The World Zoo and Aquarium Conservation Strategy -- Chapter 3 Science and Research

Summary
This chapter presents a vision of zoos and aquariums being serious, respected scientific institutions, integrated into the research community, and making sound scientific decisions for wildlife. It argues that through their living collections, zoos and aquariums are uniquely placed to contribute to conservation-directed research. Additionally they provide a venue for researchers and visitors to meet, thus assisting with the public understanding of science and offering opportunities to raise awareness about research and its conservation implications. Zoos and aquariums can undertake research to further their own as well as others' aims (e.g. by collaboration with universities). Research categories include research into pure and applied biological science (e.g. small population biology, behaviour, nutrition, reproductive biology), in situ *conservation research (e.g. behavioural ecology, habitat survey) and research aimed at developing other roles (e.g. visitor learning, marketing, exhibit evaluation). It is argued that all research projects which contribute to conservation should be recorded and the information made broadly and easily accessible. Databases are being developed to assist with this. Zoos and aquariums can develop their research capacity by supporting specific research staff, by developing collaborative partnerships with universities, and by supporting regular publications, symposia and workshops for the presentation and discussion of scientific research. Increasing accessibility of results (to both the academic and zoo and aquarium communities) and sharing techniques and experiences maximize the benefit of research. By encouraging access to their animal collections and materials, zoos and aquariums also help develop the researchers of the future. In conclusion, there is much scope for zoos and aquariums to develop their scientific research to inform decision making within their collections as well as to contribute to field conservation.*

WORLD ASSOCIATION OF ZOOS AND AQUARIUMS

Vision: ***Zoos and aquariums are fully and actively integrated into the research community and into public consciousness and understanding of science, as serious, respected scientific institutions that make significant contributions and sound scientific decisions for wildlife worldwide.***

3.1 Introduction

The world faces a conservation crisis that is both urgent and enormous. Scientific research is vital in helping to identify and solve the challenges at hand. To be more effective in delivering conservation *in situ*, we must give priority to research that has clear and significant implications for saving populations and habitats in the wild. Only through sustained research programmes will we be successful in identifying conservation problems, prioritizing actions, implementing conservation interventions and monitoring the effects of our actions. Since the publication of the World Zoo Conservation Strategy a little over 10 years ago, research in zoos and aquariums has expanded in scope, quality and importance. Despite this surge, zoos and aquariums must do even more over the next 10 years.

Through their living collections, zoos and aquariums can make a unique contribution to conservation-directed research. No other network of institutions can provide, as a resource for study, representative populations of so diverse an array of the world's wildlife. In addition, zoos and aquariums offer a rare venue for researchers and the public to meet and communicate, providing a platform for interpreting the outcome of research and explaining the implications for conservation action.

Research is a tool to assist in doing any activity better – to learn from trials, from others' trials, and from related activities. Doing this systematically should be implicit in any zoo manager's thought processes. Research should not be regarded as an extra added to day-to-day work.

3.2 Scope of research

There are two main divisions of research in zoos and aquariums: (1) research that is aimed at new knowledge to help the institution achieve its goals, and (2) research that is undertaken in a zoo by others to achieve their own goals, without being inconsistent with those of the organization. Under the first division would fall research on husbandry, visitor preferences, educational and interpretation methods, conservation approaches etc., to a greater or lesser extent depending on a zoo's particular mission. The latter division would include assisting researchers from universities and research organizations by providing access to and or material from non-domesticated species for comparative analyses.

It is impossible to describe all of the research undertaken by zoos and aquariums. However the matrix in Table 3.1 illustrates the breadth and relationships of subject matter considered. Though there are areas of overlap, we can further divide research into the following categories:

- research in pure and applied biological science (including small population biology, animal welfare, wildlife medicine, physiology, nutrition, behaviour, reproductive biology, genetics, evolution, and taxonomy);
- *in situ* conservation research (e.g. field-based ecological and habitat research);
- research aimed at identifying and improving zoo and aquarium operations (for example research on visitor learning, the effectiveness of exhibits and programmes, marketing and messaging, membership, and development and fund-raising).

All research projects undertaken by zoos and aquariums that can contribute to conservation need to be identified and recorded. Through WAZA, regional and national associations, this information should be collated and made widely accessible, to assist institutions in broadening the

scope of their own research activities. Although at present there is no systematic database worldwide, Box 3.1 provides one example of a regional database.

In addition, the global zoo and aquarium community should monitor the emergence of new areas of science for their potential application to zoo, aquarium and wider conservation problems.

Box 3.1
The AZA Computerized Database on Zoo Research
The American Zoo and Aquarium Association (AZA) has established a computerized database called the Annual Report on Conservation and Science (ARCS). It provides an excellent model for a broader database to help track research projects worldwide. The database can be searched by key word, name of researcher, topic, country or region, name of AZA institution, conservation programme title, name of cooperating institution (including governmental agencies and nongovernmental organizations, colleges or universities, and non-member zoos and aquariums), type of research, or date.

In 2000-2001, AZA member institutions reported that they participated in over 2,230 conservation projects (1,390 *in situ* and 610 *ex situ*, 230 both) in 94 countries. They published 1,450 books, book chapters, journal articles, conference proceeding papers, posters and theses or dissertations. The publications can be searched using keywords, name of author, type of publication, institution name, or date.

3.3 Establishing priorities

Resources for research are finite and must be carefully targeted. Priority must be given to research that has clear implications for saving species, populations and habitats in the wild. Processes for establishing priorities of research should be informed by the unique strengths and facilities that zoos and aquariums are able to provide as well as by independent assessments of conservation need. Zoos and aquariums should become integrated components of national and global frameworks for conservation research, by formalizing relationships with organizations whose business it is to evaluate and determine conservation priorities and associated problems. These would include government wildlife agencies; specialist groups of IUCN - The World Conservation Union and the Species Survival Commission, particularly the Conservation Breeding Specialist Group; the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES); Migratory Species Convention (CMS); universities and research institutions, and well-established, conservation-focused nongovernment organizations.

Regional and global frameworks should be established or strengthened, to translate the recommendations of these organizations into zoo and aquarium-based research action plans. These action plans should operate at global, regional and institutional levels and should be regularly evaluated.

3.4 Databases and research material banks

Databases and research material banks are essential. They increase efficiency, and provide valuable support to researchers and animal managers working in zoos and aquariums, and to those working in the field. These resources are made more valuable by wide participation and access, and by being compatible with each other where possible.

The zoo community is now poised to create a powerful database that promises to enable zoo and aquarium researchers to access data on virtually all of the animals in some 600 institutions spread over six continents. In its final form, this database will have all of the information on parentage and medical history for every animal in our care. The master inventory will be linked to other databases that deal with such topics as nutrition and behaviour. This will make the overall database, a web-based Zoological

Table 3.1 Basic and applied research in zoos and aquariums: primary disciplines involved in studying priority topics

Topic	Anatomy and morphology	Bio-geography	Ecology	Education	Ethology	Genetics	Nutrition	Physiology	Population Biology	Social Science	Systematics and taxonomy	Veterinary medicine
Ageing	X		X		X	X	X	X	X			X
Animal Welfare	X		X		X		X	X				X
Behaviour			X		X	X	X	X				X
Biomaterial banking		X				X			X		X	X
Biotechnology	X					X	X	X				X
Contraception	X				X			X				X
Dietary studies	X		X		X	X	X	X	X		X	X
Disease	X	X	X		X	X	X	X				X
Domestication	X		X		X	X	X	X	X			
Environmental enrichment	X		X		X		X	X				
Husbandry	X		X		X	X	X	X	X			X
Identification	X				X	X		X			X	
Life history	X	X	X		X	X	X	X	X			X
Population management		X	X		X	X		X	X		X	X
Reproduction	X		X		X	X	X	X	X			X
Taxonomy	X	X			X	X		X			X	
Visitor studies				X	X					X		

Information Management System (ISIS' new ZIMS), the single most powerful research tool at our disposal (Box 3.2). The establishment of this database will be carried out over the next decade. (See also Chapter 4).

Box 3.2
ISIS and the Global Database
The International Species Information System (ISIS) was established in 1973. It is now an international non-profit membership network that is governed by an international board of trustees elected by members and that involves 613 institutions from 70 countries on six continents. Members keep and share standardized and detailed information on more than 1.8 million zoological specimens of 10,000 taxa. In the 30 years of its existence, ISIS has built a unique knowledge base and archive. It is a valuable resource for sound animal management, conservation, and basic research; it has established credibility with international regulatory conventions such as the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) and national regulatory agencies around the world.

The development of the next generation web-based Zoological Information Management System (ZIMS) was begun in 2001. ISIS' new ZIMS will be the one, global, comprehensive, accurate, real-time, web-based zoological information management system many ISIS members and others see as imperative. It will have unique lifetime animal identification numbers and a multi-institutional shared master animal record (instead of separately kept institutional records). It will automate much studbook data collection, track groups, serve aquarium needs, meet modern veterinary and epidemiological needs, and include an easy-to-query data warehouse to support management questions and research initiatives. ZIMS will be based on the first systematic review/update of our community's zoological data standards in 30 years. At the time of writing, ZIMS is partly funded through pledges by ISIS members; the ISIS Capital Campaign continues. The database will be largely or completely constructed by professional software companies.

3.5 Optimizing resources
Many zoos and aquariums now employ professional researchers. Zoo and aquarium-related scientific articles are published regularly and more and more symposia on zoo research are being organized. This trend must be maintained, supported and expanded if zoos and aquariums are to realize their full potential. In particular, zoos and aquariums must have ready access to experts in widely used disciplines; ideally, these experts would be familiar with zoos and zoo operations. Examples of collaboration are provided in Box 3.3.

Zoos and aquariums that have the resources should employ researchers. Regional and global processes should also be set in motion to build a pool of experts in important research disciplines who are an integral part of, and able to advise, the wider zoo and aquarium community. There are five main ways of creating this pool.

- WAZA and regional associations can build and support regional and global networks of zoo and aquarium researchers by providing effective, universally accessible means of communication, discussion and collaboration.
- Zoos, aquariums and/or regional associations can build strategic partnerships with relevant research institutions to enable access to specialist advice and to skilled researchers.
- Groups of zoos or aquariums can cooperate to fund one or more specialist research positions to provide services to those institutions as well as feeding into regional and global advisory networks.
- Individual zoos and aquariums can develop research specializations and employ research staff to take these forward. These staff will become part of regional and global advisory networks.
- Institutions, both individually and collectively, can support and encourage regular publications, symposia and workshops for presenting and discussing conservation directed science and research.

Box 3.3
Cooperative Research Efforts
AZA and the St. Louis Zoo
The Wildlife Contraception Center (WCC) began as the American Zoo and Aquarium Association (AZA) Contraception Advisory Group in 1989. As the role of contraception in the management of breeding programmes grew, the Advisory Group expanded its services and membership. Home to the Advisory Group's co-chairs, the St. Louis Zoo has contributed funds and resources to its operation. In 2000 the AZA selected the St. Louis Zoo as the site for the newly commissioned WCC. The WCC includes scientists, veterinarians and animal managers with research and management expertise in wildlife contraception.

The Zoological Parks Board of New South Wales and the Australian Registry of Wildlife Health
This registry was established by Dr Bill Hartley in 1985 to build a collection of information and materials relating to healthy and diseased native fauna and zoo animals. Dr Hartley began operating the registry using a highly effective logbook and card-file system; since 1998, an archival database programme has been used to enhance this already comprehensive data set. The registry is the only one of its kind in the southern hemisphere and serves as a significant national and international resource for understanding the health of Australian ecosystems. It is continually used by people in both the private and public sector, including university veterinarians and biologists, as a source of information for understanding and controlling outbreaks of disease in native fauna and zoo animals. In addition, its extensive collection of normal tissues is invaluable for people carrying out research into native fauna. Access to materials within the registry is free to people interested in the study of wildlife health.

3.6 Encouraging participation
Broad participation in science and research brings together greater awareness of methods, requirements and benefits. All areas of zoo or aquarium operations, as well as

conservation outreach programmes, will benefit from research, and all staff should be involved, either directly by participation or indirectly by being informed. Collaboration between institutions is essential.

Effectively harnessed, the global network of WAZA offers a huge research resource for universities and research institutes as well as for the zoo and aquarium community itself. Carefully designed and executed research projects that operate across zoos and aquariums, providing for the involvement of both large and small institutions, will benefit from increased sample sizes as well as opportunities to assess the influence of a wider range of variables than would otherwise be possible. This can improve quality and accuracy of results. Collaboration between zoos and aquariums on *in situ* science and research programmes can ensure better and more secure resources for those projects, as well as providing opportunities for contributions from smaller institutions, many of whom would be otherwise unable to establish and fund their own field involvement. Figure 3.1 shows a template for how cooperative efforts between zoos and aquariums, and universities and research organizations, can promote scientific studies even within institutions that lack in-house scientific staff and laboratory facilities.

Zoos and aquariums should encourage wide participation in science and research by:
• ensuring that this strategy document is provided to all new staff, as part of their induction;
• ensuring that basic experimental design, analysis and presentation of results are included in training courses tailored to zoo and aquarium staff;
• promoting opportunities for staff to work with science and research practitioners both *in situ* and *ex situ*;
• using regional collaborative networks of zoos and aquariums to increase project sample sizes and therefore the quality and accuracy of results;
• working individually and collectively, and in partnership with research institutions, to give students coordinated and supervised access to zoo and aquarium animals.

This last area can have a double benefit: helping to further institutionally, regionally and/or globally agreed research priorities, and helping to train the wildlife biologists of the future.

3.7 Funding
More funds must be made available for zoo and aquarium research. Much of the cost of research in zoos and aquariums is paid for by the institutions themselves, and the amount of money available for research varies significantly between them. Institutions can fund research through their own income, through external entities such as universities or through nature conservation bodies. Funding may take the form of subsidies, research grants or sporadic payments.

3.8 Dissemination of findings
The results of research, and developments in the application of science, must reach those involved directly in its application. This has implications for both where and how results are documented and distributed. The way that results can be made available, and in some cases

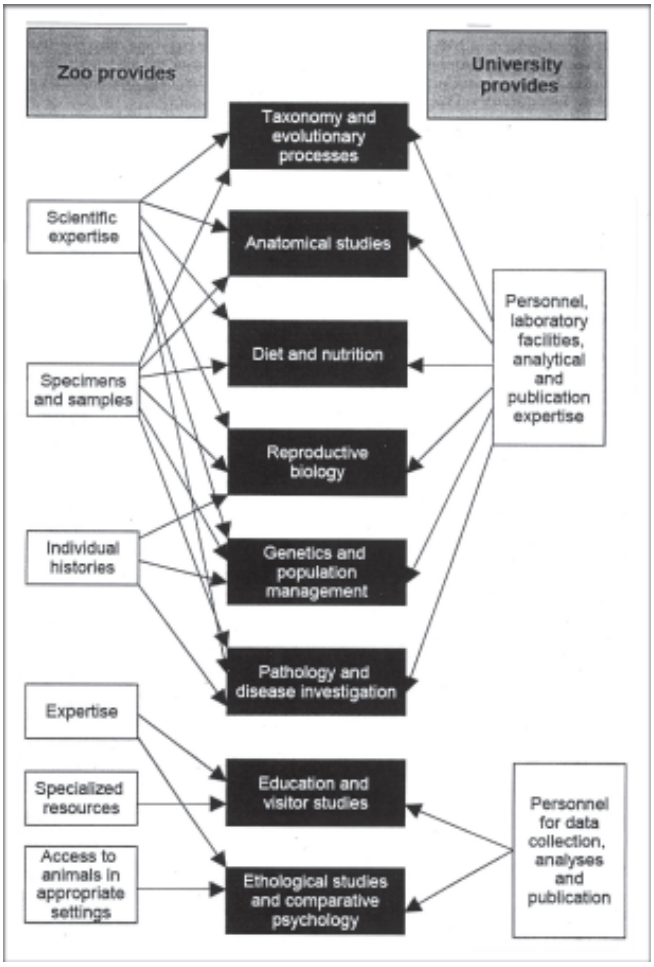

Figure 3.1 Patterns of cooperative effort between zoos, universities and reserch organizations

interpreted for those zoo and aquarium practitioners, needs careful thought.

All zoo and aquarium-supported researchers and research networks should:
• encourage the publication of their results, at least in summary form, in the journals of the zoo and aquarium profession, as well as in the literature of the appropriate scientific disciplines;
• present their work regularly at zoo and aquarium symposia, workshops, and conferences;
• make available to the wider zoo community, work of practical relevance to conservation published in specialized journals or in scientific books; this can be achieved by publishing summaries and reviews in widely read zoo literature, such as the International Zoo Yearbook, and association journals;
• make sure that all *in situ* research work and results are made available in the region where the work took place, and in the local languages.

Results that are published in scientific books and journals should also be made available to the whole zoo and aquarium community, in order to provide the information that will allow an evaluation of the practical relevance of research results. It is, however, obvious that most zoos and

aquariums do not have a large team of experts who can evaluate what are often very specialized publications in the scientific literature.

Box 3.4 (right) lists a number of publications that include zoo and aquarium research, sometimes in summary or non-technical form. This is not a complete list.

In many cases, results of research in zoos and aquariums remain in the form of internal reports and are not freely accessible as publications. These reports often include information that is of direct practical use, potentially valuable for further or similar studies or of interest to other institutions.

Box 3.4 Publications and Organizations Disseminating Zoo and Aquarium Research Findings

- Animal Conservation
- American Zoo and Aquarium Association Conference Proceedings (Annual and Regional)
- Australasian Regional Association of Zoological Parks and Aquaria (ARAZPA Newsletter, website)
- Bongo (Journal of Berlin Zoo)
- CEPA Magazine (Association CEPA, France)
- Conservation Biology
- de Harpij (Dutch/Belgian Animal Keepers Association)
- Der Zoologische Garten (Journal of WAZA and VDZ)
- Dodo (Journal of the Durrell Wildlife Conservation Trust)
- European Association of Zoos and Aquaria (EAZA Research Committee Newsletter; website)
- Federation Research Newsletter (BIAZA)
- Gazella (Journal of Prague Zoo)
- International Zoo News
- International Zoo Yearbook
- IZW – Institut für Zoo und Wildtierforschung, Berlin (Conference Proceedings other publications, website)
- Japanese Journal of Zoo and Wildlife Medicine
- Journal of Zoo and Wildlife Medicine
- Oryx: The International Journal of Conservation
- African Association of Zoological Gardens and Aquaria (PAAZAB News, website)
- Ratel (Association of British Wild Animal Keepers)
- South East Asian Zoos Association (scientific papers from conferences available on SEAZA website)
- Thylacinus (Journal of Australasian Society of Zoo Keeping)
- Wildlife Information Network
- World Association of Zoos and Aquariums (WAZA News, Magazine, Facts, Proceedings, and website)
- Zeitschrift des Kölner Zoo
- Zoo Biology
- Zoos' Print Journal (Zoo Outreach Organization)

Various specialty journals such as American Journal of Veterinary Research, Animal Behaviour, Journal of Herpetology, Journal of Mammalogy, and Reproduction also publish research conducted by zoo biologists.

3.9 Evaluation

Evaluation is critical in ensuring that research efforts remain focused on stated priorities, are adequately funded and are achieving their desired outcome. Frank and accurate appraisals should be undertaken regularly. Such appraisals will also help to identify where there are gaps in our efforts to promote the science needed for conservation, and will help identify where regional associations and others could most beneficially direct their resources.

Recommendations

The World Zoo and Aquarium Conservation Strategy (WZACS) urges all associations, regional and national, to continue to record and collate the research that their members undertake, to make that information accessible, and to monitor the emergence of new areas of science for their potential application to conservation.

The WZACS recommends that, for zoo and aquarium directed research, institutions both individually and collectively identify, prioritize and pursue their own research needs.

The WZACS calls upon the international zoo and aquarium community to promote the establishment and widespread use of databases and resource banks to assist zoo conservation efforts. In particular, it calls upon the WAZA network and the International Species Information System (ISIS) to ensure that in its final form the Zoological Information Management System (ZIMS) is valuable, accessible and affordable for all WAZA members and for members of WAZA regional and national associations. Furthermore, it calls on all regional associations to promote universal participation in ISIS' ZIMS project.

The WZACS urges all zoos and aquariums to review their resources and contribute to the greatest extent and in as many ways as possible to research initiatives, especially those directed towards conservation. In addition, they should work both independently and cooperatively to obtain external research funding. To assist this effort, WAZA and regional associations should maintain information on available funding sources and the conditions for access.

The WZACS encourages zoos and aquariums and associated research organizations to analyse and publish their research results in peer-reviewed scientific journals, and to promote their results through the compilation and circulation of bibliographies and through short reports and reviews in relevant journals, newsletters and websites.

The WZACS calls for regular discipline-related reviews of zoo research to be undertaken at institutional, regional and/or global level. These reviews should assess and document progress with their identified research priorities and evaluate and redirect those priorities as needed.