CHAPTER 1 INTRODUCTION

The green anaconda (*Eunectes murinus*) considered to be one of the longest species of snakes, and is clearly the heaviest (Minton and Minton 1973). Anacondas are semi-aquatic and many morphological traits are adaptations for such a lifestyle. These include having eyes and nostrils on the top of the head and having a dark olive coloration with black spots with lighter blotches inside that blend perfectly with aquatic vegetation. It is distributed in all the lowlands of tropical South America to the east of the Andes (Beebe 1946). Within the family Boidae, anacondas are considered to be a primitive (basal) species (Greene 1997). Evidence for this includes their possession of spurs reminiscent of the thighbone on either side of the cloaca (Mole 1924). Regardless of how famous the anaconda is among herpetologists, very little is known about its life history. No field research has been carried out on this species. The available information is limited to casual encounters with animals in the field and notes on captive specimens (Beebe 1946; Belluomini and Hoge 1957/58; Belluomini et al. 1959; Belluomini et al. 1971; Blomberg 1956; Holmstrom 1980; 1982; Holmstrom and Behler 1981; Mole 1924).

Anacondas have a number of traits that make them an excellent subject for the study of snake ecology. First, it is a very primitive snake and an excellent representative of the South American boids that can provide insight regarding the evolution of the group (Minton and Minton, 1973). Second, anacondas are ectothermic top predators that experience an incredible change in body size from birth (200 g; Belluomini and Hoge 1957/58) to adulthood (104.4 Kg; Mole 1924), compared to other snakes. Third, their large size make them an excellent model to study the ecology of snakes in the field, since they are easier to equip with transmitters than other smaller species; this is true even for juveniles and newborns. Fourth, they are possible to find and catch during the dry season in the Venezuelan Llanos. Gathering baseline information on the life history of this animal will enrich future research addressing diverse questions in snake ecology and evolution and in the ecology of large-sized reptiles.

Reproduction is clearly one of the key traits in the life history of any species. The total number of healthy, viable offspring that an individual can produce is what will determine its fitness. Lifetime Reproductive Success (LRS) refers to the reproductive value of an individual. Individuals tend to reproduce in a way that maximizes their LRS (Daan and Tinbergen 1997). How an organism will administer its resources and what strategy it will use to breed are most relevant questions in the study of any animal. Williams (1966) argued that any investment in reproduction at any given time is at the expense of future reproduction. Once an animal reaches maturity it is faced with the decision of whether it should spend energy in breeding in a given year, and secure some offspring, or use that energy to grow larger where it can make a larger reproductive investment. If the animal breeds there is still another decision that it has to make. how to breed? The female can produce a relatively small Reproductive Effort (RE) and save part of her energy to continue growing or make a very large RE that would forfeit growth in the near future and handicap future breeding events. A female can also have a few offspring of large size or several offspring of smaller size. In species with indeterminate growth, these two decisions (whether and how) keep appearing and overlapping throughout life. The way an organism faces these decisions is often under strong phylogenetic influence. However, several environmental and developmental variables can produce important variation (Stearns 1992).

While the questions about clutch size and investment per offspring are often referred to in regard to females, the male's investment and reproductive strategy is also of interest. The amount of energy that each sex invests in reproduction is not necessarily equal. Males produce smaller gametes than females (anisogamy). The subsequent investment and behavior of the individual is influenced by this first premise (Bateman, 1948). In general terms, males will benefit most by achieving many matings while the females will benefit most from "good" matings. Mating with the wrong individual represents a low cost for the males and a high one for the female. Males are, therefore, generally polygynous while females are "choosy." However, if the male has few possibilities for obtaining other mates, or if he invests a lot of energy in every mating, it pays for him to be "choosy" as well (Arnold and Duvall 1994; Reynolds and Harvey 1994; Trivers 1972).

Sexual selection is based on the differential reproduction of members of each sex. Some individuals leave more offspring than others; hence, following generations will have a higher proportion of the genes of those individuals. Sexual selection typically is produced by differential mating success whether it results from the exclusion of rivals, female choice, or from the ability to locate receptive females. However, sperm competition (Parker 1970) has the potential to decrease the benefit of large size in siring success (Andersson, 1994). Mating systems are characterized by the relationship between fecundity and mating success (Sexual Selection Gradient: SSG). If one sex produces more offspring from more matings, it will have increased SSG and will be under sexual selection. The sex that has the higher SSG will be under stronger sexual selection than the other and therefore be more likely to seek multiple mating (Arnold and Duvall 1994).

Large size in females is supposedly a benefit in species that grow throughout life with little or no parental care. Large animals can produce large numbers of eggs and can store large amounts of fat for their development. Natural selection should therefore favor large size in females (Andersson 1994). The development of large size in males can occasionally be regarded as a handicap since they are more conspicuous to predators, but it may give an advantage in male-male combat and in fighting off predators. Larger males can win more combats, drive away more rivals, and thus monopolize more females (Darwin 1871; Trivers 1972). For example, large size enables males to outcompete other males and obtain more mates in several mammals (Le Boeuf and Reiter 1988; Packer et al. 1988), lizards (Dugan 1982; Rodda 1992; Stamps 1983), and spectacled caimans (Thorbjarnarson 1990). In some male lizards, large body size can help males to force copulation with smaller females (Dugan, 1982). However, in snakes males are apparently unable to forcibly copulate with females (Shine 1993). Shine (1994*a*) reviewed sexual dimorphism in snakes related to male-male combat and provided a revised theoretical model. He found that males were generally larger compared to conspecific females in those species that have male-male combat, but the relationship is not universal. Shine (1993) argues that the determinant for Sexual Size Dimorphism (hereafter SSD) is the Operational Sex Ratio (OSR). If the probability of encounter of two or more males with a female is low, then male-male combat is not likely to occur. Hence, there is no selection pressure for the evolution of large body size. Rather, sexual selection in this case is shunted to the development of refined abilities to locate the female (scramble competition; Andersson, 1994). Shine (1993) speculated that this should occur when species are in low densities, live in aquatic or arboreal habitats, or utilize locomotive methods that do not leave a continuous track, such as side-winding.

In addition to the scientific knowledge gained from studying the biology of a species as exceptional as the anaconda, it is also important to study this species because of its value as an economic resource. Anacondas can be used rationally due to their potential value in the skin trade, pet trade, and for nature-tourism. Anaconda skin has been used for luxury articles such as bags, purses, and boots in the past. Currently, the trade of anaconda products is forbidden by Venezuelan laws and is regulated internationally by the Convention for the International Trade of Endangered Species (CITES). In Venezuela, some species has been used commercially for relatively long time. Capybara (*Hydrochaeris hydrochaeris*) has been harvested commercially since 1968 (Ojasti, 1991) and the spectacled caiman (*Caiman crocodilus*) since 1983 (Thorbjarnarson, 1991). Other species of reptiles that are being considered for commercial harvest due to their population status and economic value include the tegu (*Tupinambis teguixin*), the green iguana (*Iguana iguana*), and the green anaconda (*Eunectes murinus*). Thus, managing anacondas is not an isolated use of natural resources. The use of all these animals does not involve any kind of habitat destruction or degradation since they occur at high densities in the Llanos. Furthermore, managing these resources offers a sustainable use with no net losses to the ecosystem and has the potential to encourage habitat preservation on the economic sector that benefits from the management (Thorbjarnarson 1999). At this time, however, due to the lack of detailed information on the natural history of these species, it is not possible to implement a management plan. In 1992, Profauna, CITES, and the Wildlife Conservation Society sponsored the first study of the ecology of anaconda. This study aimed to find out the basic ecology of anacondas in order to implement sustainable management. I carried out the initial investigation and continued it over the following 7 years. I have tried to fill to some degree the gap of knowledge on natural history that is needed for the conservation of this species (Greene 1986; 1993; Rivas 1997). Here I present the basic aspects of reproductive ecology, mating system, determinant of reproduction, substantial information about natural history, and how this information can be used for management and conservation of the anaconda.