

CROCODILE FARMING WITH PARTICULAR REFERENCE TO EAST AFRICA

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INTRODUCTION

The Class Crocodylia consists of the crocodiles, alligators, caimans and gharials. There are twenty-three extant species but, in the past, many more existed (Frye, 1994).

Crocodiles are reptiles that are well adapted to life in water. While most are freshwater, one species is partly marine. The anatomy of crocodiles is dominated by their tough integument which, on the dorsum, is protected by plates of osteoderm. Internally, crocodiles have a well developed palate, a four chambered heart and a right aortic arch.

All crocodylians are oviparous. In many species the female constructs a nest of decaying vegetable matter and as this decomposes, the temperature rises and assists in incubation. Sex determination in crocodylians is temperature-related. Crocodylians are unusual amongst reptiles in that the nests are guarded by the mother (possibly the father) who also protects the young, often for a considerable period of time.

The Nile Crocodile (*Crocodylus niloticus*) is the most widespread of the three species of crocodile that are found in Africa. The Nile Crocodile is biologically similar to other crocodylians. It is an ectothermic vertebrate. The free-living crocodile reaches sexual maturity at between 20 and 35 years of age when the male is 3-3.3 m in length and the female is 2.4-2.8 m (Revol, 1995). The Nile Crocodile has one breeding season per year and eggs are laid in a hole made in the ground.

The legal status of the Nile Crocodile is relevant. It is listed on Appendix II of CITES. Therefore international trade is controlled (Cooper, 1987) and this influences farming and other commercial enterprises. Until fifteen years ago, Nile Crocodiles were hunted extensively in most parts of their range in Africa. More recently, controls on this have been introduced in many countries and crocodile farming has become popular. Much of the research to date on the farming of the Nile crocodile has been carried out in Zimbabwe (formerly Rhodesia) (Blake, 1974).

BREEDING TECHNIQUES

Eggs of crocodiles can be collected from the wild or produced (laid) in captivity. The former are usually detected using light aircraft, which locate the females, or by probing the ground with a rod. As a general rule, in East Africa, eggs are not collected until about 50 days after laying. The hatchability is then higher and the eggs are easier to monitor: predation before this time is, however, common. Eggs are transported carefully and, after

cleaning and disinfection, are placed in incubation boxes, taking care that the eggs are not turned in the process. There are two main methods of incubating eggs, 1. using an artificial nest and 2. an incubation box. In both cases, hatching rates of 80-90% can be obtained. In the artificial nest, the eggs are placed in humid sand or similar substrate with complete reliance on solar heat. It is important to protect the incubation area from predators, using fences or walls. Hatching is obvious because of the noise made by the young crocodiles at this stage. The insulation box is an insulated container, filled with sand, soil or vermiculite, in which eggs are buried. The box is then placed in an incubator maintained at 30-32°C, the approximate temperature in the wild. Relative humidity is kept high (above 60% and nearer 90-100%), usually by running through water.

The production of animals from eggs collected from the wild as described above, is termed "ranching". Crocodile "farming" implies that the animals are bred in captivity, in which case animals are allowed to mature and captive breeding is encouraged. Most Nile Crocodiles will not breed successfully until they are 8-10 years of age – this is considerably earlier than in the wild and is probably related to the higher rate of growth in captivity. In Africa, breeding crocodiles are usually kept in large pens. There are two methods of breeding, either using small pens with one male to 6-8 females or a larger pen with a maximum of 60 males and 300 females (Revol, 1995). The former is the more popular.

Rearing techniques contribute greatly to the success of a crocodile farming enterprise. Young crocodiles must be offered both water and dry land. Blake (1974) recommended a minimum surface area for hatchlings of 0.09m² per animal which is increased to 0.18 m² for a yearling and 0.3 m² for an animal of 2-3 years of age. The water must be kept warm, again preferably around 32°C; a gradient is advisable, produced by shading. Hygiene is always of great importance, particularly in the prevention of water-borne infections, and some enterprises in East Africa routinely add oxytetracycline to suppress bacterial growth. This is not a satisfactory practice – neither bacteriologically nor environmentally sound. Huchzermeyer (personal communication) recommends cleaning with a detergent and a disinfectant at each water change.

Various factors influence growth rate, including temperature and food intake. On average, a Nile Crocodile is 55 cm long at three months, 85 cm at six months and 110 cm at one year. In Zimbabwe, crocodiles are slaughtered when they are 2-3 years of age and approximately 1.2-1.5 m long (Hutton and Webb, 1990); in East Africa they are killed earlier, at 10-14 months.

Hatchlings are fed once a day with meat, fish or similar animal material. It is important to supplement with vitamins and minerals, especially when meat is used. Deaths at this stage can be associated with infectious agents (see later) or be stress-related. Stressed crocodiles tend to show behavioural changes, particularly excitability, and may have a reduced appetite and lose weight. One way of minimising this is to separate young animals into groups of comparable size and to rear them as such. "Premature" or poorly developed hatchlings may need special care.

Various management strategies can be followed as the young crocodiles grow. In East Africa they are usually handled and checked at 2-3 months of age and then moved outdoors.

Slaughter of crocodiles involves shooting or severance of the spinal cord. The former is to be preferred on welfare grounds (Cooper, 1987).

CROCODILE PRODUCTS

The most valuable part of the crocodile is the skin (hide), especially that of the belly. It is most important that skinning is carried out carefully and correctly in order to avoid damage. Grading is adversely influenced by the presence of holes, scars or other lesions and for this reason fighting amongst captive crocodiles must be kept to a minimum. The meat is usually a secondary product and, while increasingly sold as a human food, is often used primarily to feed other animals, including other crocodiles. A crocodile 1.2-1.4 m in length will yield 2.7-6.8 kg carcass weight, of which 1.4-3.4 kg is boneless meat. Crocodile meat is white and similar in taste to chicken, fish or veal. Other products from the crocodile include heads, feet, claws and teeth which can be used for a variety of purposes, mainly curios.

DISEASES

A variety of infectious and non-infectious diseases can occur when Nile Crocodiles are kept in captivity. The maintenance of water quality is essential. The rearing environment is particularly conducive to the spread of bacteria including salmonella, other enteric organisms and viruses including *Adenovirus* (Foggin, 1992) and *Poxvirus* (Buoro, 1992; Foggin, 1992). Chlamydiosis has been diagnosed in Southern Africa but not yet reported in East Africa.

Other bacteria that are important in crocodile farming are mainly Gram-negative organisms and control of these hinges upon good management. Sterilisation (with heat) is advisable for food being given to hatchlings. Vitamins must be added after heat treatment, not before.

Non-infectious diseases include fight wounds (which may become infected), stress-related disorders (see earlier) and osteodystrophy, which can include both calcium and vitamin D3 deficiencies.

Handling of crocodiles must be carried out with care. Even young animals can inflict wounds on themselves and humans; these can readily become infected. Anaesthesia may be carried out using ketamine or etorphine by injection or isoflurane or halothane by inhalation. Gallamine, not an anaesthetic but a neuromuscular blocking agent, has been used extensively to capture, transport and facilitate handling of the Nile Crocodile (Blake, 1993).

Health monitoring of captive crocodiles is important and haematology can be particularly useful in this respect (Cooper and Mbassa, 1993).

CONCLUSIONS

Crocodile farming is becoming increasingly popular and important in Africa. In East Africa (Kenya, Tanzania and Uganda) it is still at a relatively early stage and much remains to be learned. Improved management is essential on health and welfare grounds. In Zimbabwe and other Southern African countries, considerable expertise exists (Blake, 1974, 1993). A particularly encouraging development has been to link crocodile ranching or farming with the conservation of the Nile Crocodile in the wild. In the case of ranching, collection of eggs is carried out by the local community who, in the past, would probably have destroyed crocodile nests.

The return of captive-reared crocodiles to the wild is practised in many African countries: in Uganda, for example, once youngsters reach 2.3 metres in length, at least 5% must be released – a regulation that is strictly enforced. Crocodile farming that is linked with educational visits and research provides opportunities to teach local people about the value and importance of these reptiles and to encourage their conservation in the wild. Crocodile farming faces many challenges, both economic and practical, but has considerable potential in Africa as a form of sustainable utilisation.

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