Dear volunteers,

Much has happened since your journey to Tsavo. The purpose of the attached report is to summarise progress on the governing questions of the lion project and to outline the work we still hope to accomplish.

In all, 10 teams containing 77 volunteers contributed to our progress in 2006. As in 2005, one team was cancelled owing to poor recruitment (versus two in 2004 and three in 2003). For the second year running, we hosted HSBC fellows in Tsavo, which was a signal pleasure in every single case--no wonder their bank is doing so well the world over! And we settled into our new camp at the foot of Satao Rock, *Campi ya Neka* ("Lion Camp"). On more than one occasion, we actually hosted lions in camp! Volunteer Kathy Evans was back on the project for the fifth year in a row.

We had more rain than normal, which depressed lion sightings a bit. Teams averaged 5.2 lion sightings, saw an average of 6.9 lions, and observed them for six hours and 45 minutes. We also collected samples for genetic and hormonal analysis and acquired enough photos to thoroughly document several new lions. Volunteers participated in extensive monitoring of other predator and prey species in the *Commiphora-Acacia* scrub, observing animals that few persons on safari ever see. For example, every team saw aardwolves, African civets, serval, and white-tailed mongoose.

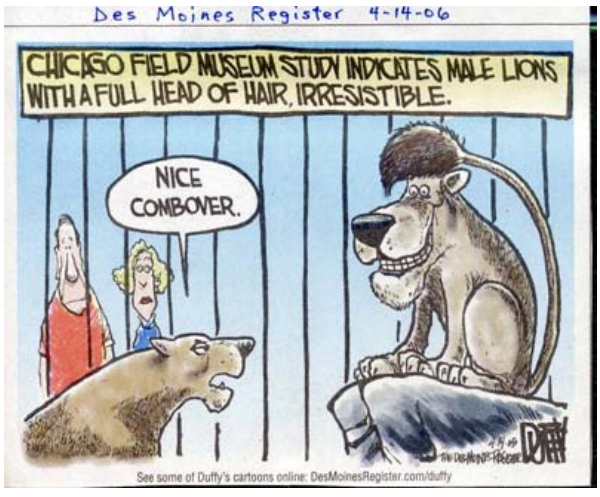
Throughout the year, we tallied 21,967 wildlife observations using the Cybertracker data-recording system. This PDA with integrated geopositioning capabilities places a time-and-place stamp on every wildlife sighting, and also allows us to record the distance at which they're seen. These data yield highly accurate density estimates based on the differential detectabilities of the different species (via the program Distance 4.0).

A number of you have visited the project's web pages both at Earthwatch's web pages http://www.earthwatch.org/expeditions/patterson.html and at the field museum's http://fm1.fieldmuseum.org/aa/staff_page.cgi?staff=patterso&id=345. We continue to post updates and circulate links to new research and articles as they appear, so keep revisiting us.

Once again, on behalf of Samuel, Alex and the entire *Lions of Tsavo* team, thanks for your participation and commitment to the project. We hope you've found it rewarding.

Very best wishes,
Sincerely,

Bruce D. Patterson
MacArthur Curator of Mammals,
The Field Museum
PI, *Lions of Tsavo*, Earthwatch Institute



EARTHWATCH INSTITUTE FIELD REPORT 2006

Project Title: Lions of Tsavo

Principal Investigators: Bruce D. Patterson, Samuel M. Kasiki, Alex M. Gombe

Position/Affiliations: MacArthur Curator of Mammals, Field Museum of Natural History

Assistant Director, Kenya Wildlife Service

Research Associate, Kenya Wildlife Service

Research Site: Kenya: Coast Province; Taita-Taveta District, Taita-Rukinga Conservancy (-3.83093 degrees S, 38.837 degrees E)

Local Management Status of the Research Site: Private conservancy under joint management of Wildlife Works® and South Cross Safaris; under consideration for federal protection.

Scientific names of primary species being studied:

*Panthera leo; a*lso collecting information on various other species of special concern, including *Acinonyx jubatus*, *Equus grevyi*, *Lycaon pictus*, *Proteles cristatus*, and various *Aquila* spp.

Key Research Objectives

To live in such varied circumstances as coastal deserts, alpine moorlands, and grassland savannas, lions must be adaptable. We expect lions to change their behavior, social groupings and even their appearance in accordance with local environmental circumstances. We believe that manelessness and their distinctive social system are responses of Tsavo's lions to a different environment, one that challenges their ability to lose heat and conserve water.

- The primary objective of this research is to characterise the physical and biotic environments of Tsavo's lions to better understand the appearance, food- and space-use, and social groupings of its lions. We pursue these life history studies in the context of three broader collaborations: (1) description and characterisation of the hormonal and developmental mechanisms that produce manelessness, led by Roland Kays and Julie Thornton; (2) regional inventories and surveys of mane and social variation, led by Tina Ramme; and (3) continental genetic surveys of lions, led by Jean Dubach.

- Another objective of our research is to mitigate lion conflict with humans through more detailed understanding of lion ecology in Tsavo. By identifying and localizing risks to people and livestock, both in space and time, we can promote more effective management decisions.

- Finally, we aim to collect information on the distribution and abundance of more than 100 species of mammals, birds and reptiles that inhabit the Taita-Rukinga

Conservancy. Many are regional endemics and some are globally threatened or endangered. Specific questions are outlined below.

Data Collection and Results

a) Give a concise account of the data you have collected during the past field season.
During the past year, 10 teams of volunteers made 52 contacts with lions (mean 5.2 per team), recording a total of 38 different lions (mean 6.9 lions per team) and spending an average of six hours, 42 minutes observing lions. In addition, volunteers used the Cybertracker system to record the time, place, age and sex compositions of 21,964 observations, totalling 66,794 individuals of 91 vertebrate species.

b) What progress have you made towards achieving your original objectives?
After five full years, we continue to chronicle the life histories of individual lions we met in 2002, as well as their progeny and newcomers. Observations throughout the year provide critical information on the dynamics of social groupings, the arrivals and passages of nomads, and the fate of newly-born cubs. Between-year variation in climate (especially precipitation and temperature) provides indications of how malleable these ecological and behavioural responses really are.

c) Please provide a summary of your results.
Lion societies in Tsavo are comprised of female groups ("prides"), as are lions elsewhere, but these are tended by remarkably small "coalitions" of males. Kays and Patterson (2002) documented only one male per pride in 1999 in arid parts of Tsavo East. In the wetter ranch lands, we have documented stable prides tended for years by lone-male and two-male coalitions. Ranch lions also differ from same-aged lions in Tsavo East in having heavier manes, which are possible because of their greater access to water throughout the year (and consequent lower heat stress from overheating). Our studies on captive lions in North America using "alumni" of the Lions of Tsavo field programme showed that up to 50% of the variation in mane length and density in zoo lions is due to climate and climate alone.

Significance/Benefits of Research

a) What is/are the significance/benefits of your research at the following levels?

- Local

Our studies (Patterson et al. 2004) analysed livestock depredations and showed the significantly greater risk of cattle and shoat herds during the rainy season, in contrast to conflict analyses in high-elevation grasslands. By seasonal stocking strategies or use of reinforced *bomas* (corrals) during the wet season, ranchers can minimise losses to predators. Once the cost of predators is reduced or eliminated, animal-human conflict disappears as well, permitting a more peaceful coexistence. We also see conspicuous evidence that KWS is actively researching lions and other predators in Tsavo to mitigate their adverse effects on local communities.

- National

Our volunteer teams have provided key support for a new economic model for the ranch lands—ecotourism. Land-use fees for volunteers generate more income than cattle leases, and incur none of the costs (over-grazing, destruction of carnivores, bushmeat

harvests). They also provide incentive for better regional security (for international visitors), which in turn discourages illegal resource exploitation, such as trafficking in bushmeat and charcoal.

- International

We have shown that lions vary significantly in behaviour, ecology and appearance, in ways that adapt them to local environmental circumstances. This suggests that proven solutions to conflicts with lions cannot be applied indiscriminately in other parts of Africa, where the same environmental controls and correlates may be missing.

b) How do your findings contribute to issues of sustainability?
To date, 374 volunteers from 30 nations have worked in the field on the Tsavo lion project. They have gained firsthand information on the complexities of living with wildlife, and of conserving vanishing species and natural resources while accommodating national development and fostering human welfare.

Dissemination of Results

a) Have you provided details of results from your research to or within:

- Scientific papers: peer reviewed (Patterson et al., 2006); in progress/press (Patterson, 2007)

PATTERSON BD, RW KAYS, SM KASIKI and VM SEBESTYEN. 2006. Developmental effects of climate on the lion's mane (*Panthera leo*). Journal of Mammalogy 87:193-200 + cover

PATTERSON, BD. 2007. The African lion (*Panthera leo*): a variable, adaptable enigma. Evolutionary Biology.

- Presentations (given or planned)

Council of Science, Field Museum of Natural History "Understanding Evolution" (lecture to 30 people, Jun 5, 2006)
Institutional Advancement, Field Museum of Natural History "Lions" (lecture to 10 prospective donors, Sep 5, 2006)
First-year seminars, Smith College, Northampton MA "Manes, man-eating, and other myths of African lions" (public lecture to 85 people; class of 12 college students (Nov 2-3, 2006)
Scientist-on-Exhibit, Field Museum of Natural History "The Legendary Lions of Tsavo" (public lecture to 200, Nov 25, 2006)
Midwest Museum of Natural History, Sycamore IL "Manes, man-eating, and other myths of African lions" (public lecture, 15 Jan 2007)

All publications and many third-party articles are posted at
http://fm1.fieldmuseum.org/aa/staff_page.cgi?staff=patterso&id=308
For example 21 web articles were based on our cover study in the *Journal of Mammalogy*

Volunteer Tasks and Accomplishments

a) How did the volunteers contribute ideas, skills, expertise and motivations beyond that which you anticipated?

Our programme of instruction during week 1 is constantly revised by feedback from volunteers. Based on volunteer suggestions, we have recently expanded our camp library to include books on Kenyan cultures and trees. We have found that volunteers with jobs requiring discipline and rigour (e.g., nurses, military) mesh especially well with the repetitive and standardised aspects of data collection. We are constantly inspired by the number of people who have left the project and changed career plans, directions, and goals in order to make the world a better place.

b) How have volunteers helped you to achieve your research or educational objectives?

There are positive correlations between the number of lions sighted and the number of volunteers per team (and the number of vehicles used to find them). The more the merrier! The flurry of activities required when lions are sighted requires something from all hands present.

We regard each and every volunteer on our project as an alumnus, and encourage them to communicate their new-found understanding of ecology, conservation and sustainability with friends, family and associates. Volunteers make dozens of presentations each year, and do so around the world. They are vital to efforts to publicise Africa's conservation and development needs.

Project Development

a) What logistical or scientific challenges have you encountered in the past season and how will you address them during the next field season?

Our largest obstacle remains the one we encountered first in Tsavo in 1998: these wide-ranging lions are difficult to locate in the woodlands that surround the park. The habitat also limits the effectiveness of radio-tracking. We remain dependent on extensive, continuous monitoring drives to bring us into contact with lions.

b) Have you used any additional methods/strategies to meet your research objectives?

Although it has given us novel insights into animal movements and furnished new data on lion ranges, the GSM-GPS technology for tracking the lions has proven disappointing for increasing volunteer contact with lions. Incomplete network coverage on the ranches (including difficult access from Campi ya Neka, which lies in the shadow of Satao Rock) appears to be the most likely cause.

Making the fullest possible use of data collected during the search for lions led us to employ the Cybertracker® data collection system via PDAs. We are assembling a massive dataset on distribution and density of numerous wildlife species of concern to both ecotourism and conservation. This year alone, we recorded the time, place, and circumstances of nearly 22,000 sightings of 66,700 individual animals.

c) How will you develop your research in the coming field season?

Our project is a long-term assessment of lion behaviour, ecology, and life-history in Tsavo. It is important that we continue to collect data and observations in a manner that can be seamlessly integrated with observations from 2002-2006. We will continue to evaluate and implement emerging technologies (like GSM-GPS collars and Cybertracker® software) when they appear to offer a legitimate extension to the data we have been considering for some years.

Educational Opportunities

a) Does your project directly or indirectly involve the following groups in your research topic?

Each year, we deliver lectures and research presentations to various audiences at universities, colleges, grade-schools, and to gap year students, as well as museum- and convention-goers. The project assistant Alex Gombe is currently pooling samples from the project for his MSc studies at Kenyatta University (expected matriculation September 2008). Each year, students applying to the highly competitive graduate program of the Committee on evolutionary Biology at the University of Chicago seek admission to pursue dissertation studies of sex and stress hormones in Tsavo lions.

b) Please tell us the ways your research helps these groups better understand the conservation of a sustainable environment (see the UNESCO definition above).

The eternal conflict between lions and pastoral people, and the real risks of "living with lions" casts animal-human conflict in a startlingly new and effective light. The potential that lions offer to ecotourism, and their costs to agriculture, are influenced by land-tenure and resource-extraction practices. The complexities of conservation in the real world exceed those imagined by armchair conservationists.

c) Has your project helped lead to the completion of Masters' theses, or other educational research findings?

A film developed around the project served as the Senior Thesis of Allison Garoza at the College of the Atlantic. One of our papers (Patterson et al 2004) served as inspiration and model for the MSc study of livestock depredations by lions in Botswana, by Christian del Valle (2005). Several high school and middle school science teachers have participated in the program and developed course modules for their classes back home based on experiences in Tsavo.

Partnerships

a) List partnerships or collaborations with other organisations that you have developed or maintained in the past season.

Kenya Wildlife Service-field permits, veterinary services, consultation, coordination
New York State Museum- radio-telemetry of lions (Roland Kays)
Harvard University-surveys of lions in Tsavo east and Tsavo West (Tina Ramme)
Chicago Zoological Society-genetic studies of African lions (Jean Dubach)
Bradford University, U.K.-histological studies of lion manes (Julie Thornton)
National Geographic Society-genetics and hormonal condition of lions

Acknowledgements

We are most grateful to the Field Museum (BDP) and Kenya Wildlife Service (SMK) for providing BDP and SMK with salary and administrative leave to conduct this research. Wildlife Works © has kindly permitted us to monitor lions on Rukinga Ranch, through the courtesy of Michael Korchinsky and Rob Dobson. We thank Torben Rune and Southern Cross Safaris for their superb hospitality in hosting our comfortable camp, and Steve Turner and Origins Safaris for providing us with such excellent guides. The financial support of Leonard Russo, John King, Linda McLaughlin, and Ellen and Walter Newsom have all furthered our ability to find lions and get meaningful data from them.