Fish Aqua Sci 13(3), 254-256, 2010

KOSFAS FISHERIES AND AQUATIC SCIENCES
The Korean Society of Fisheries and Aquatic Science

(Notes)

Length-weight Relationships for 19 Fish Species in Sargassum Beds of Gamak Bay, Korea

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Length-weight relationships were estimated for 19 fish species in sargassum beds of Gamak Bay: *Aulichthys japonicus*, *Pseudoblennius cottoides*, *Pseudoblennius percoides*, *Ditrema temmincki*, *Acanthogobius lactipes*, *Chaenogobius heptacanthus*, *Cryptocentrus filifer*, *Pterogobius elapoides*, *Pterogobius zonoleucus*, *Hyporhamphus sajori*, *Hexagrammos agrammus*, *Rudarius ercodes*, *Lateolabrax japonicus*, *Pholis crassispina*, *Pholis nebulosa*, *Scomber japonicus*, *Sebastes inermis*, *Ernogrammus hexagrammus*, and *Takifugu niphobles*. Samples were caught by surrounding net at depths of <7 m between November 2007 and June 2008. The most abundant families were Gobiidae (26.3%), Cottidae (10.5%), and Pholididae (10.5%). Estimates for parameter *b* of the length-weight relationship ($W=aL^b$) ranged between 2.491 and 3.354.

Key words: Length-weight relationships, Sargassum beds, Gamak Bay, correlation coefficient

Introduction

Length-weight relationships are useful for a wide number of studies, such as growth rate estimation, age structure, and other aspects of fish population dynamics. Length-weight regressions have been extensively used for: i) estimation of biomass from length observations required in yield assessment (Froese, 1998; García et al., 1998); ii) conversion of growth in length equations to growth in weight, for use in stock assessment models; iii) an estimate of the condition factors of fish; and iv) interregional comparisons of life histories of a certain species (Pauly, 1993; Petrakis and Stergiou, 1995; Goncalves et al., 1997). In Korea waters, length-weight relationships for sargassum ichthyofauna has not yet been studied. In the present study length-weight relationship parameters are analyzed for 19 species from Gamak Bay sargassum beds in Korea.

Materials and Methods

Study area

The Gamak Bay is located in the Jeollanamdo region on the south coast of Korea. It is a shallow water region of an oval shape 9 km wide and 15km long. The surface area of the bay is approximately 112 km^2 and its mean depth is about 9 m. The sargassum beds are widespread in shallow areas, forming subtidal bends (3,620 m^2) along the shoreline of Gamak Bay.

Sampling design and statistical analysis

Fish samples were collected by surrounding net in sargassum beds of Gamak Bay (34°43'847"N 127°38'659"E and 34°43'261"E 127°38'455"E) between depths of 5-7 m. The study period was from November 2007 to June 2008. Specimens were identified and measured to the nearest 0.1 cm total length (TL) and weighed to the nearest 0.01 g total weight (TW).

All length-weight relationships were calculated using the least squares fitting method to estimate *a* and *b* parameters of the function $W=aL^b$, where *W* and *L* data were log transformed, *W* is the weight of the fish in grams; *L* is the total length in cm; *a* is a coefficient related to body form and *b* is an exponent indicating isometric growth when equal to 3. The significance of the regression was assessed by ANOVA, and the *b*-value for each species was tested by *t*-test to verify that it was significantly different from the isometric growth ($b=3$) (Sokal and Rohlf,

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Table 1. Length-weight relationships for 19 species caught in the sargassum beds of Gamak Bay, Korea

Family	Species	n	Min	Max	*a*	*b*	SE(*b*)	r^2	Growth type
Aulorhynchidae	*Aulichthys japonicus*	6	9.0	13.8	0.00095	3.256	0.60613	0.878	+A
Cottidae	*Pseudoblennius cottoides*	25	3.1	15.2	0.00477	3.330	0.07140	0.989	+A
	Pseudoblennius percoides	6	5.7	13.1	0.00415	3.342	0.30256	0.968	+A
Embiotocidae	*Ditrema temmincki*	5	2.6	5.5	0.02345	2.657	0.07301	0.997	-A
Gobiidae	*Acanthogobius lactipes*	26	4.5	7.4	0.01266	2.562	0.27782	0.779	-A
	Chaenogobius heptacanthus	6	5.1	6.1	0.01139	2.692	0.77460	0.751	-A
	Cryptocentrus filifer	27	2.2	5.0	0.00784	2.685	0.20937	0.868	-A
	Pterogobius elapoides	333	1.7	7.7	0.00639	3.172	0.04522	0.963	I
	Pterogobius zonoleucus	486	5.3	7.8	0.02364	2.546	0.10414	0.755	-A
Hemiramphidae	*Hyporhamphus sajori*	177	2.1	30.4	0.00101	3.255	0.04843	0.962	+A
Hexagrammidae	*Hexagrammos agrammus*	48	2.3	13.9	0.00639	3.250	0.09071	0.965	+A
Monacanthidae	*Rudarius ercodes*	21	1.4	5.2	0.02922	2.873	0.12538	0.965	-A
Moronidae	*Lateolabrax japonicus*	196	3.7	10.3	0.00682	3.151	0.04982	0.953	I
Pholididae	*Pholis crassispina*	4	10.9	11.9	0.00287	2.972	0.35692	0.971	I
	Pholis nebulosa	241	3.3	14.5	0.00157	3.354	0.05344	0.952	+A
Scombridae	*Scomber japonicus*	14	2.3	4.9	0.01104	2.811	0.19152	0.947	-A
Scorpaenidae	*Sebastes inermis*	7	9.8	15.3	0.05326	2.502	0.32750	0.921	-A
Stichaeidae	*Ernogrammus hexagrammus*	13	2.5	12.6	0.01257	2.865	0.08637	0.990	-A
Tetraodontidae	*Takifugu niphobles*	275	5.1	12.3	0.05545	2.491	0.13947	0.635	-A

n is the sample size; min. and max. are minimum and maximum total lengths in cm; *a* and *b* are the parameters of the length-weight relationship; SE (*b*) is the standard error of the slope b; r^2 is the coefficient determination, +A: allometric positive, -A: allometric negative, I: isometric.

1981). The obtained results allowed to determine if the fish growth was isometric or allometric (negative or positive allometric).

Results and Discussion

Overall, 1916 specimens from 19 different species belonging to 13 families were analyzed. The species, sample size, size range (cm, TL), length-weight parameters, *a* and *b*, and the correlation coefficient (r^2) are given. The most abundant families were Gobiidae (26.3%), Cottidae (10.5%), and Pholididae (10.5%). All relationships were highly significant ($P<0.001$). Most r^2–values were greater than 0.90 with the exception of six species: *Acanthogobius lactipes* ($r^2=0.779$, 26 individuals), *Aulichthys japonicus* ($r^2=0.878$, 6 individuals), *Chaenogobius heptacanthus* ($r^2=0.751$, 6 individuals), *Cryptocentrus filifer* ($r^2=0.868$, 27 individuals), *Pterogobius zonoleucus* ($r^2=0.755$, 486 individuals), and *Takifugu niphobles* ($r^2=0.635$, 275 individuals).

The exponent *b* often has a value close to three, but varies between 2 and 4 (Tesch, 1971). A value close to 3 indicates that the fish grows isometrically and other values indicate allometric growth. The exponent *b* varied between 2.491 for *Takifugu niphobles* and 3.354 for *Pholis nebulosa* (Table 1). Three species showed isometric growth ($b=3$): *P. elapoides*, *L. japonicus* and *P. crassispina*; ten species showed negative allometric growth ($b<3$): *D. temmincki*, *A. lactipes*, *C. heptacanthus*, *C. filifer*, *P. zonoleucus*, *R.ercodes*, *S. japonicus*, *S. inermis*, *E. hexagrammus*, and *T. niphobles*; all remaining species showed positive allometric growth ($b>3$): *A. japonicus*, *P. cottoides*, *P. percoides*, *H. sajori*, *H. agrammus* and *P. nebulosa*. The length-weight relationship in fish can be affected by habitat, season, gonad maturity, sex, health, preservation techniques and differences in the observed length ranges of the specimens caught, all of which were not accounted for in the present study. Therefore, although the fish samples were obtained during different seasons throughout the sampling period, these data could be used as mean annual values for each species and are not representative of a particular season. These data are close to the median values of *a* and *b* (Froese, 2006).

Acknowledgments

This work was supported by the Korea Institute of Marine Science & Technology promotion. The authors are grateful to Il Woong Park and Yun Seol Kim for help in field sampling.

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(Received 10 August 2010; Revised 7 September 2010; Accepted 20 September 2010)