MONITORING GUIDE

FOR THE

AMBOSELI BABOON RESEARCH PROJECT

Protocols for long-term monitoring and data collection

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Published by the authors, June 2011

(Previous editions April 1979, July 1981, January 1982, July 1983 and December 1983 by Jeanne Altmann, Stuart Altmann and Glenn Hausfater, February 2004 by Jeanne Altmann and Susan Alberts)

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I. INTRODUCTION

1.Background

The Amboseli Baboon Research Project has been ongoing for four decades. Over the years a variety of data types have been collected. Of the data sets described in this guide, some (i.e., demographic data) have been ongoing since 1971, while others extend back for somewhat shorter periods. Almost all data types that we currently collect extend back to at least 1980. Still other types of data were collected for shorter periods of time and are no longer a focus of our research efforts. Whatever the data set, the value of the data collected at the Project lies in its consistency and in its consistently high quality across time. This guidebook describes the procedures we use to collect these data, which allow us to monitor the demography, behavior and habitat of the Amboseli baboons. It is meant as a guide for the permanent staff in Amboseli, for short-term visitors to the Project (less than 4 months), and for visiting researchers pursuing their own projects (Ph.D. students, post-docs and other collaborators that stay long enough to learn the baboon ID's and contribute to the long-term data). It is absolutely essential that everyone who contributes to the Project's data set collect the data in accordance with the guidelines laid out here. Visiting researchers will collect additional data for their own specific research questions, which will extend beyond the monitoring data described here; these visiting researchers will still contribute to the monitoring data collection that is described in these procedures.

When you contribute to the data of the Amboseli Baboon Research Project, you are contributing to a data set that we believe is unique in its time depth, breadth and detail. It is important to us that you take this responsibility very seriously. Never be satisfied with your data collection; always strive for more data of higher quality.

Permanent field staff should read this entire guide once every year. A good time to do this is during a visit from one of the directors. Visiting researchers should read it again after they have been in Amboseli for three months, and again after their eighth month. Each time, notify Jeanne and Susan immediately if there are any differences between what is described here and what you are doing, and if there are any sections that are not clear.

2. Data collection overview

The data we collect spans a wide range of data types. Many of our monitoring data sets (e.g., grooming records, agonism records) are collected *ad libitum*; others are collected as systematic scans (censuses and sex skin records), focal animal (individual), or focal group samples (SWERB and GPS readings). Most project participants will also do focal animal sampling. Virtually all data collection depends on individual recognition of baboons by observers, and if you are new to the project, learning baboon IDs will be your first task.

We work hard to achieve and maintain interobserver reliability; the presence of long-term, extremely knowledgeable field assistants contributes to this. It is very important that you learn to collect each type of data in the manner described here. If you have questions or concerns about a particular data collection method and your questions aren't answered here, ask the field team how and why they collect it the way they do. If you are still uncertain about how or why a certain collection method is used, consult with Susan or Jeanne. Do not make decisions on your own about changing data collection protocols; with a long-term data set already in place, any change you make during your stay will at best simply result in your data being discarded and at worst will compromise the integrity of the long-term data set.

We maintain a separate field notebook for each study group and one for non-study groups. The monitoring data are recorded in these field notebooks, which are used jointly by the field teams and are placed at the end of each day in the office, on the shelf with other data notebooks. At the end of each month, all the data are removed from the notebooks and taken to Nairobi, where they are photocopied and mailed to Princeton. Approximately every six months, the originals are carried back to Duke.

3. Field notes

Field notes that you contribute to the long-term files will be used for many years to come, well after your own recollection and familiarity with the data, format, abbreviations, etc., has diminished. Thus, it is of utmost importance that data sheets are clear and intelligible not just to the writer at the time of writing, but also to other researchers and technicians in subsequent years of the project. One test for a well prepared data sheet is to give it to a naive observer and then ask that individual to interpret each entry on the sheet without reference to other entries or other data sheets. Any notes contributed to the long-term data files should not use any symbols or abbreviations except those that are given in this Guidebook. Exceptions are the standardized ABRP 3-letter animal codes, standard metric abbreviations, abbreviations that are well known and unambiguous in American English, or those that are defined on every page of notes where used. If you develop your own unique numeric codes for individuals or behaviors, these must never be used in the long-term records.

When describing events, do not use the simple present tense; it is ambiguous. For example, the statement: "Baboons eat mushrooms from elephant dung" could be a generalization, independent of time, or it could refer to what the baboons were doing at the time of the observation. Instead, use the simple past tense: "13 Mar 84. Baboons ate mushrooms from elephant dung."

If you are describing events from several past days, use "today," etc., to avoid ambiguities: "13 Mar 84. Last week baboons ate mushrooms. Today they ignored them." An acceptable alternative to the past tense is the progressive tense: "13 Mar 84. The baboons are eating mushrooms."

4. Date and time conventions

Dates are always written only in the order day, month, year, and the month is abbreviated by the first three letters of its name, not by numerals. Thus, a standard date entry in the field notes would be of the form "16 Jul 83." Formats such as "8/10/83" or "8-10-83" should not be used under any circumstances. Similarly, even if a page is labeled "Agonisms – 2003" or "Agonisms – May 2003", you should write the entire date on any entries on that page, i.e. 16 May 03 not just 16 May.

The time that events occur should be timed to the nearest minute and recorded as a four-digit number, without inserted punctuation, in the 24-hour system. e.g. 3:15 p.m. is written 1515 and 9:17 a.m. is written 0917. Use a digital watch in the field and synchronize your watch with the rest of the field team.

5. Monitoring study groups

The number of study groups that we monitor changes from time to time, usually because of group fission or group movement. As of 2011, we monitor six social groups on a near-daily

basis: Viola's, Hokey's and Snap's Groups (fission products of Alto's Group), and Weaver's, Mica's and Narasha's Groups (fission products of Hook's Group). On a typical field day, two or three field teams go out to two or three different study groups; we alternate between morning and afternoon shifts. With six study groups, this means that each group is followed every 2nd or 3rd day, and that over the course of a week each group has been followed during all daylight hours (see "Field Schedule" in chapter V, section 3). We collect the same set of monitoring and behavioral data for each group during each shift.

5.1 Focal animal sampling during group monitoring

Soon after we arrive at the group we begin focal animal sampling. The permanent field staff collects focal samples on adult females and on juveniles, using handheld Psion Workabout computers. Visiting researchers who are pursuing their own research projects will usually also collect focal samples. Monitoring data are collected continuously throughout the day while focal sampling is occurring. Some types of monitoring data (e.g., grooming and agonism data, mounts and consorts data) are easy to collect while also conducting focal sampling, and these may even be collected as part of your focal samples. Other types of data (e.g., opportunistic censusing of non-study groups when they are near your study group, GPS readings every half hour) require special effort and may occasionally interrupt your focal sampling schedule. We expect that visiting researchers, who are conducting research as guests of the project, will make every effort to collect all the monitoring data described here unless noted otherwise in specific sections, even if these data are not relevant to your particular research question. Indeed, we ask that you agree to do this when you are invited to conduct your research with the project.

5.2 Other field work and office work

Several other types of field work are important, in addition to monitoring study groups and conducting focal animal sampling within these groups. We regularly conduct censuses of non-study groups in the population, we collect daily records of temperature and rainfall, and we periodically dart baboons in order to collect blood and tissue samples and affix a radio collar (we maintain at least one working radio transmitter collar in each study group). Each of these is described in section III.

At various times during the month, some data are downloaded onto the office computer and backed up, and some handwritten data are entered into the computer. At the end of every month we have a staff meeting in the office. We review important demographic and behavioral events in the study groups that month, we discuss vehicle and camp maintenance, and we bring up any problems we had during the month. A summary of this meeting is printed for use during the month and copies are sent to Susan and to Jeanne. We also check the GPS recorders and other equipment, photocopy the data and prepare it to be mailed from Nairobi, prepare new sheets for the field notebooks for the coming months, and carry out various other kinds of office work (see chapter IV).

II. MONITORING STUDY GROUPS

1. Demography and demographic events

Data on group size, composition and the reproductive state of females are basic information required for nearly any short-term study (e.g. Ph.D. thesis) and are some of the most important information for the long-term monitoring of the Amboseli population. Our data collection

protocols for demographic monitoring are in this section, and our protocols for monitoring reproductive states and events are in the next section.

1.1. Demographic notes

Each daily census should be accompanied by notes about changes in group composition and the cause of such changes (see chapter II, sections 1.21-1.23. These notes will include information about demographic events and also information that may not appear in the census, such as sightings of extra-group males near the study group. It will also include detailed notes on immigrant males, their spatial and temporal relationship to the group and interactions with group members, which are used to determine whether the male is considered to be a group member on that day.

1.2. Daily census sheets

We complete a daily census of the group under study as soon as possible after we arrive at the group. Each census sheet has a list of animal codes (the three-letter codes that represent each animal's name) along the left-most column and days of the month along the top row.

- "X" opposite an individual's name on a given day means that the individual was present in the group that day, at the time of the census. In the case of immigrant males it is sometimes difficult to tell whether he is part of the group or not, particularly if he is quite peripheral for most of the day. Any male that is seen to sleep with the group should be considered part of the group and should be recorded as present on that day. If you don't know whether a male slept with the group, make a determination by the end of observations that day based on interactions with group members, including whether these interactions are more than a single or fleeting one (If a male interacts with more than one group member and does more than simply run away from them, he should be considered a member of the group. This determination should be accompanied by thorough and specific demographic notes to assist in a final determination of immigration date by Susan or Jeanne.
- "0" indicates that the individual was absent, either verified by seeing the individual in another group or elsewhere, by presence of a corpse, or by failure to find the individual after several complete searches through the group.
- "Blank" (no entry) in a cell of the census record means that no census information was available for that individual on that day. This will be the case for all individuals on days when no observer was in the field. It will be the case for a subset of individuals when time or other conditions permit only a partial censusing of the group. However, a full effort should be made to complete all censuses.

It is important for each daily census that you also record the time you complete the census, that is, the time when you have either made an entry for each individual or have convinced yourself that one or more individuals are indeed not present. An individual that leaves the group or dies after the census is completed should still be recorded as present on the census for that day – that is, you should not change the status of the census if this occurs – but you should make clear notes in Demographic Notes (see section 1.1 above) describing that individual's departure or death. However, an individual that enters the group (or is born) after the census is complete should be added to the census for the day on which they entered or were born (although the time should not be changed), and clear, extensive Demographic Notes should be made describing the entry or birth. In the case of immigrant males, it can be difficult to determine when a male has actually joined a group (as opposed to just following it).

1.21 Births and neonatal assessment

If a birth has occurred, record the sex and name of the new infant in the demographic notes and add a line for the infant on the census sheet; you will also add a reproductive note (see chapter II, section 2.14). The infant should be added to the daily census sheet starting with the first day it is seen.

You will also provide information on the condition of the infant through the use of a neonatal assessment sheet. A neonatal assessment sheet should be filled out on the first day an infant is seen. This form has a space for the last date and time that a female was seen without the infant and another for the first that she was seen with the infant. Jeanne uses these and the other information to assign or estimate the birth date later in Princeton. The second assessment should be completed 3-7 days after the first assessment. You will find checksheets for first and second assessments in the office in camp; carry spares with you to the field.

1.22 Immigrations

If a new individual (one that was not with the group on the most recent observation days) has immigrated to the group add a line for it on the census sheets. In the demographic notes, give details on the individual's entry, as well as information on previous group of residence (if known). Also record any previous contact between the new individual and the study group or refer to earlier demographic notes that describe this contact. Photograph the immigrant as soon as possible and be sure to discuss the immigrant with other members of the team in order to determine whether the individual is known.

It is extremely important to get an age estimate on the immigrant male, and an assessment of his degree of hybridity, as soon as possibly after he emigrates. We schedule these estimates and measures for the last days of each month, but whenever possibly you should try to obtain them as soon as you can after immigration. See sections 14.3 and 14.4.

1.23 Deaths, disappearances and emigrations

Usually when an individual dies or disappears you will have very little information about the nature of its death or disappearance. Nonetheless, it is very important that you provide as much detail in the demographic notes as possible. If the individual was wearing a collar, you should immediately listen for the collar and track it. Retrieve the collar if you find it and the animal is dead. Obviously if you see a corpse you will record where, when, it's state, and whether you can identify the individual. You should also collect tissue samples in RNALater (see chapter II, section 13.3). If the animal disappears, record any information that might be relevant to the disappearance. Is there alarm calling when you arrive at the group? Leopard tracks or other signs of predators? Any other clues? If an adult male or a large subadult male (or even a juvenile male) disappears, you should make every reasonable effort over the course of the next week to check other study groups and non-study groups for him.

In making notes about a disappearance, imagine that you are working with the data 10 years from now, and are unable to ask questions of the person who wrote the notes. Is everything you need to know clearly written in the notes? Would you be able to draw the right conclusions about what happened? More notes are always better than less.

1.24 Radio collar checks

In each group we have one or two females with VHF radio collars, and usually several males with VHF radio collars. Between 2008-2010 we also had some GPS collars, but we have not had GPS collars since 2010. Each field notebook has a checklist of all the active collars in that group (as well as a checklist of collars on males in non-study groups on on males that are not currently known to be in a group – see section 8.3, below). All the collars in each group should be checked every day that you are with a group – check the signal, but also fit, antenna, and mortality alert (if the collared animal isn't in sight). Whenever a male leaves a study group, his collar should be moved to the appropriate group's checklist or to the non-study checklist (in every field notebook).

1.25 Naming infants and new males

All new males and infants should be named according to the following rules. (1) The first three letters of the name must be different from any other name that has previously been used for an Amboseli baboon. This rule allows us to unambiguously identify every animal in our database by the first three letters of their name alone. Visitors are sometimes disappointed that they cannot use a given name because it's first three letters have already been used, but this rule is very important for fast and efficient data collection, storage and retrieval and must not be broken. (2) When it is spoken, the name should sound different, to Kenyan as well as US fieldworkers, from other names, especially those currently in the group. This helps a lot in learning IDs and in keeping animals straight in our heads. Any new name must be discussed and approved by all research staff. (3) An infant's name will begin with the same letter as the mother's, except in the case of females with very common first letters. These exceptions are listed in the notebook in camp entitled "Baboons and names". This notebook also contains a list of names that have already been used for baboons in all groups in the population as well as the standardized three letter abbreviations for those names. Please be sure to help keep this list updated by adding new names as they are assigned. The notebook also has a list of suggested names for most letters of the alphabet.

2. Reproductive states and events

2.1 Sexual skin charts and associated notes

For all females four years of age or older, data on reproductive events, sexual skin swelling size and perineal condition should be recorded daily in standardized format. You should assess the state and size of the sexual skin, color of the paracallosal skin, presence or absence of menstrual bleeding, and information on rapid or unusual changes in the color or physical characteristics of the sexual skin and perineum.

2.11 Sexual skin state and size

A few days after a female menstruates, her sex skin begins to swell. The swelling phase continues for approximately 2 weeks. During this swelling phase the skin is shiny (light will often reflect off it), smooth, and looks tight and swollen. We call this a turgescent sex skin. After about 2 weeks of turgescence (but the time varies) the sex skin undergoes a dramatic change; it changes from shiny to dull and from smooth to wrinkled. It loses it's tight, swollen appearance and you can often see areas that are flattened or "dished". We score every swelling as either turgescent (indicated with an open circle on the sex skin charts) or deturgescent (indicated with

a closed circle). We pay close attention to the sex skin when the female has had a large swelling for several days, because we use D-day (the day a female's sex skin changes from turgescent to deturgescent, which is estimated in Princeton from the field records) to estimate likely days of ovulation (lab studies have shown that ovulation is most likely to occur within the 5 days before D-day). When you are first learning to differentiate turgescent from deturgescent swelling it is important to consult often with the experienced observers, as this is a skill that can take some time to learn. At the beginning of a female's swelling phase (the first day or two) her sex skin can look somewhat deturgescent. This is especially true for older females, but it usually clear by the second day that she is turgescent. When in doubt, always ask an experienced observer. In addition, if you have not yet seen a baboon up close when you read this monitoring guide, don't be discouraged if you can't picture the structures we describe here; as soon as you get to the field you should have an experienced field person show them to you.

A small sex skin swelling that does not extend beyond the level of the callosities should be considered a size 1 swelling. Use integer multiples of the average volume of the upper limit of a size 1 swelling to score the size of larger swellings. We find that most females show a size 7 - 8 swelling at maximum turgescence, but maximum size varies quite a bit among females. Note that the sexual skin size scale is an absolute scale, not a relative scale. Consequently, swellings of the same absolute size are given the same number even if they are on females of different sizes. It is important to "calibrate" your size scoring against the scores of experienced observers; check with other observers after you have assigned a size score to a sexual swelling, especially when you are first beginning or have been away from the field for some time. A good opportunity to do this is at the end of the month during "last days" with the group. At this time, all observers are in the field together, and should independently decide on size scorings for females, and then discuss them.

Juveniles' sex skins are particularly difficult to categorize as are those of very elderly females. Moreover, even "normal" adult females have individual differences in the shape and maximal size of the sex skin. However, what is most important is that the observers establish and maintain consistency on a day to day basis in the scoring of the sexual skin size for each individual female and among females. Remember that the goal is to make a visual estimate of the swelling volume, so take shape into account. When more than one observer is contributing data to the reproductive state records, it is extremely important that the multiple observers work to establish consistency among themselves in judgments of sexual skin size.

2.12 Paracallosal skin color

The paracallosal skin (PCS), is a patch of bare skin next to the callosities. You should have an experienced team member show you the PCS on several baboons as soon as you get to the field.It is completely black in juveniles, adult males, and non-pregnant adult females, and is pale-to-bright pink in infants. When adult females become pregnant, the PCS gradually changes color from black to bright pink. The pink usually begins at the top of the PCS and gradually spreads downwards. On the data sheet, on the lines beneath the sex skin size records, score the color of the PCS using the following color designations:

- B - black or gray in color
- P/B - pink upper portion, black or gray lower portion
- P - pink in color (record a PCS as pink only when it is solid pink over the entire PCS; a pink tinge throughout the PCS, with black and gray still visible, is scored as P/B).

Other noticeable changes in the color or brightness of the PCS should also be recorded. After several pregnancies, some females retain permanent pink "islands" in their otherwise black PCS. If a female still retains pink in her PCS 45 days after a pregnancy, this is deemed permanent pink. In this case, the female should be scored as B beginning 45 days after the end of the pregnancy. When a female has permanent pink, observers must be careful to learn her pattern of permanent pink so that they will be able to tell when she starts to turn pink after becoming pregnant again; it can be helpful to make drawings in your notebook of the permanent pink islands.

2.13 Menstrual bleeding

The presence of menstrual bleeding should be indicated in the reproductive state records. Enter an "M" on the sexual skin chart in the same lines used to note PCS coloration.

2.14 Reproductive notes

Changes in reproductive state or in the physical condition or color of the sex skin or PCS should be noted on a page labeled "Reproductive Notes", as should the name and sex of new infants (which are also recorded in demographic notes). Each note should have the date, time, name of the individual, and have a number that is continuous for the group for that month; that index number should also appear on the appropriate date in the sex skin sheet for that individual. Changes in sex skin characteristics (how shiny is it? How smooth is it?) usually precede or accompany the onset of deturgescence and so special attention should be paid to such changes around the time of peak turgescence. The goal here is not to record every nuance of change in color of the sexual skin, but rather, rapid and consistent changes in perineal appearance that may provide clues to the time of ovulation, deturgescence, birth, etc. (Wounds to the sexual skin should be recorded on the Wounds and Pathologies form, see chapter II, section 5.)

2.15 Updating of records

Reproductive state records and notes should be updated during the day if a noticeable change in swelling size or coloration occurs, or if menstrual flow is noticed. Be sure to differentiate clearly the updated record from the initial record and to give the time of the update entry. Again, attention to changes in color and size is especially important once a female is near peak turgescence or near term, to help pinpoint the time of reproductive events, including miscarriages.

2.16 Reproductive, pregnancy and due date records

In the field notebook for each group, we keep a summary record sheet of the reproductive state of every adult female in the group (one row per female, one column per month). At the end of every month in the field, we review the sex skin sheets and update this record sheet, noting for each female whether she was pregnant, cycling, or in post-partum amenorrhea that month. This record is for use in the field and is not photocopied with the primary data each month; it ensures that we do not miss important reproductive events and it alerts us to calculate a due date when a female becomes pregnant. When a female is not cycling and is showing pink in the PCS, we estimate her due date by adding 177 days to her last d-day (date on which she began to deturgescence during her last cycle; we have a simple excel spreadsheet for calculating due dates on the project computer). A record of pregnancies and due dates is kept in each field

notebook (again, for field use and not photocopied each month as primary data), just after the reproductive record sheet, so that we know when a female is likely to give birth. This sheet also serves as a convenient record of the approximate birth dates and the ages of juveniles.

3. Home range use (SWERB records & GPS readings)

Our methods for collecting data on home range use and group movement have changed more than any other methods over the years. Changes in technology have played a large part in this change. Until 1981, we charted group movement every day on large scale aerial photographs. Beginning in 1981, this continuous record was exchanged for point samples of the location of individuals, collected every thirty minutes and recorded as grid locations on the aerial photographs. In 1993 we began using handheld GPS units to record the position of the group as a whole, recording the GPS readings as handwritten SWERB notes. Beginning in January 2004, all of our SWERB and GPS records are saved electronically on our handheld GPS machines as digital waypoints, and the data are transferred to the camp computer every day. Detailed instructions for use of the GPS machines and file name conventions are in a separate document.

We take SWERB and GPS records as follows.

1. At the very beginning of our field day, as we are leaving camp, we record our time of departure (a set of D records).
2. We take a “begin” reading (a B record) when we arrive at the group and begin monitoring.
3. We take a “water” reading (a W record) when one or more baboons drinks water during the day.
4. We take an “end” reading (an E record) when we end observations and leave the group at the end of the day.
5. Throughout the day when we are with a baboon group we take a reading every thirty minutes, standing close to or in the middle of the group.

The B, W and E records are collectively known as SWERB records (the "S" and the "R" in the word SWERB refer to sleeping subgroup notes and ranging subgroup notes, which are not collected in the SWERB records in the same way that B, W, and E records are collected). We take careful notes about subgroups as handwritten notes, and we also indicate whether a B, W or E record was associated with a subgroup instead of with the whole group, by putting an “S” before the B or E.

The GPS and SWERB records are often recorded by the field assistants/drivers. However, the researchers are responsible for these data: the drivers are not always present in the field, and even when they are, your input and supervision are crucial. Therefore, you should become familiar with all aspects of the SWERB records and GPS readings and should check these records periodically in the field as well as before sending to the U.S.

3.1 SWERB records

These records provide information on sleeping grove usage, descent and ascent times, drinking, and the total number of hours that observers monitor each study group. Among other things, they allow us to estimate the rate of various events, e.g. predator attacks per hour. Therefore, the periods between your Begin Monitoring ("B") and End Monitoring ("E") Records,

as described below, should correspond to periods during which you are actually carrying out the monitoring activities described in this Guidebook. If for any reason your project results in periods of time during which you can monitor some but not all of the events listed in this Guide, please discuss the problem with Susan and Jeanne as soon as possible.

3.11 “D” Records: Departure from camp

The first entries under each day's date should be a record of the time you left camp, a set of "D" records - one line for observers and one for drivers/field assistants. People who are in training and not contributing to the data collection should not be entered. The point of the D records is so that we know how much observer effort went into collecting the data, and also to help us keep our departure times prompt. So we want a record of which observers and which drivers/field assistants are associated with each set of readings (not people who are not contributing to the data). D records also let us estimate our travel times to the groups.

3.12 "B" Records: Begin monitoring, AM grove, and median descent time

The next should be a "B" record, your arrival at the group and the beginning of monitoring activities. The "B" record includes the number/letter of the sleeping grove that the baboons slept in the previous night. The next record taken is of the median descent time of the group, if known. The median descent time (MDT) is the time of descent to the ground from the sleeping trees of the median individual in the group--the time at which half the animals have descended. If MDT occurred prior to your arrival at the group, enter BA ("Before Arrival"). Enter AA ("After Arrival") if MDT occurred after your arrival but you did not record it for some reason. If the group has subdivided between two separate sleeping groves (see chapter II, section 4), we generally take the median descent time of the subgroup that the observer is with.

Sometimes when you arrive at the group most or all baboons have already descended from the sleeping grove. On some occasions you will have no doubt that they slept in a particular grove, even if most or all baboons have descended: some members of the group may still be resting in the trees, or the group will be beneath or beside a particular grove and sitting quietly while it is still early. However, if you are not certain about which grove they slept in but a particular grove is very likely considering the baboon's line of movement, the hour of the day or the location of known sleeping groves, then indicate that grove number/letter but use a lower case "p" before it (e.g., p118). If you arrive at the group late in the morning and cannot identify the sleeping grove, or if you are doing an afternoon shift, enter the code "Unk", for Unknown, in place of a grove number.

If you stop monitoring the group at some point during the day, so that you will not see monitored events (e.g., if you have to change a flat tire) you should record both the time observations ended (see 3.12 below) and, using another "B" record, when you resume monitoring. Such secondary "B" records will not contain information on sleeping groves or descent times but should include GPS readings.

3.13 "E" Records: End monitoring, PM grove and median ascent time

The last entry in a SWERB record will be a record of the time that monitoring ended on that day. The "E" record should also contain information on the likely sleeping grove of the group that night, if known, the median ascent time of the group, and a GPS reading. PM sleeping groves should be scored as certain, highly probable, (e.g. p118) or unknown (Unk) using the

same rules as for Begin records and AM sleeping groves. Median ascent time (MAT) is defined as the time of ascent from the ground into a grove by the median individual in the group (when half the animals have ascended). If ascent occurs after your departure write AD ("After Departure") for ascent time. Write BD ("Before Departure") if it occurred while you were still with the group but you did not record it for some reason. If the baboons sleep in subgroups, score the MAT of the subgroup that you are with, make sure it is clear which this is.

As with "B" records, you will occasionally have more than one "E" record during the day, if you have to stop monitoring the group for some reason. These secondary "E" records (the ones that occur before your final ending) will not include sleeping grove information but should include a GPS reading.

3.14 "W" Records: Drinking water

"W" records include the time you saw at least one baboon drink water, either from a permanent water hole or a rain pool. If many baboons drink water over a period of time, consider all the drinking to be part of one bout unless at least 30 minutes elapses between one bout ending and the next beginning (i.e., at least 30 minutes elapses with no drinking). In addition to the time of the drinking bout enter the code for the waterhole (if it is a permanent waterhole), using the waterhole list and the laminated satellite maps with named waterholes for identification, or "rain pool". Take a GPS reading whenever the baboons drink from a permanent water hole, but not when they drink from rain pools.

3.2 GPS readings every 30 minutes

Take a GPS reading every 30 minutes on the hour and the half hour. Stand within the group. Usually the drivers take the GPS readings. The goal is to stand as close to the center of the group as possible without disturbing the animals. The observers are responsible for supervising the collection of these and any other data collected by the drivers.

When you take a GPS reading, wait until the "accuracy" indicator is less than 10 meters. Name the waypoint in the GPS machine with the single letter that designates that group and the time of the reading (e.g., W0930 for Weaver's 0930 reading).

3.3 Examples

Below are two examples of actual daily SWERB records collected with the GPS machines. The only column that you actually enter is the waypoint name – the date, time, reading and altitude are all recorded automatically by the GPS machine when you save a waypoint. In the first example the team encountered two non-study groups and took "other group" readings (OGXXX – see section 8.2 below) on them before they found their focal group (Narasha's, which is designated by the letter "R"). They ended observations at 0843 (E1) and began them again at 1024 (B1). They did not know where Narasha's slept the previous night or that night (RBUNK and REUNK indicates that Begin record for Narasha's at 0641, but that their sleeping grove was Unknown, and the end record 1130) and they did not get the MDT (RMDTBA means it happened before arrival). In the second example, Weaver's group slept in grove 151 (WB151 for Weaver's Begin at 0628) and median descent time was 0638.

Example 1:

Waypoint name	Date and time	GPS Reading	Elevation

DDBOO	01-Jun-11 05:32	37 M 301775 9703040	1145.0 m
DRSM	01-Jun-11 05:33	37 M 301775 9703043	1139.0 m
OGJIL	01-Jun-11 06:32	37 M 285099 9697262	1148.4 m
OGSIN	01-Jun-11 06:37	37 M 284163 9696852	1134.7 m
RBUNK	01-Jun-11 06:41	37 M 283996 9697074	1138.8 m
RMDTBA	01-Jun-11 06:43	37 M 283995 9697071	1136.2 m
R0700	01-Jun-11 07:03	37 M 284283 9697120	1142.9 m
R0730	01-Jun-11 07:32	37 M 284436 9697957	1136.6 m
R0800	01-Jun-11 08:03	37 M 284410 9698027	1132.8 m
RE1	01-Jun-11 08:43	37 M 284280 9699089	1139.8 m
RB1	01-Jun-11 10:24	37 M 284108 9699405	1131.1 m
R1030	01-Jun-11 10:34	37 M 284108 9699404	1131.8 m
R1100	01-Jun-11 11:02	37 M 284111 9699406	1132.6 m
REUNK	01-Jun-11 11:30	37 M 284111 9699405	1135.4 m
RMATAD	01-Jun-11 11:31	37 M 284113 9699404	1136.2 m
OGHOK20	01-Jun-11 11:48	37 M 285698 9700369	1137.8 m

Example 2:

DSNS	01-Jun-2011 05:32	37 M 301770 9703047	1140.2 m
DDILS	01-Jun-2011 05:33	37 M 301771 9703047	1137.8 m
WB151	01-Jun-2011 06:28	37 M 287780 9699472	1132.3 m
W0630	01-Jun-2011 06:30	37 M 287780 9699473	1136.4 m
WMDT0638	01-Jun-2011 06:38	37 M 287778 9699472	1145.0 m
W0700	01-Jun-2011 07:02	37 M 287934 9699548	1140.5 m
W0730	01-Jun-2011 07:31	37 M 288119 9699347	1143.1 m
W0800	01-Jun-2011 08:08	37 M 288258 9699189	1147.0 m
W0830	01-Jun-2011 08:31	37 M 288802 9699333	1145.8 m
W0900	01-Jun-2011 09:00	37 M 288882 9699262	1134.2 m
W0930	01-Jun-2011 09:43	37 M 289169 9699569	1140.2 m
W1000	01-Jun-2011 10:01	37 M 289489 9699790	1140.2 m
W1030	01-Jun-2011 10:30	37 M 289491 9699790	1141.9 m
W1100	01-Jun-2011 11:02	37 M 289533 9700054	1139.5 m
WEUNK	01-Jun-2011 11:30	37 M 289534 9700054	1138.8 m
WMATAD	01-Jun-2011 11:32	37 M 289534 9700054	1137.8 m

4. Sleeping and ranging subgroups

The study groups sometimes split into discrete subgroups either to sleep or during the day while they forage. In three of the four fissions that have occurred in Amboseli since 1990, sleeping and ranging subgroups formed regularly for several months (or more) before the actual fission. Subgroup formation should therefore be viewed as a possible indicator that fission is likely to happen, and special effort should be made to record the identities of individuals in the subgroups. Even when fissions do not occur, subgroup formation can be an important clue to patterns of social bonding within the group.

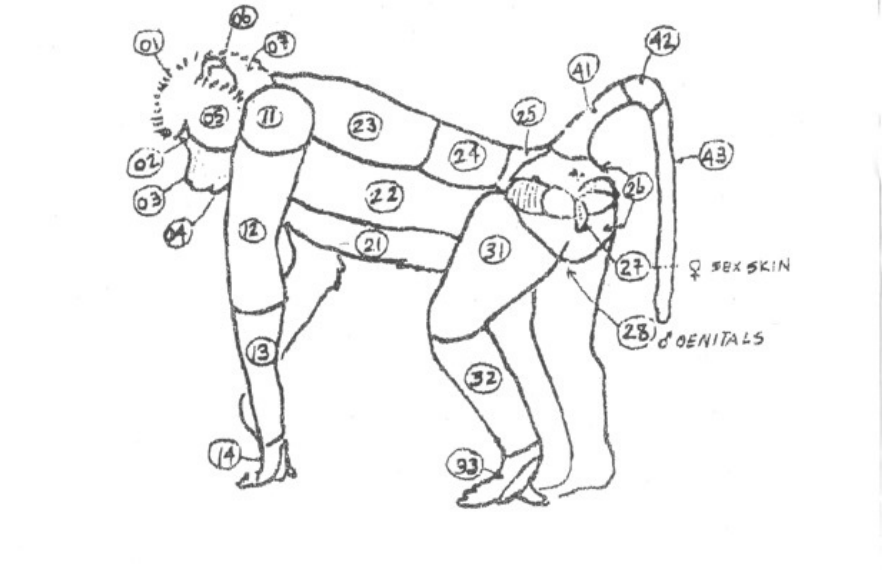
Whenever you see subgroups, record the identity of every animal in at least one of the subgroups, and make a note about whether it was a sleeping subgroup or a ranging subgroup.

Usually you will start a new page in the field notebook for this; each notebook has a section for subgroup notes. Note the time the subgroups formed (or write that you didn't see the onset) and the time they came back together (or write that you didn't see the joining), along with any other *ad lib* notes relevant to the subgrouping. Ideally you should do this for both subgroups but often this is not possible.

Sleeping subgroups occur if the group is divided between two (or more) sleeping groves such that they could not get from one grove to the other without descending to the ground, and you are confident that you are not just seeing individuals that have gone into the second grove, say to feed, shortly before your arrival. Ranging subgroups (subgroups that form during the day when the group is foraging) occur whenever a subset of individuals (other than a consorting pair) are separated from the rest of the group by a gap that is substantially greater than the distance across the main part of the larger subgroup.

5. Wounds, disease, pathologies, and deaths

Any time a baboon shows wounds, symptoms of disease or other pathologies, you should start a Wounds and Pathologies sheet. On the sheet, you will note the time of day the pathology was first noticed, the name of the individual and a description of the individual's condition. The sheet has a checklist of different types of wounds and pathologies; check all that are appropriate. The sheet also includes a diagram (see below) that gives numbers to all body parts; when you identify a wound you should indicate the affected body part and whether it is on the left or right side. In addition, make a description in the "notes" section of the sheet that provides as much information as possible, so that we can assess causes and consequences of wounds or pathologies. If you know the cause of the wound (predator, fight with another baboon, etc.), please record this as well. Give as much information as possible; even if you are making guesses about what happened, this can be useful, just be sure to indicate what is a guess versus what you really know.



Symptoms of disease and other pathologies include unusual redness or swelling around the eyes (apart from late pregnancy), diarrhea, vomiting, stiffness of the limbs or fingers, limping, indications of fatigue or weakness, tremors or convulsions, persistent coughing and sneezing,

unexpected discharges from any part of the body, and excessive thinning or lightening of the coat. Problems with movement or with other bodily functions should be indicated.

You should follow up on all wounds and pathologies that you record. It is important for us to know how long the wound takes to heal or how long the illness or pathology lasts. In the case of serious wounds or illnesses, follow up every day you are with the group, in the area indicated for that purpose on the wound sheets. To make sure that wounds are followed up, observers should check and update all current wounds sheets during the last day of the month with the group (see chapter 4).

If you find a carcass or parts of a carcass, you should record its location, the date and time you found it, and notes about its state of decomposition, with an indication of how long you think the animal has been dead. It will also be very valuable if you collect a tissue sample from the animal and we urge you to make every effort to do so. For this you will find gloves and masks, scissors and tweezers, and surgical scrub for handwashing in each vehicle (see chapter II, section 13.3). In camp you will find a dissecting kit to assist you in collecting larger samples. When you collect a tissue sample, please make a note in the demography notes that you have collected the sample, and label the tube with as much information as possible. For instance tube that simply says “unknown baboon” and the date, with no accompany demog notes is hard to work with (we have lots of these tubes in the US, and it is very hard to connect them to a given death). A tube that says “unknown baboon, suspected predation, demog notes taken” and the date, is very useful if we can then look up the demography notes associated with the tube.

If the carcass is fresh enough that we can recover part or all of the skeleton, you should make an attempt to bring it back to camp for burial, so that it can contribute to our collection of skeletons (which resides at the National Museums of Kenya). The field team knows our well-established protocol for burial.

Whenever possible, obtain photographs (preferably digital) of wounds, pathologies, and dead animals. When you do so, be sure to make a note about the photograph in the demography notes and on the wound sheet.

6. Mounts and consortships

In baboon social groups, most sexual activity takes place during consortships. Consortships are defined by close, persistent following between a male and an adult female who has a turgescent swelling. Usually the male follows the female more than the female follows the male. However, occasionally the female is very attentive to her consort partner's movements and actively stays near him. Our genetic studies confirm that consorting activity is a good predictor of paternity: males that consort more have more offspring. We keep careful track of both consortships and mounts (in and out of consortships). Each field notebook has a section for mounts and consortships. Each month, start one sheet for mounts and another sheet for consortships.

6.1 Mounts

We record mounts in order to identify sexual activity that could lead to conception. Therefore, you should only record mounts between males that are at least four years of age (i.e., may be producing viable sperm) and females that have reached menarche. Only record mounts if the female has a turgescent swelling of at least size three (or, in the unusual case of females who tend to have very small swelling, if she is suspected to be within one week of D-day, the onset of deturgescence). Only record mounts that include intromission, or probable

intromission if you don't see the whole sequence (i.e., fresh ejaculate or pelvic thrusts by the male in a position suitable for intromission). Record all mounts that fit these criteria whether or not they occur during consortships.

Use the format "0810 MLO m VIX" to indicate that Mlozi mounted Vixen at 0810. When possible, we distinguish between mounts for which there is evidence of ejaculation (e) and others (m). If you saw an ejaculatory pause or you saw fresh ejaculate on the female's sex skin or the male's penis immediately after the mount, you should assume that the male ejaculated during the mount. Record "0810 MLO e VIX" to indicate that Mlozi mounted Vixen at 0810 and ejaculated. Females give distinctive post-copulatory calls, and these can alert you to mounts. If you hear a post-copulatory vocalization, be sure to look in that direction and you may see the end of the mount. If you miss the mount, but see that the female is close to but moving away from the male as she is giving post-copulatory calls, and there is ejaculate visible on her sex skin or his penis, you should record a mount with ejaculation.

6.2 Consortships

Record each consortship (male name, then female name) that occurs in the group, the time it was first observed, and the time it ended. Record consortships as follows: "0712 MLO C VIX" to indicate that male Mlozi consorted with female Vixen, and that the consortship was first observed at 0712. On the line beneath this, record the time the consortship ended, and connect the two lines with an arrow. If the pair was still consorting when you left, record the time you left instead of the time the consortship ended, and put an "E" in parentheses after the time, to indicate that this was the end time in SWERB rather than the end of the consortship. If you are not sure what time the consortship started or ended but you strongly suspect that it happened before the first time you saw it, you can use the word "by" or "before" in front of the time, to indicate that it happened by or before that time. If the same male and female are consorting for several days in a row and you do not observe any interruptions (you suspect it is one continuous consortship), you should still make a new record of that consortship on each day you are with the group. However, a consortship between a particular male and a particular female should be scored only once on any given day, unless the consortship was interrupted during the day, e.g., a consortship that occurred for a few hours in the morning and a few hours in the afternoon but not during the noon hours would be scored twice.

7. Predation and human disturbance

Observing predation on baboons or predation by baboons on other vertebrates is relatively uncommon. Disturbance of the groups by humans (usually Maasai with cattle) is more common. We record every instance that we see of each of these events, because they are important for understanding the behavioral ecology of Amboseli baboons and the likely sources of mortality. Therefore we ask all participants in the project to make a special attempt to obtain detailed information on these events. Records of predation on or by baboons, and records of human disturbance, are combined in the field notebooks on sheets headed "Predation and Human Disturbance".

7.1 Predation on baboons and predator sightings

The main predators on baboons in Amboseli are lions, leopards, and hyenas. In the recent past pythons and wild dogs may have also been important predators, and we suspect that eagles or hawks regularly attack young juveniles. You should record the date, time, species and location (preferably the GPS reading) of the predator every time you sight lions, leopards, hyenas, pythons and wild dogs in or around Amboseli, whether or not you are with baboons. Birds of prey are too numerous and too mobile to make it worth it to record every sighting.

You should also record every time you see baboons encounter any predator. This includes not just the predators listed above, but any other species of predator (e.g., jackals, hawks, other kinds of snakes) that you see actually harass or attack baboons or to which the baboons react with alarm. This includes situations in which you witness sustained alarm barking by baboons, but are unable to see a predator. For each encounter with a predator, indicate whether you actually saw the predator or only heard alarm barking by the baboons, what species of predator it was, how many were seen, and what the outcome of the encounter was. Record any other details of the encounter that are relevant. Whenever feasible and potentially useful, obtain and document with photographs.

If you witness an actual or attempted predation on baboons, you should record the date, time, and species of predator and other details of the event. If you find a baboon corpse that you suspect was killed by a predator describe the situation in which you found it, the nature of the wounds, the time and the GPS location or a very good description of the site (e.g., under a particular sleeping grove), and whether predator footprints were seen nearby. More detail is better than less. Photographs are often feasible and very helpful; when you obtain them, document that in the demography notes.

7.2 Predation by baboons

Incidents of baboons chasing, harassing, capturing, killing, and/or eating other vertebrate animals, including lizards, birds and bird eggs as well as mammals, should also be recorded in the predation records. Please note the date, time, prey species, age-sex class of prey if known, first baboon seen with the prey, and as much additional description as time permits, including GPS location if feasible. If extensive notes are taken, please include in them some assessment of the completeness of the observational record. Try to document with photographs when valuable and feasible, particularly for rarely documented aspects of predation.

7.3 Human disturbance of the baboons

Record all instances in which the baboons' activities are affected by humans, e.g. change of group movement in response to herdsmen and their cattle, approaches to or flight from tourists. Interactions with tourists were not uncommon in the late 1970's through mid 1980's but have become rare since the groups moved west of the park. Usually the response of baboons to Maasai is simply to move away and avoid them. Occasionally this results in the creation of subgroups if different subsets of animals move off in different directions. This happened repeatedly during the two years that Alto's Group spent slowly fissioning.

Occasionally the baboons give alarms when they see Maasai, particularly if the Maasai are accompanied by domestic dogs. These dogs sometimes chase baboons. Record all reactions by baboons and interactions between baboons and dogs.

8. Intergroup encounters and sightings of other groups

Two types of data are combined in the "Other Groups Notes" in each field notebook; encounters between groups, and sightings of non-study groups and lone males.

8.1 Intergroup encounters

Encounters between baboon groups vary. Sometimes two groups simply sit quietly near each other and apparently ignore each other; other times friendly interactions such as play occur between groups; occasionally baboons behave aggressively towards members of another group. Most often, one group moves away from another’s persistent approach, often somewhat

quickly. We call this "being pushed", as in "Linda's Group was pushed by Weaver's Group", meaning that when members of Linda's Group saw members of Weaver's Group, Linda's moved away from Weaver's in a decided manner and Weaver's Group followed. Another common occurrence is for adult males to chase and attack the adult females in their own group when other groups or lone males are seen.

Every time you see a baboon group near that day's study group, or if you see a baboon group while you are searching for or leaving your study group, you should record the date, time, identity of the group, and location of the encounter in Other Groups Notes (even if the other group is another study group). You should also take an "other groups" (OG) GPS reading; the name of the waypoint should indicate the identity of the group and the distance between the study group and the other group (or between you and the other group if you are not with a study group). For instance, OGHOK70 means you are taking an Other Groups reading on Hokey's group, and you were 70 meters away. If you are within 50 m of the group you do not need to record the distance. We will interpret all Other Groups readings that lack a distance as readings that were taken within 50 meters.

If you are with a study group, record how your study group reacted (record this even if they apparently did not see the other group; if you saw it, they almost certainly did too) and also how the other group reacted if known. More information is better than less, particularly with encounters that include social, sexual or aggressive behavior. Useful information includes (1) the nature and extent of the contact, (2) the individuals closest, most attentive and most interactive with members of the other group, and (3) an assessment of the completeness of your observational record. Changes of behavior within the group (e.g within-group attacks on females as describes above) and behavior directed to the other group are important.

8.2 Sightings of non-study groups and lone males

Every time you see a non-study group or a lone male, no matter where you are or what you are doing, you should record the date, time, location and identity of the group or male if known. You should also take a GPS reading that you save as an "Other Group" (OG) waypoint or a "lone male" (LM) waypoint. In your handwritten notes, record the names of any known individuals that you see in the group and the reproductive state of any known females that you notice, as well as any other demographic or reproductive information that seems unusual or important. Information on known individuals that are no longer in one of the study groups is extremely important to our documentation of the lives and patterns of membership and group movement of adult males. During sightings of non-study groups and lone males you should also check the status of any radio collars that are active on the animals you see (see section 8.3, below).

One responsibility of all participants in the Amboseli study is censusing of other groups (see chapter II, section 12). Therefore, whenever you see a non-study group and the conditions for census are very good, you should carry out a full census even if this means that you have to leave your main study group for some time. Good census conditions do not occur very frequently, so you should rely on Raphael, Serah and Kinyua to decide whether this is a good idea.

8.3 Radio collar checks on males in non-study groups.

A number of males in non-study groups are radio-collared. This helps us gather dispersal and mortality data on males. It is extremely important to maintain a record of the status of collared males in non-study groups. Each field notebook has a checklist of collared males in

non-study groups; these collars should be checked at least twice per week and more often when possible, even if you don't see the non-study group (listen for the collars whenever you are in the neighborhood of a non-study group) and the checklist should be updated, photocopied monthly, and sent to the US. Whenever you see a non-study group, this is a particularly good time to check for these males. Many collars (not all) have a mortality signal; the beep pattern changes when the collar (and hence the male) has been still for 8 hours and so is probably dead. When you hear a mortality signal, drop everything and track the collar.

9. Grooming

Grooming is one of the most important affiliative social behaviors that the baboons exhibit. Approximately 5% of the daytime is spent in grooming. We record all grooming interactions that we see. We use these data to examine reciprocity in grooming relationships. Further, Michael Pereira and Carol Saunders compared grooming data from focal group sampling (similar to our manner of *ad lib* collection) with grooming data from focal samples, and found that both types of data show the same patterns of grooming rates and partner preferences (see Pereira's thesis, 1984, p. 290). Therefore, we have sometimes used the *ad lib* data for subsets of individuals to examine the relative frequencies with which particular dyads groom each other. However, in order for the data to be reliable in this way, observers must make an effort to observe grooming whenever it occurs, and must record every grooming bout they see without exception.

You should record a grooming interaction every time you see one baboon grooming another. Do not record self-grooming. To avoid rescoring continuous, uninterrupted grooming of one animal by another, make a new record only if you know that the grooming stopped in between (for instance, the groomer and groomee changed roles). An animal is considered to have stopped grooming if its hands leave the body or fur of the groomee for more than a few seconds.

For grooming by infants, be especially careful not to record grooming unless the behavior is coordinated grooming (coordinated picking and scraping, almost always with two hands, and coordinated hand-to-mouth movements). With young infants, you will sometimes see uncoordinated stroking of the fur. This should not be recorded as grooming until the more coordinated picking is seen. This usually occurs when infants are about 8-10 months old but is individually variable.

10. Agonism

Among Amboseli baboons, dominance rank is a good predictor of several aspects of life history. Therefore, pay special attention to dominance interactions. After you are fully trained on agonisms and IDs, you are expected to contribute to this data set. We record three different types of agonistic interactions, (1) dyadic decided agonistic interactions, (2) dyadic undecided agonistic interactions, and (3) multiparty agonistic interactions.

Each observer should compile his or her own list of decided interactions for each group, each month, with the observer's name, the group's name, and the month and year at the top of the page. Undecided interactions and multiparty interactions are less common, and so different observers often combine their observations of these interactions on a single sheet.

Section 10.1 shows the list of all the behaviors that we consider to be aggressive, all those that we consider to be submissive, and several that we see during agonistic interactions that are not clearly aggressive or submissive. You should become very familiar with these behaviors. Scoring decided and undecided interactions in the field requires being able to recognize these

behaviors as they are occurring, and agonistic interactions can be very rapid. Stuart Altmann took videos of many behaviors in 1971 and these are available on DVD from Princeton if you are interested in getting a feel for some of these behaviors before going to the field. For the first few weeks, we strongly encourage you to record the details of each interaction (i.e., write down which animal did which behavior during the interaction) until you are experienced enough to recognize the nature of the interactions (decided or undecided, and winner and loser) without this.

Sections 10.2 through 10.5 describe the various types of agonistic interactions and how we record them. The first step is to understand the behaviors underlying the interactions (section 10.1). The interactions can be complicated, but once you see the behaviors clearly they are often simple to record. This can require a good bit of training, so be patient with yourself.

10.1 Agonistic Behaviors

This section lists all aggressive and submissive behaviors, as well as several that occur during agonistic encounters that are not clearly aggressive or submissive.

10.11 Aggressive behaviors

Behavior	Code	Description
Raised brow or eyelid display	RB	Display of unpigmented skin beneath eyebrows either by raising brow itself or tilting head dorsally; often accompanied by jutting forward of the head.
Open mouth face or attempted bite	OF	Jaw held open, teeth not exposed or only slightly exposed, often accompanied by forward jutting of the head.
Bobbed head and thorax	BH	Abrupt, rapid raising and lowering of head and trunk; body may show a forward movement component.
Ground slapped	GS	Palm of hand or hands struck against ground, often audible.
Lunged at	LG	Forward leaping or jumping towards another individual; no lateral movement.
Chomped or gave exaggerated chewing motions	CH	Repeated and exaggerated chewing or grinding movements of the jaws, often with extreme lateral excursion, copious salivation and audible grinding.
Gave threat yawn or directed gape	GP	Directed gape or yawn-like moving, usually exposing canines.
Rubbed muzzle on substrate	RM	Muzzle and chin rubbed laterally on ground or tree limbs. Often accompanied by gaping and chomping.

Hit or slapped	HT	Rapid, open-handed striking or attempted striking of another individual.
Pushed	PU	Open-handed shoving or attempted shoving of another individual.
Grabbed	GB	Closed-handed gripping of another individual, usually brief.
Held down	HD	Closed-handed gripping of another individual, forcing that individual against substrate, usually prolonged.
Bite	BI	Obvious.

Historic note: In earlier versions of the monitoring guide, an additional aggressive behavior, “stare” was described as follows: “Fixed and prolonged looking at another individual; often accompanied by ears back, brows lowered and scowling, and head ventroflexed.” Current observers agree that fixed and prolonged looking at another individual can often accompany a raised brow or other aggressive behaviors. However, the rest of the description of stare - “often accompanied by ears back, brows lowered and scowling, and head ventroflexed” - does not correspond to any aggressive behavior that we recognize. Further, we never use a stare alone as an indication of an agonistic bout. Hence, we have dropped “stare” from our list of aggressive behaviors.

10.12 Submissive behaviors

Behavior	Code	Description
Averted head and/or body	AH	Turned head aside at approach of another individual, often accompanied by fixedly looking away from the other individual, but without the tensing or twisting associated with a cower.
Cowered or leaned aside	CW	Lateral flexion of the spine, often from a seated or crouching position; limbs adducted.
Gave fear paralysis	FP	Subject leaned forward or lay on ground in rigid, tensed and motionless position. Often accompanied by screaming, urination and defecation.
Grimace	GM	Corners of mouth retracted and teeth (often clenched) exposed. Grimaces are sometimes given without being specifically directed toward another individual, e.g., during copulations. Be sure grimace occurs as a directed behavior before you record it as an agonistic interaction.
Gave tail-up	TU	Tail held upright, or nearly so, or even 'pointed' forward over back. Note that tail movements occurring during "presents" should not be scored as agonistic behaviors unless they are unambiguously so (in this case there will

		usually be other submissive gestures also).
Gave high-pitched shrill scream or screech	EE	Obvious.
Gave cackle or gecker vocalization	IK	Obvious.
Repeated rapid glances	GL	Subject glances repeatedly and rapidly in the direction of a conspecific. Sometimes this involves looking over the shoulder or behind; it almost always interrupts the current activity at least briefly.
Avoid	AV	Needs definition

10.13 Other Agonistic Behaviors

The following behaviors often occur in an agonistic context, but are not clearly submissive or aggressive.

Behavior	Code	Description
Walked at or ran at	WT	Obvious.
Walked away or ran away	WY	Obvious.
Head flagged	HF	Rapid repeated lateral head movements and/or eyelid flashing oriented first toward one individual and then another. We define this behavior as "requesting support"; see section 10.32. May be accompanied by rapid full or partial closure of the eyelids producing flashes of unpigmented skin.
Low-pitched vocalizations such as grunt, roar, bellow and cough	GR	Obvious.
Brush past	BP	One animal (usually a male) walks briskly towards a second animal (usually a male) and then suddenly turns and walks away again just when he is very close. Often he literally brushes against the other animal.

10.2 Decided dyadic agonistic interactions

Decided agonistic interactions between a pair of animals occur when one animal gives submissive gestures (and no aggressive gestures) during the interaction and the other animal gives aggressive or neutral gestures (but no submissive ones). In these cases, the animal that gave the submissive gestures is considered to have "lost" the interaction, and the animal that gave aggressive or neutral gestures is considered to have "won" the interaction. The winner is then generally considered to be higher ranking than the loser (depending on the outcome of other interactions between them that month).

10.21 AS and OS interactions

When one animal (for instance, Rocky, ROC) gives only aggressive gestures and another animal (for instance, Aman, AMA) gives only submissive gestures, or a combination of submissive and “other” gestures, within the same continuous agonistic interaction, we record this interaction as "ROC AS AMA". This is shorthand for "Rocky was Aggressive, Aman was Submissive". Our verbal shorthand for this is "Rocky AS'd Aman."

If Aman gives submissive gestures (and “other” gestures, but no aggressive gestures) and Rocky gives no aggressive or submissive gestures, for instance simply walks towards or past Aman, we record this as "ROC OS AMA". This is shorthand for "Rocky did something Other than aggressive or submissive, Aman was Submissive." Our verbal shorthand for this is "Rocky OS'd Aman."

10.22. DS interactions

Beginning in the 1990's we began to record displacements as well as OS and AS interactions. DS's occur when neither animal gives aggressive or submissive gestures, but one clearly displaces the other. A displacement occurs in three situations. (1) when one animal (e.g., ROC) moves steadily towards the spot where a second animal (e.g., AMA) is sitting or standing, the second animal moves away when the first is less than five meters away, and the first comes to stand or sit, at least briefly, in the spot where second was. (2) when one animal moves steadily towards the spot where a second animal is sitting or standing, the second moves away when the first is within 5 m, and the first passes right through the spot where the second was. (3) When one animal is on a path that does not intersect with the position of a second animal but comes within one or two meters of it, and the second animal glances in the direction of the first and immediately moves away from its spot. In these cases we record "ROC DS AMA".

10.3 Undecided agonistic interactions

Undecided interactions are those that are dyadic but that do not fall within the criteria for decided encounters; these are often ones in which one or both participants give some mix of aggressive and submissive behaviors. Common undecided interactions include "A-A" (both participants give aggressive gestures), "S-S" (both submissive), "A-O" (one is aggressive, the other gives some other, non-submissive gesture or ignores the aggressor), and "A-AS" (one animal gives aggressive gestures and the other gives both aggressive and submissive behaviors). "AS-AS", "AS-S" and "AS-O" bouts are also possible but rare.

Undecided interactions between a pair of animals often indicates that a change in their rank relationship is occurring. You should pay special attention to the behavior of this pair until you are certain of their relationship. We will welcome detailed information about the nature of

undecided interactions, including information on the specific aggressive and submissive behaviors used by each individual (two-letter codes for each agonistic behavior are given in section 10.51). However, this is not required as long as you record basic information about the interaction (e.g. ROC AS-AS AMA).

10.4 Multiparty interactions

Most agonistic interactions involve only two animals, but some involve more than two. These are multiparty interactions, also known as coalitions or interventions. Beginning in July 1999, we greatly expanded our recording of these interactions by recording every multiparty interaction we see in the study groups, on an *ad lib* basis and by providing a detailed, structured recording scheme for these records. The protocol given here is a slightly modified version of the one written for the Project by Joan Silk in 1999.

There are four parts to the record of a multiparty interaction:

- The first interaction;
- Requests for support, if any;
- Support given, if any;
- Context of the interaction (e.g., consortship).

Below are descriptions for how each of these is recorded. We have given these descriptions in a lot of detail. However, they all follow the same simple protocol. (1) record the first interaction, (2) record whether anyone requested help, and (3) record whether active help (+) was given (and to whom it was given), whether passive help (P) was given (and to whom), or whether no help (-) was given.

10.41 The first interaction

Observation of multiparty interactions will usually begin with an agonistic interaction between two animals. This should be recorded like any other decided or undecided interaction. This first interaction will appear on the decided or undecided interactions sheet with an asterisk next to it (this tells us that it was part of a multiparty interaction) and it will also appear on the multiparty interactions sheet.

Sometimes, you won't know exactly what happened at the beginning (often you will just hear someone screaming). In these cases, you can just record that two animals are fighting. Use the abbreviation VS (versus) for this, as in SOU VS DUD. In this case, you will NOT record the interaction in the decided or undecided dyadic interactions sheets; we only record decided and undecided interactions when we are confident that they are dyadic and when we know what happened.

If the first event that you see involves more than two animals, i.e. is already a multiparty interaction, you should write down who is involved (e.g., SOU, SAU AS DUD or SOU, SAU VS DUD, for Soupe and Saudi AS'd Dudu together, or (in the case of VS) were seen together fighting with Dudu but the nature of the interaction was not seen). These interactions will not appear on the decided interactions sheet, because only dyadic interactions (between pairs of animals) go on those sheets. If Soupe and Saudi are AS'ing Dudu together, you will not be able to tell whether Dudu is giving submissive gestures to Soupe or Saudi, so you can't write down either one in the decided interactions.

10.42 Requests for support

Baboons request support in four ways that we recognize. These are (1) "head-flagging", moving their head quickly back and forth between their opponent and the animal they are requesting support from, (2) lying down on the ground (usually screaming but not necessarily) and lifting the head and looking all around as if to see who is there to help, (3) running toward the animal they are requesting support from and sitting or standing very close to them (sometimes in their ventrum or behind them), and (4) running directly to the animal that they are requesting support from and grooming them in a hurried manner, usually accompanied by quiet grunts and nervous glancing towards the opponent (this nervous glancing often escalates into headflagging). Screaming may also be a request for help, but we cannot differentiate screams that are requests from other screams, and so we do not record screams as requests.

If you know who the request is directed to (for instance, if the direction of the gaze is very obvious), record this as:

DUD ? DRO

meaning Dudu requested support from Drongo.

If a request is directed to several animals, record them on separate lines:

DUD ? DRO
DUD ? AMI

Sometimes it is not clear who the request is directed to. In this case, record that someone (e.g., Dudu) requested help from an unknown animal, as follows:

DUD ? UNK

10.43 Support given

Support by a third animal (or by several animals) may be ‘active’ help or ‘passive’ help. Active help is when the third animal intervenes and acts aggressively towards either of the two animals in the first interaction. Passive help is when the third animal approaches or vocalizes, but does not give aggressive gestures.

Support may be given in response to requests, or it may be given even if neither animal in the first interaction requests help. Support should be recorded regardless of whether it is in response to requests.

If an animal responds to a request for support by giving active help, add a "+" to the request record:

DUD ? DRO +

meaning Dudu requested help from Drongo and Drongo responded with aggressive gestures against Dudu's opponent.

If an animal responds to a request for support by giving passive help, add a "P" to the request record:

DUD ? DRO P

meaning Dudu requested help from Drongo and Drongo responded with passive gestures (approaching the disputing pair and/or vocalizing in their direction while looking at them).

If an animal does not respond to a request for support, add a "-" to the request record:

DUD ? DRO -

meaning Dudu requested help from Drongo and Drongo did nothing.

Sometimes animals provide help even if no request for help is given. If an animal gives active help without any request, write:

DUX + DUD

meaning that Dux helped Dudu, even though there was no request for support.

If an animal gives passive help without any request, write:

DUX P DUD

meaning that Dux provided passive help, even though there was no request.

Often when one animal helps another, the helped animal will groom its supporter immediately following the interaction. Make a note of this underneath the record of the multiparty interaction:

SER AS DUD
DUD ? ICA +
(DUD g ICA)

meaning that Dudu requested support from Icarus, who provided active help. Immediately afterwards Dudu groomed Icarus.

Here are three sample multiparty interactions from start to finish:

(1) Soupe AS'd Dudu, Dudu requested support from Drongo, who gave aggressive gestures towards Soupe. Dux and Cheka provided passive support to Dudu, even though they were not asked for help.

SOU AS DUD
DUD ? DRO +
DUX P DUD
CHE P DUD

(2) Sera AS'd Hammer, Hammer requested help from Humble who did nothing, but Soupe and Saudi joined Serah in attacking Hammer; immediately afterwards SER groomed SOU:

SER AS HAM
HAM ? HUM –
SOU + SER
SAU + SER
(SER g SOU)

(3) Voyage AS'd Vibrant, who requested support from an unknown animal (he headflagged but it was not clear who he was headflagging towards). Mlozi gave Vibrant passive help and Velcro gave Voyage active help by AS'ing Vibrant

VOY AS VIB
VIB ? UNK
MLO P VIB
VEL + VOY

There are many possible variations of multiparty interactions. For instance, sometimes one animal requests support from another, but the second animal attacks the first instead of helping. This would be recorded as:

CHA AS WIZ

WIZ ? WEM –
WEM AS WIZ

meaning that Charlie AS'd Wizard, Wizard requested support from Wema, who did not help him but did AS him.

Sometimes one animal requests support from another before beginning aggression against an opponent. For instance, Tinker asks Godot for help, then Tinker directs aggression toward Felix. Record this as:

TIN ? GOD
TIN AO FEL
GOD + TIN (if Godot aggresses against Felix also)

After a male is threatened by another male, he sometimes tries to recruit the aggressor against an imaginary opponent. For instance, Godot threatens Tinker, and then Tinker looks off into the distance as if he sees an opponent, but there is no one there. He requests support from Godot by headflagging. Males seem to do this to distract their aggressor from continuing to fight with them. Sometimes the aggressor will respond by providing support to his victim, against the imaginary opponent. Record these interactions as follows:

GOD AS TIN
TIN ? GOD vs no one
GOD – TIN (if Godot does not help Tinker)

10.44 Decided and undecided dyadic interactions that occur as part of multiparty interactions

Multiparty interactions often start with a dyadic interaction (involving only two animals) that will be recorded on the decided or undecided interactions sheet as well as in the record of multiparty interactions. Sometimes there will be other clear dyadic interactions within the multiparty interaction. For instance, if Viola AS's Vibrant and Vibrant requests help from Mlozi, Mlozi may then AS Viola without help from Vibrant in a clear dyadic interaction, which will then be recorded on the decided agonism sheet. However, you should NEVER record anything on the decided agonism sheet that is not clearly dyadic. In particular, if you see two animals (e.g., Soupe and Saudi) aggressing against a third (e.g., Dudu), and Dudu is being submissive, you will not be able to tell whether Dudu is submitting to Soupe or Saudi. This should never be recorded as a decided agonism.

10.45 Context

Currently, the only context information that we record is whether the multiparty interaction involved a consortship takeover or an attempted takeover. Record this information on the sheet, just beneath the record of the multiparty interaction. Record (1) that it involved a consortship, (2) who the female was, and (3) who ends up with the female.

10.5 Rules for recording agonistic interactions

Most agonistic interactions are very brief and discrete. However, some last for several minutes and include multiple instances of AS'ing or OS'ing. These can involve running and chasing, sometimes even away from the group for several minutes. This can make it hard to decide whether you are seeing one interaction or several. When an interaction goes on for some time, do not record a second AS or OS unless (1) You know that the interaction stopped and then started again (e.g., the animals came to rest quietly for a few minutes and then

interacted again), or (2) at least five minutes (during which you saw no interactions) have elapsed since you saw the first interaction.

Sometimes a long continuous interaction will include changes in who wins and who loses. For instance, in a long continuous interaction you might see ROC AS AMA, followed by lots of chasing in both directions, and then Aman suddenly turns and AS's Rocky. Do not record this as two decided interactions of ROC AS AMA and then AMA AS ROC. Instead, you should record this as an undecided bout (unless, as described above, you know the interaction stopped or at least five minutes elapsed between the time you saw ROC as AMA and AMA AS ROC). Undecided bouts are described in section 10.2.

You will see nearly all types of aggressive and submissive behaviors when juveniles play together. Generally these appear to be "practice" bouts and are not scored on the agonistic sheets. However, play bouts often escalate into actual decided agonistic interactions. It is usually easy to tell when this happens, because the relaxed atmosphere of play changes suddenly, often one juvenile will begin to scream, and it is not uncommon for adults to become involved. If you are not sure whether a bout between juveniles is play or agonism, do not record it as agonism.

11. Focal animal sampling

Focal sampling, currently done only by Raphael, Serah, and Kinyua, is also a part of our standard set of monitoring procedures. Each visiting researcher (except those staying only short periods) will pursue their own focal sampling scheme aimed at addressing their particular research questions.

Raphael, Serah and Kinyua all do focal sampling on adult females and on juveniles of both sexes as part of our behavioral monitoring. This was started in 1982 and has occasionally been modified slightly since then. Juvenile sampling was added in the mid-1990's. We currently use a Psion Workabout handheld computer, which runs a custom data collection program. The protocol is given below.

While we expect and encourage visiting researchers to develop their own sampling scheme for their individual projects, we also encourage them to read the description of our focal and point sample scheme for pointers and ideas. This will also enhance our ability to link the data of visiting researchers with our long-term data where this is appropriate, for collaborative purposes. And of course we also expect that visiting researchers will fully participate in collection of the other data described in this Monitoring Study Groups, in addition to their focal sampling.

11.1 Point and continuous samples collected using the Psion Workabout

We began using the Psion Workabout in mid-1999; prior to this we collected the data by hand. We made only a very few coding changes when we switched to Psion data collection; copies of the old protocol for manual data collection are available at both Princeton and Duke.

Points are collected once each minute, when the timer beeps. Samples are 10 minutes long. Four samples are collected each hour. Two are on adult females, two are on juveniles.

11.11 Adult female point and continuous samples

Samples on adult females consist of point data on the following things:

1.Activity
2.Position
3.Infant position
4.Infant suckling
5.Nearest neighbor within 5 meters.
6.Nearest adult within 5 meters.
7.Nearest adult of the other sex within 5 meters. A focal female can have a maximum of ONE adult female as a neighbor and ONE adult male as a neighbor. Hence, if the nearest adult is a female, this field must be blank or an adult male. If the nearest adult is a male, this field must be blank or an adult female.
8.Food code if the activity was Feed. Otherwise this is left blank (see section 11.13 for list of food codes).

- Activities are: Feed, Rest, Walk, Groom, Be groomed, H for groom infant, T for Be groomed by infant, Other social (Note: when data were collected manually, groom and be groomed by infant were formerly recorded by putting an I superscript next to G or B)
- Positions are: 1 = standing, 2 = sitting
- Infant positions are: Away, Ventral weight supporting, Dorsal weight supporting, Other (in contact but not weight supporting), None
- Infant suckling codes are: Suckling, Not suckling, Unknown
- Nearest neighbor = nearest adult or juvenile or infant within 5 meters. We differentiate the presence of an unknown individual (which we code as 997) from a situation in which we can't determine whether an individual was present (we code this as 998). The nearest neighbor may be any animal except the female's own infant; the female's youngest offspring is considered to be her infant until (a) she has another infant, (b) she has a miscarriage, or (c) her youngest offspring reaches two years old and she has not yet had another infant or a miscarriage. NOTE that we did not know the team was following rule (b) until May 2011 – this ambiguity had not been discussed with them. Specifically, they treat a miscarriage the same way they treat a live birth, in that both events end the "infant" status of the female's previous offspring. We do not know how long they have been doing this, but it will be consistent from now on.
- Nearest adult = nearest adult male or adult female within 5 meters. This will be the same as the nearest neighbor if the nearest neighbor was an adult. It will be different from the nearest neighbor only if the nearest neighbor was a juvenile. Again, we differentiate the presence of an unknown individual (which we code as 997) from a situation in which we can't determine whether an individual was present (we code this as 998).
- Other adults within 5 meters. A focal female can have a maximum of ONE adult female as a neighbor and ONE adult male as a neighbor. Hence, if the nearest adult is a female, this field must be blank or an adult male. If the nearest adult is a male, this field must be XXX (for "none") or an adult female. As above, we differentiate the presence of an unknown individual (which we code as 997) from a situation in which we can't determine whether an individual was present (we code this as 998).

NOTE: In March 1996, the method of collecting neighbor data changed from what it was to what it is now (as described above). Before the change, the neighbor data were collected as follows. FIRST the nearest neighbor was recorded (anyone except the female's own infant).

SECOND the nearest ADULT MALE was recorded. This might be the same as the nearest or it might be different. THIRD the second nearest ADULT MALE, if any, was recorded.

In addition, continuous event data for some behaviors, and other types of information, are collected during the sample as follows:

- All groomings are recorded as Foc g Oth or Oth g Foc, in addition to being recorded as G or B in the point sample.
- All agonisms are recorded.
- If "Other social" is recorded in the point sample, the nature of the social interaction is recorded.
- If the food being eaten is Other or Unknown, notes on the food are recorded.
- Request Groom between adult females and adult males are recorded (added as of July 2003). Request groom is defined as: one animal presents a body part other than the perineum to another animal in a directed way. Often the body part is thrust in the face or near the face of the other animal. Record request groom whenever you see it, even if no one does any grooming. Do not record request groom when one animal presents the rear end or the perineum. In some cases these do seem to be requests for grooming, but it is too hard to differentiate them from other kinds of hindquarter presents. We only record request grooms between adult males and adult focal females.
- Approaches between adult females and adult males (added as of July 2003). Definition of approach: An approach has four parts: (1) The first animal is sitting or standing (not moving), (2) a second animal moves directly towards the first and comes to within one meter of it, and (3) the second animal stops (stands, sits, requests grooming or presents). (4) Both the first and second animal stay where they are for at least five seconds before moving. If all four of these things happen, then the second animal approached the first animal. If either the first or the second moves away within five seconds, we do not record an approach. If the animal that is approached moves away suddenly, but stays within one meter, we do not record an approach. If the animal that is approached shifts position slightly but does not get up and move away, then we DO record an approach. An approach should only be recorded if the two animals end up sitting or standing near each other peacefully for at least five seconds. We only record approaches between adult males and focal adult females. NOTE by SCA: We (SCA, JKW, SNS, RSM) decided that this definition was the simplest way to record approaches, even though we sometimes might want to consider animal A to have approached animal B even if animal B moves away. We will stick with the definition above even though we might miss some "real" approaches.
- These behaviors that are continuously recorded and are entered into the Psion as given in the table below.
- The first letter of each row indicates the type of interaction (A = agonism, P = approach, R = request groom, G = groom, C = consort, O = some other social behavior).
- Interaction types A,P,R,G, and C are constrained in the sense that the format of data entry after the interaction type is specified MUST be "Sname XX Sname". That is, the Psion is programmed to only accept data in that format (see table for specifications).
- Interaction type O is without constraint; observers can enter text in any form after an O.

A	SN1	AS	SN2	Means animal 1 (sname 1) AS'd animal 2
A	SN1	OS	SN2	Animal 1 OS'd animal 2
A	SN1	DS	SN2	Animal 1 Displaced animal 2
P	SN1	P	SN2	Animal 1 approached animal 2
R	SN1	R	SN2	Animal 1 requested grooming from animal 2

G	SN1	G	SN2	Animal 1 groomed animal 2
O				No set format. Commonly recorded are M (for mounts), present, embrace, or “mounted” or “mount” (rather than M) when one female mounts another

Note: In August 1999 data collectors were reminded that if a female’s infant reaches 2 years old and the female doesn’t have another infant, then the female is considered not to have an infant. With Dotty and her last-born, the last-born was considered her infant well into the juvenile period because Dotty did not conceive again. It could easily happen again with post-reproductive females; all observers should be alert to this possibility.

11.12 Juvenile/infant point and continuous samples.

Point samples are collected on infants and juveniles from the age of 6 months until testicular enlargement (for males) or menarche (for females). When a female reaches menarche she is added to the schedule of adult female point samples. Samples on these immature animals consist of data on the following things:

1.Activity
2.Position
3.The three nearest neighbors within 5 meters.
4. Food code if the activity was feed. Otherwise this is blank

- Activities are: Feed, Rest, Walk, Groom, Be groomed, Play, Other social.
- Positions are: 1 = standing, 2 = sitting, 3 = being carried (dorsal or ventral)
- Nearest neighbors = the three nearest adult or immature neighbors within 5 meters. As with adult samples, we differentiate the presence of an unknown individual (which we code as 997) from a situation in which we can’t determine whether an individual was present (we code this as 998).

In addition, continuous event data for grooming and agonism, are collected during the sample, as well as some other information, as follows:

- All groomings are recorded as Foc g Oth or Oth g Foc, in addition to being recorded as G or B in the point sample.
- All agonisms are recorded.
- If “Other social” is recorded in the point sample, the nature of the social interaction is recorded..
- If the food being eaten is Other or Unknown, notes on the food are recorded.

11.13 Food codes used during point sample collection

Each food that the baboons eat has a three-letter code that we use in the point samples. In most cases, the first two letters of the code are shorthand for the species (or the general category, e.g., GR for grass) and the third is the part of the plant that is eaten (B for blossoms, F for fruits, and so on – see table below for complete list). If you see the baboons eat a type of the food that is not on this list, please do not invent a new code for it. Instead, categorize it as OTH (other) and make a note about what it was if you know the species. If it becomes common, as elephant dung juice did during the 1990's, we will add a new code for it. We have a herbarium in

camp that has samples of many of these plant species. If you will be collecting any ecological or feeding data, or are going to be in Amboseli for an extended period, you should take the time to go through the herbarium when you get to camp.

Code	Type	Description
ABB	B	Abutelon blossoms
ABF	F	Abutelon fruits
ATF	F	Azima tetracantha fruits
ATL	L	Azima tetracantha leaves
ATX	X	Azima tetracantha unknown part
CDL	L	Cynodon dactylon leaves
EDJ		Juice from elephant dung
FTB	B	Fever tree blossoms
FTD	D	Fever tree seeds
FTG	G	Fever tree gum
FTK	K	Fever tree bark
FTL	L	Fever tree leaves
FTP	P	Fever tree pods
FTX	X	Fever tree unknown part
GAR		Garbage
GRC	C	Grass corms of other or unknown species
GRD	D	Grass seed head
GRL	L	Grass leaves of other or unknown species
GRT	T	Grass blade bases
MCF	F	Maerua crassifolia fruits
NVR		Invertebrate
OTH		Other (formerly a 4-letter code, Othr)
PCM		Mother's milk
RMB	B	Ramphicarpa montana blossoms
RMF	F	Ramphicarpa montana fruits
RML	L	Ramphicarpa montana leaves
RNF	F	Rhus natalensis fruits
SCL	L	Sporobolus consimilis leaves
SCT	T	Sporobolus consimilis blade bases
SDF	F	Solanum dubium fruits
SFF	F	Commicarpus fruits
SKC	C	Sporobolus kentrophyllus corms
SPF	F	Salvadora persica fruits
SPL	L	Salvadora persica leaves
SUL	L	Suaeda leaves
TCF	F	Trianthema ceratosepala fruits
TCL	L	Trianthema ceratosepala leaves
TCX	X	Trianthema ceratosepala unknown part
TFB	B	Lyceum blossoms
TFF	F	Lyceum fruits
TFL	L	Lyceum leaves
TFX	X	Lyceum unknown part
TOB	B	Tortilis blossoms
TOD	D	Tortilis seeds
TOG	G	Tortilis gum
TOL	L	Tortilis leaves

TOP	P	Tortilis pods
TOX	X	Tortilis unknown part
TTB	B	Tribulus terrestris blossoms
TTF	F	Tribulus terrestris fruits
TTL	L	Tribulus terrestris leaves
TTX	X	Tribulus terrestris unknown part
UNK		Unknown
VRT		Vertebrate
WAX		Water
WSF	F	Withania fruits
XXB	B	Other or unknown blossoms
XXC	C	Other or unknown corms
XXD	D	In or under dung, or other or unknown seed
XXF	F	Other or unknown fruits
XXG	G	Other or unknown gum
XXK	K	Other or unknown bark
XXL	L	Other or unknown leaves
XXP	P	Other or unknown pods
XXR	R	Other or unknown roots

12. Census Data on Non-Study Groups

We obtain periodic censuses of non-study groups of baboons in the Amboseli area. Four of the groups that we try to obtain regular censuses on (Joy's & Nzige's – former study groups – Stud's, Olkenya and Olodare Groups) range far from our study groups, so we never encounter them while monitoring our study groups. The permanent field staff take one day per month to search for and census these groups. The other groups that we try to census regularly (Jill's and Ceejay's Group, which are fission products of Ositeti, and several groups that we designate the Sinya Groups or the far western groups because we can't reliably differentiate them) range in the same general area as our study groups, so that we encounter them regularly. If a group has not been censused for several months and is in close proximity to our study groups, you should make it a high priority to obtaining a census at that time. In addition, there are three situations in which it is particularly important to obtain censuses on other groups or to at least check thoroughly for the presence of particular animals in those groups:

(1) when an animal has disappeared from our study groups and perhaps immigrated into some other group;

(2) when a recent immigrant into any study group is believed to have come from another group in the area, and

(3) if some pathology resulting in high mortality becomes prevalent in any study group or in a non-study group.

Censusing of other groups can best be done during group progressions, as described in Altmann and Altmann's Baboon Ecology (pp. 20-21, see also section 12.1 below). There should be two people (it also works for one person to do it with a tape recorder, but we have not used this method for a number of years). One person calls out the age and sex class of the animals and the other person acts as scribe. Occasionally we do this with the scribe being on a 2-way radio in another vehicle.

Describe individuals that are easy to identify (e.g., who have very short tails or other unusual features) or who have known pathologies (e.g., broken limbs). Indicate for each female her reproductive state by describing the color of her PCS, turgescence or deturgescence of sex

skin, presence of an infant, and presence or absence of elongated nipples. Ideally we try to positively identify two or more distinctive adult or juvenile females as "marker" females, because females are the least ephemeral members of groups and marker females therefore provide the best long-term means for identifying each group. Determination of adulthood should be done according to the criteria in Altmann et al. 1981 (see section 12.2 below) and by comparison with adults of study groups. For immatures, estimate age in years by the maturational descriptions in section 14.4 or by comparison with study animals of known ages. Note signs of maturation – testicular enlargement for males and signs of menarche for females – whenever possible. Also, check for each individual that was identified in previous censuses and search for any additional new individuals. It is easy to make mistakes in this method if you don't stay with the group for a number of hours and don't know the individuals quite well.

If any part of a description is incomplete or questionable, make sure that it is clear from your notes which piece of information is questionable. For instance:

- (ad female)? means "I'm not sure this really is an additional individual; I may have counted it before.
- (ad?) female = There was definitely a female that should be counted but I'm not sure if she was adult.
- Juv-2 (Female ?) = There was a class 2 juvenile but I'm not sure if it was a female.

Have a set of conventions that you use regularly and that you describe in a sheet at the beginning of your census records. At the end of the census add a few sentences of supplementary notes as needed, e.g. "excellent visibility," "census incomplete for juveniles, complete for adults." If possible, obtain ID photos for members of other groups, particularly of juvenile or subadult males and of adults of both sexes.

12.1 Detailed Censusing Techniques (excerpted with revisions from Baboon Ecology).

Our technique for taking censuses of baboon groups was as follows. We positioned ourselves in such a way that we could watch the baboons pass an arbitrarily selected 'counting point' that was clear of obstructing foliage. This was best done in the morning as the baboons were moving in file toward the foraging areas. Binoculars, often held in place by means of a small tripod, were kept aimed at the counting point, and one person kept continuous watch on the counting point while the other either took dictation or verified the counts and the age-sex determinations. A rear oblique view of the animals as they passed was best, since it gave a view of the ischial callosities (which are separate only in females) and the sexual skin. As each individual passed the counting point, the observer indicated its age class, sex, name or conspicuous identification marks, and, when possible, the condition of the females' sexual skin. If an infant was riding on its mother's back or belly, this was indicated.

At the end of each census, we indicated the overall quality of age-sex determinations, the estimated percent of observations that were verified by the second observer, and an 'error factor', which gives estimates of, first, the number of animals that might have been missed (due to obstructing foliage and so forth), and second, the number of animals that might have been counted twice (usually the result of young animals running back and forth across the counting point). For example, 'error factor (+2, -1)' means that two animals may have been missed and one may have been counted twice. As a further check on census accuracy, simple counts of individuals were sometimes taken on groups. Simple counts were also made when observational conditions did not permit a more detailed census.

12.2 Age estimates of Amboseli baboons.

The following age estimate are used for censusing non-study groups. See Altmann et al. 1981, Amer. J. Primatol. Vol 1, pp 389-399.

Class	Description	Age class estimate (established 1980)
Infant-1	Hair completely or partially black (natal coat). Black spots in tail and shoulders remain longest. Skin pink or red from skin vascularity; ears and nose retain pink longest.	0 – 2/3 y
Infant-2	Hair brown to cream-colored, often lighter (in Amboseli) than that of adults. Skin pigmented black, as in adults (except for male scrotum, see below).	2/3 – 1.5 y
Juvenile-1	Not sharply demarcated from previous class. Fur may still be lighter than adult. Face wrinkles disappear by end of this period. Scrotum changes from pink to gray near end of this period.	1.5 – 3 or 3.5 y
Juvenile-2	Not sharply demarcated from previous class. Hair often darker like that of adults. Males may be undergoing testicular enlargement but are not fully enlarged until subadulthood. Males' canines extend beyond tooth row at end of this period.	Females: 3 or 3.5 to 4.5 or 5 Males: 3 or 3.5 to 5.5 or 6 y
Adult female	Sexually mature (has experienced menarche and undergoes sexual skin swellings. Nipples pink and button-like when nulliparous; elongated and gray in more mature, multiparous females. First pregnancy at about six years of age. Full size reached about seventh year for females.	4.5 or 5 y +
Subadult male	Secondary sexual characteristics (mantle, canine ridges, long canine teeth, greater musculature than females) partially developed. Testes are enlarged. Larger than all adult females but smaller than adult males.	5.5 or 6 to 8 or 9 y
Adult male	Secondary sexual characteristics fully developed; male is roughly twice the size of adult females.	8 or 9 y +

13. Fecal samples and other tissue collection

We collect fecal samples for both hormone analysis and genetic analysis, and beginning in 2011 we also collect fecal samples for parasite analysis. We collect tissue samples opportunistically, whenever we find a corpse (we also collect small tissue and hair samples during darting; this is described in chapter III, section 3).

The field team has a well-established protocol for fecal sample collection. When an animal defecates, the observer waits until the animal moves away from the sample, and then collects the sample in a paper cup using a wooden popsicle-type stick. The observer writes the name of the animal and the time of collection on the wooden stick and also on a personal collection list that each observer maintains for the samples they collect. The observer hands the cup with stick to the driver, who collects either a genetic sample, a set of parasite samples (one in formalin and one in EtOH), a hormone sample or all three, depending on what is needed for that animal. Note that formalin can irritate the skin, and so use caution while handling tubes containing formalin. Parasite samples are collected only for the first two samples of each day. We keep updated lists of who we need genetic samples for in the field notebooks; the drivers refer to these. We collect hormone samples every time we see a defecation unless we already collected one that day from that animal. The driver writes the animal's name, time and date of collection, and "H" for hormone sample, "G" for genetic sample, or “Beth” for parasite samples. In the case of hormone samples, this is done on two labels, one on the body of the tube and one on the cap. The sample gets placed in our "fecal collection box" for transport home.

In each field vehicle we keep a "fecal box" which includes cups, sticks, labeling tape, a pen, prepared tubes, small garbage bags for carrying home used cups, and even gloves for those who wish to use them. We also keep plenty of surgical scrub and handwashing water in each vehicle. Back at camp, the sample is entered onto a master log of fecal samples. All samples are then immediately placed in the fridge. Hormone samples are shipped to Nairobi by air once every two weeks, for freeze-drying. Genetic and parasite samples are kept in the fridge in camp for longer periods.

Our collection procedure means that we write the name of the animal who donated the sample in four places: our personal collection list, on the wooden collection stick, on the collection tube, and on the master log back at camp. This helps reduce labeling errors on the tubes; at the end of every day we enter all tubes in the master log at camp, and compare the personal fecal collection lists with the master log, to make sure there are no discrepancies. If there are, the personal collection list is taken to be the correct record, and the tube and master log are corrected. We instituted this scheme in December 2002, because we were detecting a measurable rate of tube-labeling errors during genetic analysis.

Our research increasingly depends on fecal sample collection, and it is critical that all members of the field team contribute to the effort. The various aspects of fecal sample collection, as described above, are often divided between the observers and the drivers. However, all the observers are familiar with and often perform all aspects of this job. Visiting (non-permanent) researchers are also expected to do any of the different jobs associated with fecal collection after training, including actual collection of the dung, homogenizing and putting it into tubes, and updating the master log and checking it against the personal lists. They should therefore learn all of these techniques and procedures as soon as feasible.

13.1 Fecal samples for genetic analysis

We aim for four genetic samples in ethanol for each individual. This ensures that we have more than enough for verifying identity of samples by genotyping, and for genotyping at as many loci as we wish. It also gives us extra in case some samples are hard to extract from (e.g. some plant compounds bind to DNA more than others, or the feces of some individuals seems to consistently contain less DNA, in any case making it difficult to generate PCR-ready DNA). Ideally we would have more, but there are real limitations to how much we can store in the US. We keep a list of "finished" animals in each notebook, along with a list of animals that we still need samples from (and the dates of any collection from these animals). As of July 2003, these are mostly infants, young juveniles, and immigrant males.

Fecal samples for genetic analysis are collected from the leading edge of the feces, and are collected before the fecal sample is homogenized for hormone collection (see below). Approximately 2 grams of feces is placed into a collection vial with 10ml of ethanol already dispensed into it (when the feces is added the vial will be filled up to the 15ml line), and mixed to break up the sample (although this last step does not appear to be crucial).

13.2 Fecal samples for hormone and parasite analysis

We collect hormone fecal samples from individuals of every age-sex class and every reproductive state. We try to collect as many we can per day, except that generally we collect from each individual only once per day (although particular research questions may sometimes require more than one sample per baboon per day).

Fecal samples for hormone analysis are homogenized very well by stirring and mixing with the stick. Homogenized feces, to a level of 15ml is placed into a collection vial with 10.5-11ml of ethanol already dispensed into it, and mixed well to break up the sample.

Fecal samples for parasite analysis are collected in the same way as fecal samples for hormone analysis.

13.3 Tissue sample collection from dead animals, and collection of dead animals

When we find a dead baboon, we collect tissue samples if it is possible to do this safely. In the fecal box you will find small scissors for cutting tissue, as well as gloves and mask. The ideal sample is several small pieces of muscle from a limb. Try to collect at least 5-6 pieces of tissue that are each the size of a small pea (a small piece approximately 1-2 cm long and 1-2 cm wide) in RNALater (which is stored in the fridge). Feel free to collect more than one sample; up to two or three is fine. If you cannot easily get tissue, hair samples are also welcome as long as the follicle is intact. Even corpses in a fairly advanced state of decomposition will yield good tissue samples for genetic analysis. You must use gloves and a face mask when handling dead baboons or their tissue, even if they appeared healthy at the time of death.

If the carcass is fresh enough that we can recover part or all of the skeleton, you should make an attempt to bring it back to camp for burial, so that it can contribute to our collection of skeletons (which resides at the National Museums of Kenya). The field team knows our well-established protocol for burial. Skeletons are usually excavated 4-12 months after burial by our collaborator Shannon McFarlin, who helps to manage the collection at the National Museums.

14. Last days of the month with the groups

Typically, we do not carry out focal sampling during the last three field days of each month. Instead we use these days to collect several types of data that are time consuming and difficult to collect while focal sampling. We also use these days as an opportunity to collect more *ad lib* data than usual, to talk about monitoring and data collection, and to check each other on IDs if necessary (this can be particularly useful for infants that are growing rapidly and changing color). If you are a visiting researcher with your own focal sampling project, it may be more efficient for you to continue focal sampling during these days rather than join the rest of the field team for "last days". Make sure you discuss this with Jeanne or Susan before a decision is made, as this will depend on your project.

A copy of the list of things to do on "last days" with the groups is kept in each field notebook. The different types of data collected on these days are described below.

14.1 Male scrotal development

Males experience testicular (and therefore scrotal) enlargement usually between the ages of four and six years. We check the scrota of each male who has reached four years of age, and continue to check him at the end of every month until his testes are enlarged, at which time the male is considered to be a subadult.

We use a scale of four different levels for assessing testicular enlargement (Not E, Slightly E, Almost E and E). (Previously, 3 levels were used – Not E, slightly E and E — but the long-term field assistants are getting better at detecting the very early stages of enlargement. Therefore, they are scoring Slightly E earlier than it used to be scored and have added Almost E as intermediate between Slightly E and E.) The category of E is scored consistently with the way it has always been scored. The four categories are:

- Not E. The scrotum is a thin flap of skin that makes an upside-down U with the legs when you look at it from behind. You can never see testes in it.

- Slightly E. The scrotum no longer makes an upside-down U, instead it makes a straight line between the legs. Looking from behind when the male's legs are spread, you can sometimes (but not always) see the testes; the male might retract them a lot. One side might be more enlarged than the other. Looking from the front when the male is sitting, you can begin to see that the scrotum is like a small pouch with something in it. When the male is Not E, the scrotum does not look like a small pouch with something in it, it just looks like a flap of skin. You need to look at the male repeatedly to score him when he is slightly E, because the testes are still small and he may often retract them.

- Almost E. The scrotum is no longer a straight line between the legs. Instead, it curves downward slightly like an adult scrotum, but the curve is very gentle. The male may still retract his testes often. As with Slightly E, you need to look at the male repeatedly to score him. One side may be larger than the other. But it does not hang down like the pouch of a male with fully enlarged testes.

- E. The scrotum hangs down between the male's legs almost all the time, retraction is less common now (but still occurs sometimes). The scrotum looks very much like a pouch that is full.

14.2 Canine condition checks

We check the condition of the canines for all adult and subadult males in each group. Typically this means that you have to wait until they yawn. Often this information is best collected on an *ad libitum* basis during the month while you are focal sampling, because situations vary greatly in males' tendency to yawn. However, we try to pay special attention to yawns during the last days. An assessment sheet is kept in each field notebook. For each of the four canines, we score whether it is absent (indicated by zero), present and unbroken (indicated by a check), or broken (indicated by an X). Each time we score a canine for a male we record the date.

14.3 Hybrid scoring

The Amboseli baboon population occurs in a hybrid zone. Most Amboseli animals match the phenotype of yellow baboons, but we have a few anubis animals in the population and many hybrids. Hybrid scoring is done only by Susan and the long-term field assistants. In June-July 2000 they scored every animal in the study groups, using the protocol included below (and also described in Alberts and Altmann 2001, Amer. J. of Primatol. V 53, pp 138-154, filed in the baboon camp office; this article also includes illustrative drawings).

During the last days of the month with each group, we score all males that immigrated that month and all non-adult animals that reached their birthday or immigration anniversary that month. This annual scoring is done from 1 year of age and continuing to 6 years for females and 8 years for males.

Each field researcher scores each adult animal on 7 different characteristics. These are (1) coat color, (2) hair length, (3) body shape, (4) head shape, (5) tail length and thickness, (6) tail bend at the "hook", and (7) muzzle skin. For juveniles, only the first 5 characteristics are scored, because the bending of the tail at the hook and the skin on the muzzle change during development.

Each characteristic is scored on a scale of 0 to 2, where 0 is pure yellow and 2 is pure anubis, and 1 is the midpoint between yellow and anubis. Scores of 0.5 and 1.5 can also be given. Each field researcher, after scoring each animal on each characteristic, sums the 7 characteristics (5 in the case of juveniles) and gets a "total" score for that animal. Total scores range from 0 (pure yellow) to 14 (pure anubis) for adults, and 0 to 10 for juveniles. The total score is then divided by 7 (or 5 for juveniles) to get an "average" score for each animal, which ranges from 0 (pure yellow) to 2 (pure anubis). So, each researcher will have a "total" and an "average" for each animal.

New adult males are scored once by each researcher when they immigrate, at the same time that they are given age estimates. All adults more than 8 years old (for males) or 6 years old (for females) were scored once by each researcher (SCA, RSM, SNS and JKW) during June-July 2000; we will periodically rescore to check for inter- and intra-observer reliability.

Juveniles, including males that immigrate as juveniles, are scored once each year in the month of their birth (or immigration) by each researcher. Juvenile scoring is done every year from one year of age to five years of age.

Subadults (beginning at the sixth birthday for males, fourth birthday for females) are scored as adults (i.e., tail bend and muzzle skin are included in the assessment). They are scored on the 6^{th}, 7^{th} and 8^{th} birthdays (for males) and 4^{th}, 5^{th}, and 6^{th} birthdays (for females). This applies

to males and females that mature in the study groups as well as immigrant males that are estimated to be less than 8 years old.

Each animal is given an overall hybrid score by taking the mean of means. Thus, for adults scored during June-July 2000, the means for RMS, SNS, JKW and SCA were summed and divided by 4 to get an overall hybrid score. This final overall scoring is done in the States, not in the field.

Based on the scoring we have done so far on animals of relatively well-known descent, we are good at detecting hybrids that have one anubis parent (and so are "half anubis") or one anubis grandparent (and so are "one quarter anubis"). Symmetrically, we are pretty good at hybrids that have one yellow grandparent (and so are "one quarter yellow"). However, once we get to scores that would reflect "one eighth anubis" or "one eighth yellow", we can't really separate these animals from our "pure yellow" or "pure anubis" groups, because of existing variation in the "pure yellow" and "pure anubis" populations. For instance, animals that are probably basically yellow baboons (i.e. have no anubis more recently than great-grandparent or great-great grandparent) may have some features that are somewhat anubis-like (such as short, thick tails or muzzles with little or no fur). Thus, our "pure yellow" animals have average scores that range from 0 up to 0.2 (close to "one eighth anubis") and in the case of some very dark animals like Wema and Dotty, up to 0.3 (more than "one eighth anubis").

14.4 Age estimates of immigrant males

We estimate the age of all males that enter our study groups and do not have known birth dates (all immigrants from non-study groups). These age estimates are done during the last days of each month with the group if not before. Our method of estimation was developed by Susan during the late 1980's. We have worked hard to improve it and calibrate it over the years. We rely extensively on comparisons with males of known ages (of which there are now many in the population). A list of known-age males in the population is kept in each group's notebook.

Basic rules are (1) compare the male to males of known age, and (2) examine him with binoculars while he is standing. For juvenile and young subadult males, age should be assigned by comparing him to males of known age in the study groups. Also for juvenile and young subadult males, the accuracy will generally be 1 (i.e., accurate to one year, specifically to six months on either side of the estimate you gave).

1. Assign age according to size
   - 6-7 years = bigger than adult females and smaller than adult males, but closer in size to adult females than males. Scrotum enlarged.
   - 7-8 years = bigger than adult females and smaller than adult males, but closer in size to adult males than females.
   - 8-9 years = taller and longer than small adult males like Nelson but smaller than many adult males. Grows after joining group.
   - 9+ years = looks fully adult in size.
   - Note about size: males in garbage feeding groups grow substantially faster than males in wild-feeding groups. A 6-7 year old male from a garbage group resembles in size a 7-8 year old male from a wild-feeding group. Adjust your age estimate according. You can usually identify a male from a garbage-feeding group because he will be very well-habituated and will often be somewhat fat, with unusually thick, smooth fur.

2. Assign age according to fur condition

- 8-10 years = smooth, shiny fur with no breaks in mantle or elsewhere.
- 10-13 years = fur rough in a few places, from none to a few breaks in mantle.
- 13-15 years = breaks in mantle present and quite noticeable, fur rough all over body.
- 15+ years = dull fur with many breaks in mantle and elsewhere, rough all over.

3. Assign age according to body carriage
   - 8-10 years = carriage straight, chest held high, body almost rigid looking and the animal struts while he walks.
   - 10-13 years = back is beginning to sway a bit, chest begins to sag a bit, but carriage is still mostly straight. Rigid look is beginning to disappear.
   - 13-15 years = back definitely swayed, chest sags noticeably, carriage can no longer be described as straight. Sagging and swaying especially seen when standing.
   - 15+ years = more swaying of back, hips protrude, limbs often seem stiff when first moving.

4. Assign age according to scarring and wrinkles on face and body
   - 8-10 years = face smooth and shiny, few or no scars on muzzle, usually none on body.
   - 10-13 years = More than one or two scars on face, and wrinkles beginning so that skin is no longer smooth and shiny. One or two scars may be visible on body.
   - 13-15 years = skin on face no longer smooth, wrinkles noticeable and several scars (sometimes numerous scars) are visible. Almost always one or two visible body scars.
   - 15+ years = many scars on face, one or two body scars almost always visible.

5. Assign age according to teeth (wild feeding only!)
   - 8-10 years – canines very sharp and long with slight or no discoloration
   - 10-15 years = canines shorter (somewhat blunt) and sometimes one or more broken. Teeth are brown.
   - 15+ years = 2 or more canines very blunt or broken, teeth very brown.

6. Using all 5 categories, plus comparison with males of known age, assign an age estimate to the male. There is no strict rule for how to do this but all categories above should be taken into account. Then assign an accuracy to the estimate.
   - 0 = exact (male has known birthday – this does not apply to estimates)
   - 1 = accurate to one year (six months on either side of the estimate you gave). So, if you estimate he is 9 years old with an accuracy of 1, you are saying that he could be as young as 8.5 or as old as 9.5 years.
   - 2 = accurate to within 2 years (1 year on either side of your estimate: a male with an estimate of 11 years with an accuracy of 2 is between 10 and 12 years).
   - 3 = accurate to 3 years (1.5 years on either side or your estimate: a male with an estimate of 11 years, accuracy of 3 is between 9.5 and 12.5 years)
   - 4 = accurate to 4 years (2 years on either side of your estimate: a male with an estimate of 11 years with accuracy 4 is between 9 and 13 years).

III. OTHER FIELD WORK

1. Weather monitoring

1.1 Daily rainfall and temperature readings

Every morning we read the minimum and maximum temperature recorded during the previous 24 hours, as well as the rainfall in millimeters. We have two min-max thermometers, one that reads ambient air temperature and one that reads air temperature inside our charcoal "refrigerator" (our evaporatively cooled hut for storing perishables and biological samples); you should read min-max temperatures in both places every morning (we keep a separate sheet for each). This duty is shared by all field workers that live in camp.

We also maintain a rain gauge at Nado Soito, in the Ker and Downey campsite. You should check this rain gauge daily during the rainy season or whenever there is a possibility of rain. Rainfall patterns at Nado Soito are slightly different than in camp, so you cannot make assumptions about rainfall at Nado Soito based on what you experience in camp.

1.2 Weather station

In November 2003, we added an automated Weatherhawk weather station in camp to sample a variety of parameters (including temperature, humidity, barometric pressure, and solar radiation), at hourly intervals throughout the day. These data are of particular interest as a part of our monitoring Amboseli's changing weather and its effects on the baboons, particularly the growing relevance of heat stress. The Weatherhawk station that we use readily stores a week's worth of data, which we download onto the laptop computer weekly, usually in early evening on Sundays.

2. Tree grove monitoring (this protocol is retired as of 2011, maintained here for completeness)

Trees are important to the ecology of Amboseli baboons because they provide both food and refuge. Amboseli has experienced extreme tree loss over the past 4 decades, which has greatly affected the ecology and behavior of the study animals. Tree health is also an important indicator of the overall status of the Amboseli ecosystem and so is important to researchers outside the baboon project. We monitor tree groves in Amboseli in collaboration with African Wildlife Foundation (AWF); Alfred Kikoti is the field representative of AWF who monitors groves with us.

To monitor the use and status of trees, we name and, if possible, tag or label the trees in all groves that the baboons use as sleeping groves. We also monitor a specific subset of groves in the baboons' home ranges so that we can keep track of changes in the health and status of the groves.

2.1 Procedure

The purpose of this monitoring program is to track changes in condition—loss, regeneration, maintenance--in the current range of the baboons or elephants under study by AWF and ABRP. We have identified ten groves for monitoring, based on usage by baboon study groups; six are currently monitored by AWF, four by ABRP observers. AWF may add additional groves in other parts of their study area. In practice, this is done after the fifth study group is visited on the third day of the last days of the month with study groups (see section 14).

Pick tree groves that are actively visited/used by wildlife. These clusters of trees could be relatively small, such as a grove as defined by Stuart Altmann for baboons (connectedness, for a baboon, across the canopy) or some other easily identified cluster that can be followed over time.

Sketch the grove shape. Take a GPS reading at a point you mark on the sketch. Describe the basis for identifying the boundary of the grove. Count the total number of standing live trees at the start of this monitoring; if feasible, mark these on your sketch. This should be done initially when you start monitoring the grove but does not need to be done repeatedly after that.

Monitor grove condition monthly by filling out the grove monitoring spreadsheet as follows:

- Date/observer(s): if you just use your initials, put your full-name key at the bottom of the sheet.
- Grove name (if the grove does have a name in one of the research projects, e.g. Grove 98N in ABRP); this will be the same each time the grove is monitored.
- GPS location: see above; this will be the same each time the grove is monitored
- Distance to nearest boma: Alfred Kikoti of AWF will make a list of GPS locations for bomas and will be tracking whether these bomas are occupied, particularly in TZ where ABRP personnel often do not have this information.
- Tree species: usually this will be either *Acacia xanthophloea* (fever tree) or *Acacia tortilis*, but it may be other species in some TZ locations monitored by AWF.
- Number of standing healthy trees: Check for inter-observer agreement by several observers making independent evaluations and then comparing and discussing these. Be sure to walk around a tree to get a view from all sides. If approximately 75% of the tree looks healthy, score as healthy.
- Number of standing live trees in trouble: see previous description; count a live tree as ‘in trouble’ if more than 25% of it is dead or seriously wounded, defoliated, etc.
- Notes and comments: add additional information about signs of human activity, of elephant damage or other sources of tree wounding. Also make notes of regenerating trees in the grove and any other information about grove status that is relevant. These notes will be especially helpful at first as a guide to information that perhaps should be incorporated more formally into the monitoring.

2.2 Definition of a grove

By definition, a sleeping grove consists of all trees that are `connected' to any tree that baboons sleep in. A cluster of trees is said to be connected if the baboons could if necessary get from any tree to any other (possibly via intermediate trees) without descending to the ground. In recent years, the death of fever trees has broken up many former sleeping groves, many of which were mapped and numbered while they were still connected groves. To avoid confusion, we shall when necessary refer to these original numbered locations as "grove sites." The AM groves, PM groves (chapter 2, sections 3.11 and 3.12) and subgroup groves (chapter II, section 4) will be identified in your records by the number of the grove site that they are in, even if, at the time of your study, that number refers to a cluster of several groves. (Note: this definition of a tree grove was developed by Stuart Altmann.)

3. Darting and radio collars.

We maintain one active radio collar on one adult female in each study group. This makes it possible to find the baboons relatively quickly at any time of the day, which saves fuel, increases the efficiency of data collection, and makes it possible to obtain behavioral data

during all daylight hours. We place radio collars on a number of males as well in order to measure male dispersal and mortality patterns more effectively. See Chapter II, sections 1.24, 8.2 and 8.3 for information about monitoring these radio collars.

In order to affix a radio collar, we dart an adult male or an adult female that is not beyond the first trimester of pregnancy, does not have a young dependent infant, and is not consorting at the time. We rarely dart to replace a female radio collar more than once or twice a year (collar batteries last several years).

We periodically have darting projects that involve larger numbers of individuals, so that we can get high quality DNA and RNA samples. When we dart an animal, we draw blood and take a number of body measures, including mass and long bone measures. We release the animal the same day we dart him or her, and they return to their study group by the time they ascend their sleeping trees. All procedures for darting are described in the darting notebook in the office in camp. Raphael, Serah and Kinyua have extensive experience with darting and will continue to do all the darting that is necessary in collaboration with a veterinarian that is approved by KWS; visitors do not dart the animals, but are sometimes asked to assist in the processing.

IV. DATA/OFFICE WORK

1. End of month office work and staff meeting.

Every month after the last field days are completed we have a full day of data work, including preparation of data for sending to Princeton and preparation of census sheets, reproductive sheets, and other sheets for the field notebooks for the next month. In addition, we hold a staff meeting. We discuss both scientific and logistical issues at the meeting. Short-term visitors to the project are generally exempted from these meetings, but visiting researchers who stay for longer periods (especially students pursuing research projects) will usually be expected to attend. In any case, attendance at selected staff meetings, or parts thereof, may be requested by Raphael, Susan, or Jeanne. In addition to the staff meeting, a number of other things happen at the end of the month. The exact set of office/data work varies according to how data are collected (electronic vs. handwritten, for example) and transmitted to the US. As of January 2003, the tasks are as follows:

1. Update reproductive and pregnancy lists.
2. Check for young females to add to sex skin list
3. Check for young males to add to scrotal monitoring and to begin to score mounts.
4. Update Psion ID list and update Psion backup diskette.
5. Check that information on infant sex and names and neonatal assessments is complete. List infants born at the end of the month for whom any information is needed at the beginning of the next month.
6. Check the GPS machines at camp washstand to make sure they are each reading the same thing and the same as the previous month. Record this information on a sheet to go to Nairobi with data to be copied.
7. Remove from the groups notebooks the completed wound sheets and neonatal assessments, the sheets for scrotal development, canine condition, and those for hybrid scoring and age estimation for new males.
8. Remove all other monthly data from the groups notebooks (e.g. SWERB and GPS data, agonisms, grooming, predation, etc, for copying; check that sheets such as agonism, grooming, and sex-skin sheets are numbered sequentially to facilitate proper

photocopying and subsequent data entry. Also, remove other group censuses from that notebook for copying.

9. Make the adult female and juvenile sampling schedule for the month and the field schedule for the first week of the month.
10. Check vehicles and make a parts list for Nairobi.
11. Remove fecal collection sheets and those for rainfall and min-max temperature for photocopying.
12. Complete supplies lists and data preparation for Nrb.
13. Photocopy the data for sending to the US.
14. Monthy dominance matrix. At the end of each month, Serah enters all the decided agonisms for that month into excel and produces a dominance matrix for adult males and adult females in each group. The matrices are printed out periodically and filed in the "Agonism" notebook in the office in camp; they are printed out more often if someone requests it. This ranking is very useful in the field and we encourage people to look at them and use them. However, they should not be taken as the final ranking; final ranks are produced at Duke (for adult males) and at Princeton (for adult females).
15. Prepare new sheets for each group's notebook. Number the sex-skin sheets in each notebook. On a front sheet in each notebook, add any special 'alert' notes that emerge from discussion of data (e.g. changing dominance relationships, fecals that are especially needed, etc) during the staff meeting.
16. Hold staff meeting and send the monthly meeting report to Jeanne and Susan. Print a copy for reference use during the month.