

**Morphological Comparison of the Mekong
Giant Catfish, *Pangasianodon gigas*,
with Other Pangasiid Species**

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The Mekong giant catfish *Pangasianodon gigas*, known as "pla buk" in Thailand and "pa beuk" in Laos, occurs solely in the Mekong River and its major tributaries. As its English and vernacular names indicate (both "buk" and "beuk" mean colossal), this fish is known for its huge size, attaining a length of at least 2.5 m and a weight of 250 kg (Smith, 1945; Pookaswan, 1969). Specimens usually captured from the Mekong are 1.5 to 2 m long (Pookaswan, 1969) and 135 to 200 kg in weight (Davidson, 1975). The population of the species in the Mekong has declined seriously in the past several decades (Serrene, 1951; Davidson, 1975), and its international trade is controlled by the Convention on International Trade in Endangered Species of Wild Fauna and Flora.

In the original description of *Pangasianodon gigas*, Chevey (1930) proposed the genus *Pangasianodon* for this species, distinguishing it from the closely related genus *Pangasius* on the basis of the absence of mandibular barbels and teeth in the jaws and on the palate. This generic separation based on characters which might be subject to age variations led Smith (1945) and other workers to harbour doubts about the validity of the genus *Pangasianodon*. Examination of these characters in young *Pangasianodon gigas* has therefore been awaited for long, but no small specimens referable to this species had been captured from the wild till recently.

In 1981, the Thai Department of Fisheries started a program on the artificial propagation of *Pangasianodon gigas* using wild adults from the Mekong. The first success was achieved in 1983, and the fish has been successfully bred every year except in 1986. Using specimens thus obtained, Meenakarn (1984) examined morphological characters and growth of juvenile *Pangasianodon gigas* and indicated that, while the juveniles differed from those of *Pangasius sutchi* in the shape of caudal fin and growth rate, they were very similar in possessing palate teeth and mandibular

barbels as well as in gross morphology. However, she did not touch upon the generic status of *Pangasianodon gigas*.

The purpose of this study is to examine the relationship between *Pangasianodon gigas* and other pangasiid species on the basis of external and internal characters of juvenile specimens.

Material and methods

The specimens of *Pangasianodon gigas* used in this study were all derived from captive propagation by the National Inland Fisheries Institute (NIFI), Thailand, in May 1984 using mature adults from the Mekong River. Some of the specimens were sent to Japan in a preserved state with permission from the governmental offices of Thailand and Japan concerned with the Convention on International Trade in Endangered Species of Wild Fauna and Flora. These specimens are deposited in the Ligong Laboratory of Ichthyology, Akasaka Imperial Palace (LILI), Tokyo. Other specimens were examined at NIFI. In the following list of specimens, the catalogue no., number of specimens, and standard length (SL) are indicated.

LILI 84001, 1, 58.0 mm SL; LILI 84002, 12, 54.0–151.7 mm SL (all cleared and stained); LILI 86010, 1, 450.0 mm SL, Maejo Fisheries Station, Chiangmai, Thailand; uncatalogued, 11, 20.7–385.0 mm SL (examined at NIFI).

The following species and specimens of the Pangasiidae (sensu Nelson, 1976) were examined for morphological comparison. *Pangasius beani* Smith: LILI 70009, 13 specimens, 47.0–83.2 mm SL, collected from the Mekong River at the mouth of the Houei Mong River, near Tha Bo, Thailand, July 15, 1970 (two cleared and stained). *Pangasius sutchi* Fowler: LILI 71001, 1, 124.5 mm SL, Mekong River, Thailand, Feb. 11, 1971; LILI 74007, 2, 63.5–75.0 mm SL, Mekong River at Than Chau, Vietnam, Oct. 14, 1974 (two cleared and stained). *Pangasius sanitwongsei* Smith: LILI 86007, 1, 110.0 mm SL, Mekong River, Thailand, Aug. 1986 (cleared and stained). *Pangasius larnaudii* Bocourt: LILI 86004, 1, 145.5 mm SL, Mekong River, Thailand, Aug. 22, 1986 (cleared and stained). *Pangasius nasutus* (Bleeker): LILI 74001, 2, 128.4–140.5 mm SL, Bassac River at Cai Rang, Vietnam, Mar. 4, 1974 (one cleared and stained). *Pangasius siamensis* Steindachner: LILI 76003, 1, 114.5 mm SL, Mekong River, Nong Khai Province, Thailand, Oct. 1976 (cleared and stained). *Helicophagus waandersii*

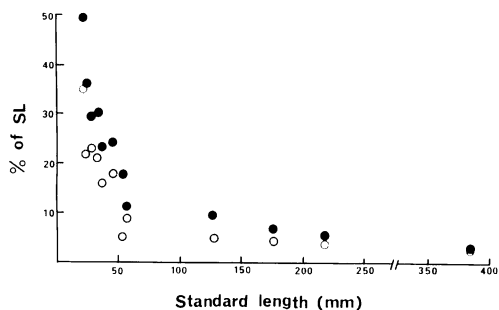


Fig. 1. Measurements of maxillary and mandibular barbels in percent of standard length in juvenile *Pangasianodon gigas*. Solid circle: maxillary barbel; open circle: mandibular barbel.

Bleeker: LILI 70006, 1, 127.8 mm SL, Nam Ngum River at Tha Ngom, Laos, June 17, 1970 (cleared and stained). *Pteropangasius cultratus* (Smith): LILI 76002, 1, 171.0 mm SL, Mekong River at Nong Khai, Thailand, Oct. 1976 (cleared and stained); LILI 64001, 3, 155.0–189.5 mm SL, Treychviet Khada, Phnom Penh, Cambodia, Dec. 28, 1964 (one cleared and stained).

Osteological observations were made on specimens stained with arizalin red S or with alcian blue and arizalin red S. Measurements were made with a dial caliper read to the nearest 0.1 mm.

Morphological observations

Barbels: Species of the genus *Pangasius* have a pair of maxillary and a pair of mandibular barbels.

In the diagnosis of the genus *Pangasianodon*, Chevey (1930) defined the genus as having only one pair of maxillary barbels. But he suspected the existence of mandibular barbels in juveniles that might have been obscured by the enormous fatty layer that developed on the jaw. Meenakarn (1984) observed both maxillary and mandibular barbels, though minute, in adult, as well as in juvenile, *Pangasianodon gigas*. According to her observation, the maxillary barbels in three-month-old juveniles were 1.33 and 1.04 times as long as the eye diameter, re-

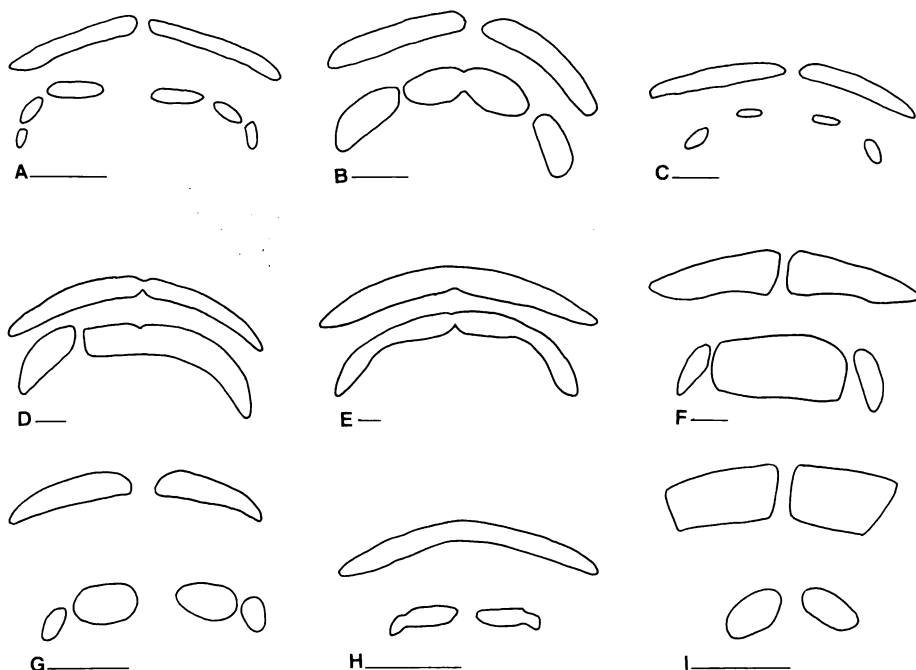


Fig. 2. Shape and arrangement of upper jaw and palate teeth in *Pangasianodon gigas* and other pangasiid species. A, *Pangasianodon gigas*, 187.6 mm SL; B, *Pangasius beani*; C, *Pangasius sutchi*; D, *Pangasius sanitwongsei*; E, *Pangasius larnaudii*; F, *Pangasius nasutus*; G, *Pangasius siamensis*; H, *Pteropangasius cultratus*; I, *Helicophagus waandersii*. Scale bar: 2 mm.

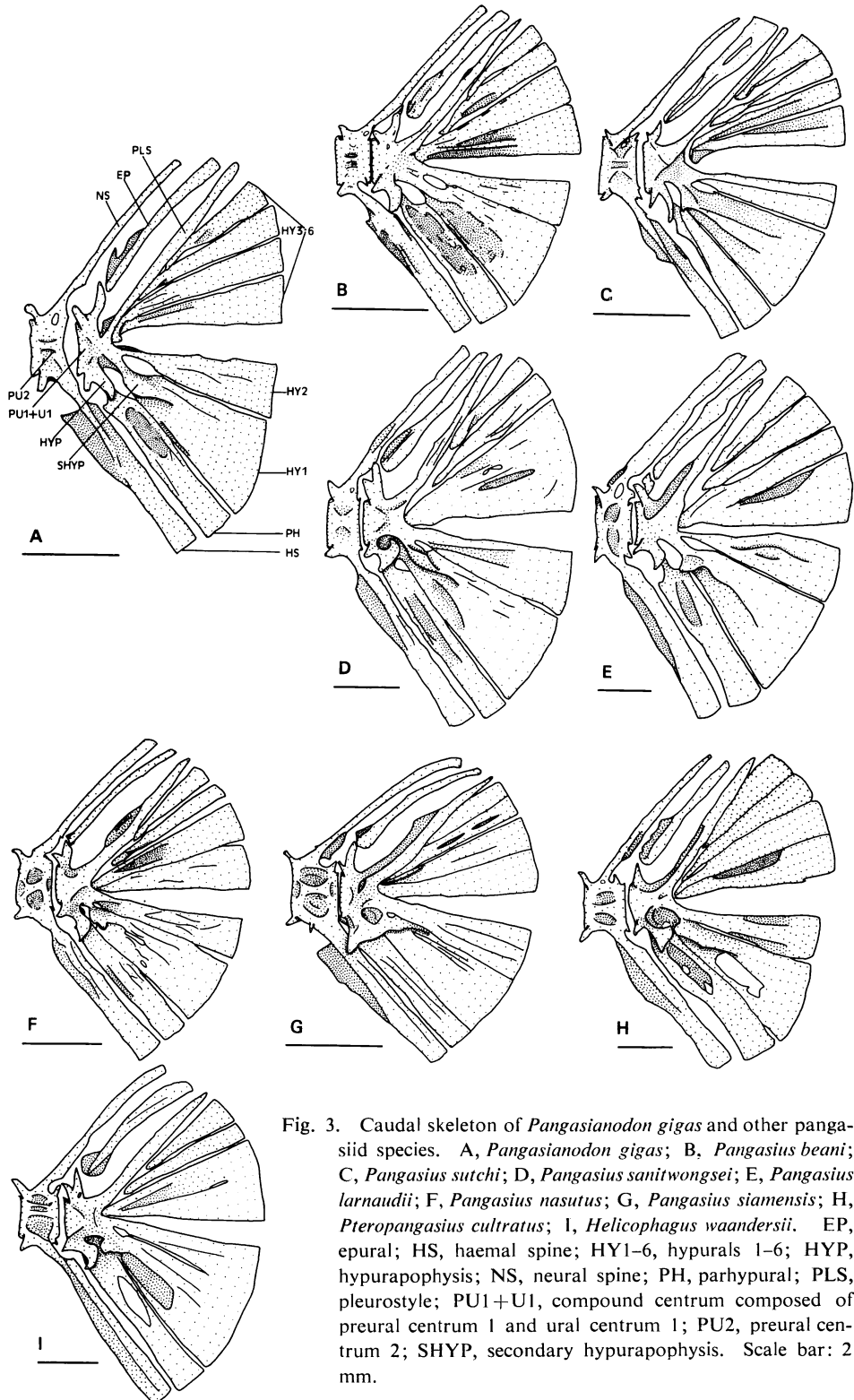


Fig. 3. Caudal skeleton of *Pangasianodon gigas* and other pangasiid species. A, *Pangasianodon gigas*; B, *Pangasius beani*; C, *Pangasius sutchi*; D, *Pangasius sanitwongsei*; E, *Pangasius larnaudii*; F, *Pangasius nasutus*; G, *Pangasius siamensis*; H, *Pteropangasius cultratus*; I, *Helicophagus waandersii*. EP, epural; HS, haemal spine; HY1-6, hypurals 1-6; HYP, hypurapophysis; NS, neural spine; PH, parhypural; PLS, pleurostyle; PU1+U1, compound centrum composed of preural centrum 1 and ural centrum 1; PU2, preural centrum 2; SHYP, secondary hypurapophysis. Scale bar: 2 mm.

spectively. In adults the maxillary barbels were less than 0.5 eye diameter and the mandibular barbels were shorter than the maxillary barbels.

In all the specimens examined in this study, both maxillary and mandibular barbels are present. In the smallest 20.7 mm SL specimen, maxillary and mandibular barbels are well developed, their length reaching 48.8% and 34.8% of SL, respectively. The length of both barbels tends to increase only slightly or decrease, and hence the relative length decreases as SL increases (Fig. 1). Maxillary barbels are always slightly longer than mandibular barbels.

Level of eyes: In juvenile *Pangasianodon gigas* up to 151.7 mm SL, the eyes are not situated below the level of the mouth angle as indicated by Chevey (1930), but the position of the eyes is much higher, as in *Pangasius* species. However, in the largest specimen observed in this study, 450.0 mm SL, the centre of the eyes is well below the level of the mouth angle. Lowering of the eye level with growth has already been reported by Meenakarn (1984).

Teeth: Teeth are totally lacking in adult *Pangasianodon gigas* larger than 2 m in length (Chevey, 1930; Smith, 1945). However, Meenakarn (1984) confirmed the presence of teeth both in the jaws and on the palate in juveniles. She stated that the tooth bands of juvenile *Pangasianodon gigas* resembled those of juvenile *Pangasius sutchi*, but that the teeth were smaller and their tips were blunter in *Pangasianodon gigas*.

In a specimen of 62.7 mm SL examined in this study, teeth are present in the upper and lower jaws and on the vomer, and on either posterior tip of the vomerine bands there are one or two teeth bands which are not borne by the vomer but free in connective tissues. These free bands of teeth, which have been termed palatine teeth by Smith (1945), are referred to as vomerine extensions in this study. The teeth in all these parts are conical and arranged in narrow bands. The teeth on the vomer are arranged in two patches separated by a wide interspace; those on the left vomerine extensions are arranged usually in two patches and those on the right in one or two patches (Fig. 2A). A similar state of the shape and arrangement of teeth is seen in specimens up to 141.4 mm SL. Teeth in the jaws, on the vomer and in the vomerine extensions can be seen in specimens up to 212.0 mm

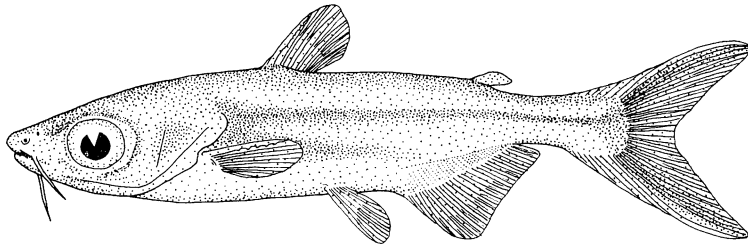
SL. In a 217.0 mm SL specimen, jaw and palate teeth are hardly discernible. In a 385.0 mm SL specimen, teeth are entirely absent.

In other species presently examined, all the *Pangasius* species and *Pteropangasius cultratus* share the fundamental features of juvenile *Pangasianodon gigas* in having teeth in the jaws, and on the vomer and in vomerine extensions. Vomerine extensions are absent in *Helicophagus waandersii* (Fig. 2).

Caudal skeleton: In all the genera examined in this study, the caudal complex consists of a urostylar element composed of preural centrum 1, ural centrum 1 and the pleurostyle (cf. Monod, 1967, 1968), neural and haemal spines of the preural centrum 2, the epural, hypurals 1–6, and the parhypural. The parhypural and hypurals 1 and 2 are fused with the urostyle, but the four upper hypural elements, hypurals 3–6, are not fused with the pleurostyle. In *Helicophagus waandersii*, hypurals 1 and 2 and hypurals 3 and 4 are partially fused together. The parhypural and hypurals are separated from each other in all other species examined in this study. Sato (1980) reported the occurrence of individual variations within each species in the state of fusion of these bones.

There is a well-developed projection at the base of the parhypural and a ridge-like or shelf-like projection on hypural 1 or hypurals 1 and 2. These projections are called hypurapophysis and secondary hypurapophysis, respectively (cf. Lundberg and Baskin, 1969). While the shape of the hypurapophysis is similar in all the species presently examined, the secondary hypurapophysis varies among species in the degree of development, and can be classified into the following three types.

In *Pangasianodon gigas*, *Pangasius beani*, *Pangasius sutchi*, *Pangasius sanitwongsei* and *Pangasius larnaudii*, the secondary hypurapophysis is less developed and there is a wide space between the hypurapophysis and secondary hypurapophysis (type A; Fig. 3A–E). In *Pangasius nasutus*, *Helicophagus waandersii* and *Pteropangasius cultratus*, the secondary hypurapophysis is much more projected, its tip extending nearly to the hypurapophysis, leaving only a narrow space between the two projections (type B; Fig. 3F, H, I). The two projections fuse distally in *Pangasius siamensis*, forming a long horizontal shelf ex-

Fig. 4. Juvenile *Pangasianodon gigas*, LILI 84001, 58.0 mm SL.

tending posteriorly to the hind border of hypural 1 (type C; Fig. 3G).

Relationships of *Pangasianodon gigas*

The characters of the nine species examined in this study are summarized in Table 1. Although all the *Pangasius* species examined, as well as *Pangasianodon gigas* and *Pteropangasius cultratus*, vary in the shape of the secondary hypurapophysis, they share in common all the other characters compared. In particular, *Pangasianodon gigas*, *Pangasius beani*, *Pangasius sutchi*, *Pangasius sanitwongsei*, and *Pangasius larnaudii* show close similarity in all the characters including the secondary hypurapophysis. In *Pangasianodon gigas*, teeth in the jaws, on the vomer and in the vomerine extensions are entirely absent in adults, but, according to the present observations, teeth are retained at least up to 217.0 mm SL. Likewise, the position of the eyes in *Pangasianodon gigas* is below the mouth angle in adults, but the eyes are

situated in a higher position in juveniles, as in *Pangasius* species. It is seen from the above that all the characters distinguishing *Pangasianodon* from other pangasiids are subject to age variations, and the juvenile features which are common to pangasiids are retained for a considerably long time in its ontogeny. All these facts point to a close relationship of *Pangasianodon gigas* to other pangasiid species.

However, other pangasiid genera examined in this study also show a close similarity to each other in the characters employed in this study: there is no difference in these characters between *Pteropangasius* and *Pangasius*; the only character distinguishing *Pteropangasius* from *Pangasius* is the cultrated abdomen; *Helicophagus* differs from *Pangasius* only in the absence of the vomerine extensions of teeth. In order to examine the taxonomic status of *Pangasianodon* and other genera, further detailed investigations are required.

Table 1. Morphological comparison of *Pangasianodon gigas* with eight other pangasiid species. For the types of the secondary hypurapophysis, see the text. +, present. *Become degenerated and finally disappear with growth.

Species name	Number of barbel pairs	Teeth		Type of secondary hypurapophysis
		Vomerine	Vomerine extensions	
<i>Pangasianodon gigas</i>	2	+*	+*	A
<i>Pangasius beani</i>	2	+	+	A
<i>P. sutchi</i>	2	+	+	A
<i>P. sanitwongsei</i>	2	+	+	A
<i>P. larnaudii</i>	2	+	+	A
<i>P. nasutus</i>	2	+	+	B
<i>P. siamensis</i>	2	+	+	C
<i>Pteropangasius cultratus</i>	2	+	+	B
<i>Helicophagus waandersii</i>	2	+	+	B

Pangasianodon gigas Chevey, 1930
(Fig. 4)

Pangasianodon gigas Chevey, 1930: 536 (original description, Mekong River); Smith, 1945: 372 (description, Mekong River, Thailand); Serrene, 1951: 6 (ecological notes, Mekong River, Laos); Pookaswan, 1969: 1 (description, ecological observations); Taki, 1974: 76 (description, Mekong River, Laos); Davidson, 1975: 66, 181 (ecology, Mekong River, Laos); Meenakarn, 1984: 1 (morphology and growth of captive-bred juveniles).

Diagnosis. D. II, 7 or rarely 8, the first spine minute and hardly discernible from outside; A. vi-vii, 25-27; P₁. I, 10-11; P₂. i, 6-8. Centre of eye above horizontal line through mouth angle in juveniles; eye totally below level of mouth angle in subadults and adults. A maxillary pair and a mandibular pair of barbels well developed in juveniles; mandibular barbels become rudimentary in subadults and adults. Teeth in jaws, on vomer and in vomerine extension in very narrow bands in juveniles, and disappear with growth.

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メコンオオナマズと他のパンガシウス科魚種との形態学的比較

禮宮文仁

パンガシウス科メコンオオナマズ *Pangasianodon gigas* は、両顎と口蓋の歯及び下顎のひげを欠き、眼が低位にあることによりパンガシウス属 *Pangasius* より分けられていた。しかし、メコンオオナマズの稚魚では、顎歯、口蓋歯と下顎のひげはよく発達し、眼も高位にあ

ることが確認された。さらに尾骨の形質では、ある種の *Pangasius* は同属の他種よりも、むしろメコンオオナマズと共通していた。これらの形態的共通性は、*Pangasianodon* が *Pangasius* と極めて近縁であることを示している。

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