ISSN: 2347-5129
(ICV-Poland) Impact Value: 5.62
(GIF) Impact Factor: 0.352
IJFAS 2015; 2(6): 344-350

www.fisheriesjournal.com
Received: 15-05-2015
Accepted: 19-06-2015

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Morphological character among five strains of giant gourami, *Oshpronemus gouramy Lacepede, 1801* (Actinopterygii: Perciformes: Osphronemidae) using a truss morphometric system

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Abstract
Research morphological characters among five strains of *O. gouramy* aim to know the morphometric characters and relation between strains. Morphometric measurements performed using a truss morphometric system. Sixteen morphometric measurements were made for each individual, data collection is correct by allometric equation for body size different and using Discriminant Function Analysis (DFA). Univariate analysis of variance (One Way Anova) was used to compare the variation among samples for truss measurements. And to know the main differentiating factor of morphological characters used Principal component analysis (PCA). The analysis showed value percentage difference morphological between Tambago strain with Palapah strain amounted 6.25% ie posterior end of dorsal fin to end of anal fin character and centroid close to each other, incorporated in the same plot. While the Merah strain and Krista strain forming a separate plot but intersect with differences in morphology amounted 37.50% ie origin of dorsal fin to origin of pelvic fin, Snout to origin of pelvic fin, snout to origin of dorsal fin, posterior end of dorsal fin to end of anal fin, origin of pelvic fin to posterior end of dorsal fin and End of anal fin to dorsal attachment of the caudal fin. The main differentiator between the strains that the character origin of dorsal fin to end of anal fin.

Keywords: Truss morphometric system, Palapah strain, Tambago strain, Jepun strain Merah strain and Krista strain.

1. Introduction
Giant gourami, *Osphronemus gouramy*, is an Indonesian native fish that has a widespread distribution to Southeast Asia [1, 2, 3], a commercially important freshwater herbivorous species and the price is relatively high [4, 5]. Therefore *O.goramy* is a commodity that is seeded in aquaculture and is an important species in the ornamental as well as the edible species aquaculture industries [6], but the results have not been able to meet the market demand.
In West Sumatra province aquaculture development of *O. gouramy* in Lima Puluh Kota Regency. In this area there are five strains of *O. gouramy* with local name are Tembaga, Jepun, Palapah, Krista dan Merah. Each of these strains have a specific characteristics, especially in terms of body shape and the typical colors. The problems of *O.gouramy* in the Lima Puluh Kota Regency is heritabilities were smaller ie the number of eggs a little, high larvae mortality, slow growth and breeding rarely done of brood stock (personal communication with farmers), and assessment of fish fecundity is essential because it will determine the potential seeds for the domestication and cultivation [7]. This is presumably due to the lack of knowledge of farmers and fish farmers will be managing the brood stock. In aquaculture, selection is not commonly used probably because of poor extension of knowledge from researchers to farmers, they do negative selection so that the inbreeding result in reduced genetic diversity. The long-term isolation of populations and interbreeding can lead to morphometric variations between populations, and this morphometric variation can provide a basis for population differentiation [8, 9, 10, 11]. History of *O.gouramy* farming activities lasting in Lima Puluh Kota Regency likely contribute to decrease genetic quality. For that the genetic quality improvement efforts fish need to know the level of genetic diversity of *O.gouramy* from each strain were reared by farmers. Measurement of fish genetic diversity can be done based on DNA [3, 13, 14] and phenotypic characters [10, 15, 16, 17, 18, 19, 20, 21] as a form of interaction with the environment [22]

caused by environmental factors can affect the morphology and genetic structure of fish [23]. Hence, it is necessary to use an effective method for morphological differentiation of among five strains of *O. gourami*. This research will be conducted genetic measurements of *O.gourami* with truss morphometric system [24].

2. Materials and Methods

2.1 *Sample collection and digitization*

Selection of species in this study was determined by the commercial importance and availability of an adequate size and number of specimens. A total of 150 specimens strains of *O.gouramy* with local name ie Tambago, Palapah, Jepun, Krista and Merah were randomly collected from fish catch in Lima Puluh Kota regency ranging from 67.33-238,00 mm total length and 13.55-202.70 g body weight (30 samples per strains) during February- March 2015 in West Sumatra Province, Indonesia (Fig.1). Samples of fish put into the container stero form size 120x50x40 cm, samples were packed in ice and they were taken to the laboratory Faculty of Fisheries and Marine Sciences of Bung Hatta University Padang for morphometric analyses.

Morphometric measurements specimens performed using digital caliper which has an accuracy of 0.10 mm. Measurement of *O. gouramy* performed on sixteen morphological characters body shape on the left side of the body of the fish. Morphometric characters represented by the integral data or continuous data. The method used to describe differences in body shape of *O. gouramy* refers to Strauss and Bookstein (1982) include distance measurement points mark made on the body frame (Fig. 2 and Table 1).

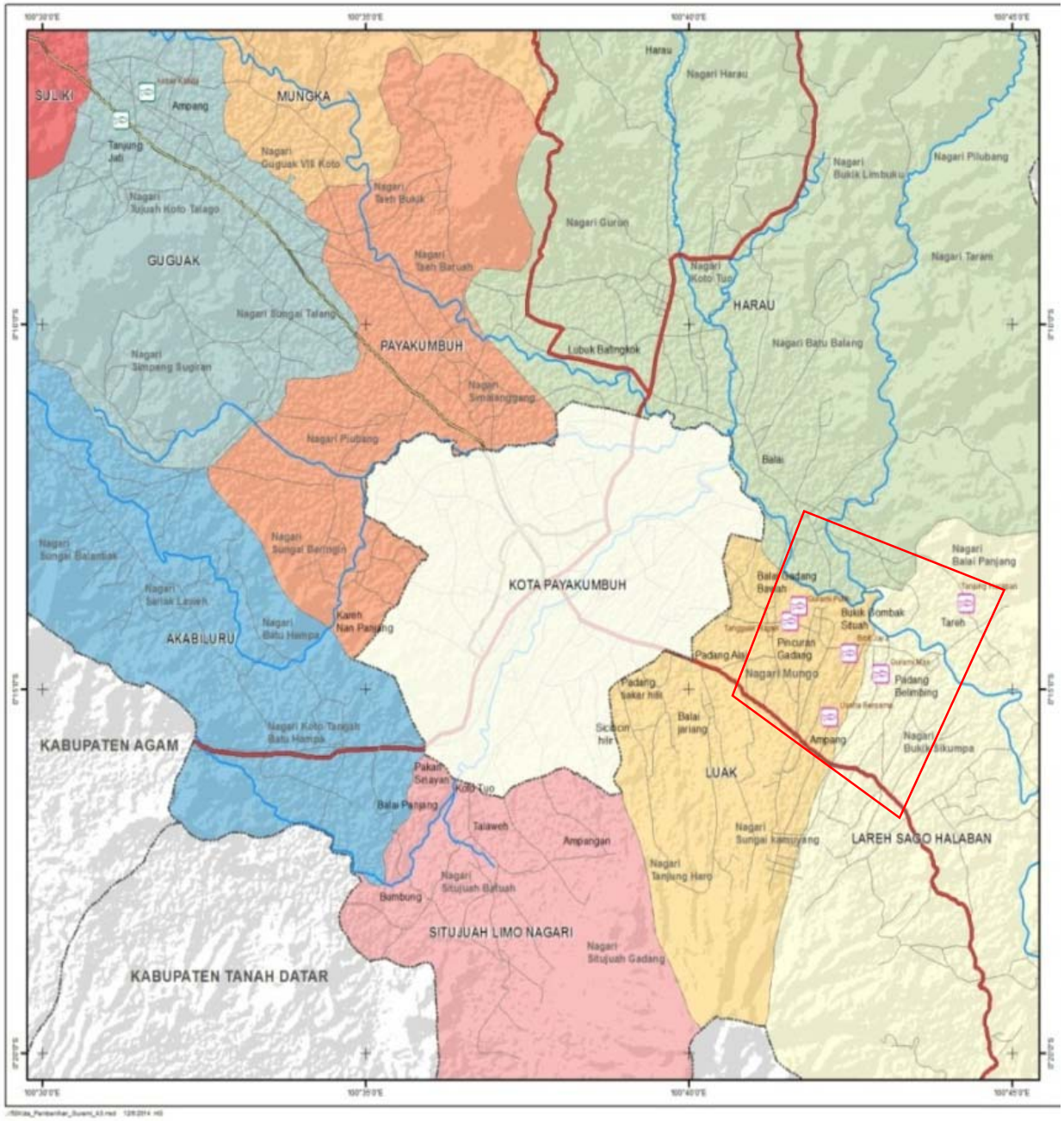

Fig 1: Site of location and five strains of *O. gourami*

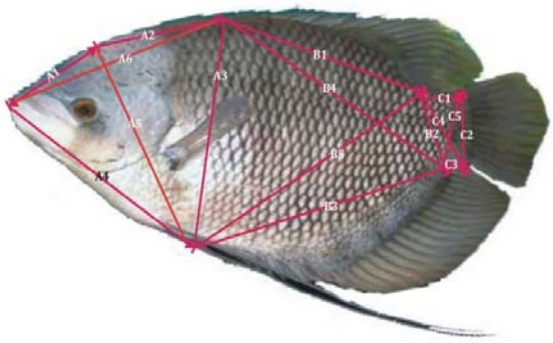

Fig 2: Sixteen landmark points used for truss measurements of five strains *O. gouramy* spesies based Blezinsky and Doyle (1988).

Table 1: Measurements used to examine morphological variations among *five strain of O. gouramy*. The code are as indicated in Figure 2.

Part of body	Code	Description of characters
Head	A1	Snout to forehead
	A2	Forehead to origin of dorsal fin
	A3	Origin of dorsal fin to origin of pelvic fin
	A4	Snout to origin of pelvic fin
	A5	Forehead to origin of pelvic fin
	A6	Snout to origin of dorsal fin
Body	B1	Origin of dorsal fin to posterior end of dorsal fin
	B2	Posterior end of dorsal fin to end of anal fin
	B3	Origin of pelvic fin to end of anal fin
	B4	Origin of dorsal fin to end of anal fin
	B5	Origin of pelvic fin to posterior end of dorsal fin
Tail	C1	Posterior end of dorsal fin to Dorsal attachment of the caudal fin to the tail
	C2	Dorsal attachment of the caudal fin to the tail to ventral attachment of the caudal fin to the tail
	C3	End of anal fin to ventral attachment of the caudal fin to the tail
	C4	Posterior end of dorsal fin to ventral attachment of the caudal fin to the tail
	C5	End of anal fin to Dorsal attachment of the caudal fin

2.2. *Statistical Analyses*

Type of data analysis that is suitable for the analysis of this data is deskriminan (Clyton and Mac Crimmon, 1987 *in* [13]. Schaeffer [26] adds deskriminan analysis is a process to distinguish between two or more groups identified which is a statistical analysis technique that is most appropriate to separate two or more groups that had previously been known. In this study deskriminan analysis technique is used to see the degree of similarity between strains of *O. gouramy* which is considered as one unit of stock and correctly identify morphometric characters [27]. Prior to the analysis conducted morphometric data is standardized in the form of % SL and normalized by log transformation (x+1). Processing data using the program package SPSS version 17. Univariate analysis of variance (ANOVA) was used to compare the variation among samples for truss measurements. Principal component analysis (PCA) requires no a priori grouping of individuals but combines and summarizes the variation associated with each of a number of measured variables into a smaller number of principal components (PC) which are a linear combination of the variables that describe he shape variations in the pooled sample. Principal component analysis was used to remove size effect from the shape measures. This method extracts a first component as isometric size factor, allowing the subsequent components to be interpreted as summarizing shape variation independent of size and random variation among the sampled individuals. The subsequent principal components were used in discriminant function analysis (DFA). Discriminant function analysis combines a selection of body measures in a linear fashion to produce a mathematical function which can be used to separate or classify individuals into groups. The percentage of correctly classified individuals gives a measure of the morphological distinctness of the samples. Furthermore describe the genetic distance based on the calculation of the mahalobis distances PAST program version 2.10

3. Result

Result of Anova showed that the mean and standard error of each morphometric characteristic of the specimens five strains of *O. gouramy* in Lima Puluh Kota Regency ie Tambago, Palapah, Jepun, Krista dan Merah (Figure 3) are given in Table 2.

Table 2: Data morphometric characteristics five strains of *O. gouramy*

Morphometric characters	Strains				
	Tambago	Palapah	Jepun	Krista	Merah
	Rata-rata±SD				
A1	0.1353±0.01^{a}	0.1411±0.01^{a}	0.1533±0.03^{a}	0.1566±0.03^{a}	0.1351±0.01^{a}
A2	0.3523±0.42^{a}	0.3701±0.01^{a}	0.4174±0.10^{b}	0.3531±0.03^{a}	0.3764±0.02^{a}
A3	0.4262±0.01^{a}	0.4465±0.01^{a}	0.4747±0.10^{b}	0.4199±0.02^{a}	0.4542±0.02^{b}
A4	0.3984±0.03^{a}	0.3929±0.02^{a}	0.4308±0.09^{a}	0.4087±0.01^{a}	0.4332±0.01^{b}
A5	0.3692±0.03^{a}	0.3748±0.01^{a}	0.4043±0.11^{a}	0.3759±0.04^{a}	0.3899±0.01^{a}
A6	0.5050±0.03^{a}	0.5133±0.01^{a}	0.5830±0.14^{b}	0.5207±0.03^{a}	0.5404±0.02^{b}
B1	0.3753±0.02^{a}	0.3864±0.02^{a}	0.4202±0.11^{b}	0.3569±0.02^{a}	0.3714±0.01^{a}
B2	0.1967±0.01^{a}	0.2752±0.14^{b}	0.2227±0.07^{b}	0.1667±0.01^{a}	0.1676±0.01^{b}
B3	0.6220±0.05^{a}	0.6288±0.07^{a}	0.7003±0.15^{b}	0.5875±0.04^{a}	0.6302±0.02^{a}
B4	0.5463±0.03^{a}	0.5525±0.02^{a}	0.6048±0.19^{b}	0.5004±0.02^{a}	0.5200±0.01^{a}
B5	0.5904±0.03^{a}	0.6197±0.03^{a}	0.6715±0.14^{b}	0.5722±0.02^{a}	0.6197±0.02^{b}
C1	0.1092±0.01^{a}	0.1033±0.01^{a}	0.1279±0.03^{a}	0.1365±0.04^{b}	0.0859±0.01^{b}
C2	0.1423±0.01^{a}	0.1434±0.01^{a}	0.1590±0.05^{a}	0.1157±0.00^{b}	0.1188±0.00^{b}
C3	0.0090±0.00^{a}	0.0076±0.00^{a}	0.0112±0.00^{b}	0.0122±0.00^{b}	0.0129±0.00^{b}
C4	0.1982±0.02^{a}	0.2032±0.01^{a}	0.2201±0.07^{b}	0.1835±0.31^{b}	0.1626±0.01^{b}
C5	0.1599±0.01^{a}	0.1632±0.00^{a}	0.1779±0.05^{b}	0.1244±0.00^{b}	0.1298±0.00^{c}

^{abcd} Values with the different superscript in each column are significantly different from each other (p<0.05) and value with the same superscript in each column are not significantly different from each other (p>0.05)

Significance test is performed to determine the characters that can be used as an identifier of a type of fish. The characters were not significantly different can be used as an identifier or the fish markers. Based on Table 2, known that of the sixteen characters are measured, fourteen characters were significantly different (P <0.05) and two characters not significantly different (P> 0.05) ie snout to forehead character and forehead to origin of pelvic fin. This indicates that among the five strains of *O. gouramy* still have the same character especially among Palapah strain and Tambago strain. Furthermore, from the One Way Anova (Table 2) analyzed the percentage difference between strains morphometric characters as presented in Table 3.

Table 3: Percentage Difference between Character Morphometrics strain of *O. gurami*

Difference Morphological Character Among Strains	The number of different characters	The value percentage difference (%)
Tambago VS Palapah	1	6,25
Tambago VS Jepun	11	68,75
Tambago VS Krista	5	31,25
Tambago VS Merah	10	62,50
Palapah VS Jepun	10	62,50
Palapah VS Krista	5	31,25
Palapah VS Merah	9	56,25
Jepun VS Krista	10	62,50
Jepun VS Merah	10	62,50
Krista VS Merah	6	37,50

From Table 3 it can be explained that morphometric characters smallest difference is between Tambago strain with Palapah strain of 6.25%. While differences in morphometric characters were greatest between Tambago strain with Jepun strain of 68.75%, as well as between Palapah strain with Jepun strain of 62.50%. Morphologically based observation of the sample in both strains can be expressed differently ie Tambago strain larger size, dark yellow, while the Jepun strain smaller size and black colored. Jepun strain is not used by farmers in Lima Puluh Kota Regency by reason of slow growth. Tambago strain with Krista strain and Palapah strain with Krista strain the value of the percentage difference of 31.25%. Further analysis of PCA distinguishing values obtained from each character is measured as presented in Table 4.

Table 4: Dominant character differentiator strain of *O. gourami*

(The main differentiating factor sequentially)	Code	Value differentiator in the sequence of the highest value
Origin of dorsal fin to end of anal fin	B4	0.963
Origin of dorsal fin to origin of pelvic fin	A3	0.932
Snout to origin of dorsal fin	A6	0.916
Origin of dorsal fin to posterior end of dorsal fin	B1	0.907
Origin of pelvic fin to posterior end of dorsal fin	B5	0.903
Dorsal attachment of the caudal fin to the tail to ventral attachment of the caudal fin to the tail	C2	0.903
Posterior end of dorsal fin to ventral attachment of the caudal fin to the tail	C4	0.892
End of anal fin to Dorsal attachment of the caudal fin	C5	0.889
Snout to origin of pelvic fin	A4	0.879
Posterior end of dorsal fin to Dorsal attachment of the caudal fin to the tail	C1	0.971
Forehead to origin of pelvic fin	A5	0.839
Snout to forehead	A1	0.838
Forehead to origin of dorsal fin	A2	0.837
Origin of pelvic fin to end of anal fin	B3	0.806
End of anal fin to ventral attachment of the caudal fin to the tail	C3	0.783
Posterior end of dorsal fin to end of anal fin	B2	0.636

Of sixteen morphological characters were measured, the principal component among five strains of *O. gouramy* are origin of dorsal fin to end of anal fin and origin of dorsal fin to origin of pelvic fin. The centroids of discriminant function scores based on morphometric in this study resulted in 3 plots: strain of Merah stocks in one, strain of Krista stock in second and the strains of Palapah, Tambago and Jepun stock in another (Fig.4).

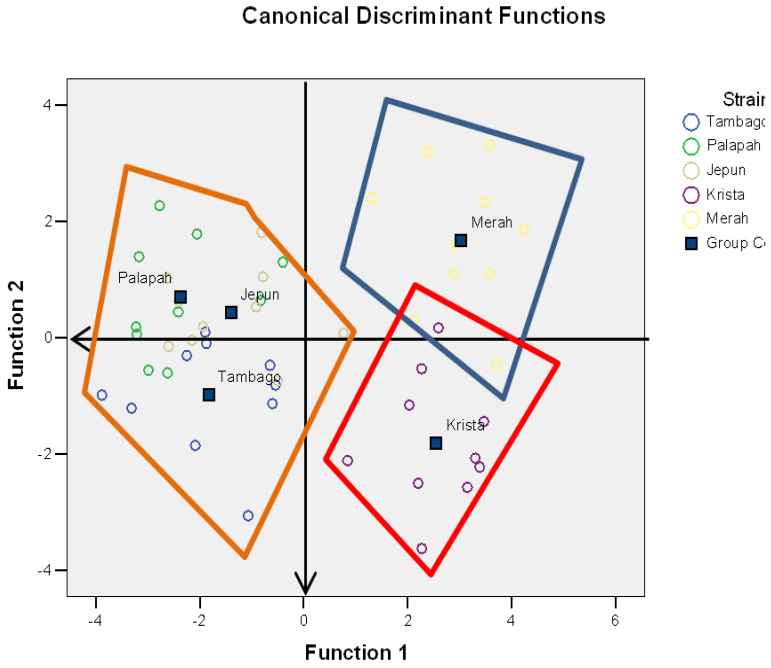

Fig 4: Sample centroids of discriminant function scores based on morphometric measurements in three plot.

Plotting DFs revealed high isolation in morphometrics among the stocks (Fig. 4), where the morphological characters of strains of *O. gouramy* shows intersect especially Palapah strain, Tambago strain and Jepun strain. Red strain morphometric characters were around above the zero line of the axis X and is on the right ordinate Y. Morphometric characters of Merah strain were around above the zero line of the axis X and is on the right ordinate Y. Intersection occurring between strains of O gouramy population showed any symptoms of mixing between the five strains of the fish.

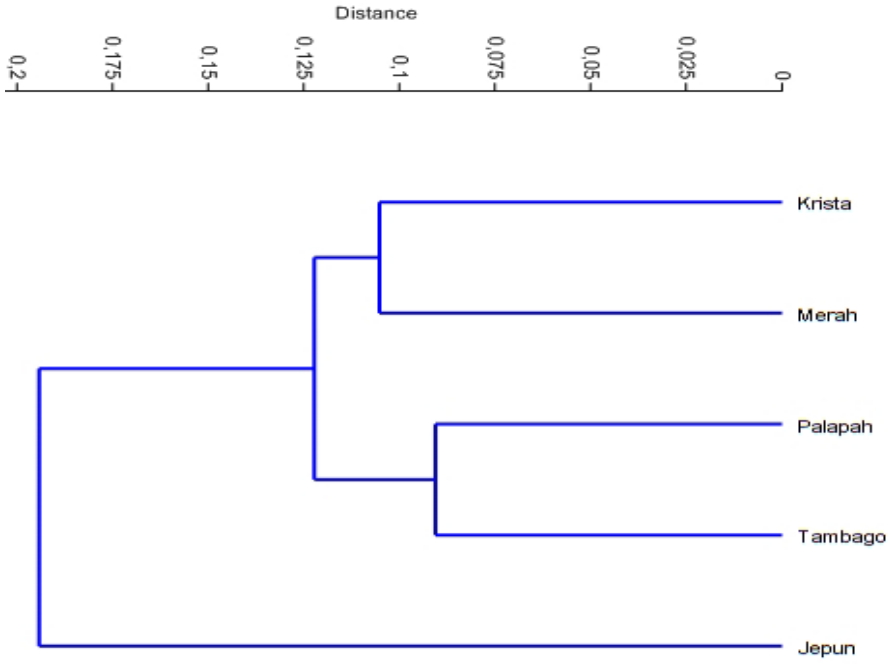

Fig 5: Dendrogram based on morphological characters and mahalobis distances of among five strains of *O. gouramy*.

Dendrogram formed by the genetic distance showed that the strain of *O. gouramy* Krista strain and Merah strain have a closer genetic relationship, as well as Palapah strain closer to Tambago strain, whereas Jepun strain have the most genetic distance of 0.2 with four other strains (Figure 3). The closeness of the genetic distance between the Palapah strain with Tambago strain, indicates that of *O. gouramy* in aquaculture is still derived from the same population. This is presumably because it happens inbreeding among five strains of *O. gouramy* at the level of farmers in Lima Puluh Kota Regency.

4. Discussion

Principal component analysis indicated that morphometric differentiation between samples was largely located in the posterior region of *O. gouramy* and from body depth measurements. A limited number of fish populations cause the chances of high inbreeding which will impact on the genetic diversity of a species. Morphometric diversity among strains of *O.gouramy* showed a low value, the alleged lack of diversity caused by *O. gouramy* has long been widely cultivated in Lima Puluh Kota Regency. Management recruitment undirected often occurs in fish farming activities that can cause accidental selection therefore contributes to the a decrease genetic diversity of fish [28]. The difference between of among of the strains is the effect of domestication as well as genetic variations. Taniguchi *et al*. [29] states that domestication can reduce genetic variation in subsequent offspring. The reason is because the strain is under selection pressure, number of brood stock and stock strain [30]. The effective number of brood stock determines the rate of change in the composition of a population caused by genetic drift. Although breeding management is partially monitored by considering age and size as the main selection criteria for each reproductive season, hatcheries do not keep records of the selected broodstock, which means that, at each breeding season, broodstock may include inbred male and female breeders [31]. Furthermore, the influence of the environment, selection, and genetic individual ontogeny stage cause morphometric differences within a species [23, 32, 33]. Genetic diversity is largely determined by the density of the population, inbreeding, migration and genetic drift [34]. The results of the study are useful as baseline information of *O. gouramy* populations for further studies to improvement of broodstock. In aquaculture, it is essential to select genetically superior stocks along with better features. Breeding strategies focus on increasing genetic variations of colour pattern and body types as well as for growth rate and reproductivity [35].

5. Conflict of Interests

The author(s) have not declared any conflict of interests

6. Acknowledgements

We are indebted to The Ministry of Education and Culture Directorate General of Higher Education to providing research funding Fundamental Grants 2015 and Faculty of Fisheries and Marine Sciences of Bung Hatta University Padang for providing full laboratory facilities during the study period. There is no conflict of interest among the authors for the publication of this research article, and also thank to reviewers at IJFAS for valuable criticism of the manuscript.

7. References

1. Welcomme RL. International introductions of inland aquatic species. Food and Agriculture Organization of the United Nations, Fisheries Technical Paper Rome, Italy

1988; 294:1-318.
2. Setijaningsih L OZ, Arifin dan R. Gustiano. Characterization ofthree strains of giant gouramy (*Osphronemus gouramy* Lac.) based on truss morphometries method. Indonesian Journal of Ichtiologi. 2007; 7(1):23-30.
3. Nugroho, E dan I, I Kusmini. Evaluation genetic variation three strain of Gurame (*Osphoronemus gouramy*) with use isozyme. Journal of Aquaculture Research. 2007; 2(1):51-57.
4. Roberts TR. The Freshwater Fishes of Western Borneo (Kalimantan Barat Indonesia), California Academy Science, San Francisco, 1989.
5. Directorate General of Aquaculture. Map Sentra of Aquaculture. Department of Marine and Fisheries of the Republic of Indonesia, 2010.
6. Amornsakun T, Kullai S, Hassan A. Some aspects in early life stage of giant gourami, *Osphronemus goramy* (Lacepede) larvae. Songklanakarin Journal of Scince and Technology. 2014; 36(5):493-498.
7. Azrita, Syandri H. Fecundity, egg diameter and food *Channa lucius* Cuvier in different waters Habitats. Journal of Fisheries and Aquaculture. 2013; 4(3):115-120.
8. Syandri H, Azrita, Junaidi. Morphological Characterization of Asang Fish (*Osteochilus vittatus*, CYPRINIDAE) in Singkarak Lake, Antokan River and Koto Panjang Reservoir West Sumatra Province, Indonesia. Journal of Fisheries and Aquaculture. 2014; 5(1):158-162.
9. Azrita, Syandri H, Dahelmi Syaifullah, Nugroho E. Morphology characterization of Bujuk fish (*Channa lucius*, Channidae) in Singkarak lake West Sumatra, Tanjung Jabung Timur Jambi floodplain and Kampar Riau floodplain. Journal of Natur Indonesia. 2013; 15(1):1-8.
10. Mir FA, Mir JI, Rabindar S, Patiyal RS, Chandra S. Pattern of Morphometric Differentiation Among Three Populations of Snowtrout, *Schizothorax plagiostomus* (Actinopterygii: Cypriniformes: Introduction Cyprinidae), From Kashmir Himalaya Using A Truss Network System. Acta Ichthyologica et Piscatoria 2013; 43(4):277-284.
11. Hossain MAR, Nahiduzzaman M, Saha D, Khanam MUH, Alam MS. Landmark-based morphometric and meristic variations of the endangered carp, *Kalibaus labeo calbasu*, from stocks of two isolated rivers, the Jamuna and Halda, and a hatchery. Zoology Study 2010; 49:556-563.
12. Azrita, Syandri H, Dahelmi Syaifullah, Nugroho E. Genetic variation of Bujuk fish (*Channa lucius*) from West Sumatra, Jambi and Riau Province based on DNA Marker. Journal of Berita Biologi. 2011; 10(5):675-680.
13. Azrita, Syandri H, Junaidi. Genetic variation among asang fish (*Osteochilus vittatus* Cyprinidae) populations using random amplified polymorphic DNA (RAPD) markers. International Journal of Fisheries and Aquatic Studies. 2014; 1(6):168-172.
14. Cadrin SX, Friedland KD. The utility of image processing techniques for morphometric analysis and stock identification. Fisheries Research 1999; 43:129-139.
15. Turan CM, Oral B, Őztürk, Düzgünes E. Morphometric and meristic variation between stocks of Bluefish (*Pomatomus saltatrix*) in the Black, Marmara, Aegean and northeastern Mediterranean Seas. *Fisheries Research* 2006; 79:139-147.
16. Vatandoust S, Anvarifar AH, Sabet HM. Morphometric and meristic characteristics and morphological differentiation among five populations of Brown Trout *Salmo trutta fario* (Pisces: Salmonidae) along the southern Caspian Sea basin. *European Journal of Zoological Research.* 2014; 3(2):56-65.
17. Akombo PM, Atile JI, Adikwu IA, Araoye PA. Morphometric measurements and growth patterns of four species of the genus *Synodontis* (Cuvier, 1816) from Lower Benue River, Makurdi, Nigeria. International Journal of Fisheries and Aquaculture. 2011; 3(15):263-270.
18. Adite A, Abou Y, Sossoukpe E, MHAG Gbaguidi, Fiogbe ED. Meristic and morphological characterization of the freshwater prawn, *Macrobrachium macrobrachion* (Herklots, 1851) from the Mono River-Coastal Lagoon system, Southern Benin (West Africa): Implications for species Conservation. International Journal of Biodiversity and Conservation. 2013; 5(11):704-714.
19. Saroniya K, Saksena DN, Nagpure NS. The morphometric and meristic analysis of some *puntius* species from central India. Biolife 2013; 1(3):144-154.
20. Konan KM, Adépo-Gourène AB, Ouattara A, Nyingy WD, Gourène G. Morphometric variation among male populations of freshwater shrimp Macrobrachium vollenhovenii Herklots, 1851 from Côte d'Ivoire Rivers. Fisheries Research 2010; 103:1-8.
21. Gustiano R. Taxonomy and phylogeny of Pangasiidae catfishes from Asia. Ph.D. Thesis, Leuven University, Belgium, 2003.
22. Turan C, Denis E, Turan F, Erguden M. Genetic and morfometric structure of Liza abu (Heckel 1843) Population from the rivers Orontes. Eupharates and Tigris. Turk. J Vet Anim Sci 2004; (28):729-734.
23. Strauss RE, Bookstein FL. The truss: body form reconstruction in morphometrics. Syst. Zool 1982; 31:113-135.
24. Blezinsky VJ, Doyle RW. A morphometric criterion for sex discrimination in tilapia. In *The Second International Symposium on Tilapia in Aquaculture* (Pullin, R. S. V., Bhukaswan, T., Tonguthai, K. & Maclean, J. L., eds), *ICLARM Conference Proceedings* Manila: ICLARM 1988; 15:439-444.
25. Schaeffer KM. Geografic variation in morphometric characters and gill-raker counts in yellowfin tuna (*Tunnus albacares*) from Pacific ocean. *Fish Buletin* 1991; 89:289-297.
26. Saraswanti PK, Sabnis SV. Comparison of CART and discriminat analysis of morphometric data in foraminiferal taxonomy. Anuario do Instituto de Geociencias. Indonesian Fisheries Research Journal, 2006, 153-162.
27. Kusmini II, Gustiani R, Mulyasari. Characterization truss morphometric of Tengadak fish (*Barbonymus schwanenfeldii*) from West Kalimantan with Tengadak Albino fish and Osteochilus sp from West Java. Proceedings of the Aquaculture Technology Innovation Forum, 2010.
28. Taniguchi N, Sunantadinata K, Iyam S. Genetic change in the first and second generation of hatchery stock of black seabeam. Aquaculture 1983; 35:309-320.
29. Hansen MM, Mensberg KLD, Rasmussen G, Simonsen V. Genetic variation within and among danish brown trout (*Salmo trutta* L) hatchery strains assesed by PCR-RFLP analysis of mithocondrial DNA segments. Journal Aquaculture. 1997; 153:16-29.

30. Bracamonte GMP, Rincon AMS, Rosa-Reyn Vera X Fa De la WA, Reyes BS. Inbreeding evidence in a traditional channel catfish (*Ictalurus punctatus*) hatchery in Mexico. Electronic Journal of Biotechnology. 2011; 14(6):1-6.
31. Jawad LA. Variation in meristic characters of a tilapian fish, *Tilapia zili* (Gervais, 1848) from the inland water bodies in Libya. Acta Ichthyol Piscat 2001; 31(1):159-164.
32. Gallardo JA, Neira R. Environmental dependence of inbreeding depression in cultured Coho salmon (*Oncorhynchus kisutch*): aggressiveness, dominance and intraspecific competition. Heredity 2005; 95:449-456.
33. Nugroho E, Hadie W, Subagja J, Kurniasih T. Genetic and morphometric variation of the green catfish (*Mystus nemurus)* from Jambi, Wonogiri and Jatiluhur. Indonesia Journal of Fisheries Research. 2005; 11(7):1-6.
34. Fan LQ, Phang VPE. Breeding program for the discus fish. Second National Congress on Genetics, November, Genetics Society of Malaysia, 1996, I3-l5.