Kenya’s Forest Monkeys

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Columbia University

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Our Mission

Earthwatch Institute engages people worldwide in scientific field research and education to promote the understanding and action necessary for a sustainable environment.

We believe that achieving a sustainable future requires objective scientific data from the field—and that the scientific process must engage the general public if it is to change the world. To that end, we involve people from all walks of life directly in global field research.

We invite you to join us.

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-- An international nonprofit organization founded in Boston, Massachusetts in 1971--
Welcome to Earthwatch Institute!

You are just one step away from an experience that may change your life. You may travel to a land you’ve never seen, live with a culture you know little about, learn skills you’ve only imagined. All in the name of field research that leads to furthering our understanding of our natural and cultural resources.

The Expedition Briefing in your hands is your initiation to the project from the scientist’s own perspective. You will learn about the inspiration that led the scientist(s) to launch the research, the objectives, goals, and even achievements of the project to date. You will get a very real sense of how your participation contributes to solving a global research question.

Your assignment is to apply your own skills and talents to the research question. Your support helps to make the project – and over 130 like it – possible. Thank you for contributing your time and money to support scientific research, providing experiential learning, and inspiring environmental responsibility and global citizenship.

Now, find a comfortable chair and prepare for a fascinating journey.

~ Earthwatch Institute Staff
Dear Earthwatch Volunteer,

Welcome to the Kenya’s Forest Monkeys expedition! Imagine yourself standing amidst ancient Arab ruins, in a beautiful African forest full of age-old baobab trees a few miles from the Indian Ocean, listening to the haunting calls of hornbills, a giant elephant shrew scattering past you on the forest floor, a big lizard basking lazily in the sun, while you watch a troop of Sykes monkeys go about their daily business of feeding and socializing. Admittedly the setting couldn’t be more idyllic - but beware! You can expect long work days, many hours of staring up at trees through binoculars during which your patience will be seriously put to test, and a lot of scrambling about trying to keep up with the monkeys. If you think you are up for the challenge, we welcome you warmly and appreciate your help in finding out the long-term effects of food supplementation on the survival and well-being of Africa’s forest guenons.

On this expedition you will become very familiar with a group of Sykes monkeys, a forest guenon that is common throughout Eastern and Southern Africa. Like at many other places where humans have slowly encroached on protected tropical forests, the monkeys at Gedi have learned to take advantage of their closeness to people and frequently raid crops and garbage pits, and even accept food from visitors. Over the last two years we have found evidence that this provisioning increases competition among the monkeys compared to populations that are not provisioned. Now we want to find out if the behavioral changes observed are correlated with changes in the secretion pattern of stress hormones. Deviation from normal stress physiological responses, particularly chronically elevated stress levels, are known to have various detrimental effects on the immune system, longevity, and thus fitness of human and non-human primates. However, with traditional scientific methods of evaluating fitness and reproductive success, it could take decades to discern any effect of chronic stress levels because the monkeys live long and only reproduce slowly. Our study is one of the first to use non-invasive measurements of stress levels to assess possible fitness consequences of human encroachment on wild forest monkeys in Africa. You can be sure that your participation in this expedition will help not only to advance science, but also to make a significant impact on conservation and management strategies of forest monkeys.

After learning to identify individual adult female monkeys, you will follow assigned individuals for a specified time period and record their general activity (feeding, resting, moving) and particularly all social behaviors (grooming, aggression). Furthermore, you will try to obtain as many fecal samples from your focal animals as possible. Don’t worry – the collection procedures are safe and designed to minimize contact with the feces. You will also get involved in other activities such as setting up vegetation plots to assess availability of natural foods, and the monitoring of provisioning events. After a long day of work in the forest, you will welcome the hospitality and paradisiacal setting of our field station, the Mwamba Bird Observatory and Field Study Center, located on a deserted stretch of beach south of Watamu village. You will be treated to a wide range of local and exotic dishes in a family environment. Outside work, you will be able to experience Swahili culture first-hand with its old and rich mixture of African and Arab traditions.

We look forward to welcoming you in Kenya!

~ Kenya’s Forest Monkeys Project Staff
Kenya’s Forest Monkeys

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GENERAL INFORMATION

PRINCIPAL INVESTIGATORS: 1) Steffen Foerster  
2) Geoffrey Wahungu

POSITIONS AND AFFILIATIONS: 1) Doctoral Fellow, Columbia University, New York, United States  
2) Senior Lecturer, Moi University, Eldoret, Kenya

PROJECT TITLE: Kenya’s Forest Monkeys

RESEARCH SITE: Gedi Ruins, Watamu (North Coast), Kenya

EXPEDITION LENGTH: 11 days

TEAM SIZE MINIMUM/MAXIMUM: 6/8 volunteers

MINIMUM AGE OF PARTICIPATION: 18 years of age
THE EXPEDITION

1. PROJECT OVERVIEW

Direct and indirect food supplementation is common in areas where human settlements encroach on the habitat of non-human primates, but also in protected areas where food from visitors is accessible to the animals. Although it is known that the behavior and ecology of non-human primates can be heavily influenced by changes in food availability and distribution, the long-term consequences to the health and well-being of the animals is little understood. This project will investigate the behavioral and physiological changes caused by provisioning in a population of wild Sykes monkeys in Kenya. Secretion of stress hormones will be quantified non-invasively through cortisol metabolites in fecal samples of individually recognized females. Parallel to the collection of feces, the project will record acute and chronic stressors and seasonal fluctuations in food availability. In addition, the researchers will record known confounds of stress levels like reproductive status, energy expenditure, and coping behavior. In a collaborative study with the Institute of Primate Research, Nairobi, they will also quantify gastrointestinal parasite infection intensity as a supplementary measure of health status. Long-term consequences of provisioning on health and well-being of the monkeys will be assessed by comparing results between social groups exhibiting different levels of food supplementation.

Your participation in this project will help the researchers collect detailed data on the relationship of behavior and stress levels on a much finer scale than would otherwise be possible. With your assistance it will be possible to determine acute (short-term) responses to stressful events in individual monkeys, which will complement the assessment of long-term stress responses through more widely spaced samples at other times of the year. The data you collect will play an important part in achieving the overall research objectives. Both short- and long-term secretion patterns of stress hormones can be affected in these monkeys, but without your help the project would only be able to assess long-term changes. In addition to assessing the relationship between behavior and stress levels, you will also help set up and monitor vegetation plots to determine food availability and distribution. Although previous experience studying animal behavior is not required, volunteers should have an honest interest in behavioral studies.

Note: See Kenya’s Forest Monkeys: The Research in the appendix of this briefing for information on the research objectives, methods, and results of this project.
2. RESEARCH AREA

Gedi (also spelled Gede) Ruins is a protected archaeological site and museum with a beautiful old-growth lowland forest among ancient Arab ruins. An extended trail system allows Earthwatch teams to follow the monkeys with the least amount of disturbance, although bushwhacking is often necessary to keep up with them. The area is rich in bird life and has several interesting mammal species as well, such as elephant shrews, duikers, and suni antelopes. It is very close to one of the largest remaining coastal forests in East Africa, the Arabuko Sokoke Forest, home to elephants and many endemic species of plants and animals. The Tsavo East National Park lies to the northeast of Gedi and can be accessed easily by car for an excellent game drive. The nearby Mida Creek is an important bird area of international relevance for migrating water and shore birds, and has excellent opportunities to explore mangrove forests. The Sabaki River mouth a few miles to the north has very impressive sand dunes and deserted beaches. The field station itself is located next to the Indian Ocean, and a Marine National Park offers one of the most diverse coral reefs in Kenya right in front of the station. Should you choose to enjoy this park during recreational time or before or after your expedition, there is an entry fee of US$10 per visit to the coral reef. Snorkeling equipment is available for rent at the station.

The majority of people at the site speak English, which is Kenya’s official language. Swahili is the second most common language, especially among older people and those who did not go to school. In general, Kenyans are very open-minded, welcoming, and tolerant of different cultures. Because the North Coast is a major tourist destination, people around the study site have been exposed to tourists from all over the world. The most widespread religions in the area are Islam and Christianity (Protestant). Western cultural influence can be found everywhere, and local cultures and traditions are slowly being lost. Though Kenya has recently experienced political unrest as a result of the 2007 elections, the political atmosphere in the research area has been stable for many years, and there are no foreseeable security concerns. Most men and, to a lesser extent, women enjoy talking about politics and other domestic and international issues. More information on the cultural environment of the country can be found in a travel guidebook.

3. PROJECT STAFF

Principal Investigator

Steffen Foerster is a Doctoral Fellow in the Department of Ecology, Evolution and Environmental Biology at Columbia University, New York, and has been working with blue monkeys in Kenya since 1999. His areas of interest are wide-ranging and have included insects and birds in past research projects. For the last seven years, however, his focus has been the social behavior and stress physiology of non-human primates, focusing on the influence of environmental changes on wildlife behavior and health. Steffen has a comprehensive first-hand understanding of many of the world’s ecosystems and wildlife, having been trained in applied ecology and zoology at a German university, and having traveled extensively in Europe, Asia, Central America and East Africa. He speaks German, English, Swahili and some Spanish.

Co-Principal Investigator

Geoffrey Wahungu is a Senior Lecturer at Moi University in Kenya, having developed an interest in conservation in 1982 after joining the Wildlife Club of Maseno School during his first year in high school. He was later to become the club’s chairman in 1987. While attending Moi University, he also chaired the Wildlife Students Association. Geoffrey’s leadership and
stewardship in practice and training for conservation has culminated in his appointment as the Chair of the Department in the same institution where he trained and now teaches. He holds B.Sc. and M.Phil. degrees in Wildlife Management from Moi University and a Ph.D. in Wildlife Ecology from Griffith University in Queensland, Australia. Geoffrey has studied the ecology and habitat relations of a wide range of species from endangered primates in the forests of Tana River in Kenya, Udzungwa in Tanzania and Kibale in Uganda, to kangaroos in the rainforests of Australia and rhinos in Laikipia, Kenya. He has visited or participated in surveys and expeditions to most of the National Parks and Game Reserves in Kenya and some in Uganda and Tanzania. He has also done several consultancies and is currently Principal Investigator and Field Team Leader for Earthwatch Institute’s Saving Sweetwater’s Rhinos project. He is married with two children, a son and a daughter, and lives with his family in Eldoret.

Research Staff

Michael Ongayo Ogutu is a long-term field assistant for the project from western Kenya. He has been working with Cercopithecus monkeys both in the Kakamega Forest and Gedi Ruins for more than two years.

Kiio Kithome is an M.Sc. candidate at Nairobi University, Kenya. He will be responsible for identifying and quantifying fecal parasites to further assess the health status of the monkeys. Kiio has extensive experience with parasitological work that he gained in more than five years of working at the Institute for Primate Research (IPR) in Nairobi. Dr. Dorcas Yole, a senior parasitologist at IPR, will act as advisor to Kiio.

Lucy Kirigo Mureu is an M.Sc. candidate in Wildlife Management at Moi University. She has completed a six-month field project with the Sykes monkeys at Gedi in partial fulfillment of her thesis. She worked on aspects of seed dispersal and will be assisting particularly with this new aspect of the Kenya’s Forest Monkeys project.

Current Staffing Schedule (Subject to Change)

<table>
<thead>
<tr>
<th>Staff Member Present</th>
<th>Team I</th>
<th>Team II</th>
<th>Team III</th>
<th>Team IV</th>
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<tr>
<td>Steffen Foerster</td>
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<tr>
<td>Geoffrey Wahungu</td>
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<tr>
<td>Michael Ongayo Ogutu</td>
<td>x</td>
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<td>Kiio Kithome</td>
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<tr>
<td>Lucy Kirigo Mureu</td>
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DAILY LIFE IN THE FIELD

4. VOLUNTEER TRAINING AND ASSIGNMENTS

Training
Volunteers will monitor acute stress events like aggressive actions but also interactions between animals and humans. As the monkey group is often spread out over several hundred meters, these crucial events are most effectively monitored with many observers. To ensure that scientifically valid, reproducible data is being gathered, staff will train and observe volunteers, and will regularly check the accuracy of the data.

On the first evening of the expedition, staff will provide a short introduction to the field site and general guidelines on how to behave in the forest and in the presence of monkeys. This will also include instructions on emergency procedures, including how to react if a snakebite occurs.

Recommended Training Before Your Expedition
Volunteers can start to learn the various skills and techniques used in the fieldwork before leaving home by visiting the Principal Investigator’s website at http://www.steffenfoerster.com/research/monkey_home/. This site includes:

- Background information on the research
- Guide to monkey behaviors (called an “ethogram”)
- Short videos illustrating monkey behaviors
- Images of the female monkeys at the research site (monkey “flash cards” will also be included in the Appendix of the full Expedition Briefing volunteers will receive)

The ethogram and videos will help you learn the various monkey behaviors you may observe and record in the field. The images and flash cards will help you learn how to recognize the different females you will study. Be sure to take the monkey quiz available under “Fun Stuff” on the website and test yourself on your ability to recognize the monkeys. Don’t worry if you find it challenging - you will have a chance to learn more and practice in the field.

Assignments
Monitoring Behavior and Collecting Fecal Samples
For these two assignments, staff will train volunteers in identification of individuals, species-typical behavior, and fecal collection procedures. Depending on observation skills, observers can learn to identify one to three individuals per day without prior experience. In groups of two, volunteers will follow one individual female monkey over the course of the day for as many hours as possible, recording social grooming and aggression and collecting fresh fecal samples. The majority of time will be spent on behavioral monitoring (about 75% of work time), while fecal collection will comprise about 5% of work time. Those with patience, attention to detail, good observation skills and who are comfortable using binoculars will excel at these assignments.

Processing Fecal Samples
Volunteers will process collected fecal samples in the lab. Samples will be dried, weighed, and added to an extraction solution. After mixing, samples will be centrifuged and supernatants dried off. No training is required for this assignment, which will make up about 5% of work time.
Monitoring Tree Abundance and Growth

In groups of two, volunteers will spend one afternoon (15% of work time) establishing vegetation plots and measuring tree circumferences in these plots.

5. TEAM ITINERARY

Day 1: Meet at the airport and proceed to the field center for lunch. Relax, get to know each other, swim in the ocean, etc. Tour of the facilities at Mwamba and introduction to the field site, the monkeys, and the work. Swahili dinner.

Day 2: Introduction to the study site, potential hazards, the monkeys and their general behaviors. Training in female monkey identification and behaviors. Guided tour of Gedi Ruins in the afternoon. Introduction to data collection in the evening.

Days 3-4: Data collection. Short debriefing of daily activities in the evening.

Day 5: Data collection in early morning and afternoon. Trip to Malindi for lunch.

Days 6-7: Recreational days (see Recreational Time below).

Days 8-9: Data collection. After-work activities such as local Giryama dance show, visit to a bat cave in Watamu (with over 15,000 bats!), exploring a mangrove forest, etc.

Day 10: Data collection. Optional dinner at a local restaurant at your own expense.

Day 11: Data entry in the morning. Early lunch and drop-off at the airport at 1:40 pm.

Recreational Time

The expedition will include two recreational days. If desired, volunteers may join an optional overnight excursion to Tsavo East/West National Parks with a recommended tour company. This trip would be at your own expense and would cost approximately US$270 (includes transport, game drives, plenty of food, and accommodation in a luxury camp with a view of Kilimanjaro). The team may arrange alternative excursions for the recreational days.

Earthwatch Recreational Time Policy

Earthwatch has a duty of care to our participants from the rendezvous to the end of the expedition. In order to ensure you are as safe during your recreational time as you are during research time, we have put a number of measures in place.

- If there is a recreational day during the expedition, the project staff will offer either a planned team activity or a small choice of recreational activities that have been vetted and comply with Earthwatch standards. You will also have the option of remaining at the project accommodations to rest. All participants are strongly encouraged to take part in the group activity, but if you are determined to pursue other options you will be asked to sign a release before doing so, stating that Earthwatch is not responsible for your welfare.

- When there is a period of free time scheduled into a regular research day, the staff will ask you to sign out of the project (using a means which may vary by project and project location) if planning to leave the group. This will include your destination and estimated time of return. If participants do not show up to the next activity the project staff will then know where to begin a search.

- In the evenings when you can go out at night, you will again be asked to sign out of the project as above. The project staff will give you 24-hour contact information for them should assistance be needed. The sign-out is informational only and will not be used to enforce a curfew. Please be aware that project staff would not start a search until the following morning or the next scheduled activity unless contacted for help sooner.
6. **DAILY SCHEDULE AND TASKS**

Please be aware that schedules can and do fluctuate due to weather, research needs, etc. Your cooperation and understanding are appreciated. Below is an example of a typical work day.

- **6:00 am:** Breakfast (self service)
- **6:45 am:** Depart for field site
- **7:00 am:** Begin observations at field site
- **12:45 pm:** Lunch break
- **2:30 pm:** Data collection
- **4:30 pm:** Return to Mwamba Field Station, scheduled activities or recreational time
- **7:00 pm:** Dinner
- **8:00 pm:** Briefings and/or debriefings as scheduled
- **9:00 pm:** Recreational/Rest time

7. **ACCOMMODATIONS**

The Mwamba Field Station, operated by the A Rocha conservation organization, is located about 12 kilometers/7.5 miles from the field site. You will be driven back and forth in a minibus. The accommodations at the station are basic. There are two double rooms and two triple rooms, all with single beds. Couples will be given priority for the double rooms. Depending on team size and gender ratios, it may be necessary to share a room with a non-Earthwatch volunteer due to limited room availability at the station. Bathrooms with cold-water showers and conventional flush toilets are available. The field station provides bedding and towels. Laundry service is available for a small additional charge (about US$1.50 per load).

All rooms have UK-style electric outlets, 240 volts. If your equipment runs on 110 volts (US), you will need to bring a power converter. There are occasional power cuts that can last up to a day. Internet access is not available at the station, but is available in the nearby village of Watamu (5 kilometers/3.1 miles away).

The Mwamba Field Station is equipped with a fully functional kitchen, storeroom, a common dining room and porch, a rooftop terrace, and more. The beach is within easy access and snorkel equipment is available for rent. Behind the field station there is a nature trail that leads through coastal bush and forest, home to a diversity of butterflies, birds, and reptiles. The center even has its own group of monkeys, but they are not being studied and not as easy to approach.

**Note:** Please be aware that the station is run by A Rocha, a Christian organization. Grace is said before all meals, and religious services are occasionally held onsite. Although it is not expected that you share the same religion or participate in grace or religious activities (but you’re welcome to if you want), it is important that you show respect and tolerance towards Christian values and beliefs. That said, the A Rocha Trust has a long tradition of extending a warm welcome to all visitors, of any faith or none, and you will find that this makes for a welcoming, tolerant, and cooperative atmosphere. Previous Earthwatch volunteers have included people of several different faiths as well as people of no faith. A Rocha staff aim to promote understanding between people, in the name of the well-being of the planet.
8. **Food**

A Rocha staff prepare lunch and dinner. Lunch is served at 1:00 pm and dinner at 7:00 pm. Volunteers are expected to help clean up after meals. Breakfast is self-service and as long as you are ready to leave the field station at 6:45 am, you can choose when you eat. Meals tend to be vegetarian but meat and fish are served regularly.

Below are examples of the foods and drinks you might expect during your expedition. Please bear in mind that variety depends on availability. This list is intended to provide a general idea of food types, but it is very important that volunteers be flexible.

**Breakfast:** Toast, cereal, fresh fruit

**Lunch:** Local Swahili dishes such as rice with beans, fish, vegetables, chicken, beef, etc.

**Dinner:** Combination of traditional Swahili and Western dishes, vegetarian option

**Beverages:** Boiled and filtered water, coffee, tea (Mwamba serves only non-alcoholic beverages; you are allowed to bring in alcohol if it is consumed in moderation)

**Special Dietary Requirements**

Please alert your Earthwatch Expedition Coordinator to any special dietary requirements as soon as possible (e.g. diabetic, lactose intolerant, etc.). Accommodating special diets is not guaranteed and will depend on your specific requirements.

**Special note to vegans and strict vegetarians:** It will be difficult to accommodate strict vegetarians and vegans because of the extra work involved for A Rocha staff when preparing the meals. Meatless meals will always be available but vegans and strict vegetarians may have a problem avoiding animal products altogether. If this poses a problem, then participation on this expedition should be seriously reconsidered.
TRAVEL PLANNING

9. BEFORE YOU LEAVE

Note: Earthwatch Institute’s international travel insurance company, International SOS, has a wealth of useful information available at their website, including visa, passport, currency, medical, etc. information for Kenya. See www.internationalsos.com and enter Earthwatch’s member identification number: 14ACPA000075. Under “Select Resource” choose “English Country Guide,” and then select Kenya from the list. For a listing of other useful websites for passport and visa requirements, see Section 15 ‘Helpful Resources.’

Entry Information for Kenya

Most volunteers traveling from outside Kenya will require a passport valid for at least six months beyond the dates of travel, as well as a tourist visa. Tourist visas may be obtained by US, EU, Japanese and Australian citizens upon arrival at the airport in Kenya for US$50 or £30; alternatively, they may be obtained in advance from the nearest Kenyan embassy or consulate or from a visa service. See the chart below for more information. Nationals from other countries should consult a tour agency, travel agency, or the Kenyan embassies and high commissions in their respective countries for details on requirements; not all nationals are allowed to get a visa in Nairobi. If you need or wish to apply for a visa in advance, the chart below should be useful.

Essential Information for Volunteers Requiring Visas

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<th>Type of Visa</th>
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<tbody>
<tr>
<td>Where to Get a Visa</td>
<td>If you wish to or must obtain a visa in advance of your travel (see above), you should contact the nearest Kenyan consulate or embassy and be sure to apply for the visa well in advance. In the US contact the Kenyan Embassy in Washington, DC for additional information (+1-202-387-6101). There are also consulates in New York City and Los Angeles, CA. In the UK, contact the Kenyan High Commission in London at +20-7636-2371/5. You may also download the visa application forms at <a href="http://www.kenyaembassy.com">http://www.kenyaembassy.com</a>. Please note that this process can take weeks or more. If you have less than six weeks or wish to save yourself trouble, you are strongly encouraged to use a visa agency, which can both expedite and simplify the process.</td>
</tr>
<tr>
<td>Required Information</td>
<td>You will need to send your passport (valid for at least six months beyond your stay), a Visa Application and Immigration Form, 2-4 passport-size photos plus payment to the embassy or visa agency (if applicable). Please be sure that your passport is valid for at least six months beyond your stay.</td>
</tr>
<tr>
<td>Cost</td>
<td>A visa currently costs US$50/£30; additional fees may be charged by a visa service.</td>
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Reminder: The purpose of your visit is for vacation, holiday or travel. Foreign immigration officials do not always understand the concept of a “working vacation” or even “volunteering.” Words such as “working”/“volunteering,” “research” or a “scientific expedition” can raise questions concerning the country’s foreign labor laws and/or prompt questions about official scientific research permits and credentials, etc., to which volunteers on their own will not be equipped to respond. All required research permits for the project are in place and have been approved by the proper authorities.
Travel Medical Insurance

Travel medical and evacuation insurance is mandatory for Earthwatch volunteers while on an Earthwatch expedition anywhere in the world. The cost of this insurance is included in your volunteer contribution. It covers volunteer travel medical risk, including medical expenses and medical evacuation, while traveling with Earthwatch overseas or on an expedition within your home country. Without insurance, the costs of such measures can range from US$20,000 to $50,000.

The emergency medical and evacuation assistance provider for Earthwatch is On Call International. On Call is a 24-hour international operation which provides medical assistance and evacuation, a 24-hour nurse help line and other travel assistance services such as lost baggage and lost document assistance.

Basic coverage is valid in the country of your Earthwatch expedition and during international travel to and from your expedition. If the expedition takes place in your home country, coverage begins when your group forms for the expedition and ends when the group disbands, and is incremental to your existing health insurance. Options are available for volunteers who would like to extend the period of coverage, increase insurance amounts or purchase additional cancellation or baggage insurance. Application forms for additional coverage are included in your volunteer packet.

A detailed description of the Volunteer Medical and Evacuation Insurance Program policy, including the optional coverage increases, will be sent with this briefing. Please note that policies are specific to each Earthwatch office.

To contact On Call International in the event of an emergency, dial:

- 1-866-509-7715 from within the US
- +1-603-898-9159 from outside the US

State that you are on an Earthwatch expedition. The Earthwatch policy number is #US008020.

Cancellation Insurance

Trip cancellation insurance is highly recommended for Earthwatch volunteers. Depending on the level of coverage you purchase, cancellation insurance will help cover your airfare and Earthwatch contribution if you need to cancel your expedition due to medical or other covered reasons. Earthwatch Institute does not reimburse airfare or costs associated with cancelled flights or expeditions. Levels of reimbursement for cancelled airline tickets or ticket change fees will vary depending on what type of trip cancellation policy you purchase. You are strongly advised to buy flexible or refundable plane tickets. Note that volunteers with preexisting medical conditions are encouraged to explore their coverage options.

For US and Canadian Volunteers

Earthwatch is offering comprehensive optional travel insurance through CSA Travel Protection as a service to our US and Canadian volunteers. While our inclusive insurance covers your emergency medical needs while in the field, this optional policy covers trip cancellation insurance due to medical emergencies, lost luggage, travel delays, etc. For more information on the insurance policy, call Earthwatch at 1-800-776-0188 or visit www.csatravelprotection.com. Please note that some coverage is dependent on purchasing insurance within 24 hours of paying in full for your expedition. Should you decide to take out our optional insurance, please use the following producer code to indicate your affiliation with Earthwatch: 83534816.
For Volunteers Signing Up through Earthwatch Europe

Earthwatch Europe volunteers can purchase travel insurance from Earthwatch that is underwritten by Endsleigh and includes Additional Cancellation Cover. Additional Cancellation Cover insurance includes cover for non-refundable travel expenses should your expedition be cancelled. Alternatively, if Earthwatch Europe volunteers hold their own travel insurance they may be able to purchase Additional Cancellation Cover through their existing insurer.

Travel Agencies

Contact your local travel agent or use the web to find the lowest rates to make your travel arrangements. A list of suggested travel agents can be found in Section 15 ‘Helpful Resources.’ Be sure to give your rendezvous details to your travel agent as soon as possible so they can plan your trip accordingly.

Other Advice / Information

- **Languages:** English, Swahili
- **Emergency police telephone number:** 999
- **Time zone:** GMT +3
- **Electricity:** 240 volts, 50 hertz, UK-style Type G three-prong plug (see image)
- **Local currency:** Kenyan shilling (KSH)
- **Telephone dialing codes:** When calling Kenya from another country, dial the country’s international dialing code, followed by +254 (country code) and the number. When calling within Kenya, omit the 254 and dial 000. When calling another country from Kenya, dial 000, followed by the other country’s country code and the number. The city code for Nairobi is 20; Mombasa is 41; Malindi is 42. All calls to Kenyan cell phones require a 0 in front of the number when calling from within Kenya. Most Kenyan cell phone numbers are nine-digit numbers beginning with 7.
- **Checking luggage:** Please note that if you will be taking an international flight that has one or more connections within Kenya, it will be necessary to collect any checked bags at the airport where you first arrive in the country. After proceeding through Customs, you will have to recheck your luggage before flying on to your final destination.
- **Personal funds:** You are advised to have the equivalent of a couple hundred US dollars or Euros in Kenyan shillings. It is important that some of your money is in small bills and coins (bill denominations of 200, 100 and 50 KSH). This should be enough to cover any incidental costs during your expedition, like phone calls, internet, dining out, snacks, etc. If you plan to go on a safari during your recreational time or before/after the expedition, or if you want to buy souvenirs, you may need more. Travel guidebooks will give you a rough idea of what to expect in terms of typical costs.
- **Banks and currency exchange:** In the baggage hall at the airport in Nairobi, after you’ve cleared Passport Control, there are two banks where you can change traveler’s checks and cash in major currencies for Kenyan shillings. There are also two outside the hall and one, Barclays, has an ATM that takes Visa and MasterCard. Do not bring traveler’s checks out of Nairobi expecting to change them. Once in the field, you will not have access to a bank except for one mid-expedition trip into Malindi (about 30 kilometers/19 miles from the station).
- **US currency restrictions:** If you bring US dollars, note that 100-dollar bills of certain years are not accepted in many banks and exchange bureaus because of counterfeiting fears. Bring smaller notes (50-dollar bills and lower) dated after 2003. They must be in good condition.
10. PROJECT CONDITIONS

Please show this section to your physician when he/she is completing your health statement. Be sure to discuss inoculation requirements with your physician well in advance of your departure date. See Section 11 ‘Health Information’ for inoculation information.

To the examining physician:

Your patient has volunteered to join a field research team that has specific physical demands of which you and your patient should be aware. We need your accurate evaluation of your patient’s ability to meet the conditions detailed below in order to safeguard his/her health and safety and ensure that he/she can participate fully and effectively.

General Conditions of the Research Site

Gedi Ruins is located just off the Indian Ocean a few degrees south of the Equator. The site experiences two rainy seasons: April-July and October-November. Even during the rainy seasons, rain tends to come in the form of short showers in the early afternoon or as drizzle in the morning. The temperatures usually hover around 32°C/90°F during the day and 24°C/75°F at night. Proximity to the ocean leads to high humidity levels very close to 100% even without rainfall, and there is often little or no breeze inside the forest. Please come prepared and be aware that these conditions can be rather uncomfortable.

<table>
<thead>
<tr>
<th>Typical Humidity</th>
<th>80% to 100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature Range</td>
<td>22°C/72°F to 27°C/90°F</td>
</tr>
<tr>
<td>Average Rainfall</td>
<td>6-8 cm/3 in per month</td>
</tr>
</tbody>
</table>

Physical Demands

Volunteers need to be able to spend long periods of time standing in the forest in hot and humid conditions, moving very little and looking through binoculars for many hours. This can be surprisingly straining for the untrained observer. It is strongly suggested that those who are not accustomed to regularly using binoculars do so as preparation for this expedition. You may choose to spend time bird-watching or, better yet, watching monkeys in a zoo for several hours.

Below are the expected demands of the project, but please keep in mind that conditions may change and the project could potentially be more or less strenuous than the chart indicates.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Workload/Intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sitting</td>
<td>In a car for 1 hour per day on 9 days</td>
</tr>
<tr>
<td>Walking/Standing</td>
<td>Over 3-5 km/2-3 mi for 9 hours per day on 7 days</td>
</tr>
<tr>
<td>Looking through binoculars</td>
<td>5 hours per day on 7 days</td>
</tr>
</tbody>
</table>
## Potential Hazards

<table>
<thead>
<tr>
<th>Hazard Type</th>
<th>Associated Risks and Precautions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport</td>
<td>While some roads are paved, they often have large potholes and may be uneven. Other road hazards include fast and reckless drivers, livestock and wildlife, rain, dust, poor or no lighting, and banditry. Traffic moves on the left side of the road. Driving at night will be avoided and volunteers will not be permitted to drive.</td>
</tr>
<tr>
<td>Terrain</td>
<td>You will be walking through the forest over uneven ground while watching study animals. Slips, trips, and falls may occur. Good footwear (well broken-in hiking boots with ankle support) is advisable.</td>
</tr>
<tr>
<td>Observation</td>
<td>You will spend a lot of time looking through binoculars. For those unused to this activity, it may cause headaches or neck strain. A strap that transfers the weight of the binoculars to the back (as opposed to the neck) may help.</td>
</tr>
<tr>
<td>Insects</td>
<td>Bees, wasps and mosquitoes are present in the area. Mosquitoes may transmit diseases such as malaria. Protect yourself against bites/stings by using repellent and covering exposed skin. If you are allergic to bee stings, bring two epi-pens.</td>
</tr>
<tr>
<td>Snakes</td>
<td>Both venomous and non-venomous snake species may be present. Bites are very unlikely, but staff will provide instructions on what to do in the event of a bite.</td>
</tr>
<tr>
<td>Plants</td>
<td>Stinging nettles and plants with thorns are present. It is advisable to wear pants, long sleeves, and sturdy, well broken-in footwear for work in the forest.</td>
</tr>
<tr>
<td>Monkeys</td>
<td>There are inherent risks involved with working with animals such as monkeys. They are strong, may bite, and may carry diseases that can affect humans. However, volunteers will not need to come into direct contact with the monkeys for this research. When fecal material is sampled, appropriate precautions will be taken. Risks are also mitigated by following the instructions of the researchers and staff; these instructions must be adhered to at all times.</td>
</tr>
<tr>
<td>Disease</td>
<td>Diseases found in Kenya include malaria, dengue fever, filariasis, leishmaniasis, onchocerciasis, trypanosomiasis, schistosomiasis, hepatitis, rabies, HIV/AIDS, Rift Valley fever, tuberculosis, plague, yellow fever, and typhoid. Recent disease outbreaks include meningitis (early 2006, in western areas, but not in the vicinity of the project area) measles (2006, mostly in Nairobi and the Northwestern Province to date), and Rift Valley fever (early 2007). Please see Section 11 ‘Health Information’ for more information and inoculation recommendations.</td>
</tr>
<tr>
<td>Climate/Weather</td>
<td>Temperature and humidity in the area can be very high, and adequate water intake is essential to prevent dehydration. There is risk of sunburn and heat stroke. Wear a hat, use strong sunscreen (SPF 30 or higher recommended for light skin) and avoid sun as much as possible.</td>
</tr>
<tr>
<td>Snorkeling (recreational time only)</td>
<td>Snorkeling on the reef is possible during recreational time. Strong currents are occasionally present. Always go with at least one other person and let project staff know when you expect to be back. Observe the tidal schedule to avoid swimming against the tide. It’s important to avoid touching the reef both for the health of the reef and to avoid getting abrasions or cuts that may get infected.</td>
</tr>
<tr>
<td>Personal security around the research area</td>
<td>The crime level in the area is very low, and you are unlikely to be in any danger even when walking alone at night on the main roads in the Watamu area. There have been a few scattered incidents over the past years of harassment on the beach at night, and you are discouraged from venturing too far at night alone. Also, boys that frequent the beach may harass others during daytime hours, but this is not as much an issue as around the tourist beaches in Watamu or Malindi. For your personal safety and the safety of your belongings, the field station employs a night guard and valuables can be placed with the manager in a safe.</td>
</tr>
</tbody>
</table>
### Hazard Type Associated Risks and Precautions (Continued)

<table>
<thead>
<tr>
<th>Hazard Type</th>
<th>Associated Risks and Precautions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nairobi</td>
<td>If you travel to Nairobi, please be aware that crime is an issue. It is best to travel through the city in pairs or groups and to avoid displaying money or valuables and traveling at night. Transportation is of particular concern. Be sure to use only reputable taxi services. The Fairview Hotel is recommended and they will provide reputable taxis and even arrange pick-up from the airport. Rooms have safes, and there is a secure storage area if you need to leave some of your belongings in Nairobi during the expedition.</td>
</tr>
<tr>
<td>Politics</td>
<td>Since the 2007 elections in Kenya there have been riots and demonstrations in market centers and other public places. Sometimes such gatherings turn violent as rival groups try to out-shout each other. Project personnel will ensure the safety of all volunteers and will avoid such gatherings if encountered. Note that political violence is very localized and is not targeted at non-locals.</td>
</tr>
</tbody>
</table>

### Medical Conditions of Special Concern

<table>
<thead>
<tr>
<th>Condition</th>
<th>Concerns and Precautions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insect allergies</td>
<td>Bees and wasps are common. Bring any necessary medications (e.g. two epi-pens) and be sure to inform the Principal Investigator and Earthwatch of any allergies. Those with severe allergies may wish to reconsider participation.</td>
</tr>
<tr>
<td>Fear of snakes</td>
<td>Snakes may be encountered in the forest, usually while moving away. Those with a strong fear of snakes may not be comfortable working in the forest. Encounters with venomous snakes are unlikely, but possible.</td>
</tr>
<tr>
<td>Bad back, neck, knees or joints</td>
<td>The team will spend many hours standing and looking up into the trees. People with back, neck, knee, etc. injuries or conditions should not participate.</td>
</tr>
<tr>
<td>Inability to concentrate</td>
<td>The work requires an above-average level of patience and the ability to stand still and quietly for many hours.</td>
</tr>
<tr>
<td>Poor eyesight</td>
<td>Good eyesight is essential for observing the monkeys. If you wear glasses, make sure you feel comfortable using binoculars.</td>
</tr>
<tr>
<td>Susceptibility to heat-related illnesses</td>
<td>The research area is very hot and humid. People who have a difficult time functioning in the heat and/or are susceptible to heat-related illnesses should seriously reconsider participation in this expedition.</td>
</tr>
</tbody>
</table>

### 11. Health Information

See [www.internationalsos.com](http://www.internationalsos.com) for information on the current health conditions in Kenya. At the homepage, enter Earthwatch’s member identification number: 14ACPA000075. Under “Select Resource” choose “English Country Guide,” and then select Kenya from the list.

### Routine Immunizations

All volunteers should make sure to have the following up-to-date immunizations: DPT (diphtheria, pertussis, tetanus), polio, MMR (measles, mumps, rubella) and varicella (if you have not already had chicken pox). **Please note that there were outbreaks of polio and measles in Kenya in 2006. Make sure your polio, measles and other standard vaccinations are up to date.**

### Project Inoculations

The following are recommendations only. Medical decisions are the responsibility of each volunteer. Note that health conditions around the world are constantly changing, so keep informed and consult your physician, a local travel health clinic, the US Center for Disease
Control (www.cdc.gov), the World Health Organization (www.who.int), International SOS (see above), and/or the resources in Section 15 ‘Helpful Resources’ for the latest health information for travelers. Please consult your physician for guidance on inoculations if you intend to travel to other parts of the country.

<table>
<thead>
<tr>
<th>Typhoid</th>
<th>Inoculations recommended for health reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hepatitis A</td>
<td></td>
</tr>
<tr>
<td>Hepatitis B</td>
<td></td>
</tr>
<tr>
<td>Yellow Fever</td>
<td>Certificate of Vaccination required if traveling from a country or region where it is endemic</td>
</tr>
</tbody>
</table>

**Other Advice / Information**

- **Malaria**: Note that malaria is present at the research site and is chloroquine resistant. Speak with your physician about prophylactic anti-malarial medication.

- **Meningitis**: Some health authorities may recommend vaccination against meningitis, though only the northwestern part of Kenya is considered part of the Meningitis Belt. There has been a recent outbreak of meningitis in western Kenya (early 2006). You should discuss the current situation and possible vaccination with your physician or travel health professional, particularly if you are considering travel to the affected area before or after your expedition.

- **Tuberculosis**: The World Health Organization (WHO) estimates that one-third of the world’s population is infected with the bacterium (\(M.\) \(tuberculosis\)) that causes tuberculosis (TB). Incidence of tuberculosis is higher in developing countries, particularly in Asia, Africa, the Caribbean and Latin America. In general, approximately 10% of persons infected with \(M.\) \(tuberculosis\) are at risk for developing active TB during their lifetimes. TB is considered highly treatable with medications that are of relatively low toxicity and cost. Volunteers returning from developing countries are encouraged to have a (PPD)-tuberculin skin-test to screen for potential infection.

- **Rabies**: Rabies is present in Kenya. You are advised to speak with a physician about whether the rabies vaccine is recommended given the length of your stay in Kenya and other activities you might be undertaking. Once in Kenya, avoid contact with local dogs and cats. Rabies is a fatal disease. Treatment after rabies exposure requires immediate care (within 24 hours). Pre-exposure vaccination does not eliminate the need for post-exposure medical attention and treatment, but it does provide additional protection against the disease in event of a delay in treatment. In addition, any bites or scratches should be immediately and thoroughly washed with soap and clean water and a topical povidone-iodine solution or ethanol, and the Principal Investigator should be notified immediately.
12. PACKING CONSIDERATIONS

PLEASE SEE THE PACKING CHECKLIST AT THE BACK OF THIS BRIEFING AND REMEMBER TO TAKE YOUR BRIEFING WITH YOU ON YOUR EXPEDITION.

General Considerations
Do not bring more luggage than you can carry and handle on your own. If you intend to check your luggage, you are advised to pack an extra set of field clothing and personal essentials in your carry-on bag in case your luggage is lost and/or takes several days to catch up with you.

Weather Considerations
Please take weather conditions into consideration when packing for your expedition. Climate information can be found in Section 10 ‘Project Conditions.’ Note that the research area is very hot and humid and you should bring lightweight clothing as well as high-SPF sunscreen.

Cultural Considerations
Generally, Kenyan dress is fairly conservative, particularly in coastal areas. Also remember that the field station is run by a Christian organization. Please avoid tight and/or revealing clothing and pack more conservative swimwear. If this is your first trip to a developing country, you may want to prepare yourself mentally for the encounter with widespread poverty. Avoid bringing expensive jewelry, etc. and displaying excessive wealth to minimize the amount of attention you get from local people.

Essential Items
Make sure to bring your Earthwatch Expedition Briefing with you! It includes essential information to which you may need to refer during your expedition, as well as during your journey to and from the project site.

Please see the Expedition Packing Checklist for a complete list of what you will need to take with you. You are encouraged to go through the list and mark off each required item right before you leave for your expedition.
13. **RECOMMENDED READING**

Please read *Kenya’s Forest Monkeys: The Research in the appendix of this briefing*. This document was prepared by the Principal Investigator and Earthwatch and explains the research conducted through this project as well as some results to date. **Also see Recommended Training Before Your Expedition in Section 4 ‘Volunteer Training and Assignments’** for resources that will help train you in the project tasks before you leave.

Below are additional materials for those interested in further preparing for the expedition. Many can be purchased online through popular vendors. See Section 15 ‘Helpful Resources’ for suggested vendor websites.

**Scientific Media**


**Popular Media**


**Project Field Report**

Each Earthwatch Institute-supported project submits a report on the past year’s research and results to Earthwatch, generally on an annual basis. The most recent field report for this project may be available online through [www.earthwatch.org/expeditions/foerster.html](http://www.earthwatch.org/expeditions/foerster.html). Note that reports are not available for all projects.
14. EMERGENCIES IN THE FIELD

In the event of a minor injury/illness in the field, the volunteer would be treated by staff onsite using First Aid. If necessary, Dr. Erulho would be consulted and/or the volunteer would be transported to the nearby clinic in Watamu. In the case of a medical emergency, transport would be provided to a full service hospital in Mombasa, about two hours from the field site. If a volunteer needs to depart prematurely due to a personal emergency, he/she will be transported to the airport in Malindi by the expedition driver.

<table>
<thead>
<tr>
<th>Safety Certified Staff</th>
<th>CPR (Cardiopulmonary Resuscitation): Wahungu</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>First Aid: Foerster, Wahungu</td>
</tr>
<tr>
<td>Nearest Doctor</td>
<td>Dr. Erulho</td>
</tr>
<tr>
<td></td>
<td>P.O. Box 322, Watamu</td>
</tr>
<tr>
<td></td>
<td>Tel: +254 (0) 42-32122 (clinic), +254 (0) 42-32046 (home), +254 (0) 733-763121 (cell)</td>
</tr>
<tr>
<td></td>
<td>Distance: 10-minute drive from the field site, 5 minutes from the field station</td>
</tr>
<tr>
<td>Nearest Full Service Hospital</td>
<td>The Aga Khan Hospital Mombasa</td>
</tr>
<tr>
<td></td>
<td>Vanga Road, Kizingo, Mombasa, Kenya</td>
</tr>
<tr>
<td></td>
<td>Tel: +254 41 222-7710 - 5</td>
</tr>
<tr>
<td></td>
<td>Fax: +254 41 231-3278</td>
</tr>
<tr>
<td></td>
<td>Website: <a href="http://www.agakhanhospitals.org/mombasa/">http://www.agakhanhospitals.org/mombasa</a></td>
</tr>
</tbody>
</table>

15. HELPFUL RESOURCES
Project-Related Websites

- Principal Investigator’s monkey site: www.steffenfoerster.com/research/monkey_home.html

Passport and Visa Information

- Embassies around the world: http://www.embassyworld.com
- Passport Visa Express (for US citizens): http://www.passportvisaexpress.com
- The Visaservice: http://www.visaservice.co.uk
- Thames Consular Services Ltd: http://www.visapassport.com

Travel Guidebooks and Booksellers

- Lonely Planet: http://www.lonelyplanet.com
- Amazon: http://www.amazon.com
- Barnes and Noble: http://www.bn.com

Travel Agencies and Advice

- World Travel Guide: http://www.worldtravelguide.com
- UK Foreign Office travel advice: http://www.fco.gov.uk/travel
- Third World Traveler: http://www.thirdworldtraveler.com/Travel/Travel_Links.html
- STA Travel (contact Angie Kurtz or Chris Chappell and mention that you will be going on an Earthwatch Expedition): http://www.statravel.com
  36 Geary Street
  San Francisco, CA 94108
  Tel: +1 415 391-8407
  Email: sfo@statravel.com
- STA Travel (UK): http://www.statravel.co.uk
  Tel: +44 (0) 1865 792800
  Fax: +44 (0) 1865 792911
  Email: manager.oxford@statravel.co.uk
  Quote code: EWE01/02
- Wexas International (Europe): http://www.wexas.com
  Tel: +44 (0) 20 7581 8761
  Fax: +44 (0) 20 7581 7679
  Email: southern@wexas.com
  Quote code: EWE01/02
- Democracy Travel (contact Jean S. West, Assistant Manager)
  4818 MacArthur Blvd NW
  Washington DC 20007
  Tel: 202 965 7200 or 866-557-9968 (toll free US and Canada)
  Fax: 202 342 0471
  Email: jean@democracytravel.com

Airline/Airport Resources

- Airport codes worldwide: http://www.logisticsworld.com/airports.asp
Country Information

- Country information from around the world: [http://www.countryreports.org](http://www.countryreports.org)
- US State Department: [http://www.state.gov](http://www.state.gov)
- Time worldwide with GMT/UTC: [http://www.worldtimeserver.com](http://www.worldtimeserver.com)
- Currency converter: [http://www.xe.com](http://www.xe.com)
- Electrical current converter: [http://kropla.com/electric2.htm](http://kropla.com/electric2.htm)
- Telephone dialing codes: [http://kropla.com/dialcode.htm](http://kropla.com/dialcode.htm)
- Online unit conversions: [http://www.onlineconversion.com](http://www.onlineconversion.com)

Health Information

- Travel health website: [http://www.mdtravelhealth.com](http://www.mdtravelhealth.com)
- Center for Disease Control: [http://www.cdc.gov](http://www.cdc.gov)
  Tel: +1 800 311-3435 or +1 888 232-3228
- World Health Organization: [http://www.who.int](http://www.who.int)
- Disease outbreaks: [http://www.who.int/csr/don/en](http://www.who.int/csr/don/en)
- Hospital for Tropical Diseases: [http://www.thehtd.org](http://www.thehtd.org)
- Travellers Healthline Advisory Service
  Tel: 020 7950 7799
- MASTA Travelers’ Healthline (UK)
  Tel: 0906 8 224100 (within UK)
The following information was taken from the research proposal submitted by the Principal Investigator to Earthwatch Institute. Included is a description of the research conducted through this project, some results to date, and other information regarding the accomplishments of the project and the staff. Specific details regarding research sites, methods, etc. is subject to change slightly from year to year and such changes may not be incorporated into this document.

BACKGROUND, OBJECTIVES, AND METHODS

Background

Humans increasingly encroach on the habitat of non-human primates throughout the world, leading to declining trends in many populations (Johns & Skorupa, 1987; Oates, 1996; Cowlishaw, 1999; Chapman & Lambert, 2000). Although protected areas can act as refuges, populations in these areas are not free of the influence of humans on their habitat (de la Torre et al., 2000; Grossberg et al., 2003). Direct and indirect provisioning (feeding) is common in and around protected areas, either in form of feeding by visitors, crop-raiding, or feeding on garbage (Asquith, 1989). Although it is known that provisioning leads to a multitude of changes in behavior and life history of primates (Asquith, 1989; Hill, 1999; Saj et al., 1999; Sterck, 1999; Ram et al., 2003), little is known about its consequences on the health and well-being of the animals. For example, rates of aggression within and between groups commonly increase as a result of the clumped and defendable nature of provisioned food (Asquith, 1989; Ram et al., 2003), but the long-term consequences of such changes are not known. As social conflict is one of the most potent stressors, one possible consequence could be chronically elevated stress levels in provisioned populations.

Although short-term physiological stress responses are largely adaptive in nature (Asterita, 1985; Sapolsky, 1992), prolonged exposure to stressors is known to have widespread and severe negative impacts on various aspects of behavior, physiology, and health of human and non-human primates (Norris, 1985; Sapolsky, 1985; Wasser & Starling, 1988; Johnson et al., 1996; Cohen et al., 1997; Kendler & Karkowski-Shuman, 1997; Capitanio et al., 1998). As it is now recognized that chronic stress may have long-term effects on immunity (McEwen, 2000) and lifespan (Epel et al., 2004) rather than short-term effects on reproduction (Chatterton, 1990; Tilbrook et al., 2000; Boonstra et al., 2001; Wingfield & Sapolsky, 2003), reproductive success is of limited use when trying to assess the long-term consequences of stress on wildlife populations. This study will use detailed characterization of stress response profiles over time in relation to provisioning of food and other interaction with humans to assess changes in the normal functioning of the stress response system in Sykes monkeys (Cercopithecus mitis ssp.).

There is good evidence, mostly from captive studies, that physiological stress responses in primates and other mammals can vary with sex (Boonstra et al., 2001; von der Ohe & Servheen, 2002), age (Gust et al., 2000; Stoinski et al., 2002; Erwin et al., 2004), the availability of food (Cavigelli, 1999), sexual activity and reproductive status (Tilbrook et al., 2000; Boonstra et al., 2001; Lynch et al., 2002), social environment (Ziegler et al., 1995; Shively et al., 1997; Wielebnowski et al., 2002), dominance status (Sapolsky & Ray, 1989; Bercovitch & Clarke, 1995; Creel, 2001; Goymann et al., 2001), personality styles (Sapolsky & Ray, 1989; Capitanio et al., 2004), early experience (Clarke et al., 1994; Weinstock, 1997; Lyons et al., 1999), and genotype.
(Lyons et al., 1999). In addition, plasma levels of glucocorticoids\(^1\) (GC) can vary widely from minute to minute (Sapolsky, 1992), hindering the comparison of circulating hormone levels between individuals assessed by single blood samples. Non-invasive methodologies have the advantage of being less sensitive to short-term fluctuations of serum cortisol levels, because they average GC levels over longer periods. The extent of this pooling effect depends on the excretion path and species-specific metabolism, diet, and other factors (Whitten et al., 1998; Wasser et al., 2000), but it generally still allows the identification of physiological responses to acute stressors.

Several field studies of non-human primates have investigated determinants of individual differences in average GC levels through analysis of feces and urine (Table 1). Social dominance, reproductive status, and seasonal variations emerged as major correlates of GC levels, but not always in the predicted directions. For example, captive studies suggest that cortisol secretion of subordinates is expected to increase when they are surrounded by unrelated animals, the target of frequent aggression, and unable to cope (Abbott et al., 2003). However, data from field studies has shown that dominant individuals can have higher GC levels than subordinates (Cavigelli et al., 2003; Muller & Wrangham, 2004), despite living in kin groups, receiving low rates of aggression, and having the opportunity to cope. Indeed, frequency of aggression may be a better predictor of GC levels than social status (Cavigelli et al., 2003; Muller & Wrangham, 2004). These findings suggest that individual differences in GC levels may depend more on individual behavioral and coping strategies than on dominance status (Sapolsky & Ray, 1989). However, it is uncertain why similar effects of aggression on GC have not been observed in field studies of other species with differentiated hierarchies and relatively high rates of aggression (van Schaik et al., 1991; Weingrill et al., 2004).

Part of the problem with prior non-invasive field studies is that they only measure long-term average GC levels without assessing differences in Hypothalamic-Pituitary-Adrenal (HPA) reactivity. Recent clinical studies have shown that the reactivity of the HPA axis (the body’s “stress system” that ultimately controls levels of stress-related hormones) to acute stressors is related to disease risk (Cohen et al., 2002), and can be compromised in subjects that suffered from long-term exposure to high stress (Gunnar & Vazquez, 2001). The limited sample size and/or frequency in past studies would have obscured any such differences in HPA axis functioning. Another possibility is that some proximate causes of individual differences in stress responses have so far been overlooked. Two recent field studies indicated, for example, that high rank may result in elevated GC levels only where dominance is energetically more costly than subordination (Barrett et al., 2002; Muller & Wrangham, 2004). Resource characteristics and the resulting competitive regime are two very promising components of a predictive framework of physiological stress responses in wild non-human primates and other mammals, because they influence energetic costs as well as the frequency and distribution of aggression among social groups.

**Objectives**

This research will enable us to assess and help predict impacts of human-wildlife interactions on the health and survival of non-human primates. Sykes monkeys can serve as an ideal model for

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\(^1\) Glucocorticoids are steroids that include the two main stress hormones cortisol and corticosterone; here used synonymously to the glucocorticoid metabolites measured in fecal samples. One of their main physiological functions is to increase blood glucose (hence their name).
investigating how similar, endangered species will respond physiologically and behaviorally to human encroachment of their habitat. About half of the guenon (monkeys of the genus *Cercopithecus*) species are currently considered endangered to some degree (Oates, 1996) and many will face a significant reduction of their forest habitats in the near future. The populations that survive in protected areas, forest islands, or community managed forests will face increasing contact with humans, followed by alterations of their habitats and food sources, the effects of which are currently largely unknown. It is vital for conservation biologists to know how surviving wildlife populations will cope with these less dramatic environmental changes brought about by human activities or simply to human presence in and around their home ranges. Stress response patterns can serve as possible indicators of subtle changes in fitness under these conditions, which could otherwise be measured only after long-term changes in growth rates.

Wildlife populations have a limited capacity to co-exist alongside humans. However, despite many declines in diversity and species abundance of primates in tropical countries over the last decades many species currently still survive in habitats surrounded by or interspersed with dense human populations. This is particularly true for arboreal non-human primates, for which wide open areas are barriers to movements (Lawes et al., 2000). The goal of this project is to understand the consequences of anthropogenic change of forest environments with regards to health and well-being of arboreal guenons. Ultimately, this knowledge can be used to facilitate the long-term co-existence of these species with humans.

**Study Species and Populations**

The blue monkey (*C. mitis*) is a widespread and common monkey in eastern and southern Africa, occurring in several subspecies in a variety of habitats, from montane rainforests to lowland dry forests and woodlands (Oates, 1996; Kingdon, 1997). These monkeys live in one-male multi-female social groups (Cords, 1988), although multiple males may join the group during the mating season (Cords, 2000b). The species is highly arboreal, but habituated groups regularly move on the ground or through the understory. Mating occurs mainly from June to September in the study populations, followed by a peak in births in January/February. Plant reproductive parts are the preferred plant food items (Cords, 1986; Kaplin et al., 1998; Lambert, 1998; Fairgrieve & Muhumuza, 2003), but use of these resources varies with seasonal availability.

**Study Sites**

Data collection will occur at two study sites, the Kakamega Forest Reserve in western Kenya, and Gede Ruins National Monument on the Kenya coast. Earthwatch volunteers will work only at one of the two sites, the Gede Ruins. The Kakamega Forest is a semi-deciduous submontane rainforest of the Congo-Guinean type (Mutangah et al., 1992), whereas the Gede Ruins comprise seasonal coastal forest and woodland. At Kakamega, four groups of blue monkeys (*C. m. stuhlmanni*) have been under observation for a period of 10-25 years (Cords, 2000ab; 2002), allowing close range observations of known individuals. Two of these groups, GN and TWS, will be the subjects of this study. Both groups include a variety of forest types within their home ranges, but TWS has access to foods provided by humans because their home range includes a small village (forest station) with gardens, horticultural trees, and household refuse. The GN group, on the other hand, mainly occupies an area of high canopy forest, with no access to food supplements in form of provisions or crop raiding.

At Gede, one group of *C. m. albogularis* has been exposed to human contact for an unknown number of years, and was further habituated to close observation in 2004. The home range of this group includes farmland and/or village areas in close proximity to the forest, with access to fruit crops (banana, mango, avocado). Visitors to the national monument frequently provide additional fruits and sweets to the monkeys, and a butterfly farm within the home range offers regular, easy access to insect food (butterfly pupae). An extensive trail system allows for easy
following of the animals with minimal disturbance at both sites. Animals show virtually no interaction with observers during group follows at either site. The study groups at each site were carefully chosen to provide a gradient in levels of contest competition, largely as a result of different levels of food supplementation (see preliminary data analysis).

In total, 30 adult females will be included in the study (10 in each group). All adult females can be individually recognized at both sites by physical features. Dominance rank of all adult females is known and well-established for the two study groups at Kakamega. Cords (2000a) has shown that the social hierarchy of blue monkeys is linear and stable over time, although weakly expressed. At Gede, recording of all observed agonistic interactions for about 240 hours enabled us to establish a fairly linear hierarchy for the adult females of that group, with most reversals involving large juvenile females. Additional data collected during the course of the study will verify rank positions in all groups.

We will evaluate five main hypotheses about the determinants of GC levels in Sykes monkeys. As the hypotheses are not mutually exclusive the relative contribution of different models for explaining variation of GC levels will be assessed by conducting variance component analysis and by comparing the explanatory power (adjusted R²) of the models.

**Hypothesis 1: Food Supplementation is a Significant Determinant of GC Levels**

As cortisol is involved in the metabolism of glycogen and the conversion of amino acids to glucose (Norris, 1985), GC levels normally increase at times of increased activity or decreased food availability (Mitev et al., 1993; Ortiz et al., 2001). There is evidence that even subtle changes in food availability can cause changes in cortisol levels in captive non-human primates (Champoux et al., 2001). In wild long-tailed macaques, urinary GC levels were shown to increase with foraging time, and decrease with resting time (van Schaik et al., 1991). Average GC levels also tended to be higher in ring-tailed lemurs that lived in comparatively marginal habitats (Cavigelli et al., 2003), and in male chimpanzees during periods of relatively low fruit abundance (Muller & Wrangham, 2004).

**Prediction**

Daily foraging effort will be positively correlated to GC levels of individual females, and increase in food supplementation will reduce foraging effort and hence lower GC levels both on a group and individual level.

**Method**

*Energy Expenditure*

Travel in search of food as well as reproduction represent two of the highest energetic costs for most mammals. Cost of travel is thought to be an important selective pressure on primates, influencing net energy balance (Nakagawa, 2000), reproductive success (Whitten, 1983) and group size (Terborgh & Janson, 1986; but see Struhsaker & Leland, 1988; Butynski, 1990; Chapman, 1990; Isbell, 1991; Williams et al., 2002). In *C. mitis*, groups can be spread over several hundred meters (Cords, 1987), so we cannot assume that straight line distance of group movement (GSLD) will provide accurate estimates of individual travel costs (Isbell et al., 1999). We will therefore use actual distance traveled by individuals (IAD) to estimate travel distances. Estimates of IAD will be based on our 15-minute focal samples of individual females. For the duration of the sample, distance of movements will be estimated by eye, where movement is defined as any locomotion involving the hind limbs (Isbell et al., 1999). Daily energy expenditure will be calculated with published equations (DaSilva, 1992; Key & Ross, 1999; Nakagawa, 2000), including estimated for costs of travel and reproduction. We will not distinguish between vertical and horizontal movements, because the energetic aspects of these different types of locomotion
are almost entirely unclear and it is likely that energy costs of climbing up are balanced by energy saved when climbing down (Pontzer & Wrangham, 2004). Reliability of distance estimates will be determined every month by estimating the distance between randomly positioned markers.

**Food Availability**

A qualitative approach to assessing food distribution has been a dichotomous classification as either dispersed or clumped (Chapman et al., 1995; Sterck et al., 1997; Koenig et al., 1998), which has been widely used for interpreting the social organization of primates and other mammals in an ecological context (Wrangham, 1980; van Schaik, 1989; Butynski, 1990; Isbell, 1991; Barton et al., 1996; Boinski, 1999). However, the measures used to classify resources on this scale differ greatly, and their relevance to foraging individuals is often uncertain because distribution changes with the plant species exploited at any particular time, with the measurement scale (e.g. food item vs. entire tree), and with the research question in mind (e.g. group vs. individual behavior). Measures of food abundance are less controversial, although not always precise either (Chapman et al. 1994). As a compromise between accuracy and efficiency, we will combine traditional measures of food availability with measures that are thought to be more indicative of the perceptions of the animals themselves (Isbell et al., 1998a).

A field assistant will assess phenology of feeding trees (the relationship of climate/season with timing of natural events, like flowering or budding) every two weeks for two days along transects covering all habitat types in the home range of each of the study groups. We will record trees over 10 cm diameter at breast height (DBH) within 5 meters on either side of the trail. Abundance of young leaves, flower buds, flowers, and ripe fruits will be estimated on a scale of 0-4. As DBH is a good indicator of crop size (Leighton & Leighton, 1982), the sum of the DBH of all trees in a given phase, multiplied by the average abundance score for each food type, may indicate food type abundance in the home range. To obtain animal-centered measures of food density, Foerster will estimate the distance between food sites (DFS) as well as the distance moved per unit time (DT) during focal animal samples. The inverse of the number of moves per unit time will give an estimate of food site depletion times (FSDT), which may be the single most important characteristic of food resources that affects female social relationships within groups (Isbell et al., 1998b).

**Analyses**

Predictions will be tested using partial correlation of GC levels (N=32 two-week averages) on foraging effort as well as food availability estimates for each preferred food type (separate correlations), while controlling for reproductive status. If the hypothesis is supported, a multiple regression of GC levels over time within females on foraging effort, food availability estimates, AND agonism will evaluate how much the latter influences the observed relationship. Average GC levels of females will be compared between groups with an analysis of variance.

**Hypothesis 2: Contest Competition is a Significant Determinant of GC Levels**

**Hypothesis 2.1**

The level of contest competition within groups depends on the abundance and distribution of resources (Wrangham, 1980; van Schaik, 1989; Isbell, 1991), which together determine their usurpability (Isbell et al., 1998b). Resources are contestable when they occur in usurpable patches, i.e. patches that have a long depletion time. Ubiquitous resources or those that are quickly ingested (and thus difficult to monopolize) provide little motivation or opportunity for contest competition. As provisioned foods are highly contestable, it is possible that the effects of food supplementation hypothesized above are confounded by the effects of stronger contest competition that results from the provisioning.
Prediction 2.1
Average GC levels within females over time as well as between groups will correlate positively with the average usurpability of preferred foods and/or the proportion of time spent feeding on clumped resources, and negatively with group spread.

Method 2.1
Usurpability will be assessed with the degree of aggregation of feeding trees at a given time (underdispersed, random, overdispersed distribution patterns), as well as average patch size of the resources used as expressed through food site depletion time (see above). Spatial distribution of food trees will be assessed with the point-center-quarter method: in random intervals along transects (N=50 points), the distance of the nearest tree from a randomly chosen tree as center point will be identified in four equally sized quarters of a circle with the sample tree as center, and compass directions as traverse. Variance-to-mean ratio of the number of trees of a species at each sample point will give a measure of spatial aggregation (Whitten, 1983; Setchell & Curtis, 2003). Group spread will be assessed by recording the number of animals feeding within 10 meter of a focal animal during group scan samples.

Hypothesis 2.2
As a very high percentage of agonism in C. mitis occurs over food (Cords, 2000a; 2002), higher frequencies of within- and between-group aggression will indicate higher levels of WGC and BGC, respectively. Both receiving and initiating aggression can be a source of stress (Das et al., 1998; Cavigelli et al., 2003). If long-term average GC levels of females are not different among groups despite differences in competitive regime, there may be a complete adaptation of physiological responses to environmental conditions, in which case the examination of behavioral differences between groups will shed light on possible adaptive behavioral strategies associated with the physiological adaptation.

Prediction 2.2
The project predicts that frequencies of agonistic interactions within and between groups are positively related to average GC levels within females over time as well as between groups.

Method 2.2
The PI and long-term assistants will collect 15-minute focal animal samples (Altmann, 1974) using a handheld computer. Behaviors (Table 2) will be recorded continuously. We will obtain focal samples for about half of the females in each group per day, alternating females between days. Focal subjects will be selected opportunistically on a given day, but balanced across different times of the day. About three 15-minute samples will be obtained per female every other day, equal to 9 hours per month. We will record circumstances for each agonistic interaction whenever possible. If food-related, we will record the type of food involved. We will obtain rates of agonistic interactions from focal animal data.

Hypothesis 2.3
The relative importance of social status for determining long-term average GC levels should increase with contest competition if dominants can increase their access to resources compared to subordinates. Although C. mitis shows a low frequency of within-group aggression, dominance status is negatively associated with rates of received aggression (Cords, 2000a), and subordinates increase their feeding time on preferred foods during times of low food abundance, presumably because they are excluded from the highest quality food patches (Pazol & Cords, 2005).

Prediction 2.3
The effect of social status on GC level differences between females will increase when contest competition for food increases.

**Method 2.3**

Dominance relationships between females will be determined by monitoring agonistic interactions (avoidance, threat, supplant, chase, hit, and bite) in which only one contestant shows signs of deference or submission.

**Analyses 2.1-2.3**

Between-subject variation will be analyzed with mixed linear models (Diggle et al., 1994). Weekly averages of GC level will enter as dependent variable (N=72 per female), individuals as random effects (accounting for repeated measures), and weekly average of food site depletion time, time spent feeding on clumped resources, and group spread as fixed effects (prediction 2.1). For prediction 2.2, fixed effects will be the frequency of within-group and between-group aggression. On a finer scale, a multiple regression analysis for each female will test the relationship of raw GC level data (sample by sample) and occurrence of aggressions the day prior to the sample. For prediction 2.3, fixed effects will be social status (top, middle, bottom third of hierarchy) and relative level of within- and between-group contest competition (low, medium, high).

**Hypothesis 3: GC Levels are Associated with Social Coping Styles and Social Support**

Short-term physiological responses to a stressor are determined by the ability of an individual to cope, which is the behavioral and physiological effort to master, reduce, minimize, or tolerate the negative consequences of internal or external demand (Olff et al., 1993; Koolhaas et al., 1999). If the stressor is too severe or long lasting, the failure of coping mechanisms can lead to negative health impacts. If social coping is used effectively, theory predicts that the effect of exposure to acute stressors on short-term GC level fluctuations will decrease, i.e. physiological stress responses will decrease in magnitude (Bohnen et al., 1991; Abbott et al., 2003). Chronic failure to cope, on the other hand, will first lead to chronically elevated GC levels, but after long-term exposure to the stressor GC levels will normalize but HPA axis reactivity will be compromised (Cavigelli & McClintock, 2003; Rohleder et al., 2003). Among the available social coping strategies, we will include reciprocated allogrooming and redirected aggression, which are known to decrease conflict and arousal after agonistic encounters (Aureli & van Schaik, 1991; Cords & Aureli, 1993; Gust & Gordon, 1993; Kappeler, 1993; Das et al., 1998). Although no prior work has been done on coping behavior in guenons, from our own experience we can confirm that the above-listed behaviors are being used in this species in ways similar to what has been reported from macaques. For example, blue monkeys show markedly increased grooming behavior after between-group aggressions (Cords, 2002), and affiliation between former opponents following aggression usually consists of grooming (Cords, unpublished data). Thus, it appears justified to adapt the terminology and methodology from prior studies of coping behavior in long-tailed macaques as the most closely related species from which data are available. As coping behaviors must be seen in context when trying to relate them to GC levels, we will assess their occurrence with focal samples of both winners and losers after decided agonistic interactions.

**Prediction**
The frequency of coping behaviors after involvement in agonism is negatively associated with the coefficient of variation in GC levels as an expression of the average magnitude of responses to acute stressors.

**Method**

Immediately after a decided agonistic interaction is observed, we will collect 10-minute focal animal samples, during which social interactions of either the submissive or dominant female (alternating) will be recorded. If a focal animal is involved in such an interaction during a 15-minute sample, we will extend the sample to include 10 minutes of post-agonism data and later separate the two data subsets. We plan to obtain at least 20 post-agonism focal samples per female, which will be used to quantify occurrences of coping behaviors such as reciprocated allogrooming and redirected aggression (Aureli & van Schaik, 1991).

**Analyses**

Differences between individuals in the short-term response to acute stressors will be analyzed by correlating the coefficients of variation in GC levels (individual averages) with the proportion of post-agonistic focal samples in which social coping occurred (prediction 3.1). Differences in variability between individuals will be assessed with the overlap of confidence intervals associated with the coefficients (Vangel, 1996). The mitigating effect of coping will be tested by adding the frequency of coping behaviors during focal animal samples as a fixed effect to the mixed linear model and multiple regressions used to test prediction 2.2. A non-parametric U-test will compare average GC levels of the 5 females with the lowest number of coping partners during post-agonism focal samples with GC levels of the top 5 females (prediction 3.2).

**Hypothesis 4: Parasitic Load Correlates with GC Levels**

The intensity of gut parasitic infection (i.e. the number of parasites in the gut) may be useful to evaluate fitness correlates of GC levels (Sheldon & Verhulst, 1996; Semple et al., 2002). The relationship between parasite load and physiological stress responses has been examined only once for a primate species (Morales-Montor et al., 2001), but together with results from other mammals there is evidence that parasite load is positively correlated with GC levels (Prichard et al., 1974; Fleming, 1997; Foley et al., 2001). Therefore, a Kenyan graduate student (Kiio Kithome, Kenyatta University, Nairobi) will measure parasite load as a potential health indicator and correlate of GC levels in all fecal samples.

There is controversy over estimating parasitic load in individuals as compared to prevalence of parasite infection in a population (Hall, 1981; Galvani, 2003), because the high variability of fecal egg output may not give accurate estimates of gastrointestinal (GI) parasite load (Stear et al., 1995; Engels et al., 1996; Engels et al., 1997; Yu et al., 1998; Harvey et al., 1999; Utzinger et al., 2001) when estimated with few, widely spaced samples. However, it has been shown experimentally that for *Trichuris suis*, a close relative to *T. trichiura* that is a common GI parasite in *C. mitis* (Munene et al., 1998; Gillespie et al., in press), there was a good correlation between female worm burden and fecal egg output (Pedersen & Saeed, 2000). As egg output does indeed vary from day to day and even within a stool sample (Engels et al., 1997; Pit et al., 1999), average parasite load needs to be estimated by frequent repeated sampling of individuals. Parasite infection intensity generally does not vary over very short time scales of days, but rather over weeks and months (Hall, 1982), hence we expect to obtain representative measures with an appropriately dense sampling schedule.

**Prediction**
Parasite load will be positively correlated with GC levels, and increase with level of human-animal interactions.

**Method**

**Formalin-ethyl Acetate Sedimentation Method**

The preserved fecal sample will be homogenized and sieved through a tea strainer into a 100 ml beaker. The fecal suspension will be dispensed into a 15 ml tube and centrifuged for one minute at 650 g in a centrifuge. The supernatant will be disposed, and 9 ml of 10% formalin will be added. Four milliliters of acetate will be added and the cap screwed tightly and the tube shaken vigorously for 30 seconds. The tubes will be centrifuged for 1 minute at 500 g. Four layers, ethyl acetate, plug of debris, formalin and sediment should form. The tubes will be ringed with an applicator stick to loosen plug. The top layers will be decanted into ethyl acetate formalin waste container and the sediment will be left. The tubes will be kept in the inverted position and wiped down the inside of the tube with cotton tipped applicator. This step is important because the ethyl acetate droplets, which reach the sediment, make reading the specimen difficult. The sediment will be mixed with a couple of drops of saline. Using a Pasteur pipette, two drops of the suspension will be placed on either side of a labeled microscopic slide. One of the drops of the fecal suspension will be stained using Lugol's iodine. The two drops will be covered by a cover slip. The non-stained drop will be examined first using 10x followed by 40x objective. The stained drop will examined for confirmation. Any parasite seen will be identified and numbers recorded. This procedure will be repeated until all the suspension from each sample is finished.

**Flotation Method**

The fecal flotation method will be used to isolate the light helminthes eggs and protozoan oocysts and cysts from the fecal debris. Saturated solution of sodium nitrate (NaNO₃) is suitable for this separation. One gram of fecal material will be placed into a centrifuge tube. The tubes will be filled 2/3 with distilled water and the pellet homogenized using a wooden applicator stick. The tubes will be centrifuged at 700 g for 10 minutes and the supernatant will be poured. The fecal material will be re-suspended using saturated sodium nitrate solution. The tubes will be filled up to meniscus with saturated NaNO₃ solution and a microscopic cover slip placed on lip of tube. The samples will be centrifuged at 700 g for 10 minutes. The cover slip will be removed from the centrifuge tube and placed on a slide labeled with sample number. Samples will be scanned using 10x objective of compound microscope and all parasite eggs, larvae and cysts will be identified and counted. Measurement and confirmation of identification will be made using 40x objectives with help of staining with Lugol’s iodine. Measurement will be made on the length and width of individual eggs, cysts, and larvae using a calibrated ocular micrometer. Representatives’ photographs of the parasites will be made.

**Cultural Method**

A 20 cm x 13 cm filter paper strip will be smeared with 1g of feces and inserted into a 15 ml centrifuge tube containing 4 ml of distilled water. The tube will be maintained in slanted position at room temperature for 10 days. The filter paper strip will be kept moist by the capillary flow. After 10 days a small amount of fluid will be withdrawn from the bottom of tube and put on watch glass. This will be placed under a dissection microscope and examined at 10x magnification. Larvae will be identified according to morphology and classified.

**Analyses**
Average monthly infection intensity will be correlated with average monthly GC level for each female. Parasite prevalence will be compared between groups and related to GC level averages of groups in a mixed linear model analysis of variance.

**Hypothesis 5: GC Levels will be Higher in Pregnant and Lactating Females**

Gestation and infant care are energetically costly (Altman & Samuels, 1992; Altman, 1998) and may thus elevate GC levels. This effect will be exaggerated when resource availability decreases and females are exposed to additional nutritional stress. The periods of highest energetic demand are late gestation and early lactation, and thus females in these stages should show higher average GC levels. Previous experimental studies have shown that high doses of estrogen stimulate GC production in the adrenal glands (Stavisky et al., 2003), and that high estrogen levels are associated with elevated GC levels in New World monkeys (Ziegler et al., 1995; Smith & French, 1997). Although the evidence is mixed regarding the degree to which natural concentrations of estrogen can be a dominant stimulant of GC secretion in Old World primates (Cavigelli, 1999; French et al., 2004; Weingrill et al., 2004), higher GC levels shortly before parturition and during early lactation may result from heightened estrogen levels as much as elevated energy requirements. This study will not distinguish between these two proximate causes of elevated GC levels, but rather assess their combined effect through the proxy of reproductive status.

**Prediction**

Females will be particularly sensitive to stressors during late gestation and early lactation, which will be reflected in higher GC levels compared to other females in the group.

**Method**

Monitoring of mating, births, and lactation will allow us to assess reproductive status. A field assistant will monitor births that occur after the end of the study period in weekly intervals for an additional 3 months. Combining birth dates with records of gestation length (Pazol et al., 2002) and infant development (Förster & Cords, 2002), we have defined the following periods: early gestation (months 1-3), late gestation (months 4-6), early lactation (months 1-2), late lactation (months 3-6). Carrying of infants significantly decreases in the second month, and nipple contact diminishes to very low levels by the sixth month. Although milk transfer rates are unknown, this delineation of periods is very likely to mirror differences in average energy output of mothers.

**Analyses**

Similar to analyses for hypothesis 2, reproductive status will be entered as a fixed factor in a mixed linear model analysis of variance, comparing stress levels within and between females during periods of high energetic demand (late gestation, early lactation) with periods of comparatively lower energetic demand (all others).

**Additional Research on Seed Dispersal**

Beginning this season, volunteers will collect data from two habituated Sykes monkeys to determine seed treatment of fruits fed by Sykes and their ranging behavior and examine how this contributes to seed dispersal and consequently overall forest regeneration in Gede Forest. This information will also be analyzed to compare the effect of provisioning by tourists (one group is provisioned) on the seed dispersal ability of the two primates. One assumption is that the provisioned group may contain less seed diet compared to the non-provisioned group.

The specific objectives involved with this work are to:
• Determine seed load in Sykes monkeys’ feces
• Establish the germination rate of seeds collected from the feces
• Examine the effect of seed predation or seed dispersal by Sykes monkeys on forest regeneration
• Compare the effect of provisioning on seed dispersal ability of Sykes monkeys

Hypotheses
• **Hypothesis 1:** The germination rate of seeds in the feces is the same both under lab and field conditions.
• **Hypothesis 2:** There is no significant difference in the seed load in feces of provisioned and non-provisioned monkeys
• **Hypothesis 3:** Sykes monkeys are significant seed dispersers in the forest.

Diet and Feeding Patterns
Two groups of habituated Sykes monkeys will be followed, each on alternate days from 6:30 a.m to 6:00 pm. Sykes diet will be determined from focal animal observations of feeding events and from analysis of fecal material. The S Group contains about 30 individuals and the K Group contains about 63 individuals and is often provisioned by tourists.

The first animal in a given group to be encountered will be taken as the initial focal subject and will be followed for a maximum of one hour after which another focal animal will be chosen according to a fixed rotation routine that will be predetermined. The behavior of the focal animal will be recorded after every minute as long as the focal animal is in sight. During the follows, the foraging behavior of the focal animal will be recorded, including plant species foraged, food item ingested, phenological state and seed treatment. Food items eaten by Sykes will be identified and recorded in the field, or a sample will be collected for later identification. Records of how seeds are treated (spat out, dropped or swallowed) will be made by categorizing how the majority of seeds per species are handled by Sykes.

The GPS location of each particular group will be recorded every hour from 6:30 am to 6:00 pm or if abrupt changes in direction of travel occurs and this will be used to calculate daily ranges. A group will be said to be dully constituted if it contains five or more adult individuals.

Plant Species Distribution and Abundance
Established 20-by-20 quadrants will be used to determine abundance of plant species and food items. In quadrants, tree species with a DBH of five centimeters or more will be measured and tagged. The growth rate of the trees in these quadrants will be monitored.

Defecation Rates and Seed Dispersal
Fecal clumps from focal animals will be marked with a flagging tape. The time of defecation and focal identity will be recorded and the deposition site marked in the GPS. These seeds will be monitored weekly. On the first monitoring, the fecal fabric will have decomposed and fragmented. Seeds of each species contained in the feces will be counted and recorded. Thereafter, the seeds will be monitored for germination and predation. On each monitoring occasion, the species and the number of seedlings germinating will be recorded. Every second fecal clump will be collected for lab analysis and treatment. These will be put in polythene bags and marked separately. The collected fecal samples will be analyzed in a small lab situated at the site. Each fecal sample will be independently weighed.

The total fecal collections per day will be divided into two.
**First Half of Fecal Collection**

Feces will be put in test tubes filled with 50% ethanol and left to stand for one day. They will then be washed under running tap water. The seeds will then be placed on a slide and dried for an hour in the shade. Slides containing seeds will then be observed under a dissecting microscope. Seeds greater than two millimeters will be identified, counted, and recorded. The size of the seeds will also be measured, both length and width, using vernier calipers. Seed condition will be recorded as either intact or destroyed.

**Second Half of Fecal Collection**

The remaining seeds will be tested for viability and germinability. Seeds will be placed on damp filter papers in the laboratory and monitored for germination for up to a period of one month. The total number of seedlings that will have germinated after one month per each species will be counted and recorded.

The significance of Sykes monkeys as seed dispersers will be determined through analysis of germination rates both in the field and under lab conditions.

**RESULTS AND OPPORTUNITIES**

**Benefits of the Research**

**Local**

Several assistants from local communities have been recruited in the past year to help carry out important tasks for the planned research project. Their involvement ranges from cutting and maintaining the trail system to collecting behavioral data from known individual monkeys. Preliminary work done at the field site has led to a better understanding of the animals and their ecology, and has helped promote awareness of research and conservation in the surrounding communities. Posters and brochures will be provided locally and distributed to both tourists and schools. For the latter, the education department of A Rocha will provide the necessary infrastructure.

**National**

Results will be presented to the National Museums of Kenya, the management authority of Gedi Ruins. Explicit guidelines will be developed to translate results from this research into management practices. One Kenyan Master’s student (Kiio Kithome) will be supported by the project and will conduct parasitological analyses of feces in collaboration with the Institute of Primate Research, Nairobi.

**International**

This research will enable us to assess and help predict impacts of human-wildlife interactions on the health and survival of non-human primates. About half of the guenon species are currently considered endangered to some degree and many will face a significant reduction of their forest habitats in the near future. Sykes monkeys can serve as an ideal model for how similar species will respond physiologically and behaviorally to human encroachment of their habitat. The populations that survive in protected areas, forest islands, or community managed forests will face increasing contact to humans, followed by alterations of their habitats and food sources, the effects of which are currently largely unknown. It is vital for conservation biologists to know how surviving wildlife populations will cope with these less dramatic environmental changes brought about by human activities or simply human presence in and around their home ranges.
LITERATURE CITED


EXPEDITION PACKING CHECKLIST

Essential Items

☐ This Expedition Briefing (includes essential information, including contains contact information should you be delayed to your rendezvous)
☐ Photocopies of your passport, flight itinerary and credit cards in case the originals are lost or stolen; the copies should be packed separately from the original documents
☐ Visa and/or passport (if necessary)
☐ Certification of inoculation (if necessary)

Required Items

Clothing/Footwear for Fieldwork

☐ Lightweight, quick drying field trousers (e.g. nylon) with cargo pockets for storing notebook
☐ Lightweight shirts to protect against sun and scratches in the forest (long-sleeved recommended)
☐ Light ankle-high hiking boots (rubber boots/gumboots/Wellingtons are not necessary)

Clothing/Footwear for Leisure

☐ One set of clothing to keep clean for occasional trips to town, dining out, and/or the end of the expedition
☐ Comfortable shoes (sandals or sneakers/trainers) to wear around the field station
☐ Conservative swimsuit

Field Supplies

☐ Small daypack/rucksack for carrying water and personal items in the field
☐ Binoculars with a neck strap (if possible, please bring 8x40, 8x42, 10x40, 10x42 or 10x50; pocket-sized binoculars will probably not be suitable)
☐ Notebook (needs to fit in your pocket but not be too small; suggested size is A6)
☐ Drybag or plastic sealable bags (e.g. Ziploc brand) for protecting equipment such as camera from dust, humidity, and water
☐ Insect repellent spray
☐ Water bottle(s) able to hold at least a liter

Personal Supplies

Note: Bed sheets, pillows, pillowcases and towels will be provided by A Rocha.
☐ Personal toiletries (biodegradable soaps and shampoos are encouraged)
☐ Antibacterial wipes or lotion (good for “washing” hands while in the field)
☐ Personal First Aid kit (e.g. anti-diarrhea pills, antibiotics, antiseptic, antihistamines, itch-relief, pain reliever, bandages, blister covers, etc.) and personal medications
☐ Sunscreen lotion with SPF 30 or higher
Miscellaneous

☐ Spending money (see Other Advice/Information in Section 9 ‘Before You Leave’)
☐ Camera and equipment (e.g. film or memory cards, extra camera battery, adapter for recharging, etc.)

Optional Items

☐ Flashlight/Torch or headlamp with extra batteries and extra bulb
☐ Sheets and pillowcase (these are provided at the accommodations, but you may prefer to bring your own)
☐ Earplugs for light sleepers
☐ Flip-flops to wear in the shower or on the beach
☐ Snorkeling equipment (can be rented at the field station, but supplies are limited and most equipment is old and worn) and a pair of water shoes or wetsuit booties for protecting feet from scrapes and cuts when walking in shallow water
☐ Field guide(s) for animals (birds, reptiles, mammals, butterflies, marine life) and/or plants
☐ Books, travel games, journal, sketchpad, etc.
☐ Travel guidebook