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*Full Length Research Paper*

# Length-weight relationships for fishes off the southwestern coast of Taiwan

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**Length-weight relationships are presented for 24 fish species representing 12 families captured monthly from February 2009 to March 2010, off the southwestern coast of Taiwan. 12 of these species are documented in fishbase, but no length-weight relationships were available. One record of maximum length was recorded. Among all estimated parameter b of 24 species, there was significant difference of 3 for 15 species. Compared length-weight relationships with previous studies, the trends were obviously different.**

**Key words:** Length-weight, fish species, fishbase.

## INTRODUCTION

Fish length-weight relationships are basic biological parameters which have been used in stock assessment (Binohlan and Pauly, 1998; Garcia et al., 1998; Haimovici and Velasco, 2000; Koutrakis and Tsikliras, 2003; Valle et al., 2003; Ecoutin et al., 2005; Fafioye and Oluajo, 2005). These relationships have been used in the conversion between fish length and weight to provide some measure of biomass (Froese, 1998). In addition, the length weight relationship indicates the degrees of stabilization of taxonomic characters in fish species and very useful in the management and exploitation of fish populations (Pervin and Mortuza, 2008). Growth of fish usually indicated through increase in length and weight (Jobling, 2002) is the most appropriate characteristic to determine the population analysis at a particular time. The values are used for prediction of growth parameters and fish mortality rate which is essential for fish stock assessment. More- over, fish length can be measured more accurately than weight on boats and can be easily converted to weight.

In this study, Sciaenidae is an important food source for *Sousa chinensis*; therefore, the survey of the fishery resources in this area is crucial. This study provided length-weight relationships for 24 fish species which were caught by bottom trawling off the southwestern coast of Taiwan.

## MATERIALS AND METHODS

In this study, the fish were collected by bottom trawling off the southwestern coast of Taiwan monthly from February 2009 to March 2010. The catches were immediately iced and transported to the laboratory for identifying and measuring weight (to the nearest 0.01 g) and length (to the nearest 0.01cm) of each specimen.

The length-weight relationship (LWR) is described by the following potential regression equation (Ricker, 1973): $W = aL^b$, where, $W$ is the total weight (g), $L$ is the length (cm), $a$ and $b$ is regression coefficients. Regression analysis was employed on log-transformed data and $a$ and $b$ were estimated. Before regression analysis of log $W$ on log $L$, log–log plots of length and weight values were performed for visual inspection of outliers (Froese, 2006). Only extreme outliers attributed to data error were deleted from further analyses. In order to ensure the quality of the parameters to describe the relationship between length and weight of the fish, a total sample size for each species of at least 20 specimens was required. To compare the difference of parameter b from 3, t-test was used to test the significant difference. Finally, the previous study of LWR for the same species was also compared using plot.

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**Table 1.** Length-weight relationships (LWR) of fishes caught by bottom trawling off southwestern coast of Taiwan.

| Family | Specie | Length type | n | Family (%) | Size (cm, FL or TM) | | a | b | $r^2$ | b value and 3 significant value | S.D. of b |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Min | Max | | | | p | |
| Carangidae | *Alepes djedaba* | SL | 87 | 0.91 | 2.3 | 14.500 | 0.05 | 2.58 | 0.97 | 0.00 | 0.44 |
| Chaetodontidae | *Chelmon rostratus* | SL | 57 | 0.60 | 3.5 | 11.500 | 0.01 | 3.47 | 0.76 | 0.07 | 1.93 |
| Clupeidae | *Nematalosa come** | SL | 542 | 5.69 | 7.3 | 16.500 | 0.04 | 2.77 | 0.83 | 0.00 | 1.27 |
| Cynoglossidae | *Paraplagusia bilineata** | TL | 20 | 0.21 | 9.3 | 31.600 | 0.01 | 3.01 | 0.96 | 0.94 | 0.61 |
| Engraulidae | *Thryssa hamiltonii* | SL | 34 | 0.83 | 7.3 | 20.500 | 0.01 | 3.01 | 0.93 | 0.94 | 0.83 |
| | *Stolephorus indicus* | SL | 45 | - | 3.3 | 5.500 | 0.00 | 4.03 | 0.91 | 0.00 | 1.28 |
| Gobiidae | *Taenioides cirratus** | TL | 134 | 1.41 | 5.2 | 20.600 | 0.01 | 2.59 | 0.86 | 0.00 | 1.04 |
| Leiognathidae | *Leiognathus berbis** | SL | 24 | 28.80 | 4.0 | 8.700 | 0.04 | 2.64 | 0.82 | 0.19 | 1.30 |
| | *Leiognathus bindus* | SL | 133 | - | 6.4 | 9.500 | 0.06 | 2.55 | 0.76 | 0.00 | 1.44 |
| | *Nuchequula nuchalis** | SL | 206 | - | 6.4 | 9.800 | 0.03 | 2.98 | 0.82 | 0.84 | 1.41 |
| | *Eubleekeria splendens* | SL | 153 | - | 3.7 | 10.800 | 0.04 | 2.73 | 0.69 | 0.07 | 1.86 |
| | *Secutor ruconius* | SL | 2229 | - | 0.7 | 7.900 | 0.06 | 2.63 | 0.8 | 0.00 | 1.30 |
| Polynemidae | *Polydactylus sexfilis* | SL | 19 | 0.20 | 5.5 | 14.200 | 0.01 | 3.27 | 0.99 | 0.00 | 0.33 |
| Sciaenidae | *Argyrosomus macrocephalus** | SL | 1784 | 52.10 | 3.2 | 16.600 | 0.01 | 3.28 | 0.88 | 0.00 | 1.20 |
| | *Argyrosomus pawak** | SL | 1076 | - | 2.6 | 18.500 | 0.01 | 3.16 | 0.91 | 0.00 | 0.98 |
| | *Chrysochir aureus** | SL | 311 | - | 2.1 | 29.700 | 0.01 | 3.10 | 0.98 | 0.00 | 0.45 |
| | *Johnius amblycephalus** | SL | 60 | - | 3.0 | 17.000 | 0.02 | 2.92 | 0.96 | 0.29 | 0.59 |
| | *Johnius belangerii* | SL | 1217 | - | 3.1 | 19.700 | 0.03 | 2.83 | 0.86 | 0.00 | 1.11 |
| | *Johnius distinctus** | SL | 151 | - | 4.2 | 18.500 | 0.03 | 2.88 | 0.85 | 0.22 | 1.20 |
| | *Johnius sina** | SL | 56 | - | 2.4 | 14.700 | 0.04 | 2.61 | 0.81 | 0.03 | 1.30 |
| | *Otolithes ruber* | SL | 311 | - | 4.3 | 20.700 | 0.03 | 2.63 | 0.83 | 0.00 | 1.19 |
| Sillaginidae | *Sillago sihama* | SL | 729 | 7.65 | 4.6 | 18.600 | 0.02 | 2.60 | 0.82 | 0.00 | 1.21 |
| Soleidae | *Solea ovata** | TL | 96 | 1.01 | 4.2 | 8.600 | 0.09 | 2.18 | 0.64 | 0.00 | 1.64 |
| Sparidae | *Acanthopagrus schlegelii schlegelii* | SL | 68 | 0.71 | 9.4 | 28.700 | 0.04 | 2.95 | 0.99 | 0.25 | 0.36 |

*, No available WLR in fishbase; n, number ; Min= minimum; Max= maximum; TL= total length; a, b = regression coefficients; $r^2$ = coefficient of determination; S.D. of b=standard deviation of b.

**Table 2.** Comparison of the parameter of length-weight and the previous studies.

| Family | Specie | This study | | | Previous study | |
|---|---|---|---|---|---|---|
| | | Max | a | b | Max length (length type) | 1/3 Max length (length type) |
| Carangidae | *A. djedaba* | 14.5 | 0.05 | 2.82 | 40 (TL) | 13.3(TL) |
| Chaetodontidae | *C. rostratus* | 11.5 | 0.02 | 3.00 | 20 (SL) | 6.7(SL) |
| Clupeidae | *N. come** | 16.5 | NA | NA | 21 (SL) | 7 (SL) |
| Cynoglossidae | *P. bilineata** | 31.6 | NA | NA | 30 (TL) | 10 (TL) |
| Engraulidae | *T. hamiltonii* | 20.5 | 0.01 | 3.16 | 27 (SL) | 9 (SL) |
| | *S. indicus* | 5.5 | 0.00 | 3.16 | 15.5 (SL) | 5.2 (SL) |
| Gobiidae | *T. cirratus** | 20.6 | NA | NA | 30 (TL) | 10 (TL) |
| Leiognathidae | *L. berbis** | 8.7 | NA | NA | 11 (TL) | 3.7 (TL) |
| | *L. bindus* | 9.5 | 0.05 | 2.87 | 11 (TL) | 3.7 (TL) |
| | *N. nuchalis** | 9.8 | NA | NA | 25 (TL) | 8.3 (TL) |
| | *E. splendens* | 10.8 | 0.04 | 2.9920 | 17 (TL) | 5.7 (TL) |
| | *S. ruconius* | 7.9 | 0.01 | 2.7340 | 8 (TL) | 2.7 (TL) |
| Polynemidae | *P. sexfilis* | 14.2* | 0.02 | 3.00 | 61 (TL) | 20.3 (TL) |
| Sciaenidae | *A. macrocephalus** | 16.6 | NA | NA | 23 (SL) | 7.7 (SL) |
| | *A. pawak** | 18.5 | NA | NA | 22 (SL) | 7.3 (SL) |
| | *Chrysochir aureus** | 29.7 | NA | NA | 30 (SL) | 10 (SL) |
| | *J. amblycephalus** | 17.0 | NA | NA | 25 (SL) | 8.3 (SL) |
| | *J. belangerii* | 19.7 | 0.01 | 3.1050 | 30 (TL) | 10 (TL) |
| | *J. distinctus** | 18.5 | NA | NA | 22 (SL) | 7.3 (SL) |
| | *J. sina** | 14.7 | NA | NA | 40 (TL) | 13.3 (TL) |
| | *O. ruber* | 20.7* | 0.02 | 2.9160 | 90 (TL) | 30 (TL) |
| Sillaginidae | *S. sihama* | 18.6 | 0.01 | 3.1800 | 31 (SL) | 10.3 (SL) |
| Soleidae | *S. ovata** | 8.6 | NA | NA | 10 (TL) | 3.3(TL) |
| Sparidae | *A. schlegelii schlegelii* | 28.7 | 0.02 | 3.00 | 50 (SL) | 16.7 (SL) |

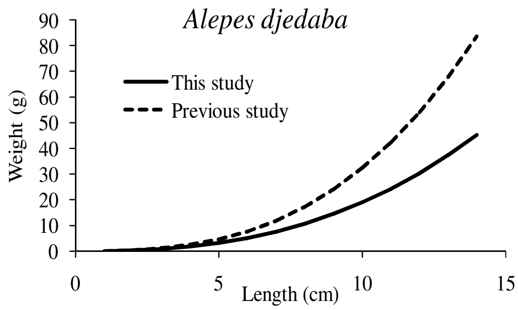
*=No available WLR in fishbase; n= number Min= minimum; Max= maximum; FL= fork length; a, b = regression coefficients; $r^2$ = coefficient of determination.

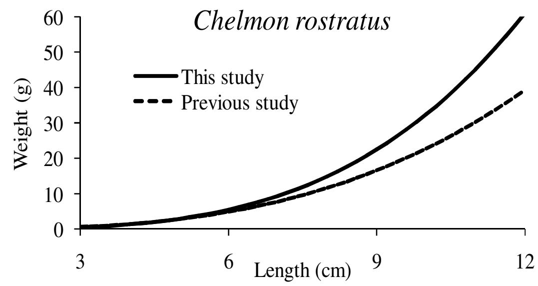
## RESULTS AND DISCUSSION

Although, 99 species were caught in the study period, only 24 species had a sample size of at least 20, representing fish from 11 families, for which LWRs were, estimated (Table 1). Among these 11 families, the most abundance was Sciaenidae (52.1%) and the second was Leiognathidae (28.8%), and other families were lower than 10% (Table 1). The species, sample size ($n$), size range of fork length (FL) or total length (TL), length-weight parameters ($a$, $b$) and the coefficient of determination ($r^2$) are given. The range of $b$ was from 2.18 to 4.03 and that of 15 species was significantly different from 3.

For 12 species whose $b$ values are asterisked in Table 1, no LWR information had been previously recorded in fishbase (Froese and Pauly, 2010). LWR parameters may vary by season, habitat and even on a daily basis (Bagenal and Tesch, 1978; Olim and Borges, 2006). The LWR in fishes can be affected by several factors including habitat, season, degree of stomach fullness, gonad maturity, sex, health, preservation techniques and differences in the observed length ranges of the specimen caught (Tesch, 1971; Wootton, 1998). None of these factors were considered in this study. However, the LWRs of this study were almost different from previous fishbase (Froese and Pauly, 2010) at the same species (Figure 1).

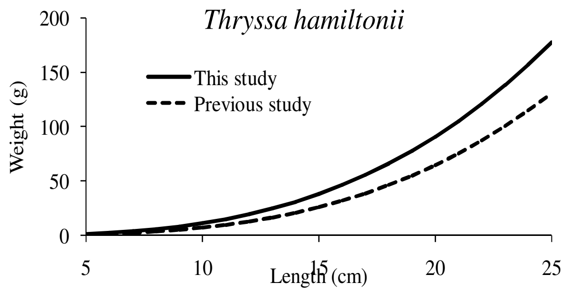
Among the maximum length of the species for this study, all species were over 1/3 recorded max length beside the two species, *Polydactylus sexfilis* and *Otolithes ruber* (Table 2). Therefore, the LWRs of this study could be used

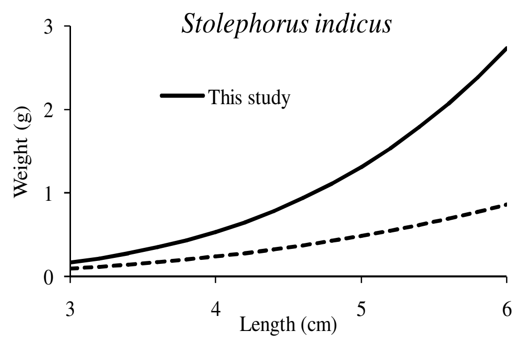

Alepes djedaba
This study
Previous study
Weight (g)
Length (cm)
0 10 20 30 40 50 60 70 80 90
0 5 10 15


Chelmon rostratus
This study
Previous study
Weight (g)
Length (cm)
0 10 20 30 40 50 60
3 6 9 12

A

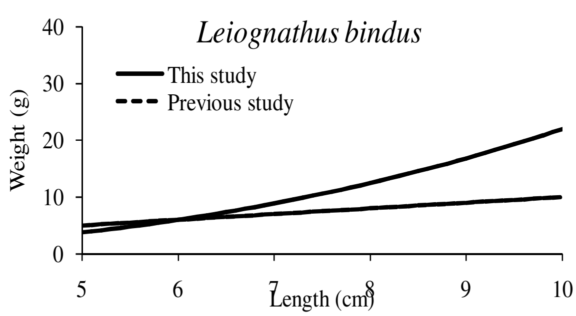
B

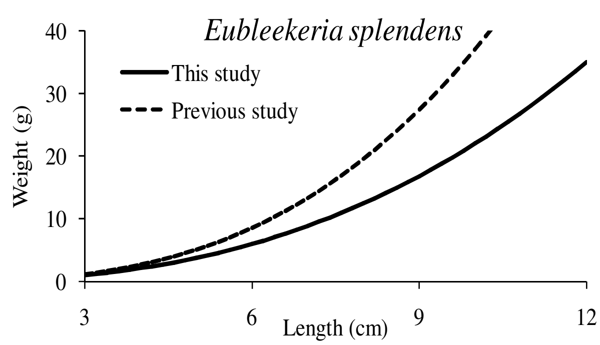

Thryssa hamiltonii
This study
Previous study
Weight (g)
Length (cm)
0 50 100 150 200
5 10 15 20 25


Stolephorus indicus
This study
Weight (g)
Length (cm)
0 1 2 3
3 4 5 6

C

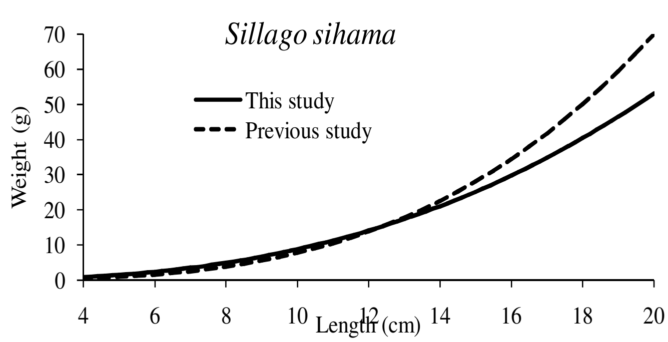
D


Leiognathus bindus
This study
Previous study
Weight (g)
Length (cm)
0 10 20 30 40
5 6 7 8 9 10

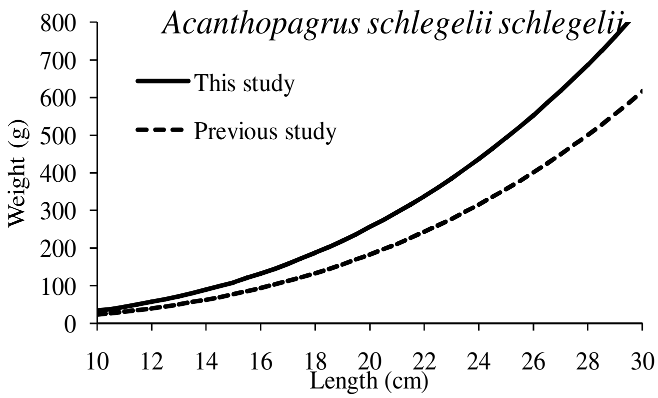

Eubleekeria splendens
This study
Previous study
Weight (g)
Length (cm)
0 10 20 30 40
3 6 9 12

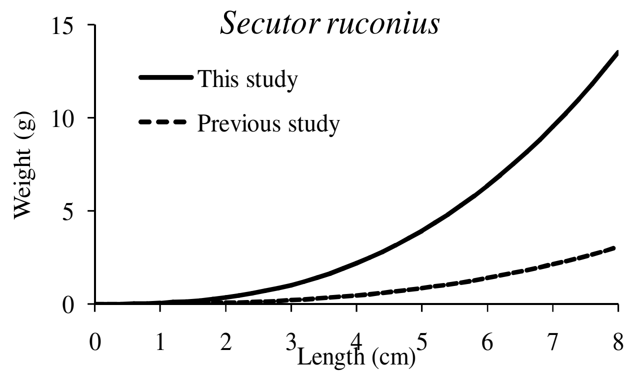
E

F


Sillago sihama
This study
Previous study
Weight (g)
Length (cm)
0 10 20 30 40 50 60 70
4 6 8 10 12 14 16 18 20

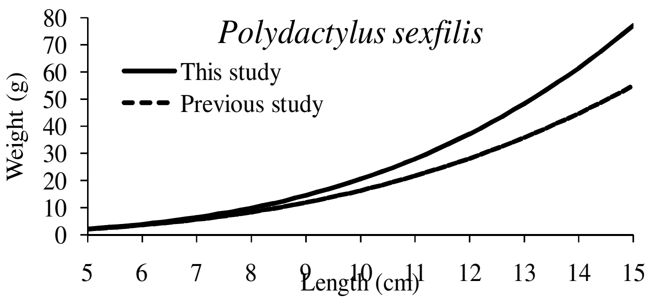
G




H

I



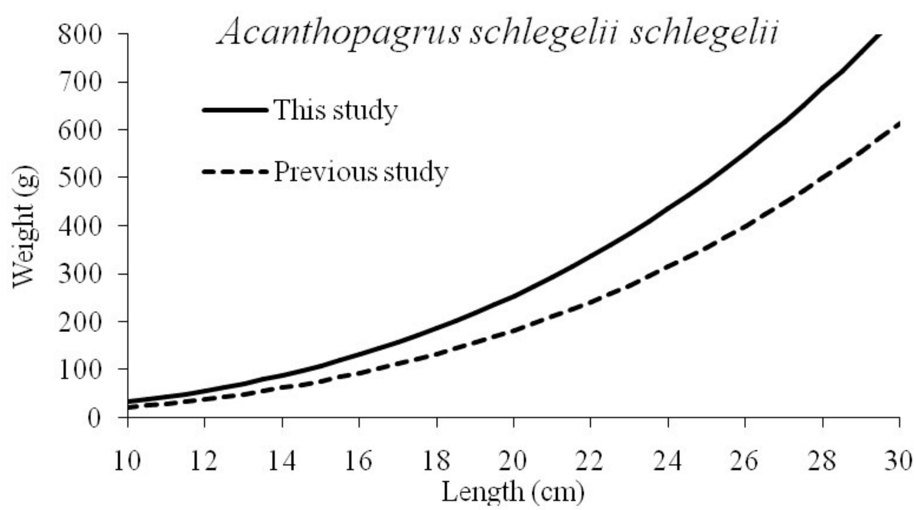




**Figure 1.** Compare this study with previous fishbase (Froese and Pauly, 2010) for LWRs at the same species.

to represent the off southwestern Taiwan.

## REFERENCES

Bagenal TB, Tesch FW (1978). Age and growth. In Methods of assessment of fish production in fresh waters, TB Bagenal,. Oxford Blackwell Scientific Publication. Pp.101-136.

Binohlan C, Pauly D (1998). The length-weight table. In: FishBase 1998: concepts, design and data sources. R. Froese and D. Pauly, Eds. ICLARM, Manila, Philippines. pp. 121-123.

Ecoutin JM, Albaret JJ, Trape S (2005). Length-weight relationships for fish populations of a relatively undisturbed tropical estuary: The

Gambia. Fish. Res. 72: 347–351.
Fafioye OO, Oluajo OA (2005). Length-weight relationships of five fish species in Epe lagoon, Nigeria. Africa. J. Biotech. 4(7): 749-751.
Froese R (1998). Length-weight relationships for 18 less-studied fish species. J. Appl. Ichthyol. 14: 117-118.
Froese R (2006). Cube law, condition factor and weight–length relationships: history, meta-analysis and recommendations. J. Appl. Ichthyol. 22: 241–253.
Froese R, Pauly D (2010). FishBase. World Wide Web electronic publication. http://www.fishbase.org/search.php Version (accessed in May 2010).
Garcia CB, Buarte JO, Sandoval N, Von Schiller D, Mello, Najavas P (1989). Length-weight Relationships of Demersal Fishes from the Gulf of Salamanca, Colombia Fishbyte 21: 30-32.
Haimovici M,Velasco G (2000). Length-weight relationship of marine fishes from southern Brazil. The ICLARM Quarterly 23 (1): 14-16.
Jobling, M. ( 2002). Environmental factors and rates of development and growth. In Handbook of Fosh Biology and Fisheries, 1., PJB. Hart and JD. Reynolds, Eds. Blackwell Publishing. pp. 107-109.
Kleanthidis PK, Sinis AI, Stergiou KI (1999). Length–weight relationships for freshwater fishes in Greece. Naga. 22(4): 25-28.
Koutrakis ET, Tsikliras AC (2003). Length-weight relationships of fishes from three northern Aegean estuarine systems (Greece). J. Appl. Ichthyol. 19: 258–260.
Olim S, Borges TC (2006). Weight–length relationships for eight species of the family Triglidae discarded on the south coast of Portugal. J. Appl. Ichthyol. 22: 257-259.
Pervin MR, Mortuza MG (2008). Notes on length-weight relationship and condition factor of freshwater fish, *Labeo boga* (Hamilton) (Cypriniformes: Cyprinidae). Univ. j. zool. Rajshahi Univ. 27: 97-98.
Petrakis G, Stergiou KI (1995). Weight–length relationships for 33 fish species in Greek waters. Fish. Res. 21: 465–469.
Ricker WE (1973). Linear regressions in fisheries research. J. Fish. Res. Board Can. 30: 409-434.
Stergiou KI, Moutopoulos DK (2001). A review of length–weight relationships of fishes from Greek marine waters. Naga. 24(1 & 2): 23-39.
Tesch W (1971). Age and growth. In: Methods for Assessment of fish production in fresh waters, 2nd edn. W. E. Ricker, Ed., International Biological Programme, Oxford and Edinburgh. pp. 97-130.
Valle C, Bayle JT, Ramos AA (2003). Weight-length relationships for selected fish species of the western Mediterranean Sea. J. Appl. Ichthyol. 19: 26-262.
Wootton RJ (1998). Ecology of teleost fishes. Kluwer Academic Publishers, Dordrecht, the Netherlands.