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FEASIBILITY AND EFFICIENCY OF TRANSMITTER FORCE-FEEDING IN STUDYING THE REPRODUCTIVE BIOLOGY OF LARGE SNAKES

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The secretive nature of the snakes imposes a serious challenge for field studies. Snake mating systems, for instance, are hard to study unless they occur in exceptionally large aggregations (Gardner 1955, 1957). These exceptional events may bias the observations in particular situations such that they do not necessarily reflect the typical mating system of the species. Radiotelemetry has been used in studies of snake biology, particularly in research about home range and habitat use (Reinert 1992) and thermoregulation (Peterson et al. 1993). Telemetry has also been used to study mating systems (Duvall and Schuett 1997; Duvall et al. 1992). However, implanting radiotransmitters surgically requires a higher degree of invasive manipulation than is desirable if the natural behavior of the animals is not to be disturbed. Force-feeding transmitters to snakes can be done much faster and with an abbreviated handling time. This technique has been used in the past with *Vipera berus* (Madsen and Shine 1994), although it is not known what the longevity of the transmitters was or how effective they were in studying the biology of the animals. In this paper I document the efficiency of force-feeding radio transmitters to study the mating system in anacondas (*Eunectes murinus*).

MATERIALS AND METHODS

Transmitters used (ATS, model 15A2) contained an antenna coiled up inside the unit and covered up with a waterproof resin. The units were cylinders with dimensions 15 x 2 cm and weighing 91 g, including two 3.6 V batteries. The frequency range was 164–165 MHz and units were set to last for 8 mo. I lubricated the transmitter with vegetable cooking oil and, holding snakes vertically by the head, transmitters were gently pushed down the digestive tract of the animal by palpating them into the stomach, or as far down as possible (Fig. 1). In larger females, muscles tended to prevent palpation too far posteriorly, but I was always able to push the transmitter down far enough to prevent the animal from regurgitating it. In males, due to their small size (Rivas 1999), I could push the transmitter all the way to the stomach and even palpate it out subsequently to recover the transmitter, if needed to implant into another animal.

Over a 4-yr period, I gathered males actively searching for females and females involved in breeding aggregations before and during the mating season (Rivas 1999). I equipped 16 males and 15 females with transmitters and monitored their behavior during the mating season and throughout pregnancy. On several instances when a male found a female, I removed the transmitter from the male by palpating it out. I also palpated out the transmitter of all the males at the end of the breeding season of each year to recover the transmitters for future use. Retrieving the transmitter from females was not possible due to their more muscular body that prevented me from feeling or pushing the transmitter.

Figure 1. Force-feeding a transmitter to an adult male anaconda (*Eunectes murinus*). The unit is oiled and pushed gently down the snake's throat. Photo by Phillip Bourseiller.

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RESULTS AND DISCUSSION

The method of force-feeding transmitters proved to be an effective means of studying the mating system of anacondas. No animal died or showed any ill effect as a consequence of either the force-feeding or the extraction of the transmitter. In fact, all of the females continued with mating, and all of the males continued their trailing activities. In no instance was the transmitter regurgitated after implantation, and all animals were followed for at least a week. The transmitters comprised 0.3% of average female weight and 1.3% of average male weight. Perhaps due to its small size transmitters were not perceived as a meal or as obstacles to the animal's movements.

I removed the transmitter from 13 males. In two cases, after 21 and 23 d, the transmitter had to be palpated out through the cloaca. In the 11 remaining cases, the transmitter was still in the stomach, even after more than 30 d, and was extracted through the mouth. In three males I allowed the transmitter to pass naturally which took 21, 43, and 45 d. It is notable that the variance in the time a transmitter remained within the animals was high. Even though I extracted most transmitters before they passed naturally, it is important that the transmitters stayed in the male's digestive tract long enough to track them throughout courtship and mating. Most females (9 of 13) kept the units until delivery as they do not feed during pregnancy (Fig. 2). Only four females passed the transmitter before parturition in 12, 14, 24, and 36 d. The extreme difference between these females and the others suggests that they might have had food in their digestive tracts at the time of the procedure so the transmitter might have passed along with the stomach contents. Two other females were not captured after the mating and I could not record the exact length of time that they kept the transmitters. These females had not defecated the transmitters after 61 and 68 d when the rainy season started. Presumably they kept them until the parturition since they do not fit the pattern of the animals that defecated. The retention times found in females are not conspicuously different from those of males (Fig. 2). There does not seem to be a correlation between passage time and animal size. The variation in retention time in females seems to be strongly influenced by the effect of pregnancy on feeding. Thus, the time that the transmitter is retained is highly variable, and perhaps it is most related to whether the animals were digesting a prior meal when the transmitter was fed or not. Breeding females do not eat during pregnancy or breeding (Rivas 1999) and courting males seem not to eat either during the mating season, judging by the long time that most transmitters lasted in many animals.

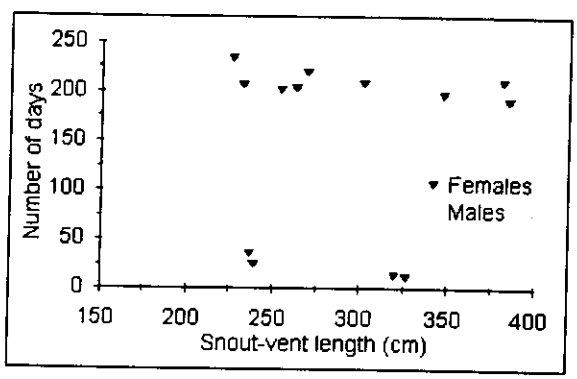

Figure 2. Time that the transmitter lasted within the studied animals. All females passed the transmitter naturally. Most males had the transmitter removed artificially at the end of the breeding season of when they found a female. Thus duration time for males is a minimum estimate.

We implanted transmitters into 16 males of which eight found breeding females (Rivas 1999). This is not necessarily an accurate reflection of male success in finding females, because in three cases I removed the transmitter before the end of the season. Thus 50% might be a minimum estimate of the actual success rate of males finding females.

Due to their particular feeding morphology, it is easy to force-feed a transmitter to a snake to study its biology. This technique proved to be reliable for short-term follow-ups, since none of the individuals thus implanted regurgitated the transmitter. The procedure did not seem to interfere with the animals' natural behavior, as suggested by the large number of males that found females, and by all the females whose mating was studied. This technique can be used quite successfully for studies of mating systems, or even reproductive biology, if care is taken in not implanting the transmitters in animals that have recently fed. I believe this method can be used successfully with other species. However, it might be less effective in smaller species with shorter passage times and higher feeding frequency.

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