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Storage of *Caiman latirostris* (Crocodylia: Alligatoridae) eggs in harvest containers: Effects on hatchability

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Abstract

In crocodilian ranching operations wild eggs are collected from the field, and delays between collection and transportation to incubators are usually minimized in the hope of maximizing embryo survival. In the ranching program for *Caiman latirostris* in Santa Fe, Argentina, gauchos do not collect eggs on the day nests are found, but rather on the day before the collectors arrive to pick them up and transport them to incubators. This is based on the untested assumption that the probability of increased mortality in the wild nests would be less than that likely to be encountered if eggs were collected on the day they were found and stored in the gaucho's house. This study tested whether storing the eggs in the houses for between 0 and 16 days, had any significant effect on hatching success. None could be demonstrated, suggesting that eggs should be collected when they are found, thereby avoiding risks of predation and flooding in the field prior to collection.

Keywords: Ranching; Broad-snouted caiman; Incubation; Hatching success

Flora and fauna sustainable use, based on economic benefits as stimuli for *in situ* conservation, has become the most realistic action for natural ecosystem conservation. Since 1990, Proyecto Yacaré (Min. Prod./ MUPCN) has been an example of wildlife sustainable use. The project harvests *Caiman latirostris* eggs involving many local inhabitants ('gauchos') as part of its harvesting structure (Larriera et al., 2005). This technique, the collection of eggs from natural populations to produce animals to be grown in captivity, is called ranching (Ross, 1999).

The project has resulted in the development of a series of research projects focusing on *C. latirostris*, including cytogenetic analyses (Amavet et al., 2002), egg incubation conditions (Donayo et al., 2002; Piña et al., 2005), determination of optimal growth parameters (Piña and Larriera, 2002), nest predation (Larriera and Piña, 2000), age of reproduction in the wild of reintroduced animals (Larriera et al., 2006), technique development for harvesting and transport of eggs (Larriera, 1991), nesting areas and harvesting period (Larriera, 1995), and temperature-dependent sex determination (Piña et al., 2003, 2007).

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Because the idea of the project is to involve gauchos in conservation, they receive a payment for every nest they harvest. At the beginning of the project, only Proyecto Yacaré members were allowed to collect the eggs, after the location of nests by the gauchos. After a few years of locating nests, we extended the technology to the gauchos on how to handle, collect, and transport the eggs to their houses in the field. During the harvest season, we arrived at gaucho's house the day after they harvested eggs from nests.

In order to make the field work more flexible, and allow the gauchos to harvest the eggs as soon as they find a nest, thus reducing losses due to depredation or flooding, we evaluated if hatching success is reduced when the eggs are kept in the container for longer time periods than one day.

1. Materials and methods

During the 2005–2006 harvesting season of *C. latirostris* eggs in Santa Fe, Argentina, we tested the effect of keeping eggs collected by gauchos within the harvesting containers (plastic tank of 20 L with a big opening that allows the introduction of eggs; Fig. 1) for different periods of time. We maintained 231 nests in the gaucho's house from 0 to 16 days, thus simulating commercial egg harvest conditions.

These time periods were selected based on the gauchos' schedules to collect eggs the day before our visit to the ranches, in order to transport the eggs to the artificial incubator as soon as possible. The collection of eggs is time-consuming and sometimes results in loss of nests due to predation or flooding (Larriera, 1995; Larriera and Piña, 2000); so evaluating if the eggs could be kept for a longer period of time within the containers would facilitate the field work and make for a safer transport of the eggs to the artificial incubator. To avoid confounding factors, we used nests with no signs of predation, flooding, or other factors that could reduce hatchability.

Fig. 1. Harvesting container used for *Caiman latirostris* eggs collection in Santa Fe ranching program. Within the container we use vegetate material from the natural nest (called nesting material) among every single layer of eggs, also in the bottom and top of the container.

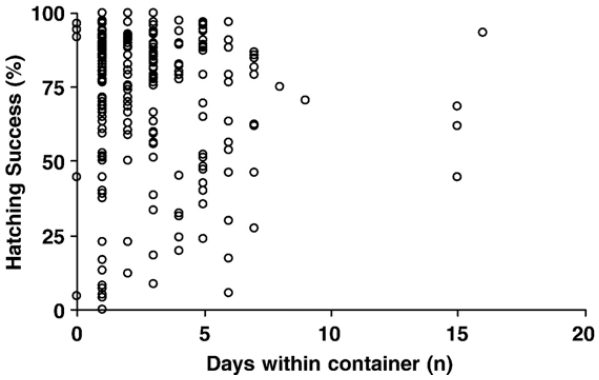

Fig. 2. Hatching success of *Caiman latirostris* nests (N=231) kept in harvesting container for different time periods.

Once collected, nests were kept in the gaucho's house, in the containers, for a specific period of time, and then transported to Santa Fe city and placed under artificial incubation until the time of hatching. During the time that the eggs are kept in the gaucho's house it is very important not to place the containers directly on the floor. The egg containers should be placed in an area where air can circulate around the container, in shade (not in direct sun light), and should be covered with sheep pelt (almost always available in gaucho's house) in order to avoid drastic temperature changes. Nest temperatures are also maintained by using vegetative nest material (from the same natural nest) to pack the eggs, in the bottom and in the top of the container and among every single layer of eggs, to help maintain constant temperatures, and to avoid eggs being damaged or rotated.

Once hatched, hatching success (HS) was calculated (# of hatchlings * # of egg^{-1} * 100), and the data were subjected to regression analysis, using time as independent variable and HS (%) as response variable.

2. Results

Average HS for the total data set (N=231 nests) was (mean ± S.E.) 73.4% ± 1.6% (range 0% to 100%). Only one nest, maintained one day in a gaucho's house, had 0% HS. On the other hand eleven nests produced 100% HS, but no nest kept in a container more than four days exhibited 100% HS. We found no effect of the time within the containers on HS (F_{229}=1.71; P=0.192; Fig. 2). Data variation was higher for nests that stayed

shorter periods of time than for those with more than eight days (Fig. 2).

3. Discussion

In this experiment, we showed that harvested eggs of *C. latirostris* (Broad-snouted caiman) could be kept for more than one week (up to two weeks was the longest) within the containers before they arrived to the commercial incubator without reducing HS.

It was reported that HS of wild harvested eggs in the American alligator (*Alligator mississippiensis*) could be as high as 76–81% (Chabreck, 1978; Joanen and McNease, 1984); our HS was 73.4%±1.6%. However, we did not discard any eggs in order to calculate HS, whereas most of the other studies report incubation success (# of hatchlings* # of fertile eggs^{-1}), because they exclude infertile or damaged eggs from the equation (Joanen and McNease, 1979).

Compliance of recommendations mentioned in the introduction, while keeping containers in gaucho's house, is crucial for maintaining live embryos. Locating containers in direct sunlight would result in overheating the eggs, thus reducing HS. Incubation over 34 °C causes embryo damage, as reported by Piña et al. (2003). On the other hand, containers placed directly on the floor, or not covered with sheep pelt, could produce a drop in the temperature at night, which also produces egg loss. Crocodilians eggs will not hatch when incubated at, or below, 28 °C (review in Deeming, 2004). Air circulation prevents O_2 supply of the developing embryo from being depleted since each container could house up to 120 eggs. As previously noted, vegetative nest material is an excellent packaging material for the eggs. It helps to maintain temperature, avoid egg damage or rotation, allows air circulation, and provides high humidity for proper embryo development.

The information provided by this study will allow gauchos involved in the program to harvest eggs on their first visit to the nests. Harvesting eggs as soon as nests are found reduces nest depredation or flooding probability, and would reduce losses due to multiple uses of the same nest by other females (Larriera, 2002). It will also reduce gaucho time required for harvesting, and will provide extra time to search for new nests, producing more income (since they are paid for every harvested nest). Furthermore, ranching programs could reduce operational costs by decreasing field trip frequency.

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