



## Short communication

# Rare occurrences of *Dasyatis bennettii* (Chondrichthyes: Dasyatidae) in freshwaters of Southern China

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### Introduction

The genus *Dasyatis* (Dasyatidae, Myliobatiformes, Batoidea) comprises 40 valid species and at least five undescribed species worldwide (Compagno, 1999). Species biodiversity of *Dasyatis* is highest in the Western Pacific, consisting of at least one-third of the extant *Dasyatis* species (Nishida and Nakaya, 1990). *Dasyatis akajei* and *D. bennettii* are two species endemic to this area. The former occurs along the coast off the Gulf of Thailand, throughout the Pacific Coast of China, and extends to the sea near Southern Japan. The latter shares an overlapping range with *D. akajei* in the northwestern Pacific, reaching as far as the Indo-West Pacific in India. *D. akajei* can tolerate fluctuating salinities in estuaries, and *Dasyatis* has long been distributed in the freshwaters of China as *D. akajei* migrated from the Pearl River estuary (Wu et al., 1963; Zhu and Meng, 2001). *Dasyatis* has been treated as locally extinct in its main freshwater habitat since the mid-1960s due to heavy hydrological construction and illegal electric fishing in the Zuojiang River, one of the main branches flowing into the upper reach of the Pearl River (Fig. 1).

### Recent records

In September 2008, an adult male specimen (clasper length, 125 mm) was captured by line-and-hook in the Zuojiang River, near Pingxiang (22°5'60"N, 106°45'4"E) (Fig. 1, P). In October 2009, a mature female specimen carrying 14 eggs (22 mm max. diameter) was also found in Zuojiang River, Longzhou (22°23'34"N, 106°51'16"E) (Fig. 1, L). The two specimens were deposited in the ichthyology collection of the Institute of Zoology of the Chinese Academy of Science (♂, ASIZB 178780; ♀, ASIZB 178781). Morphometric measurements were taken following the method of Roberts and Karnasuta (1987) with a precision of 0.1 mm. The main characteristics are presented in Table 1, along with characteristics of *D. akajei*, marine *D. bennettii*, and two freshwater *Dasyatis* specimens that were donated to the Institute of Zoology. Measurements of five freshwater *Dasyatis* collected in Longzhou and Nanning are also included in Table 1 (Wu et al., 1963). For all of these data the total length has been plotted against disc length (Fig. 2). In addition to the morphometric data, DNA barcoding, a prompt and accurate

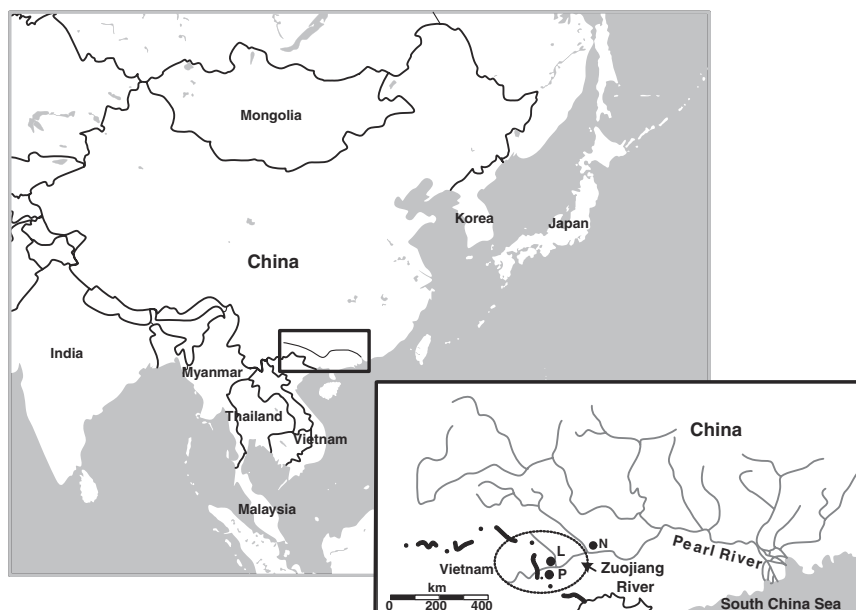


Fig. 1. Geographical distribution of freshwater *Dasyatis bennettii* in South China. = locations of present and previous records: L, Longzhou; N, Nanning; P, Pingxiang

\*These authors contributed equally to this work.

Table 1  
Morphological characteristics of the freshwater stingray *Dasyatis bennettii* along with corresponding values typical for marine *D. bennettii* and *D. akajei*

	<i>Dasyatis bennettii</i> (Freshwater)					<i>Dasyatis bennettii</i> (Marine)					<i>Dasyatis akajei</i>	
	Pingxiang Zuojiang River October 2008	Nanning Yongjiang River June 1974	Longzhou Zuojiang River October 1958	Nanning Yongjiang River November 1961	Coastal water off Zhoushan <sup>1</sup> , China November 2005	Coastal water off Xiamen, China October 2008	Coastal water off North Taiwan April 2009	Ariake Sound, southwest coast of Japan <sup>1</sup> August 2008	Coastal water off Xiamen, China October 2008	Sample size	Code	
Sample size	1	2	5	1	2	6	4	6	2	2		
Code	ASIZB 178780 <sup>2</sup> , 178781 (tissue only) <sup>2</sup>	ASIZB 65026 ASIZB 65027	L <sub>1</sub> -L <sub>5</sub>	N <sub>1</sub>	C05-1009 <sup>2</sup> C05-1003 <sup>2</sup>	ASIZB 178715 <sup>2</sup> , 178779 <sup>2</sup> ; 178802 <sup>2</sup> , 178808 <sup>2</sup> ; 178810-11	ASIZB 180045-46 <sup>2</sup> ASIZB 180049-50	NSMT-P 91848-53	ASIZB 178804-05 <sup>2</sup>			
Measurements (mm)												
Total length <sup>3</sup>	1114	394-729	950-1570	421	577-711	769.9-1253.9	388.9-538.7	294-843	520.9-627			
Disc length	392	126.9-254	290-545	118	180-200	254.8-453.5	124.1-146.2	111-371	225.5-238.4			
Disc width	413	123-249	330-610	142	201-224	273.9-451.9	133.4-162.1	123-420	231.5-258.1			
Preorbital length of snout	90.6	31.9-59.8	70-145	38	45.4-48.9	59.1-96.4	29.8-37.5	26.4-80.8	44.5-53.3			
Orbital diameter	13.6	5.7-9.7	16-28	12	6.6-7.8	8.8-13.2	5.6-7.3	6.3-14.2	7.1-8.5			
Interorbital width	57.0	18.6-32.3	43-87	16	33.4-38.7	37.8-71.9	18.2-21.5	25-76.5	32.4-36.4			
Tail length	768.2	280.2-500	620-955	285	426-535	577-964.2	275.1-411.2	196-512	334.9-424.5			
Head length	192.3	68.5-134.9	170-310	77	89.6-99.5	125.1-208.4	64.6-79.8	58.2-184.9	102.5-118.6			
Preoral length of snout	102.8	38.7-70.2	76-145	42	48.5-51.7	63.5-104.2	34-42.8	30.1-89.7	52.1-58.2			
Length from snout to first gill slit	135.6	49.7-93.0			62.1-69.1	84.9-140.3	45.1-56.2	41.9-125	67.5-79.4			
Width of mouth	41.4	14.3-29.1	34-71	18	17.4-18.5	24.4-40.6	12.4-15.2	13.7-46.3	20.4-26.5			
Body proportions												
Total length / disc length	2.84	2.87-3.10	2.88-3.55	3.57	3.21-3.56	2.76-3.17	2.87-3.80	2.27-2.77	2.31-2.63			
Disc length / disc width	0.95	1.02-1.03	0.84-0.89	0.83	0.89-0.90	0.92-1.00	0.89-0.96	0.88-0.90	0.92-0.97			
Tail length / disc width	1.86	2.01-2.28	1.57-2.16	2.01	2.12-2.39	1.88-2.17	2.02-2.58	1.22-1.72	1.45-1.64			

<sup>1</sup>Type localities.  
<sup>2</sup>Specimens used for DNA barcoding.  
<sup>3</sup>Total length taken only from intact individuals.

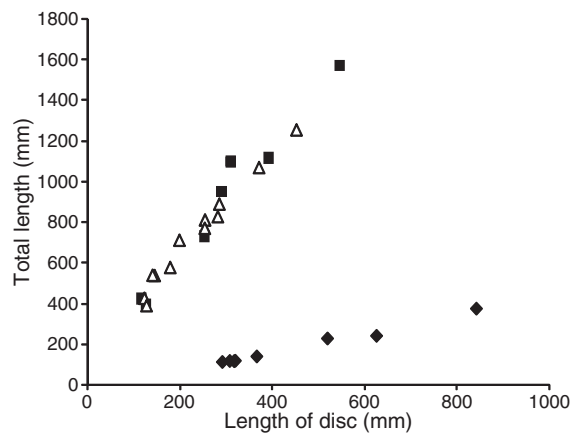


Fig. 2. Relationship between total length and disc length in freshwater *Dasyatis bennettii* (square), marine *D. bennettii* (triangle) and *D. akajei* (rhombus)

species identification system (Hebert et al., 2003), was also employed. Both morphological and molecular results prove that the freshwater *Dasyatis* distributed in China is *D. bennettii*, and not *D. akajei*, as originally thought. Across the 12 aligned 595 bp of cytochrome c oxidase subunit I (COI) gene sequences, the sequences of freshwater *Dasyatis* are identical to those of marine *D. bennettii* collected in the East China Sea and the South China Sea, but have a 4% K2P (Kimura's two-parameter model) distance compared to *D. akajei* in southwest Japan and China.

## Discussion

This discovery corroborated the first freshwater occurrences of *D. bennettii* in the world. The collection localities, Pingxiang and Longzhou, are quite distant from the Pearl River estuary, which is more than 1500 km distant.

According to the FAO species identification guide (Last and Compagno, 1999), distinguishing *D. bennettii* from *D. akajei* is not difficult when using key diagnostic features. The tail length of *D. bennettii* is usually more than twice the disc width when undamaged, while that of *D. akajei* is less than twice its disc width (1.22–1.72 times in the present study). Measurements taken for this study are consistent with the descriptions of all examined individuals, except for an individual of *D. bennettii*, which had the largest body size (L4, Table 1). *D. bennettii* shows significant specific characters that distinguish it from closely related species. These characters include the presence of tiny denticles in interorbital, mid-dorsal, and shoulder regions, as well as in the tail behind the sting origin; and the absence or extreme degeneration of the dorsal skin fold on the midline of the tail in both freshwater and marine *D. bennettii* individuals (Roberts and Karnasuta, 1987; Last and Compagno, 1999). Conversely, instead of the uniformly whitish undersurface of disc and pelvic fins in the marine variety, freshwater *D. bennettii* usually have orange, yellowish, or gray irregularly shaped blotches scattered on their undersurface. Likewise, the undersurface of disc and pelvic fins of *D. akajei* is whitish with a broad yellowish brown margin. This is possibly the main reason why freshwater *D. bennettii* was incorrectly assigned to *D. akajei* when color difference was used as a determining factor.

Juvenile individuals of freshwater *D. bennettii* with approximately 120 mm disc width were recorded as *D. akajei* in

previous collections (Wu et al., 1963). In addition, both mature male and female individuals were also caught during this study. Considering *Dasyatis* has a low dispersal capacity and may not swim across hydrological constructions in the Pearl River Basin, we profess that freshwater *D. bennettii* is sedentary rather than migratory, and suppose that the fish has become isolated in freshwater during the interglacial and glacial periods that frequently occurred in the South China Sea. Further sampling and population genetic analysis of *D. bennettii* are currently being carried out to test this hypothesis.

Most *Dasyatis* species are within the high to very high vulnerability category in fisheries (<http://filaman.ifm-geomar.de/summary/SpeciesSummary.php?id=15387>). However, *D. bennettii* has not yet been evaluated by the IUCN. This study underscores the urgent need for the conservation of the species, especially for its freshwater population. We strongly recommend that any commercial fishing for freshwater *D. bennettii* be discontinued immediately, and that a natural protected area be constructed in the Zuojiang River, South China.

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