

## Correlation Between the Length and Weight of *Arius maculatus* off the Southwestern Coast of Taiwan

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### ABSTRACT

*In this study, Arius maculatus* were collected using the samples caught by bottom trawling off the southwestern coast of Taiwan. Length-weight and length-length, fork (FL), standard (SL) and total (TL) lengths, relationships were determined. The relationships between the lengths were all significantly linear ( $p < 0.01$ ), the  $b$  value in the length-weight relationship for this value was significantly lower than 3 in the fall ( $p < 0.01$ ), when the temporal changes were taken into account, indicating that only the sampling time affected the growth pattern of *A. maculatus*. The growth was isometric in the spring, summer and winter, but it was negative and allometric in the fall.

**Key words:** *Arius maculatus*, Length-Weight Relationship, Growth, Stand Length (SL)

### INTRODUCTION

Fish length is an important point in the studies of fish growth, such as total lengths (TL), fork (FL) lengths and standard length (SL). When making comparisons between the populations, it is essential to use the standard measures for all the populations so that the results would be more reliable (Murat et al. 2004). Thus, this is utilized for the length-length relationship of the species under various environmental conditions (Murat et al. 2004). The length-weight relationships of fish are basic biological data that can be used in the studies of their population, and thus for the management of the species and their fisheries (Le Cren 1951; Shafi and Quddus 1974), as well as to provide a measurement of biomass (Petraakis and Stergiou 1995; Dulčić and Kraljević 1996; Froese, 1998), the length-weight relationships are also useful for comparing the life history and

morphological aspects of the populations inhabiting different regions (Gonçalves et al. 1997; Stergiou and Moutopoulos 2001).

The early studies on *Arius maculatus* were mainly on the growth and food habitat (Mazlan et al., 2008). However, the estimation of the length-weight relationship was common in these studies; they presented no evidence about the length-length relationship. The purpose of this study was to build life history parameters of *A. maculatus*, and specifically the length-weight relationship.

### MATERIALS AND METHODS

The specimens of *A. maculatus* were collected on a monthly basis from February 2009 to March 2010. These fishes were caught by bottom trawling off the coast of southwestern Taiwan. Among these

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catches, about 30 specimens were selected randomly to measure the fork length (FL) to nearest 0.1cm and bodyweight (BW) to nearest 0.1g.

The length-weight relationship is described by the following exponential regression equation:  $W = aL^b$ , where  $W$  is the body weight (kg),  $L$  is the fork length (cm), the parameters  $a$  and  $b$  are calculated by the least-squares regression for the males and females seasonally (spring, summer, fall and winter). The weight-length relationships curves were compared with all the four seasons, and the variation in  $b$  values from  $t_3$  were tested by the  $t$ -test for evaluating the growth curve. When the

$b$  value in length-weight relationship was equal to or did not show statistically significant deviation from 3, the growth was isometric, whereas the positive or negative allometric growth occurred when the  $b$  value deviated significantly from 3 (Ricker 1975; Erkoyuncu 1995).

## RESULTS

The results of the relationships among the total, fork and standard lengths were determined by using the length measures of 452 *A. maculatus* specimens (Table 1).

**Table 1** - Length-length relationships of *Arius maculatus*.

Lengths	n	a	b±SE	r <sup>2</sup>	Confidence Limits (95%)
TL-FL	452	-0.2548	1.1843±0.0050	0.99	1.1745~1.2823
TL-SL	452	0.1517	1.0550±0.0047	0.99	1.0458~1.0642
FL-SL	452	-0.0928	1.2509±0.0072	0.99	1.2368~1.2650

TL= total length; FL= fork length; SL= standard length; n= number; a, b = regression coefficients; r<sup>2</sup> = correlation coefficient; Confidence Limits (95%)= range of b.

All the relationships were significantly linear ( $p < 0.01$ ,  $r > 0.99$ ). The length-weight relationship determined for the seasons, and  $b$  values varied between 2.83 and 3.04. These values calculated for the spring, summer, fall and winter as 2.93, 3.04, 2.83 and 2.91, respectively. The variations in  $b$  values from 3 were not statistically significant and indicated an isometric growth for the overall

population when the seasons effects were not taken into account (Table 2 and Fig. 1(a)-(e)). The variations in  $b$  values from 3 were not statistically significant in the spring, summer, winter or, but were in the fall ( $p < 0.01$ ), implying that while the growth of *A. maculatus* was negatively allometric during the fall, it was isometric during the rest of the year.

**Table 2** - Length-weight relationship parameters of *Arius maculatus* according to the seasons

Factors	N	a	b±SE	r <sup>2</sup>	Confidence Limits (95%)	t value (difference of b from 3)	p
Winter	1185	0.017	2.91±0.019	0.95	2.873~2.947	-4.73	<0.001
Spring	407	0.017	2.93±0.043	0.92	2.846~3.014	-1.63	0.104
Summer	407	0.013	3.04±0.025	0.97	2.991~3.089	1.6	0.11
Fall	125	0.017	2.83±0.085	0.90	2.662~2.998	-2	0.048
Overall	2124	0.015	2.95±0.013	0.96	2.925~2.975	-3.84	<0.01

N= number; a, b = regression coefficients; r<sup>2</sup> = correlation coefficient; Confidence Limits (95%)= range of b; p= significant.

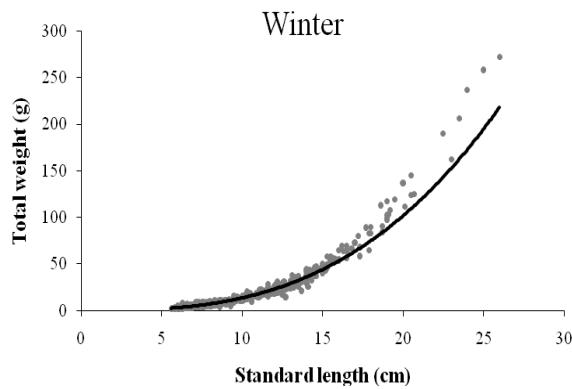


Figure 1 (a)

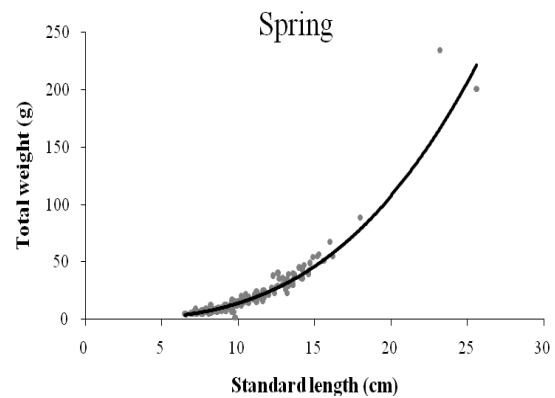


Figure 1 (b)

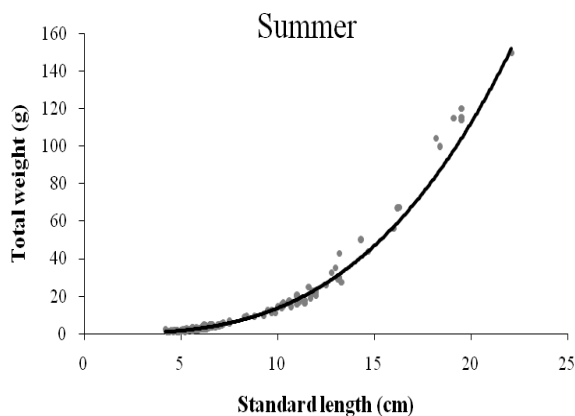


Figure 1 (c)

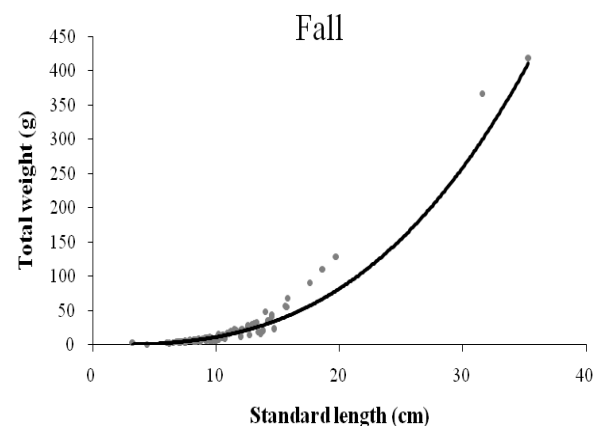


Figure 1 (d)

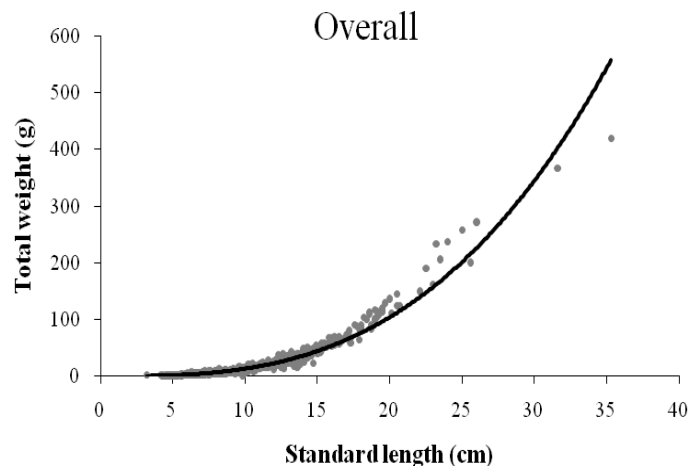


Figure 1 (e)

## DISCUSSION

*A. maculatus* is an economically important species in Malaysia. There are few studies on the basic biology of this species (Mazlan et al. 2008).

In this study, the length-weight (according to sampling time) and length-length (overall) relationships of *A. maculatus* was estimated off the southwestern coast of Taiwan. The length-length relationships were significantly linear.

Moutopoulos and Stergiou (2002) also found significantly linear relationships among TL, FL and SL in some fish species in the Aegean Sea. These significantly linear relationships among the length parameters showed that certain fish species exhibited characteristic morphological features (Murat et al. 2004).

The *b* value was used in the length-weight relationship as the indicator of the growth type of *A. maculatus* to find out whether there deviation from isometric growth had occurred at the sampling times. When the seasonal variations were considered, the *b* value reached its maximum value of 3.04 ( $r=0.97$ ,  $N=407$ ) during the summer (June, July and August) and its minimum value of 2.83 ( $r=0.90$ ,  $N=125$ ) during the fall (September, October and November). The *b* value recorded in the fall was significantly lower than 3 ( $p<0.01$ ) indicating a negative allometric growth during this season. However, the *b* value recorded in the overall was significantly lower than 3 ( $p<0.01$ ) indicating a negative allometric growth during this study period.

The *b* value in the length-weight relationship of fish can be used as an indicator of food intake and growth pattern, and may differ according to such biotic and abiotic factors as water temperature, food availability and habitat type (Wootton 1992; Avsar 1998). Hence, the *b* value recorded in the fall was insignificantly lower than 3 indicated a negative allometric growth during the season in this study. However, adequate feeding and gonad development increases fish weight and *b* values (Nikolsky 1963; Arslan 2003). The result of this study, during the fall, when biological resources were insufficient and certain abiotic factors as water temperature were inadequate, *Arius maculatus* living off the southwestern coast of Taiwan could not feed sufficiently and demonstrated a negative allometric growth. In contrast, environmental conditions did not change the normal isometric growth of this species during the rest of the year.

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Received: March 07, 2011;  
Revised: July 06, 2011;  
Accepted: March 20, 2012.