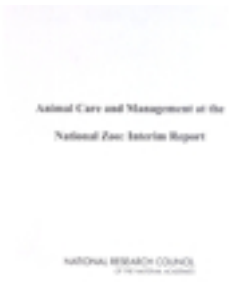

Animal Care and Management at the National Zoo: Interim Report

Committee on a Review of the Smithsonian Institution's National Zoological Park, National Research Council

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Board on Agriculture and Natural Resources

Institute for Laboratory Animal Research

Division on Earth and Life Studies

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Preface

The U.S. House of Representatives Committee on House Administration, chaired by U.S. Representative Robert W. Ney (Ohio-18th district), is responsible for oversight of the Smithsonian Institution, which administers the National Zoological Park and the Conservation and Research Center (CRC). Following a hearing held by the Committee on March 5, 2003, in which questions were raised regarding animal care and management at the National Zoological Park, Congress requested a science-based review of the quality and effectiveness of animal care and management at the National Zoo by the National Academies. In response to this request, the Board on Agriculture and Natural Resources and Institute for Laboratory Animal Research convened a committee to conduct the review. The detailed charge to the committee is as follows:

> "A committee of experts will be appointed to assess the quality and effectiveness of animal management, husbandry, and care at the Smithsonian Institution's National Zoological Park in Washington, D.C. and the Conservation and Research Center in Front Royal, Virginia. The study will identify strengths, weaknesses, needs, and gaps in the current infrastructure and provide recommendations on changes needed to ensure effective management and care of the National Zoo's animal collection. The study will provide a description of the system currently in place, the elements and characteristics of that system, and the changing nature of concerns surrounding the system. The committee will examine the historic and recent problems with animal health and animal science practices at the zoo, including recent reports on zoo operations and a scientific examination of the causes of recent animal deaths. The committee will review the National Zoo within the context of the larger zoo community, identifying unique aspects of the environment in which the National Zoo operates. The committee will evaluate the communication and coordination of the various divisions of the zoo that impact animal care, analyze the use of resources, and outline attributes of an enhanced system to ensure the health and well-being of the animals at the National Zoo. In addition, the committee will evaluate recent and ongoing changes in zoo operations. An interim report identifying the most pressing issues in animal care and management and aspects of the system in need of immediate attention, will be delivered at the end of the initial 6 months of the study. A final report that provides a comprehensive assessment of the zoo, outlines attributes of an enhanced system to ensure the health and well-being of the animals, and includes the committee's final recommendations, will be delivered at the end of 12 months."

In view of the complexity of the National Zoo, any review of the institution, even the current one, which is focused narrowly, requires a range of expertise. Accordingly the assembled committee contains individuals experienced in zoo management and operations, as well as nutritionists, veterinarians, and pathologists. Also included were experts in industrial management, toxicology, safety issues in the workplace, animal disease, zoo keeping, animal welfare, and animal physiology. The committee relied heavily on published information on how zoos should operate, input from experts presented at a National Research Council (NRC) sponsored workshop, and

previous evaluations of the National Zoo from the American Zoo and Aquarium Association (AZA), the U.S. Department of Agriculture, and by the Smithsonian Institution itself. Committee members visited the Rock Creek Park and CRC campuses to view the facilities and to meet staff members on site, including all levels of management and animal keepers. Some of these meetings were pre-arranged and organized by the NRC Staff. Others were informal and spontaneous, occurring as the result of chance encounters when committee members were walking through the grounds and buildings. Committee members had open access to the entire National Zoo operation and had the opportunity to inspect the facilities much as the public views them, but also "behind the scenes" in areas where the public rarely visits. Many personal, one-on-one, interviews with National Zoo employees were conducted in order to provide insight into perceived weaknesses and strengths of the National Zoo operation. In addition to these interviews, National Zoo staff members were encouraged to submit information to the committee through NRC staff in such a manner that their identities could be protected. These impressions were discussed during the committee's deliberations and lists of issues identified. As a result, several thousand pages of records and documents were requested from National Zoo management and carefully reviewed. The committee then decided which of the issues were most pressing and described them in this initial interim report along with a series of recommendations that the committee believes should be implemented immediately.

Animal care and management at zoos has changed dramatically in the past several decades and is guided by scientific peer-reviewed literature and other literature (regulatory, accreditation, and professional standards and data available in proceedings). Specific regulatory standards have been established by the Animal Welfare Act (enforced by the USDA Animal and Plant Health Inspection Service) and the Public Health Service Policy on the Humane Care and Use of Laboratory Animals. Standards have been developed and are obligatory for accreditation by the American Zoo and Aquarium Association. National Research Council reports serve as the scientific basis for policy and regulations pertaining to animal nutrition (Animal Nutrition Series) and to the care and use of animals used in research (Institute for Laboratory Animal Welfare publications) as well as standards utilized in industry, research, and academe. Additional standards and guidelines have been developed by professional organizations such as the American Association of Zoo Veterinarians, Zoological Registrars Association, American Veterinary Medical Association, and the Nutrition Advisory Group of the AZA. Many of these same organizations have annual proceedings that contain new and revised opinions on animal care and management. Finally, some data on animal care and management in zoos is available in the scientific peer-reviewed literature. The committee has reviewed much grey and scientific literature and has judiciously used these various sources of information to formulate its findings.

The committee acknowledges the public's disquiet about the present state of the National Zoo and the treatment and condition of the animals housed there. It has looked carefully at the circumstances surrounding the highly publicized animal deaths from the past decade. Several of these cases have been used to illustrate both the strengths and weaknesses of the present National Zoo operation. In other instances, the record is too unclear or incomplete and confounded by hearsay and conflicting statements to allow the committee to reach a firm conclusion.

This is an especially opportune time to explore the weaknesses and strengths of the present operations at the National Zoo, where scrutiny by the media has increased over the months since the committee first met. The committee hopes that this report will provide a balanced evaluation of National Zoo operations and provide the National Zoo's employees a foundation on which they can move forward with some confidence to make the National Zoo a first-rate institution.

R. Michael Roberts, Chair
Committee on the Review of the Smithsonian Institution's
National Zoological Park

Acknowledgments

This report represents the integrated efforts of many individuals. The committee thanks all those who shared their insights and knowledge to bring the document to fruition. We also thank all those who provided information at our public meetings and who participated in our public sessions.

During the course of its deliberations, the committee sought assistance from many people who gave generously of their time to provide advice and information that were considered in its deliberations. Special thanks are due the following:

Mark Edwards, Zoological Society of San Diego, San Diego, California
David Evans, Smithsonian Institution, Washington, D.C.
Michael Hutchins, American Zoo and Aquarium Association, Silver Spring, Maryland
Lynn Kramer, Denver Zoological Gardens, Denver, Colorado
Denny Lewis, American Zoo and Aquarium Association, Silver Spring, Maryland
Tom Meehan, Brookfield Zoo, Chicago, Illinois
Christian Newcomer, Johns Hopkins University, Baltimore, Maryland
Lucy Spelman, National Zoological Park, Washington, D.C.
Andrew Teare, Jacksonville Zoological Gardens, Jacksonville, Florida
Paul Vinovich, U.S. House of Representatives, Washington, D.C.
Ann Ward, Fort Worth Zoo, Fort Worth, Texas
Richard Watkins, U.S. Department of Agriculture, Washington, D.C.
Rosanne Whitehouse, University of Michigan Hospitals and Health Centers, Ann Arbor

The committee is especially grateful to the staff members of the National Zoo who took time to speak with the committee about the National Zoo and its operations and who provided essential information for the committee's work. The staff's candid, timely, and thoughtful input greatly facilitated the committee's efforts. The committee also appreciates the National Academies staff members who worked diligently to maintain progress and quality in its work. The study and the resulting report would not have been possible without the dedication and hard work of the two study directors, Dr. Jamie Jonker and Dr. Jennifer Obernier. A special acknowledgement is also due Bill Kearney (Director, Media Relations), who helped guide the committee through the challenges associated with a highly publicized subject. Susan Vaupel is thanked for editing the draft report prior to review.

The report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the National Research Council's Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process. We wish to thank the following individuals for their review of this report:

Govindasamy Agoramoorthy, Pingtung Rescue Center for Endangered Wild Animals, Kaohsiung, Taiwan
Robyn Barbiers, Lincoln Park Zoo, Chicago, Illinois
Greg Bauman, National Pest Management Association, Raleigh, North Carolina
Val Beasley, University of Illinois, Urbana
Marc Bekoff, University of Colorado, Boulder
William Foster, Birmingham Zoo, Inc., Birmingham, Alabama
Don Janssen, San Diego Wild Animal Park, San Diego, California
David Jessup, California Department of Fish and Game, Sacramento
Terry Medley, DuPont Agriculture and Nutrition, Wilmington, Delaware
Linda Munson, University of California, Davis
Craig Reed, Virginia Polytechnic Institute and State University, Blacksburg
Lee Simmons, Omaha's Henry Doorly Zoo, Omaha, Nebraska
Andrew Teare, Jacksonville Zoological Gardens, Jacksonville, Florida
Steven Thompson, Lincoln Park Zoo, Chicago, Illinois
Eduardo Valdes, Disney's Animal Kingdom, Orlando, Florida
Ann Ward, Fort Worth Zoo, Fort Worth, Texas

Although the reviewers listed above have provided many constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations, nor did they see the final draft of the report before its release. The review of this report was overseen by Harley Moon, Iowa State University, Ames, Iowa and John Dowling, Harvard University, Cambridge, Massachusetts. Appointed by the National Research Council, they were responsible for making certain that an independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content of this report rests entirely with the authoring committee and the institution.

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Executive Summary

The Smithsonian Institution's National Zoological Park (National Zoo) in Washington, D.C., hosts approximately two million visitors annually as a major tourist attraction. For families and children spending time in the nation's capital, the National Zoo is a place away from major museums that provides the opportunity to stroll and relax in a quiet setting. Consequently the National Zoo's well-being is not just a local concern but also one that resonates nationally. The prominence of the National Zoo on the national scene is additionally elevated as a result of Washington being an important media center for radio, television, and the press. The media's scrutiny of several animal deaths brought the National Zoo into the public consciousness and to the attention of Congress.

The National Zoo differs from other metropolitan zoos in that it receives much of its support from the federal taxpayer, a fact that is frequently unappreciated. As part of the Smithsonian Institution, whose museums and galleries were established "for the increase and diffusion of knowledge among men," the National Zoo is an institution in which the nation should be able to take pride. The U.S. House of Representatives Committee on House Administration (with oversight of the Smithsonian Institution) held a hearing on March 5, 2003, in which questions were raised regarding the quality of animal care and management at the National Zoo. It recommended a science-based review of the institution by the National Academies. In response to this request the Board on Agriculture and Natural Resources and the Institute for Laboratory Animal Research convened a committee and charged it to conduct a review of the care and management of animals at the National Zoo.

THE TASK OF THE COMMITTEE

A world-class zoo has missions that extend far beyond supplying attractive, humane venues for viewing wild animals in captivity. Zoos are complex organizations dedicated to conservation, education, and science with budgets derived from a mixture of sources. Except where these lesser-known aspects of the National Zoo impinged on animal care and management, they were not within the scope of this review. For example, the committee was not asked to review the education programs or the quality of the research carried out at the National Zoo or the scope or effectiveness of its conservation programs. Nor was the perceived adequacy (or inadequacy) of funding to support the various National Zoo activities within the committee's charge, although the utilization of these resources as it relates to animal care and management is within the charge. Instead, the committee was explicitly charged to focus narrowly, considering only those issues related specifically and directly to animal management, husbandry, health, and care.

THE INTERIM REPORT

Organization

The interim report is divided into five chapters. The first serves as an introduction providing facts about the National Zoo, including budgetary and personnel information. This information is provided as background material without interpretation, as these were not related to the charge of the committee. The next four chapters detail various aspects of the National Zoo that affect animal care and management at the Rock Creek Park facility. Each of these chapters is divided into four parts for each particular topic area: (1) an introduction that describes attributes of an exceptional zoo; (2) the current status of the National Zoo; (3) strengths and weakness of current practices at the National Zoo; and (4) findings and immediate needs for animal care and management at the National Zoo. In essence, the third part is the logical subtraction of part one from part two, the difference between the National Zoo today and an exceptional zoo leading to the findings and immediate needs. Where data have been available for the interim report, the committee has reported on the zoo in the context of the larger zoo community.

Criteria for Selecting Findings

The selection of findings that emerged from committee discussions relating to this interim report is based on the following criteria:

1. The immediacy of the threat to animal health and welfare,
2. The severity of the problem, or
3. The practicality of providing a quick solution to the problem in relation to present resources.

The committee relied heavily on published information on how zoos should operate, on input from experts, and on previous evaluations of the National Zoo from the American Zoo and Aquarium Association (AZA), the U.S. Department of Agriculture (USDA), and from the Smithsonian Institution itself. Committee members visited the Rock Creek Park and the Conservation and Research Center (CRC) campuses to view the facilities and to meet staff members, formally and informally. Committee members had open access to the entire National Zoo operation and had the opportunity to inspect the facilities much as the public views them, but also "behind the scenes" in areas where the public rarely visits. In addition, Smithsonian staff members were encouraged to submit information through NRC staff in such a manner that their identities could be protected. These impressions were discussed during committee deliberations, and lists of issues were identified. As a result several thousand pages of records and documents were requested from the National Zoo and were carefully reviewed by the committee. The committee decided which of the issues were most pressing at the Rock Creek Park facility and described them in this initial, interim report.

Based on observation and documentation the committee came to the opinion that the decline in the state of physical plant at the National Zoo had accrued over many years. The overarching questions were whether the visible deterioration was also reflected in the way that the animal collection was managed and in the quality of animal care and husbandry, and whether a pattern in animal deaths could be attributed to a breakdown in the authority of management, poor veterinary or nutritional care, or other types of issues.

The issues identified in this report are science-based and founded, at least in part, on lessons learned from the recent deaths of animals, mainly mammals, in the collection. Although the committee attempted to discern accurately the circumstances that led to many of the deaths, in some cases it was impossible either because the written record was incomplete or because there were conflicting accounts from involved National Zoo personnel. In any case, the charge of this committee was not to assign blame but to present recommendations that would avoid similar incidents occurring in the future. The committee has also noted that the National Zoo has been actively taking steps to correct some of the problems identified here and earlier by the AZA committee on accreditation and the inspection of the animal facilities by the USDA in the summer of 2003.

In the initial analysis of the most pressing needs for the National Zoo the committee has focused on issues identified at the Rock Creek Park facility. Some of these undoubtedly overlap with issues at the CRC (other issues at CRC be reviewed in detail in the final report). Four thematic areas of weaknesses became

apparent to the committee: (1) animal care and management, (2) record keeping, (3) pest management, and (4) mission and strategic planning for the entire National Zoo complex. These issues are treated sequentially, although in the larger complexity of issues at the National Zoo they clearly overlap.

FINDINGS AND IMMEDIATE NEEDS

The National Zoo is one of 213 zoos and aquariums accredited by the AZA. During its last AZA inspection the National Zoo accreditation was extended for one year. This accreditation is scheduled to expire in March 2004. The CRC is one of 16 certified related facilities. The CRC was certified for five years during its last AZA inspection in March 2003. This CRC certification is scheduled to expire in March 2008.

The National Zoo has undergone downsizing in its animal collection, with a decline from a maximum of over 6,000 in 1995 to the 2,600 today. However the drop in the number of species represented in the collection has not declined comparably. The reasons for the decline in animal numbers can be attributable to a drop in acquisitions, a decision to transfer some animals or groups of animals, and mortality in the collection. One of the issues raised is whether mortality rates at the National Zoo fall within acceptable bounds. The National Zoo's mortality rate during the last decade (1993-2002) period was 10.5 percent; in recent years (2000-2002) the mortality rate has declined to approximately 7 percent. The fluctuation in the National Zoo's mortality rate is in part due to biological variation, changing nature of the animal collection (species represented and animal numbers within individual species), and aging of the animal collection. Readers should be aware that the mortality rates at a zoo, whose collection is usually made up of animals with life spans much shorter than those of humans, depend greatly upon the nature of the species it houses as well as the age and health of individual animals.

Responsibility of the health of the animals at the National Zoo resides with at least three of its departments, Animal Health, Pathology, and Animal Programs. Animal Health is responsible for the health of the animals in the collection through ensuring proper nutrition, preventive medicine, and health care. Its staff includes the veterinarians and veterinary hospital staff, and nutritionists. Pathology provides clinical laboratory and postmortem diagnosis as well as research on diseases afflicting a zoo collection. The Animal Programs Department is responsible for the exhibits, day-to-day care of the animals, and the development of the animal collection.

Animal Care and Management

Finding 1: *The current preventive medicine program at the National Zoo is not being fully implemented, and since 1998, veterinary staff members have not been adhering to this program in terms of providing annual exams, vaccinations, and infectious-disease testing. Although efforts have been made in the past year to improve implementation, there is still a backlog of animals that have not received examinations, vaccinations, or tests as prescribed by the preventive medicine program.*

The Preventive Medicine Program includes quarantine, parasite surveillance, immunization, infectious diseases screening, dental prophylaxis, periodic reviews of diets, husbandry techniques, and vermin control. While the written documentation outlining the program is comprehensive and adequate, there has been poor adherence to the guidelines. Since 1998, the committee found numerous failures to provide timely vaccinations, tuberculosis tests, or physical or dental exams to primates, vaccinations and physical exams to carnivores, and vaccinations for avian species. One example is the case of the East African Bush elephant "Nancy," where the failure to administer an annual tuberculosis test resulted in the failure to diagnose an active case of tuberculosis.

During the past year the Department of Animal Health has taken steps to improve adherence with the preventive medicine program, but as of December, 2003 not all animals due to be examined/vaccinated/tested under the preventive medicine program had been treated. In addition, the department should learn to be proactive with regard to emerging problems. For example, in light of the recent death of a colobus monkey from leptospirosis as well as the ongoing issue with rodent control at the National Zoo, routine vaccination against this disease (usually transmitted by the intake of feed or water contaminated with the urine of an infected animal, often a rodent) for animals at risk, should be reevaluated as a component of the preventive medicine program.

Immediate Needs: *The Department of Animal Health should promptly eliminate the backlog of animals that should receive preventive care and document its current and future plan for preventive medicine activities. The National Zoo administration should take responsibility for ensuring that the Department of Animal Health has the resources and oversight necessary to adhere to the program.*

Finding 2: *Shortcomings exist in the animal nutrition program. There has been inadequate communication between the nutrition, keeper, and veterinary staffs; poor consultation between the research nutritionist and the acting head of clinical nutrition; and a lack of standardization and regular evaluation of animal diets. Nutrition records are not currently integrated with other record-keeping systems and, despite having adequate facilities for over a decade, the National Zoo is only now beginning to move toward a centralized commissary.*

Animal nutrition at the National Zoo is divided into two areas: research and clinical nutrition. The clinical nutrition division resides in the Animal Health Department, while the research nutrition division is located in the Department of Conservation Biology of the CRC. The National Zoo currently has a temporary acting head of clinical nutrition (on a two-year appointment) at Rock Creek Park and a research animal nutritionist in the Department of Conservation Biology of the CRC. Little direct interaction occurs between the acting head of clinical nutrition and the research nutritionist.

Lack of adequate nutrition oversight has contributed to animal deaths at the National Zoo. In the case of a zebra at Rock Creek Park in 2000 due to hypothermia and malnutrition, poor communication among keepers, nutritionists and veterinarians, poor record keeping, and a failure of adequate supervision of the health of the animals preceded the death. Nutrition management should take into account natural dietary habits and specific species recommendations. Diets should be analyzed for nutritional adequacy and records kept. Finally, after evaluation and formulation the diets should be appropriately implemented and the nutritional status of the animal monitored constantly by keepers and the veterinary staff. There were failures at many of these levels in the case of the zebra death.

The committee found that nutrition records are not integrated with medical, curatorial, keeper, and other records at the National Zoo. Additionally, there has been a lack of standard protocols for diets and for diet changes. Although the acting head of clinical nutrition built a database of currently fed diets, these are not yet complete. In addition, this staff member has recently been serving as the acting commissary manager (a new commissary manager was recently hired). With no dedicated clinical nutrition laboratory technician, only some routine nutrient analyses on feedstock are performed on zoo grounds. Lastly, the National Zoo has a decentralized commissary at the Rock Creek Park facility, with keeper kitchens for many of the animal enclosures and housing areas. More centralized diet processing could improve nutritional quality of diets, reduce food costs, and reduce pest problems. A 1992 external review requested by the National Zoo suggested the commissary had the physical capacity needed for the centralized program. A draft plan for developing a centralized commissary by 2005 has been developed by the National Zoo but the plan has not been finalized.

Immediate Needs: *The National Zoo should immediately use its existing nutrition expertise by increasing coordination and collaboration between the acting head of clinical nutrition and the research nutritionist to address nutritional issues of the animal collection, including diet review, evaluation, and modification. The zoo also should seek a permanent (rather than temporary), qualified experienced person for the role of clinical nutritionist. Centralization of standard diet formulation records and integration of those records with other record-keeping systems for animal care and management at the National Zoo should be completed. An annual schedule for evaluation of diet formulations for each animal or animal group should be developed and implemented. The National Zoo should finalize its draft plan to centralize the commissary and implement it in 2004.*

Finding 3: *There is a lack of documentation that the welfare of animals has been appropriately considered during the development and implementation of research programs and that complaints regarding the welfare of animals on exhibit were appropriately investigated. There also has been a lack of understanding within the National Zoo and the Smithsonian Institution of the requirements of federal regulations and Public Health Service Policy and how to maintain compliance.*

Since 1998, at least five research projects at the National Zoo that use animals have received Public Health Service (PHS) funding, which requires that the Smithsonian Institution provide a written Assurance

acceptable to the NIH Office of Laboratory Animal Welfare (OLAW). Based on its review of records from the Smithsonian Institution Office of Sponsored Projects and the OLAW, the committee cannot confirm whether the Smithsonian Institution had a valid Assurance from 1997 to 2000, a time during which PHS-funded research projects utilizing animals were funded and conducted at the National Zoo. Records indicate that on April 11, 2000 the Smithsonian Institution submitted paperwork to the OLAW seeking to renew its Assurance. On February 19, 2004, the committee received a letter from the OLAW stating that the office recently located this submission and now considers the Smithsonian's Assurance to be approved for the period between April 11, 2000 and March 31, 2004. The committee did not have the opportunity to consider the implications of OLAW's letter in this interim report because it was received only a few days before the report was finalized. The status of the Smithsonian's Assurance will be examined more fully in the committee's final report.

In addition, based on documents provided to the committee, the Institutional Animal Care and Use Committee (IACUC) at the Rock Creek Park facility has not consistently fulfilled its responsibilities for conducting and reporting semiannual facilities inspections, program reviews, and documenting IACUC activities. At best, this committee functioned in an "off-and on-again" manner—e.g., it did not keep adequate records and minutes, and it did not monitor and certify the correction of deficiencies it had previously noted. Because of a lack of record keeping, the committee cannot discern if PHS-funded research conducted at the Rock Creek Park facility was being conducted in accordance with provisions detailed in the Guide for the Care and Use of Laboratory Animals, again mandated by PHS Policy.

It is possible that some PHS-funded research at the National Zoo, as well as some research involving nonhuman primates is subject to the Animal Welfare Act (AWA). However, due to the lack of documentation from the Smithsonian Institution and the National Zoo, the committee was unable to discern whether this research was subject to the AWA or whether it was being conducted in accordance with the standards outlined by the AWA. Further investigation of ongoing research at the National Zoo is warranted to determine if AWA-subject research is occurring.

Although not required by any regulation, the National Zoo did have a committee (previously designated the Animal Welfare Committee and most recently called the Rock Creek Park IACUC) tasked with addressing issues pertaining to the welfare of animals on exhibit and research animals not covered by PHS Policy or the AWA. However, this committee failed to keep acceptable records of its deliberations and activities, and it appears that the committee members saw their mandate as one of solving conflicts between staff members and not of acting as an advocate for the animals. In September 2003 (General Memorandum 15) the National Zoo outlined a new IACUC program, which will be evaluated in the National Academies' final report. Nevertheless, based on the failures of the previous system, the committee believes that the current staff at the National Zoo should receive training to implement the program adequately.

Immediate Needs: *The National Zoo and the Smithsonian Institution should ensure compliance with all elements of the Animal Welfare Act and the Public Health Service Policy. The National Zoo and the Smithsonian Institution should seek outside training and assistance to achieve compliance with regulations and implement procedures meant to ensure the welfare of research and exhibit animals at the National Zoo.*

Finding 4: *There has been poor adherence to the National Zoo's own policies and procedures for animal health and welfare.*

There has been a longstanding failure of staff to abide by National Zoo policy and procedures. In some cases these failures endanger the safety of the animal collection. These incidents include failure to obtain the appropriate sign-off on nutrition and euthanasia forms, failure to document changes in animal management appropriately, failure to adhere with quarantine procedures, and failure to act in accordance with IACUC protocols (see Finding 3).

The National Zoo's euthanasia policy requires that a euthanasia form be signed by the veterinarian performing the euthanasia, the responsible curator, and the supervisory veterinarian. The case of the bobcat provides an excellent example of where the decision to euthanatize was made in a consensual manner with proper documentation. On the other hand, there have been several examples of failures to observe these guidelines (e.g. for the tree kangaroo and the orangutan euthanasia forms). Although there is no indication that these failures led to unnecessary suffering by the animals, proper procedures would have clarified the circumstances surrounding the decisions to euthanatize, which in some cases have been clouded with controversy.

The purpose of quarantine procedures and protocols is to prevent the introduction of new pathogens into the collection. Procedures may have been violated when staff-owned pets were brought onto National Zoo grounds for veterinary examinations and care. Even as a professional courtesy, bringing pets into the Zoo represents a potential risk to the zoo collection and a violation of the zoo's own policies and procedures.

Immediate Needs: *All levels of management should be held accountable for ensuring that National Zoo policies and procedures are followed. All zoo staff should take personal responsibility for educating themselves and adhering with the policies and procedures that pertain to their position and duties.*

Record Keeping

Finding 5: *The National Zoological Park lacks a comprehensive information management system for animal husbandry and management records, which results in inconsistent record keeping and practices of alteration in medical records weeks or years after events. While some issues are being addressed (e.g., an electronic keeper log system is in development) these are stop-gap measures often having no concrete timeframe for completion or implementation.*

Adequate and accurate record keeping underpins animal health and welfare. The adequacy of the record keeping at the National Zoo varied greatly across the different units and departments, with a lack of standardized practices for reporting and archiving records. Patterns of inconsistent record keeping and archiving were found in keeper logs, curator reports, nutritionist records, and medical records. One example pertained to the bobcat "Phoenix" for whom 16 weeks of requested keeper records were lost. In addition to poor record keeping, the logs throughout the Animal Programs Department were often archived improperly and many, like those for the bobcat, were irretrievable. Currently each of the eight units is responsible for archiving its own keeper records, but there is no stated expectation of how long they should be kept. No individual within the National Zoo has overall responsibility for documenting or overseeing where keeper records are archived and how they are organized. This fragile knowledge base is particularly compromised at a time of staff turnover.

There were instances of veterinary staff records being altered weeks and even years after the event. The standard practice of editing original clinical notes is unacceptable. The committee does not intend to discourage the National Zoo from using the MedARKS system as a teaching or record-keeping tool, but advises that if erroneous entries are made or pertinent facts identified later, they should be corrected by addenda and not by altering the original entry.

Overall, the National Zoo has been handicapped in its efforts to provide adequate animal care by a nonfunctional information management system. Records should provide an accurate account of situations and practices relating directly to animal management and health. They should permit reconstruction of events in the recent and distant past and should provide a rational basis for decision making. Ideally, a single, comprehensive electronic record-keeping system should be implemented, but the National Zoo may be obliged to use mixed paper and electronic records as a stop-gap measure.

Immediate Needs: *The National Zoo should implement an information management system that ensures complete documentation of animal husbandry and management and reasonable accessibility to the records by all units and departments. This does not necessarily mean that the entire system needs to be computerized immediately but rather that consistent practices be put in place, that a system be developed to make the records reasonably accessible, and that an appropriately experienced individual be given responsibility for system oversight.*

Pest Management

Finding 6: *Even though the pest management program has been reorganized and is showing signs of improvement, pest management remains inadequate and poses a potential threat to the animal collection, employees, and visitors to the National Zoo.*

On January 10, 2003, measures to control rats in the red panda enclosure went awry because the

National Zoo's own written protocols for approval of chemical use in animal enclosures were not followed. After the red panda deaths, responsibility for the Pest Management Program was transferred to the Pathology Department, and an Integrated Pest Management (IPM) Committee was formed to address the animal and insect pest problem at the zoo. Additionally, the National Zoo began the process of establishing a comprehensive program to address the widespread pest problem, including creation of a pesticide program manager position, which was subsequently filled. Despite many positive efforts by the new IPM Committee, housekeeping and site conditions remain poor throughout the Rock Creek Park facility. Rats and mice are present in animal areas and can be observed crossing public walkways in daylight. These conditions may have been exacerbated by the decision to reduce chemical control for rodents following the panda deaths. Considerable work will be required to ensure animal health and the aesthetic quality of the Rock Creek Park.

Immediate Needs: *A comprehensive IPM plan should be developed: (1) in the short term to bring current populations of pests down to acceptable levels and (2) in the long term to maintain those levels using modern IPM techniques.*

Mission and Strategic Planning

Finding 7: *The National Zoo is operating without a strategic plan, which jeopardizes its long-term operations and focused use of the zoo's resources. An integrated plan for the entire institution incorporating the 10-year facility revitalization and animal collections plans has not been developed.*

The National Zoo currently operates without a strategic plan despite the recommendations of previous AZA accreditation reports. It does have an animal collections plan and a 10-year facility revitalization plan in place, but these are not substitutes for a comprehensive planning process that takes into account all aspects of the zoo's operational structure. A strategic planning process was recently initiated as part of a Smithsonian-wide program and is a positive step forward.

An issue to be addressed during the strategic planning process is an evaluation of mission and goals. One challenge for the National Zoo is to maintain alignment with the Smithsonian Institution's mission while identifying and implementing a strategy that will enable its own independent success. Generating a plan that ensures maximum use of current resources will be important. Current and proposed projects, such as the Asia Trail and Farm, should be evaluated as to their fit with the plan.

The National Zoo will need to engage in strategic resource planning (i.e., human resources, facilities) to support its mission. The capability of the National Zoo to engage in resource planning is limited because many resource decisions, such as the recent one to reduce staffing through buyouts across all its units, are made at the Smithsonian level. Such a practice raises issues about the extent to which the National Zoo will lose experienced staff and the capability of the National Zoo to make strategic staffing decisions.

Immediate Needs: *The National Zoo should develop a comprehensive strategic plan and provide integrated goals for all aspects of the institution, with operational goals and performance measures, as soon as possible.*

MOVING FORWARD

While zoos have expanded their general mission over time from simply being exhibition facilities to becoming organizations that address conservation through research and education, their first and foremost responsibility is the health, nutrition, and welfare of the animals they maintain. The findings and immediate needs of the National Zoo outlined in this interim report are focused on correcting clear deficiencies and on enhancing animal care and management. The committee recognizes that some of the problems identified at the National Zoo are unique to the zoo, but many problems are common among other zoos. Situations and practices that negatively impact animal care and management, regardless of how common, are unacceptable at any institution housing captive live animals. The committee believes that the National Zoo should work quickly and diligently to address the problems identified in this report and to ultimately become a leader in effecting science-based change and improvement in the nation's zoo community.

THE FINAL REPORT

This interim report presents seven findings in four areas relating to animal care and management, record keeping, and pest management at the Rock Creek Park facility and strategic planning at the entire National Zoo complex. These findings and immediate needs should be considered by the National Zoo immediately because each threatens the well-being of the animals in the collection. The final report will expand on these four issues, particularly those that might be clarified as new information emerges. For example, as strategic planning proceeds the committee will be interested in how the National Zoo envisages its future and how it plans to organize its collection and its two campuses to reflect that vision. The committee will examine in detail any plans developed by the National Zoo to address issues raised in this interim report. In addition to expanding on the above four issues, the committee will also present issues that it did not consider so pressing that immediate steps had to be taken to implement change. Among these the committee has considered and may consider for the final report are management at the National Zoo, personnel health and safety issues, and formal training programs for staff, as they relate to animal care and management. A detailed analysis of other strengths and weaknesses in animal care and management at the CRC will be included in the final report. The final report is anticipated to be released during the second quarter of 2004.

1

Introduction and Background

To appreciate the scope of the study it is worthwhile to consider briefly the particular history of the National Zoo, its budget, the range of its operations, and its main missions. The National Zoo was created by an Act of Congress in 1889 for "the advancement of science and recreation of the people" (NZP History, 2003). In 1890 the zoo became part of the Smithsonian Institution (NZP History, 2003). It is one of 16 museums in the Smithsonian complex, from which it receives the majority of its budget. In fiscal year 2003 the federal appropriation to the National Zoo was approximately $23 million out of a total base budget of $43.5 million (see Table 1-1), which also includes business income, grants, gifts, and support from Friends of the National Zoo (FONZ) (NZP Budgets, September 24, 2003). In addition, the National Zoo received $18.75 million for capital improvement from the Congress in 2003, and it is slated for continued capital support through 2006. Unlike most other zoos receiving substantial public funding, the National Zoo does not charge admission for its estimated two million annual visitors. Despite its quasi-government status, the National Zoo is a complex business operation, which depends on private as well as federal support for its operations. Direct Federal support through the Congress, plus its location in the nation's capital and accessibility to the many visitors of Washington, D.C., endow the National Zoo with a special aura and prominence. Some would argue that the National Zoo is the nation's zoo, and that its well-being should be a matter of national and not just local concern.

The operating and capital improvement budgets for the National Zoo come from a combination of sources: the Smithsonian Institution, the Smithsonian Institution Trust, and FONZ. From 1999 to 2003, the budget for salaries and expenses increased approximately 17 percent (see Table 1-1); funds for capital improvements increased from $4.4 million to $18.75 million (see Table 1-2). In fiscal year 2004 it is anticipated that the personnel budget will decrease because National Zoo facilities staff are being transferred to the Smithsonian Office of Facilities Engineering and Operations (NZP Budgets, September 24, 2003). A 1992 accreditation report by the American Aquarium and Zoo Association (AZA, 1992) noted that the National Zoo had sufficient financial support at the time to maintain the zoo, but the zoo needed a plan to support program development and capital improvements.

The National Zoo consists of two campuses. The original site, on 166 acres of Rock Creek Park in northwest Washington, D.C., is open to the public 364 days of the year and houses most of the present collection of approximately 420 species and over 2,500 animals. The second site is the Conservation and Research Center (CRC) on 3,200 acres in Front Royal, Virginia, approximately 65 miles from Washington; the latter is open to the public only on special "open" days, when the CRC showcases its science. The CRC serves as a refuge for vanishing wildlife and as a laboratory for propagating a few rare species and for conservation biology. It is also

TABLE 1-1 National Zoological Park Operating Budget

($ millions)	National Zoological Park Operating Budget					
	1999	2000	2001	2002	2003	2004 (est)[a]
SI Federal Salaries and Expenses						
Facilities, staff and support	19.6	20.5	21.0	21.9	23.0	18.3
SI Trust						
Business income, gifts, grants	4.5	5.4	6.0	6.7	7.4	12.7
Subtotal	24.1	25.9	27.0	28.6	30.4	36.9
FONZ Support to NZP Programs	2.3	3.8	3.6	4.2	4.7	5.0
FONZ Operations	6.0	6.0	7.4	8.3	8.4	8.8
Total	32.4	35.7	38.0	41.1	43.5	50.7

[a]In fiscal year 2004, facilities staff reprogrammed to Office of Facilities Engineering and Operations, including $5.9 million and 95 full- time equivalents. This is included in the fiscal year 2004 totals.
SOURCE: NZP Budgets, September 24, 2003.

TABLE 1-2 National Zoological Park Capital Budget from the Smithsonian Institution's Federal Appropriation

($ millions)	National Zoological Park Capital Budget					
	1999	2000	2001	2002	2003	2004 (est.)
Maintenance	3.60	5.20	2.80	4.20	3.95	3.94
Minor revitalization				0.80	3.50	0.40
Major revitalization	0.80	0.80	4.80	5.00	11.30	9.00
Construction (Children's Farm)			4.90			
Total	4.40	6.00	12.50	10.00	18.75	13.34

SOURCE: NZP Budgets, September 24, 2003.

a classroom for training wildlife biologists from the United States and abroad. These two campuses participate as partners in conducting the three major missions of first-class modern zoos: education, research, and conservation.

The National Zoo, like all other zoos, must attract the public through its animal collection. As the American public has become more educated about wildlife, the destruction of habitat, and the accompanying threat to animal species over the last quarter century, it has also learned to be more sensitive to the treatment of animals in the wild and in captivity. Likewise, scrutiny of zoos by the media has become more intense. The public perception of zoos is therefore changing rapidly. No longer can a public zoo be viewed simply as a place of entertainment where exotic animals are viewed in cages. Modern expectation is that the wild animals of the collection be displayed in ecologically "natural" surroundings that are sensitive to their physical and psychological needs (Coe, 2003). The accreditation process for zoos, aquariums, and wildlife parks by the AZA reflects these changing expectations and sets standards for how a world-class zoo should operate.

The National Zoo is one of 213 zoo and aquariums accredited by the AZA (AZA, 2003c). During its last AZA inspection, the National Zoo accreditation was extended for one year with a directive to address deficiencies within that timeframe. This accreditation is due to expire in March 2004. The CRC is one of sixteen certified related facilities (AZA, 2003c). The CRC was certified for five years during its last AZA inspection in March 2003. This CRC certification is due to expire in March 2008.

PERSONNEL

Day-to-day operations of the National Zoo involve employees and volunteers within the organization, professionals from other parts of the Smithsonian, advisory boards, and others outside the National Zoo, including contractors, who primarily work to maintain the National Zoo's animals and physical plant. The work of the National Zoo includes exhibition, education, research, and recreation. The National Zoo organizational structure (NZP, NZP Organizational Structure, November 20, 2003; see Figure 1-1) is characterized by a hierarchical distribution of management authority and responsibility. At the apex of the structure is the zoo

director, who interfaces with three advisory boards: (1) the Friends of the National Zoo, (2) the National Zoological Park Advisory Board, and (3) the CRC Foundation. The director is supported by one deputy director.

The National Zoo has eight departments, which essentially operate independently. Departments are led by assistant directors who report to the deputy director and the director of the zoo. The Animal Programs Department (NZP, Animal Programs Organization Chart, November 20, 2003; see Figure 1-2) has primary responsibility over the day-to-day care and management of the animal collections at the Rock Creek Park facility. In the Animal Programs Department assistant curators report to associate curators (who in turn report to the general curator) and are generally individuals who have worked in the National Zoo for many years. The CRC (NZP, CRC Organizational Chart, November 20, 2003; see Figure 1-3) has primary responsibility over the day-to-day care and management of the animal collections at the facility in Front Royal, Virginia. The Animal Health Department includes veterinary and nutrition staff (see Figure 1-4). The Pathology Department has primary responsibility for examining animal deaths, and at the present time administers the pest management program (see Figure 1-5). The other four departments are Public Affairs and Communications, Administration and Technology, Exhibits and Outreach, and NZP Police.

The National Zoo employs both federal staff and outside contractors. The total number of government full-time equivalents (FTEs) decreased from about 350 in 1993 to 290 in 2002 (NZP, National Zoo Work Years September 24, 2003). A decrease in the number of permanent staff has been partially offset by gains in temporary employees, although total FTEs have decreased overall during this time. Of note, in 1996 a large proportion of curator staff left the National Zoo during a federal employee buyout program. The percentage attrition in administrative staff was comparable or higher than among non-administrative staff. While the number of employees at the National Zoo has decreased significantly during the past decade, the number of animals under the care of these employees has also decreased significantly (detailed in the Animal Care and Management chapter). Overall loss of staff has been offset to some extent by recruitment of keeper staff, whose numbers increased by six during this 10-year timeframe (NZP, Staff Gains and Losses FY 1993-2000, September 24, 2003).

NATIONAL ZOO GENERAL MEMORANDA AND BEST PRACTICES

The National Zoo has an extensive set of General Memoranda (see Appendix A) that details standard operating procedures for employees. Most of the General Memoranda have been revised or are new since April 1, 2003. Additionally, in July 2003 the General Memoranda were summarized into Best Practices for most departments (NZP , Best Practices, 2003). These Best Practices were distributed to all staff, and will be distributed to FONZ employees and new zoo employees.

Many departments and units at the National Zoo have written protocols (NZP Submission, September 24, 2003). The Animal Programs Department's Best Practice Manual serves as a guideline for keepers (NZP, Department of Animal Programs – Best Practices, 2003). Each animal area also has its own protocols for animal care, and are maintained centrally by the general curator.

Best Practices were developed by the National Zoological Park (NZP Submission, September 24, 2003) from their General Memoranda (NZP, General Memoranda, August 8, 2003) for 10 departments and units at the zoo. Each Best Practice manual contains summaries of the General Memoranda identified as core to the institution (General Memoranda #1-15). Additionally, other General Memoranda deemed necessary for successful operation were summarized for each department or unit individually; thus each of the 10 departments or units has unique Best Practices. Best Practices have been developed for the following departments or units at the National Zoo:

- Office of the Director
- Office of Communications and Public Affairs
- Department of Animal Programs
- Department of Conservation and Research
- Department of Administration and Technology
- Department of Exhibits and Outreach
- National Zoological Park Police
- Department of Animal Health
- Department of Pathology
- Office of Facilities Engineering and Operations

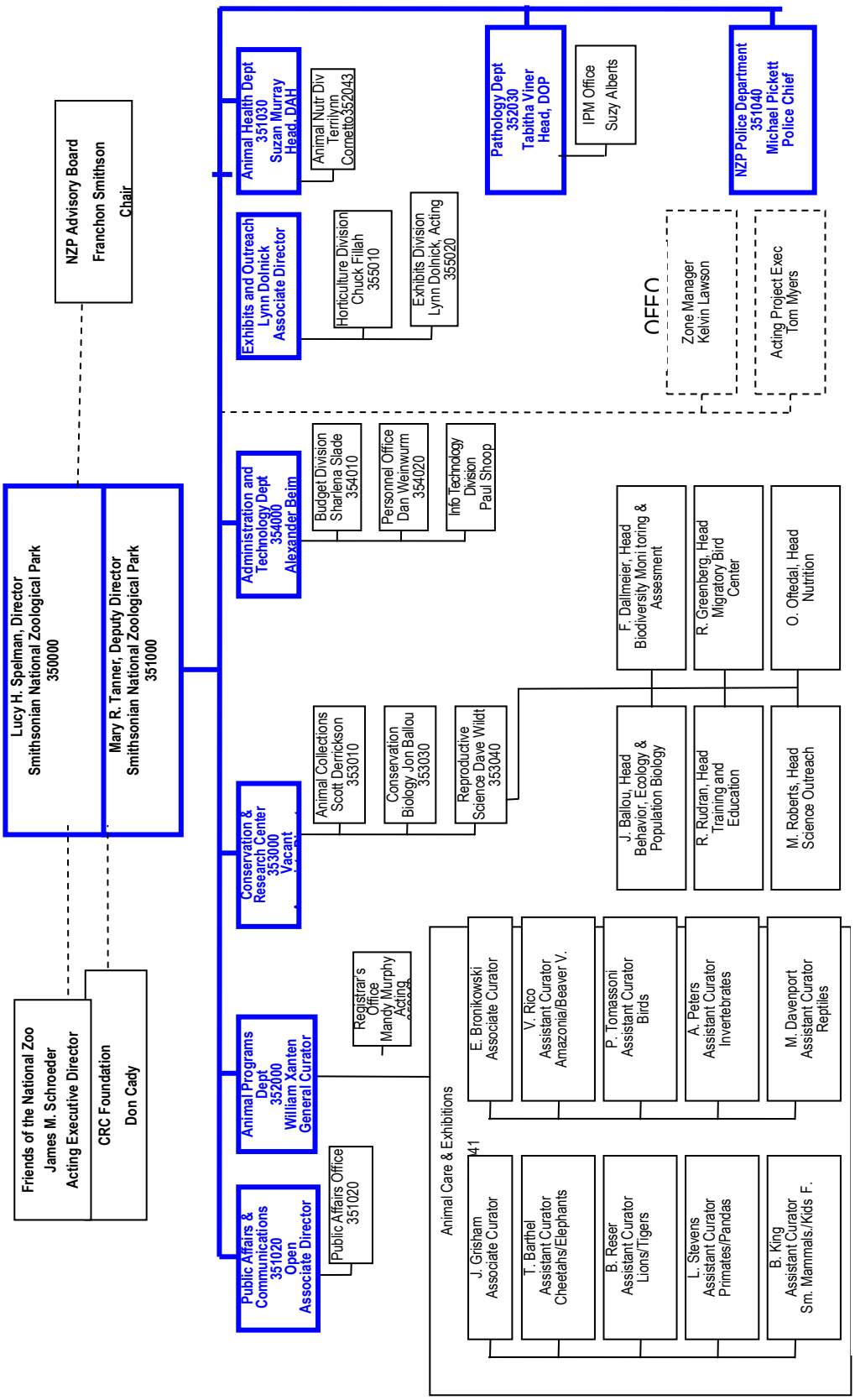

FIGURE 1-1 Organizational chart for the Smithsonian Institution's National Zoological Park.
SOURCE: NZP Organizational Chart (received November 20, 2003).

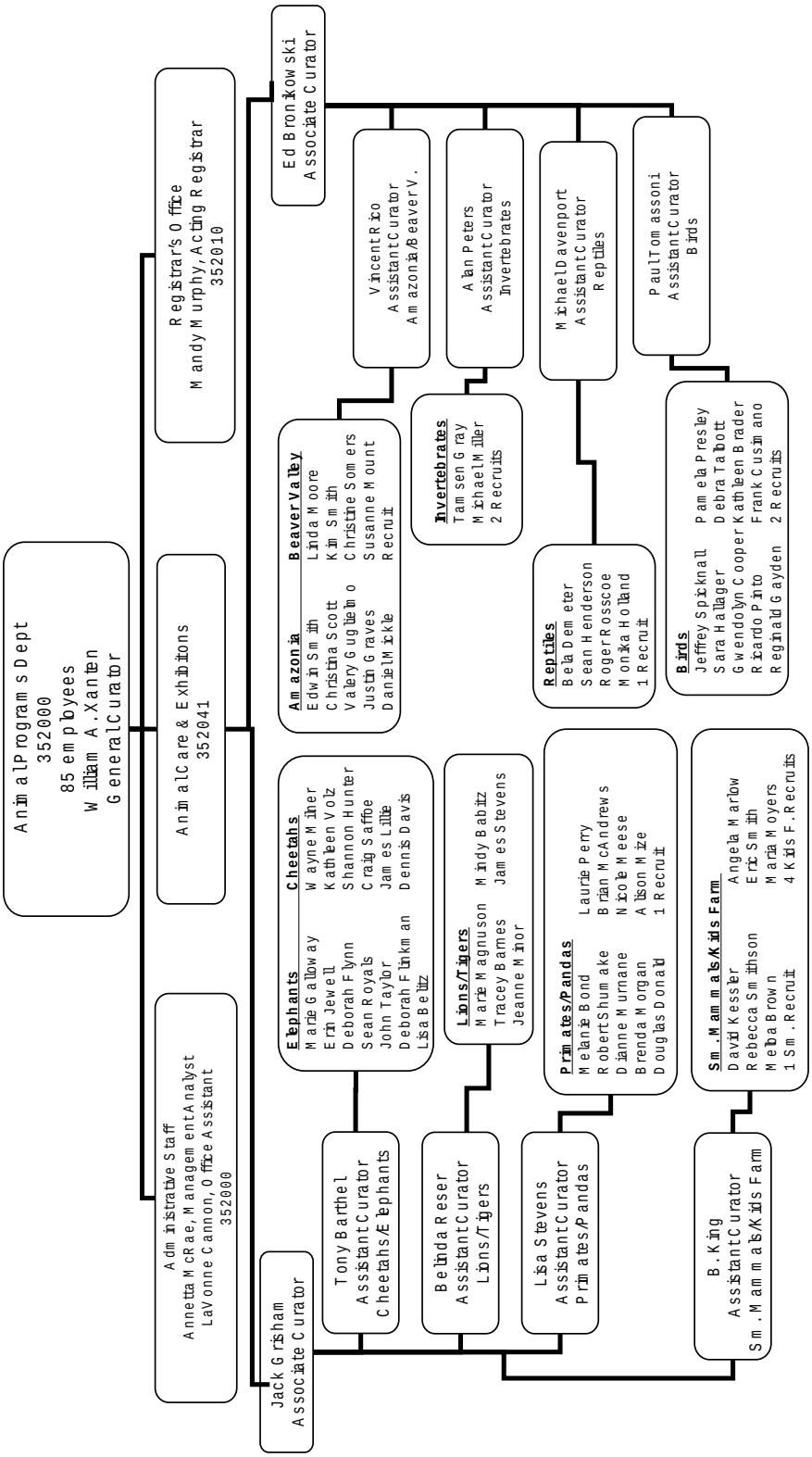

FIGURE 1-2 Organizational chart for Animal Programs Department.
SOURCE: NZP Animal Programs Department Organizational Chart (received November 20, 2003).

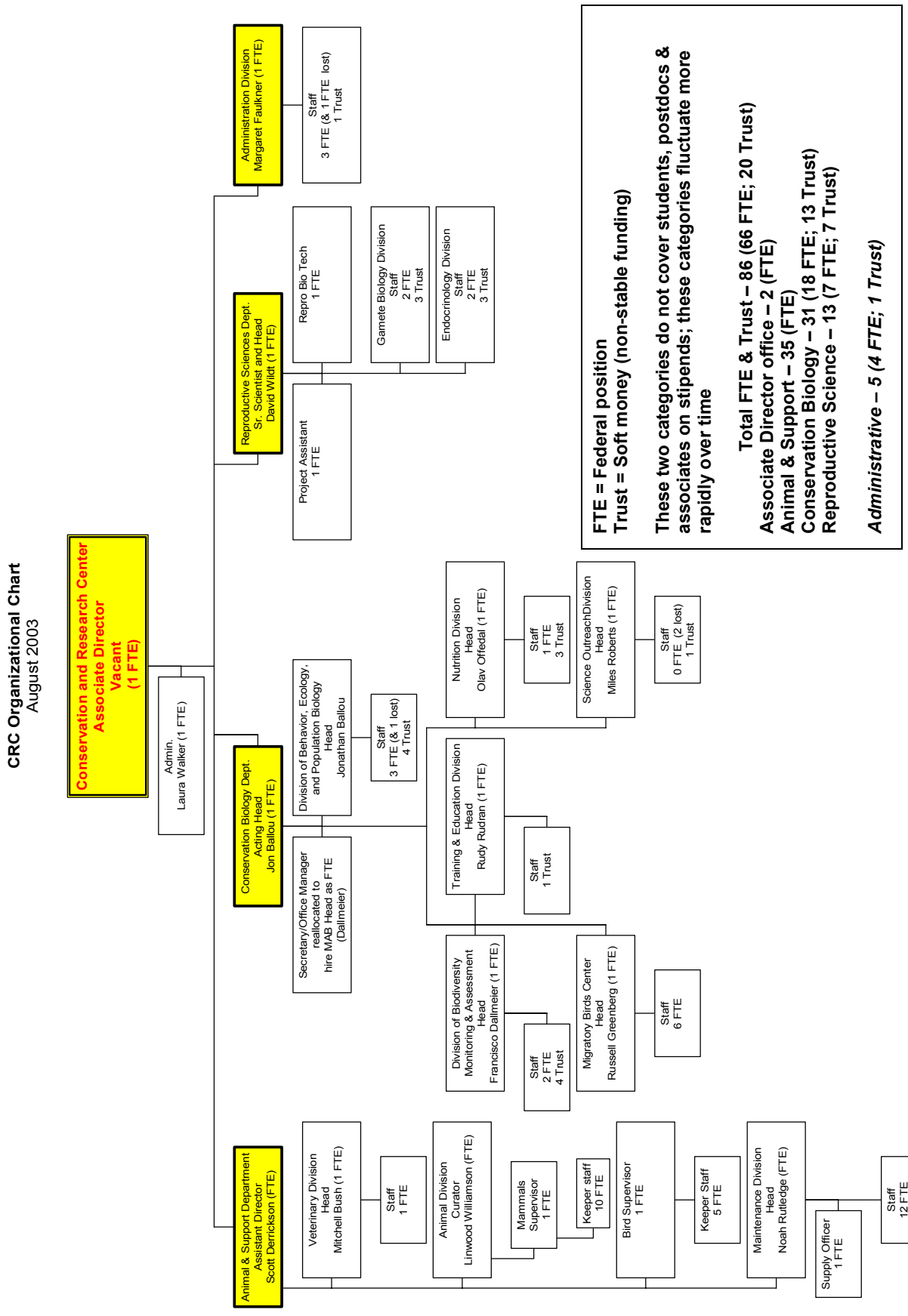

FIGURE 1-3 Organizational chart for the Conservation and Research Center.
SOURCE: NZP Conservation and Research Center Organizational Chart (received November 20, 2003).

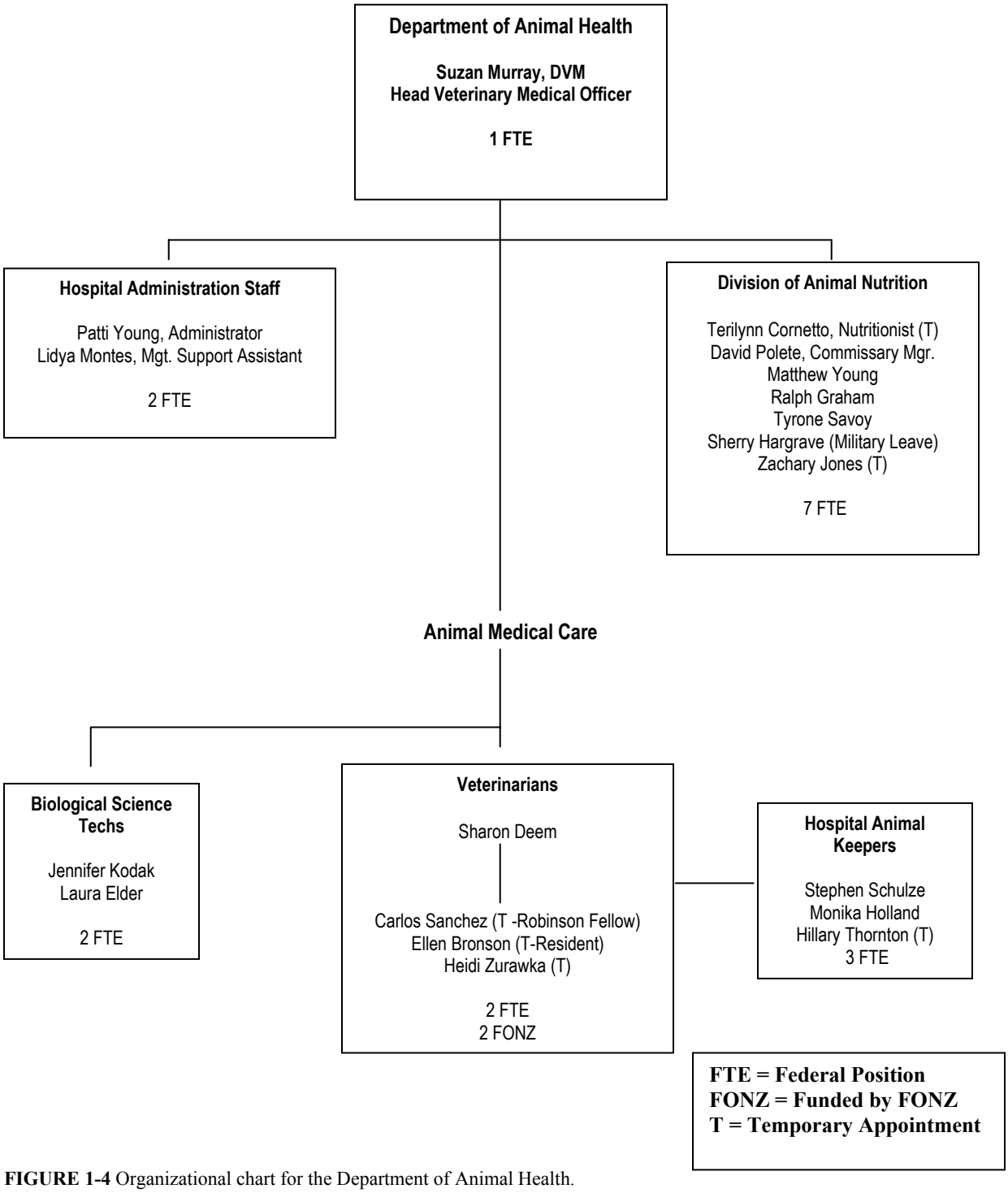

FIGURE 1-4 Organizational chart for the Department of Animal Health.
SOURCE: NZP Animal Health Department Organizational Chart (received February 11, 2004).

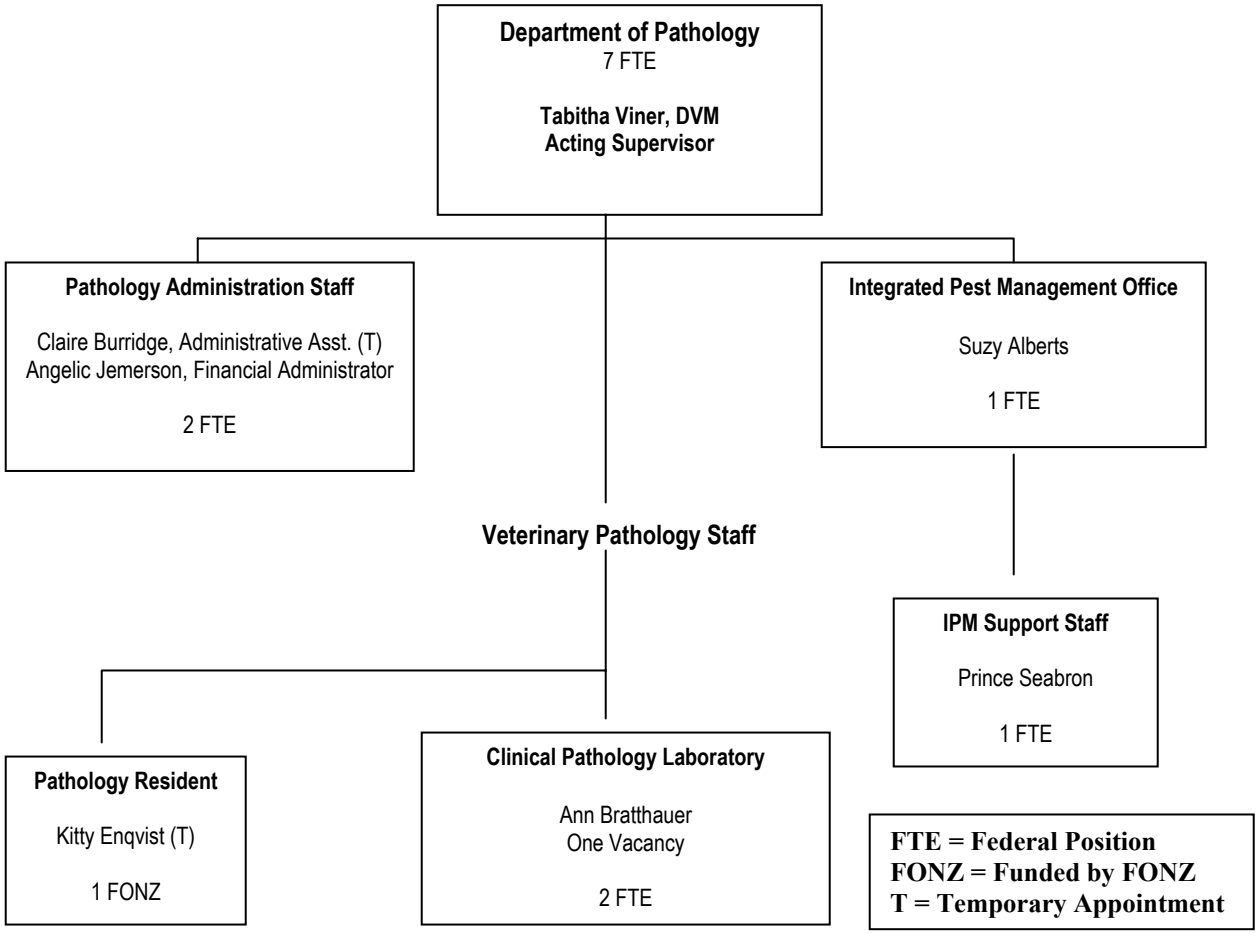

FIGURE 1-5 Organizational chart for the Department of Pathology.
SOURCE: NZP Pathology Department Organizational Chart (received February 11, 2004).

THE ANIMAL COLLECTION

The National Zoo's animal collection currently consists of approximately 2,600 animals representing just over 400 species (NZP, Status of the Collection Report, 2002). The collection has undergone dramatic changes in the past 10 years. From 1993 to 2002 the size of the animal collection has decreased 54 percent (see Figure 1-6). This decrease is due to several factors, including a decrease in the number of animals acquired by the zoo annually, as well as an increase in removal of animals from the collection. As shown in Figure 1-7, the number of animals acquired annually by the zoo was fairly stable from 1993 through 1999, but starting in 2000, there was decrease in the number of animals acquired by the zoo annually, with a 67 percent decrease in annual acquisitions from 1999 to 2002.

Even though annual acquisitions of animals remained relatively stable throughout the 1990s, the size of the animal collection continued to decline. This decline occurred because the number of animals that were being removed from the collection, either through death or relocation to other institutions (see Figure 1-8), was greater than the number of animals being acquired each year (animals born at the National Zoo or acquired from other institutions). In particular a large number of animals were removed from the collection during 1995-1997. This was partly because of a deliberate reduction in the number of mammals held at the CRC, but it was also because of a large number of animal deaths in those years (due to an increase in the number of fish, amphibian, and invertebrate animal deaths). The CRC deliberately reduced the number of mammalian species in its inventory by about 40 percent during this timeframe through relocation of their animals to other institutions. This decision to concentrate on only approximately 10 species with a high research return provided greater focus to the CRC's research effort.

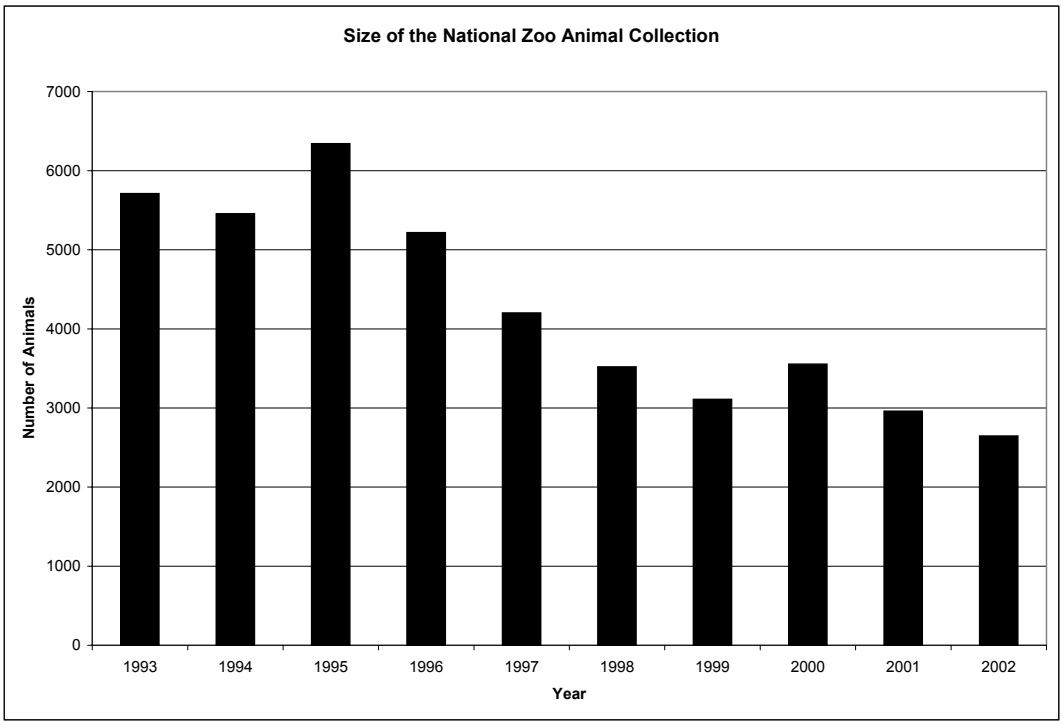

FIGURE 1-6 Annual status of the National Zoo animal collection. The annual counts for each year are a tabulation of individually counted animals, as well as estimates for groups of animals (such as fish, bats, and frogs), that are not counted individually.
SOURCE: Tabulated from NZP, Status of the Collection Reports, 1993-2002.

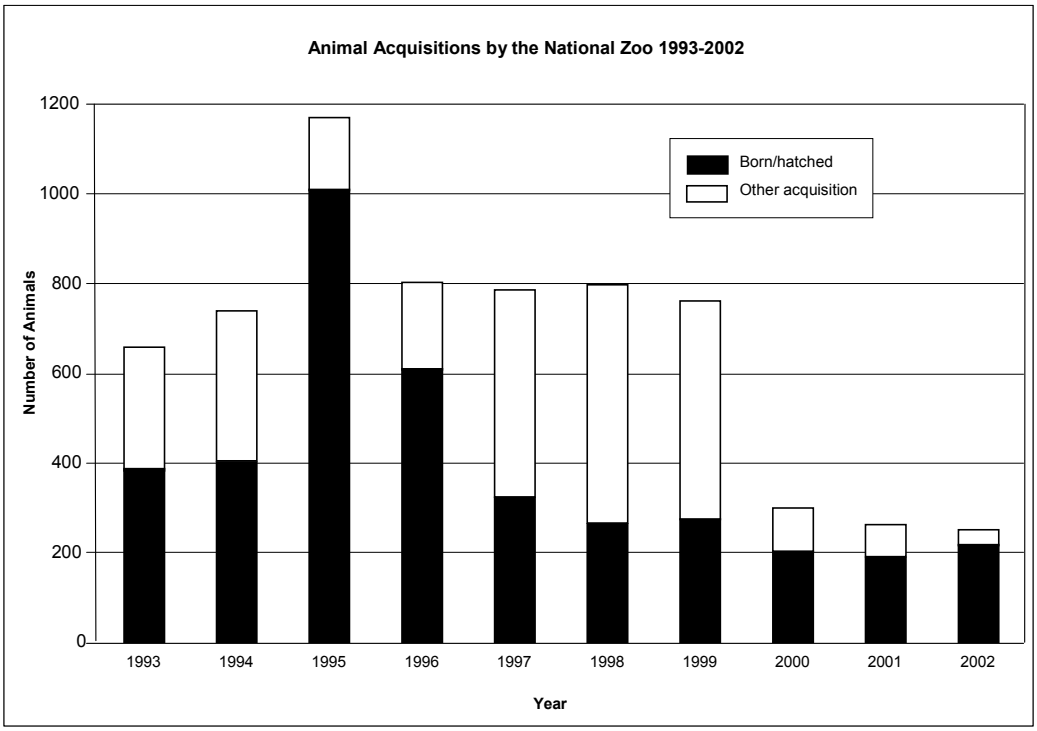

FIGURE 1-7 Annual animal acquisitions by the National Zoo. Acquisitions include animals born at the National Zoo or acquired from other institutions.
SOURCE: Tabulated from NZP, Status of the Collection Reports, 1993-2002.

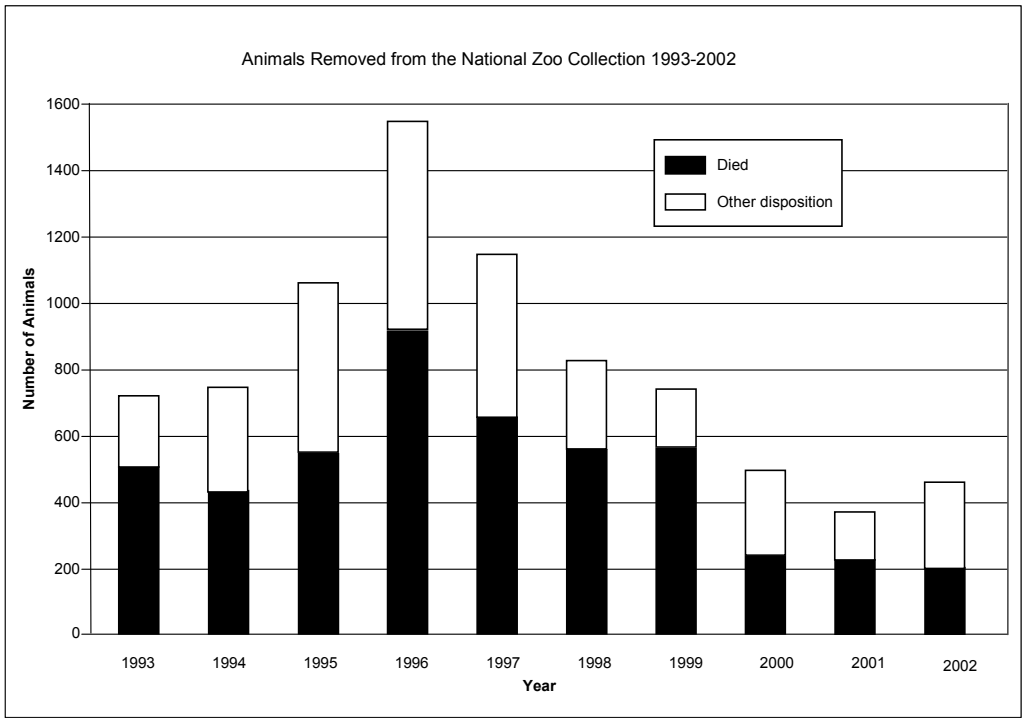

FIGURE 1-8. Number of animals removed from the National Zoo collection annually. Animals are removed from the collection either by death or relocation of the animal to another institution.
SOURCE: Tabulated from NZP, Status of the Collection Reports, 1993-2002.

FIGURE 1-9. Annual mortality rate at the National Zoo, by animal group. The annual mortality rate is calculated as a percentage of the animal collection that dies each calendar year. Mortality rates were calculated for fish, amphibians, and invertebrates (fish, amphib, invert) as a group; mammals; birds; and reptiles.
SOURCE: Tabulated from NZP, Status of the Collection Reports, 1993-2002.

Annual mortality rates are one method of assessing fluctuation in a zoo collection. This rate is determined by calculating the percentage of the total collection that dies each year, usually using the data from an annual animal inventory. To evaluate the National Zoo's annual mortality rate (see Figure 1-9) in the context of the larger zoo community, the committee sought to data from other zoos in the United States. The committee has obtained mortality data from two zoos at this time. The collection size of these two zoos currently range from just under 2,000 specimens to just over 3,700, representing approximately 240 and 750 species, respectively. Both zoo's mortality rates have remained relatively stable or declined over the past 10 years, averaging 6.8 percent (ranging from 4.7 to 9.8 percent) and 10.6 percent (ranging from 8 to 12 percent) (Denver Zoological Gardens, 2003; North Carolina Zoological Park, 2004) annually. The National Zoo's mortality rate during the same period averaged 10.5 percent (ranging from 6.3 to 15.9 percent). The fluctuation in the National Zoo's mortality rate is in part due to biological variation, changing nature of the animal collection (species represented and animal numbers within individual species), and aging of the animal collection. Readers should be aware that the mortality rates at a zoo, whose collection is usually made up of animals with life spans much shorter than those of humans, depend greatly upon the length of lifespan and robustness of the species, the ratio of short-lived to long-lived animals in a collection, as well as the age and health of individual animals. The committee has requested data from numerous institutions and anticipates having additional data for analysis of annual mortality rates in the final report.

THE NATIONAL ZOO AS PART OF THE LARGER ZOOLOGICAL COMMUNITY

To review the National Zoo as part of the larger zoo community, data from AZA-accredited zoos (AZA, 2003b) were analyzed for vertebrate animal collection size, total staff number, and annual budget. For data consistency, institutions were excluded from the committee's analysis when the institution was an aquarium or had greater than 70 percent of its vertebrate collection as fish or when no staff or budget data was available. This yielded 156 AZA-accredited institutions, including the National Zoo, for comparison.

For the data from 156 institutions reviewed, budgets ranged from approximately $60,000 to $89 million annually, with an average of $6.6 million (AZA, 2003b). The National Zoo reported a budget of $34 million (AZA, 2003b), somewhat lower than the operating budget (excluding FONZ operations) provided to the committee by the National Zoo (see Table 1-1). The National Zoo's budget is larger than 96 percent of the AZA-accredited zoos (see Figure 1-10). Staff size ranged from 6 to 1,390 (average of 108) for the 156 institutions (AZA, 2003b). The National Zoo staff is larger than 94 percent of the AZA-accredited zoos (Figure 1-11). The vertebrate animal collection size of the 156 AZA-accredited institutions ranged from 20 animals (6 species) to 12,907 animals (824 species) (AZA, 2003b). The National Zoo vertebrate animal collection size is larger than 89 percent of the other institutions with 2278 specimens (see Figure 1-12). Including invertebrates, the National Zoo collection is approximately 2,500 animals (similar to that discussed earlier). The National Zoo had a vertebrate-animal-to-staff-number ratio of 7.8:1 in its collection (see Figure 1-13), less animals per staff member than 72 percent of the AZA-accredited institutions. This ratio includes all staff (animal care, animal health, research, administrative, service, etc,) reported by each institution; approximately 50 percent of the National Zoo staff is involved directly in animal care and management (Animal Programs, Animal Health, and Pathology departments, and the Animal and Support Department at CRC). Table 1-3 presents 10 AZA-accredited zoos with 2,000 to 3,000 vertebrate animals in their collection, including the National Zoo. Table 1-4 presents 10 AZA-accredited zoos with $20 to $46 million annual budgets, including the National Zoo.

Guidelines and Standard Practices for Zoos

Animal care and management at zoos has changed dramatically in the past several decades, guided by scientific peer-reviewed literature and other literature (regulatory, accreditation, and professional standards and data available in proceedings). Specific regulatory standards have been established by the Animal Welfare Act (enforced by the USDA Animal and Plant Health Inspection Service) and the Public Health Service Policy on the Humane Care and Use of Laboratory Animals. Standards have been developed and are obligatory for accreditation by the American Zoo and Aquarium Association. National Research Council reports serve as the scientific basis for policy and regulations pertaining to animal nutrition (Animal Nutrition Series) and to the care and use of animals used in research (Institute for Laboratory Animal Welfare publications) as well as standards utilized in industry, research, and academe. Additional standards and guidelines have been developed by such professional organizations as the American Association of Zoo Veterinarians, Zoological Registrars Association, American Veterinary Medical Association, and the Nutrition Advisory Group of the AZA. Many of these same organizations have annual

proceedings that contain new and revised opinions on animal care and management. Some data on zoo animal care and management are available in the scientific peer-reviewed literature. The committee has reviewed much grey and scientific literature and has judiciously used these various sources to formulate its findings.

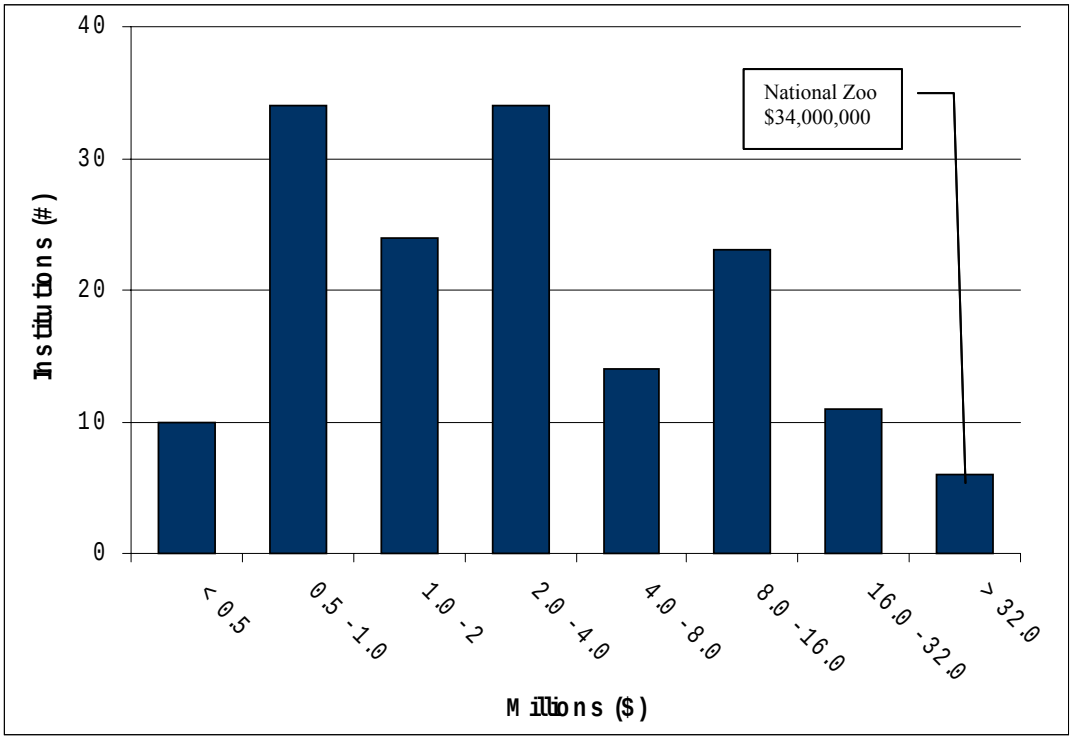

FIGURE 1-10 Annual budget for AZA- accredited institutions reported in 2003.
SOURCE: Tabulated from the 2004 AZA Membership Directory (AZA, 2003b).

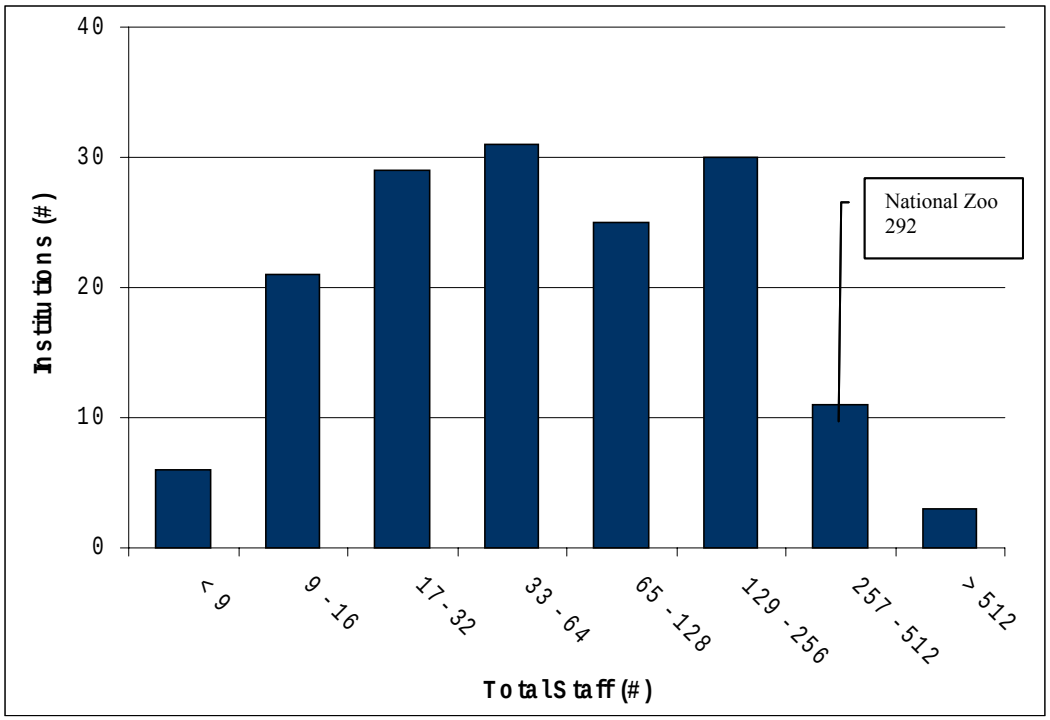

FIGURE 1-11 Total number of staff for AZA-accredited institutions reported in 2003.
SOURCE: Tabulated from the 2004 AZA Membership Directory (AZA, 2003b).

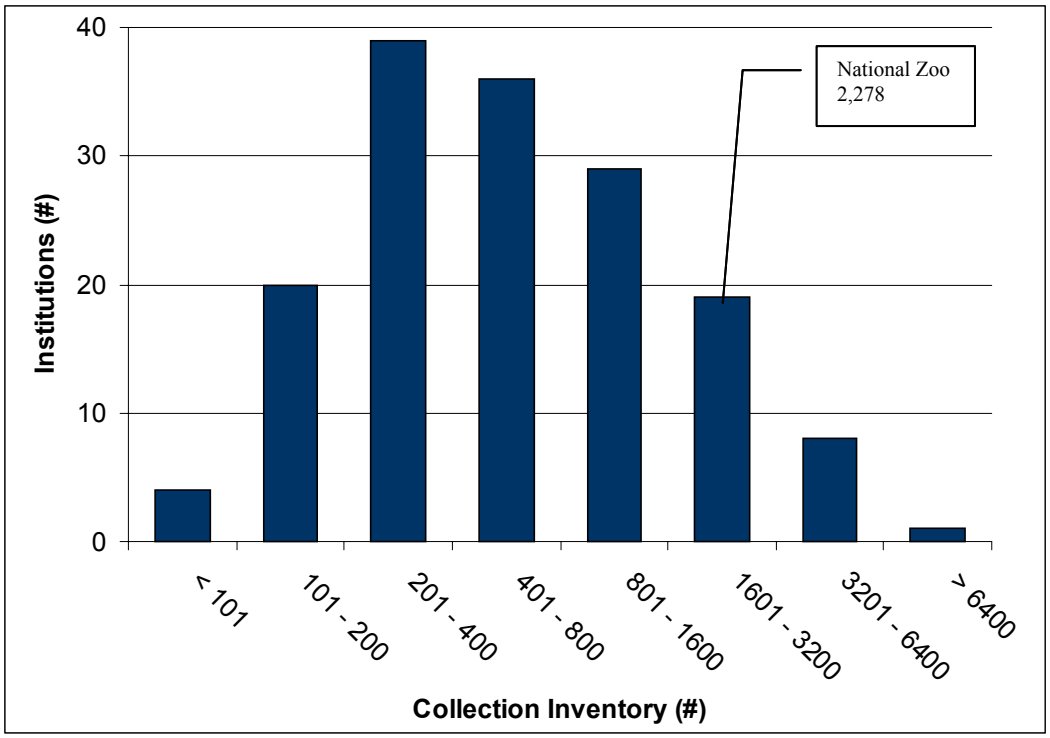

FIGURE 1-12 Vertebrate collection inventory for AZA- accredited institutions reported in 2003.
SOURCE: Tabulated from The 2004 AZA Membership Directory (AZA, 2003b).

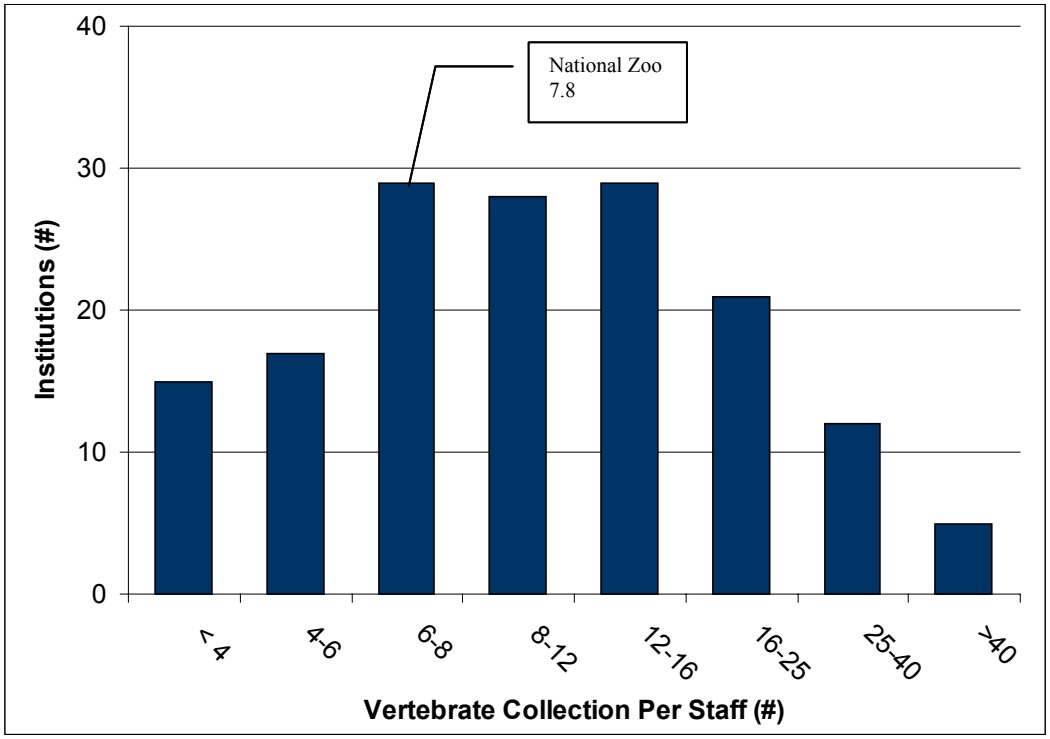

FIGURE 1-13 Number of vertebrate animals per staff for AZA- accredited institutions reported in 2003.
SOURCE: Tabulated from the 2004 AZA Membership Directory (AZA, 2003b).

TABLE 1-3 Annual Budget and Staff Number for 10AZA-accredited Zoos with 2,000 to 3,000 Vertebrate Animals in their Collection (Including the National Zoo).

Zoo	Location	Vertebrate Collection	Invertebrate Collection	Total Staff	Annual Budget ($)
Milwaukee County Zoological Gardens	Milwaukee, WI	2,024	90	294	19,053,680
Baltimore Zoo	Baltimore, MD	2,037	52	283	11,600,000
Minnesota Zoological Garden	Apple Valley, MN	2,060	1,053	240	15,782,351
Louisville Zoological Garden	Louisville, KY	2,202	62	152	9,336,400
Smithsonian National Zoological Park	Washington, DC	2,278	214	292	34,000,000
Sedgwick County Zoo	Wichita, KS	2,279	384	130	6,600,000
Detroit Zoological Park	Royal Oak, MI	2,320	996	245	20,525,680
Cincinnati Zoo & Botanical Garden	Cincinnati, OH	2,324	45	230	19,385,000
Brookfield Zoo	Brookfield, IL	2,412	2,862	470	35,100,000
Wildlife World Zoo	Litchfield Park, AZ	2,627	100	35	3,500,000

SOURCE: The 2004 AZA Membership Directory (AZA, 2003b).

TABLE 1-4 Animal Collection Size and Staff Number for Ten AZA-accredited Zoos with $20 Million to $46 Million Annual Budget (Including the National Zoo).

Zoo	Location	Vertebrate Collection	Invertebrate Collection	Total Staff	Annual Budget ($)
Woodland Park Zoological Gardens	Seattle, WA	1,005	51	223	20,235,258
Detroit Zoological Park	Royal Oak, MI	2,320	996	245	20,525,680
The Calgary Zoo	Calgary, Alberta	870	6	199	20,976,000
The Philadelphia Zoo	Philadelphia, PA	1,530	57	250	22,801,000
Museum of Science	Boston, MA	234	4	289	30,732,000
Smithsonian National Zoological Park	Washington, DC	2,278	214	292	34,000,000
Brookfield Zoo	Brookfield, IL	2,412	2,862	470	35,100,000
Saint Louis Zoological Garden	Saint Louis, MO	3,009	3,217	401	39,288,372
San Diego Wild Animal Park	Escondido, CA	3,382	0	650	40,253,000
Bronx Zoo	Bronx, NY	4,370	179	578	45,168,506

SOURCE: The 2004 AZA Membership Directory (AZA, 2003b).

2

Animal Care and Management

At the National Zoo responsibility for the care and management of the animal collection resides in the Animal Programs Department, Animal Health Department, and Pathology Department. These departments are generally responsible for the exhibition, day-to-day care, and health of the animal collection (NZP, Best Practices, 2003). The National Zoo's Institutional Animal Care and Use Committees (IACUCs) are responsible for reviewing exhibit, management, and research programs to ensure that animals in the collection and research programs receive humane care and treatment (NZP, General Memorandum No. 15, April 2003, September 2003).

The Animal Programs Department is generally responsible for the exhibition of the animals, day-to-day care of the animals, and development of the animal collection (NZP, Department of Animal Programs – Best Practices, 2003). The Department of Animal Health consists of the veterinary staff at the animal hospital, as well as the nutrition and commissary staff. This department is responsible for the health of the animal collection: proper nutrition, preventive medicine, and health care (NZP, Department of Animal Health – Best Practices, 2003). The Department of Pathology provides clinical laboratory and postmortem diagnosis and research to identify diseases that are occurring at the National Zoo and determine how they can be controlled or prevented (NZP, Department of Pathology – Best Practices, 2003).

ANIMAL PROGRAMS DEPARTMENT

Within the Animal Programs Department, the animal collection is grouped into eight units, by either species type or exhibit location:

1. Cheetahs and Elephants Unit
2. Lions and Tigers Unit
3. Primates and Pandas Unit
4. Small Mammals and Kid's Farm Unit
5. Birds Unit
6. Reptiles Unit
7. Invertebrates Unit
8. Beaver Valley and Amazonia Unit

The Animal Programs Department is headed by a general curator, who is assisted by two associate curators, each with oversight responsibility of four units. Each unit is managed by an assistant curator. The eight assistant curators, manage the activities of the animal keepers assigned to each respective unit. Responsibilities for animal care and management are divided among the staff as follows:

Animal Keeper

Keepers are responsible for independently providing the day-to-day care and maintenance of animals and the exhibits in which they are housed. Their primary responsibilities include (NZP, Animal Programs – Best Practices, Primary Keeper Responsibilities; Position Description – Animal Keeper):

- daily inspections of all animals in their care and reporting of any evidence of illness, injury, or abnormal behavior to the curator and veterinarian.
- feeding and watering assigned animals, including preparation of food, and placement in animal enclosures. Maintaining current records on food and water consumption and report deviations from normal or expected patterns.
- daily cleaning of exhibit interiors and exteriors, service areas, and public areas adjacent to the animal enclosure.
- regularly inspecting and maintaining of exhibit area, including trimming and watering of plants, maintenance of furniture, mechanical and life-support systems, and either correcting or referring the problems to the supervisor.
- applying the approved enrichment plan for each assigned animal.
- completing daily reports on assigned animals.

Their duties also consist of other activities such as assisting with research and breeding programs, interacting with zoo visitors, and developing training and enrichment programs.

Assistant Curator

The assistant curators are responsible for the conception, formulation, leadership, and conduct of all animal care, breeding, conservation, exhibition, and associated public education for a designated portion of the animal collection (called a unit). Their primary duties include (Position Description – Supervisory Biologist):

- responsibility for all aspects of the daily care and exhibition of all animals in their assigned unit. With the Nutritionist, developing diet formulations and protocols for diet preparation and presentation; with the heads of the Departments of Animal Health and Pathology, developing and overseeing preventive medical programs for animals in their assigned unit.
- developing and implementing a detailed collection plan; working with national and international conservation coordinating efforts to identify species and individual animals to be bred and exchanged with other zoo to meet breeding objectives.
- developing plans for the exhibition of the collection.
- working with the registrar to provide accurate and timely information for the NZP animal records systems.
- developing and implementing annual operating budgets.
- supervising animal keepers, scheduling staff, and appraising performance; training and directing volunteers and interns.
- formulating, conducting, analyzing, and publishing research studies that are original, hypothesis-driven research related to managerial and education responsibilities; seeking funding to support research; coordinating research of other scientists wishing to use the collection; reviewing research proposals for appropriateness and routing them to the IACUC for approval.
- working with the Department of Exhibit Interpretation on exhibit materials and providing information for demonstration tours and education materials.
- serving as spokesperson for public information efforts regarding animals in their designated unit.

Associate Curator

Each associate curator oversees 50 percent of the animal collection units, with responsibility for the conception, formulation, leadership, and conduct of all animal care, breeding, conservation, exhibition, and associated public education. Specific responsibilities as listed in the NZP Position Description are essentially identical to those described for assistant curators (Position Description – Associate Curator).

General Curator

The general curator has authority and is responsible for participating with and assisting the director and senior management team in the overall planning, direction, and management of NZP programs and activities in the exhibition, study, and care of the living animal collections at the Rock Creek Park facility (Position Description – General Curator).

VETERINARY CARE

Zoos differ from some museums in that they have the challenge of maintaining the health and welfare of living animal collections. Zoo animal medicine has made remarkable advances over the past century, in part because zoos have evolved from mere collections of exotic animals to centers of research in animal biology and disease diagnosis, treatment, and prevention. The first book on zoo animal medicine was written in 1923 (Fox, 1923). Until 1960, when the American Association of Zoo Veterinarians (AAZV) was established, few veterinarians were concerned with wildlife disease and captive animal medicine (Fowler, 1986a).

The level of sophistication in zoo animal medicine and husbandry is now such that the care provided to zoo animals is on a level with that provided to companion and other domestic animals. These improvements have resulted not only from research, but also from specialized training of veterinarians in zoo animal medicine, publications devoted to zoo animal medicine, establishment of national zoological organizations, and an increased awareness of both physical and psychological needs of captive wild animals. Zoos are increasingly becoming leaders in the science of conservation biology and in the practice of preserving rare and endangered species and their habitats.

Although variation exists between facilities, modern zoos have accepted certain minimum standards (AAZV, 1999; AZA, 2003c) related to the veterinary medical care provided to animals in their collections:

- An adequate number of technically competent veterinarians (Stetter et al., 2003).
- An adequate number of trained veterinary technicians and support staff.
- A well-equipped, well-designed facility that adequately serves the needs of the animals and the staff (Simmons, 2003).
- A complete and retrievable medical records system.
- Written protocols and procedures (Janssen et al., 2003).
- An organizational structure and medical decision process that places the responsibility for animal health with the veterinarians, while seeking input from other professionals including keepers, curators, nutritionists, and others (Stetter et al., 2003; Janssen, et al., 2003).
- A veterinary department that upholds professional decorum (Janssen, et al., 2003).
- Access to diagnostic laboratory services.

Exceptional modern zoos additionally have

- veterinarians who have received advanced certification or residency training under the auspices of the American College of Zoological Medicine, the American Veterinary Medical Association, or other professional organization.
- an active residency training program.

- opportunities, such as public viewing areas, for the public to observe veterinary medical procedures, gain a better understanding of zoo animal medicine, and acquire a greater awareness of preventive medicine and quality of animal care (Stetter, et al., 2000).

Preventive Medicine

Preventive medical programs include all practices that strengthen genetic and immunologic resistance to disease, provide sound nutrition, and minimize exposure to disease agents (Fowler, 1986b). The ultimate goal of a preventive medicine program is prevention and early detection of disease (Miller, 2000; AAZV, 1999). Fowler describes a sound program as one that involves a written plan, education and training of all parties expected to carry it out, continued monitoring, and persistence in the practice of the plan (Fowler, 1986b). An optimum preventive medicine program is reviewed and upgraded annually to reflect collection and species-specific health concerns (Miller, 2000) and it covers the elements listed in Table 2-1.

TABLE 2-1 Elements of an Effective Preventive Medicine Program[a]

Quarantine – Twenty years ago the failure to provide adequate facilities and failure to carry out an effective quarantine program were the most glaring deficiencies in zoos in North America, Great Britain, and Western Europe (Fowler, 1986a). Currently zoos are subject to government quarantine procedures as well as to quarantine requirements adopted by the AZA in 1994 (Miller, 1995). The AZA quarantine requirements (AZA, 2003c), as well as quarantine requirements subsequently laid out by the AAZV (1999), detail the most desirable quarantine design, but enacting this design is not always possible because of constraints of cost, facilities, and personnel, and ultimately each zoo has control over its own in-house quarantine program (AAZV, 1999).
Parasite Surveillance Procedures and Control - Parasite control is more complicated than the simple periodic administration of anthelmintic preparations. A regular schedule of fecal examinations is important to facilitate the detection and treatment of parasite infections before clinical signs appear. Fecal examinations are also an important part of the quarantine procedure. External parasites, though more difficult to detect, should also be considered during surveillance procedures, Examination for external parasites should be part of a complete physical exam. The movement of animals or exhibit furniture from one exhibit to another needs to be carefully considered to prevent exposure to parasites that could cause a fatal infection (AAZV, 1999).
Immunization - Vaccination programs are a key component of preventive medicine programs. The design of these programs varies widely, and is based on the animal collection, diseases endemic to the area and potential for exposure. There is a further challenge in that vaccination recommendations for exotic species are made in most cases by extrapolation rather than through extensive research (AAZV, 1999).
Infectious Diseases Screening – Monitoring the disease status of an animal collection can allow for early detection of outbreaks of infectious disease within zoos. As with vaccination programs the design of an infectious disease screening program depends on the prevalence of a disease in the vicinity of the zoological park or in the prevalence of the disease within the animal collection (AAZV, 1999).
Periodic Reviews of Diets - High-quality nutrition is key to animal health. This includes not only developing a complete and balanced diet acceptable to the animals but also ascertaining that the quality of the feed is acceptable (AAZV, 1999). A proper diet is one with which an animal will attain maximum development, maintain normal weight, breed and rear healthy offspring, and live out a full term of life (Clemens, 1984). As in farming, feed costs are one of the top operational costs (the others being labor and facilities).
Periodic Review of Exhibit Design and Husbandry Techniques - A review of exhibit design and animal management should be conducted periodically as part of a preventive medicine program. The design of animal enclosures should allow for public viewing of the animal but should also incorporate aspects of animal and keeper safety. Twenty years ago trauma was the most important cause of mortality in captive

wild animals (Griner, 1983), and is still considered a leading cause of zoo animal death today. Review of husbandry techniques, including the proper handling and disposal of animal wastes, food wastes and other debris is important for the control of infectious agents as well as vermin (AAZV, 1999).

Periodic Review of Vermin Control - Control of vermin (both vertebrate and invertebrate) is an important part of a preventive medicine programs because of the potential for pests to serve as vectors or reservoirs of disease. Review of the vermin control program should also take into account the types of pesticides being used and the signs of exposure in collection animals (AAZV, 1999). Toxicologic problems are generally not considered a major cause of mortality in zoos, however, it is a major concern.

Periodic Review of Mortality and Morbidity – A review of mortality and morbidity should be conducted periodically as part of a preventive medicine program. Changes in animal health, nutrition, and husbandry can be initiated in response to trends observed in animal illness or deaths.

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[a] Adapted from AAZV (1999) and Fowler, (1986b).

Veterinary Care at the National Zoo

The National Zoo currently employs three full-time board-certified (by the American College of Zoological Medicine) clinical veterinarians: two individuals at the Rock Creek Park facility and one at the CRC. At the Rock Creek Park facility there are two additional veterinarians: a former veterinary resident, who is on a one-year appointment, and a veterinary resident. In total there are five practicing clinical veterinarians that provide veterinary medical care to the animal collection. A research veterinarian provides additional support to the clinical veterinarian at the CRC when necessary. The Rock Creek Park veterinary staff is supported by three keepers and two veterinary technicians. The CRC veterinarian is supported by one veterinary technician. The keepers are responsible for the daily feeding of the animals currently housed in the hospital, cleaning and maintaining the enclosures, and assisting the veterinarians (NZP, Department of Animal Health Procedures—Hospitalized Animal Procedures, 2003). The veterinary technicians are responsible for ordering and dispensing all pharmaceuticals, documenting anesthesia and prescription records, and providing technical assistance to the veterinary staff (NZP, Department of Animal Health Procedures—Veterinary Technician Medical Records, 2003). The Rock Creek Park veterinary facility functions on a seven-day work week, with staggered schedules for the veterinarians, keepers, and technicians. The clinical staff works from a well-equipped facility that fulfills the recommendations for veterinary facilities outlined by the AAZV (1999). Additionally, the National Zoo employs two veterinarians in the Department of Pathology supported by two laboratory technicians (one technician position currently vacant).

Currently the Department of Animal Health has a structured work plan for active case management. Each animal within the hospital is inspected at least twice daily by the veterinary hospital keeper and at least once daily by a veterinarian. Daily rounds are held with the entire hospital staff and often a member of the Pathology Department. During rounds each animal being acutely managed by the hospital is discussed, procedures planned for that day, as well as scheduling for procedures in the future. In addition to daily rounds, the veterinary staff maintains an active case log of both acute cases and chronic cases. This log is updated daily by all veterinarians on clinical service. The veterinary staff meets twice weekly to discuss the management of all cases in the log.

In addition to providing medical treatment to injured or ill animals, the Department of Animal Health is mandated by zoo policy and by professional organizations to establish a preventive medicine program (AAZV, 1999; AZA, 2003c). The preventive medicine program at the National Zoo includes quarantine, parasite surveillance procedures and control, immunization, infectious disease screening, and dental prophylaxis (National Zoological Park Preventative Medicine Program, 1998, 1999, 2001, 2003).

Strengths and Weaknesses of Veterinary Care at the National Zoo

With three full-time veterinarians and two temporary veterinarians, the National Zoo maintains a larger clinical veterinary staff than many other zoos of similar age, size, and animal collection number. For example, the 100-year-old 200-acre Milwaukee County Zoo, with an animal collection of approximately 2,000 representing over 300 species, employs two full-time clinical veterinarians. The Baltimore Zoo, Minnesota Zoological Garden,

Louisville Zoological Garden, Sedgwick County Zoo, and the Detroit Zoological Garden all with collection sizes and annual budgets similar to those of the National Zoo each employ one or two full-time veterinarians (AZA, 2003b; AAZV, 2004). Approximately 274 veterinarians are employed by the 180 AZA-accredited zoos with on-site veterinary staff (Amand, 2004). Of those veterinarians employed by AZA-accredited zoos, approximately 35 are board certified (by the American College of Zoological Medicine) with six institutions retaining three or more board certified veterinarians: San Diego Zoo, Bronx Zoo (Wildlife Conservation Society), Disney's Animal Kingdom, Saint Louis Zoological Park, North Carolina Zoological Park, and the National Zoo (Amand, 2004).

It is important to note that clinical veterinarians at most other zoos also function as the onsite pathologist (performing necropsies, collecting postmortem diagnostic samples, and assigning gross pathologic diagnoses) in addition to their clinical duties, because most zoos do not have full-time veterinary pathologists or a pathology department (Citino, 2000). Unlike most zoo veterinarians, the clinical veterinarians at the National Zoo do not have responsibility for pathology because the National Zoo employs two additional full-time veterinary pathologists in addition to its staff of clinical veterinarians. The San Diego Zoo, Bronx Zoo (Wildlife Conservation Society), Disney's Animal Kingdom, Saint Louis Zoological Park, Philadelphia Zoo, and the National Zoo are among the few institutions with separate pathology departments. Other zoos utilize schools of veterinary medicine or commercial laboratories for pathology needs.

To assess the quality of veterinary medical care at the National Zoo, members of the committee met with veterinary staff, keepers, and curators; examined written policies and procedures of the Department of Animal Health; evaluated the medical records of select animals currently in the collection, as well as the medical records of particular animals that were brought to the attention of the committee; reviewed the scientific literature; and gathered information on preventive medicine and animal care from other zoological institutions. This process is ongoing and the committee will continue to gather information for the preparation of its final report. However, the information evaluated during the first six months of the project has revealed serious deficiencies in the preventive medicine program at the National Zoo and isolated incidents of unacceptable veterinary care.

To date, the committee has reviewed the majority of the animal deaths at the National Zoo that were brought to the public's and Congress's attention through media coverage. In the committee's opinion, after a review of medical and pathology records, many of these deaths were due to the advanced age of the animals or preexisting conditions and the medical care provided was adequate and in some cases well beyond any reasonable expectation of care. However, the committee did see evidence of a lack of veterinary knowledge regarding the physiology and nutrition of hoofstock (see Box 2-1) and lapses in veterinary care that was provided to an African bush elephant (see Box 2-2).

BOX 2-1
Case Study: Grevy's Zebras (Equus grevyi) "Buumba" (Accession #113393), "Shaka" (Accession #113392), and "Arbez" (Accession #113417)

Spring 1999	• Three zebras brought to the National Zoo were placed in quarantine (NZP, Medical Records, Accession #113393, #113392, and #113417, Grevy's Zebras).
May 12, 1999	• Shaka and Buumba were released from quarantine to the Cheetah/Elephant area (NZP, Medical Records, Accession #113393 and #113392, Grevy's Zebras).
May 17, 1999	• Buumba and Shaka examined by the veterinary staff because keepers reported that Buumba had developed a distended abdomen (NZP, Medical Records, Accession #113393 and #113392, Grevy's Zebras). • Buumba's diet reduced from 2 pounds of pellets and 2 flakes of hay to 1 pound of pellets and 2 flakes of hay (NZP, Medical Records, Accession #113393, Grevy's Zebras). • Shaka's veterinary record does not reflect any change in (NZP, Medical Records, Accession #113392, Grevy's Zebras).
June 15, 1999	• Arbez was released from quarantine to the Cheetah/Elephant area (NZP, Medical Records, Accession #113417, Grevy's Zebra).
Summer 1999	• Zebras' diet was increased to 5 pounds of pellets per day and then later reduced to 4 pounds of pellets and 4 flakes of hay (Wells, 2000b), presumably the diet that these animals received in the fall of 1999. • Dietary changes were not noted in the medical records and no nutritionist records could be produced for these animals.

(continues)

BOX 2-1 (continued)

October 30, 1999	• Keepers reported that Shaka developed a bloated abdomen (NZP, Medical Records, Accession #113392, Grevy's Zebras). • Veterinary staff assessed Shaka and ordered a reduction in food intake (NZP, Medical Records, Accession #113392, Grevy's Zebras).
November 8, 1999	• Zebras' diet reduced to 2 pounds of pellets, and hay cut in half, though there is no indication what the hay consumption was previously or what measurable amount it would then be (NZP, Keeper's Log, Accession #113417and #113392, Grevy's Zebra). • Diet reduction occurred for three or four weeks (Nichols and Stevens, undated; Wells, 2000b) • Diet reduction was not noted in any of the three animals' medical records, though the keeper logs indicated the veterinary staff was aware of the diet change; and other National Zoo documents also indicated the change was by order of the veterinary staff (Nichols and Stevens, undated; Wells, 2000a).
December 1999	• Zebras' diet returned to approximately 4 pounds of pellets and 3 flakes of hay per day (Nichols and Stevens, undated; Wells, 2000b). • This change is not noted in the keeper logs, veterinary medical records, or curator report.
January 31, 2000	• Keeper staff observes Buumba lying on the stall floor (NZP, Keeper's Log, Accession # 113393, Grevy's Zebra). • Veterinary staff sedate Buumba, examine and administer intravenous fluids and other medications (NZP, Medical Records, Accession #113393, Grevy's Zebra). • Buumba recovered from sedation and was then placed into his stall for the night (NZP, Medical Records, Accession #113393, Grevy's Zebra). • The keeper logs reflect that veterinary staff also examined Shaka and Arbez, and determined that these animals were overweight (NZP, Medical Records, Accession #113417, #113392, Grevy's Zebras). • Shaka's and Arbez's diet were reduced from 4 to 3 pounds of pellets per the veterinarian's orders (NZP, Keeper's Log, Accession #113417 and #113392, Grevy's Zebras). • The examination and resulting reduction in diet were not documented in the veterinary medical record of either animal (NZP, Medical Records, Accession #113417 and #113392, Grevy's Zebras). • Buumba died during the night of hypothermia, with inanition [starvation] as a contributing factor (NZP, Accession #113393, Grevy's Zebra, Final Pathology Report #2000-0032).
February 1, 2000	• Shaka and Arbez were evaluated by the nutritionist and determined to be underweight (NZP, Keeper's Logs, Accession #113417 and #113392, Grevy's Zebras). • Their diet was substantially increased (NZP, Keeper's Logs, Accession #113417 and #113392, Grevy's Zebras). • The examination and diet change of Shaka and Arbez were not documented in the medical record (NZP, Medical Record, Accession #113417 and #113392, Grevy's Zebras).

Zebras should be fed a diet containing 12-14 percent crude protein and 37-51 percent neutral detergent fiber (90 percent dry matter) (Lintzernich and Ward, 1997) with daily feed intake of 1.5-3 percent of body weight. Diets are suggested to be constituted of 25-40 percent low fiber pellets and 60-75 percent grass hay (Lintzernich and Ward, 1997). Diets may need to be altered to reflect changing physiological or environmental conditions. While complete documentation of the zebras' intake are not available for analysis, the death of Buumba due to hypothermia and inanition [starvation], and poor body condition of Shaka and Arbez clearly indicate the zebras were not receiving adequate nutrition.

Though various internal National Zoo documents (Nichols and Stevens, undated; Wells, 2000b; Wells, 2000a) generated after the animal's death indicated that the keepers, the curator, and the veterinary staff were all aware of the two diet changes that occurred in November and December, none documented the changes completely, if they were documented at all. It is not apparent to what extent the nutritionist was involved in these decisions, since no nutritionist records could be produced for these animals, though there are indications that diet request forms were submitted to the nutritionist (Wells, 2000a). In addition, some keeper logs pertaining to these animals were not archived, while others were improperly archived.

(continues)

BOX 2-1 (continued)

Because the reduction in diet for Shaka and Arbez is not reflected in the medical record, it is not apparent what led to the decision of the veterinary staff to reduce the diet of these animals on January 31, 2000. However, the poor condition of the animals upon evaluation by the nutritionist, as well as the inanition, contributed to Buumba's death, reflects an incorrect assessment of Shaka's and Arbez's body condition by the veterinary staff on January 31, 2000. For mammals at the National Zoo body weight is to be monitored monthly under normal conditions, biweekly when diets are changed, and weekly when monitoring health status. Updated body weight information is to be recorded in the daily keeper reports (National Zoological Park, NZP Department of Animal Health Procedures – Animal Body Weights, 2003). It is unknown if functioning scales were available for weighing hoofstock at the time of Bumba's death (Wells, 2003b).

In addition, it is apparent that substantial changes were made to Buumba's medical record. The committee received copies of the medical record from the Smithsonian's inspector general (printed on March 29, 2000), Dr. Donald Nichols, formerly the associate pathologist at the National Zoo (printed on May 30, 2002), and from the National Zoo (printed on October 2, 2003). On review of the clinical note entries it is apparent that changes were made to the entries logged on April 25, 1999; May 17, 1999; May 27, 1999; June 2, 1999; and February 1, 2000; and that a new entry was created for May 18, 1999. Comparison of the three different copies of the medical record indicates that all of these changes occurred between May 30, 2002, and October 2, 2003. Changes to the medical record, in some cases as much as three years after the entry was originally made, affect the credibility of the information contained in the medical record.

Many other details pertaining to the care of the three zebras is a matter of contention among various zoo staff, including whether attempts were made to have the veterinary staff reevaluate the zebras in December and January and whether the curatorial staff was aware and addressing the lack of adequate heat in the building where the zebras were housed (Nichols and Stevens, undated; Wells, 2000b; Wells, 2000a). The committee was not able to address these issues owing to a lack of documentation, however there is ample evidence that poor record keeping, poor veterinary care and decision making, and lack of involvement of the nutritionist contributed to Buumba's death and the poor condition of the other two zebras.

BOX 2-2
Case Study: East African Bush Elephant (*Loxodonta africana*) "Nancy" (Accession #26223)

On August 22, 2000, an East African bush elephant named Nancy was euthanatized because of her advanced age, severity of her clinical symptoms, and her poor prognosis. Between 1997 and her death this animal had been diagnosed with osteoarthritis (a functional or structural failure of an entire joint, including the nearby muscles, bone, ligaments) and osteomyelitis (a chronic inflammation of the bone caused by an infection), as well as suffering from multiple episodes of abdominal edema, skin lesions, and mastitis (inflammation of the mammary gland). She had been treated at various times with anti-inflammatory agents (Tylenol, ibuprofen, phenylbutazone) and immunosuppressants (imuran, prednisone), appropriate treatment regimens for the conditions she developed during this time. In 1999 she developed a toe lesion on her right front foot caused by the osteomyelitis. This was treated with localized injections of antibiotics (amikacin and trimethoprin sulfadiazine), with some success at first. However, she began to lose weight and her condition became resistant to treatment. In the month before her death her condition deteriorated and her apparent discomfort worsened as she began to refuse food and medication (NZP, Medical Records, Accession #26223, East African bush Elephant). Upon necropsy it was determined that Nancy suffered from infection with *Mycobacterium bovis*, a cause of tuberculosis. This caused extensive pneumonia (inflammation in the lungs) involving 60 percent of her lungs (NZP, Accession #26223, East African Bush Elephant, Final Pathology Report #2000-0331).

In 1996, two circus elephants died and were found to be infected with tuberculosis. This led to the establishment of the *Guidelines for the Control of Tuberculosis in Elephants* (The National Tuberculosis Working Group for Zoo & Wildlife Species, 1997; The National Tuberculosis Working Group for Zoo & Wildlife Species, 2000; The National Tuberculosis Working Group for Zoo & Wildlife Species, 2003), which were widely disseminated in January of 1998. These guidelines are considered the standard of care for captive elephants and were subsequently mandated by the USDA in 1998 (63 Fed. Reg. 15826 [April, 1 1998]).

Under these guidelines captive elephants are to be tested annually for tuberculosis through the use of trunk washes. This is the only acceptable way to test for tuberculosis in elephants, as skin and blood tests, like those done

(continues)

BOX 2-2 (continued)

in humans, are unreliable (Montali et al., 1998). Trunk washes will detect only active tuberculosis infections (when the animal is contagious to both other animals and humans) and not latent infections (The National Tuberculosis Working Group for Zoo & Wildlife Species, 2003). During the late 1990s, National Zoo veterinarians were deeply involved in the issue of tuberculosis in captive elephants. In fact, from 1999 to 2001 four scientific articles were published by National Zoo veterinarians on the issue (Larsen et al., 2000; Mikota et al., 2000; Mikota et al., 2001; Montali et al., 1998).

In the summer of 1997 and the fall of 1998 Nancy was tested for tuberculosis by trunk washes. However, from October 1998 until her death National Zoo staff failed to test Nancy for tuberculosis. In addition, Nancy's medical record contains an entry from February 6, 1999, stating that "tuberculosis or other granulomatous disease can not be ruled out" as the cause of her clinical symptoms.

Nancy most likely carried a latent infection of *Mycobacterium bovis*, that was activated by the immunosuppressant drugs she started receiving in 1998 (NZP, Accession #26223, East African Bush Elephant, Final Pathology Report #2000-0331).

It is impossible to determine whether a tuberculosis trunk wash test in 1999 or 2000 would have detected an active tuberculosis infection in Nancy, however the lack of preventive care is evident. Treatments for tuberculosis were published at least as early as 1994 (Mikota et al., 1994) and if tuberculosis testing of Nancy had been done in 1999 and 2000, it is reasonable to expect that her tuberculosis would have been detected and treated, possibly lessening the severity of her clinical symptoms and her apparent discomfort. However, because her advanced age and the progressive worsening of other medical conditions, it is likely that her euthanasia would still have been necessary at some point.

Failures in the Preventive Medicine Program

A review of zoo documents indicates that the veterinary department has been failing to follow various aspects of the preventive medicine program. There have been numerous examples of failures to follow quarantine procedures and provide appropriate vaccinations, infectious disease testing, and annual examinations.

Quarantine Procedures

The purpose of quarantine procedures is to prevent the introduction of pathogens to a zoo when a new animal is added to the collection (AAZV, 1999). Depending on the species, these quarantine procedures include fecal, blood, and tuberculin tests; vaccinations; and serology tests for specific pathogens (AAZV, 1999; AZA, 2003c). In reviewing a sample of 26 medical records the committee found six instances from 1999-2001 where veterinary staff failed to document any procedures or tests to which the animals were subjected during quarantine (see Table 2-1), although the quarantine procedures outlined in the National Zoo Preventative Medicine Program were comprehensive and in accordance with recognized standards (AAZV, 1999; AZA, 2003c). In most of the cases listed in Table 2-2, the only information regarding quarantine procedures and tests is a clinical note stating "Released from quarantine" or "Quarantine complete." Because of the lack of appropriate documentation it is impossible to determine whether veterinary staff administered procedures and testing, and thus a portion of the animal's medical history is not available for future assessment.

TABLE 2-2 Animals for Which National Zoo Medical Records Failed to Document Quarantine Procedures and Tests[a].

Animal	Accession No.	Year of Arrival at National Zoo
American bison	113418	1999
American bison	113419	1999
Grevy's zebra	113392	1999
Grevy's zebra	113417	1999
Fishing cat	113526	2000
Mexican wolf	113645	2001

[a]The only indication of quarantine procedures noted in the medical record as "Released from quarantine" or "Quarantine complete."

SOURCE: NZP, Medical Records, Accession #113418, #113419, #113392, #113417, #113526, and #113645.

It appears that zoo policies and quarantine procedures may have been violated on several occasions when staff-owned pets were brought onto National Zoo grounds to have tests performed at the Animal Hospital. Staff members of the Department of Pathology have indicated that most tests performed on staff pets were performed as a professional courtesy, with the approval of the head clinical veterinarian and head pathologist; occasional tests were performed to determine whether an infectious disease was present that could be passed from the pet to a zoo collection animal by way of the staff person (Montali, 2003). It is outside the purview of this committee to comment on whether performing laboratory tests on staff pets as a professional courtesy is a legally acceptable practice at the National Zoo.

According to the National Zoo's General Memorandum No. 525 (August 8, 2003), "by law, pets, regardless of the species, are not allowed in the National Zoological Park." However, clinical pathology logs indicate that over 80 laboratory tests performed on staff pets, some dated as late at April 10, 2003, were processed by the Pathology Department (Clinical Pathology Log, January 2004), although it is not clear whether the animals were on zoo grounds each time. If staff pets were brought onto National Zoo grounds to perform tests as a professional courtesy, this action represents a potential risk to the zoo collection and a violation of the zoo's own policies and procedures.

Vaccination, Infectious Disease Testing, and Annual Examinations

Since 1998, there have been numerous examples of failure to provide vaccinations, tuberculosis tests, and annual physical exams. A summary of information depicting poor adherence to the preventive medical program for 16 animals derived from a sample of 26 individual medical records of major animal groups at the National Zoo is provided in Table 2-3. It is possible that veterinary decisions were made not to vaccinate or not to test certain animals based on their current medical status; however, if these decisions were made, they were not documented in the medical record as should have been done. A recent USDA inspection (USDA, 2004b) noted that a majority of small primates had not received their annual preventive care exam as outlined by National Zoo standard operating procedures. The National Zoo has acknowledged that from the spring of 1999 through the fall of 2002 that veterinary staff failed to adhere to their preventive medicine program due to a staffing gap (NZP, Letter to Committee, December 31, 2003).

In the case of the East African elephant, failure to administer an annual tuberculosis test resulted in the failure to diagnose an active case of tuberculosis (see Box 2-2). Annual tuberculosis testing was mandated by USDA in 1998 (63 Fed. Reg. 15826). The National Zoo indicated that the tuberculosis testing that should have occurred sometime in the fall of 1999 was delayed until 2000 "due to a heavy load of veterinary care cases and an understaffed veterinary clinical department" (NZP, Fact Sheet—Elephants at the National Zoo, December 2003). It is unacceptable for preventive care to be delayed in this fashion. In particular, this elephant was being seen by a veterinarian on an almost daily basis during the fall of 1999 and had already been trained to submit to a tuberculosis test (NZP, Medical Records, Accession #26223, East African bush Elephant).

Guidelines developed by the AAZV (1999) state that the veterinary medical program at a zoo should emphasize disease prevention. If the failure to provide preventive care to the National Zoo's animal collection was caused by a shortage of staff or the inability of the veterinary staff to implement and follow the National Zoo's preventive medicine program, steps should have been taken immediately by senior management to rectify the situation, either by hiring more temporary or permanent veterinary staff, using existing veterinarians on the research staff to alleviate the backlog of preventive medicine procedures (if these veterinarians are suitably licensed to practice veterinary medicine in Washington, D.C.), providing oversight necessary to ensure effectiveness of the preventive medicine program, or by introducing technical and administrative efficiencies or organizational skills training to increase the efficiency of the veterinary staff. The inability of the National Zoo's veterinary staff to provide vaccinations and annual exams because of time or staffing shortages is not a sound scientific or medical reason for varying from the recognized standard of care outlined in the generally accepted standards preventive medicine guidelines.

During the past year the Department of Animal Health has taken steps to begin to improve the implementation of the preventive medicine program. However, as of December 29, 2003, not all of the collection had received scheduled examinations, vaccinations, or tests that were indicated in the National Zoo's Preventative Medicine Program (2003). Though veterinary staff members are in the process of updating their preventive medicine program, they have yet to create a document that describes the current vaccinations, tests, and exams that are planned for each species. It is imperative for the National Zoo to take steps to immediately handle the backlog of procedures outlined by the preventive medicine program and to ensure that adequate preventive medicine is provided in the future.

TABLE 2-3 Lapses in Preventive Medicine Program at the National Zoo between 1998-2003[a]

	AAZV/AZA Vaccination and Testing Guidelines[b]	National Zoo Preventive Medicine Program 1998-2003[c]	Lapses at the National Zoo[d]
Primates	Rabies vaccination as warranted Tetanus vaccination every 3-5 years	Annual exam (great apes exam every 2 years) Rabies vaccination annually TB test annually Tetanus vaccination every 7 years	Accession #103823 – Orangutan Failed to receive annual exam in 2001-2002. Failed to receive rabies vaccination and TB test in 2001-2003. Failed to receive tetanus vaccination in 2002. Accession #112236 – Sulawesi crested macaque Failed to receive annual exam, rabies vaccination, and TB test in 2001. Accession #102167 – Orangutan Failed to receive annual exam, rabies vaccination, and TB test in 1999-2000, 2002-2003. Accession #113376 – White-fronted marmoset Failed to receive annual exam, rabies vaccination, and TB test in 2000-2002.
Canidae	Rabies vaccination as warranted Canine distemper vaccination as warranted	Annual exam Rabies vaccination every 3 years Canine distemper vaccination annually[e]	Accession #111062 – Singing dog Failed to receive annual exam and canine distemper vaccination in 2002.
Felidae	Feline panleukopenia and calicivirus vaccination annually Rabies vaccination as warranted	Annual exam Rabies vaccination every 3 years Panleukopenia and calicivirus vaccination annually[e]	Accession #108412 – Barbary lion Failed to receive panleukopenia and calicivirus vaccination in 1999-2000, 2003. Failed to receive annual exam in 2003. Accession #113526 – Fishing cat Failed to receive panleukopenia and calicivirus vaccination in 2002-2003 Failed to receive annual exam in 2003. Accession #113184 – Sumatran tiger Failed to receive panleukopenia and calicivirus vaccination in 1999-2000, 2002, 2003. Failed to receive annual exam in 2003.

	AAZV/AZA Vaccination and Testing Guidelines[b]	National Zoo Preventive Medicine Program 1998-2003[c]	Lapses at the National Zoo[d]
Hoofstock			
Zebra	Rabies vaccination as warranted Tetanus vaccination annually	Rabies and tetanus vaccination annually	Accession #113417 – Grevy's zebra Failed to receive rabies and tetanus vaccination in 2003. Accession #113392 – Grevy's zebra Failed to receive rabies and tetanus vaccination in 2001.
Deer, gazelle, giraffe, bison	Rabies and tetanus vaccination as warranted	Rabies and tetanus vaccination annually	Accession#113418 – American bison Failed to receive rabies and tetanus vaccination in 2000-2003. Accession #113419 – American bison Failed to receive rabies and tetanus vaccination in 2000-2003.
Hippo	Rabies and tetanus vaccination as warranted	Rabies vaccination annually	Accession #25308 Hippopotamus Failed to receive rabies vaccination in 1997-2002.
Tapir	No recommendations	Rabies and tetanus vaccination annually	Accession #107049 – Malayan tapir Failed to receive rabies and tetanus vaccination 1998, 2000, 2002. Accession #106845 – Malayan tapir Failed to receive rabies and tetanus vaccination 1998-1999, 2000, 2002.
Elephant	TB testing annually	Rabies and tetanus vaccination annually TB testing annually	Accession #109171 – Asiatic elephant Failed to receive rabies and tetanus vaccination in 1998, 2000-2003. Failed to receive rabies vaccination and TB test in 1999.

[a]This table presents vaccination and infectious disease test schedules as recommended by the AAZV (1999) and the AZA (2004), and as outlined in the National Zoo's written preventive medicine program (1998, 2003). This table includes information on the most routinely administered vaccinations and is not inclusive of all requirements of the preventive medicine program.
[b]AAZV, (1999); (AZA, (2003c).
[c]Adapted from NZP, Preventive Medicine Program, 1998; 2003.
[d]A sample of 26 animal records were examined for adherence to the National Zoo's preventive medicine program (1998, 2003).
[e]May choose to alternate with rabies vaccination.

It is also important for the program to be reevaluated continually, based on new information (Miller, 2000; Fowler, 1986b). For example, vaccination to prevent leptospirosis (a disease transmitted by the intake of feed or water contaminated with the urine of an infected animal, often a rodent) (Aiello, 1998) is indicated only if there is a significant disease risk, and the veterinary staff deemed the Washington, D.C. area to be a low-risk area (Preventative Medicine Program, 2003). In light of the recent death of a colobus monkey from leptospirosis (NZP, Press Room, 2004), as well as the ongoing issue with rodent control at the National Zoo, this is an example of a component of the preventive medicine program that warrants reevaluation.

The veterinary services program should have clear authority and responsibility for animal health care decisions at the National Zoo. Based on the committee's review, materials examined, and input received, the decision-making process has not been clearly articulated and has likely obscured the authoritative role the veterinary staff should take in making these decisions. Staff participating in the care of the animals at the National Zoo, including keepers, curators, and nutrition staff, should have an opportunity to provide input on health care issues. However, the veterinarian attending to a case should have, and should accept, final authority for health care decisions.

Findings and Immediate Needs

Although the preventive medicine program at the National Zoo is generally comprehensive and in accordance with published guidelines (AZA, 2003c; AAZV, 1999), there has been a failure to successfully implement, adhere to, and continually review and improve the preventive medicine program.

Finding 1: *The current preventive medicine program at the National Zoo is not being fully implemented, and since 1998, veterinary staff members have not been adhering to this program in terms of providing annual exams, vaccinations, and infectious-disease testing. Although efforts have been made in the past year to improve implementation, there is still a backlog of animals that have not received examinations, vaccinations, or tests as prescribed by the preventive medicine program.*

Immediate Needs: *The Department of Animal Health should promptly eliminate the backlog of animals that should receive preventive care and document its current and future plan for preventive medicine activities. The National Zoo administration should take responsibility for ensuring that the Department of Animal Health has the resources and oversight necessary to adhere to the program.*

ANIMAL NUTRITION

Zoo-animal nutrition involves at least four elements to ensure that animals receive adequate nutrition for health and welfare: background, diet evaluation, diet implementation, and diet update (AZA Nutrition Advisory Group, 2001). First, background information on nutritional needs should be evaluated for a specific animal or group of animals. The nutritional needs of the animal are dictated by age, sex, health, and physiologic status (e.g., growth, pregnancy, lactation, activity level), and by external factors (e.g., exhibit conditions, exposure to elements) (Clemens, 1985). Nutritional management should take into account both nutritional and enrichment needs. While general domestic animal nutrition guides (Klasing, 1998; NRC, 1977, 1981, 1982, 1985, 1989a, 1993, 1995, 2000, 2003, 2004; Ullrey, 1981) provide a basis for diet evaluation, diet formulation for exotic animals should include consideration of natural dietary habits, gastrointestinal tract morphology and physiology, and previous diet formulations (Dierenfeld, 1987; Ullrey, 1987). Characterizations of adequate diets exist for some species (AZA Nutrition Advisory Group, 2003; NRC, 2003). Integral parts of diet evaluation are nutrient analysis of feed composition and assessment of live foods (AZA, 2003c) and maintaining those records.

After evaluation and formulation the diets should be appropriately implemented. Diets can be prepared either in a centralized commissary or in a keeper kitchen. A centralized commissary is preferred, to control costs for diet preparation (NZP, Commissary Review National Zoological Park, May 14-15, 1992). Additionally, centralized operations allow efficient use of time and equipment, and tracking and quality control of diets (NZP, Commissary Review National Zoological Park, May 14-15, 1992). Maintenance of proper sanitation is important to avoid contamination of food (Stewart, 1986; see Chapter 4). After preparation the diet is delivered to keepers, who provide the diet to the animal or group of animals for consumption. Clear diet and feeding instructions should be shared between the nutritionist, veterinarians, commissary staff, curators, and keepers (AZA Nutrition Advisory Group, 2003).

Updating the diet through monitoring and feedback are the final elements of ensuring that animals receive appropriate nutrition for health and welfare. An animal's physical condition and behavior are perhaps the best indicators of the success or failure of a diet. Body condition (a measurement of animal fat deposits and muscle tone) is an excellent indication of diet adequacy in domestic animals; however, evaluating body condition is often difficult in captive exotic animals. Increasing or decreasing body condition is an indication of an inappropriate diet (unless that change is a desired outcome of the diet). In diagnosing deficiencies of a specific nutrient within an animal,

knowledge of nutrient's metabolism is key (Ullrey, 1996). Animals should also be observed to ensure that the diet is consumed (AAZV, 1999); a simple tool to assess the general nutritional status of an animal is to measure food intake (Allen, 1981). An animal may not consume a diet for such reasons as palatability, group aggression, and excess feed. Changes in the animal's physiologic status (growth, lactation, pregnancy, activity) or environmental conditions may necessitate a change in the diet formulation (Clemens, 1985). Diet preparation and feeding should also be monitored to ensure that the diet is prepared and fed according to the instructions. This monitoring, and feedback, provide an evaluation loop to ensure that animals receive appropriate nutrition for health and welfare. Key components of a nutrition program at a zoo are protocols, record keeping, and communication. Nutrition decisions should be made after input from the nutritionist, veterinarian, curator, keeper, and commissary manager for each animal (Dierenfeld, 1987).

Comparative Nutrition

Comparative nutritionists play a unique role in animal nutrition. They are asked to formulate diets for potentially thousands of species; domestic animal nutritionists often deal with a single species (Ullrey, 1996). In 1987 only five zoos in North America had nutritionists on staff (Stewart, 1987), and today there are fewer than ten AZA-accredited zoos in the United States with a comparative nutritionist for exotic animals (Braun et al., 2003).

Greater emphasis is being placed on the relevance of nutrition in the prevention of disease; current veterinary medical curriculum does not allow students sufficient time to gain necessary knowledge and skill in animal nutrition, therefore, nutritionists are needed to provide knowledge in the optimal use of nutrition for animal health (van't Klooster, 1999). A zoo should have a comparative nutritionist either on staff or as a consultant (Stewart, 1987). An animal nutritionist has educational training in nutritional sciences (Dierenfeld, 1987), and those responsible for zoo animal collections should have an advanced degree (M.S or Ph.D.) in (animal) nutrition or an equivalent number of years of experience in management, design, and implementation of a zoo animal nutrition program (Crissey and Fulton, 1994). Zoo nutritionists should routinely evaluate diets fed to animals in the collection for nutritional value (Stewart, 1987), and revise diets according to changing nutritional status. A particular challenge for a comparative nutritionist is the formulation of diets for environmental (heat or cold stress) or physiologic (growth, lactation, gestation, ageing) challenges (Clemens, 1985).

Commissary

A movement toward centralized commissaries for diet preparation has been slowly occurring at zoos in the United States. A centralized commissary is preferred for several reasons. Records kept in a central location are more easily reviewed by both nutritionist and veterinary staff; monitoring food quality and inventory are thereby better facilitated. Pest control (including rodent and insect contamination of feed, ingredients, and storage facilities) is more efficient when there is only one location to monitor. A centralized commissary allows for efficient use of equipment and staff time and for better tracking and quality control of inventory (NZP, Commissary Review National Zoological Park, May 14-15, 1992). Individual diets or diets for groups of animals are prepared entirely in the commissary so that animal keepers can offer the diet to animals in the form in which the keepers receive it (Braun et al., 2003).

To supply foods that help maintain health and reproduction of the animals is the primary goal of a commissary (Crissey et al., 1987). The safety of food for animal diets can be threatened by biological (i.e., bacteria and mold), chemical (e.g., pesticides, heavy metals, sanitizers), and physical (i.e., wire in a bale of hay) factors (Crissey et al., 1987). An important aspect of food storage and diet preparation is the avoidance of ill employees and bacterial contamination resulting from food not being kept in pest-resistant containers (Stewart, 1986). Loss of nutrients due to degradation over time or exposure to certain elements can also compromise the food safety (Crissey et al., 1987). Employee health and well-being in the preparation of diets should also be considered; dust associated with feed, grain, and forages can cause significant respiratory conditions in commissary staff (Aherin, 1986). Commissary management (e.g., proper storage, inventory control, and quality control) plays a vital role in ensuring safety of food in animal diets.

Nutrient Analysis and Quality Control

A foundation for any successful zoo animal diet is knowledge of feed composition (Dierenfeld, 1996). Animal diets should be routinely analyzed for nutrient adequacy and suitability for each species (AZA, 2003c). Ingredients and nutritionally complete feeds should have periodic nutrient analysis to ensure accuracy of published nutrient values, or to determine those values when none exist (AZA Nutrition Advisory Group, 2001). Digestibility (affected by feed intake, chemical composition, particle size, feed processing, exercise, and age) of feed ingredients (and the entire diet) is important to consider because it is nutrient digested which are utilized by the animal meets its nutritional needs (Fahey, 1981).

Because hay (grass or legume) is a significant portion of diets for many herbivores (particularly ruminant and equine animals), its quality is key to diet formulation and animal health. Hay quality varies because of a number of factors: species, maturity and leafiness, harvesting conditions, contamination (by weeds, pesticides, and herbicides) and location (Rohweder, 1986). Digestibility of hay can be measured for ruminants in a digestion trial or *in vitro* using rumen fermentation techniques (Rohweder, 1981). Digestibility can be estimated from chemical composition of fiber (acid and neutral detergent fiber) (Van Soest et al., 1991) or soluble carbohydrates (neutral-detergent soluble fiber) (Hall et al., 1998).

Animal Nutrition at The National Zoo

Animal nutrition at the National Zoo is divided into two areas: research and clinical nutrition. The clinical nutrition division was previously in the Animal Programs Department but now resides in the Animal Health Department (see Figure 1-1) and reports directly to the head veterinarian. The research nutrition division is positioned in the Department of Conservation Biology of the CRC (see Figure 1-1) and reports directly to the head of that department. For the past decade the National Zoo has employed two animal nutritionists: one as head of research and one as head of clinical nutrition. Currently the National Zoo employs a person trained in animal behavior as an acting head of clinical nutrition (on a two-year temporary appointment) at Rock Creek Park and a research Ph.D. animal nutritionist with decades of experience with the National Zoo and its animal collection in the Department of Conservation Biology of the CRC. Little direct interaction occurs between the acting head of clinical nutrition and the research nutritionist. After an initial search for a permanent clinical nutrition position which did not yield an acceptable candidate, the National Zoo is now seeking to fill the position at the Rock Creek Park facility with another temporary appointment (Smithsonian Institution Vacancy Announcement Number 04SP-1021). Physical components of the zoo's nutrition program include a commissary and laboratory.

The 2003 AZA report (2003a) stated that "despite NZP's history of world-class nutritional research, animal diets at the National Zoo were not well coordinated amongst veterinary, nutrition and animal care staff." Protocols have now been developed for any diet changes which require approval by the curator to evaluate the impact on animal behavior and animal husbandry practices, the veterinarian to evaluate the impact on animal health, and the nutritionist to evaluate the impact on animal nutrient and metabolic needs (NZP, Nutrition and Commissary Operating Protocols, September 2003). Specific hospital diets are formulated to meet the challenged nutritional needs of sick or injured animals as approved by the nutritionist and veterinarian (NZP, Nutrition and Commissary Operating Protocols, September 2003). All food used as enrichment for the animals must be approved by the clinical nutritionist, veterinarian, and curator.

An annual evaluation of diets for is to be implemented at the National Zoo. Some diets are to be reviewed seasonally because nutrient needs may change throughout the year. However, these annual (or seasonal) reviews of dietary adequacy have been compromised. Because of a lack of documentation for standard diets or dietary changes (see Chapter 3) the acting head of clinical nutrition has compiled a database based on a variety of records (nutrition, keeper, curatorial, and veterinary). The acting head of clinical nutrition has served as the acting commissary manager for approximately four months (see "Commissary" below).

Commissary

The National Zoo has a decentralized commissary at the Rock Creek Park facility, with keeper kitchens located on separate sites for many of the animal enclosure areas. The commissary has a manager and four commissary stewards. The commissary manager is responsible for quality control, handling, and storage of all food

(NZP, Nutrition and Commissary Operating Protocols, September 2003). Commissary stewards maintain the physical inventory of food items in one of four areas.

All food orders are prepared and delivered by commissary stewards. Food is delivered during weekdays at the Rock Creek Park facility by commissary staff to the keeper kitchens, where keepers prepare the diets for individual (or groups of) animals; food is delivered weekly to the CRC (NZP, Nutrition and Commissary Operating Protocols, September 2003). The commissary delivers live food to Rock Creek Park animal units upon receipt from vendors; vendors deliver live food for CRC animals directly to the CRC. A designee in each animal unit orders food by preparing a food order sheet and submitting it to the acting head of clinical nutrition and the commissary manager.

A 1992 review (NZP, Commissary Review National Zoological Park, May 14-15, 1992) recommended more centralized diet processing to improve nutritional quality and reduce costs. A plan for developing a centralized commissary by 2005 has been drafted (NZP, Proposed Plan to Develop a Centralized Commissary, October 16, 2003). In the fall of 2003 the commissary manager position became vacant when previous manager retired. The acting head of clinical nutrition assumed the duties of commissary manager. This position has recently been filled on a permanent basis with an experienced warehouse manager who has additional experience as an animal nutrition research technician. The acting head of clinical nutrition will train the new commissary manager.

Nutrient Analysis and Quality Control

A nutrition laboratory (with six to eight rooms) containing nutrition analysis equipment (aligned with the research nutrition division) is available for nutrition analysis but is underused. The acting head of clinical nutrition performs some nutrient analysis in the laboratory; one federally funded laboratory technician is currently used in a research capacity; other laboratory personnel are only available for research activities because they are supported by research grant funds. Some routine nutritional analysis (mainly mineral and vitamin composition) of feed is performed by outside commercial laboratories.

According to operating procedures for systematic and routine laboratory analyses (proximate analysis, fiber fractions, and some major and trace minerals), analyses will be performed four times per year (March, June, September, and December) for forages and primary dry feeds; secondary dry feeds and moist feeds twice per year; and tertiary dry feeds once per year (NZP, Nutrition and Commissary Operating Protocols, September 2003). Nutrient composition (proximate analysis, fiber fractions, some major and trace minerals, and some vitamins) for meat-based diets will be analyzed for each shipment. Microbiologic screenings for *Salmonella, Campylobacter*, and *E. coli* 0157 will be conducted for meat-based diets and are analyzed for each shipment (NZP, Nutrition and Commissary Operating Protocols, September 2003).

Hay (timothy, orchard grass, and alfalfa) is grown at the CRC for many captive herbivores in the National Zoo collection (NZP, Nutrition and Commissary Operating Protocols, September 2003). The harvested hay bales are held off the ground stored in barns at the CRC. The commissary manager is responsible for monitoring the hay supply and coordinating pickups for the Rock Creek Park facility (NZP, Nutrition and Commissary Operating Protocols, September 2003). Hay quality and nutritional composition are analyzed as forages as mentioned in the previous paragraph.

Strengths and Weaknesses in Animal Nutrition at the National Zoo

The clinical nutrition program at the National Zoo is currently at risk for continued problems. This is because of several factors, including the lack of permanent, qualified, and experienced leadership; limited or no record keeping over the past decade; poor integration of nutrition with overall animal care programs; and the absence of any documented recent analyses or evaluations of the adequacy of the majority of animal diets. These deficiencies have resulted in several problems affecting the well-being of the animals at the National Zoo. For example, in 2000 a zebra at the Rock Creek Park facility died of hypothermia and malnutrition (see Box 2-1 for detailed discussion). More recently, an unannounced inspection by the USDA identified the inappropriate feeding of seasoned baked fish and beef to apes (USDA, 2004b).

The nutrition problems seen in primates and in equines at the National Zoo are not limited to the specific incidents cited. A rudimentary analysis of documented current diets of several primate groups and of zebra at the National Zoo indicate that the animals are not being fed according to requirements and recommendations established by the National Research Council (NRC) for wildlife and relevant domestic species (see Tables 2-4 and 2-5) (NRC,

1989a; 2003). The NRC recommendations are used by all government agencies with regulatory oversight of animal care and by the feed industry as the standards for animal feeding.

For three primate groups at the National Zoo, diets appeared to be deficient or excessive in specific key nutrients that are critical to normal gut function and to overall animal health (e.g., protein, fiber, vitamins and minerals), or food items were inappropriate to the species' digestive physiology (see Table 2-4) (NRC, 2003; Stevens and Hume, 1995). Additionally, great apes (gorillas and orangutans), tamarins, and marmosets at the National Zoo are being fed animal products (i.e., meat and/or eggs, yogurt), which are not appropriate food items for these species, as they are neither carnivorous (meat-eater) or omnivorous (meat and plant eater). Great apes are frugivorous (fruit eater) or herbivorous (plant eater); for example, orangutans consume primarily fruits, and gorillas consume primarily pith, shoots, leaves, and stems of herbs and shrubs in the wild (NRC, 2003). Tamarins are frugivorous, gumivorous, or insectivorous. The inclusion of inappropriate food items in an animal's diet can result in digestive problems for the animal, which directly impacts its health and welfare, and can create situations that require veterinary medical attention.

It is not uncommon for diet problems to exist in zoos because most zoos do not employ a nutrition staff as the National Zoo does. It is impossible to know whether the National Zoo diet records used in this rudimentary analysis accurately reflect the diets actually fed or consumed. In addition, published food/feed composition values, rather than analyzed food/feed composition, were used to estimate nutrient composition of the diets. However, the type and magnitude of problems identified in the few diets examined here represent clear examples of deficiencies in the current nutrition program and potential threats to the health and welfare of the animals.

TABLE 2-4 Key nutrients found to be deficient or excessive in diets fed to three primate species at the National Zoo.[b]

	Nutrient	National Zoo Diet[c]	National Research Council Recommendations[d]	Comments
Orangutan (*Pongo pygmaeus*)	NDF (%)[e]	13	20	Deficient
	ADF (%)[f]	4	10	Deficient
	Calcium (%)	0.5	0.8	Deficient
	Phosphorus (%)	0.3	0.6	Deficient
Lemur (*Lemur catta*)	Protein (%)	14	15-22	Deficient
	NDF (%)	15	20	Deficient
	ADF (%)	4	10	Deficient
	Vitamin E (IU/kg)	10	100	Deficient
	Calcium (%)	0.7	0.8	Marginal
	Phosphorus (%)	0.4	0.6	Deficient
Tamarin (*Leontopithecus* spp.)	Protein (%)	26	7	Excessive
	Vitamin D (IU/kg)	15,327	2,400	Excessive

[a]NZP, Diet Record, Accession #31264, #107881, Orangutan; Accession #106955, #106960, #111251, #111277, #112790, #113319, #113453, #113454, #113482, #113483, 113529, #113530, #113550, #113551, #113569, #113570, #113614, #113670, #113804, #113806, #113807, #113808, Tamarin; and Accession #113682, #113683, #113684, #113685, #113686, #113687, #113688, #113689, Lemur.

[b]The composition of diets fed (obtained from the National Zoological Park Diet Record forms) were compared to published nutrient requirements and feeding recommendations established by the National Research Council (NRC, 2003).

[c]Nutrient composition of the fed diet was determined by calculation of amount fed (as documented on the diet form) and with known nutrient composition of individual diet ingredients as published by USDA Nutrient Database for Standard Reference (U.S. Department of Agriculture, Agricultural Research Service. 2002. USDA National Database for Standard Reference, Release 15, Nutrient Data Laboratory Homepage, http: //www.nal.usda/gov/fnic/foodcomp) and feed composition tables published by the NRC (NRC, 2003).

[d]From *Nutrient Requirements of Nonhuman Primates, Second Revised Edition* (NRC, 2003).

[e]Neutral detergent fiber.

[f]Acid detergent fiber.

TABLE 2-5 Nutrients found to be excessive or deficient in the current winter diet fed to three zebra[a] at the National Zoo.[b]

Nutrient	National Zoo Diet[c] (adult male)	National Zoo Diet (adult male)	National Zoo Diet (young growing male)	National Research Council Recommendations[d] (adult diet/young growing diet)	Comments (adult diet/young growing diet)
Protein (g/d)	1255	1156	482	536/650	Excessive/ Deficient
Magnesium (g/d)	27	24	10.2	6/5.7	Excessive/ Excessive
Potassium (g/d)	144	123	53.2	20/18.7	Excessive/ Excessive
Calcium (g/d)	85	72	31	16/19	Excessive/ Excessive
Phosphorus (g/d)	40	40	16	11/11	Excessive/ Excessive

[a]NZP, Diet Record, Accession #113392, #113417, and #113805, Grevy's Zebra
[b]The composition of diets fed (National Zoological Park Diet Record form) were compared to published nutrient requirements established by the National Research Council for equines (NRC, 1989a).
[c]Nutrient composition of the fed diet was determined by calculation of amount fed (as documented on the diet form) and with known nutrient composition of individual diet ingredients as published in feed composition tables included in the NRC report series on nutrient requirements of animals (NRC, 1989a).
[d]From *Nutrient Requirements of Horses* (NRC, 1989a).

The National Zoo is not fully using its nutrition expertise. The zoo has an active nutrition research program (funded mainly through external grants) with a research nutritionist who has a wealth of knowledge and experience in zoo animal nutrition. In the short term (while the zoo seeks a clinical animal nutritionist), the research nutritionist should collaborate with the acting head of clinical nutrition, (who has limited relevant experience) in the formulation of diets for the animal collection. The zoo could benefit from hiring a permanent, qualified, nutritionist (M.S. or Ph.D. in animal nutrition) with years of experience managing a nutrition program and training in zoo animal nutrition, rather than filling the position temporarily. A job description for this position should clearly define educational requirements, reporting structure and areas of responsibility, essential duties, and collaboration with a research nutritionist. Lack of continuity is a concern with temporary placement; with a temporary placement the zoo could employ a nutritionist who spends a short time at the zoo and then moves to another organization when the placement is finished. This could lead to disruption of nutritional services at the zoo and a failure to develop institutional memory.

Recently implemented procedures for diet approval (requiring veterinarian, nutritionist, and curator approval) at the National Zoo are appropriate and should help ensure diet adequacy for animals in the collection, but the lack of appropriate expertise and oversight can place the nutritional care of the animal collection at risk. The research nutritionist and the acting head of clinical nutrition should collaborate immediately on completing the centralization of diet formulation records for each species (or individual animal). A schedule for annual (or seasonal, as appropriate) diet evaluations provides an excellent roadmap for routine diet formulation; however, this plan should not be a substitute for dietary evaluation (and reformulation) needed for individual animal needs (e.g., illness, injury, pregnancy, growth). More frequent (rather than only minimal) routine nutrient analysis of feedstocks would be beneficial for diet formulation and evaluation of the animal collection needs. The National Zoo should examine the support needs of the clinical nutrition position and assess the role of the current federally funded nutrition laboratory technician position in the research nutrition division to determine if there are reporting arrangements that would benefit both the research division and the animal collection.

The present commissary has the physical capacity needed for a centralized program and is currently underused (NZP, Commissary Review National Zoological Park, May 14-15, 1992). The National Zoo has developed a draft plan to move diet preparation to a centralized commissary (NZP, Proposed Plan to Develop a Centralized Commissary, October 16, 2003), with an initial pilot program scheduled for late 2004. Many specifics for moving to a centralized commissary are contained both in the 1992 commissary report (NZP, Commissary Review National Zoological Park, May 14-15, 1992) and the National Zoo draft commissary plan (NZP, Proposed Plan to Develop a Centralized Commissary, October 16, 2003). This project will lead to more consistency in diet

preparation and reduce the time that keepers spend in diet preparation. The zoo should continue this positive step and move toward a centralized commissary by empowering the acting head of clinical nutrition and new commissary manager to finalize the plan and begin implementation during 2004.

Because standard operating procedures, record keeping, and communication protocols have only been updated recently (NZP, Nutrition and Commissary Operating Procedures, September 2003), these activities as they relate to animal nutrition program have not yet been fully implemented. It is essential for the clinical nutrition division to follow through on the timely implementation of these programs and for the clinical nutrition division under qualified leadership to be given authority and responsibility for the success of these programs. Because these programs are relatively new (or newly updated), their impacts on animal care are likely just beginning, and ongoing reevaluation of their effectiveness is essential. Integration of the nutrition records with other animal records (e.g., medical, curatorial, keeper) in a comprehensive information management system is discussed in Chapter 3.

Findings and Immediate Needs

Finding 2: *Shortcomings exist in the animal nutrition program. There has been inadequate communication between the nutrition, keeper, and veterinary staffs; poor consultation between the research nutritionist and the acting head of clinical nutrition; and a lack of standardization and regular evaluation of animal diets. Nutrition records are not currently integrated with other record-keeping systems and, despite having adequate facilities for over a decade, the National Zoo is only now beginning to move toward a centralized commissary.*

Immediate Needs: *The National Zoo should immediately use its existing nutrition expertise by increasing coordination and collaboration between the acting head of clinical nutrition and the research nutritionist to address nutritional issues of the animal collection, including diet review, evaluation, and modification. The zoo also should seek a permanent (rather than temporary), qualified experienced person for the role of clinical nutritionist. Centralization of standard diet formulation records and integration of those records with other record-keeping systems for animal care and management at the National Zoo should be completed. An annual schedule for evaluation of diet formulations for each animal or animal group should be developed and implemented. The National Zoo should finalize its draft plan to centralize the commissary and implement it in 2004.*

ANIMAL WELFARE

The National Zoo currently has two Institutional Animal Care and Use Committees (IACUCs), one each for the CRC and the Rock Creek facility. Both are responsible for ensuring that the living collection and research subjects receive humane care and treatment. Each IACUC is responsible for (NZP General Memorandum No. 15, August 8, 2003, September, 2003)

- inspecting all animal areas and supporting facilities twice a year and submitting inspection reports;
- investigating and resolving concerns and complaints brought to their attention;
- reviewing proposals for research using animals at their respective facilities or field sites;
- recommending to the zoo director changes to National Zoo practices and procedures to correct deficiencies;
- recommending to the zoo director the suspension of any activity not being conducted in a manner consistent with current policy and procedures.

Animals Used in Research Programs

The responsibilities of the IACUCs, as pertains to research animals, are also federally mandated through the Public Health Service Policy on the Humane Care and Use of Laboratory Animals (PHS Policy) and the Animal Welfare Act (AWA). The NIH Office of Laboratory Animal Welfare (OLAW) and the U.S. Department of Agriculture (USDA) oversee compliance with the PHS Policy and AWA, respectively.

Public Health Service Policy on Humane Care and Use of Laboratory Animals

Research at the National Zoo that is supported by the Public Health Service (PHS) is subject to PHS Policy, which requires that all institutions receiving PHS support provide a written Animal Welfare Assurance (Assurance), a document that fully describes the institution's program for the care and use of animals in PHS-conducted or supported activities. PHS Policy requires institutions to appoint an Institutional Animal Care and Use Committee (IACUC) to oversee the institution's animal program, facilities, and procedures, including confirming that projects are conducted in accordance with the Guide for the Care and Use of Laboratory Animals (NRC, 1996b). In addition, the IACUC must inspect semiannually all facilities that are used in PHS-funded research, review animal care and use programs, prepare reports of these inspections and reviews, and maintain minutes of the IACUC meetings and records of animal protocols and changes to protocols (PHS Policies IV.C., B., and E.). The Smithsonian Institution maintains one Assurance for all PHS-funded research that occurs within the Smithsonian Institution, including research at the National Zoo. The Smithsonian Institution's Office of Sponsored Projects is responsible for maintaining the Assurance and providing an annual report to the NIH Office of Laboratory Animal Welfare (PHS Policy IV. F.) that outlines changes to National Zoo's facilities or IACUC membership, a notice of the dates of the semiannual inspections, and any serious instances of noncompliance with PHS Policy or deviations from the provisions of the Guide for the Care and Use of Laboratory Animals.

Animal Welfare Act

The AWA applies to (1) research activities that use warm-blooded vertebrates except birds, rats of the genus Rattus, and mice of the genus Mus and (2) research that is not initiated to improve nutrition, breeding, management, or production efficiency of the animal under study (9 CFR 1.1).

When research being performed at a federal institution (such as the National Zoo) is subject to the AWA, the AWA-covered research is subject to review and oversight by an IACUC in a fashion similar to that dictated by PHS Policy. The IACUC is responsible for reporting deficiencies in animal care and use that occur regarding research animals that are subject to the AWA. These deficiencies are to be reported to the head of the federal agency as outlined in 9 CFR 2.37:

> Each Federal research facility shall establish an Institutional Animal Care and Use Committee which shall have the same composition, duties, and responsibilities required of nonfederal research facilities by Sec 2.31 with the following exceptions:
>
> (a) The Committee shall report deficiencies to the head of the Federal agency conducting the research rather than to APHIS; and
>
> (b) The head of the Federal agency conducting the research shall be responsible for all corrective action to be taken at the facility and for the granting of all exceptions to inspection protocol.

> Each Federal research facility shall establish an Institutional Animal Care and Use Committee which shall have the same composition, duties, and responsibilities required of nonfederal research facilities by Sec 2.31 with the following exceptions:

Some research at the National Zoo does not fall under the oversight provided by the Animal Welfare Act or PHS Policy. This is because the research pertains to improving the nutrition, breeding, or management of an animal, does not involve an AWA-covered species, or is not funded by the PHS

Animal Exhibition Program at the National Zoo

The AWA regulates the treatment of animals on exhibition at the National Zoo (7 U.S.C. §2144). The regulations covering the care, facilities, veterinary care, and enrichment that must be provided to animals on exhibit in the United States are described in 9 CFR Section 3. The Animal and Plant Health Inspection Service (APHIS) in

the USDA ensures compliance with the AWA by inspecting exhibitors, and in cases where the AWA is violated, using civil penalties and legal action to force compliance (USDA, 2002).

While the AWA clearly defines the responsibilities of the National Zoo IACUCs and the Smithsonian Institution as it pertains to oversight and reporting on the care and use of research animals subject to the AWA, the role of the National Zoo IACUCs, the USDA, and the head of the Smithsonian for overseeing the care and use of animals not used for research (i.e., animals on exhibit or used for breeding at the zoo), is not clearly defined. The USDA's current interpretation of the law is that they do not have enforcement authority at the National Zoo (USDA Office of the General Counsel Fax to the National Academies Committee on the Review of the Smithsonian Institution's National Zoological Park, January 13, 2004). Because of a lack of clarity on enforcement authority at federal institutions, in the past USDA has provided only courtesy inspections at the behest of a federal agency, unless a memo of understanding had been entered into with the federal agency to clarify enforcement and inspection issues.

Recently, the U.S. House of Representatives Committee on House Administration, the Smithsonian Institution, and USDA have concluded that inspections of the National Zoo should be conducted without notice or consent (Chairman U.S. House of Representatives Committee on House Administration, 2003; USDA, 2004a). This led to the first unannounced APHIS inspection of the National Zoo's Rock Creek facility in January 2004 (APHIS Inspection Report, 2004). A memorandum of understanding between the USDA and the Smithsonian Institution could clarify issues relating to enforcement of the AWA at the National Zoo.

Strengths and Weaknesses in Animal Welfare at the National Zoo

Public Health Service Policy

Since 1998, at least five research projects at the National Zoo that use animals (domestic and exotic cats and zebrafish) have received PHS funding through NIH (NIH Grant Abstracts 3R01HD023853, 3R01RR008769, 5K01RR000135, 1K01RR017310, 5R03HD039430). This requires that the Smithsonian Institution provide a written Assurance acceptable to the NIH Office of Laboratory Animal Welfare, fully describing the National Zoo's program for the care and use of animals in PHS-conducted or supported activities. PHS Policy further requires that once every 12 months, the institution provide a written report to the NIH Office of Laboratory Animal Welfare detailing changes to the institution's program, facilities, and IACUC membership, and the dates of semiannual IACUC evaluations of the program and facilities, and any serious noncompliance with PHS Policy or deviations from the provisions of the Guide for the Care and Use of Laboratory Animals (PHS Policy IV.F.). Based on its review of records from the Smithsonian Institution's Office of Sponsored Projects and the NIH Office of Laboratory Animal Welfare, the committee cannot confirm whether the Smithsonian Institution had a valid Assurance from 1997 to 2000, a time during which PHS-funded research projects utilizing animals were funded and conducted at the National Zoo. Records indicate that on April 11, 2000 the Smithsonian Institution submitted paperwork to the NIH Office of Laboratory Animal Welfare seeking renewal of its Assurance. On February 19, 2004, the committee received a letter from the NIH Office of Laboratory Animal Welfare stating that the office recently located this submission and now considers the Smithsonian's Assurance to be approved for the period between April 11, 2000 and March 31, 2004 (Garnett letter of February 19, 2004). The committee did not have the opportunity to consider the implications of this letter in its interim report because it was received only a few days before the report was finalized. The status of the Smithsonian's Assurance will be examined more fully in the committee's final report. The Smithsonian Institution's Office of Sponsored Projects also has been unable to provide the committee with evidence that the annual reporting requirement (PHS Policy IV.F.) was fulfilled from 1995-2003.

Based on the documents provided to the committee, the IACUC at the Rock Creek Park facility has not consistently fulfilled its responsibilities as required by PHS Policy IV.E. Since at least 2000, the IACUC has not conducted semiannual inspections of facilities used in PHS-funded research or documented IACUC activities through minutes (PHS Policy IV.E.). Due to these failures, the committee cannot discern if PHS-funded research at the Rock Creek facility has been or is being conducted in accordance with the provisions laid out in the Guide for the Care and Use of Laboratory Animals (1996), as is required by PHS Policy. These provisions include: avoidance or minimization of pain and distress; appropriate use of sedation, analgesia, and anesthesia; and the consideration of alternatives to animal use and unnecessary duplication of experiments. There is a lack of documentation that appropriate oversight by the National Zoo, the Smithsonian Institution, or the Office of Laboratory Animal Welfare at NIH was being provided to ensure the welfare of animals used in PHS-funded research.

Animal Welfare Act

It is possible that some PHS-funded research at the National Zoo from 1998 to the present (specifically that on domestic and exotic cats) was subject to the AWA. The lack of record keeping by the IACUC at the Rock Creek Park facility, as well as the Smithsonian Institution Office of Sponsored Projects, is such that the committee cannot determine whether research being conducted at the National Zoo is subject to the AWA or whether other research projects not funded by PHS are subject to the AWA. For example, in 2001, a project to study the organization of memory in nonhuman primates was approved by the Rock Creek IACUC (NZP, IACUC Annual Report: Rock Creek Facility, 2001). The project may in fact be subject to the AWA, as it involves an AWA-covered species and it does not involve research to improve nutrition, breeding, management or production efficiency. However, the Rock Creek IACUC meeting minutes from 2001 do not reflect that this project was ever discussed or approved by the IACUC, and the Rock Creek IACUC records do not contain any information describing the research to be performed. There is no documentation to confirm whether the care these research animals received was in accordance with generally accepted standards and possibly the standards outlined by the AWA.

Further, the responsibility for identifying AWA-subject research and notifying the USDA that such research is occurring is the responsibility of the federal agency (in this case, the National Zoo and/or the Smithsonian Institution). This, in turn, triggers the Animal Care Regional Office of the USDA to send annual report forms to the National Zoo to track the research (USDA, 1999). Further investigation of ongoing research at the National Zoo is warranted to determine if AWA-subject research is being conducted.

Institutional Animal Care and Use Committee

Many animal welfare issues at the National Zoo remain unresolved. Because of the failure of the National Zoo and the Smithsonian Institution to provide the committee with sufficient documentation to enable it to ascertain whether the National Zoo is in compliance with PHS policy and the AWA, animal welfare at the National Zoo remains a serious concern of the committee. In addition, the Rock Creek Park IACUC at the National Zoo has not been diligent in establishing its authority and fulfilling its responsibilities.

Although not required by any regulation, the National Zoo did have a committee (previously designated the Animal Welfare Committee and most recently called the Rock Creek Park IACUC) tasked with addressing issues pertaining to the welfare of animals on exhibit and research animals not covered by PHS Policy or the AWA. The Rock Creek Park IACUC did not have a clear mandate as to its responsibilities for ensuring the welfare of exhibit animals and research animals not covered by PHS Policy or the AWA, and generally failed to document their activities adequately. For example, in 2002, four research projects involving exhibit animals were approved; approvals were given for these projects on March 5, March 25, and December 19, 2002 (NZP, IACUC Annual Report: Rock Creek Facility, 2002). However, the IACUC meeting minutes for 2002 reflect that a single meeting was held on December 9. The minutes of that meeting do not state that any of these projects were discussed or approved.

The Rock Creek Park IACUC also failed to adequately document its oversight of the welfare of exhibit animals not involved in any research effort. For example, the IACUC inspection of Beaver Valley in April 2000 documented numerous deficiencies that required attention and IACUC follow-up (NZP, IACUC Winter Inspection of Beaver Valley, April 19, 2000). These included (1) the grey seal beach required repair and IACUC needed to make sure that the cooling system functioned properly during the summer; (2) the beaver pool heater required repair and IACUC was to follow up before the winter; (3) the IACUC needed to follow up to ensure that the air conditioning unit in the bobcat enclosure was sufficient during the summer; and (4) a rehabilitating bald eagle required a heat source before the next winter, and the IACUC needed to confirm that this occurred. There is no indication in the IACUC minutes of 2000 or the next IACUC inspection of this area (NZP, IACUC Inspection of Elephant House and Beaver Valley, May, 2001) that the IACUC discussed these deficiencies or monitored the progress of their correction.

The lack of clarity about how the Rock Creek Park IACUC functioned, its purview, and its performance typifies the lack of consistency seen elsewhere in National Zoo functions. The Rock Creek Park IACUC's oversight of the welfare of exhibit animals appears to have been an "on again, off again" effort, which may have reflected management's failure to embrace its role in promoting and ensuring the welfare of the animals. It is instructive that a response to a request for copies of complaints submitted to the Rock Creek Park IACUC contained the following statements: "Most of the complaints turned out to be caused by differences of opinion or misunderstandings over

how animals should be cared for…" IACUC members would respond informally to "smooth the ruffled feathers…" (NZP, Nichols, 2003). It is clear that uncoordinated responses to individual complaints and concerns failed to address the fundamental need to provide an institutional structure that promoted and supported animal welfare. These sorts of intramural conflicts are resolved best through training that provides individual competence, and communication that instills confidence in one's colleagues.

Later, in the National Zoo's response (NZP Nichols Memo, October 16, 2003), it is indicated that the Rock Creek Park IACUC did not keep "official records" of complaint investigations because these were informal, and "…turned out to be problems in communications or staff management — not animal welfare issues." Given the deaths of the Grevy's zebra and the red pandas at the Rock Creek facility, it should be evident that communication and management are animal welfare issues, and an institutional failure to recognize this compromised further the welfare of other animals at the zoo. It appears that the Rock Creek Park IACUC saw its mandate as one of solving conflict between staff members and not of acting as an advocate for the animals.

The National Zoo outlined a new IACUC program in September 2003 (General Memorandum 15). This new IACUC program will be evaluated in the National Acadmies' final report. However, as evidenced by the failures of the previous system and lack of formal training of individuals involved in oversight of animal welfare, the current staff at the National Zoo and the Smithsonian do not have the appropriate training to implement and administer this new IACUC program effectively. It is imperative that the individuals responsible for the administration of the new IACUC program and IACUC committee members receive immediate, extensive training in the rules, regulations, and policies associated with overseeing the use of animals in research from an outside authority. Such training is provided by the OLAW/Applied Research Ethics National Association IACUC 101 course, among others.

Animal welfare should be a daily concern for every employee at the National Zoo. In several locations in the National Zoo, animal keepers are doing an admirable job in providing high-quality animal care, even with failing facilities. For example, during visits to the National Zoo, committee members observed that the seal lion exhibit was in severe disrepair, although it continued to house several geriatric animals. The keepers in that area worked around the ongoing repairs to provide the sea lions and seals with excellent training, enrichment, and care. Management should take an active role in promoting staff development and training that instill in the staff the skills needed to fulfill the requirements for animal welfare. Additional aspects of formal training programs and the IACUC programs will be considered for the final report.

Findings and Immediate Needs

Finding 3: *There is a lack of documentation that the welfare of animals has been appropriately considered during the development and implementation of research programs and that complaints regarding the welfare of animals on exhibit were appropriately investigated. There also has been a lack of understanding within the National Zoo and the Smithsonian Institution of the requirements of federal regulations and Public Health Service Policy and how to maintain compliance.*

Immediate Needs: *The National Zoo and the Smithsonian Institution should ensure compliance with all elements of the Animal Welfare Act and the Public Health Service Policy. The National Zoo and the Smithsonian Institution should seek outside training and assistance to achieve compliance with regulations and implement procedures meant to ensure the welfare of research and exhibit animals at the National Zoo.*

OVERARCHING ISSUES

National Zoo staff members have expressed a great affection for the animal collection and a strong desire to provide quality care. While these good intentions provide a fertile ground for high-quality care, the information reviewed by the committee and the direct observations of committee members during inspection tours of the zoo revealed a lack of evidence that the administration has embraced its role in providing for animal care and management; this is compounded by a lack of responsibility and accountability at all levels. While there appears to be pockets of excellence in various units and departments, personal responsibility and accountability for animal care and management are not pervasive at the National Zoo.

In reviewing the records of animals in the National Zoo collection, it was apparent that there is a longstanding issue with staff failing to abide by National Zoo policy and procedures. In some cases these failures

endanger the safety of the animal collection. These incidents include the previously described failures to document changes in animal management (see Box 2-1), failures to adhere with quarantine procedures (Finding 1), and failures to comply with animal welfare policies and procedures (Finding 3). The committee found evidence of failures to obtain the appropriate sign-off on euthanasia forms for an orangutan (NZP, Euthanasia Request Form, Accession #100797, Orangutan) and a tree kangaroo (NZP, Euthanasia Request Form, Accession #110974, Tree Kangaroo). Although there is no indication that these failures led to unnecessary suffering, following proper procedures would have clarified the circumstances surrounding the decisions to euthanatize, which in some cases are now clouded by controversy. The committee also found evidence of failures to complete nutrition forms for diet changes (see Box 2-1).

Findings and Immediate Needs

Finding 4: *There has been poor adherence to the National Zoo's own policies and procedures for animal health and welfare.*

Immediate Needs: *All levels of management should be held accountable for ensuring that National Zoo policies and procedures are followed. All zoo staff should take personal responsibility for educating themselves and adhering with the policies and procedures that pertain to their position and duties.*

3

Record Keeping

"Information, not data, is critical to the survival of a health care organization."
Diedling and Welfeld (1995)

Information management is fast becoming the key to effective action in animal care. As wildlife habitat for many threatened and endangered species continues to shrink, a greater responsibility is placed on zoos to function in part as the last refuges for more rather than fewer species (Teare, 1998). Long-term survival of small populations of captive wildlife requires intense management that encompasses information derived from numerous scientific disciplines, including genetics, nutrition, ethology, and veterinary medicine (Teare, 1998). When faced with questions regarding the care and management of wildlife species, literature surveys and reviews of individual medical records are labor intensive and time consuming. Thus, the more information that can be accurately collected and maintained and later effectively retrieved and used, the more successful captive animal management will become (Earnhardt et al., 1995). As with any facility responsible for the care of its residents, modern zoos require effective systems for gathering relevant information from the field, processing it in ways that provide maximum value, and presenting it in a form that is easy for staff to use in implementing appropriate actions to achieve effective animal management and disease control programs (Morris, 1991). Responsibilities of the chief information officer and managers of those systems are equally important in ensuring effectiveness (Greer, 1998).

Several published reviews describe objectives for information management systems and criteria for information-gathering activities in animal health that should be met to ensure effectiveness (Morris, 1991; Harris, 1991). Information management systems are the functional coordination of data (records) from input (the data that goes into the system) through processing (what is done with the data) to output (the information that is produced). Ten characteristics are important in any information management system (R. Whitehouse, Associate Hospitals Administrator and Director, Medical Information Services-University of Michigan Hospital and Health Centers, "Clinical Information Systems" presentation to committee, October 2, 2003):

1. Accessibility,
2. Accuracy,
3. Appropriateness,
4. Comprehensibility,
5. Comprehensiveness,
6. Consistency,
7. Relevance,
8. Reliability,
9. Timeliness
10. Usefulness

These characteristics apply to systems ranging from simple (paper record) to complex (decision support software) (see Figure 3-1). Two critical aspects of paper systems are tracking and accessibility of the records.

Records should provide an accurate account of situations and practices relating directly to animal management and health. They should permit reconstruction of events in the recent and distant past and provide a rational basis for decision making.

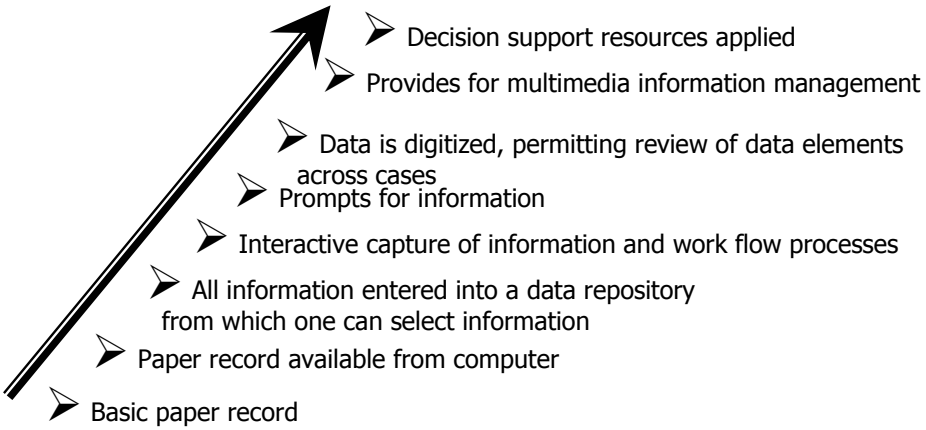

FIGURE 3-1 Range of complexity in information management systems (R. Whitehouse, Associate Hospitals Administrator and Director, Medical Information Services-University of Michigan Hospital and Health Centers, "Clinical Information Systems" presentation to committee, October 2, 2003).

ELECTRONIC DATA MANAGEMENT IN ZOOLOGICAL INSTITUTIONS

Many software programs used for zoo and aquarium animal information management have been developed by the International Species Information System (ISIS), a small nonprofit membership organization that maintains a data depository for its institutional members. It has, however, not kept pace with advances in information technology, and it does not have the resources to ensure the accuracy of member records. In an effort to supplement animal collection records, several institutions and some zoo and aquarium associations have developed additional software. For example, the Australasian Regional Association of Zoological Parks and Aquaria (ARAZPA) developed REGASP, software for managing institutional and regional collection planning data. REGASP is now used by several regional associations. The Zoological Society of London supported the development of software to manage invertebrate populations. Several individual institutions have developed in-house inventory systems that meet their individual needs but still export data to a central ISIS database (Dubois, et al., 2003). In addition, veterinarians have been searching to find a replacement for the DOS-based Medical Animal Record Keeping System (MedARKS) software program, which has been adopted as the "de facto" standard for computerized medical records in zoos. It was developed in 1986 and later supported by ISIS. MedARKS is the single largest computerized database of medical information on captive wildlife (Teare, 1998); approximately 200 institutions in over a dozen countries maintain health records in these systems.

A new Zoological Information Management System (ZIMS) is being developed by the American Zoo and Aquarium Association (AZA) and a consortium of zoological and professional organizations (Cook and DuBois, 2003) and is being coordinated by ISIS. This new system is being designed to create a global animal information system for zoos and aquariums. It will include modules for animal inventory, veterinary care, nutrition, husbandry, environmental monitoring, collection planning, and research, and will be designed to accommodate expansion (ZIMS, 2003). ZIMS will support all of the information that is in the current ISIS software (ARKS, MedARKS) and additional information as determined by planners.

The recognition that well-designed, standardized electronic medical record-keeping systems are essential to proper animal care is not limited to the zoological community. The U.S. Department of Agriculture's (USDA) Animal and Plant Health Inspection Service (APHIS) recently announced a proposed regulation of medical record keeping for research facilities, dealers, and exhibitors (Docket No. 97-033-1), which includes zoological institutions. Maintenance of medical records is implied in the Animal Welfare Act, but the regulations do not specifically stipulate the maintenance of medical records as one of the elements in a program of adequate veterinary care. The

proposed rule would amend the Animal Welfare Act (7 U.S.C. 2131 et seq.; 9 CFR 2) to require these entities to maintain medical records as part of adequate veterinary care. The proposed maintenance of medical records "would serve as a basis for reviewing the medical history and planning veterinary care, and provide a mechanism of communication for matters of animal health, behavior, and well-being. Medical records document the animal's illness, veterinary care, and treatment and serve as a basis for review, study, and evaluation of veterinary care rendered by the facility."

The lack of a standardized information technology strategy for regulatory veterinary medicine resulted in state and federal information systems evolving separately (Miller et al., 1994). Animal managers ultimately pay the price for deficiencies in regulatory coordination of U.S. animal health and disease information. As seen in the recent identification of the first U.S. case of "mad cow disease," our national system for tracking and coordinating information on animal health and management needs to be improved, and the USDA has expedited its current efforts (USDA, 2004c). The longer the development of information technology strategies is delayed, the more costly it will be to correct the deficiency (Miller et al., 1994).

In another example of moving toward record standardization, the Department of Health and Human Services (DHHS) recently announced the development of a new Systematized Nomenclature of Medicine (SNOMED) for veterinarians and physicians, which was originally created for human medicine, but has been expanded to include veterinary terms; SNOMED will allow institutions throughout the country to share information electronically (AVMA, 2003). In addition, the National Academies' Institute of Medicine has been asked by DHHS to design a standardized electronic health record.

Information Managers

Information managers, or chief information officers, have become increasingly important in recent years, especially in the human and veterinary medicine fields (Greer, 1998). These people typically occupy positions at the executive management level in the human medical field and administrative or management positions in the veterinary medical (zoo) field (Greer, 1998; Zoo Registrars Association, 2003).

There are only two formally established regional groups of animal records keepers: the Australasian Animal Records Keeping Specialist Advisory Group and the North American Zoo Registrars Association. The membership of these organizations consists of people with primary responsibility for animal record keeping in zoological institutions, aquariums, and similar organizations (i.e., registrars). A zoo registrar's responsibilities are varied and complex (see Table 3-1). Two AZA scientific advisory groups (the Institutional Data Management Advisory Group and the Small Population Management Advisory Group) have produced official standards for data management in AZA-accredited zoos. The AZA offers professional training in record keeping.

TABLE 3-1 General Responsibilities and Qualifications of a Zoo Registrar[a]

Responsibilities: Serves as a member of the Animal Management Team, assists in the development and implementation of the zoo's Collection Management Policy, and its resulting collection plans. Monitors all transactions for adherence to policies. Manages animal records and ensures the maintenance and quality of animal records for use in the management and development of husbandry and breeding programs, preparation of scientific publications, and provision of data for cooperative ventures at both the regional and international level. Serves as liaison and information source to other departments and organizations. Provides a complete inventory and record of all animal transactions. Monitors legislation for compliance with wildlife laws. Collaborates with curators. Works under the supervision of the Zoo director. (Specific responsibilities detailed in Appendix E).
Qualifications: Four-year college degree in biology or related field plus two years of experience. Knowledge of concepts, principles, and practices of professional museum and zoo registration methods and collection management standards. Knowledge of inventory accession and record-keeping practices; zoological nomenclature; laws regulating animal acquisition, disposition, exhibition, husbandry standards, and transportation within the United States and abroad; and statistics and population management. Experience with computers, animal records, and word processing software. Ability to collect and collate information from a variety of sources into concise and accurate reports. Good communication and organizational skills, and attention to detail.

[a]Adapted from Zoo Registrars Association (2003).

RECORD KEEPING PRACTICES AT THE NATIONAL ZOO

Within the National Zoo, animals are assigned a "local ID" in the form of an accession number. This accession number uniquely identifies each animal in the National Zoo and is used in each type of record generated at the National Zoo. The National Zoo generates many types of animal management and husbandry records, including

- *Keeper logs* – generated by the zoo keepers to document daily observations of each animal.
- *Curator reports* – generated by the curator, usually weekly, to highlight significant events noted in the daily keeper logs of that week.
- *Specimen reports* – generated by the records keeper within the registrar's office. It is the official history of the animal and documents major events such as birth, death, origin of specimen, medical history, behavioral and husbandry concerns, and location of a specimen (Earnhardt et al., 1998). These reports are generated from information in the curator reports.
- *Nutritionist records* – generated by the nutritionist to document diet management.
- *Veterinary medical records* – generated by the veterinary staff to document the medical care received by an animal, including clinical notes, laboratory results, anesthesia records, and parasitology records.
- *Pathology records* – generated by the Pathology Department to document the examination of tissue or fluid samples as well as the findings of necropsies.

The veterinary medical records are generated on MedARKS (ISIS, 2004; AAZV, 1999). The specimen reports are generated using the Animal Record Keeping System (ARKs) software package developed by ISIS. The keeper logs, curatorial reports, and nutritionist records are generated in a variety of ways detailed below.

Keeper Logs

The keeper log is the only record of normal daily observations of individual animals. In the past these records were generated through the use of a carbon paper form called the zookeeper's daily report. Over the past five years a prototype electronic keeper record system called the Daily Animal Records System (DARS) was developed and implemented. DARS was implemented in only one unit to test the system; that unit still uses the system. A second electronic system is being developed and implemented, using a Web-based form found on the National Zoo's intranet. This initiative was started approximately a year ago. It uses a form similar to the zookeeper's daily report on paper, and currently two units are using the system, though not every keeper within the unit uses it (NZP, Animal Records Procedures: Statement of Practice, 2003; J. Block, Registrar, National Zoo, personal communication). Both the DARS and the new intranet-based system allow for electronic entry of data onto the form; however, there is no electronic archiving of the information. The forms are printed out and the paper copies are to be archived (J. Block, Registrar, National Zoo, personal communication).

Curator Reports

Curator reports are generated by the curator, usually weekly, and contain the most salient animal management and husbandry information gleaned from the keeper reports. For one unit this report is generated through the DARS system; for all other units it is generated by a version of a curator report form. Paper copies of these reports are forwarded to the registrar's office, where they are archived, and salient information from the curator reports is included in the specimen report (NZP, Animal Records Procedures: Statement of Practice, 2003).

Nutritionist Records

In the past and currently the development, implementation, recording, and archiving of nutritionist records has been at the discretion of the National Zoo nutritionist. Nutrition files were kept on hard copy, though it was evident that there was a lack of standard documentation on the current diet of each animal and any changes made to

the diet (e.g., see Box 2-1). The acting head of the clinical nutrition program, appointed for a two-year term, has begun organizing the nutrition records, and is developing and implementing a new electronic record-keeping system for nutrition records.

STRENGTHS AND WEAKNESSES IN RECORD KEEPING AT THE NATIONAL ZOO

Failure to Adequately Document Animal Management, Husbandry, and Medical Care

With the exception of the Pathology Department, the adequacy of the record keeping varied greatly within the different units and departments of the National Zoo, and often was deficient, as in the case of the Grevy's zebra "Buumba" (see Box 2-1). This resulted in part from a lack of standardized practices for reporting and archiving records. Patterns of inconsistent record keeping and archiving were found in keeper logs, curator reports, nutritionist records, and medical records. The National Zoo has acknowledged errors in record keeping for a number of animals (African lion [Accession # 108413], bobcat [Accession # 103175], East African bush elephant [Accession # 26223], eastern bongo antelope [Accession # 110565], Geoffrey's marmoset [Accession # 113220], Masai giraffe [Accession # 104081], Sumatran orangutan [Accession #100797], tree kangaroo [Accession # 110974], Vietnamese pot-bellied pig [Accession # 109080], zebra [Accession # 113393]; NZP, Letter to Committee, December 31, 2003).

Keeper Logs

The keeper log is a particularly important record as it is a primary sources for information used for animal management decisions (Earnhardt et al., 1998). There were numerous instances of keeper logs not reflecting important changes in an animal's behavior or management (e.g., see Box 2-1). This may occur for a variety of reasons, including a failure to appropriately train keepers regarding the information that should be recorded in a keeper log and a failure of the curator to provide appropriate quality control. Another keeper log issue that arose was a failure to archive these records (see Boxes 2-1 and 2-2). Currently each unit is responsible for archiving the daily keeper logs, though there is no stated expectation of how long to archive the materials. There is a lack of appreciation at all levels of the importance of these records, and that in various situations it may be essential to be able to review weeks, months, or even years of keeper logs on a particular animal or group of animals. Not only were there numerous failures to archive these records but there was also a failure to manage these records as a whole. In essence, no individual within the National Zoo has responsibility for documenting where the records are archived and how they are organized. This leaves each unit's records vulnerable when staff turnover occurs. When staff leave the National Zoo (particularly curators, who are responsible for overseeing the quality and archiving of keeper logs), knowledge as to where the records are kept and how they are organized is lost. With the large amount of staff turnover resulting from the buyouts, it is particularly important to standardize practices relating to keeper logs, so that these records are accessible regardless of the current staffing situation.

Curator Reports

Curator reports also failed to provide complete information regarding animal management (e.g., see Box 2-1). This is partially because curator reports are compiled from keeper logs (which were deficient in many cases) but also because of a failure to appropriately train curators regarding their responsibilities in generating complete and accurate curator reports, and also their responsibilities in overseeing the quality and completeness of the keeper logs. There is no formal training process; rather, the registrar, on a case-by-case-basis, informally discusses record keeping with a curator. In addition, few curators have received training on record keeping through the AZA (2003a). The National Zoological Park Animal Records Procedures, which outline the responsibilities of the curator and the information for which they are responsible, was developed in July 2003, and there has been no organized effort to educate curators of the contents of the document, ensure they are properly trained to carry out its policies, or provide oversight to ensure they are adhering with the policies.

Nutritionist Records

In the past there has been a failure to maintain accurate, up-to-date records on the diets and nutritional management of animals at the National Zoo. This situation arose due to several factors, including: a failure on the part of nutritionists to fulfill their responsibility to maintain adequate records, the lack of written expectations as to what would be contained within nutritionist records and how they were to be managed and archived, and the failure of senior management to provide appropriate oversight to ensure that the nutrition department was fulfilling its responsibilities.

An acting head of clinical nutrition has been hired for a two-year appointment and the process of organizing the few records that do exist, developing an electronic system to document diet management, and creating a diet management record for each animal in the collection has begun. The original intent was to have a diet management record created for each animal in the collection, and to have these records accessible via the Intranet. However, due to the retirement of the commissary manager, the acting head of clinical program temporarily assumed the responsibilities of the commissary manager, which has delayed completion of the nutrition records. A new commissary manager has been hired. Those nutrition records that have already been created are slated to be assessable via the Intranet in early 2004.

Veterinary Medical Records

In general the medical records kept by the veterinary staff at the National Zoo were acceptable, however there were multiple instances of medical records being altered weeks and even years later (see Box 2-1). The National Zoo, like many other zoos, uses the MedARKS system as a teaching tool, by allowing veterinary students and residents to create the initial clinical note in an animal's record and then, at a later point, editing these records when errors are made. The MedARKS system documents the initials of the person who creates the clinical note, though the system does not automatically identify the user when edits are made to a record. Recently the veterinary department established a variety of policies regarding the identification of persons who enter or edit a record, including having students use the initials of the case veterinarian and most recently, having students use their own initials as was done previously. When edits are made, case veterinarians should manually enter their own initials. Though editing of clinical notes is a standard practice at the National Zoo, it is an unacceptable practice as currently implemented.

The American Animal Hospital Association has established clear standards for medical records, including "the author of medical record entries is permanently and uniquely identified (by a code numbers/letters, initials, or signatures) in a manner that is understood by anyone examining such records." The National Zoo's practice of editing medical records without identifying the changes made or the individual making the changes casts doubt on the credibility of their records, especially when the quality of the veterinary care is called into question. If erroneous entries are made, they should be corrected by addenda, not by altering the original entry. If the National Zoo continues to allow students to make medical record entries, the students need to be carefully supervised to limit inconsistencies and errors that would require the supervising veterinarian to create an addendum; these addendums should be made in a timely fashion.

Lack of Records Accessibility

There are two main issues regarding accessibility of records. The first was discussed above and involves a failure to consistently and appropriately archive keeper logs and curator records. Each unit and the nutrition department is responsible for archiving the unit's/department's generated records, with no apparent oversight. This has resulted in records being lost or misplaced. When records are not retrievable in a reasonable manner, their value is lost.

Second, all pertinent animal information is not archived in one location (be it paper or electronically). Currently at the National Zoo the information management infrastructure is set up so that daily information about an animal is included in the keeper log; the curator summarizes this information into a weekly curator report; medical information is contained within the MedARKS medical records; and nutritional information is contained within the nutritionist records, which are still being developed. Many units within the National Zoo submit all of their keeper logs to the veterinary medical department daily. Some do this by faxing the forms, while others send it by e-mail. Other units submit only their weekly curator reports to the veterinary medical department by fax, while at least one

unit does not submit any reports to the veterinary medical department (J. Block, Registrar, National Zoo, personal communication). In addition, there is no expectation, nor should there be, that the veterinarians archive these materials for future use. In an emergency, if veterinarians needed access to these records (for example, to determine if medications were administered or behaviors were altered.), they would have to rely on locating a member of the unit staff to find the paper copies of these records and transmit them to the veterinary staff in a timely fashion.

According to National Zoo policy (NZP, Animal Records Procedures, July 2003), the registrar is responsible for setting the standards and overseeing the animal records systems, maintaining the transaction files and the core data in the specimen records, and reporting on collection holdings and changes. In reviewing keeper logs, curator records, medical records, pathology records, and specimen records over the last six months, the committee found that the type of information being documented in the keeper and curator records was inconsistent and the keeper and curator records were inappropriately archived – if they were retained at all. These deviations from stated policy directly affected the quality of care some animals received (see Box 2-1) and hampered the investigation of the circumstances contributing to animal deaths at the National Zoo. It is clear that there was not adequate oversight of keeper and curator record keeping and archiving by the registrar. It is not apparent whether adequate policies on record keeping and archiving were in place prior to July 2003. The committee was unable to determine whether the registrar had a clear mandate and appropriate authority to ensure adequate record keeping and archiving by the keeper and curatorial staff.

Findings and Immediate Needs

As with any zoological park it has often been necessary at the National Zoo to review the history of an animal in the collection to help determine a future medical treatment, a change in diet, or to help identify a cause of illness or death. The National Zoo has been handicapped in its efforts to provide adequate animal care by a nonfunctional information management system (see Box 2-1).

Finding 5: *The National Zoological Park lacks a comprehensive information management system for animal husbandry and management records, which results in inconsistent record keeping and practices of alteration in medical records weeks or years after events. While some issues are being addressed (e.g., an electronic keeper log system is in development) these are stop-gap measures often having no concrete timeframe for completion or implementation.*

Immediate Needs: *The National Zoo should implement an information management system that ensures complete documentation of animal husbandry and management and reasonable accessibility to the records by all units and departments. This does not necessarily mean that the entire system needs to be computerized immediately but rather that consistent practices be put in place, that a system be developed to make the records reasonably accessible and that an appropriately experienced individual be given responsibility for system oversight.*

It is essential that the problems outlined within this section be addressed immediately, either through better use of the ARKs system already in place at the National Zoo or through efforts to standardize record keeping and archiving and to make records accessible. Based on the deficiencies in record keeping observed by the committee, when developing and implementing a system, the following performance standards should be established:

- There should be standardized practices for recording and archiving animal husbandry and management information. These practices should outline the information to be contained in each type of record and how and where these records are to be archived.
- Employees should be appropriately trained and prove their competence regarding recording and archiving standards.
- There should be oversight to ensure compliance with recording and archiving standards.
- A communication system should be developed to ensure that all appropriate individuals are notified about significant changes in animal husbandry or management.
- A protocol should be developed to allow for pertinent information related to a specific animal or group of animals to be reasonably accessed by an employee, even if that employee is attached to a different department.

- The information management system should be implemented in such a way that record keeping, archiving, and accessing records is unaffected by staff illness, absence, or turnover.

Records should provide an accurate account of situations and practices relating directly to animal management and health. They should permit reconstruction of events in the recent and distant past and should provide a rational basis for decision making in the present. Records should indicate

- who generated them
- which animals were involved
- when the observation was made or procedure done
- what practices were carried out or problems were encountered
- where events took place
- why actions were taken

There are several ways these performance standards can be achieved. Ideally, a single, comprehensive electronic record-keeping system should be implemented. The National Zoo already uses such a system (the ARKS and MedARKS systems), though it currently uses it only to generate specimen reports for communication with institutions outside the National Zoo. The ARKS system was developed as an electronic information management system to provide a way to organize all information about an animal and make it electronically accessible to keepers, curators, and veterinarians, nutritionists. In addition to the ARKS software, an entire system was developed around this software to describe how a zoo could standardize record keeping and use the ARKS system most efficiently and to the fullest extent. This information is contained in the document "Standards for Data Entry and Maintenance of North American Zoo and Aquarium Animal Records Databases: (Earnhardt et al., 1998).

If the National Zoo were to choose the ARKS system to address the most pressing issues relating to information management, the system would have to be accessible to all appropriate staff within the zoo, including keepers. Data entry would have to occur daily, and be derived directly from keeper reports that are quality checked by the curator. To control the security of the system the data entry and data changes should be limited to the registrar's office (Earnhardt et al., 1998).

The current staffing level of the registrar's office (a recently retired registrar who has not yet been replaced and an assistant registrar) and the lack of appropriate computer equipment and training might preclude these improvements. The National Zoo would also need to devise a system in which pertinent information originating in the veterinary hospital or nutrition department is sent to the registrar's office for daily data entry. The ZIMS system currently being developed by AZA could be an ideal solution for the National Zoo; however, it will be at least two years before this system is available. It is unacceptable for failures in the current information management system to remain unresolved for two or more years; therefore, the National Zoo may choose to make improvements to its current system (mixed paper and electronic). Resolving the failures in the current mixed paper and electronic information management system will require a quick and thorough evaluation of the current system under the direction of an individual versed in implementing and overseeing a successful information management system.

It is essential that a qualified individual be clearly designated to oversee the evaluation of the current system, development and implementation of new practices and standards, and adherence with these new practices and standards. This individual should have the authority and responsibility for achieving these goals. With the recent retirement of the National Zoo's registrar after decades of service to the zoo and significant contributions to the field of animal record keeping (Miller and Block, 1992), the zoo should quickly identify and hire an individual to head the record-keeping functions of the zoo. This person should be qualified in implementing and overseeing a comprehensive information management system.

4

Pest Management

Pests, including insects, rodents, nuisance birds, and certain mammals, are common in zoos because of the ready availability of shelter, food, and water. Control of pests is a critical aspect of preventive medicine at zoological parks (AAZV, 1999). Pests are vectors or reservoirs of disease that can adversely affect zoo animals. Pests can also significantly degrade the aesthetic quality of the park and cause economic loss from damage to stored foods and to physical facilities. Development of a comprehensive program to address a pest control problem, including safe and appropriate pesticide application protocols, generally involves determining the scope and magnitude of the problem(s), identifying appropriate expertise, defining who will do the work, devising a safe and effective plan, implementing the program, continuously evaluating the program, and making program improvements where necessary. Licensed animal facilities are required to maintain a pest management program (Animal Welfare Act; 7 U.S.C. s/s 2131 et seq.).

A successful pest management program combines a thorough knowledge of both the biology of the pests in question and the effects of any proposed control methods on the pests, and on the zoo's animal collection, employees, and visitors (AAZV, 1999). The most successful control programs at zoos use integrated pest management (IPM; Collins and Powell, 1996) as a pest management strategy, wherein natural processes (natural pest mortality factors, pest-predator relationships, genetic resistance) can be manipulated to maximize their effectiveness. Commonly, chemical controls are used only when natural processes of control fail (NRC, 1989b, 1996a) and in a way that minimizes economic, health, and environmental risks. The goal of IPM is to reduce pests to a tolerable level through methods that are least disruptive to the environment.

CONSIDERATIONS FOR INTEGRATED PEST MANAGEMENT AT ZOOS

Key pest management issues at zoos are rat and mice control, insect (primarily cockroach) control, nontarget concerns, and identification of nonchemical alternatives. A zoo poses unique problems because it is necessary to control pests without harming exhibit specimens. Both the primary toxicity of the materials used as well as relay toxicity should be considered (e.g., zoo animals consuming insects and dead rodents contaminated with pesticide). Because of these risks, trapping is preferred over baiting for removal of vertebrate pests, unless there is severe rodent overpopulation (Spelman, 1999). Fogging and fumigation should be strictly controlled, and only certified, experienced applicators should be used. A pest management program should be the responsibility of senior management personnel (limited to a very few people) who are knowledgeable about pest management principles. Each aspect of the program should be reviewed prior to implementation, and chemical storage, inventories, safety procedures, application techniques, and legal aspects (e.g., adherence to Environmental Protection Agency pesticide and state or local rules and requirements for certified applicators, restricted use pesticides, use concentrations) should be fully discussed before the pest management department conducts an application.

Personnel directly responsible for the pest management program should be knowledgeable in all areas of pest management operations and should regularly attend continuing education in professional pest management. The input of management, curator staff, safety department, exhibit personnel, keepers, and the sanitation department is essential for a successful pest management program.

A successful IPM program at a zoo includes several steps to control, reduce, or eliminate pests (Spelman, 1999). These may include inspection, exclusion and habitat management, sanitation, trapping, baiting, repellents, and other methods. As a preventive measure routine inspection of animal facilities may identify a pest problem before developing into an infestation. Physical barriers (e.g., fencing, netting, and roofing) provide a first line of defense against pest infestation (Spelman, 1999). Habitat management is intended to reduce the attractiveness of an animal enclosure to the pest.

Sanitation and proper storage and removal of solid waste (bedding, feed, enrichment items, dirt, and debris) are important steps in pest management (AAZV, 1999). Appropriate food storage bins that are well sealed will reduce potential pest problems. Cleaning and disinfecting food and water containers should occur routinely (AAZV, 1999). Public areas (e.g., walkways, concession areas) should be cleaned regularly, and the public should be discouraged from feeding animals (Spelman, 1999). The Animal Welfare Act (7 U.S.C. s/s 2131 et seq.) contains specific sanitization regulations for certain animals in captivity (e.g., indoor primary enclosures for nonhuman primates must be sanitized at least once every two weeks).

Physical (trapping), chemical (baiting, repellents, and fumigation), and biological controls (predators, contraceptive vaccines, species-specific disease) may need to be used for more severe pest infestations. Trapping of pests reduces the risk of relay and nontarget toxicity that may occur in zoos, and it is preferred except in the cases of severe rodent infestation (Spelman, 1999). Biological controls may be used in very specific situations when carefully monitored (e.g., an oral contraceptive agent [viral vectored immunocontraception] may prove effective for the control of feral rabbits and red fox (Holland and Robinson, 1995) although there is currently no biological control for rodent infestations).

Chemical use should be considered a last resource for pest management because of the aforementioned toxicity concerns; indeed, intoxication from chemical use in zoos has been reported many times. Pesticide use at zoos is a concern because of potential impacts on animal health. At the National Zoo two red pandas died as a result of ingesting aluminum phosphide placed in the animal enclosure to control a rodent infestation (see Box 4-1) (Enquist and Montali, 2003). Second-generation anticoagulant rodenticides have been associated with toxicity and in some circumstances death in several bird species: white-winged wood duck (James et al., 1998); turkey vultures, kookaburra, von der Decken's hornbill, and crested wood partridge (Borst and Counotte, 2002). Additional specific chemical toxicities in wildlife have been reviewed thoroughly (Fowler, 1978; Plumlee, 1997).

PEST MANAGEMENT AT THE NATIONAL ZOO

On January 10, 2003, when two red pandas consumed restricted-use fumigant tablets and later died, pest management was the responsibility of the safety manager. Although a contractor applied the fumigant, the application was carried out under the direction of an onsite zoo employee (a certified pesticide applicator located in the Office of Safety) who manages some pest management programs. At the National Zoo at that time the certified pesticide applicator was responsible for in-house chemical applications and baits targeted for insects, as opposed to large treatments such as rat fumigation. To become a certified pesticide applicator, an individual must complete training and pass an examination administered by the state or local authority that enforces Environmental Protection Agency regulations for pesticides (Federal Insecticide, Fungicide, Rodenticide Act; 7 U.S.C. s/s 136 et seq. as amended). This certification allows the person to purchase and apply restricted-use pesticides and is typically a benchmark for training.

After the red panda deaths the National Zoo transferred responsibility for the Pest Management Program to the Pathology Department. An Integrated Pest Management (IPM) committee has been formed to address the animal and insect pest problem at the zoo. Since February 28, 2003, the IPM committee has conducted routine inspections of the zoo to identify areas that require pest management attention (NZP, Integrated Pest Management Team Review, September 22, 2003). Additionally, the National Zoo began the process of establishing a comprehensive program to address the widespread pest problem (NZP, General Memorandum Draft, September, 2003), including creation of a pesticide program manager position, which was subsequently filled by an entomologist with IPM experience.

BOX 4-1
Lack of Procedures Jeopardizes Animal Welfare: Red Panda (Accession #113194 and #111967) Deaths

Prior to the panda deaths the National Zoo was experiencing a growing rat problem. An outside contractor was hired, but proper procedures were not in place to assure that the contractor was licensed and qualified to perform necessary activities, including application of fumigant. Mothball-size pellets (approximately 3 grams each) of aluminum phosphide were placed by the contractor with long-handled tongs approximately 2 feet deep in the rat holes inside the parapet walls while the pandas were high up in 15-20 foot trees (see photo). During this activity there was an animal attendant present. The pest holes were not all covered completely with steel plates (only eight or nine were covered), and the applicator indicated that only seven burrows were filled with the fumigant (Fumitoxin® tablets - Pestcon Systems, Inc, http://ace.orst.edu/info/extoxnet/pips/alumphos.htm). The fumigant (phosphine gas) is released upon contact with moisture. However, when the animals came down out of the trees they likely ingested some of the pellets; pathology records show that both aluminum and phosphine were detected in the stomach contents of both pandas. According to the pathology report, no signs of digging were noted in the panda yard, and it is unlikely the pandas would be able to dig deeply enough to retrieve and ingest the pellets; the most likely scenario is that the pandas (nocturnal animals) descended from the tree to investigate changes in their environment and, by their curious behavior and investigative nature of tongue-tasting, ingested portions of the pellets remaining in the yard. It is likely that they ingested fragments (product shelf life information suggests that some fragmentation may occur) of pellets that were dropped/spilled during the application on the ground. The pandas were found dead at approximately 9:00 a.m.

An outside contractor (not certified to apply pesticides in Washington, D.C.) had applied pesticide in the panda yard, and there was no material safety data sheet (MSDS) for the pesticide, no formal use plan for the fumigation, no safety policies, no posting of signs, no approval system prior to application, or pesticide use policy. According to product label restrictions for Fumitoxin® tablets: "The use of any pesticide in a manner that may kill or otherwise harm an endangered or threatened animal or adversely modify their habitat is a violation of federal laws." At the time of the investigation, information about the occurrence was scant. In response to this incident, National Zoo management took the following actions:

- Implementation of a procedure to approve the use of all chemicals, including pesticides.
- Transferred responsibility of pesticide use to the Pathology Department.
- Canceled the existing pest control contract.
- Created and filled a new position of Pest Control Manager who reports to the Pathology Department.

Since the red panda deaths, a number of actions have been taken to address issues associated with both vertebrate and insect pests at the zoo (NZP, Integrated Pest Management Team Review, September22, 2003):

- Suspension of fumigation as a primary rat control technique.
- Recovery of numerous poison bait boxes formerly used throughout the Rock Creek Park facility.
- Assessment with recommendations for infrastructural pest exclusion procedures in many of the animal unit facilities.
- Incorporation of trash receptacles with water-shedding covers at secondary holding sites.
- Introduction of animal food containers designed to exclude insects.
- Rat activity assessment and trapping in major harborage sites.
- Major roach reduction in a high-profile exhibit and holding areas with minimal pesticide application.
- Implementation of improved animal food management and feeding times, and redesign of some outside exhibits to reduce vermin attraction.
- Trash management coordination of daily pickup and removal of trash by FONZ and National Zoo personnel during peak visitor activity.
- Mosquito, wasp, and yellow-jacket trapping and control, and elimination of mosquito breeding sites.
- Educational sessions and reports on IPM activities to National Zoo and Smithsonian personnel.

Despite these efforts, housekeeping and site conditions are still poor in numerous areas throughout the zoo, both in public and in nonpublic areas. Unsecured refuse (garbage in bags outside cans) and litter were observed throughout the zoo complex. There is a lack of housekeeping and janitorial staff in public areas. Rodents (rats/mice) were present in animal exhibition areas and were observed crossing public walkways in daylight, which is significant because these pests are generally nocturnal. A Recent USDA inspection (USDA, 2004b) noted numerous

mice were observed inside primate exhibit areas.

STRENGTHS AND WEAKNESSES IN PEST MANAGEMENT AT THE NATIONAL ZOO

Prompt and appropriate actions were taken after the deaths of the red pandas to address contributing factors. These actions included reassignment of pest management responsibilities, cancellation of the existing pest management contract, suspension of rat fumigation programs, formation of an IPM committee and draft of an IPM plan, and creation of a professional pest control manager position (NZP, Integrated Pest Management Team Review, September 22, 2003; NZP, General Memorandum Draft, September, 2003). However, emphasis on pest management should continue to address the existing pest problem fully. Site observations indicate that considerable work is necessary to ensure animal health and the aesthetic quality of the zoo (USDA, 2003). A comprehensive IPM plan for pest management needs to be finalized and should

- establish clear goals and objectives, (e.g., bring current populations of pests down to acceptable levels and maintain those levels using modern IPM techniques incorporating routine management of sanitation, janitoring, trapping, treatment, and inspection.
- incorporate the input of management, curatorial staff, exhibit personnel, sanitation, facilities, and safety personnel.
- be under the leadership and direction of a pest management expert and the auspices of the pest management department (other departments should not be allowed to alter or supplement the program).
- consider consolidating the nutrition department so that food stock is in a central location.
- include continued training, certification maintenance, and professional development for pest control managers.
- involve continuous reassessment and improvement.

Success in pest management has been achieved at other zoos with a comprehensive IPM plan (Collins and Powell, 1996). With the widespread rodent problem the National Zoo may initially need to use chemical controls to reduce rodent populations to levels that can be managed by nonchemical methods. Care should be exercised to select the most suitable products or chemicals to minimize the hazards to nontarget animals. Ensuring that accidental poisoning does not occur in the animal collection is a significant challenge. The Philadelphia Zoo has successfully used hydrogen phosphide pellets and anticoagulants (bromadiolone) to control rat populations, but anticoagulants (particularly brodifacoum) should not be used near bird collections because of its high toxicity (AAZV, 1999). Other zoos have used expertise from the USDA-APHIS Wildlife Service Program for pest management.

Findings and Immediate Needs

Finding 6: *Even though the pest management program has been reorganized and is showing signs of improvement, pest management remains inadequate and poses a potential threat to the animal collection, employees, and visitors to the National Zoo.*

Immediate Needs: *A comprehensive IPM plan should be developed: (1) in the short term to bring current populations of pests down to acceptable levels and (2) in the long term to maintain those levels using modern IPM techniques.*

5

Mission and Strategic Planning

Strategic planning is essential to the success of any organization–large or small, public or private, for profit or nonprofit. Rather than being reactive to emergencies, strategic planning is proactive and is based upon decisions about the future of an organization (Steiner et al., 1994). Specific internal (e.g., change in leadership, high turnover, loss of focus, crisis) and external (e.g., competing organizations, changing accreditation, societal changes) indicators can increase the urgency for strategic planning (Steiner et al., 1994). There should be a firm commitment within an organization to completion of a strategic plan.

Many different models for strategic planning exist for nonprofit, for-profit, and governmental strategic planning (Bryson, 1988; Crittenden and Crittenden, 1997; Godet, 2000; Gummer, 1997; McNamara, 2003; Steiner et al., 1994). In one model a strategic planning process can involve six steps (McNamara, 2003): (1) assessing the current status of an organization (where we are); (2) identifying resources (human, physical, and capital) that are available to the organization (what we have to work with); (3) envisioning the future status of an organization (where we want to be); (4) formulating a process to position the organization into the future (how we get there); (5) monitoring and evaluating the strategic plan (have we implemented the strategic plan); and (6) revising the strategic plan (is the strategic plan still appropriate).

The act of creating a strategic plan facilitates organizational performance through several mechanisms: (1) It forces an organization to identify its internal strengths and weaknesses and its external opportunities and threats (SWOT analysis). This information is then used to formulate a strategy that enables the organization to capitalize on strengths and opportunities and to neutralize weaknesses or threats (Gibis et al., 2001). An organization's strategy answers the basic question of "how we will compete and be successful." (2) The strategic plan, when adequately communicated to organizational members, provides a framework for guiding and evaluating individual-, unit-, and organizational-level actions and behaviors, decision making, and planning. In other words, the strategic planning process not only identifies the organizational goals and mission but also specifies how those goals will be achieved, and what the objective, quantifiable indicators of progress and success will be (McNamara, 2003).

Strategic planning can be performed by an internal facilitator or by an external facilitator (or consultant). The use of an external facilitator may be advantageous for several reasons (McNamara, 2003). Nonprofit organizations which use a formal approach to strategic planning may have higher levels of social and financial performance than those with more informal procedures (Siciliano, 1997). Within an organization, the appropriate expertise to conduct a strategic planning process may not exist. An internal facilitator could either inhibit participation from others or may not have the opportunity to participate in planning fully. An external facilitator will likely not have strong preconceived ideas about the organization's strategic issues and ideas.

A broad range of participants (a planning team) is needed for a successful strategic planning process. The planning team should include the organization's director and, if applicable, board chair to drive development and implementation of the strategic plan (McNamara, 2003). Staff at various levels in the organization should be part of the process. Information flow throughout the organization's hierarchy is essential to obtain contributions to the

strategic planning process (Crittenden and Crittenden, 1997). Stakeholders (e.g., funders, trade associations, potential collaborators, vendors and suppliers, consumers, volunteers.) should be included to ensure that the needs of the organizations clientele are considered in the strategic plan. Volunteers particularly focus their attention on organizations that have a formal decision-making process (Crittenden and Crittenden, 1997).

A strategic plan has no value if it is not implemented, evaluated, and updated. A strategic plan should be clearly communicated at all levels within an organization before it can be fully implemented. An implementation strategy will ensure that goals and objectives set forth by management can be achieved by staff with quantifiable results (Bonoma and Clark, 1990). Allocation of responsibilities to specific members through detailed action plans are necessary elements (Crittenden and Crittenden, 1997). A strategic plan should specify who is responsible for overall implementation and should assign responsibility for achieving each goal and objective to individual staff members. Finally, a strategic plan should not be a static document; it will need to be revised in response to changing internalities and external circumstances.

In a broader context, contemporary zoos are guided by five basic principles that should be considered in a strategic plan: conservation, education, science (research), entertainment, and animal welfare (Maple, 2003). At zoos conservation goals may be inconsistent with animal welfare concerns (Cohn, 1992). Because captive animals live longer (due to improved medical care and animal husbandry, and improvements in facilities and social grouping), additional consideration should be given to the care and management of geriatric animals (Maple, 2003). As part of its accreditation process the American Zoo and Aquarium Association (2003c) requires a strategic plan for zoos. Specific elements of the strategic planning process for a zoo should include (adapted from Pensacola Junior College, 2004):

- defining the mission
- describing its organization
- outlining its vision for the future
- identifying focus areas
- detailing primary strategies to address the main issues
- setting goals and implementation strategies
- stating specific expected results in support of the goals
- performance measures

Measuring performance is critical to evaluating the success or failure of goals and objectives outlined in the strategic plan. The Perth (Australia) Zoo measures annual performance by effectiveness and efficiency indicators in three areas (Perth Zoo, 2003): (1) wildlife conservation, (2) customer awareness of conservation, and (3) customer service. A performance audit for the Philadelphia Zoo (City of Philadelphia, 1997) identified strengths, opportunities, and recommendations. In 2000 the Oregon Zoo (Metro, 2000) performance measures were evaluated by comparisons with other zoos. Other zoos have used a variety of objective, performance, and activity measures (Auckland Regional Council, 2003; City of Topeka, 2003; Woodland Park Zoological Society, 2003).

STRATEGIC PLANNING AT THE NATIONAL ZOO

The National Zoo has defined its mission as exhibiting and protecting biodiversity by joining public education and recreation with research in conservation biology and reproductive sciences (NZP, History, 2003). The mission articulates a goal to be a world-leading institution.

> The mission of the National Zoological Park (NZP) is to celebrate, study, and protect the diversity of animals and their habitats. The NZP exhibits living animal and plant collections, conducts research in conservation biology and reproductive sciences, and provides educational and recreational environments for the visiting public (Smithsonian Institution, 2004).

The National Zoo currently operates without a strategic plan that incorporates all elements of the National Zoo, and it has not recently performed a SWOT (strength, weaknesses, opportunities, and threats) analysis (NZP, October 16, 2003). The 1992 accreditation report (AZA, 1992) also indicated the lack of a strategic plan. The National Zoo was scheduled to begin a strategic planning process in October 2003 as part of a Smithsonian-wide

program (NZP Submission, October 16, 2003). The zoo does have an animal collections plan and a 10-year facility revitalization plan.

STRENGTHS AND WEAKNESSES IN STRATEGIC PLANNING AT THE NATIONAL ZOO

The National Zoo currently does not possess a strategic plan; a strategic planning process was recently initiated within the National Zoo as part of a Smithsonian-wide program (NZP Submission, October 16, 2003). This process is a positive step forward, because strategic planning is a critical and immediate need for the National Zoo. It should proceed as quickly as possible and incorporate both the animal collections plan and the 10-year facility revitalization plan, while the critical areas of needed repairs to the physical plant are under way. The strategic plan should also consider the five basic principles to which contemporary zoos are dedicated: conservation, education, science (research), entertainment, and animal welfare (Maple, 2003). This process is being facilitated by a person external to the National Zoo and the Smithsonian Institution. By having an external facilitator strong conceptions about the National Zoo's strategic issues and ideas can be avoided. The strategic plan is anticipated to be approved by the National Zoo and the Smithsonian Institution in April 2004, with implementation beginning in May 2004 (NZP, Strategic Planning Timeline, January 8, 2004).

The strategic planning process for the National Zoo has representation from a variety of internal stakeholders (NZP, Draft NZP Strategic Planning Roles, January 9, 2004). Leadership from the National Zoo and the Smithsonian Institution is critical to the success of the strategic planning process. Staff from all levels within the zoo is represented during the planning process, along with various internal stakeholder groups (e.g., NZP Advisory Board, CRC Foundation, Science Advisory Group, FONZ Board.) (NZP, Draft NZP Strategic Planning Roles, January 9, 2004). Although external stakeholders (e.g., USDA-APHIS, Congress, Fish and Wildlife Service, AZA, the public) are not directly represented in the strategic planning process (NZP, Draft NZP Strategic Planning Roles, January 9, 2004), they had an opportunity to participate through several stakeholder sessions held in February (NZP, Smithsonian's National Zoological Park Strategic Planning, 2003-2004, January 7, 2004). The strategic planning process would be strengthened by having direct representation from some of those external stakeholder groups in addition to the stakeholder sessions already held. One issue the National Zoo will need to address during the strategic planning process involves evaluating and identifying its mission and goals. One challenge for the National Zoo as part of the Smithsonian Institution is to maintain alignment with the Smithsonian Institution's mission while identifying and implementing a strategy that will enable its independent success. In addition, the National Zoo needs to decide whether it will position itself as a metropolitan zoo or as the nation's zoo. The decision should be driven by a pragmatic evaluation of the National Zoo's internal strengths and weaknesses (SWOT analysis) in areas such as human resources, facilities, animal collection, and funding. It should also be driven by an evaluation of the external marketplace, including an assessment of current and potential competition. Competition for the National Zoo consists not only of other zoos but also of other organizations that may compete with the National Zoo for visitors and private and public funding. Most successful zoos have established a niche or brand that enables them to attract visitors, secure financial resources, and generate national recognition. The National Zoo needs to identify what its niche should be.

After identifying its generic mission the National Zoo will need to develop clear and specific strategies and action plans that outline how the mission will be achieved. Key to successful implementation of the new strategy will be effective use of organizational resources. Some strategic initiatives may require additional resources. For example, as the National Zoo expands and revitalizes the animal collection, it will be important to plan for the additional needs these changes will create in facilities and staffing.

More important than acquiring additional resources will be generating a plan that ensures maximum use of current resources. For example, decisions regarding facilities repair and maintenance should consider the role of different facilities in the strategic plan. Current and proposed projects should also be evaluated in relation to their fit with the strategy. For example, it will be important to think about how current projects such as the Asia Trail and Farm can be aligned with the new mission or how current or future research will relate to conservation objectives. Similarly, it will be important to consider how to best leverage FONZ to help the zoo achieve its new strategies. FONZ members may possess unique skills or abilities that the National Zoo can tap to help implement its strategies.

The National Zoo will need to engage in strategic resource planning (i.e., human, facilities, funding) to support the mission. In the past the capability of the National Zoo to engage in resource planning has been somewhat limited because many resource decisions were made at the Smithsonian level. For example, the Smithsonian is currently conducting staff reductions (i.e., buyouts) across all its units, including the National Zoo. This practice not only raises concerns about the extent to which the National Zoo will lose valuable personnel and

expertise but also severely limits the capability of the National Zoo to make strategic staffing decisions. Moreover, the National Zoo has not been informed by the Smithsonian of the employees that are eligible for buyout, which has prevented planning for loss of staff and expertise. Overall, effective use of organizational resources will be critical to successful implementation of the National Zoo's strategic plan.

Findings and Immediate Needs

Finding 7: *The National Zoo is operating without a strategic plan, which jeopardizes its long-term operations and focused use of the zoo's resources. An integrated plan for the entire institution incorporating the 10-year facility revitalization and animal collections plans has not been developed.*

Immediate Needs: *The National Zoo should develop a comprehensive strategic plan and provide integrated goals for all aspects of the institution, with operational goals and performance measures, as soon as possible.*

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Accession #108412, Barbary lion
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Accession #111062, Singing dog
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Accession #113184, Sumatran tiger
Accession #113376, White-fronted marmoset
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Accession #111277, Tamarin
Accession #112790, Tamarin
Accession #113319, Tamarin
Accession #113392, Grevy's Zebra
Accession #113417, Grevy's Zebra
Accession #113453, Tamarin

Accession #113454, Tamarin
Accession #113482, Tamarin
Accession #113483, Tamarin
Accession #113529, Tamarin
Accession #113530, Tamarin
Accession #113550, Tamarin
Accession #113551, Tamarin
Accession #113569, Tamarin
Accession #113570, Tamarin
Accession #113614, Tamarin
Accession #113670, Tamarin
Accession #113682, Lemur
Accession #113683, Lemur
Accession #113684, Lemur
Accession #113685, Lemur
Accession #113686, Lemur
Accession #113687, Lemur
Accession #113688, Lemur
Accession #113689, Lemur
Accession #113804, Tamarin
Accession #113805, Grevy's Zebra
Accession #113806, Tamarin
Accession #113807, Tamarin
Accession #113808, Tamarin

Procedures, General Memorandums, Position Descriptions
Animal Records Procedures: Statement of Practice, 2003.
Best Practices, 2003.
Department of Animal Health Procedures – Hospitalized Animal Procedures, 2003.
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Department of Animal Programs – Best Practices, 2003.
Department of Animal Programs – Best Practices, Primary Keeper Responsibilities; Position Description – Animal Keeper
Department of Pathology– Best Practices, 2003.
General Memoranda (listed in Appendix A
NZP General Memoranda, August 8, 2003
General Memorandum Draft, September, 2003
Position Description – Associate Curator
Position Description – General Curator
Position Description – Supervisory Biologist
Preventative Medicine Program, 1998
Preventative Medicine Program, 2003.

Organizational Charts and Staffing Information
Animal Programs Organization Chart, November 20, 2003
CRC Organizational Chart, November 20, 2003
National Zoological Park Department of Animal Health Organizational Chart, February 11, 2004
National Zoological Park Department of Pathology Organizational Chart, February 11, 2004
National Zoological Park Organizational Structure November 20, 2003
National Zoological Park Staff Gains and Losses FY 1993-2000, submitted September 24, 2003
National Zoological Park Work Years, submitted September 24, 2003.

Strategic Planning
Draft NZP Strategic Planning Roles, January 9, 2004
Smithsonian's National Zoological Park Strategic Planning, 2003-2004, January 7, 2004
Strategic Planning Timeline, January 8, 2004

Commissary/Nutrition
Commissary Review of National Zoological Park, May 14-15, 1992
Nutrition and Commissary Operating Protocols, September 2003
Proposed Plan to Develop a Centralized Commissary, October 16, 2003

Pest Management
NZP Integrated Pest Management Team Review, September 22, 2003

Other
Budgets 1993-2004 est., submitted September 24, 2003
Fact Sheet—Elephants at the National Zoo, December 2003
History, Available on-line at http://nationalzoo.si.edu/AboutUs/History/ [December 2003].
IACUC Winter Inspection of Beaver Valley, April 19, 2000
IACUC Inspection of Elephant House and Beaver Valley, May, 2001
Press Room. 2003. Leptospirosis Found in National Zoo Monkey. Available on-line at http://nationalzoo.si.edu/Publications/PressMaterials/StateoftheZoo/lepto.cfm [February 2004].
IACUC Annual Report, Rock Creek facility, 2001
IACUC Annual Report, Rock Creek facility, 2002
Status of the Collection Reports, 1993-2002.
Submission, September 24, 2003
Submission, October 16, 2003
Letter to the Committee, December 31, 2003

APPENDIX A

National Zoological Park General Memoranda

GMs 0-99 -- General

GM No. 1	General Memoranda April 1, 2003 (Reissued)
GM No. 2	Mission, Goal, People, and Organization April 1, 2003 (Revised)
GM No. 3	Standards of Conduct April 1, 2003 (Revised)
GM No. 4	Relationship Between the Smithsonian's National Zoological Park and Friends of the National Zoo April 1, 2003 (Revised)
GM No. 5	Wearing of Identification Badges (IDs) April 1, 2003 (New)
GM No. 6	Electronic Mail (Email) Usage April 1, 2003 (New)
GM No. 7	Animal Escape Protocol April 1, 2003 (Revised)
GM No. 8	Weekend and Holiday Duty Officers for Senior Management and Curatorial Staffs April 1, 2003 (New)
GM No. 11	Uniforms and Safety Shoes April 1, 2003 (Revised)
GM No. 12	Animal Environmental and Life Support System Emergency Contact List April 1, 2003 (New)
GM No. 13	Performance Management and Awards July 15, 2003 (New)
GM No. 14	Recycling Plan April 1, 2003 (New)
GM No. 15	Institutional Care and Use Committee (IACUC) April 1, 2003 (New)
GM No. 16	Media Contact and Access Plan April 1, 2003 (New)
GM No. 17	Crisis Communications Plan June 25, 2003 (New)

GMs 100-199 -- Safety and Security

GM No. 100	Safety Program

April 1, 2003 (Revised)

GM No. 105 Occupational Injury and Illness Responsibilities and Procedures
April 1, 2003 (Revised)

GM No. 110 Emergency (Contingency) Self-Protection Plan
April 1, 2003 (Revised)

GM No. 115 Security Key, Lock and Access Control
April 1, 2003 (Revised)

GM No. 120 Energy (Electrical) Conservation and Emergency Procedures in the Case of Partial Power Loss
April 1, 2003 (Reissued)

GM No. 125 Hazard Communication Program
April 1, 2003 (Reissued)

GM No. 130 Chemical Hygiene Plan
April 1, 2003 (Reissued)

GM No. 135 Lead Abatement Program
April 1, 2003 (Revised)

GM No. 140 Asbestos Management Program
April 1, 2003 (Reissued)

GM No. 145 Motor Vehicle Operations
April 1, 2003 (Revised)

GM No. 155 Visitor Safety Near Exhibits
April 1, 2003 (New)

GM No. 160 Screening of Mail and Packages
April 1, 2003 (New)

GMs 200 - 299 -- Administrative/Human Resources/Travel/Purchasing/ Budget

GM No. 200 Parking in Areas Reserved for Official Business
April 1, 2003 (Reissued)

GM No. 205 Emergency Dismissal or Closure Due to Adverse Weather Conditions or Other Emergency Situations
April 1, 2003 (Reissued)

GM No. 210 Official Travel
April 1, 2003 (Revised)

GM No. 215 Timekeeping and Paid Time Off
April 1, 2003 (Revised)

GM No. 220 Purchasing Supplies and Contracted Services
April 1, 2003 (Revised)

GM No. 225 Management Responsibilities Outside Normal Working Hours
April 1, 2003 (Revised)

GM No. 230 Professional Accomplishments Evaluation Committees (PAEC)

April 1, 2003 (Revised)

GM No. 235 Non-Employee Associates
April 1, 2003 (Revised)

GM No. 240 Employee Vehicle Identification Stickers
April 1, 2003 (Reissued)

GM No. 245 Grants, Awards and Other Non-Appropriated or Interagency Funds or Personnel
July 1, 2003 (Revised)

GM No. 250 Processing Personnel Actions for Federal Recruitments
April 1, 2003 (New)

GMs 300 - 399 -- Facilities/Motor Pool/Landscape

GM No. 300 Motor Vehicle Operations
April 1, 2003 (Revised)

GM No. 305 Stock Requisitions
April 1, 2003 (Reissued)

GM No. 310 Requisitions for Supplies and Services
April 1, 2003 (Revised)

GM No. 320 Landscape Management
April 1, 2003 (Revised)

GM No. 325 Access for the Disabled
April 1, 2003 (Revised)

GM No. 330 Review of Physical Plant Construction and Improvement Projects
April 1, 2003 (Revised)

GM No. 335 Snow Removal Plan
April 1, 2003 (Reissued)

GM No. 340 Waste Management Plan
April 1, 2003 (New)

GMs 400 - 499 -- Information Technology

GM No. 400 Information Technology Resources and Support
April 1, 2003 (Revised)

GMs 500 -599 -- Animal Programs

GM No. 500 Health Program for Employees Exposed to Animals
April 1, 2003 (Revised)

GM No. 505 Snakebite Antivenin for Use Outside the Smithsonian's National Zoological Park
April 1, 2003 (Revised)

GM No. 506 Snakebite and Antivenin Use Inside the Smithsonian's National Zoological Park
April 1, 2003 (Revised)

GM No. 511 Animal Escape Protocol at the Smithsonian's National Zoological Park's Conservation and

Research Center (Front Royal)
April 1, 2003

GM No. 515 — Provision of Facilities and Assignment of Dwelling at the Front Royal, Virginia Conservation and Research Center of the Smithsonian's National Zoological Park
April 1, 2003 (Revised)

GM No. 520 — Animal Products
April 1, 2003 Revised)

GM No. 525 — Service Animals for Persons with Disabilities
April 1, 2003 (Revised)

GM No. 530 — Stray and Injured Animals on the Grounds
April 1, 2003 (New)

GM No. 535 — Collections
April 1, 2003 (New)

GM No. 540 — "Behind-the-Scenes" Tours
April 1, 2003 (New)

GMs 600 - 699 -- Fund-raising/Revenue Opportunities

GM No. 600 — Special Events
April 1, 2003 (Revised)

GM No. 605 — Naming Animals
April 1, 2003 (Revised)

GM No. 606 — Naming Areas
April 1, 2003 (Revised)

NZP Procedures and Practices

Guidelines and Procedures for Use of NZP Animals in Education Programs and Presentations
(no date indicated)

NZP Webcam Views (Interim)
(no date indicated)

Work Requests for Routine Maintenance and Small Animal Program Jobs
(no date indicated)

SD's and Other Policies

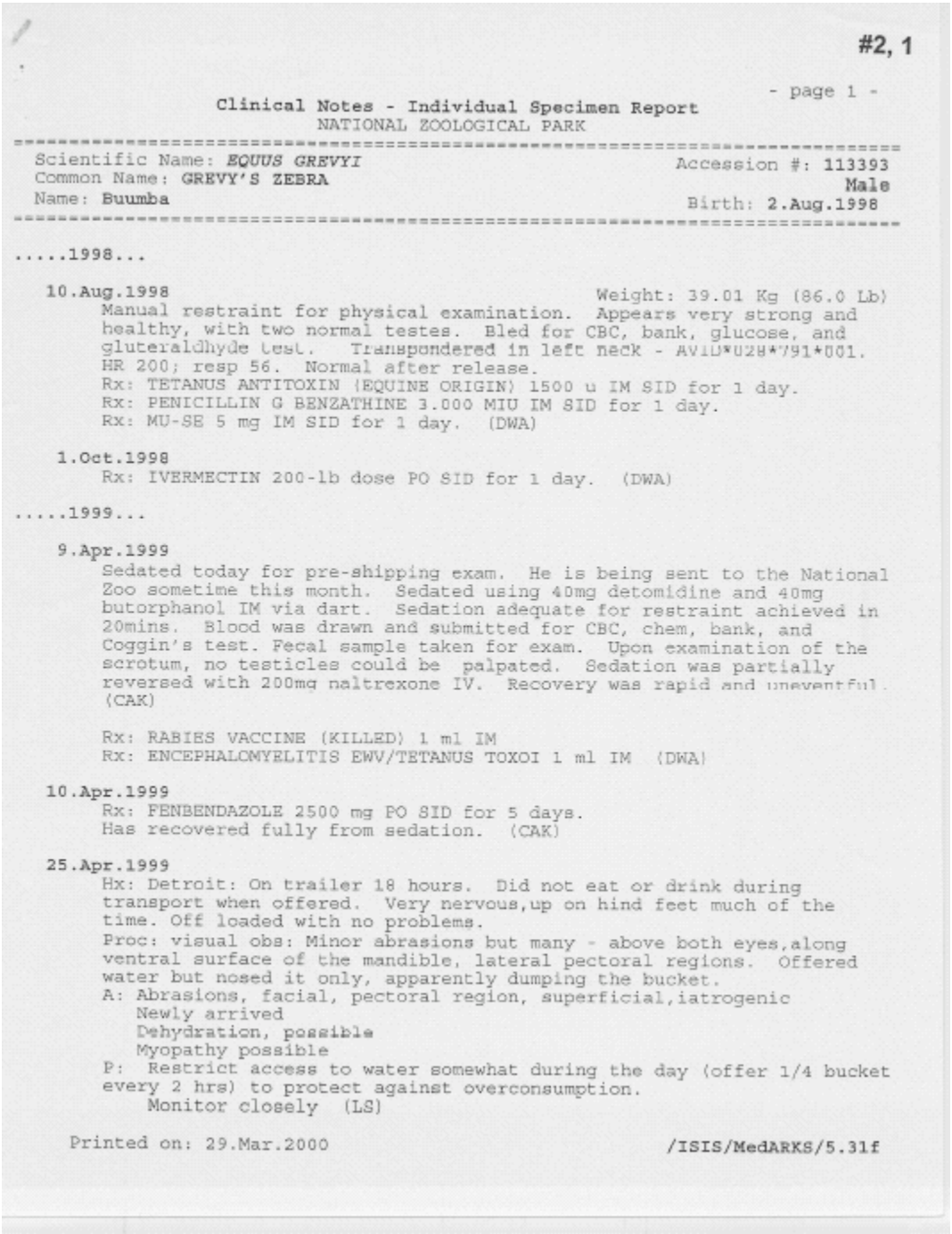
Smithsonian Standards of Conduct
(no date indicated)

Centrally Managed Award Programs and Federal Pools

Source (NZP, August 8, 2003)

APPENDIX B

Clinical Notes Summary Report
MedARKS Medical Record for Grevy's Zebra "Buumba" (Accession #113393)
Source: Smithsonian Inspector General



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Clinical Notes - Individual Specimen Report
NATIONAL ZOOLOGICAL PARK

Scientific Name: *EQUUS GREVYI* Accession #: 113393
Common Name: GREVY'S ZEBRA Male
Name: Buumba Birth: 2.Aug.1998

.....1998...

10.Aug.1998 Weight: 39.01 Kg (86.0 Lb)
Manual restraint for physical examination. Appears very strong and healthy, with two normal testes. Bled for CBC, bank, glucose, and gluteraldhyde test. Transpondered in left neck - AVID*028*791*001. HR 200; resp 56. Normal after release.
Rx: TETANUS ANTITOXIN (EQUINE ORIGIN) 1500 u IM SID for 1 day.
Rx: PENICILLIN G BENZATHINE 3.000 MIU IM SID for 1 day.
Rx: MU-SE 5 mg IM SID for 1 day. (DWA)

1.Oct.1998
Rx: IVERMECTIN 200-lb dose PO SID for 1 day. (DWA)

.....1999...

9.Apr.1999
Sedated today for pre-shipping exam. He is being sent to the National Zoo sometime this month. Sedated using 40mg detomidine and 40mg butorphanol IM via dart. Sedation adequate for restraint achieved in 20mins. Blood was drawn and submitted for CBC, chem, bank, and Coggin's test. Fecal sample taken for exam. Upon examination of the scrotum, no testicles could be palpated. Sedation was partially reversed with 200mg naltrexone IV. Recovery was rapid and uneventful. (CAK)

Rx: RABIES VACCINE (KILLED) 1 ml IM
Rx: ENCEPHALOMYELITIS EWV/TETANUS TOXOI 1 ml IM (DWA)

10.Apr.1999
Rx: FENBENDAZOLE 2500 mg PO SID for 5 days.
Has recovered fully from sedation. (CAK)

25.Apr.1999
Hx: Detroit: On trailer 18 hours. Did not eat or drink during transport when offered. Very nervous,up on hind feet much of the time. Off loaded with no problems.
Proc: visual obs: Minor abrasions but many - above both eyes,along ventral surface of the mandible, lateral pectoral regions. Offered water but nosed it only, apparently dumping the bucket.
A: Abrasions, facial, pectoral region, superficial,iatrogenic
Newly arrived
Dehydration, possible
Myopathy possible
P: Restrict access to water somewhat during the day (offer 1/4 bucket every 2 hrs) to protect against overconsumption.
Monitor closely (LS)

Printed on: 29.Mar.2000 /ISIS/MedARKS/5.31f

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Clinical Notes - Individual Specimen Report
NATIONAL ZOOLOGICAL PARK

Scientific Name: ***EQUUS GREVYI*** Accession #: **113393**
Common Name: **GREVY'S ZEBRA** **Male**
Name: **Buumba** Birth: **2.Aug.1998**

26.Apr.1999
Hx: Doing well, ad lib access to water today.
Proc: visual obs: all skin wounds appear dry, mild LH lameness but other wise calm and well adjusted.
A: Lameness, mild, LH
r/o transport injury soft tissue
P: Monitor lameness (LS)

27.Apr.1999
Hx: Abrasions over eyes healing well. Active and eating well (LS)

30.Apr.1999
Hx: All abrasions healing, but fresh abrasions both hocks.
Proc: visual obs: Superficial new abrasions over caudal aspect of both hocks (from lying down on cement?)
A: Abrasions, minor,hocks
r/o rough substrate
P: Switch to rubber pads and shavings and spot cleaning (LS)

3.May.1999
Hx: Hocks healing well, lies down on pads/shavings (LS)

11.May.1999
Rx: PYRANTEL PASTE (STRONGID T) 1320 mg PO SID for 1 dose. (LS)

12.May.1999
Hx: Abbreviated quarantine complete. Released to HH today. Fecals have been negative
Proc: visual obs: all abrasions healing well, slightly overweight with a very round abdomen
P: Begin routine deworming 3x/yr: fbz, ivermectin, pyrantel
Advised HH staff to use caution when transitioning onto new grass in new exhibit (LS)

17.May.1999
Hx: Keepers report distended abdomen, but eating well
Proc: visual exam: eating hay, all plant material closely cropped in the holding yard, normal stools. Abdomen is full, but no signs of abdominal discomfort. Being fed 2 flakes of hay and two pounds of "low pro" pellets twice a day. Exhibit has lush grass (zebras not yet given access)
A: Abdominal distension, mild
r/o overfeeding vs mild colic
At risk for laminitis, colic on new grass
P: Discuss diet - consider reducing hay, possibly also pellets, limiting access to grass once introduced to exhibit (LS)

Printed on: 29.Mar.2000 /ISIS/MedARKS/5.31f

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Clinical Notes - Individual Specimen Report
NATIONAL ZOOLOGICAL PARK

Scientific Name: ***EQUUS GREVYI*** Accession #: **113393**
Common Name: **GREVY'S ZEBRA** **Male**
Name: **Buumba** Birth: **2.Aug.1998**

27.May.1999
Hx: Keeper (D. Davis) reports that zebra has been lame on the right front leg for 1-2 days duration. Lameness worse in the afternoon.
Procedure: Visual exam (AM): Zebra is moderately lame on the RF. There is no swelling of the coronary band, fetlock, or carpus. There were no hoof wall or sole abnormalities noted. Tends to point toe as if pain is in the caudal solar region. Ground in enclosure has a lot of gravel that varies in size. Grass in enclosure still plentiful
A: Lame, RF
r/o sole bruise, abscess, laminitis (but not bilateral)
P: Monitor lameness
If lameness static or slight improvement, sole bruise more likely
Consider analgesic/antiinflammatory - phenybutazone (LS)

2.Jun.1999
Hx: Keepers report that lameness on RF has resolved. Eating and acting normal.
A: Lame, RF, resolved
r/o sole bruise
P: No further concern at this time (LS)

3.Jun.1999
Hx: Keepers fed hay this morning then let zebras out into new exhibit with lush grass. Brought back in 20 minutes later by encouraging them with apples and some pellets.
A: Continue gradual adjustment to pasture
At risk for laminitis, colic
P: Continue to allow out onto exhibit grass for gradually increasing periods of time.
Monitor for any developing signs of laminitis or colic. (LS)

.....2000...

1.Feb.2000
Hx: Curator reports animal thin, left portion of food from last PM, drinking and defecating small amounts. Late afternoon, Keeper reports animal down in stall, unable to stand despite multiple efforts.
Proc:
1. Visual exam (early afternoon): animal eating weakly, walking with stiff, upright rear gait. Small muscle mass of chest and hindquarters. Ears drooping.
A: Wt loss, severe
r/o hyponutrition due to behavior vs dental or other
Weakness
r/o neurologic, metabolic

Printed on: 29.Mar.2000 /ISIS/MedARKS/5.31f

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Clinical Notes - Individual Specimen Report
NATIONAL ZOOLOGICAL PARK

Scientific Name: ***EQUUS GREVYI*** Accession #: **113393**
Common Name: **GREVY'S ZEBRA** **Male**
Name: **Buumba** Birth: **2.Aug.1998**

1.Feb.2000

Poor anesthetic risk
P: Exam ASAP
Given time of day and cold ambient temps, plan for first thing tomorrow
Increase food offered to test appetite
Recommend separating from other zebras o/n to monitor food intake and stool/urine output, and maintain body temp
Keepers concerned about stress to zebras if separated in stalls o/n as they have not been regularly locked in at night

Comment: discussed hiearchy among the 3 zebras. This individual is apparently the dominant of the 3 so lack of access to feed seems unlikely.
Also reviewed parasitology screening - no parasites seen in this group. (LHS)

Hx: 1400: Keepers report zebra down in stall
A: Recumbent
r/o weakness, neurologic, hypothermia
Prognosis poor
P: Exam now

Proc (LHS and RAY):
1. Sedation: Detomidine 10 mg (est 50 mcg/Kg) and butorphanol 10 mg (est 50 mcg/Kg) IM via pole syringe in left tricep. Animal sedated and able to be blindfolded at 9 minutes. Some movement in lateral recumbency, supplemented with butorphanol 5 mg and detomidine 5 mg IV at 20 min. Some muscle twitching and rear limb stiffness, supplemented with midazolam 2 ml (10 mg) IV at 22 min with good effect.
HR 32 (15 min) and 36 (58 min)
RR 16 at 15 min
SPO2 93%
Reversed with yohimbine 25 mg (12.5 mg IV, 12.5 mg SQ) at 61 min and Naltrexone 100 mg IM at 80 min. with slight effect. Nystagmus present for several minutes, unable to stand but made attempts at last observation.

Keepers called as instructed 1 hr and 2 hr later: described zebra as more calm and more alert but still recumbent.

2. PEx: Hypothermic (93.1).
M/S: Thin with decreased muscle mass of shoulder girdle, chest and pelvis. EENT: Hydration appears OK, no sign of dental trauma or infection; mucous membrane color pink

Printed on: 29.Mar.2000 /ISIS/MedARKS/5.31f

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Clinical Notes - Individual Specimen Report
NATIONAL ZOOLOGICAL PARK

Scientific Name: ***EQUUS GREVYI*** Accession #: **113393**
Common Name: **GREVY'S ZEBRA** **Male**
Name: **Buumba** Birth: **2.Aug.1998**

1.Feb.2000
H/L: ausculs normally
ABD: very reduced gut sounds
3. Blood sample: STAT EDTA and clot tube
4: IV catheter: 16 ga 2 inch, right jugular vein
5.SPO2 recorded using Nellcor symphony w/ probe on the tongue
6. Bed stall with hay
7. Turn on heater in stall
Rx: LRS 4 l IV (warmed)
Rx: B vitamins 5 ml IV (in 1 l LRS)
Rx: PPG 15 ml IM R caudal thigh
Rx: Naxcel 4 g IV
Rx: Banamine 4 ml (200 mg) IM R caudal thigh
Rx: Dexamethasone 12 ml IV

Obs: Initial labwork nondiagnostic; CPK elevated as expected

A: Hypothermia
r/o exposure, lack of sc fat stores associated with metabolic dz
Underweight, severe
r/o hyponutrition vs metabolic disease
Recumbent
r/o neurologic vs weakness
Poor prognosis

P: Monitor for next hour +
Keep as warm as possible: curator to secure a spare heater for this stall to supplement wall panel
Recheck AM
Increase diet
Consider WEE and EEE titers, rabies
Repeat fecal for parasite screen (RAY)

2.Feb.2000
Hx: found dead in stall this am
Proc: visual exam: stall is cold; no supplemental heater is present and wall panel is barely putting out heat. Evidence that zebra struggled somewhat as hay is displaced and animal is facing the opposite direction. (LHS)

Printed on: 29.Mar.2000 /ISIS/MedARKS/5.31f

APPENDIX C

Clinical Notes Summary Report
MedARKS Medical Record for Grevy's Zebra "Buumba" (Accession #113393)
Source: Dr. Don Nichols

Clinical Notes - Individual Specimen Report
NATIONAL ZOOLOGICAL PARK

Scientific Name: ***EQUUS GREVYI*** Accession #: **113393**
Common Name: **GREVY'S ZEBRA** **Male**
Name: **Buumba** Birth: **2.Aug.1998**

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10.Aug.1998 Weight: 39.01 Kg (86.0 Lb)
Manual restraint for physical examination. Appears very strong and healthy, with two normal testes. Bled for CBC, bank, glucose, and gluteraldhyde test. Transpondered in left neck - AVID*028*791*001. HR 200; resp 56. Normal after release.
Rx: TETANUS ANTITOXIN (EQUINE ORIGIN) 1500 u IM SID for 1 day.
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Rx: MU-SE 5 mg IM SID for 1 day. (DWA)

1.Oct.1998
Rx: IVERMECTIN 200-lb dose PO SID for 1 day. (DWA)

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9.Apr.1999
Sedated today for pre-shipping exam. He is being sent to the National Zoo sometime this month. Sedated using 40mg detomidine and 40mg butorphanol IM via dart. Sedation adequate for restraint achieved in 20mins. Blood was drawn and submitted for CBC, chem, bank, and Coggin's test. Fecal sample taken for exam. Upon examination of the scrotum, no testicles could be palpated. Sedation was partially reversed with 200mg naltrexone IV. Recovery was rapid and uneventful. (CAK)

Rx: RABIES VACCINE (KILLED) 1 ml IM
Rx: ENCEPHALOMYELITIS EWV/TETANUS TOXOI 1 ml IM (DWA)

10.Apr.1999
Rx: FENBENDAZOLE 2500 mg PO SID for 5 days.
Has recovered fully from sedation. (CAK)

25.Apr.1999
Hx: Detroit: On trailer 18 hours. Did not eat or drink during transport when offered. Very nervous,up on hind feet much of the time. Off loaded with no problems.
Proc: Visual obs: Minor abrasions but many - above both eyes,along ventral surface of the mandible, lateral pectoral regions. Offered water but nosed it only, apparently dumping the bucket.
A: Abrasions, facial, pectoral region, superficial,iatrogenic
Newly arrived
Dehydration, possible
Myopathy possible
P: Restrict access to water somewhat during the day (offer 1/4 bucket every 2 hrs) to protect against overconsumption.
Monitor closely (LS)

Printed on: 30.May.2002 **/ISIS/MedARKS/5.31g**

IAI

- page 2 -

Clinical Notes - Individual Specimen Report
NATIONAL ZOOLOGICAL PARK

Scientific Name: ***EQUUS GREVYI*** Accession #: **113393**
Common Name: **GREVY'S ZEBRA** **Male**
Name: **Buumba** Birth: **2.Aug.1998**

26.Apr.1999
Hx: Doing well, ad lib access to water today.
Proc: visual obs: all skin wounds appear dry, mild LH lameness but other wise calm and well adjusted.
A: Lameness, mild, LH
r/o transport injury soft tissue
P: Monitor lameness (LS)

27.Apr.1999
Hx: Abrasions over eyes healing well. Active and eating well (LS)

30.Apr.1999
Hx: All abrasions healing, but fresh abrasions both hocks.
Proc: visual obs: Superficial new abrasions over caudal aspect of both hocks (from lying down on cement?)
A: Abrasions, minor,hocks
r/o rough substrate
P: Switch to rubber pads and shavings and spot cleaning (LS)

3.May.1999
Hx: Hocks healing well, lies down on pads/shavings (LS)

11.May.1999
Rx: PYRANTEL PASTE (STRONGID T) 1320 mg PO SID for 1 dose. (LS)

12.May.1999
Hx: Abbreviated quarantine complete. Released to HH today. Fecals have been negative
Proc: visual obs: all abrasions healing well, slightly overweight with a very round abdomen
P: Begin routine deworming 3x/yr: fbz, ivermectin, pyrantel
Advised HH staff to use caution when transitioning onto new grass in new exhibit (LS)

17.May.1999
Hx: Keepers report distended abdomen, but eating well
Proc: visual exam: eating hay, all plant material closely cropped in the holding yard, normal stools. Abdomen is full, but no signs of abdominal discomfort. Being fed 2 flakes of hay and two pounds of "low pro" pellets twice a day. Exhibit has lush grass (zebras not yet given access)
A: Abdominal distension, mild
r/o overfeeding vs mild colic
At risk for laminitis, colic on new grass
P: Discuss diet - consider reducing hay, possibly also pellets, limiting access to grass once introduced to exhibit (LS)

Printed on: 30.May.2002 **/ISIS/MedARKS/5.31g**

IA2

Clinical Notes - Individual Specimen Report
NATIONAL ZOOLOGICAL PARK

Scientific Name: ***EQUUS GREVYI*** Accession #: **113393**
Common Name: **GREVY'S ZEBRA** **Male**
Name: **Buumba** Birth: **2.Aug.1998**

27.May.1999
Hx: Keeper (D. Davis) reports that zebra has been lame on the right front leg for 1-2 days duration. Lameness worse in the afternoon.
Procedure: Visual exam (AM): Zebra is moderately lame on the RF. There is no swelling of the coronary band, fetlock, or carpus. There were no hoof wall or sole abnormalities noted. Tends to point toe as if pain is in the caudal solar region. Ground in enclosure has a lot of gravel that varies in size. Grass in enclosure still plentiful
A: Lame, RF
r/o sole bruise, abscess, laminitis (but not bilateral)
P: Monitor lameness
If lameness static or slight improvement, sole bruise more likely
Consider analgesic/antiinflammatory - phenybutazone (LS)

2.Jun.1999
Hx: Keepers report that lameness on RF has resolved. Eating and acting normal.
A: Lame, RF, resolved
r/o sole bruise
P: No further concern at this time (LS)

3.Jun.1999
Hx: Keepers fed hay this morning then let zebras out into new exhibit with lush grass. Brought back in 20 minutes later by encouraging them with apples and some pellets.
A: Continue gradual adjustment to pasture
At risk for laminitis, colic
P: Continue to allow out onto exhibit grass for gradually increasing periods of time.
Monitor for any developing signs of laminitis or colic. (LS)

.....2000...

1.Feb.2000
Hx: Curator reports animal thin, left portion of food from last PM, drinking and defecating small amounts. Late afternoon, Keeper reports animal down in stall, unable to stand despite multiple efforts.
Proc:
1. Visual exam (early afternoon): animal eating weakly, walking with stiff, upright rear gait. Small muscle mass of chest and hindquarters. Ears drooping.
A: Wt loss, severe
r/o hyponutrition due to behavior vs dental or other
weakness
r/o neurologic, metabolic

Printed on: 30.May.2002 **/ISIS/MedARKS/5.31g**

IA3

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Clinical Notes - Individual Specimen Report
NATIONAL ZOOLOGICAL PARK

Scientific Name: ***EQUUS GREVYI*** Accession #: **113393**
Common Name: **GREVY'S ZEBRA** **Male**
Name: **Buumba** Birth: **2.Aug.1998**

1.Feb.2000
Poor anesthetic risk
P: Exam ASAP
Given time of day and cold ambient temps, plan for first thing tomorrow
Increase food offered to test appetite
Recommend separating from other zebras o/n to monitor food intake and stool/urine output, and maintain body temp
Keepers concerned about stress to zebras if separated in stalls o/n as they have not been regularly locked in at night

Comment: discussed hiearchy among the 3 zebras. This individual is apparently the dominant of the 3 so lack of access to feed seems unlikely.
Also reviewed parasitology screening - no parasites seen in this group. (LHS)

Hx: 1400: Keepers report zebra down in stall
A: Recumbent
r/o weakness, neurologic, hypothermia
Prognosis poor
P: Exam now

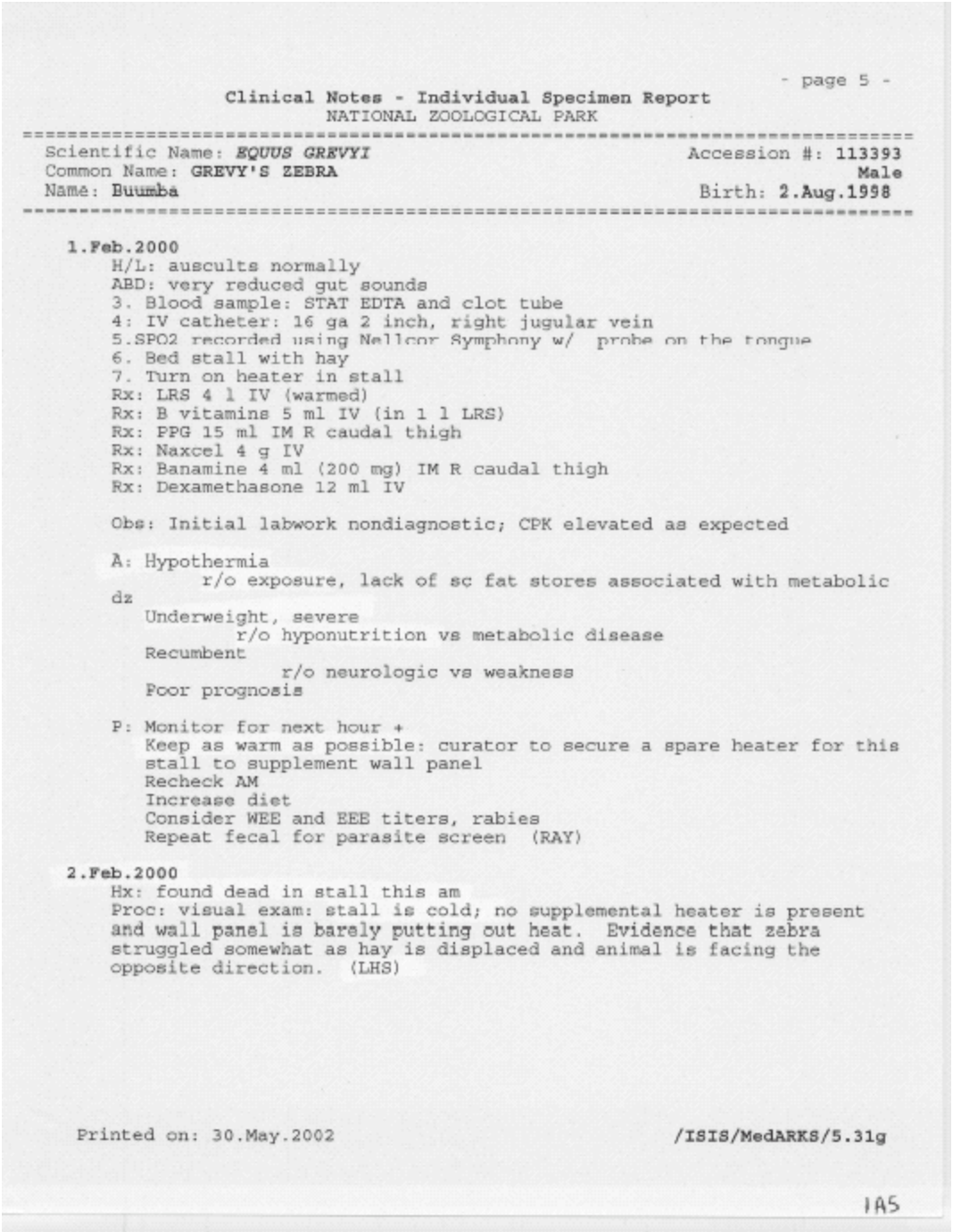
Proc (LHS and RAY):
1. Sedation: Detomidine 10 mg (est 50 mcg/Kg) and butorphanol 10 mg (est 50 mcg/Kg) IM via pole syringe in left tricep. Animal sedated and able to be blindfolded at 9 minutes. Some movement in lateral recumbency, supplemented with butorphanol 5 mg and detomidine 5 mg IV at 20 min. Some muscle twitching and rear limb stiffness, supplemented with midazolam 2 ml (10 mg) IV at 22 min with good effect.
HR 32 (15 min) and 36 (58 min)
RR 16 at 15 min
SPO2 93%
Reversed with yohimbine 25 mg (12.5 mg IV, 12.5 mg SQ) at 61 min and Naltrexone 100 mg IM at 80 min. with slight effect. Nystagmus present for several minutes, unable to stand but made attempts at last observation.

Keepers called as instructed 1 hr and 2 hr later: described zebra as more calm and more alert but still recumbent.

2. PEx: Hypothermic (93.1).
M/S: Thin with decreased muscle mass of shoulder girdle, chest and pelvis. EENT: Hydration appears OK, no sign of dental trauma or infection; mucous membrane color pink

Printed on: 30.May.2002 **/ISIS/MedARKS/5.31g**

1A4



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Clinical Notes - Individual Specimen Report
NATIONAL ZOOLOGICAL PARK

Scientific Name: ***EQUUS GREVYI*** Accession #: **113393**
Common Name: **GREVY'S ZEBRA** **Male**
Name: **Buumba** Birth: **2.Aug.1998**

1.Feb.2000
H/L: auscults normally
ABD: very reduced gut sounds
3. Blood sample: STAT EDTA and clot tube
4: IV catheter: 16 ga 2 inch, right jugular vein
5.SPO2 recorded using Nellcor Symphony w/ probe on the tongue
6. Bed stall with hay
7. Turn on heater in stall
Rx: LRS 4 l IV (warmed)
Rx: B vitamins 5 ml IV (in 1 l LRS)
Rx: PPG 15 ml IM R caudal thigh
Rx: Naxcel 4 g IV
Rx: Banamine 4 ml (200 mg) IM R caudal thigh
Rx: Dexamethasone 12 ml IV

Obs: Initial labwork nondiagnostic; CPK elevated as expected

A: Hypothermia
r/o exposure, lack of sc fat stores associated with metabolic dz
Underweight, severe
r/o hyponutrition vs metabolic disease
Recumbent
r/o neurologic vs weakness
Poor prognosis

P: Monitor for next hour +
Keep as warm as possible: curator to secure a spare heater for this stall to supplement wall panel
Recheck AM
Increase diet
Consider WEE and EEE titers, rabies
Repeat fecal for parasite screen (RAY)

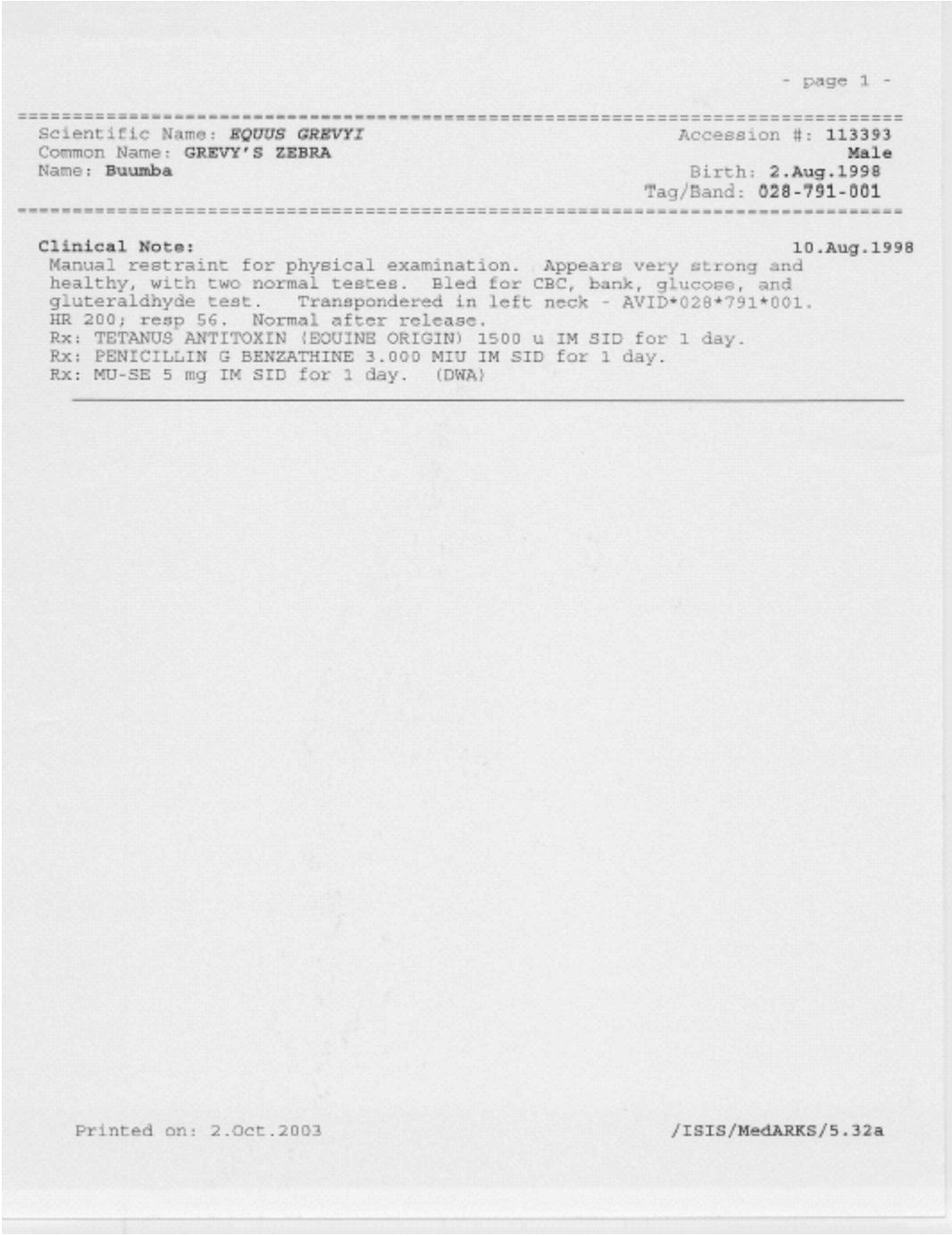
2.Feb.2000
Hx: found dead in stall this am
Proc: visual exam: stall is cold; no supplemental heater is present and wall panel is barely putting out heat. Evidence that zebra struggled somewhat as hay is displaced and animal is facing the opposite direction. (LHS)

Printed on: 30.May.2002 **/ISIS/MedARKS/5.31g**

IA5

APPENDIX D

Medical Record Report (includes clinical notes, prescription record, parasitology record, etc.)
MedARKS Medical Record for Grevy's Zebra "Buumba" (Accession #113393)
Source: National Zoological Park



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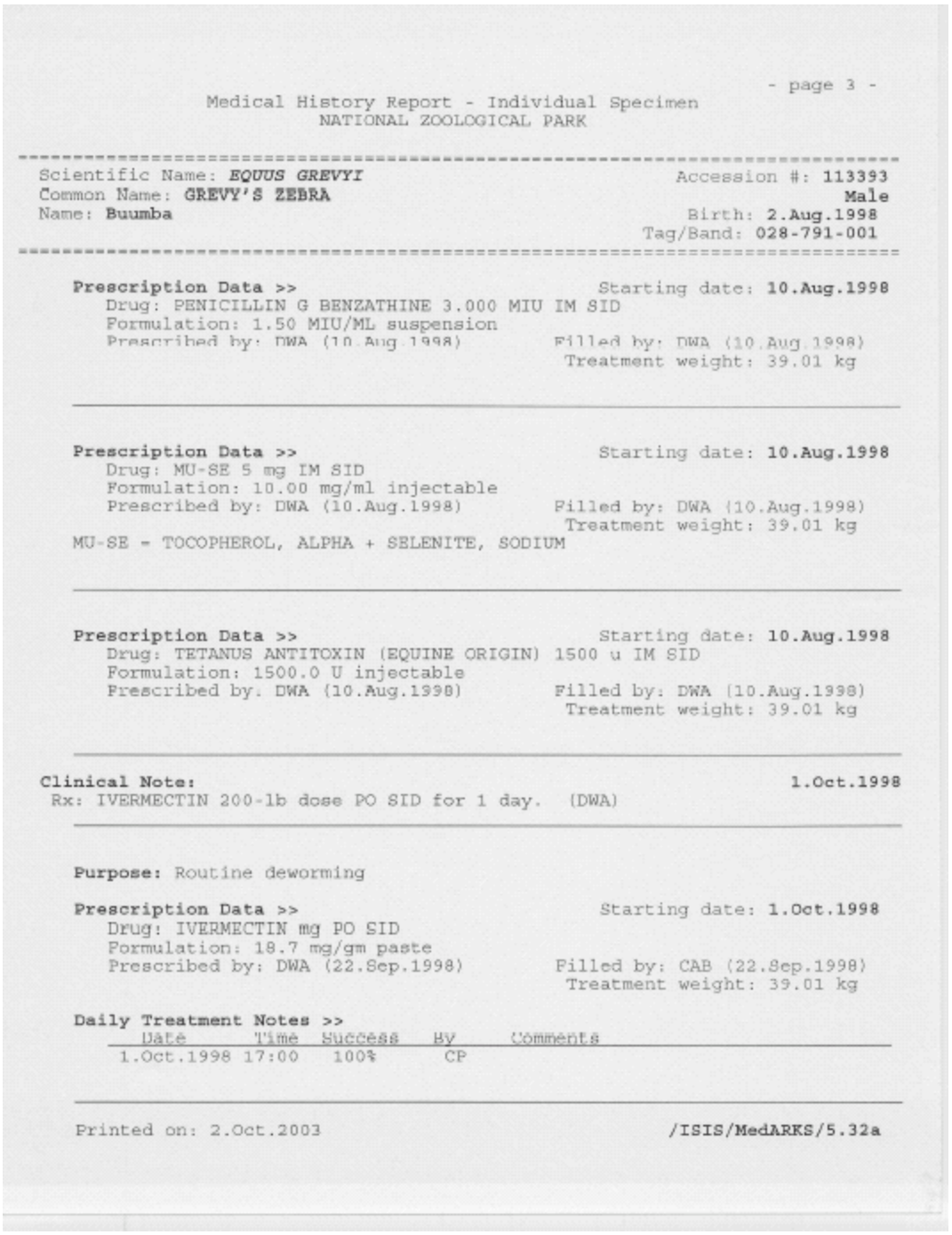
Scientific Name: ***EQUUS GREVYI***
Common Name: **GREVY'S ZEBRA**
Name: **Buumba**

Accession #: **113393**
Male
Birth: **2.Aug.1998**
Tag/Band: **028-791-001**

Clinical Note: **10.Aug.1998**

Manual restraint for physical examination. Appears very strong and healthy, with two normal testes. Bled for CBC, bank, glucose, and gluteraldhyde test. Transpondered in left neck - AVID*028*791*001. HR 200; resp 56. Normal after release.
Rx: TETANUS ANTITOXIN (EQUINE ORIGIN) 1500 u IM SID for 1 day.
Rx: PENICILLIN G BENZATHINE 3.000 MIU IM SID for 1 day.
Rx: MU-SE 5 mg IM SID for 1 day. (DWA)

Printed on: 2.Oct.2003 /ISIS/MedARKS/5.32a



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Medical History Report - Individual Specimen
NATIONAL ZOOLOGICAL PARK

Scientific Name: ***EQUUS GREVYI*** Accession #: **113393**
Common Name: **GREVY'S ZEBRA** **Male**
Name: **Buumba** Birth: **2.Aug.1998**
Tag/Band: **028-791-001**

Prescription Data >> Starting date: **10.Aug.1998**
Drug: PENICILLIN G BENZATHINE 3.000 MIU IM SID
Formulation: 1.50 MIU/ML suspension
Prescribed by: DWA (10.Aug.1998) Filled by: DWA (10.Aug.1998)
Treatment weight: 39.01 kg

Prescription Data >> Starting date: **10.Aug.1998**
Drug: MU-SE 5 mg IM SID
Formulation: 10.00 mg/ml injectable
Prescribed by: DWA (10.Aug.1998) Filled by: DWA (10.Aug.1998)
Treatment weight: 39.01 kg
MU-SE = TOCOPHEROL, ALPHA + SELENITE, SODIUM

Prescription Data >> Starting date: **10.Aug.1998**
Drug: TETANUS ANTITOXIN (EQUINE ORIGIN) 1500 u IM SID
Formulation: 1500.0 U injectable
Prescribed by: DWA (10.Aug.1998) Filled by: DWA (10.Aug.1998)
Treatment weight: 39.01 kg

Clinical Note: **1.Oct.1998**
Rx: IVERMECTIN 200-lb dose PO SID for 1 day. (DWA)

Purpose: Routine deworming

Prescription Data >> Starting date: **1.Oct.1998**
Drug: IVERMECTIN mg PO SID
Formulation: 18.7 mg/gm paste
Prescribed by: DWA (22.Sep.1998) Filled by: CAB (22.Sep.1998)
Treatment weight: 39.01 kg

Daily Treatment Notes >>

Date	Time	Success	By	Comments
1.Oct.1998	17:00	100%	CP	

Printed on: 2.Oct.2003 **/ISIS/MedARKS/5.32a**

Scientific Name: ***EQUUS GREVYI*** Accession #: **113393**
Common Name: **GREVY'S ZEBRA** **Male**
Name: **Buumba** Birth: **2.Aug.1998**

Parasitology Examination:
Submission Data >> Sample id.: 1998*A084
Type: Fecal sample Date collected: **28.Dec.1998**
Purpose: ROUTINE EXAMINATION Collected by: CD

Collected from: Enclosure: VELDT #1
Group of specimens housed together.

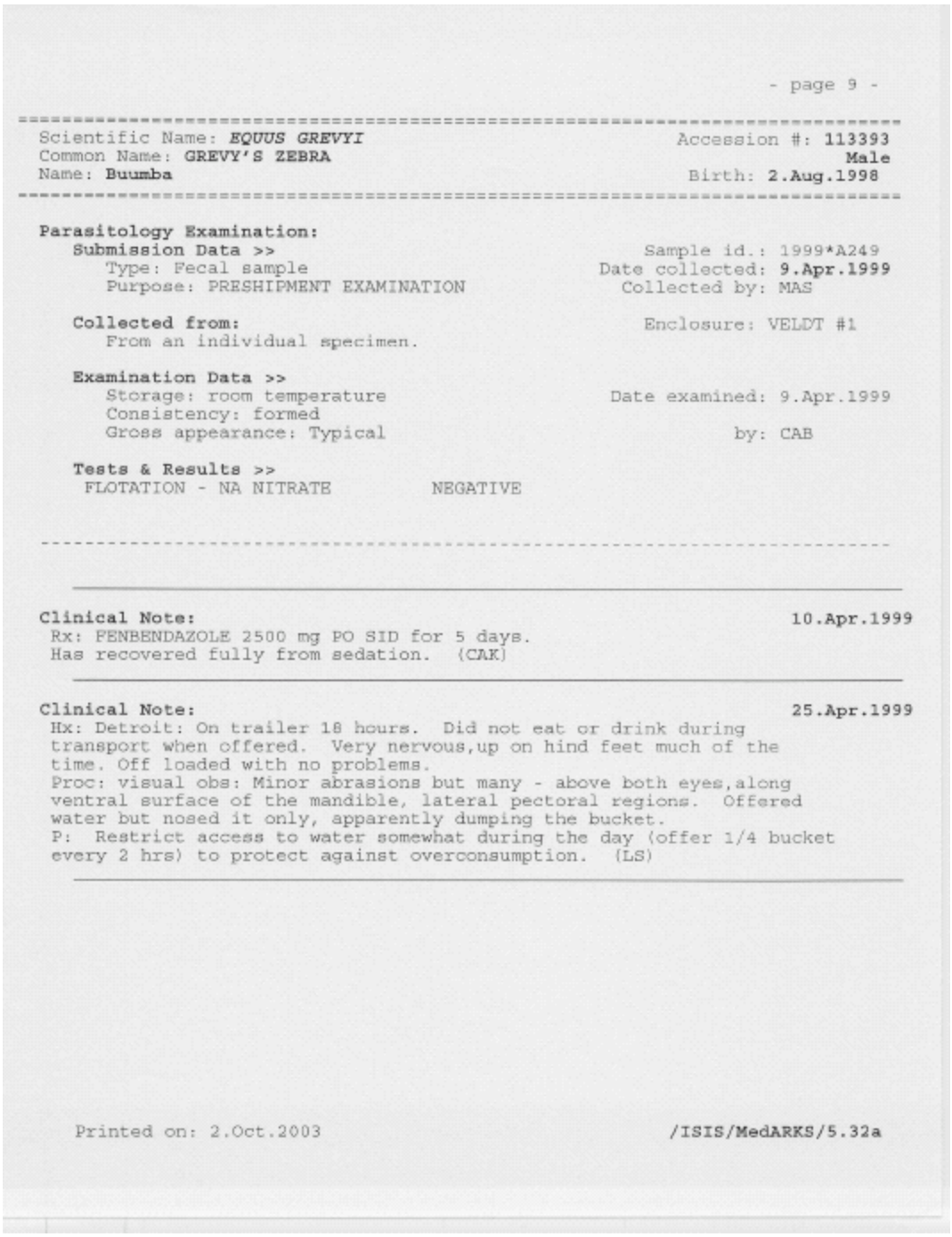
Examination Data >>
Storage: refrigerated Date examined: 29.Dec.1998
Consistency: formed
Gross appearance: Typical by: CAB

Tests & Results >>
FLOTATION - NA NITRATE NO PARASITES SEEN

Clinical Note: **9.Apr.1999**
Sedated today for pre-shipping exam. He is being sent to the National Zoo sometime this month. Sedated using 40mg detomidine and 40mg butorphanol IM via dart. Sedation adequate for restraint achieved in 20mins. Blood was drawn and submitted for CDC, chem, bank, and Coggin's test. Fecal sample taken for exam. Upon examination of the scrotum, no testicles could be palpated. Sedation was partially reversed with 200mg naltrexone IV. Recovery was rapid and uneventful. (CAK)

Clinical Note: **9.Apr.1999**
Rx: RABIES VACCINE (KILLED) 1 ml IM
Rx: ENCEPHALOMYELITIS EWV/TETANUS TOXOI 1 ml IM (DWA)

Printed on: 2.Oct.2003 **/ISIS/MedARKS/5.32a**



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Scientific Name: ***EQUUS GREVYI*** Accession #: **113393**
Common Name: **GREVY'S ZEBRA** **Male**
Name: **Buumba** Birth: **2.Aug.1998**

Parasitology Examination:
Submission Data >> Sample id.: 1999*A249
Type: Fecal sample Date collected: **9.Apr.1999**
Purpose: PRESHIPMENT EXAMINATION Collected by: MAS

Collected from: Enclosure: VELDT #1
From an individual specimen.

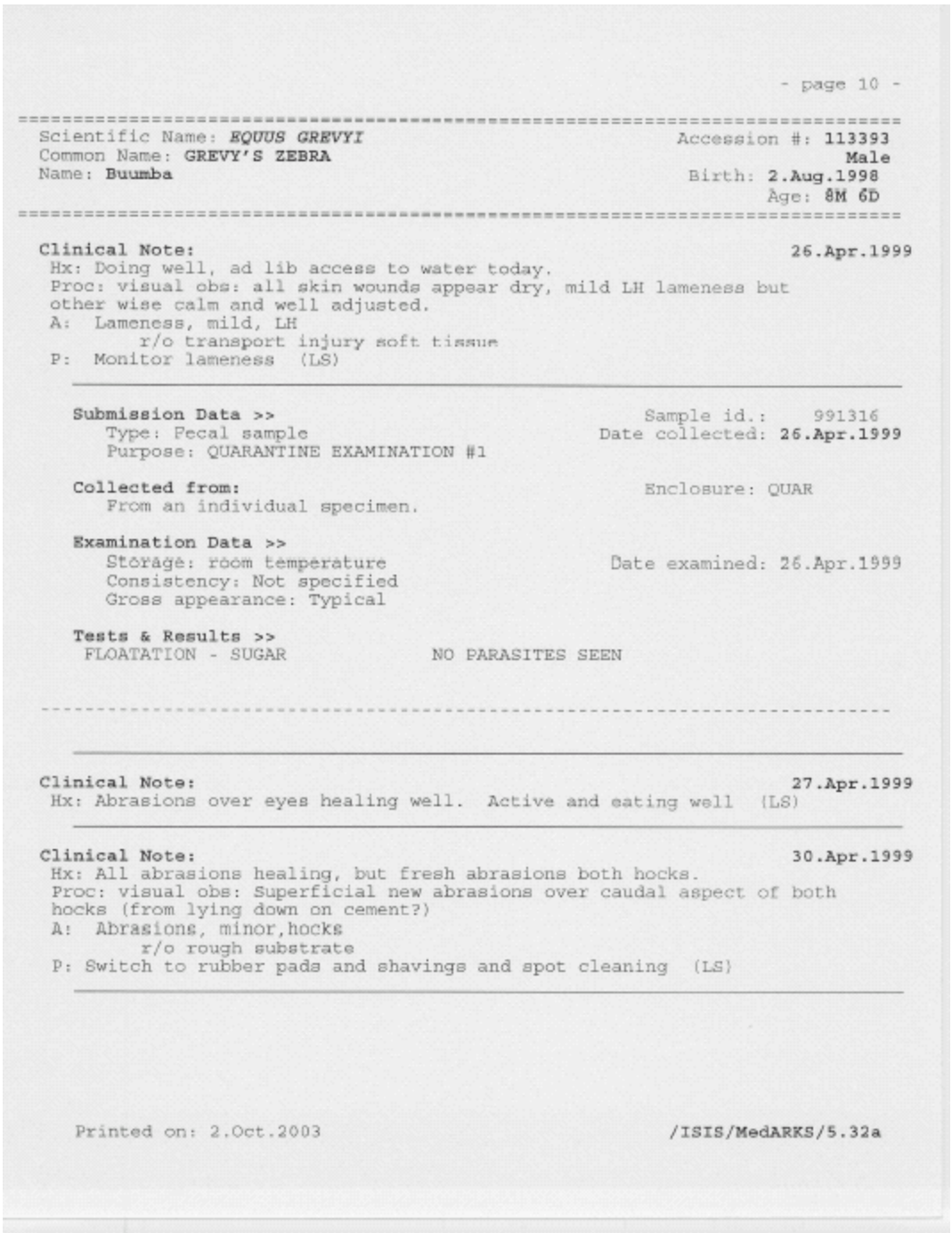
Examination Data >>
Storage: room temperature Date examined: 9.Apr.1999
Consistency: formed
Gross appearance: Typical by: CAB

Tests & Results >>
FLOTATION - NA NITRATE NEGATIVE

Clinical Note: **10.Apr.1999**
Rx: FENBENDAZOLE 2500 mg PO SID for 5 days.
Has recovered fully from sedation. (CAK)

Clinical Note: **25.Apr.1999**
Hx: Detroit: On trailer 18 hours. Did not eat or drink during transport when offered. Very nervous,up on hind feet much of the time. Off loaded with no problems.
Proc: visual obs: Minor abrasions but many - above both eyes,along ventral surface of the mandible, lateral pectoral regions. Offered water but nosed it only, apparently dumping the bucket.
P: Restrict access to water somewhat during the day (offer 1/4 bucket every 2 hrs) to protect against overconsumption. (LS)

Printed on: 2.Oct.2003 **/ISIS/MedARKS/5.32a**



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Scientific Name: ***EQUUS GREVYI*** Accession #: **113393**
Common Name: **GREVY'S ZEBRA** **Male**
Name: **Buumba** Birth: **2.Aug.1998**
Age: **8M 6D**

Clinical Note: **26.Apr.1999**
Hx: Doing well, ad lib access to water today.
Proc: visual obs: all skin wounds appear dry, mild LH lameness but other wise calm and well adjusted.
A: Lameness, mild, LH
r/o transport injury soft tissue
P: Monitor lameness (LS)

Submission Data >> Sample id.: 991316
Type: Fecal sample Date collected: **26.Apr.1999**
Purpose: QUARANTINE EXAMINATION #1

Collected from: Enclosure: QUAR
From an individual specimen.

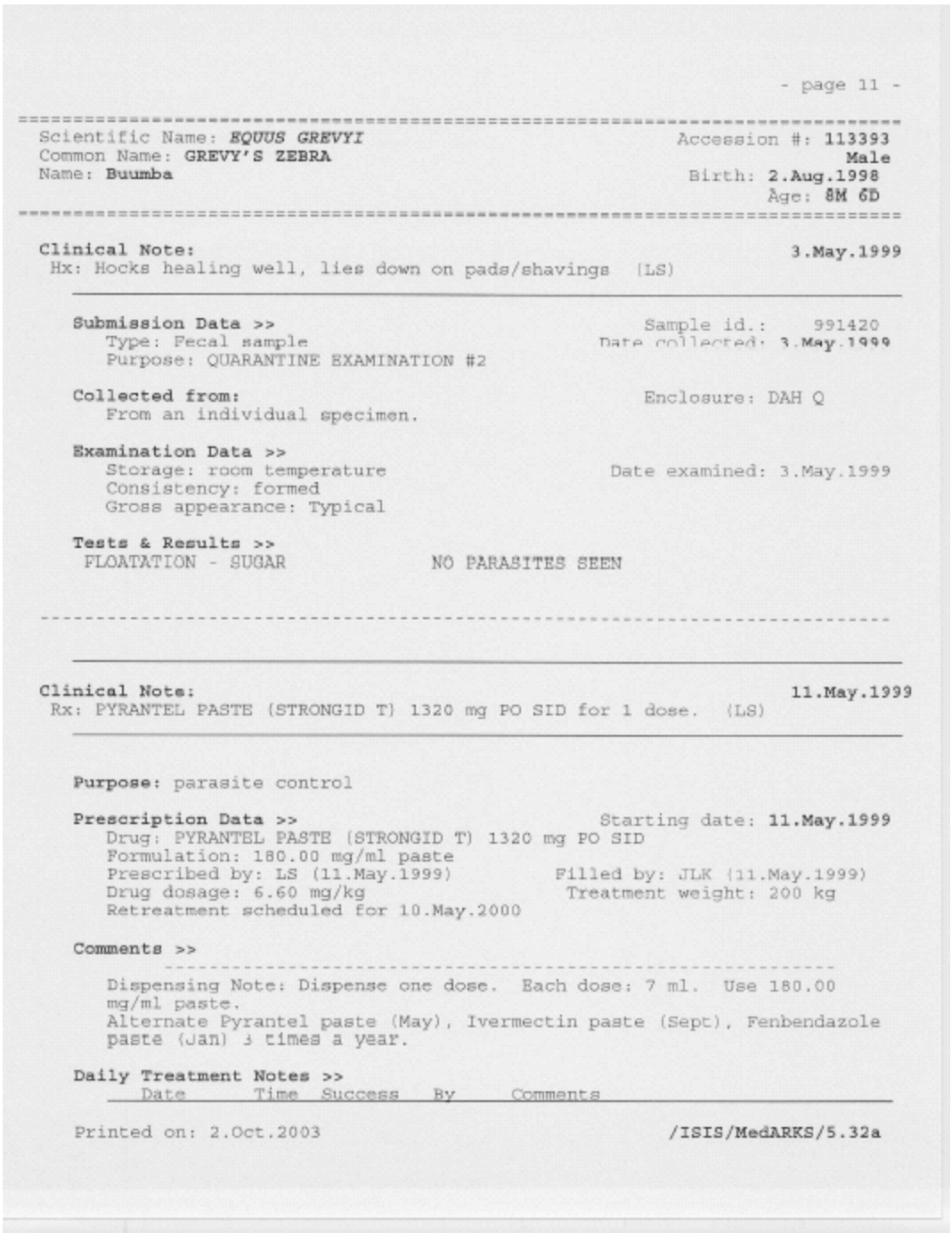
Examination Data >>
Storage: room temperature Date examined: 26.Apr.1999
Consistency: Not specified
Gross appearance: Typical

Tests & Results >>
FLOATATION - SUGAR NO PARASITES SEEN

Clinical Note: **27.Apr.1999**
Hx: Abrasions over eyes healing well. Active and eating well (LS)

Clinical Note: **30.Apr.1999**
Hx: All abrasions healing, but fresh abrasions both hocks.
Proc: visual obs: Superficial new abrasions over caudal aspect of both hocks (from lying down on cement?)
A: Abrasions, minor, hocks
r/o rough substrate
P: Switch to rubber pads and shavings and spot cleaning (LS)

Printed on: 2.Oct.2003 **/ISIS/MedARKS/5.32a**



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Scientific Name: ***EQUUS GREVYI*** Accession #: **113393**
Common Name: **GREVY'S ZEBRA** **Male**
Name: **Buumba** Birth: **2.Aug.1998**
Age: **8M 6D**

Clinical Note: **3.May.1999**
Hx: Hocks healing well, lies down on pads/shavings (LS)

Submission Data >> Sample id.: 991420
Type: Fecal sample Date collected: 3.May.1999
Purpose: QUARANTINE EXAMINATION #2

Collected from: Enclosure: DAH Q
From an individual specimen.

Examination Data >>
Storage: room temperature Date examined: 3.May.1999
Consistency: formed
Gross appearance: Typical

Tests & Results >>
FLOATATION - SUGAR NO PARASITES SEEN

Clinical Note: **11.May.1999**
Rx: PYRANTEL PASTE (STRONGID T) 1320 mg PO SID for 1 dose. (LS)

Purpose: parasite control

Prescription Data >> Starting date: **11.May.1999**
Drug: PYRANTEL PASTE (STRONGID T) 1320 mg PO SID
Formulation: 180.00 mg/ml paste
Prescribed by: LS (11.May.1999) Filled by: JLK (11.May.1999)
Drug dosage: 6.60 mg/kg Treatment weight: 200 kg
Retreatment scheduled for 10.May.2000

Comments >>
Dispensing Note: Dispense one dose. Each dose: 7 ml. Use 180.00 mg/ml paste.
Alternate Pyrantel paste (May), Ivermectin paste (Sept), Fenbendazole paste (Jan) 3 times a year.

Daily Treatment Notes >>
Date Time Success By Comments

Printed on: 2.Oct.2003 **/ISIS/MedARKS/5.32a**

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Medical History Report - Individual Specimen
NATIONAL ZOOLOGICAL PARK

Scientific Name: ***EQUUS GREVYI*** Accession #: **113393**
Common Name: **GREVY'S ZEBRA** **Male**
Name: **Buumba** Birth: **2.Aug.1998**
Tag/Band: **028-791-001**

Prescription Record (continued):
11.May.1999 : 100% TZ

Clinical Note: **12.May.1999**
Hx: Abbreviated quarantine complete. Released to HH today. Fecals have been negative
Proc: visual obs: all abrasions healing well, slightly overweight with a very round abdomen
P: Begin routine deworming 3x/yr: fbz, ivermectin, pyrantel
Advised HH staff to use caution when transitioning onto new grass in new exhibit (LS)

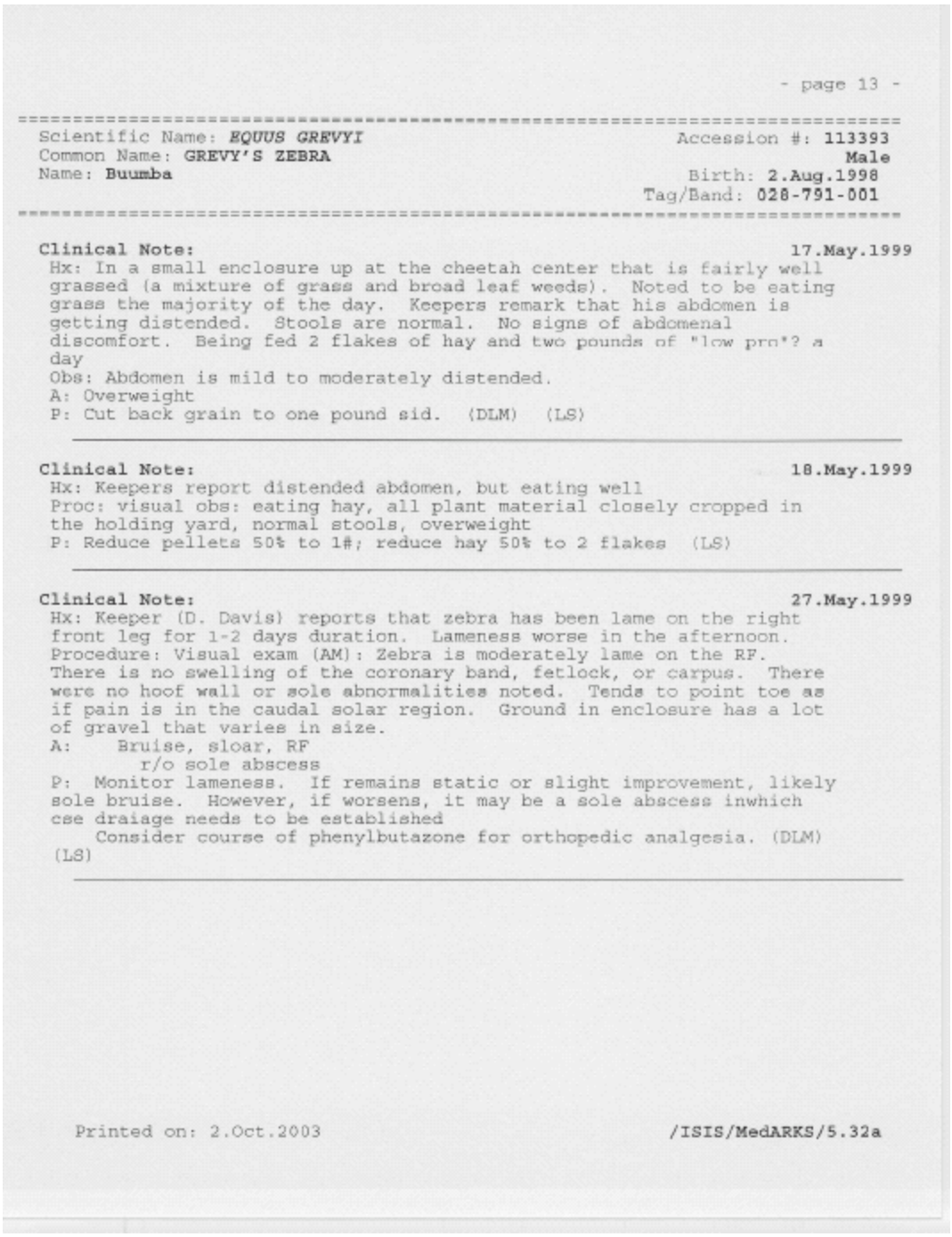
Submission Data >> Sample id.: 991560
Type: Fecal sample Date collected: **12.May.1999**
Purpose: QUARANTINE EXAMINATION #3

Collected from: Enclosure: DAH Q
From an individual specimen.

Examination Data >>
Storage: room temperature Date examined: 12.May.1999
Consistency: formed
Gross appearance: Typical

Tests & Results >>
FLOATATION - SUGAR NO PARASITES SEEN

Printed on: 2.Oct.2003 **/ISIS/MedARKS/5.32a**



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Scientific Name: ***EQUUS GREVYI*** Accession #: **113393**
Common Name: **GREVY'S ZEBRA** **Male**
Name: **Buumba** Birth: **2.Aug.1998**
Tag/Band: **028-791-001**

Clinical Note: **17.May.1999**

Hx: In a small enclosure up at the cheetah center that is fairly well grassed (a mixture of grass and broad leaf weeds). Noted to be eating grass the majority of the day. Keepers remark that his abdomen is getting distended. Stools are normal. No signs of abdomenal discomfort. Being fed 2 flakes of hay and two pounds of "low prn"? a day
Obs: Abdomen is mild to moderately distended.
A: Overweight
P: Cut back grain to one pound sid. (DLM) (LS)

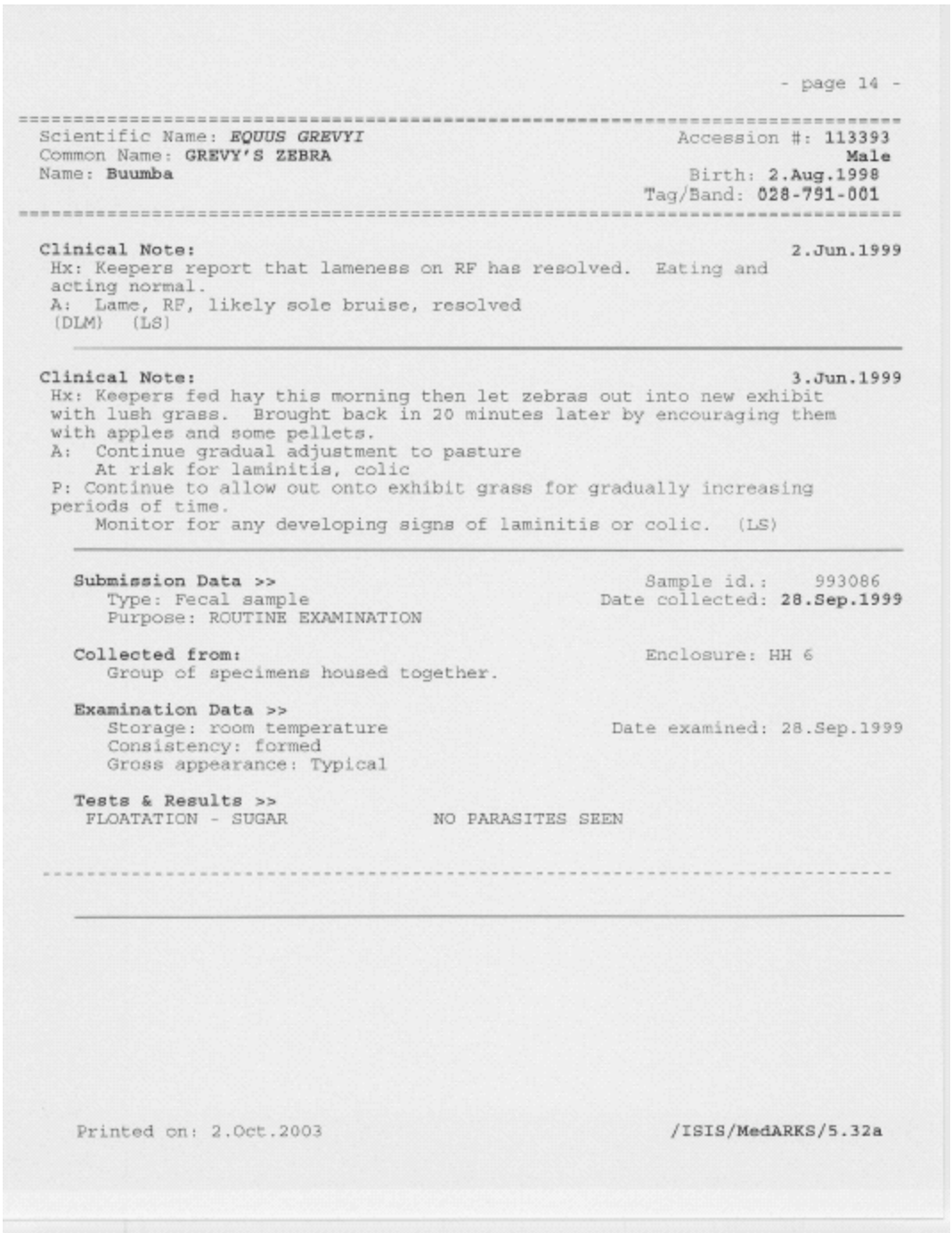
Clinical Note: **18.May.1999**

Hx: Keepers report distended abdomen, but eating well
Proc: visual obs: eating hay, all plant material closely cropped in the holding yard, normal stools, overweight
P: Reduce pellets 50% to 1#; reduce hay 50% to 2 flakes (LS)

Clinical Note: **27.May.1999**

Hx: Keeper (D. Davis) reports that zebra has been lame on the right front leg for 1-2 days duration. Lameness worse in the afternoon.
Procedure: Visual exam (AM): Zebra is moderately lame on the RF. There is no swelling of the coronary band, fetlock, or carpus. There were no hoof wall or sole abnormalities noted. Tends to point toe as if pain is in the caudal solar region. Ground in enclosure has a lot of gravel that varies in size.
A: Bruise, sloar, RF
r/o sole abscess
P: Monitor lameness. If remains static or slight improvement, likely sole bruise. However, if worsens, it may be a sole abscess inwhich cse draiage needs to be established
Consider course of phenylbutazone for orthopedic analgesia. (DLM) (LS)

Printed on: 2.Oct.2003 **/ISIS/MedARKS/5.32a**



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Scientific Name: ***EQUUS GREVYI*** Accession #: **113393**
Common Name: **GREVY'S ZEBRA** **Male**
Name: **Buumba** Birth: **2.Aug.1998**
Tag/Band: **028-791-001**

Clinical Note: **2.Jun.1999**
Hx: Keepers report that lameness on RF has resolved. Eating and acting normal.
A: Lame, RF, likely sole bruise, resolved
(DLM) (LS)

Clinical Note: **3.Jun.1999**
Hx: Keepers fed hay this morning then let zebras out into new exhibit with lush grass. Brought back in 20 minutes later by encouraging them with apples and some pellets.
A: Continue gradual adjustment to pasture
At risk for laminitis, colic
P: Continue to allow out onto exhibit grass for gradually increasing periods of time.
Monitor for any developing signs of laminitis or colic. (LS)

Submission Data >> Sample id.: 993086
Type: Fecal sample Date collected: **28.Sep.1999**
Purpose: ROUTINE EXAMINATION

Collected from: Enclosure: HH 6
Group of specimens housed together.

Examination Data >>
Storage: room temperature Date examined: 28.Sep.1999
Consistency: formed
Gross appearance: Typical

Tests & Results >>
FLOATATION - SUGAR NO PARASITES SEEN

Printed on: 2.Oct.2003 **/ISIS/MedARKS/5.32a**

Scientific Name: ***EQUUS GREVYI*** Accession #: **113393**
Common Name: **GREVY'S ZEBRA** **Male**
Name: **Buumba** Birth: **2.Aug.1998**
Tag/Band: **028-791-001**

Clinical Note: **1.Feb.2000**

Hx: Curator reports animal thin, left portion of food from last PM, drinking and defecating small amounts. Late afternoon, Keeper reports animal down in stall, unable to stand despite multiple efforts.
Proc:
1. Visual exam 0200 (In early afternoon): animal eating weakly, walking with stiff, upright rear gait. Small muscle mass of chest and hindquarters. Ears drooping.
A: Wt loss, severe
r/o hyponutrition due to behavior vs dental or other
Weakness
r/o neurologic, metabolic
Poor anesthetic risk
P: Exam ASAP
Given time of day and cold ambient temps, plan for first thing tomorrow
Increase food offered to test appetite
Recommend separating from other zebras o/n to monitor food intake and stool/urine output, and maintain body temp
Keepers concerned about stress to zebras if separated in stalls o/n as they have not been regularly locked in at night

Comment: discussed hiearchy among the 3 zebras. This individual is apparently the dominant of the 3 so lack of access to feed seems unlikely.
Also reviewed parasitology screening - no parasites seen in this group. (LHS)

Printed on: 2.Oct.2003 **/ISIS/MedARKS/5.32a**

Scientific Name: ***EQUUS GREVYI*** Accession #: **113393**
Common Name: **GREVY'S ZEBRA** **Male**
Name: **Buumba** Birth: **2.Aug.1998**
Tag/Band: **028-791-001**

Clinical Note: **1.Feb.2000**

Hx: 1400: Keepers report zebra down in stall
A: Recumbent
r/o weakness, neurologic, hypothermia
Prognosis poor
P: Exam now

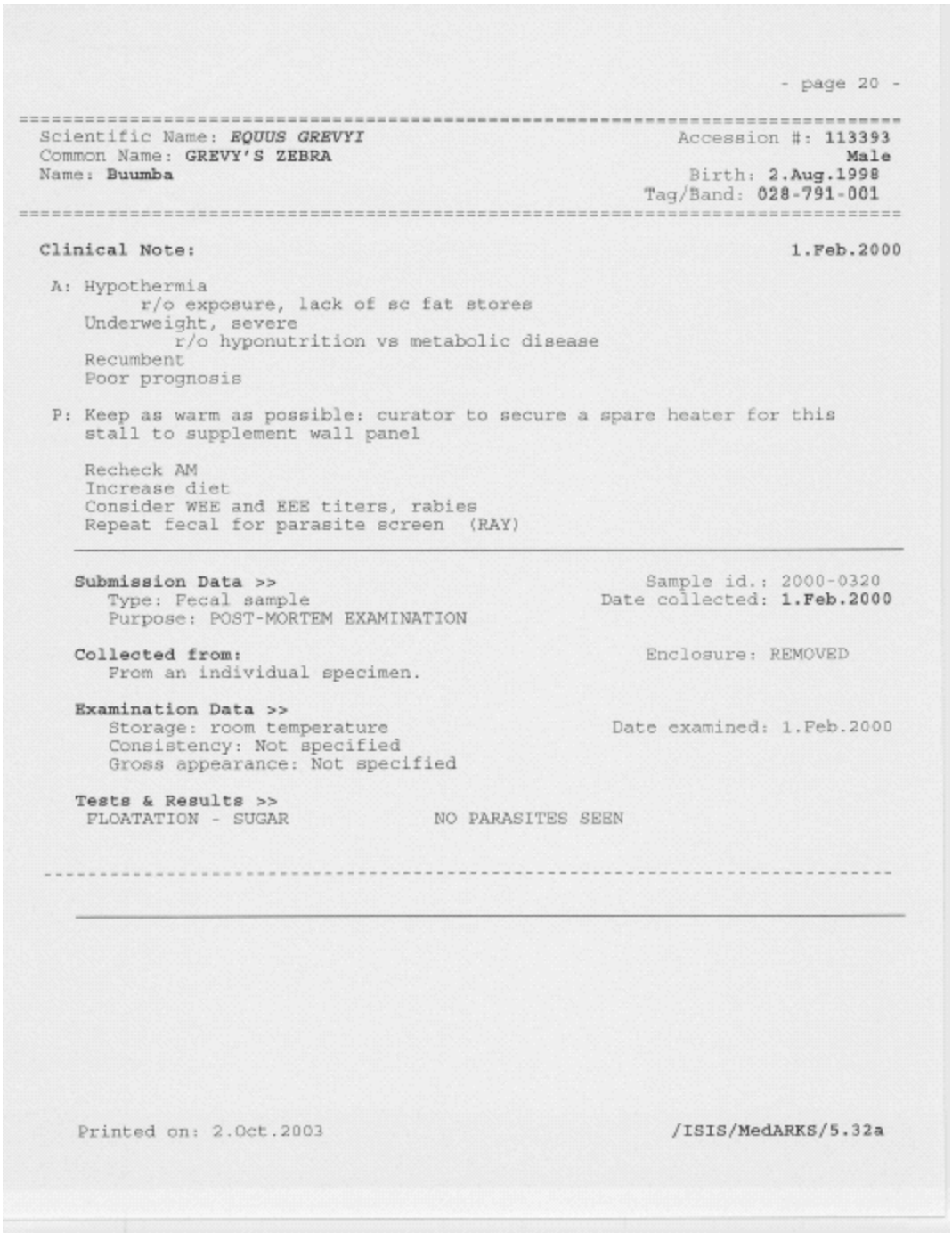
Proc (LHS and RAY):
1. Sedation: Detomidine 10 mg (est 50 mcg/Kg) and butorphanol 10 mg (est 50 mcg/Kg) IM via pole syringe in left tricep. Animal sedated and able to be blindfolded at 9 minutes. Some movement in lateral recumbency, supplemented with butorphanol 5 mg and detomidine 5 mg IV at 20 min. Some muscle twitching and rear limb stiffness, supplemented with midazolam 2 ml (10 mg) IV at 22 min with good effect.
HR 32 (15 min) and 36 (58 min)
RR 16 at 15 min
SPO2 93%
Reversed with yohimbine 25 mg (12.5 mg IV, 12.5 mg SQ) at 61 min and Naltrexone 100 mg IM at 80 min. with slight effect. Nystagmus present for several minutes, unable to stand but made attempts at last observation.

Keepers called as instructed 1 hr and 2 hr later: described zebra as more calm and more alert but still recumbent.

2. PEx: Hypothermic (93.1).
M/S: Thin with decreased muscle mass of shoulder girdle, chest and pelvis. EENT: Hydration appears OK, no sign of dental trauma or infection; mucous membrane color pink
H/L: ausculta normally
ABD: very reduced gut sounds
3. Blood sample: STAT EDTA and clot tube
4: IV catheter: 16 ga 2 inch, right jugular vein
5.SPO2 recorded using Nellcor Symphony w/ probe on the tongue
6. Bed stall with hay
7. Turn on heater in stall
Rx: LRS 4 l IV (warmed)
Rx: B vitamins 5 ml IV (in 1 l LRS)
Rx: PPG 15 ml IM R caudal thigh
Rx: Naxcel 4 g IV
Rx: Banamine 4 ml (200 mg) IM R caudal thigh
Rx: Dexamethasone 12 ml IV

Obs: initial labwork nondiagnostic

Printed on: 2.Oct.2003 **/ISIS/MedARKS/5.32a**



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Scientific Name: ***EQUUS GREVYI*** Accession #: **113393**
Common Name: **GREVY'S ZEBRA** **Male**
Name: **Buumba** Birth: **2.Aug.1998**
Tag/Band: **028-791-001**

Clinical Note: **1.Feb.2000**

A: Hypothermia
r/o exposure, lack of sc fat stores
Underweight, severe
r/o hyponutrition vs metabolic disease
Recumbent
Poor prognosis

P: Keep as warm as possible: curator to secure a spare heater for this stall to supplement wall panel

Recheck AM
Increase diet
Consider WEE and EEE titers, rabies
Repeat fecal for parasite screen (RAY)

Submission Data >> Sample id.: 2000-0320
Type: Fecal sample Date collected: **1.Feb.2000**
Purpose: POST-MORTEM EXAMINATION

Collected from: Enclosure: REMOVED
From an individual specimen.

Examination Data >>
Storage: room temperature Date examined: 1.Feb.2000
Consistency: Not specified
Gross appearance: Not specified

Tests & Results >>
FLOATATION - SUGAR NO PARASITES SEEN

Printed on: 2.Oct.2003 **/ISIS/MedARKS/5.32a**

Scientific Name: ***EQUUS GREVYI*** Accession #: **113393**
Common Name: **GREVY'S ZEBRA** **Male**
Name: **Buumba** Birth: **2.Aug.1998**
Tag/Band: **028-791-001**

Clinical Note: **2.Feb.2000**
Hx: found dead in stall this am
Proc: visual exam: stall is cold; no supplemental heater is present and wall panel is barely putting out heat. Evidence that zebra struggled somewhat as hay is displaced and animal is facing the opposite direction. (LHS)

Printed on: 2.Oct.2003 **/ISIS/MedARKS/5.32a**

APPENDIX E

Zoo Registrar – Job Description
Zoological Registrars Association
(http://www.zra.homestead.com)

Zoo Registrar - Job Description

TITLE: Zoo Registrar

DESCRIPTION

This is a management position. Serves as a member of the Animal Management Team, assists in the development and implementation of the zoo's Collections Management Policy, and it's resulting Collection Plans. Monitors all transactions for adherence to those policies. Manages Animal Records and ensures the maintenance and quality of animal records for use in the management and development of husbandry and breeding programs, preparation of scientific publications, and provision of data for cooperative ventures at both the regional and international level. Serves as a liaison and information source to other departments and organizations. Provides a complete inventory and record of all animal transactions. Monitors legislation for compliance with wildlife laws. Collaborates with curators and works under the supervision of the Director.

MAJOR DUTIES AND RESPONSIBILITIES:

Serves as principal advisor to the Director on registration and collections management, adherence to collections management policy and to senior staff on legal and logistical aspects of collections activities. Participates with administrative, curatorial and other support staff in implementing and reviewing various collections management objectives, setting and developing policy and procedures.

Monitors collection activity for compliance with policy and procedure and advises Director of problems and progress. Prepares reports on collections activity and management to the Director and other institutional officials as scheduled and on own initiative.

Monitors status of legislation pertaining to wildlife and transport procedures. Procures and maintains required Federal, State, and Local permits necessary for the maintenance and transport of wildlife in accordance with regulations. Files annual reports and renews permits as needed.

Sets procedures for domestic and international shipments of live animals, parts and products. Checks legal regulations and zoo policies for compliance, directs document preparation, logistics planning, scheduling and quarantine for animal shipments. Establishes and implements documentation standards for shipment records with advice of legal council and curatorial staff in coordination with national and international standards and requirements.

Develops and directs the collection and maintenance of an inventory of the zoo's animal collection, and records of daily transactions including shipments, births, deaths, behavioural, reproductive and medical notes. Reports these activities to the administrative, curatorial and appropriate staff.

Develops procedures and systems for inventory control of the collection via automated and manual systems. Reviews record-keeping and transaction procedures, implementing improvements to standards of records management.

Develops and implements internal and external quality control measures to ensure the quality of institutional animal records data.

Serves as liaison to the International Species Information System (ISIS), submits data to this system, and analyzes and disseminates data received from this system.

Serves as a liaison between the institution and outside organizations/institutions, as well as other departments within the zoo on matters of animal records and related issues.
Interacts with board members, directors, curators, registrars, keepers, researchers, customs brokers, lawyers, and government officials.

Works with curators and keepers through education/training programs and regular contact to improve record systems, and solve problems.

Compiles an animal inventory on an annual basis that includes data regarding activities in the animal collection.

Composes loan agreements with administrative, curatorial and legal staff, and monitors the status of loan specimens.

Maintains files of all documents related to animal transactions (eg., loans agreements, contracts, permits, etc.).

Provides institution data for studbook reports, questionnaires, surveys and Species Survival Plan updates, or directs to appropriate staff members.

Acts as a data specialist providing statistical analysis and reports for various departments regarding the animal collection.

Performs genealogy searches for use in the selection of appropriate specimens for breeding/exhibit for in-house populations as well as proposed incoming animals.

Evaluates records of animal management programs to determine historical trends and recommend improvements where necessary.

Participates in the development and implementation of conservation projects in accordance with goals established by the institution.

Assists in the zoo's participation in Species Survival Plans by maintaining SSP correspondence, generating computer analysis using population genetics software, and by attending masterplanning sessions.

Monitors SSP, TAG, FIG and various national as well as international programs to assist in the long-term management and development of captive management programs, and the preservation of endangered species.

Prepares statements concerning proposed legislation and governmental actions regarding wild and captive animals.

QUALIFICATIONS:

Four year college degree in biology or related field plus two years experience in a registrar-type position in a zoological institution. Previous animal experience desirable.

Knowledge of concepts, principles, and practices of professional museum and zoo registration methods and collection management standards.

Knowledge of inventory accession and record-keeping practices.

Knowledge of zoological nomenclature.

Knowledge of the laws regulating animal acquisition, disposition, exhibition, husbandry standards, and transportation within the U.S. and abroad is desirable.

Knowledge of statistics and population management skills is desirable.

Experience with computers and animal records software (eg., ARKS, SPARKS). Experience with word processing software.

Ability to collect and collate information from a variety of sources into concise and accurate reports.

Good communication and organizational skills.

Attention to detail.

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APPENDIX F

Public Meeting Agendas

Wednesday, August 27, 2003 – Washington, DC

Session 1: 10:30 am to 12:30 am

10:30 **Welcome and Introductions**
Dr. R. Michael Roberts, Chair
National Academies Committee on the Review of the Smithsonian Institution's National Zoological Park

10:40 **Sponsor Perspectives**
Paul Vinovich, Staff Director
Committee on House Administration

Dr. David Evans, Under Secretary for Science
Smithsonian Institution

Dr. Lucy Spelman, Director
Smithsonian Institution's National Zoological Park

12:30 PM **Adjourn for Lunch**

Session 2: 2:00 pm to 3:30 pm

2:00 **Welcome**
Dr. R. Michael Roberts, Chair
National Research Council Committee on Review of the Smithsonian Institution's National Zoological Park

2:10 **Public Comments (Registered persons)**

3:00 **Public Comments (Open)**

3:30 **Adjourn**

Thursday, October 2, 2003 – Washington, DC

Animal Care and Management in Zoos: Past, Present, and Future

8:30 **Zoological Institutions: Evolution over Time**
Mike Hutchins, AZA

9:15 a.m. **Zoo Animal Medicine and Veterinary Care**
Lynn Kramer, Denver Zoo

10:00 a.m. **Zoo-Animal Nutrition**
Ann Ward, Fort Worth Zoo
Mark S. Edwards, Zoological Society of San Diego

10:45 a.m. **Accreditation and Inspections of Zoological Institutions**
Denny L. Lewis, AZA
Richard Watkins, APHIS

11:30 a.m. **Strategies for Record Keeping Systems at Zoos: Insights from the Zoo and Beyond**
J. Andrew Teare, Jacksonville Zoological Gardens
Christian Newcomer, Johns Hopkins University
Rosanne Whitehouse, University of Michigan Hospitals and Health Centers

12:30 p.m. **Public Comment**

ABOUT THE AUTHORS

R. Michael Roberts, Ph.D., (NAS) (Chair) is the Curator's Professor of Animal Science, Biochemistry and Veterinary Pathology at the University of Missouri. He is best known for his contributions in facilitating our understanding of embryo-maternal communication during the early stages of pregnancy. Roberts was the first to discover that early placentas produce interferons that mediate maternal recognition of the embryo in cattle and sheep. He has broad expertise in plant and animal physiology and experience with the National Academies' deliberative study process. In addition to his current position, Roberts has served as Chair of the Veterinary Pathobiology Department at Missouri from 1995 to 1998, and Chief Scientist for the USDA's National Research Initiative from 1998 to 2000. He was elected to the National Academy of Sciences in 1996. Roberts received his Ph.D. in plant physiology and biochemistry from Oxford University, England, in 1965. Among his numerous awards and honors, Roberts was named a Fellow of the World Health Organization (1977), and has been awarded the U.S Department of Agriculture Distinguished Scientist (1992), Alexander von Humboldt Award for Agriculture (1996), and the Wolf Prize for Agriculture (2003). He previously served on the National Research Council Committee on Defining Science-Based Concerns Associated with Products of Animal Biotechnology, and currently serves on the Editorial Board of The Proceedings of the National Academy of Sciences.

Members

Joseph W. Alexander, D.V.M., is Vice President for Research and External Relations at Oklahoma State University, and previously was the Dean of the College of Veterinary Medicine. His responsibilities in administration of research services include ensuring that all research programs and policies are in compliance with state and federal regulations. He has extensive experience with the administration of veterinary hospitals. Alexander's research has focused on orthopedics and dysplasia in cats and dogs, with additional research involving marine mammals. While at Oklahoma State University, he oversaw the operation of the Boren Veterinary Medical Teaching Hospital. During his tenure with Virginia Tech, he was the Director for the Veterinary Medical Teaching Hospital. Alexander was selected as a Distinguished Practitioner by his peers in the National Academy of Practice in Veterinary Medicine in 1997. He is a past president of the Association of American Veterinary Medical Colleges and a past president of the International Association of Aquatic Animal Medicine. He has also been a Diplomate of the American College of Veterinary Surgeons since 1979. He is the editor of several books on the veterinary clinics of North America, and orthopedic diseases. Alexander has a B.S. in animal science from the University of Arizona, an M.S. in educational administration from the University of Tennessee and supervision, and a D.V.M. from Colorado State University.

Bradford S. Bell, Ph.D., is an Assistant Professor of Industrial and Labor Relations at Cornell University. Previously, he was a lecturer in industrial and organizational psychology at Michigan State University. Bell has experience in organizational psychology studying the implications of integrating the features of active learning techniques into complex and dynamic learning environments. His primary research focuses on developing learning

systems that can enhance individual, team, and organizational effectiveness. His most recent research examines the implications of errors for individual and organizational learning. Bell's research has also examined the impact of individual attributes on learning, and the implications this has for designing effective organizational learning systems. His work has been published in numerous journals and books. He has also worked as a consultant, designing training and development, selection, and performance management systems for a variety of public and private organizations, including the Michigan Occupational Safety and Health Administration, Veterinary Centers of America, the Michigan Center for Truck Safety, and the Toledo Police Department. He is a member of the Society for Human Resources Management, the American Psychological Association, the American Psychological Society, and the Society for Industrial and Organizational Psychology. Bell received his M.Am. and Ph.D. in industrial and organizational psychology from Michigan State University, and his B.A. in psychology from the University of Maryland at College Park.

Kurt Benirschke, M.D., is a Professor Emeritus and former Chair of the Department of Pathology at the University of California, San Diego. He also has served as Director of Research at the San Diego Zoo, and Chair of the Department of Pathology at the Dartmouth Medical School. Benirschke served on the Board of Directors (1986-2000) and as President (1998-2000) of the Zoological Society of San Diego. He has served as a consultant to the National Institutes of Health, World Health Organization, the Armed Forces Institute of Pathology, and Max Planck Institute for Evolutionary Anthropology. He has expertise in pathology, zoo research, and zoo administration. He received his M.D. in 1948 in Hamburg, Germany. Benirschke was elected to the New York Academy of Sciences in 1993 and the American Academy of Arts and Sciences in 1994. He previously served on the National Research Council Committee on the Use of Animals in Biomedical and Behavioral Research and Panel on Microlivestock. Benirschke was awarded the American Zoo and Aquarium Association's highest honor, the R. Marlin Perkins Award, in 1998.

Janet Brannian, M.A., is an Adjunct English Instructor at University of Sioux Falls and freelance journalist. She has experience as a zookeeper and animal technician. From 1983 to 1988 she was a Bird Keeper, then an Animal Technician at the Kansas City Zoo, where she maintained the animal collection and trained the zoo volunteers to handle education animals. Brannian also supervised zookeepers in the bird department. Brannian was a science museum educator at the Oregon Museum of Science and Industry from 1990-1992, developing and presenting science demonstrations to museum visitors, and outreach classes to local schools. She currently volunteers at the Sertoma Butterfly House, preparing diets and providing care for butterflies and other invertebrates, and at The Outdoor Campus, providing care for education animals. Brannian received her B.A. (1981) in psychology from the University of Missouri and M.A. in English from the University of South Dakota.

Charles C. Capen, D.V.M, Ph.D., (IOM) is a Distinguished University Professor in the Department of Veterinary Biosciences at The Ohio State University. Capen received his D.V.M from Washington State University, and his M.S. and Ph.D. in veterinary pathology from The Ohio State University. He has expertise in comparative pathology, medicine and toxicology. Capen has been a Diplomate of the American College of Veterinary Pathologists since 1965, and was named a Distinguished Member in 1999. He is a past president of the Society of Toxicologic Pathologists and the Association of Veterinary Pathology Chairpersons in North America. Capen has served on the editorial boards of Drug and Chemical Toxicology, Experimental and Toxicologic Pathology, and Food and Chemical Toxicology. He has served on the U.S. Environmental Protection Agency's Science Advisory Panel on Endocrine Disruptor Screening Programs, and the World Health Organization's International Agency for Research on Cancer.

Rhetaugh Graves Dumas, Ph.D., RN, (IOM) is Vice Provost Emerita, Dean Emerita and Lucille Cole Professor of Nursing at the University of Michigan School of Nursing. Previously, she was the Deputy Director of the National Institute of Mental Health (NIMH) of the U.S. Department of Health and Human Services. Dumas is currently finishing a book on the complexities of leadership in human groups and organizations, and continues to provide lectures, consultations, and technical assistance to students, faculty, and administrators in nursing, health care, and various other fields. She has expertise in health care and administration. She is a fellow and former President of the American Academy of Nursing and the National League of Nursing, and served as a member of President Clinton's National Bioethics Advisory Board. Dr. Dumas holds a B.S. degree in nursing from Dillard University, New Orleans, an M.S. in Psychiatric Nursing from Yale University, and a Ph.D. in social psychology from the Union Institute of Cincinnati, Ohio. She was elected to the Institute of Medicine in 1984. She previously served on the National Research Council Committee to Review the Department of Defense's Breast Cancer Research Program, Committee on A National Neural Circuitry Data Base: A Shared Resource for the Basic and Clinical Neurosciences,

and Committee to Plan a Major Study on National Long Term Care Policies.

Lester Fisher, D.V.M., is founder and President of LEF Company, a consulting firm to nonprofits. He also is Vice President of the Morris Animal Foundation and Director Emeritus of the Lincoln Park Zoological Gardens in Chicago, where he served as director for 30 years. He received his D.V.M. from Iowa State University in 1943. Fisher was also the owner and director of Berwyn (Illinois) Animal Hospital, Associate Professor in the Department of Biology at DePaul University, and Adjunct Professor of Zoology at the University of Illinois. He has expertise in zoo management and zoo veterinary medicine. Fisher was a member of the International Union of Directors of Zoological Gardens (Vice President 1980-1983; President 1983-1986) and the American Association of Zoo Veterinarians (President 1966-1969). As the second American Zoo and Aquarium Association President, he oversaw the establishment of the International Species Information System. During his presidency, a significant increase in federal legislation affecting zoos was dealt with (including major revisions to the Endangered Species Act), and the Regional Conference Proceedings began publication. Fisher was awarded the American Zoo and Aquarium Association's highest honor, the R. Marlin Perkins Award, in 1996.

Harold F. Hintz, Ph.D., is a Professor and Chair Emeritus of the Department of Animal Science at Cornell University. He has extensive expertise in animal nutrition, with a specialization in energy, mineral, and protein and amino acid metabolism in equines. Throughout his career, Hintz has also conducted nutrition research in felines, canines, and a variety of zoo animals. He is currently president of the American Academy of Veterinary Nutrition and is president emeritus of the Equine Nutrition and Physiology Society. In 2002, Hintz was named an Honorary Diplomate of the American College of Veterinary Nutrition. Previously, he has served as chair on both the National Research Council Committee on Animal Nutrition (1992) and Committee on Nutrient Requirements of Horses (1978). He also served as chair of the 2002 meeting of the International Conference on Equine Exercise Physiology. Hintz received his B.S. from The Ohio State University in animal science, and M.S. and Ph.D. from Cornell University in animal nutrition.

Paul W. Johnson, Ph.D., is the owner and operator (along with his family) of Oneota Slopes Farm near Decorah, IA, since 1974, where he has been involved raising dairy, corn, soybeans, hay, beef cattle, sheep, and Christmas trees. He has expertise in practical care and feeding of domestic livestock, and experience in managing a multifaceted operation involving animals and plants. Johnson served three terms in the Iowa State Legislature, 1984-1990, and was chief of the Soil Conservation Service (now the Natural Resources Conservation Service, NRCS) at the U.S. Department of Agriculture from 1993 to 1997. He served as the director of the Iowa Department of Natural Resources from 1999 to 2000. Johnson received a B.S. and an M.S. in forestry from the University of Michigan, and conducted doctoral research in tropical-forest ecology in Costa Rica. He holds an honorary doctorate from Luther College in Decorah, IA. He served as a Peace Corps volunteer in Ghana from 1962 to 1964. Johnson served two terms on the National Research Council Board on Agriculture (1988-1993), where he reviewed the National Research Council report on alternative agriculture and took part in the development of the National Research Initiative Competitive Grants Program. He served as an ex officio member of the Committee on Long Range Soil and Water Conservation Policy in 1990-1993, and helped to implement many of its recommendations while chief of NRCS. He most recently served on the National Research Council Committee on Opportunities in Agriculture.

Maxim Kiefer, C.I.H., is Director of the Atlanta Field Office and Senior Industrial Hygienist at the National Institute for Occupational Safety and Health (NIOSH) of the Centers for Disease Control and Prevention in Atlanta, Georgia. He is responsible for supporting the NIOSH health hazard evaluation program by planning, organizing, and conducting comprehensive industrial hygiene assessments in all industrial sectors involving chemical, biological, and physical hazards. Kiefer has expertise in providing technical advice, assistance, and training on a wide range of industrial hygiene matters to employers, employees, and the occupational safety and health community. He has served as a weapons inspector for the United Nations in Cyprus, and is a Certified Hazardous Materials Emergency Response Technician. He received the Division of Health and Human Service Award for Distinguished Service during the emergency response to the World Trade Center. He received an M.S from Colorado State University (1984) and B.S from the University of Georgia (1982), both in environmental health.

Rebecca Remillard, Ph.D., D.V.M., is a Staff Veterinarian and Clinical Nutritionist at MSPCA Angell Memorial Animal Hospital. She is also Director of Hospital Continuing Education and Director of Clinical Research at MSPCA Angell Memorial Animal Hospital. As a practicing veterinarian in a large state-of-the-art medical center, she has extensive knowledge of current veterinary medicine practices and expertise in animal nutrition. Her major

research interest is finding objective measures of nutritional status in animals to augment evaluations of patient progress. Remillard is a licensed veterinarian in Massachusetts. Since 1991, she has been a Diplomate of the American College of Veterinary Nutrition certified in comparative veterinary nutrition. She received a B.S. from Purdue University, an M.S. from University of Maine, and a Ph.D. from Colorado State University, all in animal science, and her D.V.M. from Tufts University. She is a past president of the American Academy of Veterinary Nutrition and Vice President of the American College of Veterinary Nutrition.

Bernard A. Schwetz,D.V.M., is the Acting Director for the Office for Human Research Protections at the Department of Health and Human Services. Schwetz earned his D.V.M. from the University of Minnesota and Ph.D. in pharmacology from the University of Iowa. He is nominated as a member of the committee because of his expertise in developmental and reproductive toxicology. Dr. Schwetz is a diplomate of the American Board of Toxicology. Previously, he was Acting Deputy Commissioner, Acting Principal Deputy Commissioner, and Senior Advisor for Science at FDA. He was also Director, National Center for Toxicological Research. He was also associate director of the National Toxicology Program at NIEHS. Dr. Schwetz is a member of the Society of Toxicology (SOT) and is past president of the Reproductive Toxicology Specialty Section of the national organization and of the North Carolina and South Carolina Regional Chapters of the SOT. He was editor of Fundamental and Applied Toxicology from 1986-1992, and serves on the Editorial Advisory Board of Environmental Health Perspectives and Critical Reviews in Toxicology. Dr. Schwetz was elected to the Institute of Medicine in 1998.

Thomas M. Yuill, Ph.D., is Emeritus Director of Gaylord Nelson Institute for Environmental Studies at the University of Wisconsin. He received his B.S. (1959) in wildlife management from Utah State University, and M.S. (1962) and Ph.D. (1964) in wildlife ecology and veterinary science (virology) from the University of Wisconsin. Yuill is also a professor emeritus in the Department of Animal Health and Biomedical Sciences and Department of Wildlife Ecology at the University of Wisconsin. He has expertise in virus ecology, arthropod-borne virology, animal ecology, and the environmental effects on epizootiology of animal diseases (emphasis on wildlife). Yuill is past president of the Organization for Tropical Studies and of the Wildlife Disease Association, and past Director for the Center for Livestock in International Development. He is a consultant to the National Institutes of Health (and past chair, U.S.- Japan Panel on Viral Diseases), Environmental Protection Agency, and U.S. Agency for International Development, and has served on the Board of Directors of the Tropical Agricultural Center for Research and Instruction (CATIE), headquartered in Costa Rica. He previously served on the National Research Council Panel on Microlivestock.

Stephen L. Zawistowski, Ph.D., is Senior Vice President and Science Advisor of The American Society for the Prevention of Cruelty to Animals. He has worked extensively in animal behavior and welfare. He joined The ASPCA in 1988 as vice president of education, after an academic career that included the University of Illinois, Indiana University, and St. John's University in New York. Zawistowski received his Ph.D. in 1983 and A.M. in 1979 from the University of Illinois in psychology and genetics. Zawistowski is on the Board of Directors for the National Council on Pet Population Study and Policy and is the Chairman of the Animal Behavior Society's Board of Professional Certification. He is a Certified Applied Animal Behaviorist, a Certified Technical Animal Rescue Specialist, and founding co-editor of the Journal of Applied Animal Welfare Science.

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