

Correlation Between Main Morphological traits and Body Weight of Mandarin Fish Difference Analysis of Male and Female Morphological Traits *

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Abstract: To learn about mandarin fish (*Siniperca chuatsi*) correlation between main morphological traits and body weight, and the difference between male and female morphological traits. Mandarin fish length, body height, head length, eye diameter, tail handle length and tail handle height and weight. Correlation analysis, Path Analysis and multiple linear regression analysis were used to analyze the relationship between morphological traits and body weight. Multiple regression equation was established and randomly selected male and female discrimination verification. The results showed that the full length and body height had the largest correlation coefficient with body weight among all morphological traits. Through the establishment of regression equations and partial regression coefficient test, it is found that the correlation between head length and tail handle height and body weight is not significant. After that, we made a further analysis. Path analysis showed that total length and body height had the largest direct effect on body weight, which was greater than indirect effect, full length and body height had the highest independent weight determination, and the synergistic effect was the largest. Sum of the determining coefficient of individual traits on body weight (Sigma D) ≥ 0.896 . To illustrate this, there is a great correlation between individual traits and body weight, and the fitting multiple regression equation is of great reference significance. The discriminant regression equation of male and female fish was established and verified. The accuracy rate of sex discrimination was higher. This study can provide a reference for the selection and evaluation index of growth traits of *Siniperca chuatsi*, and help to improve the efficiency of breeding.

Keywords: Mandarin fish; morphological traits; body weight; correlation; multiple regression; Path Analysis

As one of the important growth traits, body weight is often used as a fish Provide basic data for practical breeding programs. Study on morphological traits

Important target traits of Fertility (Gao et al, 2002; Yuan meiyun, 2010). Correlation Analysis and multivariate regression analysis were used to evaluate the correlation between weight traits and

There is a correlation between morphological traits and body weight traits of aquatic animals. Regression analysis, gray correlation analysis and path analysis (Tan Cai gang,

Correlation and path analysis of important economic traits can not only (Wang xin'an, 2013). Multiple linear regression analysis and Partial Regression

Correlation Between Morphology and body weight and morphological traits. Correlation analysis, due to the existence of independent variables and dependent variables of the Partial Regression

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Different classes are not conducive to the direct comparison of data. The path analysis can be expanded on the basis of multiple regression analysis, and the relationship between independent variables and their synergistic effect on the dependent variable can be analyzed, an accurate multivariate linear regression equation was established. In aquatic animals, such as fish(Yan Fusheng, 2010;Hu Yulong, 2015;Zhang Yong

Quan *et al*, 2014 ;), Crawl(Wang Chengyuan, 2013;Ma xiaetc., 2013)Crustaceans(Chai Zhan, etc., 2015;Li Yang *et al*, 2012)Shellfish(Bai linjian, 2012;Zhang jiali, 2014)And cephalopods(Ping hongling, 2015)Wait. There are reports on the relationship between morphological traits and weight traits.

Mandarin Fish(*Siniperca chuatsi*)Mandarin Fish is one of the important high-quality fish breeding in China.(Wu Bin *et al*, 2015).2015The production of mandarin fish in China reached29.8WanTAbout Guangdong Province10WanT (Yuan Xiao elementary, 2016). With the development of the breeding industry of *Siniperca chuatsi*, it is urgent to carry out the research on Breeding of Fine Varieties with fast growth and stress tolerance. At present, there are few studies on morphological characteristics and growth traits of *Siniperca chuatsi*. Zhang Jin(2013a,B)Through Path Analysis of Morphological Characters of *Siniperca chuatsi* and hybrid *Siniperca chuatsi*, it was proved that the whole length and body height of *Siniperca chuatsi* and hybrid *Siniperca chuatsi* had the largest effect on body weight.(2014)Principal component analysis of different month-old traits showed that body weight, body length and body height were the most important traits in the early growth stage of mandarin fish, and it was found that the early growth stage of mandarin fish was isokinetic growth. The number of group samples taken by these research institutes40-40 ~ 70The minimum sample requirements of statistical distribution can be satisfied.(Not less30I)However, the larger the sample size in the statistical analysis, the more responsive the overall characteristics. When the confidence level is given, the larger the sample size and the smaller the error range can effectively improve the discriminant effect and get more accurate and reliable multivariate regression equation. In this study, multiple regression and partial regression coefficient test, combined with the path analysis184A total of families2837Full-length of mandarin fish in tail Pond(TL)High School(BH), Head long(HL)Eye diameter(Ed), Tail handle full length(Cptl)And tail handle high(CPH)Altogether6. Individual traits and weight(BW)Correlation analysis; randomly selected male and female mandarin fish150Tail

Multiple regression equation was established and randomly selected.120Male and female discriminant analysis and verification. The results of this study can provide reasonable and scientific evaluation indicators for the breeding of mandarin fish in the next step, in order to improve the breeding efficiency.

1. Materials and Methods

1.1 Material

Mandarin Fish in the experiment3.The parental populations were Guangdong breeding populations.(62)Tail), Anhui qiupu river breeding group(37)Tail)And Hunan Dongting Lake wild population(63)Tail)Total162Tail. Among them, Guangdong and Anhui

All the breeding groups were raised and protected by yushun agriculture, animal husbandry and fishery Science and Technology Service Co., Ltd., Qingxin County, Qingyuan City, Guangdong Province.2015It was collected from Dongting Lake in Hunan Province. To3.

Complete double-disaggregated hybridization method for paired reproduction, obtained9.Groups(184A family), Altogether2837TailF₁.Generation individual. The juveniles were incubated in the same pond at the mandarin fish breeding base of yushun agriculture, animal husbandry and fishery Science and Technology Service Co., Ltd.140dAfter harvest, measurement.

1.2 Determination of sample morphological traits

First before MeasurementTricaine (MS-222)Anesthetic experimental fish with anesthetic concentration7.5 ~ 13.5

g/m³. The water temperature is 20°C~ 25°C. Weighing by electronic balance (Precision 0.01g). First, the full-length and high-Body Morphological Characters were photographed by digital camera, and the fish external morphological measurement software designed by our laboratory was adopted. V1.0 (Registration number: 2013sr144497), For full length, body height, head length, eye diameter, tail handle length and tail handle height. Through the pixel comparison with the ruler, the actual value of each trait is calculated. (Precision 0.001) (Figure 1). Sex was identified through anatomical examination of the gonads.

1.3 Data Processing

Eye diameter, tail handle length, tail handle height and weight. Statistical analysis of the results of individual traits (Du jia Ju and others, 2010; He Feng Hua, 2005). Calculates the average Based on the statistic (X) Standard Deviation (S) And coefficient of variation (C_v) And then analyze the correlation coefficient between morphological traits. (R_{XY}) Partial Regression Coefficient (B_i) Path Coefficient (Standard Partial Regression Coefficient P_{X_iY}, Shorthand P_i) Then, the partial regression coefficient test was carried out to exclude the non-significantly related morphological traits. (Path Coefficient P_i) And indirect effect (Wang Yi R_{X_iX_jPX_jY}, Shorthand Sigma R_{IJPJ}) Combined with the weight determination coefficient of a single trait (D_{X_iY}, Shorthand D_i) The common determining coefficient of two traits on weight (D_{X_iX_jY}, Shorthand D_{ij}) Establish the regression equation.

Average (X) Standard Deviation (S) Standard Error (Sigma) And coefficient of variation (C_v) The formula is as follows (Cai Yilin, *et al.*, 2011; Li chunxi, 2013; Wang xin'an, 2013):

$Y = B_0 + B_1X_1 + B_2X_2 + B_3X_3 + B_4X_4$

X_i Represent all morphological traits; Y Weight traits.

2. Results

2.1 Parameters of growth traits of mandarin fish

Co-determination. The body weight, length, body height, head length, eye diameter, tail handle length and tail handle height of the adult fish of *Siniperca chuatsi*. Among these traits, the coefficient of variation of body weight was the highest. 44.275%. The variation coefficient of eye diameter is the lowest. 10.964%. Coefficient of variation of other traits 13.884% ~ 16.967%. Between (Table 1) The standard errors of each trait are small, which indicates that the parameters of the sample are close to the estimation of the whole, and the reliability is high.

2.2 Correlation of the traits measured by *Siniperca chuatsi*

Correlation Analysis of morphological traits of *Siniperca chuatsi* was carried out to obtain the correlation coefficient of phenotypic values. (Table 2). The correlation coefficient between total length and body height is the largest. 0.974; Weight and Other Form traits of related coefficient were very significantly positive correlation and full-length and body height of related coefficient maximum respectively 0.929 and 0.932 and eye diameter of related coefficient minimum; the traits two between the correlation were reached very significant level (P < 0.01).

2.3 *Siniperca chuatsi* Form traits on body weight of the Degree to compare the analysis

Due to the traits between there may be different degree of multiple of linear phenomenon need to further on the traits the partial regression coefficient and path coefficient analysis. Path analysis can analysis the Form traits between complex of Interaction

Department. The path coefficient regression equations of the morphological traits of *Siniperca chuatsi* on body weight were established. (R = 0.947, F = 3490.266, P Less than 0.01) The results showed that the complex correlation and multiple regression between morphological traits and body weight of *Siniperca chuatsi* existed, and the path analysis could be carried out. (P > 0.05) (Table 3) Therefore, the traits of head length and tail stalk height were removed and further analyzed.

Analysis of traits except head length and tail stalk height. The direct and indirect effects of morphological traits

on body weight were found.(0.633)The indirect effect of total length on body weight is the smallest.(0.296)The direct effect is far greater than the indirect effect;

Straight, connected role, also higher(0.473)Slightly higher than the room, the role(0.459)(Table4)The indirect effect of eye diameter and tail stalk length was significantly greater than that of direct effect, and the direct effect of tail stalk length on body weight was the smallest.(-0.152), And the indirect effect is the largest(0.980)(Table4).

2.4 Determination of morphological traits on body weight of *Siniperca Chuatsi*

Calculate morphological traits(D_I)And morphological traits(D_{II})Synergy on the weight of the Decision coefficient, the sum of all the decision coefficient is 0.896, And Complex Correlation Coefficient(R^2)The results show that the whole length, body height

Diameter and tail handle Length4.Morphological Traits were the key traits affecting body weight,

2.5 Establishment of multiple regression equation for body weight by morphological traits of *Siniperca Chuatsi*

Stepwise multiple regression analysis was conducted based on measured data.(Table3), So remove head length and tail handle high2.Multiple regression analysis.(Table6)To establish a new regression equation associated with the body weight of mandarin fish:

Wang Yi-433.157Wang Yi20.678 X_1 .Wang Yi47.338 X_2 .Wang Yi34.056 X_3 .Wang Yi18.84 X_4 .

For weight(G), X_1 For full length(Mm), X_2 Ashiko(Mm), X_3 For the eye diameter(Mm), X_4 Full Length for Tail handle(Mm).

The results of variance analysis and correlation index analysis of multiple regression equation show that the regression relationship is very significant.($P < 0.01$)(Table7)And the partial regression coefficient of morphological traits on body weight was also very significant.($P < 0.01$)(Table6);4.Significance Test of individual traits on weight $R = 0.947$, Description4.There is a great correlation between individual traits and weight.

2.6 Establishment and validation of multiple regression equation for male and female of mandarin fish

In the determining coefficient of morphological traits on body weight, the determining coefficient of total length and body height on body weight was the highest.(Table5)Based on the data of total length and body height of male and female fish, multiple regression analysis was carried out to establish the regression equation between total length and body height and body weight.(Table8):

Female fish: $Y = 480.563 + 24.976X_1 + 18.182X_2$;

Male fish: $Y = 436.168 + 13.502X_1 + 49.657X_2$.

Type, Y For weight, X_1 For full length, X_2 For the body high.

Using the established male and female regression equation120Mandarin Fish for inspection

The results show that the total discriminant accuracy is 61.667%, At less than weight 200g The accuracy of male and female discrimination of mandarin fish 72.131%, But in greater 200g Accuracy only 50.847% (Table9).

3. Discussion

3.1 Main morphological traits affecting body weight traits of *Siniperca Chuatsi*

Body weight is an important growth trait of fish, and its coefficient of variation is large.(Yuan meiyun, 2010). This study measured 2837 Mandarin Fish 7. Growth Related

Body height, head length, eye diameter, tail handle length, tail handle height and body weight, the results indicated that it was feasible to select and breed *Siniperca Chuatsi* with body weight as the target trait, and also indicated that the detected *Siniperca Chuatsi* populations had great potential for selection and breeding.

Morphological traits are a comprehensive reflection of germplasm status and growth characteristics, and also an

important indicator of biological selection and breeding.(Wang xin'an, 2012). In the breeding process, through the study of the relationship between traits, it can provide a reference for indirect breeding, multi-Trait breeding and selection index.(Li SIFA, 2006). By using path analysis and multiple linear regression analysis and partial correlation analysis, complex variable relationship can be handled accurately and intuitively.(Jing Yanhui, 2006). In this study, the body weight and morphological traits of *Siniperca chuatsi* were systematically analyzed. It was found that there were significant differences among the measured value of morphological traits. Further establish the multiple regression equation and through the partial regression coefficient test, found that the head length and tail handle high partial regression coefficient is not significant, so eliminate².Then, the final multiple regression equation was established. Through path analysis, the direct effect of each morphological trait on body weight and the indirect effect of each morphological trait on body weight were determined. The length and body height of *Siniperca chuatsi* had the highest independent determinant of body weight, and the common coefficient of total length and body height was significantly higher than that of other pairwise traits. This with hard head trout(*Oncorhynchus mykiss*)Juvenile, ball head, bream(*Megalobrama amblycephala*)Red, FIN, Oriental, fish(*Fugu rubripes*)And white spotted salmon(*Salvelinus leucomaia*)The results of fish morphological traits are the same, and the individual traits with the largest coefficient of weight determination are both body height and full length./The synergy of body height is the largest(Tong Guangxiang, 2011;Yang guiqiang, 2011;Wang xin'an, 2013;Yuan meiyun, 2010;Zhang Yongquan, 2014). When the decision coefficient analysis is carried out, the independent decision coefficient and pairwise common

Sum of determining factors(ΣD)Greater^{0.85}It shows that the independent variable has a large correlation with the dependent variable.(Liu Xiaolin, *et al.*, 2004). In this study, total length, body height, eye diameter and tail handle⁴.Determination coefficient of individual traits on body weight^{0.896}Show this⁴.Other traits that have not been measured or eliminated have a relatively small effect on weight. In this study, the relationship between body weight and length, body height, eye diameter and tail handle of *Siniperca Chuatsi* was quantified by the regression equation established by the large sample, the full length, body height and body weight of mandarin fish can be used as the main selection parameters for multi-Trait breeding.

3.2 Identification of morphological traits of mandarin fish

In Aquatic Animals, some fish have significant differences in the growth of male and female individuals, such as large yellow croaker(*Larimichthys crocea*)Turbot(*Scopelus Maximus*)Yellow, black, fish(*Pseudobagrus Fulvidraco*)Takifugu with red fin(Wang Wei, 2014;Hu Yulong,2015;Lin Zhihua, 2004;Yue Liang, 2015)Some fish do not have obvious growth differences, such as misgurnus dabanicus(*Paramisgurnus DABRYANUS*)And North, bay mouth, glasses, fish(*Mene maculate*)Wait.(Anlie *et al.*, 2011;Du shiqiang, 2012 ;). There are also differences in the growth of male and female mandarin fish(Wang Xiaoqing, 2006)However, it is difficult to distinguish the male and female individuals from the external form in the pre-sexual maturity or non-reproductive season. It is difficult to select and leave the male and female parents in the breeding process.

This study analyzed body weight, length and height³.The regression equation of morphological parameters of male and female individuals was established.61.667%; And for small specifications(<200g)Of sample the discriminant accuracy rate of higher up^{72.131%} (Table9). Usually up to sexual maturity of individual its male individual of discriminant can

⁸²To help whether can extrusion semen identification and is small individual usually is can't judgment of male and female. This study by morphology parameters of small specifications sample of sex identification in *Siniperca Chuatsi* Breeding Process in has the actual application value.

This study by related analysis, Path Analysis and multiple regression analysis determine the *Siniperca Chuatsi* of full-length and body height traits on body weight traits influence maximum and established the *Siniperca Chuatsi* weight of regression equation; at the same time establish of culter male and female *Siniperca Chuatsi* individual form parameters of regression equation of small specifications sample has is high resolution. This research results for next

Siniperca Chuatsi of breeding provide reasonable science of breeding Evaluation Index to improve breeding efficiency.

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