Expedition Field Techniques

PRIMATES

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Front cover illustration: Line drawing by Madeleine Prangley of West African Cercopithecus - Diana monkeys

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This book is dedicated to the late Warren G Kinzey, a great primatologist, and to Alexia da Cunha who introduced me to monkeys.

Introduction[1]

This handbook has been written with undergraduate and post-graduate students in mind. It is intended as a guide for people who have little or no previous experience of primatological fieldwork. There is a UK bias for such things as sources of information. This is unavoidable, given the available space, time and resources. It is hoped that advice will at least help non-UK residents in their preparations.

With the exception of gibbons, working with apes is outside the scope of most expeditions. Consequently, techniques for studying great apes are not dealt with here.

Expeditioners are, by and large, an innovative lot and new field techniques are devised on many expeditions. But we need to hear about them to incorporate them into future editions of this manual. So if you have a good idea please send it care of Geography Outdoors - things won't get better without you.

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[1] Though a few species of primates occur in temperate zones, the majority occur in the tropics (very loosely between the tropics of Cancer and Capricorn). Comments in this publication are generally intended for such species.

Why Primates?

Studies of primates can either be the main reason for your expedition or one theme of your fieldwork. There are several good reasons for including primates in your study:

- Most primates are diurnal, vocal and group-living. This means that, of all the mammal groups you are likely to encounter, primates are probably the ones you are most likely to see and/or hear on a regular basis and with sufficient clarity to be able to make positive and verifiable identifications. Also though there are exceptions (see Section 1.10), primates are generally well known taxonomically and biogeographically. This greatly helps with field identifications.
- primates are popular animals and are of general interest. They tend to be included in field guides (generally unlike rodents, bats and quite a lot of small carnivores). This too aids identification.
- in general (see Section 1.9 for some exceptions), primates are good indicators of general ecosystem health and are thus helpful in conservation planning.
- enough work has been done for it to be generally quite clear what kind of questions fieldwork could be answering. Often these can be of a very basic nature. Data such as group size, food and habitat preferences are still needed for whole species or for certain parts of their range. Gathering such data is well within the compass of an expedition.
- studies on primates can be integrated with other fieldwork - for example observations on birds and studies of fruiting and flowering patterns of trees. It is therefore a good way of making the most of the effort you spend on fieldwork.
- people are interested in primates. This includes sponsors, the media and local government officials. Searching for a rare monkey is widely regarded as a much saner (and more supportable) pastime than trying to locate a rare slug.
- there are a large number of journals specializing in primates, and well-structured ways of accessing the information they contain. This simplifies your literature search, and it also means that there is a good chance of being able to find somewhere to get your results published. (such journals are listed in the appendices).

Bourliere (1985) has reviewed the role of primates in tropical ecosystems.

Section One

WHAT YOU CAN DO - PART ONE: SIMPLE STUFF

The following is intended as a guide to fieldwork themes, either for expeditions who are not concentrating solely on primates, do not feel they have a great deal of field experience or who are not going to be in any one place for a long period of time. Each or any of these can be done for one species of primate or as many species of the primate community as time, logistics and equipment will allow. If some of this stuff looks basic, then a quick glance through the literature will show you that fundamental information is still lacking for even some quite familiar species.

1.1 Species inventory of a primate community

There's nothing wrong with a simple list of what you saw. If you can assign relative abundances to the various species, so much the better (see Section 4.1 for quantitative indices). In a well-studied area comparison of such data with that from previous years can help assess the effect of disturbance (such as hunting, logging, road construction, eco-tourism). In little-studied areas it may be all there is to go on (see Agoramoorthy, 1989; Barnett & da Cunha, 1991; Buchanan-Smith, 1991a,b; Cameron *et al.,* 1989; Carpaneto & Gippoliti, 1990; Chivers & Burton, 1988; Choudhury, 1988; Christen & Geissmann, 1994; Kinzey *et al.*, 1988; Martins *et al.,* 1988; Mitani, 1990; Peres, 1993a; Prangley *et al.*, 1994; Raxworthy & Stephenson, 1988; Rylands *et al.,* 1988 as examples).

It is important to be absolutely sure of what you have seen. You should be familiar with the likely species from your pre-expedition researches (see Section 6) and from the field guides (see Appendix) and the photographs you have bought with you (see section 4.3.5). Sections 4.1, 4.2 and 4.3 give some tips of how to find and observe monkeys in the field.

1.2. Single species studies

The usual motivation for these is because the species is rare, little known or threatened. Ensure that the time and effort devoted to the study are enough to ensure its representativeness and the validity of its conclusions. Good examples of such conservation-focused studies include Alfred & Sati (1990), Burton *et al.* (1995), Christen & Geissmann (1994), Duckworth *et al*. (1995),

Haimoff *et al.* (1986), Hohmann & Sunderraj (1990) and Sugardjito *et al.* (1989). Buchanan-Smith (1991a,b) shows how much can be done in a comparatively short time. It can be very useful to upgrade previous census' (e.g. Clarke & Zucker, 1994; Decker & Kinnaird, 1992).

Ideally, such studies should include: some detailed census work, extrapolation to other sites, identification of factors which might reduce densities, assessment of the extent of their current impact, prediction of future trends for such threats and conservation recommendations. Examples of such highly useful studies include Marsh (1986) and Wahome *et al.* (1993).

Choudhury (1989), Ferrari (1995), Jones (1995), Rumiz (1990), Phillips (1995) and Stevenson *et al.* (1994) provide examples of single species studies with a more ecological focus.

Pets can be useful sources of additional data (see Hamada & Watanabe, 1994; Watanabe *et al*., 1991).

Some species have restricted distributions. When checking old records, remember that the political geography of areas changes over time, new countries arise and the boundaries of old ones change (e.g. see Oates & Anadu, 1989).

Decker & Kinnaird (1992) contains useful information on the kinds of statistical tests needed for comparing populations from different sized forests.

1.3 Comparison of primate communities in different habitat types

Some species show great behavioural plasticity and occur in undisturbed areas, as well as farmbush and secondary forest. Others abhor anything except pristine habitats. Some may have very exacting requirements (see Thomas, 1991 as an example).

Surveys comparing the primates of existing areas of impacted land with pristine ones can often predict the future of an unspoilt site should it suffer a similar fate. Try to choose study sites which, had one not been impacted, would have been (as close as is possible) ecological and sociological replicates. Try to ensure that the patterns and intensity of current hunting practices in each are known. Reviews on the topics of primates and habitat destruction are given by Barnett (1991b), Hill *et al.* (1994), Johns & Skorupa (1987) and Skorupa (1986). Johns (1986a,b), Johns and Johns (1995), Silva

Lopez *et al.* (1988), Ross & Srivastava (1994) and Wilson & Wilson (1975) provide examples of field studies. Note that altitude can be an important influence on the ecology and social organisation of species. (See Hall, 1963; Henzi *et al.*, 1990; Iwamoto & Dunbar, 1983; Whiten *et al.*, 1987 and references therein).

You may want to document the species, their proportional composition to the primate community, the absolute numbers of individuals, of each species and the size of troops. You may also wish to record any dietary differences, and the frequency of polyspecific associations. Try to look at more than just one pair of sites, as you cannot guarantee the representativeness of a single one. Remember also that some differences between groups may be 'cultural', reflecting different social histories of the groups involved (e.g. Chapman & Fedigan, 1990; Lefebvre 1995; White, 1992).

Fragmentation of forests (following disturbance) changes things for the monkeys which remain in the fragment. Illustrative studies of the parameters involved include Bernstein *et al.* (1976), Bicca-Marques & Calegaro-Marques (1995a), Chiarello (1993a, 1994), Galetti *et al.* (1994), Johnson *et al.* (1991), Leighton & Leighton (1982), Lemos de Sa & Strier (1992), Rylands & Keuroghlian (1988), Schwartzkopf & Rylands (1989) and Strier (1989), Galetti *et al.* (1994) provides a useful study where primates in fragments are compared long-term base-line data from continuous forests. As an additional insight into such processes, it can also be instructive to compare populations in prime and naturally marginal habitats (e.g. Mehlmann, 1989), or those with agriculture (Oyare & Strum, 1984) shifting cultivations (Gupta & Kumar, 1994) or tourist influences (Brennan *et al.*, 1985; Lee *et al.*, 1986) (see also Fa & Southwick, 1985 for an overview). However, some fragments (sacred groves, for example) may be small, but little disturbed. Under these conditions they may support a rich fauna and flora (see Fargay, 1992 & Dudley *et al.*, 1992).

Don't neglect plantations. Despite the traditional wisdom that they are species-poor places (see Patterson & Ollason, 1994 for a recent field study and Barnett, 1992 for a review), in some places they may be the only substantial tree cover left. Are they used by local primates? If so, can you assess if this is likely to be sustainable and contribute to the long-term conservation of local primate populations? Would it cause unacceptable commercial damage to the plantation? Ganzhorn (1985, 1987), Ganzhorn & Abraham (1991), Kool (1993), Wilson & Johns (1982) provide examples of this approach.

Don't forget the night shift. In South America there is only one genus of nocturnal primate. But elsewhere (especially south-east Asia) there are many and they make a suitable subject for comparative study. Gonzalez-Kirchner (1995), Galetti & Pedroni (1994) and Weisenseel *et al.* (1993) are useful introductions.

When comparing habitats it is important to compensate for differences in the ease with which primates might be encountered. For example, animals may be more easily seen in the more open canopy of a logged forest (see Johns, 1985), Greater visibility may also be due to greater activity, because food is scarcer and more widely dispersed in one habitat than in unlogged forest another (Johns, 1986a,b). Take care to avoid flawed conclusions (for example, one gibbon survey, based on call numbers alone, purportedly showed that more gibbons lived in a post-logging forest and, hence, that logging improved the environment for gibbons [but disturbed gibbons may call more]).

Remember to check on the seasonality of habitat associations. You may find that a species use different habitats in different seasons (see Boinski, 1987; Robinson, 1986; Zhao *et al.*, 1991 as examples). If you are not on site long enough to check this yourself then ask the local people. If you are on site for a long time, asking locals will help you plan for such movements and help corroborate your findings.

1.4. Records of group size and composition

Group sizes are important for two main reasons. Firstly, they can give you an idea of social structure (see Crook & Gartlan, 1966; Eisenberg *et al.*, 1972; Clutton-Brock & Harvey, 1976, 1977; Dunbar, 1988; Terborgh, 1986; Van Schaik & van Hooff, 1983; Wrangham, 1987 and Wright, 1986). Secondly, they can tell you about disturbance levels. A group size which appears smaller than standard is a good indication that the area is being heavily hunted (Pinto *et al.*, 1993). (Note that the animals may just be more shy rather than less common). Group size is not absolutely constant (see Beauchamp & Cabana, 1990) and may show seasonal fluctuations (see Henzi *et al.*, 1990).

Group (and sub-group) size may be related to foraging opportunities (see Whitten, 1988), habitat quality (Dunbar, 1987) and food availability (Gaulin *et al.*, 1980; Phillips, 1995, Robbins *et al.*, 1991) (among other things). Group composition can be related to size of forest block (Dunbar, (1987).

However, as Henzi (1988) warns, “many males do not a multimale troop make”.

Some species travel in small bands of five to six, other species move in groups numbering several hundred. In the latter case there is generally some hierarchical organization going on, with sub-groups of stable composition forming during the daily foraging (leading to so-called ‘fission-fusion’ societies). These can greatly confuse estimates of group numbers. You probably won’t have time to work out whose who and study the associated simian soap opera (e.g. Koenig, 1995), but recording group and sub-group sizes is useful as they are often still unsure for many species (e.g. see Morland, 1991).

1.5 Diet

This is one of the most frequently studied aspects of the ecology of free-living primates. But don’t let that stop you. There are often great changes through the course of the year and over the geographical range of a species, so your data may well be new or confirm previous work. The apparently simple task of finding out what the animals eat can be a real challenge and a simple list of known foods is often very helpful. Whether doing this or more quantified work, you will need to have done back-up botanical research before you go and be prepared to identify plant specimens when you come back. It is important to discuss how you are going to record your data before you go. Section 4.2 gives hints on observational methods for quantified studies of diet. If you are using these then visit the local zoo and/or test the effectiveness of your proposed techniques with trial observations in the college or department cafeteria or in a local street market.

The wealth of existing anatomical, physiological and behavioural data (see papers in Chivers *et al.*, 1984; Clutton-Brock, 1977; Else & Lee, 1986; Ferrari & Aparecida Lopes, 1995; Milton, 1980; Montgomery, 1978; Rodman & Cant 1984; Smuts *et al.*, 1987) should provide you with a good base against which to compare your results and should help explain them. (Also see the review by Cassini 1994). Julliot & Sabatier (1993), Oates (1988), Peres (1994), Stanford (1991), Strier (1991), Van Roosmalen (1985) and Yeager (1989) are classic examples of dietary studies and provide good methodological hints including how to quantify the samples. Strier (1991) includes a useful example of the statistical tests that may be used in dietary analysis (see also Dodge *et al.*, 1990 and Miles, 1990).

Long-term studies show the great number and variety of food items in most primate diets (e.g. Norton *et al.*; 1987; Rhine *et al.*, 1989). Some of these items are eaten very infrequently (see Peres, 1994 for an example), but may nevertheless be of significance (see Srivastava, 1991 for an example). Some times of the year food items may become superabundant and be used by several species (e.g. Jones, 1995; Lambert, 1990; Leighton & Leighton, 1982; Ungar, 1995), that otherwise do not normally share resources (see Terborgh, 1983 for an extended example). You may also record possible competition (e.g. Gonzalez-Kirchner, 1995; Guillotin *et al.*, 1994; Jones, 1994; Simmen, 1992; Ugar, 1995; Whitington, 1992). Studies have also been done on the same species in different habitats (especially comparing natural and artificial habitats e.g. Gonzalez-Kirchner 1995; Kool, 1993). Use of alien species has also been investigated (e.g. Figueiredo *et al.*, 1995) Wrangham *et al.* (1993) provides a useful introduction to methodology for assessing density of food items for terrestrial primates (see also Blake *et al.*, 1990; Hutto, 1990 and Smith & Rotenberry, 1990).

Remember, diet composition is variable both in time and space, especially in seasonal environments (see Chapman & Chapman, 1990 for review: Chapman, 1987; Chapman & Fedigan, 1990; Galetti & Pedroni, 1994; Harcourt, 1986; Mitani, 1989; Overdorff, 1993; Phillips, 1995; Robinson, 1984; Watanuki *et al.*, 1994 and Zhang, 1995a for field examples). These variations may occur in cycles of several years (e.g. Hill & Agetsuma, 1995). There may also be differences between sexes (e.g. Gautier-Hion, 1980; Rose, 1994) and age classes of the troop you are observing (e.g. Mori, 1995). Cultural transmission within troops can also lead to differences in diet being observed between troops (see Lefebvre, 1995).

Diet composition may be heavily influenced by negative factors (such as the chemical composition of the food items and the mechanical difficulty of handling or entering them) as well as positive ones (like their nutritional content). See Ayres (1989), Corlett & Lucas (1990), Gautier-Hion *et al.* (1985), Kinzey (1988), Kinzey & Norconk (1990, 1993), Kinzey *et al.* (1990), and Ungar (1995) for field examples involving seeds and fruit: Davies *et al.* (1988), Kar-Gupta & Kumar (1994), Lucas & Teaford (1995); McKey *et al.* (1981), Milton (1979), Oates (1978), Oates *et al.* (1977, 1980) for field examples centred on leaves, and Freeland & Janzen (1974), Janzen (1971), Rhoades & Cates (1976) and Waterman (1983, 1984) for reviews. Papers in Chivers *et al.* (1984), Montgomery (1978) and Morrison *et al.* (1990) provide useful overviews of this subject. Glander *et al.* (1989)

provide an example of a primate diet that acts as a precautionary tale for those who believe humans can always eat what monkeys do.

1.6 Group composition

As Coelho *et al.* (1977) and Eisenberg *et al.* (1972) have shown, the size and composition of a primate group is an intimate expression of its functional ecology. These details differ from place-to-place and season-to-season. Though you are unlikely to be able to get detailed records of the kind that allow the social dynamics of a troop to be followed in soap opera-like detail (as Jane Goodall has done with the chimpanzees of Gombe), projecting your numbers onto such theoretical constructs (e.g. Chapman *et al.*, 1990), can tell you a lot about what is going on (e.g. Morland, 1991).

You can record details of: absolute numbers, ratio of males to females, ratio of juveniles to adults, presence and number of juveniles and babies. Such data is especially valuable if you can compare troops of the same species in different habitats.

In some species it is usual for the troop to split-up during the day, forage either as individuals or as small bands, and then join up again at night (e.g. Cords & Rowell, 1986; McFarland Symington, 1990; see also MacFarland, 1986). Such fission-fusion organization (which is distinct from the melding of previously separate groups, see Isabel *et al.*, 1991 and Menard & Vallet, 1993), has important consequences for the social ecology of the species (see reviews by MacFarland, 1986; Terborgh, 1986).

Try to follow a small group from dawn-to-dusk to ensure you are not making erroneous conclusions about group size and structure. Chapman *et al.* (1993) have looked at the difficulties this poses for fieldwork and attempt to define sub-group sizes in such primate societies.

1.7 Get an idea of range size

You are unlikely to be on site long enough to get a full estimate of the size of the area used by a troop, but guestimates are very helpful, especially if you can pin-point particular resources between which travel is taking place (e.g. particular fruit trees). In some cases (with howler monkeys, gibbons and some manabgeys for example, see Chivers, 1969 as case study), their use of loud calls make it fairly easy to work out where the territorial boundaries lie. (See also Falls, 1981; Johnson *et al.*, 1981). Other species are not so cooperative, but such analysis can still be done (see Kool & Croft, 1992; Harrison, 1983; Isbell, 1983; Scanlon *et al.*, 1989) as field examples and

references therein). Such analysis will be facilitated if you have good maps (aerial or topographic) to allow you to pinpoint ground features to which you can refer. A simple recording of the location of a group in the morning (before the group moves out from roosting place) and in the late evening, for different reasons, may provide useful base-line information on range size.

It is easy to get lost in a forest, especially when you are trying to follow a group of monkeys. Cutting a trail network is one solution (see Jermy & Chapman, 1994 for techniques and Section 4.1) but you are probably not going to be on-site long enough for it to be worthwhile in terms of effort. Anyway, can you justify the general disturbance and destruction involved? A less damaging alternative is to tie markers to mark trails rather than cutting (but ensure you position the tags within your visual horizon).

You can also try and get information on whether the animals sleep in the same place each night or if they are more mobile than that. Such data is useful to assess the vulnerability of the troop, and the species in general, to hunting. It also gives an indication as to the minimum size of area required for a viable population of the species (see Kinnaird, 1988 as example) to exist long-term in the area.

Remember, range size is highly dependent on food density and/or nutrient content (e.g. Nagy & Milton, 1979; Zhang, 1995a) and population density (e.g. Chiarello, 1993b). There may also be strong seasonal variations (e.g. Mitani, 1989). Hayne (1949) provides a simple method of calculating range size from expedition type data.

1.8 Rare or common in an area?

You are unlikely to get sufficient data to be able to quantify this with certainty. This does not matter; to be able to report that a species previously considered rare is common in your study area is a wonderful thing. Though you will get some feel for relative abundance during your fieldwork, you may want to extend this side of your work to include a historical element and find out what happens at other times of the year (quite a lot of species of primate have local migrations, see section 1.3). For this you will need to call on local expertise. Guidance and techniques for doing this are given in Bellamy (1992) and some extra hints given in Section 4.3.5.

1.9 Effects of hunting

There are several ways in which such a study may be made:

- interview local people - do they hunt, what, how often, why (and why not others), how abundant were animals previously (e.g. Flannery *et al.*, 1995)
- compare areas known to be hunted widely with those little or never hunted (e.g. Stearman, 1990)
- how does hunting of other animals affect primates?
- can primates be caught incidentally to hunting of other species, e.g. mountain gorillas are caught in snares used to hunt duiker and bushbuck
- study areas formerly hunted and see how species have come back
- compare hunting techniques of recent colonists with those of tribal peoples in area (Redford & Robinson, 1987)
- in addition to numbers, look at species composition of monkey communities in hunted and non-hunted areas
- also are they more shy, do they spend more time in the tree-tops, are they more vigilant, are the troop sizes the same?

Remember, primates may not always be the best indicator of hunting pressure. Other groups may be more or less heavily hunted than them (see Barnett *et al.,* 1994; Bodmer *et al.,* 1988; Prangley *et al.,* 1994; and Smith 1986 as examples), especially since primates are often the subject of religious or cultural prohibitions on hunting (see Mittermeier, 1987 for review and Oates *et al.,* 1992; Peres, 1990, 1991 as field examples). Topic reviews occur in Hladik *et al.* (1993), Redford & Padoch (1992), Robinson & Redford (1991). Robinson & Redford (1994) give techniques for estimating sustainability of hunting in an area. Marks (1994) proposes a study form designed to enhance local participation.

1.10 Check geographical ranges and define taxonomic boundaries

Distributional data is important for conservation, taxonomy & evolution, ecology and zoogeography (see Brockelman & Ali, 1987; Heltne & Thorington, 1976; Oates, 1981) and for providing accurate information for GIS databases.

There is still a lot of uncertainty about the ranges of primates. Some taxa, previously thought to be monotypic, are now being revised because of recent

studies of patterns of their pelage variation (e.g. Groves & Tattersall, 1991). In others, newly-recognised intermediates synonomise previously differentiated taxa (e.g. Tattersall, 1986). While some taxa (previously thought distinct) are really hybrid swarms (e.g. Groves *et al.*, 1993). Identification of zones of hybridization is also valuable (see Samuels & Altmann, 1986). In other cases suppositions have been made about the supposed distribution of a species and fieldwork later corrects these (e.g. Boulbi, 1993). Genuine range extensions are also possible (e.g. Barnett *et al.*, 1994; Bicca-Marques, 1990; Bicca-Marques & Calegaro-Marques, 1995b; Chiarello & Galetti, 1994; Fooden *et al.*, 1994), as are finer definitions of range limits (e.g. Fooden, 1991). Recognition of all such facts can be important in later conservation planning.

It is also worth checking old records and hunters reports (e.g. Lane, 1990), as these can frequently result in the discovery of new localities and new populations. When this occurs for species which are rare and endangered, it can be of great importance for their conservation (see Martuscelli *et al*., 1994).

To avoid hybridization between distinctive populations, breeding programmes need information on morphological variation in the wild (see Lemos de Sá *et al.*, 1990; Vandenberg *et al.*, 1990). Observations on external differences can provide a basis for more complex follow-up work involving genetic studies (see Chaverud *et al.*, 1993).

Studies may also reveal completely new taxa (e.g. Anon., 1989; Ferrari & de Souza-Junior, 1994; Ferrari & Queiroz, 1994; Geissmann, 1989; Meier *et al.*, 1987; Niemitz *et al.*, 1991; Queiroz, 1992; Simons, 1988), or rediscover ones thought extinct (e.g. Meier & Albignac, 1989).

A look at the distribution maps in taxonomic revisions of various genera should show areas with question marks, where the status of taxon (species or sub-species) is unknown (see, for example, papers by Philip Hershkovitz for many of the genera of South American primates - see list in Appendices for these and other important taxonomic revisions). In such cases either it is unknown if the animal in question actually occurs there, or it is uncertain which of a species pair or sub-species live there. Being aware of this before you go can help ensure you collect the right kind of information in a verifiable and trustworthy manner (i.e. making sure you know the differences between the taxa concerned - see Colyn, [1993] for an extreme example of taxonomic and geographic complexity of primate coat colour). In getting such information you can help conservation planning and provide data which

can help refine models of speciation patterns in the tropics (see Ayres & Clutton-Brock, 1992 and Kinzey, 1982 as examples).

Be aware that occasional individuals with atypical colour patterns will occur. These are often cytogenetic variants rather than a valid taxonomic form (for an example see Lima & Seuanez, 1989; though see also Stanyon *et al.*, 1995). Also, because many species are still evolving or have only recently come into contact, there are sometimes hybrid zones (see Silva *et al.*, 1992; Watanabe & Matsumura, 1991; Watanabe *et al.*, 1991a,b; Rabarivola *et al.*, 1991 as examples). Be aware (by looking at museum skins and talking to people who know the area well) of the possibility of seeing such aberrant-looking individuals and of their likely appearance.

Do not neglect pets. These, if the provenance is accurately known, can be of value in biogeographical surveys (e.g. Watanabe *et al.*, 1991b).

Try and be sure that your records are as accurate as possible. Try and pinpoint your position, using the best available maps and (where possible) aerial photographs and/or satellite images to back these up (the maps may not always be up to Ordnance Survey standards). Rivers are often important boundaries between taxa (see Ayres & Clutton-Brock, 1992 and Cheveraud & Moore, 1990 for Amazonia, and papers in Gautier-Hion *et al.*, 1988 as examples in Africa and references in Geissmann, 1991 for South-east Asia). Make sure you know from which bank you are making your observations (it sounds simple, but some of these rivers wind a lot - left or right heading downstream is the correct procedure, but is not always followed so take care). If you have the opportunity, try checking the situation at the headwaters of a boundary river - the situation there may be rather different to that where the river is wide.

If there are local names for geographical features then try and record them, especially if they do not appear on the maps you are using. This can help you when cross-referencing to other maps, and may help you pin-down the location of places currently listed as ‘unknown’ in the gazetteers of collection localities of the species you are working with.

Errors can creep into the recording of locality data and to the interpretation of data from maps. See Anderson (1965), and Heltne & Thorington (1976) and Oates (1981) for a brief guide to these and Brandon-Jones (1995) as an example of the consequences and detective work required to unravel them.

Remember, you can always do follow-up work from previous studies (see Clarke & Zucker, 1994).

1.11 Tourism and ecotourism impacts

You may wish to see how the social organisations, feeding habits and reactions to humans are effected in troops exposed to tourist developments. This can be especially important where ecotourism developments are planned. See O'Leary & Fa (1993), Zhao & Deng (1992) as examples of such studies, Cochrane (1994) for overview of the methodology for ecotourism surveys.

1.12 What data to take

1.12.1 Examples of data needed on a daily basis

When you look through the primatological literature you will realise that a lot of the work is based on really detailed note-taking. This has set very high standards for field work. For all but the most cursory data a number of components are required for the information to be taken seriously by other primate workers (and by journal editors and reviewers of manuscripts). Accordingly, every time you start looking at an individual or a group you should try to record the following:

- time encounter began (local time, not GMT and using 24-hour clock)
- location on transect
- number of animals first seen (add any subsequent additions as they come in)
- sex and (if possible) age composition of the group
- identify the species (primates often occur in mixed groups so check to see if there's more than one species)
- the light conditions the observations are being made under
- the weather conditions the observations are being made under (e.g. cloud cover, raining or not, sunny or not)
- the general visibility between you and subject (an estimation of vegetation density will do)
- the height from the ground at first sighting (add any subsequent changes)
- distance from self to nearest animal in group (estimated, you can always do a more accurate measure later)
- the habitat type in which animals first seen (and add any subsequent changes)

- if the animals are in a tree, try and note the tree species (and the rough size of the tree - diameter at breast height [DBH] is normally sufficient: or mark the tree and come back later)
- what was the group doing when first encountered (for methods of recording subsequent behavioural data see Section 4.2.2)
- time encounter terminated.

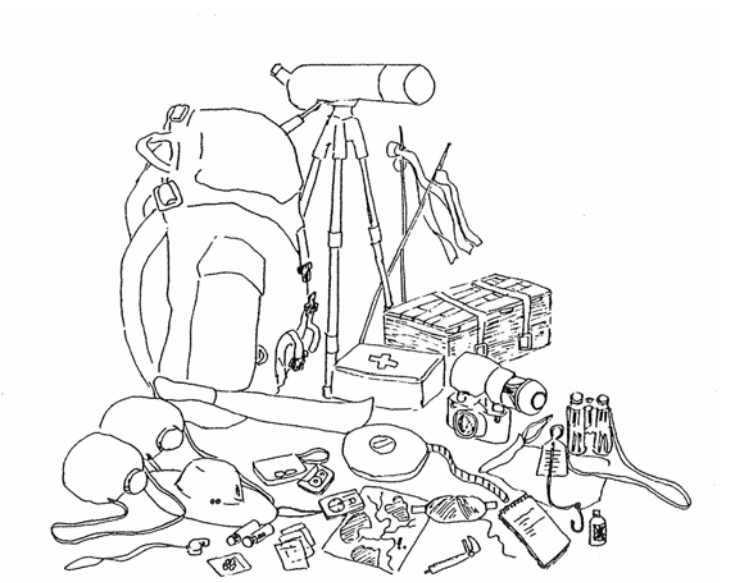
1.12.2 Recording oddities

Try to make sure you record rare and unusual events (such as predation, an animal falling from a tree etc.). Because they are so rarely recorded, such natural history observations are useful, prized and readily find a home in the 'notes' section of the appropriate journal. For example:

- odd, unexpected or previously unrecorded dietary items (see Fedigan, 1990; Figueiredo *et al.*, 1995; Goodman, 1989; Harcourt & Harcourt, 1984; Heymann & Hartmann, 1991; Huffman & Seifu, 1989; Iguchi & Uzawa, 1990; Suzuki *et al.*, 1990; Wahome *et al.*, 1988; Watanabe, 1989)
- soil-eating (geophagy) (see Bicca & Calegaro-Marques, 1994; Davies & Baillie, 1988; Ferrari, 1995; Izawa, 1993)
- unusual feeding methods (see Anderson, 1990)
- unusual drinking methods (see Ferrari, 1991; Gilbert & Stouffer, 1989; Glander, 1978; Lehman *et al.*, 1993)
- tool-use (see Galetti, 1990; Nishida & Nakamura, 1993; Westergaard & Suomi, 1994a,b)
- predation on a monkey by bird of prey or carnivore (see Chapman, 1986; Condit & Smith, 1994; Fay *et al.*, 1995; Heymann, 1987; Maisels *et al.*, 1993; Olmos, 1994; Peetz *et al.*, 1992; Sherman, 1991; Stanford, 1989)
- anti-predator defence (see Bartecki & Heymann, 1987; Gautier-Hion & Tutin, 1988; Phillips, 1995; Sauther, 1989; Yeager, 1991), predator avoidance (Cordeiro, 1992)
- unusual cross-species associations (e.g. Heymann, 1992; Puertas *et al.*, 1995)
- unusual reproductive events, e.g. twins (see Chapman & Chapman, 1986; Stott, 1953; Winkler *et al.*, 1989) or breech births (Moreno *et al.*, 1991)
- unusual social interactions (see De Waal *et al.*, 1993; Fimbel, 1992; Heymann & Sicchar Valdez, 1988; Nakagawa, 1995; Palombit, 1993; Schino *et al.*, 1993)
- unusual vocalizations (see Symmes & Goedeking, 1988; Drubbel & Gautier, 1993).
- infanticide (see Fairgrieve, 1995)

- cannibalism (Tartabini, 1991)
- odd colour variations (e.g. Hamada *et al.*,1992; Inagaki, 1992; Minezawa *et al.*, 1992)

Such records are not trivial pieces of data, nor indulgences to boost the publication list of the aspiring. Such notes are published by established primatologists just as often as by anyone else. What you will need is (i) fieldcraft, (ii) luck and (iii) a good knowledge of the literature.



Primate surveying is no picnic! Drawing by Madeleine Prangley

Primate surveying is no picnic! Drawing by Madeleine Prangley

Section Two

WHAT YOU CAN DO - PART TWO: MORE DETAILED STUFF

This is intended for groups who are either intending to work pretty much on primates alone (or at least have some members who are), or who are going to be in one place for an extended period (say several weeks to months).

Remember that you need time to familiarize yourself with your chosen study animal(s). According to Simon Bearder of Oxford Brookes University, it takes at least one month to 'get the feel' for a primate species (and he should know - he's been working on bushbabies for the last 28 years).

2.1 Calls and vocalizations

2.1.1. Recording of calls (for own sake)

There are several reasons for doing this:

- identification confirmation - you may never see some species, only hear them. Unless you are a skilled animal impersonator, possess a remarkable ear or are musically trained you are unlikely to be able to usefully reproduce the sound later. Tapes may be compared later with those in a sound library in the home or host country.
- as an aid in interviews with local people - not everyone recognises pictures, but calls may be familiar.
- the calls of the species may not be represented in the sound library collections. Getting them will help future work.
- playing calls can help enrich the environment of captive animals (Anon., 1987), your tapes may be of use broadening the variety of calls used.
- there may be racial or geographical variation. Documentation of this may aid future work (including taxonomy, see Courtenay & Bearder, 1989; Geissman, 1984; Hohmann, 1988; Oates & Trocco, 1983; Struhsaker, 1981; Zimmerman *et al.*, 1988). (According to Brockelman & Ali [1987, p.26] *"vocalizations may become as useful to taxonomy as 'hard' characteristics and can be permanently stored [and] objectively measured. They are, in fact, less variable within many populations and more easily quantified than pelage features").*
- your recordings may be compared with those of a later or earlier expedition to see if calls of individuals remain unchanged over time (and

can hence be used for long-term identification) (see Butynski *et al.*, 1992; Chapman & Weary, 1990; Jones *et al.*, 1993).

Aim for the best possible quality of recording. The equipment required and the techniques to be used are given in Gulledge (1976) and Ranft (1992). Whitehead (1995) provides an excellent introduction to current techniques of recording primate sounds.

According to Gulledge (1976), the following information should accompany each recording:

Species name	Date
Tape number and track	Weather
Location	Terrain
Time recording begun	Elevation
Recording equipment	Habitat type
Subjects height location	Disturbed?
Recording distance	Background sounds
Recordist	Calls recorded, behaviours observed
Tape time (seconds)	

The tape number and cut, date and time must be announced at the start or end of each track.

Note: the use of 'tape-luring' (where a bird's recorded call is played back to attract it into visual range) is common in some sectors of ornithological study (see Falls, 1981; Johnson *et al.*, 1981) and has been used a lot with gibbons (see Mitani, 1985) and howlers (e.g. Chiarello, 1995; Whitehead, 1995 and see references therein) and in some studies of marmosets (e.g. Norcross *et al.*, 1994). Do not do this with primates unless you have checked the likely effects this could have on the group you are looking at.

2.1.2 Recording of calls for later sonographic analysis of structural components

The aim of this is quite sophisticated and is not to be done unless you are going to spend a lot of time in post-expedition follow-up work. Sonograms give you the frequency components of the calls and allow a physical description of calls. One reason for doing this is to test theoretical predictions of frequency components of calls and their relation to vegetation density of the habitat (see Brown & Waser, 1988; Marten *et al.,* 1977; Michelsen, 1978; Morton, 1975; Richards & Wiley, 1980; Snowdon, 1989; Waser & Brown, 1986; Wiley & Richards, 1982 for theoretical background). Studies which have made such analysies include Boinski & Mitchell, 1995, Drubbel & Gautier (1993), Masters (1991), Newman *et al.* (1983) and Schon Ybarra (1986). Duration of calls is also an important factor (see Sekulic & Chivers, 1986). If you wish to work in this field you will need to make top-quality recordings, and the gear needed to achieve this may be more expensive (and carry the kind of high insurance premium), than you want to bother with (see Richard, 1991 for some more technical details). A useful example of the kind of data you can get, how you can interpret it and what you will need to do, is found in Halloy & Kleinman (1994).

As an addendum to this you may wish to test the attenuation of calls which you have already chopped up by frequency and bought out from the UK. Such specific project work is interesting, but probably not suitable for short-term field studies.

2.1.3 Other possible work with calls

- pilot study of the vocal repertoire of a species (see Hohmann, 1989; Palombit, 1992 as examples).
- pilot study of the natural history of the calls (the nature of the calls and the contexts in which they are given) (see Haimoff, 1985; Pollock, 1986).
- study of individuality of songs of species that use calls in territoriality (see Chapman & Weary, 1990; Haimoff & Tilson, 1985 as examples).
- study of social context of a call (e.g. age-specific and time specific , Hammerschmidt *et al.,* 1994; gender-specific, Boinski & Mitchell, 1995; Mitani & Gross-Lewis, 1995; Norcross & Newman, 1993; coordination of troop movement, Boinski, 1993; and monitoring of individual locations, Caine & Stevens, 1990; Jones *et al.,* 1993).

2.2 Faeces

The best overall review for faeces-related techniques is probably Putman (1984). See Section 4.5 for health considerations.

For storage, material can either be dried and stored in brown envelopes (accompanied by a sachet of silica gel), stored wet in a plastic jar with an alcohol or chloroform-soaked cottonwool ball, or teased apart and the major components stored separately. Weight can be recorded once the sample is bagged, using a spring balance (remember to minus the weight of the bag). Volume can be determined with a bagged sample and Archimedes' method (this can also be used for fruits).

2.2.1 Faecal analysis (food)

From direct observation you are unlikely to be able to compose a complete list of the diet of the species you are studying. Analysis of faeces will give extra data. Not only will it give you a more complete list of species and types of food, but will allow you to see if, for example, the species is acting as a seed predator (crushed seeds in faeces) or a seed disperser (whole seeds) for various types of plant (see Figueiredo *et al.*, 1995; Galetti *et al.*, 1995; Janson, 1983; Kinzey & Norkonk, 1993; Nunes, 1995; Wrangham *et al.*, 1994). Obviously, care must be taken to ensure you assign your collected faeces to the correct species of primate. This is best done by collecting fresh faeces under a troop while it is feeding. However, as size and consistency are fairly constant, you may soon come to recognise the origin of the faeces you encounter on the trail.

Such projects need planning and will be time consuming. Such work also requires some extra equipment. It is best to have practised at home on faeces of domestic or agricultural animals to have some initial experience. Techniques and equipment are outlined by Figueiredo *et al.* (1995), Motta-Junior *et al.* (1994), Putman (1984) and Rodrigues *et al.* (1993) (and references therein). Note that not all food items are equally digestible, which can lead to over-estimation of the importance of some dietary components (see Montgomery, 1978; Putman, 1984; Rodman & Cant 1984 for overviews). If it can be arranged, it can be most helpful to have a previous seed collection to compare with the seeds found in the faeces.

2.2.2 Faecal analysis (endoparasites)

The number and variety of endoparasites can be investigated as an indication of the health of the study animals. As this can be stress-related, such studies can form a useful adjunct to conservation-based studies on the effects of

habitat disturbance and on the viability of isolated populations of primates (e.g. Gilbert, 1994). Other papers to look at include Appleton *et al.* (1986), Appleton & Henzi (1993), Araujo Santos *et al.*, 1995, Bundy & Golden (1987), Dewitt *et al.* (1991), Eley *et al.* (1989) and Freeland (1976). Parasite checklists are available for some species (e.g. Dekeyser, 1955, Myers & Kuntz, 1965). Jesse *et al.* (1970) provide an identification manual to the eggs of intestinal parasites.

Allen & Ridley (1970), Cheesbrough (1981), Eley *et al.* (1989), Ritchie (1948) give useful guidance to techniques required to analyse endoparasites in faeces. Cox (1993) and García & Bruckner (1993) provide broad guidelines for the identification of endoparasitic organisms to family level and above (see also papers in Anon., 1966). Below this you will probably need a detailed literature search and a rather better-equipped laboratory than you can assemble out in the field. It is unlikely that you will be able to work on protozoan parasites unless you preserve your material and bring it back. This will probably require special permits from the national authorities and from the airline you travel with.

2.2.3 Faeces ecology

One of the main reasons for doing this is to gain information on how monkeys plug into the ecology of the forest they occupy. Again, this can be used in conservation planning or environmental education. Such an apparently esoteric study topic can yield data on the likely long-term future of populations in small, isolated forests. It can also show the knock-on effects of disturbances, such as logging and hunting. Habitat use by species may be effected by parasite load (e.g. Freeland, 1976; Hausfater & Meade, 1982). Study topics can include:

- **What decomposes monkey faeces?**

Such a study would involve making a record of the sequence of things which remove dung from the pile (e.g. dung beetles) and/or of the sequence of fungi which emerge from it. Does this differ in different micro-climates? Does what the monkey was eating have any effect on the number, diversity and identity of the species which visit the faeces?

Techniques for dung beetle study can be found in Giller & Doube (1994), Davis (1993, 1994), Davis & Dewhurts (1993), Davis *et al. (*1988), Doube (1983), Hanski & Cambefort (1991), Hanski & Koskela (1977), and Nealis (1977). An example of the effects of logging on the dung beetles community are provided by Howden & Nealis (1975).

Barnes & Barnes (1992) provide equations which allow decomposition rates to be calculated. Basic studies on fungal succession are outlined by Carroll & Wicklow (1992), Cooke (1979), Isaac (1993) and Winterhoff (1992). Studies of faecal microflora are also possible (see Osawa & Mitsuoka, 1990 and references therein).

These kinds of studies are not going to work unless you have worked out, in advance, how you are going to identify your specimens. Can it be done in the field, or must you collect and identify it in a museum? (always budget time on the assumption that you will have to do the identifications yourself - then help comes as a bonus). Also, be aware that rain can destroy your study items (see White, 1995).

• **What germinates from monkey faeces?**
You can do this *in situ*, recording the number of seedlings that emerge from a dropping whose location has been tagged. Information on the maximum number of viable seeds is obtained by sequentially removing seedlings as they come up. Other studies, where droppings are left alone would reveal the extent and nature of faeces-borne seed competition. Removing the seedlings from the droppings and growing them up back at camp should minimize the chance of any loss to disturbance to the study and is more convenient (you can divide seeds into form-species and, growing them up separately, can keep better tabs on them, although this scenario is obviously a bit un-natural).

Studies to see for techniques, pitfalls and the kind of conclusions that can be drawn from this kind of data include Chapman (1989), Estrada & Coates-Estrada (1984), Estrada & Fleming (1986), Janzen (1969), Murray (1986) and Nunes (1995) provide overviews (see also papers in *Vegetatio* 107/108, 1993, which is a special issue devoted to seed dispersal and seed predation).

Identification of seedlings is difficult without a reference collection, though it can be done (see de Steven, 1994). Experience counts, and your best bet is probably an experienced (and long-suffering) botanist.

Germination studies can help to answer the question of whether the primate under study is a seed-predator or a seed-disperser (or a mixture of both) (e.g. see Ayres, 1989; Chapman, 1989; Gautier-Hion *et al.*, 1993; Kinzey & Norconk, 1993b; Peres, 1993). You may want to collect some samples and check the number of species of apparently unbroken seeds. Try and identify these and those which appear to be broken open (things in this latter category may, of course, have been rather too big too pass whole through the gut anyway). Food takes time to pass through the gut (see

Maisels, 1992; Chivers & Langer 1994 and Milton, 1981, 1984 on the ecology of passage times). So, if you can identify seeds, try and locate the nearest tree of the species concerned from where you found the faeces. This will give you an idea of the minimum distance the monkey might move the propagules.

• What else visits monkey faeces?
As part of a general study, you may wish to record the other forest inhabitants that make more transient use of faeces. This may include butterflies which visit dung piles and use them (usually when quite fresh) as a source of minerals. Rodents may scavenge seeds from them. The first are quite easy to observe and identify (most modern butterfly field guides have good colour plates which allow you to identify species from pictures). As trapping would be rather too inferential, the second requires quite a lot of sitting up with a red-filtered torch.

2.3 Associations with other species

Few primates forage alone. Most are accompanied, for at least some of the time, by other primates, other mammals (often squirrels) or birds. There's a big literature on associations between primate species (niche separation between species: Gartlan & Struhsaker, 1972; Jones, 1995; Mitani, 1991; Pook & Pook, 1982 - predator response and vigilance: De Ruiter, 1987; Harrison & Tardif, 1989; Heymann, 1990; Peres, 1993c - other aspects: Garber, 1988 - see also *American Journal of Primatology* 21 (2), 1990, which is a special issue on the topic). There are also papers on primates as part of the mixed-species flocks of birds (e.g. Terborgh, 1990). The literature on mixed-species bird flocks (which have many parallels with those of primates) is also worth studying (see Munn, 1985; Powell, 1985 to start with).

Many such studies have analysed the costs and benefits of multi-species associations, including increased vigilance and access to food (e.g. Buchanan-Smith, 1990). Anti-predation benefits of multi-species associations have been reviewed by Peres (1993c).

It is also worth looking at what allows similar species to coexist in allopartic populations and see if their feeding ecology in allopatry is the same as in sympatric populations (see Gonzalez-Kirchner, 1995, Harcourt & Nash, 1986 and Jones, 1995 as examples). Oddly, some species appear to resolutely refuse to associate with each other (e.g. Boinski, 1989).

Polyspecific associations make interesting topics of study, but obviously need several encounters with the same (or a similar) troop each under conditions which are equal except for the presence of the associated species. The obvious problem with such studies is being certain you have accounted for any other variables that may be operating, and you don't know the full

recent history of a troop (it may, for example, have been traumatized recently).

2.4 Carnivory in primates

Predation by primates is known to occur quite frequently in some species. Some even eat other primates. It may be possible to identify them by their hairs (see Inagaki & Tsukahara, 1993).

2.5 Pennies from heaven

Most primates are very messy feeders. They drop quite a lot of the material they are feeding on. Some of this is because it is unsuitable (unripe, rotten, the wrong thing), but they will often drop what appears to be a perfectly good fruit after just one bite and then move on to eat another, apparently identical one. Fallen fruit is an important food source, or welcome supplement, for many floor-dwelling species (e.g. Bodmer, 1990, 1991; Emmons, 1990). Many of which may act as secondary dispersers for the seeds the fruit contains (e.g. Forget & Milleron, 1991). In the limited time available to the average expedition, you are unlikely to be able to assess the overall importance of fruit in the ecology of the species which forage on it, but you can at least, document which species visit a patch of recently dropped fruit. Recording how much of the fruit was removed can also help your understanding of seed shadows of the tree species involved (see Janzen, 1970, for discussion of seed shadow ecology and papers in *Vegatatio*, 107/108, 1993).

An interesting project would be to measure how much fruit gets knocked down by monkeys when they come and feed in a particular tree and see what proportion is green, ripe, old etc. You would need to repeat this several times with several trees to get meaningful data, but it would be worth it to get a quantified estimate. It would also be interesting to test to see if fruits that had had only one or two bites were, in some way, less nice than those from which several bites had been taken (the criteria are probably chemical and you need to have thought about it in advance so you could have your test-kit ready or have the appropriate method of preservation to hand when you got back to camp).

If you have a chance to collect fallen fruit on which a monkey has been feeding, check it for insects (both adults and larvae). For some species of ardent frugivore the tropical equivalent of the maggot-in-the-apple may be the only regular ounce of animal protein they encounter.

Section Three
INAPPROPRIATE TOPICS

3.1 What you probably can't do

There are two categories - those which are morally dodgy and those which are too logistically challenging.

In the first comes anything which involves capturing animals. This includes:

- radio-tracking (despite its utility, see Campbell & Sussman, 1994)
- dactylographic (finger prints) analysis (e.g. Newell-Morris & Wienker, 1989; Suryobroto, 1992).
- blood protein sampling (for electrophoresis or blood parasites) (e.g. Meireles *et al.*, 1992; Walker *et al.*, 1988; even though such studies can be of great use in conservation and taxonomy e.g. Silva *et al.*, 1993; Williams-Blangero *et al.*, 1990).
- tissue or blood sampling for mDNA analysis (e.g. Inone, 1995), chromosome studies (e.g. Stanyon *et al.*, 1995) or veterinary analysis of ectoparasites (though some non-invasive sampling techniques exist e.g. Woodruff, 1993 and such studies can help with taxonomic and conservation work e.g. Sineo *et al.*, 1986).
- detailed energetics studies of food choice involving captured animals
- biochemical correlates of social status (e.g. Sapolsky & Ray, 1989; Van Schaik *et al.*, 1991).

Trapping with live-traps is possible with arboreal prosimians (see Harcourt, 1987), and tamarins (Savage *et al.*, 1993). But for any other group, such work inevitably involves the use of anaesethic darts to capture animals for closer examination (see Brett *et al.*, 1982; Glander *et al.*, 1991; Lemos De Sá & Glander, 1993), even if traps are used (see Brett *et al.*, 1982; Eley *et al.*, 1989). Not only does this require specialist training to get the targeting and dosage right, but it is arguable if any short-term project can justify or needs this kind of interventionist approach. Handling can traumatise even the largest and apparently robust species (see Laurensen & Caro, 1994). Also, a blow gun or air rifle may give the wrong impression to locals about project aims (getting the thing through customs could be fun too). Also species with prehensile tails (most of the larger primates in the Neotropics) do not always

fall once immobilised by an anaesthetic, but many remain hanging by the tail still well out of the researcher's reach (see Glander *et al.*, 1991).

Those in the second category include:

- **detailed studies of social interaction** (e.g. Andrews & Rosenblum, 1995; Bernstein *et al.*, 1993; Butovskaya, 1993; De Waal, 1990; De Waal & Luttrell, 1986; Feistner & Price, 1991; Idani, 1991). For such studies to be successful, you would need detailed background knowledge of the troop you are observing, this would require longer field time than you are likely to have.
- **studies of the ontogeny of behaviour** (e.g. Westergaard & Suomi, 1993); reasons as above.
- **analysis of time budgets** (e.g. Defler, 1995; Harrison, 1985; Kurup & Kumar, 1993; Singh & Vinathe, 1990), functional analysis of behavioural repertoires (e.g. Bradshaw, 1993; Colell, *et al.*, 1995) or optimal foraging (e.g. Grether *et al.*, 1992). You are simply unlikely to be there long enough to obtain data that would be appropriate to answering sophisticated questions in, for example, behavioural sociobiology. Also you are unlikely to get the background information which would allow you to fulfil the caveats involved in such precise analysis.
- **detailed data on mating** (such as the association between rank and reproductive success studied by Berard *et al.*, 1993; Gygax, 1995; Paul *et al.*, 1993 and Rose, 1994b or mating behaviour and age, e.g. Perry & Manson, 1995 or inbreeding avoidance, e.g. Glenn Smith, 1995. Again, you will just not have the time).
- **studies of mother-offspring interactions** (e.g. Rajpurohit & Mohnot, 1991; Tanaka, 1989). The proximity you need to make your observations, may be too intrusive and could disrupt the babies development.
- **studies on effects of seasonality** (e.g. McGraw & Webster, 1995; Wallis, 1995 for reproduction; group size, e.g. Zhang 1995; or feeding, Phillips, 1995). Unless a previous team has looked at a different part of the year, you are unlikely to be in the field for long enough (and there is also the problem of between year comparability (see Hill & Agetsuma 1995, as an example).
- **studies of positional behaviour** (e.g. Garber, 1991), and other fleeting and detailed behavioural aspects (Linnankoski *et al.*, 1993). Again time constraints, plus the difficulty of getting close enough to make such detailed observations, are the reasons for the inclusion of this topic of study on this list.

- **any work on great apes**. There is more work on this group of primates than on any other. Any group not already being studied is likely to take a great deal of time to be habituated (years in many cases), while work on already habituated groups is the sort of already-established thing that an expedition should not really be doing. (Though it may be possible with orangutans).
- **re-introduction programmes**. Avoid this unless you are part of a bigger, already operational programme (e.g. Chiarello & Passamani, 1993; Nogueira *et al.*, 1994; Schneider, 1992) - unplanned or done in the short-term, such actions are just allowing the animal[s] to die out of sight - (the references above give an idea of the care and caution needed in such operations).
- **manipulations**. There is little justification for expeditions to make manipulative reintroductions for the purpose of studying social interactions (examples of such studies are Bernstein *et al.*, 1992; Fragaszy *et al.*, 1994; Hector & Raleigh, 1992; Van Schaik & Mitrasetia, 1990). The groups must be well studied in advance of such operations and, to justify the social disturbance to the group, and any valid follow-up study would have to be long-term.
- **altitudinal migrations**. It is now being recognised that, where the terrain is appropriate, quite a lot of primate species undergo seasonal altitudinal migrations. The topic has obvious conservation relevance but is probably difficult to study directly, unless you get the season and localities exactly right - but some work could be possible *via* interviews with local people.

3.2 What you should never do

It is vital, both for the immediate integrity of your expedition, and for the long-term reputation of biological field work (undertaken by nationals as well as foreigners) in your study area, that you treat both the study animals and the local people with the utmost respect. Apart from life-threatening situations there can be no justification for killing a primate. Identification does not warrant it. Even if the animal were to be a new species or sub-species, you should find that a photograph would provide sufficient evidence (a new tarsier was recently described from its call alone). You are unlikely to be on-site for anything like the length of time that it would take for the troop to settle down again after such an event. So any subsequent studies would be invalidated once an animal was killed.

What you do may well influence the way local people react to other visitors or treat the local resources. Consequently, you should not pay hunters to hunt or catch monkeys for you, pay for live specimens or capture

animals for study or observation in captivity. Never let your curiosity endanger an animal's life (this also includes such things as getting too close to mother monkey which has an infant).

Make sure you do not use native assistants as slaves and do not forget to contact scientists from the country to avoid future "fightings".

Section Four
FIELD METHODS

A huge number of techniques of field observation have been developed in primatology. It is beyond the scope of this publication to provide more than an introduction to them. For more details see Altmann (1974), Brockelman & Ali (1987), Buckland *et al.* (1993), De blase & Martin (1981), National Research Council (US) (1981) and Wilson & Wilson (1974). Dawson (1981a) gives good hints on how to do survey work in remote and rugged terrain.

There are essentially two ways in which to organize your work, quantitative and qualitative. The first includes simple surveys where species are recorded and enumeration is no more than counting the numbers of encounters with groups or individuals while walking through the forest or listening to territorial calls. The second type of survey involves the kind of detailed observations which could have statistics applied to them and are normally confined to detailed behavioural observations of a single species, or to surveys of primate density where absolute indices (rather than relative ones) are required. Details are given below.

4.1 Transects and trails

The first thing is to find out where in your study plot do the monkeys reside. Such surveys may be done in two main ways - from a fixed point or by moving through the area. Fixed point surveys, using such things as hides, watchtowers and aerial walkways, are quite rare because such infrastructure is uncommon in the tropics. However, use such facilities should they be available. By getting up into the canopy you are freed from many of the visual impediments which hinder the ground-based observer and you can get detailed information on a troop for as long as they remain in eyeshot (which may be for several days). Despite such attractions, do not attempt to construct such a structure yourself as it requires expert engineering skills and will eat into valuable field work time.

It is far more common to survey by transect. This can be the natural transect provided by, for example, a watercourse or a trail which you cut yourself, or trails cut previously by local people. **Note**: if you place your transect along a watercourse, you may bias your results! Factors influencing choice of transect orientation are given in the vegetation section below. Much attention has been given to the effective sample area of a transect.

The strip-transect method (Mackinnon, 1974) assumes that the observer can detect all primates occurring at a fixed distance (e.g. 50m) on either side of the path being walked. This is probably unrealistic (it depends on visibility in a given habitat. In forest it can be 20m on either side, but in open areas (e.g. savannas) it can be much more, even hundreds of metres on each side), so most methodological reviews favour the use of the line-transect which makes no such assumptions about detectability. You may rank the data you get, setting arbitrary figures for the categories rare, scarce, common, frequent and abundant, or try fully quantitative analysis of densities. Density estimation from line-transect data has a huge (often confusing and frequently mutually-contradictory) literature. Robinette *et al.* (1974), Burnham *et al.* (1980) and Buckland *et al.* (1993) provide key overviews. Reviewing literature, and proposing practical field-friendly methods for density estimation, Burnham *et al*. also contains methods for mathematical theory and analysis and has yet to be bettered as a review for expedition use.

Burnham *et al*. (1980) and Buckland *et al.* (1993) propose a model for density assessment from line transects which makes four assumptions, *viz*. that animals directly over the transect line are not missed, animals or social groups are seen before they move away or free, distance and angles are measured properly and that sightings are independent events. These assumptions have been criticised by Brockelman & Ali (1987) who also go through the maths of density estimation and discuss the merits of such techniques as Haynes' flushing radius, truncated distance methods and exponential models. (Don't be put off by all this - simple records of the species, number of groups of each and the size of each are very valuable from most places. Just so long as you could avoid counting the same group more than one time and give an idea of sampling effort e.g. distance surveyed).

Sinnary & Hebrard (1991) provide a method for detecting visibility bias for different species from a transect (see also Ekman, 1981).

One especially accurate method of censusing an areas' primates is the sweep-survey. Here several people cooperate and, spaced at regular intervals (50-100m or the visual horizon, whichever is smaller), walk across a forest area in concert. Good coordination is vital and may be facilitated by using parallel trails, or following tagged cords running the length of the survey quadrat, or using (muted) mobile phones. To avoid counting the same group twice, it is important that the location and time of any encounters be accurately noted and results compared and compiled. (**Note**: this may not be feasible for primates of large-group size).

If you are working from a boat the effective sampling area is likely to be much diminished as riverside vegetation tends to be rather thicker than that away from the river bank. For those contemplating such surveys, Milliken (1988) provides an excellent guide to the practicalities of boatwork in the tropics.

If you are cutting transects remember to keep them as straight as possible and to blaze or otherwise clearly mark any changes in direction. Plastic tape (of the red, orange or yellow kinds used by builders to mark off holes in the road) is most commonly used to mark trees. Place a marker tag every 100m and number it unequivocally (in numerals large enough to be read by torchlight by an exhausted person). To further assist orientation, place a second (differently coloured) marker 10m on from this. This way, if you get lost and then hit the path again, you will quickly know which way to head. Be careful when cutting off saplings, do not leave anything straight and sharp that could pierce an upward-gazing field worker, walking but concentrating on their monkeys. (see also comments in Section 1.7).

People can get ill on expeditions and someone else may be called on to take over from you. Make a map of your transects and mark out any special features, dangers or points of interest. Always mark the entrance and exit points on any water crossings you may make. Jermy & Chapman (1994) gives further information on the practicalities of trail-cutting in the tropics.

Trail-cutting can be an arduous business. In some dense areas you are not going to cut more than a couple of hundred metres in a day. So leave several days for this purpose. Be warned, trail cutting can be very tough work. Be careful not to exhaust yourself in the process (you've got field work to do!).

How long should your transects be? The functional limitation is, obviously, your ability to cover the ground in a day in a way that will ensure a viable survey (remembering, when you decide your length, that you have to walk back). Brockelman & Ali (1987) recommend a daily minimum of 4km of walking per observer per day and, in review, show that one long transect is more likely to be representative than two small ones of the same combined length. Also, you should be able to cover the whole transect.

A transect may have been designed to pass through several vegetation types (see below). Such a transect may be very long and, obviously, it is not necessary to try and cover the whole thing in one day. You may wish to take it in sections the length of one days' walking, progressively working your way down the major transect and camping for several days at various sub-

stations along the way. You may wish to take subsidiary paths off from this point.

An alternative, if the vegetation permits, is to set up a central camp from which several transects radiate into various habitat types. Each may be then walked in rotation, in sequence or simultaneously (if you have enough people). The main problem with the latter is that of inter-observer variability. In all cases it is possible to conduct sweep-surveys, strip-transect or line-transect methods from such locations.

For alternative transect design and discussion of their merits, see Whitesides *et al.* (1988).

A general minimum for a survey of one site is one which has covered a total of 50km (i.e. 5km for 10 days), with 150km being preferred. According to Brockelman & Ali (1987 pp.40-41) "*a severe limiting factor in primate surveys is time to obtain sufficient sightings for analysis; at least 40 sightings per species are recommended for* [quantitative] *analysis"*. (See also Burnham, 1980). Encounter rates of around 2 groups per km walked are unusually good, rates of 1 group per 2km are more typical.

For those species which make loud calls in the early morning, the calls can be used as a relative indicator of abundance in different areas. However, some authors have used them to estimate absolute density. The calls carry for 2km or more and in gibbons can be recognised individually in the field (not howlers) and can be surveyed by a listener located on a prominent terrain feature. Equipped with a compass, watch, ability to estimate distance, a map and a knowledge of the calls of the local gibbons, the listener plots the locations of the calling animals and then calculates their density (see Brockelman & Srikosamatara, 1993 for field study example and Brockelman & Ali, 1987 pp.43-44 for diagram and formulas). See also Falls (1981) and Johnson *et al.* (1981). This can be improved if you triangulate (2 observers or one) see Brockleman & Ali (1981).

Positioning the transects or observation posts depends not only on vegetation type. As Brockleman & Ali (1987 p.25) point out "*the lazy surveyor who observes and listens only from roads or well worn trails will miss many good records; well visited areas are usually the first to be hunted out*". This may be true for forest areas, but is not true for areas of natural grassland (see Southwell & Fletcher, 1990 for methods in this habitat type).

Aquino & Encarnación (1986a, 1988, 1990), provide methods for censusing primates at night (see also Duckworth, 1992). Aquino &

Encarnation (1986b) show it is possible to use sleeping holes for those species which use them. Animals may also have special places where they like to groom (e.g. Reichard & Sommer, 1994) or sleep (see Tutin *et al.*, 1995; Zhang, 1995b). But there can be problems with the latter (see Tutin *et al.*, 1995). Sheaffer & Jaruis (1995) discuss sources of error in sighting-based estimates of population size. Franzreb (1981) and Hilden (1981) have discussed sources of error in line-transect data sampling methods. Bull (1981) gives methods for indirect estimates of abundance. Though written about birds, the techniques are adaptable to primates. Dawson (1981b) provides a useful index of relative density and overviews influences which may bias density estimations. Thompson (1989) compares census techniques. Osztreiher (1995) and Vochteloo *et al.* (1995) each provide examples of the effects of the observer on behaviours seen.

Though local people can be essential repositories of knowledge (see Sections 1.4 and 4.3), when choosing study sites and locating transects Brockelman & Ali (1987 p.25) say "*[though] it is often advantageous (and safest) to hire local rural farmers and other residents to help in getting around an unfamiliar area ... one should never allow local people to 'select' the locations to be checked. We have found that local people usually do not like to penetrate unfamiliar or difficult forest areas and frequently do not know what is in them"*.

Unless your field studies demand it, you should always attempt to include as many of the local vegetation types as possible in your transects (see also section 4.4). This maximizes the chance of you sweeping up all the species in an area during a general survey and enhances chances of finding age and sex-specific uses of habitat types and seasonal use of habitat types by a particular species.

Do not avoid secondary habitats in an area of otherwise primary habitat. Some primate species (especially smaller ones) may specialise in these (e.g. see Araujo Santos *et al.*, 1995; Calegaro-Marques & Bicca-Marques, 1994). Though to avoid biasing your results, transects should not run exclusively through such habitats either. Nor through forest edges, along ridges (which often have their own specialised vegetation), or along water courses. Ideally percentage length of a transect that passes through a habitat reflects its proportion of the vegetation in the area (see 4.4 also).

4.1.2 Procedure and type of data collected during line transect sampling

The standard procedure is to walk at 1 to 2km per hour, to record at each contact: the point on the trail; measure (preferably) or estimated observer-animal distance, angle to trail, animal trail distance, animal/group height; group composition (sex and age class) and activity at first contact. For groups measure distance from observer to the 'geometric centre' of the group, also the distance to the first animal seen and to the animal closest to the trail. A sample data check list if given at the end of section 8.

4.2 Observation

4.2.1. Preliminaries

The first sign of primate presence is generally a crashing sound in the trees as animals move from one branch to the other. This doesn't mean that they've seen you and are moving away, they generally move like that anyway. Closer, and you may hear the vocal ebb and flow of contact calls. Sharp, repetitious, staccato calls are generally alarm calls and mean you've been spotted. Unless you are working with a habituated group or one in an area that has little hunting, you may need to spend some time (perhaps at least a week) until the group begins to get used to you. During this initial period you may wish to record the alarm calls - as they are often the commonest call greeting people in the forest, they may be useful when interviewing people in later surveys. Other helpful sounds may be the patter of fruit being dropped to the ground and the rustle of branches. In dense vegetation you may not see your target animals, but the branches will be swaying in a way that has nothing to do with the wind. If you can't see the monkeys right away, sit tight. They will appear eventually.

Try and avoid looking directly at primates. It is likely to be regarded as a threat if you make eye contact. This could lead to the disruption of the normal activities you have come to study.

Always look around in other trees to see if they too have animals. You will need to focus on specific individuals for data collection (see below), but you must first get an impression of the size and composition of the group. Do not forget to record if there are other species (of primate or other kinds of animal) associated with the troop.

If you are spotted then sometimes pretending to be more interested in something else, e.g. groom a friend, can cause the primates to come to you or to calm down, because they are very curious.

Stop working if it starts to rain heavily. Though there are exceptions, (e.g. langurs, capuchins and howlers) monkeys generally don't like it any more than we do and will generally stop all other activities, trying to keep dry. Besides, the rain might damage your equipment or notes.

Unless you are working with a permanent guide, have exceptional knowledge of the local terrain, or are working in an area which has a well-marked system of trails, resist the temptation to follow the troop into the forest. Otherwise you may get lost and thus disrupt the structure of the expedition's fieldwork. Bush-whacking is time-consuming and noisy. You should have a trail system. If you don't, and find you must still follow your monkeys, then you may wish to deploy the method first developed for tracking minotaurs (if you do, it is best to put the string ball on a smooth stick so that it unwinds freely).

There are methods for quantifying the behaviours you observe (see below), but don't rush in to this. Spend some time getting used to the monkeys, how they move, what they do, the pace they do it at. Later this may help you anticipate events and help you record fast-moving sequences or unusual circumstances.

Most monkeys get up very early, have a mid-day siesta and then start again in the early afternoon before packing-up at dusk. Where you see them at dusk is probably where they will be next morning, so if you get up before dawn and trek in you should catch them waking up.

As with bird watching it is best to avoid bright coloured cloths and things that rub against each other and squeak or rustle. These will alarm the animals and bias your data set. For similar reasons, try to avoid shouting or making expansive or rapid movements. Smoking while working may also put the monkeys off. Also, avoid wearing camouflaged or army-looking clothes in areas where there may be social conflicts or illegal activities (e.g. drug cultivation).

When trying to get primates used to you, wearing the same thing every day may help.

4.2.2 Recording data

The best guide to sampling techniques is still Altmann (1974). This reference may look out of date, but it is still the most comprehensive and lucid overview of sampling techniques and continues to be widely cited in the literature.

People differ in their approaches to finding animals from which to record data. Some prefer to walk a specified distance, halt for a specified time and then move on to the next stopping spot. Others move at a regular pace, pause frequently to stop and listen but halt only when they have an encounter. In both cases the recommended pace is between 1 and 2km an hour.

If a census is your aim then watching the group long enough to characterize it (species, size, composition and activities) is sufficient. You may then move on (or if in a multi-person group, split up, with some staying and studying and some continuing the census, then rejoining and later swapping over).

If ecological or social studies are your goal, you may wish to stay with a single group. You then have to choose how to gather data from all that is going on. The most widely accepted ways are the focal animal and scan techniques (see Altmann, 1974; Hejl *et al.,* 1990; Recher & Grebski, 1990).

The first method involves recording an individuals current activity at a preselected moment in time (say every 5 minutes). This method records states, not events (see Boinski, 1987). The other method involves recording the behaviour of all visible members of a group within a specified time (say every 10 minutes). This scan effectively represents an instantaneous sample of group activities (see Robinson, 1986). These methods have been compared by Fragaszy *et al.* (1992 p.259), who point out that 'best' field techniques get data which "*have maximum statistical power, reliability, validity and generalizability*". Fragaszy *et al.,* noted that group scans are best when much information is needed in a brief time (such as initial descriptions of activity budgets and patterns). Focal interval sampling requires the consistent recognition of particular individuals and is good for defining the mean of a behaviour (while group sampling can well define its range). Fragaszy *et al.*, concluded that a mixed sampling regime would minimize the costs of data collection while maximizing the amount and reliability of data collected (see also discussions by Gates 1981 and Scott & Ramsey 1981).

Obviously, if you are only interested in one aspect (diet, say), then you may wish to scan the group and focus on those engaged in the activity you

are interested in. An alternative is to focus on just one animal in the group for several days and then switch to another one. With experience you will be able to tell what an animal is eating, even if it has its back to you, by the way it moves and the speed of its actions.

Paterson (1992) provides a comprehensive series of exercises in observing captive monkeys that allow you to practice before going out into the field.

4.2.3 Guarding against between-observer variation

Between-observer variations (the result of differences in experience, ability, motivation and luck), can be important skewing factors in a data set (see Dawson, 1981b; Dunbar, 1976; Faanes & Bystrak 1981; Kepler & Scott 1981; Lehner, 1979; Martin & Bateson, 1986; Sharman & Dunbar, 1982).

Using Paterson (1992) before you go may help to identify strengths and weaknesses in team members' abilities. It may also be useful to do some pre-fieldwork practice to help standardize yourselves. Obviously you've all got to agree on the species identifications. Pre-field work (see section 6) should have taken care of that, but you may also have the opportunity to iron out any problems during the setting-up period. Distance estimations can present a problem for the inexperienced. Taking a monkey-sized object a measured distance and inviting the rest of the crew to estimate this, can be a useful training exercise.

4.2.4 Identifying individuals

You may wish just to divide the animals into males and females. Sexing primates is usually fairly easy as many species are sexually dimorphic (male almost always larger), and (some) others are sexually dichromatic (e.g. some sakis and gibbons). Genitalia is often obvious and may also have a display function and hence be brightly coloured (e.g. many African forest cercopithecines). Females in oestrus may have nether swellings. All these factors are ones you should be acquainted with from your preliminary reading, zoo and museum work. For work at middens and markets (see 4.3.2, 4.3.3, 4.3.4) skulls can be sexed by size and/or the generally larger canine teeth of males.

There is quite often sufficient natural individual variation in personality (McGuire *et al.*, 1994), body pelage, facial skin patterning (e.g. Lemos De Sa *et al.*, 1990), facial marks (Bhattacharya & Chakraborty, 1990), colour patterns of head (e.g. Oppenheimer, 1969), missing fingers, combined with age-specific characters like pelage condition, nipple status, tail length and

shape, body proportions and others can all help to identify individuals (see Kahumbu & Eley, 1991; Ron & Whitehead, 1993 and National Research Council (US), 1981 p.84). National Research Council (US) (1981, p.110 *et seq*.) show how information in variation in facial characteristics can be codified on cards. In terrestrial species passage of specific individuals may be recognised by palmar dermatoglyphics (see Phillips-Conroy *et al.,* 1986). Do not start a complex recording scheme at once. First make sure you can reliably recontact your intended study group(s) but don't bother if you are only there for a short time.

There are many means of marking primates (ear tags, collars, freeze-branding fur etc., see National Research Council (US), 1981) to augment natural variation. These are unlikely to be of relevance to you as they involve first trapping and subduing the animals.

Be aware of the fact that different species respond differently to the presence of observers. While some are phlegmatic, others are much more likely to be spooked and run away (e.g. Clarke & Mason, 1988).

4.3 Other methods

4.3.1 Middens

Unpleasant though it may sound, the village rubbish dump may yield some useful data. If the refuse from killed wild animals is not thrown into the nearest river (as it often is in Amazonia) or scavenged by dogs (as it is almost everywhere), then it may end up on the local rubbish heap. Checking out such a place can give you an idea of the numbers of individuals hunted, the species involved and their relative proportions in the catch. (It can also give you great sympathy for your local refuse disposal operative). Finally, it may also be used by the region's more opportunistic primates (e.g. baboons in Africa).

It is best to concentrate on skulls as they will be the easiest to identify. The sample you get is not going to be totally representative, because the skulls of small species (or individuals) are likely to get crushed into unrecognisability pretty quickly. You can't take away all the skulls to identify later, so you must be familiar with the oddities of the skulls of each species which allow you to identify them (dentition is especially useful in this regard). For this you have to do your preparatory work in the museum. A set of photographs (with the important features highlighted as an *aide de memoire*), can also be helpful. See Mittermeier (1977) as an example of a study which used this technique to look at primate hunting in rural

communities. Skulls of males can be generally be distinguished by the proportionately longer canines (see Oxnard *et al.*, 1985 and references therein).

4.3.2 Souvenir shops

You see the sickest things worked up into tourist trinkets (see Anon., 1990 for an example, Mittermeier, 1987 for a review). You may see whole skins made into rugs (e.g. colobus in Africa), whole stuffed specimens, or parts (gorilla hands), or bits of fur or skulls being used as part of some curio. The presence of a primate part worked into some tasteful dust-gatherer does not mean the animal was killed locally, but does indicate that it is involved in this trade and some populations, at least, may possibly be threatened by it. Suppress any desire you may have to do physical violence to the shop owners, and question them as politely as you can. If you say you are a scientist (not ecologist), this may help you. Try to sound rational, analytical and, above all, totally uninterested in the animal welfare and conservation aspects of it. Data on how many items they shift could be of value. Check out any other similar shops in the place to get an overall picture. Check the status of the species involved and pass the data on to the appropriate national authorities and CITES secretariat in Cambridge, UK (address in Appendix).

4.3.3 Markets

Depending on what kind of market it is you can find live animals for sale as pets, whole dead animals for sale as food, bits for sale as food or as medicine (see Mittermeier, 1987). Monkey fur is also used to decorate clothes in some places. Don't be afraid to ask people (politely) what the animal is (after all it is a market). Make sure you have a good set of local names for the species in the area. (**Note**: If the species is sexually dimorphic or dichromatic there may be different names for males and females. In some species e.g. colobus, the babies are a different colour from the adults).

Nevertheless, you may have to identify material yourself. This means getting good at identifying species (or genera) from skinned (and possibly smoked) bodies, limbs or heads (see photograph in Sheeran & Poirier, 1990 as a good example of what to expect). To effectively identify material you will need an idea of overall proportions, plus a knowledge of distinctive anatomical oddities that will separate one group from another (colobine monkeys, for example, do not have thumbs). Studying and photographing museum specimens preserved in alcohol or formalin may help you gain the visual images you need. Identifying fur can be a *gestaldt* thing. It's not only colour and length, but also its softness and springyness and how the hair lies.

Practice on museum specimens. Rode (1937) is a good guide to the shape of skulls, head and feet of African monkeys.

When it comes to purchasing of material “to buy or not to buy, that is the question”. If you buy, you may promote the trade. But, trade is not always unwanted. In some cases it may be O.K. However, overall (and to avoid encouraging others less scrupulous than you) it is probably better just to see the material on the stalls, leave it and take good notes and photos (with perhaps a small payment and certainly with stall holders permission whenever possible).

4.3.4 Interviewing local people

It is always a good idea to consult local people when working with such a high profile group as primates. In many groups (especially plants and insects) local nomenclature is not going to agree with that of western taxonomy (see Posey, 1983, 1992; Posey & Balee, 1989; Stearman, 1992). However, this is not the case with primates and the local people will likely recognise primate species in a similar way to you (though see note above). This simplifies things immensely.

A good guide to the methodology of questioning local people and, equally important, the etiquette of the procedure is given by Bellamy (1992). Remember when you are asking people things that they have other things to do and are doing you a favour by responding to your dumb questions (imagine how you would feel if someone came and button-holed you with a huge list of questions about starlings and pigeons).

Decide what you want to know before you start. Draw up a list of questions. If the interviews are going to be conducted in a foreign language, have them translated in advance and run through the list of questions to iron out any sources of likely linguistic confusion. Be sure you are not asking questions which have at their heart inherent cultural preconceptions which may not be shared by the person being asked to respond to them (this is especially true of questions involving time, distance and numbers).

Openness is the best policy. Tell people exactly what you are doing and why you are asking these questions (this may also help you clarify your ideas). Reassure them you are not from the government, the tax office or The Police! People living in small communities have a nose for mendacity. If you try to hide stuff, the rural rumour machine will go into overdrive and in no time at all you’ll find yourself pinned as part of a CIA-funded international drug cartel smuggling out gold to fund the purchase of infants for use in

satanic rituals. Worse still, no one will then want to talk to you or help you in your quest.

Who you approach depends entirely on the size and nature of the place in which you find yourself; varying from river traders in the largest rural towns to almost anyone in the small rural villages and hamlets. Hunters, fishermen and farmworkers are likely to be among your most useful informants. But you may have to reassure the former that you are not going to try and stop them hunting, otherwise they are unlikely to help you.

If you are trying to find out what monkeys are around, you should use both photographs and sounds. Photographs are better than pictures in a book because they can be passed around a group one at a time (pass a book round and people will start going ‘oh, yeah, this one and this one and this one’ and you will be lost). Also photographs are more realistic. People in very remote places may be unfamiliar with unreality of book pictures and not recognise something for what it is. You may also have to mention that the animals are actually bigger than they appear in the picture as some people don’t have the concept of scale (after looking at a series of primate polaroids, one old man in the Amazon told me how glad he was that he didn’t live in my country which was so obviously unhealthy - I was so pale and all our monkeys were dwarfs). Don’t patronize people, a simple hand signal for size often suffices.

In general, it may not be good to show photographs or pictures straight off. Often people do not like to accept that they do not know a species; they will recognise anything you show them. The best thing maybe, is to get them to describe the animal. Once you have good descriptions, then you can show photos just to confirm. Of course, it is essential to have a good command of the local language.

Heat, moisture and frequent usage can wreck your prints very quickly. Have them enclosed in plastic. And carry a second set for spares. (By the way, I don’t think you can laminate prints, but this may have changed of late).

Calls are a useful adjunct. Some species may be secretive and may not be seen very often (and some, like the douracouli in the Amazon, galagos in Africa and tarsiers in SE Asia are, of course, nocturnal). In these cases calls can be of great help. You may even impress the local hunters with your knowledge - which can go down well.

Always check for the accuracy of local information. It is not that people are trying to deliberately mislead you, more that, in their anxiousness to be

helpful they may say ‘Yes’ to anything you ask. So, first avoid leading questions. Don’t ask ‘do you have this monkey’ but rather ‘which of the following occur here’. Secondly, slip in a few pictures of things that certainly don’t occur there. These false photos can be fundamentally unsubtle; the odd baboon in a set of South American monkeys, an orang among West African ones, but you can also pick up more precise information. For example, using a sub-species you know to be wrong for the region will give you an idea of the acuity of knowledge of those you are questioning (or it may provide a biogeographical surprise, see Ferrari & De Souza - Junior, 1994 and Ayres, 1985).

Ask about legends. These can help make sense of local names for animals (see Barnett, 1991d as an example), and for beliefs about them and for taboos that may exist (such as a species not being hunted at all, or being only hunted at a particular time or eaten only by a certain sector of society, see Mittermeier, 1977 and Flannery *et al.*, 1995 as examples). Such stories also make interesting pieces to use in talks and allow you to draw the audience in to the realm of the people you were working with (but don’t be condescending). Be careful when you ask such questions of local people that you do not offend any religious sentiments. It may be best to ask such questions informally, after the questionnaire is over. However, depending on the objective, informal interviews may be more appropriate and less intrusive, (although these are difficult to quantify).

Get a native speaker. If you are unfamiliar with the local language you may need to get an interpreter. With luck this will be one of your counterparts, someone who probably has a western-style education and is familiar with your way of thinking as well as that of the local people. If this is not the case you may have fun thinking your way behind the comments and information, to what it all really means (such an experience is a great lesson in cultural assumptions). The importance of working with local counterparts cannot be over-emphasised.

Don’t go on too long. People will have other things to do, so try not to monopolize their time. Also, such formal interviews may not be their way (the only other time they may have encountered it is with government officials; if this is the case, mimicking the experience is unlikely to enhance your data or your local reputation). Guidelines on this are given by Bellamy (1992), but a couple of hours is probably the maximum permissible time (and you will probably have to spend quite a bit of this just chatting). (**Note**: pictures of family, area near home and partner help to break the ice).

Always be polite and respectful. You are only passing through and your curiosity gives you no right to disrupt other people's lives. If interviewees seem stupid, it is most likely you, your preconceptions or your way of phrasing questions which are at fault.

As a rough guide to question types and structure, a copy of a questionnaire I used in the Amazon for a study of uacaris (***Cacajao***) appears in the appendices. This is only intended as an indication. Questionnaires need to be designed to achieve the specific objectives of the project.

4.3.5 Collecting plant materials

If you are collecting material for identification, ensure that it will be possible to identify the species from the material you are collecting. Make sure you know what bits of the plant are most valuable in this regard before you start out (for example, with many bamboos it is essential to collect rhizomes and leaf-bases: see Crompton, 1992 for bamboos [and also references in Mathur & Sharma 1986]; Dransfield, 1986 for palms). If you wish to sample rainforest trees, you may have to expend considerable effort and ingenuity to secure useful specimens (see recommendations and ideas in Forman & Bridson, 1989; Hyland, 1972; Mitchell, 1982, and references in Hicks & Hicks, 1978). Flowers are generally most useful - collect fallen ones if you can be sure that you know which tree they are coming from (you may need to use binoculars). Do not neglect the older literature, there is a wealth of information to be found in things like the *Empire Forestry Review*.

If you are collecting plant material for chemical analysis (perhaps for a dietary study), ensure that you collect the same parts as the animals are eating, and also that these are of the same age (phenophases) as those chosen by the animals. A monkey's choosyness in such matters is often acute, and a collecting mistake on your part could lead to very erroneous data.

Ensure you label the plants before you put them in the press (if you label the papers you are using to dry them then things can get detrimentally confused when you change sheets over).

Remember that to be effective a specimen must be undecomposed and that the parts containing the features salient for identification must be easily visible. Consequently, large, bulky or succulent specimens are best pressed in parts and not as a whole plant.

4.4 Vegetation surveys

4.4.1 Role of vegetation surveys

You will at least need to know what habitat(s) the study species occurs in and what food items are being eaten. Only some of the plants will be relevant to you so you are unlikely to have to go into the kind of exacting botanical detail demanded by plant community studies (see Greig-Smith, 1952). Pre-fieldwork literature surveys should have sensitized you to the species of families of interest.

Do not rush straight out and start observing monkeys. You need study transects and will need to either choose from existing paths or cut your own trails (see Section 4.1). You will need to have an approximate idea of the distribution of the local vegetation types before siting your study transects. Ideally, if you are doing a general primate survey, you will want the transects to run through as many habitat types as possible (and through substantial and representative bits as well - it doesn't really count if the transect only brushes a habitat type). The knowledge for this will come from a combination of reconnaissances, asking the local people, using local promontories and (if you are fortunate) an aerial reconnaissance or aerial photography.

The access routes you are using to survey the area's primates can also serve as transects for the classification of its vegetation; this usually involves descriptions of key species, descriptions of the vegetation, divisions into type classes and an estimate of their various percentage cover. Sampling the vegetation along the transect is obviously sensible. A widely-used method is to establish a sample plot every 100m along the transect length, sampling for 5m either side of the transect (see National Research Council (US), 1981). Though this may need to be varied with habitat type.

4.4.2 Classifying vegetation types and format

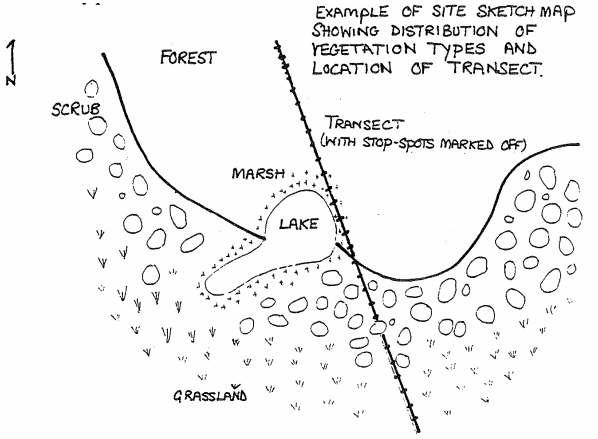
For a general discussion of this topic see Anderson (1981).

Depending on the study, you may wish to classify the vegetation very simply (e.g. Eisenberg & Lockhart, 1972 - simply divided it into grassland, scrub [woody vegetation below 2m], and trees). By recording proportions of such classes, ecotones can also be recognised. This system works well in areas with several visually distinct vegetation types, but to characterize an apparently homogeneous grassland or forest it is necessary to use a more complex system based on the presence of particular species. For methods of quantifiably analysing shrub vegetation see Dittus (1977).

The habitat surveys generally demand plant indictor species, which may or may not be the same as those that the primates use. Make sure you know of these in advance and know what they look like. Check maps that give vegetational zones and the indicator species within them (e.g. White, 1983 for Africa). For your eventual paper you should also attempt to establish which plant species were numerically dominant in the study area (and the ecological significance of this). In very diverse forests, there may not be an indicator species, at least not an obvious one. A description on terms of phygsionomy and degree of deciduosness (deciduos to evergreen) forest light, forest layers may be more useful and easy.

If you are constructing a habitat profile (including density of undergrowth, epiphytes, canopy cover), using a standard data sheet will help standardize observations. Avoid trying to estimate percentages by eye as this is rarely accurate, has low inter-observer reproductability and gives a false sense of the quantified. A rank scale of absent, rare, moderate and dense is generally sufficient. You may also wish to record the number of vegetation layers and the prevalence of lianas and creepers (the latter especially important for some of the smaller primates like marmosets).

With an eye to eventual publication, you should produce a sketch map of your study site, the position of transects and the vegetation types through which they passed.

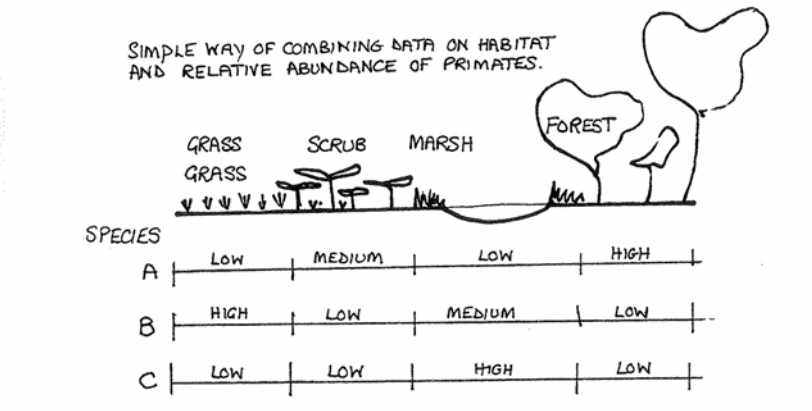


Example of site sketch-map showing distribution of vegetation types and location of transect

At ground level vegetation density may be estimated by recording the proportion of a striped 5m or 10m stick which is visible at standard distances (say 5, 10, 50 and 100m) from an observer standing on the transect path. Alternatively, visibility may be ranked to poor, fair, good and excellent.

Visibility within canopy is rarely quantified. But it is possible to do this using a striped board on the end of a long pole. Variations in foliage density within any one tree canopy require that the mean of several readings be used.

The possibility of combining data of habitat type and primate abundance are illustrated below.



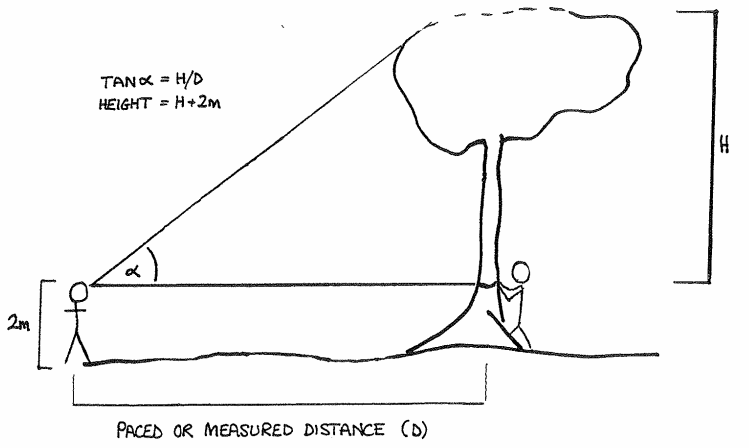
Simple way of combining data on habitat and relative abundance of primates

If your primates are frugivorous you will need an assessment of fruit abundance. A possible (but bias) useful series of methods are provided by Chapman *et al.* (1992), these include direct counting and a number of means of estimating (see also Milton *et al.*, 1982; Peters *et al.*, 1988). When estimating things like crown shape and fruit number, inter-observer variability is often high so, for consistency, it is probably best to let the same person or cooperating pair do all the assessment work.

Should you need to quantify the structure of the forest (density and size and height of a forest block rather than just of selected trees), then see Monedero & González (1994) for a study using techniques appropriate to an expedition. See also Pandeya *et al.* (1968) and Phillips (1959) for simple,

basic techniques. The latter gives formulae for the calculations of relative density and relative dominance of different tree species, factors which may be important in characterizing habitat preferences of primates (see also National Research Council (US) (1981). Kortlandt (1986) illustrates techniques for recording canopy profile.

National Research Council (US) (1981 p.18) gives the equations required should you need to estimate the crown volume. The sketch below shows you how to estimate the height of a tree.



The presence of rock outcrops and bodies of permanent water should all be recorded, as should the presence of such features as salt licks. All of these can have characteristic vegetation associated with them. Soil types can effect vegetation productivity and chemical constitution. In turn this can effect primate biomass, species diversity and the diet of individual primate species. Accordingly, if the data is not available on existing soil maps, suitable collections should be made (see Brook, 1975; Butler, 1980; Dent & Young, 1981; Landon, 1984 for methods).

Trees which are important to the animals you are studying (for food, shelter, territorial locator), should be tagged with plastic tape (preferred over metal tags which require nails be driven into the tree). If you hope to do a

follow-up study the next year, you should draw a map at the end of your time which includes all the features of importance (including such trees). For long-term studies, aluminium nails and tags may be appropriate.

4.4.3 Phenology

It is also important to classify the state of development of the leaves and flowers (phenophases) and get information on the annual cycle of flowering and fruiting (phenology). This is because the chemical constituents of leaves, stems and fruits change with age. What is nutritionally rewarding at one age may be toxic at another and almost indigestible at a third. This greatly influences the foraging behaviour of primates (see Lucas & Corlett, 1991 as an example of the relationship between phenology and diet). Examples of field techniques for phenological studies in forests can be found in Akunda & Huxley (1990), Frankie *et al.* (1974a), Guevara De Lampe *et al.* (1992), Koelmeyer (1959, 1960), Newstrom *et al.* (1994), Medway (1972) and van Schaik (1986). Monasterio & Sarmiento (1976) provide an example from drier more open habitats. Review articles include Bawa (1983), Bawa & Hadley (1990), Cole (1981), Frankie *et al.* (1974b), White (1985) and van Schaik and Terborgo (1993-4). Some cautionary tales are contained in Colwell (1974) and Stearns (1981). Newstrom *et al.* (1994) give a helpful introduction to terminology. Remember that primate species may not have the same sense of smell (e.g. Ueno, 1994) or spectral sensitivity (Jacobs & Harweth, 1989; Jacobs *et al.*, 1991; Savage *et al.*, 1987), as you and thus may distinguish categories differently.

4.5 Safety

Working with monkeys is no more dangerous than working with anything else in the forest (and a lot less dangerous than some fields of study - poisonous snakes, for example). There are, nevertheless, some basic precautions that need to be entertained so that you do not become debilitated or your study terminated through illness, absence or severe personal damage.

- at base camp, always have a log-book in which you state when you left camp, what trail you were going on, what your objective was and when you expected to return. If someone is on ‘camp duty’ that day, then tell them too.
- try to work in pairs.
- always carry a whistle with you. Arrange an emergency code. Keep a copy of the code with you (if nothing else, in case you forget what it means when you hear someone else’s signals).

- always carry a day medical kit (see medical section 4.6), some emergency rations (chocolate bars and dried fruit), salt tablets, rehydration fluid and more water than you think you'll need (plus some iodine or a water pump, just in case). Anti-viper serum (and training on how to use it) is essential in some areas (see below).
- if you go off the existing trail, leave a marker (trail tag or bark slash) to indicate your point of departure. A trail tag is best as you can write on it your departure time and estimated time of return.
- there is probably no need to carry a gun. The few big fierce things that might attack you are probably so rare that you are unlikely to encounter them (and if you did, would shooting one really be the right solution for a conservationist). Plus, guns create the wrong kind of impression locally and at customs, (and, anyway, would you be a good enough shot ?).
- if you do meet a large carnivore - don't run. Depending on the habitat either stand stock still or walk slowly backwards (the chances of attack are very slight).
- the chance of snake bite is rare (they really are more likely to be more afraid of you than you are of them and have left the vicinity as soon as they detected you clomping along). Good advice on what to do in the unlikely event of getting bitten can be found in Bent Juel-Jensen's guide to expedition medicine (Juel-Jensen & Warrell 1994), and Mark O'Shea's RGS-EAC herpetological field techniques guide (O'Shea, 1992). Just in case though, check on the availability and location of anti-serum in your host country. (Also snake-boots or similar may be necessary).
- small bitey things are likely to be the worst problem you face (see medical section). Ensure you tap out your boots each time before you put them on (yes, it's true - scorpions really do go into them at night). Tap the toe first and then the heel.

4.6 Medical aspects

General aspects:

- ensure that as many of the group as possible (preferably all) have first aid training (and that they have taken refresher courses before the expedition leaves).
- have a fully-equipped medical kit at base camp (see Juel-Jensen & Warrell, 1994 for contents). This should also include a medical guide. Voluntary Service Overseas recommends either "Where there is no Doctor" (D. Weaner, 1993: distributed by Teaching Aids at Low Cost,

PO Box 49, St. Albans, Herts., ALI 5TX), or “Travellers Health” (R. Darwood, 1994. Oxford University Press).

- be sure everyone knows where the nearest hospital is. Also the location (and phone number) of the best one in the country, where that is and how to get there.
- ensure that everyone knows a few basic phrases (‘snake bite’, ‘broken leg’, ‘carcrash’ etc.) in the major language of the country.
- make sure that allergies of any group members (to penicillin etc.) are known to all others. And have a list of everyone’s blood group in the medical kit (as well as with the medical officer).
- if someone is epileptic or diabetic make sure everyone else knows what to do in an emergency.
- take care of your feet. Fungal infections can be really unpleasant, can make field work a torture and may take ages to go away. Keep your boots as dry as possible, change your socks often and use talcum powder frequently. Remedies for the suffering are given in Juel-Jensen & Warrell (1994).

Field aspects:

- **Leishmaniasis**: however inviting they may look as places to rest while watching monkeys, try to avoid sitting in between the buttresses of large forest trees. These are favourite resting places for the kinds of flies that can give you leishmaniasis.
- **Bot flies**: sitting out in the forest for any length of time (at least in those areas of Central and South America where there are cattle nearby), you are likely to get bot fly larvae under your skin. You’ll see a little clear patch (about half-the size of a drawing pin head) with (maybe) a brown moving patch in it. Don’t panic - it’s gruesome, but not fatal. Cover the area with a piece of sellotape and wait a couple of hours. The maggot will come up for air. Not getting any it will come out of its hole. When it does so pull the sellotape off, and the grub comes too. (Other options involve vaseline or placing a bit of meat on the spot - both work but the sellotape one is the easiest - and you can easily see when the little darling has quit you). Dose with iodine after extraction.
- **Jigger fleas**: these are a tropical affliction rather than one unique to primatologists. A variety of flea has a burrowing female which passes her adult life as a swollen pea-sized egg-producing factory nestled in your flesh, normally just under a toe-nail. When she dies she rots and this can cause an infection which can cost you the joint of the infected digit.

You'll notice an itching and little salt grain-sized eggs in your socks. The flea's location will appear as a translucent circle under your skin and in the centre there should be the black circle of her breathing tube. Hook her out with a pin and dose the area with iodine. Jiggers favour sandy areas which have a high organic content. Either be vigilant or wear shoes all the time.

- **Leeches**: leeches do not transmit any diseases, but they do have a high yuk factor. It is easier to keep them out rather than keep them off: insect repellents don't seem to deter them, but military jungle boots (US Vietnam-style or ex-British Army ones, opinion is divided on their respective merits), plus trousers tucked into socks seems to work well (though a few will always be lurking on higher leaves and drop down on to you). Maybe leech-proof bandages aroung legs - knee high! Just pulling them off is ineffective as it can leave embedded mouthparts (and they are slippery anyway). They don't always respond quickly to burning either. A spot of salt makes them let go quickly (and they writhe rather satisfyingly as well). If you go in the dry season they are unlikely to be a problem. Expeditions to south-east Asian forests seem to suffer worst from leeches.
- **Ticks and mites**: like leeches, these are only really bad in places where there are lots of medium and large-sized terrestrial mammals (but unlike leeches, which tend to favour moist places, dry areas with domestic animals can be the worst). Insect repellents don't seem to work and these guys can clamber up your clothing unnoticed. Check yourself (and each other) regularly. Don't just pull them of as you could leave the mouth parts in and promote a local infection. A dob of vaseline loosens some kinds quickly, while others respond to alcohol (dabbed on with a piece of cotton wool on the end of a spent match). Quite a lot of ticks and mites act as vectors for nasty diseases so, if you suffered from ticks and mites on your trip, check with the London School of Hygiene and Tropical Medicine on your return, (tel. 0171 636 8636).
- **Things you can get from monkey faeces**: the major dangers are a nematode **Strongyloides** (possibly West Africa only) and a number of intestinal amoebas which can cause amoebic dysentery. The best defence is to pick up faecal samples using disposable plastic gloves or using a plastic bag. On your return check with the London School Hygiene and Tropical Medicine.
- **Bites from monkeys**: if you get bitten, clean the wound and go to hospital right away. The danger of rabies is very small, but there are a variety of other virus' which can be picked up from monkeys and some

are very nasty. It's better to be safe than sorry. On your return check with the London School of Hygiene and Tropical Medicine (0171-636 8636).

- **Ectoparasites**: monkeys are usually pretty clean animals (all that social grooming) and have few fleas and lice. Should your handling of a primate result in cross-species ectoparasite transfer, then either get one of your team-mates to groom you or take solace in the fact that most such beasts are pretty species specific and will probably leave you after one foul-tasting bite.
- **Stresses & strains**: survey work can be tough. Walking, trail cutting and observing can stress and pull a lot of muscles (gazing upwards for hours on end can do your neck in quite wonderfully). Get a book on massage and try the techniques out before you go.

Section Five
MISCELLANEOUS HINTS

Get work permits in advance - as part of your general organization you should seek your work or study permits well before your arrival in the country. You may still have to pick them up in person but you should save valuable time this way.

CITES coverage is probably required for any bits bought out of the host country - first of all, do you really need the material? If yes, then except for the very common species (of which there are now few), export of primates and their parts is generally covered by CITES and you will need a permit to get your material out of the country and into the UK. The Department of the Environment's offices in Bristol can supply appropriate information (see address in appendix). You are also likely to require export and sanitary permits for your specimens from the country of origin (otherwise they are likely to get confiscated at UK customs). Things change quickly in this field, so check current details with DoE, Bristol.

Always take counterparts. It is for the own benefit of the expedition (help with contacts, language, more detailed knowledge of flora and fauna etc.). Conservation-related projects can have long-term continuity. Be a good guest.

Liaise fully with local primatologists and museum staff - such people have two things: local knowledge which can help you and local power which can be used to harm you and your work if you mess them about (and ignoring them counts as such). So cooperate. Get in touch well in advance. Remember such people have their own agendas and priorities and may need some notice to give you the help you require. Don't expect them to drop everything on your account though. In many places access to research money and field materials is often tight, don't begrudge yours. Make sure you thank such people in reports and scientific papers. Even better, enshrine the cooperation with co-authorship (having got their permission first, of course).

Agree on distribution of any specimens in advance. There is no real reason for you to be collecting primates at all, but collections of collateral material (e.g. skulls found in middens, plants collected as a result of habitat survey, dung beetles), are a possible cause of friction. If it is not possible to identify material in the host country, then arrange to leave a duplicate collection there and send back identifications as they come through. Make

sure the collection you leave is a nice one, all properly labelled and well preserved. Don't try and fob them off with all the naff stuff that you don't want.

The ethics of repressing data - if it is in the animals' interests then it may be appropriate for you to do this (though it is probably best to tell some responsible authority in the host country). This situation generally arises with those species which have a commercial value, and here it may appropriate to conceal the locality where it was found (as is done routinely for cacti and for orchids). Though it won't stop the really determined operator, it may block the more casual wildlife trader. The same sentiments obviously apply to evidence of illegal trading. In which case the best people to tell are probably TRAFFIC in the UK (see address in appendix).

Section Six
PRE-FIELDWORK PREPARATION

The following are jobs that should be shared out by the team before leaving for the host country.

Produce a check-list of species likely to be encountered - field guides (see appendix), known distributions and taxonomic reviews (see appendix) will be of assistance here. Note also that the Protected Areas Data Unit at the World Conservation Monitoring Centre, Cambridge (see appendix for address) has data sheets for many of the protected areas (national parks etc.) in the World. If your study site is in one or is near one, it will be well worth getting the sheet for comparative purposes. This means you will be aware of any new locality records should you encounter them (see Section 1.10). Forewarned, you should be able to produce better notes on the event. It is also advisable to contact the local authorities who may have new and additional information not yet collated by the WCMC.

Checking skin and skull collections - do this in both UK and in the range country. It will give you the opportunity to take measurements, photos and make dental imprints. Remember, when looking at the pelage colour, that mode of preservation could have altered them and that the colours on skins slowly change over time. Doing such stuff in the range country is courteous and useful. You will have the opportunity to meet local scientists, and can pin-point strengths and weaknesses of local scientific knowledge and collections.

Check sound libraries for the calls of the species you are interested in. This may allow you to obtain copies of the sounds for use in interviews. You may also become aware of any gaps in the sound library's collections which you may be able to fill with recordings from the wild (if you are going to try this, make sure you know the species you're recording - they generally have more than enough ambient stuff and unidentified material). You should also be able to get fine tips on equipment use. The address of The British Library of Wildlife Sounds appears in the Appendices.

Check distributions - you can do this in several ways; (in reverse order of precision), locations given on specimen labels, data in taxonomic reviews, data in compilations (such as Walker's *Mammals of the World* and Wilson & Reeder 1993). A top-down approach is probably the speediest.

Remember, the old collectors were often in remote areas, working in conditions of considerable uncertainty and they often employed local people to get animals for them. This means that the locations of some of the older records may not be totally accurate (see Brandon-Jones, 1995 for an example). Spellings on some of the labels may also be odd (or phonetic) and, in many cases, place names will have changed since the departure of the colonial powers. Rivers can shift their course (ports consequently relocate) and animals ranges accordingly change. Check old maps and gazetteers. The latter are lists of place names (with grid references) and often give old and alternative versions for names and spellings. The RGS has a good collection of old maps. Taxonomic revisions are a good source of geographical synonyms and homonyms.

Check local names - they will facilitate interviews and explanations of what you are doing. Most modern field guides include this information. If not, see a dictionary in the language, buy a wildlife book when you get there, talk to scientists in the host country. Your prints will also come in handy here. Local names may also be on specimen labels. Remember, you may encounter several tribal and or ethnic groups, each with a different name for the same animal. The Library of the Museum of Mankind and the local anthropology or human sciences department may help. Many useful dictionaries for local languages were compiled during colonial times. Don't neglect them.

Check colour variations - some species are very variable, others boringly monomorphic (e.g. Colyn, 1993). Don't get caught out - seasonal and age variations in coat colour have been named as separate taxa before now (see Colyn *et al.,* 1991 for an example). Check where variations occur and what they are like. There may be separate local names for them, and this could cause confusion in interviews. In a few species (e.g. Amazonian sakis and some Asian gibbons), the sexes are different colours (sexual dichromatism). Be aware of this and the possibility of different ages being different colours (e.g. very young baby colobus are white). This can help you age animals easily.

Check existing data on food taboos - so that you can target your questions well and, if you go somewhere and hunting is now occurring of a previously inviolate species, you can recognise the change and ask appropriate questions. Good places to start on this are Martin (1991) (West Africa), Eden (1990) and Redford & Padoch (1992) (South America), Caldecott (1986) (SE Asia). More information can be found in good anthropological libraries and at places like the School of Oriental and African Studies, Museum of Mankind and the Luso-Brasilian Society (see appendices for addresses).

Check status on existing national legislation on hunting - not only will you then know who is breaking the law, but you will also be sensitive when asking questions of them. Data on this can be obtained via the Embassy of the country concerned (though this may take some time) or from the offices of TRAFFIC at the World Conservation Monitoring Centre, Cambridge.

Familiarise self with likely fruits and flowers - visits to botanic gardens in the UK and in the range country are essential for this. Take photos. Smell things. Studies in the herbarium also help but it is a back-to-front approach (a friend of mine once recognised a species only after having pressed it - for it then resembled the one he had seen in Kew's herbarium. Luckily it was quite common).

Visit zoos to see target species - take photos (for use in interviews), and familiarise yourself with the 'jizz' of the species. You may also wish to record its calls at this point. *International Zoo Yearbook* publishes yearly lists on which zoos have which primate species.

Think how you will publish your data - it may sound a bit premature, doing this before you go. But it isn't. Check journals to see what is in them, look at their style and content. See what requires statistical tests and make sure that you arrange your collection methods and data sheets to record data in a way that is appropriate to these forms of analysis. Are you going to do several short papers or one big one? - and who's going to do what? This should also help you clarify your division of fieldwork too. See Barnett, (1994) for a guide to results publication (and Section 7.4).

Draw up data sheets - you don't need to take out a full complement of these (you can xerox them in the host country), but working out a standard sheet in advance will at least give you something to modify from. If nothing else, it will focus your mind on techniques and focus of data collection (see Raphael & Maurer 1990 for discussions).

Check on import licences required for equipment - this can be done by contacting the commercial section of the Embassy of the host country. The Foreign Office may also be able to help. Such precautions may sound daft, but it could save you a lot of time and grief in customs offices of the host country, and what if the equipment impounded is vital? Proscribed items may include electrical and optical gear (including cameras and binoculars). Be careful.

Section Seven
EQUIPMENT

7.1 Equipment recommendations (field)

A basic day's field kit is going to consist of the following: binoculars, camera, spare film, note-book (or mini-tape recorder) and medical kit. Optional extras are going to include collecting equipment (zip-lock bags for faeces and fruits, plus plant press and insect collecting tubes) and sound recording equipment (with spare batteries).

7.1.1 Data gathering equipment

Binoculars: binoculars are generally defined by two measurements, the magnification and the width (in millimetres) of the light-gathering element. So, for example, 8x30 means a magnification of eight times and end elements of 30mm across. For monkey watching don't take anything too big and bulky - you are going to spend a lot of time holding these things up at odd angles, so you don't want them to be too heavy (so it's probably best to gently refuse the things your great-uncle used to spot U-boats on the North Atlantic convoys). On the other hand you need to be able to see details (so farewell great-auntie's opera glasses). Also, beware of the consequences of the optical ratio known as the Exit Pupil (magnification divided by lens diameter). As a result of this, the image seen through a pair of 10x50's, for example, will appear darker than that seen through a pair of 8x50's, which would make them less useful at dawn and dusk and in darker parts of the canopy. So when all is said and done, choose something between 8x30 and 10x50. Try to get ones with a rubber-coating as this is more shock-resistant and is also better at keeping moisture out of the optics and choose a compact model.

There are two main types of binoculars: the 'Dach' or roof prism type with straight barrels and the Porro prism variety where the barrels are shaped like this . All except the cheapest roof prism ones have internal focussing (the optical elements moving back and forth within the barrel itself). This has the advantage that they can be fully sealed and so are better proofed against grunge, humidity and moisture. All Porro prism binoculars have a bridge focussing mechanism where focussing is done by moving the eye pieces themselves. Such a system cannot be sealed and so is more vulnerable to invasion by vision-degrading nastyness (see also section 7.2.1).

A good, general guide to binoculars is *The Infocus Equipment Guide to Binoculars and Telescope* (Craig, 1994), which lists the specifications, plus'

and minus' and requirements of all the types of binoculars and telescopes currently sold in the UK. This guide is available from Infocus shops at: 8-10 Royal Opera Arcade, Pall Mall, London SW1Y 4UY (0171 839 1181) and 204 High Street, Barnet EN5 5SZ (0181 449 1445). The RSPB (The Lodge, Sandy, Beds) also has very informative pamphlets on binoculars and telescopes and on the care of optical equipment in the field (don't forget to make a donation).

Telescopes: If you are doing detailed study, or the animals are living in high canopy (something about the nature of your study site you should try to find out in advance), you may want the extra magnification afforded by a telescope. See Craig (1994) for up-to-date recommendations and users' guide, or call Infocus for advice. You will need a tripod for your telescope. The one you choose depends on how big (and heavy) your telescope is. Make sure you choose one with a good fluid head so that you can pan smoothly. Slik, Manfrotto and Velbon are all good, robust and comparatively cheap. Note that it is easier (and quicker) to set up a tripod if the leg-clamps are of the 'flick' type (rather than the screw alternative). The RSPB guide on telescopes includes information on tripods.

Camera*:* The plethora of varieties makes it difficult to offer advice (what one person swears by another simply swears at). You had best take something with interchangeable lenses (to get monkeys up in the trees and close-ups of fruit). A metal shutter is reported to be better than a cloth one in hot, humid conditions. Some makes have the circuitry coated with a fungus-resistant resin, which prevents growth which could otherwise short out the electrics. Choose a make which is well known. That way you stand a better chance of getting it repaired in somewhere distant. Take a spare. You may want to arrange with the rest of the team so that most of you have compatible systems, so that you can at least swop lenses if the need arises or investigate the possibility of z-rings. Jessops hotline (0116 313191) is a good source of second-hand gear. Ring up and they will find if any of their shops have what you require and they deliver free of charge to your nearest UK branch.

Nikon cameras are ranked the best, under moist conditions (tropical forests). For good photographs you may need at least 400mm tele and good sturdy tripod to support it. To check shake, you may need a shutter-release cord. Many field primatologists feel that it is best to take cameras with both shutters and aperture priorities and both manual and auto features.

Cap-keepers are a cunning combination of sticky bit, thread and elastic band, which should stop you losing your lens cap. If you are absent-minded,

a piece of orange marker tape tied to your camera strap should increase your chances of finding it again after you've "put it down ... somewhere around here ... I'm sure it was".

You may find a shoulder pod or rifle grip useful if you are going to use a long or heavy lens to photograph monkeys in the treetops. A small tripod, or groundspike is almost essential when photographing material on the forest floor or when doing close-up work. One of the most robust and versatile tripods is the Benbo Trekker. (Benbo's suppliers are Patterson Photax Group, Unit 5B, Vaughan Trading Estate, Sedgeley Road East, Tipton, West Midlands DY4 7UJ - but most good photographic shops also stock them). Useful hints on wildlife photography are given in Breen (1992), Campbell (1990) and Shaw (1984, 1988). Shaw (1984) is also good on equipment care.

A padded camera bag is a good idea. Ones with a waist-strap leave your hands free and you can store other bits of gear in them too. Be careful not to leave stuff in them overnight if you got caught in a heavy rain shower, (not unless you wish to change your project title to 'measurements of the rate of fungal growth on irreplaceable optical equipment in the tropics').

Spare film: Though slide film ('crome') is used most frequently, some people also take a second camera loaded with print film ('colour'). Either way because the forest is quite dark you will want high ASA film (200 minimum and probably some 400 as well). This also lets you use telephoto lenses on moving animals. The problem with this is that fast films can be more sensitive to heat. **Note**: because of the way slide films are made, Kodak Kodachrome is more resistant to heat exposure over long periods than E6-type films (like Fuji and Kodak Echtachrome), though the differences only become apparent after several months in the tropics.

Note-book (or mini-tape recorder): Keeping the note books dry. Few things are more annoying than trying to jot down vital observations on the pages of a soggy notebook. In camp, store the books in a dry place and expose them to the sun whenever possible. In the field keep them in a plastic bag or a zip-lock bag (available at W.H. Smiths!). If its big enough you should be able to write inside it even in the wet. Plastic map cases can also serve in this regard, with the added advantage of a neck-string.

For the standard contact information you may want to make-out standard forms in advance to minimize the chance that you forget something. As with your data book, these can be water-proofed by spraying them with a silicone-based waterproofing agent. (**Note**: the one called 'MapDry' is reported not to be all that good).

Remember, only make your notes in pencil or India ink. It is no fun at all to watch spilt alcohol make a chromatogram of several months of notes, all carefully written out in biro.

For recording of a fast-changing situation (such as when you are observing a large troop in some complex interaction), a small Dictaphone-like portable recorder is hard to beat. Apart from initial cost and the life of the batteries, the only limit is tape time, which for many makes is between 30 and 60 minutes (special microtapes are used). However, some makes have a tape counter, so you can work out when the tape is going to run out. They are quite robust, but be careful about humidity effects (keep the thing overnight in a box with silica-gel). Some of the Dictaphones available are voice activated (avoiding the possibly disturbing 'click' of manual activation), and some can take a small microphone. Most weigh less than 40 grammes and cost between £35 and £50 (in early 1995).

A good combination is to use a note-book for regular data and a Dictaphone for behavioural stuff. Remember to transcribe the Dictaphone notes each night, or you'll find yourself taping over previous work and losing it.

7.1.2 Collecting equipment

Fruit and faeces: is best collected and stored in strong plastic bags (and either sealed with a tag or, better still, use a self-sealing zip-lock bag). You may wish to photograph the material *in situ*. Remember to include a scale and a collection number.

Sampling from the canopy: secateurs are useful for trimming a sample, but unlikely to give you the reach you initially require. A pruning hook (on a long pole), long-arm trimmer (the kind where the blade is pulled by a cord) give access to medium heights. For very tall canopies you may need to shoot down a specimen with a small bore rifle or (rather less politically suspect) use a crossbow and line (the line may have a commando saw added) - (see Munn, 1991 and references therein for practical hints).

Direct sampling can be achieved by climbing into the canopy. But, be warned, tropical tree-climbing is a specialist pursuit and requires prior knowledge and the right equipment. Merrist Wood College (Worpleston, Guildford, Surrey GU3 3PE, 01483 232424) runs a tree-climbing course. Mitchell (1982) provides practical hints.

Plant Presses: these are effectively botanical sandwiches, with two boards as the bread and a layered filling of newspaper with inserted plants, all bound round with straps.

Each board need be only a little larger than a broadsheet newspaper folded in half. They can be of either rim-strengthened wire mesh or of wood (3- or 5-ply) into which several large holes have been bored. Old belts make fine straps. Newspapers are used to dry specimens. Make sure you have a large number (as you will need to change them regularly to fully dry specimens out). Keep spare newspapers dry by storing them in sealed plastic bags with silica gel packets.

7.1.3 Sound-recording equipment

The Sony Professional tape recorder, a gun (directional) microphone and a parabolic reflector are the basic kit. For details see Ranft (1992).

Wildsound (Cross Street, Salthouse, Norfolk NR25 7XB) is a good source of advice on equipment and stocks a wide range of sound-recording gear.

7.2 Equipment recommendations (base)

7.2.1 Preserving optics

The major enemies are fungus and moisture. You can keep your optics happy by (i) keeping them in containers with fabric bags of silica gel, (ii) leaving them in the hot sun for a bit, to kill the fungus (lenses only for cameras, or take the film out first), (iii) buying binoculars filled with nitrogen (though these are generally top of the range ones and rather expensive). For further information see Shaw (1984) and tips in Fjelksdå & Krabbe (1990).

With binnoculars you are likely to see two levels of impermiability being sold. “Rainproof”, where rubberised seals (‘o’ rings) should keep water out if the binoculars get wet, and “waterproof”. The second type are totally sealed and should be capable of total immersion with no ill-effects (see also 7.1.1.). Even so, play safe and submit them to regular doses of (i) and (ii) anyway.

7.2.2 Preserving film

Keep the film as cool as possible and keep moisture off with silica gel bags. As with optical equipment you should use silica gel which is contained in bags (less messy, less scratchy). The bags should be of fabric, not plastic (so as the moist air can get to the crystals). Use the kind which change colour when they have reached critical moisture level, then dry them out and re-use.

Termites and leaf-cutter ants sometimes attack film and notes. It is worth protecting your material against them, as it is not amusing to see your precious store of Fuji being converted into little parasols and carried off down a jungle track. Either keep everything in sealed plastic containers or use moth balls (the latter with discretion as I've heard that it can harm higher ASA film).

7.2.3 Preserving tapes & tape recorders

Spool and cassette tapes are robust and not generally effected by humidity. DAT technology does suffer though and may need to be placed in a box with bagged silica gel when not in use. See also Ranft (1992).

7.2.4 Keeping notes (and making multiple copies)

Never trust to memory, always make notes on site or record your observations as they happen. Then write these up neatly back at base in the evening. Also never trust to luck, always make copies of your neat set and keep the two sets separate. Ideally send one set back to the UK in parts as the opportunities present themselves and deposit another set at another safe (non-field) location. Be paranoid about your data - lose it and the trip has been just a holiday. Remember too that your field notes should be capable of being understood one hundred years from now by someone whose first language is not English. So, avoid colloquialisms too. Don't get in to the habit of using abbreviations (unless you keep a fully explained list of what they mean). It is amazing how incomprehensible "WLM, FD, SLK" can appear after a gap of several months.

For the kind of subsidiary notes it is worth taking, check the additional data which accompanies observational papers. These are often the short papers in the 'notes' section of a journal.

7.3 Labelling and storing specimens

For botanical specimens probably the best guide to the whole field is Forman & Bridson (1989) (also, check the references in Hicks & Hicks, 1978), however a few pointers follow.

If you are collecting botanical material, familiarise yourself with the botanical terms which are used to describe plant parts. They are a very useful shorthand (and you'll probably have to get a handle on them anyway at some point in order to understand the botanical keys you may well be called upon to use in order to identify the material you have collected). A good

introduction to this terminology can be found in the glossary at the back of the *Excursion Flora of the British Isles* (by Clapham, Tutin & Warburg).

If you are pressing leaves and flowers make sure you log a written description of them first before you press them. Describe anything which might change when the parts are dried, especially shape, colour and texture. Record smells too. Labelling specimens is vital. Use a simple sequential numbering system (things like 47i/B-j may make sense at the time, but the subtleties can be lost later and can be hell for anyone else who has to try and make sense of your material, especially as stuff tends to get dispersed in a herbarium anyway).

Fruit can't generally be pressed, but can be dried or pickled in alcohol. When this is done, the colours and the shape often go, so you'll need to record these before you douse them. Photographs (with a size gauge) also help.

You may wish to supplement your written records with photographs. If you do, make sure you make assiduous notes as to which specimen number you are photographing on what film.

Preserving material for biochemical analysis is more complex than saving it to be identified later. Methods obviously depend on what chemicals you are going to look at later. Those interested in tannins, alkaloids and fibre content should see Barton *et al.* (1993). For pigments, amino acids, total nitrogen, phenols and others, the references in Hulme (1971) provide a good introduction to older (and generally simpler) techniques. Other useful information sources are *Horticultural Abstracts* and *Chemical Abstracts*

If you are saving dung then dry the material well, either heated (gently), or by drying it in hot (heated) sand. Bag it up well and keep it with silica gel. You cannot wet preserve this kind of material.

If you are collecting fungi then check the references and techniques in Ainsworth *et al.* (1973), Courtecuisse (1991) and Hawksworth (1974). If you are collecting insects then see Cogan & Smith (1974), Martin (1977) for preservation methods.

7.4 Publications

For a general guideline to the publishing of data from expeditions in scientific journals, see Barnett (1994), and Day (1995).

Remember, keep the title of your paper as obvious as possible. When people are scanning the literature it is most helpful if the paper's title provides a clear idea of what it is about. An obscure title may mean your work is passed-over (see the reference section of this booklet as proof).

Section Eight

APPENDICES

Sources & resources

Conservation Grants for Primates

Grants (for conservation-related work only) are available from the Primate Society of Great Britain. See *Primate Eye* No. 44: 13, 1991 for details, addresses and restrictions.

Check current issues of the journals, especially *African Primates, Asian Primates, Neotropical Primates, Primate Conservation* and *Primate Eye*.

Deciding where to do your work

In 1993 the Organization of Tropical Studies (Tyson Research Centre, Washington University PO Box 258, Eureka, Missouri 63025, USA) published a Guide to Biological Field Stations: directory of members, which lists 150 biological stations throughout North America, Central America, Mexico and the Caribbean.

Every other year the Primate Society of Great Britain (website www.ana.ed.ac.uk/PSGB/) publishes a supplement to their journal *Primate Eye* which lists current field research activities of its members throughout the world. The supplement gives subjects, contact addresses and is organised on a country-by-country basis. Copies may be obtained from Dr. Hannah Buchanan-Smith, Hon. Secretary, PSGB, Department of Psychology, University of Stirling FK9 4LA , cost £5 (cheques made payable to PSGB)

For those with access to the internet The International Directory of Primatology (IDP) provides a convenient Internet source of information about organisations, field studies, population management, information resources and people active in the field of primatology. The International Directory of Primatology is an on-line publication of the Wisconsin Regional Primate Research Center (website: http://www.primate.wisc.edu/pin/idp/).

Conservation priorities for various areas of the world, for species and countries are to be found in the appropriate IUCN/SSC Action Plan for the area in question. These are listed elsewhere in the appendix section.

A major source of information for conservation expeditions, is the WCMC, 219c Huntingdon Road, Cambridge but (they plead) do not expect them to do the donkey work for you - they are generally happy to assist with sensible and thoroughly researched enquiries about rare and endangered species, conservation priorities and protected areas, but don't have the time or resources to choose or organise a project for you.

The Wisconsin Regional Primate Research Centre hosts an information exchange on e-mail, called 'Primate Talk'. This may also be a source of help and information (see *African Primates* 1(1):24, 1995 for further information on this service).

Collections of skins and skulls

The largest is at the Mammal Section, of the Natural History Museum, South Kensington, London. (You cannot just turn up, but must phone to make an appointment). Local and college museums may also hold material (data on this may well be contained in taxonomic reviews which generally list the provenance of all known specimens of a species).

Information on TRAFFIC, CITES and Protected areas.

As mentioned before there is no real reason why you should need specimens of primates. But just in case ...

The international movement of species which appear in the Red Data Books (and some which do not) is controlled under CITES (Convention on International Trade in Endangered Species). If you attempt to bring out a specimen (or parts) of such a species, the specimen(s) will be confiscated, you will be fined and future reputations will be sullied. Without an accompanying CITES permit your specimen is also very unlikely to be taken by a museum.

Regulations change, so check the latest requirments at the Department of the Environment, Wildlife Trade Licensing Branch, Room 822, Tollgate House, Houlton Street, Bristol BS2 9DJ (0117 9878691).

In addition to a CITES certificate, customs (at both ends) will require a certificate stating any animal specimens you have are free from infectious diseases. This is also likely to be true for faeces and parts (like stomach contents). Plants will require a phytosanitary certificate. Make sure you allow time to get such documentation before you leave your host country (several days, probably).

Data on phytosanitary requirements can be obtained from Plant Health Division, Ministry of Agriculture Fisheries and Foods, Kings Pool, 1-2 Peasholme Green, York Y01 2PX.

International trade in CITES-listed species is monitored by TRAFFIC (at the World Conservation Monitoring Centre [WCMC], 219c Huntingdon Road, Cambridge CB3 ODL, 01223 277314).

Data on national parks can be obtained from the Protected Areas Data Unit, WCMC, Cambridge (see above). Using their data the WCMC and IUCN also published:

- *The UN List of National Parks and Protected Areas (1993).*
- *Protected Areas of the World: volume I: Indo-Malaya, Oceania, Australia and Antarctica; volume 3: Afro-tropical region; volume 4: Nearctic and Neotropical. (all 1991).*

Another useful trilogy is the *Conservation Atlas of Tropical Forests*: *Asia and the Pacific* (1991 - edited by N.M. Collins, J.A. Sayer & T.C. Whitmore); *Africa* (1992 - edited by J.A. Sayer, C.S. Harcourt & N.M. Collins) and *Latin America* (due out late 1995/early 1996).

All of the above are available from the Publications Unit at the WCMC, Cambridge. Good libraries should have them or be able to get them. It is probably best to check these for data on your proposed site before bothering the busy PADU people with any queries you might have.

Libraries

(Just a list of suggestions - not an exclusive or exhaustive list).

Extensive resources of zoological literature can be found at the following:

- Natural History Museum, Cromwell Road, London SW7 5BD
- Science Reference Library, Kean Street, London WC2B 4AT
- Zoological Society of London, Regent's Park, London NW1 4RY

Ethnographic material is available from:

- The Museum of Mankind Library, 8 Burlington Gds, London W1X 2EX
- School of Oriental and African Studies, London University, Thornhaugh Street, Russell Square, London WClH OXG
- Hispanic & Luso-Brazilian Society, 2 Belgrave Square, London SW1 8PJ

Check your local libraries too. Your local librarian may well be able to arrange the loan of certain materials.

List of source books for regions and countries

Central America (including Mexico)

Alvarez Del Toro, M. (1977). *Los Mamíferos de Chiapas*. Universidad Autónoma de Chiapas, Tuxtla Gutiérrez, Chiapas.

Janzen, D.H. (ed), (1983). *Costa Rican Natural History*. University of Chicago Press

South America

Emmons, L.H. (1990). *Neotropical Rainforest Mammals: a field guide*. University Chicago Press, Chicago

Eisenberg, J.F. (1990). *Mammals of the Neotropics: the northern neotropics Vol.1: Panama, Colombia, Venezuela, Guyana, Suriname, French Guyana*. University Chicago Press.

Kleiman, D.G. (ed), (1977). *The Biology of Conservation of the Callitrichidae*. Smithsonian Institution Press, Washington.

Mittermeier, R.A. *et al.* (eds), (1981 & 1988). *Ecology and Behaviour of Neotropical Primates. volumes I and II*. WWF-US and others.

Moynihan, M. (1976). *The New World Primates: adaptive radiation and evolution of social behaviours, languages, intelligence*. Princeton University Press, Princeton.

Terbourgh, J. (1983). *Five New World Primates: a study in comparitive ecology*. Princeton University Press, Princeton.

Africa

Altmann, S.A. & Altmann, J. (1970). *Baboon Ecology: African field research*. University of Chicago Press, Chicago.

Charles-Dominique, P. (1977). *Ecology and Behaviour of Nocturnal Primates: prosimians of Equatorial Africa*. Duckworth, London.

Dekeyser, P.L. (1955). *Les Mammiferes de L'Afrique Francaise.* IFAN, Dakar.

Gautier-Hion, A., Bourliere, F., Gautier, J-P & Kingdon, J. (1988). *A Primate Radiation: evolutionary biology of the African guenons.* Cambridge University Press, Cambridge.

Haltendorth, T & Diller, H. (1990). *A field-guide to the Mammals of Africa, including Madagascar.* Collins, London.

Oates, J.F. (1994). Africa's primates in 1992: conservation issues and options. *American Journal of Primatology 34*: 61-71.
Peters, C.R., O'Brien, E.M. & Drummond, R.B. (1992). *Edible wild plants of sub-saharan Africa*. Royal Botanic Gardens, Kew.
Rode, O. (1937). *Les Primates de l'Afrique*. Publications du comite d'etudes historiques et scientifiques de l'Afrique Occidental Francaise, Paris. (has useful illustrations of hands and skulls).
Stuart, C & Stuart, T (1995) 2nd edition. *A field guide to the mammals of Southern Africa*. New Holland
Swynnerton, G.H. & Hayman, R.W. (1951). A checklist of the land mammals of the Tanganyika Territory and the Zanzibar Protectorate. *Journal of the East African Natural History Society 20:* 274-392.
Zucker, E.L. (ed), (1987). Comparitive Behaviour of African Monkeys. *Monographs in Primatology No. 10*. Alan R. Liss, New York.

Madagascar

Charles-Dominique, P., Cooper, H.M., Hladik, A., Hladik, C.M., Pages, E., Pariente, G.F., Petter-Rousseaux, A., Petter, J.J. & Schilling, A.(eds), (1980). *Nocturnal Malagasy Primates: ecology, physiology and behaviour*. Academic Press, New York.
Kappeler, P.M. & Ganzhorn, J.U. (eds) (1993). Lemur Social Systems and their Ecological Basis. Plenum Press, New York & London.
Petter, J-J., Albignac, R. & Rumpler, Y. (1977). Faune de Madagascar. 44. Mamimmiferes lemuriens. O.R.S.T.R.O.M., Paris.
Tattershall, I. (1982). *The Primates of Madagascar*. Colombia University Press, New York.
Tattershall, I. & Sussman, R.W. (eds) (1975). Lemur Biology, Plenum Press, London and New York.

India

Prater, S.H. (1990). *The Book of Indian Mammals.* Bombay Natural History Society, Bombay.

South East Asia

Allen, G.M. (1938). *Mammals of China and Mongolia*. American Museum of Natural History, Washington DC.
Chivers D.J. (1980). *Malaysian Forest Primates: 10 years in Tropical Rainforest*. Plenum Press, New York.
Corbett, G.B. & Hill, J. E. (1992). *Mammals of the Indo Malay Region*. Natural History Museum Publications, London.

Harrison, J. (1974). *An Introduction to the Mammals of Singapore and Malaya*. Malayan Nature Society, Singapore branch.
Jones, G. S. & Jones, D.B. *A Bibliography of the Land Mammals of SE Asia, 1699-1969*. Department Entomology, Bernice P. Bishop Museum, Honolulu, Hawaii. Special publication.
Le Kagul, B & McNeely, J.A. (1988). *Mammals of Thailand.* Sara Karn Bhaet Co & Darnsutha Press, Bangkok. Second Edition.
Lindburg, B.G. (ed), (1990). *The Macaques: studies in ecology, behaviour and evolution*. Van Nostrand Reinhold, Amsterdam.
Medway, L. *Wild Mammals of Malaya (Peninsular Malaysia) and Singapore*. Oxford University Press, Oxford.
Niemitz, C. (1984). *Biology of Tarsiers*. Gustav Fisher Verlag, New York.
Nisbett, R.A. & Clochon, R.L. (1993). Primates in northern Vietnam: a review of the ecology and conservation status of extant species, with notes on Pleistocene localities. *International Journal of Primatology 14:* 765-795.
Roonwal, M.L. & Mohnot, S.M. (1977). *Primates of South-east Asia: ecology, sociobiology and behaviour*, Harvard University Press, Massachusetts.
Van Peenen, P.F.D., Ryan, P.F. & Light, R.H. (1969). *Preliminary Identification Manual for the Mammals of South Vietnam*. United States National Museum, Smithsonian Institution, Washington, DC.

Books with a broader-base

Benirschke, K. (ed), (1986). *Primates: the road to self-sustaining populations*. Springer-Verlag, New York.
Bemant, G. & Lindberg, D.G. (eds), (1975). *Primate Utilization and Conservation*. John Wiley & Co., New York.
Chalmers, N. (1979). *Social Behaviour in Primates.* Edward Arnold, London.
Chance, M.R.A. & Jolly, C.J. (1970). *Social Groups of Monkeys, Apes and Men*. Jonathon Cape, London.
Hill, W.C.O. (1953-1970). *The Primates: comparative anatomy and taxonomy.* Edinburgh University Press. 8 volumes.
Fleagle, J.G. (1988). *Primates: adaptation and evolution*. Academic Press, London.
Kavanah, M, (1983). *A Complete Guide to Monkeys, Apes and other Primates*. Jonathon Cape, London.
Lovett, J.C. & Wasser, S.K. (eds) (1993). *Biogeography and ecology of the rain forests of eastern Africa*. Cambridge University Press, Cambridge.

Marsh, C.W. & Mittermeier, R.A. (eds), (1977). Primate Conservation in the tropical Rainforest. *Monographs in Primatology No. 9*. Alan R. Liss, New York.
Martin, C. (1991). *The rainforests of West Africa: ecology, threats and conservation*. Birkhauser, London.
Mitchell, G. & Erwin, J. (eds), (1986). *Comparitive Primate Biology, Volume 2A: behaviour, conservation and ecology*. Alan R. Liss, New York.
Mitchell, R.P. & Crook, J.H. (1973). *Comparitive Ecology of Behaviour of Primates*. Academic Press, London.
Napier, J.P. & Napier, P.H.
(1967). *A Handbook of Living Primates*. Academic Press, London.
(1970). *Old World Monkeys: evolution, systematics and behaviour*. Academic Press, London.
Prince Rainier III of Monaco & Bourne, G.H. (eds), (1977). *Primate Conservation*. Academic Press, London.
Roonwal, M.L., Mohnot, S.M., & Rathore, N.S. (eds), (1984). *Current Primate Researches*. University of Johdpur Press, India.
Smuts *et al.* (1987). *Primate Societies*. University of Chicago Press.
Sussman, R.W. (1979). *Primate Ecology: problem-orientated field studies*. John Wiley & Sons, London.
Whitten, A. & Widdowson, E.M.(eds), (1992). *Foraging Strategies and Natural Diet of Monkeys, Apes and Men*. Oxford Scientific Publications, Oxford.

List of the IUCN/Species Survival Commission's Action Plans for each geographical area and the Red Data Books.

Lemurs of Madagascar: an action plan for their conservation, 1993-1999. Mittermeier, R.A. *et al.* (1992). IUCN, Gland, Switzerland.
Action Plan for Asian Primate Conservation, 1987-1991. Eudey, A.A. (complier), (1987). UNEP, Paris. (update being prepared). See African Primates 1(1):25, 1995. Oates, (1994) provides a good interim report.
Action Plan for African Primate Conservation. Oates, J., 1986. IUCN, Gland. (update being prepared).
Neotropics - one is in the process of being prepared.

Red Data Books

Fitter, R. & Fitter, M. (1987). *The Road to Extinction: problems of catagorizing the status of taxa threatened with extinction.* IUCN, Gland.

Harcourt, C. & Thornback, J. (1990). *Lemurs of Madagascar and the Comores - the IUCN Red Data Book*. IUCN, Gland.

Lee, P.C. & Thornback, J. (1988). *Threatened Primates of Africa. The IUCN Red Data Book*. IUCN, Gland.

Thornback, J. & Jenkins, M. (1982). *The IUCN Mammal Red Data Book*. IUCN, Gland.

Note: The IUCN has directories for protected areas in each major biogeographic region, and the IUCN Environmental Policy and Law Ocassional Series updates on Wildlife Law.

List of Useful Journals

Primates only - mostly fieldwork:

African Primates
American Journal of Primatology
Asian Primates
Australian Primatology
Current Primate References
Folia Primatologica
International Journal of Primatology
Lemur News
Neotropical Primates
Primate Conservation
Primate Eye
Primate News
Primates
Proceedings of the International Congress on Primatology

Primates only - mostly overviews, lab-based work and theoretical stuff:

American Journal of Physical Anthropology
Annual Review of Anthropology
Comparative Primate Biology
Journal of Human Evolution
Human Evolution
International Journal of Anthropology
Laboratory Primate Newsletter
Primate Research
Studies in Physical Anthropology
Studies of Human Ecology
Yearbook of Physical Anthropology

Mostly humans, but some other primates too - mostly overviews, evolution and theoretical stuff:

Annals of Human Biology
Anthropologischer Anzinger
American Journal of Human Biology
Homo
Human Biology

Man
Zeitschrift fur Morphologie und Anthropologie

Mammals (all mammals, but including primates):

Acta Theriologica
Current Mammalogy
Hysterix
Journal of Mammalogy
Mammalia
Mammalian Species
Mammal Review
Mastozoologia Neotropical
Saugetierkundliche Mitteilungen
Zeitschrift für Saugetierkund
Zoologische Mededelingen

Other useful journals which deal exclusively with tropical stuff or have a high content of tropical-based papers

Acta Amazonica
Acta Biologica Venezuelica
African Journal of Ecology
African Wildlife
American Naturalist
Biological Conservation
Biotropica
Bulletin, Institut Française d'Afrique Noir (replaced by Bulletin, Institut Fondamental d'Afrique Noir)
Conservation Biology
Journal of African Zoology (formerly African Review of Zoology/Revue de Zoologie Africaine).
Journal of the Bombay Natural History Society
Journal of the East African Natural History Society
Journal of Tropical Ecology
Journal of Tropical Zoology
Journal of Zoology, London
Malayan Nature Journal
Nigerian Field
Oryx
Records of the Zoological Survey of India

Spixiania
Studies in Neotropical Fauna and Environment
Tropical Biodiversity
Tropical Biology
Vida Silvestre Neotropical

Miscellania

Wilson & Reeder (1993) *Mammal Species of the World*: *a taxonomic and geographic reference*, (Smithsonian Institute Press, Washington) is generally accepted as the universal taxonomic authority. Make sure the designations and appellations for your genera, species and sub-species agree with it, otherwise you will find your work less well regarded and work submitted for publication will come back for tedious correction.

Zoological Record: invaluable for a literature search, goes back to 1864, lists things by country, topic, author, genus and species. Updated yearly. Now on CD-ROM (where it goes back to 1978 and is updated quarterly).

Current Primate References: started in 1973 and updated monthly. As *Zoological Record* is published about 2 years behind, *CPR* is essential if you want to keep up-to-date with the massive literature on primates.

Note: some journals, like *Neotropical Primates*, also publish a list of current publications on species and topics appropriate to their geographical area.

List of taxonomic literature for primates

Note: this list is not exhaustive, does not cover all primate genera (many of which do not have a recent revision), and does not generally deal with sub-species.

Coimbra-Filho, A.F. (1990). Sistematica, distribucão geographica e situacão atual dos simios Brasilieros (Platyrrhini-Primates). *Revista Brasiliera de Biologia 50:* 1063-1079.

Cronin, J.E. & Meikle, W.E. (1979). The phylogenetic position of ***Theropithecus:*** congruence among molecular, morphological and paleontological evidence. *Systematic Zoology 28:* 259-269.

Dandelot, P. (1974). Order primates, part 3. Pp. 1-45 in *The Mammals of Africa: an identification manual*, Meester, J. & Setzer, H.W. (eds). Smithsonian Institution Press, Washington DC.

Fooden, J., Quong, G-Q, Wang ,Z-R. & Wang, Y-X (1985). The stumptailed macaques of China. *American Journal of Primatology 8:* 11-30.

Groves, C.P.,
(1970). The forgotten leaf-eaters, and the phylogeny of the Colobinae. Pp. 555-587 in *Old World Monkeys: evolution, systematics and behaviour* JR Napier and PH Napier (eds). Academic Press, London.
(1971). Systematics of the genus ***Nycticebus***. *Proceedings of the 3rd International Congress of Primatology 1:* 44-53.
(1972). Systematics and phylogeny of gibbons. Pp. 1-89 in *Gibbon and Siamang: evolution, ecology, behaviour and captive maintenance*. Rumbaugh, D.M. (ed). Karger, S. New York.
(1974). Taxonomy and phylogeny of prosiminans. Pp. 449-473. in *Prosimian Biology*, Martin, R.D., Doyle, G.A. & Walker, A.C. (eds). Duckworth & Co., London.
(1978a). A note on nomenclature and taxonomy in the Lemuridae. *Mammalia 42:* 131-132.
(1978b). Phylogenetic and population systematics of mangabeys (Primates: Cecropithecoidea). *Primates 19*: 1-34.
(1989). *A Theory of Human and Primate Evolution*. Oxford University Press.
Groves, C.P. & Eaglan, H. (1988). Systematics of the Lemuridae (Primates, Strepsirhini). *Journal of Human Evolution 17:* 513-538.
Groves, C.P. & Tattershall, I. (1991). Geographical variation in the fork-marked lemur, ***Phaner furcifer*** (Primates, Cheirogaleidae). *Folia Primatologia 56:* 39-49.
Groves ,C.P. & Wang, Y-X (1990). The gibbons of the subgenus ***Nomascus*** (Primates, Mammalia). *Zoological Research 11:* 147-154.
Grubb, P. (1973). Distribution, divergence and speciation of the drill and mandrill. *Folia Primatologia 20:* 161-177.
Hershkovitz, P.,
(1977). *Living New World Monkeys (Platyrrhini) volume 1*. Chicago University Press, Chicago.
(1979). The species of sakis, genus ***Pithecia***, with notes on sexual dichromism. *Folia Primatologia 31:* 1-22.
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Part 1: Families callitrichidae and cebidae
Part 2: Family cercopithecidae (sub-family cercopithecinae)
Part 3: Family cercopithecidae (sub-family colobinae)

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Checklist of essential equipment

(**Note**: Suppliers for these and other pieces of equipment can be found in Barnett & Dutton, 1995).

Basic fieldwork

Camera
Small medical kit
Torch + spare batteries
Waterbottle
Binoculars
Penknife
Map
Machete/parang
Watch
Compass
Stopwatch
Notebook & pencil/dictaphone
Trail markers

Mapping

Compass
Machete/parang
Map
Medical kit
Poles
Rangefinder
Surveyors' tape
Tape Measure
Waterbottle
Diameter tape
Clinometer
Altimeter

Plant Collecting and Identification

Alcohol (in plastic bottle)
Cardboard sheets
Colour chart
Corrugated Aluminium
Flora and Keys
Handlens
Labels
Newspapers + blotting paper for dried specimens
Pencils
Plant press + long straps
Plastic bags including large ones for transporting press
Ruler/Callipers
Scales
Tree tags
Photocopies of all important documents like passports etc.

Sample questionnaire

Used by Da Cunha & Barnett (1989) in a survey of the golden-backed uacari on the Rio Negro, Brazil. (all questions originally in Portuguese)

General Section

date locality time
name of interviewer
name of interviewees (with age & occupation)
other informants present?
how long have you lived here?
have you been anywhere else (why, when)?
community details?
how many people live here?
how many adult males?
how many women?
is there a school (with a teacher)?
what is taught?
do only some of the men and women hunt (how many)?
food resources?
what are your major food sources?
do you raise domestic animals (how many of each type do you have)?
on what types of occasions do you eat your domestic animals?
do the domestic animals belong to the community or to individuals?
do agricultural products belong to the community or to individuals?
is hunted meat shared by the community?
is fish shared by the community?
are any products externally commercialised (what)?
do you have firearms (what types, how many)?
how much does a bullet cost?
is this expensive?
what equipment do you use for hunting?
what equipment do you use for fishing?
special hunting methods
regularity of hunting
distanced ranged while on hunting trips
preferred areas

General Primate Section

what monkeys do you know from around here?
what are their indigenous names?
do any occur only in one place or on one side of the river?
when do you see monkeys with babies?
what do they eat?
do you ever see different types of monkey together (which)?
which types are most frequent in the area?
the monkeys that live in the area, are they amongst these photographs?
do you know about any of these monkeys being kept in captivity in this area?
do monkeys raid crops (when, which species, is it a serious problem, what do you do about it)?

General Animal Section

what other animals occur in this area [use local names if poss.]?
what 3 animals do you hunt most frequently?
do you keep or sell any of the skins?
what animals do you use for fishbait?
apart from food and bait, do you use any other part of the hunted animals for any other purpose?

Uacari section

what does the uacari look like?
what part of the year do you see it, or see it most frequently?
in what type of vegetation?
how often do you see them?
how many animals together?
how many animals are there in a howler monkey group?
in what month do you see them with babies?
how many babies does a female have?
at what height in the trees or vegetation do you see uacaris?
do you know if they move to other areas at other times of the year?
what do uacaris eat?

do you now see this monkey less often, more often or as often as you did in the past
do you hunt this monkey (how often, to eat, for bait, other)?

Miscellania
are there any animals which, for some reason, you will not hunt to eat? do you think there are now more, less or about the same numbers of animals in the region as there used to be (why)?

time interview finished

Summary of how to do a daily field study of primates

1. **Locate group** - be in forest by dawn; listen for sound of falling faeces/urine; listen/look for movements in canopy; listen for calls - reach source quickly and quietly.

2. **Follow group** - as quietly as possible, but quickly. They must get used to noises below - this is part of habituation process. They have regular pathways around their territory with clear boundaries. You learn this on the ground, building up a picture of where they/you go.

(i) **map route** taken, according to trail locations and distinctive and/or numbered trees, which should be added to the map. You need to take lots of copies of the map of study area, so that you can use one each day (or group of days) and add to it various things.

(ii) **record activity** (and weather, location, tree use, etc.) at 10-minute intervals. Best to supplement continuous notes by time, with check sheets to sample behaviour - again best to take numerous copies.

Data sheet for mammal censuses

Date Month	Species	Sighting angle	Perpendicular distance	Sighting distance	No point every 50km	km walked that day	Other observations - feeding, activity, height, group composition

Example of data sheet

Data Sheet

1. Date
2. Time
3. Weather (sun,temperature, humidity, rain)
4. Location
5. Animal sex
6. Activity
7. Food plant species
8. Plant part
9. Tree species
10. Tree height
11. Animal height
12. Canopy width
13. Canopy height
14. Next neighbour (sex)
15. Next neighbour (distance)
16. Group dispersal
17. Other primate (sex)
18. Other primate (distance)
19. Other animals
20. Field notes

Example of a Vegetation Survey

1	2	3	4	5	6	7	8	9
Plot number and size	Tree species	Diameter at breast height (DBH)	Tree Height	Canopy width	Canopy height	Epiphyte growth (in terms of % crown cover)	Liana growth (in terms of % crown cover)	Notes e.g. no of tree stumps, major wildlife species present
1 (Nazeni area)	*Ficus mucoso* FIC-MUC ID: 26	120 (at 3 meters above buttress)	category 3	12x15m	25	category 0	category 0	tree in fruit, signs of *Colobus* spp

Comments for each category:

1. **Plot number** and size, also include approximate location.
2. **Tree species** and tree identification number to confirm identification. If the tree is unidentified, details of slash, canopy structure etc. may be useful. Also codes with 3 letters for generic and specific species are useful for putting the data into a Cornell Ecology Programme format (see Jongman, 1987) e.g. *Ficus-mucoso* is written as FIC-MUC (keep a note of what the abbreviations mean).
3. **DBH**. Check the literature for the various different cases. But always measure from the base of the trunk, do not measure over abnormal growths. If the tree has buttresses, normally measure above the butresses and mention on sheet.
4. **Tree height**. This has to be estimated (use broad categories) in thick forest. Otherwise, rangefinders etc. can be used.
5. **Canopy width**. Measure the longest width and the width at right angles to get an idea of canopy area.
6. **Canopy height**. This is the height at which the canopy begins. Range finders or are useful.
7. & 8. **Epiphyte and Liane growth**: problems with examples such as *Ficus* spp which may start as epiphytes but end up as a tree. also hard to assess epiphyte growth as most epiphyte covered trees are old and large.
9. **Notes**: Also record any fallen branches, gaps in vegetation, dominant herbaceous species,tree stump and the human use of the area. Also think of tree phenology: is the tree in fruit? is it in flower? Consider what to do about trees on edge of the study plot or transect. Remember that a strip plot will have a higher edge to area ratio than a circular plot (and is harder to demarcate).

For rapid assessments of vegetation the plotless method can be used. Some different types include:

- Quadrat point method. At a certain point on a transect, split the directions into 4 quarters and locate the nearest tree and measure its DBH (problems include, you may miss out rarer species.)
- Wandering method.
- Locate all tree species in a habitat until no more can be found. See Coker and Kent (1992) for more details.

Example of a Check Sheet for Activity Patterns

1	2	3	4	4	5	6	7	8
Time	Location	Weather	Identity of individual	Activity of individual	Height above ground	Distance/ identity of nearest neighbour	Tree individual is located in	Comments
0910	Nazeni NA @100m	Sun Bright	Adult female (no 11)	Feeding	10	5	*Ficus mucoso*	Hoot to male indivs
0910	Nazeni NA@100m	Sun Bright	Adolescent male (no12)	Resting	15	5	*Ficus mucoso*	
0920	Nazeni NA@100m	Cloud Light	Adolescent male (no12)	Feeding	12	>20m	*Ficus mucoso*	

Notes:

Depending on what species are being followed it may only be possible to follow one individual at one time.

Weather can be split up into: sun (bright, light/hazy); rain (light, heavy), cloud (high/low, light /heavy).

Activities could include resting, feeding, travelling, calling (or combinations of them).

The activities should be further split up into: Rest (sit, lie, stand, hang, in nest (with chimps, gorrillas); Feed, hang, sit, pick, ingest leaves (young or mature)). Describing what the food is and how it is eaten (e.g. number of figs per minute) may be useful; Travel (brachiate, leap, climb, walk [bipedal, or quadrupedal]; Call (type of call with chimpanzees, for example, this could include, Pant-hoot, pant-grunt, Wraa bark, etc). This is important if the group is being recorded

It is important to add as much detail to the activity as possible in the comments section e.g. who is grooming who, who is mating who.

Section Nine

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