ALLOMETRY VARIATION IN MORPHOMETRICS OF GLOSSOGOBUS SPARSIPAPILLUS CAUGHT ALONG HAU RIVER, FROM CAN THO TO SOC TRANG PROVINCES

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ABSTRACT

This study provides data on allometric variation in morphometrics of Glossogobius sparsipapillus in the Mekong Delta. A collection of 355 individuals, comprising 155 females and 200 males, was collected from Cai Rang in Can Tho province and Long Phu in Soc Trang province between January and December 2020 for morphological analysis. Statistic analyses showed that fish total length (TL) had strong relation with standard length (SL), body height (BH) and head length (HL) due to significant values of the regressions, e.g., SL = aTL², HL = aTL² and BD = aTL² (r² > 0.666 for all cases). The slope values (b) of TL-SL and TL-HL regressions show A- and I in males but I and A+ in females, respectively; but b of TL-HL regression shares the same pattern between genders (A-). It indicates that fish sex can be determined from the TL-SL and TL-BH regressions. Fish maturation can be estimated from three regressions as b values display I in mature but A in immature one. The TL-HL and TL-BH regressions can be used in order to evaluate when and where fish are caught since b values change with different seasons and locations. The findings show that we can use SL and BL to determine fish gender; SL; BL and HL to confirm when and where fish are caught and when fish reaches maturity.

KEYWORDS

Can Tho Morphological characteristics Goby Glossogobius sparsipapillus Soc Trang

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BIỂN DOI ĐẠC DIỄM HÌNH THÁI Ở LOẠI GLOSSOGOBUS PARSIPAPILLUS PHÂN BỌ ĐỌC SỒNG HẬU, TỪ CÁN THƠ ĐẾN SỐC TRÀNG

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Tóm tắt

Ngحن curvature cung cấp dữ liệu về biên độ đặc điểm hình thái của loài Glossogobius sparsipapillus ở Đồng bằng sông Cửu Long. Một tập hợp 355 cá thể, gồm 155 cá cái và 200 cá đực, được thu thập từ Cái Rang, tỉnh Cần Thơ và Long Phú, tỉnh Soc Trang từ tháng 1 đến tháng 12 năm 2020 để phân tích hình thái. Các phân tích thống kê cho thấy chiều dài tổng (TL) của cá có mối quan hệ chặt chẽ với chiều dài cơ thể (SL), chiều cao cơ thể (BH) và chiều dài đầu (HL) do các giá trị r² cao của các phép hồi quy, ví dụ SL = aTL², HL = aTL² và BD = aTL² (r² > 0.666 cho mọi trường hợp). Các giá trị độ dốc (b) hồi quy TL-SL và TL-HL cho thấy A- và I ở cá đực nhưng I và A+ ở cá cái tương ứng; trong khi đó b của hồi quy TL-HL cho cùng kết quả ở hai giới tính (A-). Nói chung tạo giới tính cá có thể được xác định từ các hồi quy TL-SL và TL-HL. Sự thành thức của cá có thể được ước tính từ b hai hồi quy khi giả thiết I ở cá trưởng thành nhưng A ở cá chưa trưởng thành. Các hồi quy TL-HL và TL-BH có thể được sử dụng để đánh giá giới tính và địa điểm đánh bắt cá; với các giá trị b thay đổi theo các mùa và địa điểm khác nhau. Kết quả cho thấy chúng ta có thể sử dụng SL và BL để xác định giới tính cá; SL, BL và HL để xác nhận thời điểm, địa điểm đánh bắt cá và thời điểm cá trưởng thành.

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1. Introduction

The Linecheek tank goby *Glossogobius sparsipapillus* was originally described by Akihito & Meguro [1]. It is one of three species of the genus *Glossogobius* recorded from brackish to freshwater in the Mekong Delta [2]-[4]. This goby displays isometric growth in Soc Trang, downstream of Hau river [5]. The species is a multiple spawner based on testis and ovarian histological description [6], [7] and a carnivore based on the relative gut length analysis [8]. Some morphometric and meristic characteristics of *G. sparsipapillus* caught from different places along the coastline in the Mekong Delta are reported by Nguyen et al. (2020) [4]. However, these authors did not verify whether fish sex can be determined based on morphometric data and their fish collection was collected from some estuarine and coastal regions in the Mekong Delta. This study aims to test whether this goby’s allometry change with gender, fish size, season, and sampling site variables based on a new collection of *Glossogobius sparsipapillus* from Hau River in Can Tho and Soc Trang provinces.

2. Material and methods

2.1. Sampling and morphological analysis

Fish was collected monthly along the Hau river from Cai Rang, Can Tho (CRCT, Site 1, 10°00’26.9 “N 105°48’37.5 “E) to Long Phu, Soc Trang (LPST, Site 2, 9°44’58.5 “N 106°04’09.9”E) from January to December 2020 using gill nets (Figure 1). Sampling was conducted in the dry season (from January to May) and the wet season (from June to December). The rainfall at the sampling sites was usually low in the dry season and high in the rainy season, with approximately 400 mm precipitation per month [9]. Taxonomic identification was based on external morphology described by Akihito & Meguro [1].

![Figure 1. Map showing sampling sites in the Mekong Delta](http://jst.tnu.edu.vn)
Gender determination was based on the shape of genital papilla, which is a triangle in males and an oval in females [10]. The morphometric and meristic characteristics were followed the description of Daud et al. [11]: total length (TL, from the mouth to the tail tip), standard length (SL, from the mouth to the position between body and tail), head length (HL, from the mouth to the gill cover), and body depth (BD, maximum distance from dorsal fin to fish belly).

2.2. Data analysis

The allometric growth of each morphometric dimension related to the total length (TL) was calculated by the equation \( Y = aTL^b \), where \( Y \) is the morphometric dimension (SL, HL and BD), \( a \) is the intercept, and \( b \) is the slope of regression [12]. The growth patterns of morphometric variables were determined by comparing the slopes and isometric value of one using t-tests. The morphometric variable was categorized into positive allometry (A+) if the slope was significantly higher than one, negative allometry (A-) if the slope markedly lower than one, and isometry (I) if the slope was equal to one. T-test was also used to confirm if \( b \) change with gender, fish size, season, and sampling site variables. The SPSS software v21 was used for data analysis. All tests were set at reliability \( P < 0.05 \).

3. Results and discussion

Data analysis of 355 individual fish caught from CRCT and LPST showed that morphological characteristics of Glossogobius sparsipapillus were various in accordance with sampling season, sampling location, sex, and age group. This goby showed a positive relationship between TL and SL, TL and BH, and TL and HL since these regressions' determination values were high \( (r^2 > 0.666 \text{ for all cases, Tables } 1 - 4). \)

As shown in Table 1, the growth pattern of males and females varied with SL and BL, but not HL. In particular, SL and BH of males increased faster than those in females as the slope values \( (b) \) of TL-SL and TL-BH regressions of this species displayed \( I \) and \( A+ \) in males but \( A \) and \( I \) in females, respectively. In contrast, HL shared the same growth pattern with gender due to a similar growth type \( (I) \). It indicated that fish gender could be determined from SL and BH. Likewise, the use of morphometric characteristics in gender differentiating was found in Heterotis niloticus [13] and Zacco koreanus [14].

Table 1. The relationship between TL and SL, BH and HL of male and female Glossogobius sparsipapillus

| Dimension | \( t \) | \( P \) | Type | \( b \) | \( SE_b \) | \( a \) | \( SE_a \) | \( n \) | \( r^2 \) | F | \( P \) | ts | \( P \) |
|-----------|--------|------|------|------|--------|------|--------|------|-------|----|------|-----|-----|
| Female    |        |      |      |      |        |      |        |      |       |    |      |     |     |
| SL        | 50.033 | 0.000 A- | 0.916 | 0.018 | 0.963 | 0.042 | 155 | 0.942 | 2503.305 | 0.000 | -4.667 | 1.975 |
| BH        | 17.561 | 0.000 I  | 0.953 | 0.054 | 0.138 | 0.018 | 155 | 0.666 | 308.390 | 0.000 | -0.870 | 1.975 |
| BL        | 31.790 | 0.000 A- | 0.914 | 0.029 | 0.300 | 0.020 | 155 | 0.868 | 1010.579 | 0.000 | -2.966 | 1.975 |

Male

| SL        | 64.472 | 0.000 I  | 0.974 | 0.015 | 0.835 | 0.030 | 200 | 0.954 | 4156.589 | 0.000 | -1.733 | 1.972 |
| BH        | 28.705 | 0.000 A+ | 1.188 | 0.041 | 0.077 | 0.008 | 200 | 0.805 | 823.957 | 0.000 | 4.585 | 1.972 |
| HL        | 32.482 | 0.000 A- | 0.935 | 0.029 | 0.290 | 0.020 | 200 | 0.841 | 1055.091 | 0.000 | -2.241 | 1.972 |

Likely, a difference in fish morphology from immature to mature was found in the present study. Specifically, the mature SL and HL of mature fish increased faster than those in the immature one as fish grew because \( b \) values of TL-SL and TL-HL regressions showed \( I \) in the mature group but \( A- \) in the immature one (Table 2). The reverse case was found in BH since \( b \) value of the TL-BH regression was \( A+ \) in the immature group but \( I \) in mature one. It revealed that SL, BH, and HL increased in the same level with TL as fish grew in the mature group, but not in the immature one; and these morphological characteristics can be considered as a tool in fish maturity determination.

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Regarding the sampling site, *Glossogobius sparsipapillus*’ morphological characteristics were also varied. Indeed, *BH* and *HL* shared the same level in increasing in CRCT – freshwater region (I: isometric pattern) but changed around allometric type (A+/-) in LPST – salinization in the dry season. It suggested that the environment can regulate fish morphometrics. It suggested that we could use *BL* and *HL* as two indicators in estimating fish’ location.

**Table 2. The relationship between TL and SL, BH and HL of immature and mature *Glossogobius sparsipapillus***

| Dimension | t    | P     | Type | SEb   | a     | SEa   | n  | r²   | F       | P    | ts  | P    |
|-----------|------|-------|------|-------|-------|-------|----|------|---------|------|-----|------|
| Immature  | SL   | 42.075| 0.000| A-    | 0.882 | 0.021 | 1.034| 0.051| 132     | 0.931| 1770.286| 0.000| -5.619| 1.978|
|           | BH   | 21.808| 0.000| A+    | 1.125 | 0.052 | 0.089| 0.011| 132     | 0.784| 475.568| 0.000| 2.404| 1.978|
|           | HL   | 28.046| 0.000| A-    | 0.861 | 0.031 | 0.338| 0.024| 132     | 0.857| 786.582| 0.000| -4.484| 1.978|
| Mature    | SL   | 71.022| 0.000| I     | 0.976 | 0.014 | 0.836| 0.027| 223     | 0.958| 5044.168| 0.000| -1.714| 1.971|
|           | BH   | 23.541| 0.000| I     | 1.042 | 0.044 | 0.111| 0.012| 223     | 0.714| 554.192| 0.000| 0.955| 1.971|
|           | HL   | 35.993| 0.000| I     | 0.953 | 0.026 | 0.278| 0.018| 223     | 0.854| 1295.515| 0.000| -1.808| 1.971|

Like a temporal variable, the variation in morphological characteristics of this goby was also regulated by seasons. The *BH* increased faster than *TL* in the dry season as *b* value of *TL-BH* regression fell into A+ pattern, but in the wet season, *BH* and *TL* share a similar level in increase when fish grew because of *I* category (Table 4). The reversed case was found in *HL*, whereas *SL* showed the same growth level in both dry and wet seasons (Table 4). It seems that morphometrics was regulated by seasons and used to estimate when fish was caught.

**Table 3. The relationship between TL and SL, BH and HL of *Glossogobius sparsipapillus* in two sampling sites**

| Dimension | t    | P     | Type | SEb   | a     | SEa   | n  | r²   | F       | P    | ts  | P    |
|-----------|------|-------|------|-------|-------|-------|----|------|---------|------|-----|------|
| CRCT      | SL   | 40.594| 0.000| A-    | 0.920 | 0.023 | 0.954| 0.052| 159     | 0.912| 1647.910| 0.000| -3.478| 1.975|
|           | BH   | 15.086| 0.000| I     | 0.889 | 0.059 | 0.163| 0.023| 159     | 0.589| 227.597| 0.000| -1.881| 1.975|
|           | HL   | 28.383| 0.000| I     | 1.012 | 0.036 | 0.238| 0.020| 159     | 0.836| 805.596| 0.000| 0.333| 1.975|
| LPST      | SL   | 81.890| 0.000| A-    | 0.963 | 0.012 | 0.858| 0.024| 196     | 0.972| 6705.905| 0.000| -3.083| 1.972|
|           | BH   | 31.702| 0.000| A+    | 1.186 | 0.037 | 0.078| 0.007| 196     | 0.837| 1004.991| 0.000| 0.027| 1.972|
|           | HL   | 37.118| 0.000| A-    | 0.873 | 0.024 | 0.335| 0.018| 196     | 0.876| 1377.709| 0.000| -5.292| 1.972|

**Table 4. The relationship between TL and SL, BH and HL of *Glossogobius sparsipapillus* in dry and wet seasons**

| Dimension | t    | P     | Type | SEb   | a     | SEa   | n  | r²   | F       | P    | ts  | P    |
|-----------|------|-------|------|-------|-------|-------|----|------|---------|------|-----|------|
| Dry       | SL   | 54.575| 0.000| A-    | 0.957 | 0.018 | 0.874| 0.036| 113     | 0.964| 2978.415| 0.000| -2.389| 1.981|
|           | BH   | 19.686| 0.000| A+    | 1.164 | 0.059 | 0.081| 0.011| 113     | 0.775| 387.520| 0.000| 2.780| 1.981|
|           | HL   | 24.736| 0.000| I     | 0.983 | 0.040 | 0.263| 0.024| 113     | 0.845| 611.878| 0.000| -0.425| 1.981|
| Wet       | SL   | 60.115| 0.000| A-    | 0.943 | 0.016 | 0.901| 0.034| 242     | 0.937| 3613.776| 0.000| -3.563| 1.970|
|           | BH   | 24.314| 0.000| I     | 0.997 | 0.041 | 0.125| 0.012| 242     | 0.710| 591.159| 0.000| -0.073| 1.970|
|           | HL   | 39.865| 0.000| A-    | 0.915 | 0.023 | 0.299| 0.016| 242     | 0.868| 1589.199| 0.000| -3.696| 1.970|

*Note: different letters in each category represented the significant difference*
4. Conclusion

Glossogobius sparsipapillus displayed sexual, intraspecific, and seasonal variation in allometry. We can use SL and BH to determine fish gender and use SL, BH, and HL to confirm collecting site and fish maturity.

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