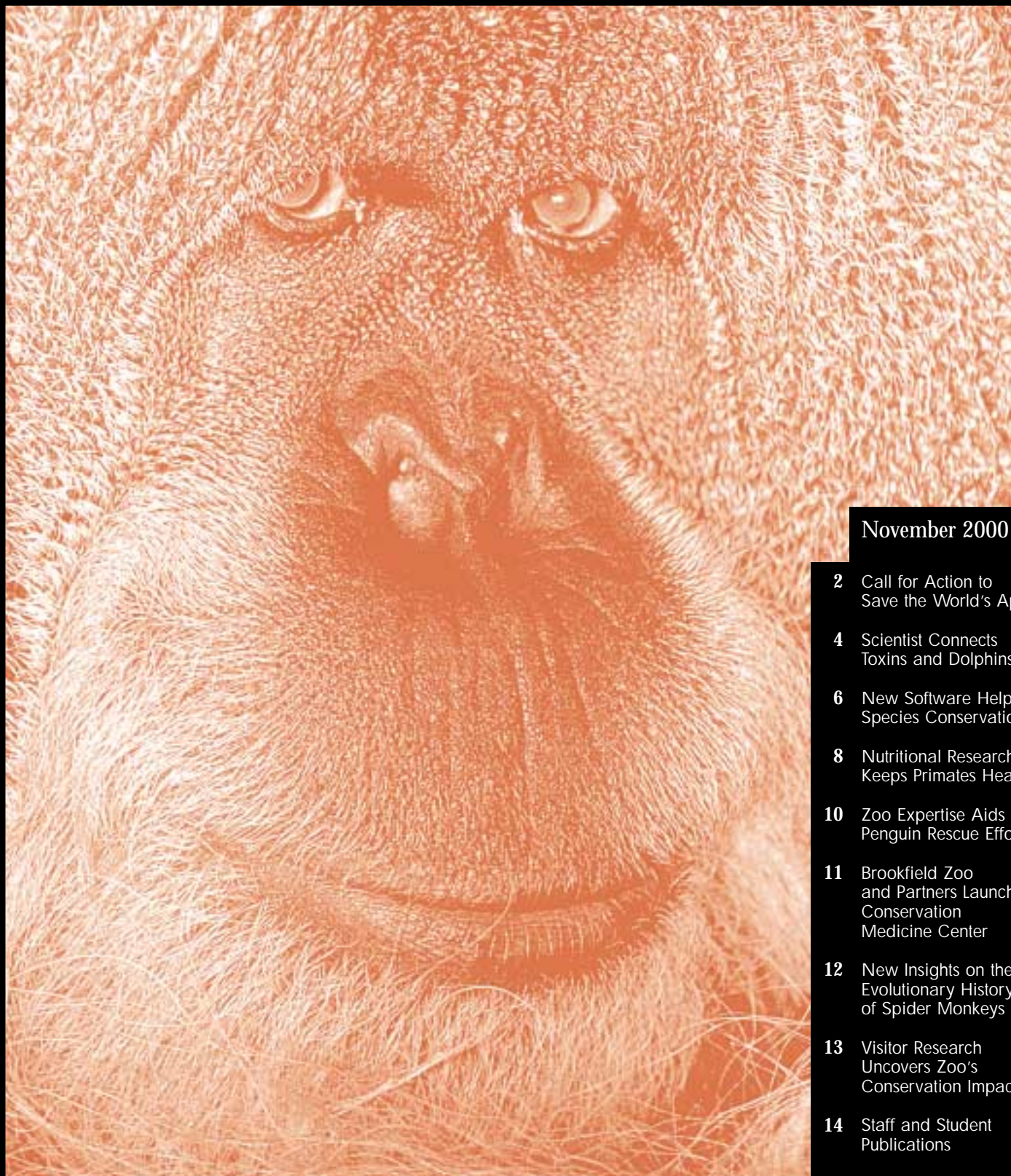


biota

Chicago
Zoological
Society

Report on Conservation Programs



November 2000

- 2 Call for Action to Save the World's Apes
- 4 Scientist Connects Toxins and Dolphins
- 6 New Software Helps Species Conservation
- 8 Nutritional Research Keeps Primates Healthy
- 10 Zoo Expertise Aids Penguin Rescue Efforts
- 11 Brookfield Zoo and Partners Launch Conservation Medicine Center
- 12 New Insights on the Evolutionary History of Spider Monkeys
- 13 Visitor Research Uncovers Zoo's Conservation Impact
- 14 Staff and Student Publications
- 17 Conservation Grants

biota



The mission of the Chicago Zoological Society is to help people develop a sustainable and harmonious relationship with nature. In so doing, the Society shall provide for the education of the people, the conservation of wildlife, and the discovery of biological knowledge.

**Chicago Zoological Society
Senior Conservation Programs Staff**
George B. Rabb, Ph.D.
Director, Brookfield Zoo

Timothy Sullivan
Deputy Director,
Conservation Programs

Animal Collection
Patricia McGill, Ph.D., Chair
John Cadle, Ph.D.
Sue Crissey, Ph.D.
Tom Meehan, DVM
Gail Mikenas
Ann Petric
Melinda Pruett-Jones

Communications
Cynthia Vernon, Chair
Carol Saunders, Ph.D.
Keith Winsten

Conservation Biology
Jeanne Altmann, Ph.D.
Jean Dubach, Ph.D.
Robert Lacy, Ph.D.
Sue Margulis, Ph.D.
Pamela Parker, Ph.D.
Amy Samuels, Ph.D.
Randall Wells, Ph.D.

**Biota Editorial
and Design Staff**

Chris Howes
Andy Murashige
Maria Sadowski
Nancy Saunders

biota (n.): The animal and plant life in a region. The Chicago Zoological Society's *Biota* is an annual publication that highlights the zoo's ongoing research and conservation programs.

Brookfield Zoo
3300 Golf Road
Brookfield, IL 60513

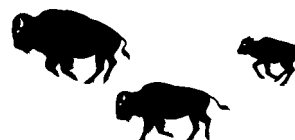
708.485.0263
www.brookfieldzoo.org

Tree-Free *Biota* is printed with soy-based inks on 100% Forest-Free paper made from sugar cane and hemp, renewable nontree fibers that require fewer pesticides and fertilizers and can be recycled more easily.



African Elephants
Cover: *Bornean Orangutan*

©2000 Chicago Zoological Society.
Brookfield Zoo is owned by the Forest Preserve District of Cook County and managed by the Chicago Zoological Society.

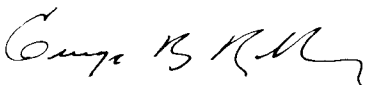


Welcome to the premier issue of *Biota*, the Chicago Zoological Society's annual magazine on conservation and science. *Biota* will share recent achievements and results of some of our conservation and science programs to give a better sense of the depth and breadth of our conservation programs. This publication will help spread the word about our work and paint a picture of the many ways zoos can contribute to conservation. Each year, we will be presenting a different snapshot of our efforts, covering the spectrum from conservation research to conservation breeding to field conservation to education and conservation psychology.

It is not possible to present results from all of our work in a short publication, but the achievements detailed here are representative of our efforts in other arenas. *Biota* is not intended as an annual report, as much as it is a place to focus on particular projects that have broad interest or applicability of approaches or results. Future issues, for example, may highlight field conservation in Australia or southern Africa, or conservation education efforts for biodiversity in Chicagoland.

To help present a picture of the full array of our work, *Biota* includes a list of staff and staff-directed student publications from the past year. *Biota* also includes lists of recent grants from our two conservation funds, the Conservation and Research Fund and the Chicago Board of Trade Endangered Species Fund. The first is supported primarily from a portion of individual contributions to our annual fund appeal. The second is supported primarily from gifts to the zoo from members of the Chicago Board of Trade in support of our work to conserve species threatened with extinction. Much of the work detailed in this issue of *Biota* takes place in the Daniel F. and Ada L. Rice Conservation Biology and Research Center at Brookfield Zoo.

The Chicago Zoological Society has always had the conservation of the natural world at the core of its mission. Today, we see ourselves as a conservation center for the local and global community. The zoo as a conservation center helps conserve wildlife and the natural world through inspiring caring attitudes in children and adults alike, helping people who visit the zoo to change their own behavior to protect the environment, generating biological knowledge that is essential for conservation efforts, conducting and supporting field programs that address direct threats to wildlife and their habitats, and of course caring for and breeding the animals at the zoo. We believe that zoos can and must be a vital force for conservation in their own communities and around the world. This magazine will give some additional insight into the many ways that is possible.



George B. Rabb, Ph.D.

President, Chicago Zoological Society

Director, Brookfield Zoo



Bornean Orangutans

Call for Action to Save the World's Apes

Nearly 400 delegates from around the world—including Indonesia, Kenya, the Democratic Republic of Congo, the United Kingdom, Germany, Japan, Bangladesh, Russia, and Australia—traveled to Illinois this spring to participate in a groundbreaking international ape conference. Researchers, zoological park personnel, and field biologists exchanged information, shared resources, built collaborative relationships, and defined immediate and long-term goals to ensure the survival of ape species.

Hosted and organized by Brookfield Zoo and supported by American Airlines, the Margot Marsh Biodiversity Foundation, and other generous donors, “The Apes: Challenges for the 21st Century” was the first conference of its kind in many respects. It was the first to address issues affecting great apes (gorillas, orangutans, chimpanzees, and bonobos) and lesser apes (gibbons and siamangs). It was the first to bring together researchers from range countries of all the apes. And it was the first to address conservation issues affecting apes in zoos and in the wild.

Over three days, participants considered diverse topics such as behavior, nutrition, veterinary medicine, genetics, socioeconomics, exhibit design, rehabilitation, cognition, and husbandry. Conservationists and researchers from the range countries of the apes shared news of the growing threats apes face. The threats to various species are similar, including habitat destruction (primarily from illegal and legal logging), poaching of bushmeat, the illegal pet trade, and the effects of war and refugees in ape habitat.

Attendees included leading primate researchers like plenary speaker Dr. Russell Mittermeier, president of Conservation International and chairman of the Primate Specialist Group of IUCN—The World Conservation Union. Keynote speakers included Dr. David Chivers of Cambridge University, speaking on lesser apes; Dr. Toshisada Nishida of Kyoto University, speaking on chimpanzees; Dr. Claudia Olejniczak of Washington University, speaking on gorillas; Dr. Gay Reinartz of the Milwaukee County Zoo, speaking on bonobos; and Dr. Carel van Schaik of Duke University, speaking on orangutans. Brookfield Zoo supported the attendance of researchers from many of the African and Asian countries in which apes are found.

Of particular concern in Africa is the current civil war in the Democratic Republic of Congo. The bonobo is found only in that country, and the current dividing line between government and rebel forces runs through the bonobo's native forest habitat. With only one major protected area harboring the species, the threat from habitat loss is great. “At least 45 percent of the bonobo's habitat is now in forest concessions slated for logging in the near future,” said Reinartz. The eastern lowland gorilla (Grauer's gorilla) is also threatened by the effects of war, with all of its populations remaining in areas that are no longer controlled by the government forces.

In addition to the effects of war, the growing crisis with bushmeat received a great deal of attention. While apes represent only a small proportion of the total biomass of wild caught animals hunted and sold for human consumption, their small populations and low reproductive rates make them particularly vulnerable. A working group at the conference called for greater immediate support for on-the-ground projects at priority sites and for increased efforts to pressure governments and international agencies to address the problem.

Several speakers stressed the importance of finding solutions to problems by involving local people. “The people who live in and around forests in Cameroon have always used the forest for their own subsistence. However, they now see truckloads of trees passing out of the forest and the country with no benefit coming back in,” said Leonard Usongo, field biologist from Cameroon. “Long-term solutions will only come when we address the root causes of environmental problems, focusing on the needs of people who live around the protected areas that contain apes.”

For the Asia plan, the conference broke new ground by fully including concerns for the lesser apes in the discussions. Chivers reported that some of the most critically endangered populations of apes are the gibbons in Cambodia, Laos, and Vietnam, and information on their actual status is too sparse. Of equal concern is the fate of orangutans, which are being hit particularly hard due to illegal logging throughout most of their range, including within protected areas. The rapidly increasing risk of extinction for orangutans comes at a time when researchers are discovering what can be called “cultures” in different orangutan populations.



Left: A silent auction raised funds to support ape conservation.

Below: Keynote speaker Dr. Toshisada Nishida, Kyoto University and President, International Primatological Society, addressed chimpanzee conservation.

Taught behaviors are “culture in the making,” according to van Schaik, who stressed the importance of studying ape cultures so that we might better understand the evolution of human culture.

A growing threat at a global level is the risk of disease transmission from humans to nonhuman primates living in natural settings. This is an important, though often overlooked, conservation concern given the genetic similarities among humans and the other apes and the close contact that researchers and tourists can have with wild ape populations. The conference featured a panel discussion and a working group that identified steps researchers, veterinary and human healthcare professionals, tourists and tour operators, governmental officials, park personnel, and local residents can take to protect ape and human health.

Panel discussions and working groups covered issues relating to improving management of apes in captivity, capitalizing on the public appeal of apes to promote conservation education, and studying apes in captivity to investigate issues important for their survival in the wild. Throughout discussions of every issue, conference participants emphasized the important role that zoos must play in supporting field conservation activities and directing public attention to priority problems.

International action is seen as critical to the survival of the apes. In many countries, the government is simply unable to provide the support necessary for basic functions such as paying staff to guard and work in the parks. In cases where governments are unable to provide support, international assistance will be critical. In other cases, governments are allowing exploitation in parks and are not enforcing laws restricting hunting of apes. This is often associated with major new resource extraction developments, such as logging or mining. The conference called for stronger international incentives and penalties to encourage governments to enforce existing laws.



Below: Leonard Usongo, WWF-Cameroon; Omari Ilambu, Yale University and Wildlife Conservation Society; Bila-Isia Inogwabini, Field Coordinator, Milwaukee Zoological Society's Bonobo Program, the Democratic Republic of Congo; and Dr. George Rabb, Director, Brookfield Zoo discussed local conservation efforts in Africa.



Nongovernmental international cooperation is also needed. Conference participants celebrated the launch of the Wild Chimpanzee Foundation to raise international attention for conservation of chimpanzees, and they created the Orangutan Network to increase support for field research sites for orangutans. In closing remarks, Brookfield Zoo director George Rabb called for the consideration of an international ape foundation or council that would encourage and coordinate private support for the conservation of all apes and possibly all nonhuman primates.

The conference's theme of promoting action for all ape species was solidified in the passage of a resolution calling on the United Nations, through UNESCO, to give all apes a special protected status “to ensure that all possible measures are taken to protect them from extinction, so that our descendants may continue to share this planet with these unique human relatives.”

At the strong urging of conservationists, the U.S. Senate approved a bill in late October to help save the remaining populations of great apes. The Great Ape Conservation Act will provide \$5 million annually for the Secretary of the Interior to provide grants to local wildlife management agencies and other institutions to protect apes and their habitats. Collaborative efforts such as this conference may be instrumental in accomplishing these activities.

Abstracts from conference papers and full working group reports are available on Brookfield Zoo's Web site (www.brookfieldzoo.org), in the Conservation section. Full proceedings will be on the site in the future. 🐒

Scientist Connects Toxins and Dolphins

The world's longest-running study of bottlenose dolphins is conducted by Dr. Randall Wells, a Chicago Zoological Society conservation biologist who is examining the connections between increasing contamination of marine environments and the health of the creatures that inhabit them. Some species of cetaceans, the group of marine mammals that includes dolphins, porpoises, and whales, carry tissue pollutant levels that are among the highest recorded.

Wells is looking to evaluate hypothesized connections between dolphins and pollutants. As head of the Chicago Zoological Society's Sarasota Dolphin Research Program for 30 years, he has observed 120 or so resident bottlenose dolphins (and more than 2,500 residents of adjacent waters) near Florida's 50-square-mile Sarasota Bay.

Scientists such as Wells believe there may be a direct link between dolphin mortality and reduced reproductive success and pollutants like polychlorinated biphenyl compounds (PCBs). These and other toxins were used widely in industrial applications and in products like electrical transformers, adhesives, and paints before many were banned during the latter part of the 20th century.

Improper disposal allowed the remnants of thousands of kinds of PCBs and other toxins to settle from the air or leach into waterways and groundwater, where they have remained for decades, even spreading around the world. Today, PCBs are found in high concentrations in many cetaceans, whose long lives allow the toxins to accumulate and whose lipid-rich blubber offers ideal storage. Top predators on the food chain, cetaceans have become the innocent victims of contaminants in the fish they ingest.

Wells closely monitors the health of the dolphin group by occasionally, and only temporarily, capturing individuals to record their weight, health, contaminant levels, blood values, blubber thickness, bacteria levels, and other variables. Combining these data with boat-based observations of individuals provides him with the information and experience needed to track the group over time. Wells and his staff, volunteers, and colleagues have contributed perhaps more than any other group to the body of scientific knowledge about bottlenose dolphins. Preliminary work by scientists working with Wells and his team has suggested

Lab manager Stephanie Nowacek and graduate students Kristi Fazioli and Caryn Owen help collect a small blood sample from a dolphin's tail fin.




that pollutants are changing marine mammals' physiology in that they may reduce male dolphins' immunity to diseases.

Additionally, about 85% of firstborn wild dolphins die before the typical age that they would leave their mothers, Wells has found. He and his students are studying whether the inexperience of mothers may contribute to these mortalities, but he is also searching for answers in mothers' milk. Scientists know that dolphins and other animals store PCBs and other toxins in their fatty tissues and that the toxins aggregate over time. Dolphins and other mammals may pass on toxic substances through mothers' milk. Combined, these two factors could mean that a firstborn dolphin, because it is first in line to suckle, receives a larger dose of toxins in its mother's milk than subsequent siblings, which receive the toxins accumulated over shorter periods of time.

Wells' research has captured the interest of the National Marine Fisheries Service, the U.S. agency responsible for cetacean protection, and the International Whaling Commission (IWC), the 41-nation organization that ensures whales' future by regulating when, where, and how many of these cetaceans can be taken from the oceans. In a series of meetings in the 1990s, the IWC found that enough evidence of danger to cetaceans by pollutants exists to demand serious consideration. The Commission cites the more than 200,000 manufactured chemicals that have been introduced into marine and terrestrial habitats, all relatively recently, as among the most dangerous threats to wildlife. It is now looking to the Chicago Zoological Society's Sarasota Dolphin Research Program, which offers a known cetacean population and a defined test area, to help further its studies. The combination of a known resident population of dolphins and a long-term research program can be found almost nowhere else.

The Sarasota Dolphin Research Program is also studying other aspects of dolphin biology and human impacts. These include a multiyear effort that examines the effects of boat noise on dolphin acoustics; a series of studies assessing the factors, including contaminants, that might influence the reproductive success and survival of adult dolphins; and, in conjunction with the National Marine Fisheries Service, an education program for boaters about the negative effects of feeding and interacting with wild dolphins.

The discoveries that will lead to more tangible evidence of the connections between cetaceans and deadly pollutants are still in their infancy. Through the Chicago Zoological Society's Sarasota Dolphin Research Program, Wells will continue to provide benchmark findings that advance other studies and help save cetaceans around the world. 

Recent Publications Offer New Insights into Dolphins

Cetacean Societies (University of Chicago Press), to which Brookfield Zoo biologists Randy Wells and Amy Samuels and many other leading researchers contributed their expertise, is an examination of whales and dolphins as a whole, describing what's known about how they relate, communicate, and generally live their lives, as well as the latest in behavioral research and conservation issues.

Biology and Conservation of the Bottlenose Dolphin (University of Florida Press), coauthored by Wells and Marine Mammal Commission chair John Reynolds, focuses on the cultural and natural history of bottlenose dolphins, perhaps the world's most recognizable dolphin species. This book presents a comprehensive and colorfully illustrated overview of dolphins. Personal anecdotes and scientific information about dolphin evolution, behavior, and genetics address the complicated issues of dolphin conservation in zoos and in the wild.

Field Studies Reveal Effects of Sonar on Whales

Toxins are not the only human-caused disturbances affecting marine mammals. In the June 22 issue of *Nature* magazine, an article coauthored by Amy Samuels presented the results of a study on the effects of low-frequency active sonar on the songs, quite possibly a form of sexual display, of male humpback whales during breeding season.

Samuels and the research team followed 16 whales and, with the help of the U.S. Navy, broadcast a signal no louder than 150 dB prior to, during, and after each whale's song. While some whales sang continuously throughout the tests and others only partially through, the team found conclusively that on average the whales' songs were 29% longer once the signal was broadcast.

Even if it's now clear that low-frequency active sonar impacts these whales, the quality of that impact is not well-defined. The increase in song length may be merely the whales' accommodation to the broadcast. More ominously, it may represent a larger-scale disruption in the breeding process.

New Software Helps Species Conservation

The many ways zoos care for animals may not be immediately obvious to visitors. A great deal of time and effort by zoo staff is put into the complexities of population management, yet the results are deceptively easy to take for granted. Zoo visitors expect to see animals of many different species, some familiar (tigers, lions, gorillas, and elephants) and some unfamiliar (sooty mangabeys, Asian small-clawed otters, and Andean condors). They expect to see different groups of animals at different zoos, and they expect to see those same species when they visit a zoo 30 years into the future. Zoos have limited space, but for every species a significant number of animals are needed to produce genetically viable offspring for future generations. How do zoos manage these complexities? What is the best way to coordinate and monitor which and how many of each animal should be bred in captivity to ensure long-term survival of its species?

One way is through innovative and user-friendly computer software called PM2000, which helps zoos and other wildlife agencies make sound breeding decisions. PM2000 was developed by Dr. Robert Lacy of Brookfield Zoo and Dr. Jonathan Ballou of the National Zoological Park, with assistance from Cornell University, and supported by those institutions and the American Zoo and Aquarium Association (AZA) and The Walt Disney Company Foundation.

What PM2000 enables is nothing less than groundbreaking: the recruitment of more and more zoo professionals into the ranks of those who feel comfortable doing genetic and demographic management of animal populations; the ability to manage more populations in scientifically responsible ways while using fewer resources; and the improved conservation of zoo populations.

Breeding animals responsibly—ensuring genetic diversity and healthy and predictable population sizes—is important for all animals, particularly for those that are in danger of extinction. PM2000 is a “grassroots” effort by zoos, responding to their own needs. It is freely available on the Internet, and CD-ROMs are available through the Chicago Zoological Society and the International Species Information System (ISIS). PM2000 is expected to be

used widely by zoos, wildlife and government agencies, and universities around the world.

The use of PM2000 will be central to the newly formed Population Management Center (PMC). Supported by AZA and by a grant from the Stewart Foundation, and staffed by two full-time population biologists, this joint venture between Brookfield Zoo and Lincoln Park Zoo will provide much-needed professional assistance to groups and institutions doing population management planning. Through PMC, AZA-affiliated institutions and others will have access to high-level data analysis, assistance in preparing species management plans, and rapid answers to questions about PM2000 and population management in general.

The goals of population management sound simple: manage groups of animals over time so that the optimal number of animals is attained, is constant, is predictable, and can be maintained over time. Then selectively mate pairs of animals to avoid genetic or demographic decay (essentially, to avoid inbreeding or breeding of nonviable animals) and to ensure robust populations into the foreseeable future.

But making responsible conservation decisions about groups of captive-born or -bred animals isn't easy or simple. In the past few decades, zoos have become adept at gathering and analyzing information and developing management plans. Population management, though, is a science in which most animal-care staff or biologists have not received formal training. PM2000 was developed to be straightforward to learn and easy to use, yet capable of sophisticated but easily understood levels of analysis. It helps users to make decisions, prompting them to consider and provide different kinds of information, then providing tables, graphs, and summaries.

Data on zoo animals are kept by individual zoos and shared cooperatively nationally and internationally through studbooks, medical databases, and ISIS. Zoos have a long history of tracking pedigree information for individual animals so they can look far back into animals' heritages and use that information to plan for, and even manipulate, the future. For example, demographic data (on ages,


birth and death rates, etc.) are used to calculate and create Life Tables for species. The tables show the current number of males and females in a population, the average age-specific survival and reproductive rates, the mean population growth rate for the population under the current conditions, and the projected number of males and females x number of years from now. Knowledge of the species' biology and husbandry can be included in the calculations.

Creating age distribution charts helps zoo professionals determine, among other things, if there are enough animals in the breeding age classes to provide the desired amount of reproduction. Reproductive planning analyses help determine how many births are needed to attain the target population size. Then planning can begin to determine how many breeding pairs or groups are needed to produce that number of births. Again, zoos will incorporate their knowledge about species' biology and behavior, as well as knowledge about individuals in the population. Though it sounds abstract, these are real data about real animals. A zookeeper's knowledge about an individual animal's behavior or temperament will impact what decisions are made.

Equally important is PM2000's ability to perform high-level genetic analyses, such as determining how much

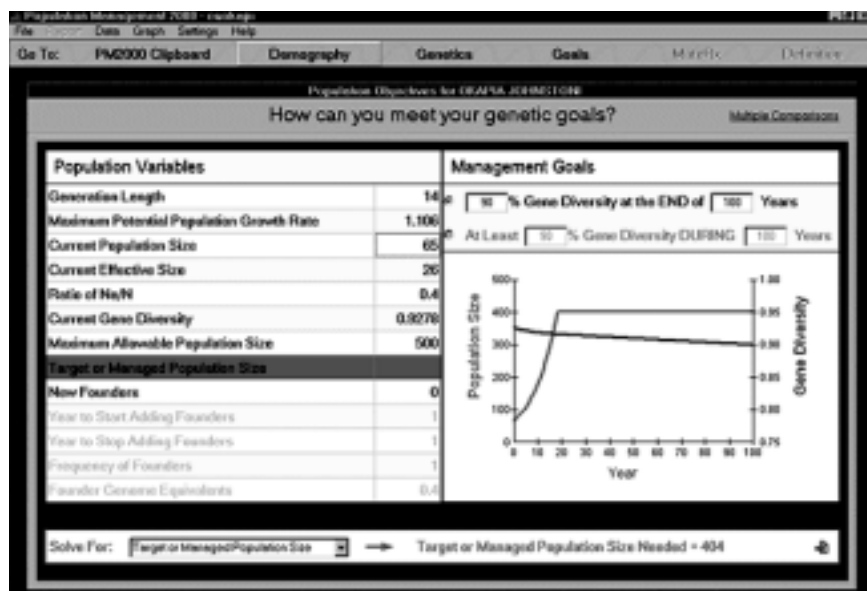
gene diversity there is in a captive population versus wild populations and what the potential levels could be under perfectly controlled breeding. It allows "testing" of the effects of breeding different animals on the genetics of the population, allowing many factors to be included or dismissed as needed.

The team that developed PM2000 continues to look forward. The challenge is to have enough zoo professionals trained in the software to then develop sound management decisions for all species with known pedigrees, not just for those of primary conservation concern. Additionally, at this time PM2000 addresses only those animals with two known parents. But in the case of schools of fish or groups of naked mole-rats, for example, it may not be possible to identify parents. Or in the case of some snakes, salamanders, and snails, some species are capable of single-sex reproduction. It is the hope that PM2001 (or perhaps PM2005) will be able to deal with these and other complex kinds of analyses to help ensure that zoos decades or even a century in the future are as we all envision they will be.

PM2000 is on the Web at www.b22crew.com/pm2000. CD-ROMs are available from Brookfield Zoo's Conservation Biology Department at (708) 485-0263, ext. 380, or the International Species Information System on the Web at www.isis.org. 



Sample screen shots from PM2000 showing the opening screen and an okapi data sheet.



Nutritional Research Keeps Primates Healthy

Brookfield Zoo is one of the few zoos in the world with professional nutritionists on staff. There are less than 20 zoo nutritionists in the United States, many of whom interned or received training at Brookfield Zoo. The ultimate goal of our nutrition program is to help provide nutritional diets to keep zoo animals around the world healthy. Recently, members of Zoo Nutrition Services—including Dr. Sue Crissey, Barbara Lintzenich, Kerri Slifka, and Kimberly Ange—gathered and analyzed data on the nutritional status of captive primates, and conducted research trials on specific primate nutrition topics.

There is a direct relationship between the nutritional status of an animal and its diet. But studies of free-ranging animals rarely provide data on the quantity of food consumed or the nutrient content of those food items. It is therefore important to compare the nutritional status of captive and free-ranging animals since captive animals have known, quantified food and nutrient intake. Analyses of nutritional data may be used to refine or change an animal's diet, or they may simply confirm that the animal's nutrient needs are sufficiently met.

Animals require as many as 64 nutrients to maintain optimal health. High nutrient levels in the body may indicate potential disease or excesses in dietary nutrients. Low nutrient levels in the body may indicate disease, deficiencies in available nutrients, or a malabsorption syndrome. To assess the nutritional health of animals, researchers need to determine the normal values for captive and free-ranging animals. But what is normal? Are zoo animals normal? Are free-ranging animals that are exposed to the harsh conditions of their environment—including fire, drought, and deforestation—normal? Understanding nutritional status is vital to efforts to successfully conserve and propagate animal populations, in the wild and in captivity.

As part of an effort to better understand the nutrition of nonhuman primates, staff evaluated the nutritional status of more than 150 primates in multiple zoos. To establish normal values of circulating nutrients in healthy primates, they examined many of the parameters used with human nutrition research. For example, all primates, including humans, require vitamins A, E, and D for normal growth,

reproduction, and health, while carotenoids, found in carrots and sweet potatoes (staples in captive primates' diets), have been found to be important in maintaining various immune functions.

Such a comprehensive look at nutritional status in nonhuman primates has never before been accomplished. The large number of individuals assessed and the inclusion of multiple institutions provide valuable comparisons among species and zoos.

The results are intriguing. When monkeys were compared to great apes, monkeys had lower cholesterol but higher vitamin D levels. For apes, gorillas had the highest levels of cholesterol and other substances. Their levels were even higher than those reported normal for humans. All the ape species had low vitamin D levels, which may mean that despite a good diet, limited sun exposure in their captive environment leads to vitamin D deficiencies. Interestingly, orangutans that consumed diets similar to the other apes had carotenoid concentrations 40 and 90 times higher than the other ape species. Researchers don't know what this means except that they may just absorb carotenoids better. The zoo's guinea baboons also appear to have high carotenoid levels. Nutrition staff are in the process of examining these data to see if there are differences between sexes and ages.

More specific nutrient studies are called for when a biological question or management problem needs to be addressed. That was the case when nutrition staff studied vitamin D in Goeldi's monkeys and performed in-depth reviews of literature in the nutritional management of Old and New World monkeys.

The endangered Goeldi's monkey is one of the least-studied of the New World primates. Researchers at the zoo thought there might be a link between mortality rates and kidney disease, so they undertook a large study with 56 animals ranging from 18 months to 16 years of age. They concluded that Brookfield Zoo's Goeldi's monkey population has kidney dysfunction to some level, especially in males; that vitamin D metabolites normally found in Goeldi's monkeys were lower than other New World monkeys; and that while dietary vitamin D did not cause the

kidney problems, the renal dysfunction may have influenced the vitamin D metabolites. In essence, they found a connection between diet and the kidney problems, but diet was not the cause of the kidney problems.

To publish a succinct reference for the information, staff conducted an in-depth review of the literature on deficiencies and toxicities in New World primates. In this review, they found that in captive animals, anemia (as a result of an inadequate diet) remains a concern. Deficiencies of specific nutrients such as protein and vitamins, as well as minerals such as zinc, have been described by various studies. Toxicities of certain nutrients, such as the fat-soluble vitamins (A, D, and K), also can become a concern, especially with respect to oversupplementation in the diet.

Zoo Nutrition Services staff remain extremely involved in captive primate nutritional research and have begun to examine some free-ranging populations in their native environment. Last year, Crissey and our chief veterinarian, Dr. Tom Meehan, collaborated with Mexican colleagues to investigate the nutritional status of free-ranging Mexican mantled howler monkeys in Veracruz, Mexico. The primary collaborator in Mexico was Dr. Juan Carlos Serio Silva (Instituto de Ecología, A.C. Xalapa, Veracruz). Wild populations of Mexican mantled howler monkey in southern Mexico have decreased by 90% over the past 40 years, with only 1,200 howlers left in their natural habitat and only four animals in captivity. The samples collected have been analyzed and examination of the data is underway. The findings will determine if the environment is supporting appropriate nutritional status of the group studied and may have vast implications to the management of the wild population.

In support of other projects, Zoo Nutrition Services also provided guidance and offered the zoo's laboratory facilities to field researchers studying the biology, including feeding ecology, of free-ranging Goeldi's monkeys. The researchers were provided with samples of the fungi the Goeldi's monkeys consume. The nutritional characterization of the fungi is the first step toward describing the nutrient composition of the free-ranging Goeldi's monkeys' diet.



Goeldi's Monkey

This comparison of diets may shed light on some of the discoveries with the zoo's Goeldi's monkeys.

Located in the Daniel F. and Ada L. Rice Conservation Biology and Research Center at Brookfield Zoo, Zoo Nutrition Services staff serve as members of the American Zoo and Aquarium Association Nutritional Advisory Group, a scientific body that helps bring the results of research to the attention of other institutions. They also work closely with the Comparative Nutritionist Society (CNS), comprising representatives from universities, government agencies, agricultural industries, and others. Through their networking activities, research efforts, and information sharing, Zoo Nutrition Services helps zoos and aquariums around the world ensure the best health of the animals in their care. 🐒

Zoo Expertise Aids Penguin Rescue Efforts

On June 23, 2000, the *Treasure*—a Panamanian ship carrying bulk iron ore from Brazil to China—sank just off the coast of South Africa, near Cape Town. The *Treasure* leaked the more than 1,300 tons of fuel oil on board, creating a crisis in and around Table Bay Harbor, a critical spot for seabirds. African penguins, a threatened species, were in the middle of the chick-rearing season, and the oil spill occurred at a spot between the largest and third-largest breeding colonies for these birds. The spill covered nearly 15 square miles, and weather conditions drove the oil toward prime breeding grounds on Dassen and Robben Islands, directly threatening more than 40% of the world's population of African penguins.

Without intervention, an oil spill of this magnitude would likely have been deadly to the majority of the population, which were particularly vulnerable during this season, when young chicks cannot fend for themselves and many adults are lingering nearby or sitting on eggs. Penguin feathers contaminated with oil lose their insulating qualities, causing the birds to either die of hypothermia in the water or shun the water and starve to death on land.

Given these conditions, it was essential to begin rescue efforts immediately. The rescue effort had three components. First, volunteers collected as many oiled adult birds as possible and took them to cleaning stations, where they were rehabilitated and cared for. Second, they collected any unoiled yet mostly grown chicks and reared them

until they could fend for themselves. Finally, they captured any unoiled adult birds and transported them up the coast to unaffected areas, leaving them to swim back to their nesting grounds after the oil had been contained. In all, nearly 20,000 birds were collected for rehabilitation.

Along with eight other zoos, Brookfield Zoo responded to the call for help, sending two animal-care staff to assist. Patricia Shreve, assistant curator of birds, had prior experience in oil-spill response with seabirds on the West Coast of the United States, and Darlene Broniewicz (*pictured at right*), senior keeper in The Living Coast, is responsible for daily care of the zoo's Humboldt penguin colony. Over several weeks, they and some 40,000 other volunteers helped rehabilitate and return almost 90% of the oiled birds back to the wild. Though the spill will surely have an impact on the population, it does not appear to be catastrophic, thanks to rapid intervention and advance knowledge about the potential dangers such a spill would have on a population.

Brookfield Zoo was instrumental in developing precisely that kind of advance information. Slightly more than a year ago, Brookfield Zoo geneticist Dr. Robert Lacy went to South Africa to conduct a Population and Habitat Viability Analysis (PHVA), which assesses extinction risks and develops and tests management strategies for particular endangered species and their habitat. VORTEX, a computer simulation modeling tool developed by Lacy,

is used for this process. The model identified oil spills as one of the most significant threats to African penguins and suggested that contingency plans be developed to minimize the impact of any spill.



Additionally, Brookfield Zoo, through its Conservation and Research Fund, had supported the analysis of results of rescue efforts on birds oiled and cleaned following a spill in 1995. The results from this work demonstrate that birds cleaned of spilled oil have similar survival patterns as unoiled birds. This demonstrates the conservation value of rescue efforts and helped bolster support for the South Africans to develop a capacity to respond to a major oil spill.

Though it is tragic that the computer modeling was proven out in a real-life disaster, the analysis and planning of Brookfield Zoo and other partners helped prevent what could have been an unrecoverable loss to African penguin populations. 🐧

Brookfield Zoo and Partners Launch Conservation Medicine Center

The lives of animals and people are invariably connected with their environment. Human encroachment into pristine areas can lead to an imbalance in the environment—the loss of a prey or predator species or stresses such as inbreeding, for example. Such destabilization in natural areas around the world has forced the planet's living beings into a dilemma looming large: an increase in zoonoses, infectious diseases transmittable between animals and humans.

These connections are well-studied, but they are not always well-understood. To learn more, Brookfield Zoo has teamed with Loyola University Chicago Stritch School of Medicine and the University of Illinois College of Veterinary Medicine to form the Conservation Medicine Center of Chicago (CMCC).

Some of the initial projects taking place under the CMCC include:

- a study of the immunology and health of deer mice to help determine their role in transmitting Lyme disease.
- a study of frog immunology and its meaning in the global declines of amphibian populations.
- a comparative study of the effects of environmental toxins on the health of dolphin populations.
- a study at the molecular level of the immune responses of Goeldi's monkeys.

The unique CMCC collaboration focuses resources, tools, and ideas onto conservation medicine, the application of principles of human and veterinary medicine to environmental conservation. Together, physician and veterinarian, biologist and conservationist, health specialist and geneticist will try to break through the wall of questions surrounding the dynamics of conservation medicine, including zoonoses. How do zoonotic diseases arise, for example, and how are they transmitted to other species, including humans? Why do they pinpoint particular species? How do technology, land use, travel, commerce, and other human endeavors impact nature?

There are no easy answers, but there is a natural flow of resources among the participating institutions. Brookfield Zoo targets veterinary problems as one aspect of its intense, long-standing study of small populations of species worldwide, and it offers ready access to in-depth data on wild and zoo

populations. Loyola's scientists are experts in virology, immunology, and molecular biology. The University of Illinois College of Veterinary Medicine provides pathology services to Brookfield Zoo, Lincoln Park Zoo, and the Shedd Aquarium and currently studies wildlife diseases.

The program also focuses on educating people about zoonotic diseases and their origins. Specifically, undergraduate and graduate students, residents, and fellows will be trained to understand these diseases and apply their knowledge to aspects of conservation medicine. Two laboratories will be established, located at Brookfield Zoo and Loyola University Stritch School of Medicine. Equipment for the laboratories is 65% funded by a \$906,198 grant from the U.S. Department of Health and Human Services, Health Resources and Services Administration. Brookfield Zoo and Loyola University Stritch School of Medicine will provide 35% of the funding through nonfederal support of \$476,742.

Ultimately, the center will establish a base of knowledge that will enable government agencies and other researchers to identify pathogens and subsequently take necessary actions. In this way the CMCC hopes to help manage infectious diseases and their dangers for all life. 🐾



CONSERVATION MEDICINE CENTER
OF CHICAGO

New Insights on the Evolutionary History of Spider Monkeys

Eight species or subspecies of *Ateles*—a genus of New World primate commonly known as spider monkeys—are considered either critically endangered or endangered. Conservation of these species has been impeded by lack of a universally accepted taxonomy for the genus.

Over the past 10 years, Dr. Jean Dubach of Brookfield Zoo's Conservation Biology Department has used chromosome and DNA tests to verify species and subspecies status of most of the North American population of captive *Ateles*.

DNA methodology has become a useful tool to deepen our understanding of the evolution and historical relationships of species, support investigations of the study of the geographic distribution of species, and facilitate the conservation of species. With this information, population managers can make appropriate breeding recommendations that result in a genetically diverse captive population and avoid the creation of hybrid individuals.

Since 1944, scientists have generally recognized four *Ateles* species:

Ateles geoffroyi The black-handed spider monkey, with nine subspecies, all located in Central America.

Ateles fusciceps The brown-headed spider monkey, with two subspecies on the Pacific coast of northwestern South America.

Ateles belzebuth The long-haired spider monkey, including three subspecies with discontinuous distribution in and around Amazonia.

Ateles paniscus The black spider monkey, including two subspecies with discontinuous distribution in and around Amazonia.

In 1996, supported in part from the Institute of Museum and Library Services and a Sigma Xi Grant-in-Aid-of-Research, doctoral candidate Andrew Collins began working with Dubach to examine the historical relationships that led to the speciation of distinct races of spider monkeys. Using geographically and chromosomally defined populations of spider monkeys, Collins and Dubach compared mitochondrial and nuclear DNA sequences based on the indication that dispersal of females upon maturation would allow them to track gene flow through populations. Overlaying the gene analysis with existing research on biogeography, Collins and Dubach have advanced understanding of *Ateles* evolutionary history and dispersion over time.

Using samples of DNA or tissue obtained directly from wild specimens or captive specimens of known origin, Collins and Dubach identified four major clades or species groups:

Ateles geoffroyi Gene analyses determined that *Ateles fusciceps* is actually a subspecies of *A. geoffroyi*. Individuals in this clade have no real geographic barriers from southern Mexico throughout most of Central America.

Ateles belzebuth Gene analyses placed *Ateles paniscus chamek* here as a subspecies renamed *Ateles belzebuth chamek*. This species occupies a vast geographic range from the Andes



Spider Monkeys

Mountains to the Xingu, or possibly Tocantins River, in Para State, Brazil.

Ateles paniscus Determined to be a monotypic species—one with no subspecies—that is geologically isolated by the Amazon River on the south and the Guianan Highlands on the west.

Ateles hybridus Previous assessments had placed *Ateles belzebuth hybridus* into a “superclade” that included *A. fusciceps* and *A. geoffroyi*. However, geographic isolation and DNA analyses indicate that *Ateles hybridus* is in fact the second monotypic species of the genus.

DNA analyses such as these undertaken at Brookfield Zoo's Daniel F. and Ada L. Rice Conservation Biology and Research Center deepen understanding of the evolution of species and facilitate their conservation. These findings, particularly because they identify two monotypic species, should significantly alter future conservation efforts and long-term management of the captive population by focusing attention on animals of highest evolutionary significance. The Spider Monkey Species Survival Plan of the American Zoo and Aquarium Association has already adopted the taxonomy suggested by this study. 🐒

Visitor Research Uncovers Zoo's Conservation Impact

With more than two million visitors annually, Brookfield Zoo has enormous potential to inspire people to care for the natural world. Communications vehicles—including signs, newsletters, even napkins—demonstrate the zoo's efforts to encourage people to be mindful of the ways that animals, plants, and people are interconnected. It is more than a casual case of self-doubt when the zoo struggles to answer one of its most important questions: is the zoo effectively encouraging people to take action, and if so, which zoo experiences are most influential?

A recent study by the zoo's Communications Research Department suggests that the public is interested in participating in conservation activities.

Even more notable, it seems that a zoo exhibit can increase that interest.

Dr. Carol Saunders and other Communications Research staff spoke with visitors who had never been to Brookfield Zoo's The Swamp exhibit, as well as those who had visited that exhibit multiple times. A visitor was given a stack of cards, each with a different conservation behavior, and asked to sort the stack into three piles: 1) behaviors they had done recently, 2) behaviors they were interested in doing, and 3) behaviors they were not interested in doing. A behavior could be something related to the exhibit's message, like "visit a wetland," or something unrelated, like "carpool." What behaviors were people interested in doing as a result of a visit to

The Swamp? The ones that emerged were: "talk to family and friends about wetlands," "revisit The Swamp exhibit," and "visit other wetland exhibits."

As might be expected from the number of broken New Year's resolutions, intention to take action does not automatically mean the desired behaviors will happen. But if someone expresses an interest in doing something, that person is more likely to follow through. Phone calls were made to those visitors in the study who had indicated an interest in doing a particular behavior in the near future. An impressive 47% of the visitors claimed they actually did the behaviors they predicted.

This study was possible thanks to funding from the USDA Forest Service. As the first of its kind undertaken in a zoo setting, it provides a way for other zoos to talk to their visitors about conservation behaviors. Other aspects of the study will be published in a scientific journal to share with fellow researchers. In a sense, the results show that Brookfield Zoo has the potential to incite its visitors to bring about positive change in the natural world—a strong statement, but one at the heart of Brookfield Zoo's mission and vision of being a conservation center. 🐾



Visitors are interviewed to determine if they understood the exhibit's message.

Chicago Zoological Society Staff and Student Publications

July 1999 to July 2000

Behavior/Ethology

Connor, R.C., Wells, R.S., Mann, J., and Read, A.J. The bottlenose dolphin (*Tursiops spp.*): Social relationships in a fission-fusion society. Pp. 91-126 in CETACEAN SOCIETIES: FIELD STUDIES OF DOLPHINS AND WHALES. P.L. Tyack, R.C. Connor, and J. Mann, eds. Chicago, IL: University of Chicago Press, 1999.

Flamm, R.O., Owen, E.C.G., Weiss, C.F., Wells, R.S., and Nowacek, D.P. Aerial videogrammetry from a tethered airship to assess manatee life stage structure. MARINE MAMMAL SCIENCE 16(3):617-630, 2000.

Miller, P.J.O., Biassoni, N., Samuels, A., and Tyack, P.L. Whale songs lengthen in response to sonar. NATURE 405: 903, 22 June 2000.

Nowacek, D.P. SOUND USE, SEQUENTIAL BEHAVIOR AND ECOLOGY OF FORAGING BOTTLENOSE DOLPHINS (*Tursiops truncatus*). Ph.D. dissertation, Massachusetts Institute of Technology and Woods Hole Oceanographic Institution, 1999.

Reynolds, J.E. III, Wells, R.S., and Eide, S.D. BIOLOGY AND CONSERVATION OF THE BOTTLENOSE DOLPHIN. Miami, FL: University of Florida Press, 2000.

Samuels, A., Flaherty, C. Peaceful conflict resolution in the sea? Pp. 229-231 in NATURAL CONFLICT RESOLUTION. F. Aureli, F.B.M. De Waal, eds. Berkeley, CA: University of California Press, 2000.

Samuels, A., Tyack, P. Flukeprints: A history of studying cetacean societies. Pp. 9-44 in CETACEAN SOCIETIES: FIELD STUDIES OF DOLPHINS AND WHALES. J. Mann, R.C. Connor, P. L. Tyack, and H. Whitehead, eds. Chicago, IL: University of Chicago Press, 2000.

Watkins, W. A., Daher, M. A., DiMarzio, N. A., Samuels, A., Wartzok, D., Fristrup, K. M., Gannon, D. P., Howey, P. W., Maiefski, P. R., and Spradlin, T. R. Sperm whale surface activity from tracking by radio and satellite tags. MARINE MAMMAL SCIENCE 15(4): 1158-1180, 1999.

Wells, R.S., Ken Norris. Dolphin society insights. MARINE MAMMAL SCIENCE 15:931-932, 1999.

Wells, R.S., Rhinehart, H.L., Cunningham, P., Whaley, J., Baran, M., Koberna, C., and Costa, D.P. Long-distance offshore movements of bottlenose dolphins. MARINE MAMMAL SCIENCE 15:1098-1114, 1999.

Wells, R.S., Boness, D.J., and Rathbun, G.B. Behavior. Pp. 324-422 in BIOLOGY OF MARINE MAMMALS. J.E. Reynolds, III, S.A. Rommel, eds. Washington, DC: Smithsonian Institution Press, 1999.

Wells, R.S. Long-term perspectives from research with free-ranging bottlenose dolphins (*Tursiops truncatus*). Reproduction Workshop Report. EUROPEAN RESEARCH ON CETACEANS 12:380-382, 1999.

Wells, R.S., Scott, M.D. Bottlenose dolphin (*Tursiops truncatus*) (Montagu, 1821). Pp. 137-182 in HANDBOOK OF MARINE MAMMALS, VOL. 6, THE SECOND BOOK OF DOLPHINS AND PORPOISES. S.H. Ridgway, R. Harrison, eds. San Diego, CA: Academic Press, 1999.

Wells, R.S. Reproduction and mating. Pp. 98 in DOLPHINS. Washington, DC: National Geographic Society, 2000.

Ecology/Field Conservation

Ackerman, B.B., Pitchford, T.D., Weigle, B.L., Reynolds III, J.E., Wells, R.S., and Baran, M.A. Marine mammals. Pp. 11-1 in BAYWIDE ENVIRONMENTAL MONITORING REPORT, 1993-1998, TAMPA BAY, FLORIDA. J. R. Pribble, A. J. Janicki, and H. Greening, eds. St. Petersburg, FL: Tampa Bay Estuary Program, Technical Publication 07-99, July 1999.

Cadle, J.E., Reichle, S. Reptiles and amphibians. Pp. 34-36 + Appendices 2a and 2b in BOLIVIA, PANDO, RIO TAHUAMANU (RAPID BIOLOGICAL INVENTORIES 01). W.S. Alverson, D.K. Moskovits, and J.M. Shopland, eds. Chicago, IL: The Field Museum, 2000.

Fazioli, K. L., Wells, R.S. Stock structure of coastal bottlenose dolphins, (*Tursiops truncatus*) near Sarasota, Florida. FINAL CONTRACT REPORT TO NATIONAL MARINE FISHERIES SERVICE, Miami, FL: Southeast Fisheries Science Center, 1999.

Fazioli, Kristi L. DISTRIBUTION, RELATIVE ABUNDANCE, AND COMMUNITY STRUCTURE OF COASTAL BOTTLENOSE DOLPHINS (*Tursiops truncatus*) IN THE GULF OF MEXICO OFF SARASOTA, FLORIDA. M. Sc. Thesis, University of California, Santa Cruz, 1999.

Foster, R., Porter, L., Schulenberg, T.S., Cadle, J.E., Reichle, S., Rojas, J., and Nacimiento, E. Overview of results. Pp. 17-27 in BOLIVIA, PANDO, RIO TAHUAMANU (RAPID BIOLOGICAL INVENTORIES 01). W.S. Alverson, D.K. Moskovits, and J.M. Shopland, eds. Chicago, IL: The Field Museum, 2000.

Reeves, R.R., Jefferson, T.A., Kasuya, R., Smith, B.D., Ding, W., Peilie, W., Wells, R.S., Wursig, B., and Kaiya, A. Report of the workshop to develop a conservation action plan for the Yangtze River finless porpoise, Ocean Park, Hong Kong, 16-18 September 1997. Pp. 67-80 in BIOLOGY AND CONSERVATION OF FRESH-WATER CETACEANS IN ASIA. R.R. Reeves, B.D. Smith, and T. Kasuya, eds. Switzerland and Cambridge, UK: IUCN, Gland, 1999.

Samuels, A., Bejder, L. A pilot study of habitual humans and wild bottlenose dolphins near Panama City Beach, Florida. Pp 15-16 in WILD DOLPHIN SWIM PROGRAM WORKSHOP, December 1999.

Samuels, A., Bejder, L., and Heinrich, S. A REVIEW OF THE LITERATURE PERTAINING TO SWIMMING WITH WILD DOLPHINS. Silver Spring, MD: U. S. Marine Mammal Commission, 2000.

Samuels, A., Flaherty, C., Charles, D., and Pearce, K. Food provisioning by humans of wild bottlenose dolphins at Monkey Mia, Western Australia: An update. PROCEEDINGS OF THE CONFERENCE OF THE INTERNATIONAL MARINE ANIMAL TRAINERS ASSOCIATION, December 1999.

Suarez, S., Hansen, A., Sodaro, V., Dammerann, S., and Haggerty, L. Primates. Pp. 40-44 in BOLIVIA, PANDO, RIO TAHUAMANU (RAPID BIOLOGICAL INVENTORIES 01). W.S. Alverson, D.K. Moskovits, and J.M. Shopland, eds. Chicago, IL: The Field Museum, 2000.

- Waring, G.T., Palka, D.L., Clapham, P.J., Swartz, S.L., Rossman, M., Cole, T., Hansen, L.J., Bisack, K.D., Mullin, K., Wells, R.S., Odell, D.K., and Barros, N.B. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments - 1999. NOAA TECHNICAL MEMO. NMFS-NE-153, 1999.
- Wells, R.S., Nowacek, S.M., and Flamm, R.O. Manatee behavioral responses to vessel approaches. FINAL CONTRACT REPORT for Contract No. MR-277. St. Petersburg, FL: Florida Fish and Wildlife Conservation Commission, 1999.
- Nutrition**
- Campbell, J., Eisemann, J., Glander, K., and Crissey, S. Intake, digestibility, and passage rate of a commercially designed diet by two *Propithecus* species. AMERICAN JOURNAL OF PRIMATOLOGY 48:237-246, 1999.
- Crissey, S., Meehan, T., Langman, C., and Pruett-Jones, M. Vitamin D metabolites 25 (OH)D and 1,25 (OH)₂D and kidney function indices and the relationship to diet in Goeldi's monkeys (*Callimico goeldii*). ZOO BIOLOGY 18:565-574, 1999.
- Crissey, S., Barr, J., Slifka, K., Bowen, P., Stacewicz-Sapuntzakis, M., Langman, C., Ward, A., and Ange, K. Serum concentrations of lipids, vitamin A and E, vitamin D metabolites, and carotenoids in nine primate species at four zoos. ZOO BIOLOGY 18:551-564, 1999.
- Crissey, S., Maslanka, M., and Ullery, D. Assessment of nutritional status of captive and free-ranging animals. AZA NUTRITION ADVISORY GROUP HANDBOOK 008, 1999.
- Crissey, S., Wells, R. Serum alpha and gamma tocopherols, retinol, retinyl palmitate, and carotenoid concentrations in captive and free-ranging bottlenose dolphins (*Tursiops truncatus*). COMPARATIVE BIOCHEMISTRY AND PHYSIOLOGY, PART B 124: 391-396, 1999.
- Crissey, S., Slifka, K., and Lintzenich, B. Whole body cholesterol, fat, and fatty acid concentrations of mice (*Mus domesticus*) used as a food source. JOURNAL OF ZOO WILDLIFE MEDICINE 30(2): 222-227, 1999.
- Crissey, S., Toddes, B., and Slifka, K. Micronesian Kingfishers: Nutrition and Dietary Husbandry. AZA NUTRITION ADVISORY GROUP HANDBOOK 009, 1999.
- Kopczynski, K., Maslanka, M., and Crissey, S. Determining nutritionally balanced raptor diets on a kilocalorie basis to maintain optimal body mass in a captive training environment. PROCEEDINGS, INTERNATIONAL ANIMAL TRAINING CONFERENCE, 1999.
- Maslanka, M., Crissey, S. Asian small-clawed otters: Nutrition and dietary husbandry. AZA NUTRITION ADVISORY GROUP HANDBOOK 011, 1999.
- Crissey, S., Slifka, K., and Lintzenich, B. Quantifying Animal Diets: Is what you feed what they get? PROCEEDINGS: AMERICAN ASSOCIATION OF ZOO VETERINARIANS CONFERENCE, October 1999.
- Slifka, K., Bowen, P., Stacewicz-Sapuntzakis M., and Crissey, S. Survey of serum dietary carotenoids in captive wild animals. JOURNAL OF ZOO NUTRITION 129:380-390, 1999.
- Population Biology**
- Altmann, J. Models of outcome and process: Predicting male distribution among primate groups. Pp. 236-247 in PRIMATE MALES. P. Kappler, ed. Cambridge, MA: Cambridge University Press, 2000.
- Araya, B., Garland, D., Espinoza, G., Sanhuesa, A., Simeone, A., Teare, A., Zavalaga, C., Lacy, R., and Ellis, S. eds. TALLER ANALISIS DE LA VIABILIDAD DEL HABITAT Y DE LA POBLACION DEL PINGUINO HUMBOLDT (*Spheniscus humboldti*). BORRADOR DEL INFORME. Apple Valley, MN: IUCN/SSC Conservation Breeding Specialist Group, 1999.
- Cooper, J., Oschadleus, D., Shannon, L., Thornton, M., Whittington, P., Lacy, R., and Ellis, S. eds. AFRICAN PENGUIN POPULATION AND HABITAT VIABILITY ASSESSMENT. Apple Valley, MN: IUCN/SSC Conservation Breeding Specialist Group, 1999.
- Ellis, S., Lacy, R.C., Kennedy-Stoskopf, S., Wildt, D.E., Shillcox, J., Byers, O., and Seal, U.S. FLORIDA PANTHER POPULATION AND HABITAT VIABILITY ASSESSMENT AND GENETICS WORKSHOP REPORT. Apple Valley, MN: IUCN/SSC Conservation Breeding Specialist Group, 1999.
- Lindenmayer, D.B., Lacy, R.C., Tyndale-Biscoe, H., Taylor, A.C., Viggers, K.L., and Pope, M.L. Integrating demographic and genetic studies of the greater glider (*Petauroides volans*) in fragmented forests: predicting movement patterns and rates for future testing. PACIFIC CONSERVATION BIOLOGY 5:2-8, 1999.
- Lindenmayer, D.B., Lacy, R.C., and Pope, M.L. Testing a simulation model for Population Viability Analysis. ECOLOGICAL APPLICATIONS 10:580-597, 2000.
- Penn, A.M., Sherwin, W.B., Gordon, G., Lunney, D., Melzer, A., and Lacy, R.C. Demographic forecasting in koala conservation. CONSERVATION BIOLOGY 14:629-638, 2000.
- Pergams, O.R.W., Lacy, R.C., and Ashley, M.V. Conservation and management of Anacapa Island deer mice. CONSERVATION BIOLOGY 14:819-832, 2000.
- Smith, K.L., Alberts, S.C., Bayes, M.K., Bruford, M.W., Altmann, J., and Ober, C. Cross-species amplification, non-invasive genotyping, and non-Mendelian inheritance of human STRPs in savannah baboons. AMERICAN JOURNAL OF PRIMATOLOGY 151: 219-227, 2000.
- Records/Data Management**
- Brandt, G. NORTH AMERICAN STUDBOOK FOR THE HUMBOLDT PENGUIN (*Spheniscus humboldti*). Chicago Zoological Society, 1999.
- Laird, E. INTERNATIONAL STUDBOOK FOR THE SPRINGHAAS (*Pedetes capensis*) ISSUE 3. Chicago Zoological Society, 1999.
- Oiler, A. NORTH AMERICAN REGIONAL STUDBOOK FOR THE INCA TERN (*Larosterna inca*). Chicago Zoological Society, 1999.
- Social Science/Education**
- Cohen, R., Slivovsky, K. Nature Sense. Pp. 36-37 in ENJOYING CHICAGO WILDERNESS WITH YOUR FAMILY: AN ACTIVITY GUIDE. Chicago, IL 2000.
- Birjulin A.A., Bell, P.A., Peterson, G.L., Brown, T.C., and Loomis, R.J. Valuation of public goods using the method of paired comparison. P. 148 in ABSTRACTS OF THE AMERICAN PSYCHOLOGICAL SOCIETY ANNUAL CONFERENCE. Denver, CO, June, 1999.

Birjulin, A.A., Saunders, C.D., and Gieseke, T.J. Motives for joining and continuing membership at a mission-driven organization. P. 6 in ABSTRACTS OF THE VISITOR STUDIES ASSOCIATION 12TH ANNUAL CONFERENCE. Chicago, IL, August 3-7, 1999.

Birjulin, A.A., Peterson, G.L., and Brown, T.C. Valuation of public goods using the method of paired comparison. Pp. 28-29 in ABSTRACTS OF THE EIGHTH INTERNATIONAL SYMPOSIUM ON SOCIETY AND RESOURCE MANAGEMENT. Western Washington University, Bellingham, WA, June 17-22, 2000.

Gieseke, T.J., Saunders, C.D., Birjulin, A.A., and Jennings, H. North is up? Examining the effectiveness of maps at Brookfield Zoo. P. 11 in ABSTRACTS OF THE VISITOR STUDIES ASSOCIATION 12TH ANNUAL CONFERENCE. Chicago, IL, August 3-7, 1999.

Rabb, G.B., Saunders, C.D. God, unicorns, and toilets. Pp. 354-359 IN MISSION-INSPIRED EVALUATION, ABSTRACTS FROM THE AMERICAN ZOO AND AQUARIUM ASSOCIATION ANNUAL CONFERENCE PROCEEDINGS. Minnesota Zoo, Minneapolis, MN, 1999.

Samuels, A. FOLLOW THAT FIN! STUDYING DOLPHIN BEHAVIOR. Austin, TX: Steck-Vaughn Company, 2000

Saunders, C.D., Birjulin, A.A., Gieseke, T.J., and Bacon, L. Can an exhibit affect visitor conservation behaviors? Pp. 23-24 in ABSTRACTS FROM THE VISITOR STUDIES ASSOCIATION 12TH ANNUAL CONFERENCE. Chicago, IL, August 3-7, 1999.

Vernon, C., Saunders, C. What Good is "The Swamp?" Motivating visitors for conservation through an exhibit. Pp. 108-111 in CONSERVATION CENTRES FOR THE NEW MILLENNIUM, PROCEEDINGS OF THE 5TH INTERNATIONAL SYMPOSIUM ON ZOO DESIGN. Whitley Wildlife Conservation Trust, 1999.

Taxonomy/Systematics

Cadle, J.E. The dentition, systematics, and phylogeny of *Pseudoxyrhopus* and related genera from Madagascar, with descriptions of a new species and a new genus. BULLETIN OF THE MUSEUM OF COMPARATIVE ZOOLOGY 155(8):381-443, 1999.

Collins, A.C. Species status of the Colombian spider monkey, *Ateles belzebeth hybridus*, NEOTROPICAL PRIMATES 7 (2): 39-43, 1999.

Collins, A.C., Dubach, J.M. Phylogenetic relationships of spider monkeys (*Ateles*) based on mitochondrial DNA variation. INTERNATIONAL JOURNAL OF PRIMATOLOGY 21(3): 381-420), 2000.

Collins, A.C., Dubach, J.M. Biogeographic and ecological forces responsible for speciation in *Ateles*. INTERNATIONAL JOURNAL OF PRIMATOLOGY 21(3): 421-444, 2000.

Wildlife Diseases

Gauthier, J.M., Dubeau, H., Rassart, E., Jarman, W.M., and Wells, R.S. Biomarkers of DNA damage in marine mammals. MUTATION RESEARCH 444:427-439, 1999.

Wilson, B., Arnold, H., Bearzi, G., Fortuna, C.M., Gaspar, R., Ingram, S., Liret, C., Pribanic, S., Read, A.J., Ridoux, V., Schneider, K., Urian, K.W., Wells, R.S., Wood, C., Thompson, P.M., and Hammond, P.S. Epidermal diseases in bottlenose dolphins: Impacts of natural and anthropogenic factors. PROCEEDINGS OF THE ROYAL SOCIETY OF LONDON B. 266(1423):1077-1083, 1999.

Snow Leopards



Chicago Zoological Society Conservation Grants

January 1999 to October 2000

Conservation and Research Fund

Supported Primarily from a Portion of Individual Contributions to the Society's Annual Fund

- Consequences of hunting and logging for wildlife-tree interdependence and tropical forest conservation (Belize).
- A telemetry study of the ecology of Andean bears in the Apolobamba range (Bolivia).
- Feeding ecology of the Goeldi's monkey with particular reference to mycophagy (Bolivia).
- Time-based space utilization of Humboldt penguins during the nonbreeding season (Chile).
- Declining amphibian research in the Qinghai-Xizang plateau (China).
- Morne Diablotin National Park: A conservation management project (Dominica).
- A joint survey of herpetofauna and avifauna: A preliminary look at congruence and prioritization (India).
- Evidence of exposure to endemic human pathogens among wild and pet macaques in Sulawesi (Indonesia).
- Conservation genetics of the endangered Rodrigues Island fruit bat (Mauritius).
- Birds, hedgerows, and natural vegetation remnants in Guanajuato (Mexico).
- Small mammal community patterns in El Cielo biosphere reserve (Mexico).
- Molecular conservation genetics of Baird's tapirs: Genetic structure, variation, and management (Panama and Costa Rica).
- Community ecology of Andean ungulates in Huascarán National Park (Peru).
- Seed dispersal by frugivorous bats and birds in a rain forest and adjoining grassland (Philippines).
- Monitoring and population dynamics of the African penguin (South Africa).
- Will loss of dispersal agents from forest fragmentation impact recruitment of endemic tree species in Montane East Africa? (Tanzania).
- A combined investigation of the stock-structure and health of coastal bottlenose dolphins inhabiting the Gulf of Mexico and Sarasota (USA, Florida).
- Challenges for the 21st century: A conference addressing conservation issues of apes (USA, Illinois).
- Effects of captivity on behavior of the oldfield mouse (USA, Illinois).

- Effects of habitat fragmentation on small mammals (USA, Illinois).
- Inbreeding depression and parasite resistance in oldfield mice (USA, Illinois).
- Population dynamics of yellow-headed blackbirds (USA, Illinois).
- Snow leopard papillomavirus vaccine development (USA, Washington).
- Assessing hybridization and management issues in a threatened species of garter snake (USA, Wisconsin).

Chicago Board of Trade Endangered Species Fund

Supported Primarily from Gifts to the Society from Members of the Chicago Board of Trade

- A census using DNA techniques of the last remaining population of northern hairy-nosed wombat (Australia).
- Community based species and community monitoring and restoration projects at the Bookmark Biosphere Reserve (Australia).
- Manatee and dolphin studies in Southern Lagoon (Belize).
- Vegetation surveys in key tapir habitat to evaluate the impacts of a proposed dam (Belize).
- Conservation surveys on deer species (Bolivia).
- Educational material on the Amazonian manatee (Brazil).
- Assessing local community knowledge on the abundance and distribution of harlequin ducks in southern Baffin Island (Canada).
- Documenting the movements of Humboldt penguins during the nonbreeding season (Chile).
- Humboldt penguin surveys and small projects (Chile and Peru).
- The status of freshwater turtles on the island of Hainan in the South China Sea (China).
- Survey of Chinese alligator populations and habitat in Anhui province (China).
- Support to Cuban biologists in their ongoing conservation and management programs for marine turtles (Cuba).
- Conservation genetics of the African wild ass (Eritrea and Ethiopia).
- Behavioral studies in the wild on a subspecies of Micronesian kingfisher (Guam).

- Investigation of the killing of river dolphins in gillnets and for development of alternatives to the use of dolphin oil as bait in the Brahmaputra River (India).
- Development of a model conservation program for the maleo (Indonesia).
- A conservation booklet on the mountain salamanders of the genus *Ranodon* (Kazakhstan).
- Land use patterns and changes in the West Kilimanjaro area (Kenya and Tanzania).
- Training in behavioral research associated with studying baboons around Amboseli National Park (Kenya).
- Research on the genetic structure and conservation needs of *Kirengeshoma koreana* (Korea).
- Survey of amphibians and reptiles in Ranomafana National Park (Madagascar).
- Status survey of the Tehuantepec jackrabbit (Mexico).
- Development of an independent observer program to monitor the killing of dolphins and porpoises in commercial fisheries (Peru).
- The status and ecology of the horned curassow (Peru).
- Support of community-based sustainable management of natural resources at Reserva Comunal Tamshiyacu-Tahuayo (Peru).
- The impact of an infectious disease on European bison in Bialowieza Primitive Forest (Poland).
- Production of global species maps for each of the 23 species of wild goats and sheep.
- Support of an antipoaching program for Amur leopard (Russia).
- Status survey of the riverine rabbit (South Africa).
- Surveys for endangered deer in South America (South America).
- Reintroduction of Ader's duiker on Chumbe Island, Zanzibar (Tanzania).
- The activities of sharks as dolphin predators in Sarasota Bay (USA, Florida).
- Conservation of the Tonkin snub-nosed monkey (Vietnam).
- Survey of the eastern black-crested gibbon (Vietnam).
- Digitized iguana photo archive (West Indies).

Brookfield Zoo
3300 Golf Road
Brookfield, IL 60513

Non-Profit Organization
U.S. Postage
PAID
Chicago Zoological Society

Look Us Up on the Web

Brookfield Zoo envisions itself as a conservation center for the community, acting as a model to operate in an environmentally responsible manner; as a wildlife, habitat, and ecosystem conservationist; as a resource and motivator for conservation action; and as a mentor, training others in conservation.

At www.brookfieldzoo.org, you'll learn how Brookfield Zoo achieves this vision. You'll also find updates on many of the activities outlined here and an online version of *Biota*. Plus, you'll find information to help plan a visit to the zoo, learn about classes and lectures relating to conservation efforts, and discover conservation actions you can take. Finally, you can join the zoo community as a donor, member, or part of the travel, Corporate Conservation Council, or Living Legacy programs.



Warthog