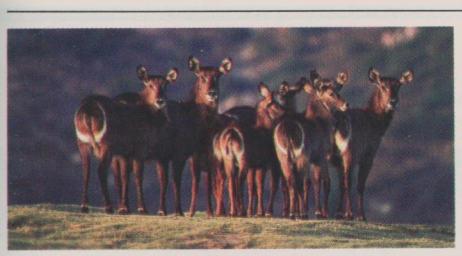

The Zoological Society's wildlife genetics research, whether in a laboratory in Kenya or here in San Diego at CRES, is this issue's focus. Also "wild" is this month's Celebration for the Critters, held on September 21.

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Front: Among African elephants *Loxodonta africana africana*, calves will stay close to their mothers and the herd for many months after birth. San Diego Zoo photo by Ron Garrison.

Back: The sight of an African lion *Panthera leo* up in a tree is not unusual in the wild—it's the ideal spot for a nap. San Diego Zoo photo by Ron Garrison.

LETTERS

Thank you for the large-sized pictures you print in ZOONOOZ every month. My 18-month-old enjoys looking at the pictures while I read and tell him about them. To expose our children now to the joy of animals is an investment in our future, for the children of today will save the animals of tomorrow.

Karen L. Bowersox
San Diego, CA

We should like to express to you our sincere appreciation for your thoughtfulness in sending us copies of the ZOONOOZ publication.

Every issue is received with the keenest of interest by all staff members here. It is without question the world's premiere zoo publication. It is the most avidly read zoo magazine in our library, and constantly checked back into for vital references.

Thank you for this fine work. It is truly appreciated.

Donald C. McKenzie
Senior Curator, Polar Park
Alberta, Canada

A Note to Members: During our busy summer and fall seasons you can help the Zoo and Wild Animal Park admissions staffs to get you through the turnstiles quickly by having both your membership and your photo identification cards available when you are ready to enter at either facility.

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- Promote activities at the San Diego Zoo and San Diego Wild Animal Park, and stimulate attendance.
- Generate interest in and membership in the Society.
- Contribute to the reader's knowledge of exhibits, research, education, animals, plants, and other matters pertinent to the Society's purposes.

Board of Trustees **November 1983**

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Hours from September 4 through October 21

San Diego Zoo	Wild Animal Park
Gates open: 9 A.M.	Gates open: 9 A.M.
Gates close: 4 P.M.	Gates close: 4 P.M.
Off grounds: 6 P.M.	Off grounds: 5 P.M.

Amboseli National Park in Kenya lies at the foot of Mt. Kilimanjaro, the tallest mountain in Africa. Amboseli is famous for its resident population of elephants.

Oliver Ryder

A Wildlife Genetics Laboratory in Kenya

Dr. Oliver Ryder, Kleberg Chair in Genetics at the Zoological Society's Center for Reproduction of Endangered Species, expands here on his project involving the transfer of wildlife genetics research technology to Kenya, first described in his Letter from the Field (ZOONOOZ, June 1990). For the period of February through May of this year, Dr. Ryder worked in Kenya at the National Museums of Kenya. He was assisted in this project by CRES staff members Arlene Kumamoto, cytogenetics specialist, and Leona Chemnick, molecular genetics specialist.

Oliver A. Ryder, Ph.D. GENETICIST

Newly developed technologies in the field of molecular genetics have produced significant advances in the fields of human and animal genetics. For selected endangered species, the "new genetics" has resulted in new insights into population structure, evolution, systematics (or taxonomy), and the consequences of reproductive isolation for these species. Examples include California condors, orangutans, zebras, and the Asiatic wild asses. However, the number of species for which such state-of-the-art investigations could provide significant gene pool management data greatly surpasses the resources currently available.

To date, the laboratories that have worked on and applied the new technologies reside in developed countries, yet many of the necessary studies can only be conducted with the cooperation of zoological parks and/or wildlife departments in developing countries. Quarantine and agricultural import and export regulations often do not allow the transfer of appropriate biological samples from field laboratories in these countries to laboratories elsewhere. For

example, samples for chromosome analysis from African antelopes cannot be legally imported into the United States. Thus, the transfer of current conservation genetics technology to zoological parks and wildlife research centers in other countries is urgently needed in order to develop appropriate strategies for preserving wildlife. Conservation biologists in Kenya have also recognized the need for the local development and application of new research approaches, but they lack access to instruction in these new technologies.

The Zoological Society of San Diego is now assisting in the development of a wildlife genetics laboratory within the National Museums of Kenya. The Department of Genetics of the National Museums is headed by Dr. Rashid Abdi Aman, a native-born Kenyan. We met and had planning discussions in San Diego and in Kenya prior to my extended visit early in 1990. As a result of these visits, we produced an overall project plan as well as plans for what we hoped to accomplish during the initial phase, when I would visit and set up the laboratory.

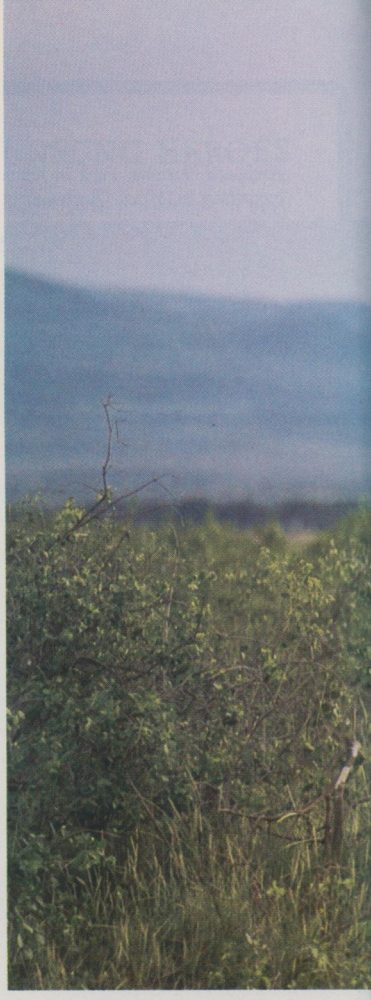
We implemented our plan over a three-month period earlier this year and discovered unique opportunities for wildlife genetics studies at the lab in Kenya. Just outside Nairobi, in a forest reserve, the Institute of Primate Research (IPR) of the National Museums has sophisticated laboratory facilities that provided an ideal starting point for our collaborative effort in genetics, especially because the mission of IPR includes species conservation.

The new laboratory for molecular genetics studies of African wildlife complements the existing program in genetics at the National Museums. Funding to help establish the new laboratory in Kenya, and to support the advanced training of a Kenyan scholar at CRES (who will return to Kenya to work on projects in conservation genetics), was provided by The Pew Charitable Trusts and the John and Beverly Stauffer Foundation.

Our plan called for developing the capability to grow cells for chromosomal analysis. We wanted to be able to grow white blood cells and skin cells (fibroblasts) in cell culture, harvest cells for chromosomal studies, and begin a collection of frozen fibroblast cell strains in Kenya similar to the large collection that exists at CRES. Our plan also called for developing DNA analysis capabilities, including detection of DNA molecules by hybridization with molecular probes, and the amplification of DNA sequences utilizing a technique called PCR (polymerase chain reaction). Dr. Aman and I also developed a plan for collecting the necessary samples for genetic characterization. We chose several species to focus on initially; the first efforts in the lab involved studying the chromosomes of colobus monkeys from IPR's breeding group.

We recognized that it was critical to establish a collaboration with the wildlife veterinarians of the Kenya Wildlife Services in order for our program to be successful. Kenya Wildlife Services, headed by Dr. Richard Leakey, noted anthropologist, is responsible for the national parks and reserves of Kenya as well as all Kenyan wildlife. The wildlife veterinarians were the necessary link between such efforts as the translocation of black rhinos into and between the system of established Kenyan sanctuaries and the studies at the wildlife genetics lab. We supplied Drs. Dieter Röttcher and John Jonyo, wildlife veterinarians, with the necessary materials and demonstrated the procedure for obtaining the skin biopsy samples that we needed in order to establish the cell strains.

Our first opportunity to study animals from Kenya's national parks came when Drs. Röttcher and Jonyo had to immobilize an elephant in Amboseli National Park in order to treat him for an infection from a snare wound. We were able to establish and freeze our first fibroblast cell line at the IPR lab from a small piece of tissue obtained from the elephant's ear while he was anesthetized. Over the course of the three months, several more elephants were treated by the



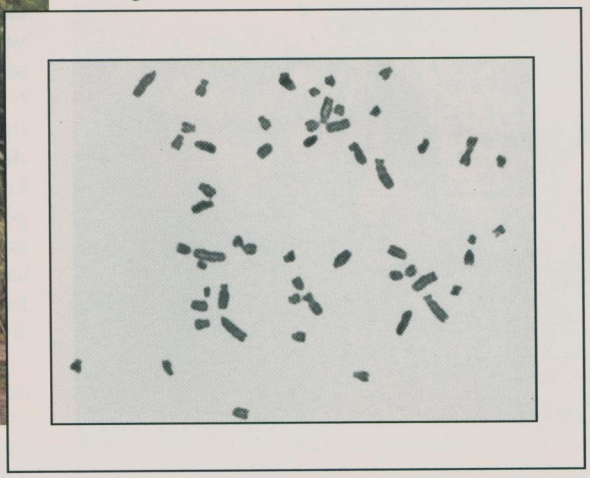
Oliver Ryder

Oliver Ryder

Vervet monkeys Cercopithecus aethiops *are still numerous inhabitants of acacia forests in Kenya. The young nurse for about one year after birth, until the arrival of the next offspring.*

At the Zoological Society's Center for Reproduction of Endangered Species, investigations . . . have provided insights into the biology of threatened and endangered species and have had impacts on conservation management plans.

Metaphase chromosomes of a male African elephant Loxodonta africana africana, *cultured from white blood cells at the Kenya wildlife lab. Condensed chromosomes can only be observed from cells about to undergo cell division.*



wildlife veterinarians and several more valuable cell lines were established. I think that our preparations of elephant chromosomes derived from white blood cells were the first ever made in Africa (see inset).

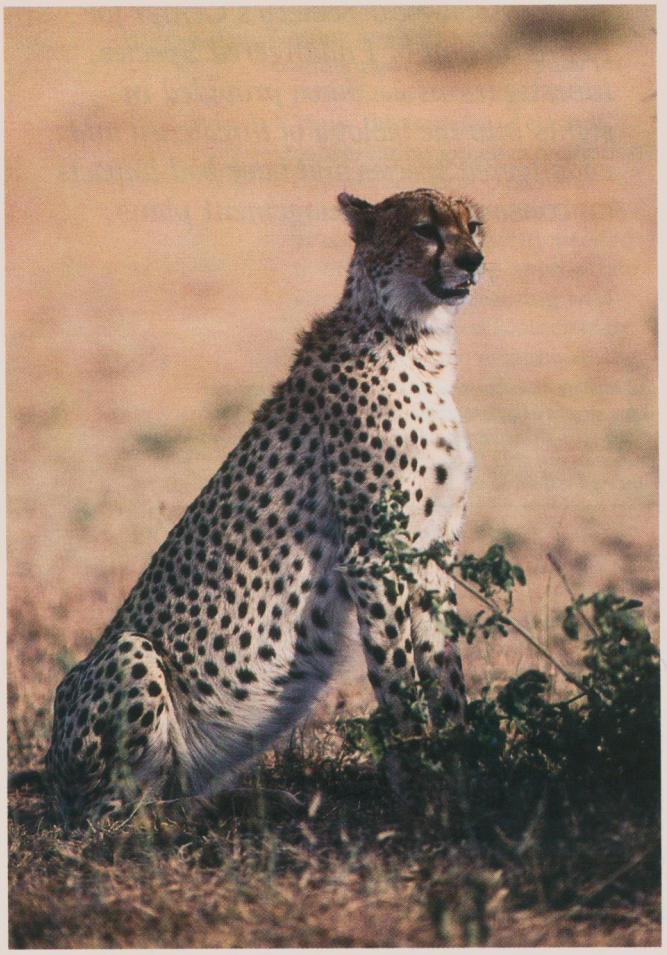
In addition to chromosomal studies and the freezing of cell strains, another major part of our plans for the lab at IPR included developing a program in molecular genetics. Analysis of DNA molecules is providing significant information about genetic aspects of many species that was not previously available. Dr. Aman and I want to develop approaches based on DNA analysis that will allow us to identify and monitor genetic variation that constitutes the gene pool of some of Kenya's endangered species, such as the black rhino.

In collaboration with Kenya Wildlife Services, we will have the opportunity to investigate the mitochondrial DNA and chromosomes from animals of known geographic origin. Blood samples were obtained from the 20 black rhinos translocated into the fenced rhino sanctuary in Lake Nakuru National Park and were held in ultracold freezers in Nairobi. DNA purified from these samples has been dissected and analyzed at the wildlife genetics laboratory. The objective was to search for heritable characteristics known to vary among rhino individuals from different parts of the species' range.

East African black rhinoceros Diceros bicornis michaeli *and calf.*

San Diego Zoo: C. Raciot

San Diego Zoo: R. Garrison



The future survival of African cheetahs Acinonyx jubatus *depends on increased understanding of their immune system, reproduction, and genetics. Working with cheetahs at the Wild Animal Park, CRES researchers are involved in investigations in these areas.*

The genetic variation that constitutes the gene pool of a species is, rather typically, not distributed uniformly across the range of a species. Even cheetahs, with their notoriously low extent of genetic variation, exhibit genetic differences between the southern and East African forms. For the vast majority of threatened or endangered animal species, no scientific knowledge exists concerning the extent of genetic variation within the species as a whole or among the geographically distributed populations of the species. However, this information will be useful, and in some instances, critical, within a country such as Kenya that has national parks distributed among differing ecological zones. Such knowledge will have specific application as animals are considered for translocation between sanctuaries and as attention is focused on protecting the diversity of the wildlife resources.

The link between the knowledge gained at the wildlife genetics laboratory (National Museums of Kenya) and the applied efforts to sustain wildlife within Kenya will result in the first studies of their kind undertaken for many species. A genetic survey of animals within Kenya's marvelous national parks would provide information about the genetic status of species in each park and the extent of gene pool similarities and differences among the populations of the same species in each park. Such studies may also help recognize populations of animals that differ genetically, and may possibly suggest they have had separate evolutionary histories, or are adapting to different environments, or are genetically incompatible.

The next major component of the transfer of conservation genetics research technologies to Kenya will involve the training of a Kenyan scientist at the CRES genetics laboratories. Over the next year, the visiting scientist will engage in research activities at CRES, using the new technologies that now exist in the wildlife genetics laboratory in Kenya. Upon returning home, the Kenyan scientist will be able to participate with Dr. Aman in his program, undertaking studies of importance to conservation planning and wildlife management in Kenya.

Already, wildlife genetics studies undertaken at the laboratory at IPR include such species as the African elephant *Loxodonta africana africana*, waterbuck *Kobus ellipsiprymnus* (see accompanying CRES Corner article), Grevy's zebra *Equus grevyi*, Kirk's dik-dik *Madoqua kirki*, and beisa oryx *Oryx gazella beisa*. The DNA studies have

GOALS OF TECHNOLOGY TRANSFER

- To provide training and research experience to scientists in developing countries in order that they might better develop their own in-house research capabilities in conservation genetics.
- To undertake research investigations necessary for conservation management in laboratories within developing countries.
- To provide educational exchanges of scientific personnel between institutions.
- To jointly publish reports in the scientific literature.

Oliver Ryder

Kirk's dik-dik Madoqua kirki

Grevy's zebra Equus grevyi

concentrated on the East African black rhinoceros *Diceros bicornis michaeli*.

Surely, there is a large amount of information to be collected, and it cannot be expected to accumulate more rapidly than samples can be obtained. Nonetheless, it is an exciting prospect that the effort can begin in earnest in Kenya. Collecting necessary genetic information will enable Kenya to gain a better understanding of its wildlife resources, and to conserve them for future generations of both its citizens and the citizens of the world. ZNZ

Countries such as the Republic of Kenya face the challenge of meeting the needs of its human population while also conserving the wildlife that is of significant benefit to the national economy as well as a global resource of biological diversity.

One of the ways that zoological parks now contribute to the conservation of biological diversity is by establishing self-sustaining, captive wildlife populations that are managed to preserve species' gene pools. Concerns about inbreeding, disease epidemics, and reduction of the gene pool in small populations have led to new approaches in zoo animal management because of the threat to population viability.

For many species in the wild, habitat changes, poaching activities, and other human pressures have reduced population numbers, fragmented remnant populations, and led to their endangerment. Concerns about the population viability of these small populations, similar to those mentioned above for captive populations, are being raised for an increasing number of species, such as the black rhino. The expertise that has been developed within the zoo community, appropriately applied, can help ensure that wildlife populations in natural habitats are also self-sustaining.

In the zoos and aquaria of the developed world, research centers have been established in response to these concerns that make an effort to gather the information required to create wildlife populations that are secure from the risk of extinction. For each species of concern, there is specific information to be gathered. At the Zoological Society's Center for Reproduction of Endangered Species, investigations into behavior, genetics, infectious diseases, reproductive physiology, and endocrinology have provided insights into the biology of threatened and endangered species and have had impacts on conservation management plans.

Countries such as the Republic of Kenya face the challenge of meeting the needs of its human population while also conserving the wildlife that is of significant benefit to the national economy as well as a global resource of biological diversity. The ability to gather the scientific information required for management plans significantly affects whether or not they can achieve the goal of sustaining their wildlife resources.

Sunset over Amboseli National Park. Oliver Ryder

Author's Note: A discussion of the Kenya wildlife lab and CRES will be included in KPBS-TV Channel 15's airing of "The Keepers of Eden," an episode of the Infinite Voyage series, on October 1, at 8 p.m.