Relationship of body size with some body structures of three young marine fish species collected from Khor Al-Zubair, Iraq

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Abstract

The relationships between both fish body size versus weight of the otolith, eye lens and liver were studied in *Acanthopagrus latus*, *Therapon theraps*, and *Pelates quadrilineatus* collected from the Khor Al-Zubair area, Iraq. We concluded that it is possible to use the weights of the otolith, eye lens and liver as an age indicator for young individuals of the three fish species in question.

Key words: Marine fish, *Acanthopagrus latus*, *Therapon theraps, Pelates quadrilineatus*, Body size, Otolith, Eye lens, Liver, Khor Al-Zubair, Iraq.

Resumen

Relación entre el tamaño corporal y distintas estructuras corporales en formas jóvenes de tres especies de peces capturados en Khor Al-Zubair, Iraq

Se ha estudiado en tres especies de peces, *Acanthopagrus latus*, *Therapon theraps y Pelates quadrilineatus*, capturados en la zona de Khor Al-Zubair (Iraq), la relación entre el tamaño corporal frente al peso del otolito, de la lente ocular y del hígado. Los resultados obtenidos indican la posibilidad de utilizar este parámetro como indicador de de la edad en los individuos jóvenes de las tres especies.

Palabras clave: Peces marinos, *Acanthopagrus latus*, *Therapon theraps, Pelates quadrilineatus*, Tamaño corporal, Otolito, Lente ocular, Hígado, Khor Al-Zubair, Iraq.

Introduction

The most obvious character of the living body is its size, which may be determined by several factors. Within certain physiological and biological limits, the body size of organisms often varies widely due to the effect of ecological factors (Roff, 1986). Several authors have used different parts of the fish body for age determination or for finding its relationship with the weight, growth, and age of fishes.

In addition, they also examined the factors that affect such relationships. The fish otolith is the body part that has been most commonly used in such studies (Mosgaard & Reeves 2001, Mourad 1999, Beamish & Mahnken 2001, Newman 2002). Information from the otolith has been used to indicate feeding level (Johnson et al. 2002), effects of oil pollution (Hashim et al. 1994), and fat and protein deposition (Krivobok & Shatunovskij 1976). On the other hand, the eye lens has also been widely used in fish age determination (Al-Hassan et al. 1992, Crivelli 1980, Carlton & Jackson 1968, Burkett & Jackson 1971). Finally, the weight of the fish liver has been used in several studies. Carneiro et al. (1998) examined the effect of the intensity of aquaculture on the liver weight of Florida red tilapia, Uzars et al. (2001) used liver weight to determine the relationship between fish maturity and food availability, and Ferraro et al. (2001) studied the effect of pollution on the relationship between liver weight and body weight.

The aim of the present study is to investigate various relationships between the total body length and weight and the weights of the otolith, eye lens and liver of the juveniles of *Acanthopagrus latus*, *Therapon theraps* and *Pelates quadrilineatus*.

Materials and Methods

Fish specimens of *A. latus* (113-245 mm), *T. theraps* (144-159 mm), and *P. quadrilineatus* (122-169 mm) were collected from the Khor al-Zubair area in the northwest region of the Arabian Gulf during January 2000 - April 2001. Different nets of different mesh sizes were used. Fishes were brought fresh as possible to the laboratory in kept in temperature proof container filled with ice and later identified according to Al-Daham (1979) and Froese & Pauly (www.fishbase.org). Fish length and weight were taken to the nearest 0.1 cm and 0.1 g respectively. Fishes were dissected to extract the otolith and the eye lens and to remove the liver. The eye lenses and livers were dried in an ordinary laboratory oven until their weights remained constant to the nearest 0.0001g. The average of the weight of the right and left otolith and eye lens was recorded for each fish specimen. To overcome the effect of the statistical bias, adult fishes were not included. The length range of juveniles of *A. latus* was chosen according to Al-Ariki (2001) while those of *T. theraps* and *P. quadrilineatus* were chosen according to Al-Jadir (2001). SPSS statistical software [software version: 11] was used to calculate correlation coefficients and regression constants, as well as to perform a cluster analysis between body weight and the three body structures mentioned above.

Results

Table 1 shows the average body length, the average total body weight, and the average weights of the eye lens, otolith and liver for all three fish species. The three species showed clear differences in the measurements of, and the morphometric relationships between, these three body structures. The correlation coefficients were high and positive between the fish total length and weight for all three species (Table 2).

In *A. latus*, a high positive correlation coefficient was obtained for both the total length and weight with the weights of both the eye lens (r=0.47, 0.53) and the liver (r=0.97, 0.90). In *T. theraps*, a high correlation coefficient was obtained for total body length and weight with the weights of both the eye lens (r=0.57, 0.69) and the otolith (r=0.53, 0.46). In *P. quadrilineatus*, a high correlation coefficients were obtained for both the total body length and weight with the weights of both the otolith (r=0.41, 0.34) and the liver (0.50, 0.67) (Table 2).

Table 3 shows the values of the regression constants a and b for the three species and their three body structures. R2 was significant for the total body length with weight and weight of otolith in *A. latus* (R2 =0.937, 0.947); total body weight with weight and weight of eye lens in *T. theraps* (R2 =0.893, 0.626); and total body with weight and weight of eye lens in *P. quadrilineatus* (R2 =0.74, 0.140). Negative b values were obtained for the following relationships: total body length – weight of eye lens and liver in *A. latus*,

Measures	*A. latus*			*T. theraps*			*P. quadrilineatus*		
	mean	S.D.	number	mean	S.D.	number	mean	S.D.	number
Total length(c.m.)	21.14	3.14	49	15.59	0.64	30	14.92	1.81	116
Total weight(g.m.)	233.28	64.43	47	64.47	9.34	30	50.87	20.97	116
Eye weight(g.m.	0.7011	0.6843	31	0.1145	0.0336	26	1.6993	6.6901	95
Otolith weight(g.m.)	0.0658	0.0758	29	0.0294	0.0412	12	0.0609	0.0391	106
Liver weight(gm)	2.441	1.5931	46	0.1293	0.0699	15	0.3251	0.3012	63

Table 1.- Total length and total body weight, eye, otolith, liver and heart weight of *A. latus*, *T. theraps and P. quadrilineatus* (± S.D.).

Tabla 1.- Longitud total, peso corporal total, peso del ojo, otolito, hígado y corazón de *A. latus*, *T. theraps and P. quadrilineatus* (± S.D.).

Measures	A. latus		T. theraps		P. quadrilineatus	
	correlation coefficient		correlation coefficient		correlation coefficient	
	Total length(cm)	Total weight (gm)	Total length(cm)	Total weight (gm)	Total length (cm)	Total weight (gm)
Total length(cm)	---------	0.95*	------------	0.83*	-----	0.51*
Total weight (gm)	0.95*	----------	0.83*	-----------------	0.51*	------------
Eye weight (gm)	0.47*	0.53*	0.57*	0.69*	0.82-*	0.05-
Otolith weight (gm)	0.97*	0.90*	0.53*	0.46*	0.41*	0.34*
Liver weight(gm)	0.49*	0.62*	0.08	0.29	0.50*	0.67*

Table 2.- Correlation coefficient between total lenght and total, eye, otolith, liver and heart weight of *A. latus, T. theraps* and *P. quadrilineatus* (±S.D.).

Tabla 2.- Coeficiente de correlación entre la longitude total y el peso tal, peso del ojo, otolito, hígado y corazón de *A. latus, T. theraps* and *P. quadrilineatus* (±S.D.).

Measures	A. latus			T. theraps			P. quadrilineatus		
	a	b	R^2	a	b	R^2	a	b	R^2
Total weight (gm)	6.72	0.163	0.937*	4.147	0.178	0.893*	3.704	0.169	0.704*
Eye weight (gm)	3.33	0.070	0.011	0.003	0.241	0.626*	12.74	0.274	0.140*
Otolith weight (gm)	0.007	0.085	0.947*	0.0001	0.916	0.360	0.123	0.537	0.027
Liver weight (gm)	3.047	0.041	0.006	0.249	0.034	0.003	2.418	0.164	0.079

Table 3.- Coefficients of exponential regression equation and (R^2)value between total length and each total weight, eye, otolith ,liver and heart weight of *A. latus*, *T. theraps and P. quadrilineatus* (± S.D.).

Tabla 3.- Coeficiente de regression exponencial y valor de (R^2) entre la longitud total y el peso total, peso del ojo, otolito, hígado y corazón de *A. latus*, *T. theraps and P. quadrilineatus* (± S.D.).

total body length and weight – weight of liver in *T. theraps*, and total body length and weight – weight of otolith, eye lens, and liver in *P. quadrilineatus*.

Discussion

The results of the present study showed that the total body length and weight for the three species in question are highly correlated. This finding is in agreement with the results obtained for other Iraqi marine fish species (Abdullah 2000, Al-Ariki 2001, Al-Jadir 2002). Among the other variables studied, otolith weight has shown a positive correlation with both total body length and weight for the three species studied. Such correlation was recorded in other teleost fishes, including salmon (Beamish & Mahnken, 2001), cod (Mosegaard & Reeves 2001), and pearl perch (Newman 2002). Thus this correlation was recommended for age determination in the three species in question.

Eye lens weight showed a weak correlation with total body length and weight for *A. latus* and *P. quadrilineatus* while in *T. theraps* such correlation was high. On the other hand, eye lens weight proved to have a high correlation with body length of common carp (Crivelli 1980) and was also a good criterion to estimate age in *Heteropneustes fossilis* and *Ilisha filigera* (Al-Hassan et al. 1992).

The high correlation recorded for the liver weight and both total body length and weight is in accord with results obtained for other teleost fishes such as carp (Mahboob & Sheri 2001, Ferraro et al. 2001). Such a relationship was shown to be directly connected with food availability in channel catfish, *Ictalurus puntatus* (Gaylord & Gathini 1998) and with the period of reproduction of *Symphodus tinca* (Ouannes-Ghorbel et al. 2002).

The relationship between the weights of the body structures studied showed that they are suitable for aging fish of less than three years of age. At the same time, they seem not to be suitable for aging older fish due to the irregularities that may occur in the weight of such structures during growth beyond three years of age. This finding is in support with the results obtained by Carlton & Jackson (1968) and Burkett & Jackson (1971). This interaction may also be connected with the stages of sexual maturation (Crivelli 1980).

Newman (2002) and Mosegaard & Reeves (2001) have recorded a linear relationship for both the total body length and weight and otolith weight. On the other hand, curvilinear relationships were recorded for those variables by Cruz & Rebelo (2000) and Mourad (1999) and with the weight of the eye lens by Crivelli (1980). The curvilinear relationships obtained by these authors are in agreement with those of the present work.

In conclusion, the weight of some body structures such as the otolith and eye lens may be indirectly related to the growth of the juveniles of the three fish species studied.

References

Abdullah JN 2000. The Biology of Ilisha megaloptera (Swainson, 1839) In Iraqi Marine Waters, Khor Al-Amaya. M.Sc. Thesis, College of Agriculture, University of Basrah.

Al-Ariki MK 2001. Biology of Acanthopagrus latus (Houttuyn, 1782) in the Iraqi marine waters. M.Sc. Thesis, College of Agriculture, University of Basrah, Basrah, Iraq.

Al-Daham NK. 1979. Fishes of Iraq and the Arabian Gulf. Volume 2. Basrah University of Basrah Press.

Al-Hassan LAJ, Al-Dubakel AY & Wahab NK. 1992. Ocular lens diameter as an age indicator in two teleost fishes collected from Basrah water (Iraq). Acta Hydrobiologica, 36: 275-279.

Al-Jadir FA. 2002. Some biological aspects of two species of the family Theraponidae collected from the Iraqi marine water. M.Sc. Thesis, College of Agriculture, University of Basrah, Basrah, Iraq.

Beamish RJ & Mahnken C. 2001. A critical size and period hypothesis to explain natural regulation of salmon abundance and the linkage to climate change. Progress Oceanography. 49 (1-4): 423-437.

Burkett RD & Jackson WB. 1971. The eye lens as an age indicator in freshwater drum. The American Midland Naturalist 85: 222-225.

Carlton WG & Jackson WB. 1968. The eye lens as an age indicator in carp. Copeia 3: 633-636.

Carneiro PCF, Urbinat EC & Castagnolli N. 1998. Growth and metabolic parameters of Florida red tilapia reared in floating net cages. Aquaculture Abstract 1998: 98.

Crivelli A. 1980. The eye lens weight and age in the common carp, Cyprinus carpio L. Journal of Fish Biology. 16: 469-473.

Cruz R & Rebelo J. 2000. Growth data in fish of the Ria of Averio. Revista de Biologia. 18 (1-4): 41-47.

Ferraro ML, Kaplan LAE, Leamon J & Crivllo JF. 2001. Variations in physiological biomarkers among mummichogs collected from Connecticut salt marshes. Journal of Aquatic Animal Health. 13 (3): 246-256.

Gaylord TG & Gatlin DM. 1998. Assessment of compensatory growth in channel catfish (Ictalurus punctatus) and associated changes in body condition indices. Aquaculture Abstract 1998: 200.

Hashim OA, Al-Hussaini M & Al-Baz A. 1994. Signs of oil pollution on fishes in the Arabian Gulf. Journal of King Abdulaziz University Marine Sciences jeddah 6: 79-92.

Johnson MW, Rooker JR, Gatlin DM & Holt GJ. 2002. Effect of variable ration on direct and indirect measures of growth in juvenile red drum (Sciaenop ocellatus). Journal of Experimental Marine Biology and Ecology. 274 (2): 141-157.

Krivobok MN & Shatunovskij MI. 1976. The effect of gonad maturation on the otolith weight increase in the Baltic cod, Gadus morhua callarius L. Vopr Ikhtiol 16 (3): 454-460.

Mahboob S & Sheri AN. 2001. Relationships among gonad weight, liver weight and body weight of major, common, and some Chinese carps under composite culture system with special reference to pond fertilization. 6th Asian Fisheries Forum Book of Abstract: 164.

Mosegaard H & Reeves SA. 2001. Revision of Baltic cod age determination based on otolith accretion characteristics and weight distribution. International Council for the Exploration of the Sea. Report 2001/p12.

Mourad MH. 1999. Age determination of Trachinotus ovatus (L.) based on otolith weight. Journal King Abdulaziz University Marine Sciences Jeddah 110: 149-155.

Newman SJ. 2002. Age, growth, mortality, and population characteristic of the pearl perch (Glaucosoma buergeri Richardson, 1845), from deeper continental shelf waters off the Pibara coast of North Western Australia. Journal of Applied Ichthyology 18 (2): 95-101.

Ouannes-Ghorbel A, Bradai MN & Bouain A. 2002.

Spawning period and sexual maturity of Symphodus (Grenlabrus) tinca (Labridae) in Sfax coasts, Tunisia. Cybium 26 (2): 89-92.

Roff A. 1986. Predicting body size with life history models. BioScience 36 (5): 316-323.

Uzars D, Baranova T & Yula E. 2001. Inter annual variation in gonadal maturation of cod in the Gotland Basin of the Baltic Sea: Influence of environment and fish condition. International Council for the Exploration of the Sea. Report 2001/V29.