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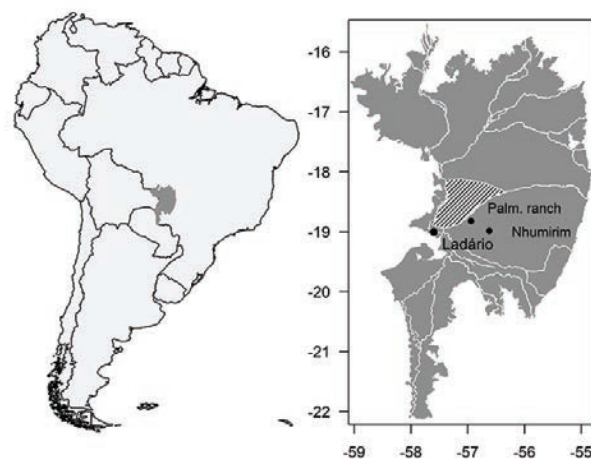


Figure 1. Location of the Pantanal wetland (right), Palmeirinha Ranch, Nhumirim (Embrapa's Field Station), and Ladário City, where measurements of the water level of the Paraguay River have been taken daily since 1900. The shaded area indicates the Taquari Fan, an area that flooded during most part of each year during the last decades.

DROUGHT DRASTICALLY REDUCES SUITABLE HABITAT FOR YACARE CAIMAN. The Pantanal wetlands is a Neotropical floodplain of about 165,000 km² area located in the middle of South America (Fig. 1). It is regulated by an annual flood pulse, with dry (April-September) and wet (October-March) periods (Junk and Da Silva 2000; Junk and Cunha 20005), which favors populations of aquatic and

semiaquatic species such as the Yacare caiman (*Caiman yacare*). Besides the annual flood pulse, the Pantanal is also subject to a largely unpredictable multiyear variation in flood intensity. For example, from 1964 to 1974 there was an unusually long dry period, in which the level of the Paraguay River stayed well below its historic mean level. However, for the next four decades its water level tended to be at high or average levels during the floods (Fig. 2).

Since the mid-1970s, the Yacare caiman, with its early reproduction capability and fast-growth rate, took advantage of the expansion and diversification of permanent or semi-permanent aquatic habitats in the Pantanal to rapidly become one of the most abundant of the crocodylians (eg Coutinho and Campos 1996; Mourão *et al.* 2000). Such population density was impressive, especially since the species was intensively

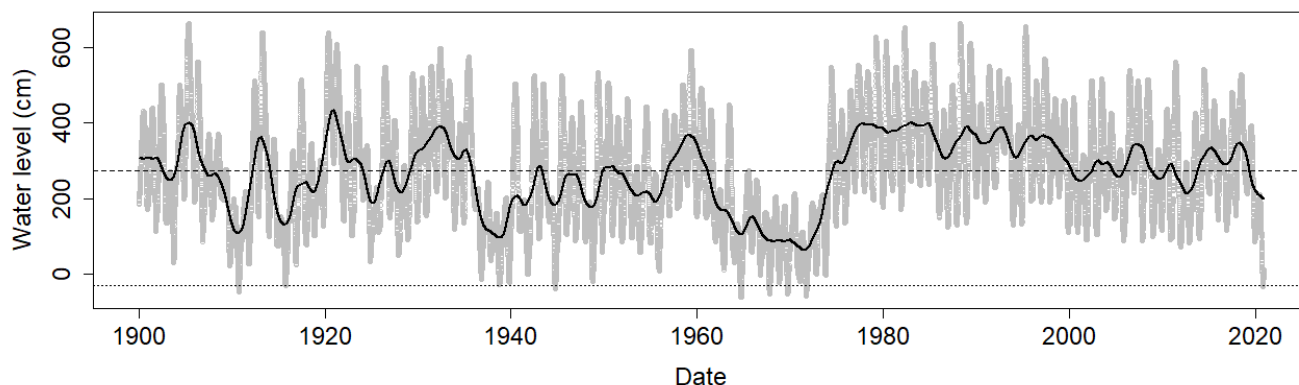


Figure 2. Daily water level (grey dots) of the Paraguay River, measured at the municipality of Ladário, MS, Brazil, from 1 January 1900 to 24 November 2020. The black line was obtained by a LOWESS smoother, which uses locally-weighted polynomial regression (Cleveland 1979). The dashed horizontal line indicates the historical water level average (272.5 cm) and the dotted line indicates the minimum value measured in November 2020 (-30 cm). Measurements of the Paraguay River level at Ladário are convenient to index the history of flood-pulse of the Pantanal, because the Paraguay River drains most of the water that flows through the tributaries and plains across the Pantanal and because it is by far the longest series of hydrological data available for the Pantanal.



Figure 3. Yacare caiman concentrated in ponds at Palmeirinha Ranch, November 2020.



Figure 4. Another pond “jammed” with cattle, caimans and capybaras, 2 km from the first ponds with many caimans on Palmeirinha Ranch, November 2020.



Figure 5. Yacare caiman at Palmeirinha Ranch, after water was supplied by a semi-artesian well, December 2020.

poached during the 1980s (Mourão *et al.* 1996). The poaching was largely controlled during the first years of the 1990s. However, we are now experiencing a drought comparable to the dry years from the mid-1960s to mid-1970s, and the effects on the Yacare caiman populations could be dramatic.

The reduction of water level in the Paraguay River was precipitous during the last two years (Fig. 2), but since 2006

rainfall was decreasing every year in the Pantanal, reducing the availability of water bodies (Araújo *et al.* 2018) suitable for caimans. The cumulative rainfall for the hydrologic year of 2019-2020 at Embrapa’s field station in the Pantanal was just 715 mm, well below from the historic mean of 1077 mm. The yacare caiman has some behavioral responses to periods of water scarcity (Campos and Mourão 2020), including aestivation in mud for several months or seeking refuge within forest patches, and sheltering under the litter, to avoid desiccation.

However, rainfall in 2019 and 2020 was extremely low for those caimans living in habitats other than perennial rivers. At Embrapa’s Field Station (Nhumirim), which is far from the rivers and where flooding is caused by local rain, most of the almost 100 shallow lakes that used to be “perennial” and were habitat for thousands of Yacare caiman a few decades ago, became dry or almost dry during the dry season from the mid-1990s to now (Mourão *et al.* 2013). At this site, increased caiman mortality and emigration, and reduction in the number of nests were processes diluted in time (Mourão *et al.* 2013; Campos *et al.* 2015). However, in sites located close to the intricate net of channels that form the Taquari River fan, the water only became limiting during the dry period of this year. For example, Palmerinha Ranch (18°49’29.40” S 56°56’25.11” W) used to have a large part of its area of one 100 km² flooded year-round. However, on 20 November, 2020, we found about 4000 Yacare caimans crowded in the mud of a waterhole made for cattle (Fig. 3).

Of the 8 waterholes originally on Palmeirinha Ranch, only two still have mud or a few centimetres of water (Fig. 4), and probably even the cattle will suffer from lack of water. It seems that most or all of the caiman in the mud will, if heavy rains do not start soon. Some of them could find refuge in the forest, within the litter or underground holes, but there they will be more exposed to fire, that has increased severely in the last two years (Einhorn *et al.* 2020).

At the time we are writing this note we learned that the owner of the ranch managed to drill a semi-artesian well to supply water to that waterhole (Fig. 5). Of course, we feel relieved with this news, but we do not know how effective this will be to reduce caiman mortality. There are probably hundreds of mud puddles like that one with crowded with caimans spread over the Pantanal. Therefore, we must realize that action was meritorious, but unlikely to be followed for other ranchowners. We know that the Pantanal suffered from severe and long droughts in the past, and Yacare caiman, as well as other semi-aquatic species such as giant otters and capybaras, survived somehow to re-expand their distribution when conditions became favorable. What is new and worrying is the expectation that climate changes will push the conditions to levels beyond the capacity of adaptation for many species.

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Europe

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REPATRIATION OF PHILIPPINE CROCODILES FROM COLOGNE ZOO TO THE PHILIPPINES. The Philippine crocodile (*Crocodylus mindorensis*) is endemic to the Philippines, and the wild population is considered to comprise around 100 individuals, making it one of the rarest crocodilians in the world. Its status means that it is listed as Critically Endangered by both Department of Environment and Natural Resources (DENR) (DAO 2019-09) and the International Union for Conservation of Nature (IUCN), and listed in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The CSG has recommended *ex-situ* management, (eg conservation breeding in zoos) as an action to improve the status of the species in the wild.

International captive breeding programs have been executed under Memoranda of Agreement by the Philippine Government under DENR with the zoos in the USA, Australia, and Europe. In Europe, 15 hatchling *C. mindorensis* were transferred in 2006 from the DENR-Palawan Wildlife Rescue & Conservation Center (PWRCC) based on a Memorandum of Agreement between DENR, Protected Areas & Wildlife Bureau (PAWB; now Biodiversity Management Bureau), Government of the Philippines, and the Danish Crocodile Zoo. In 2009, 10 of the 15 hatchlings were transferred to other European zoos based on Wildlife Transfer Certificates issued by PAWB.

The first Philippine crocodile captive breeding program in Europe was officially initiated in April 2012, when the European Studbook (ESB) was established by the European Association of Zoos and Aquaria (EAZA), and administered by Cologne Zoo, Germany. The goal of the ESB was to build up a captive assurance/reserve colony in Europe for the critically endangered species.

Breeding first occurred at Cologne Zoo in July 2013, and further breeding successes occurred at Protivin Crocodile Zoo (Czech Republic), ZSL London Zoo (UK) and Krokodille Zoo (Denmark). Mainly due to these recent breeding successes, the number of *C. mindorensis* within the ESB has increased from the original 15 individuals to 52 individuals distributed among 12 institutions.

Genetic screening of the *C. mindorensis* held in Europe was undertaken in cooperation with Omaha's Henry Doorly Zoo (USA) and the Zoological Institute of the Technical University of Braunschweig (Germany) seven years ago. These and further tests conducted in 2015 were necessary,