

# BIOMETRIC ANALYSIS OF THE ARTIFICIAL HYBRIDIZATION BETWEEN *Pangasius djambal* BLEEKER, 1846 AND *Pangasianodon hypophthalmus* SAUVAGE, 1878

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## ABSTRACT

It is really important, since the possible use of these pangasiid hybrids in aquaculture faces the problem of potential impact on wild population. Therefore, it is urgently needed to provide quick identification tools in the field. This study investigated morphological characters of *Pangasius djambal* and *Pangasianodon hypophthalmus* and their hybrids. A detailed morphological analysis using 32 morphometric measurements and five meristic counts was done on the hybridization of *P. djambal* and *P. hypophthalmus*. Morphometric analysis and meristic counts showed that the reciprocal hybrids have intermediate characters except for gill raker number in which lower than that of parental species. In general, the hybrids have tendency to be like *P. hypophthalmus* rather than *P. djambal*. The only typical character of *P. djambal* appeared on hybrids is teeth shape, both vomerine and palatine. It is clearly defined that the true hybrids have seven pelvic fin rays.

[Keywords: *Pangasius djambal*, *Pangasianodon hypophthalmus*, hybridization, biometry]

## INTRODUCTION

Catfishes of the family Pangasiidae are of great economic importance in Southeast Asia region such as *Pangasius djambal* in Indonesia (Legendre *et al.* 2000), *P. bocourti* in Vietnam (Hung *et al.* 1999), and *Pangasianodon hypophthalmus* (senior of *P. sutchi*) (Tarnchalanukit 1986). Thus, many efforts of breeding practices have been done to increase their production. As interspecific cross-breeding in fish may lead hybrid with valuable characteristics for aquaculture (sterility, monosex population, heterosis or growth etc.), it was decided to evaluate the effect of hybrid vigor on the artificial hybridization in pangasiid catfishes. In contrast with the abundant literature on the hybridization in other cultured fish families, in particular cichlids, salmonids, cyprinids and ictalurids (for review see Sneed 1971; Moav 1976; Chevassus 1979, Wohlfart and Hulata 1981; Chevassus 1983), reports on hybridization of pangasiid catfishes are rather scarce.

Enzymatic system (protein total) allowed to differentiate easily and quickly *P. djambal* from *P. hypophthalmus*: allele 100 for locus Prot1 and allele 105 for locus Prot2 for the first species, while allele 100 for Prot1 and alleles 100 and 150 for Prot2 (Legendre *et al.* 2000). However, there is no genetic data available for the hybrids so far. Therefore, it is really important to provide quick identification tools in the field since the possible use of these pangasiid hybrids in aquaculture faces the problem of potential impact, genetic deterioration, on wild population. This study investigated morphological characters of *P. djambal* and *P. hypophthalmus* and their hybrids.

## MATERIALS AND METHODS

Specimens examined in this hybridization experiment consisted of 114 specimens of *P. djambal* (142-635 mm), 31 specimens of *P. hypophthalmus* (147-630 mm), 45 specimens of hybrids of female *P. djambal* x male *P. hypophthalmus* (133-490 mm), and 45 specimens of hybrids of male *P. hypophthalmus* x female *P. djambal* (129-473 mm). Specimens of *P. djambal* were collected from the main rivers in Java, Sumatra and Kalimantan (Indonesia), while those of *P. hypophthalmus* mostly originated from fish culture in Mekong River (Vietnam) and in West Java (Indonesia). Specimens of *P. djambal* and *P. hypophthalmus* were deposited in the Museum Zoologicum Bogoriense (MZB), Cibinong, Indonesia, and in the Muséum National d'Histoire Naturelle (MNHN), Paris, France. All of the hybrid specimens originated from artificial breeding performed at Research Institute for Freshwater Fisheries (RIFF) station in Sukamandi, West Java, Indonesia. Specimens of *P. djambal* and *P. hypophthalmus* were identified following Gustiano (2003).

Body length was measured using a graduated ruler of 1 m. Thirty two measurements were made using dial

calliper following Pouyaud *et al.* (1999). Three additional measurements were done: (1) width of pectoral spine, measured at base of second dorsal spine; (2) anterior width of snout, taken between the border of anterior nostril; and (3) posterior width of snout, taken between the border of posterior nostril. Five counts were noted, i.e. total number of gill rakers on the first branchial arch and number of dorsal, anal, pectoral and pelvic fin rays. Morphological observations include the shape of the swimbladder and the shape of palatine and vomerine tooth patches.

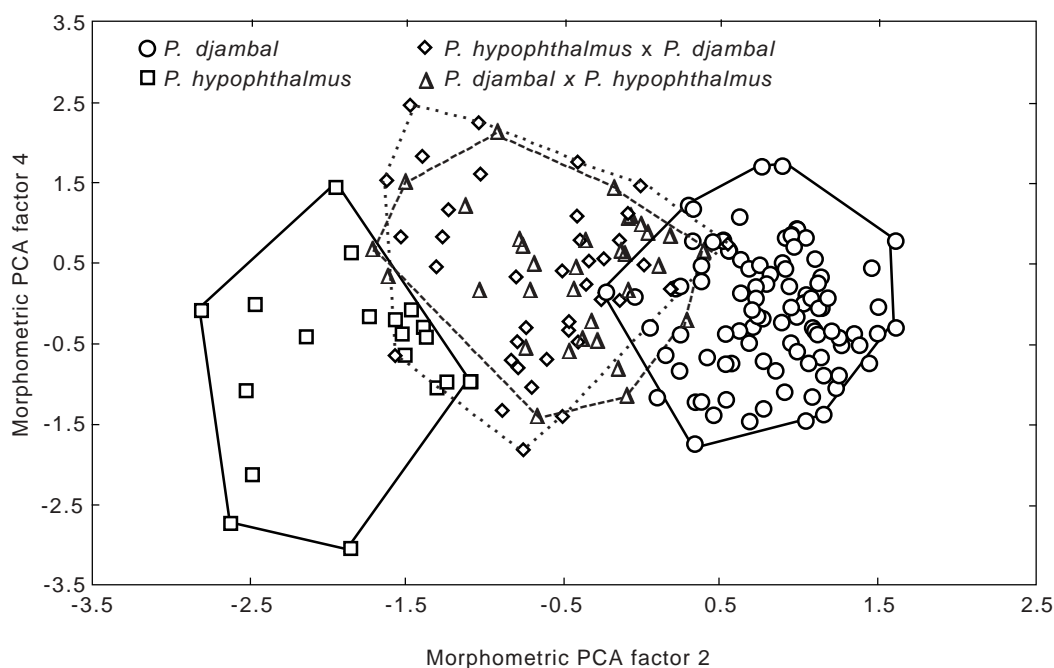
## RESULTS AND DISCUSSION

A principal component analysis performed on the 235 specimens using the covariance matrix for 30 measurements enable to separate *P. djambal*, *P. hypophthalmus*, and their hybrids. *Pangasius djambal* was located on the positive sector of factor 2, *P. hypophthalmus* was on the negative sector of factor 2, and their hybrids were in between parental species (Fig. 1).

Factor loading revealed that the second component of principal component analyses (PCA) was defined by vomerine length, palatine width, mandibular barbel length, palatine length, post-ocular length, anal fin length, maxillary barbel length, caudal peduncle depth, and anal fin height (in decreasing order of importance). Further analysis showed that *P.*

*djambal* differs from *P. hypophthalmus* by having a longer vomerine length, i.e. 3.8-14% head length (HL) vs 0.6-2.5% HL, and a larger palatine width (1.9-8.8% HL vs 0.7-1.8% HL). While on hybrids, those two characters were intermediate, i.e. 1.2-9.4% HL for vomerine length and 1.2-4% HL for palatine width. Morphometric analysis of the specimens demonstrated clearly the presence of two species as defined by Roberts and Vidthayanon (1991), Vidthayanon (1993), and Gustiano (2003), as well as hybrids in between of them. This intermediate shape of hybrids suggest that the products of present hybridization were "true" hybrids resulting from the fusions of both parents and not parthenogenesis as observed on general occasions in fish (Chevassus 1983).

The important characters revealed from PCA of parental species and reciprocal hybrids are listed on Table 1. Based on the morphometric data, even though the reciprocal hybrids have intermediate characters, in general their morphology was relatively *hypophthalmus*-like except the teeth (vomerine and palatine) that was relatively *djambal*-like. Plot of the second principal component (factor 2) referring to standard length (Fig. 2) supported this phenomenon in which the tendency of important character of hybrids was similar to that of *P. hypophthalmus*. Figure 2 also showed that the overlap between hybrids and parental species related to the size. For meristic observation, all of *P. djambal* have six pelvic



**Fig. 1.** Plot of the second principal component (factor 2) versus the fourth principal component (factor 4) taken from a principal component analysis (PCA) of 30 metric measurements on 235 specimens of *Pangasius djambal*, *Pangasianodon hypophthalmus*, and their reciprocal hybrids.

**Table 1. The important measured characters for specimens of *Pangasius djambal*, *Pangasianodon hypophthalmus*, and their reciprocal hybrids.**

Characters		<i>P. djambal</i>	<i>P. hypophthalmus</i>	<i>P. hypophthalmus</i> x <i>P. djambal</i>	<i>P. djambal</i> x <i>P. hypophthalmus</i>
Standard length (%)					
Caudal peduncle depth	N	114	30	43	45
	Mean	8.18	8.64	9.00	9.32
	Min	6.70	7.40	7.67	8.22
	Max	10.60	9.50	10.05	11.77
	SD	0.59	0.53	0.53	0.65
Anal fin height	N	110	30	45	45
	Mean	13.09	14.86	15.03	13.80
	Min	9.82	11.99	11.24	9.93
	Max	18.89	18.25	17.66	16.24
	SD	1.28	1.39	1.16	1.30
Anal fin length	N	114	30	45	45
	Mean	27.53	31.53	32.14	29.96
	Min	23.78	29.07	27.00	22.27
	Max	39.27	34.18	34.37	32.91
	SD	1.80	1.45	1.51	1.86
Head length (%)					
Post-ocular length	N	112	29	45	45
	Mean	8.71	10.72	9.49	9.95
	Min	6.58	9.74	8.02	7.92
	Max	17.56	14.32	11.86	11.65
	SD	1.36	0.85	0.70	0.83
Maxillary barbel length	N	108	26	45	45
	Mean	56.23	38.79	47.70	49.56
	Min	31.81	21.95	24.76	21.10
	Max	88.32	57.16	63.05	67.44
	SD	6.60	10.61	8.65	13.03
Mandibular barbel length	N	109	25	45	42
	Mean	37.41	20.80	30.45	29.48
	Min	7.64	7.11	18.33	15.60
	Max	65.69	33.91	44.56	42.70
	SD	6.94	8.66	6.94	9.05
Vomerine length	N	113	27	45	45
	Mean	6.32	1.40	2.48	2.89
	Min	3.79	0.61	1.22	1.46
	Max	14.54	2.50	5.79	9.38
	SD	1.86	0.39	0.98	1.33
Palatine length	N	113	25	45	45
	Mean	13.33	7.81	9.24	9.70
	Min	8.29	5.25	6.06	7.20
	Max	16.97	10.87	13.14	13.61
	SD	1.62	1.51	1.66	1.59
Palatine width	N	112	25	45	45
	Mean	3.94	1.36	2.25	2.35
	Min	1.94	0.69	1.45	1.27
	Max	8.76	1.82	3.31	4.00
	SD	0.89	0.31	0.49	0.65

fin rays, while eight on *P. hypophthalmus*. Of the hybrids, more than 97% of *P. hypophthalmus* x *P. djambal* have seven pelvic fin rays. On the other side, the percentage was lower on the *P. djambal* x *P. hypophthalmus* where it was about 17% of the hybrids have 6 or 8 pelvic fin rays. It is also clearly

defined that the true hybrids appeared on the pelvic ray count. However, the case was contrary for gill raker number. The reciprocal hybrids have lower number than that of the parental species (Fig. 3). The only reason for the gill raker number was probably due to the recessive evidence.

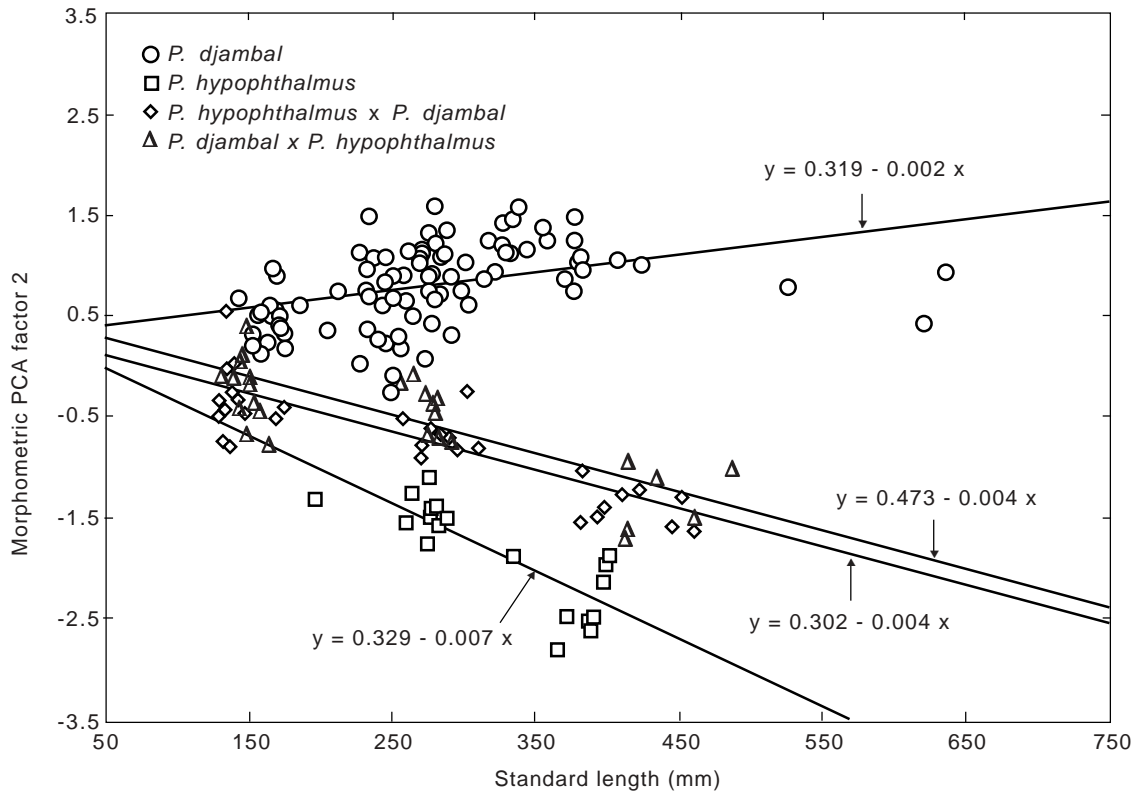


Fig. 2. Plot of the second principal component (factor 2) referring to standard length of 235 specimens of *Pangasius djambal*, *Pangasianodon hypophthalmus*, and their reciprocal hybrids.

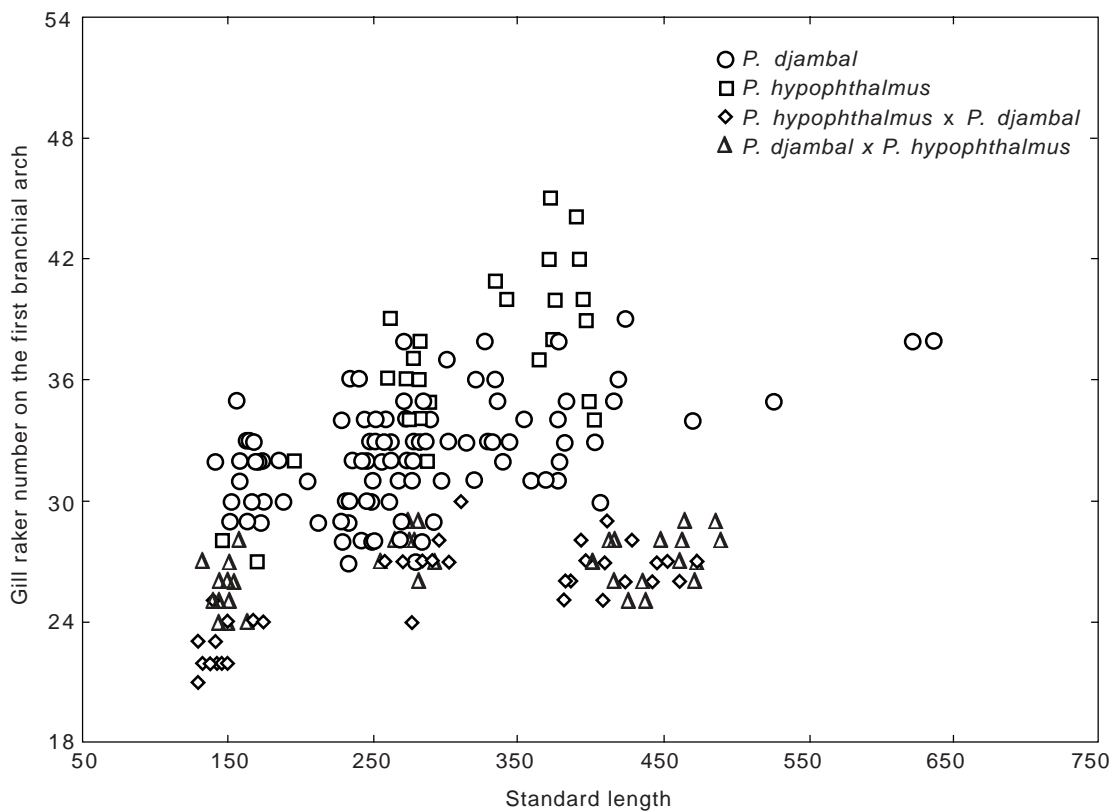


Fig. 3. Scatter plot showing the gill raker number on the first branchial arch referring to standard length for *Pangasius djambal*, *Pangasianodon hypophthalmus*, and their reciprocal hybrids.

Based on the result found in the present study, several characters enable to separate between the hybrids and parental species, especially for pelvic fin rays. The results are very useful in providing cheap and quick identification tool in field rather than other genetic analysis, such as enzymatic and DNA. Hence, the result can also be used as a model to analyse other intergeneric hybridization in which there is no concern too much about homozygosity. Most of intergeneric hybridization succeeded under artificial breeding, but in the future the study to observe the fertility of the hybrids is needed.

### CONCLUSION

The reciprocal hybrids of *Pangasius djambal* and *Pangasianodon hypophthalmus* have intermediate characters, except lower number of gill rakers than that of parental species. It is clearly defined that the true hybrids have seven pelvic fin rays.

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