



KOEN MARGODT

THE WELFARE ARK

SUGGESTIONS FOR A RENEWED POLICY IN ZOOS

VUB UNIVERSITY
PRESS

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SUGGESTIONS FOR A RENEWED POLICY IN ZOOS

KOEN MARGODT

This book is the result of more than ten years of research. Species are vanishing at an increasing rate in the wild and many animals are living in unfavourable welfare conditions. The Welfare Ark offers suggestions that will help zoos deal with both of these issues. In doing this this book intends to help bridge the gap between zoos and organisations for animal welfare and animal rights. At the same time it is a highly critical investigation and offers a constructive proposal for innovation.

Koen Margodt holds a degree in Moral Philosophy from the University of Ghent, Belgium.

"I highly recommend this important book. It will be of great interest to those with interest in zoo politics, to the zoo going public – and, indeed, to anyone who is interested in and cares for animals."

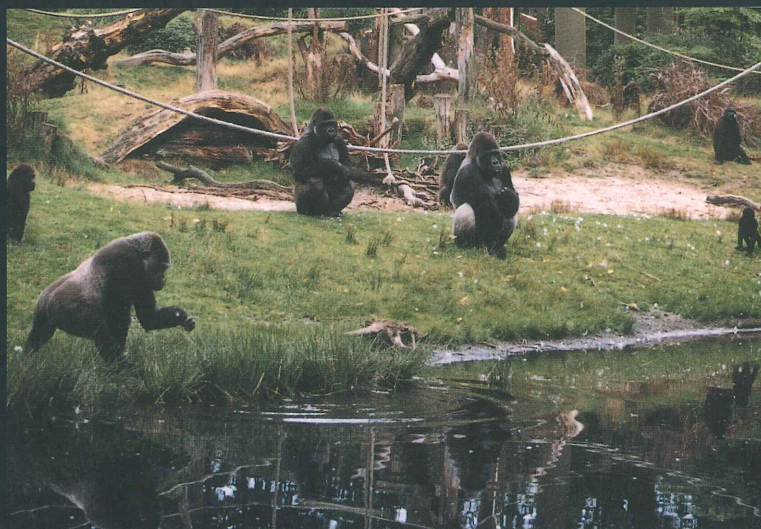
Jane Goodall

"(...) an impressive and genuine piece of research on an important subject (...)"

Mary Midgley

"I am impressed by how well informed his account of various zoo problems is, how well rooted it is in actual cases he has observed or investigated, and how careful his discussion of some very tricky issues is. (...) [This] book has a great deal to contribute to an ongoing debate (...)"

Stephen Bostock, Glasgow Zoo



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Koen Margodt

The Welfare Ark

*Suggestions for a renewed
policy in zoos*



**VUB UNIVERSITY
PRESS**

In memory of Dr. Barbara Petri.

And for Arnold, Flip, Iris, Ivo, Jimmy, Maaïke and Tony.

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List of Abbreviations

ARKS	Animal Records Keeping System
AZA	American Zoo and Aquarium Association
BFF	Born Free Foundation
CBSG	Captive Breeding Specialist Group
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
EAAM	European Association for Aquatic Mammals
EAZA	European Association of Zoos and Aquaria
EEP	European Endangered Species Programme
GAIA	Global Action in the Interest of Animals
IMATA	International Marine Animal Trainers Association
IPPL	International Primate Protection League
ISIS	International Species Information System
IUCN	International Conservation Union
IUDZG	International Union of Directors of Zoological Gardens
IZY	International Zoo Yearbook
NFRZG	National Foundation for Research in Zoological Gardens
PETA	People for the Ethical Treatment of Animals
SSC	Species Survival Committee
SSP	Species Survival Plan
TAG	Taxon Advisory Group
TRAFFIC	Trade Records Analysis of Flora and Fauna in Commerce
UFAW	Universities Federation for Animal Welfare
UNEP	United Nations Environment Programme
WSPA	World Society for the Protection of Animals
WWF	World Wildlife Fund
WZCS	World Zoo Conservation Strategy

Introduction and Acknowledgements

This book is partly based on my thesis on zoos, which I wrote as a student of Moral Philosophy at the University of Ghent. My interest in animals in general and animal ethics in particular was already present a long time ago, when my mentor Prof. Jaap Kruithof proposed that I should undertake a study on zoos. Why did I accept his proposal? The subject of zoos combined several advantages. Relatively few systematic evaluations on this subject seemed to exist when compared, for example, to the topics of laboratory animals and intensive farming, and so this project could perhaps have a wider significance. It also allowed me to deal with two themes that are of special interest to me: animal welfare and the conservation of endangered wildlife, and the way they are interrelated. The most fascinating challenge, however, was to find an answer to the question of what influence zoos may have on the animals they display. Criticism of zoos mainly relates to the suggestion that animals feel bored, that they suffer — in a psychological sense. However, how is it possible to deal rationally with notions such as animal boredom in zoos and the psychological welfare of animals?

As a child I loved to be taken by my parents to Antwerp Zoo. Yet I remember very well the feelings and questions that came into my mind when I saw, as a five year old boy, a single silverback gorilla on a small patch of grass, living between tiled walls and with only one tree-trunk to climb on. Or when I saw a lone orangutan in a monotonous indoor enclosure, who could only enrich his life by repeating the movements made by amused visitors in front of him — touching his left or right ear, clapping his hands... The response of the zoo guide to my questions, when we visited

the zoo as sixteen-year-old schoolpupils, was completely unsatisfactory to me. I only made her nervous and annoyed our accompanying mathematics teacher. These very questions of course evolved throughout the years, but they were my main motive to deal with this subject.

Concern for the welfare of individual animals was thus an important driving force of my research. However, by visiting several zoos, I have learnt to know and appreciate the changes that are taking place in the world of zoos. I was delighted when I saw, for example, the bonobo island and otter enclosure at Animal park Planckendael (Belgium), the chimpanzee island at Arnhem Zoo (the Netherlands), the Asiatic black bear enclosure at Glasgow Zoo (Scotland) and the many rich enclosures at Apenheul Zoo and Emmen Zoo (the Netherlands).

This report consists mainly of three parts. Firstly some general considerations will be made on the characteristics of animals and the notion of animal welfare. I will describe some welfare problems that can be found in zoos. For this, I have primarily made use of reports and publications of the zoo community itself. I am convinced that many of the elements that are mentioned in these documents deserve the attention of the general public. Publications for the layperson often focus on the successful enrichment of zoo enclosures. Reading — or writing — about negative welfare conditions is certainly not an enjoyable activity, especially given the valuable efforts of many zoo people. However, as long as welfare problems can and do occur in zoos they deserve our special attention. The examples I will give are by no means exhaustive; neither should it be concluded that they represent the overall welfare situation in zoos. They are only meant to illustrate some welfare problems that still exist in certain zoos.

In the second part I will discuss the arguments for and against the roles that zoos aim to fulfil: conservation of endangered species, education, recreation and research. In this discussion, people from both sides sometimes seem to play the game of musical chairs: they jump from one argument/role to another. My intention is to evaluate each role on its own merit.

The third part is perhaps the most important — most constructive — one. It contains a proposal for a new policy, a policy that attempts to integrate both the goal of respect for the welfare interests of individual animals and the aim of contributing to the conservation of endangered species of animals in a variety of ways.

Several people have provided me with valuable information and/or suggestions: Leobert de Boer (Apenheul Zoo), Roy Borghouts (The Jane Goodall Institute, Holland), Ian Bride (The Durrell Institute of Conservation and Ecology, Canterbury), Koen Brouwer (EEP/EAZA Executive Office and The National Foundation for Research in Zoological Gardens, Amsterdam), Fred Daman (The Royal Zoological Society of Antwerp), Helga De Bois (The Royal Zoological Society of Antwerp), Walter De Meurichy (The Royal Zoological Society of Antwerp), Estella Franssen (The Jane Goodall Institute, Holland), Tine Griede (Emmen Zoo), Hendrik Gysels (University of Ghent), Tricia Holford (The Born Free Foundation, Surrey), Philippe Jouk (The Royal Zoological Society of Antwerp), Janet Kear (The Wildfowl Trust, Ormskirk), Jaap Kruithof (University of Ghent), Frank Odberg (University of Ghent), Florence Pieters (Artis Zoo, Amsterdam), Esteban Rivas, Andrew Rowan (Tufts School of Veterinary Medicine, Grafton), Gie Robeyns (The Royal Zoological Society of Antwerp), Mark Schoonvliet, Harry Schram, Fernand Schrevers (The Royal Zoological Society of Antwerp), Gabriela Seifert (Species Survival Programme, IUCN, Gland), Wim de Temmerman (University of Ghent), Leo Thiers, William Travers (The Born Free Foundation, Surrey), Roland Van Bockstaele (The Royal Zoological Society of Antwerp), Erik Van der Straeten (University of Antwerp), Michel Vandebosch (Global Action in the Interest of Animals, Brussels), Linda Van Elsacker (The Royal Zoological Society of Antwerp), Hella Van Rooij (Sink or Swim, Amsterdam), Etienne Vermeersch (University of Ghent), Henk Verhoog (University of Leiden) and Françoise Wemelsfelder (University of Leiden). To all of them: many thanks for your help.

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Welfare considerations¹

Characteristics of animals

The behaviouristic school of thought, which has profoundly influenced the attitude of scientists towards animals, states that no reliable information can be obtained about what animals experience, that their experiences are inaccessible for scientific investigation. This has been taken further by stating that animals have no experiences at all. What might have originated in an attitude of scientific prudence towards dealing with such a complex topic as animal minds, has thus resulted in the statement that animals have no minds at all, that animals cannot have feelings such as pain, hunger or joy.

Such a concept of animals clearly has significant consequences for the meaning of animal welfare. As far as it is still meaningful to speak of welfare, it becomes comparable to the 'welfare' of plants, or of cars and computers. Animals then 'need' food, just as plants need water, or cars oil.

However, studies concerning mainly mammals and birds, both in nature and in captivity, have made it highly questionable to consider animals as mere 'automatons', having no experiences at all. Many animals seem to be *subjects, beings with cognitive capacities, who can explore, memorise and who seek to control their environments, who can have feelings of pain, depression, joy and anger, and who can have preferences and show volitional behaviour.*

The sceptical assertion that the complex behaviour shown by animals does not prove that they experience anything, or that their experiences are inaccessible, is a defensible position. But it can also be applied to human

beings, at least to humans other than oneself. Although we cannot know exactly what it is that animals experience, there is considerable evidence available to make reliable assumptions that certain animals have cognitive, emotional and volitional capacities.

Three intertwined arguments can be mentioned in support of this: (i) evolutionary considerations, (ii) anatomical and physiological data and (iii) ethological observations.

Evolutionary considerations point towards (a) the relationship between humans and several animal species and (b) the survival value of being a subject:

- a) The close evolutionary ties between human beings and chimpanzees are well accounted for. These two species divided only five to ten million years ago and they share about 98.4% of their genetic material. Chimpanzees have more genes in common with humans than horses have with zebras. So we ought not to be surprised that non-humans may also turn out to be subjects².
- b) Subjective capacities can be relevant for the chances of survival. Experiencing pain can be a valuable means of helping to avoid further harm. When it is possible for animals to play, explore and manipulate, it seems that these actions are beneficial for their behavioural flexibility, making them more capable of adapting to changes in their environment³.

In so far as *anatomical and physiological information* is concerned, the structure and function of the nervous system is of special importance. For instance, pain fibres identical to those in humans exist in mammals and electrical stimulation of the pulp of a tooth leads to a pattern of electrical activity that is alike in both the human somatosensory cortex and in the somatosensory cortex of dogs, cats and monkeys⁴.

The most varied and impressive are perhaps the *ethological observations* in support of animals being subjects. This evidence can be grouped along three lines: (i) the behavioural similarities between animals and humans (for instance the screaming and shivering of a dog), (ii) the conditions under which this behaviour is shown (when the dog is beaten) and (iii) the effects which can be predicted when some aspects are changed (when the beating stops, the screaming also ends).

Before giving some examples of ethological support for animal subjectivity, it ought to be noted that any search for experience in animals also re-

lies to some extent on a comparison with human experience. The same is true for the investigation of experience in other humans: one can only understand what it means for someone else to be in pain or to be able to hear, when he himself is capable of being in pain or being able to hear. This does not automatically mean that the study of animals as subjects is anthropomorphic, in the sense that typical human characteristics are attributed to non-humans, that animals are seen "as little human beings in furry skins"⁵. Rather, it signifies that one tries to find common characteristics in both humans and animals, knowing that these may be considerably different from each other (for example prey detection in snakes by infrared vision and in bats and dolphins by echolocation).

Behavioural illustrations

In the beginning of this section several subjective capacities of animals were mentioned. In the following, these capacities will be illustrated step by step by ethological observations.

Animals as subjects with cognitive capacities, who explore, memorise and seek to control their environments.

In a study described by Dawkins captive marsh tits and chickadees were allowed to hide fifteen seeds in 72 holes in artificial trees. The birds were then removed for 24 hours. Next, the seeds were also removed and the holes were covered with small doors in order to block out factors such as smell or visual marks. When the birds re-entered the cage, they flew systematically to those holes where the food would have been and they did this without following a fixed track⁶.

Primatologist Biruté Galdikas uses the following image to illustrate the knowledge that orangutans have of their environment:

"(...) wild orangutans do not wander aimlessly about their home range, taking pot luck. Their movements are deliberate and purposeful. Orangutans seem to operate according to detailed cognitive maps of their surroundings, which include not only the location of food sources, but also quantitative information on distances. Orangutans know that when one tree of a particular species is fruiting, other members of that species probably will be, too. For instance, an orangutan may spend an hour or so eating in a particular species of tree, leave

that tree, and move rapidly toward an unseen goal, arriving at another member of the same tree species. Along the way the orangutan may stop to inspect the leaves, fruit, or bark of other species of trees, but leave without eating. Apparently, the orangutan is checking the condition of the food (...). If the fruit is not yet ripe or the leaves are too mature and therefore toxic, the orangutan seems to file this information away, and returns to the tree sometime later when the fruit is ripe or a new flush of young leaves has bloomed. I once saw Cara leave her home range and head directly to two wild durian trees, which happened not to be fruiting. In one thousand hours of observing Cara, I never saw her visit those trees before or after, but I had no doubt she knew where she was going. For wild orangutans, out of sight is not out of mind."⁷

Animals as subjects, who can experience feelings of pain, depression, joy and anger.

George Schaller (Director for Science at Wildlife Conservation International, a division of the New York Zoological Society) describes the play behaviour of a panda at the Chinese breeding station at Wolong:

"The one surviving panda youngster, then two years old, was permitted into the outdoor enclosure because we were there. Released from its dark cell, it exploded with joy. Exuberantly it trotted up an incline with a high-stepping, lively gait, bashing down any bamboo in its path, then turned and somersaulted down, an ecstatic black and white ball rolling over and over; then it raced back up to repeat the descent, and again. It gave me a glimpse behind the panda's tranquil face, it emphasized the imagination there."⁸

An offspring of a chimpanzee at Arnhem Zoo died within a few weeks of birth, most likely because the mother did not produce enough milk. Ethologist De Waal describes her reaction:

"Every time one of her own children died, she would go into a kind of depression. For weeks on end she would sit huddled in a corner without reacting at all to the goings-on about her. Sometimes she would start screaming and yelping of her own accord."⁹

Animals as subjects who have preferences and show volitional behaviour.

Many animals prefer to work for their food instead of taking it directly from an available food-source. Animals such as rats and pigeons will, in the

presence of free food, even spontaneously learn a behavioural task to obtain food. In an experiment with rats, 95% of the animals maintained preference for working when the amount of food received in the work chamber was diminished. It is suggested that they prefer to control events in their lives¹⁰.

An example that indicates both the experience of discomfort and the existence of preference in rats is that they normally prefer to drink a sugar solution rather than water containing an analgesic, but when their joints are chronically inflamed, they prefer to drink the solution with the analgesic¹¹.

A researcher set up an experiment regarding the long-term effects of smoking. This failed, however, when many of the mice and hamsters involved started to deposit their faeces in the tubes that blew cigarette smoke into their living container¹².

These examples suggest that the members of several animal species are beings who are capable of experience. Although many questions still remain (for example if invertebrates are capable of experience, or to what extent animals are conscious of what they appear to experience), this information is best taken into account when dealing with the notion of animal welfare.

Animal welfare

The above implies that what happens to animals matters to themselves and that welfare not only includes physical, but also social and psychological well-being. These factors are clearly connected with each other.

Physical well-being refers to aspects such as length of life, reproduction and being free of disease. Important factors which secure physical well-being are the availability of adequate food, shelter, health care and appropriate climatic conditions.

Social well-being entails much more than how often animals can have sexual intercourse. Individual preferences can be shown for social interactions such as playing and grooming, and lifelong bonds can be established between certain animals (for example chimpanzees).

Psychological well-being goes beyond having no pain or living a safe life. Many animals can have positive experiences, illustrated by play behaviour.

Many animals are active subjects. They explore new environments, seek novel stimulation and have their own preferences. A carefully designed notion of animal welfare will take this into account. Such a notion might be called '*welfare autonomy*', with autonomy not referring to a life of complete freedom and independence, but to the possibility of living according to one's own needs and preferences.

Although autonomy is an important part of animal welfare, it does not mean that assuring maximum autonomy is sufficient in itself as a guarantee of this welfare. An animal clearly does not always do what is best for its own welfare (for instance eating poisonous plants). Therefore, besides the preferences of an animal other welfare parameters (for instance not getting injured) also have to be taken into consideration when trying to determine what is best in serving the animal's welfare.

NOTES

¹ For the first part of this section I have primarily consulted Bateson, 1991; Dawkins, 1980; Dawkins, 1990; Dawkins, 1993; Griffin, 1992; Wemelsfelder, 1993; Wemelsfelder and Griede, 1989 and Wiepkema and Koolhaas, 1992.

² Leakey and Lewin, 1992: 88, 101-103.

³ Wemelsfelder and Griede, 1989: 10.

⁴ Bateson, 1991: 833.

⁵ Dawkins, 1980: 13.

⁶ Dawkins, 1993: 40-45.

⁷ Galdikas, 1995: 368-369.

⁸ Schaller, 1993: 66.

⁹ De Waal, 1982: 36.

¹⁰ Wemelsfelder, 1993: 95-99.

¹¹ Bateson, 1991: 832.

¹² Dawkins, 1993: 150-151.

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Structural welfare aspects

An evaluation of the situation of animal welfare in zoos should not be limited to an examination of the animals' living conditions in the enclosures, but must also take into account the zoos' policies within a broader context. These structural aspects mainly concern the seizure of animals from nature and how zoos deal with surplus animals.

The seizure of animals from nature

The signing of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 1973 seriously reduced the seizure of animals for zoos. According to William Conway (Director of the Bronx Zoo and President of the Wildlife Conservation Society — formerly the New York Zoological Society) about 93% of all mammals and 75% of all birds added to the collections of zoos of the American Zoo and Aquarium Association (AZA) in recent years have been zoo-bred. Conway stresses that he cannot find any example of zoo-collecting which has formed a significant cause in the decline of any species¹. Leobert de Boer (then the Director of the EEP Executive Office in Amsterdam, which co-ordinates the European Endangered Species Programmes) has said that in so far as animals are still captured for zoos, they do not belong to the class of mammals in the main². William Travers (Director of the animal welfare and conservation organisation The Born Free Foundation — formerly Zoo Check) has written that birds, reptiles, amphibians and fish are still caught in large numbers for zoos, whereas this is less the case for mammals³.

Although many new animals and at least most mammals seem to be zoo-bred, it must be remembered that CITES is intended to regulate the trade in endangered species and is not a welfare treaty. Insofar as animals are still acquired for zoos, the conditions under which this happens must be questioned. *Very little is actually known about this.* Even if zoos have never seriously contributed to the extinction of any species, it still remains that the seizure for zoos in the past has often been very negative for the welfare of the animals involved. Although this point should not, of course, be used to blame actual zoos, it should neither be minimised nor forgotten.

Nowadays one might expect that because of the endangered status of certain animals, any new animals captured for breeding in captivity would be treated with the greatest care. However, most animals kept in zoos are not endangered species (see below) and there are indications that in the recent past and also at present certain animals acquired for zoos experience considerable welfare problems. A few examples will illustrate this.

Klinowska (University of Cambridge) and Brown (formerly of the Musée Océanographique, Monaco) recorded a mortality rate of 5% for the capture and transport of dolphins in around 1986. This used to be much higher in the past — sometimes reaching 40%, with first-year losses an additional 50%⁴.

According to Johnson, who wrote a very critical book on the keeping of dolphins, most dolphins are caught in the coastal waters of the Gulf of Mexico and the Caribbean. They are chased by powerful motor launches and caught in nets. This process can produce victims in several ways:

"Pulling up the nets, perhaps the first victims are found; those dolphins which became entangled and drowned, those that have injured themselves trying to escape, sometimes tearing off a flipper as they thrash around in panic. Then comes the strenuous effort of heaving the selected animals on board. (...) many a dolphin has to be thrown back into the water, paralysed, after its spine has been injured. The boats then speed back to land, leaving the dolphin school with its own unseen, unrecognised bereavement, the sucklings will die without their mothers to nurse them, the injured which are held aloft by their companions, perhaps for days until they take their last breath."⁵

This grim picture is at least partially similar to a broadcast by Dutch television. This broadcast reported how Peter Bössenecker (of the 'Société des

Caraibes') caught several dolphins in Guatemala in 1984. One of the dolphins fell by accident when attempts were made to lift him. This documentary also showed how Bössenecker force-fed a dolphin with dead fish in a contemporary small enclosure near the coast. A baby dolphin was separated from its mother, and placed together with another female outside this enclosure. It approached the fence and tried to get in touch with its mother. The mother, however, was destined for a dolphinarium⁶.

In 1987 Janet Kear (Wildfowl Trust, Ormskirk) wrote that large numbers of red flamingos were still being caught because they do not breed well in zoos. Many of them die because they cannot endure the transportation and the stresses after their arrival. However, in 1993 she stated that these numbers have decreased due to seizure restrictions and improved breeding⁷.

With regards to the seizure of chameleons, a 1982 publication (first publication 1976) mentions that:

"Freshly imported chameleons as a rule suffer broken ribs inflicted during capture. Bone regenerates readily but is different from that in warm-blooded animals."⁸

More recently, Iain and Oria Douglas-Hamilton have described a culling in Zimbabwe, where animal contractors buy African elephants for zoos. After a plane localised a herd of elephants, men with FN rifles surrounded the elephants and shot the adults. The gunmen jumped on the corpses to fire brain shots when necessary, such as for a bull "which screamed in pain". The adult elephant had been hit in the spine and this immobilised his hind legs. The babies were tied to their mothers as the skinning started. Those who were old enough to survive were pulled and pushed over carcasses and put in crates, to be sold to animal contractors⁹.

Surplus animals

Most new mammals in zoos seem to be bred in captivity. The breeding of animals in zoos can be so effective that a problem of surplus animals arises. This has become one of the main subjects of ethical concern in zoos. It is not self-evident to suggest that this problem can be resolved completely by means of birth control, because the attempt of zoos to conserve as many

endangered species as possible and their efforts to retain the maximum genetic variation result in animals becoming surplus (see below).

Besides a genetic motivation, economic motives may also play a role and an argument based on welfare has even been put forward in order to support the breeding of surplus animals. But firstly, we will take a closer look at what is being done with surplus animals.

Zoos that no longer want to display certain animals have three main options in order to deal with them: (i) they can be sent or sold directly or indirectly (via animal dealers) to other zoos, circuses, laboratories or private persons, (ii) they can be culled and (iii) they can be housed off-exhibit¹⁰.

Substandard facilities

When it becomes difficult to find a new destination for animals within the zoo community, it can be tempting to send them to a substandard place or to make use of the mediation of animal dealers. In a very important article, called 'EAZA/EEP Available and Wanted List; a step further towards responsible animal exchanges in European zoos' (published in the 1992-1993 EEP Yearbook), Koen Brouwer — now the Director of the EAZA/EEP Executive Office in Amsterdam — strongly and very openly criticises this system of animal dealership.

According to Brouwer this system is detrimental to both the welfare of the individual animals involved and to the efficiency of the endangered species breeding programmes. I quote Brouwer extensively since his description is of great relevance, at least for the beginning of the Nineties:

"A number of European zoos frequently work with several well known animal dealers or brokers, who are claimed to have a good overview of minimally the European animal market. They can usually get rid of the most problematic surplus animal, and if a zoo is lucky, in trade for a much desired new animal. (...)

Dealers often buy and sell animals without knowing — or after changing — their pedigrees, sometimes resulting in genetically unsuitable matches. Sadly, many dealers also seem to be unable to resist the temptation of illegal animal trafficking. Animals of known sex sometimes become listed as unknown sex for sale by dealers, as it is easier to sell an unsexed animal than a male or female, in those species in which the sex-ratio is

quite skewed. (...) Although many zoos request that animal brokers inform them in advance on the destination of the surplus animal for which the animal broker has finally found a new home, this policy does not always seem to be effective. One only has to visit a number of small zoos in Belgium, France, Italy or Spain to find that quite a number of exotic species can be traced back through the original CITES papers to very well-known and professionally respected zoos in western Europe.

(...) It is frighteningly plausible that an animal bred in a respected zoo, reared by qualified keepers, supervised by university-trained curators and veterinarians, enjoyed as a newborn baby by thousands of visitors may finally be sold by the zoo through an animal broker to a unknown, obscure facility somewhere else in Europe, where conditions are so appalling that most of us would agree it should be immediately closed. There the animal may be kept in an inadequate enclosure without conspecifics, fed on a wrong diet, lacking veterinary care, and eventually perhaps dying. One might ask why a zoo would put all this effort into an animal that they later do not take responsibility for. One might also imagine the negative impression this could give of zoos. (...)

It is interesting to note that not only difficult-to-place animals such as cats, bears, certain deer and antelope are offered to animal dealers for sale. (...) Some EEP animals have even been advertised by brokers before they reached the age of one month. One can not always directly blame the zoo managers concerned for working with dealers to dispose of EEP species, as many brokers are rather clever in convincing or even forcing zoos to make certain animals available for the trade, for example by allowing zoos to accumulate "trade debt" and then later demanding EEP species to repay this obligation. On the other hand, if problems have occurred between a certain zoo and an EEP coordinator, it is quite tempting for the "disgruntled" zoo to start making their own decisions, sometimes involving a broker."¹¹

The Noorder Dierenpark Zoo of Emmen, in the Netherlands, has an excellent reputation both for its enriched enclosures and its education programme. I have noticed here, among many others, enriched enclosures for panthers, servals and Siberian tigers. These enclosures look very natural and spacious by zoo standards. The tiger enclosure may be 600 square metres or more. It contains rocks, grass-covered terraces, bushes, trees and a water pool. In a former zoo guide the visitor could read about the tiger enclosure — in Dutch: "The traditional image of the caged beast of prey now really belongs to history at Emmen"¹².

However, this was not the case for the puma cages at the Belgian zoo of Olmen, when I made a visit in 1992. Two pumas were on display in a monotonous enclosure of only about 20 square metres. Their sole enrichment material was a single wooden log. On 15th of May 1996 four pumas were

shown in two enclosures. The right cage measured about 40 square metres (10x4m) and contained three pumas. The left cage measured only approximately 10 square metres (2.5x4m) and contained one puma. This last animal and one puma from the other cage stereotypically paced to and fro in their enclosures. The enclosures were traditional cages constructed of bars and concrete. Fortunately, the new owner of this zoo is making efforts to enrich the lives of the animals at his zoo. As can be seen in one of the photographs, several wooden structures have been added to both cages. However, these cages cannot be compared with the enclosures at Emmen Zoo.

The puma information board — hanging up at the cage where a lynx is displayed — is identical to the ones at Emmen, and the owner of Olmen Zoo confirmed to me that the pumas came from Emmen Zoo. When asked for a reaction, curator Tine Griede of Emmen Zoo explained that the pumas went years ago — somewhere around the end of the eighties, the beginning of the nineties — to an animal dealer and from there to Olmen Zoo. She stressed that Emmen Zoo has changed its policy since several years. They only send animals to EAZA accredited zoos and make no longer use of the mediation of animal dealers. Griede added that the puma enclosure at Emmen Zoo was certainly not so varied and naturalistic as their current enclosures for large cats¹³.

In December 1999, representatives of Olmen Zoo had a stand at an animal fair in Goes, the Netherlands. They were publicising their zoo using five cubs: two pumas, two tigers and a black panther. For five guilders, visitors could have a photograph taken while posing with one of the cubs. Estella Franssen (Jane Goodall Institute-Holland), who had a stand just beside Olmen Zoo's one, succeeded in stopping this. The WWF also protested against Olmen Zoo's practices. It is currently being investigated as to whether Olmen Zoo carried out illegal commercial activities and whether they illegally brought CITES protected species across the border¹⁴.

The owners and animals of Zwartberg Zoo — also called Limburg Zoo — have gone through some very difficult and insecure years. This Belgian zoo has received a lot of negative media attention in, amongst others, the BBC television programme 'State of the Ark' (1994 and 1995). Zoo veterinarian David Taylor visited Zwartberg and compared it to a kind of "death row" on the programme. According to the press, he has also called this zoo the worst zoo he has ever seen outside the Third World since he started working with wild animals in the Fifties. Remarkably, Zwartberg Zoo was also mentioned on the 'List of EEP participants as of 1995'. This means that this zoo participated in



Tiger enclosure at Emmen Zoo.



The puma enclosures at Olmen Zoo in 1992 (above) and 1996 (below).



In 1999 Olmen Zoo has made publicity for itself using puma, tiger and panther cubs at an animal fair in Goes, the Netherlands. Visitors could pay to have a photograph of themselves taken while posing with one of the cubs.

one or more EEPs and thus that it was taken into consideration for animal exchanges with other EEP participating zoos¹⁵.

Indeed, Zwartberg Zoo has very traditional enclosures with very little enrichment. However, meeting the Wauters family, who own the zoo, has taught me that they like animals in their own way very much. For example, Marcel Wauters was badly injured when he tried to save a small dog that was being attacked by one of his escaped bears. Nevertheless, it seems that economical considerations have caused them to co-operate with people who are not very scrupulous about welfare considerations. In 1995, the BBC television programme 'State of the Ark: Zoo update' revealed that Zwartberg Zoo had sent baby chimpanzees to Hugo and Regina Roselly's German circus. The programme showed how Hugo Roselly tried to discipline Tibo (a baby chimpanzee from Zwartberg who was born in 1993) by beating him, and how other chimpanzees had to smoke, walk on ropes dressed in children's clothes holding a parasol and how they had to drive motorcycles. According to the BBC's programme, once they are adults, the chimpanzees return to Zwartberg.

Zwartberg Zoo has had its license withdrawn by the Ministry of the Environment and visitors are no longer allowed in. This has forced the Wauters family to look for a new home for their many zoo animals. At one point, the Wauters felt so desperate that they saw no other option left than considering the culling of all remaining inhabitants, among which were twelve chimpanzees and tens of large cats and bears. I was able to convince the Wauters to delay the culling, but just finding a new home for the chimpanzees turned out to be extremely difficult. Fortunately, the animal protection organisation Veeweyde has offered to take over all of the animals and to construct a new sanctuary for them in green surroundings. In the meantime many of the animals have already been moved to this sanctuary and within a short time the other ones should follow.

However, shortly before Veeweyde took over the animals, the Wauters sent two chimpanzees to France. The Wauters explained to me that Toto and Judy had gone to a safari park in the South of France, where they would live on a spacious natural island. The Inspector of the Belgian Ministry of Agriculture's documents mentioned Parc de la Jonquaise in Mèze as the destination.

In the summer of 1998, not long after the chimpanzees left Zwartberg, I tried to see them in France. However, I could not find a safari park. The police, tourist information and local authorities all told me that there has never been a safari park or zoo in Mèze. I only saw a large advertisement along the road mentioning the name Michel Romero, who was presented as a 'naturaliste' and 'taxidermiste'.

After some calls with the Wauters, I got in touch with a certain Jean-Luc who would take me to both chimpanzees. He arrived accompanied by the owner of the chimpanzees, who introduced himself as Romero. He explained that because of troubles with his wife he had to move the zoo to Agde, some twenty kilometres from Mèze. They took me to this place, which turned out to be dirty and secluded, with some animals such as baboons and ostriches. Toto and Judy were living in an indoor enclosure of 4x2x2m. The cage was of concrete and covered with metal plates. The enclosure was dirty and faeces had been smeared on the walls. I was told that they could not clean the cage, because there was no second cage yet to move the chimpanzees into. When asked for his profession, Romero said he was in publicity affairs.

When I returned to Belgium, the Wauters were very upset about the living conditions of the chimpanzees and they felt deceived. They handed me

documents showing that they had also sent a jaguar and two tigers to this so-called Parc de la Jonquaise. I did not see any large cats in Agde and it remains unclear what has become of them. Later on, the animal protection organisation Veeweyde helped Romero to build a cage of about ten metres long for Toto and Judy. However, they were unable to get more information on what has happened to the large cats.

In 'The Zoo Inquiry', the Born Free Foundation and the World Society for the Protection of Animals quote the following example from The International Zoo News (Spring 1994) in order to illustrate that "A zoo animal can have many strange homes during its lifetime":

"A male Sumatran tiger is being quarantined at Chessington [a U.K. zoo, K.M.], having arrived from Antwerp Zoo. Born at Leipzig Zoo, he later went to a circus, then to a dealer's before going to Antwerp. Genetically, he is a very important animal, with a largely unrepresented bloodline."¹⁶

As both zoos and laboratories are more dependent than ever on captive breeding the question arises: do zoos and laboratories provide one another with animals to display or experiment upon and to maintain maximum genetic variation? Author Dale Peterson explains:

"(...) many zoos, including at least a dozen in North America, have at times offered their "surplus" primates to laboratories. The Detroit Zoo once sent more than thirty crab-eating macaques to a terminal research project at Washington University in St. Louis. The San Diego Zoo sold one of its gibbons to a cancer research project at the University of California at Davis. During the late 1970s at least four "safari park" zoos in England were selling their surplus primates to animal dealers that supplied laboratories. Although the sale provoked some public clamor, one of the dealers, Richard Hackett of Shamrock Farms, defended the practice by noting that "animals are killed to provide bacon and so on, what's the difference?" Hackett later assured the public that not all the animals would be placed in painful experiments, and that some were fed "chocolate cake and ham sandwiches."¹⁷

Wildlife consultant Stefan Ormrod refers to the:

"(...) 1992 outrage when it was proven that Longleat Safari Park [in the United Kingdom, K.M.] was supplying monkeys to Shamrock (GB) Ltd – the UK's main suppliers of laboratory animals."¹⁸

'The Zoo Inquiry' offers the following quote by Professor Flint (Director of Sciences, London Zoo) who is quoted to have said in The London Evening Standard Letters page (22nd July 1991) that:

"decapitation of fully conscious wallabies, surgical induction of anosmia in marmoset monkeys and the administration of environmental toxins to rats... procedures had not been used in the institute since February 1990, July 1990 and mid-1988 respectively."¹⁹

In 1990 the American CBS television programme '60 Minutes' stated that surplus animals from reputable American zoos passed through a network of animal dealers to private hunting ranches. In reaction to this, the President of the American Association of Zoological Parks and Aquaria (AAZPA, now AZA), Charles Hoesle, declared that the AAZPA has a code of ethics which requests that zoo animals do not end up in shooting ranches. The Director of Denver Zoo (a member of the AAZPA), Clayton Freiheit, wrote that they try to find "the best possible destinations" for their animals when necessary, but also that:

"The responsibility of a producing zoo has to end somewhere. We cannot logically assume a "cradle-to-the-grave" responsibility for everything we must dispose of for once possession is relinquished, all real control is lost."²⁰

Culling

A second option for the disposing of surplus zoo animals is to cull them. Although very little information is available about how frequently this practice is applied, more and more zoo voices rise in support of what Robert Lacy (Department of Conservation Biology, Chicago Zoological Park) calls 'managerial euthanasia' or 'culling'²¹. Lacy painted the following picture in 1990, in order to demonstrate that the application of culling is species-dependent:

"Great apes are almost never euthanized; zoos will go to extreme lengths to maintain the life of an ape, at times beyond the point at which it could breed or even be returned to a social group. Other primates are rarely euth-

anized for management reasons, at least not if the public (read *press*) are likely to notice. Hoofstock are euthanized by some zoos, usually after fulfilling reproduction goals. Rodents and bats are frequently euthanized at many facilities, just because the zoo did not bother to control reproduction. Birds, herps, and especially fish hardly merit consideration in most debates about euthanasia."²²

How frequently cats and bears — which are difficult to place — are culled, is not clear to me.

When are zoo animals seen as surplus? For what reasons could zoos take culling into consideration? Welfare concerns sometimes play a role, as for example in cases of very old and sick animals or for animals that are born with serious disorders.

Surplus animals can be a consequence of careless management or of a conscious decision not to intervene by using contraceptives or other birth-control methods, because culling is seen as the easiest management tool (for instance the rodents and bats in Lacy's quotation).

Captive breeding programmes are trying to maintain as much genetic variation as possible. In order to achieve this, the programmes are organised around fundamental breeding rules. Some of these automatically result in a number of animals becoming surplus for these breeding programmes. What are these rules²³?

- a) It is important that the effective breeding population is as large as possible. All animals should have offspring and they should also have offspring in equal numbers²⁴. In reality, some animals that are intended to breed may turn out to be unusable because "they have become reproductively or behaviorally compromised"²⁵. They may show reproductive disorders or too much abnormal behaviour. Also, animals that have produced the foreseen number of descendants become superfluous to the breeding programme and, as some animals may be more fecund than others, some of their offspring may not be required for further breeding.
- b) The sexes have to be represented in a balanced way, so it may be considered negative when there are, for instance, too many males born in comparison to females²⁶.
- c) Tudge (Zoological Society of London) explains that the time between generations has to be maximised, because there is some genetic loss with each generation. Thus, females should be as old as possible when they

breed²⁷. In practice this could result in zoos allowing animals to have some offspring in order to determine whether the parents are good breeders and care-takers and to have an emergency solution in case something goes wrong with the last litter. Each time that the parents have successfully raised a new litter, their previous offspring could be culled. Thus a female bear which must only contribute one youngster to the breeding programme, could be allowed to have four cubs, three of which are culled and only the last one kept by the zoo. As we shall see below, having more young than necessary may be of interest not only to the breeding programme as such, but it can also be economically lucrative.

What is important here, is that these surplus animals are *not* a result of negligent management. They are the result of a carefully designed breeding programme, intended to maintain the maximum genetic variation as possible in the captive population.

More and more zoo staff seem to argue in favour of culling surplus animals, essentially because the animals cost money and take up space. Both could be used to invest in the breeding of desired individuals of the same or other threatened species. Lindburg (who does not approve of managerial euthanasia) gives the example of a female orangutan that becomes surplus at 20 years of age. He calculates that if she costs about \$12 a day, nearly \$44,000 will be needed for her upkeep for the next ten years. Lacy replies that there are about 88 hybrid and therefore surplus orangutans in North America, and that keeping these animals for another ten years will cost about \$3,872,000. Lacy argues that with this money some species could probably be saved and he therefore advocates managerial euthanasia²⁸.

Others also defend culling in order to conserve endangered species:

"(...) it is better to try to save the species by maintaining a viable population than to try to save every individual that happens to be born."²⁹

It may be interesting to breed young animals in order to attract visitors. Conway states that "Today the zoo-baby has replaced the new species as the focus of public interest" and according to Zuckerman London Zoo reached its highest annual number of visitors, 3,100,000, in 1950 mainly because of the birth of a polar bear cub³⁰.

Stockholm Zoo clearly understands the power young animals have to attract crowds. In 1988, author and broadcaster Jeremy Cherfas wrote:

"Stockholm Zoo has a very good record of breeding bears. (...) Cubs naturally attract visitors, so the zoo takes advantage of them to bring people in; visitors who come to see the playful little cubs will stay to see other exhibits, and will, the zoo hopes, be educated into the bargain. Adorable little cubs, however, have an unavoidable habit of growing into large, expensive, adult bears. And because zoos like Stockholm have, through their research, become quite adept at breeding bears, it gets harder and harder to place the cubs. The zoos are trapped by their own success, and their solution is euthanasia."³¹

Cherfas uses education as a motive for breeding and culling here, but breeding young animals is clearly also of economic interest. Of course, the revenue brought in this way might be used for species conservation. So it could be argued that young animals have to be bred and culled in order to save species.

In an article in a Dutch zoo magazine, ethologist Jan van Hooff (University of Utrecht) states that culling of surplus animals must be considered from a welfare perspective. He writes that contact with young animals is an important source of satisfaction for animals. Instead of letting two bears gaze at each other in a cage year after year, they could be allowed to have cubs every three years. After half a year of caring for and playing with these youngsters, which benefits the older bears, the bear cubs could be culled³².

Behind the scenes housing

Besides sending animals away or culling, a zoo can also keep surplus animals behind the scenes. According to Lindburg this is not unusual and the welfare conditions of the animals are often questionable:

"This leaves us with what is probably the most common practice: behind-the-scenes warehousing. Holding surplus individuals in off-exhibit areas is practised when no other recourse is available. Animals so held are not only a drain on zoo resources, but are often forced to live in debilitating social and physical situations."³³

At their Animal park Planckendael, the Royal Zoological Society of Antwerp has constructed a famous 3,000 square metre island for their bonobos or pygmy chimpanzees (see below). Just behind this island, almost bordering it, a small building with frosted glass windows is located, largely covered with ivy. When I was shown this off-exhibit area in around June 1997, three male common chimpanzees (*Pan troglodytes schweinfurthii*) were living there: A3 (or Flip), Arnold and Tony. Their enclosure had a total volume of 10.8x2.5x2.3 metres. The chimpanzees had just been separated, because Tony had to go to another zoo. Arnold and Flip were living in the left part, Tony in the right part. As enrichment I noticed a shelf along the back of the enclosure, a lot of woodwool and some plastic barrels. A keeper explained that they received, amongst other items, seeds in woodwool, branches with leaves, cardboard and gunny sacks as enrichment.

An article in Antwerp Zoo's magazine learns that in 1992 chimpanzee Shirley could not protect her baby Taibu from Tony at Antwerp Zoo. This had fatal consequences for Taibu. Arnold and Tony returned respectively in 1992 and 1993 from the group at Antwerp Zoo to Planckendael for safety reasons. Flip has been living at Animal park Planckendael since 9th January 1962. A keeper explained to me that he and other chimpanzees used to be housed separately in this building. He added that there were nine quarters each measuring 1.2x2.5x2.3 metres. Ethologist Linda Van Elsacker says that when she started working at Animal park Planckendael in around 1990 there were two chimpanzees — Flip and Jack — living in this building. They were housed in separate compartments, of which they may have had several at their disposal. Upon her advice several walls were removed, so that the enclosures became more spacious and the chimpanzees could live together. When Arnold and Tony came to Planckendael, the four chimpanzees had been housed for some time in another building. The four chimpanzees were moved to the current building because of problems with the ceiling of the other building, says Director of Zoology Roland Van Bockstaele. According to an ISIS/ARKS report made available to me by curator Van Puijnenbroeck, chimpanzee Jacky had been living at Animal park Planckendael from 1962 until his death in 1995³⁴.

Shortly after my visit, Tony was sent to Nikolaev Zoo in the Ukraine. At that time Nikolaev Zoo had a lonely female chimpanzee Susan, of 27 years old, and a group of three young chimpanzees of six years old. The intention was to bring Tony and Susan together and consequently to

unite the entire group. There were two outdoor and three indoor enclosures, each measuring approximately 4x4x4.5 metres. Among others ropes, ladders and artificial termite mounds were available as enrichment. The zoo was planning to build a new outdoor enclosure of 12x12 metres. Frank Rietkerk of the EAZA/EEP Executive Office in Amsterdam explained to me that Nikolaev Zoo cannot be compared with zoos in Western Europe but that it has very motivated keepers, who do a lot to enrich the lives of the animals in their care. According to Roland Van Bockstaele, this new enclosure of 12x12 metres has been realised in the meantime³⁵.

The staff of the Royal Zoological Society of Antwerp told me that they have been trying to find a good solution for the chimpanzees for a long time, and that any suggestions would be very much appreciated. Unfortunately, the problem of chimpanzees — especially males — in need of a new home seems to be tremendous. While doing a survey for the Jane Goodall Institute in Germany several zoos offered me their chimpanzees for free. At that moment there were already at least thirty chimpanzees in Belgium and Germany alone who were in need of a new home. I suggested that the Royal Zoological Society of Antwerp should construct a new enclosure for Arnold and Flip — and possibly also for other surplus male chimpanzees from other zoos — but Roland Van Bockstaele replied that this was an issue to be dealt with within EAZA.

Arnold and Flip turned out not to be the only chimpanzees being kept behind the scenes by the Royal Zoological Society of Antwerp. On 26th April 1999 former caregiver Mark Schoonvliet reported in a newspaper that the female chimpanzee Maaïke had been living in solitary confinement in a cage of about 2x3 metres behind the scenes at Antwerp Zoo since August 1997. Maaïke was removed from the group because of a skin disease, which caused her to become almost bald. She was scratching a lot and was covered with many little wounds. At first she was placed in an enclosure bordering that of the group. The visitors' window had been covered with a large white sheet. She was moved from this place to the behind-the-scenes enclosure in August 1997.

The case of Flip and Arnold also went public and the three chimpanzees received a lot of attention in Belgian newspapers and on the television. Minister of Agriculture Karel Pinxten ordered an investigation into the living conditions of the three chimpanzees. Michel Vandenbosch (of the ani-

mal rights organisation GAIA) and Roland Corluy (IPPL) saw the chimpanzees. It was agreed that they would work together with the Royal Zoological Society of Antwerp to find a solution for the chimpanzees.

In a sense the debate became heated and polarised: the Royal Zoological Society of Antwerp said that Schoonvliet wanted to 'back-stab' because he had been fired, while Schoonvliet stated that he himself wanted to leave because he could no longer stand the living conditions of orangutans and chimpanzees at Antwerp Zoo. Whatever may have been true, only a few days after the revelations by Mark Schoonvliet the future of the three chimpanzees seemed to become much more promising. The Royal Zoological Society of Antwerp announced that they would at least construct an outdoor enclosure for Arnold and Flip — possibly even an island for surplus male chimpanzees — and that Maaïke would probably be reintroduced into the group because of her improving health.

Mark Schoonvliet stated that Maaïke had been removed because she was too ugly to be shown to the public and one newspaper cited veterinarian Walter De Meurichy as saying that animals should be presentable and that her situation was more a case of the public. However, De Meurichy later stated that he had been cited incorrectly. According to De Meurichy and Roland Van Bockstaele it was necessary to move Maaïke to the quarantine in order to provide her with proper medical treatment (taking biopsies, sedating her, treating the wounds), to have the opportunity to observe her more accurately and to provide her with a quiet environment. At the quarantine two enclosures of about 2x3 metres were available to her. I was told that these enclosures were purposefully built no higher than about two metres, so that when she needed to be sedated she would not fall down from a higher area.

On 11th May 1999 Maaïke returned from the quarantine to the Great Ape house. Now she lives in the group most of the time. Ethological observations show that when she is eating alone she scratches herself five times more than usual. In order to find out if this was related to being alone or rather to the excitement of feeding, it was decided to allow her to eat in a small group. In this situation she happened to scratch herself only twice as much. She is being treated further with Cortisone, which keeps the wounds under control although it does not stop the scratching completely. I understand from veterinarian De Meurichy that it remains uncertain how

her health will evolve in the long term and that terminating her life is an option which cannot be entirely excluded.

For Flip and Arnold the existing building is being adapted, so that there will be more light and that they can make use of a keeper's corridor as well. An outdoor enclosure of about 6x6x3 metres is being built as I write this, and should be completed by the time this book is published³⁶.

What about the living conditions of animals displayed in zoos? The following sections will discuss the welfare of animals in their enclosures. The physical, social and psychological welfare of animals in zoos will be considered. In making these distinctions, the interconnection and overlap between these welfare aspects should not be overlooked.

NOTES

- ¹ Conway, 1995: 3.
- ² Personal communication, 6th April 1993.
- ³ Personal communication, 4th February 1993.
- ⁴ Klinowska and Brown, (1986): 131, 139.
- ⁵ Johnson, 1990: 205.
- ⁶ Johnson, 1990: 247-251. The programme was called 'Dolfijnenverhalen' ('Dolpin Stories', own translation) and broadcast on Dutch television ('Nederland 2') on 14th April 1993. When Bössenecker made his request to the Guatemalan authorities to catch the dolphins, he had testimonials in support of his application from the Royal Zoological Society of Antwerp (Belgium), Rhenen Zoo (the Netherlands), Dolphinarium Harderwijk (the Netherlands) and Nürnberg Tiergarten (Germany). All of these bodies expressed satisfaction concerning the dolphins delivered by Bössenecker. However, the above-mentioned dolphin transportation encountered considerable questioning by CITES. Two of the ten dolphins died within a few weeks and four others went to a Bulgarian amusement park. René Duss, of dolphinarium Hansaland (Germany), accused Bössenecker of having sent a baby dolphin to him in around 1985, that died only a few hours after its arrival. Rhenen Zoo later distanced itself from Bössenecker.
- ⁷ Kear, 1990: 87 and personal communication, 4th July 1993.
- ⁸ Frank, 1982: 373-374.
- ⁹ Douglas-Hamilton and Douglas-Hamilton, 1992: 121-122, 217-220 and the photographs between pages 224 and 225.
- ¹⁰ I prefer to use the term 'culling' of surplus zoo animals instead of the verb 'euthanise'. Euthanasia refers at the very least to an act that is intended to be in favour of the respective individual.
- ¹¹ Brouwer, 1993: 278-280.
- ¹² Hiddingh, s.d.: No. 36 (own translation). The personal observations at Emmen Zoo have been made in 1991 and 1999.

- ¹³ Personal communication with Tine Griede, 26th October 1999.
- ¹⁴ Personal observations, 18th December 1999, and personal communication with Estella Franssen, 6th January 2000.
- ¹⁵ Rietkerk, Brouwer and Smits, 1995: 520-521.
- ¹⁶ In BFF/WSPA, 1994: 22.
- ¹⁷ Peterson, 1989: 260.
- ¹⁸ Ormrod, 1994: 43.
- ¹⁹ In BFF/WSPA, 1994: 22. See also Ormrod, 1994: 43.
- ²⁰ Freiheit originally expressed his reaction in a letter to 'The Zoo Review' of February 1990; I read the letter in a fact-sheet of the Dutch National Foundation for Research in Zoological Gardens of 14th March 1990. Hoessle's statement was quoted by Freiheit in his letter.
- ²¹ Lacy, 1991: 293.
- ²² Lacy, 1991: 296.
- ²³ Information about these rules comes largely from Tudge, 1991.
- ²⁴ Tudge, 1991: 83-85.
- ²⁵ Lindburg, 1991: 1.
- ²⁶ Lindburg, 1991: 1 and Tudge, 1991: 62, 85.
- ²⁷ Tudge, 1991: 86-87.
- ²⁸ Lacy, 1991: 294-295 and Lindburg, 1991: 1. Hybrid orangutans are the result of pairing the Bornean and Sumatran subspecies. In Europe there were about 41 hybrids in 19 zoos in 1997 or 13% of the European orangutan population (Becker, 1999: 157).
- ²⁹ Tudge, 1991: 84.
- ³⁰ Conway, 1986: 217 and Zuckerman, (1979a): 18.
- ³¹ Cherfas, 1988: 3-4.
- ³² Van Hooff, 1991: 10-11.
- ³³ Lindburg, 1991: 2.
- ³⁴ Anonymous, 1992: 4 and Josten *et al.*, 1992: 24-25. ISIS/ARKS report of 28th May 1997. Personal communication with Roland Van Bockstaele and Linda Van Elsacker, 8th October 1999.
- ³⁵ Personal communication with Vladimir Topchy (deputy director, Nikolaev Zoo) of 11 June 1997 and letter of Vladimir Topchy to Marleen Huyghe (curator at Animal park Planckendael) of 18 June 1997. Personal communication with Roland Van Bockstaele, 8th October 1999.
- ³⁶ Van Elsacker and Van Puijenbroeck, s.d. Personal communication with Van Bockstaele and Van Elsacker, 8th October 1999 and with De Meurichy, 11th and 26th October 1999. For attention in newspapers, see for example Grobben, 1999a, b and c and Steenhoudt, 1999a and b.

- 3 -

Physical welfare in zoo enclosures

It is regularly stated that zoo animals live in a positive welfare situation. They have plenty of food, they live in a safe environment free from predators, they receive medical care when necessary and they have the opportunity to breed and raise offspring. As zoos are increasingly dependent upon sustainable captive breeding, it might be presumed that they are successful with regard to this particular welfare aspect.

However, several general points ought to be raised. Firstly, zoos keep a large variety of animals, which have divergent requirements for their maintenance. To what extent do zoos have the required knowledge to keep these animals?

It is remarkable that as late as 1985 a report by the zoos of Amsterdam and Rotterdam still stated that knowledge that is indispensable for the optimal conservation of numerous species in zoo collections is still lacking to a high degree. Moreover, knowledge about the large majority of exotic species is limited. According to this report, even the most elementary data, essential for the survival and reproduction of animals in zoos (such as data concerning natural feeding, social life, physiology and reproductive biology), are often not available.

Furthermore the report says that it seems unimaginable that after 150 years of zoo history the best diet for a large number of animals is still not certain. This is attributed to the limited knowledge of natural diets. Where these are known, it is often not possible to get the natural ingredients. For this reason zoo diets are largely developed through experimentation. This process

initially started from almost nothing and in the past (until the mid-1960-70s) was rarely carried out in a scientific way.

Whereas normal veterinary medicine works with a limited number of species and many individual animals, of which relatively much is known, zoo medicine works with many hundreds of species, very few individuals and a great shortage of knowledge¹.

If this information is correct, it means that a large amount of important knowledge essential to guarantee the physical welfare of many animals in zoos could either have only been developed in the last fifteen years or is actually non-existent.

While commenting on the need for improvements of zoo enclosures at a workshop at the White Oak Conservation Center in Florida in 1994, Michael Hutchins (Director for Conservation and Science for the American Zoo and Aquarium Association) confirmed the view that important information is still lacking:

"We need standards. However, there are thousands of species of mammals and birds, reptiles and amphibians, in zoo collections each with specific biological needs that must be accounted for. This is an incredible task. In many cases we are operating with imperfect knowledge, with very little information to try to develop their diets, their care and maintenance standards. We know very little about their behavior. Information from the field has led to the understanding of many animals we were previously not doing well with in captivity."²

Secondly, zoos are making great efforts to establish sustainable breeding populations. However, (i) it must be questioned to what extent they are successful and (ii) even when a breeding population is successful (from the viewpoint of sustainability), this does not mean that there cannot still be a considerable mortality of young animals, or that this global result indicates that individual animals breed eagerly (for instance artificial insemination may have been applied).

According to Peterson "(...) it is extremely difficult to get most zoo animals to breed". In addition, in a background information paper for a conference on zoos at the University of London, it has been written that "(...) many of the animals presently taking part in captive breeding programmes are not breeding well."³

A third consideration is that in so far as the medical health of zoo animals is concerned, it must be remarked (besides questions about the availability of knowledge for treatment) that:

- a) Stress may have a negative influence upon the susceptibility of animals to disease.
- b) Zoo animals may be confronted with diseases that they would not normally encounter in their natural surroundings.
- c) The risk of disease may be high in zoos due to a large concentration of species and visitors in a limited amount of space.

We will now take a closer look at the specific physical welfare situation of some animals in zoos. Clearly, this information is only relevant to the species involved and cannot be seen as representative for the overall situation in zoos.

Juvenile mortality in primates

Isolde Debyser (University of Utrecht) investigated juvenile mortality in captive populations of primates. This research consisted mainly of literary research, retrospective follow-up research in ten Dutch and Belgian zoos (1980-1989), prospective research in these zoos (1990-1992) and a comparison with the breeding unit of a German primate research centre. This research provides important information on the frequency and causes of juvenile mortality of primates in zoos.

The incidence of juvenile primate mortality after live birth was estimated at 28% for the investigated zoos, which is considered as high⁴. The most accurate estimate for stillbirth incidence varied between 7.4 and 9.7% depending on the primate suborder. However, this figure is considered to be an underestimation of the real incidence.

The literary research did not allow for a comparison with mortality rates in wild populations of prosimian and platyrrhine primates, because of a lack of information about wild populations. However, first year mortality rates for catarrhine primates seem to be comparable for zoo and wild populations (between 28 and 56% and between 10 and 60% respectively).

With regard to cause of death, several remarks can be made. Infectious diseases are an important cause of juvenile death. Preventive medicine should be investigated, as well as the importance of factors like hygiene and stress. Debyser has observed that there is an increased risk of infection in some enclosures because of a relatively high animal density. In addition more clinical knowledge of curative medicine is required.

Traumatic injury is another important cause of juvenile mortality. Parents or other cage mates may, for example, inflict bite wounds or skull fractures. Factors such as stress and not having had the opportunity of observing and taking part in parental care for the young (because of being wild-caught at too young an age) are important in this respect. The transfer of a chimpanzee group from a crowded cage to a much larger enclosure resulted in decreased juvenile mortality.

Climate also has an important influence on the number of stillbirths and survival chances of young animals. Because of the sensitivity of tropical species to the relatively cold climate of Western Europe, Debyser suggests that it might be better to concentrate the births in late spring and early summer in continuous breeders. It is possible that the stress of being forced into an indoor enclosure in case of bad weather and the stress of high animal density indoors also count as factors. The risk was lower in enclosures where animals were in a position to choose between being inside or outside in comparison with enclosures where animals were locked up indoors or outdoors.

A trend of lower vitamin A content was observed in the livers of animals that died from infections rather than in animals that died of other causes. There may be an insufficient vitamin A intake in the zoo primate population. However, this link is unclear and requires more nutritional research. Debyser comments:

"The assessment of the nutritional requirements and their translation into diet formulas for primate species held in captivity is a difficult matter. The adjustment of diets in pregnancy and lactation is rather empiric and differs according to the institute or personal interests and competence more than that it is based on scientific studies."⁵

In early life the mortality rate in apes is low in comparison with other primate species, whereas the total juvenile mortality rate is the highest in

apes. This initial low mortality rate could be explained partially by the unequal attention paid to different species (for instance in terms of husbandry), because of the attractive value and thus economic importance of young animals of certain species⁶.

Bears

According to Lydia Kolter (Cologne Zoo), of all the bears held in Europe the breeding of the spectacled bear (*Tremarctos ornatus*), Asiatic black bear (*Selenarctos Thibetanus*) and brown bear (*Ursus arctos*) is (quite) prolific, but the breeding populations of polar bears (*Ursus maritimus*), sun bears (*Helarctos malayanus*) and sloth bears (*Melursus ursinus*) are not self-sustained and population decline is prevented by imports⁷.

The international breeding list in the International Zoo Yearbook (IZY) mentions for these species that among the number of animals born in 1995 and 1996 the following did not survive: 12/29 spectacled bears, 11/30 Asiatic black bears, 15/124 brown bears, 39/53 polar bears, 3/6 sun bears and 4/12 sloth bears. The real mortality rate may be higher; it is mentioned that not all institutions indicate whether or not their animals survive and some only record the young ones that have been successfully reared⁸.

The welfare of captive polar bears has received relatively much attention in studies⁹. According to Ames — in a study for UFAW — the natural mortality of polar bear cubs can be as high as 38%, but this is still considerably lower than the 73% loss in captivity in 1995-1996, as revealed in the IZY (see above)¹⁰.

According to Horsman there are indications of a correlation between temperature and breeding success: the lower the winter temperature, the higher the chance of successful breeding¹¹.

The cubbing den and the absence of disturbance also seem to be important factors. In nature, the female bear stays in her den from October to February/April. She is very choosy about the spot and the kind of snow used. She may walk many miles and dig several test pits, before choosing the final place. The den is continuously adjusted during her confinement, in order to regulate the supply of fresh air and the temperature for her cubs. In some situations a mother may eat her cubs in nature, such as when she is malnourished or when she smells or hears a male polar bear. Digging

the den in a more remote place, away from the sea, usually prevents cannibalism by male bears¹².

This gives rise to questions about the quality of artificial cubbing dens in zoos. In captivity polar bear cubs are also sometimes eaten by their mothers. This is what possibly happened in Amsterdam Zoo in 1992 when polar bear cubs were born. Most remarkably, a male polar bear (Boris) was on display in the zoo, although Feazel states that in such a case the bear must be removed. The influence of other disturbances such as environmental noise (by visitors) should also be considered in the case of cannibalism. Of the two cubs born in Amsterdam in 1995, one probably died because it was supercooled (the other was stillborn)¹³.

In 1980 Van Puijenbroeck (Antwerp Zoo) recorded that several polar bear cubs had been born in the zoo in the preceding years. All of them died, however, due to maternal neglect or because their mothers killed them. The mothers took the cubs in their mouths and walked anxiously around with them, just as if they wanted to hide them somewhere. Van Puijenbroeck attributes this behaviour to a lack of privacy and negative climatological conditions. Since the bears did not like the nesting boxes, the cubs were found soaked to the skin, they had grown numb with cold and were badly bruised by their mothers' mouths. Those who were found alive quickly died because of infections¹⁴.

In so far as the physical welfare of polar bears in zoos is concerned, Feazel mentions that they must be continuously monitored for parasites (especially intestinal worms), that they can experience hair loss problems (some have gone completely bald) and can lose teeth (because of rough play or gnawing on the steel bars). He also states that polar bears can live in captivity for a long time. In the 1993 studbook, for example, 35% of the female polar bears were more than twenty years old¹⁵.

Dolphins

According to a preliminary report by Van den Sande and De Bois (The Royal Zoological Society of Antwerp) there were 109 bottlenose dolphins (*Tursiops truncatus*) living in European zoos and entertainment facilities in 1990, of which 104 were wild-caught and five were captive-born. The survival chances of the wild-caught dolphins seem to have increased signifi-

cantly between 1980-90, when compared with the low survival rate in the Seventies. Of the dolphins that were imported at the age of three 60% are supposed to live beyond twenty years. The oldest animal of this population was a 37 year old female who was still alive¹⁶.

In an article written in 1990, Jacques Smolders (then Head of the dolphinarium at Antwerp Zoo), wrote that in nature 67% of the dolphins die within their first year and that in the best American dolphinariums between 75% and 85% of the captive-born dolphins survive. However, Van den Sande and De Bois' report reveals that 76% (or 19/25) of the dolphins that were born alive between 1980-90 in Europe died before the age of one year. 40% died in the second week after birth. Although the information is seen as preliminary, the list of the causes of death indicates that "many newborns die as a result of trauma, often caused by the mother or another dolphin". This list includes:

Napo, who died at the age of three days at Antwerp Zoo in 1986, because of "bleeding meninges, attacked by mother".

Prinses, who died at the age of nine days at Antwerp Zoo in 1988, because of "trauma".

A nameless dolphin, who died at the age of eleven days at the Duisburg Zoo (Germany) in 1989, because of "internal bleeding from liver rupture, baby came between two fighting females".

A nameless dolphin, who died at the age of one month at the marine mammals park of Harderwijk (the Netherlands) in 1989, because of "peritonitis, pleuritis, pneumonia, caused by wounds inflicted by mother"¹⁷.

Since 1968 Antwerp Zoo has undertaken many attempts to keep and breed bottlenose dolphins. An overview can be found in the Appendix. What does this information tell us with regard to the keeping and breeding of dolphins at Antwerp Zoo?

Since 1968 there have been 34 bottlenose dolphins at Antwerp Zoo, 23 of which were caught in nature. Of these 34, two are still alive and in 1999 they were moved to the dolphinarium at Duisburg Zoo, Germany (see below). However, bottlenose dolphins are not the only dolphins that have been kept in the dolphinarium at Antwerp Zoo. In 1977 three tucuxi — or Guyana dolphins (*Sotalia guianensis*) — were added to the collection consisting of five bottlenose dolphins — among them a 3.2m long South African bottlenose dolphin named Dick.

The eight dolphins were kept indoors in a dolphinarium which comprised a show pool of about 600 cubic metres (28x7x3m) and three smaller pools behind the scenes — one pool of 150 cubic metres (11x5x3m) and two of 60 cubic metres. The dolphinarium at Antwerp Zoo was clearly too small for keeping dolphins in. According to Klinowska and Brown, a pool for bottlenose dolphins should measure at least 1,000 cubic metres¹⁸. Moreover, the combination of tucuxi and bottlenose dolphins appeared to be a most negative one, as will be described in the section on social welfare.

Of the 23 wild-caught bottlenose dolphins, fourteen animals died within five years of their arrival. Eight of them died within the first year of their arrival, most of which — six — after only a few days. Several dolphins were in a very bad condition upon their arrival, according to curator Philippe Jouk.

As far as their ages were known, the dolphins were between two and eighteen years old when they arrived at Antwerp Zoo. Seven dolphins were not older than five years when they were caught and brought to Antwerp Zoo. Two of these died within about two weeks — they were then two (Zolly) and three (Chris) years old. The other five dolphins lived at Antwerp Zoo for several years — three for more than fifteen years. Dolly had been at Antwerp for 25 years and she died there in 1997 at the age of 29.

The EAAM (European Association for Aquatic Mammals) gave the following explanation to Klinowska and Brown regarding the import of young animals:

“(…) for many years European dolphinarium imported small (young) animals, mainly because small animals reduced shipping costs but also because it seemed that the younger animals might have a longer life in the dolphinarium.”¹⁹

According to Smolders, calves are normally suckled until they are 15 to 22 months old, and stay with their mother for about four to five years.

Six dolphins have been kept at Antwerp Zoo for more than fifteen years. Dolly was the longest kept dolphin at Antwerp Zoo (for 25 years). Four of them died aged between 19 and 29 years old. In 1999 the other two dolphins were sent to Duisburg Zoo and were 21 (Ivo) and 30 (Iris) years old at the time.

Research carried out on a wild population of bottlenose dolphins in Florida (the Sarasota population) by Deborah Duffield (Portland State University) and Randall Wells (Chicago Zoological Society) showed that the average age of death was nine years. This number is clearly influenced by the mortality of the calves. The average age of living Sarasota dolphins (not including the animals born or deceased within the last year) is fifteen years. Duffield and Wells have recorded the longest living dolphins as being aged 48 (Sarasota, female), 38 (Sarasota, male), 42 (captivity USA, female) and 37 (captivity USA, male) years old.

Problems with the respiratory system are the most common cause of death (nine dolphins) at Antwerp Zoo, for the wild-caught as well as captive-bred animals. Other reported causes of death are mainly related to intestinal or stomach problems (five dolphins) and fractures or trauma (six dolphins). The death rate of the captive-born dolphins is 100%. Of the eleven dolphins born at the zoo only one survived for more than a year — Nicky, who reached four years old. A few years ago Antwerp Zoo made the decision to stop breeding dolphins²⁰.

What factors are relevant for captive breeding of dolphins? According to Cornell *et al.* of Sea World Enterprises, USA (where breeding is much more successful than in Europe), a compatible, relatively undisturbed breeding colony built around reproductively effective males and experienced females is very important. The facilities at Sea World comprise one to five adult and sub-adult males and four to nine females. Another consideration is that females may have been too young when they were captured. They may not have learned enough by observing older animals about taking care of babies.

Cornell *et al.* confirm that “pneumonia is a common contributing factor to neonatal mortality in dolphins”. Gauckler (Zoo Nürnberg, Germany) raises the question as to whether or not the “dry and dusty air of the indoor environment may be a predisposing factor”. Amundin has expressed that since the Kolmarden Dolphinarium (Sweden) is situated indoors, ventilation has been a major concern especially during the winter. By installing fans, an attempt was made to bring warm air downwards and to make the air just above the water more mobile. This seems to have reduced the dolphins’ coughing. Also noteworthy is that the facilities at Sea World are in the open air.

In so far as pool requirements are concerned, the only detailed information that Klinowska and Brown have found indicates that large pools, more

particularly with a large surface, may be necessary. Amundin describes a practical problem in relation to this. Normally the calf can follow its mother without problems even when she is at top speed because it is caught in her pressure wave. However, in captivity the mother is often forced to make sharp turns, even in a large pool. At this point the calf may be released from the pressure wave, and before the mother can retrieve it the calf will often collide with the side of the pool.

Amundin gives an example of a female in a pool of 7x13m who exhausted herself with continuous attempts to prevent the calf from hitting the walls. Moreover, the activity created a complex wave pattern, which in turn created problems for the calf to avoid the water from entering its blow-hole while breathing.

In the show pool (800 square metres) waves died out because of the skimmer groove. An incident took place here, when presumably a large wave — caused by “rough play or sexual activity” — swept a seven-and-a-half-week-old calf over the edge of the pool and into the groove. The young dolphin was found there one evening unwounded and needing help to return to the pool. An elastic wall had been installed in Antwerp, in order to prevent the baby dolphin Unica from hitting the hard pool walls²¹.

In the 1997/98 EEP Yearbook it is among others recommended to:

“Separate a pregnant female from the rest of the herd just prior to or in connection with the delivery, and keep her and the neonate separated for at least one, preferably two weeks. This eliminates fights over the newborn, allows for undisturbed bonding between the mother and the calf, and the complete transfer of colostrum milk.”²²

Besides these breeding problems, other concerns have been mentioned with regards to the physical environment in which dolphins are kept in captivity. A dolphin produces four litres of urine and 1.4 kg of faeces each day. This load to the filtration system is similar to that of 70 human swimmers, according to Victor Manton (Whipsnade Park). Filters do part of the cleaning, and chlorine is also added to disinfect and clear the water. It has been said that this can cause irritation to dolphins' eyes. However, Erich Hoyt stated that apart from incidents of overuse, there is no solid proof that the typical water quality is damaging to the eyes or skin of dolphins²³.

Some parks use natural sea water in an open system or man-made sea water (such as at Sea World), but most use a mix of common salt and fresh water. Geraci (marine mammal veterinarian) and Prescott (New England Aquarium) stated that a higher salinity level is “less stressful behaviourally”, but according to Hoyt too much salt can cause dehydration²⁴.

Captive dolphins must learn to eat dead fish. During the freezing process of the fish, Vitamin B1 is lost and, therefore, the dolphins need vitamin supplements. In an article in 1986, Amundin refers to analyses of frozen fish at the Kolmarden Dolphinarium showing that the fish often contain high levels of peroxide. This rancidity causes vomiting in dolphins²⁵.

Hoyt advises the use of live fish in open systems with natural seawater. He cites an article by a pioneer in environmental enrichment, Hal Markowitz. In this article, Markowitz refers to the increased vigour in otters, pinnipeds and many cetaceans when they have the opportunity of chasing and consuming live prey in spacious environments. This would outweigh the minor increase in health hazards in comparison with properly frozen and handled fish. According to Hoyt the main problem for most dolphinariums is that chlorine kills fish rapidly²⁶. I also wonder what effect giving live fish would have on the attitude of the dolphins towards dead fish and, therefore, how this would affect their performance during shows — of which dead fish is an essential element. Or would they be rewarded with live fish?

Concern has been expressed that the walls of the pool may bombard the dolphins with the echoes of their own echolocation clicks. However, according to John Ford (Vancouver Public Aquarium and the first identifier of orca dialects in nature) echolocation is used to a lesser extent when visibility is high and, because of the clarity of the water, dolphins may choose not to use sonar, for there is no need to do so²⁷.

It has also been suggested that the noise from pumps, for instance, can have a disturbing effect on dolphins. According to Geraci, dolphins seem to adjust to equipment sounds. However, loud sounds such as noise originating from construction works may have a negative impact and could result in food refusal, for example²⁸.

Reptiles

Clifford Warwick (Institute of Herpetology) has carried out ethological research on more than 4,000 reptiles for over twelve years in zoos and in private collections. He has detected many problems, two examples of which will be given here.

"An extremely common sight" on many medium- to large-sized captive lizards is lesions at the tip of the snout. Lizards which in nature forage or rest in trees, usually dive into deep water or thick terrestrial substrate when threatened. In captivity, however, thick substrate is impractical for general maintenance reasons and deep water requires unusually large enclosures. This factor and particularly the concrete-based water containers cause the injuries.

Sometimes enclosures do not allow lizards, such as monitors (*Varanus*) or crocodiles, to accelerate and move quickly. This can result in loss of condition, overgrown claws and collisions with walls²⁹.

The examples of physical welfare problems that have been given demonstrate some of the problems that may exist in zoo collections. However, one ought to bear in mind that this is by no means a general evaluation of the physical welfare of all species in all zoos. Other problems may exist. Furthermore it is also conceivable that many species are kept very well and do not endure physical welfare problems in zoos.

NOTES

- ¹ Anonymous, 1985: 118-119, 121-123.
- ² Hutchins (in a discussion of a paper by John Lukas) in Anonymous, (1995a): 185.
- ³ Peterson, 1989: 296 and Anonymous, (1995b): 11. (This last paper is largely based on a House of Commons Library (Science and Environment Section) Research Paper.)
- ⁴ Debyser, 1995: 290-291.
- ⁵ Debyser, 1995: 259.
- ⁶ Debyser, 1995: 26, 28, 44, 46, 48, 52-53, 70, 73, 75, 76, 83, 181, 258-259, 271-294.
- ⁷ Kolter, 1995: 431-432.
- ⁸ Anonymous, 1998: 518-519.
- ⁹ See Horsman, 1986; Ames, 1990 and Ormrod, 1992.
- ¹⁰ Ames, 1990: 6.
- ¹¹ Horsman, 1986: 37-38.
- ¹² Miles and Salisbury, 1986 and Feazel, 1990: 51, 60-63, 195.

- ¹³ Horsman, 1986: 9; Feazel, 1990: 195; Anonymous, 1993a; Anonymous, 1993b and Anonymous, 1996a: 30.
- ¹⁴ Van Puijenbroeck, 1980: 119-120.
- ¹⁵ Feazel, 1990: 195 and Kolter, 1995: 432.
- ¹⁶ Van den Sande and De Bois, 1990: 1, 4.
- ¹⁷ Smolders, 1990: 10; Van den Sande and De Bois, 1990: 3, 9.
- ¹⁸ Van Den Bergh, 1969: 194-195; De Block, 1979: 106-107; Terry, 1989: 45 and Klinowska and Brown, (1986): 219.
- ¹⁹ Klinowska and Brown, (1986): 184.
- ²⁰ Duffield and Wells, 1990 and Smolders, 1990: 12. For the sources in connection with the dolphins that lived at Antwerp Zoo, see the notes in the Appendix.
- ²¹ Gauckler, 1982: 148; Amundin, 1986: 264, 265, 268-269; Klinowska and Brown, (1986): 185; Cornell *et al.*, 1987: 41-43; Anonymous, 1993c.
- ²² Amundin, 1999: 227.
- ²³ Hoyt, 1992: 37-38. Erich Hoyt carried out extensive research with orcas in their natural habitat. His report also contains relevant information regarding dolphins.
- ²⁴ Cornell *et al.*, 1987: 42 and Hoyt, 1992: 37-39.
- ²⁵ Gauckler, 1982: 151; Amundin, 1986: 265; Hoyt, 1992: 42-43.
- ²⁶ Hoyt, 1992: 42-43.
- ²⁷ Hoyt, 1992: 44.
- ²⁸ Geraci (1984) in Klinowska and Brown, (1986): 135.
- ²⁹ Warwick, 1990: 1-4.

Social welfare in zoo enclosures

Social bonding...

Questions ought to be raised regarding the extent to which group composition in zoos provides animals with the opportunity of a wide variety of social contact customary to the animals' own preferences. An enclosure with two (or even one) chimpanzees clearly offers much less (or no) opportunity for social contact than the group of more than twenty chimpanzees at Burgers' Zoo island at Arnhem or the colony of eleven pygmy chimpanzees (or bonobos) at Animal park Planckendael (the outdoor zoo of the Royal Zoological Society of Antwerp)¹.

What are the social effects of moving animals to other zoos, for instance in order to maintain genetic variation? How many times are these animals transported to other places for breeding purposes? How do the animals, both those which go and those which stay, experience this social change and what is the effect on the social relations within a group when, for instance, the dominant animal has to leave? What, in particular, is the effect of separating animals that normally establish lifelong bonds?

In 'The Great Ape Project', David Cantor of the Research and Investigations Department of the American animal rights organisation PETA (People for the Ethical Treatment of Animals) relates the social impact of zoo decisions on a silverback lowland gorilla, Timmy. This gorilla had lived at the Cleveland Metroparks Zoo since 1966. He was kept in isolation for years, and did not mate with two females to whom he was introduced. In 1990 the slightly older female Katie was brought in and they "quickly began to

display affection for each other, playing together, having sexual relations and sleeping in each other's arms".

However, Katie could no longer conceive and it was decided to send Timmy to the Bronx Zoo, New York, in order to take part in the gorilla SSP (Species Survival Plan, the captive breeding programme of AZA). Cantor cites a primate keeper of Metroparks Zoo, Steve Gove, who said that Timmy was not a very adaptable gorilla, that he had been very shy since 1966 up until Katie's arrival and that the change might make him crawl back into his shell.

The Director of Metroparks Zoo, Steve Taylor, has been cited as saying "It sickens me when people start to put human emotions in animals. (...) When people start saying that animals have emotions, they cross the bridge of reality." The Director of the New York Zoological Society (now called the Wildlife Conservation Society), William Conway, wrote that gorillas evolved to manage a harem and that Timmy is not monogamous.

Timmy was sent to the Bronx Zoo in November 1991 and in May 1992 he was seen mating for the first time. However, in November 1992 no female gorilla was pregnant yet. According to Cantor this might be due to Timmy's low sperm count. The General Curator of the New York Zoological Society, James Doherty, is quoted to have said that "No one wants to see baby gorillas more than we do". He also stated that if Timmy did not impregnate the females then he would not be kept indefinitely².

Nevertheless, Terry Maple (President of Zoo Atlanta, Psychology Professor at the Georgia Institute of Technology and co-author of the book 'Gorilla Behaviour') later wrote that "Timmy adjusted quite well to life in the Bronx" and that he became a father in July 1993. Maple also mentioned that the case was brought to court, and was won by the advocates of the Bronx move. He commented that "Our side argued that in this case, the good of the species was a higher priority, but that Timmy's opportunity to meet other females was likely to produce equally successful social relationships"³.

Also of relevance is that Timmy had been living indoors in concrete quarters at Cleveland Zoo, and upon arrival at the Bronx Zoo he was placed in a grassy outdoor enclosure⁴.

According to Cantor a new gorilla (Oscar) was brought into Katie's enclosure at Metroparks Zoo and they fought with each other. Katie's toe had to be amputated because of a bite by Oscar, and her bruised back

had to be treated. In November 1992 she was sent to Fort Worth Zoological Park⁵.

A question I ask myself — besides the debate on whether or not Timmy really had to be sent to the Bronx — is why Katie was not transferred together with Timmy. Keeping her together with Oscar did not seem to be necessary from a genetics perspective, because she could not conceive. Maple indirectly acknowledges in the above quote that Katie and Timmy had a successful social relationship, so the situation seems to have evolved negatively for Katie. Although it may be right that Timmy (and eventually also Katie) can start new successful social relations, it is still possible that the move caused considerable social welfare problems for Timmy. Of special relevance here is that the bond between female gorillas and the silver-back male normally seems to last for a lifetime⁶.

... and conflicts

To what extent are animals living in enclosures regularly or permanently the inescapable victims of aggression by cagemates of the same or other species? Careful group composition and provision of escape possibilities such as hiding places are most important when dealing with this issue.

A recent article, which appeared in Antwerp Zoo's magazine, claimed that the antlers of the male European elks are always sawed off in the rutting-season. This is done because their frequent attempts to mate with the female elks can be very dangerous for the latter in the limited space of their enclosure, especially when an unwilling female is forced into a corner of the exhibit.

The female reindeer, on the other hand, were always able to escape the attempts made by the male by fleeing behind a partition. However, this partition was removed some time ago, and this resulted in a male wounding a female reindeer so badly in the rutting-season that she had to be put down by the veterinarian⁷.

Amundin described the social problems that were the result of keeping two male dolphins together at the Kolmarden Dolphinarium. The two dolphins, Skipper and Flip, arrived in 1969 at Kolmarden. Because of serious fighting in the winter of 1981-82, the dominant male Skipper was administered intramuscular hormone treatments. These had an

anti-stress effect and reduced the aggression considerably for about 18 to 25 days, without ending the dominance of Skipper over Flip. Amundin also writes that Siru (a seven-year-old female) died in 1984 from pseudomonas septicaemia (blood poisoning) following numerous bite wounds from Flip. Also Siru's calf received many bite wounds on several occasions when accidentally becoming involved in conflicts between Flip and Skipper⁸.

R.P. Terry (Delft University of Technology, the Netherlands) observed the keeping together of tucuxi (*Sotalia*) and bottlenose dolphins (*Tursiops*) at, among others, Antwerp Zoo over a long period of time. Terry comments:

"In general, the species demonstrates a distinct lack of curiosity behavior and will usually avoid tactile stimulation from humans (unless well conditioned). In fact, *Sotalia* was rated higher than *Tursiops* in only one specific individual behavior: aggression towards other cetacean species. The aggressiveness of the tucuxi, especially when allowed normal social groupings, was noted early in captive experience as a species trademark."

The most aggressive confrontations were observed when several tucuxi were allowed to interact with several bottlenose dolphins:

"(...) the smaller dolphins clearly claimed the role of aggressors. Omniously stalking the larger dolphins in an inside, tight, circular pattern, the behavior of the *Sotalia* was reminiscent of the cooperative hunting pattern of social predators. Time and again, a deceptively small tucuxi broke formation for a short charge at a targeted *Tursiops*, striking the larger dolphin with its head, just behind the melon. The force of the resulting impact was clearly audible to observers behind glass windows. (...) Involvement between the two species was terminated when safety became a clear concern to their handlers."⁹

Terry adds that the aggression continued even in the form of head-on confrontations when the species were separated in tanks with net barriers¹⁰.

Considering that Antwerp only had three small pools behind the scenes (one of 150 cubic metres and two of 60 cubic metres each) serious questions are raised concerning the practices that Antwerp Zoo used to employ to house its dolphins. A 1980 article, which appeared in the zoo's maga-

zine, expressed that all of the dolphins stayed together in the show pool during the night and for a few hours during the day. The rest of the day they were kept individually or per 'team' behind the scenes, in order to facilitate the training sessions and shows.

It was sometimes necessary to force the dolphins to go behind the scenes using a large net. When a dolphin made an attempt to pass the net, it was threatened with a stick. On one occasion, the female Dolly refused to leave the show pool, which had to be emptied for repair works. The water level was lowered to 60cm. Although she still had the opportunity to swim, Dolly became completely motionless. A caretaker drew her to a kind of hammock, in which she was carried to one of the smaller pools behind the scenes.

The same article mentions how the dolphins started to lift the steel fences in order to get out of the small pools. One of them even 'liberated' other dolphins and the keepers had to block the fences with pins. The dolphins learnt how to remove the pins by means of small blows, and they also started to slip over the fences. The keepers tried to prevent this by putting 50-kilogram salt bags or buckets full of water on the fences, but the dolphins simply head-butted these into the air.

When higher fences were built, the dolphins forced an opening by administering very heavy butts to the steel bars. On one occasion Dick, the large South African bottlenose dolphin, even swam at full speed through such a fence. The article concludes that the real problem was solved by the construction of new double fences with nets in between.

Until a few years ago, Antwerp Zoo had four bottlenose dolphins. During my many visits I never saw more than two dolphins at once in the show pool of 600 cubic metres. This suggests that Antwerp still housed some of its dolphins behind the scenes for at least part of the day. These dolphins were housed in pools that were smaller still than the show pool, thus much smaller than the 1,000 cubic metres required in the report by Klinowska and Brown¹¹.

Warwick found that physical injuries among captive reptiles are often the consequence of persecution by other animals in the enclosure. This aggression can result in hypoactivity (being unusually inactive), anorexia and occasionally hyperactivity. The natural aggressive tendencies of certain reptiles can be enforced by inadequate enclosures. The aquatic soft-shelled turtle (*Trionyx sinensis*) frequently attacks, injures and kills co-oc-

cupants of an enclosure in captivity. However, when provided with deep substrate (10-30cm of sand or mud), the turtles start burrowing and hyperaggression quickly diminishes. Also, aggression between snakes that only receive dead food can be reduced by moving the dead and warm prey by means of a pole and by allowing the predator to 'struggle' for some time with the prey¹².

Parental behaviour

Social care by parents of their offspring may be problematic because of the interruption to the learning process in nature when they were caught.

The dolphin report by Van den Sande and De Bois states that many calves seem to die in captivity because of trauma, often inflicted by the mother or by other dolphins. The comment by Bryden (Professor in veterinary anatomy, University of Sydney) relates to this. In nature, dolphin mothers are assisted by other dolphins, called 'aunts'. According to Bryden there is often a difference in the behaviour of these aunts in nature and in captivity. In nature, they support the calf by protecting it against other animals, by bringing it to the surface so that it can breathe for the first time, when it is ill or even when it is dead. In captivity the potential aunts often show little interest in ill or still-born calves; sometimes they even kill them. More than once it has been observed that the mother or another dolphin takes the still-born calf to the bottom of the pool and keeps it there. Bryden believes that the dolphins can perceive whether or not the calves are dead or alive and possibly judge the survival chances of the calves¹³.

The name Odin features in the list of bottlenose dolphins that were kept at Antwerp Zoo (see Appendix). This dolphin was born on 28th July 1987 and died on 9th August 1987. "Fibrous-purulent bronchopneumonia, aspergillose" was reported as the cause of death. What happened during the two weeks of Odin's life? An article by Smolders for the IMATA (International Marine Animal Trainers Association) gives more information regarding the circumstances under which Odin lived. It draws attention to the social problems Odin was confronted with as well as the adoptive behaviour by other dolphins in the pool.

When Odin was born in the 600 cubic metre show-pool, there were four females and one nursing male present. Although Ina cared well for her calf Odin, the other dolphins were quite nervous and swam around at high speed. It was thought that this might disturb the suckling period of Odin, and so all of the dolphins were given as much food as possible to create a more relaxed atmosphere. This seemed to work well.

From the second day onwards Ina refused Odin's further suckling. Odin regularly made attempts, but they were fruitless and on the fourth day he was too tired to dive. Ina was thought to be in pain. After a period of very fast swimming, in which Odin had difficulties in following his mother, Ina — then under medication — hung her head against the pool bottom thus making an apathetic impression. At this moment Pat, who was pregnant, started swimming with Odin. Ina died on day five in the treatment pool (because of pathological complications caused by an acute uterine infection).

Pat allowed Odin to suckle until she herself gave birth to a female calf, Orfee, on day six. After his rejection Odin tried to make contact with every dolphin in the pool, but they always either swam away or gave him a firm tail slap. On day seven it was noticed that Odin was quite calm, "(...) he did not once hit a pool wall!"

After considering forced-feeding, it was decided to stimulate adoption behaviour in another female called Iris, by giving her trained bringing commands of Odin, while at the same time keeping her fifteen-month-old calf Nicky occupied. The adoption worked, and Iris allowed Odin to suckle. Nicky, however, showed "very jealous behaviour" and positioned himself in between Iris and Odin.

Odin had to spend most of the night between days seven and eight on his own. His whistles were answered by the other dolphins with soft tail-slaps or a jawclap in his direction (resulting in a hard echo).

On day eight Iris allowed Odin to suckle several times and to swim with her for up to eight minutes. Odin, who had become "only skin-and-bones", was permitted to suckle extensively on day nine. Because of the fear that his resistance had become too weak, all visitors were refused access to the building.

Odin swam underneath Iris. This behaviour was too ineffective, and on day ten Iris swam towards the bottom several times, until Odin started

swimming next to her dorsal fin. Once in this position, Odin was able to benefit from Iris' slipstream and had more opportunities for resting.

Mutual aggression arose between Iris and Nicky. The latter got bitten, received some tailslaps and was rejected. After initial food-refusal, Nicky started eating again and found a good playmate in the female adult Dolly.

The adoption was thought to be successful, but on day thirteen Odin started to have respiratory problems and eventually died. Iris tried to bring him to the surface several times but gave up after five minutes and began swimming with Nicky again. The necropsy revealed a severe infection of the upper respiratory tract. The following night the nightwatch noticed baby Orfee lying dead on the bottom of the pool. Orfee died of a "generalised parenchym degeneration"¹⁴.

NOTES

- ¹ De Waal, 1982: 22 and personal communication with Linda Van Elsacker, 8th October 1999.
- ² Cantor, 1993: 287-289.
- ³ Maple, 1995: xiv, 27.
- ⁴ Tarpy, 1993: 33.
- ⁵ Cantor, 1993: 288.
- ⁶ Harcourt, 1989: 128-129.
- ⁷ Anonymous, 1996c: 10.
- ⁸ Amundin, 1986: 270.
- ⁹ Terry, 1989: 48.
- ¹⁰ Terry, 1989: 49.
- ¹¹ De Block, 1980: 96-98.
- ¹² Warwick, 1990: 5, 8-10.
- ¹³ Bryden, 1990: 138.
- ¹⁴ Smolders, 1989: 173-180. Personal communication with Walter De Meurichy, 13th October 1999. Regarding jawclaps producing a hard echo, see Corkeron, 1990: 146.

- 5 -

Psychological welfare in zoo enclosures

Stereotyped and other 'abnormal' behaviour is often referred to as evidence of mental suffering in zoos. An article frequently referred to is 'Abnormal behavior in zoo animals' by Monica Meyer-Holzapfel. This article dates back to 1968, when Meyer-Holzapfel was a Professor in Animal Behaviour at the University of Bern and the Director of the Municipal Zoo Park of Bern, Switzerland. This article will also serve as our frame-work, not only because it is one of the few extensive surveys on this subject, but also because many of the examples considered can still be encountered in certain zoos and because the article gives a good impression of behaviour patterns which could occur in zoos. Meyer-Holzapfel uses the term 'abnormal' to refer to behaviour uncommon or absent in free-ranging animals. Types of 'abnormal' behaviour in zoo animals are as follows.

Abnormal escape reactions

Especially after transport, animals may get panic-stricken and can run against the wire or wall of the enclosure, sometimes breaking their necks or legs. As Jarofke states in the 'Handbook of Zoo Medicine':

"Some animals such as pudu, proboscis and Hamlyn's monkey or Père David's deer are very sensitive and susceptible to shock, so a simple procedure or merely restraint can result in death."¹

In 1991 a pudu died at Antwerp Zoo because of trauma that ensued as a result of panic. Recently the young female okapi Katanda, who was imported from the American SSP for EEP breeding purposes at Copenhagen Zoo (Denmark), "died as a result of an extreme stress-reaction to an open-air concert"².

There may also be an inhibition of escape behaviour. Meyer-Holzapel describes that animals may go into a stupor for hours or days after capture and change of environment. Social conflicts may also result in what appears to be inactive behaviour. She gives the example of a low-ranking black bear at Basel Zoo, who was often attacked by other bears and "used to sit motionless for hours in a rock hollow, gnashing its teeth"³.

Refusal of food

According to Meyer-Holzapel, refusal of food often happens after capture or change of enclosure. She illustrates this for sea elephants and snakes, which can respectively refuse food for 40 to 100 days and for 1 to 2 years⁴.

Stereotypical behaviour

Stereotypical behaviour is a type of abnormal behaviour regularly observed in zoo animals. Stereotypies can be characterised by (i) a relatively invariant pattern, (ii) regular repetition and (iii) apparent uselessness⁵. Several forms of stereotypical behaviour can be distinguished.

Behaviour such as pacing to and fro along one side of the enclosure or stepping in a figure of eight or in a circular form is still very common in many — including reputable — zoos. It can be especially observed in large cats and bears.

At a small zoo in Ghent (Belgium) a single exhibited wolf has been running in a figure of eight for years in a cage with a tiled floor. Since his enclosure became smaller, the wolf is running in circles. He runs even faster when visitors are approaching or scurries constantly in and out of his indoor quarters⁶.

A video by Zoo Check — now the Born Free Foundation — shows how an African elephant stereotypically walks around a small rock. Footprints in the sand show how the elephant repeatedly places his feet on the exact same spots. The video also shows how a monkey makes a large stereotypical movement through its enclosure by actually performing small circles in the opposite direction. Each small circle is formed by him pushing his body away from the wall with his hands and swaying his head backwards⁷.

Meyer-Holzapel refers to Eipper, who in 1928 gave the example of a polar bear who used to walk six steps forward and seven steps back in a narrow wagon cage of a travelling menagerie. When this animal was bought by Munich Zoo and placed in a large enclosure, it kept displaying exactly the same behaviour. I myself observed this behavioural pattern of walking a fixed number of steps forward and backward in 1994 at Antwerp Zoo by one of the Kamchatka bears (*Ursus arctos beringianus*), who walked to and from a closed door.

Weaving is mostly observable in bears and elephants. This behaviour pattern involves rhythmical movements of the head from the left to the right side and back, while putting their weight alternately on one of the front legs. This can clearly be seen, for instance, in one of the polar bears at Antwerp Zoo (next to the enclosure of the Kamchatka bears) and by one of the elephants at Arnhem Zoo (the Netherlands).

This weaving behaviour pattern can also be vertically directed and involves regular head movements going up and down. This vertical weaving behaviour has been displayed for years by one of the Asiatic black bears (*Selenarctos thibetanus*) at Zwartberg Zoo where I have observed many of tens of large cats and bears displaying one or another form of stereotyped behaviour⁸.

Animals may lick the bars or walls of their enclosure in a stereotypical way. Examples of this could be seen in the chimpanzee Bongo at Zwartberg Zoo and can still be observed in some of the buffaloes and giraffes at Antwerp Zoo.

In a study of 116 giraffes in 31 zoos in Japan, dating from 1988, Shusuke Sato (Miyazaki University) and I. Takagaki frequently observed stereotyped tongue-rolling, crib-licking, wall-licking and mane-biting. One giraffe also repeatedly beat her head against the window in spite of bleeding and another repeatedly swallowed her own vomit⁹.

Abnormal aggression and automutilation

Abnormal aggression has already been dealt with above, where it was shown that aggression can be problematic in captivity because of the combination of factors which can raise the level of aggression and the impossibility of escape.

Automutilation involves, for example, exaggerated licking, gnawing and scratching parts of the body. Meyer-Holzapfel refers to Freund, who in 1929 gave examples of a hyena that gnawed away both hind paws and a Moor macaque that had eaten its own penis, scrotum and testes. Other examples given by Meyer-Holzapfel are, for instance, large cats and monkeys that gnaw away their tails and parrots that pull out their feathers.

Automutilation in captive dolphins can result in the death of the animals. Jacques and Jean-Michel Cousteau have become opposed to keeping marine mammals in captivity, after seeing some dolphins die at their Oceanographic Institute in Monaco. According to Hoyt, it was concluded that one of these dolphins had committed suicide. Johnson writes about several dolphins at Cousteau's Institute who "quite simply hit their heads against the hard edge of the pool until they died".

Klinowska and Brown give the example of a pilot whale, that "refused food when his two companions died and swam around the tank clasping the bodies; the animal later swam against a glass port, shattering it".

At the dolphinarium at Whipsnade, the dolphin Samson began attacking the underwater windows in around 1985. It was thought that the dolphin attacked his reflection, but efforts to reduce reflection did not have much effect. During observation a dropped pencil startled Samson and resulted in him bumping his head on the glass. Klinowska and Brown write that the "fact that the glass attacks developed during Samson's isolation [two females died, K.M.] and almost ceased after the introduction of Lady tends to demonstrate that this animal was disturbed when alone". In 1988 the dolphinarium at Whipsnade was closed. Samson was sent to Spain and Lady to another U.K. dolphinarium, where she died a year later¹⁰.

Abnormal parental behaviour

Attention has already been drawn to problems in parental care. Besides the occasional neglecting or even killing of young ones, excessive care behaviour has also been observed:

"Rectal stenoses have been observed several times in okapis between 4 weeks and 7 months of age (...). The extent and severity of lesions were hardly noticeable clinically. (...) The cause or mechanism involved in this condition is not completely understood. It is believed that the mother out of boredom may exercise excessive care and thus inflict damage to the rectum by means of the long flexible tongue"¹¹

Compensation reactions

Birds may catch "non-existing, imaginary" insects or a cat can "kill" bananas. The latter behaviour was shown by one of the civet cats at Gerald Durrell's Jersey Zoo. Before eating the banana, the animal first shook it, as if to make it lose consciousness, and then fell on it repeatedly until it was smeared over the ground. Durrell supposed that this was done as some kind of substitute for natural predator behaviour¹².

Abnormal feeding behaviour

Coprophagy refers to active oral contact with faeces, such as eating them or smearing them on walls with the lips. This behaviour has been seen in nature in gorillas and chimpanzees, but occurs more frequently in captivity. Once this behaviour pattern has been developed, it becomes very difficult to eliminate¹³.

The Zoo Check video shows how a gorilla regurgitates and reingests his food. In 1982, Maple and Hoff wrote about a study carried out at that time in North American zoos. They reported that this behaviour is common in zoo apes.

Meyer-Holzapfel refers to Portielje's research of 1942, which describes a gorilla who watched the wriggling intestinal worms in his vomit with curiosity. In the same period a female bear used to run away to a place where

she normally weaved when a male attempted to chase her away from her food. There she regurgitated and reingested her food for about two hours — up to 200 times. When she was separated from the male, both her weaving and vomiting behaviour patterns immediately disappeared, and returned when reunited¹⁴.

Increased passivity and apathy

Wemelsfelder (University of Leiden) refers to literary sources, according to which captive animals display more sleeping-, lying- and sitting-behaviour patterns than their conspecifics in (semi-)nature.

Meyer-Holzapfel quotes an example of a female orangutan who became apathetic when her cagemate died. She looked ill and was lying in her sleeping box for most of the day. Occasionally she sat dejectedly under the heating lamp. It was only when a male was added to her enclosure (after more than one year of isolation) that her behaviour patterns changed. She hardly slept during the daytime, she actively initiated contact and she became a lively animal again¹⁵.

The behaviour patterns described in the above section show a large amount of variation and the same seems to be true for their origin. I will, nevertheless, attempt to put forward some general assumptions that may be relevant for the explanation of some of these patterns. Special attention will be given to the question of what these teach us about the psychological welfare of the animals involved. With this focus of attention, it should be kept in mind that several aspects of this subject show an overlap¹⁶.

Frustration

Some behaviour patterns seem to be the consequence of frustration of specific forms of natural behaviour. The stereotypical tongue movements in giraffes are thought to be in part the consequence of lacking the opportunity to carry out natural, complex tongue movements. Sato and Takagaki found that the feeding of leaves, which require such complex movements,

reduced the duration of this stereotypical behaviour by half (in contrast with hay feeding)¹⁷.

Coprophagy can also in part be attributed to a lack of dietary roughage. In nature, chimpanzees make “wadges”: seeds, peelings and leaves are kept in the mouth and sucked on, until all juices have been extracted. It is possible that in captivity chimpanzees try to compensate this by chewing their own faeces. Giving captive chimpanzees foraging grains increases activity rates and decreases the rates of aggression, but it may also increase coprophagy (perhaps because of the grains in the faeces). According to Fritz *et al.*, this may be reduced by providing wadge materials as well, such as cardboard and fruit peels (chimpanzees show a preference for both as wadge materials)¹⁸.

The point has been made that provision of deep substrate to aquatic soft-shelled turtles can replace hyperaggression with burrowing behaviour. Meyer-Holzapfel gives the example of an armadillo that used to quickly run to and fro in his small, bare enclosure. When a layer of earth was provided, the animal started to dig a hole and slept there for hours¹⁹.

Stress

The examples given of escape reactions are associated with an extreme stress-reaction (one of them caused by an open-air concert). In addition, refusal of food after either capture or change of enclosure may be the result of acute stress.

Do certain animals in zoos live in a state of chronic or permanent stress, caused by the presence of cagemates or humans for instance? This is possibly the case for the female bear that used to regurgitate and reingest her food each time the male approached her, for the hyperaggressive turtles mentioned by Warwick, for the several examples of fighting dolphins and — in the rutting-season — for the female elks and reindeer in the zoos of the Royal Zoological Society of Antwerp.

The possible negative effect on animal welfare caused by human visitors is a factor requiring special consideration. At San Diego Zoo, the douc langurs “have frequently been plagued by vomiting, probably caused by psychological stress”. In an attempt to reduce stress, the breeding groups

of this primate species have been placed behind the scenes, "away from staring people and the commotion of other animals"²⁰.

Research carried out by Isolde Debyser suggests a link between stress on the one hand and trauma and infectious disease as causes of juvenile mortality in primates on the other hand. She writes that there may be a link between stress and high social density in the enclosures (see above). Literature reviewed by Debyser also draws special attention to the stress to animals engendered by the presence of humans (both visitors and caretakers). In so far as breeding and juvenile mortality is concerned, stress can lead to lower fertility (decreased conception rates, increased embryonal resorption), increased premature births, failure to lactate, maternal neglect and abuse²¹.

Research on primates carried out by Hosey and Druck of the Bolton Institute of Higher Education (published in 1987) states that it is often presumed that the displayed animals are accustomed to the presence of the public. However, according to the authors:

"Zoo primates do not habituate completely to the presence of the public, nor do they ignore them. On the contrary, the mere presence of zoo visitors influences primate behaviour to a greater extent than has previously been thought."²²

Research by Chamove (Stirling University), Hosey and Schaetzel (University of Vienna) on primates has shown that "visitors are a source of stressful excitement rather than of enrichment". The observed animals at Edinburgh Zoo had access to indoor and outdoor enclosures. The indoor enclosures were at least 5x5.3x4 m and furnished with ledges and dead trees. The presence of visitors led to a significant increase in aggression as well as to a significant decrease in grooming (80%), inactivity and affiliative behaviour. At Schoenbrunn Zoo the male mandrill started to masturbate frequently when visitors were present. The two female mandrills stopped grooming and showed more stereotyped behaviour. Negative influences of visitors were especially observed on arboreal monkeys, and could be reduced by 50% by lowering the position of the visitors²³.

Boredom

Klöppel suggests that the damage done to the rectum of some okapi calves by excessive care behaviour of their mother, may find its origin in boredom (see above). Fritz *et al.* believe that boredom (and also stress) may in part explain the much more frequent occurrence of coprophagy in captivity as compared to nature²⁴. However, what is meant by boredom and can we really know if animals are bored?

Wemelsfelder states that whereas frustration may be induced by a blockage of the performance of specific motivated behaviour by environmental conditions, boredom can be induced by a general lack of sensory stimulation in the environment²⁵.

I have stated that ethological observations can support the idea of animals being subjects along three lines. An example was given of a dog experiencing pain while being beaten. What if this idea was applied to the notion of animal boredom and other psychological welfare problems?

Firstly, are there behavioural similarities between animals and humans that suggest that animals may be bored? In around 1994 I visited Artis — Amsterdam Zoo. It was wintertime and the orangutans had to stay in their indoor enclosures. There were three enclosures: one on the right with a male orangutan, one in the middle with a female orangutan and two youngsters and a third exhibit on the left with another lone orangutan. According to a rough estimate each enclosure was about 3 to 4m wide and about 7m deep. The enclosure in the middle was the largest. All enclosures were rather traditional but enrichment material was available in each one. The youngsters and the female were quite playful, unlike the male in the right hand side exhibit who was lying towards the front of his enclosure for almost the total duration of time I spent there (a few hours spread throughout the day). He rested his head on his arm and he was constantly looking through the glass in the direction of the wall in front of him. Sometimes he looked at the few visitors who passed by and at me. Occasionally he rose up and went to look through a very narrow opening of a door leading to the middle enclosure, apparently in order to catch a glimpse of the female and/or her youngsters. Then he would lie down again in the same way as before and occasionally he would sigh deeply. In my opinion this orangutan manifested passivity and boredom.

This animal very much resembled an animal featured in an impressive picture published by Desmond Morris²⁶. Morris shows two pictures of beings who look bored: one of a young man sitting on a staircase with his hand supporting his head, another of an orangutan lying in his nest in a zoo, his head resting on his arm, his eyes half-shut.

The orangutan in Amsterdam also reminded me of a very sad example given by Gerald Durrell of an orangutan who had to live alone in an indoor enclosure of about 5x3m. It was very dark inside and there was no outdoor enclosure. Contained within this cement cage was only one small piece of enrichment:

"The orang sat in the middle of the floor, carefully putting a tiny piece of sacking on its head and taking it off, over and over again. It was the only thing it had to occupy its highly intelligent and inquisitive mind."²⁷

Is one making anthropomorphic projections by suggesting that these animals might be bored? Perhaps, but if it is true that orangutans are very intelligent, inquisitive and sensitive animals (see for instance the quotation by Biruté Galdikas above), then these forms of passive behaviour should raise serious concerns.

Although it may never be possible to know exactly what animals experience — unless possibly by means of sign language, as used in the project of Lyn White Miles with the orangutan Chantek — it may at least prove valuable to build an ethological picture based on careful observations of certain behaviour patterns in these animals²⁸.

Secondly, what are the conditions under which this behaviour is displayed? I have already indicated that animals in captivity show more sleeping-, lying- and sitting-behaviour patterns than conspecifics in nature. As shall be shown below, there seems to be a demonstrable link between passive characteristics and the monotony of the environment.

In addition, stereotypical behaviour is partly linked to monotonous living conditions. In an article written in 1991, Georgia Mason (then of the Sub-Department of Animal Behavior, University of Cambridge) describes three different — but not mutually exclusive — contexts under which stereotypical behaviour develops:

a) A frustrating situation, which does not allow the animal to perform a particular behaviour pattern. Mason gives the example of stereotypical

pacing in egg-laying hens, which develops when they have no access to a suitable nest-site or when there is intense food frustration. According to Meyer-Holzappel, pacing in many zoo animals such as large cats is related to the feeding time routine. The example of the armadillo also illustrates this point.

- b) A situation of unavoidable stress or fear. Mason refers to the example presented by Meyer-Holzappel of the bear with the stereotypical vomiting behaviour in the presence of an aggressive male.
- c) Barren and restrictive conditions. Research referred to by Mason has shown that the more restricted the confinement of sows is, the more extensive the stereotypical behaviour they have developed²⁹.

This takes us to the *third* factor: bringing changes to the environment. This can be achieved in two ways. As a first possibility, one can study the effect of rendering the environment as monotonous as possible. Research carried out with the sows is one example. There are also the notorious experiments performed by Harry Harlow (University of Wisconsin) in around the 1960-70s.

Harlow placed rhesus macaques in isolation in very small V-shaped chambers, which he called "the pits of despair". The animals could not climb up the slippery sides, and had to sit on the mesh bottom. Each monkey was only able to see the hands of the caretaker who brought him food and water. Deborah Blum, in her book 'The Monkey Wars', writes:

"In a way, the animals raised in the steel chambers had lost the ability to be monkeys. They were still alive, they still ate and drank. But beyond basic survival (...) the animals could not cope. They were not explorers, climbers, chatterers, fighters, or friends. They were dazed and unresponsive (...). Some of them would finger the air, freeze in fright at the sight of their own arms — a characteristic of humans with severe schizophrenia. In a typical experiment, Harlow reported, the monkeys would spend the first few days scrambling around the bottom, slipping on the metal sides, trying to get out. They would spend the rest of their stay huddled, head down, on the bottom."³⁰

Comparable experiments performed by Harlow, in which the monkeys could only see walls and were isolated from each other for months or even for up to two years, transformed the animals into pacers, self-abusers and chronic masturbators. No positive effort could make them lift their heads anymore. Harlow reported that they were mentally destroyed³¹.

Another possibility, and clearly preferable from a welfare perspective, is to enrich the living conditions and then look at the effects on animal behaviour. At Burgers' Zoo — the Netherlands — the chimpanzees have to stay in a building in the winter. Although it contains sleeping quarters and two halls (the largest hall measuring 21x18m), it is still considerably smaller than the open-air island. This results in twice as many aggressive encounters as compared to during the summer. De Waal describes the first day that the animals were allowed onto the island after the winter as follows:

"The day the chimpanzees leave their winter quarters is the most festive day of the year. In the morning the keeper opens the trapdoor leading to the open-air enclosure. The apes cannot see what is going on from their sleeping quarters, but they can distinguish all the trapdoors in the building by ear. Within a second the whole colony reacts with a deafening scream. They are let out into the open air in small groups. The screaming and hooting continues. All over the enclosure apes can be seen embracing and kissing each other. Sometimes they stand in groups of three or more jumping and thumping each other excitedly on the back.

The apes' delight in regaining their freedom is obvious. (...) And, most important of all, the tension, which has been bottled up all winter, will dissolve again in the open air."³²

Clarke, Juno and Maple investigated the transfer of four chimpanzees from restricted living conditions to a naturalistic man-made island of about 40x10m. As a result of the move a significant decrease in stereotyped (rocking) and self-directed (self-grooming) behaviour was noticed. The animals' passivity changed into more active and innovative manipulative behaviour (for example, orange peel and on one occasion a glass bottle were used to bring lake water to the centre of the island for drinking)³³.

If animals show passive behaviour in zoo enclosures, one could still argue that they are just resting rather than being bored. This may be a plausible hypothesis. However, a perhaps more prudent approach would be to give them the benefit of the doubt. Many animals seem to be complex subjects, beings with their own preferences, beings that are intelligent and sensitive. The fact that animals display a variety of active behaviour patterns in rich environments makes their passivity in mo-

notonous enclosures a serious cause of concern. At the very least, the assumption that they are possibly bored ought not to be labelled as 'misplaced sentimentalism' and 'an anthropomorphic projection' and rejected.

What to think of the assertion that stereotypical behaviour does not need to refer to mental suffering? Does stereotypical behaviour develop as a means to cope with the living conditions enforced upon animals? Is the animal's welfare left intact in this way? It has been suggested that stereotypical behaviour increases endogenous opiates thereby inducing self-narcotization. However, this thesis has met serious criticism since some studies point towards a positive correlation between stereotypical behaviour and sensitivity to pain³⁴.

Even if we would assume that an animal with stereotypical behaviour does not suffer, several remarks could still be made. Firstly, the animal may have been in a negative psychological welfare situation when the stereotypical behaviour developed. Philosopher Peter Singer refers to research by Cronin of the University of Wageningen (Netherlands). Cronin described the reaction of sows when they were tethered for the first time as follows:

"The sows threw themselves violently backwards, straining against the tether. Sows thrashed their heads about as they twisted and turned in their struggle to free themselves. Often loud screams were emitted and occasionally individuals crashed bodily against the side boards of the tether stalls. This sometimes resulted in sows collapsing to the floor."³⁵

Singer adds that:

"These violent attempts to escape can last up to three hours. When they subside, Cronin reports, the sows lie still for long periods, often with their snouts thrust under the bars, making occasional quiet groans and whining noises. After a further period, the sows show other signs of stress, such as gnawing the bars of their stalls, chewing when there is nothing to chew, waving their heads back and forth, and so on. This is known as stereotypical behavior."³⁶

It might be highly valuable to investigate how zoo animals used to behave before stereotypical behaviour developed.

Secondly, there seem to be many kinds of stereotypical behaviour. However, it is not reassuring that they seem to occur mainly (i) in animals living in very restricted conditions (such as within intensive agricultural systems and in laboratories), (ii) in humans with schizophrenia, autism or learning disabilities and (iii) when induced by drugs (such as amphetamine and apomorphine). Of the latter type of stereotypical behaviour — stimulant-induced — Mason writes:

“In human subjects under the influence of amphetamine, routine and thought processes become unvarying and obsessive or compulsive, in a manner similar to that of schizophrenics (...).”³⁷

High doses of stimulants make the stereotypical behaviour more intense and this may even cause self-damage (for instance, self-biting or overgrooming). Stereotypical behaviour can also result from brain damage. For example, a dog with a bilateral frontal lobotomy may constantly and purposelessly shift between two bowls of food³⁸.

In spite of the large variety of patterns of stereotypical behaviour and their various causes, it seems appropriate to place these within this perspective as opposed to making comparisons on the basis of a rather vague analogy — such as a repetitive behaviour pattern. An illustration of this is the analogy made by Bostock between the swimming stereotypy in a polar bear and the habit of a human being to swim in a swimming pool every day. Bostock also refers to the punctual daily walks of the philosopher Immanuel Kant. However, I should add that Bostock also mentions the behaviour of deprived children³⁹.

Thirdly, even when mental suffering is absent in animals showing stereotyped behaviour, it is still possible that an undesirable welfare situation exists because the animal may be deprived of a variety of positive welfare experiences.

Fourthly, it also seems that the development of stereotyped behaviour in captive animals means a “gradual impairment of the capacity to interact with the environment”, as Wemelsfelder explains⁴⁰. The behaviour becomes more and more fixed and thus the animal loses its behavioural flexibility. So, the view that an animal showing stereotyped behaviour is just adapting to or cop-

ing with its environment, and that this is just a normal way of exercising control, seems to miss out on the point that behaviour becomes increasingly inflexible. After all, the ability to adapt to changes in the environment and to control this environment thus becomes impaired, with possibly very grave consequences for the welfare (for instance, of survival chances in a changing environment) of the animal involved. Eventually, the stereotyped behaviour can become so fixed, that return to normal flexible behaviour becomes very difficult or even impossible. The behaviour of the polar bear that carried on walking a fixed number of steps forwards and backwards when moved to a larger enclosure, may be an example of this.

Passive behaviour may also be the result of having insufficient control over the environment. ‘*Learned helplessness*’ is the consequence of a complete lack of control. Animals that cannot avoid an electric shock will finally sit down passively and undergo the shock⁴¹. The monkeys that could not escape the V-chamber in Harlow’s experiment ended up sitting huddled on the bottom with their heads down, as described above. This may also be called a state of helplessness. (Also compare this with the example of the sows by Cronin, in which attempts to escape seem to be replaced by passive and stereotyped behaviour). Do some zoo animals also live in a kind of state of helplessness?

Sometime around 1992, a newly arrived zebra at Animal park Planckendaal, the first of a new herd, ran through its new enclosure in a way that gave the impression that it was trying to escape rather than displaying contentment. If after some time this animal should become calmer, should this be interpreted as a sign of helplessness or of positive acceptance? What if the animal should eventually show rather passive behaviour, such as the orangutan at Amsterdam Zoo? And what about the orangutan described by Durrell, who constantly puts something small on his head and takes it off again?

Wemelsfelder indicates that, besides helplessness, the terms ‘depression’ and ‘apathy’ have also been used by ethologists to describe the psychological state of animals in long-term confinement (see also above). She refers, for instance, to Odberg, who “characterises apathy as an abnormal form of lasting immobility in response to long-term behavioural restriction”⁴².

Maybe the example given by Stefan Ormrod of the polar bear Spunky at Dublin Zoo is a recent example of apathy exhibited by a zoo animal. This male would sit at the pool for long periods (up to three hours) staring at the wall of his enclosure. Ormrod describes this position as “an uncom-

fortable-looking squat". Efforts to distract this animal were not very successful. At best, it would "languidly" take a few thrown peanuts and return to its position⁴³.

Where psychological welfare problems occur in zoo animals, these seem to be connected to monotonous living conditions. These conditions are not varied enough to allow animals to exert their own way of control — compare this, for example, with the preference for working for food instead of just receiving it — and can even impair their behavioural flexibility. Imposed restrictions mean that the animals cannot live according to their own needs and preferences; they seem to lack welfare autonomy.

NOTES

- ¹ Jarofke, 1982: 9-10.
- ² Meyer-Holzapfel, 1968: 476-477; Anonymous, 1991a: 18 and Van Puijenbroeck and De Bois, 1995: 244.
- ³ Meyer-Holzapfel, 1968: 477.
- ⁴ Meyer-Holzapfel, 1968: 477.
- ⁵ Odberg, 1993: 175.
- ⁶ My own observations made since 1991; see also Vandenbosch and Van der Straeten, 1995: 46.
- ⁷ McKenna and Mugford, (after 1985): (video).
- ⁸ Meyer-Holzapfel, 1968: 479-487.
- ⁹ This information is based on a text that was referred to by Sato and Takagaki during the International Ethological Conference of 1991 at Kyoto and in a letter dated 9th November 1991 by Sato to Bill Travers of Zoo Check.
- ¹⁰ Meyer-Holzapfel, 1968: 490-493; Klinowska and Brown, (1986): 120, 122, 130; Meyer-Holzapfel, 1988: 47-48; Johnson, 1990: 182, 226-227; Hoyt, 1992: 84.
- ¹¹ Klöppel, 1982: 254.
- ¹² Durrell, 1976: 66 and van der Helm, 1990: 4.
- ¹³ Fritz *et al.*, 1992: 313-315.
- ¹⁴ Meyer-Holzapfel, 1968: 487-488 and Maple and Hoff, 1982: 39.
- ¹⁵ Meyer-Holzapfel, 1968: 496 and Wemelsfelder, 1989: 68.
- ¹⁶ Of special relevance for considerations in connection with frustration, stress and boredom in animals is Wemelsfelder, 1993.
- ¹⁷ Sato and Takagaki, 1991.
- ¹⁸ Fritz *et al.*, 1992: 314, 317-318.
- ¹⁹ Meyer-Holzapfel, 1968: 480.
- ²⁰ Peterson, 1989: 288.
- ²¹ Debyser, 1995: 28, 76.
- ²² Hosey and Druck, 1987: 19.
- ²³ Chamove, Hosey and Schaetzel, 1988: 359-368.
- ²⁴ Fritz *et al.*, 1992: 314.

- ²⁵ Wemelsfelder, 1993: 27, 142.
- ²⁶ Morris, 1986: picture between p. 136-137.
- ²⁷ Durrell, 1976: 39.
- ²⁸ See, for instance, Miles, 1993.
- ²⁹ Meyer-Holzapfel, 1968: 481 and Mason, 1991: 1017-1018.
- ³⁰ Blum, 1994: 95.
- ³¹ Blum, 1994: 92-95.
- ³² De Waal, 1982: 25-26.
- ³³ Clarke, Juno and Maple, 1982: 371, 373-374, 378.
- ³⁴ See, for example, Ladewig *et al.*, 1993: 107-108 and Dantzer and Mittleman, 1993: 164.
- ³⁵ Cronin in Singer, 1991: 127.
- ³⁶ Singer, 1991: 127.
- ³⁷ Mason, 1993: 19.
- ³⁸ Mason, 1993: 19-23.
- ³⁹ Bostock, 1993: 88.
- ⁴⁰ Wemelsfelder, 1993: 140.
- ⁴¹ Wemelsfelder, 1993: 26.
- ⁴² Wemelsfelder, 1993: 26.
- ⁴³ Ormrod, 1992: 23, 25-26.

Nature, (enriched) zoos and domesticated animals

Enrichment

Over the last two decades in particular, leading zoos have been making considerable and important efforts to enrich the enclosures of the animals that they keep. In general, a trend seems to be developing to keep fewer species and to display animals in larger and more natural enclosures. Attention is paid to social structures and to providing animals with materials to occupy themselves in a way that is akin to their natural lifestyles. One only has to consult literature on zoos to realise that many people who work in zoos are creative and work very hard to find ways to enrich the lives of the animals for which they are responsible.

This shift towards more natural enclosures has been called "Cosmetic variations on nineteenth-century zoo design" ¹. However, I am convinced that these changes often result in very valuable improvements for the welfare of the animals involved. It would simply be unfair to keep on saying that all zoo enclosures are essentially barren cages of concrete and to deny all the changes taking place in order to make enclosures more natural and richer for their inhabitants.

Examples have already been cited of several primate enclosures. In 1993 the Royal Zoological Society of Antwerp constructed an island of 3,000 square metres for bonobos — or pygmy chimpanzees — at Animal park Planckendael. In 1999 eleven bonobos lived on this island: four adult females, three adult males, one sub-adult, a juvenile and two infants. Several climbing and play structures (among them a kind of slide) have been

dispersed over the island. The types of trees and other vegetation have been carefully selected, taking into account the preferences of the bonobos. The bonobos build nests high in a willow tree and carefully select water plants that grow in the swampy area of the surrounding water-moat. In the morning caregivers disperse breakfast all over the island, hiding some of it in bushes so that the bonobos have to actively search for it. Sometimes they catch the eggs of birds such as moorhens and then one can see bonobos walking around with seven or eight eggs in their arms. Sometimes they catch frogs or fish in the water-moat. A wooden log hanging on a rope serves as an artificial termite mound. Its holes can be filled with yoghurt, mustard or honey, for example. The bonobos have to search for branches on the island in order to obtain these treats. They are allowed onto the island when the temperature reaches 15° C.

The indoor enclosure consists of night quarters and a hall of 600 cubic metres. Large trees, ropes, nets and nesting-sites are provided and can be relocated. Other enrichment materials, such as branches, woodwool (used as a kind of drinking sponge, for instance), large cardboard boxes, rolls of paper, small mirrors and canisters are also provided. Clothes and gunny-sacks are sometimes used to play games with. One bonobo runs around keeping a piece of cloth in his mouth while another one chases him. In the wintertime caregivers sometimes put containers filled with snow in the indoor enclosure.

Food is offered in such a way that it stimulates the bonobos to be active. Entire coconuts are provided and it has been observed that bonobos use woodwool to protect their hands while hitting coconuts against the walls. Sometimes chestnuts in husks, frozen yoghurt lollipops, bottles with syrup and cardboard boxes containing seeds and other titbits dispersed in woodwool are placed in the enclosure.

Van Elsacker (Royal Zoological Society of Antwerp) and Walraven (Department of Biology, Antwerp University) described what happened when a pineapple had been hidden in the enclosure for the first time. Upon their arrival, the bonobos started searching as usual and after a short time the oldest and dominant female Dzeeta found it. Having hesitated for some time, she then took the food item, carried it around for a while and started grooming the fruit. This resulted in the loosening of the scales and the release of juice. Other bonobos gathered around Dzeeta and began begging. While Dzeeta was eating the pulp, the others were allowed to drink the



ANIMAL PARK PLANCKENDAEL

Part of the bonobo island and indoor enclosure at Animal park Planckendael.



spilled juice and to take pieces of pineapple skin from the floor. After some time, Dzeeta stood up, took the largest of the cup-like remains — the pineapple had broken into two parts during eating — and walked to the drink nipple. She kept the “cup” in one hand, pushed the nipple with the other, filled it with water and immediately drank from it. She repeated this action several times. In total, Dzeeta was active with this pineapple for more than one hour².

Other examples of rich primate enclosures are the chimpanzee island at Arnhem Zoo and the gorilla island — and many other primate enclosures — at Apeldoorn Zoo (or Apenheul) in the Netherlands.

Examples of eco-displays are the rainforest and desert halls at Arnhem Zoo. The rainforest hall measures about 150x95x20m (highest point) and exhibits — in a rich flora — varieties of birds, lizards, frogs and insects, in semi-freedom. The desert hall has a surface of about 7,500 square metres and is 10m high. In an area of sand plains, rock formations and plants (such as cacti of more than 6m tall, and small trees), many species of birds (such as vultures and humming-birds) and lizards are displayed. In both halls some animals are shown in more limited enclosures (for instance manatees, aardvarks, bobcats and peccaries)³.

Colin Tudge has described examples of enriched enclosures for bears and cats at Glasgow Zoo, Scotland. Glasgow Zoo was asked to find a new home for four Asiatic black bears (also called Himalayan bears; *Selenarctos thibetanus*), originating from a park whose license was withdrawn by the local council. To this purpose Glasgow Zoo constructed an enclosure of about 1.5 hectare, 1ha of which consisted of a wooded hillside with a stream. In the wooded area, the bears can make nests. This is also possible inside their building, where they can sleep at night and hibernate in metal baskets, which they fill with straw.

In the mornings the caretakers spread meat, fruit (such as raisins) and vegetables throughout the whole enclosure. Scent trails are drawn with pieces of meat. In addition, food items are hidden in a woodpile or in drainpipes vertically fixed into the ground and into which the animals must reach. The bears also have a look-out platform from which they can enjoy the view. They have to climb on its poles to reach attached pieces of meat⁴.

A platform was also built for the cheetahs at Glasgow Zoo since they have remarkable long-distance vision. They often look at the deer and the

cars on the motorway, according to Tudge. For the leopards and small cats, the number of feeding times was increased from only one to three times a day. The food is placed out of reach, so that the animals have to work for it (for instance, leaping to a pick-axe handle hanging at the roof or finding food hidden in piles of sticks)⁵.

Another example is the hanging of a perforated tube containing sawdust and mealworms in a meerkat cage — so that at irregular intervals a worm falls into the enclosure⁶.

The lives of animals can also be enriched by carefully placing several species together in the same enclosure, such as the aforementioned eco-halls or the African savannah enclosure of 1ha at Emmen Zoo (an example of a zoo with many enriched enclosures). If desired, antelopes can move away from zebras, rhinos, giraffes and ostriches by passing between big rocks. At Apeldoorn Zoo, hussar monkeys are kept on the gorilla island. Sometimes, the younger gorillas try to make contact with these monkeys⁷.

Enrichment efforts are very important. However, while enclosures may appear more enriched and nature-like when compared to traditional bare cages, one may not simply conclude from this (often based on good intentions and hard effort), that this automatically means that a positive welfare situation has been created. The effectiveness can only be evaluated by looking at the behaviour of the animal itself, by investigating its activity over time.

When I visited Glasgow Zoo in 1994, one of the cheetahs was performing some stereotyped pacing and one of the small cats showed apparently very fixed stereotyped pacing (in an enclosure with a pickaxe handle on the roof). Tudge gives the example of pumas, who started to perform what looked like a new type of abnormal behaviour: hunting for their artificial prey up to two hundred times a day. Ormrod states that meerkats can wait hours for mealworms to drop. He also wrote that a polar bear at Chessington Zoo performed a play-routine with a plastic container in the water in such a way that it might eventually develop into stereotyped behaviour⁸.

All this clearly does not refute the value of zoo enrichment. It only shows the need for evaluation by investigating the animals' behaviour over longer periods of time. A positive example is, for instance, the research by Chamove and Anderson into the effects of covering the floor of a primate

enclosure with woodchips and food items. It was demonstrated that this significantly increased foraging behaviour patterns as well as reducing aggression and abnormal behaviour. Play and affiliative behaviour were also reduced, but the overall welfare effect seems to be positive⁹.

Nature and zoos

A comparison between the welfare of animals in nature and in zoos is very complex. This is essentially because of the many differences between the species involved, because of their different lifestyles in nature and the ways in which they are displayed in organised zoos. Matters become even more difficult when the following factors are taken into account: the destructive influence of humans on nature, the structural welfare problems in captivity and the living conditions in the many small, sub-standard zoos. In the following section I will draw a comparison between animals living their natural lives, relatively protected from human interference — for instance in nature reserves — and animals living in enriched zoo enclosures.

Animals in nature can be confronted with very serious welfare problems, as described by David Jones (Zoological Society of London):

a) Predation: cape hunting dogs can follow a zebra until it is exhausted, and while one bites in its tail and another in its upper lip, the remaining dogs start tearing the animal's belly apart, eating it while it is still alive. A cheetah may hand a young gazelle, still alive, to her cubs in order to acquire hunting experience.

b) Sick, injured or old animals can suffer a lingering death from starvation (if not killed by a predator).

c) Seasonal shortages of water and food can cause the death of many animals. Elephants need large volumes of water each day and can die of dehydration in prolonged periods of drought.

d) Climatic conditions can be not only disturbing, but can also create many casualties. Rainstorms can considerably increase the already high losses among wildebeest crossing rivers on their annual migrations. Large numbers of birds succumb in severe European winters.

Mortality rates can be high in nature. Stephen Bostock states that only about 20% of lion cubs survive to maturity in nature¹⁰.

These are examples of negative welfare experiences of life in nature. On the other hand, there are also important welfare advantages. Firstly, zoos can make considerable efforts to render their enclosures as rich as possible, but they remain and will probably always be less rich than the natural environment. Natural variety is characterised by factors such as richness of food sources, variations in the habitat and possibilities for migration and social contact with members of the same and other species.

About 184 kinds of vegetable food (such as fruits, leaves, seeds, blossoms and bark) have been identified on the menu of chimpanzees. To this diet is added a variety of insects, eggs, birds and mammals such as colobus monkeys and bushpigs¹¹.

Gorillas are not just living in 'the rainforest'. Dian Fossey described about seven major vegetation zones around the Karisoke Research Centre's study area. Each of them attracts gorillas at different times of the year, depending upon seasonal and weather conditions¹².

Even though some people call protected areas of the wild (such as National Parks) 'megazoo's', they are still much richer and larger than zoo enclosures. The habitat of the last 500 mountain gorillas is small, but still measures approx. 600 square kilometres. Even if a group of gorillas mainly live within an area of three to ten square kilometres (or 300 to 1,000 hectares), this is still considerably larger than the enriched gorilla enclosures at zoos of one or at best a few hectares¹³.

Dolphins in a dolphinarium clearly have much fewer environmental and social opportunities than, for instance, the community of 100 dolphins — consisting of relatively stable subgroups of on average two to six dolphins — living in an area of 85 square kilometres near the Florida coastline¹⁴.

The falcon in its enclosure in the desert hall of Arnhem Zoo can maybe fly several metres, but will never have the opportunity to attack its prey at a speed of 160 to 400 kilometres an hour¹⁵.

A second consideration is that although it may be true that animals are not perfectly adapted to their natural environment¹⁶, it is still important to consider nature as the place in which animals have evolved and adapted for millions of years. It may be wiser to allow them to carry on living in the wild, rather than trying to keep them in a reconstructed, man-made zoo environment.

A rich environment seems to be important for psychological welfare and a zoo environment will never be as rich as a natural one¹⁷. Still, *this*

finding on its own does not mean that a zoo enclosure cannot be rich enough to guarantee a sufficiently positive welfare situation for the animals involved. In order to find out, carefully conducted research on the behaviour patterns displayed by animals in enriched enclosures as compared to behaviour patterns shown in nature, needs to be carried out. In addition other relevant welfare aspects, such as mortality rates, have to be investigated. At the very least such research may give us some indication of the extent of animal activity or passivity and the kinds of behaviour patterns that are shown in zoo enclosures.

Suppose social groups of tamarins live in a large eco-display such as the rainforest hall at Arnhem Zoo. They share a large variety of trees and other vegetation with all kinds of birds and insects. Pieces of food can be scattered throughout their living area in a variety of places. That way they live in a complex, changing environment that offers them safety as well as challenges. Of course, their enclosure will never be as rich as their natural habitat, but it could very well be that they live a very fulfilling life in a high quality welfare environment.

On the other hand one could question whether or not zoo environments will always be too restrictive for certain animals, especially animals such as great apes, elephants, dolphins and large cats. From a welfare autonomy perspective — defined as giving animals the opportunity to exert maximal control over their own lives according to their own needs and preferences — the best option may be a life in as rich an environment as possible, one in which animals are historically adapted to: nature itself. But what about the risks encountered by animals in nature? Do these risks outweigh the loss of autonomy of animals in zoos?

In addition to considerations relating to the individual animal, it is also important to adopt a structural welfare approach. For instance, let us suppose that many welfare problems are observed in nature and that it is possible to offer animals a safe and varied life in zoo enclosures. Would it not be more responsible to help many animals in nature instead of gathering a limited number in zoos (for instance by taking measures to protect elephants against starvation or against poachers)?

On the other hand, what about the animals already in zoos? Consider, for example, the situation of Willie B. This wild-caught gorilla had been living in a barren tiled enclosure without seeing another gorilla, for 27 years. After all those years of solitude, Zoo Atlanta's director Terry Maple provided him with

a new, naturalistic enclosure with trees and grass. Moreover, he was introduced to social companions — four female gorillas. Would it have been more responsible to cull Willie B? Or to let him live his natural life span in an enriched enclosure, but to prohibit the producing of offspring? The best way to serve the welfare interests of individual zoo animals may be to let them live in as spacious and rich an enclosure as possible, which automatically implies controlling the zoo population through breeding restrictions¹⁸.

How do other people compare the welfare of animals in zoos to that of animals living in the wild? Jane Goodall, who has studied the chimpanzees at Gombe (Tanzania) since 1960, writes the following regarding chimpanzees in captivity:

"I do not enjoy visiting chimpanzees in zoos. I should prefer to see all chimpanzees free in protected African forests. Even in the very best zoos, where chimpanzees have plenty of space, plenty of stimulation, and a sizable social group, their situation is dull when compared with life in a forest such as Gombe. The captives can never know the sheer delight of arriving, after a long journey, at a stand of trees laden with the first luscious fruits of a new crop. They cannot climb high into a tree in the evening and look out, from fresh nests of springy green leaves, over the hills and valleys of their territory. They cannot enjoy the exhilaration and exuberance of being part of a large gathering, when many members of the community join for a while, the males display their prowess, and the young ones play. They will never experience, these captives, the excitement of the hunt, or the spice of danger provided by intercommunity encounters. A male cannot wander away by himself, or with a female consort."¹⁹

On the other hand, she adds:

"We must remember, though, that life in the wild is not always easy. The chimpanzees at Gombe and elsewhere sometimes suffer agonizing injuries and illnesses. I shall never forget the grim days of the polio epidemic, or Mandy's infant with her broken arm, or Passion's pain during her last days in the grip of an unknown disease. Nor is it always comfortable, especially during the wet season when the chimpanzees may be cold and shivering day after day, night after night. When they may, indeed, catch pneumonia and die. Yes, even in the totally protected area of Gombe, life can be grim. Yet the Gombe chimps live in paradise compared with those in nonprotected areas where there is constant risk from poachers."²⁰

And also:

"I wonder if many — even most — of these increasingly persecuted individuals, given the choice, would not opt for life in one of the better zoos. These thoughts occurred to me the other day as I watched an adult male chimpanzee, his coat sleek and glossy, his demeanor confident and proud, sitting on a high platform of his large enclosure, his females and a couple of subordinate males grooming and feeding peacefully in the late afternoon sun. He looked utterly content with his lot. He was born in captivity; he has never known the zest of life in the wild. He lives in a European zoo. The fact is that many zoos have built excellent enclosures for groups of chimpanzees."²¹

Goodall also believes that limited breeding should be permitted for the sake of the group, but only in really good zoos which have carefully considered all the main problems, such as the identification of equally good zoos where chimpanzees can be moved to when necessary²².

Domesticated animals and zoos

Bostock states that zoo animals are slightly domesticated. He questions whether or not it is acceptable to keep fully domesticated animals in captivity and why it would be wrong to keep slightly domesticated animals²³.

Indeed, if one can guarantee a similar welfare situation for zoo animals and domesticated animals, how can one defend the keeping of pets and reject the keeping of zoo animals at the same time? The following points should be considered.

Firstly, domesticated animals are kept in a large variety of ways, and presumably not all cases will be used as evidence in the argument, because some of these conditions are unacceptable in themselves. Examples might be the keeping of farm animals in intensive systems (such as sows displaying stereotypical behaviour), or cats in small apartments whose owners are absent for most of the day because of work or recreation, who lack the opportunity to come outside, depriving them of contact with other cats.

Secondly and more importantly, how exactly are the living conditions to be compared with each other? Many cats and dogs live in relatively privileged conditions because they can interact with people and they can fre-

quent many places. Cats in particular often possess a far-reaching welfare autonomy. In the countryside, they can often wander through fields, chase mice and birds, they have contact with other cats and they have a place to stay with caring people. This kind of interaction and freedom of movement is out of the question for many zoo animals.

So, what kinds of welfare conditions are comparable? Perhaps wolves that live in zoo enclosures can be compared with dogs kept in enclosures of, for instance, 30x20m. Both enclosures contain varied vegetation and enrichment materials yet provide very little opportunity for contact with human beings. Once more the question arises as to whether or not this is a positive welfare situation.

Thirdly, there may still be important differences between many zoo animals and domesticated animals:

- a) Even when zoo animals are slightly domesticated, they may be much less adapted to life in captivity than domesticated animals (this can be inferred from the fear many zoo animals display towards humans).
- b) The physical capacities of animals kept in zoos may be considerably different from those of domesticated animals. This might be the reason why it is much more difficult to give elephants, dolphins, birds of prey and tigers similar opportunities of movement (such as diving, running, flying) compared to domesticated dogs or cats.
- c) Is the knowledge of certain requirements (such as nutrition and medical care) of the large variety of zoo animals comparable to knowledge acquired about the limited number of domesticated animals?

A fourth consideration is if it would be acceptable to keep domesticated cats and dogs in zoo exhibits. And as a logical consequence of this kind of argument, is it acceptable for private individuals to keep the same animal species as in zoos, in enclosures similar to the ones in zoos?

And lastly, which are the best possible living conditions for animals kept in zoos and for domesticated animals? Whilst it might be possible to reintroduce zoo animals to nature, it might be highly undesirable — even merely from a welfare perspective — to 'reintroduce' domesticated animals such as poodles into the wild.

The fact remains that Bostock's arguments are very important. This is primarily due to the fact that similar examples are at hand. For instance, keeping zebras in large grassy areas can be compared with keeping

horses on pastures. The primates at Apeldoorn Zoo do probably have a life richer than that of many domesticated animals. The comparison is important, but in the end the same question ought to be raised: exactly which living conditions are rich enough to guarantee a positive welfare situation, both for zoo animals and for domesticated animals?

NOTES

- ¹ Malamud, 1998: 32.
- ² Van Elsacker *et al.*, 1993: 35-42, 45-46; Van Elsacker and Walraven, 1994 and Walraven *et al.*, 1993: 28-31. Personal communication with Linda Van Elsacker, 8th October 1999.
- ³ Based on information from recent Arnhem Zoo brochures.
- ⁴ Tudge, 1991: 226-227.
- ⁵ Tudge, 1991: 223-224.
- ⁶ Tudge, 1991: 221.
- ⁷ Scheve, 1991: 18-21 and Mager *et al.*, 1993: 78-79.
- ⁸ Tudge, 1991: 220 and Ormrod, 1992: 19-21.
- ⁹ Chamove and Anderson, 1989: 196-199.
- ¹⁰ Jones, 1987: 1-2; Malcolm, 1989: 65 and Bostock, 1993: 64.
- ¹¹ Goodall, 1986: 232, 268-269.
- ¹² Fossey, 1983: 48-50.
- ¹³ The term 'megazooos' is used by Conway, 1995: 5-6. The figures of gorilla ranges are calculations based on a map in Fossey, 1983: 50.
- ¹⁴ Corkeron, 1990: 146.
- ¹⁵ Newton, 1990: 16-17.
- ¹⁶ See for instance Bostock, 1993: 72-75.
- ¹⁷ See for instance Griede, 1992: chapter 2, p. 9.
- ¹⁸ For Willie B. see Tarpy, 1993: 9 and Croke, 1997.
- ¹⁹ Goodall in Peterson and Goodall, 1993: 291-292.
- ²⁰ Goodall in Peterson and Goodall, 1993: 292.
- ²¹ Goodall in Peterson and Goodall, 1993: 292-293.
- ²² Personal communication, 16th June 1996.
- ²³ Bostock, 1993: 53-56.

The conservation of endangered species

In their attempt to conserve endangered species, zoos want to contribute to the solution of a very serious problem, one that has reached dramatic proportions. Biodiversity is more and more in decline. According to Edward Wilson (Harvard University), the natural extinction rate has increased between 1,000 and 10,000 times in the rainforests solely because of habitat reduction. Species are part of ecosystems. Taking them away may have an impact on other species. This can lead to a downward spiral and ultimately to the collapse of the ecosystem itself¹.

Besides ecological reasons (including the dependence of human beings upon ecosystems for their own survival) species can, for instance, also be conserved for scientific, medical, aesthetic and economic purposes. These are not only relevant for people living nowadays, but also for future generations. Furthermore species can also be conserved because they and their members are valued for themselves.

Organised zoos are establishing more and more breeding programmes for endangered species. For practical reasons these programmes are administered mainly regionally — that is, within (sub-)continents. Examples are the SSPs — Species Survival Plans, conducted by the AZA (the American Zoo and Aquaria Association) — and the EEPs — European Endangered Species Programmes, conducted by the EAZA (European Association of Zoos and Aquaria).

Co-ordination between the regional breeding programmes is taken care of by the Captive Breeding Specialist Group (CBSG). This global co-ordinat-

ing body is one of the specialist groups of the Species Survival Committee (SSC) of the International Conservation Union (IUCN)².

One could assert that zoos are making efforts to form stable *ex situ* populations, because they can no longer obtain these animals in the wild³. Their co-operation for exchange might also be explained in terms of self-interest: if zoo populations are not genetically healthy, they might eventually disappear. Whether or not this is true, such an argument is not cardinal — it conveys little about the importance of zoos for conservation and about their other roles.

Quantitative considerations

The total number of currently known living species is about 1,413,000. Among these are about 751,000 insects, 18,800 fishes and lower chordates, 9,000 birds, 6,300 reptiles, 4,200 amphibians and 4,000 mammals. The exact number of all existing species is difficult to calculate, but figures range from somewhere between 5 and 30 million, the majority of which are invertebrates predominantly living in rainforests⁴.

If the current destruction rate continues, approximately half of the rainforests that remain at present will have disappeared by around 2020. This means that between now and 2020, one fifth of the existing species could vanish or be doomed to early extinction. Even a very conservative calculation (based upon, for example, a total of ten million species in rainforests) leads to the conclusion that each year about 27,000 (or 74 per day) species are disappearing (most of which are invertebrates)⁵.

Zoo breeding programmes are intended to maintain about 90% of genetic variability for a period of 100 to 200 years or even longer. The required population for such a breeding programme consists of 250 to 500 animals. Since there are about 1,000 organised zoos with a combined number of 500,000 available animal spaces, it can be estimated that zoos can establish breeding programmes for 1,000 to 2,000 species⁶.

In 1991, 201 regional captive breeding programmes were either in operation or in preparation. Of these, there were 110 SSPs and 76 EEPs (in several programmes, two or more regions are co-operating). In 1999 the number of EEPs had reached 125⁷.

Even if zoos were able to realise breeding programmes for 1,000 to 2,000 species this would still only be a partial answer to the decline of bio-

diversity. Zoos should be explicit about this limited capacity. Colin Tudge has written a very interesting book on the conservation role of zoos. However, the title 'Last Animals at the Zoo: How Mass Extinction Can Be Stopped' seems to suggest that zoos can solve the extinction problem and this creates illusions.

Nevertheless, this does not mean that zoos cannot play an important role in the conservation of certain species. There is no doubt that an ideal situation would be to succeed in conserving all species in nature. However, should zoos turn out to be the only means to prevent the extinction of certain species then zoos may have an invaluable role to play.

In 1993 William Travers (The Born Free Foundation) wrote that he believes that the conservation of 300 to 400 species is likely to be the limit for zoos⁸. Even then it remains possible that zoos have a valuable conservation role to fulfil, complementary to attempts at in situ conservation of species (and ecosystems).

Qualitative considerations

Breeding programmes can be faced with several problems. In this section attention will be given respectively to the risk of loss of genetic variation, the mixing of subspecies, unnatural selection, the loss of learned behaviour, the relevance of artificial breeding technology and cryopreservation and finally the feasibility of reintroductions.

Loss of genetic variation

In order to maintain sufficient genetic variation⁹, zoos have to follow some basic guidelines (see also above). Is it possible to maintain sufficient genetic variation by following those guidelines?

According to the World Zoo Conservation Strategy (WZCS), the founder group should consist "of at least several dozen animals". With fewer animals good breeding programmes are still possible, but other guidelines have to be strictly adhered to.

This means that (i) the population size must reach the required number as quickly as possible (250 to 500 animals), (ii) once this number is

reached the generation time must be extended (breeding with older animals), (iii) inbreeding by reproduction of kin-related animals must be avoided, (iv) the sex ratio must remain balanced, (v) continual efforts must be made to prevent unnatural selection and (vi) preferably, for each generation some unrelated animals should be added to the population.

Execution of these guidelines could be problematic. Are there enough founders? What is their kinship? (According to Tudge many zoo animals are closely related and sometimes their ancestry is unknown.) Do the animals breed in the expected way and in a balanced manner? Is it legally possible to acquire unrelated animals in nature?

The EEP okapi population, for example, faces a problem of population growth and numbered only 42 animals in 1997. Contributing factors are a high number of stillbirths and abortions, a high mortality rate in the reproductive age classes, more males than females being born and a high number of females which did not reproduce because of abnormal mating behaviour, having no access to breeding males, hormonal abnormalities or health problems.

The relevant question arising is what will zoos do if they have a limited population with a high grade of kinship, which cannot legally be extended by importing new animals from nature? Will they carry on breeding these animals, for instance for economic reasons (attracting visitors), even when this is not really necessary to prevent the extinction of the species and in spite of the fact that this can have negative welfare consequences such as those caused by inbreeding¹⁰?

The mixing of subspecies

Breeding programmes are further complicated by the presence of subspecies in captivity, which have been mixed:

"Thus zoos these days, worldwide, contain huge numbers of hybrids between subspecies. There are dozens of hybrid tigers and leopards; and the fine distinctions that have often been drawn between different lions (Abyssinian, Arabian, and so on) have in many cases been lost. It was recently shown, indeed (by genetic studies) that the world's zoo population of Asian lions was corrupted with African 'blood'"¹¹

The example of the orangutans has already been given. Other examples are monkeys and gazelles, both of which are described as "a particular mess"¹². Problems with the mixing of subspecies are the possible decrease of fertility and the adaptation to different natural environments by organisms of different subspecies.

On the other hand it needs to be said that differentiation may be very difficult and dealing with several subspecies confronts zoos with organisational problems because of shortage of space. It is easier to maintain one population of red pandas instead of two (there are two subspecies of red panda)¹³.

Unnatural selection

Conditions in captivity may put pressure of unnatural selection on zoo animals, even when attempts are made to maintain a maximum of genetic variation. Characteristics that are negative in nature but positive in captivity may be favoured, while those positive for survival in nature may disappear. The reproduction of animals that cannot adapt well to zoo conditions (such as climate, diet and housing conditions) may be low, while reproduction of those who do adapt well will prevail¹⁴.

Loss of learned behaviour

Zoos may rightly express concern about supporting natural populations by maintaining genetic variation, thus preventing them from going through a 'genetic bottleneck'. Nevertheless one also ought to express concern with regard to the maintenance of learned behaviour.

I have already mentioned that some animals or their parents were caught in the wild at too young an age to have had the opportunity to learn how to raise their young. This caused and still causes problems in, for example, primates and dolphins. Zoos are now trying to help apes by allowing human caretakers to demonstrate how to care for their young.

Chimpanzee communities in nature appear to have divergent cultural traditions (for instance, differences in the use of hammer stones for cracking nuts). Moreover, a 1999 article in *Nature* shows that there is significant cultural variation among different chimpanzee communi-

ties. If animals should spend several generations in captivity, these traditions may disappear¹⁵.

Technologies such as cryopreservation and embryo transfer in females of other species may have a profound influence on the passing of learned behaviour¹⁶.

As I will demonstrate below, this loss of learned behaviour can have serious consequences for the survival of animals that are reintroduced. Moreover, they may learn new behaviour patterns in captivity and take these with them when reintroduced.

Whenever possible captive-born animals could be made to reproduce with conspecifics living in nature. However, the latter may show aggressive behaviour towards the reintroduced animals. Integration of translocated or confiscated wild-borns with captive-borns creates the possibility for observational learning and may be a solution according to Benjamin Beck (National Zoological Park, Washington)¹⁷.

Besides the loss of particular skills, we should also take into consideration the risk of loss of behavioural flexibility, resulting in increasing behavioural fixation, such as suggested by Françoise Wemelsfelder (see above). Clearly, by being concerned about the maintenance of sufficient genetic variation, the risk of what I propose to call a '*learning bottleneck*' should not be overlooked.

Artificial breeding techniques and cryopreservation

Other examples of artificial breeding techniques are artificial insemination (the insertion of collected sperm into the reproductive tract of a female), 'egg rescue' (the collection of eggs from the ovaries of a deceased female and the maturing of these eggs *in vitro*) and *in vitro* fertilisation (the collection of some eggs from an anaesthetised female to be fertilised in a 'test tube' — this technique is followed by embryo transfer to the natural mother or another female — of the same or another species).

These techniques may have important advantages, such as:

- a) Transport of embryos between zoos for breeding programmes is less expensive and carries fewer risks than transport of animals.
- b) Animals with certain reproductive handicaps can still be involved in breeding programmes.

- c) Rapid population growth is made possible.
- d) The correction of uneven sex ratios or unequally reproducing animals is allowed.
- e) Genetic material can be moved between *ex situ* and *in situ* populations.
- f) Cryopreservation allows an increase in generation time (the stored sperm, eggs or embryos can be used long after the death of the parents). Therefore, fewer animals are required per *ex situ* population. This results in more space for other species in zoos.
- g) Cryopreservation may be a kind of insurance against unnatural selection¹⁸.

On the other hand, the research required to apply these techniques on non-domesticated species is still in its infant-stages, and per species requires new research for each aspect. Furthermore one can only rely upon a limited number of animals per species. This may take much more time than available to prevent the extinction of many species as well as being very costly. Conway writes:

"Unfortunately, practically all that we know of animal reproductive physiology has been worked out with a few domestic and laboratory species. The technology of sperm and embryo storage in use with domestic cattle is the product of 20 years of research, millions of dollars, and thousands of specimens — a critical matrix for investigation and discovery. A vast amount of research would have to be undertaken before a technology of embryo and sperm storage and transfer as reliable as that in use with cattle could be available for wild species without domestic analogs. But where is the economic incentive for such research? Where are the animals? The apparently simple techniques of artificial insemination, for example, have been successful with scarcely 20 wild species of mammals (...)"¹⁹

According to Tudge, scientists assert that these techniques could be very advanced in 200 years²⁰. He remarks that:

"If we could apply, now, the reproductive technologies that might be routinely available by 2200 AD (...) then, with just a few million pounds, we might establish a truly comprehensive Frozen Zoo, with thousands of gene pools to pass on intact to our distant descendants, who perhaps might live in easier times and could restore the suspended creatures to a

newfound wilderness. But by the time we get to 2200 AD, there might be very little left to put in the Frozen Zoo.”²¹

The feasibility of reintroductions

According to Benjamin Beck (National Zoological Park, Washington), about 145 projects are known to have released captive-bred animals in order to re-establish or reinforce the natural population for conservation purposes. Only sixteen projects (11%) of these reintroduction programmes contributed to the establishment of a self-sustaining natural population. Species that were successfully reintroduced include, for instance, the Arabian Oryx, the plains and wood bison, the peregrine falcon and the Galapagos tortoise. Not all of the other projects are failures — some are making positive progress — but “at this point there is not overwhelming evidence that reintroduction is successful”²².

Important aspects with respect to reintroduction of animals in the wild are the complexity of the environment and learned behaviour. According to Stanley Price (African Wildlife Foundation) and Gordon (Macaulay Land Use Research Institute) it would for instance be much harder to successfully reintroduce orangutans than Arabian oryxes.

Hilary Box (University of Reading) lists the following skills as important for survival:

- a) Orientation and movement in space. Unprepared orangutans may be reluctant to climb trees and they must learn the mental skill of orientation in a complex three-dimensional environment, with trees as tall as 60m.
- b) Foraging. Orangutans in nature know which food is edible and non-toxic. They eat more than 400 different food types. Besides knowing what to eat, they also know where and when to find food (see above).
- c) Obtaining suitable places to rest and sleep. How and where to build a nest must be mastered.
- d) Establishment of intraspecific relationships. This may be very difficult because of the possible aggressive attitude of conspecifics living in nature.
- e) Interaction with other species, such as avoiding predators. It was discovered that reintroduced orangutans were more likely to become the victims of predators. This was probably a consequence of moving more frequently over the forest floor.

Regarding these skills in general, Box emphasises that “very little of this behaviour is genetically hard-wired”.

The reintroduction of golden lion tamarins in Brazil has met several welfare problems, partially because the animals were not skilled enough to deal with the challenge of a natural environment. Examples given by Beck are:

A tamarin found dead in a tree cavity. She was presumably eating insects and could not get out of the cavity.

A female who tried to eat a snake and was fatally bitten.

A tamarin who sat immobile for twelve hours shivering in cold rain. This one was rescued.

A family that entered a nest box that had been taken over by bees. The female died.

Important means to prepare animals for reintroduction, reported by Beck, are (i) training by keeping them in more nature-like enclosures, (ii) integrating translocated or confiscated animals born in nature into the captive-born group, so that they can play the role of guide, and (iii) gradual reintroduction by means of post-release support, such as providing food, medical care, artificial shelters and separation from competitors over a long period²³.

Two other problems related to reintroduction programmes are:

- a) The animals may have learnt new and undesirable behaviour patterns in captivity. Cats may, for instance, start coming too close to livestock or man and represent a real danger. Tudge gives an example of a released cheetah that was observed chasing motorcyclists in South Africa and had to be caught again²⁴.
- b) Zoo animals may have less resistance against disease, but also carry the risk of introducing new diseases into the natural habitat. Wildlife consultant Stefan Ormrod wrote in 1994:

“(...) in 1991 — three days before it was due to be sent for release in Brazil — a zoo tamarin was found to be carrying a lethal virus that could have passed on to the wild population.”²⁵

Economic considerations

One of the important downsides of captive breeding and reintroduction programmes is that these programmes are very expensive. One of the

few detailed estimations of a breeding and introduction project can be found in an article by Kleiman *et al.* relating to the golden lion tamarin project. The cost of maintaining a captive population of 550 golden lion tamarins at 100 zoos is estimated at \$911,875 per year (in 1989) or \$1,657 per animal annually. These costs include husbandry, food, veterinary care, administration, supplies and equipment (such as shipment of crates), and utilities (for instance, heating) and repairs of facilities. Costs of facility construction are not included in this calculation. This captive population "will continue to exist regardless of the re-introduction programme".

Apart from this, the total cost of the reintroduction programme for the golden lion tamarins for the period between 1983-89 was estimated to be about \$1,083,005, or \$22,563 per surviving reintroduced tamarin (48 animals survived to the end of 1989; that is 27/71 released and 21/26 born). This includes (amongst other costs) building costs, vehicles, radio-telemetry and salaries.

It has been foreseen that costs for reintroduction will decrease dramatically per further reintroduced animal as the programme develops. Although programmes for other species can benefit from this experience, it is considered unlikely that it will be possible to significantly reduce the costs for similar species. This is because (i) "there are insufficient numbers of individuals of most endangered species (both in the wild and in captivity) to justify 'hard' releases, in which animals are neither prepared nor monitored nor provisioned" and (ii) most reintroductions are likely to take place in remote areas and will therefore entail considerable transport and housing costs.

These efforts have increased the wild population by 25-30%. Kleiman *et al.* acknowledge that reintroduction is a "very expensive means" to support the natural population. However, they also stress that they have succeeded in realising additional benefits, such as (i) extending the protected area (some 1,100ha were added to a reserve of 5,000ha) and improving its quality (reforestation) and (ii) providing education in order to raise conservation consciousness²⁶.

Another example of a breeding and reintroduction project is the one developed for the red wolf. Keeping this species in zoos costs about \$4,020 per animal annually. The reintroduction cost for twelve captive-bred red wolves was estimated at \$11,250 per animal in each of five years (costs for travelling, medical care, monitoring and salaries)²⁷.

Relevant from a welfare perspective is the opinion that, when there are enough animals available, it is justified to increase welfare risks of reintroductions in order to reduce costs:

"Rarity will encourage 'soft' releases in which released animals have been trained for life in the wild (...). Re-introduction costs can be reduced if the species becomes more secure in captivity during the re-introduction phase so that 'hard' releases with their greater risks but lower costs can be employed."²⁸

How do 'in situ' and 'ex situ' conservation programmes interrelate?

Because of (i) limited space in zoos, (ii) the difficulties and risks of captive breeding programmes (such as unnatural selection and loss of learned behaviour) and reintroduction programmes and (iii) the high cost of captive breeding and reintroduction programmes, it seems that the most desirable way to conserve endangered species is by *in situ* conservation.

This may be accomplished by protecting nature in reserves, creating corridors between natural places and when necessary translocating animals between islands of nature, in order to maintain enough genetic variation. In addition, it is clear that protecting nature is the only way to preserve entire ecosystems.

Zoos acknowledge the importance of *in situ* conservation and (at least in general) do not present themselves as an alternative for *in situ* conservation. They perceive their responsibility rather as a limited but very important complementary role alongside *in situ* conservation. However, is this relationship just one of two complementary means of conservation?

Translocations seem to be more successful than reintroductions. Griffith *et al.* conclude that translocations are about twice as successful as reintroductions. The estimated success of reintroduction of captive-bred animals is about 38% (compare with Beck, 11%) and the estimated success of translocations 75%. Beck also refers to this study, as well as to the reintroduction project of golden lion tamarins. Of all the reintroduced tamarins up to 1990, 26% of the captive-born (22/86) and 57% of the (confiscated) wild-born (4/7) survived²⁹.

Translocations are not only more successful, they are also less expensive than reintroductions³⁰. In spite of this information David Chivers (Sub-Department of Veterinary Anatomy, University of Cambridge) comments that:

"We have come little further down the road to developing the best techniques of translocation, efforts still being concentrated on techniques for re-introducing confiscated or captive-bred animals."³¹

Thus it could be that captive breeding and reintroduction programmes are rather an (unintended) source of competition for more successful and less expensive techniques such as translocations, than a means of fulfilling a valuable complementary role. This danger should be taken seriously, particularly when we bear in mind how many species are threatened with extinction and how limited the available budgets are for their conservation.

Attention ought to be focused as much as possible on *in situ* conservation of animals. Only when favourable methods appear to fail should *ex situ* conservation be considered. According to Chivers, priority should be given to preservation in the country of origin, for instance by translocating animals to protected habitats or semi-natural habitats. If necessary, animals can be transferred to *ex situ* places to promote conservation, for captive breeding and reintroduction. Only when all opportunities have been exploited to the full in the country of origin should animals be exported to other countries for captive breeding³².

Yet the question remains: exactly when are zoos needed for a complementary conservation role and to what extent are they fulfilling that role at the moment?

Selection of species

In a publication in 1991, Ulysses Seal (Captive Breeding Specialist Group) refers to estimates of the ISIS (International Species Information System), according to which only 5 to 10% of the space available in zoos participating in this system (370 zoos in 34 countries) are allocated to endangered species³³. What is the motivation of zoos for their choice of species for display?

Criteria for species selection

As indicated before, 201 regional captive breeding programmes were in existence in 1991 (either in operation or in preparatory stages), 105 of which involved mammals, 41 birds, 29 fish, 14 invertebrates and 12 herps. Of the 125 EEP approved of 1999, 89 are for mammals, 33 for birds, 2 for reptiles and 1 for invertebrates. The majority of the EEP for mammals consists of programmes for primates (28) and carnivores (24)³⁴.

Why are mammals and birds so central to these programmes? It has been suggested that large animals are particularly threatened by extinction:

"Imaginative and powerful international efforts are being made to slow-down this rate of habitat destruction but, even in the best of prognoses, many species — especially large ones — will certainly be lost. A jaguar, for example, needs considerably more than a 24,700-acre (10,000ha) area in the rain forest."³⁵

The World Zoo Conservation Strategy also acknowledges that:

"(...) these species are often more vulnerable to extinction, as they live in lower densities and reproduce at slower rates than many smaller species."³⁶

However, given the alarming rate of rainforest destruction and the vast number of species of invertebrates living in a rainforest ecosystem, we can infer that especially large numbers of invertebrates are becoming extinct. Wilson estimates that about 27,000 species disappear each year, most of which are invertebrates (see above).

One could assert that there is a special indication to conserve larger species — despite the fact that zoos could accommodate a larger number of animals from smaller species. It could be argued that larger species have an important influence on the ecosystem they are living in and thus can be considered as *keystone species*.

The most potent of all known keystone species, according to Wilson, may be the sea otter. Due to hunting, this species was almost extinct at the end of the nineteenth century. In locations where this animal disappeared (along the shores of Northwest America), sea urchins (among the prey of otters) increased in number dramatically. The sea urchins ate

away the kelp and the ocean changed from what looked like a forest of kelp into a desert. By means of translocation sea otters were brought back to these sites. As a consequence, the number of sea urchins decreased, kelp forests grew back and again became inhabited by crustaceans, squid, fishes and other organisms³⁷.

Some larger species have an extremely influential impact upon their habitat. However, smaller species may also be keystone species:

"Because ecology is still a primitive science, no one is sure of the identity of most keystone species. We are accustomed to thinking of the organisms in this vital category as being large in size — sea otters, elephants, Douglas firs, coral heads — but they might as easily include any of the tiny invertebrates, algae, and micro-organisms that teem in the substratum and that also possess most of its protoplasm and move the mass of nutrients."³⁸

As an example of a smaller keystone species, Wilson points out driver ants. In the African savannah, a colony of driver ants form a long front, moving at the speed of twenty metres per hour. It kills millions of small animals each day. In this way, this species has an important impact on the composition of its ecosystem³⁹.

Therefore, the importance attached by zoos to mainly mammals and birds is not self-evident from an ecological viewpoint. One could question whether it is too difficult to ascertain which small species are keystone species, or whether it is too difficult to conserve these species in zoos. However, other issues also appear to play a role. Colin Tudge writes:

"Aesthetics does play a part, too, whether this is morally justified or not. (...) Ideally we would save California condors and every Amazonian beetle. But if it came to a straight choice, as for economic and logistic reasons it can, then it would seem perverse to sacrifice the bird for the beetle: like throwing out a Rembrandt to make way for an amateur watercolour."⁴⁰

Economic considerations seem to be important as well:

"Indeed, zoos can't serve every animal, says Foose [Tom Foose, then conservation coordinator for AAZPA and now CBSG Executive Officer, K.M.]. They tend, if only for their own economic survival, to focus on creatures that the public finds most fascinating — animals with whatever charisma it

takes to propel those visitors through the turnstiles. And that, says Foose, is where zoos can and will concentrate — on the big and attractive animals. He's fond of using a term that cropped up at a meeting of zoo biologists to describe those target animals: "charismatic megavertebrates."⁴¹

While many people possibly share the aesthetic preferences of Colin Tudge, entomologists among others may strongly disagree. What matters here is that although it is acknowledged that aesthetic and economic considerations play a role (zoos cannot support conservation efforts if they are financially unstable), these motives should not be justified by using some kind of *ecological camouflage*. This could lead to misconceptions, such as the idea that smaller species are not threatened with extinction or that only large species are keystone species.

Zoos as a last resort

In situ conservation can be seen as a preferred option, but there is a possibility that, due to the increase in human population, the pressure on many species will be too high. Given the number of species already extinct, zoos can be a last resort for several species threatened with extinction. The number of species that zoos will be able to conserve may be limited. Nevertheless this does not mean that the existing opportunities should not be utilised to the full.

How high does the pressure on a species have to be to justify an *ex situ* breeding programme? In cases where an entire population is critically endangered with extinction the remaining number of individuals of that species in the wild is no longer of much significance. An *ex situ* conservation programme could be taken into consideration immediately, before any conservation measures come too late.

Is there some kind of 'yard-stick' to form an opinion on critically low numbers? The support for captive breeding in zoos by the IUCN, as expressed in 'The IUCN Policy Statement on Captive Breeding' in 1987, can be seen as an important form of recognition of the importance of the role of zoos in conservation. In this policy statement, written by the CBSG and approved by the IUCN Council, recommendations are given as to the moment of initiation of an *ex situ* programme:

"The vulnerability of small populations has been consistently underestimated. This has erroneously shifted the timing of establishment of captive populations to the last moment, when the crisis is enormous and when extinction is probable. (...) Management to best reduce the risk of extinction requires the establishment of supporting captive populations much earlier, preferably when the wild population is still in the thousands. Vertebrate taxa with a current census below one thousand individuals in the wild require close and swift cooperation between field conservationists and captive breeding specialists, to make their efforts complementary and minimize the likelihood of the extinction of these taxa."⁴²

Seal (CBSG) refers to the policy statement where it indicates that "when population numbers of a taxon fall below 1,000 a captive programme may need to be initiated". A reasonable population size seems to be 2,000-5,000 individuals. Leobert de Boer believes that an *ex situ* programme becomes necessary when the *in situ* population numbers 1,000 to 2,000 animals⁴³.

It seems that some 600,000 African elephants, 30,000 to 55,000 Indian elephants, 200,000 chimpanzees, 17,000 bonobos and some tens of thousands of orangutans are remaining in the wild⁴⁴. These species are under considerable pressure. Should it be argued that they ought to be kept in zoos, in order to support the numbers and the genetic variation of the population in nature?

It appears that only approximately 500 mountain gorillas are remaining, living in an area of less than 600 square kilometres⁴⁵. Their habitat, the Virunga mountains, is situated in three countries: Congo, Rwanda and Uganda. In this region the political climate is highly unstable. Why has no *ex situ* programme been started for this species? This seems to suggest that not everyone agrees with the idea of starting breeding programmes in zoos when numbers decrease below 1,000. Perhaps considerations such as risks of seizure, breeding difficulties and reintroduction problems play a role.

Some 1,000 giant pandas — the estimated range is between 872 and 1,352 animals — are still living in their natural habitat in China, mostly in the province of Sichuan. In 'The Last Panda' (1993), George Schaller (New York Zoological Society) is critical of the *ex situ* attempts to preserve this species. Schaller writes:

"The construction of a breeding facility for pandas in Wolong was part of a trend by the Chinese government to protect an endangered species by raising it in captivity. It disconcerts me that, however noble its intentions, China spends millions of conservation dollars on building facilities for pandas, tigers, and other animals when, more than anything else, the money is needed to protect species in their natural habitats."⁴⁶

In addition:

"Captive breeding should be a last resort, used only after genuine efforts to maintain a species in the wild are clearly failing. Such efforts have not yet been made."⁴⁷

He accentuates that, whilst habitat destruction poses the most serious long-term threat, the most acute problem is poaching. However:

"Poaching is relatively easy and inexpensive to control or at least reduce, but the necessary patrolling is a hard and thankless task with little glory or public acclaim."⁴⁸

The 1989 'National Conservation Management Plan for the Giant Panda and its Habitat' (published by WWF) acknowledges how useful captive breeding can be, but notes that:

"At present the breeding rate in captivity is still very low, mortality of captive born pandas is too high and the captive population of pandas continues to be a drain on the wild population rather than a booster to the wild population. It is proposed to put a ban on any more wild-caught pandas reaching zoos."⁴⁹

Schaller draws attention to the problem of selection of species for *ex situ* conservation programmes. He alleges that animals such as Chinese alligators and Mongolian wild horses "have benefited greatly from captive propagation", because these animals are relatively easy to breed and reintroduce.

The most renowned illustration of a programme in which zoos have been a last resort for a species is probably the project for the Arabian oryx. Sport hunting of this species reduced its number so drastically that only 100 to 200 oryx were remaining in the desert of the Rub-al-

Khali, along the border of Saudi Arabia and Oman. After the shooting of 48 animals by sport hunters, the Fauna Preservation Society tried to catch animals for a captive breeding programme. They found evidence of only eleven oryx and finally caught four animals in 1962. These four oryx were placed at the Phoenix Zoo in the USA, together with other oryx already in captivity. As the oryx population grew, some animals were moved to other zoos, such as the zoos of San Diego, London, Antwerp, Berlin and Zurich.

At the beginning of the 1980s two herds of about ten oryx each were gradually reintroduced to the Jiddat-al-Harasis plateau, Oman. In 1986 one herd covered an area of about 3,000 square kilometres. Other successful reintroductions followed, the herds are growing and nowadays more than 100 oryx are living in Oman again. Reintroductions have also taken place in Jordan, Saudi Arabia and Qatar, for instance⁵⁰.

Examples of other species for whom *ex situ* projects seem to be essential for their survival, are the black-footed ferret (the last animals were placed in captivity because they were threatened by canine distemper), the red wolf and the golden lion tamarin⁵¹.

Fund-raising for conservation

As well as being a last resort for some species, zoos could also play another valuable role in conservation, namely the support of *in situ* conservation projects through the raising of funds.

As *ex situ* conservation and reintroductions seem to be more expensive than *in situ* conservation, it can be argued on the one hand that the money that goes to zoos could be better spent on *in situ* conservation. On the other hand, several considerations ought to be taken into account.

Firstly, some species may be truly dependent upon zoos for their survival. Should it be decided that it is wiser to allow extinction of some species and at the same time attempt to save many others by means of *in situ* conservation programmes?

Secondly, the above argument — using money for *in situ* conservation instead of putting it into zoos — seems to originate from the idea that this amount of money is simply available. It could be the case that the money

raised by zoos would otherwise be very difficult to obtain for conservation projects. Conway remarks:

“Uniquely, zoo conservation action bends recreational dollars to conservation purposes. Money otherwise used to go to the ball game, the movies, or a symphony is converted to endangered-species propagation and conservation education programs (...)”⁵²

Thirdly, zoo projects may be a worthwhile investment for obtaining the support of others. Although *ex situ* programmes are very expensive, they can help to draw attention to conservation issues. This in turn can result in financial, public and political support for *in situ* conservation. According to Conway AZA institutions were conducting about 390 conservation and science projects in 63 countries in 1990-91⁵³.

It may be worthwhile to focus attention on specific fund-raising projects. At Apeldoorn Zoo for instance, money is collected for an endangered subspecies of the woolly monkey (*Lagothrix flavicauda*), which lives in the rainforests of northern Peru. Visitors can interact with the females of a less threatened subspecies of the woolly monkey (*Lagothrix lagotricha*), or rather the inquisitive monkeys themselves initiate contact (the males are kept on a separate island during the day). Attention is drawn to the natural habitat of the woolly monkey by means of an exhibition and visitors are invited to support *in situ* conservation financially⁵⁴.

Another example of the support that zoos can give to conservation projects is an initiative taken by four European zoos in favour of the Okapi Wildlife Reserve (Ituri Forest, Congo). In 1994, the zoos of Antwerp, Cologne, Marwell and Rotterdam donated \$22,800 for the salaries of twenty guards and for the training of conservation staff⁵⁵.

Foose uses the phrase ‘charismatic megavertebrates’ (see above). Perhaps the notion of ‘charismatic fund-raiser’ is also a useful one. It emphasises the important role of the respective animals and it also includes smaller charismatic animals such as woolly monkeys and red pandas.

In the WZCS it is written that:

“Species receiving *ex situ* conservation support are frequently species that fulfill a key role in their original biotope, if not in the biological sense then in human perception. The large, majestic, compelling higher vertebrates move

people much more than do the less appealing, often hidden, or apparently invisible smaller species. The interest of habitat conservation is greatly served by the conservation of such keystone species that can also often function as flag ships."⁵⁶

Yet, given the limited amount of space one ought to question (from a conservation perspective) whether or not it is responsible to use species that are not endangered or that do not really need an *ex situ* conservation programme as flagships, as ambassadors for their habitat or as charismatic fund-raisers. Would it not be possible to fulfil the same role solely with endangered species, which are in real need of an *ex situ* conservation programme?

The most famous example of a charismatic fund-raiser is the giant panda. Schaller describes the exhibition loans of pandas by China to North American and European zoos. What at first sight appears to be a fund-raising programme for conservation by zoos, seems to have gone completely awry.

In these "rent-a-panda" programmes, zoos were "vying for status, publicity, and profit". The pandas were "treasured more for their display value than for themselves" and had become "big business". From 1984 onwards, zoos in the USA — for instance San Diego, Los Angeles and New York (the latter was only involved because of political pressure) — and also in Japan, the Netherlands, Belgium, Ireland and some other countries hired pandas. In 1988, the WWF and AAZPA succeeded in obtaining a moratorium on panda loans in the USA, and negotiations with China took place in order to reach an accord on an acceptable loan policy.

Nevertheless, at the end of 1988 panda star Gong-Gong, of the Great Circus of China, toured Canada. The justification for this "commercial activity" was the contribution of \$1,000,000 for panda conservation in China. Other places also continued receiving pandas.

In 1990, WWF, IUCN, AAZPA and the International Union of Directors of Zoological Gardens voted for a worldwide moratorium on panda loans. Withstanding opposition by the WWF and the AAZPA, Columbus Zoo succeeded — encouraged by George Bush — in hiring two pandas in 1992 in order to celebrate Christopher Columbus' discovery of America in 1492. The AAZPA suspended the zoo.

The specific problems of these rentals raise questions that are also relevant to the general idea of fund-raising for conservation purposes by zoos:

- a) It should be precisely known for which conservation purposes the funds are used and if the money is spent in the most efficient way. With regards to the donation of \$600,000 by the New York Zoological Society and \$120,000 by Antwerp Zoo for the construction of a captive breeding station for pandas, Schaller comments:

"If the millions of dollars that have been raised from loans were spent on anti-poaching and forest protection measures instead of on the construction and maintenance of walls around pandas, the future of the species would be brighter."⁵⁷

- b) It should also be known exactly what proportion of the total profits are used for conservation purposes, in order to prevent commercial purposes from creeping in under the cover of conservation. China, for instance, receives a few hundred thousand dollars for a single rental. Schaller called this "a poor bargain" when compared with the total profit. Toledo Zoo projected an income of \$3.3 million from the rental of two pandas in 1988. It was calculated that this panda loan resulted in a profit of \$60 million for Toledo city, mainly due to increased tourism.
- c) The consequences for welfare and direct conservation of animals have to be taken into consideration. Schaller calls the rentals "stressful world trips during which their reproductive life is wholly disrupted"⁵⁸. China sent "whatever pandas were readily available". For example, a wild-caught adult female was sent to New York. According to the Chinese, this female was incapable of breeding, but shortly after arrival she came into heat. The male that was sent with her was too young to breed. Consequently the natural population and the *ex situ* captive breeding population in China were negatively influenced⁵⁹.

NOTES

¹ Wilson, 1992: 280, 308-309.

² IUDZG/CBSG (IUCN/SSC), 1993: 11-14, 41-42.

³ *Ex situ* and *in situ* conservation refer respectively to conservation outside and inside the natural habitat.

- ⁴ Wilson, 1992: 134, 140-141.
- ⁵ Wilson, 1992: 276-280.
- ⁶ Seal, 1991: 40; Tudge, 1991: 53, 81 and IUDZG/CBSG (IUCN/SSC), 1993: 37, 47.
- ⁷ Foose, 1991 and Anonymous, 1999: 561-571.
- ⁸ Personal communication, 4th February 1993.
- ⁹ When there is a lack of genetic variation, then: (i) all individuals of a population are very identical, also in their susceptibility to environmental forces such as rainstorms, (ii) the population has fewer chances to adapt to the pressure of natural selection and (iii) the risk of inbreeding rises, and harmful genes can become more prevalent.
- ¹⁰ De Bois *et al.* state that a decrease of viability and/or fecundity due to inbreeding has been found in, for instance, zoo populations of the elk, the Przewalski horse, the Dorcas gazelle, the Siberian tiger, the red panda, the Sumatran tiger, the okapi and the Speke's gazelle. De Bois *et al.*, 1990: 148; Tudge, 1991: 70-87; IUDZG/CBSG (IUCN/SSC), 1993: 38; Van Puijenbroeck, 1999: 270-71.
- ¹¹ Tudge, 1991: 99.
- ¹² Tudge, 1991: 116.
- ¹³ Tudge, 1991: 94, 98-99.
- ¹⁴ De Boer, 1984: 225.
- ¹⁵ See Goodall, 1986: 561 and Whiten *et al.*, 1999.
- ¹⁶ Cryopreservation refers to the storage of eggs, sperm and embryos in liquid nitrogen at -196°C. The concept of the 'frozen zoo' is used for this. Examples of embryo transfer to another species are, for instance, a gaur calf and an Indian desert cat, which were respectively born to a domestic Holstein cow and a domestic cat.
- ¹⁷ Stanley Price and Gordon, 1989: 58; Tudge, 1991: 170, 184-185 and Beck, 1995: 160-161.
- ¹⁸ Tudge, 1991: 169-192 and IUDZG/CBSG (IUCN/SSC), 1993: 54-57.
- ¹⁹ Conway, 1988: 266-267.
- ²⁰ Tudge, 1991: 192.
- ²¹ Tudge, 1991: 192.
- ²² Beck, 1995: 155-157.
- ²³ Stanley Price and Gordon, 1989: 58; Box, 1991: 112-120; Tudge, 1991: 235; Beck, 1995: 158-161 and Galdikas, 1995: 367-369.
- ²⁴ Moore III and Smith, 1990: 273 and Tudge, 1991: 238-239.
- ²⁵ Ormrod, 1994: 42.
- ²⁶ Kleiman *et al.*, 1991: 129-139.
- ²⁷ Gordon, 1991: 222.
- ²⁸ Stanley Price, 1991: 19.
- ²⁹ Griffith *et al.*, 1989: 478 and Beck, 1995: 160.
- ³⁰ Chivers, 1991: 89.
- ³¹ Chivers, 1991: 95.
- ³² Chivers, 1991: 96-97.
- ³³ Seal, 1991: 40.
- ³⁴ Foose, 1991 and Anonymous, 1999a: 561-571.
- ³⁵ Page in Maier and Page, 1990: 44.
- ³⁶ IUDZG/CBSG (IUCN/SSC), 1993: 52.
- ³⁷ Wilson, 1992: 164-165.
- ³⁸ Wilson, 1992: 309.
- ³⁹ Wilson, 1992: 168-170.
- ⁴⁰ Tudge, 1991: 91.

- ⁴¹ Luoma, 1987: 70. For the function of Foose, see Luoma, 1987: 37 and Gipps, 1991: xvii.
- ⁴² Anonymous, 1987: 3.
- ⁴³ Seal, 1991: 41, 43 and de Boer, personal communication, 6th April 1993.
- ⁴⁴ MacKinnon and MacKinnon, 1991: 189; Peterson and Goodall, 1993: 313 and Redmond, 1994: 72, 74.
- ⁴⁵ Conway, 1995: 5.
- ⁴⁶ Schaller, 1993: 259. For population estimates and habitat distribution, see p. 7 and p. 229-230.
- ⁴⁷ Schaller, 1993: 260.
- ⁴⁸ Schaller, 1993: 224.
- ⁴⁹ Schaller, 1993: 273.
- ⁵⁰ Tudge, 1991: 125-127, 129, 141-147 and de Boer, 1992: 38-40.
- ⁵¹ Thorne and Oakleaf, 1991: 248 and Moore III and Smith, 1991: 263-278.
- ⁵² Conway, 1995: 7.
- ⁵³ Conway, 1995: 7.
- ⁵⁴ Mager *et al.*, 1993: 29, 86-88, 104.
- ⁵⁵ Van Puijenbroeck and De Bois, 1995: 243.
- ⁵⁶ IUDZG/CBSG (IUCN/SSC), 1993: 52.
- ⁵⁷ Schaller, 1993: 245.
- ⁵⁸ Schaller, 1993: 236.
- ⁵⁹ Schaller, 1993: 230-231, 235-249.

Education and recreation

According to the WZCS, the (approximately) 1,200 organised zoos — including zoos believed to be potential members of the organised zoo network in the near future — are visited by at least 600 million people each year. The distribution per continent is roughly as follows:

Continent	Number of organised zoos	Number of visitors
Europe	300	125 million
North America	175	106 million
Latin America	125	61 million
Asia	545	308 million
Africa	25	15 million
Australia, New Zealand	30	6 million
World total	1,200	619 million ¹

(²)

This network of zoos is acknowledged by the WZCS to be perhaps the largest conservation network, apart from the IUCN/SSC network. The WZCS further explains that, although this network is not perfect from an organisational standpoint, it is “an exceptional system with great potential for conservation effort”³.

Undoubtedly zoos provide the opportunity for large numbers of people to come into close contact with a variety of living animals. However, to

what extent do they succeed in realising their educational aspirations? Little research seems to have been carried out on the educational impact of zoos. Two studies will be referred to in this respect: one by Marcellini and Jenssen (1988) and another by Kellert and Dunlap (1989).

Dale Marcellini (National Zoo, Washington) and Thomas Jenssen (Virginia Polytechnic Institute and State University) evaluated the behaviour of 573 visitors at the reptile house of the National Zoo (enriched to look more naturalistic in 1980). An average time of 14.7 minutes was spent in the reptile house, of which only about eight minutes were spent looking at the total of 74 exhibits. The researchers write that the results "all indicate that our visitors may not be interested in the exhibits". Reversing the direction of the visit results in the same pattern of less and less time spent at an exhibit. According to the authors, this suggests that the content of the exhibit is not very relevant to the visitors' interests⁴.

The reptile house probably does not contain the most popular species in a zoo. However, the authors also hint at research that reveals that visitors looked at lion and gorilla exhibits for about two minutes only (according to a study dating from 1978). In an article in the Washington Post (1991), William Booth referred to further research by Marcellini at the National Zoo. It demonstrates that visitors look at Père David's deer for an average of 27 seconds, one minute at lions and rhinos, three minutes at bats and five minutes at pandas⁵.

Two students studied the behaviour of visitors at the chimpanzee island of Arnhem Zoo and found that they watch the apes for about 3.5 minutes on average. De Waal notes that people who walk away after only a few minutes regularly say "Oh, I could watch them for hours!"⁶

Stephen Kellert (Yale University) and Julie Dunlap (The Humane Society of the United States) did extensive research on informal learning at three zoos: the Philadelphia Zoo (with both traditional and naturalistic enclosures), the Sonoran Desert Museum (a pioneer in naturalistic exhibits) and the Sedgwick County Zoo (a local zoo, with a number of naturalistic enclosures somewhere in between the other two zoos).

The following findings appeared from this research:

- a) The most important motivating factors for zoo visits were family enjoyment (about 70%) and the aesthetic appeal of the animals. At the Sonoran Desert Museum, 62% of the visitors also expressed a desire to learn about animals.

- b) Greater ecological and scientific interest were more typical for the Sonoran Desert Museum visitors. This attitude was apparently enhanced by the experience of visiting this facility.
- c) Knowledge scores for all three zoos were lower after the visit than before. Kellert and Dunlap acknowledge that their investigation was limited, but maintain that this finding nevertheless suggests that "the zoo visit exerted only a minimal influence on visitor factual knowledge of animals".
- d) Although only a limited number of visitors (with the possible exception of those who visited the Sonoran Desert Museum) seemed to be motivated to visit by an interest in conservation, between 74 and 88% of the visitors said that they would prefer to receive more information on wildlife conservation. (According to the researchers, zoos are often reluctant to provide conservation messages because they fear offending the visitors).

In their general comment, the authors write that:

"Despite verbal support for the importance of education, an examination of most zoos suggests education has and continues to receive inadequate resources, a secondary status, and a separate and discrete function modestly "housed" in something called an educational department. The educational function certainly does not exist at the core of the mission, identity and functional operation of most zoos."⁷

In spite of their findings Kellert and Dunlap seem to be convinced that zoos have considerable educational potential. They refer to an earlier publication (1987), in which Kellert called the modern zoo "the sleeping giant" of the wildlife and conservation field⁸.

A zoo that has education as its main purpose, and which perhaps plays a leading role in the zoo world, is Emmen Zoo in the Netherlands. Firstly, this zoo allows animals to show a lot of natural behaviour by displaying them in large, naturalistic enclosures.

Educational information panels at each enclosure give additional information by means of text and realistic drawings. The text is arranged as in newspapers: a more general section in larger type, and more detailed information in small type for those who want to know more. Once every three to four years these panels are replaced, so that the zoo can highlight another main issue (such as natural environment, visual perception or propa-

gation). On this same issue an additional central exhibition is organised in one of the museums.

The most important museum exhibition is the Biochron, which illustrates the evolution of life on earth in a systematic and didactically varied way. Several zoo enclosures are also accompanied by smaller exhibitions and there are ten rooms for projecting films. This provides an opportunity to make a link with the natural habitat.

Educational material for pupils is varied and contains, amongst other material, questionnaires, with instructions for ethological observations⁹.

This system of educational action may be a source of inspiration for many other zoos. Can zoos really have an impact? Can they create more concern and respect for nature? Evaluations are clearly needed, but in general, two factors might help to make zoos' educational efforts more effective. Firstly, the quality of enclosures: do they evoke interest and admiration for active animals who are behaving normally, or rather concern because of the monotony of the enclosures and the passivity of the animals? Secondly, the availability of a precise conservation message: if zoo animals are ambassadors for their species and the entire ecosystem from which they originate, then this link must also be made. It might be valuable to create at least the opportunity for visitors to obtain more information. An attractive and informative exhibition incorporating a short documentary film in order to make the animals' *in situ* living circumstances clear and, where possible, a presentation of an ongoing *in situ* project — which can be actively supported — allow people to express concern if they desire to do so. The aforementioned woolly monkey project at Apeldoorn Zoo may be a good example. If attention is drawn to conservation and concern is evoked, a way to positively canalise this interest should be offered. A carefully selected number of projects which can be funded directly by visitors (and for which also a percentage of the income fee is used), could also provide information about the effects of educational efforts by zoos.

It is often argued that zoos have become educationally redundant because of the many nature programmes on television. Firstly, it could still be noted that during this era of decreasing biodiversity, all the available means should perhaps be exploited to the full.

Secondly, what about the idea that zoos deflect attention from the real problems? This issue ought to be taken seriously. Zoos should not give the

impression that they provide an alternative to *in situ* conservation. In order to prevent this, zoos should adapt a general policy of giving full attention to more effective *in situ* conservation projects. Instead of stressing their role as a safety net for some species zoos should move towards the frontline and stimulate direct and indirect support for *in situ* projects.

Thirdly, many people would probably agree that it is a more fascinating experience to see animals live in their natural habitat rather than to watch them on television. On the other hand, television programmes can show a variety of interesting behavioural aspects of animals within a limited amount of time as well as a large variety of species and ecosystems, to a large number of people.

What about zoos? Can they also bring about similar excitement through direct confrontation with living animals and in this way have educational value? Can zoos show sufficient natural behaviour to have such an effect? At Apeldoorn Zoo, many visitors have given the impression of being moved and fascinated by contact initiated by the woolly monkeys among others, but what is the effect of such interaction in terms of creating respect?

In his book 'Reading Zoos' Randy Malamud (Georgia State University) analyses attitudes towards zoos from a great variety of literary sources. The author's overall position on zoos is clearly a negative one. In connection with their educational role Malamud believes it is better for children not to go to a zoo. When reflecting upon the idea of whether it would be important for his son to see a real giraffe, the author writes:

"Even if my son did go to the zoo, he would still not see what I consider to be a real giraffe, but rather a cultural stylization, simplification, distillation, of a giraffe; a sample of a giraffe; a (stinted) representation of a giraffe. Teaching children about animals in the zoo is like exposing them to human cultural and ethnic diversity via Epcot's World Showcase Pavilion."¹⁰

Once, a sea lion at Amsterdam Zoo started throwing a small branch to me. After he had repeated this a few times, I thought I understood his intentions. I threw the branch as far as I could in the pool and immediately he went after it vigorously and brought it back at high speed. This game went on for perhaps more than five minutes, with no reward such as fish. Other visitors gathered around the enclosure, a child took over

my role and all of us seemed to enjoy this activity. After some time the sea lion apparently lost interest and started swimming with his companions again. I was impressed by this animal, who took some control of his situation. Perhaps he had fewer or different skills than his conspecifics in the wild. But he clearly struck me as an intelligent, lively, complex and very real being — in no way would I ever think of this animal as a simplification or a sample of a sea lion. And we all seemed to have fun and to respect this being.

Jane Goodall believes that zoos can have an educational value. When asked for her opinion regarding the value of zoos, Goodall answered:

"I think a good zoo plays an important role for children. TV is often cited as a better way of learning about wildlife. But TV today is such a mixture of fact and fiction. What is the difference, for a small child, between animated dinosaurs and real elephants, on TV. Or a gorilla and a modern king kong. But seeing a live animal, looking into the eyes, is a very important experience for many young children. And adults too. You can't imagine how many letters I've received from people of all ages whose whole attitude was changed by looking into the eyes of chimps, gorillas or orangutans. Or watching them behave. Learning about their personalities. This is why I developed our ChimpanZoo program."¹¹

Lastly, attention should be paid to implicit messages by zoos. Education and recreation do not need to exclude each other, but sometimes the emphasis may lie on the recreational angle and in such a way that the implicit message may be a negative one regarding conservation.

What kinds of effects do, for instance, the many restaurants and stalls (which sell fast food, ice-cream, all kinds of sweets etc.) in zoos have on consumer attitudes? What about eating a hamburger at the restaurant in the rainforest exhibit of Arnhem Zoo?

The entire atmosphere of people making noise is very different from the atmosphere in many museums. Of course, many visitors are families with young children, but perhaps measures can be taken to create some quieter places where one can simply observe, without the distraction of people banging on windows and disturbing the animals. It seems that too much is tolerated in zoos.

In a small Belgian zoo — the Aviflora in Ingelmunster — as recently as 1992, visitors first passed by distorting mirrors, before finally arriving (in

quite a humorous mood) at the cage of the "acrobatic" chimpanzee Cheeta, which merely contained a small children's bed and a small table and chair. Most organised zoos, though, do not present such a misleading image and many of them make genuine efforts to actively stimulate a more realistic and respectful attitude towards animals.

NOTES

- ¹ This number is given by the WZCS. Counting the numbers shows, however, that the real sum is 621 million.
- ² IUDZG/CBSG (IUCN/SSC), 1993: 12-15.
- ³ IUDZG/CBSG (IUCN/SSC), 1993: 14.
- ⁴ Marcellini and Jenssen, 1988: 329-332, 337-338.
- ⁵ Marcellini and Jenssen, 1988: 336 and Booth, 1991: D11.
- ⁶ De Waal, 1989: 35.
- ⁷ Kellert and Dunlap, 1989: no numbered pages.
- ⁸ Kellert and Dunlap, 1989: unnumbered pages. Kellert's report is entitled 'The educational potential of the zoo and its visitor' and appeared in the Philadelphia Zoo Review in 1987.
- ⁹ Based on several publications and fact-sheets by Emmen Zoo and observations made during visits in 1991 and 1999.
- ¹⁰ Malamud, 1998: 29.
- ¹¹ Personal communication, 16th June 1996.

Research

According to the WZCS, 150 years of modern zoo history have led to a considerable amount of knowledge. The potential for further basic and applied research is stressed. WZCS notes that, in spite of the great need for research in relation to conservation objectives, "manpower and financial resources for extensive research is rarely available in zoos". Nevertheless, there is still a considerable research output, because many zoo workers (scientific, curatorial and keeper staff) carry out some research in addition to their normal work¹.

Besides the shortage of manpower and financial resources, it is also stated that research in zoos frequently suffers from a shortage of individual animals per species. For this reason co-ordination between zoos is necessary, and advice has been given on ways to integrate research within breeding programmes and to set up databases².

In Europe, the Research Working Group analysed some 1,300 zoo publications in order to learn more about the research carried out by European zoos between 1980-90. The publications appeared in magazines such as *Zoo Biology*, the *International Zoo Yearbook* and *Der Zoologische Garten*. Werner Kaumanns (German Primate Centre, Göttingen) published the preliminary results of this analysis in the 'EEP Yearbook 1990'.

The quantitative scientific output is characterised as "quite respectable". A trend seems to go in a direction directly linked to the tasks of zoos. The majority of the studies were related to the fields of 'ethology' and 'husbandry/breeding' (each field counting more than 400 publications). The field 'pathology' comes third with some 200 publications. Other fields

have less than 100 articles, and are related to 'genetics', 'reproductive biology', 'nutrition', 'morphology', 'physiology', 'reintroduction', 'taxonomy' and a category of 'others'. The most frequently studied class of animals is mammals (almost 800 publications), followed by birds.

However, Kaumanns adds that the studies have been carried out in about 30% of the zoos only and by an even smaller percentage of the biologists working in European zoos. He points out that a very preliminary analysis suggests that:

"(...) the sample contains many small descriptive studies with rather specific aims of local or otherwise limited importance which rarely contribute significantly by to scientific progress or to the development of major keeping and breeding strategies. Larger research projects comprising several related studies performed over a longer period of time are almost lacking."³

Nevertheless, Kaumanns maintains that a lot has been achieved, albeit with inefficient strategies. The Research Working Group identified two main possible explanations for the situation, namely (i) the fact that zoos are still working independently from one another and (ii) that the individual zoo is not fundamentally a research institute (because of a lack of means and money).

The Research Working Group concludes that an organisational approach is required, one which exceeds the level of individual zoos and is in close contact with basic research structures. More attention should go to research related to conservation biology and the importance of EEP organisational units should be stressed⁴.

In the 'EEP Yearbook 1994/95', Gunther Nogge reports that in 1994 the EAZA formally established a Research Committee. The Committee is equally represented by people from zoos and academic communities. Its main goals are to establish a link between these two communities and to stimulate research projects in close co-operation with EEP co-ordinators and TAG (Taxon Advisory Group) chairs.

The Research Committee carried out a 'Survey on Research in European Zoos 1995'. A questionnaire was sent to all EAZA members. Only 57 zoos (or 26%) returned the questionnaire. Of these 57, 41 are involved in a varying number of research projects (one to fifteen), most of which are in co-operation with research institutions or universities. It is remarkable that only eleven zoos have a research budget. ("This low number is

quite astonishing, since zoos generally claim research to be one of their main objectives"⁵.)

Although the above reports express many critical opinions, it ought to be added that important changes have effectively been taking place over the last years. The NFRZG (National Foundation for Research in Zoological Gardens) was founded in 1988 to operate on a national level in the Netherlands. It has become more and more involved on a European and global level. For instance, in 1991 the NFRZG became the Executive Office of the EEP. The 1990-91 report of the NFRZG mentions three broad research projects with a duration of two to three years, namely 'Well-being of zoo animals' (by T. Griede), 'Zoo animal nutrition' (by A.F.M. Melissen and P. Rooymans) and 'Juvenile mortality' (by I. Debyser)⁶. These three research projects seem to indicate that there is a trend towards more co-ordinated research, on a level that exceeds that of the individual zoo.

Are zoos inappropriate places for carrying out research, as alleged by some? Devra Kleiman (Department of Zoological Research, National Zoo, Washington) describes some disadvantages with regard to behavioural research in zoos, such as:

- a) The testing of hypotheses can be hindered by the inadmissibility of certain manipulations.
- b) The artificiality of the environment can be perceived by researchers as reducing the impact of research results.
- c) It can be difficult to obtain enough species and subjects. Zoos no longer want to be postage stamp collections, showing as many species as possible. Consequently fewer closely related species can be found for conducting comparative research. In the context of breeding programmes, species are managed as metapopulations. As a result, breeding is much more restricted and researchers have to visit several zoos to find enough subjects. These travel costs can be as huge as the costs of an overseas field study⁷.

The profound influence of an artificial environment on animals is illustrated by Luoma. After a few generations in captivity, the digestive tracts of red grouse became much shorter. The caecum was only 25% and the small intestine 72% of the size of those of animals living in nature. This was thought to be an adaptive consequence of a diet of mostly commercial, easily digestible food⁸.

The above does not mean that zoos are inappropriate for scientific research. For instance, Kleiman refers to advantages such as controlled envi-

ronmental conditions, the opportunity for longitudinal studies of species — which is often not available to field or laboratory workers — and the many data (for instance on oestrous cycles, inter-birth intervals, litter size and growth rate) that can be gathered in zoos⁹.

Those who believe that studying animals in captivity has no scientific value at all may be confusing the legitimate question of the morality of this research with the one of scientific usefulness of such research. Surely research on animal subjectivity in captivity, such as that of the behaviour of and communication with great apes or towards preferences in hens, offers convincing examples of the scientific value of some of the research on animals in captivity.

Ethological research carried out by Frans de Waal on the social behaviour of chimpanzees on an island in Arnhem Zoo is esteemed by primatologists and beyond. For example, Goodall writes:

“Observations of captive groups such as the Arnhem colony have assuredly made meaningful contributions to our understanding of the complexities of chimpanzee social awareness. No one has revealed these complexities in more depth and with greater understanding than Frans de Waal.”¹⁰

De Waal appreciates research in captivity as a valuable complement for research in nature:

“In no sense can captive studies in isolation replace research in the natural habitat, but they do complement it in one very important respect: *detail*.”¹¹

Captivity may thus have the disadvantage that certain behaviours cannot be observed, but on the other hand there is the advantage that the animals are highly visible.

Although research in zoos may be valuable, it is important to notice that (according to Kleiman) this research has become more focused on applied research instead of basic research because of the emphasis placed by zoos on breeding programmes for the purpose of the conservation of endangered species. She expresses her concern about the possible negative impact of the focus on conservation or husbandry-related applied studies upon the potential to conduct basic behavioural research in zoos¹².

This finding might indicate that the role of research in zoos becomes more and more important as a means of supporting the conservation role

rather than as a goal in its own right. This would also imply that in order to justify themselves, zoos must rely more upon their conservation role than upon their contribution to research. Clearly, research that is mainly valuable for the functioning of the zoo does not in itself offer a sufficient justification for the existence of zoos.

Nevertheless one cannot draw the conclusion that it is impossible to design research programmes which focus on benefits appreciated by the management of zoos as well as the acquirement of knowledge relevant beyond the zoo community. Van Elsacker *et al.* illustrate this in their research on bonobos at Animal park Planckendael. This research is the result of a co-operative effort between the Royal Zoological Society of Antwerp and Antwerp University. Research carried out to determine the fertile period of female bonobos is focused on both basic relevance (in order to understand the changes in social behaviour and to obtain physiological information) and applied relevance (management of the breeding programme). Kleiman also gives examples of such integrated zoo research, such as the study of pair bonds and parental care¹³.

Conservation-oriented research may also produce information that is valuable for *in situ* conservation in the field such as, for instance, techniques to anaesthetise. However, perhaps one ought to bear David Chivers' remarks in mind here — that the emphasis on the development of techniques related to *ex situ* conservation has distracted the attention from the development of *in situ* conservation techniques (see above).

NOTES

¹ IUDZG/CBSG (IUCN/SSC), 1993: 67-69.

² IUDZG/CBSG (IUCN/SSC), 1993: 71-72.

³ Kaumanns, 1991: 191-192.

⁴ Kaumanns, 1991: 190-194.

⁵ Nogge, 1995: 403-404.

⁶ Anonymous, (1991 or later): 1, 7, 9-11.

⁷ Kleiman, 1992: 307-309.

⁸ Luoma, 1987: 147.

⁹ Kleiman, 1992: 301-302.

¹⁰ Goodall, 1986: 583.

¹¹ De Waal, 1989: 32.

¹² Kleiman, 1992: 307-308, 310.

¹³ Kleiman, 1992: 305-306 and Van Elsacker *et al.*, 1995: 292-294.

Zoos and the future: some suggestions

Important changes are taking place in the organised zoo community. The most remarkable changes are (i) the fast development, especially in the last decade, of an organisational structure for the management of breeding programmes for endangered species at both a regional and a global level and (ii) the innovative realisation of larger and more naturalistic, enriched enclosures, at a faster pace for some organised zoos. Economic factors do not always allow for a pace of change that is as quick as desired, but the fact that many enclosures are improving cannot be denied and many zoos are delivering very serious financial efforts to create varied naturalistic enclosures for the animals in their care.

A polarised conflict is going on between zoos on the one hand and several animal welfare and animal rights organisations on the other. Apart from the question as to whether or not their critical opinions of zoos are justified, it should be noted that because of this strong polarisation opportunities for potentially fruitful dialogue are missed. I believe that this cannot be a good thing, not only for the zoos and the tasks they commit themselves to, but also for the many animals living in zoos. Although certain differences in beliefs held by zoos and their opponents are probably irreconcilable, some basis for agreement may be found, as I will try to demonstrate further on.

Sustainable exploitation

The surplus problem seems to have become one of the most important problems that zoos have to face. The organisation of breeding programmes

that enable the maintenance of sufficient genetic variation has generated animals that are considered surplus. These animals take up space and are seen as a drain on financial resources of zoos. More and more zoo staff express the opinion that surplus individuals have to be culled in order to conserve more species. Is this a justified viewpoint?

Firstly, it should be mentioned that we are not talking about an isolated case. The plea for culling surplus zoo animals seems to fit into a larger ethical context, namely that which includes the concepts of 'sustainable development' and 'sustainable use'.

By means of the 'World Zoo Conservation Strategy' organised zoos express their support of the goals of the World Conservation Union (IUCN), namely nature conservation and sustainable development. In 'Caring for the Earth. A Strategy for Sustainable Living' (published in 1991 by IUCN, UNEP and WWF), 'sustainable development' is described as "improving the quality of human life while living within the carrying capacity of supporting ecosystems" and refers to 'sustainable use' as the use of renewable resources at rates within their capacity for renewal. Among these renewable resources are wild and domesticated organisms¹.

Although these concepts of sustainable development and use are very important in general, the sustainable use of animals may raise particular questions because of welfare implications. It demonstrates the trend to move away from trying to save species by protecting all individual members towards a conservation system that supports selective exploitation.

This conflict concerning the acceptability of sustainable use becomes clearer when we consider the exploitation of elephants for ivory. According to Iain and Oria Douglas-Hamilton, the IUCN and WWF have been in favour of the control of the ivory trade by means of a quota system for a long time, instead of supporting a complete ban on killing elephants by placing them on 'Appendix One' of the CITES. In 1989, these organisations decided to support a complete ban, when this appeared to be the only way to prevent a further decline in the African elephant population².

Is sustainable harvesting, such as culling elephants for their tusks, skin and meat economically justifiable in order to raise conservation funds? Should a fraction of the profit of ivory sales, skin products (such as table-tops, briefcases and shoes) and feet (umbrella stands, foot stools and — with the feet of baby elephants — pencil holders and cigar containers) be

used for funding WWF projects? Would it be morally acceptable to sell or buy these 'eco-products'³?

Other examples of 'sustainable use' are mentioned in an article by Richard Luxmoore (World Conservation Monitoring Centre, Cambridge) and Timothy Swanson (London Environmental Economics Centre) in 'Economics for the Wilds', a book published in 1992 with the support of WWF, IUCN and TRAFFIC.

A number of examples of wildlife breeding in captivity are for commercial purposes, such as the silver fox, blue fox, chinchilla (all for their fur), plains bison (meat), red deer, silka deer (both for their meat and antlers), ostrich (leather, meat and feathers) and crocodile (leather, meat). In Ethiopia, civet cats are caught in nature and placed in cages. Every ten days, musk is extracted for use in the perfume industry. Luxmoore and Swanson mention that the hunting of elephants, buffaloes, lions, leopards and sable antelopes by overseas trophy hunters can yield a very high price per animal. In South Africa, a new way of trophy hunting consists of shooting rhinos with a tranquilliser dart. A mould of the unconscious animal's head is taken and later used to fabricate a cast to hang on the wall⁴.

The potential for wildlife utilisation must be enormous to those who adhere to these forms of conservation, at least when this can be achieved in a sustainable way. Schaller writes that in China tigers are bred in captivity to provide bones, whiskers, sex organs and other parts for use in traditional medicine. The bones are sold for more than \$300 per pound. China has asked for a CITES permit to sell these products on the international market⁵.

How far will this kind of conservation philosophy be taken? Will it be possible one day not only to watch mountain gorillas as a tourist, but also to shoot a carefully selected old male — for example Digit, past breeding age and having lost leadership? Would this not make many people feel satisfied? The trophy hunter would be happy with both his experience and with the head and hands of the gorilla and the conservationist would be grateful because the profit made can be used for the conservation of mountain gorilla habitat. If hunting is not perceived as humane, the animal could first be shot with a tranquilliser gun.

When considering the morality of culling surplus animals in zoos, this larger context should not be overlooked. It refers to a moral position, which entails that species are a form of capital, and that killing individuals

of these species is a way of collecting the interest. When zoos are proposing to cull surplus animals, they could very well be making way for the acceptance of the principle of sustainable use by the public, in a sense as described above.

Would it be acceptable to sell animal products if zoos decide to cull them *anyway* because of the space they take up and the money they cost (where this does not serve as an unintended cover for further illegal trade)? What about the argument presented by zoo people that it is permissible to cull surplus animals because of their lesser value in comparison with endangered species?

Firstly, the value of individual animals and their welfare need serious consideration. It is much too simple to state that those who plead for respect for individual animals are just 'humaniacs', 'anthropomorphists' or 'sentimentalists'.

In my opinion, it seems to be impossible to find a *rational* criterion to establish that human individuals have a higher moral value than all non-human animals. When considering the characteristics of great apes for example — their intelligence, their ability to learn sign language, their sensitivity and sociability — it becomes most difficult to point out differences relevant to the argument that they have lower moral value than humans do. Of course, differences can be found (for example in intelligence, being a moral agent and capacity to make and use tools), but what is the moral weight of these gradual differences? It is not sufficient just to find differences — they should also be morally relevant.

Also, when a difference has been identified, one ought to question if this difference is valid for all human beings. The way some people talk about the supposed absence of certain qualities in animals is alarming when we realise that their argument for the use of these animals could also be applied to certain disabled humans who may lack the respective qualities as well.

In 1993, Paola Cavalieri and Peter Singer initiated The Great Ape Project. A document entitled 'A Declaration on Great Apes' includes a demand for "the extension of the community of equals to include all great apes: human beings, chimpanzees, gorillas and orang-utans". Within this moral community, certain basic moral principles are accepted for its members, such as the right to life, the protection of individual liberty and the prohibition of torture. This declaration is supported by Marc Bekoff, Richard

Dawkins, Jared Diamond, Roger and Deborah Fouts, Jane Goodall and Toshisada Nishida among others⁶.

At the very least, it is clear that the value of individual animals requires more serious consideration than given hitherto. It is, for example, rather peculiar that in 1994 a journalist in a reputable Belgian newspaper respectfully refers to Jane Goodall as the chimpanzee authority and — in the same article — calls Peter Singer a fundamentalist animal liberator, on the grounds that Singer states that great apes deserve a juridical status as persons. Besides the question of the correctness of this stigmatisation of Peter Singer, the journalist apparently was not aware that Jane Goodall had also subscribed to the Great Ape Project in 1993⁷.

Zoos may have to rethink the value of individual animals before saying that surplus animals may be culled in the interest of the species. But what about the idea of culling for parental welfare? I have already brought up Jan Van Hooff's suggestion that zoos should consider allowing bears to have cubs every three years as a way of enrichment and to cull these cubs after six months of age. He also remarks that there is not only an overproduction of bears, but also of wolves and many other species, and that this will probably become the case for more and more animals, even for species like the great apes⁸.

The following question must be posed: if zoos do not succeed in keeping animals in conditions that are rich enough and have to consider the breeding and culling of surplus cubs, should they keep these animals at all? Welfare is more than just the prevention of suffering (although culling itself may also cause suffering, see below). A comprehensive welfare concept includes the opportunity to live for a natural period of time. I wonder how such an instrumentalisation as suggested by van Hooff could be justified and how far such a vision could lead, and for whom⁹? Research is required to establish a reasonable rate for parents to have youngsters and what consequences this has for the carrying capacity of zoos and their requirements concerning the keeping of endangered species.

When asked for a reaction on the idea of applying Van Hooff's suggestion to chimpanzees, Goodall replied:

"But chimp mothers, and others in the group, bond with infants. A death is mourned. I most definitely would never, ever agree to breed, then kill infants. Never. The group individuals lives are not enriched by tiny babies,

who simply cling to their mothers. Not until the infant begins tottering around, and the mother permits social contacts — not until then does the infant begin to enrich the lives of group members. To kill a young chimp deliberately equates with murder.”¹⁰

Secondly, if zoos defend the culling of surplus animals, they have to do this openly (the same holds for conservation organisations). Visitors pay for their zoo visit and have the right to know what kind of zoo policy they are supporting. It may be the case that many people will oppose such a zoo policy which in turn could have serious repercussions for conservation efforts made by zoos (and other organisations), such as captive breeding and fund-raising for *in situ* conservation.

Thirdly, before taking the position that individual animals have to be culled in order to save species, zoos have to ascertain that this is indeed the case. The following specific issues will have to be considered:

- a) Will the species disappear when left without human intervention? Is *ex situ* conservation really necessary for the survival of the species concerned?
- b) Is there really not enough space in zoos? It should not be forgotten that according to Seal only five to ten per cent of the spaces in zoos are assigned to endangered species (see above). Or does this mean that 90 to 95% of the zoo animals are surplus animals and thus qualify for culling?
- c) Have all possible resources been fully exploited to prevent culling? Donald Lindburg suggests placing surplus orangutans in what he calls “retirement sanctuaries”: low cost facilities, preferably situated in a warm climate and outside North America¹¹. It might be more effective and ethical to motivate the general public to fund such sanctuaries instead of defending the culling of surplus animals.

If zoos were to reach a point where they really had to consider culling animals in order to save species, the public might be persuaded to provide funds for conservation — or perhaps more desirable, to fund less expensive projects such as *in situ* conservation. Of course, before all this can be undertaken zoos should be convinced that surplus animals are worth the effort and that their individual lives carry more weight than certain economic considerations.

Do these considerations also apply to the conservation of species in general? Sustainable use may be defended by considering the interests of people living in developing countries. It is understandable that local peo-

ple utilise wildlife. However, it seems to me most reprehensible to defend the welfare of people by promoting the idea of sending wealthy tourists, who pay large sums of money, to these countries to shoot animals for kicks and to get trophies. Is wildlife utilisation the solution for inequalities between North and South? Should we not try to find ways to serve the welfare of both people and wildlife, for instance by more balanced trade relations or tourism instead of sport hunting? Finding ways to protect the welfare of both humans and non-humans may require a greater effort, but would be a more morally responsible way of acting.

A structural welfare role

When considering the role of zoos, the following is usually referred to: conservation, education, recreation and research. However, I believe that zoos could and should also fulfil a *fifth role*, a *structural welfare role* and they may mention this explicitly.

A welfare policy can be more than maintaining species in larger, more natural and richer enclosures. A structural welfare policy also incorporates (i) a surplus policy, (ii) the selection of species according to their welfare requirements, (iii) welfare education and advice, (iv) being a welfare sanctuary for certain animals and (v) support of *in situ* projects which also have (besides conservation value) a high welfare value.

Zoos may respond to such a proposal by claiming that things are already complicated enough as they are. Animal protection and animal rights organisations could retort that the only responsible welfare policy for zoos to adopt is to put a complete stop to breeding and to send as many animals back to (semi-)nature as possible. However, I believe that cases exist in which zoos can and should fulfil an important welfare role. In fact, it is noteworthy that some zoos do succeed in meeting this objective.

Surplus policy

Zoos can adopt a policy that is not only oriented towards enriching the lives of the animals on display, but also towards the creation of a rich environment where surplus animals can live out their natural lives. This is a

factor which should be incorporated into management plans, thus avoiding not knowing what to do with these animals and considering to cull them, to place them in monotonous enclosures behind the scenes or to send them to substandard facilities. John Lukas (White Oak Conservation Center, Yulee) wrote the following for a workshop that brought people from zoos and animal welfare organisations together:

"Zoos must be prepared to provide quality environments and care for all their animals for their entire life if they are to be perceived as providing conditions conducive for well-being. Aged animals, like aged people, deserve special care. Planning for their retirement needs to begin while the animal is young."¹²

I strongly disagree with Cleiton Freiheit who commented, in a debate concerning zoo animals that were shot at game ranches in the USA, that once you dispose of animals all control is lost and therefore that zoos cannot be blamed for what happens with these animals (see above). Zoos should keep animals within the organised zoo community, and completely ban selling and sending animals to substandard facilities. The system of organised breeding programmes offers a good medium for communication. It is within this organisational structure that zoos should try to find new places for surplus animals, in consultation with the species co-ordinator.

Co-operation with animal dealers (or brokers) has to come to an end completely. This often seems to be an indirect, camouflaged way of sending animals to substandard facilities. The placing of all zoo animals, not only those that are taking part in EEPs, SSPs or other breeding programmes, can be regulated by the organised zoos themselves.

Ideally substandard zoo facilities should no longer be in existence; they should be forbidden by law. As long as this is not the case, zoos themselves could undertake action. Organised zoos are in the position to adopt such a policy and could sanction those who do not take such a regulation seriously.

It would be hypocritical to assert that a law is needed to abolish substandard zoos and at the same time to send, directly or indirectly (via brokers), animals to such facilities. This not only harms the welfare of the animals involved, it also deceives visitors who are glad to see that animal welfare has apparently been taken care of because they are kept in enriched enclosures.

Selection of species

If animals are going to be kept in zoos in the future, then zoos should give priority to those animals whose welfare can be guaranteed the best. It may be advisable to keep by preference those species which — when compared to each other — show the most normal, varied and active behaviour in zoos.

Zoos should consider whether or not they should continue to keep certain large species that require very complex environments. For instance dolphins, elephants and large cats perhaps should not be kept at all or else in very large enclosures. The latter would imply that many zoos could only keep a very restricted number of such charismatic vertebrates.

Certainly, some forms of enclosure are completely unacceptable, even in reputable organised zoos. These zoos should not wait until minimum standards¹³ are imposed by law, but develop their own standards and raise them continuously. Lukas wrote that the zoo community should develop optimum standards of confinement (osc) in order to encourage themselves to set their aims higher. He believes that zoos that want to keep certain animals should reach a certain percentage of compliance with the osc. If some species should prove to be too difficult to keep in zoos, then they should be conserved only in semi-liberty or perhaps only *in situ*¹⁴.

Although a causal relationship is not certain, a few weeks after sending a first draft of this book to Antwerp Zoo I heard on the radio that Antwerp Zoo had decided to stop keeping dolphins — even though no alternative home had been found yet. Breeding experiments have been a failure and it had been decided to stop these some years before. The two remaining bottlenose dolphins — Ivo and Iris — have been sent to Duisburg Zoo in Germany in the meantime.

The much larger dolphinarium at Duisburg was renovated in 1995. It consists of two interconnected pools with a total volume of about 3,100 cubic metres. The smallest pool is the breeding pool and contains about one fourth of the total water volume. When there is no breeding female, or during shows, the dolphins can use both pools. Duisburg Zoo had five bottlenose dolphins in 1998 — two males and three females. Curator Philippe Jouk of Antwerp Zoo told me that Ivo is actively initiating contact with the other dolphins at Duisburg Zoo — including in a sexual sense — while Iris behaves a little more reserved. However, it has since been reported that Iris has become pregnant.

Initially — when there were still four dolphins — the intention was to allow these animals to have a natural life span at Antwerp and to replace them with sea lions. Several considerations could be made against this idea.

Firstly, the dolphinarium at Antwerp Zoo has always been much too small. The total water volume was about 850 cubic metres. The show pool contained about 600 cubic metres and behind the scenes there was one pool of 150 cubic metres and two pools of 60 cubic metres each. As mentioned above, Klinowska and Brown believe that a pool for bottlenose dolphins should contain a minimum of 1,000 cubic metres' space.

Secondly, Antwerp Zoo added some sea lions to this dolphinarium when there were still four dolphins there, and organised sea lion shows in the show pool. This probably means that the space for the dolphins behind the scenes became even more restricted and that the dolphins were spending less time in the show pool.

Thirdly, according to Geraci, dolphins can be disturbed by construction work, one of the consequences of which is to refuse food. The dolphinarium bordered the central train station of Antwerp. On 18th March 1996, one of the dolphins refused to take part in the show. It remained close to the corridor towards the behind-the-scenes pools almost constantly. One of the possible explanations given by the trainer was that the dolphin was disturbed by the long-term construction work at the central station (going on for months).

Fourthly, the two remaining dolphins may still live many years. In 1999 they were 21 (Ivo, male) and 30 (Iris, female) years old. As indicated above, male and female dolphins can reach the age of more than 30 and 40 years respectively.

Ric O'Barry, who trained five dolphins for the television programme 'Flipper', is preparing dolphins for life in the wild again (for instance, by teaching them to catch fish). The Born Free Foundation, The Bellerive Foundation and The Humane Society of the United States support the reintroduction of dolphins that have been kept in dolphinarium. (All dolphinarium have been closed in the United Kingdom, and some of the dolphins have been reintroduced.)

Thanks to their decision, Antwerp Zoo finally provides some compensation for their disastrous dolphin experiment, which has taken so many lives and caused so much suffering since 1968. However, one might wonder if it would not have been better to place the dolphins in a semi-natural sanctuary

(for instance a fenced coastal area), together with dolphins from other dolphinarium. This might carry a risk of transportation as well as deprive the involved zoos of further use of these dolphins as charismatic fundraisers¹⁵. It might also have demanded (more) financial efforts from Antwerp Zoo. But this option might have been much more richer and valuable for the dolphins themselves. After years of living in an artificial environment, they might enjoy their last years in natural surroundings again — surroundings from which they were violently removed all those years ago¹⁶.

In a paper preceding the transfer of the two dolphins to Duisburg Zoo, curator Manuel Garcia Hartmann (Duisburg Zoo) wrote:

"Since ethical considerations and the legal situation make the import of wild caught dolphins more than difficult, the emphasis of the husbandry of bottlenose dolphins should be on captive propagation. Since most dolphinarium in Europe do not have sufficiently large numbers of founder animals to become self sustaining, this can only be achieved by an efficient cooperation between facilities. (...) The potential transfer of two animals from Antwerp Zoo to Duisburg would enable the future transport of a male from Duisburg to Genova Aquarium, which is an EEP participant and currently looking for a single animal in order to ensure the survival of its dolphin exhibit. (...) If such steps fail, one EEP facility would have to close for lack of animals, giving a very symbolic sign to all dolphin EEP critics."¹⁷

Polar bears are another example of a species which, if at all, should only be kept in very large zoo enclosures, similar to the Asiatic black bear enclosure of 1.5ha at Glasgow Zoo. Polar bears are very prone to develop stereotypical behaviour, as illustrated in reports by Horsman (1986), Ames (1990) and Ormrod (1992). The polar bear exhibit at Port Defiance Zoo, Tacoma, was praised by Jeremy Cherfas. However, Ormrod noticed that even in this enclosure a polar bear exhibited stereotypical behaviour.

According to Ames, since polar bears have only recently evolved they still share many characteristics with brown bears. When given the opportunity, they like to dig in the soil and climb in trees. She recommends that it would be preferable to offer these animals areas of soil and grass instead of rock and concrete. Such enrichment may be valuable, but what would the educational impact be on visitors? Would it not be more appropriate to display other species of bears, whose behaviour in captivity resembles more their natural behaviour?

According to Ormrod, the IUCN has not yet established whether or not it is desirable to keep polar bears in captivity. There are still about 20,000 to 40,000 polar bears in the wild. If this species needs captive breeding, should it not preferably take place in a part of their natural habitat?

At Antwerp Zoo, several polar bears are kept in an enclosure of concrete measuring about 15 to 20x7m. Several animals show stereotypical behaviour, one of them performing a severe form of weaving. Antwerp Zoo is considering making investments to renovate the polar bear enclosure and to double its size. This is not just an effort to improve the living conditions of these animals, but part of their Master Plan; it shows their resolve to retain this species in the future¹⁸.

For several reasons, this plan does not seem to be a good idea:

- a) The size of the enclosure will still be very limited. It will certainly not be an enclosure comparable to the one for black bears at Glasgow, because Antwerp Zoo does not have the required space.
- b) Just like the dolphinarium, the polar bear enclosure borders the train station. It has already been described just how difficult it is to breed polar bears in captivity. Does Antwerp Zoo have the ambition to build a cubbing den in that location? It should also be mentioned here that according to Alison Ames, male polar bears in particular tend to initiate stereotypical behaviour as a result of loud noises (such as building work and machinery).

Will Antwerp Zoo keep the same polar bears in this expensive new enclosure, even when they continue to display stereotypical behaviour (and the research by Ames has shown that it is difficult to eradicate such behaviour)? Or are they going to sell or cull these animals and replace them with others?

Polar bears are charismatic animals but, by trying to retain this species, Antwerp Zoo seems to be persisting in an experiment that is doomed to fail. Several zoos have already decided to discontinue the display of polar bears. If the Royal Zoological Society of Antwerp wants to carry on keeping this species, it might be better to consider the construction of a designated enclosure at their more spacious Animal park Planckendaal. Their current polar bear enclosure could be adjusted for a smaller species instead. This would follow advice given by Poole and Law — in a paper composed for the UFAW — for enclosures that are not large enough. Glasgow Zoo has, for instance, converted its polar bear enclosure into one suitable for ocelots. A large variety of climbing structures and vegetation have been provided. By

adopting such a policy towards their polar bear enclosure, Antwerp might obtain more satisfactory welfare results¹⁹.

Welfare education and advice

Zoos can provide general information to the public on characteristics and welfare requirements of animals. They can actively inform the public about the welfare problems endured by animals due to the destruction of their natural habitat. They can also send positive messages, such as how to deal with domestic animals and how to help animals in the wild. Visitors to Emmen Zoo can, for example, obtain practical guidelines on how to make boxes for owls.

The question remains: in the long term will zoos make way for keeping new kinds of species, turning them into domestic animals? Maybe zoos could inform the public about the difficulties of keeping certain animals (why not confront the public with the problems zoos face, such as the problem of stereotypical behaviour?), advise them not to keep certain animals (for instance warning them about the size of an adult turtle) or how to enrich their enclosures (for instance in order to prevent feather plucking in parrots).

Organised zoos can and do make centralised efforts to produce reports on how to keep particular species in zoos. The research project by Tine Griede on 'Well-being and zoo animals' for the National Foundation for Research in Zoological Gardens (NFRZG) is a good example of such an approach. The husbandry guidelines developed by Taxon Advisory Groups for particular groups of species are also very valuable and will only become more and more important as these are further developed by the zoo community. The 'EEP Yearbook 1994/95' mentions, for example, the development of guidelines for bears and rhinos and in 1998 there were already 30 TAGS active in the EAZA region²⁰.

The organised zoo community should not restrict their advice to their own members. Many substandard zoos will only slowly change or disappear. In the meantime — and one can hope that laws will come into effect in order to enforce this — zoos could discontinue the delivery of animals to such facilities as well as distribute their husbandry guidelines to substandard zoos, in order to invite them to add some enrichment to their enclosures.

In conversations with the owners of substandard zoos, I got the impression that many of them are working mainly on their own. They often have good intentions, but lack not only the finances but also the proper knowledge of what exactly has to change. For instance, Tine Griede's information contains many simple and cheap ways of enriching the lives of zoo animals. It might be very helpful for this information to be divulged by the organised zoos to substandard zoos, for example through the authorities responsible for animal welfare (inspectors of the Ministry of Agriculture) or — and why not? — in co-operation with animal welfare organisations.

Such limited enrichment does not imply that substandard zoos have to be embraced. If they do not change within a reasonable amount of time, then they should disappear. Those who would remark that the best way to make substandard zoos disappear is to withhold them any support, might very well be responsible for denying the animals the basic enrichment necessary to bring limited but important relief to the many animals living in extremely monotonous enclosures. This is an issue around which organised zoos and animal organisations could and should meet and co-operate.

At Lochristi Zoo (Belgium), the outside enclosure of the lone chimpanzee Jimmy contained only a single motor tyre on a chain. The enclosure was of concrete and situated in a corner of the zoo. It offered him very little to look at. His indoor enclosure was extremely dark and consisted of two parts, each one *only 1m wide, and 2.5 to 3m deep and 3m high*. He had to spend the whole winter in this enclosure. It should not come as a surprise that on one occasion I saw him eating his own faeces.

Thanks to a letter from Jane Goodall, the owner, Willy Wauters, became convinced of the need to make changes. He started by giving branches with fresh leaves and he offered Jimmy the companionship of another lonely male chimpanzee, named Desiree, whom he obtained from a French circus. After years of loneliness, both chimpanzees are now living together. Visitors can see how they groom and tickle one another and how they play chasing games. Later on, Wauters constructed a new outdoor and indoor enclosure. The outdoor part measures about 10x6x3m. The floor is still of concrete, but the enclosure contains several trees, rocks and a small pond. The new indoor enclosure measures about 4 to 5x8x2.5m. It has large windows, so that they always have daylight and the opportunity to look outside. Wooden boxes in the top of the enclosure allow them to make nesting places. One could still call the changes very limited. On the other hand, this

small zoo has limited means and the owner — who used to believe that a good enclosure was just a clean place — makes serious efforts. A lot will depend upon the enrichment activities that he will organise. At the very least, the improvements for Jimmy and Desiree themselves must be significant.

Welfare sanctuaries

Zoos can fulfil an important welfare role by becoming a sanctuary or by creating what I propose to call '*sanctuary enclosures*'.

Some 45 chimpanzees have begun a new life at Monkey World, an English sanctuary and member of the EAZA. Monkey World has rescued chimpanzees from Austria, England, France, Greece, Israel and Spain. They were being used by photographers, as exotic pets, as circus animals or in laboratories. Many of them were born in Africa and taken away by poachers. The poachers slaughtered mothers and other family members in order to obtain the babies. These were smuggled out of Africa and illegally sold to Spanish beach photographers, amongst others. Tourists paid the photographers in order to get a picture of themselves holding a young dressed chimpanzee. What these tourists did not know was that these babies often had to work for sixteen hours per day. Neither did they know that the photographers tried to control the chimpanzees by beating them, pulling out their teeth or putting them on drugs. Thanks to the co-operation between Monkey World and the Spanish authorities nearly all beach chimpanzees have been confiscated. Upon their arrival the chimpanzees sometimes had to be treated for machete wounds, broken bones, malnutrition or anaemia. They had to be rehabilitated from their drug addiction and learn to live in social groups again.

Monkey World has four groups of chimpanzees, the largest numbering 22. Each group has at least an enclosure of one hectare. They can play in the grass, run over hills, dive away in culverts, climb on huge wooden structures and swing on ropes. The indoor enclosures also have a variety of enrichment materials. All year round the chimpanzees can choose whether they prefer to be outdoors or indoors. Visitors can hand over birthday presents, such as fruit, toys and cards²¹.

Rhenen Zoo in the Netherlands has a forested area of two hectares to house bears. This zoo has accepted the responsibility of becoming a sanctuary for bears from Turkey, where they had to earn money for gypsies.

They had to stand erect to be photographed with tourists. The animals lived a large part of their lives attached to a tree or rock. They constantly had a chain through their nose. Pulling at the chain severely harmed their noses and lips and is said to be most painful.

In 1993 fourteen bears were confiscated by the authorities in co-operation with the animal protection organisation WSPA (World Society for the Protection of Animals) and Rhenen Zoo. Most of the animals were moved to a Turkish nature reserve of 20ha and some blind bears went to the enclosure at Rhenen Zoo²².

It has been mentioned that Glasgow Zoo made a great effort by creating a 1.5ha nature-like enclosure for four Asiatic black bears and providing them with different types of enrichment. Glasgow Zoo accepted the care of the bears when the authorities withdrew the license of an animal park.

Some of the bears of Zwartberg Zoo (Belgium) also went to a spacious and natural enclosure. According to the Wauters, they sold five Kodiak bears to Emmen Zoo (the Netherlands) at the beginning of 1994. The living conditions for these bears must have changed considerably. Although the Wauters have stressed to me that they have always gone to great lengths to guarantee the welfare of all animals at their zoo – for example in terms of giving proper food and medical attention – it cannot be denied that many animals have been kept in very traditional, monotonous enclosures for years. All bear enclosures used to be kinds of concrete pits, with no objects to play with – there were just some shelves for lying down on. Most enclosures were about 30 square metres. At Emmen Zoo the Kodiak bears have a large enclosure with many rocks, trees, grass, bushes, streams and a spacious pond. An automatic feeding system releases food from time to time. This is done in such a way that the bears cannot know where or when this will happen. Thus they are stimulated to explore the enclosure. The bears can catch fish in the pond, something they learnt within a few weeks of their arrival at Emmen Zoo²³.

Although Emmen Zoo may have done a wonderful job by taking over Kodiak bears from Zwartberg Zoo, the question should be raised as to whether it was justified to pay for them. One can reason that paying for these bears is a way of stimulating such substandard places to go on breeding them for commercial purposes. Curator Tine Griede of Emmen Zoo has stressed that there was an important welfare motivation in their deci-



One of the bear enclosures at Zwartberg Zoo (1992).



The enclosure for Kodiak bears at Emmen Zoo, with bears coming from Zwartberg Zoo (1999).

sion, that Zwartberg Zoo was going to close (it has since closed) and that it is understandable that the owners of Zwartberg Zoo wanted to think of their own welfare when entering retirement. Griede also explained that this happened several years ago.

What about a justification from a species conservation perspective? In their report of 1998 in connection with the keeping of Kodiak bears in Europe, the Bear TAG (Taxon Advisory Group) mentions the existence of North American specialist collections as a positive argument. They argue against this by referring to the small size of the captive population, the species not being threatened, the limited number of holders and that space is important for other species²⁴.

Supporting in situ welfare projects

Zoos can raise funds and provide practical support for *in situ* projects that have both high conservation and welfare values. The Gibbon Rehabilitation Project (GRP) in Thailand is trying to rehabilitate confiscated gibbons, formerly kept as pets, on an uninhabited island. London Zoo is helping, for example, with the detection of diseases and the search for paying volunteer-assistants. This project is not only valuable from a welfare perspective, but also interesting from a conservation point of view — it provides information on ways to reintroduce gibbons into the wild²⁵.

The Jane Goodall Institute has chimpanzee sanctuaries in Canada, Congo, Kenya, Tanzania and Uganda. This organisation is taking care of more than 50 chimpanzee orphans at their Tchimpounga Sanctuary in Pointe Noire, Congo, for example. Official permission has been obtained to create a wildlife reserve around this sanctuary. The goal is to construct a conservation education centre in the short term, at each sanctuary site, so that local people can learn more about and gain appreciation for chimpanzees. The sanctuaries support the local economy by employing local people and by purchasing fruit and vegetables from the local villagers. At the Tchimpounga sanctuary a small clinic is even being built for the nearby villagers. The welfare of the individual chimpanzees involved may be sufficient to justify the creation of such a sanctuary, but clearly, these welfare efforts go hand in hand with valuable conservation and development work²⁶.

Space on the welfare ark

In addition to their other functions, zoos could fulfil a welfare role. I have argued that this role should involve more than just creating large and rich enclosures. It could be a continuous challenge for zoos to integrate the above described welfare tasks in their global policy. Sometimes this might result in conflict with other functions, but this does not mean that zoos cannot undertake important and consistent efforts towards a structural welfare policy.

Some zoos can place an accent on the welfare role, such as a sanctuary, and in doing so become a kind of 'welfare zoo' or — if combined with conservation work — a 'welfare ark'.

Zoos are confronted with important problems, and adopting such a welfare policy may result in a serious shortage of space. What kind of population pressures would zoos have to deal with in those circumstances? The following factors are relevant in this respect:

- a) More and more species could become dependent on *ex situ* conservation in zoos.
- b) Zoos try to keep species in larger, richer, more nature-like enclosures. This implies a reduction of the number of species kept.
- c) Genetic management requires that populations contain a certain minimum number of animals.
- d) Zoos should end the practice of sending surplus animals to dealers or substandard facilities and stop putting them behind the scenes in small enclosures or culling them.
- e) Zoos should try to become sanctuaries for animals that come, for example, from substandard facilities that have been forced to close down.

This could create a problematic situation for zoos, a situation that never would have reached such proportions had a welfare policy such as described above been adopted much earlier. The question remains as to which alternative solutions can be found, instead of keeping animals at substandard facilities and/or culling many of these animals.

Will culling become a generally accepted policy in organised zoos? Will it become permissible to cull both young and adult healthy animals of all types of species (including the charismatic ones), within the context of breeding programmes? What will the consequences be for our attitudes towards animals? Will we still perceive them as individuals with a value in themselves?

What will the educational impact of such a 'culling zoo' be on visitors, and on children in particular?

Nevertheless, a structural welfare policy may also result in ways to release population pressure:

a) Zoos should concentrate on those species that really need *ex situ* conservation programmes. In the first place an attempt should be made to conserve species *in situ*, in sanctuaries and conservation areas in their country of origin. Zoos can co-operate with other organisations in order to reintroduce animals to the wild, if possible, and also to transfer animals to semi-natural areas.

b) Because of this shift towards species that really need *ex situ* conservation and adapting a structural welfare policy, zoos will become more positively valued. This in turn will create new means for support (including funding) and co-operation with animal welfare organisations and the general public, among others.

Such a transformation requires a lot of flexibility from zoos. It requires good communication between the representatives of zoos, (other) *ex situ* sanctuaries, *in situ* sanctuaries and wildlife reserves, which is needed for the regular movement of animals.

When reflecting on the several pros and cons of the welfare of animals in nature and in zoos, I believe that a strong case could be made for large, protected areas in nature, where animals receive additional support if necessary. However, when contemplating the current situation, it appears that aside from nature itself, a combination of zoos and a range of gradations between these two could all fulfil an important role, from both an ecological and a welfare perspective.

NOTES

- ¹ IUCN/UNEP/WWF, 1991: 9-10 and IUDZG/CBSG (IUCN/SSC), 1993: x.
- ² Douglas-Hamilton and Douglas-Hamilton, 1992: 305-306, 316-318, 335-345.
- ³ Douglas-Hamilton and Douglas-Hamilton, 1992: 121-122, 217-220.
- ⁴ Luxmoore and Swanson, 1992: 175-180, 186.
- ⁵ Schaller, 1993: 257.
- ⁶ Cavaliere and Singer, 1993: v-vii, 2, 4.
- ⁷ Wullaert, 1993: 27.
- ⁸ Van Hooff, 1991: 11.
- ⁹ Those who adhere to this culling will probably refer to the production of farm animals. It could also be applied to keeping a small dog in the family until the summer holidays, year after year. The family goes on holiday and the dog is humanely culled. It could be argued that in this way the dog and the children amused themselves for one year, that the dog did

not have to endure the stress of the social separation and that a new dog will replace him — for at least one year...

- ¹⁰ Personal communication, 16th June 1996.
- ¹¹ Lindburg, 1991: 2.
- ¹² Lukas, (1995): 175.
- ¹³ An important minimum welfare standard that should be taken into consideration is that all animals should always be provided with a place where they can find privacy, away from the public. Such a requirement would guarantee that the animals could live at least according to some of their preferences. It is also a very simple measure to force zoos to create environments that are rich enough to invite animals not to withdraw themselves for the whole time in a smaller enclosure, out of sight of the visitors.
- ¹⁴ Lukas, (1995): 174-177.
- ¹⁵ This is probably the main reason for keeping dolphins. Bottlenose dolphins are not threatened with extinction. Research projects could also take place at the dolphin sanctuary. Stating that they are needed to educate the visitors is questionable. It would seem more reasonable to concentrate on the keeping of endangered species and to provide educational information on these species. Also, dolphins are already extremely popular and the educational value of dolphin shows has been very strongly criticized by educational experts — for instance in Klinowska and Brown (1986).
It is in addition remarkable that — while an EEP (!) has been setup for the bottlenose dolphin, a species which is not under threat of extinction — there is "scepticism within the dolphinarium community to participate in the programme", according to species coordinator Mats Amundin. He writes that the "main reason is a fear of losing control over crucial performing animals" (Amundin, 1999: 227).
- ¹⁶ Klinowska and Brown, (1986): 219; O'Barry and Coulbourn, 1989: 242-252; Smolders, 1989: 173; Baetens, 1993: 155; Travers, 1993: 9 and Hartmann, 1998: 1, 3. The information on the initial intention to further keep the dolphins at Antwerp Zoo comes from personal communication with Roland Van Bockstaele, 7th December 1994. For the pregnancy of Iris, see for example <http://www.gva.be/archief/nieuwsarchief/1999/1218/arch028907.html>.
- ¹⁷ Hartmann, 1998: 4.
- ¹⁸ Personal communication with Roland Van Bockstaele, 7th December 1994.
- ¹⁹ Ames, 1990: 19-20, 39-40, 42, 49; Ormrod, 1992: 35-37 and Poole and Law, s.d.: 2.
- ²⁰ For the work of Tine Griede see Griede, 1992. For the housing of primates see Griede, 1989. The information on TAGs and their guidelines can be found in Rietkerk, Brouwer and Smits, 1995: 355-356, 364-377 and in Anonymous, 1999b: 555.
- ²¹ This information comes from information included in Monkey World's The Discovery Pack.
- ²² Pereboom, 1994: 3-9 and Kolter and Usher-Smith, 1995: 357.
- ²³ Letter from Marcel Wauters of 18 July 1994, published in Wildpeace News (1995, nr 3), and Anonymous, (1999). Personal observations at Zwartberg Zoo between 1991 and 1999 and at Emmen Zoo in 1991 and 1999.
- ²⁴ Kolter and Usher-Smith, 1999: 423. Personal communication with Tine Griede, 26th October 1999.
- ²⁵ Christie, 1995: 425-426.
- ²⁶ Anonymous, 1996d: 3-4 and Webpage http://www.janegoodall.org/inst/inst_sanct_need.html and http://www.janegoodall.org/inst/inst_sanct_tchim.html of 15th August 1999.

Conclusions

As a summary, I would like to submit the following recommendations:

1. Several zoos will have to reconsider their ethical position. Instead of moving towards a stand of selective exploitation, they should opt for a policy that respects the welfare of all individual animals in their care. This does not have to exclude a successful conservation policy, well on the contrary. Given the fast decline of biodiversity and the limited capacity of zoos for species conservation, zoos should try to establish co-operative links with both animal welfare and conservation organisations. I believe that the welfare policy outlined above is the most realistic one for overcoming existing differences, at the same time as increasing conservation success to the maximum. Zoos depend upon the support of the public. An open, integrated welfare and conservation policy as described in the previous chapter will be a lot more likely to gain broad support than an overt or hidden policy of selective exploitation.
2. Zoos should have an open attitude. This implies the creation of ways for other bodies to evaluate zoo policies. Easy-access information should be assured concerning, for instance, structural decisions, diets, enrichment schedules, breeding successes and mortality rates. This is not a difficult request; it simply requires the making available of information that is recorded anyway, at least by organised zoos. Computer networks such as ISIS create exciting opportunities for information exchange between zoos.

This information could also be made available to third parties, for instance on the Internet.

3. The authorities should take up their responsibility to eradicate a myriad of substandard facilities. Either they should raise their standards or disappear. In Europe this would preferably be done at the level of the European Union. Recommendations clearly are not sufficient with regards to this problem; more pressure will be necessary. Furthermore, national governments can undertake actions themselves. Imposing welfare standards could create a problem in case substandard zoos have to close down; a solution would have to be found for the animals involved. This problem is very real indeed, but not undertaking any action could even worsen the situation. Installing a breeding prohibition for substandard facilities could be helpful for the time being.

Organised zoos do not have to wait for authorities to proclaim laws. At the very least, the organised zoos — represented in Europe by EAZA and in the USA by AZA — should establish a complete ban on the direct or indirect (via brokers) transfer of animals to substandard zoos.

4. Fortunately, organised zoos are reducing their collections in order to keep the animals in more adequate enclosures. In addition they may focus much more on smaller animals, both for reasons of welfare and conservation¹. How can a zoo of only a few hectares guarantee acceptable welfare conditions when it displays elephants, rhinos, giraffes, chimpanzees, gorillas, orangutans, lions, tigers, pumas, jaguars, leopards, dolphins, polar bears and Kamchatka bears? One could still argue that these animals are charismatic fundraisers. If so, only a few of these species should be kept and then only in really large enclosures².

More than ever, zoos are in a very special position. Research carried out — especially over the past four decades — has shown that many animals are very complex beings. The intelligence and sensitivity of many species is astonishing, and zoos face an enormous responsibility and challenge in order to meet the special requirements of these animals. Zoos should take note of the changing knowledge about animals, which leads to new ethical considerations concerning their moral status. The Great Ape Project has brought together leading primatologists, other leading biologists and philosophers who state that all great apes deserve the same moral status as

humans. Given these considerations, it sounds incredible that for several years at Animal park Planckendael, for example, chimpanzees have been living in a very small building with frosted glass. Valuable beings are living in zoos. Instead of thinking of culling the 'surplus' animals or storing them behind the scenes, it should become clear to zoos that they have a very special responsibility. Remarkable ethical changes are taking place, and zoo staff should not neglect these signs.

Furthermore it seems to be extremely difficult to meet the welfare needs of certain species. It may be wiser and an expression of respect to stop keeping these species at all. Examples of such species seem to be polar bears and dolphins.

5. With regards to conservation, zoos should strive to avoid any competition with *in situ* conservation projects, and should instead support them in any way they can, which would be much more efficient. Carefully selected and well-presented educational and fundraising projects should be undertaken for the support of specific *in situ* conservation programmes.

If zoos would adhere to these recommendations and to a structural welfare policy as described in the previous chapter, I am convinced that the future could only become much brighter for the welfare of many animals, for the conservation of wildlife, for zoos themselves and for all those people who truly care for animals.

NOTES

¹ Keeping smaller endangered keystone species allows zoos to have more of these than when keeping larger species.

² It is simple to state that the complexity and quality of an enclosure is much more important than its space. However, it is clear that an enclosure needs to be sufficiently spacious in order to make a certain degree of variety and quality possible.

Appendix:

List of bottlenose dolphins that have been kept at Antwerp Zoo (since 1968)¹.

The dolphins that were captive-born are in bold type.

Name	Date of birth	Date of arrival at Antwerp	Date of death	Cause of death
Monique	1960	20-12-1968	07-05-1979	Unknown
Scooter	1962	20-12-1968	24-01-1974	Bronchopneumonia on both sides
Sonny	1962	20-12-1968	13-04-1973	Bronchopneumonia on both sides
Ina	1963	03-03-1981	31-07-1987	Acute heart failure, degeneration of parenchym (tissue)
Gi-Bi	1964	20-12-1968	16-12-1973	Bronchopneumonia
Zarin	1964	19-12-1972	30-12-1980	Icterus (jaundice)
Chris	1965	20-12-1968	06-01-1969	Unknown
Ziska	1967	19-10-1972	14-09-1975	Unknown
Bert	Unknown, adult upon arrival	20-12-1968	30-05-1971	Bronchitis, pneumonia, gastritis (inflammation of the stomach)
Dolly	1968	19-10-1972	21-01-1997	Necrosis (refers to death of living tissue), calcification in kidney stones
Julie	Unknown, adult upon arrival	20-12-1968	12-04-1972	Chronic pleuropneumonia (inflammation of the pleura – membrane lining part of the thorax – and lungs)
Pat	1968	12-02-1972	19-08-1989	Unknown
Iris	1969	03-03-1981	Still alive	Still alive
Zolly	1970	12-02-1972	26-02-1972	Drowned, accident: head in drain-pipe
Karin	Unknown, adult upon arrival	12-02-1972	23-07-1972	Fracture of the sternum (breast bone), haemorrhage (discharge of blood) in chest-cavity

1. Anonymous, 1990: 22; Smolders, 1990: 12; Van den Sande and De Bois, 1990: 9-11, A.35-A.36; Anonymous, 1996b: 10 and some corrections and supplementary information to the report of Van den Sande and De Bois provided by Philippe Jouk and Walter De Meurichy (personal communication, 13th October 1999).

Appendix

Nameless	30-04-1973	30-04-1973	30-04-1973	Stillborn
Ilias	1973	03-03-1981	26-04-1996	Put down. Broken vertebrae and pressure necrosis of spinal cord
Ben	Unknown, adult upon arrival	25-04-1974	28-04-1974	Chronic and acute broncho-pneumonia. Arrived in a very bad condition
Bill	Unknown, adult upon arrival	25-04-1974	01-05-1974	Acute peritonitis (inflammation of the peritoneum, the membrane lining the abdominal cavity), haemorrhagic enteritis (inflammation of the intestines), acute pneumonia and septicaemia (blood poisoning). Arrived in a very bad condition
Bobby	Unknown, adult upon arrival	25-04-1974	27-04-1974	Chronic and acute purulent pleuritis (inflammation of the pleura, accompanied by the formation of pus) and peritonitis. Arrived in a very bad condition
Brabo	Unknown, adult upon arrival	25-04-1974	28-04-1974	Unknown. Arrived in a very bad condition
Dany	Unknown, adult upon arrival	28-01-1976	27-02-1976	Gastritis, fracture of the rib on the left side
Dick	Unknown, adult upon arrival	28-01-1976	06-01-1980	Enteritis
Ivo	1978	03-03-1981	Still alive	Still alive
Jan	30-01-1982	30-01-1982	09-02-1982	Acute muscular dystrophy (progressive wasting of muscles)
Nicky	20-05-1986	20-05-1986	04-12-1990	Erysipelas (disease associated with inflammation of the skin)
Napo	31-05-1986	31-05-1986	03-06-1986	Bleeding meninges (cerebral membrane), trauma
Odin	28-07-1987	28-07-1987	09-08-1987	Fibrous-purulent bronchopneumonia, aspergillose (respiratory disease)
Orfee	02-08-1987	02-08-1987	10-08-1987	Generalised parenchym degeneration
Prinse	08-09-1988	08-09-1988	17-09-1988	Trauma
Querida	08-10-1989	08-10-1989	20-10-1989	Pneumonia enteritis
Nameless	14-11-1990	14-11-1990	26-11-1990	Unknown
Tootsie	02-04-1992	02-04-1992	08-04-1992	Unknown
Unica	28-06-1993	28-06-1993	05-07-1993	Unknown

Bibliography

- ALBERS, K. and K. BROUWER, 1991, *The European Bear Survey*. Amsterdam, National Foundation for Research in Zoological Gardens, 16 p.
- AMES, A., 1990, *Management and behaviour of polar bears in captivity*. S.I., UFAW, 49 p.
- AMUNDIN, M., 1986, 'Breeding the Bottle-nosed dolphin at the Kolmarden Dolphinarium'. *International Zoo Yearbook*, Vol. 24/25, p. 263-271.
- 1999, 'Bottle-nosed dolphin (*Tursiops truncatus*) EEP Annual Report 1997'. In: Rietkerk, F., S. Smits, K. Brouwer and M. Kurtz, (eds.), *EEP Yearbook 1997/98 including Proceedings of the 15th EAZA Conference, Berlin 2-6 September 1998*. Amsterdam, EAZA Executive Office, p. 226-228.
- ANONYMOUS, 1985, *Taken en problemen van de hedendaagse grote, culturele dieren-tuinen*. Rotterdam and Amsterdam, Stichting Rotterdamse Diergaarde and Stichting tot instandhouding van de diergaarde van het Koninklijk Zoologisch Genootschap Natura Artis Magistra, 138 p.
- ANONYMOUS, 1987, *The IUCN Policy Statement on Captive Breeding. Prepared by the SSC Captive Breeding Specialist Group*. Gland, IUCN/CBSG, 3 p.
- ANONYMOUS, 1990, *Werkingsverslag van de vereniging*. 1990. Antwerpen, Koninklijke Maatschappij voor Dierkunde van Antwerpen-v.z.w., 66p.
- ANONYMOUS, 1991a, *Werkingsverslag van de vereniging*. 1991. Antwerpen, Koninklijke Maatschappij voor Dierkunde van Antwerpen-v.z.w., 72 p.
- ANONYMOUS, 1991b, *CBSG Regional Conservation Coordinator Committee. 1991 Annual Report*. Apple Valley/Bloomington.
- ANONYMOUS, (1991 or later) *Report 1990-1991. National Foundation for Research in Zoological Gardens (NFRZG)*. Amsterdam, NFRZG, 37 p.
- ANONYMOUS, 1992, 'Twee borelingen in het mensapengebouw'. *Zoo*, Vol. 58, No. 1, p. 4.
- ANONYMOUS, 1993a, 'Ijsbeertjes dood'. *Het Parool*, 18th February.
- ANONYMOUS, 1993b, 'Ijsbeerjongen in Artis doodgegaan'. *Nieuws van de Dag*, 18th February.

- ANONYMOUS, 1993c, 'Baby-dolfijn Unica dood'. *De Morgen*, 6th July.
- ANONYMOUS, 1993d, *Bonobo Tidings*. Jubilee volume on the occasion of the 150th anniversary of the Royal Zoological Society of Antwerp. 47 p.
- ANONYMOUS, 1995, 'List of approved EEP programmes as of December 1995'. In: Rietkerk, F., K. Brouwer and S. Smits, (eds.), *EEP Yearbook 1994/95 including the Proceedings of the 12th EEP Conference, Poznan 30th June - 2nd July 1995*. Amsterdam, EAZA/EEP Executive Office, p. 506-516.
- ANONYMOUS, (1995a), 'Lukas discussion'. In: Rowan, A.N., (ed.), *Wildlife conservation, zoos and animal protection — A strategic analysis. A workshop held at the White Oak Conservation Center, Yulee, Florida. April 21 - 24, 1994*. P. 182-187.
- ANONYMOUS, (1995b), *Conservation and animal welfare — a new era in Europe? The limits of Europe law and policy in ex situ conservation. A background information paper*. London, The London School of Economics and Political Science, 14 p.
- ANONYMOUS, 1996a, 'Ijsbeertjes'. *De Harpij*. Vol 15, No. 1, p. 30.
- ANONYMOUS, 1996b, 'Zoo-dolfinarium neemt afscheid van Ilias'. *Zoo*, Vol. 62, No. 1, p. 10.
- ANONYMOUS, 1996c, 'Fatale afloop bij rendieren'. *Zoo*, Vol. 61, No. 3, p. 10.
- ANONYMOUS, 1996d, *Chimpanzee orphans in Africa — the problem*. (Newsletter of the Jane Goodall Institute UK, April, 4 p.)
- ANONYMOUS, 1998, 'Mammals bred in captivity during 1995/1996 and multiple generation births'. *International Zoo Yearbook*. Vol. 36, p. 485-551.
- ANONYMOUS, 1999a, 'List of approved EEP species programmes as of January 1999'. In: Rietkerk, F., S. Smits, K. Brouwer and M. Kurtz, (eds.), *EEP Yearbook 1997/98 including Proceedings of the 15th EAZA Conference, Berlin 2-6 September 1998*. Amsterdam, EAZA Executive Office, p. 561-571.
- ANONYMOUS, 1999b, 'New EEPs, ESBS and TAGS in 1998'. In: Rietkerk, F., S. Smits, K. Brouwer and M. Kurtz, (eds.), *EEP Yearbook 1997/98 including Proceedings of the 15th EAZA Conference, Berlin 2-6 September 1998*. Amsterdam, EAZA Executive Office, p. 555-556.
- ANONYMOUS, (1999), *Noorder Dierenpark Gids*. Emmen, Noorder Dierenpark Zoo.
- BAETENS, R., 1993, *De roep van het paradijs. 150 jaar Antwerpse Zoo*. Tielt, Lannoo, 263 p.
- BATEMAN, G. (ed.), 1989a, *Dieren van de hele wereld. Apen*. Vianen, ECI, 158 p. (Transl. of *Animals of the World — Apes and other Primates*, 1987, Oxford, Equinox.)
- 1989b, *Dieren van de hele wereld. Roofdieren*. Vianen, ECI, 158 p. (Transl. of *Animals of the World — Predators*, 1986, Oxford, Equinox.)
- 1990, *Dieren van de hele wereld. Vogels*. Vianen, ECI, 160 p. (Transl. of *Animals of the World — Birds of Forest, Moor and Mountain*, 1987, Oxford, Equinox.)
- BATESON, P., 1991, 'Assessment of pain in animals'. *Animal Behaviour*, Vol. 42 (November), No. 5, p. 827-839.
- BECK, B., 1995, 'Reintroduction, zoos, conservation, and animal welfare'. In: Norton, B.G. et al., (eds.), *Ethics on the ark: zoos, animal welfare, and wildlife*

- conservation*. Washington and London, Smithsonian Institution Press, p. 155-163.
- BECKER, C., 1999, 'Orang utan (*Pongo pygmaeus*) EEP Annual Report 1997'. In: Rietkerk, F., S. Smits, K. Brouwer and M. Kurtz, (eds.), *EEP Yearbook 1997/98 including Proceedings of the 15th EAZA Conference, Berlin 2-6 September 1998*. Amsterdam, EAZA Executive Office, p. 156-161.
- BFF/WSPA, 1994, *The Zoo Inquiry*. Dorking/London, The Born Free Foundation/The World Society for the Protection of Animals, 56 p.
- BLUM, D., 1994, *The Monkey Wars*. New York and Oxford, Oxford University Press, 306 p.
- BOOTH, W., 1991, 'Naked Ape New Zoo Attraction. Surprise Results From People-Watching Study'. *The Washington Post*, 14th March, p. D1 and D11.
- BOSTOCK, S., 1993, *Zoos and animal rights. The ethics of keeping animals*. London and New York, Routledge, 227 p.
- BOX, H.O., 1991, 'Training for life after release: simian primates as examples'. In: Gipps, J.H.W., (ed.), *Beyond Captive Breeding. Re-introducing Endangered Mammals to the Wild. The Proceedings of a Symposium held at the Zoological Society of London on 24th and 25th November 1989*. Oxford, Clarendon Press, p. 111-123.
- BECK, K., S. SMITS and L. DE BOER (eds.), 1991, *EEP Yearbook 1990. With Summaries of Contributions and Discussions of the 8th EEP Conference, Budapest, 12th-15th May 1991*. Amsterdam, EEP Executive Office.
- BROUWER, K., 1993, 'EAZA/EEP Available and Wanted List; a step further towards responsible animal exchanges in European zoos'. In: L.E.M. de Boer, K. Brouwer and S. Smits, (eds.), *EEP Yearbook 1992/93 including the Proceedings of the 10th EEP Conference, Salzburg 28th-30th June 1993*. Amsterdam, EAZA/EEP Executive Office, p. 278-284.
- BRYDEN, M.M., 1990, 'Voortplanting en ontwikkeling'. In: Harrison, R. and M.M. Bryden, (eds.), *Walvissen. Dolfijnen en bruinvissen*. Weert, M&P, p. 134-141.
- CANTOR, D., 1993, 'Items of Property'. In: Cavalieri, P. and P. Singer, (eds.), *The Great Ape Project. Equality beyond Humanity*. London, Fourth Estate, p. 280-290.
- CAVALIERI, P. and P. SINGER (eds.), 1993, *The Great Ape Project. Equality beyond Humanity*. London, Fourth Estate, 312 p.
- CHAMOVE, A.S., G.R. HOSEY and P. SCHAEZEL, 1988, 'Visitors Excite Primates in Zoos'. *Zoo Biology*, Vol. 7, p. 359-369.
- CHAMOVE, A.S. and J.R. ANDERSON, 1989, 'Examining Environmental Enrichment'. In: Segal, E.F., (ed.), *Housing, care and psychological wellbeing of captive and laboratory primates*. New Jersey, Noyes Publications, p. 183-202.
- CHERFAS, J., 1988, 'Introduction'. In: UFAW, *Why Zoos?* UFAW Courier No. 24. Herts, UFAW, 58 p.
- CHIVERS, D.J., 1991, 'Guidelines for re-introductions: procedures and problems'. In: Gipps, J.H.W., (ed.), *Beyond Captive Breeding. Reintroducing Endangered Mammals to the Wild. The Proceedings of a Symposium held at the Zo-*

- ological Society of London on 24th and 25th November 1989. Oxford, Clarendon Press, p. 89-99.
- CHRISTIE, S., 1995, 'Notes on gibbons'. In: Rietkerk, F., K. Brouwer and S. Smits, (eds.), *EEP Yearbook 1994/95 including the Proceedings of the 12th EEP Conference, Poznan 30 June - 2 July 1995*. Amsterdam, EAZA/EEP Executive Office, 536 p.
- CLARKE, A.S., C.J. JUNO and T.L. MAPLE, 1982, 'Behavioral Effects of a Change in the Physical Environment: A Pilot Study of Captive Chimpanzees'. *Zoo Biology*, Vol. 1, p. 371-380.
- CLOSE, B., F. DOLINS and G. MASON (eds.), 1989, *Animal use in education. Proceedings of the second international conference. Edinburgh, Scotland, 2nd-5th April 1989*. London, Humane Education Centre.
- CONWAY, W.G., 1986, 'The practical difficulties and financial implications of endangered species breeding programmes'. *International Zoo Yearbook*, Vols. 24/25, p. 210-219.
- 1988, 'Can Technology Aid Species Preservation?' In: Wilson, E.O., (ed.), *Biodiversity*. Washington, National Academy Press, p. 263-268.
- 1995, 'Zoo conservation and ethical paradoxes'. In: Norton, B.G. et al., (eds.), *Ethics on the ark: zoos, animal welfare, and wildlife conservation*. Washington and London, Smithsonian Institution Press, p. 1-9.
- CORKERON, P., 1990, 'Sociaal gedrag'. In: Harrison, R. and M.M. Bryden, (eds.), *Walvissen. Dolfijnen en bruinvissen*. Weert, M&P, p. 142-159.
- CORNELL, L.H., E.D. ASPER, J.E. ANTRIM, S.S. SEARLES, W.G. YOUNG and T. GOFF, 1987, 'Progress Report: Results of a Long-range Captive Breeding Program for the Bottlenose Dolphin, *Tursiops truncatus* and *Tursiops truncatus gilli*'. *Zoo Biology*, Vol. 6, p. 41-53.
- CROKE, V., 1997, *The Modern Ark*. New York, Scribner.
- DANTZER, R. and G. MITTLEMAN, 1993, 'Functional Consequences of Behavioural Stereotypy'. In: Lawrence, A.B. and J. Rushen, (eds.), *Stereotypic Animal Behaviour. Fundamentals and Applications to Welfare*. Wallingford, CAB International, p. 147-172.
- DAWKINS, M.S., 1980, *Animal Suffering. The Science of Animal Welfare*. London and New York, Chapman and Hall, 149 p.
- 1990, 'From an animal's point of view: Motivation, fitness, and animal welfare'. *Behavioural and Brain Sciences*, Vol. 13 (March), No. 1, p. 1-9.
- 1993, *Through Our Eyes Only? The search for animal consciousness*. New York and Oxford, W.H. Freeman, 192 p.
- DE BLOCK, P., 1979, 'Onze Guyana-dolfijnen (*Sotalia guianensis*)'. *Zoo*, No. 3, p. 106-107.
- 1980, 'Aspekten van de gedragsstudie bij afgerichte tuimelaars'. *Zoo*, No. 3, p. 95-98.
- DE BOER, L., 1984, 'Het behoud van bedreigde diersoorten in dierentuinen. Eigenbelang en idealisme'. *Vakbl. Biol.*, Vol. 64, No. 11, p. 222-227.
- 1992, *Een wereld, een natuur*. Kampen, La Rivière&Voorhoeve, 94 p.
- DE BOIS, H., A.A. DHONDT and B. VAN PUIJENBROECK, 1990, 'Effects of Inbreeding on Juvenile Survival of the Okapi *Okapia Johnstoni* in Captivity'. *Biological Conservation*, Vol. 54, p. 147-155.
- DE WAAL, F., 1982, *Chimpanzee Politics. Power and Sex among Apes*. London, Jonathan Cape, 223 p.
- 1989, *Peacemaking among Primates*. Cambridge (Massachusetts) and London, Harvard University Press, 294 p.
- DEBYSER, I., 1995, *Juvenile mortality in captive populations of primates: an epidemiological and pathological study in Dutch and Belgian zoological gardens and a German primate centre*. Utrecht, Universiteit Utrecht, 313 p.
- DOUGLAS-HAMILTON, I. and O. DOUGLAS-HAMILTON, 1992, *Battle for the elephants*. London, New York, Toronto, Sydney and Auckland, Doubleday, 368 p.
- DUFFIELD, D.A. and R.S. WELLS, 1990, 'Bottlenose dolphins: comparison of census data from dolphins in captivity with a wild population'. *Soundings*.
- DURRELL, G., 1976, *The Stationary Ark*. London, Collins, 156 p.
- FEAZEL, C.T., 1990, *White Bear. Encounters with the Master of the Arctic Ice*. New York, Ballantine Books, 223 p.
- FOOSE, T.J., 1991, 'Regional captive propagation programmes worldwide'. In: Anonymous, *CBSG Regional Conservation Coordinator Committee. 1991 Annual Report*. Apple Valley/Bloomington.
- FOSSEY, D., 1983, *Gorillas in the Mist*. London, Penguin Books, 282 p.
- FOX, M.W. (ed.), 1968, *Abnormal behavior in animals*. Philadelphia, London and Toronto, W.B. Saunders.
- FRANK, W., 1982, 'Amphibia - Reptiles'. In: Klös, H.-G. and E.M. Lang, (eds.), *Handbook of Zoo Medicine. Diseases and Treatment of Wild Animals in Zoos, Game Parks, Circuses and Private Collections*. New York, Van Nostrand Reinhold Company, p. 355-374.
- FRITZ, J., S. MAKI, L.T. NASH, T. MARTIN and M. MATEVIA, 1992, 'The Relationship Between Forage Material and Levels of Coprophagy in Captive Chimpanzees (*Pan troglodytes*)'. *Zoo Biology*, Vol. 11, p. 313-318.
- GALDIKAS, B., 1995, *Reflections of Eden: my years with the orangutans of Borneo*. Boston, New York, Toronto and London, Little, Brown and Company, 408 p.
- GANSLOBER, U., J.K. HODGES and W. KAUMANN, 1995, *Research and Captive Propagation*. Fürth, Filander Verlag.
- GAUCKLER, A., 1982, 'Dolphins'. In: Klös, H.-G. and E.M. Lang, (eds.), *Handbook of Zoo Medicine. Diseases and Treatment of Wild Animals in Zoos, Game Parks, Circuses and Private Collections*. New York, Van Nostrand Reinhold Company, p. 144-152.
- GIPPS, J.H.W. (ed.), 1991, *Beyond Captive Breeding. Re-introducing Endangered Mammals to the Wild. The Proceedings of a Symposium held at the Zoological Society of London on 24th and 25th November 1989*. Oxford, Clarendon Press, 284 p.

- GOODALL, J., 1986, *The Chimpanzees of Gombe. Patterns of Behavior*. Cambridge (Massachusetts) and London, The Belknap Press of Harvard University Press, 673 p.
- GORDON, I.J., 1991, 'Ungulate re-introductions: the case of the scimitar-horned oryx'. In: Gipps, J.H.W., (ed.), *Beyond Captive Breeding. Re-introducing Endangered Mammals to the Wild. The Proceedings of a Symposium held at the Zoological Society of London on 24th and 25th November 1989*. Oxford, Clarendon Press, p. 217-240.
- GRIEDE, T., 1989, *Guidelines for adequate housing and care of non-human primates in zoos*. Amsterdam, Stichting Nationaal Onderzoek Dierentuinen, 148 p.
- 1992, *Handboek welzijn dierentuindieren*. Amsterdam, Stichting N.O.D.
- GRIFFIN, D.R., 1992, *Animal minds*. Chicago and London, The University of Chicago Press, 310 p.
- GRIFFITH, B., J.M. SCOTT, J.W. CARPENTER and C. REED, 1989, 'Translocations as a Species Conservation Tool: Status and Strategy'. *Science*, Vol. 245, p. 477-480.
- GROBBEN, A., 1999a, 'Ex-verzorger laakt lot mensapen in Zoo'. *Gazet van Antwerpen*, 26th April.
- 1999b, 'Arts: "In de Zoo moeten de dieren toonbaar zijn"'. *Gazet van Antwerpen*, 26th April.
- 1999c, 'Zoo zoekt oplossing voor geïsoleerde apen'. *Gazet van Antwerpen*, 29th April.
- GROBBEN, A. and L. MOOLENAAR, 1999, 'Apentrio mag weer zonnen'. *Gazet van Antwerpen*, 30th April.
- HARCOURT, A.H., 1989, 'De gorilla'. In: Bateman, Graham, (ed.), *Dieren van de hele wereld. Apen*. Vianen, ECI, p. 124-131.
- HARRISON, R. and M.M. BRYDEN (eds.), 1990, *Walvissen. Dolfijnen en bruinvissen*. Weert, M&P, 240 p. (Transl. of *Whales — dolphins and porpoises*, 1988, Sydney, Auckland, Hong Kong, London and Chicago, Intercontinental Publishing Corporation.)
- HARTMANN, M. G., 1998, *Short description of the dolphinarium of Duisburg Zoo*. (Unpublished information provided by Duisburg Zoo to Antwerp Zoo.)
- HIDDINGH, H., s.d., *Noorder Dierenpark Gids*. Emmen, Noorder Dierenpark Zoo.
- HORSMAN, P., 1986, *Captive Polar Bears in U.K. and Ireland*. Barry, 53p.
- HOSEY, G.R. and P.L. DRUCK, 1987, 'The Influence of Zoo Visitors on the Behaviour of Captive Primates'. *Applied Animal Behaviour Science*, Vol. 18, p. 19-29.
- HOUX, B., 1993, *Pro Primates Report: Possession and use of non-human primates in the Netherlands*. Leiden, Pro Primates, 91 p.
- HOYT, E., 1992, *The Performing Orca — Why The Show Must Stop. An in-depth review of the captive orca industry*. Bath, Whale and Dolphin Conservation Society, 102 p.
- IUCN/UNEP/WWF, 1991, *Caring for the Earth. A Strategy for Sustainable Living*. Gland, IUCN/UNEP/WWF, 228 p.

- IUDZG/CBSG (IUCN/SSC), 1993, *The World Zoo Conservation Strategy. The Role of the Zoos and Aquaria of the World in Global Conservation*. Brookfield, The Chicago Zoological Society, 76 p.
- JAROFKE, D., 1982, 'Capture, restraint, and handling of wild animals in the zoo'. In: Klös, H.-G. and E.M. Lang, (eds.), *Handbook of Zoo Medicine. Diseases and Treatment of Wild Animals in Zoos, Game Parks, Circuses and Private Collections*. New York, Van Nostrand Reinhold Company, p. 9-15.
- JOHNSON, W., 1990, *The rose-tinted menagerie*. London, Heretic Books, 335 p.
- JONES, D., 1987, 'Welfare in the Wild and in Captivity — How do they compare?' (paper for the fourth BVA Animal Welfare Foundation Symposium "The Welfare of Animals in Captivity", held at the Zoological Society of London, on 13th May 1987), p. 1-9.
- JOSTEN, D., N. DE COSTER, E. DE WOLF, W. HORANIN, G. VAN DEN BROECK and L. VAN ELSACKER, 1992, 'Uit het plakalbum van de chimpanseefamilie'. *Zoo*, Vol. 58, No. 1, p. 24-25.
- KAUMANN, W., 1991, 'The importance of basic research to captive breeding. Report of the Research Working Group'. In: Brouwer, K., S. Smits and L. de Boer, (eds.), *EEP Yearbook 1990. With Summaries of Contributions and Discussions of the 8th EEP Conference, Budapest, 12th-15th May 1991*. Amsterdam, EEP Executive Office, p. 190-194.
- KEAR, J., 1990, 'Flamingo's'. In: Bateman, G., (ed.), *Dieren van de hele wereld. Vogels*. Vianen, ECI, p. 82-87.
- KELLERT, S.R. and J. DUNLAP, 1989, *Informal Learning at the Zoo: a Study of Attitude and Knowledge Impacts*. (A Report to the Zoological Society of Philadelphia of a Study Funded by the G.R. Dodge Foundation.)
- KIRTLAND, J. (ed.), 1989, *Proceedings of the International Marine Animal Trainers Association Conference. October 29th - November 3rd, 1989*. Baltimore, National Aquarium Baltimore, 181 p.
- KLEIMAN, D.G., 1992, 'Behavior research in Zoos: Past, Present, and Future'. *Zoo Biology*, Vol. 11, p. 301-312.
- KLEIMAN, D.G., B.B. BECK, J.M. DIETZ and L.A. DIETZ, 1991, 'Costs of a re-introduction and criteria for success: accounting and accountability in the Golden Lion Tamarin Conservation Program'. In: Gipps, J.H.W., (ed.), *Beyond Captive Breeding. Re-introducing Endangered Mammals to the Wild. The Proceedings of a Symposium held at the Zoological Society of London on 24th and 25th November 1989*. Oxford, Clarendon Press, p. 125-142.
- KLINOWSKA, M. and S.L. BROWN, (1986), *A Review of Dolphinarium*. Prepared for the Department of the Environment (UK).
- KLOPPPEL, G., 1982, 'Giraffidae'. In: Klös, H.-G. and E.M. Lang, (eds.), *Handbook of Zoo Medicine. Diseases and Treatment of Wild Animals in Zoos, Game Parks, Circuses and Private Collections*. New York, Van Nostrand Reinhold Company, p. 247-256.

- KLOS, H.-G. and E.M. LANG (eds.), 1982, *Handbook of Zoo Medicine. Diseases and Treatment of Wild Animals in Zoos, Game Parks, Circuses and Private Collections*. New York, Van Nostrand Reinhold Company, 453 p.
- KOLTER, L., 1995, 'European collection planning for bears'. In: Rietkerk, F., K. Brouwer and S. Smits, (eds.), *EEP Yearbook 1994/95 including the Proceedings of the 12th EEP Conference, Poznan 30th June – 2nd July 1995*. Amsterdam, EAZA/EEP Executive Office, p. 431-435.
- KOLTER, L. and J. USHER-SMITH, 1995, 'EEP Bear TAG Annual Report 1995'. In: Rietkerk, F., K. Brouwer and S. Smits, (eds.), *EEP Yearbook 1994/95 including the Proceedings of the 12th EEP Conference, Poznan 30th June – 2nd July 1995*. Amsterdam, EAZA/EEP Executive Office, p. 354-359.
- 1999, 'EEP Bear TAG Annual Report 1998'. In: Rietkerk, F., S. Smits, K. Brouwer and M. Kurtz, (eds.), *EEP Yearbook 1997/98 including Proceedings of the 15th EAZA Conference, Berlin 2-6 September 1998*. Amsterdam, EAZA Executive Office, p. 419-424.
- LACY, R., 1991, 'Zoos and the Surplus Problem: An Alternative Solution'. *Zoo Biology*, Vol. 10, p. 293-297.
- LADEWIG, J., A.M. DE PASILLE, J. RUSHEN, W. SCHOUTEN, E.M.C. TERLOUW and E. VON BORELL, 1993, 'Stress and the Physiological Correlates of Stereotypic Behaviour'. In: Lawrence, A.B. and J. Rushen, (eds.), *Stereotypic Animal Behaviour. Fundamentals and Applications to Welfare*. Wallingford, CAB International, p. 97-118.
- LAWRENCE, A.B. and J. RUSHEN (eds.), 1993, *Stereotypic Animal Behaviour. Fundamentals and Applications to Welfare*. Wallingford, CAB International, 212 p.
- LEAKEY, R. and R. LEWIN, 1992, *Onze oorsprong: een speurtocht naar het ontstaan van de mensheid*. Amsterdam, Contact, 335 p. (Transl. of *Origins reconsidered. In search of what makes us human*, 1992, New York, Doubleday.)
- LINDBURG, D.G., 1991, 'Zoos and the "Surplus" Problem'. *Zoo Biology*, Vol. 10, p. 1-2.
- LUKAS, J., (1995), 'Animal Well-being in Zoos, Conservation Centers and In-Situ Conservation Programs'. In: Rowan, A., (ed.), *Wildlife conservation, zoos and animal protection — A strategic analysis. A workshop held at the White Oak Conservation Center, Yulee, Florida. April 21st-24th, 1994*. P. 170-181.
- LUOMA, J.R., 1987, *A Crowded Ark. The Role of Zoos in Wildlife Conservation*. Boston, Houghton Mifflin Company, 209 p.
- LUXMOORE, R. and T.M. SWANSON, 1992, 'Wildlife and wildland utilization and conservation'. In: Swanson, T.M. and E.B. Barbier, (eds.), *Economics for the Wilds. Wildlife, Wildlands, Diversity and Development*. London, Earthscan Publications Limited, p. 170-194.
- MacKINNON, K. and J. MacKINNON, 1991, 'Habitat protection and re-introduction programmes'. In: Gipps, J.H.W., (ed.), *Beyond Captive Breeding. Re-introducing Endangered Mammals to the Wild. The Proceedings of a Symposium held at the Zoological Society of London on 24th and 25th November 1989*. Oxford, Clarendon Press, p. 173-198.
- MAGER, W., O. BEAUJON and E. MAGER, 1993, *Apen in Apeldoorn. Ambassadeurs van het regenwoud*. La Rivière&Voorhoeve, 127 p.
- MAIER, F. and J. PAGE, 1990, *Zoo: the modern ark*. Toronto, Key Porter Book, 190 p.
- MALAMUD, R., 1998, *Reading Zoos. Representations of Animals and Captivity*. London, MacMillan Press, 377 p.
- MALCOLM, J., 1989, 'De hyenahond'. In: Bateman, G., (ed.), *Dieren van de hele wereld. Roofdieren*. Vianen, ECI, p. 64-67.
- MAPLE, T., 1995, 'Toward a responsible zoo agenda'. In: Norton, B.G. et al., (eds.), *Ethics on the ark: zoos, animal welfare, and wildlife conservation*. Washington and London, Smithsonian Institution Press, p. 20-30.
- MAPLE, T.L. and M.P. HOFF, 1982, *Gorilla Behavior*. New York, Cincinnati, Toronto, London and Melbourne, Van Nostrand Reinhold, 290 p.
- MARCELLINI, D.L. and T.A. JENSSEN, 1988, 'Visitor Behavior in the National Zoo's Reptile House'. *Zoo Biology*, Vol. 7, p. 329-338.
- MASON, G.J., 1991, 'Stereotypes: a critical review'. *Animal Behaviour*, Vol. 41, p. 1015-1037.
- 1993, 'Forms of Stereotypic Behaviour'. In: Lawrence, A.B. and J. Rushen, (eds.), *Stereotypic Animal Behaviour. Fundamentals and Applications to Welfare*. Wallingford, CAB International, p. 7-40.
- MASSON, J.M. and S. MCCARTHY, 1994, *When Elephants Weep. The Emotional Lives of Animals*. London, Jonathan Cape, 268 p.
- McKENNA, V. and R. MUGFORD, (after 1985), *Stereotypic and abnormal behaviour in zoos*. (Video)
- MEYER-HOLZAPFEL, M., 1968, 'Abnormal behaviour in zoo animals'. In: Fox, M.W., (ed.), *Abnormal Behaviour in Animals*. Philadelphia, London and Toronto, W.B. Saunders, p. 476-501.
- 1988, 'Automutilation bei Zootieren — Ein ungelöstes Rätsel'. *Zool. Garten*. Vol. 58, No. 1, p. 47-54.
- MILES, H. and M. SALISBURY, 1986, *Kingdom of the Ice Bear*. London, BBC Enterprises Ltd, 90 min., (video).
- MILES, L.W., 1993, 'Language and the Orang-utan: The Old 'Person' of the Forest'. In: Cavalieri, P. and P. Singer, (eds.), *The Great Ape Project. Equality beyond Humanity*. London, Fourth Estate, p. 42-57.
- MOORE III, D.E. and R. SMITH, 1990, 'The red wolf as a model for carnivore re-introductions'. In: Gipps, J.H.W., (ed.), *Beyond Captive Breeding. Re-introducing Endangered Mammals to the Wild. The Proceedings of a Symposium held at the Zoological Society of London on 24th and 25th November 1989*. Oxford, Clarendon Press, p. 263-278.
- MORRIS, D., 1986, *De naakte aap*. Utrecht and Aartselaar, A.W. Bruna & Zoon, 248 p. (Transl. of *The Naked Ape*, 1967).
- NEWTON, I., 1990, 'Roofvogels'. In: Bateman, G., (ed.), *Dieren van de hele wereld. Vogels*. Vianen, ECI, p. 10-33.

- NOGGE, G., 1995, 'Report from the Research Committee'. In: Rietkerk, F. K. Brouwer and S. Smits, (eds.), *EEP Yearbook 1994/95 including the Proceedings of the 12th EEP Conference, Poznan 30th June – 2nd July 1995*. Amsterdam, EAZA/EEP Executive Office, p. 403-404.
- NORTON, B.G., M. HUTCHINS, E.F. STEVENS and T.L. MAPLE (eds.), 1995, *Ethics on the ark: zoos, animal welfare, and wildlife conservation*. Washington and London, Smithsonian Institution Press, 330 p.
- O'BARRY, R. and K. COULBOURN, 1989, *Behind the Dolphin Smile*. Chapel Hill, Algoquin Books, 259 p.
- ÖDBERG, F.O., 1993, 'Future Research Directions'. In: Lawrence, A.B. and J.R. Rushen, (eds.), *Stereotypic Animal Behaviour. Fundamentals and Applications to Welfare*. Wallingford, CAB International, p. 173-191.
- ORMROD, S.A., 1992, *A review of Captive Polar Bears in Great Britain and Ireland*. 39p.
- 1994, 'Showboat as Ark'. *BBC Wildlife*, Vol. 12, No. 7, p. 40-44.
- PEREBOOM, T., 1994, 'De bevrijding van 14 "dansende" beren'. *De Harpij*, Vol. 13, No. 2, p. 3-9.
- PETERSON, D., 1989, *The Deluge and the Ark: a journey into primate worlds*. New York, Avon Books, 378 p.
- PETERSON, D. and J. GOODALL, 1993, *Visions of Caliban. On Chimpanzees and People*. Boston and New York, Houghton Mifflin Company, 367 p.
- POOLE, T. and G. LAW, s.d., *Inexpensive ways of improving zoo enclosures for mammals*. Potters Bar, Universities Federation for Animal Welfare (UFAW), 6 p.
- REDMOND, I., 1994, 'Status and environmental enrichment for captive elephants'. In: Spooner, N.G. and J.A. Whitear, (eds.), *Proceedings of the seventh U.K. elephant workshop. Hosted by Cricket St Thomas Wildlife Park, Somerset, 20th October 1993*. North of England Zoological Society, p. 71-100.
- RIETKERK, F. K. BROUWER and S. SMITS (eds.), 1995, *EEP Yearbook 1994/95 including the Proceedings of the 12th EEP Conference, Poznan 30th June – 2nd July 1995*. Amsterdam, EAZA/EEP Executive Office, 536 p.
- RIETKERK, F. S. SMITS, K. BROUWER and M. KURTZ (eds.), 1999, *EEP Yearbook 1997/98 including Proceedings of the 15th EAZA Conference, Berlin 2-6 September 1998*. Amsterdam, EAZA Executive Office, 594 p.
- ROWAN, A.N. (ed.), (1995), *Wildlife conservation, zoos and animal protection — A strategic analysis. A workshop held at the White Oak Conservation Center, Yulee, Florida. April 21st-24th, 1994*. 232 p.
- SATO, S. and I. TAKAGAKI, 1991, *Tongue-playing in captive giraffe*. (Text presented at the International Ethological Conference in Kyoto, Japan.)
- SCHALLER, G., 1993, *The last panda*. Chicago and London, The University of Chicago Press, 291 p.
- SCHEVE, R., 1991, 'Natuurgetrouwe huisvesting in het Noorder Dierenpark'. *De Harpij*, Vol. 10, No. 1/2, p. 18-21.

- SEAL, U.S., 1991, 'Life after extinction'. In: Gipps, J.H.W., (ed.), *Beyond Captive Breeding. Re-introducing Endangered Mammals to the Wild. The Proceedings of a Symposium held at the Zoological Society of London on the 24th and 25th November 1989*. Oxford, Clarendon Press, p. 39-55.
- SINGER, P., 1991, *Animal Liberation. Second Edition*. London, Thorsons, 320 p.
- SMOLDERS, J., 1989, 'Adoption behaviour in the bottlenose dolphin'. In: Kirtland, J., (ed.), *Proceedings of the International Marine Animal Trainers Association Conference. October 29th - November 3rd, 1989*. Baltimore, National Aquarium Baltimore, 173-181 p.
- 1990, 'Welke problemen zijn er bij het kweken van dolfijnen?'. *De Harpij*, Vol. 9, No. 3, p. 10-13.
- SPOONER, N.G. and J.A. Whitear (eds.), 1994, *Proceedings of the seventh U.K. elephant workshop. Hosted by Cricket St Thomas Wildlife Park, Somerset, 20th October 1993*. North of England Zoological Society.
- STANLEY PRICE, M.R., 1991, 'A review of mammal re-introductions, and the role of the Re-introduction Specialist Group of IUCN/SSC'. In: Gipps, J.H.W., (ed.), *Beyond Captive Breeding. Re-introducing Mammals to the Wild. The Proceedings of a Symposium held at the Zoological Society of London on 24th and 25th November 1989*. Oxford, Clarendon Press, p. 9-25.
- STANLEY PRICE, M. and I. GORDON, 1989, 'How to go wild'. *New Scientist*, 28 October, p. 56-58.
- STEENHOUDT, F., 1999a, 'Chimpansees jarenlang in isoleercel in Planckendaal'. *De Morgen*, 28th April.
- 1999b, 'Chimpanseeprobleem in zes maanden opgelost'. *De Morgen*, 30th April.
- SWANSON, T.M. and E.B. BARBIER (eds.), *Economics for the Wilds. Wildlife, Wildlands, Diversity and Development*. London, Earthscan Publications Limited, 226 p.
- TARPY, C., 1993, 'New Zoos. Taking down the bars.' *National Geographic*, Vol. 184, No. 1, p. 2-37.
- TERRY, R. P., 1989, 'A short guide to the biology of the tucuxi: lessons from captivity and the wild'. In: Kirtland, J., (ed.), *Proceedings of the International Marine Animal Trainers Association Conference. October 29th - November 3rd, 1989*. Baltimore, National Aquarium Baltimore, p. 43-59.
- THORNE, E.T. and B. OAKLEAF, 1991, 'Species rescue for captive breeding: black-footed ferret as example'. In: Gipps, J.H.W., (ed.), *Beyond Captive Breeding. Re-introducing Endangered Mammals to the Wild. The Proceedings of a Symposium held at the Zoological Society of London on 24th and 25th November 1989*. Oxford, Clarendon Press, p. 241-261.
- TRAVERS, W., 1993, 'Living free'. *Wildlife Times*, Vol. 2, No. 3, p. 9.
- TUDGE, C., 1991, *Last Animals at the Zoo. How Mass Extinction Can Be Stopped*. London, Sydney, Auckland and Johannesburg, Hutchinson Radius, 266 p.
- UFAW, 1988, *Why Zoos?* UFAW Courier No. 24. Herts, UFAW, 58 p.
- VAN DEN BERGH, W., 1969, 'Het Delphinarium'. *Zoo*, No. 4, p. 190-197.

- VAN DEN SANDE, P. and H. DE BOIS, 1990, *Preliminary report on the demographic status of the bottle-nosed dolphin, Tursiops truncatus, in the E.E.C.* Antwerp, Royal Zoological Society of Antwerp, 11 + A.48 p.
- VAN DER HELM, F., 1990, 'Frustratie, verveling en verrijking'. *De Harpij*. Vol. 9, No. 4, p. 3-7.
- VAN ELSACKER, L. and B. VAN PUIJENBROECK, s.d., 'Solidariteit in de chimpanseefamilie'. (In preparation, to be published in *Zoo* of April 2000.)
- VAN ELSACKER, L., G. CLAES, W. MELENS, K. STRUYF, H. VERVAECKE and V. WALRAVEN, 1993, 'New outdoor exhibit for a bonobo group at Planckendael: design and introduction procedures'. In: Anonymous, *Bonobo Tidings. Jubilee volume on the occasion of the 150th anniversary of the Royal Zoological Society of Antwerp*. P. 35-47.
- VAN ELSACKER, L., H. VERVAECKE, V. WALRAVEN and R.F. VERHEYEN, 1992, 'Pregnancy and periparturitional behaviour of a bonobo (*Pan paniscus*) within a multimale, multifemale social group'. In: Anonymous, *Bonobo Tidings. Jubilee volume on the occasion of the 150th anniversary of the Royal Zoological Society of Antwerp*. P. 1-15.
- VAN ELSACKER, L. and V. WALRAVEN, 1994, 'The spontaneous use of a pineapple as a recipient by a captive bonobo (*Pan paniscus*)'. *Mammalia*, Vol. 58, No. 1, p. 159-162.
- VAN ELSACKER, L., H. VERVAECKE and R.F. VERHEYEN, 1995, 'Research into Bonobos (*Pan paniscus*). The integration of Basic and Applied research in "Zoo-Biology": a Symbiotic Relationship between Zoo Management and Research'. In: Gansloßer, U., J.K. Hodges and W. Kaumanns, (eds.), *Research and Captive Propagation*. Fürth, Filander Verlag, p. 292-295.
- VAN HOOFF, J.A.R.A.M., 1991, 'Dierentuinen zijn gedragsmusea'. *De Harpij*, Vol. 10, No. 1/2, p. 5-11.
- VAN PUIJENBROECK, B., 1980, 'Nieuws over enkele zoogdieren uit onze collectie'. *Zoo*, No. 4, p. 119-122.
- 1999, 'Okapi (*Okapia johnstoni*) EEP Annual Report 1997'. In: RIETKERK, F., S. SMITS, K. BROUWER and M. KURTZ, (eds.), *EEP Yearbook 1997/98 including Proceedings of the 15th EAZA Conference, Berlin 2-6 September 1998*. Amsterdam, EAZA Executive Office, p. 269-271.
- VAN PUIJENBROECK, B. and H. DE BOIS, 1995, 'Okapi (*Okapia johnstoni*) EEP Annual Report 1994'. In: Rietkerk, F., K. Brouwer and S. Smits, (eds.), *EEP Yearbook 1994/95 including the Proceedings of the 12th EEP Conference, Poznan 30th June - 2nd July 1995*. Amsterdam, EAZA/EEP Executive Office, p. 243-245.
- VANDENBOSCH, M. and E. VAN DER STRAETEN, 1995, *Uit de hand gelopen zoo's in België. Rampgebieden voor wilde dieren*. Brussel, GAIA, 71 p.
- VIDAL, K., 1996, 'Pinxten zet fors de hakbijl in dierentuinen'. *De Morgen*, 13th August, p. 1.
- WALRAVEN, V., L. VAN ELSACKER and R.F. VERHEYEN, 1993, 'Spontaneous object manipulation in captive bonobos (*Pan paniscus*)'. In: Anonymous, *Bonobo Tidings*.

- Jubilee volume on the occasion of the 150th anniversary of the Royal Zoological Society of Antwerp*. P. 25-34.
- WARWICK, C., 1990, 'Reptilian Ethology in Captivity: Observations of Some Problems and an Evaluation of Their Aetiology'. *Applied Animal Behaviour Science*, Vol. 26, p. 1-13.
- WEMELSFELDER, F., 1989, 'Animal boredom: do animals miss what they've never known?'. In: Close, B., F. Dolisn and G. Mason, (eds.), *Animal use in education. Proceedings of the second international conference. Edinburgh, Scotland, 2nd-5th April 1989*. London, Humane Education Centre, p. 67-87.
- 1993, *Animal Boredom: towards an empirical approach of animal subjectivity*. Utrecht, Elinkwijk, 195 p.
- WEMELSFELDER, F. and T. GRIEDE, 1989, 'Well-being; theoretical background'. In: Griede, T., *Guidelines for adequate housing and care of non-human primates in zoos*. Amsterdam, Stichting Nationaal Onderzoek Dierentuinen, p. 7-15.
- WHITEN, A., J. GOODALL, W.C. MCGREW, T. NISHIDA, V. REYNOLDS, Y. SUGIYAMA, C.E.G. TUTIN, R.W. WRANGHAM and C. BOESCH, 1999, 'Cultures in chimpanzees'. *Nature*, Vol. 399, p. 682-685.
- WIEPKEMA, P.R. and J.M. KOOLHAAS, 1992, 'The emotional brain'. *Animal Welfare*, Vol. 1, p. 13-18.
- WILSON, E.O. (ed.), 1988, *Biodiversity*. Washington, National Academy Press, 521 p.
- WILSON, E.O., 1992, *The Diversity of Life*. Harmondsworth, Penguin Books, 424 p.
- WULLAERT, J., 1994, 'Op familiebezoek'. *De Standaard Magazine*, 9th September, p. 26-27.
- ZUCKERMAN, S., (1979a), 'The Rise of Zoos and Zoological Societies'. In: Zuckerman, S., (ed.), *Great Zoos of the World. Their Origins and Significance*. London, Weidenfeld and Nicholson, p. 3-26.
- (1979b), *Great Zoos of the World. Their Origins and Significance*. London, Weidenfeld and Nicholson, 231 p.