

(2.3) from the world herd at Phoenix and San Diego Wild Animal Park and I am happy to report that the first calf was born on 1 October.

Other antelopes at Berlin with satisfactory breeding records are Scimitar-horned oryx *O. dammah* (19 births), Addax *Addax nasomaculatus* (19 births) and Bontebok *Damaliscus d. dorcas* (18 births). Addax at Dresden and Bontebok at Leipzig should also be mentioned.

BIRDS

Although over the past 20 years a number of zoos in the GDR have pursued bird breeding programmes, I will limit my comments to Berlin.

Of the world's eight species of pelican, only the Australian pelican *Pelecanus conspicillatus* has not laid and incubated eggs in our collection. In 1961 we successfully raised the first White pelican *P. onocrotalus* and since then 15 chicks, including six second generation, have been reared. Two American white pelicans *P. erythrorhynchos* and two Brown pelicans *P. occidentalis* have been hatched.

We attribute our success with these rarely bred birds to management techniques which include (1) feeding throughout the year with freshwater fish, acquired once or twice a week from local lakes; (2) maintaining a large group of birds (i.e. c. 25) to provide social stimulation; (3) the availability of large amounts of nesting material during the breeding period, a further factor in sexual stimulation.

In 1978, as part of an international breeding programme, we received on loan from the Wildfowl Trust a pair of White-winged wood ducks *Cairina scutulata*, which will reach sexual maturity in 1980. Hawaiian geese *Branta sandvicensis* are regularly bred.

Up to the present only small numbers of pheasants have been kept at Berlin. Edwards' pheasants *Lophura edwardsi* are regularly bred and we have sent some birds to the World Pheasant Association in England for out-breeding. In 1966 we quarantined four pairs of White eared pheasant *Crossoptilon crossoptilon* from Peking, subsequently retaining

one pair and sending two pairs to Jersey Zoo and a pair to Antwerp. Our first successful hatching was seven chicks in 1968 and the Jersey birds began to reproduce in 1969. To date we have bred 64 young, some of which have been exchanged with young from Jersey.

Other pheasants kept and bred include the Siamese fireback *Lophura diardi*, Hume's bar-tailed pheasant *Symaticus humiae*, Mikado pheasant *S. mikado* and Palawan peacock pheasant *Polyplectron emphanum*.

Since the establishment of the Tierpark Berlin, 25 years ago, we have systematically built up our collection of birds of prey. The more spectacular of the numerous breeding successes have been nine Bald eagles *Haliaeetus leucocephalus*, eight Tawny eagles *Aquila rapax*, nine Long-legged buzzards *Buteo rufinus*, eight American black vultures *Coragyps atratus* and Himalayan vultures *Cyps himalayensis*. A number of other important species, which have nested but so far without success, include the Lammergeier *Cypaetus barbatus* Steller's sea eagle *Haliaeetus pelagicus*, White-tailed sea eagle *H. albicilla*, Golden eagle *Aquila chrysaetos*, Wedge-tailed eagle *A. audax* and Ornate hawk eagle *Spizaetus ornatus*. Our Harpy eagles *Harpia harpyja* laid and brooded this year but unfortunately both are ♀.

A special breeding area is planned and the first section, four pens for cranes, was completed this year. At present these are occupied by two pairs of White-naped cranes *Grus vipio* and a pair of Hooded cranes *G. monacha*. We hope that breeding will occur in the not too distant future.

Special mention must be made of work on a native bird, the Great bustard *Otis tarda*, whose north-western limit of distribution lies within the GDR. Throughout its entire range there has been a rapid decline in the last decade and at present the only relatively stable European population is in Hungary. Our native population of 800 was drastically affected by the severe winter of 1978/79, but undoubtedly the wide use of pesticides and the increasing mechanisation of farming has accelerated the decline. Each year nests are abandoned as a result of agricultural disturbance and the Academy of Agricultural

Sciences has established a rearing station where threatened clutches are brought for artificial incubation, and the young are reared and released. Between 1973 and 1978 188 young bustards have been returned to the wild and last year some of these were recorded as breeding for the first time.

Despite protective measures, however, the wild population continues to fall and this places greater emphasis on captive reproduction. Berlin has kept the species since 1958 and before the establishment of the rearing station was, together with Leipzig and Magdeburg, concerned with the rearing of the abandoned wild young.

At present we have 23 captive birds which are housed in a 2500 m² enclosure. After many attempts, 1972 saw the successful rear-

ing of two young from four eggs laid. This was only the second success in captivity, the first being in West Berlin Zoo in the 1960's. Poland and Hungary are also seriously concerned with the maintenance of this species in captivity and at the Third International Symposium at Poznan in 1979, it was resolved to encourage further studies on the biology and ecology of the species with the aim of regular captive breeding and eventual return to the wild.

I hope that this paper has conveyed some idea of the many-sided activities in the GDR relating to conservation and reproduction of endangered species. Naturally, breeding is but one aspect of the range of scientific studies which involve maintenance, behaviour, reproductive biology and nutrition.

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Philosophy and results of breeding endangered species at Dvur Kralove n.l.

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If the conflict between man's continuing demands and the needs of the rest of the living world is not to result in the tragic and unjustifiable extinction of many animal species in the near future, positive action is imperative. We have two practical courses open to us. One is to try by all available means to save parts of the natural habitat and make it possible for some critically endangered populations to survive in national parks, reserves and sanctuaries protected by legislation. Secondly we can create a modern type of 'zoological gardens' which will act as genetic banks where animals can live and breed under conditions similar to those of the original habitat. The second is the aim of the Zoological Garden in Dvur Kralove nad Labem.

Situated on the western outskirts of the town at an altitude of c. 300 m, the 107 ha zoo occupies a grassy valley, through which a small brook runs, and partially forested slopes where the original vegetation has been

preserved. A high quality water supply is guaranteed by the brook which rises in a forested, sparsely inhabited region with little agrochemical interference. A range of hills, some 800 m high, protects the zoo from prevailing cold and humid west winds and to the north it is sheltered by the Giant Mountain range and its promontory. Air pollution is low since any emissions carried by the prevailing winds from distant industrial areas are effectively filtered during their passage over the mountainous, densely forested areas.

The region is a mild one of medium humidity; the annual average temperature is 7.2°C and average rainfall 686 mm/m². These exceptionally favourable conditions for central Europe, together with a number of other factors, have led to this once relatively unimportant provincial zoo being chosen as the site of a preservation centre.

Since no one institution would be capable of including all the endangered vertebrates

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within its orbit, specialisation is always necessary and, taking into consideration the conditions and facilities at our disposal, we decided to concentrate on the large African ungulates. Thanks to successful expeditions to Africa, we have assembled basic breeding groups direct from the wild and believe we have a good genetic pool founded on healthy animals.

RESEARCH FACILITIES

The zoo, however, is not only a storehouse of rare species. In a large research institute, well equipped with modern facilities, ecological, ethological, physiological and biochemical studies are made of the species in our charge.

The institute has two main aims: (a) to contribute to knowledge of specific biological data which are difficult, if not impossible, to obtain in the wild; (b) to endeavour to discover the optimum conditions for each species, i.e. ideal living, food, social and other conditions necessary to allow the species to reach its full physiological development, including sexual cycles.

Specialised laboratories, in close co-operation with ecologists and ethologists, investigate the best type of care for the animals with maximum breeding as the aim, and excellent results are being achieved through co-operation and discussion with similar institutions in Czechoslovakia and other parts of the world.

An integral part of the institute is a modern veterinary clinic, specialised in disease prevention, diagnosis and therapy of captive species. It includes laboratories of parasitology, microbiology, virology, haematology, biochemistry and nutrition, as well as a clinic with two operating theatres and supporting laboratories.

The pathology department is an essential feature in a zoo, particularly where rare animals are involved, since, even after death, the individual is valuable for scientific and research purposes. A taxidermy and preparation department processes carcasses for use as biological specimens, many of which are passed to the zoological department of the National Museum in Prague.

EDUCATION

Education, recreation and cultural activities are of no less importance. For modern man, largely divorced from nature, a visit to the zoo is a useful and attractive way to spend leisure time. Through education schemes, it is possible to encourage the young from an early age to appreciate and understand nature, to acquaint them with animals they have known only from books or films, and finally to encourage university graduates to study and make their own contributions to knowledge of wildlife. At present our staff includes 21 university graduates and 28 secondary school technicians who work in research, science, management and education.

Dvur Kralove itself is a town of only 16,000 inhabitants, but the zoo attracts visitors from far afield, its average annual attendance figure being in the region of 800,000, of which some 140,000 come from abroad.

THE COLLECTION

The zoo is divided into two sections: the 'classical', which is basically the modernised original zoo and contains a collection of animals from all the continents, and the much larger 'safari', which specialises in African ungulates. Here the animals are housed in large open-air enclosures which are set into the landscape and separated from each other by ditches and mounds to help preserve a natural appearance. While the old zoo remains largely recreational and educational, the second section is our scientific workshop and the subject of our experiment.

The construction of such an area, the design and concept of which was quite unusual in our conditions, was not without problems. It was necessary to build up our own team of designers and construction workers and a technical department for dealing with construction and transport equipment. The services of some of the best Czechoslovak design and construction companies were also engaged for work on bridges and communications.

The designs for winter quarters suitable for African ungulates were untested and

SPECIES	BREEDING COMMENCED	AVERAGE NO IN BREEDING HERDS	NO BIRTHS
Hartmann's mountain zebra <i>Equus zebra hartmannae</i>	1972	2.15	4.8
Grant's zebra <i>E. burchelli boehmi</i>	1974	2.7	4.2
Chapman's zebra <i>E. k. chapmani</i>	1970	2.11	17.18
Damara zebra <i>E. k. antiquorum</i>	1971	2.11	10.15
Maneless zebra <i>E. burchelli ssp</i>	1969	2.15	25.25
Grevy's zebra <i>E. grevyi</i>	1971	2.16	19.19
Southern white rhinoceros <i>Ceratotherium s. simum</i>	1970	2.6	1.1
Northern white rhinoceros <i>C. s. cottoni</i>	1975	2.5	0.1
Black rhinoceros <i>Diceros bicornis</i>	1971	2.8	1.2
Uganda or Baringo giraffe <i>Giraffa camelopardalis rothschildi</i>	1969*	3.26	10.15
	1976	3.15	1.0
Nyala <i>Tragelaphus angasi</i>	1974	2.8	8.12
Lesser kudu <i>T. imberbis</i>	1972	2.13	11.11
Greater kudu <i>T. strepsiceros</i>	1971	2.12	6.17
Bongo <i>Bococercus eurycerus</i>	1974	2.3	5.5
Eland <i>Taurotragus oryx</i>	1969	2.15	49.55
Cape buffalo <i>Syncerus c. caffer</i>	1971	2.10	12.18
Eastern waterbuck <i>Kobus c. ellipsiprymnus</i>	1972	2.10	12.8
Lechwe waterbuck <i>K. leche</i>	1974	1.4	4.9
Nile lechwe <i>K. megaceros</i>	1972	2.4	7.5
Mountain reedbuck <i>Redunca fulvorufula</i>	1972	2.5	4.12
Roan antelope <i>Hippotragus equinus</i>	1969	2.15	34.61
Sable antelope <i>H. niger</i>	1969	2.10	42.38
Gemsbok <i>Oryx g. gazella</i>	1971	2.12	18.20
Bontebok <i>Damaliscus d. dorcas</i>	1972	2.5	2.2
Blesbok <i>D. d. phillipsi</i>	1972	2.12	22.20
Tupii <i>D. lunatus jimela</i>	1974	2.4	3.7
Hunter's antelope <i>D. hunteri</i>	1971	2.3	6.6
Cape hartebeest <i>Alcelaphus buselaphus caama</i>	1972	2.13	11.14

SPECIES	BREEDING COMMENCED	AVERAGE NO IN BREEDING HERDS	NO. BIRTHS
Jackson's hartebeest <i>A. b. jacksoni</i>	1974	1.6	1.3
White-tailed gnu <i>Connochaetes gnou</i>	1972	2.8	3.9
Brindled gnu <i>C. t. taurinus</i>	1974	2.9	7.7
White-bearded gnu <i>C. t. albojubatus</i>	1969	2.9	12.13
Impala <i>Aepyceros melampus</i>	1974	2.10	9.12
Springbok <i>Antidorcas marsupialis</i>	1974	2.10	5.14
white form	1972	2.6	4.9
black form	1972	2.13	32.35

* herds destroyed by order of State Veterinary Service 29 Apr 1975.

Table 1. Breeding record of 35 species or subspecies of African ungulates at Dvur Kralove Zoo between 1969-1979.

based purely on our own experiments. As there may be up to -20°C of frost in our winters, completely reliable heating and air-conditioning systems were essential and each house was provided with two alternative means of heating, functioning on different power sources, fully automatic and centrally controlled. Quarters for the most valuable animals have a closed-circuit television relayed to the central management office.

Most of the houses are not open to the public but all have open-air pens attached where, in favourable conditions, the animals can remain for at least part of the day, so that their acclimatisation is not lost. Inside the areas are subdivided into different sized sections, which can be interconnected as necessary depending on the animals' requirements. Temperature is usually kept within $15-18^{\circ}\text{C}$ although, occasionally, when sensitive young are born this is raised for a short period to 20°C or more. In summer, i.e. from the middle of May to middle of October, the animals can usually remain outdoors and need only simple shelters to protect them in bad weather.

The first expedition to Africa to collect the founders of our breeding groups was organised in 1969 and we tried to select young animals in good health and with good

breeding prospects. After several months in confinement in their natural climatic conditions, when they were becoming accustomed to the presence of human beings and strange food, another selection was made. The final choice of the most adaptable individuals was, we believe, the reason for the successful transport, with little loss of life (Vagner, 1974). In following years another six expeditions were organised. Altogether 847 mammals, 617 birds and 429 reptiles were imported. All were quarantined at the zoo for three months and acclimatised to central European conditions. Only after this were breeding groups created and put into open-air enclosures (Dobroruka, 1974).

Great attention is given to the structure of breeding herds. With most species only one mature σ is kept in the herd. The q are of different ages and some of the original animals captured in Africa, although slowly coming to the end of their reproductive lives, are still breeding. Many of the younger mothers have themselves been born in the zoo. Adult and subadult $\sigma\sigma$ born in the zoo are separated from the breeding herd and often kept in small, sometimes mixed species, groups. If no σ is required for breeding purposes by another institution they are often used for research and experimental purposes.

With the very rare species, we try to form two independent lines, which are kept completely apart, to provide separate gene pools and to diminish the risk of an epidemic annihilating the entire breeding population.

During the past few years we have been able to evaluate the results achieved. Today we can report that the majority of the imported animals have acclimatised well to our conditions and breed successfully (Table 1). The data suggest that our policy is a sound one and much valuable experience has been gained, but we realise that we are still only at the beginning of our work. We are

lucky that we are not facing this task alone. Similar institutions are being founded throughout the world and co-operating in the common aim of preserving the immense variety of nature for future generations. The human race is exceptional only in that nature has equipped us with intellect. Let us therefore try to use it.

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Breeding endangered species in Israel

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Amongst those of us who in 1964 initiated the Nature Reserves Authority were several people who had already given a great deal of thought to the fate of the animal species, frequently mentioned in the Bible, which were once indigenous to Israel. It was our hope that species which by now had disappeared completely from Israel - but remnants of which were still to be found in other countries - might be returned, first as breeding nuclei and eventually to pave the way for reintroduction to their ancient habitats. Inherent in this scheme was a dual purpose: first, to participate in the worldwide task of saving animal species from extinction; and second, to help in the national effort of reclaiming the land for agriculture and making it once again flow with milk and honey. Such a plan, we considered, would not be complete without at least some attempt to reintroduce the wildlife that had inhabited the country in years gone by, and in this way to preserve the heritage passed down to us through the Bible.

When and how these species had vanished from the land which connects three continents - Africa to the south, Asia to the east, and Europe to the north - is not known.

All that we do know is that throughout history, whenever a great power had set out to conquer the ancient world, its passage lay through Israel, a path that could not but play havoc with the country's fauna and flora. In modern times also, the natural environment has continued to bear the consequences of the strategic position of this strip of land.

The aim was the establishment of three wildlife, or 'Hai-Bar', reserves. One was to be set up in the Arava, an area of desert in the Afro-Syrian rift valley between the Dead Sea and the Red Sea. The second reserve was planned for the wooded central part of the country, a mediterranean environment once chiefly inhabited by browsers. The third was to be established in the north, in a mountainous region closely resembling an alpine terrain. With the funds at our disposal we have so far been able to set up the first two reserves; the third must await further finance.

SELECTION OF SPECIES

Our first hurdle - a serious and difficult one - was how to identify the animals mentioned, sometimes in brief, sometimes at length, in the Bible with species such as we know them at the present time. Amongst the