

# Preliminary report for the management system of yacare caiman in the Pantanal: A proposal for future research and the development of a monitoring system for wild population subjected to nest harvests

MARCOS COUTINHO<sup>1</sup>, ZILCA CAMPOS<sup>1</sup>, IOLITA BAMPI<sup>2</sup>, FERNANDO DAL'AVA<sup>2</sup>

<sup>1</sup>CPAP/EMBRAPA, Laboratório de Vida Selvagem, Corumbá, MS 79320-900 and

<sup>2</sup>DEVIS/IBAMA, SAIN, Brasília, DF 70770-000, Brasil

Since the 1990s legal exploitation of natural populations of yacare caiman (*Caiman crocodilus yacare*) has been permitted in ranching systems where eggs are collected in the wild and subsequent hatchlings are raised in captivity for commercial purposes. We present an analysis of the yacare caiman management system in the Pantanal and suggest strategies to improve its efficiency so as to ensure that the main conservation goals are reached. We present also a proposal of a research project aiming at the development of a feasible monitoring system to be applied to the Pantanal conditions, in order to evaluate the effects of nest harvesting on yacare caiman population dynamics.

*A partir do princípio desta década tem sido permitida a exploração legal de populações naturais de caiman yacare (Caiman crocodilus yacare) no Pantanal, num sistema onde os ovos são coletados no ambiente natural e os jovens são criados em cativeiro*

*com propósitos comerciais. Neste trabalho apresentamos uma análise das informações existentes sobre este sistema de manejo e sugerimos estratégias para assegurar que os compromissos com a conservação do recurso sejam alcançados. Apresentamos uma*

*proposta de projeto de pesquisa para avaliar os efeitos da extração de ninhos sobre a dinâmica populacional do jacaré e discutimos alguns aspectos à nível de legislação, visando o aperfeiçoamento do sistema de manejo.*

**W**ildlife management programs may have an important role to play in sustainable land use as well as conservation politics, if economic values are attributed to native species and their respective habitats (1,2). How-

ever, we view these statements as an untested hypothesis that deserves further examination. One of the features of the extensive Pantanal floodplain is the abundance and diversity of wildlife species with known economic value. Yacare caiman is an example of a widely distributed species with potential for utilization (3).

There are different possibilities to manage wild population of yacare caiman in the Pantanal (4); these include: i) To harvest eggs and/or hatchlings in

the wild and raise them in captivity and ii) to harvest wild adults, preferentially males provided that the reproductive potential of the population is not affected. In any case management will be biologically sustained if the productivity of natural populations supports the level of harvest imposed over time. In order to quantify the productivity of wild populations and to establish optimum harvest levels it is necessary to develop efficient monitoring systems, to measure the impact of harvest on populations

Correspondence to: Marcos Coutinho, CPAP/EMBRAPA, Laboratório de Vida Selvagem, Caixa Postal 109, Corumbá, MS 79320-900, Brasil

and, as a prerequisite, to have basic knowledge on species ecology and life-history parameters (Figs. 1 and 2).

In this report we present an analysis of the yacare caiman management system in the Pantanal and suggest some strategies to improve its efficiency to ensure that the main conservation goals are reached. We also present a proposal of a research project aimed at the development of feasible monitoring methods to evaluate the impact of egg

harvests on wild populations of yacare caiman in the Pantanal.

### Preliminary diagnosis of the management system

Before 1967 there was no restriction on wildlife utilization in Brazil. Although there is little historical information on the extent of the activity and the role that it played as a mechanism of socio-economic development, it is well known that in the Pantanal the exploitation of wildlife for subsistence and commercial purposes was an important socioeconomic activity (5). In 1967 the legislation implemented by the Brazilian government prohibited almost all types of wildlife exploitation. There was, however, special permission for farming wildlife. The use of yacare caiman was consented in completely closed systems; the production was based on breeding adult male and females kept in captivity. In February 1990 a new act specific for yacare caiman was passed (Brazilian

Institute for the Environment and Natural Resources - IBAMA, act number 126), allowing the use of natural population in a ranching system where eggs can be collected in the wild and subsequent hatchlings raised in captivity for commercial purposes. According to Crawshaw (6), in the last decade there were more than 100 farms raising yacare caiman in the Pantanal, including those located at the floodplain and at adjacent areas of the upper Paraguay river basin. The number of farms has not changed since then. However, in the state of Mato Grosso there was a trend towards the organization of a cooperative system in which a number of farms merged to supply eggs to a combined raising facility, while in the state of South Mato Grosso no cooperatives were formed. We present here data on nest production and harvesting licenses of two cooperatives located in different subregions of the north Pantanal (Fig. 3), which are responsible for a large proportion of the total yacare caiman production in the Pantanal.



Figure 1. Nest of yacare caiman built in floating grass mats in the Brazilian Pantanal.



Figure 2. Adult yacare caiman in the Brazilian Pantanal.

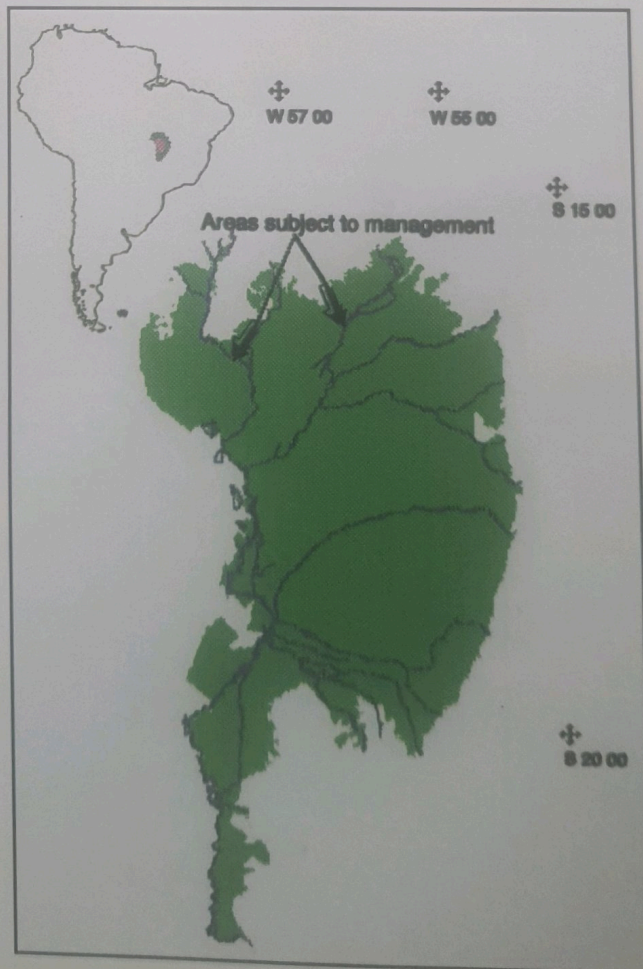


Figure 3. Map of the Brazilian Pantanal, showing the area subject to management of yacare caiman, where nests are harvested in the wild and hatchlings are raised in captivity.

**The TecnoCaiman cooperative**

TecnoCaiman is a group of 30 farms located in the subregion of Poconé with raising facilities in the city of Varzea Grande, state of Mato Grosso. Results presented here were obtained from 22 farms which were regularly monitored since 1991.

A general trend of decreasing nest density per farm as the areas of the farms increase (Fig. 4) was observed. This may be associated with a greater efficiency in the search for nests on smaller farms. However there was a large variability in density of nests on farms with areas < 10,000 ha, with some of these farms exhibiting extremely high numbers of nests (0.08 nest ha<sup>-1</sup>).

The density of nests estimated from farm surveys showed a significant increase ( $p < 0.01$ ) between 1991 and 1993 (Fig. 5A). Since nest harvest permits are allocated based on information provided by farmers, the same significant increase ( $p < 0.01$ ) was observed in the number of nests permitted to be harvested from 1992 to 1994 (Fig. 5B). The total number of nests found by farmers increased by 96% from 1991 to 1992 and, by 66% from 1992 to 1993. The total number of nests allowed to be harvested increased by 140% from 1992 to 1993 and, by 19% from 1993 to 1994 (Table 1). Reports of TecnoCaiman (7) show a mean clutch size of 26 eggs per nest and a mean egg survival of 95%. Using these data, TecnoCaiman would have raised almost 20,000 individuals in 1992, 47,000 in 1993

and 56,500 in 1994. This represents about 123,500 potential yacare caiman over three years. Since legislation determines that 10% of managed individuals should be returned to the wild, about 12,000 subadult yacare caiman would have been released. However, there has been no returning to the wild since it is a common agreement among specialists and authorities that released individuals might have a negative impact on natural populations and that the issue deserves further ecological studies.

Based on the results of the 1993 estimates of nest numbers, it was possible to make a first guess of the minimum size of the adult population at each farm (Table 2). Extrapolations were made considering the results of previous yacare caiman studies (8), which showed that adults comprised 50% of the total populations, of which 40% were female. The number of breeding females in a given year was related to environmental conditions especially the availability of aquatic habitats during the dry season that precedes the nesting period (9). Here we assume three scenarios in which all, half or one third of females breed. Extrapolations may be biased, however in this particular case they are of interest for future research since the relationship between population size and the number of breeding females is highly desired in population studies and management.

The area of the Poconé subregion is approximately 15,800,000 ha (10). Estimates of nest numbers were made in an area of about 224,697 ha, or 1.4% of the total. The mean density of nests in

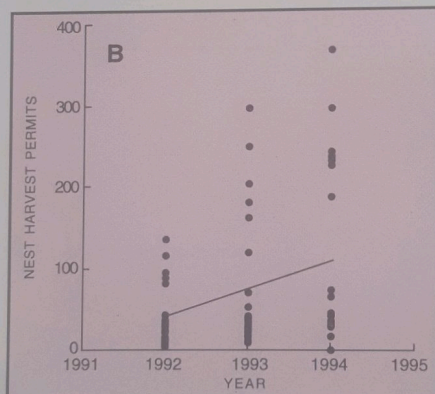
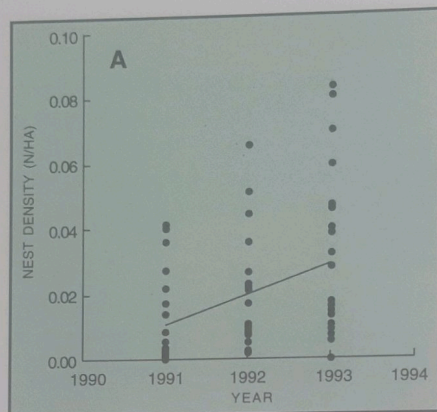


Figure 5. A. Estimated densities of nests (nest ha<sup>-1</sup>) and B. the number of harvest permits given to the TecnoCaiman cooperative from 1991 to 1994, Poconé subregion, Pantanal, Brazil.

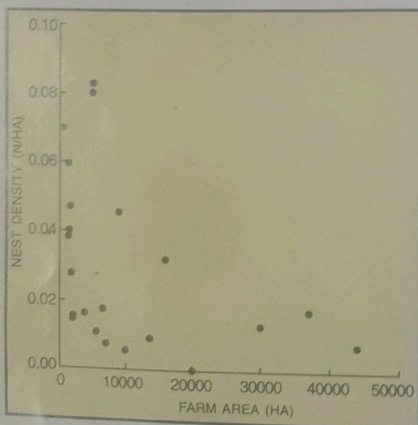


Figure 4. Estimated densities of nests (nest ha<sup>-1</sup>) in relation to the area of farms (ha), TecnoCaiman cooperative, Poconé subregion, Pantanal, Brazil.

Table 1 - Production of nests estimated by farms, and the harvest licenses given to 22 farms of TecnoCaiman cooperative from 1991 to 1994, Poconé subregion, north Pantanal, Brazil.

Year	Located nests	Licensed nests	Increase (%)
1991	1224	-	-
1992	2397	799	-
1993	3985	1916	140
1994	2793	2287	19

Table 2 - Estimates of minimum size of adult population of yacare caiman from farms of the TecnoCaiman cooperative, Poconé subregion, Pantanal. Calculations were based on 1993 nest production assuming three scenarios in which 100%, 50% and 30% of females breed, and that adults comprise 50% of the total population, of which 40% were females.

Farm	Minimum population size		
	100%	50%	30%
Porto Jofre	1600	2500	3500
Santa Ines	1300	2060	2800
São Jorge	1050	1680	2300
São V.B. Alto	1020	1600	2250
Ipoeira	1000	1600	2200
São S. Piquiri	1000	1600	2200
Santa Izabel	800	1300	1800
São V.R. Claro	300	500	700
Malhada	280	460	630
Capão Barreiro	200	300	450
Figuera Chata	190	300	410
Santa Lucia	150	250	330
São Benedito	150	240	330
Campo Largo	150	240	330
Ipiranga	130	200	280
São Bom Jesus	130	200	280
Barrinha	130	200	280
São Bento	130	200	280
Samambaia	80	130	180
Santa Cristina	80	130	180
Carvãozinho	70	120	160
S.C. Rio Novo	5	8	11

the 22 farms was 0.02 nest ha<sup>-1</sup>, meaning that a first guess on the total number of nests in the Poconé subregion could be of the order of 28,500 nests. The TecnoCaiman harvested 2,287 nests in 1994, which was 8% of the estimated total number of nests.

### The Coocrijapan cooperative

The farms within the Coocrijapan cooperative are located at the Cáceres subregion, northwest of the Pantanal and the raising facilities are located in the city of Cáceres, state of Mato Grosso (see Fig. 1).

In 1991, the cooperative consisted only of 2 farms; the number increased to 30 in 1992 and 1993 but dropped to 9 farms in 1994. As shown in Table 3, the number of harvested nests was always less than the number of nests permitted to be harvested. In 1994, the cooperative harvested only 14% of the total number permitted. Assuming a mean clutch size of 26 eggs per nest and 95% survival rate of eggs, the cooperative managed about 80,750 young yacare caiman in four years.

### The development of a monitoring system

A monitoring system to measure the impact of egg harvest on the wild population of *Caiman crocodilus yacare* needs to be developed because of the variability in nest production between years, habitats and subregions of the Pantanal. Within each habitat or subregion, it is also necessary to monitor control areas free of nest harvest management.

**Table 3** - Number of farms, number of given licenses, and number of nests harvested by the Coocrijapan cooperative from 1991 to 1994, Cáceres subregion, north Pantanal, Brazil.

Year	Number of farms	Number of nests	
		Permitted	Harvested
1991	02	200	141 (71%)
1992	30	2570	1465 (57%)
1993	30	3312	1160 (35%)
1994	09	3565	493 (14%)

Research for management purposes may be divided into four main activities:

1. *Qualitative and quantitative description of habitats*: Habitat studies should be made by interpretation of satellite images cross-checked with ground observations;

2. *Estimates of minimum population size of adults*: Absolute counts or indices of population size could be done by nighttime spotlight counts in conjunction with aerial surveys using ultralight and/or Cessna aircraft (3,11);

3. *Size-age structure and sexual ratios*: This is estimated using a random sample of individuals which are measured and sexed (8);

4. *Reproductive biology and behavior*: The main aspects of reproduction and behavior to be studied are the number and distribution of nests, the number of eggs per nest and its relation to female size, nest temperature and female attendance and care of nests (12,13).

Special attention should be given to the number, biometrics and survival of hatchlings during the dry season. Studies should be conducted using standard methodologies allowing comparisons of results obtained from different sites. Since farms and cooperatives have been collecting information on minimum nest numbers, it is necessary to evaluate their procedure, and if necessary, to suggest changes in order to achieve a standard methodology.

### Suggestions to improve the efficiency and quality of the management system

#### Legislation

Based on the existing knowledge on yacare caiman ecology it is desirable to suggest changes in some aspects of current legislation which would considerably improve the current management system. In the following we will highlight some of the points referred to in the IBAMA Act 126 which deserve further discussion and probably future modification.

With respect to the description of the managed area (Article 4b), charac-

terization and general description need to be made in quantitative terms, during the dry season, by describing the availability of water bodies, the main vegetation types/physiognomies, and current environmental impacts. This should be done by specialists using satellite image interpretation and ground observation. With respect to estimates of nest production (Article 4c), farmers need to follow a standard procedure to collect information. It is of critical importance to compare results obtained from different farms in distinct habitats and subregions. However, it is also important to institute a common procedure which is feasible, considering the different working conditions of farms within the Pantanal. With respect to the number of nests permitted to be harvested (Article 7), quotas are based on the nest numbers estimated by farmers in the preceding year. Nest production varies considerably between years because of changes in environmental conditions, particularly the availability of water during the dry period that precedes the breeding season. Depending on the amount of variation the number of nests permitted to be harvest may be seriously biased. This point deserves further analyses and discussions. As a suggestion, we propose that authorizations should be based on population parameters such as indices of adult population size, size structures, sex ratios and environmental characteristics, in particular availability of aquatic habitats during the dry season and nesting sites. This would be assessed by specialized personnel sponsored by the farmers. With respect to the percentage of the total number of nests allowed to be harvested (Article 9), a maximum of 60% of the total production would be permitted. Proportional release to the wild should be excluded, however IBAMA should have the authority to decide in which case releasing would be necessary.

### Establishment of a "Program for the conservation and management of yacare caiman in the Pantanal"

The management of exploited populations of yacare caiman should be devel-

oped on a sustained-yield basis. It therefore requires responsible participation of all people involved in the production system. To achieve this goal and the subsequent conservation purposes, it is important to establish an autonomous program with the responsibility to coordinate and orientate the management system. In brief, the functional structure of the program could be organized around three main aspects:

1) *Biological aspects*: Concerned with research, monitoring and transfer of knowledge and information among researchers, farmers and industry;

2) *Socioeconomic aspects*: Concerned with social and cultural benefits, market research and analyses of cost and benefit of the production system;

3) *Normative and fiscal aspects*: Responsible for the constant improvement of the legislation and fiscal procedures. ■

## References and notes

1. IUCN UNEP WWF 1980 *World conservation strategy. Living resources conservation for sustainable development*. Gland, IUCN
2. IUCN UNEP WWF 1991 *Caring for the earth. A strategy for sustainable living*. Gland, IUCN
3. Mourão GM, P Bayliss, ME Coutinho, C Abercrombie, A Arruda 1994 Test of an aerial survey for caiman and other wildlife in the Pantanal, Brazil. *Wild Soc Bull* 22: 50-56
4. Campos Z, GM Mourão, ME Coutinho 1993 Proposta de pesquisa e manejo para o Jacaré do Pantanal *Caiman crocodilus yacare* (Daudin, 1802). In *Memorias del IV Workshop sobre conservación y manejo del yacare "oveiro" (Caiman latirostris)*, p 58-64. 21-22 October 1993, Santa Fe, Argentina
5. Lourival R 1994 *Caça de subsistência no Pantanal, Brasil*. MSc Thesis, Instituto de Ciências Biológicas, Universidade Federal de Minas Gerais, MG
6. Crawshaw Jr PG 1987 *Nesting ecology of the Paraguayan Caiman (Caiman yacare) in the Pantanal of Mato Grosso, Brazil*. Msc Thesis, University of Florida, FL
7. Campos Z, GM Mourão, ME Coutinho, C Abercrombie 1995 Night-light counts, size structure, and sex ratio in wild population of caiman, *Caiman crocodilus yacare*, in the Pantanal, Brazil. *Vida Silv Neotrop* 4: 46-50
8. Borges GA, A Arruda Filho 1993 Avaliação do potencial de ninhos de *Caiman crocodilus yacare* numa sub-região do Pantanal de Poconé. In *Memorias de la I Reunion Regional del Grupo de Especialistas en Cocodrilos de la IUCN: I Taller sobre Zoocria de los Cocodylia*, p 55-117. 11-14 November 1991, Santa Marta, Colombia
9. Coutinho ME 1993 Aspectos reprodutivos do jacaré (*Caiman crocodilus yacare*) no Pantanal: O efeito do nível d'água na produção de ninhos. In *Memorias de la I Reunion Regional del Grupo de Especialistas en Cocodrilos de la IUCN: I Taller sobre Zoocria de los Cocodylia*, p 134. 11-14 November 1991, Santa Marta, Colombia
10. Adamoli J 1984 Fitogeografia do Pantanal. In *Simpósio sobre recursos naturais e socio-econômicos do Pantanal*, p 105-106. Corumbá, Brasil
11. Coutinho ME, Z Campos 1996 Effect of habitat and seasonality on the densities of caiman in southern Pantanal, Brazil. *J Trop Ecol* 12: 741-747
12. Campos Z 1993 Effect of habitat on survival of eggs and sex ratio of hatchlings of *Caiman crocodilus yacare* in the Pantanal. *J Herpetol* 27: 127-132
13. Campos Z, W Magnusson 1995 Relationships between rainfall, nesting habitat and fecundity of *Caiman crocodilus yacare* in the Pantanal, Brazil. *J Trop Ecol* 11: 353-358
14. *Acknowledgements*: We would like to thank people from the cooperatives, specially Anacleto Arruda from TecnoCaiman, for their contribution in providing data and helpful discussions. Peter Bayliss and Arnildo Pott made comments and suggestions that greatly helped in improving the manuscript, and Beto Pelegrim for helping with Figures. Special thanks are due to Conservation International and WWF-Brazil for their support in wildlife research in the Pantanal.

Received 29 November 1995

Accepted 29 August 1996

SP 15592

# Ciência e Cultura

JOURNAL OF THE BRAZILIAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

ISSN 0009-6725  
N. 1

VOLUME 50  
JANUARY/FEBRUARY 1998

Preliminary report for the ...  
1998

SP-PP-15592



Embrapa 35840-1

