

wish the reverse were true. I have the strange feeling that "Big Brother" feels it is alright for him to meddle (e.g. osprey and peregrine campaign and sea eagle release – all of which I applaud incidentally), but it is not allowable for the rest of us "lesser mortals" to try and do our bit for our own particular favourites. Be that as it may, my organisation B.O.B.A.R.S. (The British Owl Breeding and Release Scheme), has now been responsible for the release of well over 200 captive-bred barn owlets in the past 15 years. In this work we have been aided by our dedicated breeding members, Peter Olney at London Zoo, many individuals too numerous to name, farmers and landowners. We now have 9th generation barn owls breeding in the wild whose originators began life in our Hovabator. We have barn owls breeding at farms which had long since lost their wild birds and single, mateless birds once again paired at isolated sites where the chances of a new mate had become remote. We have nest boxes erected where once the owls nested in hay bales and risked the loss of eggs and young. We are proud of our record and will continue the fight in the hope that the barn owl will one day return as a familiar sight in our countryside.

For further details of BOBARS, nest-box design and erection, or owlet release, write to: BOBARS, Muncaster Castle Bird Gardens, Revenglass, Cumbria. CA18 1RG. (06577-393).

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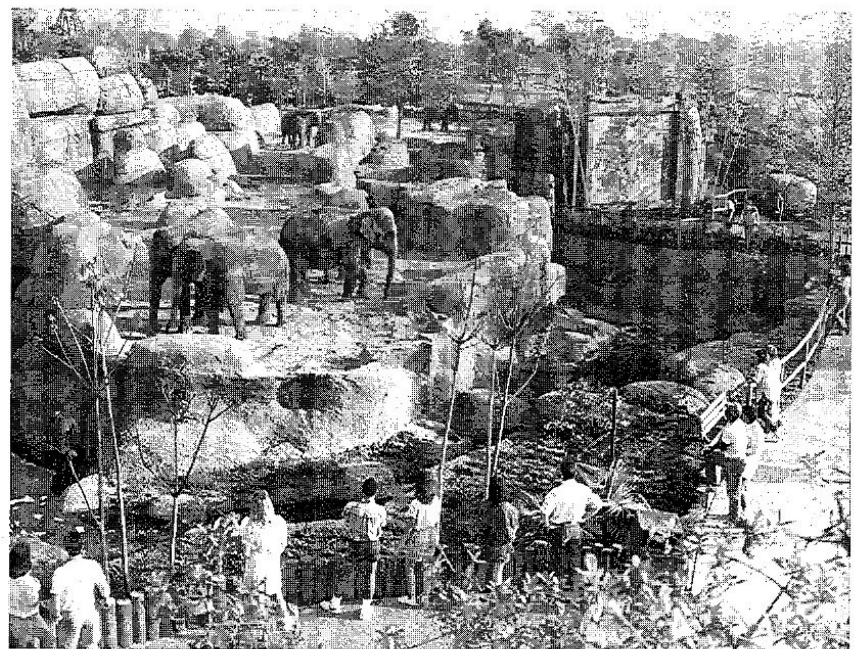


PHOTO: BUSH GARDENS, TAMPA, USA

THE ZOO – LAST HAVEN, LAST CHANCE? ★

BY FRANCESCO NARDELLI

Recognising the role of zoos as conservation and captive-breeding centres is really just a matter of accepting the inevitable: it is going to happen; there will be very little natural habitat left by the year 2000 – less than 13 years from now. Having accepted that, we as conservationists have to ask ourselves whether we are going to let this take place without lifting a finger to preserve the creatures – marvellous products of evolution, a treasure-house of genetic diversity – which still survive in that threatened natural habitat. Surely, the answer must be no, whether for moral and aesthetic reasons, or for pragmatic ones such as the future needs of science, education, medicine, industry or just recreation.

But how can endangered animal species best be preserved? It seems obvious that the most practical way is by breeding them in captivity. And

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it is equally obvious that the best equipped place in which to do such breeding is the zoo. Yet the conservationist movement is split in two on this issue, in so far as it is discussed at all, which amazingly, it often is not! One school of thought clings stubbornly to the idea of preserving wild habitat and entire ecosystems as a *sine qua non*. What, asks this faction, is the meaning of a wild animal divorced from its natural environment? Also, perhaps understandably, zoos have a bad reputation with many conservationists. This is the result of history – the bad old days when zoos were little more than glorified circuses for the amusement of humans – and of the mismanagement still far too prevalent in existing zoos.

Yet unfortunately, for all its good intentions, the habitat-preservation lobby could easily end up with plenty of beautiful habitat, devoid of animals. Poachers thrive in such habitats just as well as their prey. Habitat alone is not sufficient condition for breeding or survival. We must face facts: tigers in India have been reduced from 70,000 to only 3,000 since the beginning of this century, American bison have dwindled from 60 million to 20,000 in the space of 200 years, and so the lamentable list goes on pointing inexorably to extinction for many species in the near future. Since the last dodo was killed on Mauritius in 1680, at least 300 vertebrate species or sub-species have been exterminated, more than half of these being full species in their own right. In Africa alone, wildlife has declined by more than 70 per cent since the turn of the century.

Most significant of all, the tropical rainforests, which originally covered more than 16 million square kilometres of the earth, have been depleted by more than 50 per cent. Each year, about 110,000 square kilometres of such forest, crucial habitat for many rare animals, are cleared, three times the surface area of Switzerland. At present rates of destruction, there will be no tropical forests in Malaysia a decade from now, nor in Indonesia about 25 years ahead. Meanwhile, the human race has increased from 450 million to five billion over the last 300 years alone. In the words of Peter Steinhart of the National Audubon Society, USA, 'Humankind is probably now the most numerous species of mammalNo other primate comes closer....Only rodents are likely to rival humans for the teeming title. But recent studies demonstrate that the rat population comes out smaller'. Indeed, in New York, there are 36 humans for every one rat. Such figures lead to inescapable conclusions about the carrying capacity of Earth, for humans as well as for animals. But in the short term it is the animals who are losing out. As John Aspinall, founder of England's Howletts and Port Lympne Zoo Parks, has put it, 'On the whole, Africa, South America and Southeast Asia offer a dismal prospect for the protection of wild creatures....' There has probably never been an issue as important as the one now confronting the conservationist movement. Our decisions at this time will decide the future of many unique species. Nor are they easy decisions to make. We have little but faith and hope to guide us, for we are pioneers in virgin,

uncharted territory; and we must both expect and tolerate the occasional mistake or accident along the way. But time is extremely short – the traffic lights, now hovering at amber, will change to red very soon. We have to clear our heads, make up our minds and unite with a common purpose if we are to be in time to achieve anything worthwhile. Again and again, we have moved into captive-breeding only at the eleventh hour, when the species concerned was already on the verge of extinction, with very poor chances of reproduction even in captivity.



Siberian tiger cubs.

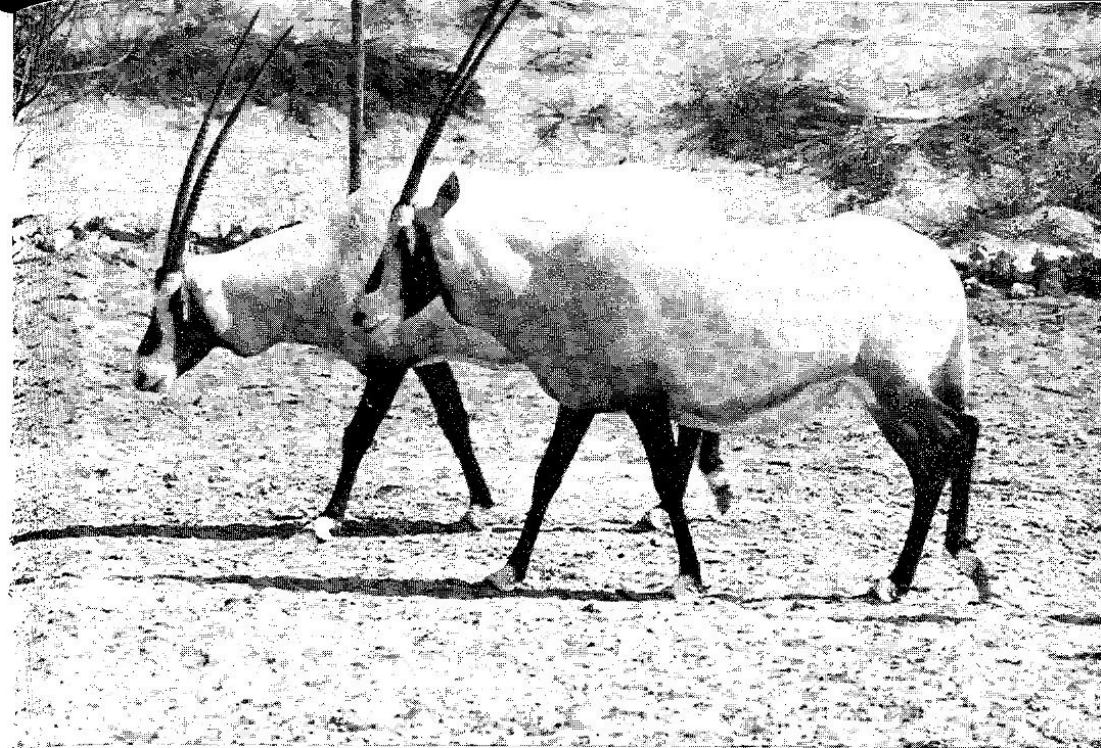
Before I examine the role zoos can play in the conservation of endangered species, let me first outline briefly the history of zoos in general. Zoological gardens, as zoos were once called, existed as long ago as one thousand years before Christ – Chinese Emperor Wen Wang's 1500-acre 'Garden of Intelligence' and King Solomon's zoo-farm, for example – and later in the kingdoms of Assyria and Babylonia, and in classical Greece. What may be termed modern zoo-keeping, however, began in 1752, with the founding of the Imperial Menagerie at the Schonbrunn Palace in Vienna. The world famous Regent's Park Zoo in London, managed by the Zoological Society of London, was first estab-

lished in 1828. The nineteenth century saw a proliferation of new zoos. More than 40 still in existence today, mainly in Europe, are over 100 years old. (The total number of zoos now in existence is estimated to be over 1000). Even from these early times, most zoo managers of any consequence, such as the Zoological Society of London, declared scientific enquiry to be one of their major objectives. To this was added, after World War II, a new impetus to create zoo-based education centres for schoolchildren. The role of zoos in modern, often highly urbanised societies was already mutating. It is only in very recent decades, however, that the idea of zoos as breeding and conservation centres has begun to emerge, a natural response to the increasing human pressures on wild habitat.

Many animals that do still remain in the wild – the Sumatran rhinoceros and the Siberian tiger are two striking examples – cling on to life in such small numbers, and often so isolated from one another, that their chances of survival or propagation already look slim. Even within protected nature reserves, as William Conway, General Director of the New York Zoological Society, has pointed out, populations will probably diminish. Habitat without animals would be as absurd as the reverse situation. But even without wild habitat we should save these animals, if only for a future unknown time when we may be able to reintroduce them somewhere, somehow.... We simply do not know when or where that will be (it could even be in outer space!), but we owe it to future generations at least to make it possible.

It seems likely that zoos will be totally dependent on captive-breeding to supply their exhibits by the year 2000: so it can be argued that the increased interest zoos are showing in breeding springs to some extent from self-interest. About nine per cent of all bird species and 19 per cent of mammals have now been bred in zoos. However, of the approximately 433 species of birds and 320 of mammals officially classified as 'endangered', only about 53 and 154 species respectively are represented in captivity. By 1982, according to Conway, eleven off-exhibit breeding centres were being run by zoos in the USA. They have used laboratory and factory-farm techniques to 'mass-produce' animals such as lemurs, marmosets and even rare parrots.

Although, as I have already pointed out, captive-breeding in many of the more delicate cases leads us into unknown territory, zoos have in fact already chalked up some striking successes, several of them quite early on: the Hawaiian goose and European bison are two cases in point. In 1947, only 50 Hawaiian geese were believed to survive on Hawaii itself, their only home. But after two birds had been taken to Sir Peter Scott's Wildfowl Trust grounds at Slimbridge, England, a gander was at last hatched in 1951, signalling the start of a healthy population increase. In the case of the European bison, the last wild specimen died in 1925, leaving 45 survivors in European zoos. By 1938, these had increased to about 97 pure-bred bison, and today there are more than 600.



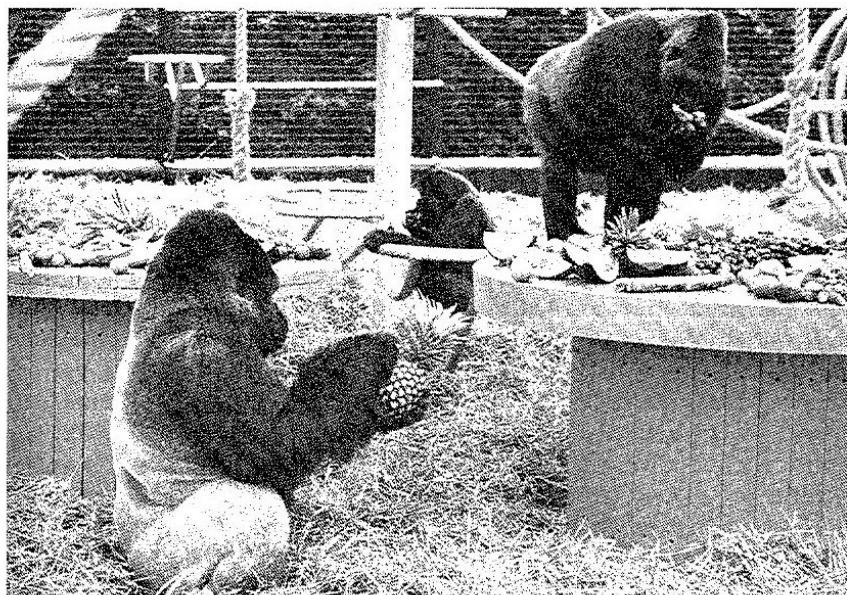
Arabian oryx.

Since these early experiments, zoos have gained much experience and the confidence to attempt even more daring ventures. The record already shows many notable successes in the fields of breeding and reintroduction. The recent return of Père David's deer to China is one very well known such achievement. Had Père Armand David not spotted these deer, already extinct in the wild, in an imperial hunting park near Peking in 1865, and had he not brought a few back to Europe to breed, at the Duke of Bedford's Woburn Abbey estate and elsewhere, these deer would never have survived – before the recent reintroduction exercise, there were no remaining specimens in China itself. Another striking case has been that of the Arabian oryx, thanks to the efforts of Phoenix Zoo, Arizona, in cooperation with London Zoo. In 1961, when the animals were clearly heading for extinction (the last wild specimen, in the Sultanate of Oman, was indeed eliminated in 1972), a small breeding herd of nine oryx was established at Phoenix Zoo. This had increased to 100 by 1969, by which time the animals had been distributed amongst six centres in Europe and the USA. Today the reintroduced Arabian oryx gallops once again across the deserts of its homeland, in the Shaumari Reserve in Jordan and the Jiddat al Harasis plain in Oman. A new generation has already been born to the captive-bred founder herds, young oryx which know only the wild state and have learned all they know only from their natural mothers: thus can the social traditions of a species be

restored even after the trauma of near-extinction and prolonged captivity.

Private collectors' eggs, especially from England, have played a key role in saving Pakistan's cheer pheasant, reduced to less than 5000 individuals by the 1980s. San Diego Zoo in the USA managed in 1984 to rear five chicks from an imported pair of Chinese monal pheasants, a species which was last known even in captivity in 1938. And we may soon hear similar good news of Southeast Asia's green peafowl, thanks to three breeding centres now established in Thailand. The list of zoos boasting successful breeding of rare animals is already long: Washington for the golden lion tamarin; Lincoln Park and Howletts for the gorilla; Whipsnade, England, for the white rhinoceros; Frankfurt for the bush dog; Stuttgart and Basle for the Indian rhinoceros; Helsinki for the snow leopard; Singapore for the orang-utan....

'Natural-environment' zoos like Whipsnade seem to have particularly good breeding potential. Another zoo reporting startling successes is John Aspinall's 500-acre Howletts and Port Lympne Zoo Parks in England, where the motto is, 'The animals come first, the visitors second'. Howletts has notched up 22 gorilla births (19 surviving), three black rhino, the first two African elephant ever to be born in England, 200 tiger and 20 clouded leopard. Very recent Howletts successes have been the fishing cat, the rusty spotted cat, the Javan langur and the maned wolf. Howletts is now concentrating on the hunting dog, bush dog, black-footed cat and marbled cat. In total, more than 90 per cent of the species held at this zoopark have bred. Howletts is also actively involved in rein-



Gorillas at Howletts Zoo.

roduction - programmes are under way for the Przewalski horse, the Indian desert cat and (as a long shot) the gorilla, for example.

But Howlett's most ambitious project yet may well prove a turning-point for the captive-breeding concept worldwide. A Sumatran rhinoceros, recently captured from the wild in an operation sponsored by Howletts jointly with the Indonesian government, is currently housed at Port Lympne, awaiting the transportation of his mate to form the first breeding pair of such rhino in captivity in the West in recent times. Sumatran rhino pairs will also be established at Jakarta Zoo in Indonesia, and at Malacca Zoo in Malaysia, the latter under the auspices of the Malaysian Department of Wildlife and National Parks. At present there is a total of only nine captive Sumatran rhinos in the world, held at these three centres.

An example of how the average nature reserve fails to cope with sudden disaster can be found in the case of the Javan rhinoceros at Ujung Kulon reserve in Java, Indonesia. There are now only about 50 of these animals in the world, and only at this one location. When a mysterious disease, probably anthrax, struck down five of them in 1982, there was no fallback population from which to restock. There was, in fact, nothing anybody could do except stand by and watch.

The terrain at Ujung Kulon is so difficult that it took a very long time even to determine whether any deaths had occurred, or how many, and even longer to discover their cause. Such difficulties would hardly have arisen in a zoo situation.

An additional bonus of zoo-breeding is the potential for acquiring completely new data about the animal's behaviour and needs: very little is known so far about the vast majority of endangered species. Such zoo-acquired data would feed back to improve our management of populations still in the wild. New biotechnology also allows us now to consider a range of 'non-natural' strategies, from artificial insemination to embryo transfer or storage and surrogate motherhood. And one day, maybe, as some zoologists apparently dream, even the complete 'zoo in a freezer' (thanks to cryobiology). Obviously, these techniques can only be used in the context of zoos and good scientific laboratory facilities, with first class veterinary attention always on call.

But it would not be honest to end without reference to some disadvantages of captive-breeding in zoos. Our still limited knowledge and experience in this field, and the trauma of the capture operation itself, always threatens the loss of some valuable specimens along the way in unfortunate accidents. Where the total population is already tiny, as in the case of the Javan rhino, this could be as dangerous as natural disasters in the field. Then there is the problem of maintaining genetic diversity: as Ulysses Seal of the VA Medical Centre, Minnesota, has written elsewhere, the 1,200 or so Siberian tigers now in captivity in the world have been derived largely from only six founder animals. This implies a problem which could hamper other breeding programmes in the

future. The possible incompatibility of subspecies as yet barely even distinguished will require meticulous chromosomal analysis, genetic studies of pedigrees and so on. Reintroduction may be hindered if zoo-bred animals are not carefully managed to avoid 'imprinting' by humans and other non-natural behaviour which could reduce their ability to adjust back to the wild. And of course there is the ever-present spectre of animals marooned in zoos without any remaining habitat into which to reintroduce them.

Another major disadvantage of captive-breeding, from some zoos' point of view, will be the huge financial outlay involved in special laboratory research facilities and equipment, an outlay which will only begin to repay the investing zoo after some considerable time has passed. The cost of both acquiring and reintroducing endangered animals, together with post-reintroduction monitoring, will also weigh heavily on the shoulders of zoo breeding centres, or on those of their sponsors. Only the biggest and best zoos will be able to bear such burdens easily. Only truly selfless and international cooperation can spread the load. Yet, as Conway has put it, 'The value of stewardship of irreplaceable living fragments of nature is not measurable since the fragments cannot be assigned a price and are not expendable at a single point in time'. Or put my way, more simply, what choice have we got?

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BADGERS' SOCIAL BEHAVIOUR:

Some Captive Observations – Part 1

BY M. HANCOX

Badgers and badger watching have become very popular since the publication of Ernest Neal's classic monograph, *The Badger*, just forty years ago. Several superb documentary films, and some 45 books have now appeared in English, including some fine studies of badgers reared as pets prior to the 1973 Badgers Act. Sylvia Shepherd's *Brocky* (1964) and Phil Drabble's *Badgers at my Window* (1969) were amongst the first clear demonstrations of brock territoriality; and a wealth of sociobiological information, albeit rather scattered, has now accumulated. Chris Ferris for example records traditional learnt specialist foraging techniques; to discover mole earthworm-larders, unroll hedgehogs, or locate rabbit breeding stops; while the summer communal living of families teaches cubs the home range and clan's outliers, encourages independence, and perhaps most importantly, establishes the cubs' "place" amongst the other members of the community. The functions of scent marking, grooming and play have long been controversial, with surprisingly few critical studies (e.g. to define "dominance"); although comparison with primates suggests a socially integrative role for all three traits. Non-procreative sexual behaviour may also comparably fulfil this function, although remarkably few observations on badger mating have been published. Records were scanty, mostly of chance summer sightings, prior to the 1950's, since the main rut is post-partum in February/March, not a time of year conducive to prolonged badger watching! Mating is hence now recorded for every month of the year, despite consistent spring cubbing with variable delays in implantation, but February/March accounts for 31 per cent of Neal's latest survey. Social behaviour is perhaps most easily observed in captivity, and the present study attempts firstly to clarify social organisation; the second section looks at rutting behaviour.

Intensive observation of social behaviour in a private collection "artificial clan" at Banchory, Scotland, were made during the spring rut and entailed 42 hours of watching, over 16 days, from 5th March to 15th April 1979 (see *Ratel* 14(5)162 & 14(6)189). The colony of 3 M / 3 F adults comprised the dominant mature pair, and their progeny, as in wild situations: Tim / One Lug circa 4/6 years old (N.B. ears are frequently damaged in territorial battles); Charlie & Joanna were 2 year olds; Peter and Valentina were yearlings, born on Valentine's day the previous year.