# Research in zoological gardens

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**Abstract:** Zoological gardens are important sources of biological knowledge. Zoos played an important role in the development of descriptive biological sciences in the 19th century. To date, zoos apply ethical rules that restrict the use of zoo animals to non-invasive research. Although research in the field of animal behaviour found its way to the zoo, the collaboration between zoos and universities decreased in the second half of the 20th century. Specialisation within biological sciences was one of the causes. Meanwhile, the need for research to solve practical problems in zoo management and conservation increased. The rate of decline in wildlife makes these questions urgent. Fortunately the holistic sciences of conservation biology and zoo biology are now well established and growing. Zoos are actively involved in these fields of research and provide training opportunities as well.

*Keywords:* conservation, research, training, zoos.

## Introduction

Zoological gardens were already historically important sources of biological knowledge. Living examples of numerous species in these institutions were available to 19th century scientists. Zoos therefore played an important role in the development of biological sciences, especially descriptive ones such as anatomy, morphology and taxonomy. The role of zoos in biological sciences has been continued in the 20th century, especially through enabling behavioural studies on non-domestic species (see for example Hediger 1950). The World Zoo Conservation Strategy (WZCS) emphasises the potential source of knowledge that can be gathered in zoos. The availability of this resource to the scientific community lends an intrinsic value to zoo animal collections. Their use is therefore encouraged (IUDZG/CBSG 1993).

Zoos have evolved during the last two centuries from menageries with plain bar cages to nature education centres with naturalistic exhibits and eco-displays. The overall tendency in modern zoos is to have visitors 'experience' nature. This requires that the behaviour of animals should resemble the species-specific natural behaviour as closely as possible. Consequently, animals need to be housed according to the species social system. In this, the welfare of zoo animals plays an equal role. It is clear that modern zoos offer an even greater potential of knowledge to the scientific community than their 19th century ancestors did.

Early scientists most likely had opportunities to receive biological 'material' from zoos on demand. To date, strict ethical rules apply to research on zoo animals. These rules are not only based on welfare issues but also take into account the fact that many of these animals belong to the category of endangered species. Generally, zoo management would allow only non-invasive research. This means that, for example, blood samples can often only be obtained in cases when an animal is immobilised for veterinary (health) reasons. Behavioural studies that involve manipulation of social structures that potentially can lead to disruptive events will also be subject to ethical rules. Moreover, disruption of social structure can conflict with the educational role of zoos. Research that requires extra logis-



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tics, from extra time of zoo staff (biologists, zoo keepers or veterinarians) to building extra animal holding facilities will also be subject to critical review by zoo management.

It may seem that the various constraints to carrying out research, as described above, are in contradiction to the fact that research is encouraged in the WZCS document (IUDZG/CBSG 1993). The magic word to explain this contradiction is "conservation". The state of nature and its wildlife has dramatically changed during the last century. Various species that are maintained in zoos are endangered or even extinct in the wild. This situation has resulted in a moral obligation of zoos to safeguard these species (animals). Various zoos, for example the members of the Dutch Federation of Zoos, even consider their zoo animal collections as "being given in trust from nature" (Nederlandse Vereniging van Dierentuinen 2000).

Cooperative breeding (or better: population management) programmes for endangered animal species were established by regional zoo associations in the early 1980s (see e.g. Princée 1998). The goal of these programmes is to establish zoo populations that are not dependent on imports from the wild. Furthermore, an equally important goal is to maintain zoo populations as resources for (future) reintroduction (IUCN 1987, IUDZG/CBSG 1993). It is obvious that such programmes do not aim at "simply" keeping animals alive, but require that species are maintained under conditions which "saves" their biological characteristics, from behaviour to genetics.

## Information gap

It is estimated that some 6000 species are maintained in zoos world-wide (Flesness et al. 1995). Zoos experience almost daily the enormous gap in biological information on wild populations of these species (see for example Benirschke 1996). Moreover, most information that is available generally refers to the (large) charismatic mammals or non-domestic laboratory species. This enormous gap in biological information not only affects zoos in routine long-term management, but also affects conservation of wild populations equally. Zoos, therefore, tend to facilitate research that is aimed at improving animal management (welfare, husbandry and breeding programmes) and/or conservation of wild populations (Ryder & Feistner 1995, Robinson 1998). It also means that zoos favour applied research rather than fundamental research (Kleiman 1992, Ganslosser et al. 1995).

The historic interest of universities in zoo collections declined in the second half of the 20th century, despite the increased interest from animal psychology and ethology (Hediger 1950). This trend was mainly due to the subdivision of biological science into more specialised topic-oriented research departments. For example, the field of genetics can nowadays be divided over several departments such as Evolution, Molecular genetics and Population genetics. Practical problems in zoos, however, often require an holistic approach. A question like 'Why does this species not reproduce in my zoo?' could require a multi-disciplinary approach which ranges from research on the (sub-)species status and identification, mating behaviour, social structure, nutrition, and health to inbreeding depression. It may be clear that it will be difficult to translate such a question into a research project that fits within the curriculum of one specialised department.

## Growth area

Fortunately, new activities regarding research in zoos are increasing, as indicated in contributions to scientific journals such as the International Zoo Yearbook, Zoo Biology and Conservation Biology (Ryder & Feistner 1995). For example, the Dutch Zoo Federation established Stichting Nationaal Onderzoek Dierentuinen (NOD) – or National Foundation for Research in Zoological Gardens – in 1988. An important goal of the NOD is to support the Dutch Zoo Federation zoos in long-term management of animal collections. Research projects that have been carried out by the NOD involved, for example, animal

welfare (Griede 1989), juvenile mortality (Debyser 1995), population genetics (Princée 1998) and development of software tools required to register and analyse zoo populations (Princée 1989). Brouwer (1990) and Huizinga (1999) provide an overview of research and student projects in Dutch Zoo Federation zoos.

The active research role of the NOD has changed towards facilitation and co-ordination of projects since the European Association of Zoos and Aquaria has been established. This regionalisation in research is logical as problems that need to be solved in zoo animal management and conservation are not restricted to individual zoos or groups of zoos. However, smaller groups of zoos, such as members of national zoo federations, can often catalyse research.

## Resource pool

Zoo animal collections are now, given the conservation context, even more important sources of biological knowledge than they were in the 19th century. Researchers in the fields of animal psychology and behaviour already found their way to the zoo (Hediger 1950). However, research in modern zoos is not limited to these biological sciences. Standardised computerisation of animal records have resulted in a global database system that is maintained at International Species Information System (ISIS) in Apple Valley (MN, USA). This system provides historical data through linking the individual zoo record systems, including parentages, on specimens belonging to some 6000 species which are maintained in zoos world-wide (Flesness et al. 1995). The availability of such data opens an enormous scale of possibilities for research, especially when pedigree data are required.

Basic biological data such as litter size and reproductive life-span can be extracted from this database system. Such data are often not (immediately) available on wild populations, but are required in studies that involve Population and Habitat Viability Assessment (PHVA) of endangered species. Population genetic theory can benefit from the (computerised) population data of zoos. This allows a comparison of results from theoretical models, such as simulation models, with results from empirical data in molecular genetics.

It is clear that killing zoo animals for anatomy, morphology or taxonomy, as happened 150 years ago, is not possible. However, once animals have died (of a natural cause) in a zoo, an enormous source of biological material is potentially available. Any research that requires blood or hair samples of non-domestic animals can obtain such material from zoos. Researchers may have to wait until such samples can be obtained during veterinary control. Therefore, forward planning is important to build a collection of the required samples, before the actual research starts. In this, it must be noted that the Convention on International Trade in Endangered Species (CITES) also applies to parts of (dead) specimens. Therefore, institutions need to have a permit to acquire material from species that are listed under CITES (Nederlandse Vereniging van Dierentuinen 1996).

Zoos provide opportunities to develop and test non-invasive techniques which are applicable to the wild. Increasingly endocrinological and genetic information is being extracted from non-invasively obtained samples of urine and faeces. These techniques can be developed for a wide range of species using zoo populations and can then be applied to wild populations in field studies. Vaccination of wild populations against a specific aggressive viral variant can be required to prevent total extinction of an endangered species. It is important that the effectiveness (protection) of such vaccines are tested before being applied in the wild. Such tests require blood samples that are easier to obtain from zoo animals than from wild specimens (see Schaftenaar, this volume).

## Training centre

Researchers who are planning to study animal species in the wild could gain tremendously from

Census techniques for the study of mammals in the wild, such as the identification of individuals on the basis of line pattern in zebra species, can be developed and practised in zoos. *Photograph: Jan Vermeer.*

observing 'their' species in zoos. For example, census techniques as used in assessing size of small populations, may involve identification of individuals on the basis of characteristics such as whisker spots in lions or line pattern in zebra species. Familiarity with the study animals' distinguishing features, postures and behaviour will also help in any habituation process (Williamson & Feistner, in press). It is evident that the more naturalistic the physical and social environment of the captive animal, the better its potential as a model for wild conspecifics. Training in recognising such patterns will be more efficient in a zoo than in the wild. Such capacity development results in more efficient research in terms of time, costs and even quality (better skills of researchers). Given the relatively limited financial resources that are available for conservation such training, like handling laboratory animals, should be included in the curriculum of biological and veterinary sciences.

## Conclusion

The zoo world already offers a broad array of research opportunities to scientists who are interested in conservation, but has plenty of potential to offer even more. Since conservation biology is multi-disciplinary, encompassing a blend of basic and applied sciences in biological, sociological and economic subjects, zoos can provide research opportunities to researchers and students in a wide spectrum of disciplines (Primack 1993, Feistner & Price 2000). This volume of Lutra provides some examples of research in Dutch zoos which illustrate the various topics, from genetics to veterinary science, which are part of the wider goal to protect endangered species from extinction.

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## Samenvatting


### Onderzoek in dierentuinen

Dierentuinen zijn een belangrijke bron voor het verkijgen van biologische kennis. Zij speelden een belangrijke rol in de ontwikkeling van de beschrijvende biologische vakgebieden (zoals anatomie en taxonomie) in de 19e eeuw. Tegenwoordig gelden in dierentuinen ethische regels die alleen non-invasief onderzoek toelaten. Alhoewel ethologisch onderzoek de weg naar de dierentuinen gevonden heeft, nam de samenwerking tussen dierentuinen en universiteiten in de tweede helft van de 20e eeuw af. Eén van de re-

denen hiervoor is specialisatie binnen de biologische wetenschap. In de tussentijd nam de vraag toe naar onderzoek om praktische problemen ten behoeve van collectiebeheer en natuurbehoud op te lossen. De wereldwijde achteruitgang van veel diersoorten maakt deze vragen uiterst urgent. Gelukkig zijn de holistische vakgebieden conservation-biologie en dierentuin-biologie inmiddels gevestigd en groeiend. Dierentuinen zijn actief betrokken bij deze onderzoeksgebieden en bieden tevens mogelijkheden voor training.

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