Sex Determination of Kissing Gourami (*Helostoma temminckii* Cuvier, 1829) Using Truss Morphometrics Method

[1]Atik Nuraini, [1]Indra Gumay Yudha, [1]Rara Diantari, [1]Rachmad Caesario

[1] Department of Marine and Fisherie, Faculty of Agriculture, Lampung University, Indonesia; Corresponding author: Indra Gumay Yudha, indra_gumay@yahoo.com

Abstract. Kissing gourami (Helostoma temminckii) is one of the freshwater fish in Helostomatidae Family which can be found in Tulang Bawang River Basin. This study aims to differentiate the sex of kissing gourami (male and female) by using truss morphometrics method and to identify the morphometric character which can be used as sex identifier of kissing gourami. The samples used were mature gonad fish caught in the swamp of Bawang Latak, Tulang Bawang, Indonesia. The measured variable is the morphometric character based on truss morphometrics point. The data were then compared with the standard length (SL) to obtain the truss gap ratio. Furthermore, a statistical analysis was performed with the t-test between the male-female fish group and continued with data reduction process using SPSS software of 23 version. The results showed that the male-female of kissing gourami could be differentiated by the truss morphometrics method. There are 11 gap ratios out of 24 which can be used as identifier for male and female kissing gourami. These gap ratios are located in the head, body and tail.
Key Words: Helostomatidae, gap ratios, Tulang Bawang River Basin, morphometric character.

Introduction. Kissing gourami (Helostoma temminckii Cuvier, 1829) can be found in in river or lake environment with dense vegetation and slow water currents. This fish eats a variety of aquatic plants and small animals, green algae and zooplankton. This fish has body shape resembles to giant gourami. However, this fish has protrusible mouth as its distinctive feature. Including in the family of Helostomatidae, this fish has high economic value, but has yet to be widely cultivated (Setyaningrum, 2007). However, Freshwater Aquaculture Research and Development Center in Cijeruk Bogor has successfully cultivated the fish in 2017.

Kissing gourami is quite popular because it has a relatively good nutrition in terms of protein and fat, making this fish has high market demand. However, continuous exploitation from their natural habitat may lead to the extinction. In order to minimize fishing pressure toward this species, aquaculture may be the best option to fulfill the demand. However, to support kissing gourami production through aquaculture requires basic biological information from various aspects such as taxonomic character with the aim to differentiate the sex of matured fish. According to Mayr and Ashlock (1991), taxonomic characters can be morphological, physiological, reproductive, ecological, geographical, genetic and other characters. Morphometric characters are part of morphological characters observing the size and shape of organisms in quantitative.

There are two methods to study morphometric characteristics, namely: morphometric method and truss morphometric method. Truss morphometric method is performed by measuring the gap between truss morphometric outside particular body that can be used to distinguish the sex based on morphological characters with a fairly accurate results. Truss morphometric gap based on truss points that can be determined as much as possible. The truss morphometric points are interconnected with the horizontal, vertical and diagonal in order to obtain a more detailed and specific body image than the usual morphometric method. This method is created based on the different growth rate of male and female fish. Therefore, this method can be utilized to determine the difference in body parts and truss gap (Brezky and Doyle, 1988).

According to Turan et al. (2004), truss morphometric method can be used to identify the morphological differences of organisms with close family relationships between species and fellow species. This method is more recommended compared to ordinary morphometric methods where the truss gap is so limited, making it unable to distinguish body shape. Truss morphometric method has been proven to be able to identify differences in the secondary sex of various fish species in which the dimorphisms are generally uncorrelated

unclear such as in goldfish (Nugroho et al., 1991), gourami in pre-matured stadia (Suryaningsih et al., 2003), tilapia (Ariyanto and Imron, 2002), and snakeskin gourami (Hadiyudin, 2007).

Kissing gourami belongs to dimorphism fish with unclear sexual, making the information about the sex differences is important to study (Kottelat et al., 1993 in Suryaningsih, 2003). Sexing information is beneficial for conservations such as fishing rationalization in public waters and also on spawning process. Sufficiently identifiable broodstock candidates may improve the spawning success rate.

This study aims to differentiate the sex of kissing gourami (Helostoma temminckii) with morphometric truss method and to identify the morphometric characters that can be used as sex identifier feature.

Material and Method.

Time and location. This research was conducted on August - September 2017 at Laboratory of Aquaculture, Department of Marine and Fisheries, Faculty of Agriculture, Lampung University by analyzing fish samples from the Bawang Latak swamp, Tulang Bawang, Indonesia.

Materials. The tools used in this research are The tools used in this research are a ruler with a maximum of 300 mm and 0.5 mm accuracy, and a Vernier caliper with the accuracy of 0.05 mm. The materials used are kissing gourami which consist of 200 male and 200 female. The size of the fish ranged from 130-150 mm and already reach its gonad maturity which can be identified by looking at the gonad through the surgery.

Research Procedures. Morphometric truss observation was performed with the following steps :

a. Put the object (Kissing gourami) on a paper-coated plastic sheet with the head position facing to the left and left the fins in a natural position.
b. Sixteen points are used as a reference in the truss morphometric method to form 24 characters based on Turan, et al. (2004) as shown in Figure 4.
c. After the marking was performed, there will be eighteen marking points on the paper and each gap between points should be measured (using ruler with 0.5 mm accuracy and Vernier caliper with 0.05 mm accuracy).

Sixteen truss points observed in kissing gourami are:

1. Point on the vertical line of the mandibular bone outside the body;
2. Vertical lines drawn from the point behind the eye to the dorsal part of the body;
3. The base of ventral fin;
4. The base of dorsal fin;
5. The base of anal fin;
6. The base of the last spine of the dorsal fin;
7. The tip of anal fin;
8. The tip of dorsal fin;
9. The base of ventral caudal fin;
10. The base of dorsal caudal fin;
11. The tip of lips;
12. The end of the gill;
13. The largest body of the upper side (dorsal);
14. The largest body of the lower part (ventral);
15. The upper side (dorsal) of the middle base of the tail;
16. The lower side (ventral) of the middle base of the tail.

The measurement of truss morphometric is divided into 4 parts (A, B, C and D). The coinciding section is considered as one character. Therefore, there are 24 characters obtained from 16 truss points, namely :

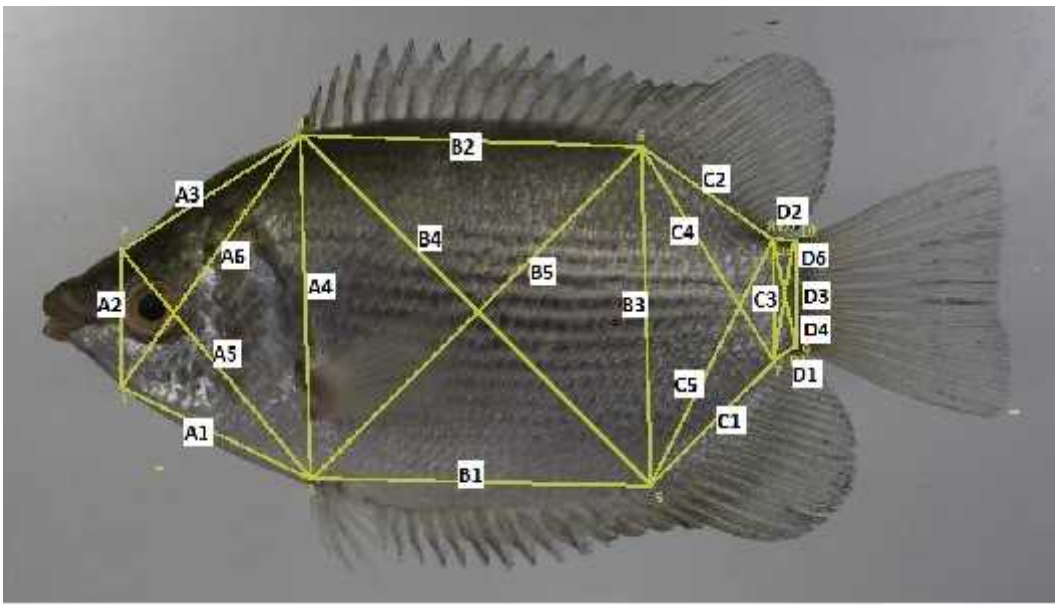
Table 1.

Truss morphometric gap

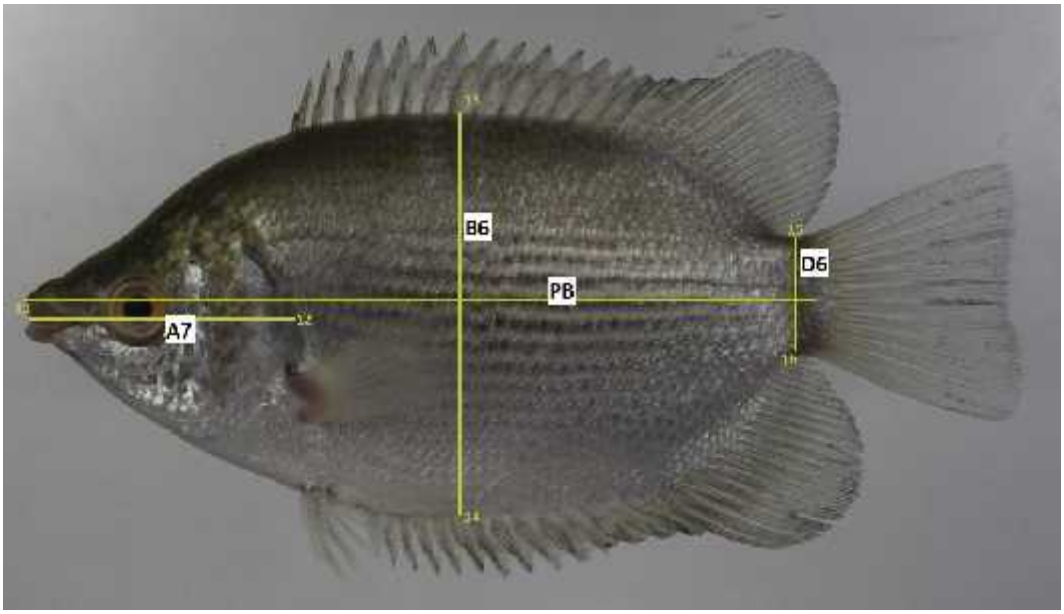
Truss character	***Truss gap code***	**Descriptions**

Head	A1	Point on the vertical line of the mandibular bone outside the body - The base of the abdominal fin
	A2	Point on the vertical line of the mandibular bone outside the body - Vertical line drawn from the point behind the eye to the dorsal part of the body
	A3	Vertical lines drawn from the point in front of the eye to the dorsal parts of body - The base of the dorsal fin
	A4	The base of the abdominal fins - The base of the dorsal fin
	A5	Vertical lines drawn from the point behind the eye to the dorsal part of the body - The base of the abdominal fin
	A6	Point on the vertical line of the mandibular bone on outside the body - The base of the dorsal fin
	A7	The tip of lips - The end of the gill
Interior Body Parts	B1	The base of the abdominal fin - The base of the anal fin
	B2	The base of the dorsal fin - The base of the last spiny rays of the dorsal fin
	B3	The base of anal fin - The base of the last spine of the dorsal fin
	B4	The base of the dorsal fin - The base of the anal fin
	B5	The base of the abdominal fin - The base of the last spine of the dorsal fin
	B6	The largest body of the upper side (dorsal) - The largest body of the lower part (ventral)
Posterior Body Parts	C1	The base of anal fin - The tip of anal fin
	C2	The base of the last spine of the dorsal fin - The tip of the dorsal fin
	C3	The tip of the anal fin - The tip of the dorsal fin
	C4	The base of last spine of the dorsal fin - The tip of anal fin
	C5	The base of anal fin – The tip of dorsal fin
Caudal	D1	The tip of anal fin – The base of ventral caudal fin
	D2	The base of spine of dorsal fin – The tip of dorsal fin
	D3	The base of ventral caudal fin – The base of dorsal caudal fin
	D4	The tip of dorsal fin – The base of ventral caudal fin
	D5	The tip of anal fin –The base of dorsal caudal fin
	D6	The upper side (dorsal) of the middle base of the tail - The lower side (ventral) of the middle base of the tail
SL		Standard Length

The location of points and truss gap can be seen in Figure 1.



a)



b)

Figure 1. a) Truss gap morphometrics A1, A2, A3, A4, B1, B2, B3, B4, B5, C1, C2, C3, C4, C5, D1, D2, D3, D4 and D5; and b) truss morphometrics gap A7, B6, PB and D6

TThe result of all truss gap were compared with standard length to obtain the ratio of truss gap.

d. t-test analysis between male and female fish were performed with 95% of confidence level which is expected to have morphometric truss ratio on certain significant truss gap between males and females.

e. Determining the morphometric characters which can be used as sex-differentiating characteristics through different t-test results.

f. Conducting post hoc test toward morphometric character from the result of t-test with data reduction process using SPSS software version 23 to find dominant morphometric character to differentiate male and female fish.

Results and discussions. The result of truss gap ratio measurement based on total length and t-test analysis toward 200 males and 200 females kissing gourami are shown in Table 3.

Table 3.

Average truss gap ratio and t-test on kissing gourami

Body Parts	Truss gap code	Average truss gap ratio		t-Test
		Female	male	
Head	A1	0,2644±0,038	0,273±0,066	NS
	A2	0,263±0,029	0,270±0,063	NS
	A3	0,239±0,034	0,459±0,069	*
	A4	0,500±0,055	0,049±0,069	*
	A5	0,663±0,059	0,264±0,067	NS
	A6	0,456±0,037	0,424±0,042	*
	A7	0,328±0,026	0,311±0,032	*
Interior Body Parts	B1	0,477±0,027	0,467±0,032	*
	B2	0,469±0,031	0,473±0,236	*
	B3	0,439±0,030	0,433±0,046	NS
	B4	0,653±0,471	0,912±0,443	NS
	B5	0,646±0,059	0,806±0,711	*
	B6	0,552±0,034	0,511±0,061	*
Posterior Body Parts	C1	0,204±0,027	0,215±0,054	*
	C2	0,178±0,022	0,177±0,022	NS
	C3	0,187±0,032	0,164±0,036	*
	C4	0,343±0,031	0,331±0,039	*
	C5	0,351±0,048	0,333±0,040	*
Caudal	D1	0,038±0,076	0,116±0,456	*
	D2	0,037±0,007	0,036±0,006	NS
	D3	0,123±0,016	0,142±0,037	*
	D4	0,143±0,014	0,137±0,012	*
	D5	0,144±0,018	0,137±0,013	*
	D6	0,158±0,025	0,146±0,035	*

Descriptions:
NS : No significance different on 95% confidence interval
*: Significance different on 95% confidence interval

The result of t-test showed that there are 17, out of 24, truss gap ratios which showed a significant difference between male and female kissing gourami. In order to determine the dominant truss gap, which can identify the sex difference between male and female kissing gourami, then 17 truss gap ratios were reduced into 11. According to Miles and Huberman (1992) data reduction in qualitative research is defined as the process of selecting, centralizing, classifying and organizing data in such a way that the final conclusions can be drawn and verified. The results of data reduction toward 17 dominant truss gap are presented in Table 4.

Table 4.

The results of data reduction toward truss gap ratio on male and female kissing gourami

Body Parts	Truss gap code	Average truss gap ratio		Females (< / >) Compared to Males
		Female	Male	
Head	A3	0,239±0,034	0,459±0,069	<
	A4	0,500±0,055	0,049±0,069	>
	A6	0,456±0,037	0,424±0,042	>
	A7	0,328±0,026	0,311±0,032	>
Interior Body Parts	B1	0,477±0,027	0,467±0,032	>
	B6	0,552±0,034	0,511±0,061	>
Posterior	C3	0,187±0,032	0,164±0,036	>

Body Parts	C4	0,343±0,031	0,331±0,039	>
Caudal	D3	0,123±0,016	0,142±0,037	<
	D5	0,144±0,018	0,137±0,013	>
	D6	0,158±0,025	0,146±0,035	<

Descriptions
< : Females size are smaller than males
> : Females size are bigger than males

In Table 4 it can be seen that there are four truss gap ratio located on the head which are significantly different between male and female kissing gourami, namely A3, A4, A6, and A7. Truss gap ratio of A3 in male fish (0.459 ± 0.069) is bigger than truss gap ratio in female fish (0.239 ± 0.034). This truss gap can easily recognizable visually which can be applied as a guideline for sexing. In general male kissing gourami has bigger forehead than female.

Truss gap ratio A4 of female kissing gourami (0,500 ± 0.055) is bigger than male kissing gourami (0,049 ± 0,069). This truss gap ratio is visually recognizable and can be applied as a sexing guideline. This implies that female fish has higher back head than the male fish.

The next truss gap ratio which can be used in sexing between male and female kissing gourami is A6. A6 in female fish (0.456 ± 0.037) is bigger than male fish (0.424 ± 0.042). However, this truss gap is hard to visually recognize, making it difficult to apply as a guideline for sexing.

Truss gap ratio A7 of female kissing gourami (0.328 ± 0.026) is bigger than male fish (0.311 ± 0.032). These number implies that the head of female fish is longer than males. Therefore, this truss gap ratio is easily recognized visually and can be used as guideline for sexing.

In interior body, truss gap ratio which significantly different between male and female kissing gourami are B1 and B6. Truss gap ratio B1 of female fish (0,477 ± 0,027) is bigger than male fish (0,467 ± 0,032). This result implies that female fish has longer inferior body part than male fish. This truss gap ratio is visually identifiable and can be applied as guidance for sexing. According to Tafrani (2012), kissing gourami has fecundity up to 144,104 eggs which requires a large body cavity. Therefore, it is reasonable if the gap of B1 on female fish is significantly longer compared with male fish.

Truss gap ratio B6 in female fish (0,552 ± 0,034) is bigger than male fish (0,511 ± 0,061). This value means that female fish has longer body height than male fish. Therefore, this truss gap is visually recognizable and can be applied as a guideline for sexing.

In posterior body parts, there are two truss gap ratio which showed significant difference, namely C3 and C4. Truss gap ratio C3 in female fish are 0.187 ± 0.032, which is bigger than male fish with the value of 0.164 ± 0.036. This result implies that female kissing gourami has higher posterior body part than male fish. This truss gap is also visually recognizable and can be applied as a guideline for sexing.

Truss gap C4 on female fish (0.343 ± 0.031) is bigger than male fish (0.331 ± 0.039). However, this truss gap is hard to recognize, making it difficult to apply as a guideline for sexing.
In caudal, there are three truss gap ratio which showed significant difference, namely D3, D5 and D6. Based on Table 4, truss gap D3 on female fish (0,123±0,016) is smaller than male fish (0,142±0,037) while truss gap D5 on female fish (0,144±0,018) is higher than male fish (0,137±0,013) and truss gap D6 on female fish (0,158±0,025) is smaller than male fish (0,146±0,035).

Among the three truss gap ratios on caudal, D3 can be easily recognized since male kissing gourami has higher caudal than female. Therefore, it can be applied as a guideline for sexing. Differences of truss gap ratios between male and female kissing gourami can be seen in Figure 5.

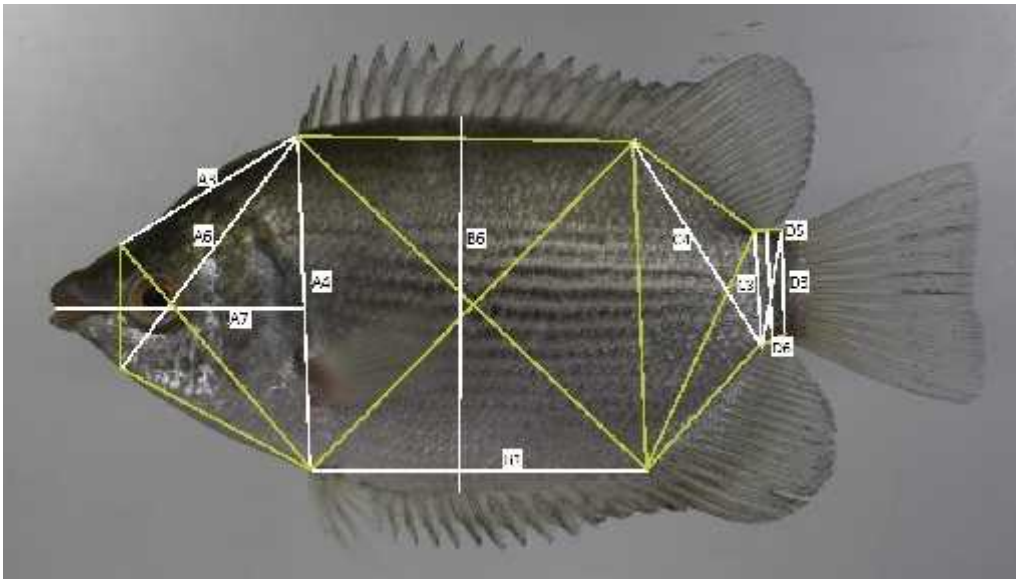


Figure 5. Differences in truss gap ratio between male and female kissing gourami (white line)
Descriptions :
-(yellow line) : truss gap with no significance difference
-(white line) : truss gap with significance difference

Based on 11 truss morphometric gap which distinguish male and female fish, 5 truss morphometric gap ratios are exactly the same with truss morphometric gap which distinguish red cheek barb (Puntius orphoides), namely A4, A6, B1, C3 and D3. Truss gap ratio C3 informs that female red chick barb has higher posterior body part than male fish (Suryaningsih et al., 2013). Truss gap ratio A4 shows that female fish has higher head than male fish. Similarly, giant gourami (Osphronemus gourami) (Suryaningsih et al., 2003), mahseer (Labeobarbus tambroides) (Nugraheni, 2005), and snakeskin gourami (Trichogaster pectoralis) (Hadiyudin, 2007) also show the same phenomenon as kissing gourami and red cheek barb.

Conclusions. Male and female kissing gourami can be sexually identified the truss morphometric method. There are 11 truss morphometric ratio, out of 24, that can be used as identifier. These morphometric ratios are located in the head, body and tail of kissing gourami.

Acknowledgements. We would like to thank Lampung University (UNILA) and for all people supporting this research. And for our fellow friends providing samples taken from Bawang Latak swamp, Tulang Bawang, Lampung Province, Indonesia.

References

Ardiwinata R. O., 1981. Aquaculture : Kissing Gourami. Sumur Bandung. Bandung.116 p [In Indonesian]

Ariyanto D., 2003. Genetic diversity analysis on three strains of tilapia and one strain of Mozambique tilapia based on their morphological characters. Journal of Zuriat 14(1): 1-6.

Ariyanto D., Imron., 2002. Truss morphometric diversity of tilapia (Oreochromis niloticus) on strain 69; GIFT G-3, and GIFT G-6. Journal of Penelitian Perikanan Indonesia 8: 11-18. [In Indonesian]

Brzeski V.J., Doyle R.W., 1988. A Morphometric criterion for sex discrimination in Tilapia, p. 439-444. In R.S.V. Pulin, T. Bhukaswan, K. Tonguthai and J.L. Maclean (eds.). The Second International Symposium on Tilapia in Aquaculture.ICLARM Conference Proceedings 15, 623 p

Desrino., 2009. Aquaculture in creating superior seeds. Jakarta : Agro Media Pustaka. 212 p

Effendi M. I., 2002.Fisheries Biology. Yayasan Pustaka Nustama. Yogyakarta.

Froese R., Pauly D., 2017.Editors.Fishbase.World Wide Web electronic publication. www.fishbase.org

Hadiyudin A., 2007. Sex determination of snakeskin gourami (trichogaster pectoralis) with truss morphometric method. Faculty of Biologi Soedirman University, Purwokerto. J. Biota 6:109-116.

Haryono., 2001. Morphologic variation of spanner barb (Puntius lateristriga) in Sumatra. Biota Jurnal Ilmiah ilmu-ilmu hayati vol VI (3) : 109-116. [In Indonesian]

Hartoto D.I, Sarnita A.S, Sjafei D.S, Satya A, Syawal Y, Sulastri, Kamal M.M, Siddik Y., 1998. Evaluation Criteria for inland water fisheries. Cibinong : LIPI. 144 p. [In Indonesian]

Indarmawan A.M., Bhagawati D., 2010. Lecturer's Notes of Animals Taxonomy. Jakarta: Rineka Cipta Ltd. 112 p
Kordi K.M.G., 2010. Kissing gourami cultivation in tarpaulin ponds. Yogyakarta: Lily Publisher. 359 p.
Kottelat M., Whitten A.J., 1993. Freshwater fishes of western Indonesia and Sulawesi (ikan air tawar Indonesia bagian barat dan Sulawesi). Periplus Edition Limited. Munich. Germany. 293 p.
Li S., Cai W., Zhou B., 1993. Variation in morphology and biochemical genetic markers among population of blunt snout bream {Megalobrama amblycephala). Journal of Aquaculture 111:117-127 pp.
Lisna. 2016. Reproduction aspects of Kissing gourami (Helostoma temmincki) in Back water District of Kumpeh Muaro Jambi Regency. Journal of Biospecies. Jambi 9(1): 15-22.
Mashudi, Ediwarman, Maskur., 2001. Cultivation of Kissing gourami (Helostoma temmincki). Journal of Perikanan.Jambi. 1(1):34-35.
Mayr E., Ashlock P. D., 1991. Principles of Systematic Zoology. Mc. Graw- Hill Inc., New York, 475 p.
Miles, Matthew B., Huberman A. M., 1992. Qualitative Data Analysis. Jakarta : UI Press. Page 15
Nugraheni D., 2005. Sex difference of mahseer (Labeobarbus tambroidess) using truss morphometrics method. Journal of Penelitian. Perikanan Darat 10 (1):23-29.
Nugroho E., Wahyudi N.A., Sudarto., 1991. Body shape through truss morphometries technique. Bulletin of Inland Fisheries Research. 10:(I):23-29.
Pante M. J. R., Lester L. J., Pullin R. S. V., 1988. A preliminary study on the use of canonical discriminant analysis of morphometric and meristic characters to identify cultured tilapias, J Aquaculture .1(1): 251-257 pp.
Pulungan, Putra, Nuraini, Aryani, Efiyeldi. 2004. Fishes Physiology. Pekanbaru : Riau University. 126 p.
Rachmawati R., 1999. Morphological characters and several varieties of gourami (Osphronemus gourami, Lacepede) [Undergraduate Thesis]. Program Study of Aquatic Resources Management. Faculty of Fisheries and Marine Science. Bogor Agricultural University. Bogor. 107 p.
Saanin H., 1984. Fish taxonomy and key identification. Binacipta, Jakarta. 508 p
Setyaningrum N., 2007. Domestication and Culture of Tinfoil Barb (Puntius orphoides) as an Effort Toward Fish Farming Diversification. Journal of Pembangunan Pedesaan (6) 1: 1-4.
Suryaningsih S., Nadjmi M. A., Dian B., Agus N., 2003. Sexing in the red chick barb (Puntius orphoides, Valenciennes, 1863) by using Truss Morfometrics Method. Journal of Biosfera 31(1): 8-16 pp
Suryobroto B., 1999. Morphometry as a support in biological research. Development of Eleven High Education Institutions DIKTI. Department of Biology. Faculty of Mathematics and Science. Bogor Agricultural University. Bogor. 131 p
Tafrani., 2012. Food and reproduction of kissing gourami (Helostoma temminckii, CV 1829) in the waters of Lubuk Lampam, Lempuing River, South Sumatera. [Thesis]. Postgraduate Program. Faculty of Fisheries and Marine Sciences. Bogor Agricultural University. Bogor
Turan C., Ergoden D., Gurlek M., Basusta N., Turan F., 2004. Morphometrics structuring of the anchovy (Engraulisencrasiculus L.) in The Black Aegean &Northeastein Mediterranean Seas. TurkeyJ. Vetern. Anim. Sci. 28:865-871.
Winans G. A., 1984. Multivariate morphometric variability in Pacific salmon: technical demonstration. Can. Journal of Fish Aquaculture Sci. 41:1150-1159 pp.

Received:
Authors:
Atik Nuraini, Departement of Marine and Fisheries, Faculty of Agriculture, Lampung University, Bandar Lampung, Indonesia, e-mail: atiknuraini14@gmail.com
Indra Gumay Yudha, Departement of Marine and Fisheries, Faculty of Agriculture, Lampung University, Bandar lampung, Indonesia, e-mail: indra_gumay@yahoo.com
Rara Diantari, Departement of Marine and Fisheries, Faculty of Agriculture, Lampung University, Bandar Lampung, Indonesia, e-mail: rara_dt@yahoo.com
Rachmad Caesario, Departement of Marine and Fisheries, Faculty of Agriculture, Lampung University, Bandar Lampung, Indonesia, e-mail: rachmad.caesario@gmail.com

How to cite this article:

Yudha I. G., Nuraini A., Diantari R., Caesario R., 2018 Sex Determination of Kissing Gourami (Helostoma temminckii Cuvier, 1829) Using Truss Morphometrics Method. AACL Bioflux X(X):xxxx-xxxx.