Section 5: Field Issues: Logistics and data collection protocols

5.1 Planning a great ape survey

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5.1.1 Scheduling and Logistics

The survey design has been drawn up. It will involve a total number of kilometres of transects, with perhaps “guided recces”, connected by “recce voyages”.

5.1.1.1 How long will this take?

If you are carrying out a design which includes transects, they will almost certainly be spaced too far apart to be able to do more than one transect in a day. Some sites are very small and thus perhaps transects will be close enough to do two in a day. So, first, calculate how many days you need to do the transects.

To get between the transects, you will be walking on recces, collecting data as you go. In very mountainous areas, survey speed can be as little as 3 to 5 kilometres per day on recces. In flat areas, some teams are able to do 10 kilometres a day. Of course, if your survey has no transects, then you just need to calculate how many kilometres your recces are, and estimate how many days the team will take to walk them.

In large areas, it can take months to get around all the transects and recces. It is good to carry out three-week or four-week trips to the forest (I personally think two to three weeks should be the maximum as people get too tired to collect reliable data), and then give the team a break of a couple of weeks. This gives the team leader time to sort out the data collected, and to write a short report on the mission. This should detail human signs observed, especially hunting signs and any evidence of illegal logging or mining. The report should be given to the manager of the protected area within which the survey is taking place, or, if in a forestry concession or state forest, to the authority in charge of wildlife in state forests.

You should also add in down time. Several days will be lost due to staff illness.. Days, or at least hours, will be lost in the wet season, as one cannot collect reliable data in the rain: it is very difficult to spot tree nests with water falling in your eyes, and the darkness that falls during tropical rainfall limits visibility greatly.

Plan for being able to get, on average, 15 field days per month, and the rest is data entry, backup and storage, preparing for the next mission, cleaning the kit on return to basecamp, and a rest period.

Because ape nests will have a variable rate of decay depending on season, try to carry out the survey during a season when most data can be collected in a short space of time. It is even better if the decay rate can be measured shortly before you start your survey or or use the marked nest method (see section 2.1.1XX)

5.1.1.2 What do you need?

Food. Like an army, a survey team tends to march on its stomach. People will be more observant, in a better mood, less likely to fall ill, and happier to spend long periods in the field if they are not hungry. So, the first thing is to calculate how much food is required for each field mission. Most projects have standard rations for field work, and the trick is not to run out of anything before the end of the trip. Another trick is to take the lightest food that people will accept (so, manioc flour is better than manioc "loaves" which already contain water; dried smoked fish is better than tins of sardines, etc.) Two main methods have been tested and which one you choose depends on you.

The first is that the team leader and his/ her assistant calculates the number of person-days that will be spent in the field. For example, if you have a team of eight and you will spend three weeks in the forest, you have 168 person-days to cater for. If one person needs, for example, 300 g of rice per day, or 400 g of cassava flour per day, and you want to vary the menu, pack 25 kilos of rice and 34 kilos of cassava. The rest of the menu is calculated in the same way, except for things like spices and oil where there is an economy of scale. In this way, one person is assigned, say, 10kg of rice, and 10kg of smoked fish, and another person 20 tins of sardines, 2 bottles of oil, etc etc, so each porter carries the same weight.

The second method is to write down a daily menu for the whole trip, including mornings and evenings, and calculate the total needed from that. Packaging is done in more discrete units. This is actually more practical, because each person then carries food for specific days and the weight of each person's pack can be reduced more easily over time.

The team leader should keep a list of the daily menu, and should have a list of what each person has in his or her pack. This also encourages responsibility and team spirit, as each person knows what they are carrying, as does the team leader, and arguments over missing items are more easily resolved.

Once you have calculated what you need in the way of food for the trip, add *at least* two extra day's worth of ration for the whole team. This helps if you are unavoidably delayed. The base ration should *include* days that people may be sick or days lost because of rain. The extra two or more days

are for unexpected delays, such as being unable to cross a river which floods, losing time because of encounters with hunters, etc.

Camping kit. Survey teams carry their own tents or hammocks, so that they are completely independent of villages. In addition, they should carry sleeping mats (if using tents), cooking equipment (two cooking pots per team is enough), a sheet or sleeping bag, plates, cups, spoons, etc. A large tarpaulin and a thin but strong cord (washing line is good) should be carried in the wet season to provide a large roof for cooking under and for stacking the packs at night. Do NOT build camp chairs and tables using saplings cut from the forest- this is unnecessary damage to the habitat (see section 5.2.3).

Before leaving base camp, check each tent by putting it up. Make sure all the poles and pegs are there; make sure the flysheet fits properly, make sure the zips work, check for holes, especially in the fly. It is very disagreeable to find, at the end of what is the first day of twenty, that an essential part is missing or that you have an avoidable leak in the roof!

Teams should carry several lighters (each person can be issued one) and at least three should be kept in one of the Pelican cases to ensure that they remain dry. Some strips of inner tube or candles make for easy firelighting. Cooking fires are essential on long trips and may, in some places, also be needed to boil water for drinking, although most areas where apes occur are fairly far from human settlements and therefore water sources tend to be clean. However if there are water quality issues one can use a water filter:; there is a new filter system on the market called Life Straw which is a filter that filters 700 l and you suck directly on the filter for drinking, consult the following link http://www.lifestraw.com). At times the fire will be necessary to dry boots and clothing, and also to keep smoked fish dry. Fires are also essential to burn paper, plastic rubbish and tin cans.

All team members should be issued with “professional” water bottles), a torch and some spare batteries and spare torch bulbs. At least two machetes should be taken on the trip, less for opening up transects than for camp tasks, and, importantly, digging holes deep enough to bury both human and cooking waste. All equipment is best carried in larger (50 l or more) good quality back backs. To securely store technical equipment and in case of heavy rains or crossing of rivers, at least one large waterproofed pack should be taken along.

Clothing. Clothing should be sombre in colour, preferably green or brown. All team members should be issued with waterproofs in the wet season- a poncho is good as it covers the pack as well as the wearer, and can also be used as an undersheet if a tent leaks at the sides. All team members should also be issued with appropriate footwear: some people prefer rubber boots, some "Teva" style sports sandals, some "jellies", some ordinary light walking boots. This depends largely on individual choice and local culture. If hats are worn, the observers should not wear ones with a bill that impedes detection of tree nests or animals in trees: (explained later). At least two team members should carry a digital watch.

Medical kit. Ensure that you are carrying an appropriate medical kit. You should have first aid items, including antiseptic, anti-malarials, antibiotics, painkillers, and antidiarrhea. You should also have at least two people on the team who have recently taken a first aid course. The team leader should have a list of everything in the kit and if an item is used, the name of the "patient", his symptoms, the date, and the items used should be recorded. This helps (i) to replace used items for the next trip and (ii) helps the doctor in case of any medical intervention required afterwards.

In general, do not try and be a "bush doctor". If serious illnesses or injuries occur, go back to base camp as quickly as you can without further harming the patient.

Communications equipment. The ideal emergency communication tool is a telephone. If you are working in an area where a mobile phone network reaches everywhere, simply send a text message to base camp at prearranged intervals (every 2 days for example, at mid-day). Text messages use less battery than voice communication. If you do not have a cell phone network, carry a satellite phone (Thuraya or Iridium) and do the same. It is always a good idea to carry a spare, charged battery for a phone. These items should be kept in a watertight case with silica gel (see section 5.3 for more details on this).

Some sites have access to a Motorola network, and if used, a regular communication message should be sent to base as for the phone.

Some teams may not have any of these items. However, satellite phones are becoming relatively inexpensive and even if only used to report an emergency once a year, are well worth the

expense. They can also be used to rapidly alert Park authorities of illegal activities that would otherwise take days to report, even if the team came straight out of the forest to report it.

Scientific and navigation equipment. See section 5.3 for more details about navigation equipment- briefly all team members should have a map and compass, so if they are lost they can individually navigate their way out. The team should carry two GPS units and enough batteries to last slightly longer than the mission, and a set of plastified gridded maps of the survey area. A printed list of the planned waypoints to be visited should also be carried. Electronic items, batteries, and paper documents should be kept in a watertight Pelican case with silica gel. Plastic, transparent, waterproof map cases are useful for team members who do not have plastified maps.

In addition the team will need binoculars, 50m tape measures and a hip chain for measuring longitudinal distances along transects and perpendicular distances from nests and dung. Plenty of spare thread for the hip chain should be carried. Each roll is about 2 kilometres long. Recces do not need topofil, so if your survey does not include transects, you do not need the hip chain. A small (preferably waterproof) digital camera and spare, charged batteries are now indispensable for taking images of the start points of transects if they are to be revisited a few years later; and in addition images can be taken of food plants, unknown animal sign, human sign, hunter camps, or any other feature of interest. Compact flash memory cards are now cheap, very robust, and of very high memory capacity for photo storage, and a spare should be carried along.

Genetic studies are becoming more and more useful as techniques improve. Teams should carry a number of small sample tubes containing either RNA later or silica gel for collecting fresh ape dung. Doubles of each dung sample should be collected, for parasites (use ethanol) and infectious diseases. In addition a supply of latex gloves should be carried in order to avoid team members touching ape dung directly. Team members *must* receive strict training in the collection of dung samples.

Finally the team leader should ensure that there are enough field notebooks for the mission (usually one 150-page book is filled in a month, if all wildlife and human signs are recorded along with vegetation and slope changes), and a good supply of propelling pencils and spare leads. If you are five days walk from the nearest office supply possibility and you can't write down your data….. A simple plastic ruler helps to prepare checksheets by drawing them up in the notebook ahead of time.

Survey Team

The survey team is composed of a forward team, who navigate, cut (only if necessary!) if on a transect, and collect all information. A support team follows, carrying the camping kit and the food.

The forward team is composed of: the team leader, who is usually the first observer, and a second observer. They may be preceded on recces by a tracker (but this is not always necessary); on transects they are preceded by a cutter and a compass bearer. The observers may be accompanied on a transect by an assistant who helps to measure distances between the transect and the nests or dung recorded.

The team leader records the data in the notebook and should also be carrying the GPS and, on transects, running the topofil. The second observer carries the tape measure. We recommend two observers on each survey everywhere, in order to try and control for search effort across a region.

It is absolutely necessary that observers, compass bearers, and even cutters are rigorously trained.

5.1.2.1 Line transect opener

Cutters should be aware that if they deviate from the line then they will be immediately guided back to it by the compass bearer. Therefore they should not go too quickly and should listen carefully to instructions. They should also understand the necessity for minimum vegetation damage- the line is simply where the topofil runs. Often cutters have worked for logging companies, who create survey lines one or two metres wide; it should be carefully explained that transects are different.

5.1.2.2 Compass bearer

Compass bearers should concentrate on the line, and ensure that they correct cutter's errors as they happen, not three metres later. They in turn should be aware of the team leader who will, at some point, call a halt as the end of the transect approaches.

5.1.2.3 Observers

The two observers should be aware of the need for accurate and careful measurements, especially perpendicular distances along the transects. They should be trained in the common faults (assigning objects near the line to zero distance; rounding up data to the nearest five or ten measurement units, not paying enough attention to the possibility of tree nests directly overhead or

near the transect line). They should both also be familiar with wildlife vocalisations as well as with observation, as many observations (especially primates) are confirmed by species-specific calls.

One observer concentrates on signs on the ground (dung, ground nests, human sign) and the other scans the trees for tree nests (and arboreal primates). These tasks should be allocated beforehand. (already explained in Procedure section).

On recces, the team leader walks out at front, navigating along the required compass bearing. If vegetation is particularly thick, a tracker can go ahead, cutting (with secateurs: Fig. 1) enough to allow the passage of the forward team. The tracker can use a compass to help maintain direction, but the team leader must continuously check direction of travel and correct the tracker as necessary. Using a Go To on the GPS is usually the best way to check direction (see section 5.3).

Fig. 1. Cutter with secateurs

While the The tracker should not walk far from the observers, or animals will flee before being recorded by the person taking notes. The support team should follow some distance behind..- On transects, the cutter goes first, guided by a compass bearer. The cutter should try only to use secateurs and a machete only when it is impossible to pass (in a tangled mass of vegetation, for

example). Transects should be almost invisible: they will otherwise be used by forest antelopes (thus creating a path) or, worse, by hunters. In addition, too much cutting changes the visibility along a transect, thus biasing the results. The compass bearer's task is to ensure that the cutter goes absolutely straight. As for recces, during transect cutting and surveying the rest of the team (porters) should stay well behind, and follow at a distance. They should not overtake the observer team, nor indicate animal sign to the observers, as the search effort should be uniform throughout the survey. To communicate as silently as possible, the various team members should agree on a sign (e.g. a whistle) to capture the attention of the others if necessary.

5.2 Defining Protocols

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Because the range of most wildlife species spans several countries, within which there are several important sites, under different national wildlife and forestry authorities, it is important that the estimations of density (or of relative abundance) are collected in such a way that the different sites/ and populations can be compared with each other. This has been discussed in detail in section 1 of this manual, so here we simply describe the field methods for data collection on recces and on transects.

5.2.1 Procedures

5.2.1.1 Recces

In general, recces refer to linear foot surveys along a predetermined compass bearing. The difference between recces and transects is threefold:

- Recces do not have to be absolutely straight, but follow the path of least resistance along the compass bearing. This makes for minimal cutting.
- When an object is noted along a recce, perpendicular distances are not recorded. On a transect, the perpendicular distance between the topofil (centre of the transect) and certain objects is recorded. The objects are ape nests, and the centre of dung piles.
- On recces, only dung within one metre either side of the observer is recorded. On transects, all visible dung is recorded, at any distance.

Section 5.3 describes the GPS procedure for recording using a tracklog in detail. Here we will concentrate on the field data collection.

The procedure for collecting data at the beginning of the day is as follows:

- Ensure that you have pre-prepared check sheets in a notebook, a couple of propelling pencils, and spare lead (graphite).
- Ensure you have a functioning GPS, spare batteries, and that the tracklog is set at the appropriate time interval and is switched on. The team leader's watch should be synchronised with the GPS, on GMT. The team leader, and preferably also the assistant should have a pair of good quality waterproof binoculars at the ready, for

identifying species that flee rapidly, and for close examination of tree nests and identification of the tree species in which nests are built. One observer should be assigned the task of detecting ape nests in trees (this should be the more experienced observer, as tree nests are more difficult to spot than objects or features on the ground). The other observer is assigned the task of spotting all dung, nests on the ground, and human sign.

The direction of a recce should be fairly constant. The team will have to deviate around rocks, treefalls, and possibly lakes, but should come back onto the line after a deviation. This is where good navigation training is essential- team leaders should understand exactly the principles of navigation and be aware of how to get back to the planned survey line. Data will be more representative of a site the straighter the lines, so large deviations are discouraged. During recce-only surveys teams should not follow roads for any great distance, as they give a false impression of human and animal use. Teams should not chat, smoke, or make unnecessary noise when travelling along the line; the forward team (the data collectors) should precede the support team (the porters) by a hundred metres or more. This is in order to make as little noise as possible, so animals can be seen and identified by the people in front.

A waypoint should be recorded at the start of the day and thereafter every hour, on the hour. A running relevé of vegetation and slope should be recorded along the track of the recce. Every hour, record the weather conditions. Every observation is written on a single line, with the time of day (as GMT) in the first column. See section 5.3. and annex ii for more details on data columns and standard codes.

As the team moves along the line, the “tree nest” observer should constantly be scanning both to the sides and above the travel line. It is useful if he/she repeatedly looks *back* along the line: often nests are more visible from some angles than others. The other observer should be scanning the ground to one metre either side of him/herself for dung, and looking for ape nests on the ground as well (at any distance). If possible the nest group should be assigned to species. The presence of ground nests in a group of tree nests of the same age means that the nest group was constructed by gorillas (chimps do not make elaborate ground nests) (Chimps can make ground nests during the day but they are not very elaborate so often fall apart very quickly). If all nests are in trees, and the nests

are fresh or recent, search for dung under the nests. Dung is usually easy to attribute to either gorilla or chimp because of the odour, shape (gorilla dung is lobed) size (in adult gorillas) and texture (gorilla dung is solid and rather like horse dung; chimp dung tends to be softer and more offensive to humans, as it more closely resembles our own). The other data to collect on ape nest groups are: age and type of each nest (see annex ii), species of tree in which each tree nest is built, height of each tree nest, type of undergrowth, and visibility in the undergrowth below each nest, total number of nests in the group. If tree species is unknown, record the local name and/or family of tree if known. Recent research has indicated that these details can help distinguish between gorilla and chimp nests. On a recce it is not necessary to map each nest group, but the team should be aware that if a nest is over 50m from the next nearest nest, it should be assigned to a separate nest group. Importantly, on a recce, it is not necessary to search for all the nests in a nest group *unless the nests are fresh or recent.* If the nests are fresh or recent, the total number of nests should be counted, as this information is part of the dataset that is used to calculate mean group size, which is used to estimate ape density (see transects, below). Because it takes a long time to find all nests, and because recces are designed to cover a large area fairly rapidly in order to give relative abundance estimates (and *not* density estimates), it is not reccommended to search for all the nests at old nest group sites.

If live animals are seen, an effort should be made to identify the species, estimate group size, and record any age/ sex details (not always possible).

In addition to ape sign, it is recommended that all other large mammal sign is recorded along the recces (elephant dung and paths, all ungulate dung, pig sign, all live animals seen) because the cost of sending teams into remote areas to survey for apes is high, and the additional cost of recording other wildlife sign is proportionally very low. These additional data serve as the general baseline for relative abundance of fauna at a site. Ungulates are thought to be affected by Ebola, so if a site has a very low encounter rate of apes *and* ungulates, but there are no signs of hunting, it may be that a recent Ebola epidemic has passed through the area.

All human sign, whether within the 2 metre band or not, should be recorded. If hunting camps are discovered, a description should be written down and a waypoint recorded (and written down). Record construction of camp (permanent or temporary?), number of beds, presence of smoking racks, type of animal killed (look for bones and hooves lying around; scraps of animal hair on the smoking

rack- have any protected species been killed?), type of ammunition used (look for the cartridge cases), nationality of hunters. In countries where hunters may be from a neighbouring country, the litter around the camp usually reveals their nationality: look at the brand of cigarette packets, sugar cartons, matchboxes, or the wrapping of other locally made products. Any other information which may lead to identification of the hunters, their prey, and their provenance is useful to protected area authorities.

At the end of the day, if there is a possibility to download the tracklog from the GPS, this should be done while there is still daylight, and two backups made. If there is also a possibility to enter the day's data, this should also be done using the maximum daylight available. This should be done by the team leader, whilst the rest of the team prepares the campsite. Again, some more details of this procedure are in section 5.3.

5.2.1.2 Transects

So much has been written about transects in recent years that most people have heard of them or at least read about them. For general procedure the methodology of White & Edwards (2000) should be used. Great care should be taken to ensure that the line is absolutely straight. This is because transects are for estimating density rather than relative abundance, so any potential source of bias should be eliminated or at least minimised.

Standard line transect cutting procedures are as follows: ensure that the waypoint for the beginning of the transect is in the GPS; use Go To and standard navigation techniques to locate this point. On arrival at the point, use the nearest medium to large tree as the start point of the transect. This is because transects will be revisited time and time again over the years in a monitoring programme and the start points must be easy to identify during the next cycle. For the beginning of each transect, a metal tree tag should be nailed into the trunk of the tree, and the number recorded. It is also useful to attach a brightly coloured plastic tag with the transect number written on it. The head of the nail should not be flush with the trunk, as tree growth will otherwise "eat" the head of the nail and start to engulf the tag. A digital photo should then be taken of the tree tag, and of the tree itself in relation to the neighbouring trees. This photo should be carefully archived and printed out at the next cycle of monitoring, facilitating identification of the start of the transect even if the tag has been

removed by elephants. This exact (real) start point should be marked as the waypoint for the next time the transect is visited.

Cut a straight pole and make sure that the top is flat (Fig 2) and the bottom is sharpened. The pole should be firmly planted in the ground at the beginning of the transect. The compass bearer places the compass on top and faces it in the required direction of travel, ensuring that it is level and stable. The cutter places himself in front of the compass bearer and the compass bearer then directs the cutter in the required direction. The cutter should use secateurs to leave small signs along the line which the observers will follow. Only in thick vegetation does the cutter need to cut very much; he may need a machete at times, but this should be kept to the absolute minimum. The compass bearer should look through the compass the whole time, directing the cutter so that the centre of his back is aligned with the required compass bearing. Experienced line transect compass bearers and cutters can cut a very straight line, as they form a team. The cutter knows that as soon as he makes a single step in the wrong direction, the compass bearer can centre him again. The compass bearer knows that the cutter is listening for corrections and will not deviate after he hears the call “Right” or “”Left”.

The greater the distance between the compass bearer and the cutter, the more accurate the line will be. To maximise this accuracy, the cutter should carry on until he is just about to become invisible to the compass bearer, and then the latter should call out “Halt and wait for me”. The pole is carried to a couple of metres behind the cutter, and the line is continued. To maximise visibility of the cutter for the compass bearer, and thus the distance cut before moving on to the next “leg” of the transect, the cutter should be given a white, red, yellow or otherwise brightly coloured hat or headband.

Fig. 2. Correct use of compass.

This team should carry on in a straight line, followed by the observation team. If the transects are walked at the same time as they are opened, few live animals will be seen by the observation team. However, so few live animals are generally seen on transects that it is often impossible to estimate density from them in any case, unless they are rewalked many times. For the purposes of this manual we will assume that the objects of greatest interest are those which are most numerous in the forest- the indirect signs left by apes (as you pointed out earlier in the manual surveys are very cost and time consuming and I personally think other observations of live animals should be maximised where possible).

All signs, human and animal, should be recorded along the transect. For dung and for ape nests, the perpendicular distance between the taut topofil and the *centre* of the object of interest should be recorded. Unlike recces, any sign seen should be recorded; there is no width limit. For nest

groups, it is the centre of the group of nests that is used to calculate ape density, by multiplying the ape nest group density by the mean *fresh and recent* nest group size *at that site.* This is why, even on recces, the size of each fresh and recent ape nest group should be recorded, in order to increase sample size. The count of the number of nests in old nest groups can often be smaller in size than the reality, as ground nests become engulfed in vegetation or rot more rapidly than the more visible tree nests.

5.2.1.3 Dung

The assistant should cut a slim vertical stick of about 1.5 metres long, and position it in the middle of the dungpile. (Fig. 3) He or she should hold the tag end of the tape measure. The second observer should run the tape measure up to the topofil, which is kept taut by the first observer (Fig 4.) and read off the distance to the nearest centimetre.

In general, the recce data collection procedure is used with the following additions: all dung seen from the transect by observers 1 and 2 are recorded (not just dung within 1m of the observers); perpendicular distance of each dungpile from the transect carefully recorded.

Fig. 3. Measuring to centre of dungpile using a slim stick positioned in the middle of the dungpile.

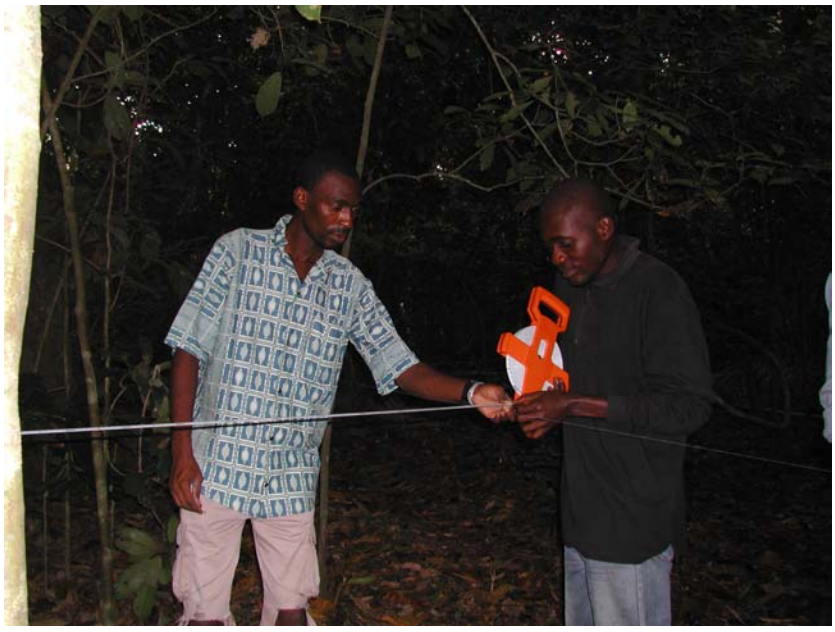

Fig. 4. Measuring up to the topofil.

Nests.

The same data that is collected on recces should be collected for nests on transects. In addition, *all* nests in each nest group should be found, which allows the centre of the nest group to be identified for the purpose of calculating the perpendicular distance of the nest group from the transect. It can take up to an hour and occasionally even longer to "process" a nest group, especially in very thick undergrowth and if nest group size is large. Once a nest has been spotted from the transect, it is highly advisable for the team to *continue along the transect* for at least 50-70 metres in order to spot nests which might belong to other nest groups. In this way, the topofil is also extended for some distance ahead. Once this has been done, as many people as are available (the two observers, cutter and compass bearer, porters is nearby) can leave the transect and try to find all the nests in the group. Care should be taken as to nest group spread: if a nest is over 50m away from the nest nearest nest, it is considered to be in another group, and if it was not spotted from the transect, it should not be counted. Care should also be taken as to nest age; it may seem obvious but only nests of the same age should be counted as a "nest group".

Measuring perpendicular distances

Once all nests in a nest group have been found, if all the nests are to one side of the transect, the perpendicular distance between the transect and the two nests furthest from and nearest to the transect should be measured. The mean of these two distances is the perpendicular distance of the *centre of the nest* group from the transect (and is thus the distance used by DISTANCE). If there are nests on both sides of the transect, the perpendicular distances of the two nests furthest from the transect o*n each side* should be recorded. Then the centre of the nest group is calculated as the largest distance minus the mean of the two perpendicular distances.

"Invisible" nests

Sometimes a nest is so far from the transect (or in such thick vegetation) that it cannot be seen by anyone standing on the transect itself. In this case, the second observer should stand directly under (or in) the nest, holding the reel end of the measuring tape, and, using a compass, he or she should direct the assistant to the transect. The direction is, of course, the transect bearing plus or minus 90^{o}

(depending on which side of the transect the nest is found). The assistant walks with the tag end of the tape measure until it touches the topofil, and the perpendicular distance is then read off by the second observer and recorded. If the nest is further from the topofil than the measuring tape (over 50m) then the second observer has to follow the tape up to where the assistant has stopped, and simply adds 50m to the final recorded distance.

White, L., & Edwards, A. 2000. Conservation research in the African rain forests. A technical handbook. The Wildlife Conservation Society, New-York, U.S.A.

5.2.2. Policies and low-impact survey methods

5.2.2.1 Safety and security

Survey teams should be aware that they will often be going into large, often completely uninhabited, roadless areas for extended periods. At least two people in the team should have received recent first aid training, preferably the team leader. A medical kit should be carried, and the team leader manages its contents and use. See section 5.1. for more details. [Probably a medical kit list should be attached as annex]

Some means of communication should be carried, preferably a telephone, and teams should send a sms message to the base camp at regular, prearranged times, stating their position. The base camp should have a copy of the planned itinerary, with named waypoints. The message just needs to be something like “Team OK; at waypoint 25”. If the team is between waypoints they can send a GPS point as a text message. Other communication options are listed in section 5.1, but the essential is that the team communicates with the base at prearranged times (even if it is every week) and that there is a medical emergency procedure that has been discussed and agreed on before the team goes into the field.

Field teams should be aware of the potential risks in the forest and to take appropriate precautions. Getting lost is one: see section 5.3 (navigation). Team members should not wander off alone for any distance, and should remain relatively close to the camp during the hours of darkness. People should not attempt to approach elephants or gorillas or to take flash photographs of them.

Behaviour in general should be quiet and calm at all times. A general team spirit should be the order of the day, where mutual respect helps the implementation of survey activities during the day, and of the more domestic tasks in the evening and morning at camp.

At some sites, teams may encounter hunters, poachers, rebels, illegal loggers, etc. Very often biological survey teams are *not* ecoguards and have no legal right to arrest others. However they are usually dressed in green or brown forest gear and could, in some cases, be mistaken for either military personnel or ecoguards. There should be a discussion before the team goes into the field as to what the procedure should be when people are unexpectedly encountered in the forest. These discussions should be held with the appropriate Government representative for the area: it may be the Head Warden of a protected area, it may be the local Ministry of Forests and Fauna delegate, it may be the representative of the wildlife authority of the region. In addition, if the team are to come out of the forest into villages in remote areas where there has been civil war in the recent past, the village chief should be informed in advance that a band of people dressed in drab green clothing are due to come out of the forest into their area on such and such a date, and that they are simply counting animals. It has also proved very useful in the past that the team leader carries a mission order signed by the relevant authority, to show to military personnel or local village representatives. Where possible and especially in smaller forest areas, sensitization meetings should be carried out with representatives of all/most villages neighbouring the forest to inform and explain the ongoing survey activities.

5.2.2.2 Impact on the environment

The ultimate objective of carrying out surveys and monitoring of wildlife in general and, in this context, of great apes, is to ensure their long-term conservation. Therefore our activities should not compromise this final objective. The major threat to wildlife in general in the Central African forests, and in many other areas as well, is hunting. The second major threat in Central Africa to apes is Ebola.

In general teams should be aware of basic low-impact behaviour in general. Any meat consumed in the forest should come from outside and should always be sourced from domestic stock (dried or tinned beef, tinned pork). Fishing by survey teams should be strongly discouraged, even if it is legal at a site. No hunting whatsoever should be tolerated. Survey teams should not disturb animals,

interfere with bird nests, damage plants unnecessarily, or leave any avoidable trace of their passage. Often, National Park by-laws are an excellent set of guidelines for low-impact behaviour at forest sites.

5.2.2.3 Cutting

Hunters use human sign in the forest to navigate, and the way that hunters mark their own passage is by folding over the tops of saplings, so that the light underside of the leaves are visible from a distance at about waist height. This is also done by cutting small saplings with a machete, leaving a clean diagonal cut, visible from some distance away. Even after the top of the sapling has dried out and is no longer highly visible, the characteristic machete cut is visible for several years later, allowing the hunter to follow the line of cuts through the forest. During surveys, therefore, the tracker must NOT use a machete to clear the way ahead on a recce. Firstly, if possible, no signs at all should be left that could later be followed by a hunter. Secondly, if cutting needs to be done, the tracker should use secateurs, which leaves a flat-topped cut which is both much harder to see from a distance, as it resembles an upright twig, and which, when rotten, is indistinguishable from a naturally broken sapling. Even on transects, the cutter should make as few cuts as possible, and those should be made with secateurs. A machete should only be used for very thick tangles of vegetation: normally the observers should be able to pass along a transect if only secateurs have been used to open the line a little.

5.2.2.4 Low impact camping

Survey camps are normally only for one night, sometimes two or three nights if transects are closely spaced. Always try and leave the lightest ecological “footprint” as possible. When setting up camp, cut as little of the undergrowth as possible. Refrain particularly from cutting tree saplings, as they may already be from ten to thirty years old. The growth of saplings in the understorey is suppressed by the shade under the canopy, and they pass a very long time in a state of “suspended animation” until a treefall creates a light gap. A thin, five centimetre dbh *Diospyros* sapling, for example, will have taken a couple of decades to grow. Therefore, do *not* make camping tables, benches, etc out of small understorey trees. Sit on a log, or on your sleeping mat. Use a strong cord as the ridgepole over which to stretch the “kitchen tarp”, rather than felling a small tree (or three). Avoid the use of camp beds which need the supports cut each night from hardwood saplings. If

possible, the team should use field hammocks (equipped with a built-in mosquito net and with a rain flysheet) rather than tents, as this means less understorey needs to be cleared. (Hammocks are also much lighter than tents, do not require a sleeping mat to be carried, and are much more comfortable as there is no problem with sloping, rocky, or marshy ground).

When using a stream or river for washing dishes or for bathing, it is good practice to use biodegradable soap, if available. Bathing should, of course, always be downstream of where drinking and cooking water is taken.

After packing up camp in the morning, look around carefully. Any remaining scraps of paper, plastic, or other flammable refuse can be burned. The firewood should be separated and the fire extinguished so that (i) the remaining wood does not burn away and (ii) to reduce risk of bushfire in dry habitats/ seasons.

5.2.2.5 Disease transmission

Another major threat to wildlife is the introduction of disease. Many diseases and parasites carried by humans can easily pass to animals, especially to apes, other terrestrial or semi-terrestrial primates, and to wild pigs. If anyone feels ill – especially if suffering from nausea or diarrhoea, they should not go into the forest at all, as the risk of uncontrolled deposition of disease-rich vomit or faeces adds to the dangers faced by the animals which are the object of the survey and monitoring programme! Individuals suffering from respiratory disease should also not go on field surveys.

It is absolutely essential that all field staff are very strict about their own waste disposal. Firstly, if field trips are carried out from a base camp, where there is a pit or water latrine, everybody should try not to defecate in the forest, but to go either before or after fieldwork at camp. Most surveys are not, however, based from a permanent field site. All human faeces, and any toilet paper used, should be buried at about 0.5m deep. A machete should be used to dig a hole, and the excavated soil replaced in the hole and stamped down hard afterwards. It is a good idea to place a heavy stone or log over the hole as well, further discouraging animals from digging it up. Deposition of faeces in or beside streams or rivers should be expressly forbidden. This is actually common practice in some regions, as the water is then used for personal hygiene following defecation. However it pollutes the water downstream, both for the survey team themselves or for other people using the water; and it is a source of disease for apes and other wildlife.

During fieldwork, smoking is prohibited. The smell of smoke is associated with humans by wildlife, and will affect observations. If individuals choose to smoke at camp then cigarette butts must be burned in the fire as this is a source of disease transmission. All staff should be forbidden to spit or clear their noses onto the forest floor, as this is also a potential source of disease which could pass to wildlife. Any soiled tissues should be kept until the night's camp, and then burned in the fire.

After food has been prepared, any plastic or paper waste must be burned in the campfire. Importantly, any food scraps must be burned, as they are another important medium of disease transmission to apes and other wildlife. All tin cans should be burned in the fire, and then buried to a depth of about 30 to 40 cm. Burning the cans removes any odour of food (so animals will not dig them up) and renders them brittle, so they can be easily crushed and will rust away rapidly. Burying them removes them from the surface of the forest floor, where they could cause injury to terrestrial wildlife. Do NOT bury used batteries but always carry them out of the forest!

Finally, all staff should be vaccinated against yellow fever, polio, tetanus, hepatitis, measles, and TB. Staff should also be treated with anti-parasite medicine at least twice a year. For more detailed ape health recommendations, see Homsy (1999).

Homsy, J. 1999. Ape tourism and human diseases: how close should we get? International Gorilla Conservation Programme.

Maybe also cite the GAHMU website, guidelines

5.2.3. Possible sources of bias: Inter-observer reliability; field impracticability

In general, it is reccomended that all possible sources of bias be identified *before* carrying out a survey. One source is interobserver variation. For this reason it is advisable, wherever possible, to keep the same two observers for one survey, whether recce or transect. Time of day has also been shown to be a cause of variation as people tire towards the end of the day and light levels vary; as observations should not start before about 07:00 (because of poor light levels in forests), we advise ending field observations around 15:30h. Poor weather conditions also influence visibility, observations should *not* be carried out during rain.

Surveys in swampy conditions mean that speed of travel is reduced. That can mean two things- that *more* observations than the average on dry ground are made- even if the true density of the objects is the same- because observers have more time to see dung and nests, or that *fewer* observations are made because observers are paying more attention to not falling into the deeper places. Similarly, very steep slopes often lead to a higer probability of observing nests whist going *downhill* (as it is easier to see the canopy) and a lower probability whilst going *uphill* (because more of one's visual field is comprised of ground vegetation). The solution to this is to frequently look backwards along the transect whilst going uphill to spot any missed nests.

All sources of bias (steepness of slope, observer name, time of day, weather, vegetation type, etc) should in any case be recorded as a matter of course on the checksheets, as these can be modelled as sources of variation *post hoc*.

5.3 Utilizing GPS Technology

Author: Fiona Maisels

In the last few years, the use of handheld Global Positioning Systems (GPS) has become the norm in field surveys. In May 2000, accuracy of these devices was improved to about 10 to 15 metres on the ground. With the addition of an external antenna, GPS units are now able to capture enough satellites to give an accurate fix even under the rainforest canopy. Their use in the context of ape surveys and monitoring falls into the following categories:

- Basic navigation;
- Providing proof of survey itineraries (tracklogs);
- Georeferencing field data such as ape sightings and nests

5.3.1 Navigation

For the purposes of this manual, it is assumed that field researchers and technicians have a clear understanding of the principles of navigation. They must be able to use the combination of map and compass to navigate their way out of trouble. Too often people rely on the GPS units to the exclusion of the "older" methods, which means that when the GPS breaks down, or when the batteries run out and there are no more available, teams cannot easily navigate to the nearest exit point, but have to retrace their steps or follow rivers downstream.

Therefore, it is essential that all field teams undergo a strict theoretical and practical navigation course before using GPS technology. They should be able to prove that they can carry out exercises such as navigating their way around a triangle of, say, 2 km a side *without* GPS, in thick forest, and end up at the starting point. The navigation course should last at the very least a month and include periods of a week or two in the forest moving camp each night, following a prearranged itinerary. This itinerary should have been drawn up by the trainees in the base camp, using features such as river confluences and obvious landmarks. The trainees should be accompanied by the instructor, who has a GPS unit with the tracklog running, in order to later show the trainees exactly where they went and where any mistakes were made. We strongly advise the use of a set of laminated topographic maps at 1:100 000 scale, showing contour lines and watercourses. The maps should be gridded and the coordinates shown along the edges: if using degrees and minutes, a grid of 1 minute is useful; if using

UTM, a grid of 1 km is useful, especially in rugged sites. These maps can be prepared for each survey (covering the whole area to be surveyed, such as a protected area) fcin advance, and laminated using fairly strong plastic.

When all survey team personnel have shown themselves apt in the correct use of map and compass, the GPS can then be introduced into the set of navigation tools.

5.3.2 Basic care and maintenance of GPS units- what the manual does not tell you

Battery issues. The units commonly used (Garmin 12XL and other more recent models) are relatively waterproof and robust. They use AA alkaline batteries, and it is highly recommended that a reputable type is purchased (Duracell for example) both to avoid them running out too rapidly and to avoid any leakage of battery material into the GPS unit itself. A set of fresh batteries should last about 12 hours of continuous use. Batteries will lose charge in a humid atmosphere, so spares should be carried in a waterproof Pelican case or a plastic box containing silica gel and NOT running around loose in a backpack. Never leave a GPS unit for more than an hour or so without charged batteries inside; when the AA batteries are not present, the machine drains its internal (non-removable) memory battery in order to maintain the waypoints and routes held in its memory. After a certain point, the internal battery no longer functions properly, all waypoints are lost, and the unit becomes of little practical use in the field. A message will be displayed on the screen: *Memory battery weak.* The unit must then be sent back to the factory to install a new battery! If this happens to you, the reference number of this particular problem is RMA # (W317915), and the Garmin address is:

GARMIN International,

ATTN: RMA # (W317915)

1200 E. 151st Street

Olathe, KS 66062 USA

Keeping things dry. It is advisable that the GPS units are kept in the same Pelican case /plastic box as the batteries when not in use (overnight for example) together with the external antenna. The canvas holders can be dried out, if necessary, near the campfire. A tightly woven bag containing dry silica gel crystals inside the Pelican case/plastic box is required; this is a humidity

absorber and the preferred type is that with a humidity indicator colour. A sock tied at the ankle forms an excellent bag for the silica gel. Usually the crystals are blue when dry and pink when wet. The crystals should be dried out every three nights at most, more frequently if everything is getting very wet in the rainy season. They can be dried in a frying pan or cooking pot over the campfire, which takes less than ten minutes; the crystals should be stirred to ensure uniform drying rate without burning them, and when they have turned bright blue they can be replaced in the bag. The bag should be kept in an empty watertight metal tin (an old 200g coffee tin with a metal, not plastic lid is best) until it is cool enough to put back in the Pelican case/plastic box. Rinse the frying pan or cooking pot thoroughly with soap after drying the silica inside before reusing it for cooking!

5.3.3 External antenna- use and care

Which one to use? If working in forest, it is advisable that an external antenna is used all the time. This allows much better capture of the satellite signal and can make the difference between no signal for many hours and an adequate signal (and thus record of exact trajectory) under forest. The GPS has a small socket at the back into which the antenna is plugged, and the cable and socket area should be taped up with duck tape or electrician's tape to prevent the connection being damaged by repeated movements when the user is working in the forest. (Fig. 5).

Fig. 5. Scotching the antenna to the connector at the back of the GPS unit. Back and front views.

Some cheaper types of antenna are available which plug into the back of the GPS but which are easily broken off in forest conditions, where the user is moving all the time. These cheaper antennae are designed for use in a vehicle where the GPS is attached to an immovable surface, and should not be used in the bush: buy the ones where the cable sits flush with the back of the GPS unit (Fig 6).

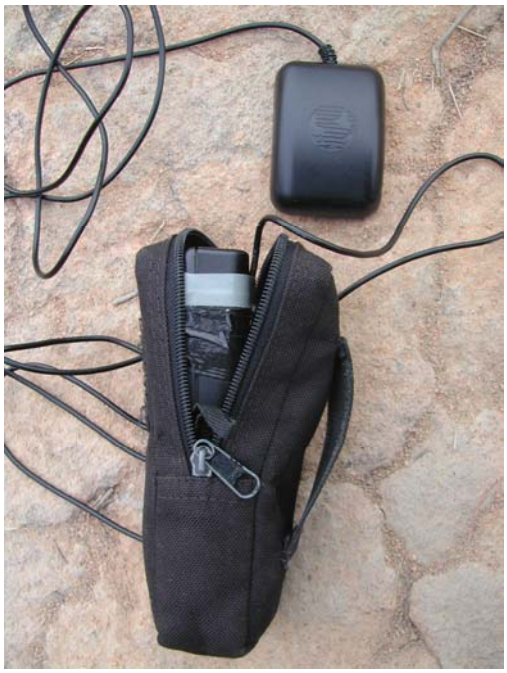

Fig. 6. Cable flush with the back of the GPS unit.

Use of the antenna in the field- what the manual does not tell you either. The antenna is supplied with a relatively long cable that should be passed under the shirt of the user, to avoid it being caught in vegetation and to avoid it being confused with a thin liana and thus cut through by the user. The receptor end of the antenna is worn under a hat (for ape surveys, preferably one with no brim that can impede detection of overhead nests: a reversed baseball cap is fine) (Fig. 7). The other advantage of the external antenna is that it frees up both hands.

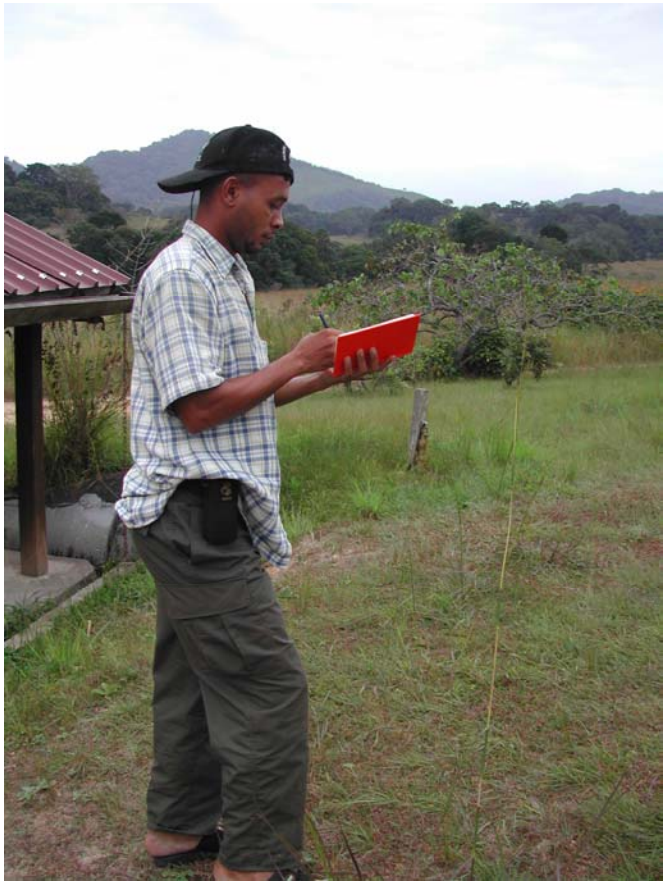

Fig. 7. Cable under reversed baseball cap.

If using a GPS in forest without an external antenna it has to be carried at roughly chest height in one hand so that it can capture satellite signals. With the antenna in use the unit is carried at waist height by threading the user's belt through the carrying case (Fig 8); the antenna is under the hat, in the best position to capture satellites, and the GPS can still be consulted at any moment by the user.

Antennae will be damaged if folded or knotted. Care must be taken that they are folded neatly around the GPS unit when not in use (Fig 9) and that they are not folded back on themselves.

Fig. 8. Position of GPS on user's belt.

Fig. 9. Correct storage of antenna and GPS unit.

5.3.4 GPS (this will be in annexxx)x

The user manuals of GPS units are well written and should be consulted before using the machines.

Users should familiarize themselves with ALL the different “pages” available. The “page” button allows you to run through the five consecutive pages. Very briefly these are:

- the “satellite” page: This page shows the position (in relation to the North and to the horizon) of each satellite which should be available and which are currently being detected by the GPS unit. The position of each and whether it is being detected is shown as a circular diagram; the strength of each satellite as a series of bars along the bottom of the screen. A power meter to the left shows how much battery life is left. At the top right the unit shows the estimated position error (in the units chosen: it is best to set the GPS to metric units). At the top left the unit indicates one of three choices: (i) whether the GPS has obtained a “fix” or not” if not it displays “Acquiring”. When the unit has a fix it shows either “3D Nav” or “2D Nav”; 3D is more accurate but may not always be possible under the forest canopy or in highly dissected, rocky landscapes. Importantly if switching on the unit under the canopy, ensure that you have either 2D or 3D Nav before setting out on your survey. If it remains on “Acquiring” you will walk along using up your batteries but the position it shows will merely be the last one it took before being switched off.
- - the “position” page: the most important information is that it shows you where you are in your chosen coordinate system. The easiest system to use in the field is either UTM or degrees and decimal minutes. These are the most rapid to read off a map. Make sure your GPS coordinate system is the same as on the field maps you are using. When it is raining and nearly dark, and you have to find a campsite quickly, you don’t want to have to transform decimal minutes to minutes and seconds, and you can’t even try between UTM and geographic coordinates. The position page also includes local time, speed of travel, distance traveled , and altitude (this last is very approximate).
- the “map” page: shows you where you are and your tracklog in relation to the nearby waypoints. It also shows the speed and direction of your movement. The scale of the “map” is

shown at the top of the screen in your chosen map units (use metric units!) and corresponds to the distance represented by the width of the screen. You can change the scale using the "enter" button and then the up and down arrows on the cursor to increase or reduce this scale. The range is from 0.3 km to 800 km. It is through this page (the options menu at the top of the screen) that you set the timing of the automatic tracklog, and also where you can switch it on and off. See "Tracklogs", below.

- the "navigation" page: has two view options, a compass and a "highway". It is used for navigating to waypoints previously entered into the GPS unit. In conjunction with the "Go To" button, this page displays constantly updated information on the distance and direction to the destination waypoint, and is used in field surveys to find, for example, the exact start point of a transect, or to run recces to a predetermined waypoint some distance away.
- the "Main menu" page: allows the user to change the GPS settings such as language, map datum, coordinate system, map units, and local time. This is also the access page into the waypoints: entering waypoints by hand is done from this page, as is consulting waypoints already in the machine, setting routes to follow, and measuring the distance and compass direction between any two waypoints already in the machine. Once again we stress the importance of choosing coordinate units that are the same as the printed maps! Finally it is through the Main menu page that you set the unit to download mode: this is called "Interface" in the Garmin 12XL, which allows tracklogs and waypoints to be sent from the GPS unit through a cable to a computer using an appropriate software program.

5.3.5 Track Logs

When running any kind of survey it is enormously informative to have a continuous tracklog running. A tracklog is a series of geographic locations recorded automatically by a GPS unit, at predetermined time intervals. The minimum is at 1-second intervals; the maximum is at 99 hours 59 minutes and 59 seconds (in other words virtually every 100 hours). In for example the Garmin 12XL there are 1024 tracklog points available. They are held in a memory bank that is separate from the waypoint memory bank: the Garmin 12XL has 500 places available for waypoints, but this has no effect on the tracklog memory. For the use of the tracklog consult ANNEX ?

How to set the tracklog? In the “Map” page, scroll to the right to “OPT” (options) and choose “Track setup”. Pressing “Enter” allows access into this menu, as for almost all other GPS operations.

The screen shows several lines: see diagram below. Each line has several alternatives. The “Record” line has three choices: Off, Fill, or Wrap. Fill means “Fill up all 1024 points, and then stop recording data”. “Wrap” means “When 1024 points have been recorded, *overwrite the first ones with new ones”*. Never use this option because you will lose the information from the first part of your trip! When you are walking along, it should be on “Fill”; when you stop for a break or at the end of the day, switch it to “Off”, so unnecessary tracklog points are not collected. **Remember to switch it back to “Fill” when you start in the morning or after a break!**

The second line is “Method”. Here the two choices are “Auto” or “Time interval”. Choose “Time interval” and then set the tracklog to a logical interval.

What intervals are useful in wildlife surveys? If you are traveling by plane you can set it to 1 second intervals. However it will fill up the 1024 memory points in 17 minutes, so unless you have a way to continuously download the GPS into a computer as you travel, adjust your interval to a thousandth of the time the flight will take.

If traveling by car the interval needs to be fairly close- every 5 or 10 seconds for example- if you want a really detailed tracklog of the road. If you are track logging illegal roads into a protected area you may want this. However if you are simply logging a day’s travel then every minute should be fine, which will give you up to 17 hours of tracklog before the memory is full.

The most important use of the tracklog in wildlife surveys is, however, for work on foot. Firstly it provides proof of where the team went. Did they follow the transect plan? If they found signs of human disturbance, the exact route they took can be easily mapped using the tracklog. If they followed an illegal logging road on foot, that road can be then digitised onto the basemap using the tracklog superimposed using a GIS system. Every data point recorded by the team, whether animal or human sign, or changes in vegetation type, or salt licks, can be mapped if the exact time (GMT) of each observation is recorded.

Choosing time intervals for foot survey tracklogs. The most important point here is to calculate the time interval as a function of the total time you will spend walking between downloading opportunities. If you are working out of a base camp and can download your tracklog into a computer at the end of every day, or if you have a way of downloading the data into a portable handheld computer at each night's campsite, then you can choose a very short time interval. This will give you a very detailed map of your track, and is easier to localise data you may have collected along the way. If you are going on week-long or month-long trips with no possibility to download data, then the time interval must be much longer, which means your trajectory will be much less detailed and localisations of individual ape nest sites, for example, or hunter's camps will be rather approximate. It is advisable to take waypoints for important features such as hunting camps in any case.

The procedure for calculating the time interval is simple. How many hours will the team spend actually moving each day? Eight hours is a good average. How many days will they be in the field between data downloading possibilities? Calculate the total number of minutes (8 x 60) of field travel between downloads, and divide by 1000 (to be on the safe side and to facilitate calculations: although there are 1024 points it is better to leave a margin of error). The table below indicates time intervals for a series of trip lengths, from a day to two months between downloads.

Downloading data. When the tracklog memory is nearly full (at about 1000 points) you should download it into a computer. This can be done in the field or in the office, using either a small portable computer such as an HP Palmtop, Visor, or other PDA. There is a commercially available cable for the Garmin 12XL and similar units, a different cable for the e-trex, etc. Ensure you have the right cable for your GPS unit. These cables have a proprietary connection end which fits into the GPS unit, and the other end either connects to a serial port or to a USB port. If your computer has no serial port but you only have a serial port end on the cable, you will have to purchase an adaptor.

Ensure that your computer has appropriate download software. For PC computers there are several available- dnrgarmin seems to work very well and allows the option of saving the data as text files and/ or shapefiles for ArcView. For handhelds running DOS (such as the HP palmtop) Gardown6 works well and uses up very little memory space.

When you have downloaded your data, even if you are in the field, make two backups. The best type of media for a backup is a compact flash card, as these have no moving parts and are very

robust. The team leader should carry one backup, in a waterproof Pelican/plastic box, *and the other backup should be carried by the assistant, also in a waterproof case.* This means if one person falls in the river and loses their bag, there is always another copy of all that hard work that you have done.

5.3.6 Georeferencing important features.

The waypoint memory in the GPS contains 500 points in the Garmin 12XL model and 1000 in the CX model. Other units will vary, but it is essential to be aware of the upper limit and to clear the memory of unwanted points after they are downloaded. In most field situations, users will need the location of a certain number of geographical features kept in the waypoint memory, such as base camp, important river crossings, village locations etc. The start points of each transect should be entered into the GPS before starting each mission, and the start and end points of each recce planned as well. The Go To function on the GPS unit is then used to help you to navigate to these points (see section 5.3.4/ ANNEX, below).

A general, but important point to remember is this: GPS units can and do malfunction in the field, and people sometimes forget to take enough batteries with them. To be sure of teams returning from the field with a permanent record of all waypoints and each itinerary that they have taken, *every time a waypoint is marked, it should also be written down in the field notebook.* Teams should take a waypoint *every hour* that they are travelling through the forest, as well as the important features that they come across (mission field camps, hunter's camps, ape and gorilla carcasses, villages, illegal logging, road crossings, major river crossings). These should all be written down in the notebook. That way, even if the GPS malfunctions so badly that no data can be downloaded, there is a written list of the features encountered plus a series of points denoting the travel route each day.

Because there are 500 waypoints available in a GPS 12XL, if eight waypoints are recorded for the route every day (each night's campsite, and one per hour on the route), the teams can have about 250 waypoints used for the route, leaving 250 for "things" encountered. There seems to be a phrase missing referring to 250 waypoints usually taken on a x long mission? Usually field missions are shorter than this (the time between downloads if no handheld computer is carried) but if trips are longer than a month then teams should consider a slightly longer interval between waypoints.

Finally: if you can possibly do so, carry two GPS units into the field with you. That way, you have a backup if things go wrong. If there are two units, two separate people should carry them (if the team leader loses the main one in a river, for example, there is another one). Both should have a small watertight pelican case/plastic box with silica gel for storage overnight or when not in use.

5.3.7 Using a combination of tracklogs and waypoints to collect data on surveys

Before leaving the basecamp, ensure that you have the start points of all transects, and the start and end points of recces entered into your GPS unit, (and into the spare GPS unit if you have one). In addition, make sure that you have entered useful points such as village locations, basecamp location, and planned campsites, if any, into the unit(s). Two printed copies of these waypoints should be carried by two separate people in the team. Ideally one copy should be laminated, and the other kept in the watertight pelican case/plastic box. These act as the backup for navigating safely if the GPS malfunctions.

Ensure that each member of the team has a compass and a paper copy of the main map, and that all team members are capable of navigating themselves out of the forest before you leave. Finally, check that you have enough AA batteries to last the whole of the field mission, plus at least three or four extra days worth.

5.3.8 Using a notebook and GPS to georeference all data

Set the tracklog on a short time interval (30 seconds for a one-day trip for example) and when you start to walk, set it to “Fill”(option where no data gets overwritten once the memory is filled). Ensure that the person recording data has a digital, waterproof watch *set to GMT (universal) time.* It is useful if this is set to beep every hour, on the hour. Another person in the team should have a watch showing local time.

Prepare a sturdy hard-backed field notebook, preferably the type with waterproof paper, with a checksheet. Use pencil as this will not run in the rain. An example for a recconnaissance checksheet is below: the daily details are entered at the top of the first page of the day, and the rest of the day the columns starting with “Time” are filled in. When the information is entered into the database at the end

of the mission, the daily details are entered into columns with the same headings (if using Excel); or into the appropriate tables (if using Access). A set of two or three-letter codes should be established in advance (see Annexes) so that time spent noting each type of information is minimised. Transect checksheets have additional columns: Distance along the transect and Perpendicular distance. These should be just to the right of the “Time” column (see Figs. 10 & 11)

Much of this next section is identical to the protocols used by the CITES-MIKE (Monitoring the Illegal Killing of Elephants) data collection standards.

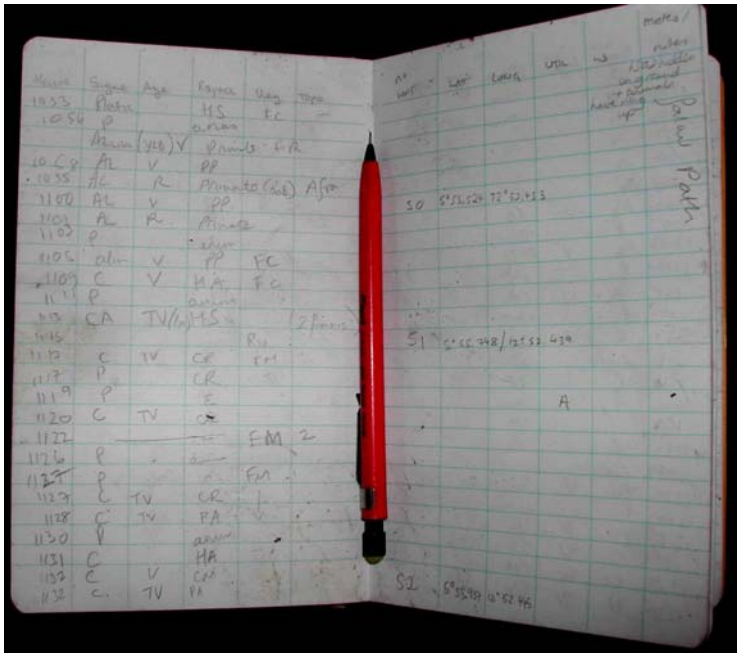

Fig. 10. Notebook and propelling pencil

Fig. 11. Checksheet in a field notebook should look like this and should take up the full width of the open notebook.

Date:	Observer 1:	Start time:	Recce ID number:
Site:	Observer 2:	Finish time:	

												APE NEST DETAILS					
Time	Sign	Age	Species	Veg type	Slope	No. way-point	Lat	Long	Under-growth	Canopy	Visibility	Group ID	Type	Ht. (m)	Tree species	Meteo	Notes

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Column details:

Time: should be to nearest second unless tracklog interval is one or more minutes; must be in GMT, as the GPS unit's internal clock runs on GMT, even if the display is set to local time.

Sign: denotes animal or human sign: can be nests, feeding sign, footprints, vocalisation, direct observations, camps, traps etc. Use pre-established codes.

Age (of the sign): Fresh, recent, old, very old, rotten or fossilised. Use pre-established codes.

Species: of animal, or human. Use pre-established codes.

Vegetation type: as it changes**.** Use pre-established codes

Slope: as it changes**.** Use pre-established codes

No. way- point: as given automatically by the GPS when the "mark" button is pressed. Every hour, and at important features.

Lat: Latitude (or UTM equivalent)
Long: Longitude (or UTM equivalent)
Meteo: Every hour. (Listen for the watch beep signal). Use pre-established codes.
Undergrowth: At nest sites, and every hour on recces OR every 250m on transects. (Listen for the watch beep signal on recces). Use pre-established codes.
Canopy opening: a scale of 0-3 depending on the percent cover. At nest sites, and every hour on recces OR every 250m on transects. (Listen for the watch beep signal on recces). Use pre-established codes.
Visibility: at ground level: on a scale of 4 from very open to very closed. At nest sites, and every hour on recces OR every 250m on transects. (Listen for the watch beep signal on recces). Use pre-established codes.
Group ID: A separate group number for *each nest group* of the mission.
Type: construction of each nest. Use pre-established codes.
Nest height: in metres, for each nest.
Tree species (in which nest is built). If the species is not known, use the local name. Record at least family of tree if possible.
Notes: any other information not in the above. For more details on hunter camps or carcasses make a cross-reference to a separate page *in the same notebook* where you have written these down.

Survey data collection using the tracklog:

At the start of the first day, fill in the daily details, and then enter the waypoint of your departure point on the first line, and the exact time (in GMT) of your departure in the appropriate columns. The “Note” column should read “start”. Record vegetation type, slope class, and weather. If on a transect, record more detailed vegetation classes (see Annex iii), and fill in canopy, visibility and undergrowth details every 250m. (See above for more details on timing).

As you proceed along the recce or transect line, every time you note something down (change in vegetation, change in slope, animal or human sign, etc) *write down the time, in GMT, in the first column*. Ensure you mark *and write down* a waypoint every hour as well.

At the end of each day make sure you fill in the last waypoint of the day (camp) and switch off the tracklog.

Downloading and file management:
When the tracklog is full, or when you have the opportunity to download the GPS data:

(i) Download the tracklog, and save it onto the hard drive of the downloading unit (computer or pocket computer); save two other copies onto flashcards.
(ii) Download all the waypoints in the memory; save three copies as above.
(iii) Check that both tracklog and waypoint files actually contain the data (i.e. that downloading has been successful)
(iv) Clear the tracklog, ready for the next day or mission. Only clear the waypoints at the end of the mission, when they can all be copied to at least two hard drives and backed up onto a CD.

These files are the raw GPS data and should be stored carefully. They are often in text format, but can also be easily coped and transformed to spreadsheet format. However the original files should not be transformed: use copies only. That way you can go back to the original files if you make errors whilst entering field data (see next section).

File nomenclature protocol
During a survey one builds up a large number of similar files. There is an easy way to name them so that they appear in chronological order in Windows Explorer. This is to name them by year, month, day, and type of file.

Tracklogs should be followed by ".trk". For example, five consecutive days of tracklogs from the 5th – 10th April 2003 will be named as follows:

030405.trk
030406.trk
030407.trk
030408.trk
030409.trk
030410.trk

Waypoints will be the same, except followed by ".wpt".

If you have the possibility to download data every night, you should then open the tracklog file in a spreadsheet program (such as Lotus 1-2-3 or Excel) and save it as a spreadsheet copy. Because the last column of a tracklog contains the time (in GMT), the rest of the field data can then be filled in alongside the time, using the same column headings as in the notebook. An example is shown on the next page.

The field data should be stored in similar files, but with an added indication as to whether it was a transect or a recce, and the extension of the software added. Thus, for three consecutive days where both a transect and a recce was walked each day, files should be named as follows:

030405-R.xls
030405-T.xls
30406-R.xls
030406-T.xls
030407-R.xls
030407-T.xls

It is good practice to arrange each type of data in separate folders and subfolders: one big folder for raw geographic data and one for data with the observations added; and subfolders for recces and transects.

Example of part of a spreadsheet where the tracklog was used as the template for data entry.

The tracklog was set at every 45 seconds in this case. Only the first 12 columns are shown, but see Fig. 10 for the additional columns that should be to the right of “Long”. Note how the continuous tracklog shows the whole itinerary, whether data was recorded or not, and how each observation is georeferenced. The fifth line is “vocalisation, chimp”; the last one is “dung, recent, gorilla”.

These data can then easily be transferred to a GIS system for spatial analysis.

Lat	Long	date	Time (GMT)	Sign	Age	Species	Veg	Slope	No WPT	Lat	Long
-1.12073	11.13646	5-Dec-05	7:05:57	Camp		hs	Fsec	1	1	01°07.244'	011°08.187'
-1.12078	11.13645	5-Dec-05	7:06:43				Fsec	1			
-1.12072	11.13632	5-Dec-05	7:07:28				Fsec	1			
-1.12042	11.13638	5-Dec-05	7:08:14				Fsec	1			
-1.12008	11.13651	5-Dec-05	7:08:59	vo		pt	Fsec	1			
-1.11966	11.13662	5-Dec-05	7:09:44				Fsec	1			
-1.11921	11.13654	5-Dec-05	7:10:29				Fsec	1			
-1.11881	11.13624	5-Dec-05	7:11:15				Fsec	1			
-1.11856	11.13579	5-Dec-05	7:12:01				Fsec	1			
-1.11864	11.13526	5-Dec-05	7:12:47				Fsec	1			
-1.11882	11.13479	5-Dec-05	7:13:32	roab		hs	Fsec	2			
-1.11877	11.13427	5-Dec-05	7:14:18				Fsec	2			
-1.11845	11.13380	5-Dec-05	7:15:04				Fsec	2			
-1.11824	11.13329	5-Dec-05	7:15:49				Fsec	2			
-1.11797	11.13301	5-Dec-05	7:16:35				Fsec	2			
-1.11745	11.13319	5-Dec-05	7:17:20				Fsec	2			
-1.11693	11.13336	5-Dec-05	7:18:05				Fsec	2			
-1.11638	11.13321	5-Dec-05	7:18:51				Fsec	2			
-1.11588	11.13319	5-Dec-05	7:19:36	t	r	hs	Fsec	2			
-1.11550	11.13355	5-Dec-05	7:20:22				Fsec	1			
-1.11503	11.13353	5-Dec-05	7:21:07				Fsec	1			
-1.11457	11.13339	5-Dec-05	7:21:53				Fsec	1			
-1.11463	11.13377	5-Dec-05	7:22:38	roab		hs	Fsec	2			
-1.11479	11.13423	5-Dec-05	7:23:23				Fsec	2			
-1.11475	11.13476	5-Dec-05	7:24:09				Fsec	2			
-1.11513	11.13506	5-Dec-05	7:24:54				Fsec	2			
-1.11561	11.13486	5-Dec-05	7:25:40				Fsec	2			
-1.11606	11.13451	5-Dec-05	7:26:26	d	r	gg	Fsec	2			

Annex i. Pre-established codes for animal sign and human sign. These are in French and English: each horizontal line is the same thing.

Traces des animaux	Code
Alimentation	A
Boue sur l'arbre	B
Crotte	C
Decortissage	DE
Empreinte	E
Observation Directe	O
Nid	N
Signe de passage	PA
Piste	P
Activité saline	S
Vocalisation	VO

Animal sign	Code
Feeding sign	F
Mud on trees	M
Dung	D
Debarking	DE
Track (Footprint)	T
Direct observation	O
Nest	N
Sign of passage	PA
Path	P
Activity at a salt lick	S
Vocalisation	VO

Traces humaines	Code
Animale abattu, reste d'un…	AA
Arbre coupee	AC
Bruit de moteur	M
Campement	CA
Coupe de machete	CM
Coups de fusil entendu	CF
Douille de cartouche	DC
Ecorcement d'arbre	EA
Extraction de latex	EL
Extraction de miel	EM
Feu	FE
Fumoir	FU
Observation directe	O
Peche	PE
Piège	PG
Piste	P
Recolte de fruit	RF
Route actif/ aband	ROAC/ ROAB
Signe de passage	PA
Utilisation artisanales	UA
Village abandonne	VA
Voiture	VT

Maybe add mining

Human sign	Code
Animal carcass	AC
Tree cut down	TC
Noise of a motor	M
Camp	CA
Cut made by machete	CM
Gunshot	GS
Cartridge case ("dead cartridge)	DC
Bark extraction	EB
Latex extraction	EL
Honey extraction	EH
Fire	FE
Smoking rack or pit	SK
Direct observation	O
Fishing	FI
Snare	SN
Path	P
Fruit collection/ extraction	EF
Road: Active /Abandoned	ROAC/ ROAB
Sign of passage	PA
Extraction of non-food NTFP (wood, bamboo, lianas, raphia etc)	EW
Abandoned village	VA
Vehicle	VT

Annex ii. Pre-established codes for age of all sign (animal and human) and for ape nest types.

Age of signs. The last category (Rotten) is for nests; or Fossilised for elephant dung.

Age de crotte	Code
Fraîche	F
Récente	R
Vielle	V
Très vielle	TV
Fossilisée/ Pourri	FO/ P

Age de crotte	Code
Fresh	F
Recent	R
Old	O
Very old	VO
Fossilised/ Rotten	F/ R

We should add definitions to these classes (according to MIKE: Monitoring of the Illegal Killing of Elephants: IUCN)

Construction type of nests.

Type du nid	Code
Arbre	A
Zero (pas de construction)	Z
Minimum	M
Herbacee	H
Mixte	Mx
Ligneuse	L
Ligneuse detachee	LD
Palmier	P

Type of nest	Code
Tree	T
Zero (no construction)	Z
Minimum	M
Herbaceaous	H
Mixed	Mx
Woody	W
Woody detached	WD
Palm	P

These types also need clarification or definitions

Annex ii. Pre-established codes for Central African animal species. These are in French and English: each horizontal line is the same thing.

Scientific name	**Nom français**	**English**	**Code**
Loxodonta africana cyclotis	Eléphant	Elephant	E
Homo sapiens	Humain	Human	HS
Gorilla gorilla	Gorille	Gorilla	GG
Pan troglodytes	Chimpanzé	Chimpanzee	PT
Grands singes	Grands singes	Apes	GS
Miopithecus talapoin/ ogoouensis	Talapoin	Talapoin	TAL
Cercopithecus pogonias	Singe couronnée	Crowned guenon	PG
Cercopithecus aethiops	Grivet, singe verte	Tantalus/ Vervet monkeys	CT
Cercopithecus cephus	Moustac	Moustached monkey	CC
Cercopithecus neglectus	Singe de Brazza	De Brazza's monkey	BZ
Cercopithecus nictitans	Hocheur	Putty-nosed monkey	NI
Erythrocebus patas	Patas	Patas monkey	EP
Papio anubis	Babouin doguera	Olive baboon	PA
Papio cynocephalus	Babouin cynocéphale	Yellow baboon	PC
Colobus guereza	Colobe noir et blanc	Guereza colobus	GZ
Lophocebus albigena	Cercocèbe à joues grises	Grey-cheeked mangabey	LA
Dendrohyrax dorsalis	Daman d'arbres	Tree hyrax	DD
Hippopotamus amphibius	Hippopotame	Hippopotamus	HI
Neotragus batesi	Antilope de Bates	Bates' antelope	NB
Hyemoschus aquaticus	Chevrotain aquatique	Water chevrotain	HA
Cephalophus callipygus	Céphalophe de Peters	Peters' duiker	CP
Cephalophus monticola	Céphalophe bleu	Blue duiker	CM
Cephalophus nigrifons	Céphalophe à front noir	Black-fronted duiker	CN
Cephalophus dorsalis	Céphalophe bai	Bay duiker	CD
Cephalophus leucogaster	Céphalophe a ventre blanc	White-bellied duiker	CL
Cephalophus spp.	Céphalophes rouges	Red duikers (unidentified)	CR
Cephalophus sylvicultor	Céphalophe à dos jaune	Yellow-backed duiker	CS
Sylvicapra grimmia	Céphalophe de Grimm	Grimm's duiker, bush duiker	SG
Syncerus caffer	Buffle	Buffalo	SC
Tragelaphus euryceros	Bongo	Bongo	BO
Tragelaphus scriptus	Guib harnaché	Bushbuck	TS
Tragelaphus spekei	Sitatunga	Sitatunga	ST
Kobus kob	Kobe de Buffon	Kob	KK
Kobus ellipsiprymnus	Kobe défassa	Waterbuck	KE
Hippotragus equinus	Hippotrague	Roan antelope	HE
Phacochoerus africanus	Phacochère	Warthog	PH
Hylochoerus meinertzhageni	Hylochère	Giant Forest Hog	HM
Potamochoerus porcus	Potamochère	Red River Hog	PO
Crocuta crocuta	Hyène	Spotted Hyaena	HY
Canis adjusts	Chacal à flancs rayes	Side striped jackal	CA
Felis serval	Serval	Serval	FS
Felis aurata	Chat doré	Golden cat	FA
Panthera pardus	Léopard	Leopard	PP
Panthera leo	Lion	Lion	PL
Manis gigantea	Pangolin géant	Giant pangolin	MG
Manis tetradactyla	Pangolin à longue queue	Long tailed pangolin	MT
Manis tricuspus	Pangolin à écailles tricuspides	Tree pangolin	P3
Orycteropus afer	Oryctérope	Aardvaark	OA

Annex iii. Pre-established codes for vegetation type. These are in French and English: each horizontal line is the same thing.

Végétation (simplifiée, pour les Recces)	Code
Bai	B
Forêt de Colonisation	FC
Foret Secondaire	Fsec
foret mature sur terre firme	FM
foret monodominante	Fmono
Marécage	MC
Saline	SAL
Savane arbustif	SA
Savane boisée	SB
Savane herbeuse	SH
Plantations, jachère, ou autre utilisation agriculturale	PLT JAC

Vegetation (Simplified, for Recces)	Code
Bai (marshy clearing)	B
Colonising forest	FC
Secondary forest	FSec
Forest- mature, on terra firma	FM
Forest- monodominant	Fmono
Marshes	MC
Salt lick	SAL
Savannah- bushy	SA
Savannah- wooded	SW
Savannah- herbs (prairie-like)	SH
Plantations, fallow, or other human agricultural use	PLT, FAL

Végétation (détaillée, pour transects)	Code
Bai (clairière marécageuse)	B
Bosquet (petit forêt dans une savane)	BO
Cuirasse - Foret	CF
Cuirasse - Savane	CS
Forêt de Bambous	FB
Forêt de Colonisation	FC
Forêt de Lianes	FL
Forêt de Lianes avec Rotins	FLR
Forêt de Marantacée	FM
Forêt Inondée Saisonnièrement	FI
Forêt Mixte Sous-bois Ferme	FMSF
Forêt Mixte Sous-bois Ferme Liane	FMSFL
Forêt Mixte Sous-bois Ferme Marantacée	FMSFM
Forêt Mixte Sous-bois Ouvert	FMSO
Foret Monodominante	Fmono
Forêt Secondaire Jeune	FSJ
Forêt Secondaire Vieille	FSV
Galerie forestière	GF
Inselberg	INS
Jachère	JAC
Marécage	MC
Marécage de Lianes	MCL
Plantation	PLT
Raphiale	RAP
Rivière	RIV
Rocher	ROC
Saline	SAL
Savane arbustif	SA
Savane boisée	SB
Savane herbeuse	SH
Trouée (Chablis)	TR

Vegetation (detailed, for transects)	Code
Bai (marshy clearing)	B
Forest fragment (woodland patch in a savannah)	FF
Forest on rock	RF
Savannah on rock	RS
Forest- Bamboo	FB
Forest -Colonising	FC
Forest- Lianas	FL
Forest - Lianes (Rattan)	FLR
Forest -Marantaceae	FM
Forest- seasonally Inundated	FI
Forest – mixed, closed understorey	FMCU
Forest – mixed, closed understorey of Lianas	FMCUL
Forest – mixed, closed understorey of Marantaceae	FMCUM
Forest – mixed, open understorey	FMCO
Forest - Monodominant	Fmono
Forest- Young Secondary	FSY
Forest- Old Secondary	FSV
Gallery forest	GF
Inselberg	INS
Fallow	FAL
Marshes	MA
Liana marshes	MAL
Plantation	PLT
Raphia swamp	RAP
River	RIV
Rocks	ROC
Salt lick	SAL
Savannah- bushy	SA
Savannah- wooded	SW
Savannah- herbs (prairie-like)	SH
Gap in canopy (Treefall)	TR

Annex iii. Pre-established codes for slope class and weather conditions. These are in French and English: each horizontal line is the same thing.

A chaque changement:	
Pente	**Code**
Plat	0
Faible	1
Moderee	2
Raid	3

At each change:	
Slope	**Code**
Flat	0
Slight	1
Moderate	2
Steep	3

Chaque heure:	
Meteo	**Code**
Ensoleillé	E
Légèrement nuageux	LN
Nuageux	N
Pluvieux	P

Each hour:	
Meteo	**Code**
Sunny	S
Light cloud	LC
Cloudy	C
Rain	R

Annex iv. Pre-established codes for vegetation details: type of undergrowth, percent closure of the canopy, and visibility (by distance class) in the undergrowth.

Groupement végétal du Sous-bois	**Code**	**Canopée**	**Code**
Herbes	H	0-25%	0
Arbustif	A	26-50%	1
Lianes	L	51-75%	2
Steppes	S	>75%	3

Undergrowth type	**Code**	**Canopy**	**Code**
Herbs	H	0-25%	0
Saplings/ bushy	S	26-50%	1
Lianas	L	51-75%	2
Grass	G	>75%	3

Visibilité en sous bois	**Code**
Très ouvert (>15m)	TO
Ouvert (10-15m)	O
Fermé (5-10m)	F
Très fermé (<5m)	TF

Visibility in undergrowth	**Code**
Very open (>15m)	VO
Open (10-15m)	O
Closed (5-10m)	C
Very closed (<5m)	VC