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FERTILITY PROBLEMS IN CAPTIVE ANIMALS

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INTRODUCTION

The alarming decline of wild animal populations, due to human activity, presents a serious challenge to the modern zoological garden. Zoos must aim not merely at exhibiting rare animals but at establishing breeding groups of threatened species with a view to releasing their progeny when mankind has grasped the fundamental significance of wildlife. During the last twenty years great progress has been made in maintaining and breeding wild animals. Their life-span has been prolonged—for example, up to fifty years in anthropoids—and breeding activity has been induced in many species which, although kept in pairs, formerly did not reproduce. I recall the first captive births of the Lowland gorilla (Columbus, Ohio, U.S.A., 1956) and of the Great Indian rhinoceros (Basle, Switzerland, 1956).

THE IMPORTANCE OF NUTRITION

These advances may be attributed to research in different fields. Above all, it has been recognized that wild animals have virtually the same nutritional requirements as domestic animals. Modern husbandry paved the way to diet reform by demonstrating that domestic animals yield more if they are properly nourished. An examination of the traditional diets for zoo animals revealed them to be deficient in protein and other essential nutrients. At first glance it seems incredible that any breeding successes, however modest and of brief duration compared with the wild potential, were registered under the former system. A critical assessment of earlier records indicates that births occurred chiefly among animals indigenous to the steppes and, therefore, adapted to a fluctuating food supply. According to the season, the organism of the so-called grazer has to exist on poor dry fodder of little nutritional value and to make up for deficiencies during the period of herbaceous growth. The browsers of the tropical forests profit from a superabundance of vegetation all the year round and, as experience in zoological gardens has shown, are much less adaptable.

H. L. Ratcliffe recognized these specialized requirements in 1935 and, by composing recipes containing the essential nutrients, provided ideal rations for the animals in Philadelphia Zoo. But the voice of the prophet is rarely heard in his own land and, in America, Ratcliffe's results were scarcely acknowledged. In 1956 H. Wackernagel modified the recipes for the Basle Zoo and has since then steadily improved upon them. More than 75 per cent of our mammals reproduce regularly and we claim that the high breeding rate is chiefly related to feeding methods on scientific principles.

I quote from *Feeding wild animals in zoological gardens*, published by H. Wackernagel in 1966: "The science of nutrition is based on the fact that all animals, from protozoans to mammals, need the same broad groups of nutrients, i.e. proteins, carbohydrates and fats. Vitamins and minerals play essentially the same important role in the most diverse species of animals." The objection to this theory by workers who regard it as the "retort-theory", in other words that it is too artificial, must rest on a misunderstanding. From the nutritional standpoint, it is surely immaterial whether the right amounts of carbohydrates, protein and fat with the necessary vitamins and minerals are fed in the form of pellets or meal or even in their original state as meat, fish, hay and so on, as long as a sufficient quantity of all these components is eaten; the form in which they are eaten is unimportant. We must, however, bear in mind that meals should provide occupation and pleasure as well as the right nourishment. It is up to the zoo biologist to meet as many of these needs as possible. Most of the year our anthropoids are given a supply of freshly cut branches in addition to their staple diet; the apes spend considerable time examining them minutely and, as well as eating the leaves, gnawing the bark and opening the pods, they play with the branches and even build nests of them, just as in the wild. In a number of cases the food supply should be shared out over the day instead of offered in one or two portions. The condition of our sealions has improved since they have been fed three to four times a day and they have also begun to breed successfully. Obviously nutrition is only one of the decisive factors in breeding but its importance cannot be emphasized strongly enough.

EXAMPLES OF BREEDING PROBLEMS

Mammals are fertile, provided their sexual organs are anatomically normal, provided spermatogenesis in the male and ovulation in the female function properly and provided compatible partners find each other and mate. This statement alone can be split up into many known and unknown factors. This is not the place to discuss causes of infertility through anatomical or physiological anomalies; current research in the field of zoo veterinary medicine has yielded valuable information on these questions. The fertility problems still concerning us are related to the closely interwoven aspects of maintenance and behaviour. I would like to take a few examples by way of illustration.

Okapi

In 1955 and 1957 I selected a pair of sexually immature okapi (*Okapia johnstoni*),

free from *Monodontella giraffae*, in the Ituri Forest, Belgian Congo, and supervized their transport to Basle. These gave birth to male calves in March 1960, June 1962 and October 1963. The first two were exported to other zoos and a second female obtained from Paris as a mate for the third. After an abortion in February 1965 no further pregnancies occurred until this female was served by the second born bull, mentioned above, when reimported to Basle. A female calf was born in January, 1971, but unfortunately both dam and calf were lost soon afterwards. Tragically the original pair were lost in 1970 when moved to an outlying farm—probably from feeding errors. This move was an attempt to combat the infertility which was felt to be largely a reflection of inadequate maintenance. It is possible that oestrus, which is brief in the okapi, had occurred at night and was overlooked. Certain animals are known, however, to suppress oestrus if the population density is disturbed. At all events the female lay fallow for four years. The two pairs of okapis had shared the same house. Moreover they lived in comparatively small adjoining stalls (3 × 4 m). Although kept in separate quarters, the males, father and son, displayed a mild aggressive behaviour towards each other. The move to the zoo's external breeding station on 1st April, 1970, resulted initially in a vast improvement in the condition of all the animals. Apparently they had suffered from crowding effects. Okapis live solitary lives in the remoteness of the tropical forests and probably do better if one pair only is kept in the same house.

Gorilla

A young pair of gorillas, both hand-reared from an early age, were allowed to watch the adult pair which had produced four infants by September, 1970, and expect a fifth early in 1972. The young female, despite the hand-rearing, produced a male infant in May, 1971, and is rearing him successfully.

Mandrills

In 1953 we imported one or two young mandrills (*Mandrillus sphinx*). The females regularly come into oestrus, whereupon the male attempts to copulate. Shortly before the climax of coition, he withdraws his penis and ejaculates the sperms over the females' backs. He is also observed masturbating. During all these years the animals have not succeeded in reproducing.

Crested mangabeys

We possess a group of crested mangabeys (*Cerocebus atterimus*). In February, 1972, it comprised a male and three females, all born in Basle with the exception of one female which originates from a collection imported in 1955. In the social hierarchy, the zoo bred male has remained inferior to his mother, the originally imported female, and breeding activity has come to a standstill.

These last three cases illustrate problems arising from innate behaviour patterns. On the one hand experience plays a prominent role. Animals which have grown up in isolation, that is, have been deprived in infancy of the opportunity to observe infant care or copulation among their own kind, often fail to become fertile. If breeding mechanisms in anthropoids are to function norm-

ally, it is vitally important to satisfy their social needs by keeping them in family groups. These methods have proved rewarding in that we can report on a gorilla and an orang-utan female which, although latterly introduced into their respective groups, mated successfully. In males, isolation from the group in infancy appears to be attended by more serious and possibly irreparable consequences. The case of our mangabeys shows the significance of social hierarchy. Failure in a male to attain dominance may lead to infertility.

Sealion

An animal which has occupied our attention for a long time is the Californian sealion (*Zalophus californianus*), a popular zoo exhibit. While it is true that, on rare occasions, sealion cubs have been born, for instance, in the London Zoo, few have become adult. On examining the causes underlying failure, we decided that loss of warmth through floor surfaces and, possibly, through cold water might be partially responsible. Electrically heated floors were duly installed in the sealions' quarters and have perceptibly enhanced the inhabitants' well-being. During recent years great pains have been taken to improve the diets. Sea water fish, such as herrings and whiting, which form the sealions' main food, are known to deteriorate rapidly. Rancid fat has a harmful effect on the digestive system and destroys vitamins. We feed fresh, high quality fish and the vitamin supply has been drastically increased. Every sealion receives 100 g meat supplement daily as well as vitamin capsules containing A: 100 000 i.u.; D: 10 000 i.u.; E: 500 i.u.

I must also add that we have latterly increased the number of feeds a day as a means of providing play and occupation.

Great Indian rhinoceroses

The first captive born Indian rhinoceros (*Rhinoceros unicornis*) was born in 1956 to a pair imported four and five years earlier. The animals had benefited from balanced rations and were housed in roomy quarters with a spacious open-air enclosure. Sexual maturity is reached in females at three and a half years old and in bulls at seven and a half years old. Mature bulls are always ready to respond to an oestrus female. Copulation is preceded by a dramatic courtship. The bull and cow chase each other alternately, often joining in violent combat, charging each other with their horns and inflicting bites with their sharp incisors. The aggressive display is followed by a peaceful phase. The actual copulation usually takes place unexpectedly as a sequel to the quiet phase; it lasts for at least 60–70 minutes, with an ejaculation occurring almost every minute. Should no further oestrus appear after 45 days—being the mean interval—it may be assumed that the cow is pregnant. Adult bulls may not be admitted into the same enclosure as a female unless she is in oestrus; otherwise she might sustain severe injuries. After a gestation period of 470 to 480 days, the calf is born. Hitherto ten Great Indian rhino calves have been born in the Basle Zoo and raised by their mothers. A case of metritis prevented pregnancies in 1960 and 1961.

Over the years we have evolved a management system. The oestrus female

is confined to a small section of the outside enclosure; the bull, in the main enclosure, is not given access to her immediately but the animals are able to establish contact. They are kept apart for six to seven hours or—if oestrus began in the evening—overnight. After sufficient time has elapsed to allow for the aggressive phase to subside, the animals are permitted to join each other. In females which have calved more than once the quiet courtship phase usually follows and mating occurs with no danger of serious injuries.

Zebra

A fertility problem of a particular nature has been observed in our Grant's zebras (*Equus quagga böhmi*) in recent years. Breeding in our herd suffered a setback when the stallion was lost on 2nd March, 1963, due to a fractured leg. A stallion, born in Basle in August, 1962, was looked upon as the new breeding male and, according to expectations, sired a foal in 1966. But an undesirable trait in the stallion soon revealed itself in that he persistently persecuted one particular mare in the herd and declined to mount her. On the removal of this mare he transferred his aversion to another mare. The stallion continues to produce foals regularly with two chosen mares but has never admitted a third or fourth to the herd, although adult females in good condition were available.

Field studies made by Klingel (1967) have shown that, from time to time, zebra stallions form new family groups by making a conquest of young mares from other groups. Frequently a stallion has some six females in his charge. Whether personal sympathies and antipathies play a role is unknown but we imagine that, under the confined conditions imposed by a zoological garden, such factors are of importance. Our stallion together with three mares and a foal were recently released into a private park of 6000 m^2 but the experiment has, as yet, brought no change in the situation.

Cats

Our felines, with the exception of the clouded leopards and cheetahs, no longer present any fertility problems. Former difficulties have been overcome by offering balanced rations and by providing heated floors and retiring dens where the females can raise their litters undisturbed. The causes of infertility in the animals mentioned above are so obscure that I hesitate to venture any explanation. A detailed study should be undertaken as soon as possible.

CONCLUSION

Fertility problems in captive animals have been largely overcome by the introduction of balanced rations; malnutrition no longer plays a role in disease and infertility. Improvement in zoo design and in standards of hygiene, as a means of controlling worm infestation and bacterial infection, has promoted physical well-being and induced breeding; serious attention has been given to details such as climate, lighting and cover; well planned habitats offer sufficient possibilities for exercise—climbing, swimming, etc.—and are built of material

chosen for comfort and cleanliness. Lastly, research on native behaviour patterns has given us a better understanding of the need for socially balanced groups, the right population density, occupation and play, thus bringing us closer to achieving ideal maintenance. We appreciate, however, that although the number of fertility problems has been greatly reduced, further intensive efforts are required to produce a final solution.

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