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Misconceptions about the taxonomy and distribution of *Caiman crocodilus chiapasius* and *C. crocodilus fuscus* (Reptilia: Crocodylia: Alligatoridae)

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Four subspecies are currently recognized for the Spectacled Caiman, *Caiman crocodilus* (Linnaeus 1758): *Caiman crocodilus fuscus* (Cope 1868: *Perosuchus fuscus*), described from a single specimen from the Magdalena River, Colombia; *C. c. chiapasius* (Bocourt 1876: *Alligator chiapasius*), described from the Tonalá Valley, Chiapas, México; *C. c. apaporiensis* (Medem 1955) from the upper Apaporis River, Colombia; and, *C. c. crocodilus* (Linnaeus 1758: *Lacerta crocodilus*), named for the species originally described (Smith & Smith 1977; Busack & Pandya 2001). *Caiman yacare* was previously considered to be a fifth subspecies (i.e., *C. c. yacare*), but it is now generally accepted that it is a full species (King & Burke 1989), and is no longer treated as a subspecies (Velasco & Ayarzagüena 2010). There is some confusion about the current distributions of *C. c. chiapasius* and *C. c. fuscus*, and although some works have attempted to clarify this situation (Busack & Pandya 2001), the confusion still remains (i.e., Rueda-Almonacid *et al.* 2007; Velasco & Ayarzagüena 2010). Here, we present a brief review of the taxonomic status of caiman subspecies, and its implications for their distributions.

When Bocourt (1876) described *C. c. chiapasius* he only made comparisons with material ascribed to *C. c. crocodilus* and *C. c. yacare* (now *C. yacare*), and suggested that *C. c. chiapasius* be recognized as a different species (Smith & Smith 1977). Apparently, Bocourt (1876) did not examine the only specimen ascribed to *C. c. fuscus* that was deposited in the Academy of Natural Sciences of Philadelphia (ANSP 9720). On the basis of Bocourt's (1876) superficial description of *C. c. chiapasius*, it has therefore been considered as a synonym of *C. c. fuscus* (Boulenger 1889; Schmidt 1928).

In the mid-twentieth century, Medem (1981) reviewed the paratypes of the two subspecies of *Caiman crocodilus*, using additional specimens from Colombia, Ecuador, Venezuela and Panama. He observed differences in cranial shape, coloration and scalation; suggesting that *C. c. chiapasius* could occur in Pacific lowlands of Colombia, specifically in the Chocó region (Medem 1962). Subsequently, Medem (1983) reviewed another specimen from Ecuador, which was determined to be *C. c. chiapasius*, and stated that *C. c. chiapasius* occurred from México, through Central America, in both versant Pacific and Caribbean Central America, to the Pacific lowlands of Colombia and Ecuador.

More recently, Busack & Pandya (2001) examined the morphological variation in *C. crocodilus* subspecies across the complete distributional range, and found insufficient morphological evidence to support the split of *C. crocodilus* into subspecies (*C. c. apaporiensis* was not included in the analysis). However, we suggest that their results could be skewed by three aspects: (i) first, Busack & Pandya (2001) used scalation characters (scalation, cranial measurements and coloration) to differentiate the subspecies, but these were do not exhibit in a regular pattern to distinguish among populations (i.e., Platt *et al.* 2008; García-Grajales *et al.* 2009); (ii) second, the low sample size of *C. c. fuscus* (n= 8); and, (iii) the original assignation of each specimen to the taxonomic categories (museum collections). The taxonomic assignation *a priori* based on distribution source (i.e., using locality data) has problems to correctly assigning specimens to any subspecies due to the difficulty of determining accurate distributional limits (Venegas-Anaya *et al.* 2008). Using a different analyses (covariance, principal component and discriminate function), Busack & Pandya (2001) observed that the percentage of specimens assigned to each subspecies varied considerably and suggested that some *C. crocodilus* subspecies were incorrectly recognized. The lack of morphological variation found in *C. crocodilus* through its distributional range does not allow the accurate recognition of subspecies. However, DNA analysis should help us to recognize subspecies and accurately delimit geographic distributions within *C. crocodilus* (Busack & Pandya 2001; Vasconcelos *et al.* 2006; Rueda-Almonacid *et al.* 2007).

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Recently, mtDNA analysis was used to evaluate the evolutionary history of *C. crocodilus* across its distributional range (Venegas-Anaya *et al.* 2008). These results confirmed a divergent lineage between Mesoamerican (*C. c. chiapasius* and *C. c. fuscus*) and South American caimans (*C. c. crocodilus* and *C. yacare*). Also, these results suggested that *C. c. chiapasius* should be considered as a valid subspecies and not a synonym of *C. c. fuscus*. The estimated divergence time between *C. c. chiapasius* and *C. c. fuscus* was between 2.5 and 2.9 mya, corresponding with the closure of the Pacific-Caribbean seaway. Based on Venegas-Anaya *et al.*'s (2008) DNA analysis, *C. c. chiapasius* ranges from the border-states of Oaxaca and Chiapas, Mexico, to El Salvador (Fig. 1), while *C. c. fuscus* is present from Honduran Caribbean and from Pacific and Caribbean of Nicaragua to the Pacific lowlands of Colombia and Ecuador extending in Venezuela to the Yaracuy River (Fig. 1). This brief review supported the notion that there had been an error in the interpretation of the distribution of caiman subspecies, although Medem (1962, 1981, 1983) assigned correctly the specimens from parts of Central and South America to *Caiman crocodilus* based on their morphology, was incorrect in assigning them to *C.c. chiapasius*, which has remained largely unchanged to date (e.g., Rueda-Almonacid *et al.* 2007; Velasco & Ayarzagüena 2010).

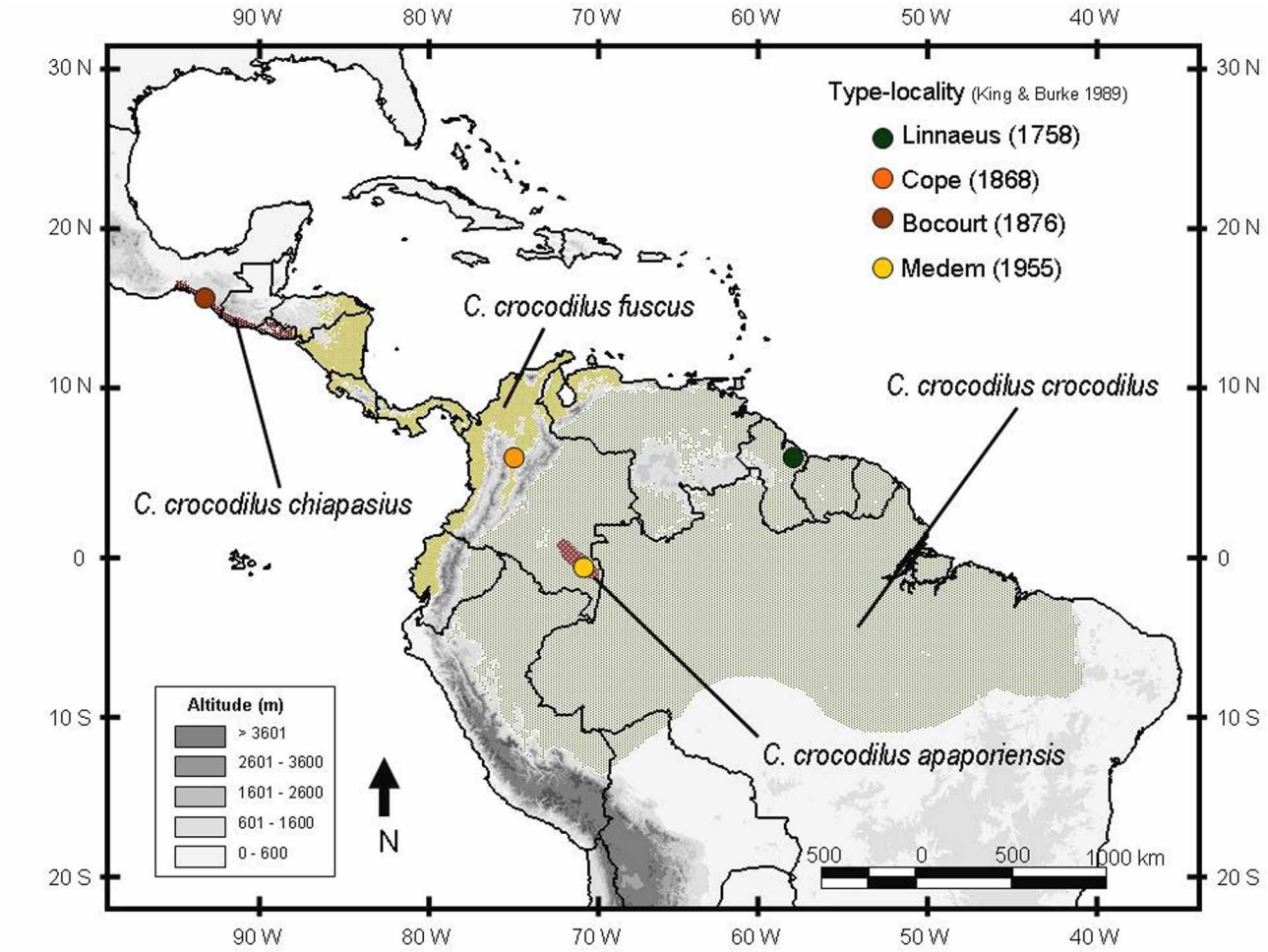

FIGURE 1. Distribution of *Caiman crocodilus* subspecies based on mtDNA analysis (*see*, Venegas-Anaya *et al.* 2008) and location of holotype. *Caiman crocodilus crocodilus* type-locality is unknown (King & Burke 1989), but Medem (1983) considered it to be the Demerara River, Guyana.

In summary, the mtDNA study of Venegas-Anaya *et al.* (2008) supported *C. crocodilus* subspecies taxonomy for *C. c. chiapasius*, *C. c. crocodilus* and *C. c. fuscus* (the taxonomic status of *C. c. apaporiensis* is pending), and clarifies the distributions of each to be clarified (fig. 1). However, an integrative taxonomic approach, using a combination of molecular and morphology data, would further improve our understanding of distribution and taxonomic status of the populations of *C. crocodilus* and its subspecies.

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