

Sexual Dimorphism Characterization of Splendid threadfin (*Philimanus perplexa* Feltes, 1991)

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Sexual Dimorphism Characterization of Splendid threadfin (*Filimanus perplexa* Feltes, 1991)

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Abstract. *Filimanus perplexa* is among fish species with high economic value. It has a flattened body shape and yellowish body color. Another characteristic of *F. perplexa* is seven free filaments on the pectoral fin whose exceeds the anal fin. These species do not show sexual dimorphisms. Therefore, a taxonomic study is needed to distinguish male and female individuals of Kurau fish. Differences between male and female fish can be seen in their morphological performance, truss morphometrics, and meristic characters. The purpose of this study was to know morphological characters that can be used to differentiate between male and female individuals of Splendid threadfin fish. The method used in this research surveys. Samples were taken by purposive random sampling technique. Samples of Kurau fish were obtained from PPI Tanjungsari Pemalang. The variables observed were the morphological performance, truss morphometrics distances, and meristic characters. Morphological data were analyzed descriptively. The truss morphometrics character was statistically analyzed using a t-test on SPSS Version 16.0 program. Furthermore, meristic characters were analyzed descriptively. The results showed that male and female individuals of Kurau fish could be differentiated based on truss distance, where males individuals have larger body sizes and are relatively longer than females. Morphological performance and meristic characteristics cannot be the difference between male and female Kurau fish.

1. Introduction

Splendid threadfin (*Filimanus perplexa*) or locally known as kurau fish, is among landed fish species at Tanjungsari Auction Center (PPI) Pemalang. Splendid threadfin has a flattened body shape and yellowish body color. This species is also characterized by having seven filaments on the pectoral fin, whose length exceeds the anal fin [1]. Kurau fish is widely consumed as a food fish [2], which might suffer from high exploitation and lead to overfishing.

According to their sexuality, the fish specimen can be distinguished into male and female individuals [3]. In certain species, both sexes show sexual dimorphisms that make it easy to distinguish between males and females individuals [4]. According to Fishbase [5], the sexuality of *Filimanus perplexa* cannot be distinguished. In that case, a particular method is required to differentiate between male and female individuals of *F. perplexa*. Data on the number of male and female individuals of *Filimanus perplexa* are vital for its conservation. A careful examination of morphological performance [6], morphometric characteristics, and meristic characters [7] is one technique to determine male and female individuals of *F. perplexa*.

Various characters can be examined to illustrate body performance of fish, namely, body shape, mouth shape and position, caudal fin shape, scales type, and tooth type [6]. Morphometric character is



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among the morphological characters. It is a quantitative measure of the size and shape of the organism [8]. Morphometric characters can be measured using a truss morphometric technique. Truss morphometrics is a body measurement technique that is based on truss points [9]. Previous studies had used truss morphometrics to differentiate male and female individuals of various fish species that do not show sexual dimorphism. For example, the study of [10] showed that male and female *Lepidorhombus whiffiagonis* fish could be distinguished based on the ratio between body height and standard length.

Meristic characters can also be used to describe the character of fish species [6]. Meristic is a character related to the number of body parts of a fish, for example, the number of scales on the rib line, the number of hard and soft fin rays. The study from [11] showed that male and female fish in Gelik fish (*Otolithes ruber*) could be differentiated based on their meristic characters.

No study has been done about the morphological characteristic of male and female individuals of splendid threadfin (*Filimanus perplexa*). The purpose of this study was to figure out morphological performance, morphometrics truss technique, and meristic characters that can be used to distinguish male and female individuals of splendid threadfin (*F. perplexa*).

2. Methods

The material used is fish Kurau (*Filimanus perplexa* Feltes, 1991), which was taken from PPI Tanjungsari Pemalang as many as 90 fish. The method used in this study is a survey method. The variables observed were morphological characters, morphometrics truss distance, and meristic. The parameter measured is the ratio of the distance between the truss distance and the standard length [12].

Morphological performance observed were body shape, mouth shape, and position, caudal fin shape, scale type, and tooth type [6]. Morphometrics truss characters measured are truss distances that have been determined [12] by 15 points (modification). Meristic characters were calculated, namely the number of hard and soft fin rays on the dorsal, anal and pectoral fins; the number of scales above and below the rib line; the number of gill filters on the first gill arch on one side of the body; the number of scales surrounding the tail shaft [6] and the number of filaments on the pectoral fin [12].

2.1. Research procedure

2.1.1 Fish are identified and determined with guidance [12], [5], and [14].

2.1.2 Determination of morphological performance in fish is carried out directly to observe the body shape of the fish, the shape and position of the fish's mouth, the shape of the caudal fins, the type of scales, and the type of teeth [6].

2.1.3 Measuring fish with morphometrics truss techniques. Standard length measurements are taken from the front end of the snout to the base of the caudal fin. Each sample is determined by 15 points that serve as a benchmark point for morphometrics truss to obtain 33 characters [12]. (Figure 2.1; Table 2.1). The morphometrics truss benchmark points are:

1. The base of the lower jaw; 1.1.A. The tip of the upper jaw; 2. The leading edge of the snout; 3. Ventral head and body boundaries; 4. Dorsal head and body boundaries; 5. The front base of the ventral fin; 6. Dorsal fin front base I; 7. The front base of the anal fin; 8. Dorsal fin base I; 9. The base of the back of the anal fin; 10. Dorsal fin front II; 11. The base of the back of the ventral fin; 12. Dorsal fin II base; 13. Ventral tail folding; 14. Dorsal tail folding.

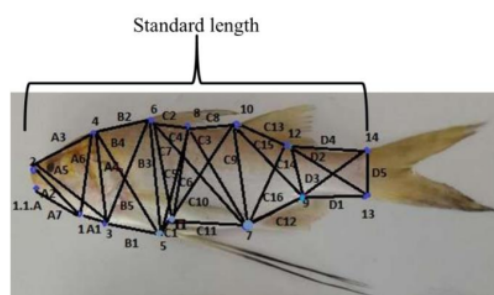


Figure 2.1 The points and distance of morphometrics truss fish Kurau (*Filimanus perplexa*, Feltes, 1991) [12] with modification

Table 2.1 Description of morphometrics truss distances used in research

Area	Code	Description of Distance
Head	A1 (1-3)	Distance between the base of the lower jaw - the boundary of the head and ventral body
	A2 (1-2)	Distance between the base points of the lower jaw - the leading edge of the snout
	A3 (2-4)	The distance between the leading endpoints of the snout – the boundary of the head and dorsal body
	A4 (3-4)	Distance between the head and ventral body border - the head and dorsal body boundary
	A5 (2-3)	Distance between the leading endpoints of the muzzle - the boundary of the head and ventral body
	A6 (4-1)	Distance between the head and dorsal body border - the base of the lower jaw
	A7 (1.1.A-1)	Distance between the tip of the maxilla - the base of the mandible
Body part Anterior	B1 (3-5)	Distance between the head point and the ventral body - the front of the ventral fins
	B2 (4-6)	Distance between the head and dorsal body boundary point - the front base of the dorsal fin I
	B3 (6-5)	The distance between the dorsal fin front point I - the front end of the ventral fin
	B4 (4-5)	The distance between the head and dorsal body boundary point - the front of the ventral fins
	B5 (6-3)	Distance between the dorsal fin front point I - head and ventral body boundary
	C1 (5-11)	Distance between the starting point of the ventral fin front - the rear base of the ventral fin
Body part Posterior	C2 (6-8)	Distance between the dorsal fin I dorsal base - dorsal fin I dorsal base
	C3 (8-7)	The distance between the dorsal fin base point I - the front base of the anal fin
	C4 (6-7)	The distance between the dorsal fin front point I - the front base of the anal fin
	C5 (8-5)	The distance between the dorsal fin dorsal point I - the back base of the ventral fin
	C6 (8-11)	Distance between the dorsal fin base I - the rear of bottom the ventral fin
	C7 (6-11)	Distance between the front base of the dorsal fin I - the rear base of the ventral fin
	C8 (8-10)	Distance between the dorsal fin I dorsal point - the front base of dorsal fin II
	C9 (10-7)	The distance between the dorsal fin front point II - the front base of the anal fin
	C10 (10-11)	The distance between the dorsal fin front point II - the rear base of the ventral fin

C11 (11-7)	Distance between the rear base point of the ventral fin - the front base of the anal fin
C12 (7-9)	Distance between the starting point of the front of the anal fin-the rear base of the anal fin
C13 (10-12)	Distance between the starting point of the dorsal fin II - the rear base of the dorsal fin II

2.1.4 Counting of Meristic Characters.

Meristic characters were calculated, namely the number of hard and soft fingers on the dorsal, anal and pectoral fins; the number of scales above and below the rib line; the number of gill filters on the first gill arch on one side of the body; the number of scales surrounding the tail shaft [6] and the number of filaments on the pectoral fin [14]. Meristic character calculation, according to [6] and [13], is as follows. Number of dorsal fin radii I, number of dorsal fin radii II, number of anal fin radii, number of pectoral fin radii, number of rib line scales, number of scales above the rib line, number of scales below the rib line, number of scales surrounding the tail stem, number of filaments on the pectoral fin, number of Gill rakers were calculated.

2.1.5 Data analysis

Data on the morphological performances were analyzed descriptively. The truss character measurements between male and female Kurau fish were analyzed statistically by the "t" test of the SPSS Version 16.0 program, and meristic characters were analyzed descriptively.

3. Results

Morphological Performance, Morphometrics Truss and Meristics Kurau Fish

3.1. Morphological performance

The observations showed the morphology of the fish Kurau *Philimanus* *perplexa* has a flat body shape, lower mouth, and not prominent. Body shape and mouth position between male and female Kurau fish are not different. The shape of the two-branched Kurau fish tail fins shows no difference in tail fin shape between male and female Kurau fish. The types of scales observed in Kurau fish are ctenoid scales. Types of comb scales in male and female Kurau fish have no difference. Kurau fish have villiform teeth, and there is no difference in tooth shape between male and female Kurau fish.

3.2. Truss morphometrics characters

The truss ratio of male and female individuals was analyzed using a t-test and is presented in Figure 3.1 and Table 3.1. It can be seen both in Figure 3.1 and Table 3.1 that nine out of 33 truss distance ratios were significantly different between male and female kurau fish, e.g., A,1, B1, B4, B5, C3, C9, C11, C12, and D5. The B4 truss distance ratio is the distance between the head and dorsal body boundary point and the ventral fins with a standard length; male fish has a value of 0.369, bigger than female fish that is 0.359. The next significant truss distance ratio is B5, which is the distance between the ductal fins I and the head and ventral body boundary with standard length, and the male fish has a value of 0.346, higher than the female fish that is 0.335. The next significant truss distance ratio is C3, which is the distance between the dorsal fin base point I and the front base of the anal fin with standard length, in male fish has a value of 0.362, higher than that of female fish that is 0.354. The next significant truss distance ratio is C9, which is the distance between the dorsal fin front point II and the anal fins (posterior height) with standard length, in male fish having a value of 0.329, higher than that of female fish that is 0.319. The next significant truss distance ratio is D5, which is the distance between the dorsal tail folding and the ventral tail folding with a standard length, in male fish with a value of 0.153, higher than that of the female fish that is 0.149.

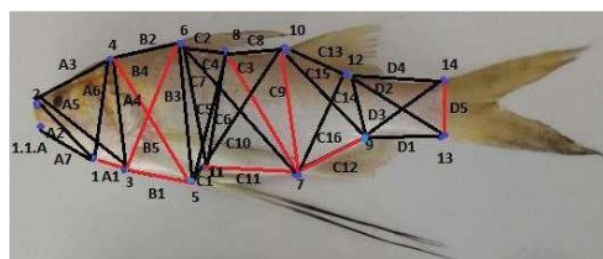


Figure 3.1 Distance truss Kurau fish (*Filimanus perplexa*, Feltes 1991). Blackline: Non-significant. Redline: Significant

Table 3.1 Test results "t" ratio between truss distance and the standard length of Kurau fish (*Filimanus perplexa* Feltes, 1991).

No	Truss Distance	Average Ratio		'T'	No	Truss Distance	Average Ratio		'T'
		Male	Female				Male	Female	
1	A1 (1-3)	0,041	0,046	*	18	C6 (8-11)	0,321	0,322	NS
2	A2 (1-2)	0,177	0,177	NS	19	C7 (6-11)	0,337	0,339	NS
3	A3 (2-4)	0,185	0,185	NS	20	C8 (8-10)	0,165	0,162	NS
4	A4 (3-4)	0,247	0,249	NS	21	C9 (10-7)	0,329	0,319	*
5	A5 (2-3)	0,216	0,221	NS	22	C10 (10-11)	0,392	0,385	NS
6	A6 (4-1)	0,236	0,236	NS	23	C11 (11-7)	0,226	0,208	*
7	A7 (1.1.A-1)	0,139	0,134	NS	24	C12 (7-9)	0,21	0,222	*
8	B1 (3-5)	0,215	0,189	*	25	C13 (10-12)	0,157	0,164	NS
9	B2 (4-6)	0,177	0,168	NS	26	C14 (12-9)	0,178	0,161	NS
10	B3 (6-5)	0,363	0,359	NS	27	C15 (10-9)	0,3	0,303	NS
11	B4 (4-5)	0,369	0,359	*	28	C16 (12-7)	0,282	0,285	NS
12	B5 (6-3)	0,346	0,335	*	29	D1 (9-13)	0,198	0,192	NS
13	C1 (5-11)	0,027	0,032	NS	30	D2 (12-13)	0,284	0,295	NS
14	C2 (6-8)	0,118	0,12	NS	31	D3 (9-14)	0,25	0,25	NS
15	C3 (8-7)	0,362	0,354	*	32	D4 (12-14)	0,254	0,26	NS
16	C4 (6-7)	0,434	0,434	NS	33	D5 (14-13)	0,153	0,149	*
17	C5 (8-5)	0,342	0,342	NS					

NS : Non-Significant

* : Significant

Truss distances B4, B5, C3, and C9, are vertical distances as well as at D5, which is the height of the caudal peduncle. The vertical distance in male fish is higher than that in female individuals. Therefore, in general, it can be stated that in male fish is larger than female fish. The next significant truss distance ratio is the truss distance B1, C11, and C12, which are horizontal lines. Truss distance ratio B1, which is the distance between the head and ventral body boundary point and the ventral fins with a standard length, in male fish has a value of 0.215 higher than female fish, which is 0.189. C11 truss distance ratio, which is the distance between the rear base point of the ventral fin and the front base of the anal fin with a standard length, in male fish has a value of 0.226 higher than the female fish is 0.208. The next significant truss distance ratio is C12 which is the distance between the base point of the front of the anal fin and the base of the back of the anal fin with a standard length, in male fish having a value of 0.210 is smaller than that of the female fish which is 0.222. The distance ratio of

truss B1 and C11 in male fish has a higher value than female fish, so it can be stated that male fish are relatively longer than females.

The head shows that the distance ratio A1 truss, which is the distance between the base of the lower jaw and the head and ventral body boundary with a standard length in females, has a value of 0.046, higher than the male fish that is 0.041. The A1 truss distance ratio in female fish is higher than male fish. The vertical and horizontal truss distances in male fish are higher than female fish, so it can be stated that in male fish, the body size is larger and relatively longer than female fish. The results of this study show a significant difference in some truss distances between male and female fish.

3.3. Meristic characteristics

The meristic characters consisting of the radii of the dorsal fin, anal fin, pectoral fin, linea lateralis scales, upper and lower linea lateralis, scales that surround the tail stem, gill rakers, and chest filaments are presented in Table 3.2. Table 3.2. shows that of the ten meristic characters observed, there are no characters that can distinguish between male and female Kurau fish. Kurau fish have long gills rakers with as many as 46-48 and 115-gill filaments.

Table 3.2 The results of the meristic characteristics of the Kurau fish (*Filimanus perplexa* Feltes, 1991).

Karakter meristic	Female					Male				
Number of dorsal fin radii I	VII	VII	VII	VII	VII	VII	VII	VII	VII	VII
Number of dorsal fin radii II	I.13	I.13	I.12	I.13	I.13	I.12	I.12	I.12	I.13	I.13
Number of anal fin radii	II.14	II.14	II.14	II.14	II.14	II.14	II.14	II.14	II.14	II.14
Number of pectoral fin radii	XIII	XIII	XIII	XIII	XIII	XIII	XIII	XIII	XIII	XIII
Number of scales above the linea lateralis	7	7	7	7	7	7	7	7	7	7
Number of linea lateralis scales	40	37	34	31	34	51	41	38	44	43
Number of scales below the linea lateralis	5	5	5	5	5	5	5	5	5	5
Number of scales surrounding the tail	12	12	12	12	12	12	12	12	12	12
Steam Number of gill rakers	46	46	46	48	45	46	54	48	48	45
Number of filaments on the pectoral fin	7	7	7	7	7	7	7	7	7	7

4. Discussions

4.1. Morphological performance

The character found in kurau in line with [14] that fish species from the Polynemidae family have flattened body shapes and inferior mouth positions, and the mouth cannot be protruded. According to [12], fish from the Polynemidae family have ctenoid scales. Moreover, [13] has stated that the posterior part of ctenoid scales is equipped with stenii (small serrations). Osteichthyes fish have ctenoid scales both in Malacopterygii and Actinopterygii. According to [13], parts of ctenoid scales in fish are nuclei, radius, and stenii. Focus is the starting point for the development of scales and is usually located in the middle of the scales. However, in later developments, the nucleus can grow more posteriorly or more anteriorly. That tooth type, as observed in the samples similar to [12] that Kurau fish have villiform tooth shapes as adaptations for prey hunters (fish eaters and small crustaceans).

4.2. Truss morphometrics characters

The results of this study, similar to the previous study by [15]. Which stated that to distinguish male and female *Oryzias dancena* fish were located in 4 characters in which there was one character that was the same as the kurau fish, namely the ratio of truss distance between the dorsal fin base and the front base of the anal fin. The distance ratio in male fish is higher than female fish.

The results of this study indicate that the distance ratio of A1 truss in females is higher than male fish; that is different from research [16] on Threespine Stickleback fish, which shows that the size of the head and jaw in male fish is larger than females. This condition is relatively similar to the results of research [17] in yellowtail fish (*Caesio cuning*) where male fish are bigger than female fish. It can be seen from the results of measurements on the length of the abdominal fin length, base length of the anal fin, the height of the tail stem, body width, so it is suspected that male fish have a higher growth rate than female fish.

According to [18], the morphological variation in fish is influenced by several factors, including genetic factors inherited from their parents that distinguish them from other species. [16] states that sexual dimorphism can occur due to several factors, for example, the role of different reproduction and intrasexual competition, which can encourage differences in reproductive structure externally. According to [18], male and female fish have different growth patterns, which will produce differences in body shape, which is an essential factor in differentiating the sex of a species.

4.3. Meristic characteristics

Almost the same research results from this study are found in studies [20], which state that in male and female *Liza melinoptera* fish, there are no differences in the characteristics of the number of first dorsal fins and number of anal fins. It is supported by [21], which states that the characteristics do not change significantly outside the range of coverage. According to [22], meristic features are more stable during growth even though fish body size has reached a maximum. These results differ from studies [10], which state that in male and female fish, *Lepidodromus whiffiagonis* found differences in the characteristics of a meristic on the number of dorsal fins, number of anal fins, number of gill sails, and number of rib scale. According to [23], environmental conditions can affect fish adaptation patterns. The impact can occur on the shape, size, and number of several parts of the body, including the meristic character.

5. Conclusion

It can be concluded that the technique of truss morphometrics can be a differentiator of male and female Kurau fish. In male fish, the body size is larger and relatively longer than female fish. Morphological performance and meristic characteristics cannot be the difference between male and female Kurau fish.

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