OBSERVATIONS ON CAPTIVE JUVENILE SALT-WATER CROCODILES *CROCODYLUS POROSUS*

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INTRODUCTION

The salt-water or estuarine crocodile, *Crocodylus porosus* Schneider is the largest living crocodilian (perhaps reaching 9 m length in hisltorical times, the largest living specimens are of the order of 6-7 m length). It is the only species known to traverse great distances at sea, which probably explains its very wide geographical distribution (Sri Lanka to Northern Australia) (IUCN, 1982). Endangered in most parts of its distribution, the wild populations are generally listed on CITES Appendix I. However, the species is the mainstay of many crocodile farming operations in the Far East, and some populations (e.g. those of Papua New Guinea and Australia) have been transferred to Appendix II to facilitate managed ranching/ farming operations (Luxmore *et al,* 1985).

In May 1987, 12 hatchling salt-water crocodiles arrived in Menai Bridge from Australia. Their dispatch and export permit documentation in Australia had been arranged by Dr. Graham Webb of the Conservation Commission of the Northern Territories; an appropriate CITES import permit was obtained in the U.K. The funds for the animals' transport and the subsequent scientific work to be performed upon them were provided by a grant from the Nuffield Foundation to the author. The animals were purchased from a crocodile farm (where they would have been reared for their skins and meat) and it was agreed that most would be sacrificed for anatomical/histological studies at the end of the experimental programme, but that any remaining live animals could be transferred to a recognized zoo.

The experimental programme is in progress, being devoted mainly to the gut function of the animals, but with side projects involving studies of locomotory mechanisms and behavioural responses to temperature and salinity. The intention in this report is to describe handling and feeding techniques, and to comment on some aspects of the animals' behaviour.

ACCOMMODATION

The young crocodiles are held in a tank of flowing low salinity water (usually fresh water, but sometimes with added sea water as this is known to promote good skin condition), constantly circulated through a biological filter and header tank. The holding tank (5m long x 0.4 m wide x 0.6 m deep) is made of epoxy-coated ply with a perspex front for observation. A feeding platform constructed of varnished marine ply may be reached by gently sloping ramps, cross cut to provide purchase for the crocodiles' claws. The whole arrangement is held in a temperature controlled room at 30°C. Given that the species is a "salt-water" crocodile, it might appear strange to keep them in fresh water. However, although wild hatchlings have been seen in full strength sea water (Gregg, pers. comm.), and possess lingual salt glands which secrete a salt-rich fluid to remove a salt load, they do not thrive in captivity in this medium for reasons which are as yet obscure.

FEEDING & HANDLING

For convenience, routine feeding is upon fish or squid available in the laboratories (mackeral, condemned rainbow trout from a trout farm fish kill, and squid from the Falklands area have all figured in their diet). Chopped whole food organisms are used to ensure plenty of calcium in the diet (crocodilians are prone to skeletal deformities if fed on filleted fish). Usually, no single food organism is used for more than a week. Experience has shown that daily feeding is wasteful, the animals showing a poor appetite and feeding over a prolonged period. Instead, the animals are fed every second day, which results in rapid and complete consumption of meals. At intervals, the animals have been supplied with large insects, as this elicits interesting

feeding behaviour (see below). Cockroaches, locusts and crickets have all been taken readily.

Handling of the animals has so far involved neither gloves nor special apparatus. Although the crocodiles will snap at hands when they are out of water they do not do so when immersed. The normal capture procedure is to chase each animal into the water and then catch it with two hands, one encircling the throat and immobilising the head, the other immobilising the tail.

BEHAVIOUR

For a few weeks the young crocodiles were shy and reacted violently to movements outside their tank. They did not feed in the presence of observers and grew very slowly. Handling was initially kept to a minimum of once per week during weighing sessions. Over a period of 4-5 weeks the animals became progressively tamer and fed more readily. They were handled with increasing frequency as it was intended that they be used in experiments demanding repeated manipulation (e.g. for serial X-radiography). At the time of writing, all animals feed within about 15 minutes of being offered a meal and their sole reaction to handling is to emit loud squawks when first grasped. An initial tendency to urinate when handled has subsided. Initially 50-70 g in weight, the animals have now grown to 110-280 g (5 months' growth).

Feeding behaviour is fairly complex. As soon as regular feeding started, a feeding hierarchy developed, with a few animals growing much more rapidly than the rest as a result of monopolizing (and defending) space on the feeding platform. Initially, attempts were made to counteract this problem by offering more food, but this simply exacerbated the differential growth rate. At present, any animals showing an unusually high rate of weight increase are separated from the others for a few weeks and fed separately until their smaller fellows have "caught up" as far as weight is concerned.

Feeding responses to dead food (fish, squid) are very different from the reactions to live food (insects). At no time have the crocodiles taken dead food placed in their water. Dead food is only taken into the mouth out of water, although the crocodiles often retreat to the water when they have a mouthful of food. In contrast, live insects struggling at the water surface are taken readily and immediately. The crocodiles are also capable of jumping out of the water to catch insects moving on objects above water. To do this, the crocodile first takes up position at the water surface with the snout pointing towards the insect and the eyes focussed upon it. The body is held obliquely or vertically in the water (obliquely if the prey is some distance in front of the crocodile, vertically if the insect is above the predator). The rear feet are drawn forward and their toes parted to deploy the webs between them completely. The crocodile then propels itself upwards and forwards by a powerful downwards and backwards thrust of the hindlegs. As the snout clears the water, the jaws begin to part and are wide open by the time the whole head is above the water line. The jaws snap shut around the insect, which may be as much as a complete body length above the water surface, since the crocodiles are capable of jumping completely out of water. When on land, the young crocodiles are also able to catch insects, either by side snaps of the jaws if the prey is nearby, or by lunges or jumps if the insects are further away (again, the hind limbs provide propulsion). Insects which sank below the water surface, even if still alive and showing limb movements, were not eaten.

Whatever the nature of their food, the crocodiles have a problem when swallowing it. Normally, whether on land or immersed in water, the throat of the crocodile is closed by the upper surface of the back of the tongue forming a seal against the palate (air is drawn in through the nostrils). The tongue is not mobile, so cannot be used to move food from the front of the jaws towards the throat. Instead, the crocodile has to throw its head back and use gravity to supply food to the oesophagus (food items are tossed about by head and jaw movements until their longitudinal axes point towards the gullet). This behaviour is effective when the animal is on land, but when a crocodile has taken food into the water, or has captured food at the water surface, the buoyancy of the food items (particularly insects which have a density well below that of water) means that he gravity-based mechanism would become ineffective if the crocodile tried to swallow whilst under water. Instead, the animal adopts a vertical position in the water, with the head projected above the water surface. The crocodile treads water vigorously (by movements of all four limbs), with the jaws pointing skywards, until the food is swallowed.

REFERENCES

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