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MORPHOLOGICAL CHARACTERISTICS OF THE KNIFEFISH (CHITALA SPP.) POPULATION FROM DIFFERENT AQUATIC LOCATIONS OF KALIMANTAN

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ABSTRACT
Currently, information on the identification of knifefish species (Chitala spp.) is very limited. Thus, successful identification of knifefish species will significantly aid in naming and distinguishing these species for domestication activities, genetic improvement, and the development of knifefish aquaculture to support the conservation of Indonesia's native fishery germplasm. This study aims to analyze the morphological characteristics of the knifefish population from different aquatic locations in Kalimantan. Fish samples were collected from the Riam Kanan Reservoir and Martapura River in South Kalimantan Province, and the Seruyan River in Central Kalimantan Province. The fish samples to be identified were first documented with a camera, then visually identified for morphological characteristics. Morphometric characters were measured, and meristic characters were counted one by one until 30 fish samples from each location were examined. The data were recorded individually according to a pre-established morphological character observation instrument based on references. The analysis of meristic characters of knifefish from the Riam Kanan Reservoir, Martapura River, and Seruyan River showed no differences; however, there were morphological differences in the body patterns of knifefish from the three aquatic environments.

KEY WORDS
Knifefish, morphology, Kalimantan.

The public waters of Kalimantan are home to more than 394 fish species, most of which belong to the orders Ostariophysi and Labyrinthici. These species are distributed in river waters, floodplain swamps, and other aquatic environments. A small number of species have been successfully domesticated, including catfish (baung), jelawat, local catfish (lele lokal), gourami, red-eye fish (mata merah), nilem, patin jambal, tambakan, tawes, sepat, climbing perch (betok), and giant freshwater prawn (udang galah). However, several potential local fish species have not been widely domesticated, and their capture from the wild has raised concerns about their future conservation.

The knifefish (Chitala spp.) is a specific local fish species from Indonesian waters that is fully protected under the Decree of the Minister of Marine Affairs and Fisheries of the Republic of Indonesia Number 1 of 2021 concerning protected fish species. The knife fish, also known as ikan pipih, inhabits freshwater environments, frequently found in rivers, lakes, swamps, and reservoirs in Java, Sumatra, and Kalimantan. The knifefish is carnivorous, preying on smaller fish or other smaller creatures. Its meat is savory and delicious, making it a popular food ingredient, and smaller knifefish are also used as ornamental fish (Mulyani and Budijono, 2020; Kottelat and Wijanarti, 2005). The knifefish species is recognized as an important food source for humans, which has led to a decline in its population in the wild (Sudarto, 2011).

To date, the exact number of knifefish species in the Kalimantan region, along with their characteristics and differences, remains unknown. The species of knifefish suitable for aquaculture are also yet to be identified. Domestication is a crucial step to obtaining aquaculture-compatible knife fish. A successful domestication program for knifefish requires fundamental information about the species to be developed. Therefore, studies on the identification of knifefish species based on morphological and genetic characteristics are essential.

Currently, population identification of fish has become a crucial part of managing inland public fishery resources that are already endangered (Wibowo et al., 2008). Population identification has been used for various purposes, including ensuring population structure for both in situ and ex situ conservation (Sunarno et al., 2007). Fish population characteristics can be determined through morphological measurements (meristic and morphometric) as a form of their interaction with the environment (Gustiano, 2003), because environmental factors can influence the morphological and genetic structure of fish (Turan et al., 2004).

At present, information on the identification of knifefish species is still very limited. Thus, successful identification of knifefish species will significantly aid in naming and distinguishing these species for domestication activities, genetic improvement, and the development of knifefish aquaculture to support the conservation of Indonesia's native fishery germplasm. This study aims to analyze the morphological characteristics of the knifefish population from different aquatic locations in Kalimantan.

MATERIALS AND METHODS OF RESEARCH

Fish samples were taken from the Riam Kanan Reservoir and the Martapura River in South Kalimantan Province and the Seruyan River in Central Kalimantan Province.

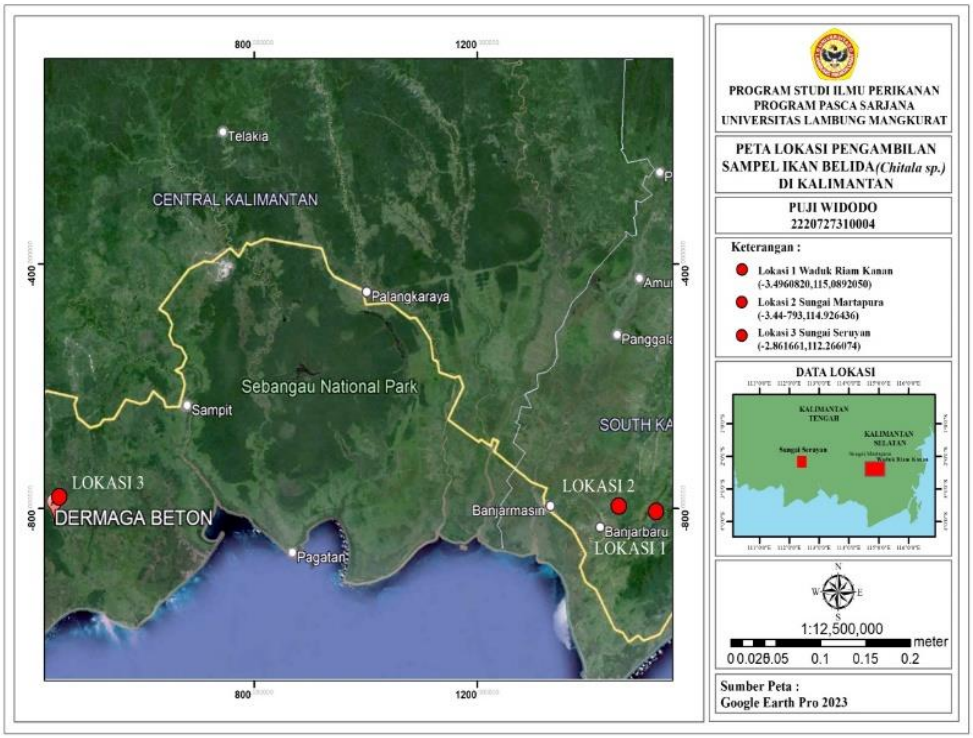

Figure 1 – Map of Knifefish Sampling Locations in Riam Kanan Reservoir, Martapura River and Seruyan River

Fish samples to be identified were first documented with a camera. The samples were then visually identified for morphological characteristics. Morphometric characters were measured, and meristic characters were counted one by one until 30 fish samples from each location were examined. The data were recorded individually according to a pre-established morphological character observation instrument based on references and available fish identification guides, including Kottelat et al. (1993), Kottelat and Widjanarti (2005), and Wibowo et al. (2008).

Data analysis of morphological characteristics utilized references from available fish identification guides, including Kottelat et al. (1993), Kottelat and Widjanarti (2005), and other supporting references relevant to the research findings.

RESULTS AND DISCUSSION

The observed morphological characteristics of the knifefish include the head, body, and tail parts. The observations of the morphological characteristics of the head, body, and tail are presented in Table 1.

Table 1 – Morphological characteristics of knifefish in three water bodies in Kalimantan based on observation results

Fish Body Parts	Morphological Characteristics
Head Section	
Form head	Form sunken near back and more small to direction front
Surface head	Surface head flat slightly slanted and concave to direction back
Form hump	Slightly convex with corner slope between 23 ^{o} – 36 ^{o}
Location of mouth	Terminal / is located at the end nose
Form mouth	Form mouth No can appears
Size mouth	Size mouth big
Location of teeth	Located on the ceiling mouth /palatine
Form tooth	Form cone
Location of eyes	On mouth on head part on
Eye color	Black
Surface eye	Stand out
Form eye	Round
Amount closed gill	Closed gill there are two (preoperculum and operculum)
Cover color gill	Light ash
Body Parts	
Form body symmetrical	*Compressed* or flat upright
Dominant color	The majority of body color is gray brownish
Part body color on	Light green
Part body color lower	Gray green
Special patterns/patterns on the body	There is pattern of faint slanted lines on the surface his body
Form streak side	Long curved
Gurat side disconnected / not	Elongated No disconnected
Form fin back	Small and elongated with end rounded like hair
Location of fins back	Above in section middle body
Form pectoral fin	Rounded length
Location of pectoral fins	In section lower body behind closed gill second
Spotting black at the base pectoral fin	There is spotting black at the base pectoral fin
Form fin stomach	Small and elongated
Location of fins stomach	In section lower body in front of hole sex
Types of scales	Cycloid shaped round part edge smooth and even
Scale color	Scale part back ashes and parts stomach white silvery
Tail Section	
Form anal/ tail fin	Elongated and rounded in section end
Location of the anal/ tail fin	Anal fin and flippers tail merges
Pattern/Style on the part tail	There is no spots on parts base tail and above anal fin to direction stomach There is spots on parts base tail and above anal fin to direction stomach tail
Pattern/pattern on the anal/ tail fin	There is no spots on parts anal fin There is spots on parts anal fin

From the observation results of the morphological characteristics, which include the head, body, and tail of knifefish samples from three different water bodies in Kalimantan, it can be determined that no specific features were found in the head and body sections to distinguish between the different knifefish species. However, in the tail section, a pattern of spots was observed on the caudal fin and along the area above the anal fin/tail.The knifefish samples from the three water bodies in Kalimantan that have been collected can be seen in Figures 2 and 3.

Figure 2 – Knifefish with Plain Pattern from Riam Kanan Reservoir.

Figure 3 – Knifefish with Spotted Pattern from Riam Kanan Reservoir.

Figure 4 – Knifefish with Plain Pattern from Martapura River

Figure 5 – Knifefish with Spotted Pattern from Martapura River

Figure 6 – Knifefish with Plain Pattern from Seruyan River

Figure 7 – Knifefish with Spotted Pattern from Seruyan River

The data from the observation of specific morphological characteristics of knifefish consist of body pattern and body color. Visual differences in the specific morphological characteristics of body pattern and color can be seen in Table 2.

Table 2 – Visual Differences of Knifefish in Three Water Bodies in Kalimantan Based on Observations

Characteristics	Location of Origin of Knifefish Samples (*Chitala* sp.)		
	Riam Kanan Reservoir	Martapura River	Seruyan River
Body Pattern			
Lots of Spots	Average A little	Average Lots	Average Lots
Clarity Freckles	Freckles There is Which faint/thin, there are some seen clear	Freckles There is Which faint/thin, there are some seen clear	Freckles There is Which faint/thin, there are some seen clear
Deployment Freckles	Majority clumped in one area	Most spread many areas of the body from stomach until tail	Most spread many areas of the body from stomach until tail
Spotted Pattern	Most patterns are regular, forming line down follow arrangement scale	Most patterns are regular, forming line down follow arrangement scale	Some are abstract (undetectable pattern), some are semi-regular andsemi-abstract (front part body the pattern seen clear, but at the tail pattern be abstract)
Spot Shape	Freckles form point small gray or black	Freckles form point small gray or black	There is Which like large dots resembling spots, there are Which point small
Body Color			
Color body	The majority of body color is light grayor silvery, but in parts tail color dark	The majority of body color is light grayor silvery, but in parts tail color dark	Body color is dark gray with patternsopaque and in parts tail color dark
Color Fin Chest	Ash bright, dark ash	Ash bright, dark ash	Ash dark
Color Fin Anal	Ash dark, edge blackened	Ash dark, edge blackened	Black
Color Fin Back	Ash dark	Ash dark	Ash dark

From visual observations of body pattern and color, it is evident that the body pattern and color of knifefish from three water bodies in Kalimantan exhibit several differences. Knifefish in South Kalimantan waters tend to differ more noticeably from those in Central Kalimantan waters.

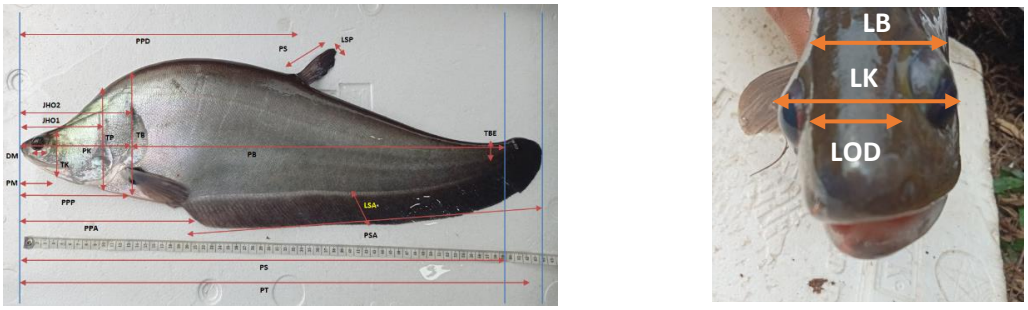

Figure 8 – Morphometric Measurements of Knife Fish

Morphometric measurements were conducted on a total of 90 knifefish samples from three water bodies in Kalimantan, with 30 samples observed from each location. The data

from morphometric measurements of knifefish included 22 measured characters: Total Length (PT), Standard Length (PS), Body Length (PB), Body Height (TB), Head Length (PK), Head Height (TK), Head Width (LK), Snout Length (PM), Eye Diameter (DM), Dorsal Fin Length (PSP), Dorsal Fin Width (LSP), Anal Fin Length (PSA), Anal Fin Width (LSA), Inner Orbital Width (LOD), Pre-Anal Length (PPA), Body Peduncle Height (TBE), Peduncle Height (TP), Pre-Dorsal Length (PPD), Body Width (LB), Distance from Snout to Second Operculum (JHO2), Pre-Pectoral Length (PPP), Distance from Snout to First Operculum (JHO1). Complete measurements of morphometric characters in knifefish can be seen in Figure 8.

The complete results of morphometric measurements on knifefish samples from three water bodies in Kalimantan can be seen in Table 3.

Table 3 – Analysis of morphometric measurements of knifefish from three water bodies in Kalimantan

Character	Code	Average Morphometric Values Knife Reservoir Riam Kanan (*Mean* ± SD)	Knife Martapura River (*Mean* ± SD)	Knife Seruyan River (*Mean* ± SD)
Total length	PT	61.85±5.56	61.85±10.57	60.68±7.55
Standard Length	PS	58.16±5.42	58.23±9.96	56.56±7.67
Body Length	PB	43.69±4.04	43.98±7.19	42.65±5.61
Height	TB	15.57±1.84	15.43 ± 2.84	15.21 ± 2.16
Head Length	PK	14.91 ± 1.39	14.88±2.69	14.73 ± 2.01
Head Height	Kindergarten	4.68 ± 0.43	5.04 ± 0.51	5.02 ± 0.50
Head Width	LK	3.06 ± 0.28	3.12 ± 0.53	3.12 ± 0.37
Muzzle Length	PM	5.67 ± 0.53	5.80 ± 0.93	5.38 ± 0.74
Eye Diameter	DM	1.43 ± 0.12	1.45 ± 0.17	1.51 ± 0.15
Dorsal Fin Length	PSP	6.60 ± 0.56	6.98±0.90	6.86 ± 0.61
Fin Width	LSP	4.47 ± 0.62	4.57 ± 0.88	4.43 ± 0.73
Anal Fin Length	PSAs	44.60±4.16	44.31±7.96	44.15±5.77
Anal Fin Width	LSA	4.69 ± 0.37	4.57 ± 0.66	4.89 ± 0.44
Inner Orbital Width	LOD	1.49 ± 0.18	1.44 ± 0.28	1.56 ± 0.22
Preanal Length	PPA	16.97±1.82	17.07±3.03	16.46 ± 2.33
Stem Height Tail	TBE	1.60±0.25	1.55±0.40	1.67 ± 0.27
Peduncule Height	T.P	10.51 ± 1.10	10.87±1.61	10.30±1.44
Predorsal Length	PPD	31.06 ± 3.09	31.61±5.49	31.08±3.92
Body Width	LB	4.38 ± 0.71	4.27 ± 1.01	4.63 ± 0.65
Nose Distance Operculum 2	JHO2	13.23 ± 1.11	13.78 ± 2.04	13.76 ± 1.69
Nose Distance Operculum 1	JHO1	10.38 ± 0.88	10.62 ± 1.60	11.82 ± 1.61
Prepectoral Length	PPP	11.94 ± 0.99	12.31 ± 2.21	10.42 ± 1.40

The morphometric measurements of knifefish from three water bodies in Kalimantan were further analyzed using discriminant analysis. Discriminant analysis is a statistical method that requires categorical dependent variables and ratio-scale independent variables (Santoso, 2017). Categorical data serve as benchmarks for distinguishing between specific types, such as knifefish from Seruyan River, Martapura River, and Riam Kanan Reservoir, while ratio-scale data are numeric measurements obtained from length measurements, head length, body height, head width, and others. The goal of discriminant analysis is to determine whether there are differences between groups.

Discriminant analysis can identify which variables most significantly contribute to these differences between groups. The results of discriminant analysis can be used to understand morphological variations and relationships among different fish species.

The normality test results of morphometric characteristics of knifefish from three water bodies in Kalimantan showed that the Lmax value > Ltab 5% (0.05), indicating that the data are normally distributed. The morphometric character data from the normality test were then transformed with Mtrans before conducting discriminant analysis using SPSS version 23. The results of the discriminant analysis showed a Wilk's Lambda Sig. value of 0.000, which approaches zero. Wilk's Lambda ranges from 0 to 1: values closer to 0 indicate significant differences between groups, while values closer to 1 indicate similarities between groups. The Wilk's Lambda Sig. value of 0.000 indicates significant morphometric differences among knifefish from the three water bodies in Kalimantan.

The results of the discriminant analysis using SPSS version 23 can be seen in Tables 4, 5, and 6 below.

Table 4 – Classification results of knifefish in each population based on discriminant analysis of morphometric method

Location	Membership Predicted Group (%)		
	Martapura River	Location	Martapura River
Martapura River	76.7	Martapura River	76.7
Riam Kanan Reservoir	23.3	Riam Kanan Reservoir	23.3
Seruyan River	3.3	Seruyan River	3.3

The results of discriminant analysis through the sharing component values indicate that the three locations do not completely separate. Each group of knifefish (Chitala sp.) from Martapura River, Riam Kanan Reservoir, and Seruyan River was classified correctly at 76.7%, 73.3%, and 86.7%, respectively. Based on the table, it is known that there is a sharing component between the Martapura River and Riam Kanan Reservoir populations of 23.3%, indicating morphometric similarities between these two populations. The discriminant analysis results show that clustering of knifefish species based on three different water bodies can be observed in Figure 9.

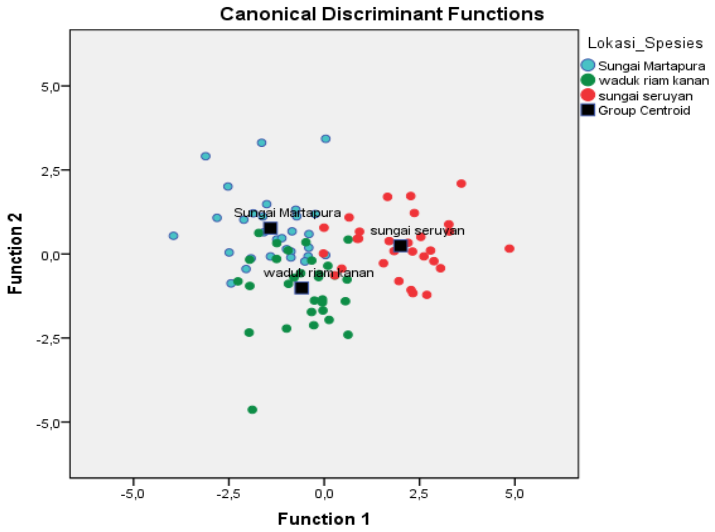

Figure 9 – Scatter plot of knifefish (chitala sp.) based on morphometric characters from three water bodies in Kalimantan

The results of Discriminant Function Analysis (DFA) yielded 2 functions where Function 1 obtained eigenvalues greater than Function 2, indicating that Function 1 to 2 play a significant role in grouping the three types of knifefish originating from three water bodies in Kalimantan. The morphometric characters contributing to Function 1 and Function 2 can be seen in Table 5.

It can be observed that the morphometric characters contributing to Function 1 include LSP (Dorsal Fin Width), LOD (Inner Orbital Width), LB (Body Width), PM (Snout Length), TBE (Body Peduncle Height), PB (Body Length), PS (Standard Length), and PSA (Anal Fin Length). Meanwhile, the morphometric characters contributing to Function 2 include JHO2 (Distance from Snout to Second Operculum), PSP (Dorsal Fin Length), JHO1 (Distance from Snout to First Operculum), TP (Peduncle Height), PPP (Pre-Pectoral Length), LK (Head Width), TK (Head Height), DM (Eye Diameter), PPD (Pre-Dorsal Length), PP (Peduncle Length), PK (Head Length), LSA (Anal Fin Width), and TB (Body Height).

The results shown in the dendrogram illustrate the relationship of kinship among Knifefish from three different water bodies. Morphometrically, Knifefish from Martapura River and Riam Kanan Reservoir, clustered together in one branch, indicate a close kinship, whereas Knifefish from Seruyan River, separate in another branch from those of Martapura River and Riam Kanan Reservoir, suggest a distant kinship.

Table 5 – Agent values and Matrix Structure

Function	1	2
Eigenvalue	2,187[a]	,576[a]
% of Variance	79,2	20,8
Cumulative %	79,2	100,0
Canonical Correlation	,828	,605
LSP	,484*	-,101
LOD	,368*	,005
LB	,347*	-,027
PM	-,304*	,155
TBE[b]	,135*	-,046
PB[b]	-,087*	-,031
PS[b]	-,066*	-,023
PSA[b]	-,043*	-,038
JHO2	,177	,604*
PSP	,068	,488*
JHO1[b]	,057	,477*
TP	-,185	,372*
PPP[b]	,004	,355*
LK[b]	-,052	,345*
TK[b]	,009	,313*
DM[b]	,123	,240*
PPR[b]	,098	,178*
PP[b]	-,055	,169*
PK[b]	,011	,158*
LSA[b]	,069	,116*
TB[b]	,034	,079*

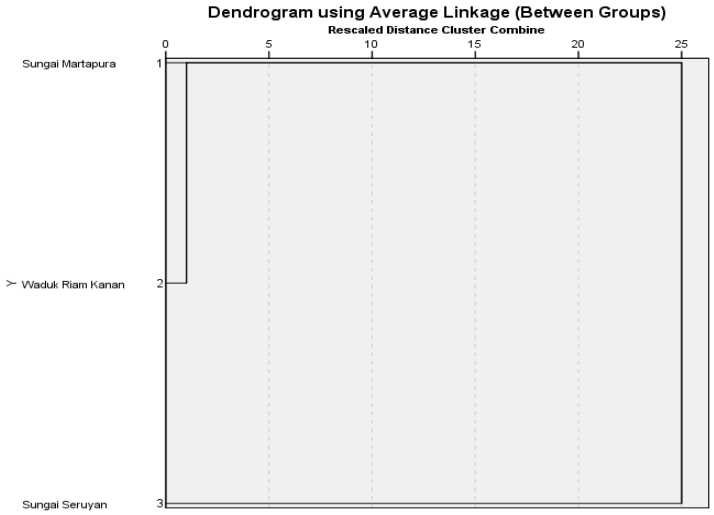

Figure 9 – Dendogram based on morphometric characteristics of knifefish from three waters in Kalimantan

The meristic character calculations were analyzed descriptively, presenting information on the mean, range, and standard deviation (SD) values of each sample of Knife fish. The data from the meristic character measurements can be seen in Table 6 below.

It can be observed that the calculation results of meristic characters of knifefish from three water bodies in Kalimantan show that the range values of eight meristic characters in the three observed samples of knifefish are within the same range or not significantly different.

The morphological features comprising the head, body, and tail parts of knifefish samples from three water bodies in Kalimantan, as observed, align with the explanations from the references (Kottelat et al., 1993; Kottelat et al., 2005). Observations of morphological characteristics on the head and body did not reveal specific features to distinguish between different types of knife fish, whereas on the tail part, a spotted pattern can be observed on the anal/caudal fin and along the upper part of the anal/caudal fin.

Visual observations of body patterns and body colors reveal differences among knifefish from three water bodies in Kalimantan. The body pattern of knifefish in South

Kalimantan exhibits a more regular spotted pattern forming lines downward following the scale arrangement, compared to knifefish in Central Kalimantan which have irregularly patterned spots. The body color of knifefish in South Kalimantan tends to be brighter than those in Central Kalimantan. This difference is likely due to the varying habitat locations of knifefish samples from South Kalimantan and Central Kalimantan, which influence changes in body pattern and color.

Table 6 – Analysis of meristic character calculation results of knifefish from three water bodies in Kalimantan

Character	Average Meristic Value					
	Knife Reservoir Riam Kanan (*Mean* ± SD)	Range	Knife Martapura River (*Mean* ± SD)	Range	Knife Seruyan River (*Mean* ± SD)	Range
Fingers hard fin back	1.00±0.00	1 – 1	1.00±0.00	1 – 1	1.00±0.00	1 – 1
Fingers soft fin back	7.37 ± 0.56	6 – 8	7.77±0.73	7 – 9	7.53 ± 0.51	7 – 8
Fingers hard pectoral fin	2.00±0.00	2	1.30±0.47	1 – 2	2.97 ± 0.18	2 – 3
Fingers soft pectoral fin	12.30 ± 0.60	11 – 13	11.33 ± 1.54	8 – 13	12.50 ± 0.73	11 – 13
Fingers fin stomach	1.67 ± 0.55	0 – 2	1.60±0.50	1 – 2	1.77 ± 0.43	1 – 2
Fingers anal/ tail fin	134.63 ± 3.91	124 – 142	131.30 ± 6.05	113 – 147	133.17±3.98	124 – 141
Amount scale streak side	265.00±14.29	237 – 296	245.37±30.67	167 – 288	254.27±15.06	225 – 283
Amount scale vertical from predorsal to direction anal fin	62.23 ± 2.43	60 – 71	58.50±3.24	51 – 64	65.03±3.37	56 – 71

Kottelat et al. (1993) describe the morphological features of Chitala lopis, including a head shape near a concave dorsal, with the jaw becoming longer as they age, extending far beyond the back of the eye in large specimens. The color pattern ranges through three phases: the entire body and fins covered with small round spots (maculosus phase, size 150-270 mm), many oblique rows of spots on the anal fin and the posterior body (borneensis phase, size 300-600 mm).

The analysis shows a Wilk's Lambda significance value of 0.000, indicating differences in morphometric characters among knifefish from three water bodies in Kalimantan. The differences in morphometric characters are found in the characters forming the discriminant function, namely 7 out of 22 morphometric characters used to form the discriminant function, including characters LSP, TP, LOD, PSP, JHO2, LB, and PM. Based on these results, it can be stated that these seven morphometric characters are more significant in classifying the three populations of knife fish.

Discriminant analysis was performed using transformed data of knifefish morphometric characters, encompassing combined data from three water body locations. It is known that there is a sharing component between the populations of Sungai Martapura and Reservoir Riam Kanan amounting to 23.3%, which is greater than the sharing component value between the populations of Sungai Seruyan and Reservoir Riam Kanan at 3.3%, indicating similarity in morphometric characters between the former populations. The sharing component values between populations indicate the closeness relationship based on morphometric characters. Inference of the sharing component on morphometric characters can explain mixing between populations or differences among them (Bungas, 2014). Statements by Kusrini et al. (2009) regarding the sharing component value provide an explanation that certain morphometric characters can be considered traits that have been maintained or shared during the process of gene flow.

The canonical discriminant function scatterplot results show that there is clustering of knifefish types based on three different water bodies. The population of knifefish originating from Reservoir Riam Kanan and Sungai Martapura exhibit a high level of similarity compared to the Sungai Seruyan location. It is evident that knifefish from Reservoir Riam Kanan generally exhibit proximity to the population from Sungai Martapura. This proximity is indicated by overlaps between populations (Kusrini et al., 2009). Populations without overlap indicate relatively distant genetic relationships. Abinawanto et al. (2018) add that overlapping morphometric characteristics between two populations suggest high morphological similarity.

The clustering of morphometric characteristics of knifefish from Reservoir Riam Kanan and Sungai Martapura is due to the geographical proximity of these two populations. Kusrini et al. (2009) suggest that clustering between populations is likely due to geographic

proximity. Fadhil et al. (2016) state that morphometric similarities across different locations may result from similar environmental conditions at those sites. According to Abinawanto et al. (2018), populations located closer geographically are grouped together, indicating similar water conditions (water quality). The genetic relatedness of knifefish (Chitala lopis) from these three locations shows that populations from Sungai Martapura and Reservoir Riam Kanan are more closely related compared to those from Sungai Seruyan.

The dendrogram results show that the morphometric characteristics of knifefish from Sungai Martapura and Reservoir Riam Kanan, grouped in one branch, indicate close genetic relationships, while those from Sungai Seruyan and knifefish from Sungai Martapura and Reservoir Riam Kanan, placed in separate branches, indicate more distant relationships. This is likely because Reservoir Riam Kanan and Sungai Martapura are connected in the same water flow, facilitating interaction between knifefish populations in these locations, whereas Sungai Seruyan is far separated from both Reservoir Riam Kanan and Sungai Martapura locations. Mohaddasi et al. (2013) suggest that morphological differences among populations from different locations in a species may be related to habitat differences. Nuryanto (2001) adds that genetic differences can occur due to geographic and environmental differences, which can impact adaptation patterns, including body shape and size in various body parts.

The meristic characters calculated consist of 9 measured characters: Dorsal fin spines (D), Dorsal fin soft rays (I+6-9), Pectoral fin spines (P), Pectoral fin soft rays (I-III+8-13), Ventral fin rays (V), Anal/Caudal fin rays (A), Number of lateral line scales (Linea lateralis), Number of vertical scales from predorsal towards anal fin. The meristic formula for knifefish (Chitala lopis) from the study is written as D, I+6-9; P, I-III+8-13; V, 1-2; A, 113-147.

An important component to consider in meristic analysis is standard deviation. Standard deviation provides insight into the variability of measurement data. According to Masood et al. (2024), a large standard deviation for a character indicates significant variation within the species population. A standard deviation value ≥ 10 is considered high (Langer et al., 2013).

Descriptive statistical analysis reveals that the 9 meristic characters measured in each species from the three water bodies in Kalimantan do not show significant variation. Both morphometric and meristic characters are highly influenced by the environment where the fish live (Masood et al., 2024). The nearly homogeneous meristic calculation results suggest that the sampled fish species in this study originate from the same environment (Langer et al., 2013). Research by Wibowo et al. (2008) on meristic characters of knifefish (Chitala spp.) from multiple locations indicates that no single meristic character can clearly distinguish populations, though NVS (Number of Ventral Spines) and NAFL (Number of Anal Fin Length) are key characters distinguishing the seven studied knife populations.

CONCLUSION

The morphological characteristics of knifefish populations from different water locations in Kalimantan, analyzed through morphometric characteristics from Reservoir Riam Kanan, Sungai Martapura, and Sungai Seruyan, show three distinct groupings of fish types with differences in 7 out of 22 observed morphometric characters. These characters include Dorsal Fin Width (LSP), Peduncle Height (TP), Internal Orbital Width (LOD), Dorsal Fin Length (PSP), Snout to Second Operculum Distance (JHO2), Body Width (LB), and Snout Length (PM). Analysis of meristic characters of knifefish from Reservoir Riam Kanan, Sungai Martapura, and Sungai Seruyan did not show differences, but there are morphological differences in the body pattern of knifefish from the three water bodies.

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