
Recent distribution records of Estuarine crocodiles (*Crocodylus porosus*) in northern Sulawesi, Indonesia

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SULAWESI (formerly known as Celebes) is a large equatorial island in the Indonesian Archipelago situated between Borneo and the Maluku islands (Whitten *et al.*, 1987; Gillespie *et al.*, 2005). Its fauna is among the most distinctive in Indonesia with high levels of endemism across all vertebrate groups (Whitten *et al.*, 1987). Despite the biogeographical significance of Sulawesi, little is known about the distribution and biology of most reptiles inhabiting the island (Gillespie *et al.*, 2005), and this is particularly true with regards to crocodiles (Ross, 1986; Platt & Lee, 2000).

Although various authors (e.g., Schmidt, 1935; Groombridge, 1982; Ross, 1986; Sebastian, 1994) have suggested that as many as four species of crocodylians (*Crocodylus porosus*, *C. siamensis*, *Crocodylus* n. sp., *Tomistoma schlegelii*) might be found in Sulawesi, the Estuarine crocodile (*C. porosus*) is the only species definitely known to occur on the island (see review in Platt & Lee, 2000). Historic accounts suggest that *C. porosus* was formerly widespread and abundant on Sulawesi (Guillemard, 1889; Hickson, 1889; Whitten *et al.*, 1987). Indeed, *C. porosus* was once so common that many riverside villages were forced to construct waterfront stockades of tightly woven bamboo fences to protect villagers from crocodile attacks (Whitten *et al.*, 1987). However, decades of unrestricted skin hunting, collecting to stock crocodile farms, and habitat degradation have reduced *C. porosus* populations to scattered remnants (Groombridge, 1982; Whitten *et al.*,

1987; Cox, 1992; Platt & Lee, 2000). Although now regarded as rare and declining (Groombridge, 1982), field surveys have yet to be undertaken (Thorbjarnarson, 1992; Ross, 1998), and there is a notable paucity of information regarding the current distribution of *C. porosus* in Sulawesi (Platt & Lee, 2000).

In the most recent review, Platt & Lee (2000) noted that populations of *C. porosus* persist in the Sangihe Talud Islands where villagers refrain from killing crocodiles for religious reasons. Similarly, Cox (1992) suggested that substantial numbers of *C. porosus* may occur in the Ancona, Cerekan, and Parakayu rivers where crocodiles are locally protected as a totem animal. According to Whitten *et al.* (1987), Estuarine crocodiles inhabit an extensive (ca. 31,400 ha) peat swamp comprising the northern portion of the Rawa Aopa-Watumohae National Park (Whitten *et al.*, 1987). Platt & Lee (2000) examined a number of crocodiles captured near Gorontalo and Kotamobagu, but could not determine their specific provenance, and Gillespie *et al.* (2005) found *C. porosus* in mangrove swamps on Buton Island in southeastern Sulawesi. Herein we report additional distribution records for *C. porosus* from Sulawesi, and comment on the conservation status of these populations. Our distribution records were opportunistically collected during a recent survey of endemic chelonians in northern Sulawesi (Platt, 2006).

We documented the occurrence of *C. porosus* at three localities in northern Sulawesi (Figure 1);

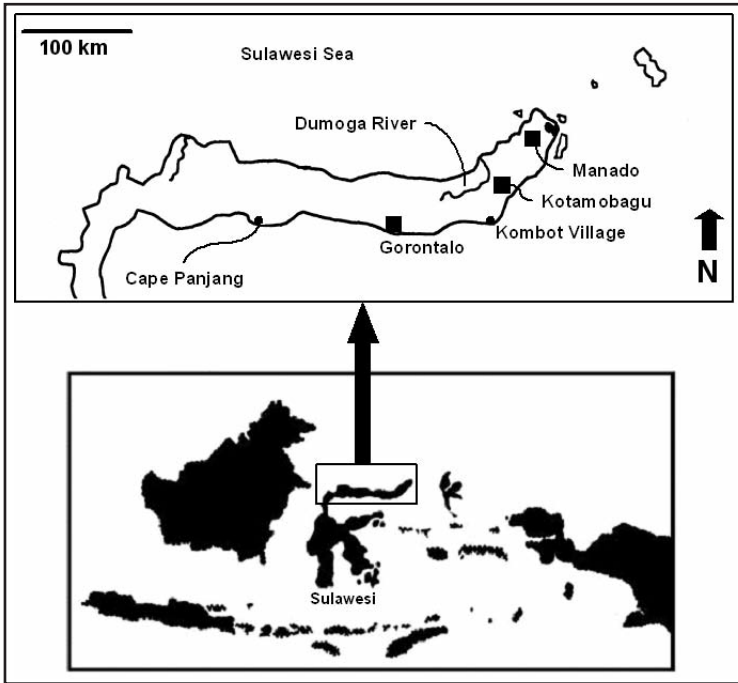


Figure 1. Map of northern Sulawesi, Indonesia showing localities where estuarine crocodiles (*Crocodylus porosus*) were found during July 2006. Dark squares indicate major population centres.

these include two coastal sites (Cape Panjang and Kombat Village), and an inland river (Dumoga River). Notably, all of the crocodiles that we examined lacked post-occipital scutellation (Figure 2), a character consistent with the description of *C. porosus* (Brazaitis, 1973; Ross, 1990). This is significant because others have observed crocodiles in Sulawesi that exhibited prominent post-occipital scutellation (Cox, 1992; Platt & Lee, 2000); these have been variously identified as *C. siamensis*, *C. novaeguineae*, *C. raninus*, or a hitherto undescribed taxa (Ross, 1990; Cox, 1992; Platt & Lee, 2000), but their taxonomic status currently remains unresolved. Regardless, these observations strongly suggest that at least one additional species of crocodylian besides *C. porosus* occurs in Sulawesi.

While interviewing residents of a roadside hamlet near Wonggarasi Village (00°31.16'N; 121°45.67'E) on 15th July 2006, we were shown an adult *C. porosus* measuring approximately 230 cm in total length (TL) being held in a make-shift pen. The crocodile was reportedly captured in a

coastal mangrove swamp on Cape Panjang, a short distance from the village. According to area residents, crocodiles remain common in these swamps where they are regarded as a nuisance by local fishermen. However, we noted that an extensive area of coastal habitat on Cape Panjang has already been converted to prawn culture and additional land-clearing is underway, casting doubt on the long-term viability of this population.

On 27th July 2006, we examined two hatchling *C. porosus* (TL = 34.0 cm) that were captured by farmers on the outskirts of Kombat Village (00°23.81'N; 124°09.36'E). We later accompanied villagers to the capture site (00°24.31'N; 124°08.30'E), a

flooded rice field adjacent to an extensive freshwater coastal swamp characterized by dense, monotypic stands of high grass (*Saccharum* sp.). Farmers stated that hatchlings and small juvenile crocodiles are encountered every year in rice fields near the swamps, indicating that local population recruitment is occurring; large adults are occasionally encountered as well. Similar herbaceous swamps are important nesting habitat for *C. porosus* in northern Australia (Webb *et al.*, 1983). The extensive and largely inaccessible grass swamps near Kombat probably function as an important local refuge for crocodiles. Moreover, human population density in this coastal area is low and the relatively high wages people receive from local timber extraction and processing enterprises provide little incentive for commercial exploitation of wildlife (Platt, 2006). Thus, crocodile populations in this area appear to be under minimal threat and relatively secure at the moment.

Finally, we examined two captive adult female *C. porosus* (TL ca. 180 and 210 cm) at a fish farm in Tambun Village (00°35.31'N; 124°07.13'E) on 25th July 2006. These crocodiles were captured in late December 2004 while nesting along the Dumoga River, approximately 30–40 km upstream



Figure 2. Female Estuarine crocodile (*Crocodylus porosus*) photographed in Tambun Village, northern Sulawesi, Indonesia. This crocodile was captured by villagers at a nest along the Dumoga River in late December 2004. Note the absence of post-occipital scutellation. Photograph © Iwan Hunowu.

from the river mouth. The two nests contained 40 and 52 eggs, although it was unclear which female was associated with the larger clutch. Although the nesting ecology of *C. porosus* has not been well-studied outside of northern Australia, these values for clutch size are within the range reported by others (Deraniyagala, 1939; Neill, 1971; Webb *et al.*, 1977; Hollands, 1987; Thorbjarnarson *et al.*, 2006). Hunters captured the crocodiles by placing snares along well-worn trails leading from the nests to the river.

On 29th July 2006, we accompanied villagers to the nest site where the larger clutch was found. The nest was constructed in a bamboo thicket on a low ridge approximately 30 m from the river, which at this point flows swiftly through a rocky channel. Other than a narrow strip of riparian vegetation where the nest was constructed, the surrounding habitat is largely fallow agricultural fields and coconut plantations. Additionally, villagers reported capturing two adult crocodiles

(ca. 250 to 300 cm) while electro-fishing in the Dumoga River; these animals were held briefly in hopes of establishing a crocodile farm, but escaped during a flood in early July 2006. While MacKinnon (1981) suggested that *C. porosus* occurred in the Dumoga River based on ‘unsubstantiated reports from villagers’, our observations constitute the first verified records from this region. Collectively these data suggest that the Dumoga River harbors a significant number of crocodiles; however, given the density of human settlement and conversion of wetlands to agriculture in the river valley (Goodland, 1988), we regard the viability of this population as questionable.

In conclusion, our records and those of others (reviewed by Platt & Lee, 2000) indicate *C. porosus* continues to occur at scattered localities in northern Sulawesi, although the long-term viability of many of these populations must be regarded as tenuous. While commercial skin hunting and trade in live crocodiles now appears minimal (Lee *et al.*, 2005; J. Tasirin, unpubl. data), populations are undoubtedly threatened by the continued loss of coastal wetland habitats. Furthermore, our records highlight the need for an island-wide crocodile survey in Sulawesi. Particular attention should be devoted to rivers, swamps, and wetlands in the mountainous and relatively undisturbed interior of the island, and the large freshwater lakes where an as yet undescribed species of *Crocodylus* is thought to occur (Schmidt, 1935). Such a survey is essential for conservation planning and management, and will also hopefully resolve the taxonomic confusion that currently surrounds the crocodylians of Sulawesi.

ACKNOWLEDGEMENTS

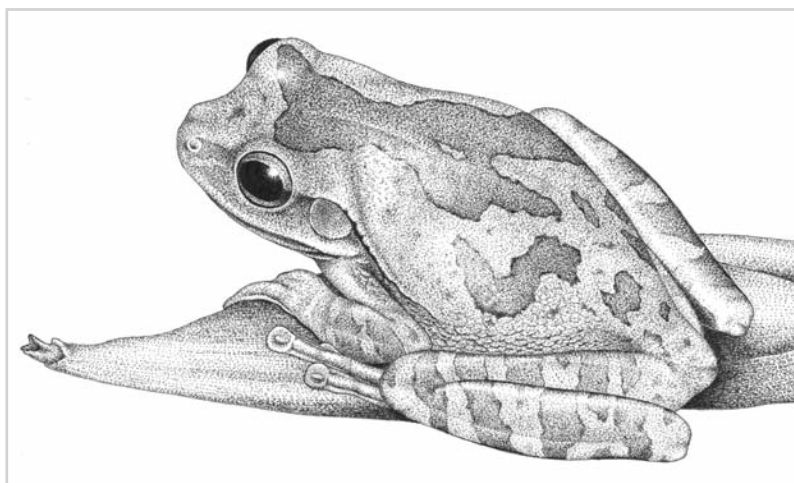
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Smilisca baudini (Mexican treefrog) on bract of *Heliconia* sp., Cayo District, Belize. Pen and ink illustration by P. Stafford.