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Short Communication

Length-Weight Relationships of the Pond-Cultured Spotted Barb (*Puntius binotatus*)

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Abstract

Length-weight relationship and relative condition factor of the pond-cultured spotted barb, Puntius binotatus *were calculated to determine its growth and health conditions in order to evaluate the efficiency of present culture practice. The cultured fish were growing well in the ponds as they attained strong positive allometric growth as the b value was 3.356 (> 3), and the linear relationship r^2 value (0.96) was significant at level 0.01. Nevertheless, the relative condition value of the pond cultured fish (1.008) was lower than those of the wild fish caught from the Upper Kerian River and Serdang River. The fish from Upper Kerian River were in much better condition than the pond cultured fish. Such differences could be due to the gaps in the water quality between the ponds and the rivers. Further studies should be conducted to determine the optimum range of water parameters especially temperature, pH and total dissolved solution (TDS) level of the culture environment for this fish, in order to optimize its culture condition.*

Keywords: Length-weight relationship, relative condition factor, spotted barb, *Puntius binotatus.*

Introduction

The spotted barb *Puntius binotatus* is a member of subfamily Barbinae from Family Cyprinidae, and it has been synonymous with *Systomus binotatus*, *Capoeta binotata*, and *Barbodes binotatus* in some scientific literatures[1-2]. It is a native fish in Asia[3], widely distributed in Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Thailand and Vietnam, but an introduced species to Singapore and Palau[4]. In wild, it can be easily found in the mountain streams, rivers and lakes[5]. Due to its common availability, *P. binotatus* has been utilized as an important bio-indicator to habitat degradation or health status of environments in these freshwater resources[6-8]. Besides that, it is a common ornamental fish species. In Sabah, *P. binotatus* is locally known as "Turongou" and popular to the indigenous people as a deep-fried delicacy. For promoting the delicacy at commercial level, this fish should be mass produced and intensively cultured. However, there is no information on the culture of this fish; probably it is not an aquacultural important species in any other regions. In our preliminary pond culture at the first hatchery of *P. binotatus* in Sabah, run by the company Innovasi Sedia Private Limited, wild-caught *P. binotatus* have been used as the broodstocks and extensively cultured in earthen ponds with vegetation for natural spawning. The pond water was sourced from mountain streams by gravity and no water exchange, except during raining seasons. The extra volume of water during raining seasons will automatically drained out from the ponds through the outlet pipes that were setup to maintain the water level in ponds. Aerations were provided to every pond, and the fish were fed twice daily until satiation with commercial tilapia starter pellets (protein content about 37%). Younger classes of fish were noticed in the ponds but the spawning events were never been observed. These young fish were remained and cultured in the same pond with the broodstocks. Such pond culture practice has been continued for about 2 years but the fish growth and health conditions have never been evaluated. The cultured fish condition is important information as it can reflect the efficiency of the current rearing practice and provide insights to improve it.

The length-weight relationships (LWR) of fish can be used to determine its condition factor (CF) that refers to the degree of well-being[9], and the suitability to the environment[10]. This method is commonly applied in fisheries for stock assessments[11], environmental impact survey as mentioned earlier, and sometimes in aquaculture for evaluating the condition of the cultured fish that reflects the efficiency of the culture environment[12-13]. Derived from the calculation of LWR, the relative condition factor (RCF) can be computed[14] and used to compare the fish condition from different locations[7-8]. Therefore in the present study, the growth and health conditions of the pond-reared *P. binotatus* were assessed through its LWRs. Water quality is an important reference to the fish growth and health conditions hence the water parameters in the culture ponds of *P. binotatus* were measured.

Material and Methods

Measurements of Fish Specimens: Various sizes of pond-reared *P. binotatus* were obtained from Innovasi Sedia Private Limited. Three times of fish sampling were done at 10th

September, 1st October and 15th December 2012, and in total 85 specimens were collected. After each time of sampling, the live fish specimens were transported to the wet laboratory of the Borneo Marine Research Institute and maintained in several aquaria with aeration. Before measurements, the fish were anesthetized with 200 ppm Tricaine methanesulfonate (MS-222), and mopped with towel to remove the excessive water on the body surface. All fish were measured for its total length (TL in centimeter) and body weight (BW in gram). Digital analytical balance (Model Precisa 404A, Swiss) was used to measure the body weight value close to two decimal points.

Water Parameters Measurements: The water parameters were measured at the same dates as mentioned above, before the samplings started. The measured parameters included dissolved oxygen (DO), total dissolved solids (TDS), pH, temperature and conductivity. In each pond (in total 8 ponds), 3 - 4 locations were randomly selected for the measurements in morning and afternoon. The water parameters were measured by using the multi-parameter water quality meter (Model HANNA HI 9828, England).

Calculations of LWR and RCF: LWR of the fish specimens were calculated with the formula $W = a L^b$, where W= fish body weight and L= fish total length [15]. Values of the constant *a* and slope *b* were estimated from the linear regression graph, plotted based on the logarithm-transformed formula $ln\ W = lna + b ln\ L$. The *b* values were used to categorize the growth condition of the fish; b= 3 indicated isometric, b< 3 indicated negative allometric, and b>3 indicated positive allometric growth[7-8].

The RCF was calculated by using formula $Kn = 100*W/W'$ where W is the observed weight, and W' is the expected weight of individual fish ($a L^b$) with the earlier estimated *b* value[9].

Results and Discussion

Table-1 shows the estimated parameters of the LWR for the pond-reared *P. binotatus*. The fish attained positive allometric growth as the *b* value was 3.356 (> 3), and possessed strong linear relationship as the regression coefficient r^2 value (0.96) was significant at level 0.01. These results indicated that the fish were gaining more weight than an increase in length; therefore, they were in good fitness and health condition. In fact, the condition of the pond-cultured *P. binotatus* was comparable to those of in the wild. Mat Isa *et al.* [7] reported the *b* value of the wild-caught *P. binotatus* from the Kerian River in Peninsular of Malaysia was 4.1063. Zakeyudin *et al.* [8] also reported the *b* values of those caught from the Upper Kerian River and Serdang River were 3.133 and 3.507, respectively.

The *Kn* value of the pond-cultured *P. binotatus* was 1.008 ± 0.126 (mean ± standard deviation). It was slightly greater than one, showing that the fish had achieved growth the expectation. Such results indicated that the fish were growing well in the culture ponds. However, this value was lower than those of the wild-caught *P. binotatus* from the Upper Kerian River (*Kn*= 1.131 ± 0.212) and Serdang River (*Kn*= 1.052 ± 0.219) [8]. This outcome demonstrated that the optimum condition of the pond-cultured fish was not yet achieved, and suggested that the current culture practice were not optimized. The environmental factors such as water quality could be one of the major factors that contributed to this outcome.

Table-2 shows the means ± standard deviations of each water parameter in the culture ponds, together with those from the Upper Kerian and Serdang Rivers [8]. In comparison with the Upper Kerian and Serdang Rivers, the water parameters that obtained from the earthen ponds were similar with those at the Serdang River, although it contained slightly higher DO and more alkaline but lower TDS and conductivity. Such similarity is reasonable as the sampling site at Serdang River is surrounded by oil palm plantation, exposed to small scale of aquaculture and very near to residential areas [8], which may regularly contribute excessive nutrients to the river that lead to the higher level of TDS and conductivity. Besides that, the sampling site is exposed directly to sunlight, similarly to the pond culture condition. Therefore, the water temperature under these two environments was very close (approximately 26 °C). Such similarity in the water quality may explain why the *Kn* value of the pond-cultured fish was closed to that of the fish from the Serdang River.

In opposite, water in the Upper Kerian River possessed much lower temperature, TDS and conductivity but higher in DO and was more acidic than the water in the culture ponds. Nevertheless, the *Kn* value of the *P. binotatus* from the Upper Kerian River was much higher than that of the pond-cultured one. Apparently, *P. binotatus* required water with low temperature (around 22 °C) and TDS and slightly acidic (pH 5-6) in order to achieve better growth. In fact, water temperature and pH can affect fish growth performance as the temperature can influence the fish metabolism rate [16] while the pH and TDS level and content can affect the ion regulation in fish[17-19]. However, there is no information on the suitable range of these water parameters to culture the *P. binotatus*, in order for them to obtain optimum growth. Further researches should be conducted to determine the optimum range of the water parameters, mainly temperature and pH, for the culture of *P. binotatus*.

Table-1
Estimated parameters of the length-weight relationships for the farm-reared *P. binotatus*

n	Total length (cm)		Body weight (g)						
	Min	Max	Min	Max	*lna*	*b*	S.E. of *b*	95% C. I.	r^2
85	4.00	9.55	0.70	11.23	-2.213	3.356	0.072	3.212-3.499	0.96*

n= number of specimens, min= minimum, max= maximum, a= intercept of regression line, b= slope of regression line, S.E.= standard error, C.I.= confidence interval, r^2= regression coefficient, * significant P<0.01

Table-2
Mean ± standard deviation of the water parameters at habitats of the wild caught *P. binotatus* from literature and at the culture ponds from the present study

Sampling sites	Temp. (°C)	DO (mg/ L)	pH	TDS (mg/ L)	Cond. (µs cm^{-1})	Reference
Upper Kerian River	22.61 ± 0.15	8.14 ± 0.42	5.83 ± 0.74	10.61 ± 2.25	22.49 ± 2.99	Zakeyudin *et al*., 2012
Serdang River	26.00 ± 1.46	6.69 ± 0.33	6.04 ± 0.20	18.45 ± 1.50	40.90 ± 9.70	Zakeyudin *et al*., 2012
Earthen ponds	26.36 ± 0.69	7.83 ± 2.12	7.35 ± 0.74	17.06 ± 2.10	33.96 ± 4.48	Present study

Temp. = temperature, DO = dissolved oxygen, TDS = total dissolved solids, Cond.= conductivity

Conclusion

The cultured *P. binotatus* were grown well in the ponds as they attained strong positive allometric growth. Nevertheless, further studies should be carried out to determine the optimum range of water parameters, especially temperature, pH and TDS level for the culture environment of this fish, in order to optimize their growth and fitness conditions. The present study was conducted based on the first trial in culturing this fish and no intensive or special care has been provided. Despite that, the fish grow well. The fish is very easy to be handled; therefore, it is suitable and recommended for mass production.

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