

**A GIANT CROCODILE SKULL FROM CAN THO, NAMED “DAU SAU”,
REPRESENTS THE LARGEST KNOWN SALTWATER CROCODILE
(*Crocodylus porosus*) EVER REPORTED FROM VIETNAM**

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ABSTRACT

We report on a large crocodile skull recovered from a river bank in August 2010 near Dau Sau Bridge, in An Binh, Ninh Kieu District, Can Tho Province, in southern Vietnam. As the skull from Can Tho, named “Dau Sau” herein, is now deposited in the Vietnam National Museum of Nature, Ha Noi, we reinvestigated the circumstances surrounding its discovery and provide exact measurements. Skull length (dorsal mid-point) is 70.7 cm. The morphological features confirm it is from a Saltwater crocodile (*Crocodylus porosus*), and not a Siamese crocodile (*C. siamensis*), which historically also occurred throughout the Mekong Delta of Vietnam. Skull measurements are compared with those of other large *C. porosus* skulls for which reliable estimates of total length are available. We also provide measurements of the prepared skull of “Lolong” (69.8 cm), a 6.17 m long *C. porosus* captured in the Philippines in 2011. On the basis of known skull length:total length ratios the crocodile from Can Tho is estimated to be 6.3–6.8 m long. The skull of Dau Sau is likely to have been buried for at least 100 years. We discuss the origin of the local name Dau Sau, which has traditional and cultural significance, and provide historical reports of crocodiles in the area. Dau Sau is smaller than the largest known *C. porosus* skull (76 cm), but is the largest ever reported from Vietnam, and one of the largest *C. porosus* known.

Keywords: Crocodylidae, Mekong delta, morphology, size, “Lolong”, Philippines.

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INTRODUCTION

Extant crocodylian species show a wide range of maximum total lengths (TL), and the Saltwater crocodile (*Crocodylus porosus*) is considered one of the largest, with males exceeding 6 m TL. However, precise data on exceptionally large crocodile skulls and the individuals from which they were derived (TL, origin, date of acquisition) are usually incomplete (Fukuda et al., 2018).

Saltwater crocodiles have one of the widest geographic distributions of any crocodylian, ranging from eastern India, through Southeast Asia and the Pacific islands, to Australia in the south. In Vietnam, *C. porosus* is considered to have become extinct long ago, through overexploitation for food and skin, and extensive habitat degradation (Webb et al., 2010). The endemic Siamese crocodile (*C. siamensis*) had suffered a similar fate, but in 2001–2004 a reintroduced population was established in Cat Tien National Park (Polet 2002; Murphy et al., 2004). Few *C. porosus* are currently held within the 800+ crocodile farms in Vietnam, and hybridization between *C. porosus*, *C. siamensis* and the exotic Cuban crocodile (*C. rhombifer*) is likely within the captive population (Jelden 2008).

On 31 August 2010, a large crocodile skull was dug up during excavations at a river bank near Dau Sau Bridge (10°01'247''N; 105°75'377''E), in An Binh, Ninh Kieu District, Can Tho Province, in southern Vietnam. The skull was pulled out at 6 pm by Mr. Tran Van Ut.

Local newspapers reported the skull as being some 90 cm long, surpassing known size records for *C. porosus* (76 cm), and even the longest known recent crocodylian skull in existence (84 cm) - that of a Tomistoma (*Tomistoma schlegelii*) held in the British Museum of Natural History (Whitaker and Whitaker 2008). The articles also provided estimates of other attributes, such as age (100 years), length (5–6 m), and body weight (400 kg).

Here, we provide accurate measurements of the Can Tho skull, confirm its identity and derive estimates of the TL of the crocodile from which it came. The skull is now deposited in the Vietnam National Museum of Nature (VNMN) in Ha Noi.

MATERIALS AND METHODS

The crocodile skull from Can Tho was examined by T. Ziegler at VNMN and the following measurements (after Webb and Messel 1978) were taken using a metal measuring tape. Total skull length was measured to the nearest mm, and all other measurements to the nearest 0.5 cm.

1. Total skull length (TSL): Tip of snout to the median hind edge of the cranial platform. Due to damage to the left premaxillary bone, the “tip” was estimated.
2. Maximum skull width: Measured at the widest point.
3. Cranial platform width: Maximum width of the cranial platform.
4. Cranial platform midpoint width: Narrowest width of the cranial platform (where it is usually concave).
5. Snout-eye length: Tip of snout to anterior edge of orbit.
6. Snout length: Tip of snout to level of anterior edge of orbit, measured along midline of snout.
7. Interocular width: Narrowest distance between orbits.

For comparison, we included the measurements of the skull of ‘Lolong’ (see table 1), a giant Saltwater crocodile captured in 2011 from Magsagang Creek in Agusan Marsh, Agusan del Sur Province, in the southern Island of Mindanao, the Philippines. The skull is at the National Museum of the Philippines in Butuan City, Mindanao, and was examined and measured by R. Manalo.

RESULTS

The skull from Can Tho, named Dau Sau herein, is in relatively good condition, with the

only significant damage being the left premaxillary bone of the snout and the right pterygoid (Fig. 1). The two elongate ridges running from the orbits down the upper part of the snout are characteristic of *C. porosus*. In *C. siamensis* the squamosals form a pronounced bony ridge with another ridge (crest) that extends anteriorly between the orbits (Platt et

al., 2018). This feature is absent in the skull from Can Tho. In addition, the size of the skull is from a crocodile that well exceeds the TL of *C. siamensis*, with a maximum TL around 4.0 m (Platt et al., 2018). The skull measurements of Dau Sau are compared with other known large *C. porosus* skulls (table 1) for which reliable estimates of TL are available.

Table 1. Measurements (cm) of Dau Sau, the skull from Can Tho, relative to other large *Crocodylus porosus* skulls

	<i>Dau Sau</i> Ziegler et al., (this study)	<i>Old Charlie</i> Webb and Messel (1978)	<i>Dhamara</i> Kar (2006)	<i>Stuart</i> Manolis (2006)	<i>Lolong</i> (live specimen) Britton et al., (2012)	<i>Lolong</i> (skull) Ziegler et al., (this study)	<i>Edgar</i> Fukuda et al., (2018)	<i>Giryu</i> Fukuda et al., (2018)
Total Skull Length	70.7	66.6	68	72.8	-	69.8	70.1	70.6
Total Head Length	-	-	-	-	70.0	-	-	-
Maximum Skull Width	42.0	48.0	40	45.8	45.0	43.7	52.0	-
Cranial Platform Width	22.5	23.5	18	23.0	22.8	22.8	240	205
Cranial Platform Midpoint Width	19.0	18.9	15	19.4	-	-	-	-
Snout-eye Length	51.0	44.3	35	50.0	49.6	-	-	-
Snout Length	49.5	-	-	-	-	49.2	-	-
Interocular Width (cm)	8.0	7.5	8	7.1	8.4	8.3	8.0	6.7
Total Length	?	615	608	670	617	-	670	-

The year in which Dau Sau died and its remains were longed in sediments is unknown. Local residents indicated that crocodiles had not been seen in the region for decades, but the oldest residents (ca. 80 years old) reported anecdotes from their grandparents, about a very large crocodile occurring in that river historically. It is thus considered likely that the skull had been buried underground for over 100 years.

DISCUSSION

The name “Dau Sau” has many meanings in the local vernacular. In reference to a

locality, Dau Sau means “crocodile head”, and there exists a number of places named as such, including Dau Sau channel, Dau Sau estuary, or Dau Sau bridge. Traditional beliefs (e.g., Can Tho Online 2010) refer to Dau Sau as “a huge land mass inhabited by few people and where both sides of the river are deserted.” It is unknown from where the name “Dau Sau” actually originated, but there is a folk tale about an area of Cai Rang (formerly belonged to Can Tho), that had many crocodiles. According to the folklore, one day, during a traditional wedding ceremony involving boats on this river, a large crocodile

whipped its tail, flipped a boat, and took the bride away. The groom, anguished and furious, gathered many strong young people to capture the crocodile. After catching the crocodile, the groom cut it into pieces and threw them into the river to satisfy his anger. Wherever a piece of the crocodile was washed up, people named that part of the channel accordingly. The area where the skin was found was named *Cái Da* (skin), the area where the teeth were found was called *Cái Răng* (teeth), and the area where the head was found was called *Đầu Sấu* (crocodile head).



Figure 1. Dau Sau , the crocodile skull from Can Tho, with measuring tape from above (top) and below (bottom). Photo T. Ziegler

The man who discovered the crocodile skull did so when he was 86 years old. His family had worked as net fishermen at Dau Sau estuary for generations. His grandfather, who passed away in 1942, and his father, who passed away in 1965, told a story about a remote part of Dau Sau channel where big fish abounds, and where crocodiles “as large as

two men” are found. His story continues that in the early years of the 20th century, there was a group of *Chà* people who were famous for hunting crocodiles. They helped to spear and kill a crocodile “as large as a five-plank-boat” - longer than 6 meters - in the *Cái Răng* River. Therefore, after capturing the crocodile, everyone was cheerful, gathered around to divide up the meat. Mr. Ut also reported that up until around 1940 he still saw people butchering crocodiles upstream of the estuary. Crocodile meat was transported from Nam Vang and An Giang to Can Tho by boat (e.g., Can Tho Online 2010). At that point, this area had already been called Dau Sau estuary/Dau Sau channel. In area 1 (An Bình ward nowadays) there is still an ancient temple named *ông Vàm Dau Sau* [translated as sir Dau Sau estuary; people usually refer to big animals respectfully as *ông* (which means sir or grandfather)].



Figure 2. Two elongate ridges running from the orbits down the upper part of the snout are a characteristic of *C. porosus* and well discernible in Dau Sau, the crocodile skull from Can Tho. Photo T. Ziegler



Figure 3. Held by one of the authors (Nguyen Thien Tao), the huge dimension of Dau Sau becomes apparent. Photo T. Ziegler

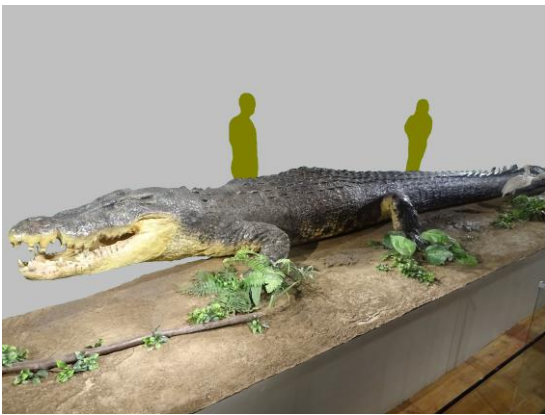


Figure 4. The Saltwater crocodile (*Crocodylus porosus*) Lolong (6.17 m TL) in the public exhibit of the National Museum of the Philippines in Manila; for size comparisons see egrets at the right and adult visitors standing behind and observing the giant crocodile. Photo T. Ziegler

The skull is totally consistent with *C. porosus*. The possibility that it is a hybrid

involving *C. rhombifer* can be rejected, because *C. rhombifer* were first imported in the 1980's. It also clearly predates crocodile farming in South-East Asia (from 1950's) and Vietnam specifically (1980's), where hybridization between *C. siamensis* and *C. porosus* is commonplace in captive animals. It seems unlikely that it could involve natural hybridisation in the wild with *C. siamensis*, but the possibility cannot be rejected as pending molecular analysis currently is underway.

Total length in *C. porosus* less than 5 m can be reliably estimated from head length (HL) alone, but the relationship between these attributes in large (> 5 m TL) *C. porosus* is more complex (Webb and Messel 1978). Fukuda et al. (2013) recommended a TL:HL ratio of 8.0 for > 5 m long *C. porosus*, and although this may be suitable for estimating size during population surveys, it does not take into account the variation that can occur among individuals. Definitive TL measurements are available for few large *C. porosus* skulls, but for five individuals reliable TL:HL ratios can be derived: 8.8 for Lolong (6.17 m); and, after adjusting for tissue loss (4%; Webb and Messel 1978) between HL and TSL, 9.2 for Old Charlie from Australia (6.15 m) and Edgar from Java, Indonesia (6.7 m), 8.8 for Stuart from Australia (6.7 m), and 8.5 for Dhamara from India (6.04 m) (table 1). On the basis of these size ratios, the crocodile from Can Tho is estimated to be 6.3–6.8 m long.

Although slightly smaller than the largest known *C. porosus* skull (76 cm), from an individual killed in the early 1800s in Cambodia, and now held in the Natural History Museum, Paris (Whitaker and Whitaker 2008), Dau Sau, the skull from Can Tho, with a length of 70.7 cm certainly represents the largest known *C. porosus* ever reported from Vietnam and one of the largest *C. porosus* skulls recorded from anywhere in the world.

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