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# Comparative Biometry of the Iranian Cichlid, *Iranocichla hormuzensis*, in Different Seasons and Sexes

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**Abstract** Biometry of *Iranocichlahormuzensis* was compared between males and females and two seasons. A total of 120 specimens were collected from Mehran River and 25 morphometric and 13 meristic characters were measured. All mean values of the morphometric characters, except eye diameter and pectoral fin base length, were significantly higher in males ($p$<0.05). To analyze the effects of seasonal change on biometric characters, these characters were compared in wet and cooler (October-March) and dry and warmer (April-September) seasons for males and females. All morphometric characters increased significantly ($p$<0.05) from wet to dry season, although females were more affected by season than males. The correlation between morphometric measurements and total length, except for the pectoral fin base length, were high. There were no significant differences in meristic characters between males and females of *I. hormuzensis*. Comparison between meristic characters in different seasons showed that rudimentary caudal fin rays and scales above the lateral line in dry season were significantly higher than in wet season for both sexes($p$<0.05). Sex and season did not significantly affect the meristics of the Iranian cichlid, however, morphometricswere highly affected by these factors and should be considered in comparative biology studies.

**Keywords** Cichlidae, Hormuz Basin, Morphometrics, Meristics

## 1. Introduction

*Iranocichlahormuzensis,* the only native cichlid in Iran[1,2]) (Figure 1), is a small fish, usually eaten by local people whenavailable in large numbers during spring[3]. Iranian cichlid has a terminal mouth and in aquaria, feed from surface, bottom and water columns. *Iranocichlahormuzensis* is easily recognized by the single nostril opening on each side of the head. Ctenoid Scales are regularly arranged on the flanks, but may be entirely absent from some parts of the body. The lateral line is divided into two parts, an anterior and higher portion and a lower, posterior portion.

Morphometric characters describe aspects of body shape and meristicare the number of countable structures that are fixed in embryos or larvae[4]. Morphometrics and meristics have been used to identify fish species and their habitat specificity, as well as, ecological criteria in streams, lakes or seas[5,6]. The morphometry of fishes is used for characterizing strains of one species[7], for stock identification[8] and assessing the evolutionary adaptation of a species to its environment[9]. Morphometric characters have been suggested as potential means for identifying thresholds in the life history of fishes[10,11]. Specimens from different areas have different morphology and knowledge of biometric variations is useful in descriptions of the species[12].

This paper provides the first information on morphometric and meristic characters of *I. hormuzensis* for male and female in Mehran River, and compares these characters between wet and cooler (October to March, 20.8±3.2°C) and dry and warmer (April to September, 32.2±2.3°C) seasons.

**Figure 1.** A photo of *Iranocichlahormuzensis* from Mehran River

## 2. Materials and Methods

A total of 120 specimens (66 males and 54 females) of *Iranocichlahormuzensis* from Mehran River at 26°52′53″, 55°16′21″E 31 maltitude, in HormuzganProvince (Figure 2), were collected by a seine net (8 m×1 m, 5 mm mesh size) from September 2008 through August 2009. The specimens were transferred to the Ichthyology Laboratory of Fisheries Division, Isfahan University of Technology, where all morphometric and meristic characteristics were carried out.

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Specimens were measured with a digital calliper to the nearest 0.01 mm and weighed with an electric scale to the nearest 0.01g.


**Figure 2.** Collection site of *Iranocichlahormuzensis*from Mehran River

Body measurements were expressed as percentages of the total length. Some 25 morphometric and 10 meristic characters were measured. Morphometric characters included total length, standard length, fork length, body depth, body width, head length, snout length, Interorbital width, postorbital length, eye diameter, predorsal length, postdorsal length, prepelvic length, preanal length, soft dorsal fin length, soft anal fin height, pectoral fin base length, soft dorsal fin base length, fin base anal length, ventral fin length, pectoral fin length, pecto-ventral length, vent-anal length, caudal peduncle length and caudal peduncle depth. The studied meristic characters were the number of rays and spines in dorsal, anal, pectoral, ventral, principle, and rudimentary caudal fin rays, lateral line scales, scales above and below the lateral line and circum-pedancle scales.

Minimum, maximum, average, standard deviation and 95% confidence intervals obtained for all morphometric and meristic characters. Significant differences for morphological characters was tested with t-test[13] between male and female, and different seasons. Morphometric measurements compared with total length and correlation between all of them and total length was calculated with Pearson product-moment correlation coefficient (PMCC) as indicated in equation (1)[14].

$$r = \frac{\Sigma_{i=1}^{n}(X_i-\bar{X})(Y_i-\bar{Y})}{\sqrt{\Sigma_{i=1}^{n}(X_i-\bar{X})^2}\sqrt{\Sigma_{i=1}^{n}(Y_i-\bar{Y})^2}} \quad (1)$$

It is widely used inscience as a measure of the strength of linear dependence between two variables[15]. To test the null hypothesis that the correlation between $X$ and $Y$ in male population is the same as that in female population, first, the two correlation coefficients were transform as indicated in equation to remove the size effects on the results (2).

$$r' = (0.5)\log_e\left|\frac{1+r}{1-r}\right| \quad (2)$$

Then, the test statistic was computed by equation (3).

$$z = \frac{r_1' - r_2'}{\sqrt{\frac{1}{n_1-3}+\frac{1}{n_2-3}}} \quad (3)$$

Third, the obtained $P$ was used to compute $z$. In this formula r= correlation coefficient, $Y_i$= total length of each fish, $\bar{Y}$= mean total length of population, $X_i$= value of each other morphometric character, $\bar{X}$ = mean of each morphometric character of population, $n_1$ number of males and $n_2$ number of females. A simple linear regression model was used to plot the dependent variables against the total length.

## 3. Results

A total of 120 specimens (66 males and 54 females) of *I. hormuzensis* ranging between 35.88-91.79 mm in total length (TL) and 0.78-16.9 g in weight, were used for morphometric and meristic analyses. Males ranged from 37.98 to 91.79 mm (63.53±10.53) in total length and from 0.97 to 16.09 g (5.48±2.81) in weight. Females ranged from 35.88 to 84.43 mm (61.40±6.47) in total length and from 0.78 to 11.12 g (3.7±1.85) in weight. Table 1 presents relative morphometric measurements for males, females and combined sexes of *I. hormuzensis*. Morphometric characters were compared between males and females. Except eye diameter and pectoral fin base length which were not different between the sexes, males mean values of other characters were significantly higher than those of females (*t*-test, $P$<0.05). Head length values were19.58±3.42 for males and 18.14±10.96 mm for females, indicating a significantly largerhead in the males (*t*-test, $P$<0.05).

Morphometric characters were compared between wet and cooler (October to March, 20.8±3.2 °C) and dry and warmer (April to September, 32.2±2.3 °C) seasons for males and females to observe the effects of seasonal changes on these

characters. All characters that were different between the two seasons, showed significantly higher values in dry season for both males and females. Nine characters for males (standard length, body depth, body width, head length, postdorsal length, soft anal fin height, fin base anal length, ventral fin length and caudal peduncle length) and 18 characters for females (total, standard, and fork lengths, body depth and width, headand snout lengths, interorbital width, postorbital, predorsal, postdorsal, prepelvic, preanal, soft dorsal fin base, ventral Fin, pecto-ventral, vent-anal, and caudal peduncle lengths) were significantly different between dry and wet seasons (*t*-test, $P<0.05$).

The relative values of standard, fork, and head length, eye diameter, soft dorsal fin height, soft anal fin height, soft dorsal fin base length and caudal peduncle depth, against the total length, were significantly different between males and females.

Correlations between all morphometric measurements and total length were calculated (Table 2). Pearson product-moment correlation coefficient showed that except for pectoral fin base length, other morphometric characters were highly correlated with total length. In both males and females, fork length and pecto-ventral length showed the highest and lowest correlation with total length, respectively. Correlation coefficient (r) of all morphometric characters with total length were compared between males and females. Interorbital width correlation coefficient (0.945) was higher in males than females and postorbital length and pectoral fin length correlation coefficients(0.977 and 0.932, respectively) were greater in females.

Data on meristics of *I. hormuzensis* from Mehran River are summarized in Table 2. There were insignificant differences in meristic characters between the two sexes. Dorsal fin of Iranian cichlid bears 14.99±0.48 spine. Maximum and minimum number of rays were observed in pectoral (11.99±0.37) and ventral (4.97±0.2) fins, respectively. Numbers of scales in lateral lines of *I. hormuzensis* were (21.45±3.85). Scales below lateral line (7.4±1.2) were more than scale above lateral line (3.3±1.61), but the number of circum-pedancle scales (16.48±1.83) were more than scales above and below the lateral line. Meristic characters also compared between wet and dry season for males and females. For both sexes rudimentary caudal fin rays and scales above the lateral line were significantly higher in the dry season (*t*-test, $P<0.05$).

**Table 1.** Relative Morphometric Measurements in Males and Females of *I. hormuzensis*. The Statistically Significant Differences are Indicated by an asterisk($P<0.05$)

| Morphometric Character | Morphometric Character/TL | | | | *r* | | | |
|---|---|---|---|---|---|---|---|---|
| | Male | Female | P | Total | Male | Female | \|Z\| | Total |
| Standard Length | 0.824 | 0.817 | 0.012* | 0.821 | 0.993 | 0.995 | 0.9 | 0.994 |
| Fork Length | 0.995 | 0.989 | 0.003* | 0.993 | 0.998 | 0.998 | 0 | 0.998 |
| Body Depth | 0.273 | 0.269 | 0.132 | 0.271 | 0.971 | 0.954 | 1.25 | 0.967 |
| Body Width | 0.125 | 0.124 | 0.728 | 0.125 | 0.830 | 0.720 | 1.49 | 0.797 |
| Head Length | 0.308 | 0.313 | 0.005* | 0.31 | 0.984 | 0.984 | 0 | 0.984 |
| Snout Length | 0.130 | 0.129 | 0.357 | 0.129 | 0.949 | 0.935 | 0.66 | 0.947 |
| Interorbital Width | 0.097 | 0.096 | 0.608 | 0.097 | 0.945 | 0.877 | 2.23* | 0.922 |
| Postorbital Length | 0.136 | 0.138 | 0.107 | 0.136 | 0.950 | 0.977 | 2.1* | 0.962 |
| Eye Diameter | 0.067 | 0.071 | 0.000* | 0.069 | 0.781 | 0.871 | 1.54 | 0.812 |
| Predorsal Length | 0.337 | 0.339 | 0.328 | 0.338 | 0.979 | 0.965 | 1.37 | 0.975 |
| Postdorsal Length | 0.108 | 0.108 | 0.943 | 0.108 | 0.893 | 0.881 | 0.3 | 0.894 |
| Prepelvic Length | 0.356 | 0.356 | 0.995 | 0.356 | 0.976 | 0.971 | 0.51 | 0.975 |
| Preanal Length | 0.604 | 0.605 | 0.619 | 0.605 | 0.978 | 0.986 | 1.21 | 0.982 |
| Soft Dorsal Fin Height | 0.108 | 0.1 | 0.000* | 0.105 | 0.931 | 0.909 | 0.77 | 0.924 |
| Soft Anal Fin Height | 0.106 | 0.1 | 0.001* | 0.103 | 0.923 | 0.933 | 0.38 | 0.930 |
| Pectoral Fin Base Length | 0.056 | 0.057 | 0.790 | 0.056 | 0.365 | 0.321 | 0.26 | 0.348 |
| Soft Dorsal Fin Base Length | 0.414 | 0.407 | 0.004* | 0.411 | 0.985 | 0.978 | 1.03 | 0.983 |
| Fin Base Anal Length | 0.089 | 0.087 | 0.133 | 0.088 | 0.859 | 0.844 | 0.29 | 0.864 |
| Ventral Fin Length | 0.137 | 0.133 | 0.174 | 0.136 | 0.903 | 0.911 | 0.24 | 0.907 |
| Pectoral Fin Length | 0.217 | 0.216 | 0.674 | 0.216 | 0.795 | 0.932 | 3.12* | 0.855 |
| Pecto-Ventral Length | 0.055 | 0.052 | 0.211 | 0.053 | 0.637 | 0.718 | 0.8 | 0.679 |
| Vent-Anal Length | 0.262 | 0.258 | 0.091 | 0.26 | 0.933 | 0.954 | 1.03 | 0.945 |
| Caudal Peduncle Length | 0.133 | 0.132 | 0.492 | 0.133 | 0.902 | 0.903 | 0.03 | 0.908 |
| Caudal Peduncle Depth | 0.103 | 0.099 | 0.003* | 0.102 | 0.951 | 0.911 | 1.64 | 0.939 |

**Table 2.** Meristic Characters of Males and Females in *I. hormuzensis*The statistically Significant differences are indicated by an asterisk($P<0.05$)

| Meristic characters | Sex | Min | Max | Mean±SD | P | 95% confidence interval | |
|---|---|---|---|---|---|---|---|
| Dorsal fin rays | Male | 9 | 11 | 9.87±0.6 | 0.546 | 10.16 | 10.01 |
| | Female | 8 | 12 | 9.94±0.68 | | 9.75 | 10.14 |
| | Total | 8 | 12 | 9.98±0.63 | | 9.87 | 10.1 |
| Dorsal fin spines | Male | 13 | 17 | 15±0.58 | 0.679 | 18.87 | 15.04 |
| | Female | 14 | 16 | 14.96±0.33 | | 14.87 | 15.05 |
| | Total | 13 | 17 | 14.99±0.48 | | 14.9 | 15.07 |
| Anal fin rays | Male | 6 | 8 | 6.86±0.50 | 0.289 | 6.74 | 6.99 |
| | Female | 6 | 8 | 6.76±0.58 | | 6.6 | 6.92 |
| | Total | 6 | 8 | 6.81±0.53 | | 6.72 | 6.91 |
| Anal fin spines | Male | 2 | 3 | 2.98±0.12 | 0.887 | 2.95 | 3.01 |
| | Female | 2 | 3 | 2.98±0.14 | | 2.94 | 3.01 |
| | Total | 2 | 3 | 2.99±0.12 | | 2.96 | 3 |
| Pectoral fin rays | Male | 11 | 13 | 11.92±0.36 | 0.050 | 11.83 | 12.01 |
| | Female | 11 | 13 | 12.05±0.36 | | 11.95 | 12.15 |
| | Total | 11 | 13 | 11.99±0.37 | | 11.91 | 12.05 |
| Pelvic fin rays | Male | 4 | 5 | 4.96±0.17 | 0.754 | 4.92 | 5.01 |
| | Female | 4 | 6 | 4.99±0.24 | | 4.91 | 5.04 |
| | Total | 4 | 6 | 4.97±0.20 | | 4.93 | 5.01 |
| no of spin in ventral fin | Male | 1 | 1 | 1±0 | | 1 | 1 |
| | Female | 1 | 1 | 1±0 | | 1 | 1 |
| | Total | 1 | 1 | 1±0 | | 1 | 1 |
| Principal caudal fin rays | Male | 16 | 16 | 16±0 | | 16 | 16 |
| | Female | 16 | 16 | 16±0 | | 16 | 16 |
| | Total | 16 | 16 | 16±0 | | 16 | 16 |
| Rudimentary caudal fin rays | Male | 3 | 6 | 4.24±0.53 | 0.744 | 4.11 | 4.37 |
| | Female | 3 | 6 | 4.27±0.65 | | 4.10 | 4.45 |
| | Total | 3 | 6 | 4.25±0.58 | | 4.15 | 4.36 |
| Lateral line Scales | Male | 13 | 30 | 21.87±3.75 | 0.188 | 20.95 | 22.8 |
| | Female | 13 | 30 | 20.94±3.95 | | 19.86 | 22.02 |
| | Total | 13 | 30 | 21.45±3.85 | | 20.76 | 22.15 |
| Scales above Lateral line | Male | 1 | 7 | 3.31±1.59 | 0.892 | 2.92 | 3.70 |
| | Female | 1 | 8 | 3.27±1.65 | | 2.82 | 3.72 |
| | Total | 1 | 8 | 3.3±1.61 | | 3.00 | 3.59 |
| Scales below Lateral line | Male | 4 | 10 | 7.45±1.20 | 0.643 | 7.15 | 7.75 |
| | Female | 5 | 10 | 7.35±1.20 | | 7.02 | 7.67 |
| | Total | 4 | 10 | 7.4±1.20 | | 7.19 | 7.62 |
| Circum-pedancle Scales | Male | 13 | 20 | 16.71±1.7 | 0.132 | 16.30 | 17.14 |
| | Female | 12 | 21 | 16.2±1.96 | | 15.66 | 16.74 |
| | Total | 12 | 21 | 16.48±1.83 | | 16.15 | 16.81 |

# 4. Discussion

These data are the first report on the morphometric and meristic differences of *Iranocichlahormuzensis* in males and females and in different seasons (wet and dry). These results show that except for the eye diameter and pectoral fin base length, the other morphological characters are different between the two sexes. It is noted that larger males are common in riverine and lagoonal populations of cichlids[16] and it was attributed to the fact that sperm production needs less energy than egg production[17]. Such a sex differences are reported in other fishes[18-26]. Differences in sizes of males and females could be related to spatial segregation of the sexes[27]. In cichlid fishes, it is a selective advantage during the reproductive season if males can defend a nest or brood against potential predators[27].All morphometric characters with significant differences in different seasons, increased from wet to dry season for both males and females. Differences in morphometric characters between the two seasons could be related to sexual activity; in February to June, males consumemore energy to make nests and protect them and females consumed more energy for egg production and maintain offspring. The 19 significantly different morphometrics for females and 10 for males in wet and dry seasons, indicated that females are more affected by seasonal changes than males.

Comparisons between relative values of morphometric measurements showed that the ratio of standard length, fork length, soft dorsal fin height, soft anal fin height, soft dorsal fin base length and caudal peduncle depth to total length in males are significantly higher than in females. On the other hand, in females,head length andeye diameter/total length showed higher values than those in males.

Although head lengths of males were significantly larger than females ($t$-test $P<0.05$), but eye diameter values did not significantly differ between males and females($t$-test $P>0.05$). Ratio of head length and eye diameter to total length of females were larger than males. As a mouth breeder fish, after mating, females incubate their offsprings in their mouth. The reason for having a larger head in females could be related to females need for more space to hold eggs and larva. Also, larger eyes in females may be related to the greater role of females to protect the progenies against predators. A longer body, higher soft dorsal and soft anal fins and deeper caudal peduncle in males could be related to having more and faster swimming in males. In the present study we found no significant sex differences in meristic characters of *I. hormuzensis*. Different numbers of rudimentary caudal fin rays in the two seasons may be due to a faster growth in dry season.

# 5. Conclusions

In conclusion, the sex and season do not significantly affect the meristics of the Iranian cichlid, however, morphometrics are highly affected by these factors both by sex and season and should be considered in comparative biology studies.

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# REFERENCES

[1] B. W. Coad, 1982,A new genus and species of cichlid endemic to southern Iran. Copeia,1982(1), 28–37.

[2] T. M. Berra, 2007, Freshwater Fish Distribution. University Of Chicago Press, San Diego, California.

[3] H. R. Esmaeili, Z. Ganjali, and M. Monsefi,2010, Gonad morphology and histology of the endemic hormuz cichlid, *Iranocichlahormuzensis*Coad, 1982 from Mehran River, Southern Iran. IUFS J. Biol. 69, 1-12.

[4] C. Turan, 2004, Stock identification of Mediterranean horse mackerel (*Trachurusmediterraneus*)using morphometric and meristic characters. ICES J. Mar. Sci., 61, 774-781.

[5] R. Geldiay, and S. Balik, 1998, Turkish Freshwater Fishes. Ege University Press, Izmir, Turkey.

[6] M. Karatas, 2005, Research Techniques in Fish Biology. Nobel Press, Ankara, Turkey.

[7] A. K.Jaiswar, P. K.Parida, S. K.Chakraborty, and R.Palaniswamy, 2004, Morphometry and length-weight relationship of obtuse barracuda Sphraenaobtusata (Cuvier) (Teleostomi/Actinopterygii/Sphyraenidae) from Bombay waters, west coast of India. Indian J. Mar. Sci,33(3), 307-309.

[8] C.Turan, D.Ergüden, M.Gürlek, N.Başusta, and F.Turan, 2004, Morphometric Structuring of the Anchovy (*Engraulise ncrasicolus* L.) in the Black, Aegean and Northeastern Mediterranean Seas. Turk. J. Vet. Anim. Sci., 28, 865-871.

[9] V. Kováč, G. Copp, and M. P. Francis, 1999,Morphometry of the stone loach, *Barbatulabarbatula*: do mensural characters reflect the species' life history thresholds? Env. Biol. Fish., 56, 105–115.

[10] S. S. Crawford and E. K. Balon, 1994, Alternative life histories of the genusLucania: 3. Anecomorphological explanation of altricial (L. parva) and precocial (L. goodei) species." Env.Boil. Fish., 41(1), 369-402.

[11] V. Kováč,and G. H. Copp,1996, Ontogenetic patterns of relative growth in young roach *Rutilusrutilus*: within-river basin comparisons.Ecography, 19(2), 153-161.

[12] M.Franiĉeviĉ, G.Sinovĉiĉ, V.Čikeškeĉ, and B.Zorica, 2005,

Biometry analysis of the Atlantic bonito, *Sardasarda* (Bloch, 1793, in the Adriatic Sea. ActaAdriat.,46, 213–222.

[13] R. R.Sokal, and F. J.Rohlf, 1994, Biometry: the principles and practice of statistics in biological research. Freeman WH, San Francisco.

[14] K.Pearson, 1896, Mathematical contributions to the theory of evolution. III. Regression, heredity and panmixia. Phil. Trans. R. Soc.Lond. A, 187, 253–318.

[15] R. A.Fisher, 1921, On the probable error of a coefficient of correlation deduced from a small sample. Metron, 1, 3-32.

[16] C. F. Faunce, H. M. Patterson, and J. J.Lorenz, 2002, Age, growth, and mortality of the Mayan cichlid (*Cichlasomauro phthalmus*) from the southeastern Everglades. Fish. Bull. 100, 42-50.

[17] B.Jalabort, and Y.Zohar, 1982, Reproductive physiology in cichlid fishes, with particular reference to *Tilapia* and *Sarotherodon*. InProceedings ICLARM Conference 7, the biology and culture of tilapias (R.S.V. Pullin, and R. H. Lowe-McConnell, eds.), pp. 129–140.

[18] R. A. Kaim-Malka, and S. S. Jakob, 1985, Donnéespreliminairessur la biologie de troisespeces de Scorpaenidae de la region de Marseille (Preliminary data on the biology of three Scorpaenidae species from the Marseille area). Rapp. Comm. Int. Mer. Médit., 29, 45-47.

[19] J.Ferri, M. Petrić, and S. Matić-Skoko, 2010, Biometry analysis of the black scorpionfish, *Scorpaenaporcus* (Linnaeus, 1758) from the eastern Adriatic Sea. ActaAdriat., 51(1), 45-53.

[20] Y. Keivany, P. Zare, and L. Kalteh, 2012, Age, Growth and Reproduction of the Female Kutum, *Rutiluskutum*(Kamensky, 1901) (Teleostei: Cyprinidae), in Gorgan-Rud Estuary, Northern Iran. Res. Zool., 2(3), 7-14.

[21] Y. Keivany, and N.M. Soofiani, 2004,Contribution to the biology of Zagros tooth-carp, *Aphanius vladykovi*, in central Iran (Cyprinodontidae). Env. Biol. Fish., 71(2), 165-169.

[22] B.W. Coad, and Y. Keivany, 2000, *Aphanius vladykovi*Coad, 1988. Zagros pupfish, mahi-e gour-e khari. J. Amer. Killifish Assoc., 33(6), 195-198.

[23] N.M.Soofiani,Y. Keivany, and A.M. Shooshtari, 2006, Contribution to the biology of the lizardfish, *Sauridatumbil* (Teleostei: Aulopiformes), from the Persian Gulf. Zool. Mid. East, 38, 49-56.

[24] S. Asadollah, N. M. Soofiani, Y. Keivany and M. Shadkhast, 2011, Reproduction of *Capoetadamascina*, a cyprinid fish, in Zayandeh-Rud River, central Iran. J. Appl. Ichthyol., 27, 1061-1066.

[25] M. S. Alavi-Yeganeh, S. J. Seifabadi, Y. Keivany, B. Kazemi and G. P. Wallis, 2011, Comparison of length-weight relationships in different populations and sexes of Iranian thoothcarps. J. Appl. Ichthyol., 27(6), 1401-1403.

[26] V. J. Wearmouth, and D. W. Sims, 2008, Sexual segregation in marine fish, reptiles, birds and mammals: behaviour patterns, mechanisms and conservation implications. Adv. Mar. Biol., 54, 107-170.

[27] R. H. Lowe-McConnell, 1982, “Tilapias in fish communities” InProceedings ICLARM Conference 7, the biology and culture of tilapias (R.S.V. Pullin, and R.H. Lowe-McConnell, eds.), pp. 83–113.