Growth Performance of Milkfish (*Chanos chanos*) Cultured in Marine Pen Designed for Integrated Multi-Trophic Aquaculture (IMTA)

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Introduction

Milkfish (*Chanos chanos*) is one of the most economically important cultured fish in Southeast Asia with distribution in the tropical and subtropical area centered in Indo-Pacific at waters with temperatures greater than 20°C, as defined by the winter surface isotherms (Bagarinao, 1991). In the Philippines, it is one of the major contributors to aquaculture production next to seaweed with an annual production of 411 metric tons in 2017 (PSA, 2017). Its euryhaline nature made it viable for culture in different systems, such as freshwater (*e.g.* lakes), brackish water (*e.g.* ponds), and marine systems (*e.g.* coastal areas).

The growth information of cultured fish is important for planning and management in aquaculture. Indicators such as specific growth rate (SGR) and condition factor (CF) provides basic information in evaluating the specific conditions for the growth of the organism.

In this study, common models were tested to determine the best-fit model for milkfish cultured in marine pen and the controlling factors of specific growth rate and condition factor were investigated.

Materials and Methods

The study was conducted during a series of experimental farming trials of milkfish in pens at the coastal water of Baranggay Pandaraonan, Nueva Valencia, Guimaras, in the Philippines from August 2015 to January 2018. There were two runs conducted during the dry season (*i.e.* Run 2 and Run 4) and two runs during the rainy season (*i.e.* Run 1 and Run 3).

Monthly, 10 % of the fish population was sampled for body weight (g) and body length (cm) measurements. Three common models were tested to describe growth performance of milkfish based on monthly data, namely: Linear, Logistic and Gompertz. The p-value of r^2 and AIC (Akaike's Information Criterion) were used to evaluate and compare the fitness of the models.

Results and Discussion

Among the three tested models, logistic model was found to be best for both weight-based and length-based growth. Reasonably, daily specific growth rate in weight ($DSGR_W$) and length ($DSGR_L$) were positively correlated with water temperature while both $DSGR_W$ and $DSGR_L$ were correlated negatively with size of the fish which supported the findings in the growth model fitting (**Table 1**).

Table 1. Fitting of growth models in Weight. Values highlighted in bold indicates smallest (best fit) among comparison of three models.

Model	Indicator	Run 2	Run 3		Run 4		Run 5	
		Pen 1 n=4	Pen 1 n=4	Pen 2 n=4	Pen 1 n=3	Pen 2 n=4	Pen 1 n=4	Pen 2 n=4
Linear	AIC	363.6	347.3	347.3	340.3	355.2	262.4	269.7
	r^2	0.987	0.994	0.995	0.992	0.990	0.999	0.996
	p value	0.05265	0.03736	0.03465	0.18297	0.04647	0.05798	0.11435
Logistic	AIC	131.0	163.5	144.0	120.0	147.9	125.2	179.5
	r^2	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	p value	0.00090	0.00312	0.00158	0.00264	0.00200	0.00106	0.00746
Gompertz	AIC	184.0	209.7	193.6	123.0	227.7	170.4	132.2
	r^2	1.000	1.000	1.000	1.000	0.999	1.000	0.997
	p value	0.00508	0.01044	0.00644	0.02105	0.01685	0.00661	0.00162

Condition factor (CF) of milkfish exhibited positive correlation with feed conversion ratio (FCR) (**Figure 1**) and significant seasonal variation, lower during the relatively fast-growing season (dry season) and higher in slow-growing season (rainy season) (**Figure 2**). Integrating these controversial findings, low temperature and inefficient feeding makes 'fat' fish and vice versa. Water temperature seemed to be explained the changes of proximate body composition (*e.g.* protein and water content) and metabolic rate of the fish.

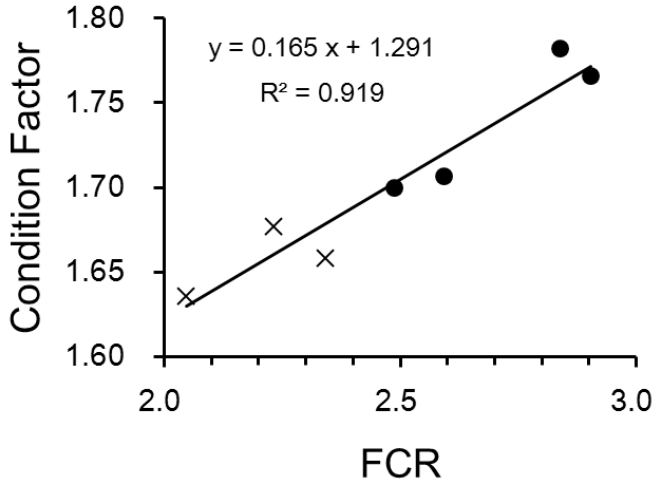

Figure 1. Relationship between Feed Conversion Ratio (FCR) and Condition Factor (CF) in dry season (×) and rainy season (●).

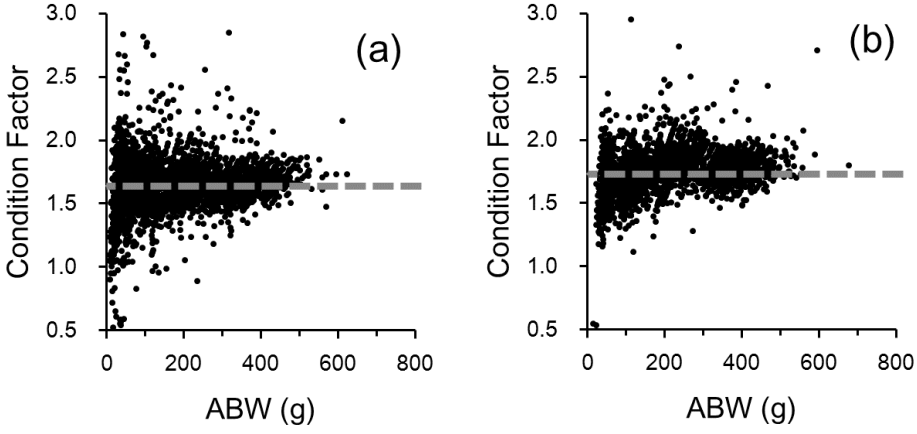

Figure 2. Condition factor of all sampled fish. (a) dry season and (b) rainy season. Gray dashed lines indicate mean values of dry season (= 1.64) and rainy season (= 1.73), respectively.

References

Bagarinao, T. U. (1991). Biology of milkfish (Chanos chanos Forsskal). Tigbauan, Iloilo, Philippines: SEAFDEC Aquaculture Department

PSA, 2017. Fisheries Statistics of the Philippines, 2015-2017, pp. 103.