Minnesota State Zoological Board. Zoo-Related Organizations Files.

Copyright Notice:

Version 3
August 20, 2018

MINNESOTA ZOO

September 8, 2000

Mr. William V.A. Dennler
WZO Membership Committee Chairman
C/o The Toledo Zoo
P.O. Box 4010
Toledo, OH 43609

Dear Mr. Dennler:

Attached is the information you requested from me in order to assess my qualifications for WZO membership. Included is a copy of my curriculum vitae as well as the statement required of the Minnesota Zoo's governing body, the Minnesota Zoo Board, which is being copied to all members of the membership committee.

I look forward to meeting all of you in October.

Sincerely,

Lee C. Ehmke
Director / CEO

Enc.

Cc: WZO Membership Committee

Minnesota Zoological Garden 13000 Zoo Boulevard Apple Valley, Minnesota 55124 Telephone (612) 431-9200 Telecopier (612) 431-9300

LEE C. EHMKE

2900 Thomas Ave. South, #2307
Minneapolis, MN 55416
Home: 612 285-8493
Work: 952 431-9333
E-mail: lee.Ehmke@state.mn.us

Birthdate: September 10, 1957

EDUCATION:

University of California
Berkeley, California
Masters in Landscape Architecture
Awarded May 1988

University of California
Hastings College of the Law
San Francisco, California
J.D. Awarded May 1983
Admitted to California State Bar Association 1984

University of California
Berkeley, California
A.B. in Political Science
Awarded December 1979
Graduated with Honors and Distinction in Scholarship

EXPERIENCE:

ZOO ADMINISTRATION, ZOO DESIGN, ENVIRONMENTAL PLANNING

Director/Chief Executive Officer
Minnesota Zoological Garden
Apple Valley, Minnesota Zoo
August 2000 – Present
Direct all aspects of 500-acre Zoological Garden, with a current staff of 230+, animal collection of 350+ species (2300+ specimens), and annual budget of $18 million.

Director, Facilities Planning and Design
Wildlife Conservation Society - Bronx Zoo
Bronx, New York
February 2000-August 2000
Direct all aspects of Wildlife Conservation Society Exhibit Design department, including personnel management, budget development and tracking, and coordination of consultants and contractors. Provide design oversight and project management for all new construction and renovation of exhibits, public spaces and zoological management facilities.

Represent Department at Trustee presentations, staff meetings, media events, governmental forums and donor presentations.

Associate Director, Exhibition and Graphic Arts Department
July 1997-January 2000
Assistant Director, Exhibition and Graphic Arts Department
June 1994 - June 1997
Manager of Exhibitions
May 1992 - June 1994
Exhibit Designer
July 1988 - May 1992
As a member of the Bronx Zoo's Exhibition and Graphic Arts Department, involved in conceptual planning, design development, detailed design, contract documentation, design supervision and construction management for numerous projects, including:

Congo Gorilla Forest--6.5 acre, $43 million indoor/outdoor Central African Rainforest exhibition and associated educational facilities featuring okapis, mandrills, guenons, birds, fish, reptiles, and gorillas. Opened June 1999.
Aitken Seabird Colony--$3 million total reconstruction of outdoor walk-through aviary with coastal habitat featuring birds of Patagonia. Opened April 1997.
Butterfly Zone--$400,000 display and retail area exhibiting native butterflies.
World of Birds Renovation--Phased redevelopment of existing bird exhibition facility to improve animal habitats, public interpretation, and management spaces. 1993 - 1997.
Elk Range and Kodiak Bear Exhibit Renovations--City-funded reconstruction of existing habitats to improve animal environments and public interpretive areas. Completed 1993.
Baboon Reserve and African Market--5 acre complex including a mixed species habitat for gelada baboons, hyrax, ibex and waterfowl and an associated public plaza with food, gift and interpretive components. Opened 1990.
Zoo Center Elephant, Rhino and Tapir Exhibits--New outdoor habitats developed as part of renovation of historic Elephant House into Zoo Center. Opened 1989.

California State Coastal Conservancy
Oakland, California
December 1985 - June 1987
As a member of the agency's Enhancement Program, worked on all aspects of habitat restoration projects, including graphic production, staff report preparation, coordination of grant recipients, consultants and agencies, and contract/specifications preparation.

ZOOLOGICAL DESIGN CONSULTATION

El Picacho Zoo
Tegucigalpa, Honduras
2000 - Developed Concept Master Plan for Honduran National Zoo as member of Zoo Conservation Outreach Group (ZCOG) team.

Entebbe Wildlife Education Centre
Entebbe, Uganda
1991 - Co-authored Master Plan for redevelopment of Entebbe Zoo (funded by USAID).
1993/1994 - Designed and oversaw construction of new exhibits for hoofed animals, shoebill storks and chimpanzees.
1997 - Updated Master Plan.

Nairobi Safari Walk
Kenya Wildlife Service Headquarters
Nairobi, Kenya
1993/1995 - Developed Master Plan for converting Nairobi Animal Orphanage into a public education center featuring naturalistic live animal exhibits and interpretive pathways and boardwalks entering Nairobi National Park. Assisted Kenya Wildlife Service in selection and briefing of local architectural firm to develop construction documents.
1996/1997 - Assisted Kenya Wildlife Service and Symbion Architects in developing detailed plans and interpretive programs.

Kansas City Zoological Gardens
Kansas City, Missouri
1996 - Developed concept plans for proposed satellite education/ exhibition facility.

Binder Park Zoo
Battle Creek, Michigan
1994 - Member of design team preparing concept plan for 50 acre "Wilds of Africa" exhibit.

San Francisco Zoological Gardens
San Francisco, California
1986/1988 - Assisted the Portico Group Architects and Landscape Architects in site analysis, programming and production of a Master Plan for the San Francisco Zoological Society. Participated in workshops and presentations to the Society Board of Directors.

LAND USE LAW
May 1984 - January 1987
Member, California State Bar Association (currently inactive)

Acted as legal counsel for individual and organizational clients. Performed legal research and writing and made court appearances for several agencies and law firms including:
California Coastal Commission
Shute Mihaly and Weinberger
Sierra Club Legal Defense Fund

PUBLICATIONS:

Stream Restoration: A Little Goes a Long Way, **Waterfront Age,** Fall 1986
The Age of Aquaria, **Waterfront Age,** Summer 1987
Design Considerations for Baboon Reserve, **Conference Proceedings, Association of Zoological Horticulture,** 1990
Congo Gorilla Forest: It's All in the Details, **National Conference Proceedings, American Zoo and Aquarium Association (AZA),** 1999.

ACTIVITIES AND AWARDS:

Board of Advisors, Ventana Wilderness Society, Big Sur California
Professional Fellow, American Zoo and Aquarium Association
Congo Gorilla Forest: American Association of Museums (AAM) Excellence in Exhibition Award, 2000; New York City Commission for the Arts Award for Excellence in Design 1996.
Butterfly Zone: AZA Annual Exhibit Award 1997.
Baboon Reserve and African Market: AZA Annual Exhibit Award 1991. Print Casebooks Award 1991.
Zoo Center Elephant and Rhino Exhibits: AZA Significant Achievement Award, Exhibits 1990. Print Casebooks Award 1990.

MINNESOTA ZOO

WHEREAS, the World Zoo Organization (WZO) is an international group of zoological garden directors, elected on the basis of their institution's qualifications, and the Minnesota Zoo was accorded membership in 1990,

WHEREAS, the constitution of the WZO requires that a new director of a member institution be admitted after review of certain documentation, including a statement from the governing body that it will support the director's membership in the WZO involving meetings held annually in various parts of the world; and a statement that the individual is the chief executive, functioning as the official spokesperson for the organization; and

WHEREAS, the Minnesota Zoological Board is the governing authority of the Minnesota Zoological Garden,

NOW THEREFORE BE IT RESOLVED, that the Executive Committee, authorized to act on behalf of the Minnesota Zoological Board on such matters, hereby affirms its support of Lee C. Ehmke's membership in WZO as the chief executive of the Minnesota Zoo.

Approved this 7th day of September, 2000.

Peter B. Myers, Chair
Minnesota Zoological Board

Minnesota Zoological Garden 13000 Zoo Boulevard Apple Valley, Minnesota 55124 Telephone (612) 431-9200 Telecopier (612) 431-9300

The World Zoo Organisation

Founded as
International Union of Directors of Zoological Gardens (IUDZG)

"The World Zoo Organisation promotes effective stewardship of the natural world by encouraging its members to bring people close to living animals, applying and advancing conservation science and education, and setting standards of excellence in animal welfare and environmental responsibility."

August 10, 2000

Mr. Lee C. Ehmke
CEO/Director
Minnesota Zoological Garden
13000 Zoo Blvd
Apple Valley, MN 55124-8199

Dear Mr. Ehmke:

Please accept my congratulations on your appointment as the new Director of the Minnesota Zoological Garden. As the Chairman of the Membership Committee of the World Zoo Organization (W.Z.O.), I am requesting the following information for our files:

- A statement from the governing body of your institution that it will support your membership in the WZO and that you will be permitted to attend a reasonable number of meetings. These meetings are held annually in various parts of the world. Furthermore, a statement is also needed that you are the chief executive and that you function as the official spokesperson for the organization.

- Your curriculum vitae, including birth date. 9-10-51

Please send one set to each of the Committee members, including the Chairman, as listed on the enclosed sheet. The members of the Committee will determine your status and, if a simple majority feels that you meet the necessary qualifications, you will be recommended as a candidate to the Council of WZO at their next meeting.

For your interest and information, I am enclosing a copy of the WZO constitution. If you have any questions regarding WZO or the membership process, please feel free to contact me.

Sincerely,

Bill Dennler (sa)

William V.A. Dennler
Membership Committee Chairman
C/o The Toledo Zoo
P O Box 4010
Toledo, OH 43609 USA
Phone: (419) 385-5721
Fax: (419) 385-6935

WVAD/sa

Enclosures

Cc: WZO Council
WZO Membership Committee
Karen Sausman, The Living Desert

The World Zoo Organisation

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"The World Zoo Organisation promotes effective stewardship of the natural world by encouraging its members to bring people close to living animals, applying and advancing conservation science and education, and setting standards of excellence in animal welfare and environmental responsibility."

WZO MEMBERSHIP COMMITTEE

Mr. William V.A. Dennler
Membership Chairman
The Toledo Zoo
P O Box 4010
Toledo, OH 43609 USA
Phone: (419) 385-5721
Fax: (419) 385-6935
Email: efl@toledozoo.org

Mr. Gerald W. Borin
Executive Director
Columbus Zoo
9990 Riverside Dr
Box 400
Powell, OH 43065-0400 USA
Phone: (614) 645-3494
Fax: (614) 645-3542
Email: jborin@colszoo.org

Dr. Anton H. Dorrestyn
Rotterdam Zoo
Van Aerssenlaan 49
NL-3039 JE Rotterdam THE NETHERLANDS
Phone: 31-10-4431431
Fax: 31-10-4677811
Email: directie@rotterdamzoo.nl

Ms. Yolanda Matamoras
Simon Bolivar Zoo
Apdo 11594
1000 San Jose COSTA RICA
Phone: 506-233-6701
Fax: 506-223-1817
Email: fundazoo@sol.racsa.co.cr

Ms. Laura Mumaw
Director
Melbourne Zoo
P O Box 74
Parkville 3052
Victoria AUSTRALIA
Phone: 61-3-9285-9300
Fax: 61-3-9285-9339
Email: lmumaw@zoo.org.au

Dr. Christian Schmidt
Zoologischer Garten Frankfurt
Alfred Brehm-Platz 16
D-60316 Frankfurt/Main GERMANY
Phone: 49-69-212 33 727
Fax: 49-69-212 37 855

Dr. Itaru Uchida
Port of Nagoya Public Aquarium
1-3 Minato-machi, Minato-ku
Nagoya, Aichi JAPAN
Phone: 81-52-654-7130
Fax: 81-52-654-7010
Email: I-uchida@nagoya-pub-aqu.or.jp

Updated 6/17/00

MINNESOTA ZOO

WHEREAS, the World Zoo Organization (WZO) is an international group of zoological garden directors, elected on the basis of their institution's qualifications, and the Minnesota Zoo was accorded membership in 1990,

WHEREAS, the constitution of the WZO requires that a new director of a member institution be admitted after review of certain documentation, including a statement from the governing body that it will support the director's membership in the WZO involving meetings held annually in various parts of the world; and a statement that the individual is the chief executive, functioning as the official spokesperson for the organization; and

WHEREAS, the Minnesota Zoological Board is the governing authority of the Minnesota Zoological Garden,

NOW THEREFORE BE IT RESOLVED, that the Executive Committee, authorized to act on behalf of the Minnesota Zoological Board on such matters, hereby affirms its support of Lee C. Ehmke's membership in WZO as the chief executive of the Minnesota Zoo.

Approved this 7th day of September, 2000.

Peter B. Myers, Chair
Minnesota Zoological Board

Minnesota Zoological Garden 13000 Zoo Boulevard Apple Valley, Minnesota 55124 Telephone (612) 431-9200 Telecopier (612) 431-9300

WAZA

World Association of Zoos & Aquariums
58th Annual Meeting
Central America, San José, Costa Rica

November 16-20, 2003

REGISTRATION & HOTEL BOOKING FORM

PARTICIPANT

Family Name Ehmke FirstName Lee Title Mr.

Institution Minnesota Zoo Street 13000 Zoo Blvd Zip code 55124

City Apple Valley, MN Country USA

Phone 952 431-9333 Fax 952 431-9334 Email lee.ehmke@state.mn.us

ACCOMPANYING PERSON

Family Name_____ First Name_____ Title_____

REGISTRATION FEES

Payment Received	**before / on Sep 10, 2003**	**after Sep 10, 2003**
Member	☐ US $500.00	☐ US $550.00
Accompanying Person	☐ US $400.00	☐ US $450.00
Membership Status	☐ Institution ☐ Honorary	☐ Association ☐ Candidate for Election

VISAS / FLIGHT INFORMATION

Please find attached in appendix A a list of countries that do NOT need a visa to travel to Costa Rica.

Do you live in a Country that is not in the list Yes No

Passport ·#	Date of issue:	Date of expiration:	Date of birth:
Arrival date:	Time/flight No. to San Jose, Costa Rica:	Departure date:	Departure time/flight from San Jose:

HOTEL RESERVATION

Please indicate your options:

ARRIVAL DATE_____ DEPARTURE DATE_____

HOTEL FIESTA

	Single	**Double**
Fiesta Hotel (per person)	☐ $85.00	☐ $68.00

*Per night per person. The Hotel Fiesta is all inclusive. Minimum booking is three nights
Note: this is the CBSG conference site therefore all participants and their guests have to stay in this hotel.

ARRIVAL DATE_____ DEPARTURE DATE_____

	Single Room	Double room	**Deposit**
Real Intercontinental *****	☐ $124.00	☐ $124.00	☐ $124.00
Comfort Real ****	☐ $65.00	☐ $65.00	☐ $65.00
Residencias de Golf ***	☐ $60.00	☐ $60.00	☐ $60.00

The prices listed are in **US dollars,** per room, per night, including breakfast (except Hotel Residencias de Golf) and taxes.

PRE AND POST TOURS

DISCOVERY TRAVEL
COSTA RICA

Name of Tour	**Pre**	**Post**	**Number of People**
Arenal Volcano	_____	_____	_____
Monteverde	_____	_____	_____
Arenal Volcano and Monteverde	_____	_____	_____
Guanacaste	_____	_____	_____
Quepos	_____	_____	_____
Tortuguero	_____	_____	_____

*For pricing information see Pre & Post Tours section

ONE DAY TOURS (Daily)

Tour	Number of People
San Jose City Tour	_____
Poas Volcano and Sarchi	_____
Irazu Volcano, Orosi Valley and Lankaster Gardens	_____
Arenal Volcano and Tabacon Hot Springs	_____
Coffee Tour of Café Britt	_____
Great Expedition	_____
Carara National Park and Villa Lapas Hotel	_____
Rain Forest Aerial Tram	_____
Reventazon River Rafting	_____
Pacuare River Rafting	_____
Tortuga Island Cruise	_____

* For pricing information see One Day Tours section

PAYMENT

The total amount of US dollars_____ was sent by:

- ❑ **Bank transfer**
  Transfer funds to: Wachovia Bank, NA (New York International Branch)
  New York, NY, USA
  Swift: PNBPUS3NNYC
  ABA: 026005092
  Account between banks: 2000192000042
  Beneficiary Bank: Banco San Jose, S.A.
  San Jose, Costa Rica
  Swift: BSNJCRSJ
  Beneficiary Name: Viajes de Descubrimiento Costa Rica S.A.
  Benf. Account Number: 900854910

- ❑ Please charge my **credit card** in US dollars_____

MasterCard Visa American Express Other (specify)

Credit card No._____ _____ Expiration date _____

I definitely accept all booking and cancellation conditions.

_____ _____
Date Signature

Please send this registration form to: **DISCOVERY TRAVEL / Costa Rica**
to our fax (506) 290-5947

Full payment in advance is necessary for hotel confirmation. On receipt of your payment, you will be sent a confirmation of your booking. Meals and tours tickets will be handed to you at the registration desk at the congress venue.
Cancellation and refunds of confirmed services are not possible. For hotel changes and cancellations see Hotel Accommodations section.
Program changes are reserved.

file
WAZA

UNLIMITED FUN SAFARIS, INC.
P.O. Box 6313
Bloomingdale, IL 60108
1•800•323•8020
FAX 1•630•529•9769
E-Mail safari@unlimitedfun.net
Bloomingdale, IL 60108

April 29, 2003

Mr. Lee C. Ehmke
Director
Minnesota Zoological Garden
13000 Zoo Blvd.
Apple Valley, MN 55124

Dear Lee

I have had a very nice response to my invitation regarding the pre- and post-conference adventures surrounding the WAZA conference in Costa Rica in November and I appreciate the interest and hope that you will consider joining me on one of these trips.

Please find enclosed three itineraries for your consideration:

1. Pre-conference visit to Tortuguero for three days
2. Post – Option 1 – Visit to Manual Antonio & Las Cruces Biological Station
3. Option 2 – Arenal and Monte Verde Cloud Forest

Do please let me know if you will join me. I am truly looking forward to visiting this beautiful country and sharing the experience with a group of friends and colleagues. The descriptions of these exciting tours will, I hope, persuade you to extend your stay for a few days. Just complete the application form and return it to me at your early convenience and I will reserve a place for you on the trip.

Very best regards,

WAZA CONFERENCE

COSTA RICA

PRE TOUR OPTION

TORTUGUERO NATIONAL PARK

Day 1 Sunday, November 16 ***SAN JOSE***
Local hosts will welcome you at the San Jose International Airport and transfer you to the *Grano de Oro Hotel.*

Your deluxe, boutique style hotel, is situated on a quiet street just off the Paseo Colon, San Jose's main thoroughfare. Converted from a tropical Victorian mansion, the hotel maintains the warmth and comfort of a private home. Your room is furnished in tropical Victorian style, with wrought-iron beds, rich damask fabrics, fine art and handcrafted furnishings. A rooftop garden terrace with a Jacuzzi provides secluded lounging. A sanctuary in the heart of the city, the hotel is close to numerous restaurants, theaters and shopping.

Day 2 Monday, November 1 ***SAN JOSE / TORTUGUERO***
Land transfer to Freeman deck to board small boats for the ride along the inner coastal waterway to Tortuguero National Park. This park protects a unique series of natural inland waterways and is the habitat for numerous species of wildlife, including freshwater turtles, crocodiles, three-toed sloths, howler, spider and white-faced capuchin monkeys, toucans, oropendolas, parrots and brilliant blue morpho butterflies. As the boat glides quietly along, you should be on the lookout for any of these. Overnight at Pachira Lodge. D.

Day 3 Tuesday, November 18 ***TORTUGUERO***
Enjoy a full day of activities including exploration of the fascinating wildlife sanctuary, coastal areas, and waterways of the Tortuguero National Park by boat. An interesting visit is planned to the Turtle Conservation Center to learn about Tortuguero's nesting areas for the endangered green sea turtles, who return each year from July through September to mate and deposit their eggs. Cultural stops are made at the museum, town and at a local family farm for a coffee stop. B/L/D.

Day 4 Wednesday, November 19 ***TORTUGUERO / SAN JOSE***
Overland Transfer back to San José. B

* * * * *

Price per person based on double occupancy - $570 Minimum 4 persons
Price per person based on double occupancy - $499 Minimum 6 persons

The Price includes:
Transfer from International Airport to hotel
1 night at Grano de Oro Hotel, double standard room
3 days & 2 nights package at Pachira Lodge. Includes: Land and boat transportation, meals, tour through the canals, visit to the Museum and town, bilingual guide, coffee break at a local family farm, entrance to Tortuguero and taxes.
Hotel taxes
Meals as specified with taxes

POST TOURS

OPTION #1
MANUEL ANTONIO
& LAS CRUCES BIOLOGICAL STATION

Day 1 Friday, November 21 *SAN JOSE / MANUEL ANTONIO*
Transfer from San José to Manuel Antonio. Stay at Manuel Antonio for optional tours and activities such as visit Manuel Antonio National Park, rafting, canopy tour among others. Overnight at Casitas Eclipse Hotel. B

At the Casitas Eclipse, you will experience all the beauty of a true tropical paradise on Costa Rica's Pacific Coast. Enjoy the hotel's premier location and the comfortable accommodations of its distinctive Mediterranean style villas with private bath and terrace. Take a dip in the tiled pool, enjoy a day at the national park, or an evening of "fun" and food, "Tico" style. B

Day 2 Saturday, November 22 *MANUEL ANTONIO*
Stay at Manuel Antonio for optional tours and activities such as a visit to Manuel Antonio National Park, rafting, kayaking, and canopy tours, among others. Manuel Antonio is Costa Rica's most famous national park, where tropical rain forest meets dazzling white sand. You can observe some of the rarest and most fascinating animal life in the world from this park. Costa Rica is home to more than 9000 species of birds and animals. B

Day 3 Sunday, November 23 *MANUEL ANTONIO / SAN VITO –*
Las Cruces Biological Station
Transfer from Manuel Antonio to San Vito. Overnight at *Las Cruces Biological Station.* Located in the Pacific highlands of southern Costa Rica, 178 miles south of the capital city of San Jose. Discover the richest botanical collection in Central America and learn about the flora and fauna of a mid-elevation forest at this leading research station in southern Costa Rica. Exotic plants, breathtaking birds, and personalized service welcome guests to Las Cruces Biological Station. Twelve guestrooms have private baths (hot-water showers) and balconies that overlook the beautiful grounds of the Wilson Garden. Meals are served family style at set hours (6:30 am, 12:00 noon, 18:00 hrs) in a light-filled dining room that also has an outdoor terrace and views of the Talamanca Mountains. Food is plentiful and delicious, vegetarian offerings are always available, and box lunches can be arranged. Drinking water is from a mountain spring and is safe. Same-day laundry service is available. Visitors walk on well-maintained, gently sloping trails through enchanting ground filled with the richness of tropical colors and scents. Palm and bromeliad collections are outstanding, along with heliconias, gingers, bananas, bamboos, and many others. Guests enjoy the Orchid trail, tree fern hill, and the hummingbird garden. The landscaped gardens adjoin 256 hectares (633 acres) of forest, which together contain 7000 species of plants, habitat for 330 species of birds and numerous mammal species, such as sloths, peccaries, and olingos, plus 38 species of bats. Las Cruces is a favorite with birdwatchers, who may see scartlet-thighed dacnis, silver-throated tanagers, violaceous trogons, blue-headed parrots, violet sabrewing hummingbirds, and turquoise cotingas. B,L,D.

Day 4 Monday, November 24 SAN VITO – Las Cruces Biological Station
Stay at Las Cruces Biological Station for optional activities such as birdwatching tours and nature walks among others offered by the Lodge. B/L/D

Day 5 Tuesday, November 25 SAN VITO – Las Cruces Biological Station / SAN JOSE
Transfer to the Coto 47 airstrip for a charter flight from Coto 47 to San José. Upon arrival you will be transferred to the Hotel for your last night in our country. Overnight at Bougainvillea Hotel. B

Your comfortable accommodation is surrounded by 12 acres of beautiful gardens. Your tastfully decorated room includes a full range of amenities. Furnishings are made of Costa Rican hardwoods, and your terrace overlooks the beautifully landscaped gardens, or the Central Valley. Enjoy the heated pool, sauna and tennis courts. The restaurant is well known for its continental cuisine.

Day 6 Wednesday, November 26 ***SAN JOSE / USA***
Transfer to the International Airport for your flight back home.

Price per person based on double occupancy $995 – Minimum 4 persons
Price per person based on double occupancy $795 - Minimum 6 persons

The Price includes:
Ground transfer from San José to Manuel Antonio
2 nights at Casitas Eclipse Hotel, double standard room with breakfast included

Transfer from Manuel Antonio/ San Vito de Coto Brus
2 nights at Las Cruces Biological Station, double standard room with meals,
Guided walk at Las Cruces 1
Transfer from San Vito to Coto 47
Charter flight from Coto 47 to San José
Transfer from San Jose domestic airport to hotel
1 night at Bougainvillea Hotel, double standard room
Transfer out to International Airport
Hotel taxes
Meals as specified with taxes

OPTION # 2
ARENAL AND MONTEVERDE
Day 1 Friday, November 21 ***SAN JOSE / ARENAL***

Transfer from San José to Arenal area. Overnight at Arenal Paraíso Hotel.

Your hotel faces the majestic Arenal Volcano and lava flow. Individual cabin-style accommodations are surrounded by beautiful gardens. The birding here is wonderful. In the evening,you can enjoy the hot spring fed pools, or take a walk along the private trails, viewing the impressive lava flows. B

Day 2 Saturday, November 22 ***ARENAL / MONTEVERDE***
After breakfast, transfer to Monteverde by car and boat crossing the Arenal Lake. Overnight at Fonda Vela Hotel.

The lovely Fonda Vela hotel provides an opportunity to discover the beauty of the Costa Rican Highlands. Your room overlooks the forested private reserve. Lush forests, forest walks and verdant pastures will provide excellent opportunities for birding and hiking. The common areas of Fonda Vela include paintings of Paul Smith, and other local Monteverde artists, portraying many interpretations of the mysterious cloud forest with its veils of mist.

The rich diversity of plants and animals that occurs in the Monteverde Cloud Forest Preserve justifies its reputation as one of the best-known wildlife preserves in the world. This is one of the best places to find the resplendent quetzal, an astonishingly beautiful bird found only in the high altitude forests of Central America. The Monteverde Cloud Forest Reserve, laden with orchids and

bromeliads has more than 2,000 plant species native to Monteverde, including a host of wild orchids. Also, there are more than 400 species of birds and 100 species of mammals, including howler monkeys, kinkajou, two-toed sloth, prehensile-tailed porcupine, three-wattled bellbird, black guan, and emerald toucanette.

Day 3 Sunday, November 23 ***MONTEVERDE***
During your stay, enjoy an included Monteverde "Sky Walk" tour. The sky walk is a complex of five suspended bridges, platforms and paths, built within the cloud forest, that allow the observation of flora and fauna from ground level all the way up to the treetops. This system offers a great opportunity to learn about the complexity and beauty of tropical forests in a safe and comfortable manner. Overnight at Fonda Vela Hotel.

Day 4 Monday, November 24 ***MONTEVERDE***
Day at leisure to enjoy the area and take part in some optional tours and activities such as a canopy tour, visit to the Monteverde Biological Reserve, Butterfly Garden or horse-back riding, and cheese factory among others. Overnight at Fonda Vela Hotel.

Day 5 Tuesday, November 25 ***MONTEVERDE / SAN JOSE***
Transfer from Monteverde to San José for your last night in our country. Overnight at Bougainvillea Hotel.

Your comfortable accommodation is surrounded by 12 acres of beautiful gardens. Your tastfully decorated room includes a full range of amenities. Furnishings are made of Costa Rican hardwoods, and your terrace overlooks the beautifully landscaped gardens, or the Central Valley. Enjoy the heated pool, sauna and tennis courts. The restaurant is well known for its continental cuisine.

Day 6 Wednesday, November 26 ***SAN JOSE / USA***
Transfer to the International Airport for your flight back home.

Price per person based on double occupancy $525 Minimum 4 persons
Price per person based on double occupancy $465 Minimum 6 persons

The Price includes:
Transfer from San José to Arenal
1 night at Arenal Paraíso Hotel, double superior room with breakfast included
Transfer from Arenal to Monteverde
3 nights at Fonda Vela Hotel, double junior suite room
Sky Walk tour with guide and transportation
Transfer from Monteverde to San José
1 night at Bougainvillea Hotel, double standard room
Transfer out to International Airport
Hotel taxes
Meals as specified with taxes

Meal code: B = Breakfast; L = Lunch; D = Dinner

Send to attention:
Waza Conference – Costa Rica

UNLIMITED FUN SAFARIS, INC.
P.O. Box 6313
Bloomingdale, IL 60108
Telephone: 800•323•8020

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CANCELLATION POLICY:

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The massive growth in the world's human population, and the demands that it is now making on the world's rapidly diminishing natural resources, has caused a very serious crisis for the natural environment and all the wild species of animals and plants which depend on it for their survival.

This threat to the integrity of the global ecological system is also a threat to the survival of human civilisation itself. If humanity could ever respond intelligently to this situation it might be able to save itself, but I believe that we have a very special practical, and moral, responsibility to ensure the survival of the rest of life on earth.

Much can be done by establishing and managing protected areas, but there are many species whose natural habitats have already been degraded or destroyed. For these the only hope of survival is the direct stewardship and human care in zoological and botanical gardens and captive breeding centers.

I warmly welcome the World Zoo Conservation Strategy. It is a very important contribution to the whole concept of partnership between zoos and conservation organisations in the task of conserving nature and the natural environment. Zoos serve some 600 million visitors annually and their potential for making people of all ages aware of the threats to the global ecology is unlimited. I hope that the World Zoo Conservation Strategy will bring about the cooperation and partnership between zoos all over the world, that is so vital to the conservation of nature, and so help them to realise that potential.

The World Zoo Conservation Strategy

The Role of the Zoos and Aquaria of the World in Global Conservation

IUDZG—The World Zoo Organization
and
The Captive Breeding Specialist Group of IUCN/SSC

The World Zoo Conservation Strategy

The Role of the Zoos and Aquaria of the World in Global Conservation

by

IUDZG—The World Zoo Organization
and
The Captive Breeding Specialist Group of IUCN/SSC

September 1993

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Foreword

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HRH The Duke of Edinburgh
President, World-Wide Fund for Nature
September 1993

Preface

The World Zoo Conservation Strategy defines the responsibilities and opportunities of the world's zoos and aquaria towards the conservation of the variety of global wildlife. It sets out the conditions which individual zoos and aquaria and their co-operative networks must satisfy in order to realize their full potential in conservation.

The Strategy is the result of the initiative of IUDZG—The World Zoo Organization, and of the Captive Breeding Specialist Group (CBSG) of IUCN—The World Conservation Union. Many elements of the global network of zoos and aquaria contributed to the Strategy—individual professionals and institutions, regional and global associations. Thus the Strategy truly represents the views of the progressive world-wide zoo and aquarium community.

The Strategy demonstrates that zoos and aquaria are prepared and able to dedicate their potential to conservation and it demonstrates this to the wider world, to governments, to other conservation bodies and to all interested parties.

The Strategy advocates the complete integration of all zoo and aquarium conservation initiatives with those of other conservation agencies and institutions, governmentally as well as independently controlled. It cannot be stressed enough that, where there is still hope, the conservation potential of the Zoo community will be aimed primarily at supporting the conservation of natural habitats and ecosystems. Where such conservation is no longer possible the Strategy underlines the importance of within-zoo species conservation until such times as suitable habitats can be restored or created and maintained.

The World Zoo Conservation Strategy is to be regarded as a "living" document which will evolve and adapt as the needs of conservation change and as the underlying philosophies become further refined.

The release of this first edition of the World Zoo Conservation Strategy marks how far many zoos and aquaria, and their coordinating organizations, have already progressed and points the way for others to follow. It aims to increase the contribution by individual zoos and aquaria to all aspects of conservation. It aims to heighten the motivation of zoo personnel, the commitment of governing bodies, and the support of governmental agencies.

It is hoped most sincerely that all these aims will lead to a quickening and intensification of the processes for the successful conservation of the Earth's biological systems, from which humankind cannot detach itself.

If its contribution to this end is effective, the World Zoo Conservation Strategy will not have been formulated in vain.

The Editorial Board:

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Chairman of the Editorial Board
Edinburgh

Mr. Peter Karsten
President of IUDZG
Calgary

Prof. Dr. Ulysses Seal
Chairman of CBSG (IUCN/SSC)
Minneapolis

September 1993

Acknowledgments

The Editorial Board of the World Zoo Conservation Strategy is deeply indebted to Dr. Leobert E.M. de Boer (director of the National Foundation for Research in Zoological Gardens, Amsterdam) for the great amount of time, effort and thought he has given to the initial drafting of this document, as well as to guiding the process of collecting comments, suggestions, and input from a large number of zoo professionals and other experts from all parts of the world. Only through his painstaking work and dedication, aiming at the inclusion of as many as possible of the valuable suggestions received, could this document become a comprehensive, clearly structured account reflecting the views of the zoo community on its role in global conservation. In this endeavour he was continuously assisted by Dr. Koen Brouwer and Ms. Simone Smits (both of the same Foundation) and Ms. Catherine King (Royal Rotterdam Zoological and Botanical Gardens).

The various drafts of the World Zoo Conservation Strategy were carefully reviewed by the members of the Advisory Board, consisting of:

- General D. Ashari (president of PKBSI—the Indonesian Zoological Parks Association, and of SEAZA—the Association of South East Asian Zoos, Djakarta).
- Dr. Michael Brambell (director of The North of England Zoological Society, Chester).
- Mrs. Lorena Calvo (coordinator of AMAZOO—the Association of Meso-american Zoos, and director of La Aurora Zoo, National Zoo, Guatemala).
- Dr. William G. Conway (president of NYZS—the Wildlife Conservation Society).
- Mr. Frederic J. Daman (chairman of EAZA—the European Association of Zoos and Aquaria, and director of the Royal Zoological Society of Antwerp).
- Mr. John P. DeJose (councillor of ARAZPA—the Australasian Regional Association of Zoological Parks and Aquaria, chairman of ASMP—the Australian Species Management Program, and director of the Zoological Gardens of Perth).
- Mr. Bernard Harrison (director of the Singapore Zoological Gardens).
- Dr. Atsushi Komori (executive director of JAZGA—the Japanese Association of Zoological Gardens and Aquariums, Tokyo).
- Mr. Willie Labuschagne (chairman of PAAZAB—the Pan African Association of Zoos, Aquaria and Botanical Gardens, and director of the National Zoological Gardens of South Africa, Pretoria).
- Mr. Jeremy Mallinson (director of the Jersey Wildlife Preservation Trust).
- Dr. Murray A. Newman, C.M. (director emeritus of the Vancouver Aquarium).
- Prof. Dr. Gunther Nogge (chairman of the Committee of the EEP—the European Endangered Species Programme, and director of the Zoological Gardens of Cologne).
- Dr. Adauto Nunes (president of SZB—the Society of Zoological Gardens of Brazil, Sorocaba).
- Dr. George B. Rabb (chairman of IUCN's Species Survival Commission, and president of the Chicago Zoological Society, Brookfield).
- Zheng Shuling (executive director of CAZG—the Chinese Association of Zoological Gardens, Beijing).

All members of the Advisory Board are sincerely thanked for their valuable comments and suggestions and their stimulating support to the production of the Strategy.

Additional input was received from the following whose suggestions added considerably to the depth of the final document:

Chris Banks (Melbourne Zoological Gardens), Dr. Benjamin Beck (National Zoo, Washington), Dr. Brian C.R. Bertram (then director of the Wildfowl and Wetlands Trust, Slimbridge), Nathan R. Flesness (director of ISIS, the International Species Information System, Minneapolis), Dr. Thomas J. Foose (then executive officer of CBSG, Minneapolis), Dr. Hans Frädrich (director of the Zoological Garden and Aquarium of Berlin), Prof. Dr. Maarten T. Frankenhuis (director of the Zoological Gardens of Amsterdam), Mr. Paul Garland (director of Orana Park Wildlife Trust, Christchurch), Dr. Michael Hutchins (director of the Conservation and Science Centre of AAZPA, the American Association of Zoological Parks and Aquariums, Bethesda), Mr. John M. Knowles O.B.E. (vice-chairman of CBSG, the Captive Breeding Specialist Group of IUCN/SSC and director of Marwell Zoological Park, Winchester), Mr. Enric Mas (director of the Zoological Park of Barcelona), Mr. Robert J. Ollason (president of IZE, the International Association of Zoo Educators, Edinburgh), Dr. Helmut Pechlaner (director of the Zoological Garden Schönbrunn, Vienna), and Dr. Ulrich Schürer (director of the Zoological Gardens of Wuppertal).

On behalf of IUCN—The World Conservation Union, Dr. Simon Stuart (Head of the Species Survival Programme of IUCN, Gland) reviewed the draft of the World Zoo Conservation Strategy, while a number of SSC Specialist Group chairpersons and SSC regional vice chairpersons presented many valuable comments as well, notably:

Dr. Ruth Chunge (Nairobi), Dr. Simon Dowell (Liverpool), Dr. Patrick Duncan (Beauvoir-sur-Niort), Dr. S. Keith Eltringham (Cambridge), Dr. Joshua R. Ginsberg (London), Dr. David Given (Christchurch), Dr. John Hicks (Canberra), Dr. Norman W. Moore (Cambridge), Prof. Dr. Hideo Obara (Saitama), Prof. Dr. Michael Samways (Pietermaritzburg), Dr. Mark Stanley Price (Nairobi), and Dr. Michael H. Woodford (Washington).

On behalf of WWF, The World-Wide Fund for Nature, Dr. Claude Martin (director general of WWF, Gland) critically reviewed the draft of the World Zoo Conservation Strategy.

Much valuable information was further collected during personal discussions with many zoo and conservation professionals, and during discussions on subsequent drafts of the World Zoo Conservation Strategy at various meetings of IUDZG, national and regional zoo associations, and CBSG. All colleagues, named or unnamed, who actively participated in these discussions, or contributed to the production of the Strategy in any other form, are gratefully acknowledged.

Finally, on behalf of IUDZG and CBSG, the Editorial Board would like to express its sincere gratitude to the Chicago Zoological Society for its generous support toward the publication of this document.

Guide to the World Zoo Conservation Strategy

Why a World Zoo Conservation Strategy?

More than a decade after publication of the *World Conservation Strategy* by IUCN—The World Conservation Union, the importance of nature conservation and sustainable development is even more critical. The continued existence of humankind and other biological species is dependent on prompt decisions and actions that will enable the long-term coexistence of people and nature. This can only be achieved through the awareness of all nations, including all strata of their societies, their governments, other institutions and organizations. This also includes zoos and aquaria found in nearly every country of the world. Individually, many of these institutions have already demonstrated that they have an enormous potential for action in conservation. Until now, however, the magnitude of the collective potential of the global zoo and aquarium community has never realistically been expressed. The purpose of the World Zoo Conservation Strategy is to clarify the role of this community in global conservation.

Aim and Objectives

The aim of the World Zoo Conservation Strategy is to help conserve Earth's fast-disappearing wildlife and biodiversity. Its main objectives are:

1. To identify the areas in which zoos and aquaria can make a contribution and determine how zoos can support and consolidate the processes leading to nature conservation and sustainable use of natural resources.
2. To develop understanding and support for the conservation potential of zoos and aquaria, from national, supranational, and global authorities, as well as other social and political bodies and organizations.
3. To convince local zoo and aquarium authorities and conservation agencies that presently the greatest purpose to be served by the existence of these institutions is the contribution they can make to conservation, both directly and indirectly.
4. To assist zoos and aquaria in the formulation of policies wherein priorities relating to conservation are incorporated.
5. To indicate how contributions by the individual zoo and aquarium can be augmented by extending and intensifying of contacts in the global zoo and aquarium network and other conservation networks.

For Whom?

The World Zoo Conservation Strategy is primarily written for:

1. National and international policy and decision makers and local government authorities, who can exercise some degree of influence in implementing policies that will, directly or indirectly, further the contribution of zoos and aquaria to conservation. It is important that all of these policy makers and authorities have a clear understanding of the potential contributions that these institutions have to offer in regard to nature conservation.
2. Governing bodies, councils, and benefactors of zoos and aquaria, who can directly influence and support the policy course of the individual institutions. It is important that these are convinced that the very right of existence of a zoo or aquarium is in fact dependent on what contribution it makes to conservation. They can thus stimulate and support a zoo or aquarium in carrying out conservation tasks, and use their own influence to heighten the institution's standing and effectiveness.
3. Zoo and aquarium professionals, including directors, curators, educators, and animal keepers, public relations officers, and all others who are affected by policies on a daily basis through their employment. The Strategy provides them with an insight as to the conditions under which zoos and aquariums can satisfactorily carry out the conservation goals. This document should also help professionals convince those on whom their institution is dependent that the conservation way is the right way.
4. Other conservation organizations, particularly governmental agencies responsible for conservation in the wild. They will find a cooperative ally in the zoo and aquarium community.

By Whom?

The drafting of the World Zoo Conservation Strategy began as a collective initiative by IUDZG—The World Zoo Organization, and the Captive Breeding Specialist Group (CBSG) of IUCN's Species Survival Commission. In addition to these organizations, a large number of national and regional zoo and aquarium organizations from all parts of the world, representing the vast majority of the world's community of responsible zoos and aquaria, were involved in the completion of this Strategy.

Using the Document

The World Zoo Conservation Strategy includes four levels of information:

1. The sections in normal letter-type present general background information on which conclusions, statements, and recommendations of the Strategy are based.
2. The sections in *italic* letter-type present the conclusions, statements, and recommendations of the Strategy. They form the core of the document.
3. The titles of sub-chapters (1.1, 1.2, etc.) very briefly reflect the main point or conclusions of each section.
4. Additional information is presented in boxes.

This structure enables the reader to obtain a very quick overview of the Strategy's main conclusions by reading the sub-chapter headings. More detailed information on the Strategy's conclusions, statements, and recommendations is in the italic letter-type sections, while background information and additional information is in the sections printed in normal letter-type and in the boxes. An executive summary is available.

List of Acronyms

The following acronyms are used throughout the World Zoo Conservation Strategy:

ARKS	Animal Records Keeping System
CAMP	Conservation Assessment and Management Plan
CBSG	Captive Breeding Specialist Group of IUCN/SSC
CITES	Convention on International Trade in Endangered Species of Flora and Fauna
GASP	Global Animal Survival Plan
GCAP	Global Captive Action Plan

IATA	International Air Transport Association
ISIS	International Species Information System
IUCN	The World Conservation Union (International Union for the Conservation of Nature and Natural Resources)
IUDZG	The World Zoo Organization (International Union of Directors of Zoological Gardens)
IZE	International Union of Zoo Educators
IZY	International Zoo Yearbook
PHVA	Population and Habitat Viability Analysis
RCP	Regional Collection Plan
SSC	Species Survival Commission of IUCN
TAG	Taxon Advisory Group
UNEP	United Nations Environment Programme
WCMC	World Conservation Monitoring Centre
WRI	World Resources Institute
WWF	World-Wide Fund for Nature (formerly World Wildlife Fund)

All acronyms for names of regional zoo and aquarium associations are listed in Box 3; those for regional breeding programme organizations are given in Box 10.

References

There exists an abundance of scientific literature relating to the various topics discussed in the World Zoo Conservation Strategy, such as zoo and aquarium history, education, captive breeding, reintroduction, and zoo-based research. Any selection of the literally thousands of references in each of these categories would be almost arbitrary. Thus, it was decided not to include references in the Strategy. An exception was made for a number of documents and policy statements by IUCN, UNEP, WWF, and WRI:

IUCN/UNEP/WWF (1980). World Conservation Strategy: Living Resource Conservation for Sustainable Development. IUCN/UNEP/WWF, Gland: 44 pp.

IUCN (1987). The IUCN Position Statement on Translocations of Living Organisms. IUCN, Gland: 20 pp.

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IUCN/UNEP/WWF (1991). Caring for the Earth: A Strategy for Sustainable Living. IUCN/UNEP/WWF, Gland: 228 pp.

WRI/IUCN/UNEP (1992). Global Biodiversity Strategy. WRI/IUCN/UNEP, Baltimore/Gland: 244 pp.

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Chapter 1

Introduction: Zoos in a Changing World

1.1 200 Years of Modern Zoo History

Collections of living animals have been in existence since antiquity. Well known early examples include those of Chinese emperors, Aztec emperors and Egyptian pharaohs. The tradition of gathering and holding impressive animal collections by royal and noble families continued into the 18th century in different parts of the world.

The history of the present day zoo began in the late 18th and early 19th century with the formation of zoos in Vienna (1752), Paris (1793) and London (1826). These were quickly followed by numerous other institutions in Europe, North America, and many other parts of the world. These zoos were established primarily because of interest, in part scientific, of zoological society members in exotic animal life. Originally, many of them were not open to the general public, just serving the interest of members. As zoos became more available to the public it became apparent that the general population also had a strong interest in them. Exotic animals obviously had a great power of attraction. This, together with an increase in free time and better transportation, resulted in the establishment of even more zoos, both private and public, since the beginning of this century.

1.2 Great Diversity Developed Among Zoos

A great variation among zoos has developed since the 19th century. Examples include:

1. *Variation in size.* There is considerable variation amongst the different features of zoos: the

Box 1
Variation in Animal Collections and Names of Zoos

The institutions collectively designated as "zoos" in the World Zoo Conservation Strategy greatly vary with respect to the types of animal collections they exhibit. This is often closely related to the specific character of the "zoo" in question and the name the institution carries:

- General collections, consisting of representatives of all the vertebrate classes: mammals, birds, reptiles, amphibians, and fish (sometimes a few invertebrates are also exhibited). A taxonomic overview of the most important families within the vertebrate classes may also be exhibited. The taxonomic selection is somewhat dependent on the size of the zoo and the interest of zoo personnel; consequently the animal species included in a collection vary widely. Institutions with such collections generally call themselves "zoos".
- Specialized bird collections, which may or may not have sub-specialities, such as parrots or waterfowl. Such zoos go by a variety of names (e.g. birdparks, waterfowl parks, wild fowl reserves, parrot gardens).
- Specialized reptile collections which may or may not be combined with amphibians (e.g. reptile zoos, vivaria).
- Specialized fish collections in aquaria. Often these include aquatic and terrestrial invertebrates and amphibians. Many aquaria also have small collections of birds, reptiles, and even mammals.
- Specialized insect collections (e.g. insectaria, insect zoos, butterfly houses).
- Specialized marine mammal collections. These may or may not be combined with other marine animals, such as fish or (sea-)birds (e.g. dolphinaria, sea mammal parks, marine zoos).
- Specialized collections of other mammal groups (e.g. primate zoos).
- Specialized zoos featuring a particular biotope (e.g. desert zoos).

It should be noted that the more specialized the collection, the more likely it is that the word "zoo" will not be included in its name.

There can also be variation in collections based on the geographic origins of the animals exhibited, including:

- General collections, with animals from all or many areas of the world, including the country in which the zoo is found.
- Specialized collections featuring specific parts of the world (e.g. South America, Africa).
- Specialized collections exhibiting only native fauna, and no exotic animals.

number of animals in collections varies from a few dozen animals to several thousand, the number of personnel ranges between 5 and over 500, and the actual sizes of zoos between 0.1 and 500 hectares. Annual budgets of zoos vary between U.S. $10,000 and U.S. $60,000,000 while the number of visitors is between 10,000 and over 7,000,000 per year.

2. *Variation in composition of the collection.* The range of animals in a zoo's collection may be selected according to a particular type of animal or a particular geographic location of the animals' origins, or it may be a general collection (see Box 1). Some zoos also display other types of collections; plant collections play an important role in many zoos. Art, ethnography, natural history, geology, and other typical museum collections may also be prominently displayed. In several cases the zoo is incorporated within a museum or public park.
3. *Variation in character and themes of the collection.* There are different concepts in exhibition that play an important role in establishing the character of a zoo. There are the traditional city zoos, countryside zoos, safari parks, and zoos integrated with nature parks. The arrangement of the collection (systematic, geographic, habitats/ecosystems, or other themes) plays an important role in establishing the character of a collection.
4. *Variation in the financial and management background.* There are zoos that fall directly under the managerial responsibility of national, provincial, or city governments; zoos that are managed through societies or foundations; and those with private company structures. Some zoos are financially self-reliant, while others receive operational subsidies from various government bodies.
5. *Variation in objectives.* These range from highly idealistic (cultural, educational, scientific, conservational) to purely commercial. In between lie several variations. Although many zoos may be run as commercial enterprises, often all of the profits are invested into conservation goals!

Additionally, a great amount of variation is determined by outside factors through the city, country, or continent in which the zoo is found. This naturally leads to variation in scientific and cultural backgrounds, but also to great diversity in standards for keeping animals. Furthermore, there are countries with official standards for zoos (zoo licensing laws) and countries in which these are non-existent. Some zoos fall under the administrative responsibility of recreation authorities, others under education, culture, forestry, or agriculture authorities. Some zoos may be under the jurisdiction of more than one of these, while some may not be under any.

1.3 The Word "Zoo" Indicates Institutions That Manage and Exhibit Collections of Wild Animals

Because of the enormous variation among the institutions that are known as "zoos", there is no concise definition for this word. However, there are in fact two characteristics that all such institutions have in common:

1. *Zoos possess and manage collections that primarily consist of wild (non-domesticated) animals, of one or more species, that are housed so that they are easier to see and to study than in nature.*
2. *Zoos display at least a portion of this collection to the public for at least a significant part of the year, if not throughout the year.*

Regardless of the composition of their collections, and their official name (zoo, aquarium, insectarium, etc.), all these zoological institutions will be known by the general term "zoo" within the framework of the World Zoo Conservation Strategy.

The fact that all zoos exhibit living specimens of wild animal species underscores the difference between zoos and most museums or other cultural and recreational institutions, and is what gives zoos their own unique character. This character is clearly valued by much of the general public, as, despite yearly fluctuations in numbers, zoos from all areas of the world are still

visited by many millions of people. Living animals that are not easily seen in the wild, either because they live in other parts of the world or because they live secretive lives, hold a great fascination for many people throughout the world. It is this power of attraction, which indicates a general interest in elements of wild nature, that provides zoos with a great potential to make a significant contribution to conservation.

The fact that zoos hold and exhibit live wild animals plays a crucial role in achieving the fundamental objectives of the World Zoo Conservation Strategy.

1.4 Great Changes Have Taken Place in the World Since the Establishment of the First Public Zoos

A number of changes have taken place in the world since the founding of the early public zoos in the first half of the 19th century set the course of modern zoo history. These changes, which had great consequences in terms of goals, policies, and management of zoos, include:

1. *Changes in human society.* Across the Earth—especially in the more affluent countries of the world—an increasing amount of free time is being enjoyed by an increasing proportion of the population. The rate of this change varies greatly according to location, but nevertheless is occurring. Thus, a great diversity of places and ways to spend free time has developed. This has resulted in zoos losing what was essentially a monopoly as a mass recreational facility. During the first decades of the 1900s zoos were one of the few places in which the general public could relax, while in recent years the competition in this area has become enormous. Simultaneously, zoos have lost their monopoly as the one institution in which the general population can become acquainted with exotic animals. Improved education, films, television, videos, popular magazines, books, and encyclopedias now offer—in contrast with earlier times—opportunities to become knowledgeable about animals originating from outside the immediate surroundings.
2. *Changes in the biological sciences.* The publication in 1858 of the *Origin of Species*, Charles Darwin's general theory of evolution by natural selection, transformed biological science. Existing zoos were thereby given, and provided, a new interest. Biological science, which had concentrated on comparative anatomy and classification, moved ahead fast and produced many new or resurrected disciplines such as ethology, ecology, genetics, and molecular biology. The increase in knowledge and techniques has been enormous.
3. *Changes in nature.* An exponential increase in the destruction of nature has taken place during modern zoo history, most particularly recognized during the last twenty years. Widescale pollution, human overpopulation, tremendous increases in energy use, and careless, unplanned use of natural resources and natural areas have led to the disappearance of numerous species, while an even greater number have been brought to the brink of extinction. Entire biomes are endangered; biodiversity in many areas is under so much pressure that the continued existence of complete ecosystems—particularly the ones with great biological diversity—is in jeopardy.

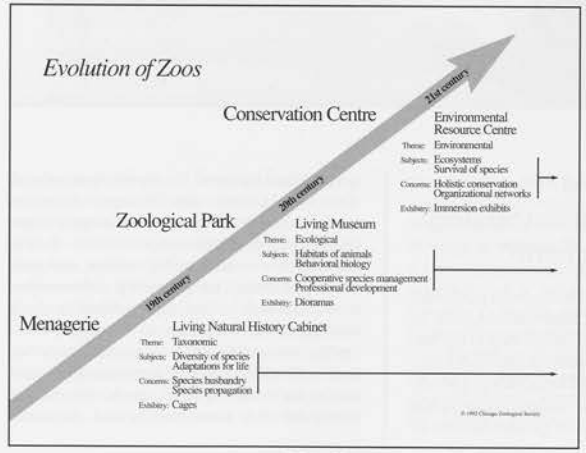
1.5 The Consequences for Zoos: A Demand for an Increased Interlinking with the Fate of Nature

The great consequences for zoos regarding the above three categories of changes are understandable:

1. *Because of the number and diversity of leisure possibilities for spending free time available to the general public, zoos must now, more than ever, make evident their unique character.* The attractive power of zoos lies in the fact that they display live, exotic animals, and can simultaneously acquaint the visitor with many facets of nature and its conservation. In order to continue to play their part, zoos must hold their position in the free time spending market, and so they must emphasize these characteristics rather than obscure them among unrelated attractions.
2. *Zoos must respond to the increased general knowledge that the public now has regarding animals and nature by providing educational opportunities and informative materials with more substance. The strides made in biological knowledge also require that more thought be given to informative materials and educational facilities in zoos.*

   A vast number of biological principles that were completely or practically unknown 100 years ago can now be explained using zoo animals as examples.
3. *The enormous growth in the biological sciences has also led to increasingly stringent requirements for husbandry and housing of zoo animals.* The "trial and error" period of animal keeping is largely over, and the care of zoo animals has become a scientific endeavour requiring considerable attention from zoos. A better informed public is also one more critical of housing and care of animals; zoos must continually strive for improvement in these areas, even if this results in higher costs of maintenance per animal.
4. *The growing threats to nature necessitate the careful and coordinated management of zoo animal collections.* Intensively managed captive populations of threatened species can play an important role in conservation efforts for their conspecifics in the wild.
5. *The threats now disrupting natural systems require that zoos make as great a contribution as possible to protecting holistic life systems and to conservation education.* All aspects of the work of today's zoo must endorse and emphasize the nature conservation message.

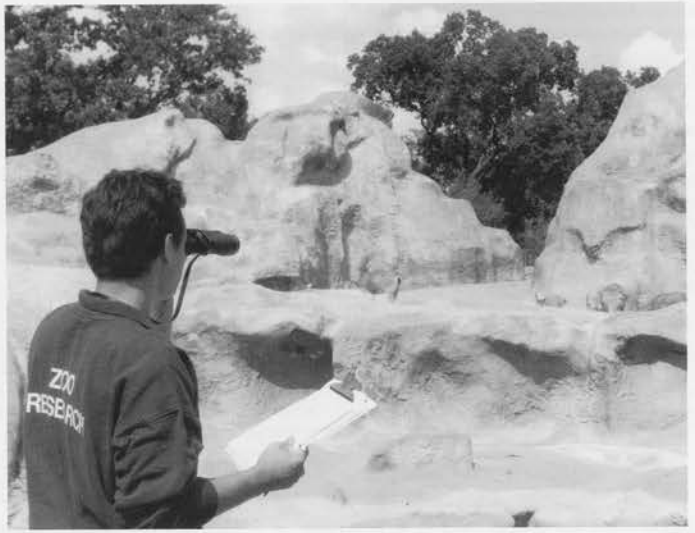
All of the above discussed changes and consequences necessitate a re-evaluation of the position of zoos in present day society, and a re-appraisal of their objectives, tasks, and the execution of these. The interlinking of zoos with the fate of nature plays a central role in these re-evaluations. For both ideological and practical reasons, nature conservation must be the central theme of zoos in the future. Many progressive zoos have already incorporated aspects of nature conservation into their policies and plans, and therefore have set outstanding examples. The time has come for the zoo community as a whole to come forward and clarify its commitment to conservation. This is precisely the purpose of the World Zoo Conservation Strategy.



Zoos are rapidly evolving to serve in multiple ways as conservation centres. The horizontal arrows indicate that professional capacities of concern and subjects communicated to the public in earlier phases of zoo development are now vital services to conservation. As conservation centres, zoos must additionally address sustainable relationships of humankind and nature, explain the values of ecosystems and the necessity of conserving biological diversity, practise the conservation ethic throughout zoo operations, and cooperate within the world zoo network and with other conservation organizations. Immersion exhibits involve zoo visitors in the environmental circumstances of the animals, and such experiences are conducive to favourable reception by visitors of strong conservation messages.

Chapter 2

The World Conservation Strategy and Zoos



2.1 The World Conservation Strategy: "Caring for the Earth"

The *World Conservation Strategy* was published by IUCN—The World Conservation Union, in 1980. This document—a crucial step in the history of global nature conservation—came into existence with the help of hundreds of governmental institutions and nature conservation organizations, and an even greater number of scientists and advisers. The most important goal of the World Conservation Strategy was "to persuade the nations of the world to adopt ecologically sound development practices". It was intended to convince policy makers, and provided guidelines for preparing conservation strategies at national and supranational levels. It tried to correct two general misconceptions: firstly, it showed that conservation not only has to do with wildlife and wilderness, but is essential for the well-being of all people. Secondly, it illustrated that conservation and economic development should not be considered as being inherently incompatible. Further economic development is fully dependent on long-term conservation of living and non-living natural resources, while optimal human well-being is only possible if humankind finds a balance in which it can live in harmony with nature.

A number of countries have developed conservation strategies since 1980 based on the World Conservation Strategy. IUCN has also further developed scientific and strategic elements for diverse documents in which prime importance is given to the conservation of biological diversity. Much attention has been given to the concept of sustainable development. The Strategy of 1980 was thus not the conclusion of a philosophical/scientific development, but the beginning of a continuing process directed towards guidance and interpretation of the future of humankind and nature.

The process started in 1980 with the release of the World Conservation Strategy, *which resulted in the publication of* Caring for the Earth *in 1991, and the* Global Biodiversity Strategy *and the*

Box 2
Statements on the Role of Zoos in Conservation

Action 4.2 of "Caring for the Earth" (1991) calls to "Use a combination of in situ* *and* ex situ* *conservation to maintain species and genetic resources".* It states that "Zoological gardens have a key role in maintaining *ex situ* populations of animals". It calls on the zoo world to develop a "Zoological Gardens Conservation Strategy".

Action 69 of the "Global Biodiversity Strategy" (1992) calls to "Strengthen the conservation role of zoological parks". It states that "A conservation strategy should be developed to help set priorities and strengthen collaboration among zoos. The starting point would be identifying collective institutional strengths and weaknesses and evaluating national and international opportunities for further contributions to conservation".

Action 71 of the "Global Biodiversity Strategy" calls to "Strengthen collaboration among off-site and on-site conservation institutions, partly to enlarge the role of off-site facilities in species reintroduction, habitat restoration, and habitat rehabilitation". It states that "Zoos also continue to play an important role in reestablishing naturally extinct species in the wild". And it recognizes that "Aquaria are increasingly becoming involved in on-site conservation as well".

Article 9 of the "Convention on Biological Diversity" (1992) states that: "Each Contracting Party shall..., predominantly for the purpose of complementing in situ *measures (a) Adopt measures for* ex situ *conservation...; (b) Establish and maintain facilities for* ex situ *conservation of and research on plants, animals, and micro-organisms...; (c) Adopt measures for the recovery and rehabilitation of threatened species and for their reintroduction...; (d) Regulate and manage collection of biological resources from natural habitats for* ex situ *conservation purposes...; and (e) Cooperate in providing financial and other support for* ex situ *conservation..."* IUCN's "Guide to the Convention on Biological Diversity" (1993) remarks that "the main institutions for *ex situ* conservation of wild animal species are zoos and aquaria."

*A definition of *in situ* and *ex situ* is provided in Chapter 2.3.

Convention on Biological Diversity *in 1992. All these documents call for globally coordinated efforts to improve human well-being and to stop the destruction of the earth's capacity to support life. These documents also specifically call upon the world's zoos and aquaria to play an active role in conservation efforts (Box 2).*

2.2 Loss of Biological Diversity and Biomass Should Be Halted by Furthering Conservation, Scientific Knowledge, and Public Awareness

A period of growing awareness concerning the enormous risks of uncontrolled use of natural resources and debasement of the biosphere arose after the publication of the World Conservation Strategy. Never before has the importance of clean air, unpolluted water, and undegraded land, and the conservation of living nature received so much political and media attention as in the last few years. Nevertheless, human society is so complex, and the world's problems so numerous, that despite the growth in consciousness and concern regarding nature and the environment, it has not been possible to halt many of the destructive processes.

The tide of destruction must turn. The positive developments that were brought about through publication of the "World Conservation Strategy" and its successor "Caring for the Earth" must be vigorously sustained and furthered, because the destruction clearly goes on. All available forces must be mobilized and organized to realize:

1. *An increase in effective conservation of the biosphere, ecosystems, and their constituent elements.*
2. *An increase in scientific knowledge regarding how to conserve and sustainably use nature.*
3. *An increase in political and public awareness with respect to the necessity of finding a new harmony between human society and nature.*

As part of the global conservation community, the zoos of the world can make significant contributions in all three of these areas. The potential role of zoos in each of these areas is briefly summarized below, while this role is more elaborately discussed in the following chapters of the World Zoo Conservation Strategy.

2.3 Zoos Have a Key Role to Play in Species Conservation

Conservation must be directed towards the conservation of biological diversity and biomass. Conservation of biological diversity means the conservation of species and of biological communities. Many species cannot survive away from the communities in which they are naturally found. Conservation of diversity means the conservation of sufficient numbers of individuals of species, and sufficiently large areas for the maintenance of their natural communities and ecological structures.

Zoos keep animals outside of their natural living area (*ex situ*), and in this situation can contribute to the conservation of individual animal species. This course is now generally accepted by most conservation circles as often being the only one available for *critically* endangered species. Furthermore, there is an ongoing development in techniques for integrated conservation of *in situ* (wild) and *ex situ* populations, in which relict populations of the species concerned profit from numerical support by *ex situ* populations. Consideration for this type of conservation action often goes to flagship species, i.e., those species whose conservation will have an important influence on conservation of the entire biotope.

Zoo collections include—more for historical reasons than any other—many individuals of species that are now severely threatened in the wild, and even in a number of cases those which have entirely disappeared. Zoos, therefore, hold living material that is of crucial importance to the continued existence of these species. These captive specimens represent an important part of the

remaining gene pool, which with well planned and coordinated breeding management, may be used in the future to supplement wild populations, or to build entirely new populations.

The World Zoo Conservation Strategy emphasizes that good zoos responsibly manage their often irreplaceable living material to ensure that it most effectively contributes to the conservation of biological diversity. Moreover, zoos should increase their potential to maintain and manage populations of endangered species, and should, in a coordinated effort, select additional species that are in need of the support of ex situ *conservation. Simultaneously,* ex situ *conservation efforts of zoos should be carried out in a relationship as close as possible to* in situ *conservation of these species and their habitats.*

2.4 Zoos Are Important Contributors to Scientific Knowledge

A scientific understanding of nature and all of its component parts is necessary for effective conservation. Information is also needed to establish how natural resources can be best used by humankind without irretrievably depleting them and thereby disturbing the natural balance. Although our understanding of the living and non-living world has increased exponentially over the last 100 years, much knowledge needed to solve the countless problems caused through present day development by humankind is still lacking.

Zoos have contributed to the increase in biological knowledge since historic times. Their animal collections have provided valuable study material for biological researchers, and still form an unlimited source of information that is of fundamental importance in gaining more insight into the biology of countless species. This insight is essential in the effective conservation of species and of their natural biotopes. Zoos also played, and continue to play an important role in the development of technologies that are directly relevant to *in situ* wildlife conservation. In addition, the collective potential of a large number of people that work in zoos who have experience and knowledge of endangered animals and of associated biological fields offers an important contribution to conservation.

The World Zoo Conservation Strategy concludes that responsible zoos put their unique potential to optimal use for conservation objectives by initiating their own research programmes, or by making their facilities available for benign conservation research undertaken by universities and nature protection organizations and other similar bodies. Good zoos also make all the knowledge they have accumulated available in support of nature conservation.

2.5 Zoos Have Great Potential to Increase Public and Political Awareness

The attainment of goals set by the World Conservation Strategy is dependent on the political consciousness of decision makers at all levels: these goals can never be realized in time if the necessity for nature conservation and for sustainable development is not appropriately advanced at each level of decision making. Consciousness at these levels can in part be achieved directly, through presentation of reports, statements of strategy and so forth, and in part achieved indirectly, through the influence of public opinion. In any case, influence through education is especially important because every world citizen is in reality affected by whatever new balance is struck between humankind and the environment.

Political decisions are generally made in urban areas. Public opinion in such areas is formed by a population used to living at a high density with little contact with nature. The likelihood that nature and nature conservation would have a genuine priority in public opinions and decisions in urban areas is quite small, as nature always seems remote. Zoos are pre-eminently suited to bring nature closer. The majority of the zoos are situated in urban areas, and the people nearby are the ones that zoos are most likely to attract. By exhibiting live animals, the

ambassadors of their conspecifics in the wild, zoos can have an influence over the opinion of all sections of the public, provided that they do so in a humane and constructive manner. Zoos can make sure through educational facilities and informative programmes that distant and often apparently irrelevant nature plays a role in the thinking of city dwellers, and consequently in political decisions. An extra dimension is added in that not only animals from the same country can be seen, but also animals from far-off lands, emphasizing the importance of conservation on a worldwide scale.

The opportunity to see, hear, and even smell animals eating, sleeping, playing, climbing, walking, flying, or swimming, and to observe their responses to their surroundings and to other animals, gives the visitor a unique chance to develop a respect for these creatures and to understand the importance of their continued existence on this earth.

The World Zoo Conservation Strategy emphasizes that it is the task of zoos to use all their opportunities to heighten public and political awareness; to build on the public's amazement and curiosity about the impressive, strange, and sometimes alarming animals in zoos so that people come to respect them, and to make clear the interdependence that exists between these animals, other species in their natural habitats, and the habitats themselves; to demonstrate that this interdependence is formed by an entire network of elements in a fragile balance so easily disturbed by human activities. Finally, it is the task of zoos to show that the future of present life on this earth, including humankind, is highly dependent on maintaining these networks or ecosystems. Living animals comprise an incomparable introduction to the whole conservation story, and zoos should use all educational, informative, and communicative tools to optimize the telling of this story.

2.6 The Mission Statements of Zoos Should Express Their Conservation Aims

The above mentioned considerations lead to the following objectives for all zoos that wish to make a substantial contribution to conservation.

Conservation Objectives for Zoos

Zoos should support the objectives of the World Conservation Strategy *(and related documents) by:*

1. *Actively supporting, through coordinated programmes, the conservation of populations of endangered species* in situ *and* ex situ *and, through these, to the conservation of natural habitats, biotopes, and ecosystems.*
2. *Offering support and facilities in order to increase scientific knowledge that will benefit conservation, and lending support to the conservation community by making available relevant knowledge and experience.*
3. *Promoting an increase of public and political awareness of the necessity for conservation, natural resource sustainability, and the creation of a new equilibrium between people and nature.*

This statement of objectives is the core of the World Zoo Conservation Strategy. All responsible zoos will play a role in reaching the goals of the World Zoo Conservation Strategy. They should formulate their own mission statements and conservation objectives, using the above statement as a starting point.

Chapter 3

The Global Zoo Network

3.1 Over 1,000 Organized Zoos Worldwide

As a consequence of the lack of a concise definition of what a zoo is, and the enormous diversity of type and size of zoos, it is also difficult to say exactly how many zoos there are in the world. If all institutions under a broad definition of zoos (i.e., exhibiting wild, or non-domestic, animals to the public) are included, then the total number of zoos in the world may be well over 10,000.

The number of zoos worldwide participating in national, regional, or international zoo federations is approximately 1,000 (Box 3). These federated zoos are considered the core of the zoo world, as they have demonstrated that they wish to work in a structured manner with other zoos towards a joint future. Perhaps a few hundred more zoos located in regions or countries without as yet officially formed organizations might also be included in this group. The World Zoo Conservation Strategy is primarily directed at these organized, and potentially organizable, zoos. This is principally because such zoos can become the

Box 3
Distribution of Zoos and Zoo Associations Over the World

The numbers of zoos in the above world map include zoos that are organized in national and/or regional zoo associations, plus zoos that are believed to be potential members of such associations in the near future. National and regional zoo associations include:

North America
- National association in: Canada
- Regional association for the subcontinent: AAZPA (American Association of Zoological Parks and Aquariums)

Latin America
- National associations in: Brazil, Colombia, Venezuela, Mexico, Guatemala
- Regional association for Meso America: AMAZOO (Association of Meso American Zoos)

Europe
- National associations in: United Kingdom, Sweden, Denmark, Netherlands, Germany (plus Austria and Switzerland), Czechia/Slovakia, Poland, Italy, France, Spain, Hungary
- Regional association for all of Europe: EAZA (European Association of Zoos and Aquaria)

Africa
- Regional association: PAAZAB (Pan African Association of Zoological Gardens, Aquariums and Botanic Gardens)

Asia
- National associations in: Pakistan, India, China, Japan, Indonesia, Thailand
- Regional association for South East Asia: SEAZA (South East Asian Zoo Association)

Australasia
- Regional association for Australia and New Zealand: ARAZPA (Australasian Regional Association of Zoological Parks and Aquaria)

basis for further developments within the framework of this strategy, using existing networks for communication and cooperation that can be extended in the future. Those that are not as yet included in this group still represent a potential that should be drawn into the network whenever possible.

There is an irregular pattern of distribution of zoos throughout the world. Historically the greatest densities of zoos are found in the moderate climatic areas of richer countries: in North America, West and Central Europe, Japan, and Australasia. It is noticeable that these are not only the richer areas, but also areas with rather high population densities, traditional worldwide trade relations, and relatively low biological diversity. The number of zoos is significantly lower in developing countries, which generally have high to very high biological diversity and increasingly high human population density. Nonetheless, the number of recorded zoos in some countries and regions, for example China, India, southeast Asia, Central America, and South America is certainly not insignificant. A striking exception is tropical Africa, where relatively few zoos are recorded.

3.2 600,000,000 Zoo Visitors Globally

The total number of people visiting zoos annually is even more difficult to estimate than the total number of zoos, and can only realistically be estimated for the above mentioned organized zoos. Nevertheless, these estimates provide important indications of the general potential conservation role of zoos. A number of examples of zoo attendance recorded by regional and national zoo organizations and by the International Zoo Yearbook are given in Box 4. These indicate, for instance, that in North America roughly 100 million people, almost 50% of the total population, visit zoos on an annual basis. Similar numbers are found in Europe and Japan. Zoos in urban areas in other parts of the world also have impressive visitor attendances.

Worldwide, over 1,000 zoos in organized networks annually receive at least 600 million visitors, this being over 10% of the entire world population. The World Zoo Conservation Strategy notes that these exceptionally high figures are unequalled by any other group of public, conservation-oriented institutions.

3.3 The Global Zoo Network Consists of Geographical and Disciplinary Organizations

Geographical Networks: A Step System of National, Regional, and Global Associations (see also Box 3)

Besides bilateral contacts between two or more individual zoos, the most common network structure is organized at the *national level*. A few traditional zoo countries have had national zoo federations for more than a century, while most of the other such organizations have arisen in the last few decades. Currently there are some 25 countries with a national zoo federation, and the number is still growing. There is considerable variation in size of national federations, and also much variability in the measure of internal organization and cooperation. Some federations are loosely associated for the purpose of general interest and promotion. Others are strictly structured, having stringent entrance requirements and practising intensive cooperation in all sorts of relevant areas, for example education, maintenance and management of collections, research, promotion of conservation objectives, etc.

Zoo associations organized at the *supranational (regional) level* also exist in different parts of the world, including North America, Europe, Australasia, southeast Asia, Central America, and Africa. A supranational organization may be formed in the South American region in the foreseeable future. Once these expected developments are completed there will be supranational organizations on all continents. Although it is understandable that the whole of Asia will not be organized into one huge association, there are already four strong associations in that region: the above mentioned southeast Asian association and the large Chinese, Japanese, and Indian national federations.

At the *global level* there is one single zoo organization: IUDZG—The World Zoo Organization. In addition to membership by individual institutions, national and supranational zoo associations are also represented in IUDZG.

In conclusion, a sort of non-hierarchial step system of zoo organizations exists with national associations as a basis, supranational associations at the regional level, and the global organization of IUDZG at the apex.

Disciplinary Networks: Based on Specific Functions

In addition to geographic networks, zoos also have other organizational and communication networks that are not dependent on geographic location of institutions, but rather on specific functions and subdisciplines of the zoo profession. Some of the best established of these are:

- *The International Union of Zoo Educators (IZE)*, a global network specifically dealing with the educational aims of zoos.
- *National and supranational organizations of zoo veterinarians*, dealing with veterinary aspects. These may or may not have formal bonds with national and supranational zoo organizations.
- *National and supranational organizations of zoo keepers*, dealing with a wide variety of animal husbandry considerations. Generally these do not have formal bonds with national and supranational zoo organizations, but usually work in close harmony with them.
- *Organizations focusing on the long term conservation of animal populations*, dealing with breeding programmes for endangered species. These are more and more frequently organized at regional, supranational levels, and are often part of, or are at least undertaken in close cooperation with, supranational zoo organizations.
- *The International Species Information System (ISIS)*, a global network of zoos and related institutions contributing information to a global computerized database on wild animals in captivity (see Chapters 5 and 6 for further details).

3.4 The Global Zoo Network is Unique and Has Great Relevance to Conservation Aims

Though the global network described above is not perfect from an organizational standpoint, it is an exceptional system with great potential for conservation effort. Comprising more than 1,000 institutions throughout the world, apart from the IUCN/SSC network, it is perhaps the largest conservation network. Though communication is incomplete in parts of the network, there is an overall willingness and a trend to improve communication, to exchange information, and to fine-tune policies and goals. An additional, special feature of the global zoo network, and one of great consequence to conservation, is that each of the participating institutions (the individual zoos) not only functions within the zoo network, but also has its own, sometimes global, network. Through its own specific educational programmes, its research and/or its contributions to conservation of endangered species the individual zoo addresses many conservation issues. Other local institutions and organizations that focus only on local, national, and regional conservation issues do not have the advantage of the more global perspective and network support. This advantage constitutes a unique and potentially enormously powerful conservation tool.

There are a number of clear-cut advantages to networking, structuring, and organizing zoos at a global level for conservation-oriented potentials and objectives:

1. *It enhances the degree of exchange between zoos in various parts of the world. This is considered to be of the utmost importance in all areas of zoo conservation: education, research, and the maintenance and conservation of zoo animal collections. The individual zoo is a relatively small institution*

Box 4
Zoo Visitor Numbers

The annual numbers of zoo visits below are given per continent. Data are obtained from the International Zoo Yearbook (1990) and national and regional zoo associations. The data are largely restricted to the organized and potentially organizable zoos listed in Box 3.

Europe (including European part of former Soviet Union)		125 million
North America		106 million
Latin America		
Mexico	20	
Meso America	5	
Brazil	11	
Remaining Latin America	25	
Total Latin America		61 million
Asia		
Japan	88	
China	140	
Rest of Asia	80	
Total Asia		308 million
Africa		
Northern Africa	10	
Subsaharan Africa	5	
Total Africa		15 million
Australia, New Zealand		6 million
Estimated World Total		**619 million**

Some examples of zoo visitation in typically urban areas in proportion to the area population (some areas include more than one zoo or aquarium):

	Area Population	**Zoo Visitors**
Chicago (3)	7.8 million	7.3 million
Boston (2)	2.7 million	1.3 million
Beijing	5.0 million	10.0 million
Johannesburg	1.7 million	0.6 million
Amsterdam	0.8 million	1.0 million
Berlin (2)	5.0 million	5.0 million
Guatemala City	2.5 million	1.0 million
Djakarta	7.0 million	2.0 million
Tokyo (3)	10.0 million	9.5 million
Melbourne	2.0 million	1.1 million
São Paulo	11.0 million	1.0 million

which copes with a set of very complex problems. Thus, the greater the degree to which the zoos share knowledge and experience, the better they can reach their objectives.

2. *It is crucial to the conservation of zoo animal collections generally, and of populations of endangered animal species specifically.*
3. *It facilitates strategic planning with respect to all conservation oriented tasks and coordination of conservation programmes.*
4. *It provides a basis for improved cooperation with local, national, and international conservation bodies and authorities, including non-governmental organizations; this is of great importance to the acceptance, coordination, and funding of conservation-oriented projects initiated by zoos.*

The World Zoo Conservation Strategy concludes that global networking, structuring, and organization will contribute to the overall effectiveness of zoos' conservation activities, and will further develop potentials not realized without such backing.

3.5 The Global Zoo Network Should Be Further Developed

Based on the above conclusion, the World Zoo Conservation Strategy calls for a further strengthening and expansion of the global zoo network. There are a number of points that are related to this:

1. *Organization of national and supranational zoo federations should be stimulated in the countries and regions where they do not yet exist.*
2. *National and regional associations which have not yet done so, should develop accreditation systems establishing a code of ethics and standards that members and candidate members must comply with. Standards should include guidelines regarding, amongst others, physiological and psychological well-being of zoo animals. Such accreditation systems have proven to be powerful tools in raising standards and conservation efforts of zoos. Whenever feasible such standards should be established by zoo organizations in close relationship with the development of national or supranational legislation to regulate zoos. The standards relating to such legislation, whilst having a regard for cultural and other differences, should provide minimum standards practical on a global basis.*
3. *In order to enable the broadest possible representation, individual zoos and national and supranational zoo associations should become members of IUDZG—The World Zoo Organization.*
4. *Disciplinary networks, i.e., those for educators, veterinarians, breeding programmes, keepers, etc., should be closely associated with the national, supranational, and global zoo organization systems.*
5. *The entire system must be directed towards increasing the contribution of zoos to conservation. That is to say, not only increasing the individual contribution of zoos that participate in the network, but also the number of institutions making contributions. Policies should involve all institutions in the undertaking of conservation goals.*
6. *The whole system, at all levels, must strengthen ties with other conservation organizations.*
7. *Cross connections should be strengthened at all levels of the network, and special focus should be on connections between institutions and organizations in developed countries and those in developing parts of the world. Strengthening of these connections heightens the feeling that unity is of essential importance in conservation at the global level. Attention, however, should be given to the avoidance of overlapping and duplication of conservation efforts. This requires development of global coordination by IUDZG.*

Chapter 4

Education

4.1 Education: An Essential Conservation Task of Zoos

Awareness of the necessity to establish a new balance between human development and the earth's biological system is basic to conservation. This awareness should grow in all countries of the world and in all layers of human society, and should be the basis for political decisions. Education—explaining the irreplaceable value of the entire biological system of our planet and all of its constituent components—is a most powerful tool in raising the level of general awareness. Thus, the future of humankind greatly depends on extensive and effective environmental and conservation education. The zoos of the world have a unique role to play in the global efforts to educate people.

The World Zoo Conservation Strategy notes that zoos reach hundreds of millions of people all over the world. The great majority of these people live in urban areas and have little or no contact with nature. They come to the zoo because in one way or another they have an interest in animals. Whatever the level of interest may be, it offers an opportunity for education. This, together with the mass character of zoo visitation and the fact that this is occurring in almost every country on every continent throughout the

world, gives zoos an unequalled potential to heighten public and political awareness of the importance of nature conservation. Additionally, zoos are visited by a significant number of people from rural areas. Zoo education may also have great impact on this section of the public, especially in developing countries, where these people in their day-to-day life are dealing closely with the use of living natural resources.

4.2 Living Animals: The Basis of Zoo Education

Zoos attract many more visitors than most natural history museums, botanical gardens, and other comparable nature-oriented institutions. The reason for this is that zoos exhibit living, wild animals. Living animals clearly have an enormous power of attraction. The impression made on the visitor through the close physical proximity of living animals cannot be replaced by photos, films, videos, books, or encyclopedia.

The World Zoo Conservation Strategy emphasizes that living animals form the basis for education in zoos, however important the manner of exhibition and the addition of other collection components (for example plants and non-living materials) may be. The zoo visitor's susceptibility to educational information exists because of the attraction to the living animal, and animal collections are therefore the foundation of the enormous potential educational value of zoos.

4.3 Informal Education Reaches Widely Varied Target Groups

Dependent on their size and location, zoos receive between a few tens of thousands to several million visitors annually. Despite some local variation, it can be safely said that generally a considerable proportion of the area population visits a zoo in their region annually or at least every few years (see also Box 4 in Chapter 3). Additionally, zoos are not only visited by *many* people, but also by a public that is *broad in composition*. Research on visitation in many zoos has indicated that many diverse groups of people visit zoos, including groups of all ages and most educational levels. Groups of different social, ethnic, and cultural backgrounds visit zoos. The diversity in visitors that is so characteristic of zoos is seldom seen in other cultural, educational, or nature-oriented institutions. This gives an extra dimension to the education potential of zoos.

The World Zoo Conservation Strategy emphasizes that the total zoo public forms the target group for informal education in or by the zoo (that is, education which is not connected with the curricula of formal educational institutions). It would not be valuable for zoo education to be directed towards only one or a few groups within this total. It is a misconception that education must primarily be meant for children. Certainly children form an important part of the zoo public, and children indeed form a vital target group for education, but other groups deserve just as much attention in the total zoo education plan. Education—particularly conservation education—should reach every category of zoo visitors.

In addition to target groups within the zoo, zoos can also reach target groups outside of the zoo, including those groups that are relatively under-represented among the visitors. These groups can be reached through zoo outreach programmes and through media presentations, such as press releases and radio and television coverage of conservation oriented activities, and thus also belong to the target group for zoo education.

4.4 Education is Compatible with Recreation

People all over the world go to zoos during their free time and of their own free will. They could just as easily be doing something else, and in the richer parts of the world they are competitively invited to spend that free time in other recreational facilities. That they choose zoos over these many other possibilities demonstrates an interest in seeing the living, wild animals that zoos exhibit, and this indicates nothing else than an interest in learning about these creatures. People visiting zoos are open to receiving information about animals, which means they are susceptible to education. They may be willing to be educated of their own free will in their own leisure time.

The World Zoo Conservation Strategy states that the zoo, in all of its details, is intrinsically educational, and education is an indispensable part of the zoo's attractiveness. Improving education in fact increases the zoo's attractiveness. Improved education and increased financial investments in education can go hand-in-hand with increased visitor attendance, provided that technically and in its content zoo education meets the public's requirements and the standards for the time and place.

The Strategy emphasizes that this also means that investing in zoo educational projects is always of value to governments and nature conservation organizations. They should take advantage of the unique facilities offered by zoos rather than investing in and setting up new structures for their educational and conservation objectives.

4.5 Formal Education: Intensive Education for Selected Groups

Formal zoo education comprises education that is conducted in the framework of the educational curriculum of educational institutions (schools, colleges, etc.) within or in relationship to the zoo. Most, if not all zoos are regularly visited by numerous classes from a variety of educational institutions. Several thousand classes visiting a particular zoo per year is not exceptional. These classes receive structured educational tours and lessons focusing around selected themes as part of their formal teaching programme at the zoo. Many zoos have developed professional programmes and facilities for this type of zoo education. Formal zoo education has a number of clear-cut advantages, such as:

1. Formal education groups are unique in as much they visit the zoo *specifically* for education purposes.
2. The inclusion of zoo-based biological and conservation education in formal teaching curricula stresses the importance of taking into account wild animals, their habitats, and ecosystems as part of the learning process that should lead to the insight that life on earth forms one great system.
3. The direct contact between students and zoo teachers enables an intensive and interactive manner of education.
4. Regular contact with classes from a variety of educational institutions and their professional teachers ensures that the zoo staff is informed about developments and levels of formal education in their country's society. This is important, as designing zoo educational programmes with the needs of institutional teachers and authorities in mind will serve two purposes: the programmes designed are more likely to be used, and the zoo is more likely to receive support from the authorities. Additionally, it enhances professionalization of the zoo's educational techniques and programmes.

A wide range of educational institutions/levels can be considered target groups for formal zoo education, ranging from pre-school, primary, and secondary schools to institutions for special education up to and including university levels. In practice, however, most efforts focus on the preschool, primary, and secondary levels. Special attention is often given to institutions for the education of mentally and physically handicapped people, for which zoos constitute excellent educational media.

The World Zoo Conservation Strategy concludes that formal education serves an important function for the educational institutions involved, their students and their teaching staff, as well as for the zoos themselves. Thus, involvement in formal education should be stimulated and increased whenever possible. As many of the various levels of educa-

tion should be included as possible. Educational institutions should be stimulated to pay visits to the zoo and to make these part of their teaching curricula. Universities and other degree awarding institutions should be encouraged to include the role of zoos in wildlife conservation as part of the curriculum of relevant courses in biology, ecology, environmental sciences, and other related disciplines. Zoo teaching programmes should be developed in consultation with institutional teachers. The zoo should take optimal advantage of the knowledge and experience gained from formal education to make its entire educational programme as professional as possible.

4.6 Education Should Be Conducted at Various Levels

The basic level of zoo education is simply the display of living animals. This is the only means by which countless people will ever come into contact with living, wild animals and in a compelling manner become acquainted with elements pertaining to nature conservation. Zoos make a huge contribution to the success of education campaigns undertaken by governmental and nature conservation organizations (such as the World-Wide Fund for Nature) simply by providing the opportunity for contact with examples that these organizations are concerned with.

Other levels and styles of interpretation, directed towards different age groups, and groups with different levels of knowledge and interest, must be built onto this important substrate. It is obvious that entirely different approaches are required for children of primary school age and for adults. It is obvious that those who have little biological knowledge must be approached in a way different from that for a student of biology, and that the enthusiastic aquarium/terrarium hobbyist will expect different information from a zoo than will the average visitor.

The World Zoo Conservation Strategy emphasizes that, despite the great diversity of the zoo public, it is possible to present educational information and facilities that are suitable to each and every one of the various visitor categories. How these levels should be arranged and approached is a question of knowledge about, and insight into, the composition and motivation of the public that visits that zoo, as well as a matter of creativity, inventiveness, and belief in the importance of the conservation message that zoos must deliver.

4.7 A Variety of Biological Themes Can Be Explained by Zoo Education

The exhibition of animals in zoos provides the foundation for an educational approach to a wide variety of biological themes. Morphology, geographical distribution, and anatomical and physiological adaptations to the environment are obvious educational subjects in the zoo. These lead directly to explanations of adaptive evolution and the history of life. Feeding, behaviour, and social interactions are good introductions in zoo education, offering starting points for explanations about ecology, behavioural adaptations, sociobiology, reproductive behaviour, natural balances within biotopes, and a number of other biological principles. The variety of animal species within the zoo can be used to illustrate the overall importance of biological diversity. Even more complex biological disciplines, such as molecular biology, genetics, and population dynamics, can be explained using zoo animal exhibits.

The World Zoo Conservation Strategy concludes that the array of educational possibilities offered by zoo animals is inexhaustible, and certainly does not stop with topics in classical biology. The more complex the biological principles are, however, the more educational skill is required to explain them, and the more subtle and sophisticated interpretations of the animal and, where appropriate, the design of the exhibits must be to serve the educational goals.

4.8 Conservation Education: A Specially Important Element of Zoo Education

All of the biological information available about zoo animals, including their physical appearance and natural behaviour, that can be given to the public is of basic importance to conservation education. However, the importance of nature conservation must also be expressed more directly in zoo education. The most basic form of conservation education includes informing the public about the threatened status of the species of zoo animals, and other animals which are taxonomically and/or geographically related. The factors causing the declines can be indicated, and the importance of removal of these factors emphasized. In a more elaborate approach to conservation education, the exhibited animal can be used to symbolize the interactions and complex balances in nature, and how these have evolved over millions of years to their present forms. The ease with which this evolutionary process can be disrupted through the carelessness of humans, and what fatal consequences this will have, both to humankind and nature, can also be pointed out. That it is of the greatest urgency to halt this disruption of natural systems naturally follows. It is important to indicate how these processes can be stopped in the countries of origin of the animals used as the examples, but it is equally important to indicate how changes in the attitudes of people within the zoos' own countries can contribute to conservation in other parts of the world.

The World Zoo Conservation Strategy emphasizes that conservation education in zoos can make it clear that nature conservation affects everyone, and that everyone needs to be concerned with it. It can demonstrate that the future of human beings and nature is only ensured if the whole of humankind can live in a new harmony with nature. Furthermore, every person has both a community and individual responsibility to help achieve this on a local, national, and global scale. In addition to approaching conservation issues from the view of biological sciences, zoos should also develop educational programmes that elucidate the socio-economic backgrounds of the threats to nature. Through this, they should play an active role in increasing the public and political awareness of the connections between consumption and lifestyle and the survival of species and biological systems.

4.9 The Global Zoo Network Plays an Important Role in Zoo Education

Zoos are well suited to emphasizing the importance of a world perspective in nature conservation because they usually show animals that live in diverse biotopes and ecosystems in different parts of the world. The interdependence between the whole of nature and all of its components can be explained through zoo animals. The destruction of nature in places far away from the zoo visitor will eventually also have an influence on him or her. Thus the conservation of that far away nature is just as important to this person as is the conservation of nature within his or her own country.

The World Zoo Conservation Strategy recognizes that it is of great value that zoos worldwide are carrying the same message, and have a network that is demonstrating the importance of nature conservation on a global scale. This can also be made clear to the visitor. For example, if a visitor looking at an orang-utan realizes that at the same time other people, in countless other zoos, are also looking at orang-utans, and that all of these people are being informed about the importance of the rainforest in which the orang-utan lives, then a feeling of collective responsibility can be awakened. If it is also clearly explained to the visitor that zoos and nature protection organizations in the orang-utan's native countries are fighting for this animal's conservation by telling the native population the same story, then the visitor can understand that the fight to conserve the orang-utan and the trop-

Box 5

An Overview of Some Educational Techniques Used by Zoos

Many zoos have accumulated great experience in education over the past decades, and have developed many effective educational techniques:

- Since the living animal that is exhibited forms the introductory point, the choice of the species used is of primary concern. The animal chosen must best illustrate the formulated educational objective.
- Exhibit design, the furnishing of enclosures, and the composition of the animal group (of one or more species) within the individual enclosure are important parts of the educational effect. These must help convey the desired educational information about the species.
- The arrangement of the enclosures in relation to aspects such as how they fit into different themes, the atmosphere (as through plantings) and the furnishing of the associated public area also convey educational information.
- Illusions created through the previous three techniques form an educational technique. The feeling of being in a tropical rainforest or desert, and encountering various elements associated with these surroundings, has a great educational value.
- Legible signs with the names and ranges of the relevant animals still form an unmistakable educational element. Expanding the written information with appropriate sectioning into educational levels, adding illustrations and giving it an attractive form, heightens the educational value considerably, and provides the opportunity to present information on a number of biological features.
- Exhibition of diverse special effects (prepared plant and animal materials, inorganic components, models, artificial products, and so on) in various ways (e.g. glass cases, permanent mini-exhibitions) can add strong support to educational themes.
- Interactive education (touching materials, searching games, question-and-answer systems, locomotion experiences) can be very effective.
- Audio-visual tools (slide shows, films, videos, audio guides) can present extra information that the visitor may not have the opportunity to learn from observing the living animal.

- Computer simulations and interactive, computerized audio-visual tools (e.g. videodiscs, interactive compact discs) constitute ever growing important media forms that offer great possibilities in zoo education.
- Keeper talks, guided tours, and other forms of verbal information transfer (including information booths, active approach to the public by guides, peeks behind the scenes, etc.), though rather labour intensive, are very effective.
- Animal shows can have a valuable educational appeal, though they should demonstrate natural animal characteristics and specializations and should not denigrate the animals' integrity.
- Children's zoos and classroom facilities offer good possibilities for activities specifically directed towards children.
- Volunteer organizations greatly increase the potential of education programmes involving direct contact with the public.
- Special educational opportunities for physically and mentally handicapped people always receive much use.
- Temporary special exhibitions form an important addition to the permanent educational facilities.
- Partnership programmes—cooperative educational programmes with zoos and nature reserves in other parts of the world—have been demonstrated to be very useful educational projects.
- Zoo guides, zoo maps, brochures, and other printed materials potentially constitute invaluable educational materials.
- Bookshops in the zoo and the sale of selected souvenirs may have educational value.
- Zoo publications, press and broadcasting interviews, and documentaries carry the educational message outside the zoo.

ical rainforests in which it lives does not have to be a futile battle. If the visitor just understands that he or she is not the only one receiving this message, but also countless other fellow human beings on this earth, then he or she will more rapidly be prepared to make a personal contribution to nature conservation, however large or small, in attitude, personal commitment, financial support, and so on. The global zoo network can make an important contribution to the birth of a worldwide conscience network by promoting this understanding.

An effective way to underline and further develop the worldwide nature of zoo education is formed by partnerships between individual zoos or zoo associations in one part of the world and counterparts in other regions, often involving institutions or organizations in developed countries on the one hand, and those in developing countries on the other. Such partnerships create firstly a feeling of solidarity, not only with respect to the institutions and their staffs, but also (if properly used in educational programmes) with respect to the zoos' visitors. This feeling of solidarity and joint responsibility for the future of nature is of utmost importance to conservation. Secondly, zoo partnership programmes often aim at increasing the level and effectiveness of zoo education in developing countries. This is highly significant, as especially in these parts of the world conservation and environmental education by zoos reaches many millions of people who otherwise receive comparatively little information on the intrinsic values of nature for human survival. Therefore, such programmes should be stimulated and extended as much as possible.

4.10 Research and Conservation of Endangered Species Can Be Excellent Educational Themes

The two other zoo conservation tasks—research and the associated conservation of populations of endangered animal species—can play an important role in conservation education. Both can demonstrate clearly to the public that no cost or effort should be spared to conserve elements of nature. Both also underscore the importance of worldwide cooperation, because so much of the research relevant to the conservation of threatened species rests on intensive involvement of many zoos and other institutions in different parts of the world.

The World Zoo Conservation Strategy emphasizes that the results of scientific study and conservation of populations, if properly used in education within and outside the zoo, e.g., via publications and public relations, can have a far greater impact than just the conservation of the relevant species. They can contribute to a speeding up of the awareness process, and through this to the conservation of whole biotopes that would otherwise be lost. Zoos must emphasize both of these other two conservation tasks in their educational expression.

4.11 Zoos Use a Variety of Educational Techniques

Zoo education is no longer just the display of animals, accompanied by signs with their correct names and areas of origin, and regular conducting of school class tours. Important though this is, zoo education has grown into a valuable profession in which insight into psychology, didactics, communication, and information transfer are of essential importance, and in which a whole scale of techniques and technical tools play an important role. Just a few of the most important aspects are shown in Box 5.

The World Zoo Conservation Strategy emphasizes that the use of a wide variety of educational techniques, facilities, and considerations, together with knowledge, creativity, and inventiveness can make zoos highly interesting, attractive, and effective places for environmental, conservation, and holistic life system education.

4.12 Good Education Requires a Number of Conditions

Many leading zoos have already clearly demonstrated their educational potential. The World Zoo Conservation Strategy emphasizes that, in order for this potential to be most effectively realized, a number of conditions must be fulfilled:

1. *It is important for each zoo to obtain information on the composition of its public. Which groups (with respect to age, educational, social, cultural, and ethnic background) do visit the zoo, which groups are under-represented, and why do the groups come or stay away? What are their needs, which may have little to do with conservation, that the zoo experience must satisfy? This knowledge is important for choosing the most effective educational strategies, as well as for finding ways to reach potential new visitors.*
2. *Improved results may be obtained by the use of surveys and other evaluation techniques before and after establishing educational displays and programmes and building animal exhibits.*
3. *Zoo education requires a professional approach. This may mean that a well-staffed education department should be established. However, education is not only dependent on professional zoo educators; every person working in a zoo must be involved in education one way or another. Even casual, informal visitor contact can promote an educational agenda. If the entire zoo staff is indeed education-minded and time is made available, then even small zoos which cannot afford to set up an education department can still be excellent educational institutions. This is especially true if volunteer educators or docents can be recruited and trained.*
4. *Effective education is enhanced when the entire zoo (not only the zoo staff, but also the composition of the animal collection, the arrangement of animal enclosures, their design, visitor routing, etc.) is related to a clear-cut educational plan. Certainly each new or renovated exhibit should have an educational purpose, preferably identified in advance. Individual zoos may, however, have different concepts and diverse educational approaches. Diversity among zoos may in itself add considerably to the educational value of the entire zoo world. Nevertheless, within an individual zoo a plan should be developed, and its expression should be clearly evident to the zoo visitors. An educational "house style" is very important to help ensure that the experiences offered to a zoo visitor consisently convey a conservation ethic.*
5. *Effective education requires maintenance, husbandry, and behavioural management techniques that guarantee the well-being of zoo animals. Animals that appear to suffer from physical and/or psychological restraint are counterproductive to education and will spoil the conservation message. Conversely, people are attracted to animals that are enabled to explore and display a full variety of natural behaviour. People are thereby more apt to care and act positively on behalf of conservation of the relevant species and their environments.*
6. *Zoo education has almost become an independent discipline. An enormous amount of knowledge on how to educate the public and on the many methods that have proven to be effective under various circumstances has been accumulated. Zoos should be willing to share their educational experiences with colleague institutions. Educational wheels need not be re-invented over and over again if zoos freely exchange information and materials, and if they are willing to help their colleagues in other parts of the world to establish programmes and facilities that are suitable to the local situation. Extension of such cooperation could rapidly increase the effectiveness of education within the global zoo network.*

Chapter 5

Zoo Animal Collections and Their Conservation

5.1 Numbers: 1,000,000 Animals in Zoos

Zoo collections vary greatly in size, depending on their specializations and approach to exhibition. Large zoos with general collections may have several thousand animals of several hundred species of higher vertebrates. Specialized fish and bird collections may have a similar number of individual animals and species, while other specialist collections are often considerably smaller. Primate zoos might hold a maximum of 200 animals of 20 species. Marine mammal facilities at most usually only have a few animals of three or four species.

It is difficult to estimate the total number of animal individuals and species in zoos. Many zoos annually publish detailed animal inventory lists presenting the exact numbers of specimens in their collections. A number of examples are given in Box 6. Over 400 of the world's zoos register their collections in ISIS, the International Species Information System, while some 800 zoos include special data on their collection in the International Zoo Yearbook (IZY) on an annual basis. The total number of living animals listed in the database of ISIS as of 31 December 1992 was 180,000. Given the fact that—in spite of the rapid increase of the number of zoos participating in the ISIS registration over the recent years—less than 40% of the organized zoos send

Box 6
Numbers of Individual Animals in Zoos

The table below gives estimated numbers of individuals of mammals, birds, reptiles, and amphibians in zoos on all continents. The estimates are based on information from ISIS (International Species Information System), IZY (International Zoo Yearbook), and extrapolations to cover all zoos indicated in Box 3. Invertebrates are not included. Fish are not registered in ISIS; their numbers are estimates based on the collections of a number of aquariums. [For amphibians and fish only those individuals beyond larval and very young stages are included.]

	Mammals	Birds	Reptiles	Amphibians	Fish
North America	60,000	70,000	25,000	5,000	100,000
Latin America	10,000	25,000	5,000	1,000	25,000
Europe	90,000	130,000	20,000	8,000	180,000
Asia	75,000	100,000	20,000	10,000	50,000
Africa	7,500	15,000	2,500	500	5,000
Australia	7,500	10,000	2,500	500	20,000
Totals per group	**250,000**	**350,000**	**75,000**	**25,000**	**300,000**

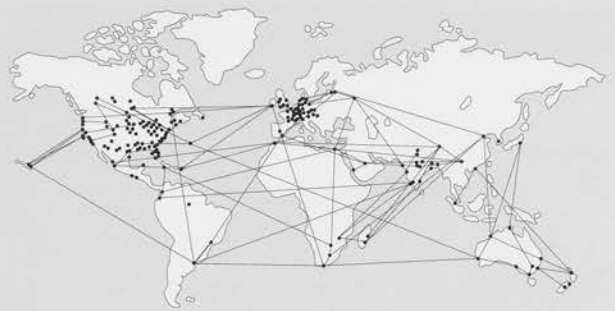
Estimated World Total of Zoo Vertebrates: 1,000,000

The following table presents some examples of numbers of animal species and specimens in various kinds of zoos (data from the International Zoo Yearbook 1990). [Numbers of species are in bold, numbers of individuals are in normal type.]

	Mammals	Birds	Reptiles	Amphibians	Fish	Invert.	Total
New York (Bronx)	**148**	**284**	**128**	**25**	**—**	**20**	**605**
(typical zoo, large)	1,756	1,015	803	372	—	1,400	5,346
Doué la Fontaine	**40**	**45**	**12**	**—**	**—**	**—**	**97**
(typical zoo, small)	280	350	100	—	—	—	730
Vancouver	**8**	**15**	**25**	**19**	**342**	**229**	**638**
(aquarium)	41	46	265	98	4,193	4,756	9,399
Walsrode	**—**	**932**	**—**	**—**	**—**	**—**	**932**
(birdpark)	—	5,620	—	—	—	—	5,620
Apeldoorn	**17**	**6**	**—**	**—**	**—**	**—**	**23**
(primate zoo)	294	28	—	—	—	—	322
Regensburg	**—**	**—**	**257**	**—**	**—**	**—**	**257**
(reptile zoo)	—	—	517	—	—	—	517

The International Species Information System (ISIS) registers data on zoo animals. In 1993 over 400 zoos submitted data on (parts of) their collections to ISIS. The ISIS database comprises historical data on over 400,000 zoo animals, and on 180,000 living specimens (not including fish and invertebrates).

ISIS Network
405 Members in 48 Countries



data to ISIS, and that many of these zoos include only part of their collections in this system (fish for instance are not yet included in ISIS), the total number of animals in the approximately 1,000 organized zoos is estimated to be at least five to six times higher. Thus, a rough estimate of the current capacity of the world's zoos is almost 1,000,000 animals.

It is the higher vertebrates, birds and mammals, which are strongly represented in most zoos (Box 6). Fish are also present in considerable numbers. Amphibians and reptiles are present in much fewer numbers, and invertebrates are scarcely represented in the average zoo collection. In specialised collections, such as aquaria, insectaria, etc., however, lower vertebrates and invertebrates may be better represented by substantial numbers of species and individuals.

Although there are notable exceptions, the vast majority of animals in zoos are exotic, that is, they are not native to the country or region in which the zoo is located (see Box 7).

With approximately 1,000,000 animals the 1,000 organized zoos of the world have a considerable capacity to hold a wide range of species, particularly of the various vertebrate classes. However, because of a lack of detailed documentation regarding the animal collections from some members of the zoo community, the total number of fish, amphibians, reptiles, birds, and mammals as presented in Box 6 can only be estimated. The World Zoo Conservation Strategy therefore calls on all zoos that do not yet do so:

1. *To publish as detailed as possible data on their collections on an annual basis.*
2. *To register all their animals in ISIS.*

These recommendations should lead to a clearer insight into the total capacity of the world's zoos with respect to the various species and groups of animals they hold.

Box 7
What Are "Exotic" Animals?

Zoos are usually associated with exotic animals, and exotic is usually thought of as being far away, strange, mysterious, or rare. To some extent this gives zoos the image of the earlier curiosity museums: collectors of strange life forms from all different parts of the world. It may be that zoos were indeed at one time collectors of curiosities, but if so this time is most certainly past.

The word exotic is Greek in origin, and literally means "originating from out of hearing range" (ex = out, otikos = hear). A zoologist uses this word to indicate animals that do not live in his/her country or faunal region because the natural range of the species is elsewhere in the world. Exotic thus has nothing to do with beauty, ugliness, mysteriousness, or strangeness, but only with the geographic origin of an animal. The common European wood pigeon would be exotic to an Australian zoologist, and a typical South American vole is exotic to a European zoologist. Contrarily, the attractive barn owl, a bird found in almost all parts of the world, would not be exotic to many zoologists. Exotic is thus a relative term, meaning different animals to zoologists in different parts of the world.

Whether an animal is exotic is not really relevant to the average zoo visitor, and certainly is not to most of the city dwellers that constitute the majority of zoo visitors. For these visitors, most of the animals in their own country are outside of their normal experience. These visitors, in contrast to the zoologists, rarely or never come into contact with wild animals that live in their own country, much less on the other side of the world. The American bison, rattlesnake, and hummingbird are just as exotic to a citizen of New York City as is the golden lion tamarin of South America. The golden lion tamarin, macaw, and giant anteater are just as exotic to the average São Paulo inhabitant as to someone in Amsterdam, Colombo, or Sydney.

It comes down to the fact that zoos exhibit animals that the public is not used to seeing. The difference between native or exotic is of minor importance. Both are just as important in conveying a conservation message: the native animals illustrate the need to conserve local environments and their biota, while exotic animals bring home the point that nature conservation must be approached on a global scale.

5.2 Endangered Animal Species in Zoo Collections: Growing Numbers

Although detailed comprehensive figures are lacking, there has been a considerable increase of the proportion of animals belonging to endangered species in the total of zoo collections. There are two reasons for this. Firstly, the number of species listed as endangered has increased rapidly over the past decades, and will keep increasing. Secondly, a growing number of zoos adopted an active policy to use an increasing proportion of their available space to accommodate animals of endangered species.

For reasons explained below (see Chapter 7), the World Zoo Conservation Strategy calls on the zoos to contribute to conservation by shifting the use of available animal space from more common species towards more space for endangered species in coordinated, managed programmes.

5.3 Collection Plans: Each Animal Must Have a Role to Play

A variety of criteria were used in the past to determine which animals were kept by zoos. It was not uncommon for personal interest to play a role; sometimes leading to a collecting obsession on the part of curators or directors, in which numbers of species and acquisition of rare animals were important factors. Although this, as a general practice belongs in the past in most zoos, it must be clearly established in the structure of the World Zoo Conservation Strategy that:

An important premise in determining the composition of the collection is that every animal must have a function within the framework of the objectives of that zoo. Conservation goals should be an important part of these objectives. Animals already in the collection or animals to be acquired should have their individual role within the areas of conservation-related education, increase of knowledge (conservation-related research), conservation of that species, or a combination of these three. This rule should not only apply to endangered species, but rather to all animals in the collection. It should be noted that even some common animals—because of their charismatic appeal to the public—may be important to a zoo's contribution to conservation, simply because by attracting large numbers of visitors they support the economic well-being of the zoo which is the basis for the institution's conservation efforts.

To the above rule, three stipulations must be added regarding the composition of collections:

1. *Legal acquisition.* Animals should only be added to the zoo collection when they can legally be acquired. Illegal acquisition is counter-productive to conservation objectives and the worldwide image of zoos. Legislation, however, should take into account that proper conservation of species in zoos involves occasional importation of animals in the framework of breeding programmes (see also Chapter 6).
2. *Well-being.* Animals should only be added to the collection after suitable surroundings and sufficient space have been created for them, together with the provision of appropriate diet, husbandry, and veterinary care.
3. *Conservation.* There must be a reasonably favourable prospect concerning the possibility of the species establishing a long-term stable captive population. The species should not be added to the collection if this is unlikely. One exception is if this action is taken in conjunction with a specific research programme, that among other objectives, attempts to promote captive propagation of the species. Another exception would be where a non-conservation-sensitive species is used to develop husbandry techniques for a related conservation-sensitive species, in which case a short-term programme would be favoured.

Based on the three considerations above, and the premise that all animals in the collection should serve conservation-oriented goals, the World Zoo Conservation Strategy calls on each individual zoo to develop a collection plan which is part of coordinated needs.

5.4 Coordination is Necessary at Regional and Global Levels

The collection plans of individual zoos should take into account that the composition of zoo animal collections should be coordinated among groups of zoos. This is particularly important in regard to the cooperative conservation of endangered species and to long-term conservation of animal collections (both of which require sufficiently large zoo populations per species), and is also in the interest of educational programmes. A number of national and regional zoo associations have already begun this process of coordination.

The World Zoo Conservation Strategy calls on all zoo associations to intensify coordination of the composition of collections, and on all individual zoos to incorporate collective recommendations into their own collection plans whenever possible. Coordination between nations and regions is also needed on a global scale, at least with respect to endangered species in zoo collections. Thus, the global zoo network (including the regional associations, IUDZG, ISIS, and IZY) should be used to develop structures to facilitate this coordination (see also Chapter 7).

5.5 Conservation of Collections Requires Satisfactory Lifespan and Continuity Over the Generations

Diverse collections of living animals form the basis for all the conservation tasks in zoo education, scientific study, and the maintenance of endangered species. The long-term conservation of animal collections is therefore of critical importance to zoos. The keeping of collections of living animals is quite different from the conservation of mounted animals, paintings, pottery, or other museum collections. These latter artifacts, with proper handling and storage, can last hundreds or even thousands of years. Living animals will sooner or later die, no matter how well they are cared for.

There are two basic requirements involved in maintaining animal collections in zoos:

1. *Individuals must be housed and cared for in such way that satisfactory longevities and high welfare standards are guaranteed.*
2. *Multiple generation populations must be planned for and maintained.*

5.6 Lifespan and Welfare: Continuous Improvement

Life expectancy for many zoo animals was often rather poor during the first part of the twentieth century. Wild animal husbandry was in its infancy, exotic animal medicine was undeveloped and animal housing in zoos was often primitive. Knowledge and experience have increased greatly through research and empirical work since that time. Much more information in areas such as diet, social structure, environmental enrichment, physiology, veterinary concerns, and climatic influences is now available for animal species held in zoos. Furthermore, modern technology can be used to optimize the conditions for each individual species. As a result, most zoo animals today outlive their conspecifics in the wild, while provision for their welfare has considerably increased as well. Many species once thought too difficult to sustain in zoos are now routinely maintained.

The World Zoo Conservation Strategy calls for zoos to continue and accelerate advances in animal care, and to facilitate the communication and free exchange of their research results and experience.

5.7 Continuity Over the Generations is Increasing Through Reproduction in Zoos

The necessary replacement of individual animals can be achieved by two means: the bringing in of new individuals from outside of the zoo, and through reproduction within the zoo. Earlier in zoo history, replacement was usually achieved through the acquisition of new animals from the wild. Knowledge of wild animal reproduction and of factors having an important influence on reproduction has increased enormously in the last decades. Consequently, the number of species that reproduce regularly in zoos is now much higher than ever before, and many species have stable populations that do not require new animals from the wild. However, there are clear differences in breeding success amongst the different vertebrate classes, orders, families, and even genera: usually, as a group, mammals have a better breeding success in zoos than birds, reptiles, amphibians, and fish, though notable advances are now being made in these latter groups.

Zoos are called on to continue to strive to improve breeding success of all animal groups, so that zoo populations of as many species as possible become independent of large-scale importation from the wild.

5.8 Acquisition from the Wild is Legitimate Under Certain Conditions

Although the forecast for the future of breeding species in zoos is promising, there are still a number of species that require addition from the wild for their captive populations to be maintained. This is true for those species that are not as yet reproducing sufficiently to sustain their numbers in zoos. However, some species that are breeding regularly in zoos still require occasional input of fresh blood from outside the zoo population. (As will be explained in Chapter 6, remnant wild populations also benefit from input of fresh blood, so that captive and wild populations may be mutually reinforced by occasional exchange of animals.)

In accord with the Convention on Biological Diversity, *the World Zoo Conservation Strategy emphasizes that the responsible acquisition of animals from wild populations must only be made under the following conditions:*

1. *Zoos must in no manner be involved in illegal or unethical trade of wild animals.*
2. *The removal of animals from wild populations must in no way threaten the long-term survival or recovery of that species in the wild, and where possible must be done in cooperation with the responsible authorities of the country of origin.*
3. *Animals that come from the wild must offer a contribution to the maintenance of their wild conspecifics, either through their optimal use in educational programmes, and/or by contribution to the conservation of threatened species within the framework of breeding and research programmes.*
4. *The collection of animals from the wild must be in agreement with the policies of wildlife agencies and governments. Collecting should take place on the invitation of such bodies as part of programmes to save species.*
5. *Whenever feasible, animals removed from the wild should be placed in programmes to improve reproduction within the zoo.*
6. *Animal transportation must accord with strict regulations such as the international IATA guidelines.*

5.9 The Role of Commercial Animal Trade As a Source of Zoo Animals Is To Be Decreased

Zoo animals were largely acquired from animal dealers in the past. Nevertheless, zoos have never constituted more than 1% of the entire trade in wild animals, and thanks to improved reproduction in zoos, this percentage is now insignificant.

The World Zoo Conservation Strategy requires that the commercial wild animal trade as a source of zoo animals should cease as soon as possible. Such animals as must be collected from the wild, must be collected for specific educational and conservation purposes. They should not be chosen from dealers' lists of animals randomly collected for commercial purposes. The Strategy also takes the long-term view that the placing of price tags on zoo animals may be counter-productive to fostering true conservation-based programmes. It therefore endorses the nil commercial value on conservation-sensitive zoo animals and requires that all national and supranational zoo associations develop policies towards the elimination of price tags where these still exist.

5.10 Population Sizes Need To Be Regulated Cooperatively

Normal reproduction in all wild species leads to the production of much larger numbers of animals than can survive in nature. Predation, disease, starvation, and competition rapidly reduce these numbers in the wild. Thus, the average longevity of a robin may be but 1.25 years in nature, while such birds may live and reproduce for 10 to 15 years in zoos. Thus, successful zoo breeding programmes inevitably have the potential to produce surpluses.

The World Zoo Conservation Strategy emphasizes that good zoos work together to manage populations with potential surpluses, thus serving the continued existence of all the zoo populations. In the first place, surplus animals should be sent to other responsible zoos and institutions. As the population size for a species is approaching its maximum, birth control measures should, where practical, be undertaken, or the size of the population regulated in some other suitable manner. In addition to various methods for regulating reproduction, euthanasia, if practised responsibly within an ethical policy, can be a component of population management, thus replacing normal loss in nature. It is acknowledged that it is not always possible to avoid some surpluses while ensuring that an adequate breeding population is maintained.

5.11 Quality is as Important as Quantity

The maintenance of collections of living animals is not only a question of keeping populations numerically sound by optimizing the chances of survival, increasing longevity and reproduction, and regulating the population size of each species. Additionally, the "quality" of the total population of each species is important. Above all, population structures must be healthy, and genetic degeneration and selection leading to domestication of these wild animals avoided. Achievement of these objectives requires implementation of specific population management methods that are discussed in the next chapters.

Chapter 6

Ex Situ Conservation of Animal Populations

6.1 Definition and Goals: Off-site (*ex situ*) Conservation is to Support On-site (*in situ*) Survival of Species

"Ex situ" (off-site) conservation refers to the maintenance of wild animals in stable populations outside their original biotope. Being out of the original habitat usually means that the animals are separated from the other components of their natural community, and are kept in zoos, other types of scientific institutions, breeding centres, or in semi-reserves. The ultimate goal of *ex situ* conservation is to provide support for the survival of species in their natural environment (*in situ*). As such, *ex situ* programmes are not an alternative for, but rather are complementary to, conservation through biotope protection. There are a number of ways in which *ex situ* propagation can serve this purpose:

1. *Ex situ* propagation of critically endangered species can prevent their immediate extinction.
2. *Ex situ* populations of critically endangered species can be employed in conservation strategies that interactively manage captive

Box 8
IUCN Policy Statement on Captive Breeding

IUCN released a policy statement on captive breeding (4 September 1987) stating that:

"....Certain groups of species are at particularly high risk, especially forms with restricted distribution, those at the top of food chains, and those which occur only in climax habitats. Species in these categories are likely to be lost first, but a wide range of other forms are also at risk. Conservation over the long term will require management to reduce risk, including *ex situ* populations which could support and interact demographically and genetically with wild populations."

"Over 3,000 vertebrate species are being bred in zoos and other captive animal facilities. When a serious attempt is made, most species breed in captivity, and viable populations can be maintained over the long term. A wealth of experience is available in these situations, including husbandry, veterinary medicine, reproductive biology, behaviour, and genetics. They offer space for supporting populations of many threatened taxa, using resources not competitive with those for *in situ* conservation...."

IUCN urged that:

"....Those national and international organizations and those individual institutions concerned with maintaining wild animals in captivity commit themselves to a general policy of developing demographically self-sustaining captive populations of endangered species wherever necessary."

IUCN suggested the following protocol:

"*WHAT:* The specific problems of the species concerned need to be considered, and appropriate aims for a captive breeding programme made explicit."

"*WHEN:* The vulnerability of small populations has been consistently underestimated. This erroneously shifted the timing of establishment of captive populations to the last moment, when the crisis is enormous and when extinction is probable. Therefore, timely recognition of such situations is critical, and is dependent on information on wild population status, particularly that provided by the IUCN/Conservation Monitoring Centre. 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."

"*HOW:* Captive populations need to be founded and managed according to sound scientific principles for the primary purpose of securing the survival of species through stable, self-sustaining captive populations. Stable captive populations preserve the options of reintroduction and/or supplementation of wild populations...."

(= *ex situ*) and wild (= *in situ*) populations; re-establishing and reinforcing natural populations can ensure the ultimate survival of species in their natural environments.

3. *Ex situ* populations can function in public relations, education, and research programmes beneficial to the survival of conspecifics in the wild.

In concordance with the IUCN Policy Statement on Captive Breeding, and statements in the World Conservation Strategy, Caring for the Earth, the Global Biodiversity Strategy, and the Convention on Biological Diversity, the World Zoo Conservation Strategy calls on the entire global zoo network, all its constituent components, and all other relevant parties, to support ex situ *conservation of endangered species as strongly as possible (see Boxes 2 and 8).* Ex situ *programmes in support of* in situ *conservation are indispensable for the continued existence of an ever increasing number of critically endangered species.*

6.2 Natural Populations: Variability, Fitness, and Adaptability

Almost all long-lasting natural populations of wild animals are large to very large; minimally numbering thousands, but more often hundreds of thousands or even millions of individuals. The overwhelming majority of wild populations that have been examined display a high measure of variability. This is in part externally obvious through individual differences in appearance, for example in colour, size, coat quality, and form. However, the most striking variation is found in non-discernible, internal characters such as blood groups, enzymes, and immune defense systems. This variability in characteristics is largely hereditary; established in the genes of the individual and in the gene pool of the total population.

This variability in genetic material is of great importance in wild populations. The foremost advantage is that it allows populations to react to the forces of natural selection working on them. Conditions in a habitat continuously fluctuate. Normal seasons, but also exceptionally dry and wet summers, very cold and relatively warm winters, periods of food abundance and food scarcity, alternate with each other. Diseases and their carriers change, new food plants appear and old food plants disappear, formerly unknown competitors and predators arise. These dynamic factors in the habitat lead to continually changing selection pressures; different variations in hereditable features that are at one time an advantage may be at another time a disadvantage. Because of the great amount of variation in a natural population there is normally a sufficient number of individuals possessing the needed combination of specific hereditable characteristics to allow the population to survive even quite extreme changes in conditions.

The natural genetic variation in a wild population provides it with an adaptability that is essential to survival in an environment with perpetually fluctuating conditions. Of course, some of the heritable variation will slowly disappear from a population if the average pattern of selective forces remains constant for a very long time. This occurs at more or less the same rate as the origin of new genetic material through mutation. The variability in the gene pool of a population also provides an adaptiveness that makes survival over the long term, as well as the short term, possible. Climatic changes and many other factors can gradually shift the pattern of selective pressures. Because of the always present and self-rejuvenating genetic variation, a population can adapt both to sudden fluctuations and a gradually changing environment, thereby surviving thousands or millions of years.

6.3 Zoo (*ex situ*) Populations: Risks of Degeneration and Domestication

Because genetic variation is of vital importance to wild populations, an attempt must be made to keep that original variation as intact as possible in *ex situ* populations. *Ex situ* populations in general, and zoo populations in particular, differ from original, unthreatened natural populations in three important aspects:

1. They are much smaller, including only some tens to hundreds of individuals. They are therefore susceptible to random processes that lead to a loss in genetic variability.
2. They are divided into many small sub-populations (individual zoo collections). A danger of inbreeding through the breeding of close relatives within these sub-populations exists if there is not an exchange between the sub-populations.
3. The animals live in conditions that are different from those in their natural habitats, and thus there is a risk of unnatural selective pressures acting on them.

Small size and subdivision of a zoo population, together with risks of unnatural selection, can lead to a loss in genetic variability, causing genetic impoverishment and defects and expression of genetic traits that would be unfavourable in the original natural situation. Symptoms of genetic degeneration and domestication may be exhibited in ex situ populations. In the event that this occurs, such populations:

1. *Are no longer as suitable for educational objectives; non-degenerated, non-domesticated animals are necessary to convey an accurate impression of nature.*
2. *Can make no contribution to reinforcement or re-establishment of populations in natural environments; animals suffering from genetic impoverishment and degeneration are less likely to survive selective pressures in natural conditions.*
3. *Are less likely to survive even in captivity over the long term.*

It is thus of crucial importance to avoid, as far as possible, such developments in ex situ *populations.*

6.4 The Solution: Cooperative Population Management

Fortunately, deleterious processes that can occur in small and fragmented *ex situ* populations have been intensively studied in recent years by theoretical and practical population geneticists in zoos and universities. Because of the insight gained through this work, it is now clear how such processes can be avoided or minimized. A number of guidelines have consequently been established. The most important of these are shown in Box 9.

Strictly controlled and regulated breeding will result from following relevant guidelines. Ex situ *breeding programmes practised in this manner can maintain a large amount (more than 90%) of the genetic variability for a long period of time (100 to 200 years and perhaps even longer). Opportunities for degeneration and domestication are virtually eliminated; in fact, these managed populations are even less susceptible to such processes than are relict populations of comparable size of endangered species in natural conditions. Thus, the initial disadvantages of* ex situ *populations over* in situ *populations are turned into advantages.*

Intensive regulation and control of breeding efforts demands population management based on:

1. *Sufficient understanding of population biology.*
2. *Population analyses and year-to-year adjustment of the breeding programme according to the analyses.*
3. *An organizational structure that ensures that breeding recommendations will be carried out.*

The current status and future development of each of these aspects is briefly reviewed below.

6.5 Understanding of Population Biology: Continuous Development

Knowledge of population biology has greatly increased during the past decade. Population geneticists and demographers—many connected with zoos—have in particular been studying the effects of small population size and fragmentation of populations. This knowledge is now being used to the advantage of the conservation of *ex situ* populations.

Box 9
Basic Guidelines for Population Management

Maintenance of genetic variability and prevention of the deleterious effects of inbreeding require management measures based on a number of guidelines. The most important of these are:

- The founder group, the group of wild-caught animals that forms the basis of the *ex situ* population, preferably should consist of at least several dozen animals. Good breeding programmes can be established with fewer animals if necessary so long as the other guidelines are strictly followed.
- This starting (= founder) population must be increased as quickly as possible to the target population size.
- The necessary minimum size of the target population is dependent on a number of factors, such as the number of founders and the generation time, but generally will include some 250 to 500 animals. In exceptional cases (e.g. island species), even smaller populations may survive.
- The sex ratio of the reproductive animals must remain as close as possible to 1:1, or the management should strive at assuring such an effect (e.g. by social exchanges of males in polygamous groups).
- Inbreeding through mating of closely related animals must be avoided as much as possible.
- As soon as the target population size is reached the generation time should be extended so that animals will reproduce at later ages, thereby slowing down the potential rate of genetic change.
- Although many of the above mentioned guidelines already help to avoid undesirable selection, continual efforts must be made to evade unnatural selection pressures.
- If it is possible, a small number of animals unrelated to the population should be added to it each generation.

The World Zoo Conservation Strategy emphasizes that continuing further development of the theoretical basis of population biology will lead to a still better foundation for ex situ *conservation of animal populations, including the maximal conservation of their genetic properties.*

6.6 Tools for Population Analyses: Databases, ISIS, IZY, Studbooks, and Computer Software

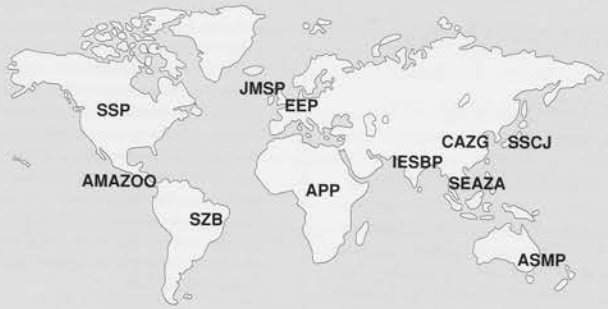
Keeping of records on the animals involved is essential to all forms of population management. Good management is impossible without thorough, reliable information on aspects such as the number of animals in the population, where these animals are located, their kin relationships, descendants, and so on.

The zoo world has three levels for the recording and reporting of individual animal data:

1. *The "in-house" registration of animal data in the individual zoos.* Good zoos register as much information as possible for each individual animal. This includes not only data such as place of origin, birth, death, parents, and offspring, but also such information on diet and feeding habits, health, medical treatments, and breeding habits. Some of the large zoos have been recording such data for over a century, and have accumulated a wealth of information. Hitherto, zoos generally kept records on card systems, but now many use computers and standardized software packages developed particularly for zoos: e.g., the Animal Record Keeping System (ARKS). This system ensures that all zoos record their information in the same manner, allowing data from different zoos to be combined. Over 300 zoos are presently using the ARKS system and its supplementary programmes.
2. *The worldwide databases for animal information: the International Species Information System (ISIS), and the International Zoo Yearbook (IZY).* The ISIS system, based in Minneapolis, Minnesota (U.S.A.) has been collecting zoo animal data and entering them into a computer system since 1975. Presently over 400 zoos provide information on a part, or all, of the animals in their collections. Zoos that use the ARKS system (developed through ISIS) can enter data directly into ISIS, as the systems are compatible. The ISIS database currently includes historic data for hundreds of thousands of zoo animals of more than 4,000 species. In some countries or regions national or regional databases for zoo animal records are being maintained as intermediates between the in-house registration systems of the individual zoos and the global ISIS database. On species and higher taxonomic levels, rather than for individuals, worldwide data on zoo animals are also collected by the IZY. Approximately 800 zoos contribute data on numbers of animals per species and on reproduction to the IZY.
3. *Studbooks for endangered species.* Studbooks are compiled using information from ISIS and IZY and information from individual zoos that have not begun to register their animals in these databases. Each international studbook contains information on all individuals of one particular species that live in zoos throughout the world, or have ever lived in zoos. The international studbooks are maintained by studbook keepers jointly appointed by IUDZG and IUCN/SSC and coordinated by the editor of the IZY. Presently international studbooks for over 100 endangered animal species exist, and this number is rapidly increasing. Studbooks are also kept on regional levels, as a component of the regional breeding programmes (see Chapter 6.7).

All of these animal data, and particularly those in studbooks, are used for population analyses. ISIS personnel, along with other specialists from within and outside the zoo world, are continuously upgrading existing programmes and working to develop new software programmes that simplify these processes. This studbook and population management software makes it possible to carry out detailed and complicated analyses in a short amount of time; the results of these analyses can then be used to formulate management proposals for ex situ *populations. Further development*

Box 10
Regional Breeding Programme Organizations



SSP:	Species Survival Plans, conducted by the American Association of Zoos and Aquaria (AAZPA)
EEP:	European Endangered Species Programme, conducted by the European Association of Zoos and Aquaria (EAZA)
JMSP:	Joint Management of Species Programme, conducted by the Federation of Zoological Gardens of Great Britain and Ireland (these nations also participate in the European Endangered Species Programme, EEP)
APP:	African Propagation Programmes, being initiated by the Pan African Association of Zoological Gardens, Aquaria and Botanic Gardens (PAAZAB)
AMAZOO:	Regional captive breeding programmes being initiated by the Association of Meso American Zoos (AMAZOO)
ASMP:	Australasian Species Management Programme, conducted by the Australian Regional Association of Zoological Parks and Aquaria (ARAZPA)
SSCJ:	Species Survival Committees Japan, conducted by the Japanese Association of Zoological Gardens and Aquaria (JAZGA)
CAZG:	Captive breeding programmes being initiated by the Chinese Association of Zoological Gardens (CAZG)
SZB:	Captive breeding programmes being initiated by the Brazilian Zoo Society (SZB)
IESBP:	Indian Endangered Species Breeding Programmes, conducted by the Central Zoo Authority of India
SEAZA:	Regional captive breeding programmes being initiated by the South East Asian Association of Zoos (SEAZA)

Box 11
The Basic Organizational Structure of Regional Breeding Programmes

The basic organizational structure is the same for each of the regional breeding programme organizations. A species coordinator and studbook keeper are appointed for each species with a regional programme. The studbook keeper and species coordinator are often one and the same person, but sometimes these tasks are shared by different people. Data for all animals of that particular species within the region are collected and compiled in a studbook. The species coordinator, together with the species committee—a group consisting of representatives from zoos participating in the breeding programme for that species, and possibly also other specialists—analyze the population data, and work out a masterplan for the breeding policy. The breeding policy takes into consideration not only genetic concerns such as inbreeding and conservation of genetic variability, but also the demographics of the population (the sex ratio, fertility, mortality, age structure, etc.). Participating zoos sign a declaration wherein they agree to follow the policy proposed by the species coordinator and committee as closely as possible. The analyses are repeated each year, so that the policy can be continually adjusted to include new developments within the population.

In addition to providing direction in population management, the species coordinator, committee, and participating zoos also establish guidelines regarding optimal feeding, housing, medical care, and husbandry practices for their species, and also seek to stimulate further research in improvement of husbandry and reproduction.

of these software tools, particularly regarding species specific situations (such as husbandry, social structure, and reproductive strategy) should be stimulated.

6.7 Organizational Structures: Based on Regional Breeding Programmes

Analyses of studbook data lead to recommendations regarding breeding policies for *ex situ* populations. Usually a number of zoos (up to more than 100) are involved in the management of one species. A breeding policy often requires the exchange of animals, encouraging or discouraging breeding of certain genetic lines, expanding or reducing the total population size, and so on. Such a policy can in practice only be effective if a good organizational structure exists. Within this structure, binding agreements can be made so that population management measures can actually be carried out.

Despite the enormous diversity among zoos, the zoo world has made considerable progress within the last fifteen years in establishing organizational structures for management of ex situ *populations. A system of regional breeding programme organizations has been chosen for practical reasons; cooperation and carrying out of management measures is much easier*

within continents or sub-continents than on a worldwide scale. Such programmes have already existed for some time in Australasia, Great Britain and Ireland, North America, Europe, and Japan (see Box 10). Similar organizations are in various stages of development in India, southeast Asia, Africa, and Latin America. Currently there are breeding programmes for over 300 endangered species in the established regions.

The basic organizational structure is the same for each of these regional breeding programme organizations (see Box 11).

Zoos within the established regions invest considerably in cooperative breeding programmes. Nearly all species coordinators and committee members functioning in these programmes are zoo employees, and they invest considerable amounts of time. Financial investments are involved in transportation of animals for exchanges specified in the breeding policy, improving husbandry practices, the creation of new animal spaces, and so on. Several of the regional organizations have also established a coordinating office with one or more full-time staff members to support their breeding programme systems.

The World Zoo Conservation Strategy recognizes the great value of the development of organizational structures for ex situ *conservation of endangered species as seen in the past 15 years. It calls for continued further extension of these structures to eventually cover all geographical regions of the world, to include a growing number of endangered species, and to render their functioning as effective as possible.*

6.8 The Role of CBSG: Catalyzing and Facilitating on a Global Scale

The number of species for which two, three, or more regions have breeding programmes is increasing as the total number of regional breeding programmes grows. The need for coordination of these programmes on a worldwide scale is consequently also growing.

The most important organization involved in global coordination of *ex situ* conservation of endangered animal species is the Captive Breeding Specialist Group (CBSG), one of the many specialist groups of the Species Survival Commission (SSC) of IUCN—The World Conservation Union. Currently CBSG consists of over 500 members, all of whom are in some manner experts in *ex situ* conservation. Many of them are connected to zoos, but others come from nature conservation organizations, universities and other research institutions. The CBSG constitutes a network of expertise throughout the world, supporting the potential role that *ex situ* conservation can play within the framework of nature conservation. The CBSG is one of the largest and most active of the IUCN/SSC Specialist Groups, and in 1990 established its own executive office with a permanent, full-time staff.

The CBSG, as global facilitating body for regionally organized breeding programmes, stimulates contact between currently existing regions, enhances the establishment of breeding programmes in new regions, brings together regional species coordinators working with the same species in different parts of the world, and assists them in formulating global masterplans. In addition, CBSG acts as a catalyst in nearly all aspects of *ex situ* conservation. It stimulates further development of theoretical considerations, actively supports the continuing development of databases and software tools, gathers together as much of the required expertise as possible, and develops action plans crucial to the proper choice of species for which new breeding programmes are urgently needed (see Chapter 7). Finally CBSG is aware of the needs of other IUCN/SSC Specialists Groups responsible for *in situ* conservation, so that *ex situ* support can be developed in the frameworks of total species strategies.

The World Zoo Conservation Strategy recognizes that the Captive Breeding Specialist Group (CBSG) forms an extremely important link between the global zoo network and the IUCN conservation network. It therefore calls for further development of CBSG and continued support of this Specialist Group from both the zoo world and IUCN. Liaisons between CBSG, other IUCN/SSC Specialist Groups and government conservation agencies are essential for the attunement of ex situ *and* in situ *species conservation efforts.*

6.9 Metapopulations: Reduced and Fragmented *in situ* Populations Benefit From Interactive Management With *ex situ* Populations

Countless natural animal populations have been greatly reduced in size because of human expansion. This is often because the original range of a species becomes divided into many small, isolated fragments. Small relict animal populations still remain in fragments of the original biotope, but because of their small size they are susceptible to random genetic and demographic processes, and the possible consequences of inbreeding. The risk of each of these mini-populations quickly dying out is thus great. The survival chance for all of the small, isolated relict populations can be increased only if they are viewed together as a "metapopulation". Population management in such cases is necessary: natural connecting corridors must be constructed so that exchange between the isolated populations is possible, or if this is not practical, animals can be translocated at arranged intervals in an attempt to prevent further loss of genetic material in sub-populations.

If we look at the entire biosphere, rather than at individual species, we see the same general trends throughout much of the world: a decrease in size of natural areas and similar habitat fragmentation. Often all that remains of originally huge biotopes are small, isolated pieces unevenly distributed throughout the landscape, and ringed by agricultural and industrial areas and city agglomerations.

The metapopulation concept and the extreme fragmentation of natural habitats cast a new light on nature conservation and the potential role of zoos in conservation efforts. The conservation and management of zoo animal populations on the one hand, and the conservation and management of relict habitats and populations of endangered species in nature on the other hand, have many of the same basic requirements. Workers within these fields can learn much from each other; intensive cooperation will reinforce the efforts on both sides, while increasing the effectiveness of conservation efforts overall:

1. *Much of the necessary theoretical and practical knowledge is equally important in both fields. Exchange of information and the undertaking of cooperative research is therefore essential.*
2. Ex situ *populations in zoos should be considered as components of metapopulations in which the remnant natural populations constitute the* in situ *components.*
3. *Intensive population management of greatly diminished natural populations, involving strict control and regulation of breeding, is currently considered an efficient tool for their conservation. Establishment of* ex situ *populations should be seriously considered before a species is on the verge of extinction in the wild. The intensive management required can be accomplished effectively in* ex situ *situations, whereas in* in situ *situations relict populations are very vulnerable to all kinds of random disasters, not only genetically and demographically, but also environmentally induced.*
4. *The* in situ *and* ex situ *components of endangered animal metapopulations should be interactively managed in relation to each other. Management policies for each should take the other into consideration, and in certain cases a mutual exchange of animals or genetic material may be necessary (see following Chapters), provided that risks of disease transmission and other deleterious effects can be minimized. This integration of policy and interactive management must lead to effective protection of populations in remnant biotopes where the reduction in area and number of animals has progressed beyond critical limits.*

The World Zoo Conservation Strategy therefore calls for all parties involved to recognize the close interdependence of ex situ *and* in situ *conservation, to cooperate, and to mutually reinforce* ex situ *and* in situ *conservation efforts.*

6.10 Animal Transfers for Population Management Must Be Legally Possible

Intensive population management serving conservation goals requires transfers of animals, e.g. exchanges of animals between the sub-units of the *ex situ* population, introduction to existing *ex situ* populations of animals from the wild for genetic reinforcement, the establishment of new *ex situ* populations with wild animals, and the interactive exchange of animals between *in situ* and *ex situ* populations for mutual reinforcement. Many of these transfers—planned in the framework of species conservation—often involve the crossing of national and continental borders.

Three types of legislation may considerably hamper or delay such transfers, however important they are for population management:

1. CITES regulations and related national and international legislation, preventing imports and exports of animals of endangered species.
2. National legislation restricting the imports of animals (both domesticated and wild) in order to prevent the unwanted introduction of diseases.
3. National legislation or conservation codes regarding the removal or (re)introduction of animals from or to a natural habitat.

The World Zoo Conservation Strategy recognizes that zoos should stay strictly within the limits of national and international legislation with respect to animal transfers. However, existing legislation should be adapted and legislation still to be developed should leave open ample possibilities for the transfer of animals between registered zoos and in situ *and* ex situ *populations for the sake of effective population management, which is crucial to species conservation. The amount of paperwork connected with applications, certificates, and permits should be kept to a minimum in order to enable quick action whenever required for conservation purposes.*

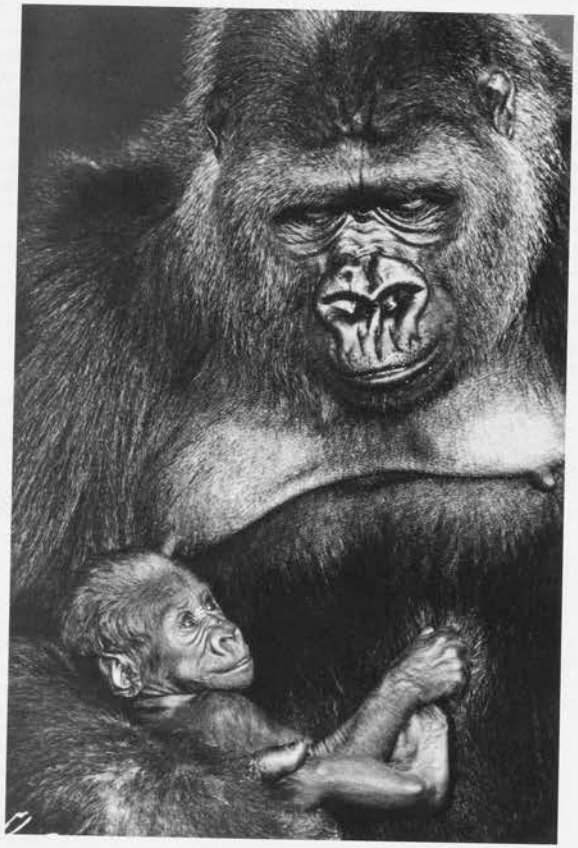
6.11 The *ex situ* Conservation Network Should Be Further Developed

Although an enormous amount of progress has been made by the zoo world in organizing and establishing ex situ *breeding programmes for endangered species during the last ten years, this is but the beginning of what must be an ongoing process for many years to come. The World Zoo Conservation Strategy emphasizes that:*

1. *All zoos that have not already done so should establish good record keeping systems, preferably using the universal ARKS registration programme. Zoos should enter their animal data in ISIS, via their in-house animal registration systems. These databases are of crucial importance to all* ex situ *conservation efforts.*
2. *All zoos should regularly submit data on animal species for which there are studbooks and coordinated breeding programmes. This is particularly important for ISIS, IZY, the studbook keepers, and for the species coordinators.*
3. *All zoos participating in such breeding programmes should realize that populations of endangered species must be collectively managed over the long term. All zoos should abide by cooperative agreements within such coordinated breeding programmes.*
4. *All zoos, even the smallest ones, should participate in all breeding programmes in their region whenever they hold specimens of breeding programme species in their collection.*
5. *Zoos should understand that investing money, time and space into breeding programmes over the long term benefits not only the survival of populations of endangered species, but also the continued existence of the zoo itself. Without effective, cooperative population management, zoo collections will slowly become poorer, as it will soon no longer be possible to supplement zoo collections with animals caught in the wild, unless for sound conservation reasons. Zoos must not dispose of animals to parties outside of breeding programmes if there is a requirement for them in the programme.*
6. *All zoos should be encouraged to disregard the financial value of animals required for transfer to other zoos as part of an endangered species breeding programme (see also Chapter 5.9).*
7. *The zoos in a given breeding programme region should be collectively responsible for a sound breeding programme organizational structure. Usually the regional zoo associations can suitably provide this. Financial means and personnel can be made available within the association structure for central coordination and collective adjustment of breeding programmes, training of studbook keepers and species coordinators, as well as a number of other executive tasks.*
8. *Although some regions have already gone far in the establishment of such structures, a beginning still needs to be made in other parts of the world. The international zoo community—through IUDZG, CBSG and the established regional associations—must provide an active, stimulating, and supportive leadership role in this.*
9. *Zoos and zoo associations in developed countries should help developing regions of the world in establishing breeding programme organizations, and in improving zoo animal management and husbandry conditions. Knowledge, experience, and equipment should be placed at the disposal of associations and zoos in these developing regions in order to accelerate the process. This is of particular importance, as many of the endangered species in breeding programmes are native to these parts of the world.*
10. *All members of the zoo community should work on mobilizing external parties (universities, research institutions, financiers, local or regional nature conservation organizations, politicians, law makers, publicity agents, etc.) in the interest of* ex situ *conservation of endangered species, and of the cooperative interaction between* in situ *and* ex situ *programmes.*

Chapter 7

Capacity: Space Limitations and Choice of Species



7.1 Assessment of Available Space: 500,000 Animal Spaces for Species Conservation Purposes

Every *ex situ* population has a minimum size necessary to adequately maintain genetic characteristics for many generations, and to remain invulnerable to random demographic disasters. The theoretical effective population size depends on different species-specific factors and on the history of the population (including considerations such as the number of founder animals on which the population is based). The actual population size required is usually larger, because the breeding of animals in such populations seldom or never in practice precisely follows the theoretical rules for biological and logistic reasons.

A rough estimate of the average required population size for *ex situ* breeding programmes is in practice 250 to 500 animals, though there is a great deal of variation. It was mentioned in Chapter 2 that at least 1,000 relatively large zoos that are organized in societies and associations are found throughout the world. If these zoos each have an average of 500 spaces for the larger species of vertebrates available for use in breeding programmes, some half million breeding programme animals can be housed. The estimate of 500 available animal spaces is approximate; the number is assuredly much higher in larger zoos within developed countries, and lower in many of the zoos found in developing countries. Space availability of course also depends on the size of the animals involved.

If it is assumed that there are a half million available animal spaces in organized zoos of the world, and that the average required population size for breeding programmes is 250 to 500 animals, it can be estimated that ex situ *populations can be established for 1,000 to 2,000 species. The World Zoo Conservation Strategy, however, emphasizes that:*

1. *Many of the estimated available animal spaces in the organized zoos are currently being used by animals that are not in breeding programmes. Re-allocation of these spaces for breeding programmes will require more emphasis from the zoos regarding* ex situ *programmes, and coordination between institutions in terms of collection composition and choice of breeding programme species. This should be done in the framework of regional zoo associations and breeding programme organizations.*
2. *The total number of available animal spaces can be considerably expanded if the countless small zoos that are not yet organized can also make spaces available. This would probably double the number of species for which programmes could be established. A great amount of effort to convince these zoos to participate, and to adapt them to international standards would be required to meet this goal.*
3. *The total number of available spaces might also be extended by including other types of institutions and private collections in breeding programmes. This, however, can only be done under certain conditions (see Box 12).*
4. *It should be taken into account that breeding programmes for rescue of species do not necessarily require long-term (100 years or more) occupation of zoo animal space. A number of examples have shown that after five to twenty years of captive breeding, viable populations in natural habitats may already be re-established. In such cases the* ex situ *population of the species concerned may be reduced in size (leaving a stringently genetically managed core population as a security), and most of the space may be made available to programmes for other species.*
5. *Full size* ex situ *populations are only required for the most critically endangered species. Smaller, so-called nucleus populations of approximately 100 animals each will function as* ex situ *security reserves for endangered species which currently are not (yet) in immediate danger of extinction. In terms of numbers of species, the establishment of such nucleus populations would considerably increase the zoo world's capacity to support species conservation.*

Box 12

Extension of Capacity for *ex situ* Conservation by Involving Other Institutions and Private Breeders

Outside of zoos, countless exotic animal species are also held in captivity, primarily in the private sector but also in scientific institutions. If a part of this non-zoo space was allocated to cooperative breeding programmes, the total *ex situ* capacity would be considerably increased.

Many scientific institutions already participate in ex situ *breeding programmes for a number of endangered species. This does not apply to institutions working with laboratory animals, but usually to institutions holding breeding groups of animals for behavioural research, or conservation oriented studies.*

Private breeders, on an individual and incidental basis, also work with breeding programmes. They usually do not have extensive facilities, but often possess great, specialized knowledge about particular animal species, their husbandry and their housing requirements. Additionally, private breeders can often devote much time, money and attention to a relatively small group of animals. Although they can offer a positive contribution to breeding programmes, a number of conditions need to be clearly established concerning their participation.

The World Zoo Conservation Strategy emphasizes that private breeders can participate in ex situ *breeding programmes, provided that:*

1. *They fully abide by the codes of ethical conduct as applied by the zoos in their region and by written breeding policy agreements. Above all, this means that they must avoid unnatural genetically selective breeding, a breeding method often used by private breeders. Instead, all pairings must be in accordance with the masterplan for the species.*
2. *They register their breeding programme animals in studbooks and ISIS according to the agreements.*
3. *They do not dispose of breeding programme animals or their offspring without approval from the species coordinator.*
4. *There is no involvement with commercial animal trade with regard to breeding programme animals.*
5. *A basis for continuity exists. This often means that breeding programme animals should only be made available to private breeders through "breeding loan" contracts, in which the ownership of the animals and offspring is not transferred to the breeder. The animals are then available to the breeding programme under all circumstances.*

This means that, regardless of the great potential contribution that private breeders could offer to breeding programmes, probably relatively few of them will actually participate in programmes in the short term. However, in the long term the maintenance of special interest collections may not be possible without resorting to and fully abiding with cooperative programmes.

7.2 Criteria for Species Choice: Two Approaches

There are two questions that are important in the process of choosing species for *ex situ* breeding programmes in zoos:

1. What species are most in the need of conservation in the form of *ex situ* propagation?
2. What are the capabilities and strengths of the zoos in regard to their knowledge, experience and space resources?

Conservation needs, combined with zoo capabilities, lead to a number of criteria that are important in species choice for ex situ *programmes, resulting in the following generalizations:*

1. *Critically endangered species have a higher priority than less endangered or non-endangered species;*
2. *Species for which zoos have husbandry and reproduction experience enjoy a preference, since these are the species for which* ex situ *programmes are most likely to be successful;*
3. *Species for which founder stock is already present in zoos have preference above other considerations;*
4. *Species that play a key role in their habitat enjoy a high priority;*
5. *Species that represent a high degree of taxonomic uniqueness have a higher priority than species belonging to taxa containing many varied species;*
6. *Flagship species that can serve as effective ambassadors for nature conservation have preference.*

The World Zoo Conservation Strategy states that the above considerations require two approaches in species choice: the zoo approach and the conservation approach. The combination of these yields the most useful selection method.

7.3 Zoos Should Determine Their Strengths in Species Conservation

As a basis for the choice of species for ex situ *breeding programmes the Strategy calls on zoos to:*

1. *Make a collective inventory of the animals they hold in their collections;*
2. *Identify species for which good breeding results have been achieved, and how these results can be used to improve breeding of related species;*
3. *Indicate which other species zoos are suited to maintain and breed in the future, based on existing knowledge and experience;*
4. *Indicate which species are most suited to the task of raising public consciousness.*

Completion of these tasks is necessary to determine which species are best choices from the zoo point of view, and organizations within the world zoo network can formulate advice in this matter. This process has been initiated within the regional breeding programme organizations; there are the regional Taxon Advisory Groups (TAGs) which have made a beginning in inventorying their animals group by group to assess strengths and possibilities. The International Species Information System (ISIS) greatly facilitates this process.

The World Zoo Conservation Strategy calls on all national, regional, and international zoo organizations to intensify the process of determining their strengths with respect to selection of species for ex situ *species conservation.*

7.4 The Conservation Community Should Determine Priorities: Initiatives of IUCN, SSC, CBSG, and Other Groups

People around the world have been accustomed to the idea that some species are more threatened

by the prospect of extinction than other species. The history of categorizing the conservation status of species is recounted in *"The Road to Extinction"* (IUCN/UNEP). A signal advance began in 1966, when detailed accounts of those species most likely to become extinct were provided in "Red Data Books" of IUCN/SSC, and simple catalogues of threatened species are now offered in the continuing "Red Lists" of IUCN. Similar (and overlapping) lists were generated under national laws such as the Endangered Species Protection Act of the United States (1966 et seq.) and under international treaties such as CITES. Various countries have also worked to produce comprehensive accounts of their threatened species.

More recently the taxon specialist groups of SSC have begun assessing in detail the status of each species in entire large taxonomic groups such as the fruit bats, antelopes, and the Australasian marsupials, in a series of conservation "Action Plans". SSC is following on with regional conservation overviews combining taxonomic and environmental information. Also, IUCN/SSC member organizations such as BirdLife International (ICBP) have done intensive surveys to determine the relative priorities for conservation attention amongst species relevant to their interests.

Most recently the SSC initiated a review and revision of the categories of threat, which have lacked an objective basis and had limited precision as a result. The new system in process at this time relies on principles of population biology and on geographical distribution patterns to determine the degree of threat and temporal risk of extinction if no corrective actions are taken. Zoo biologists who are part of CBSG began the development of the new system and have continued to be directly involved in its refinement.

Simultaneous with the re-examination of the categories of threat, zoo biologists have been refining the techniques of population viability analysis originated by wildlife biologists and ecologists. Employing the power of modern computer technology, they have adapted and created software programmes for modeling the dynamics of small population of animals in various genetic, demographic, environmental, and disaster scenarios. Again, the predictive potentials developed are a great assist in determining priorities and concerns in countering the extinction vortex for populations that is produced by the interaction of the factors mentioned above.

The Captive Breeding Specialist Group of SSC has taken the lead in applying these two developments to the real world dilemmas of prioritizing conservation actions and allocating scarce financial and human resources to the solutions most likely to be effective in conserving species and their habitats for the long term.

For the best outcome in setting priorities, clear, thoughtful advice from the standpoint of zoo capabilities must be coupled with comparable advice based on conservation needs and individual species concerns. The CBSG, building on recent developments, has employed two important methods to this end:

1. *Conservation Assessment and Management Plans (CAMPs)* indicate which species in assessed animal groups urgently need support through *ex situ* breeding programmes. Zoo and non-zoo experts, such as members of other relevant IUCN/SSC specialist groups, are involved in the formulation of such plans. The World Conservation Monitoring Centre (WCMC) and the International Species Information System (ISIS) also provide important data for CAMPs.

2. *Population and Habitat Viability Analyses (PHVAs)* form a method for establishing the degree to which populations of a species are threatened, and what the chance of survival is for these populations. Important conclusions can be drawn from such analyses; for example whether an *ex situ* programme for that particular species is feasible or desirable.

The World Zoo Conservation Strategy recognizes the importance of the assessment of conservation needs as performed by CBSG and partners. It calls on CBSG to continue and intensify this work, and on other IUCN/SSC specialist groups, government conservation agencies, and the zoo world to strongly support these efforts and participate in them.

7.5 Combined Efforts Should Lead to Regional Collection Plans and Global Captive Action Plans

The advice from both the zoo world and the field conservationists must eventually lead to definitive choices of species for *ex situ* conservation. This can be done most effectively at the level of regional zoo associations. Several of these associations already have started this process by developing Regional Collection Plans (RCPs) for a number of broader taxa, e.g. families or orders of birds, mammals, and reptiles. These RCPs identify strategies for optimal use of the available zoo space in the region for *ex situ* conservation aims. Once RCP proposals for a given taxon have been formulated in various regions of the world, global attunement and coordination should result in the establishment of Global Captive Action Plans (GCAPs). Such GCAPs—taxon by taxon—will set out the global zoo community's course in *ex situ* conservation.

The World Zoo Conservation Strategy calls on the regional zoo associations, the global zoo community, and CBSG to intensify their efforts to formulate proposals for Regional Collection Plans, and to establish Global Captive Action Plans. Eventually Regional Collection Plans (RCPs) and Global Captive Action Plans (GCAPs) should be established for all taxa that are or can be maintained in zoos. For each taxon RCPs and GCAPs should clearly indicate which contribution to species conservation the zoo world can make by establishing and maintaining ex situ *populations. It should be noted, however, that the formulation of RCPs and GCAPs is a dynamic process: such plans will require continuous development and modification in the light of conservation needs. The World Conservation Strategy calls on individual zoos to implement regional and global plans by translating these into institutional collection plans.*

7.6 Species Rescue Operations: Quick Action Must Be Possible

The above considerations imply time consuming deliberation, involving many parties. Indeed, such a process is needed to make responsible decisions in nature conservation. Possibilities for rapid action must also exist however. It has been proven more than once that a species on the verge of vanishing can be saved from immediate extinction through prompt action and speedy establishment of an *ex situ* breeding programme. Examples include the California condor, black-footed ferret, *Partula* snails of Moorea Island, Guam rail, and Guam kingfisher. These examples, and others, demonstrate that species can be rescued from near-term extinction through translocation of part of or the entire population to the safety of captive surroundings to set up a breeding programme and provide for eventual re-establishment of a wild population.

The World Zoo Conservation Strategy calls on zoos, local and international nature conservation organizations, and responsible governmental bodies to be prepared to make decisions quickly in order to benefit the long-term interest of a species.

7.7 Species/Subspecies Questions Require Careful Consideration

The choice of the taxonomic unit to be worked with is an important consideration in breeding programmes. In principle, the "biological species" should offer a sound, basically uniform unit for *ex situ* breeding programmes, since each individual in the species fulfills the biological definition of a species: that is, reproduction between this individual and another of the same species will yield fertile offspring. Species are usually defined according to their external appearance and anatomical characteristics, while in actuality barriers to mutual fertility can also lie in non-visible genetic or molecular characteristics, or in behavioural incompatibilities. Taxa

originally described as single species have in some cases, upon closer inspection, turned out to be composed of several reproductively isolated groups. Such groups may often be viewed as discrete populations in *ex situ* breeding programmes. It is also possible that different geographic forms of a species are in principle not reproductively isolated, but are perfectly adapted to specific features in their own specific habitats that are unlike other habitats within the rest of the species' range. Consequences of these within-species differences need to be considered if *ex situ* propagation is to contribute to the survival chances of natural populations.

However, the *ex situ* population of one species should not be unreasonably split up into too many geographical or subspecies sub-populations. Each of these individual sub-populations requires its own minimum number of animals: *ex situ* programmes for ten subspecies or geographical forms take up just as much room as do programmes for ten species.

The World Zoo Conservation Strategy emphasizes that breeding programmes for more than one subspecies per species should be undertaken only if there is a very clear conservation strategy or scientific reason for doing so. Otherwise, just one pure subspecies should be selected for breeding; or as necessary, different intraspecific forms might be mixed within a total species population. Which of these strategies should be selected requires in-depth research for each taxon.

7.8 The Impact of *ex situ* Conservation: Greater Than Numbers Alone

Many thousands of species, whole biotopes and entire ecosystems are now in danger of disappearing. Many experts predict the extinction of a million or more species in the coming decades. It is thus justified to ask what sense there is in saving from extinction one or two thousand species at considerable cost in terms of time, labour, and money through *ex situ* programmes. Would it not be better just to put the effort directly into habitat conservation, thereby saving not just an arbitrary selection of species, such as the higher vertebrates, but rather a whole spectrum of interdependent biological forms, inclusive of countless inconspicuous plants, invertebrates, and unicellular organisms?

The World Zoo Conservation Strategy emphasizes that the impact of ex situ *conservation is many times greater than is indicated by the limited number of species that it can directly save from extinction. Obvious reasons for this are:*

1. *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 flagships. Additionally these species are often more vulnerable to extinction, as they live in lower densities and reproduce at slower rates than many smaller species.
2. *A great influence on public awareness can be exerted using a flagship species in* ex situ *programmes, by bringing the importance of conservation of that species to the centre of public attention.* The point can also be made that conservation of that particular species only makes sense if there is also a healthy habitat for it to be returned to eventually. An *ex situ* programme for one species thus serves as a publicity nucleus for the conservation of a whole biotope and the hundreds or thousands of less conspicuous species also living there.
3. Ex situ *conservation programmes demonstrate to zoo visitors that each human generation has a responsibility to following generations to save other species at any cost.* Each species serves irreplaceable purposes and its conservation is the conservation of future options for the restoration of nature and also for utilisation by man in as yet undiscovered ways.

If these points are advantageously used (i.e., well chosen keystone and flagship species, and optimal use of publicity opportunities), the total contribution of ex situ *programmes to nature conservation is of considerable magnitude.*

Chapter 8

Artificial Reproduction and Cryopreservation: Biotechnology in Support of Conservation

8.1 The Use of Artificial Reproduction Techniques in Zoos Can Be of Benefit to Species Conservation

Artificial reproduction techniques have been practised in the farm animal industry for some time now, and have developed into routine procedures within the last 20 or 30 years. In fact, reproduction of some animal species in this sector is now almost entirely dependent on such techniques. Experimentation with reproductive biotechnology began in the 1980's within the zoo world, and is already practised with success in various zoos (some examples are given in Box 13). Most of these successes have occurred within the last decade. When the great research needs can be met, it is to be expected that development and adaptation of reproductive biotechniques for exotic animal species will proceed at a faster rate in the future.

Artificial reproduction techniques potentially can be of great service in breeding programmes that strive to save the original genetic

Box 13
Examples of Successful Artificial Reproduction in Zoos

Some examples of successful use of artificial reproduction techniques in zoos include:

- Artificial insemination with fresh sperm (e.g. in cranes, raptors, galliform birds, and various mammals, including gorilla and giant panda);
- Artificial insemination using frozen and subsequently thawed semen (e.g. cranes and various mammals);
- *In vitro* fertilization (e.g. various mammals);
- Intraspecific embryo transplantation (e.g. eland and bongo antelopes, Przewalski horse/domestic horse, tiger, baboon, marmosets);
- Interspecific embryo transplantation (e.g. zebra to domestic horse, bongo to eland antelope, gaur to domestic cattle, Indian desert cat to domestic cat);
- Embryo transplantation, using frozen and subsequently thawed embryos (e.g. eland antelope, marmoset);
- Embryo cleavage and subsequent transplantation (e.g. bongo antelope).

variability of a population through strict regulation and control of breeding, as is shown in Box 14.

The World Zoo Conservation Strategy emphasizes that the application of techniques for artificial reproduction can potentially promote a natural genetic structure within ex situ *populations and thereby increase their chances of survival, and make interactive management of* in situ *and* ex situ *populations possible. The chance of survival of natural, relict populations is thus also increased.*

8.2 Limiting Factors Should Be Reduced: More Research is Needed

The possibilities for conservation strategies offered by artificial reproduction techniques are complicated by the need for handling of the animals, and medical procedures that must be carried out under anaesthesia, i.e. electro-ejaculation, collection of ova or embryos, implantation, etc. Although these techniques do not constitute much risk with modern methods, zoos naturally want to keep the possible disturbance of their animals' daily existence and rhythm to an absolute minimum.

Another limiting factor in the application of artificial reproduction techniques is the shortage of knowledge and experience. Although these techniques are routinely used with farm and pet animals, they are not all directly applicable to zoo animals. Each aspect of a particular technique (e.g. collection of sperm, ova, or embryos; hormonal treatments and implantation) requires preparatory research for each new species or group of species, and often requires a long experimental phase.

The research that has been undertaken on a number of zoo animals in recent years has demonstrated well that important successes can be achieved.

Box 14
Benefits of Artificial Reproduction Techniques for Population Management

Artificial reproduction techniques are useful tools for population management, because:

1. They can simplify the exchange of genetic material between two or more *ex situ* programme sites in order to avoid inbreeding, and for other objectives. Transport of sperm and embryos is considerably less expensive, and also carries far fewer risks than transport of animals.

2. They can enable reproduction in animals with behavioural or physical reproductive handicaps (e.g. behaviourally incompatible pairs, human imprinted animals, physical obstructions to mating and/or pregnancy). This can be very important if it involves animals that represent important genetic lines in breeding programmes. Care should be taken, however, not to breed animals with genetically determined handicaps.

3. They make rapid population growth possible. This can be of crucial importance if only a very small founder population is available for a critically endangered species, as it is then of paramount importance to have swift population expansion in the first few generations.

4. They can help to correct uneven sex ratios; for example embryos of the needed sex can be transplanted.

5. They can help to regulate the number of offspring per individual animal, i.e. reproduction can be stimulated in animals with too few offspring; this is particularly important if the animal represents an important founder line.

6. They can make possible exchange of genetic material between *ex situ* and *in situ* populations, when and where necessary, without requiring the transfer of animals. *Ex situ* populations can be reinforced without removing animals from wild, relict populations. *In situ* populations can be "injected" with new genetic material from captive populations without all of the problems associated with reintroduction of animals, and the dangers of introducing diseases.

Box 15
Benefits of Cryopreservation to Species Conservation

Cryopreservation of germ plasm (semen, ova, and embryos) has a number of distinct advantages in regard to species conservation:

1. It enables easy transportation of genetic material over long distances; this can greatly simplify exchange of genetic material between sub-units of *ex situ* populations, as well as between *ex situ* and *in situ* populations.

2. It makes increase of generation time in *ex situ* populations possible—frozen sperm, ova, or embryos may be used long after a parent's death. This means that fewer animals would be required per *ex situ* population, hence more species can be preserved in a more cost effective way through *ex situ* efforts.

3. It enables retrospective analyses of genetic founder material, which may be important in pedigree analysis.

4. It may form an insurance against loss of living representatives of important genetic lineages, as frozen genetic material of ancestors can be revived.

5. Similarly, it may form an insurance against undesirable effects of unnatural selection in *ex situ* populations—if such selection did occur, founder material that had not yet been selected upon could be injected into the population.

6. Finally, cryopreserved material could provide insurance against epidemic diseases or other catastrophes in *in situ* or *ex situ* populations. After decimation of the population by such an event, reintroduction of genetic material from cryopreserved bloodlines could help revitalize the population. It should be noted, however, that cryopreserved germ plasm can only be used for this purpose as long as at least a minimal number of living individuals of a species are available to carry on the species' non-genetic heritage (see Box 16).

Above all, the knowledge acquired in this initial phase serves to speed up future developments. Further research and expansion of knowledge and experience over a broad spectrum of wild animals is a major objective of the World Zoo Conservation Strategy. The Strategy calls on zoos and their personnel to realize that application of these modern techniques is in the interest of conservation of endangered animal species. Scientists assisting in the development of these techniques and methods should realize that they are working with wild animals rather than cattle, sheep, or laboratory mice. This requires particular respect for the integrity of the relevant animals and their keepers, and great care in the execution of research projects.

8.3 Cryopreservation: A Third Component of Species Conservation

Cryopreservation techniques, the temporary conservation of sperm, egg cells, and embryos (jointly referred to as "germ plasm") in liquid nitrogen (-196° C), are used in combination with different artificial reproduction techniques in the zoo world. Frozen and subsequently thawed sperm have been used to fertilize antelopes, deer, apes, and wolves, with young resulting from these undertakings. Eland antelopes, baboons, and marmosets have been produced by transplantation of frozen and thawed embryos.

Much research has been directed towards cryopreservation of germ plasm of wild animals during the last ten years. Despite many initial setbacks, just as occurred with artificial reproduction techniques, considerable progress has been made, indicating that the applicability of these techniques will grow quickly in the coming years. Different zoos and zoo-related research institutions have already accumulated extensive collections of deep frozen germ plasm material from exotic animal species. As shown in Box 15, cryopreservation has a number of distinct advantages for species conservation.

The World Zoo Conservation Strategy recognizes that banks of cryopreserved material of endangered species could serve as the third component (besides the in situ *and* ex situ *components) of species conservation. These three components together guarantee the optimal survival chance for a threatened species. The building up of such banks, and further research in cryopreservation techniques, must be stimulated. Zoos can be important providers of the germ plasm material, although material from wild populations must be gathered as well. Zoos can be the mechanisms by which wild germ plasm can be both stored and re-expressed. Zoos are particularly well equipped to this task as they can guarantee that not only genetic resources are conserved—in part through cryopreservation techniques—but also the behavioural repertoires of endangered species through the maintenance of living* ex situ *populations and the re-expression of cryopreserved germ plasms in these living populations. (See also Box 16)*

The germ plasm banks should not operate independently from in situ *and* ex situ *populations, rather their management and use should be integrated through interactive management. Studbook keepers, species coordinators, breeding programme organizations, and relevant nature conservation bodies must be involved, as germ plasm banks cannot substitute for living populations as reservoirs of learned behaviour, but can only complement their genetic reservoirs.*

Box 16
Genetic and Behavioural Resources

In Chapters 6, 7, and 8 of this strategy the basic approach is that it is of utmost importance to save the genetic inheritance of species as completely and thoroughly as possible as a *genetic resource* for the future. Special attention, however, must also be paid to behaviour, because along with the physical and molecular character sets of individuals, populations, and species, behaviours also constitute sets of characters that are of crucial importance to survival in natural environments. If *ex situ* breeding programmes are to support the ultimate survival of populations in natural environments, great care should be taken to preserve natural, species-specific behaviours. Two main points are of importance here:

1. *A part of the behavioural repertoire of each species is genetically determined.* If all of the established guidelines for breeding programmes are followed, and genetic variability is retained and unnatural selection avoided, then all the genetically determined behavioural characteristics will also remain present in the population. Such characteristics can be retained for generations, even if these are not always expressed in the *ex situ* situation. Reintroduction projects and studies of domestic animals that have run wild have proved that these genetically determined natural behaviours can reappear when animals are living in natural surroundings again.
2. *The non-fixed part of the behavioural repertoire of a species is acquired during the life of the animal. It is not genetically determined, but taught by the parents or other conspecifics, or learned by the individual through trial and error.* The portion of an animal's behavioural repertoire made up of these learned aspects varies greatly between species. Learned behaviours are a very small part of the repertoire of a megapode, a bird that does not come into contact with its parents and immediately must fend for itself. However, for an animal such as an orang-utan, which is cared for and educated by its mother and other conspecifics for a six year period, learning plays an important part in acquisition of the behavioural repertoire, and in its chance of survival within the rain forest. A continuum of variations apparently lies between these two extremes.

Essential but acquired behavioural characteristics can be lost in *ex situ* situations. Food choice behaviour is an illustrative example of this. Animals with complex herbivorous menus rely on their parents to teach them what of the wealth of potential food plants surrounding them they can and cannot eat. Food items in zoos—although carefully chosen to guarantee health—are pre-selected for the animals, and are often not items the animals would ever come into contact with in the wild. Thus, in captivity, traditions, knowledge, and experience built up over many generations can be lost in a matter of one life span.

Animals for which acquired behaviour plays an important role in survival usually possess an innate capacity to learn the necessary behaviours. Behaviour that is lost during an *ex situ* period can in principle be relearned—taught by living conspecifics still in the wild (after, for example, embryo transplantations from animals in the *ex situ* situation to *in situ* animals). It

may also be possible for humans to teach such behaviour if there is sufficient knowledge about the natural behaviour, and if suitable training techniques can be designed and applied. Diverse examples demonstrate that this can be a viable solution in some situations.

As there is insufficient knowledge in many cases about acquisition of behavioural repertoires by wild animals, and the importance of various components for survival in the natural situation, *it is necessary to save behavioural resources as well as genetic resources for the future.* Extra attention should be provided to the conservation of intact behavioural repertoires of the *ex situ* populations for which *in situ* counterparts have a low chance of survival.

Encouraging the natural behaviour of animals is just equally important to the other conservation oriented tasks of zoos:

1. Natural behaviour of zoo animals is often of great importance from an educational standpoint. Not only can factual information about a species be conveyed through such behaviour, but natural behaviour can play an instrumental role in cultivating the public's respect and admiration for animals.
2. The display of natural behaviour by zoo animals is essential to many types of research, and depends on creation of conditions in which natural behaviour will be expressed and preserved for a long term. Zoos are often the only place where many types of research can be carried out relatively efficiently and inexpensively, while still delivering a wealth of information.

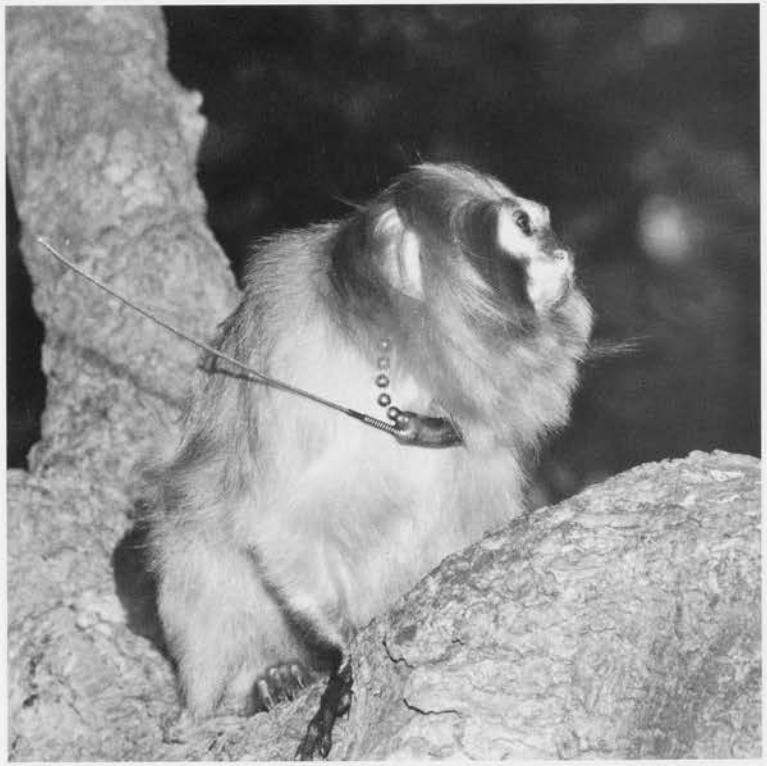
Moreover, the performance of elements and patterns in the behavioural repertoire is of great importance in guaranteeing an acceptable level of well-being in zoo animals.

The World Zoo Conservation Strategy recognizes that good zoos should strongly invest in encouraging full expression of natural behaviour of animals in zoo surroundings:

1. *by the zoo animal management staff (curators, biologists, veterinarians, keepers) devoting much time to exploring and developing expression of behavioural characteristics of animals in their care. Despite a shortage of scientific publications in this area, there is still much information available in the literature from studies in the wild or zoo research, and from personal communications with colleagues working with animals in other zoos. The existing knowledge forms the basis for further improvements in zoos and further research in this area.*
2. *by ensuring that zoo animal enclosures are constructed and furnished so that natural behaviours are stimulated and expressed. A wide range of basic behaviours are addressed, including: species-specific locomotion, food searching activities, nest building, reproductive behaviour and parental care, flight behaviour, healthy and productive use of time, satisfaction of natural curiosity, and so on.*
3. *by reviewing the composition of the animal group in each enclosure so that it is flexible, allowing adjustments to natural behavioural needs and responses. Not only is the normal group social structure considered, but also changes in the group structure, e.g., introduction of a new animal to, or a birth within, the existing group, or the departure of an animal.*

Chapter 9

Back to Nature: Zoo Animals for Reintroduction and Restocking



9.1 The Ultimate Goal of *ex situ* Conservation: Support of Survival in the Wild

The ultimate goal of *ex situ* breeding programmes is to support the survival of populations of endangered species in their natural environments (see Chapter 6). The use of *ex situ* populations for educational and research objectives helps to meet this goal, but increasingly these populations must also serve as reservoir populations, which with strict protection and intensive management can prevent the extinction of species. Although relict wild populations still exist for many of the species that have *ex situ* populations, some of these are so threatened that it is doubtful whether they will survive in the short or long term in the wild. Sooner or later the moment will come in which the *ex situ* reserve must directly support the survival of such species in the wild. In fact, for an increasing number of species that moment has already arrived.

The World Zoo Conservation Strategy—in accordance with the Convention on Biological Diversity (Box 2)— concludes that ex situ *zoo populations ultimately should support the survival of wild populations. Besides the use of the* ex situ *population for promotional, educational, and research purposes, this may also mean that the genetic reservoir of the captive population will be used to help re-establish viable populations in natural habitats. Although biotechnology—at some point in the future—may offer special opportunities to achieve this goal (such as transplantation of embryos from* ex situ *populations to remnant wild populations), support to the re-establishment of viable wild populations will generally involve the return of captive-born animals to nature.*

9.2 Reintroductions Can Bring Great Benefits to Natural Biological Systems

The IUCN Council adopted the position statement *Translocation of Living Organisms* in 1987, in which the release of animals from *ex situ* populations into natural environments was included. IUCN states that:

"Translocations are powerful tools for the management of the natural and man-made environments which, properly used, can bring great benefits to natural biological systems and to man...."

The IUCN statement defines three types of translocations involving transfers of individuals from a captive situation to a wild habitat, or from one natural habitat to another:

1. *Introduction* of an organism, which is the intentional or accidental dispersal by human agency of a living organism outside its historically known home range.
2. *Reintroduction* of an organism, which is the intentional movement of an organism into a part of its native range from which it disappeared or became extirpated in historic times as a result of human activity or natural catastrophe.
3. *Restocking*, which is the movement of numbers of plants or animals of a species with the intention of building up the number of individuals of that species in an original habitat.

The World Zoo Conservation Strategy focuses on reintroduction and restocking. Introduction of alien species from *ex situ* populations into natural or semi-natural environments, either intentionally (by release) or unintentionally (e.g. by escape), is strongly discouraged, except in very special circumstances.

Note: As substantially more of the original habitat of some species disappears, it is quite possible that the IUCN position on introduction of species into habitats outside their historic range

will change. If so, zoo policy should be adapted accordingly. As technical aspects of introductions for species conservation must satisfy the same conditions as those for reintroductions, introductions will not be discussed separately.

9.3 Reintroduction and Restocking: *Pros* Outweigh *Cons*

Although the IUCN position is clearly that reintroduction and restocking can offer a sizeable contribution to conservation of threatened animals in natural environments, there have been years of discussion of *pros* and *cons* in nature protection and academic circles over returning animals to the wild from *ex situ* populations generally, and from zoos particularly. Despite the IUCN statement, this discussion still continues, particularly at local and national levels. It is therefore warranted at this time to give a short presentation of opposing arguments, and the position of the World Zoo Conservation Strategy in these:

1. "Populations that have been *ex situ* for a considerable length of time would no longer possess the genetic material necessary to survive natural adversities or the potential to adapt to these."

   As clearly indicated in Chapter 6, ex situ *breeding programmes are theoretically and organizationally directed towards preserving virtually all the genetic potential of populations. The World Zoo Conservation Strategy therefore emphasizes that there is no need to fear that animals from* ex situ *populations are unfit to survive in nature from a genetic point of view, or that they cannot contribute in the building up of new populations that can withstand natural selective forces.*

2. "Behavioural elements that are indispensable for survival in the wild may be lost during the *ex situ* period."

   Special attention is paid to behavioural aspects of ex situ *populations in Chapter 8 (Box 16) of this Strategy. In conclusion, it can be said that if all the conditions for conservation of natural, species-specific behaviours are satisfied, many species will be well suited to return to nature. Certainly, in all cases extensive preparation and thorough research is required before action is taken.*

3. "Reintroduction of a species would not be feasible or even possible if the original habitat is unavailable or considerably changed."

   The World Zoo Conservation Strategy distinguishes various aspects of the relationship between habitat availability and reintroduction:

   Firstly, even if the habitat is still available, it must be ascertained that the factors originally threatening the population no longer exist.

   Secondly, in a number of cases only certain species or groups of species of an entire habitat are endangered. If the threats can be removed from the entire habitat or part of it, then rescue operations and temporary ex situ *propagation may be very valuable in bridging the critical period until the species can be safely returned to its habitat.*

   Thirdly, in many cases only specific areas within an animal's habitat are threatened, e.g. their breeding areas, while other parts, e.g. feeding areas, remain intact. If threats from these specific areas can be removed, or the areas recreated, ex situ *populations could be very useful in rebuilding natural populations.*

   Fourthly, the possibility of returning ex situ *populations in cases of severely damaged or unavailable habitats depends on two main factors: the complexity of the original biotope, and the complexity of the relationships of the species within its natural surroundings. Species which originally lived in complex environments and had complex interactions may not be able to return to the wild after the total disappearance of their biotope. Nonetheless, species with less complex relationships, or living in a less complex habitat may have a much better chance.*

4. "Restocking remnant wild populations with released animals from ex situ populations might exceed the carrying capacity of the remnant habitat."

   The World Zoo Conservation Strategy recognizes that exceeding the carrying capacity of a remnant population through restocking is a danger to be aware of. However, the goal of restocking programmes may not always be to increase the size of the population, but rather to increase genetic variation. For some small populations this may be necessary, even if they are on the edge of their carrying capacity. The advantages of genetic restocking can well outweigh the disadvantages of temporarily slightly exceeding the carrying capacity in such cases.

5. "Animals used for restocking projects might transfer pathogens or parasites from the *ex situ* population to animals in the wild habitat where the pathogens or parasites are absent."

   The World Zoo Conservation Strategy emphasizes that transfer of pathogens or parasites is a potential problem which demands great attention, as well as maximal use of the medical skills, knowledge and experience available in institutions caring for ex situ *populations. It therefore calls on zoo associations, CBSG, the Reintroduction Specialist Group, and the Veterinary Specialist Group of IUCN/SSC to continue to focus attention on the veterinary aspects of reintroductions. However, the Strategy also observes that national and international legislation restricting the transportation of animals in order to reduce risks of importation of diseases may unnecessarily hamper reintroductions for conservation purposes.*

6. "Restocking might result in undesirable mixing of the gene pool of the subspecies or race indigenous to the release area with genes of other subspecies or races."

   The World Zoo Conservation Strategy states that if sufficient attention is given to separation of intraspecific forms in warranted situations, as discussed in Chapter 6, the risk of undesirable mixing of gene pools would be avoided.

The Strategy calls on all local, national and international authorities and on all nature conservation organizations and other parties involved to recognize and support well prepared and carefully planned reintroduction and restocking projects involving animals from ex situ *zoo populations, provided that these projects do not divert attention and funds from habitat conservation.*

9.4 Two Lessons Can Be Learned from Unwanted Introductions

Countless animal species have been intentionally or unintentionally introduced in areas all over the world. This has lead in many cases to the establishment of wild populations without further human aid. Even populations of domestic animals, after hundreds of generations of selective breeding, have managed to establish themselves in the wild without human help, and have often done so in habitats quite unlike their original ones. Such "successful" introductions of alien species continue to occur, and often have disastrous consequences for the local, indigenous flora and fauna. Many of the indigenous species have been brought to the edge of extinction, or have become extinct already, through competition with, or predation by, introduced species.

The World Zoo Conservation Strategy concludes that two lessons should be learned from unwanted introductions:

1. *The evidence that* introductions *of species to strange habitats without intensive support are regularly "successful to very successful" provides support to the belief that* reintroductions *of animals in their own original habitats may also have a chance of success as long as nothing interferes with the process. However,* reintroduction *of highly specialised species may prove to be more difficult than the* introduction *of generalist species.*

Box 17
Reintroductions Using Captive-born Animals

The IUCN/SSC Reintroduction Specialist Group compiles and maintains a database on reintroductions using captive-born animals to re-establish or reinforce wild populations. As of December 1992 the database included 138 administratively distinct projects, involving 120 species and a total of over 14 million captive-bred individuals.

Among the reintroduced species mammals (32% of the reintroduced species) and birds (40%) are clearly over-represented. Fish (8%) and invertebrates (2%) are under-represented. The average numbers of individuals reintroduced per species, however, are considerably smaller for mammals (61) and birds (786) than for the lower vertebrates (19,307 for reptiles and amphibians, 1,522,337 for fish species).

Zoos were involved in as many as 52% of the recorded reintroduction projects which, however, included only some 9,000 zoo-born mammals and birds. Thus, in terms of numbers of individuals hitherto the zoo community cannot be considered as a major provider of reintroduced animals. This probably is related to the fact that only 20% of the reintroduction projects took place in the tropics; the majority of reintroductions having been carried out by federal and state wildlife agencies in the moderate and subtropical climatic zones of North America, Europe, Australia, and New Zealand. As the majority of zoo animals are tropical species, zoo participation in reintroductions would increase if the number of tropical reintroduction projects increased.

The Reintroduction Specialist Group considers 15 (11%) of the 138 recorded reintroduction projects as having proven to be successful, where "successful" is defined as having contributed to the re-establishment of a self-sustaining wild population. Many on-going projects are considered promising, while many projects have yielded other benefits, such as increased public awareness and support for conservation, professional training, enhanced habitat protection and increased scientific knowledge. Successful projects differ from unsuccessful ones in that they have reintroduced larger numbers of animals per species, have a longer duration, and have established better public awareness programmes.

Some well-known reintroduction projects involving zoo-born animals include:

- European bison (*Bison bonasus*) in Poland and Byelorussia
- American bison (*Bison bison*) in the United States and Canada
- Alpine ibex (*Capra i. ibex*) in various Alpine countries
- Arabian oryx (*Oryx leucoryx*) in Oman
- Przewalski's horse (*Equus przewalskii*) in Mongolia
- Père David's deer (*Elaphurus davidianus*) in China
- Golden lion tamarin (*Leontopithecus rosalia*) in Brazil
- Black-footed ferret (*Mustela nigripes*) in the United States
- Hawaiian goose (*Branta sandvicensis*) on Hawaii
- Mauritius kestrel (*Falco punctatus*) on Mauritius
- Californian condor (*Gymnogyps californianus*) in the United States
- Eagle owl (*Bubo b. bubo*) in various European countries
- Bali mynah (*Leucopsar rothschildi*) on Bali
- Mallorcan midwife toad (*Alytes muletensis*) on Mallorca

2. *Because* introductions *have often severely threatened local animal species*, ex situ *breeding programmes and subsequent* reintroduction *projects that are meant to guarantee the continued existence of such threatened species must have strong support. Part of the reason why* ex situ *programmes are necessary now is because of the serious mistakes made by* introduction *of species.* Reintroduction *is meant to mend what has been damaged by humankind. Consequently,* reintroduction *attempts must be approached with both care and science.*

9.5 Experience, Successes, and Failures: Building Up Knowledge

Reintroduction and restocking efforts using *ex situ* bred animals have been attempted with over 120 different species during the last hundred years—excluding a few early attempts, most have in fact been undertaken just in the past few decades. The degree of success of these projects has been quite variable. Some were clearly failures. No more than 15 so far have led to the establishment of new, self-sufficient populations in nature. The remaining projects are still in too early a stage to assess the outcome. A number of examples are given in Box 17.

All projects to date must be viewed as experimental; providing knowledge for future projects. To this end, unsuccessful projects can yield just as much information as successful ones. A wealth of useful data has been collected in recent years, thanks to better prepared and better led projects. It is important to continue these efforts, as only in this manner can sufficient knowledge and experience be accumulated in regard to the possibilities and limitations of reintroduction and restocking, and in regard to refinement of useful techniques and creation of suitable conditions. This understanding will be indispensable in the future, when *ex situ* populations must be used on a greater scale in support of conservation of natural populations.

It is a major objective of the World Zoo Conservation Strategy to continue and accelerate the process of compiling knowledge and experience on the strengths and weaknesses of reintroduction projects. The global zoo network, together with the IUCN/SSC Reintroduction Specialist Group, the Captive Breeding Specialist Group, the Veterinary Specialist Group and other taxon-based Specialist Groups should continue exploration of reintroduction techniques and procedures on a scientific basis.

9.6 Reintroduction and Restocking May Take Time

It is a general misunderstanding that reintroduction and restocking attempts will lead to instantaneous success. A number of projects have been condemned by opponents or abandoned by supporters because they did not appear to be successful within a couple of years. It must be realized, however, that the processes leading to the extinction of species and the destruction of habitats have often been in operation for many decades. Why then should the rebuilding of healthy, self-sustaining wild populations be successful within a few years? Rather, it is to be expected that in many cases a considerable number of generations of repeated reintroduction of animals, and continued reinforcement of the founder group and its descendants will be required before a population develops that can survive all the natural conditions.

The World Zoo Conservation Strategy emphasizes that reintroduction projects for re-establishing or reinforcing wild populations of endangered species deserve long-term investments in time, dedication, and money.

9.7 There Are a Number of Additional Prerequisites

As clearly indicated in this document, the World Zoo Conservation Strategy takes the position that an important contribution in conservation of species in

their natural habitats can be offered through establishment and management of ex situ *populations. Reintroduction and restocking projects using* ex situ *animals now form a substantial part of that contribution, and are destined to form an even larger part in the future. The Strategy emphasizes that the involvement of the zoo world in such projects will meet the following conditions:*

1. *The IUCN position statement "Translocations of Living Organisms" lists a number of conditions and considerations for responsible reintroduction and restocking projects. These, and potentially other conditions formulated in the future by IUCN as new information becomes available, will serve as the basis for projects initiated by zoos, or in which zoos participate. Veterinary guidelines and protocols—including those issued by the authorities of the recipient country—will be respected.*
2. *Zoos will not operate independently concerning reintroduction and restocking projects. Whenever possible, they will establish a cooperative group of zoos working with the relevant species. Studbook keepers, species coordinators, and species committees will also be involved. Reintroduction and restocking projects will in fact be components of breeding programme master plans. Moreover, reintroduction and restocking projects will be undertaken only in consultation with the relevant IUCN/SSC Specialist Groups and other conservation agencies, particularly the conservation authorities of the recipient country. Zoos can provide valuable stock for reintroductions, but often will be collaborators rather than the actual implementors of reintroductions.*
3. *Reintroduction and restocking will only involve sustainable harvesting from* ex situ *populations. There is only a solid basis for future attempts in case of failure if intact, demographically stable and genetically balanced* ex situ *populations remain in existence.*
4. *Reintroduction and restocking will not be used as an instrument for disposing of surplus animals. Animals for these projects will be carefully selected, based on detailed population analyses. This benefits the* ex situ *population as well as the* in situ *population that is being re-established or reinforced. Animals surplus to the* ex situ *population can be suitable reintroduction candidates, but potential surplus problems per se will be solved using other methods.*
5. *Publicity for reintroduction and restocking efforts can play an extremely important role in raising public awareness about the importance of conserving species and their habitats, and gives publicity to conservation efforts of the involved zoos.*

Chapter 10

Knowledge and Research

10.1 Zoos Are Important Sources of Scientific Knowledge

The 19th century zoos were already important sources of biological knowledge. Numerous species could only be studied well because there were living examples available to scientific researchers in zoos. Because of this, zoos played an important role in the development of descriptive biological sciences: anatomy, morphology, taxonomy, classification, study of locomotion, feeding, etc. Science has also made good use of the existence of zoos in this century. Many of the early behavioural studies were carried out in zoos, and a great amount of the present medical understanding of exotic animals is a result of research in zoos. Studies on nutrition, reproduction, physiology, psychology and many other such aspects also have yielded much information.

The World Zoo Conservation Strategy emphasizes that the rapid development of the biological sciences in recent decades has ensured that zoos now offer an even greater potential source of knowledge than they did earlier. Basic scientific information, even in the most modern branches of biological sciences, can be gathered in zoos. The availability of this resource to the scientific community lends an intrin-

sic value to the existence of zoo animal collections, and such use is encouraged by zoos.

10.2 Proper Management of Zoo Collections Requires Much Knowledge

Zoos manage diverse collections of animals from all over the world. An enormous amount of scientific knowledge is required about virtually all biological and medical aspects of the animals that are held. This knowledge is necessary to feed, house, and care for the animals, to stimulate their reproduction and to keep them healthy. It is also necessary in order to achieve the maximal educational potential of zoos.

The need for scientific knowledge has grown considerably since it became clear that zoo collections must not only be managed over the short term, but must also remain healthy and viable over the long term, and since it became established irrefutably that zoos could offer an essential contribution to the conservation of species and habitats through the maintenance of *ex situ* populations. Comparatively new branches of science, such as genetics, population biology, conservation biology, biotechnology and others, have been added to the long list of areas that serve as necessary foundations for zoo practices.

The World Zoo Conservation Strategy recognizes that there is a virtually unending need for knowledge in the zoo world in the most diverse of biological and veterinary medical disciplines as well as other related sciences, including all sciences that are necessary for the best educational use of the collections and for animal welfare.

10.3 A Wealth of Knowledge is Already Available, But Still More Needs To Be Acquired Through Scientific Research

A considerable amount of knowledge has been accumulated during the 150 years of modern zoo history. Thus, the educational value of zoos is enormously increased, countless animals survive and reproduce much better than earlier, and their populations can be managed and conserved for the future. A great part of the knowledge acquired has been recorded in reports, books, journals, magazines and other publications, and in databases. The present day zoo world includes thousands of knowledgable collaborators, ranging from zoologists, veterinarians and other scientists, to educators, curators, and keepers. Together these collaborators represent an enormous source of information.

The World Zoo Conservation Strategy emphasizes that it is the task of each zoo individually to optimize use of available knowledge resources in order to further conservation goals, and of all zoos collectively to make all of the written and unwritten information easily accessible and usable for the entire global zoo network.

Despite the immense amount of knowledge that has been gathered, there is still a great need for additional information. The more that is known about zoo animals and their biological characteristics, the more questions there are. Additionally, the more involved zoos become in species conservation and nature conservation, the greater the demands become on all aspects of management, and the more scientific information required to meet these demands.

The World Zoo Conservation Strategy concludes that gaps in understanding must be filled through research. This must be developed through directed scientific research projects, and through analysis of the stream of empirical and experimental data that are collected and recorded in each zoo on a daily basis. Research is not an exclusive undertaking that should involve only a limited scientific staff, rather each zoo employee should be involved either directly or indirectly in its pursuit. Because zoos have to consider a broad scale of bioscientific factors in their conservation goals, research topics will also be diverse. Box 18 presents an overview of the most important categories of required research.

10.4 Research Potential Needs To Be Increased

Despite the great need for research in relation to conservation objectives, manpower and financial resources for extensive research is rarely available in zoos. Many zoos do not have a full-time researcher on staff, a relatively small number have one or more researchers, and in a few exceptional cases zoos have a research department with a full, professional research staff. Nevertheless, countless zoo workers (scientific, curatorial, and keeper staff) undertake some research in addition to their normal daily tasks, and continually collect data that can form the basis for analytical study. The total research output from zoos is therefore considerable despite the shortage of research staff.

The World Zoo Conservation Strategy emphasizes that the research potential should be further heightened through:

1. *Cooperation with research institutions, universities and nature conservation organizations. Zoos should have an active policy to interest and involve as many parties in research as possible. This does not only relate to zoological and veterinary disciplines, but also to other sciences that may be relevant to aspects of zoo conservation, such as botany, sociology, etc.*
2. *Intensive cooperation between zoos regarding exchange of data and research materials.*

Additionally, zoos should continue to increase their research potential and efficiency in view of the growing need for knowledge necessary for undertaking conservation tasks.

10.5 More Funds Should Be Made Available to Zoo Research

Much of the cost of research in zoos is paid by the zoos themselves. The amount of money available for research varies significantly between zoos. It is difficult to arrive at an estimate for actual research investment, as many zoo workers collect research data in combination with other duties. Research funding opportunities for zoos, other than their own income, include subsidies, research grants, and sporadic funding through external institutions, e.g. universities, research fund, or nature conservation bodies.

The World Zoo Conservation Strategy concludes that zoos should try to increase their own financial contribution whenever possible to further intensify and expand necessary research efforts. Additionally, they should work both independently and cooperatively to obtain external research funding. The Strategy calls on research and conservation bodies to realize that zoo-based research has great scientific and conservation value (see 10.9), justifying substantial financial contributions.

10.6 Research Priorities Should Be Identified and Coordination Improved

More research is needed than can be carried out practically by zoos and the other scientific institutions with which they cooperate, within the limits of manpower and financial resources available.

As resources for research are limited, the World Zoo Conservation Strategy calls for the establishment of research priorities on different levels:

1. *Individual zoos should categorize their own specific problems and formulate research questions for these.*
2. *Groups of zoos at a national or international zoo associations level should establish which projects should be undertaken by zoos independently and*

Box 18
Important Categories of Zoo Research

It is impossible to give within the framework of this document a summary of all the professional areas, subdisciplines, and related sciences that are of importance to the conservation objectives of zoos. Thus, only a short overview of important research categories is provided here:

1. *Species-specific research.* Almost all animal species in zoos, especially those playing an important role in *ex situ* conservation, require further research in a wide range of areas, e.g. husbandry, nutrition, various behavioural characteristics, interactions with the environment, medicine, reproduction, physiology, endocrinology, and a whole host of others. Increased knowledge in these areas is required for improvement of longevity, well-being, reproduction, long-term conservation, and reintroduction potential.

2. *Population biology research* to increase our general knowledge of the dynamics of *in situ* and *ex situ* populations. It includes: theoretical development of small population genetics and demographics, adjustment of theoretical generalizations to species-specific situations, genetic and molecular genetic studies of various real populations, taxonomic studies to determine species and subspecies boundaries (using a variety of techniques and approaches), improvement of population management techniques, etc.

3. *Biotechnical research* is required to explore fully the ways in which artificial reproduction and cryopreservation techniques can support *in situ* and *ex situ* conservation.

4. *Conservation research* is primarily species-specific, but also involves the development of general methods and techniques for assessing the viability and degree of endangerment of species, populations, and habitats. This information is basic to the formulation of action plans and priority lists for species requiring *ex situ* conservation.

5. *Educational research* is needed to increase the educational impact of all aspects of conservation on public awareness.

collectively, and for which projects outside help is required.

3. *A research plan should be developed for every species with a breeding programme, within the framework of that programme.*

4. *Regional breeding programme organizations, together with supranational zoo associations, should establish research priorities and formulate action plans for these.*

5. *IUCN/SSC's Captive Breeding Specialist Group and its various working groups should overview national and regional activities and help integrate research action plans.*

The Strategy emphasizes that establishment of research priorities and formulation of action plans requires coordination between all parties involved. Because of the low number of researchers per zoo, good coordination is essential for maximizing research effectiveness. It is necessary for avoiding unnecessary duplication of effort, and also for giving sufficient consideration to all of the diverse research areas.

10.7 Databases and Research Material Banks Can Increase Efficiency

Research in zoos frequently suffers from a shortage of research material. The number of animals per species present within one zoo is often too small to address a species-specific research question within a limited amount of time. It is frequently necessary to have material and data from a number of zoos in order to do valid research.

The World Zoo Conservation Strategy advises that research should be increasingly within the framework of breeding programmes, in which the regional or world population of a species forms the research material.

Another possible method of increasing the available research material is through the establishment of material banks. Much research involves use of materials that can be fairly easily collected in a zoo, and that can be held for a long period of time, e.g. blood, serum, urine, tissue, and whole animals resulting from natural mortality.

The Strategy calls on the zoo research community to establish banks in which materials can be stored in order to increase efficiency of research in a number of areas; such banks could be established within the framework of regional breeding programme organizations. However, global coordination is required in order to avoid unnecessary duplication.

A third possibility for making more efficient use of research materials is to establish data banks for basic data, and for this the uniform registration of animal data via ISIS-ARKS computer software forms a good basis.

The World Zoo Conservation Strategy recommends further expansion of databases for such basic data as feeding, behaviour, medical aspects, and many other variables related to zoo animals. Once built, such databases will greatly simplify analytical and comparative research.

10.8 Research Data Should Be Easily Accessible and Available to the Zoo Conservation Community

Results of zoo research are often published in professional scientific books and journals, and consequently are directed to a scientific audience outside the zoo world. However, zoo research should also increase the knowledge within the zoos, and zoos must be able to evaluate the practical relevance of research results. Obviously most zoos are not equipped with a large team of diverse experts that can evaluate what are often very specialized publications in the scientific literature.

The World Zoo Conservation Strategy calls on all researchers to publish their results in literature that is available to zoos, with the accent on relevancy whenever possible. The International Zoo Yearbook and journals within the zoo world are entirely suitable, and symposia, conferences, and workshops where results can be presented are frequently organized.

In many cases, results of research in zoos remain in the form of internal reports and are not freely acces-

sible in publications. Because these reports often include information that is also important for other zoos, the Strategy recommends to make them as accessible as possible. Short reports in relevant zoo journals and newsletters can contribute to this.

The accessibility and availability of research results can also be promoted through the compilation of bibliographies. Such bibliographies for species, animal group, or research discipline can be compiled by individual researchers, zoos, zoo organizations, or research institutions, and should have as broad a distribution as possible. Use of universal computer software can be of great service in achieving this.

10.9 Zoo-based Knowledge and Research Has Substantial Relevance to *in situ* Conservation

Much of the information acquired through zoo research is of great relevance to conservation generally and to the conservation of species and habitats in particular. This is undoubtedly true for all the basic information collected for countless animal species. It is also true for the various techniques (veterinary-medical, reproductive, genetic, husbandry, management of animal social groups, etc.), and for the understanding of management and conservation of small populations. The knowledge and techniques developed in zoos are also increasingly applied to management and conservation of wild populations.

Many zoos publish much of this information so that it is accessible and useful for conservation. Zoos also provide service to nature protection by making a large amount of knowledge, experience, and expertise available. Zoos participate in numerous nature protection projects by providing both people and means; they regularly contribute important information and their employees function in diverse committees, working groups, and research groups that are involved with nature conservation. It is significant that zoo personnel have prominent roles in the majority of IUCN/SSC Specialist Groups. They also often serve on the editorial boards of international serial research publications in conservation biology, and may be involved in the teaching and supervision of students.

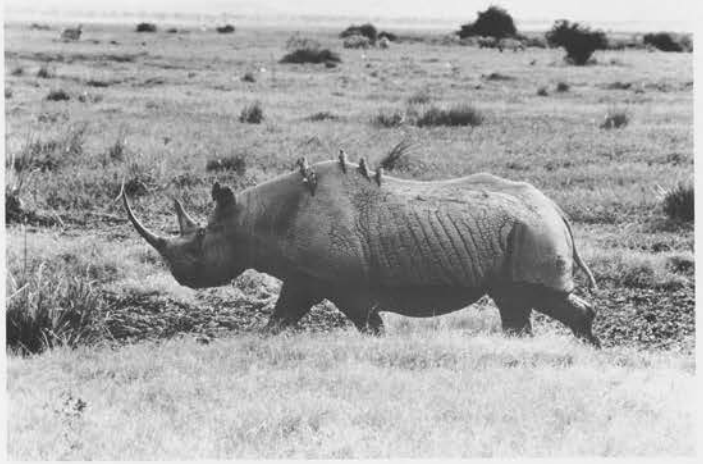
The World Zoo Conservation Strategy calls on the global zoo community to continue to contribute knowledge to nature conservation, and to increase the level of contribution where feasible. Conservation organizations are called on to be aware of the significant contribution by the world's zoos, and to make the most use of it. Although zoo research will not be directly applicable to conservation of wild populations in all cases, it can often stimulate and direct research undertaken in the wild. Ex situ *and* in situ *research are thus intertwined in regard to nature conservation.*

Many zoos are also involved with conservation-oriented research in the field, within their own local region, or elsewhere in the world. They therefore contribute directly to the increase in knowledge concerning conservation of species and habitats. It is an important objective of the World Zoo Conservation Strategy to stimulate further this type of involvement of zoos, as it forms a valuable link between ex situ *and* in situ *conservation efforts, as well as between single species conservation and ecosystem conservation.*

VORTEX is a powerful computer programme for assessing species population viability on the basis of genetic, demographic, ecological, and catastrophic factors. It has been applied to wild populations of rhinos, puma, and other species as well as to captive populations. It is available through CBSG.

Chapter 11

The Way Forward: Towards a New Integration



11.1 Synthesis: Direct Inter-relationship Between All Aspects of Conservation Makes Zoos Effective and Powerful Conservation Institutions

Zoos have important roles to play in conservation. They can have a fundamental impact on the consciousness of hundreds of millions of people regarding the importance of nature conservation and other environmental issues through their education programmes. They help to save biodiversity on our planet through their dedication to the conservation of endangered species. They add greatly to the understanding of nature and its interactions through their continual quest for new information, and this understanding is indispensable for all forms of nature conservation.

These three aspects of conservation are interrelated. Zoo research is not carried out in ivory towers, but rather in the eye of the public. This is also true of *ex situ* conservation of populations of endangered animal species; a mass public can see the necessity of conservation through zoos, and learn that we must fight for the continued existence of every single species. Conservation of species requires knowledge,

Box 19

Zoo Management: Bringing Theory Into Practice

Zoos are highly complex institutions:

High standards are demanded of zoos regarding such diverse aspects as:

- management of animal collections, with the most varied aspects of zoology, zootechnics, veterinary medicine, record keeping, legislation, etc.;
- participation in *ex situ* conservation of species (studbook keeping, population analyses, coordinated cooperative breeding, etc.);
- participation in *in situ* conservation projects;
- diverse aspects of bioscientific research (data collection and analyses);
- education on a wide range of levels for a public with a complex composition;
- direction of visitor traffic through the zoo (safety, customer service, etc.);
- public relations, both in and out of the zoo (development of a house style, advertisements, publications, interactions with the media);
- all other aspects of running a business.

Zoos are just small businesses in proportion to the complexity of tasks and the degree of quality demanded of them. The number of personnel varies from 10 to over 500 people; hence a relatively small number of people must carry out a great diversity of tasks, and execute them with exemplary quality. This makes extraordinary demands on the management and organization of every zoo.

Zoo management and organization: The success of zoos, particularly concerning conservation objectives, is dependent on management and organization. An organizational structure appropriate to the complexity of the institution and excellent management are indispensable. The financial and personnel resources must be available for this.

Mission and planning: The development of a mission statement and masterplan by the individual zoo, incorporating the principles laid down in the World Zoo Conservation Strategy, can step by step lead to a growing contribution in regard to conservation objectives.

Staff training: A great diversity of tasks must be well carried out by a relatively small number of personnel, requiring a highly qualified, experienced, and well-trained staff. Much of the knowledge and training necessary cannot be taught in school, but must be learned through practical experience. Training for diverse categories of personnel within the individual zoos and/or a group of zoos is very important. Of particular importance in this regard are the training programmes developed by individual zoos and zoo associations for zoo staff in third world countries. The further extension of such programmes should be stimulated.

Cooperation: No matter how well organized, how well led and how well trained zoo personnel are, a major contribution to conservation can only be achieved if zoos work together and exchange information. No zoo has all of the necessary knowledge and experience within the limits of its own confines. Each zoo is dependent on others for information in a variety of specialized areas. Zoos have made much progress in the sharing of knowledge and experience with others; yet zoos should still strive for even more intensive cooperation. The growing world zoo network can play a prominent role in this.

and zoo research is directed towards providing that knowledge. This same information also serves simultaneously to improve education and to provide a clearer image of living nature and all of its components. The close inter-relationships and direct connections between these three facets of conservation are possible because these conservation tasks are all carried out by one organizational structure: the zoo. That makes zoos very effective and powerful conservation organizations, provided that their management, staff and organizational structure are optimally equipped to bring theory into practice (see Box 19).

The World Zoo Conservation Strategy emphasizes that the integrated role of zoo education, research and species and habitat conservation, combined with the enormous public interest in zoos, and the ever more intensive cooperation within the world-wide zoo network, results in a great potential for conservation. It is the duty of the zoo world to make full use of this potential for nature conservation on a local, regional, and global scale.

11.2 A Time Bridge is Required, and Zoos Will Help Construct It

The outlook for the 21st century for the earth's entire natural system is bleak. There is nothing to indicate that the destruction occurring in practically all parts of the world will soon cease; the human population continues to grow, and the drain on our natural resources is correspondingly increased. Economic growth is the ideal of almost all nations, placing ever more demands for raw materials and the use of natural resources. Technical developments are happening more rapidly than ever, and the risk that misused technology will further damage our planet also grows. No reason for early optimism is indicated: the earth's biological system is entering a very critical period.

Parties involved with *in situ* conservation must not think only in the short term, but must also direct their vision to a more distant future. Of course they must attempt to conserve what they can conserve over the short term, and strive to stem the threatening influences when and where possible, now as well as in the future. At the same time, however, they must be prepared for the possibility that their efforts may fail in some part, regardless of the amount of dedication to these tasks. They must keep in mind that environmental conditions may continue to worsen, and that in any particular instance a critical point may be reached. It is indisputable that humankind must achieve a balance with nature if it is to survive; and it is possible that this fact will be realised and acted upon before a crisis point is reached. Nevertheless, by that time all the damaging consequences of the destruction of biodiversity and natural systems will be very difficult to reverse.

The World Zoo Conservation Strategy concludes that conservationists must be prepared to find a means of weathering the expected critical period. Though most of their efforts and thought must be directed towards in situ *conservation, they must direct some to the* ex situ *conservation of natural systems over whatever periods of time may be necessary until the tide has turned and the systems once again can operate in safety. Furthermore, conservationists must prepare for the return of these elements to their natural state by ensuring that the maximum relevant information is available.*

The zoos of the world will offer an important contribution in the crossing of that time bridge. They will dedicate all of their capacities and experience to the conservation of those threatened animal species which are no longer likely to survive in their natural habitats. They will make all of their knowledge available for the conservation of remnant habitats and ecosystems, and they will help with the necessary acquisition of information for these endeavours. Above all, they will work unceasingly to increase public awareness by continually pointing out the dangers, and the importance of halting the destruction of species and their habitats. Thus the zoos of the world will help to limit the degree of the expected crisis and help to lessen, if not eliminate, the length of time for which the bridge is needed; for the smaller the cleft, the easier it is to make an effective time bridge.

11.3 Integration is the Sole Solution to Successful Conservation

Clearly, zoos have a great potential in assisting with the making of a time bridge, and they wish to realize this potential and help to build the bridge as efficiently as possible. The potential of the world's zoos will be most effectively used only if their efforts are closely integrated with those of other parties involved in conservation. The time is past for the diverse conservation groups to permit themselves to stand dogmatically by their various viewpoints, criticising each other and doubting the effectiveness of each others contributions to nature conservation.

The time has come for each conservationist to accept that there is only one way to save our planet's natural system, and that is through cooperation, coordination and interaction of all the positive aspects of conservation work.

Many of the leading zoos have already clearly shown how great can be the effect of integration of many aspects of nature conservation. These zoos couple the *ex situ* conservation of threatened animal species with research and publicity on the *in situ* areas and work together with nature protection projects and agencies to conserve remnant habitats. Because of zoo education and publicity they can obtain finances which can be directly given towards nature protection in their own or in other countries. They transfer their knowledge to zoos and other nature conservationists in other parts of the world. Integration is the key to species conservation, habitat protection, education, research, and conservation in general.

The World Zoo Conservation Strategy emphasizes that the growing global zoo network seeks to further intensify the integration that is crucial to successful conservation. Each individual zoo can contribute to this by actively cooperating with other parties within and outside the zoo community. The entire global zoo network can contribute by stimulating individual zoos, by providing them with direction, and by integrating the efforts of their network with those of other nature conservation-oriented networks, such as IUCN's Commission on National Parks and Protected Areas. This great mustering of all available powers will be necessary to give our Earth's biosphere and all its living elements the best possible chance of survival. There are many who believe that if we fail to conserve other species we will fail to save ourselves.

Illustrations and Acknowledgments

Cover: Siberian tiger (*Panthera tigris altaica*). Mike Greer.
Page vi: Polar bear (*Ursus maritimus*). Leland LaFrance.
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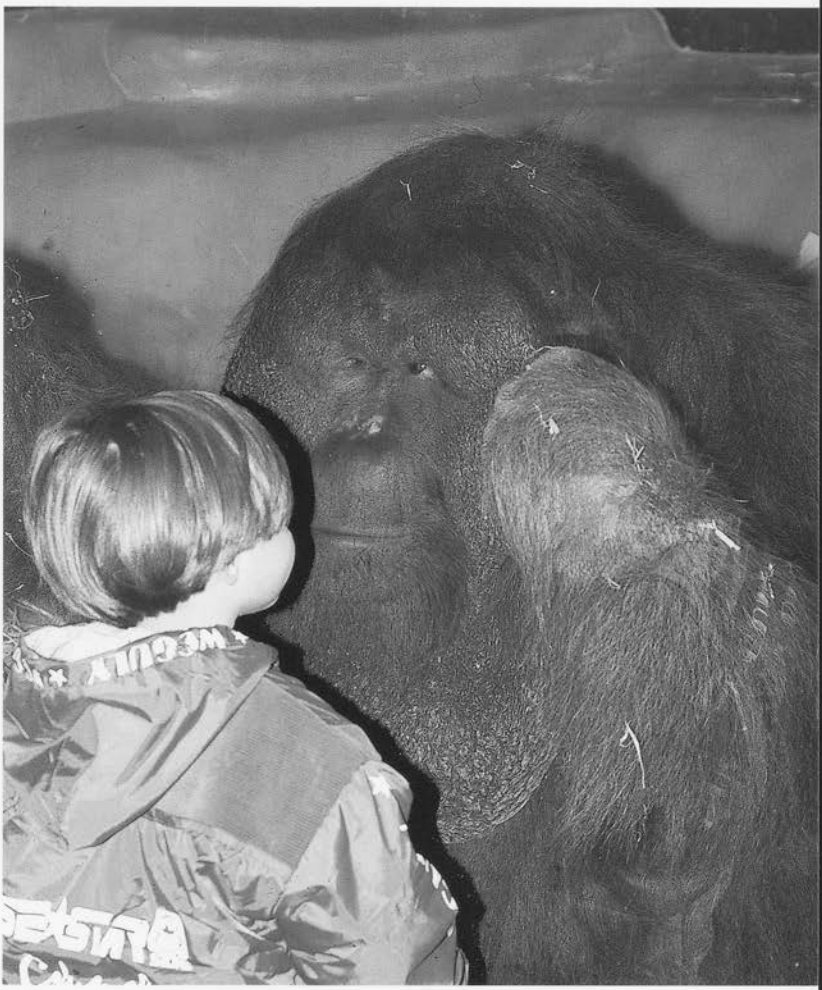
WAZA Facts



UNITED FOR CONSERVATION

What is

WAZA is the acronym of the **World Association of Zoos and Aquariums**, which unites, at a global level, zoological gardens, aquaria, national and regional associations, like-minded organisations and individuals willing to abide by its Bylaws and all other rules and regulations set by the Association, including its Code of Ethics.

The World Association of Zoos and Aquariums (WAZA) was founded in 1946 as the International Union of Directors of Zoological Gardens (IUDZG).

The objectives of the Association are:

- to promote cooperation between zoological gardens and aquaria with regard to the conservation, management and breeding of animals in captivity;
- to promote and coordinate cooperation between national and regional associations and their constituents;
- to assist in representing zoological gardens and aquaria in other international organisations or assemblies;
- to promote environmental education, wildlife conservation and environmental research.

WAZA unifies close to 200 zoological parks and aquaria, a small number of affiliate members, which support the vision, mission and interests of the association, and 17 regional or national associations with another 800 member institutions.

The 1000 zoos and aquaria organised in the WAZA network and the about 200 institutions organised in national associations not yet members to WAZA receive annually at least 600 million visitors, more than any other group of public, conservation-oriented institutions.

The Associati

AIZA

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CAZA

DAZA

EAZA

FUNPZA

JAZGA

FZG

PAAZAB

SEAZA

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Close encounter – child meets male Borneo orang utan (*Pongo p. pygmaeus*)
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Member of IUCN
The World Conservation Union

What is WAZA ?

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AIZA	Iberian Association of Zoos and Aquaria
AMACZOOA	Mesoamerican & Caribbean Zoo & Aquaria Association
ARAZPA	Australian Regional Association of Zoological Parks and Aquaria
AZA	American Zoo & Aquarium Association
CAZA	Canadian Association of Zoological Parks and Aquariums
DAZA	Danish Association of Zoological Gardens
EAZA	European Assoc. of Zoos and Aquaria
FUNPZA	National Foundation of Zoological Parks and Aquaria, Venezuela
JAZGA	Japanese Association of Zoological Gardens and Aquariums
FZG	The Federation of Zoological Gardens of Great Britain and Ireland
PAAZAB	Panafrican Association of Zoological Gardens, Aquaria & Botanic Gardens
SEAZA	South East Asian Zoo Association
SZB	Sociedade de Zoológicos do Brazil
SAZA	Swedish Association of Zoological Parks and Aquaria
UCSZ	Union of Czech and Slovak Zoos
UIZA	Italian Union of Zoos and Aquaria
VDZ	German Federation of Zoo Directors

WAZA's World Zoo Conservation Strategy

In 1993, WAZA published the **World Zoo Conservation Strategy**, which defines the role zoos and aquaria of the world shall play in global conservation.

The strategy was developed in cooperation with IUCN's Conservation Breeding Specialist Group and received input from many individuals, institutions and associations belonging to the global zoo and aquarium network. It is a living document and may be reviewed from time to time.

The aim of the World Zoo Conservation Strategy is to help conserve Earth's fast disappearing wildlife and biodiversity. Its main objectives are:

- To identify the areas in which zoos and aquaria can make a contribution and determine how zoos and aquaria can support and consolidate the process leading to nature conservation and sustainable use of natural resources.

- To develop understanding and support for the conservation potential of zoos and aquaria, from national, supranational and global authorities, as well as other social and political bodies and organisations, and, in particular, to convince local zoo and aquarium authorities and conservation agencies that presently the greatest purpose to be served by the existence of these institutions is the contribution they can make to conservation, both directly and indirectly.

- To assist zoos and aquaria in the formulation of policies wherein priorities relating to conservation are incorporated.

- To indicate how contributions by the individual zoo and aquarium can be augmented by extending and intensifying of contacts in the global zoo and aquarium network and other conservation networks.

The World Zoo Conservation Strategy stipulates that zoos and aquaria should:

- Actively support, through coordinated programmes, the **conservation of populations** of endangered species *in situ* and *ex situ* and, through these, contribute to the conservation of natural habitats, biotopes and ecosystems.

- Offer support and facilities in order to **increase scientific knowledge** that will benefit conservation, and lend support to the conservation community by making available relevant knowledge and experience.

- Promote an increase of **public and political awareness** of the necessity for conservation, natural resource sustainability, and the creation of a new equilibrium between people and nature.

The World Zoo Conservation Strategy emphasizes that the growing global zoo network seeks to further intensify the integration that is crucial to successful conservation. Each individual zoo can contribute to this by actively cooperating with other parties within and outside the zoo community. The entire global zoo network, comprising over 1000 organised zoos world wide, can contribute by stimulating individual zoos, by providing them with direction and by integrating the efforts of their network with those of other nature conservation-oriented networks, such as IUCN. This great mustering of all available powers will be necessary to give our Earth's biosphere and all its living elements the best possible chance of survival.

World Association of Zoos and Aquariums (WAZA)
UNITED FOR CONSERVATION

WAZA promotes animal welfare
through its Code of Ethics

The continued existence of zoological parks and aquaria depends upon recognition that their operation is based on respect for the dignity of the animals in their care.

Whilst recognising that cultural differences exist in different parts of the world, and that each region may have formulated its own code of ethics, WAZA strives to develop an ethical tradition which is strong and which will form the basis of a standard of conduct for the zoo profession.

To this effect, WAZA has adopted, in 1999, a Code of Ethics setting basic principles for the guidance of all its members. The Code stipulates that assisting in achieving the conservation and survival of species must be the aim of all members of the profession. Any actions taken in relation to an individual animal, e.g. euthanasia or contraception, must be undertaken with this higher ideal of species survival in mind. Among other things, the Code requests members to:

- Promote the interests of wildlife conservation, biodiversity and animal welfare to colleagues and to society at large.
- Cooperate with the wider conservation community including wildlife agencies, conservation organisations and research institutions to assist in maintaining global biodiversity.

- Co-operate with governments and other appropriate bodies to improve standards of animal welfare and ensure the welfare of all animals in our care.
- Act, at all times, in accordance with all local, national and international law and to strive for the highest standards of operation in all areas and in particular regarding animal welfare
- Acquire preferably captive bred animals by direct zoo to zoo contact. This will not preclude the receipt of animals resulting from confiscation or rescues. If animals have to be obtained from the wild, members must be confident that such acquisitions will not have a deleterious effect upon the wild population.
- Ensure institutions receiving animals have appropriate facilities to hold the animals and skilled staff who are capable of maintaining high standard of husbandry and welfare. All animals being transferred must be accompanied by appropriate, detailed records allowing the receiving institution to make appropriate decisions regarding the future management of the animal. All animal transfers should conform to the international standards and laws applying to the particular species ad, where appropriate, should be accompanied by qualified staff.
- Consider the possible physiological side effects, as well as the negative impact on behaviour, before a final decision to implement contraception is made.
- Follow the IUCN/SSC/Reintroduction Specialist Group guidelines for reintroduction when participating in release-to-the-wild programmes
- Euthanise an animal only after all other options have been evaluated, and to ensure that euthanasia is carried out in a manner that ensures a quick death without suffering.
- Not allow the mutilation of any animal for cosmetic purpose, or to change the physical appearance, and to restrict pinioning of birds as much as possible.

World Association of Zoos and Aquariums (WAZA)
UNITED FOR CONSERVATION

The WAZA Network
- gives people opportunities to meet with animals

Nature conservation begins what we know: the plants, animals, and landscapes around us, in our own surroundings. While the interdependence of all ecosystems has become increasingly obvious as knowledge in the field of ecology has grown, the problem remains that "what is unknown is unappreciated". Thus enthusiasm for conservation of unfamiliar plants, animals and ecosystems elsewhere in the world, can only be expected to be, at best, lukewarm.

Travelling to experience unfamiliar nature is an option not available to many people. Even those individuals lucky enough to have such opportunities can still experience only a fraction of the whole. From the comfort of an easy-chair in one's own living room, television, internet, books and magazines offer an opportunity to come into contact with unique elements of nature found only in the farthest corners of the earth. Yet regardless of how well these media present their material, the experience remains two dimensional, with limited emotional impact.

Zoos offer an alternative means by which to become acquainted with life forms from distant continents and seas, adding new dimensions to the personal experience. The zoo visitor not only has the opportunity to view live animals, but also to observe how they move, eat, and interact with con-specifics. Zoo animal enclosures are increasingly often designed to encourage animals to behave in a natural manner, but at the same time to allow visitors an intimate view of the animals' life. The visitor can additionally experience animals using more senses:

they see the animals in 3-D and can also hear and smell them. Though the segments of nature that can be experienced in zoos cannot be representative of all possible environments, they can be presented in an penetrating manner and can demonstrate the biological diversity we have on this planet.

Some 1000 zoos and aquaria throughout the world are associated with WAZA and these are visited by more than 600,000,000 people annually. The ready availability of the zoo network makes it possible for most people, whether young or old, rich or poor, to visit a zoo regularly. Through zoos and aquaria they have the opportunity to develop a feeling for the amazing diversity of life on this planet, and the necessity of preserving the creatures they see, their coinhabitants in nature, and the environments in which these animals exist. Providing the public with this opportunity is the most important role that the zoo network can play in nature conservation. There is no other institution or medium that can bring a conservation message so forcefully, to such a large number of people.

The WAZA Network
- provides class rooms for environmental education

Zoos reach hundreds of millions of people all over the world, most of them living in urban areas and having little or no contact with nature. They come to the zoo because in one way or another they have an interest in animals. Consequently, **living animals form the basis for education in zoos**, however important the manner of exhibition and the addition of other collection components – such as plants and non-living materials – may be.

Education in zoos focuses increasingly on conservation issues.

The total zoo public, not only children, forms the target group for **informal education** in or by zoos. In addition, target groups outside of the zoo can be reached through zoo outreach programmes and through media presentation. **Formal zoo education** comprises education that is conducted in the framework of the educational curriculum of schools, colleges etc. within or in relationship with the zoo. Most if not all zoos are regularly visited by numerous classes from kindergarten up to university level. These classes receive structured educational tours and lessons focusing around selected themes as part of their formal teaching programme at the zoo. Many zoos have developed professional programmes and facilities for this type of zoo education.

The array of educational possibilities offered by zoo animals is inexhaustible, and certainly does not stop with topics in classical biology. Special emphasis is laid on **conservation education**. In this context, the Zoo Conservation Strategy recommends that, in addition to approaching conservation issues from the view of biological sciences, zoos should also develop educational programmes that elucidate the socio-economic backgrounds of the threats to nature. Through this they should play an active role in increasing the public and political awareness of the connection between consumption and lifestyle and the survival of species and biological systems.

It is of great value that zoos are carrying the same message world wide, and have a **network** that is demonstrating the importance of nature conservation on a global scale.

Zoo Educators worldwide are organised in Zoo Educators Associations.

Their global umbrella is the International Zoo Educators Association, an affiliate member of WAZA which organises international meetings on a regular basis, publishes a Journal and maintains a web site under www.izea.net .

The WAZA Network
- protects endangered species through *ex situ*-breeding

Professionally managed zoos and aquaria play an important role in conserving the world's threatened species. Modern zoological facilities contributions to *in situ* conservation are diverse and growing. Through careful planning and management, zoos and aquaria maintain populations of animals that contribute to conservation in numerous ways, including public education, scientific research, development of relevant technologies, professional training and technology transfer, ecotourism, political action, fundraising and development of and participation in field projects.

The World Zoo Conservation Strategy establishes three conservation objectives for zoos, including "actively supporting, through coordinated programmes, the conservation of populations of endangered species *in situ* and *ex situ* and through these to the conservation of natural habitats, biotopes, and ecosystems." The IUCN Species Survival Commission acknowledges the power of zoos and aquaria, stating, "habitat protection alone is not sufficient if the expressed goal of the World Conservation Strategy, the maintenance of biotic diversity, is to be achieved. Establishment of self-sustaining *ex situ* populations and other supportive intervention will be needed to avoid the loss of many species, especially those at high risk." Zoos and aquaria are a powerful force in conservation, providing a strong link between their living collections and the fate of these animals and their habitats in nature.

As of July 2002, no less than 172 international studbooks for threatened species or subspecies were kept under the auspices of WAZA, covering a wide range of taxa from *Partula* snails to large apes. In addition, the regional zoo association keep regional studbooks and run, since 1981, cooperative *ex situ* population management programmes for selected species.

For example, AZA currently administers 107 Species Survival Plans® covering 158 species whose membership includes 205 accredited zoos and aquaria throughout North America. EAZA operates 138 European Endangered Species Programmes (EEPs) in which about 300 institutions all over Europe and in the Near East participate. In the Australasian Region, the Australasian Species Management Program (ASMP) of ARAZPA generates species management recommendations and collection planning recommendations for the 47 institutional members of the association, covering a wide range of native and exotic species. Under the African Preservation Programme (APP), PAAZAB cooperatively manages some 30 threatened African reptile, bird and mammal species

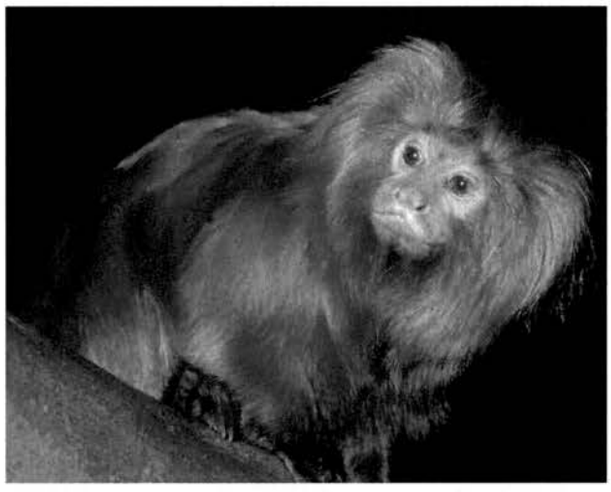
As human populations explode and natural habitats become smaller and more isolated, the situation for wildlife becomes more perilous each day, and cooperative breeding programmes run by zoos and aquaria become more and more important.

World Association of Zoos and Aquariums (WAZA)
UNITED FOR CONSERVATION

The WAZA Network
- works globally towards *in situ*-Conservation

Conservation is not just a question of keeping the last surviving specimens of a species in zoos, nor is it a question of fencing in specific areas to protect specific species. Conservation is a question of saving species from extinction through developments that secure the viability of the populations in an environment that is politically, socially and biologically stable enough to support them far into the future.

Recognising this principle, the conservation activities of zoos are continuously shifting from simple ex-situ breeding towards a more holistic approach with in situ conservation becoming increasingly important.



Ex situ zoo populations can directly support the *in situ* survival of some species by providing the nuclei for re-establishment or reinforcement of wild populations in nature. The World Zoo Conservation Strategy emphasizes that such reintroductions and restocking projects, when properly applied (i.e. in agreement with the IUCN/SSC Guidelines for Re-Introductions), can bring great benefits to natural biological systems.

Reintroduction and restocking projects have been undertaken with more than 120 species. Typically such projects are carried out by a consortium of zoos and in co-operation with the co-ordinators of the relevant regional ex-situ programmes and taxon advisory groups. Examples of successful reintroduction projects, each involving several tens of zoos, include the Golden lion-tamarin, the Przewalski's horse, the European bison, the Arabian and the Scimitar-horned oryx, the Addax antelope, the Alpine ibex, the Bearded vulture, the White stork etc.

In addition to the *ex situ* breeding programmes, and the subsequent re-introduction of captive-bred animals to the wild, the zoos' *in situ* activities include now often also educational programmes aimed at the local people and at the politicians, biological programmes (research and monitoring), socio-economical projects, social work among the local people, PR activities and much more on a national and international scale – all in order to secure the conservation efforts far into the future.

World Association of Zoos and Aquariums (WAZA)
UNITED FOR CONSERVATION

The WAZA Network
- is crucial for CITES implementation

Without assistance from the world zoo and aquarium community, CITES implementation would be difficult. As a matter of fact, zoos and aquaria play an important role for implementing this treaty; providing expertise, technical assistance and infrastructure to the authorities charged with the preparation of technical standards, increasing public awareness, carrying out border checks or having to seize or confiscate animals.

When animals arrive at a border checkpoint, the controlling agents very often do not have the necessary expertise for proper species identification. They will seek the assistance of zoo directors or curators who do not only have the necessary knowledge to identify the specimens, but are also able to handle the animals to make the necessary checks. Also many data sheets of the CITES Identification Manual were prepared by zoo staff.

Under Article III of CITES, an import permit for a live Appendix I specimen may be issued only if the proposed recipient is suitably equipped to house and care for it. The zoos and aquaria adhering to the WAZA Network employ several thousand academics, including veterinarians and biologists, who are experts in wild animal care and husbandry, and these experts are available for assisting the Scientific Authorities in the development of criteria or standards for keeping Appendix I specimens.

The 1000 zoos and aquaria of the WAZA Network attract 600 million visitors per year. Many zoos and aquaria have taken the opportunity to inform their visitors on CITES issues by installing temporary or permanent exhibits on the detrimental effect of illegal or unsustainable trade in live animals, plants and wildlife products, and explaining the role CITES plays in monitoring and preventing such trade.

In cases where an animal has to be seized, the problem of where it can be properly housed and cared for until a final decision is taken in agreement with Article VIII.4 of CITES arises. In many cases, the only institutions having the necessary infrastructure, expertise and ability to accept such animals are zoological parks or aquaria. In the event that the animal cannot be returned to its state of origin, the Management Authority will have to decide to entrust it to a rescue centre or such other place as is deemed appropriate and consistent with the purposes of the Convention. In most cases, the animal will be given to a zoo or an aquarium. In doing this, the authorities ideally seek the advice of WAZA or of the relevant regional or national zoo association to identify the institution which is best suited to accept the animal. Whenever possible, WAZA and its association members will integrate such animals into a coordinated *ex situ* breeding programme.

The WAZA Network

- supports sustainable use of natural resources and environment-friendly production

Considering that most conservation is by protecting habitats or large areas or concentrating on one or more flagship species, remembering that no protected area or species can long exist or be protected in the long term without the support of the local people who live in or around the protected areas or species, and being aware that the local people must have a sufficient income or interest in the protected area to abide by the laws or rules governing the area, it becomes increasingly important to get the interest and support of local communities and people around protected areas.

This often also means helping to ensure that these people have sources of income and subsistence that are sustainable with the use of natural resources. Often this entails simply providing information and education, but most of the time it also means seeking to assist local people with environment-friendly production systems and products in and around protected areas. Tourism has been recognized as one way to increase interest in areas or species, however care must be taken to assure that local people and communities benefit from the tourism and not all profits are generated outside the local area. Environment-friendly production of goods, such as organic shade grown coffee, needs to be explored as an alternative to sun grown coffee. Assisting local communities and local coffee companies can have great benefits

Recently some coffee companies have been willing to contribute a percentage of the sales of their coffee directly back to local conservation efforts. This kind of program benefits local landowners who produce organic shade grown coffee, it supports the local coffee company thereby creating local jobs, it creates funds for local conservation projects and education, while at the same time still providing upper canopy tree cover as habitat for many species. More efforts are needed to assist locals in producing and marketing other forest or agricultural products such as baskets, carvings, and other handicrafts which create income but do not result in significant increases in forest destruction, but hopefully will encourage forest or other habitat protection. Butterfly farming as practiced in PNG is another good example where local people are provided with food plants for valuable butterflies, which they plant to attract adult butterflies from the nearby forest to lay their eggs on the plants. The people then harvest some of the butterflies, but must understand that the income from them is clearly dependent on a relatively undisturbed forest habitat for the adult butterflies. This program creates income while encouraging forest protection. Care must be taken to avail over production of any one species which can destroy the market by flooding the limited market for that species.

Conservationists must seek more ways to assist local people in these more sustainable uses of natural resources and environment-friendly production systems.

World Association of Zoos and Aquariums (WAZA)
UNITED FOR CONSERVATION

The WAZA Network
- a network of wildlife habitats in urbanised surroundings

Altogether, the 1000 member institutions of WAZA cover an area of more than 300 square kilometres – twice the size of the Swiss National Park, or twice the size of the Principality of Liechtenstein. As most zoos are localised in cities or otherwise densely populated areas, they provide an important retreat for many native species, which otherwise could not survive in an urbanised surrounding. Zoos are thus natural islands in an inhospitable environment, serving as step stones or corridors for wildlife.

Several hectares of diverse vegetation, populated with hundreds of animals showing no fear of humans, and food available everywhere, these are factors, which attract wild animals to the zoo. And with the exception of a few species, such as red fox, which may decimate bird collections in an unacceptable way, or brown rat, house mouse or certain insects, which pose a major risk of disease transmission, all these animals are welcome. A few species, like wild rabbits or cotton tails, may need some management to keep a balance between vegetation and animals, but the vast majority enjoys full protection, and very often care is taken to provide nesting sites or to otherwise improve their habitat.

The range of wild animal species having chosen to live voluntarily in a zoo is enormous. Mammals comprise ungulates, like roe deer in Europe, or white-tailed deer in North America; carnivores including foxes, raccoons, otters, beech marten, pole cat, stoat or mouse weasel; insectivores like hedgehogs and different shrews; microchiroptera and, in the tropics, frugivorous flying foxes; hares and rabbits; a wide range of tree and ground squirrels and many other rodents.

Zoos are a haven for hibernating birds, but many bird species use zoos also as breeding sites. Among the most conspicuous breeding birds are cormorants, storks, herons, and waterfowl. A closer look will also reveal a large number of passerine species, pigeons and doves, and possibly woodpeckers, owls, birds of prey, hummingbirds etc.. During a recent wild bird survey at Berlin Zoo, located in the heart of a city of 3.5 million inhabitants, no less than 41 breeding species were identified. The herpetofauna is particularly rich in zoos located in tropical or subtropic areas and includes snakes – up to rock pythons - regularly found at Singapore Zoo, a wide range of lizards, some turtles, and also tree frogs and other amphibians.

When visiting your zoo next time, keep an eye on the areas between the enclosures – and you will realise how much your zoo contributes to local biodiversity.

Member of WAZA

The World Association of Zoos and Aquariums

- United for Conservation -

WORLD ASSOCIATION OF ZOOS AND AQUARIUMS

UNITED FOR CONSERVATION