25 EXPEDITION RESEARCH PROJECTS IN SAVANNAH REGIONS

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ECOLOGICAL STUDIES

If you are planning an expedition to a semi-arid tropical savannah you will have plenty of places to choose from, whether it is your intention to study animals, plants or even the ecology of the local people. As a rough guide, these exciting but harsh environments cover up to 65 per cent of the surface of Africa, 60 per cent of Australia and 45 per cent of South America (Huntley and Walker, 1982). They are characterised by an intensely seasonal climate, in which the wet seasons are often unpredictable. When the rains do arrive they will frequently do so as gentle "grass rains" to start with, followed by irregular, intense storms, during which up to 16 per cent of the annual total may fall in a single day (Coe, 1990). Between the rainy seasons, savannah environments are usually intensely dry, during which the daily temperature range may approach 40°C. During the dry season virtually no plant growth will take place and large quantities of dead organic matter will accumulate on the ground surface until the next rains, when decomposition will take place very rapidly, releasing nutrients for future photosynthetic activity.

Top tip

It is worth remembering that most of the material collected on your expedition will have to be deposited in the local museum or university, but you may obtain permission to return some samples to your home base for identification. Voucher specimens must always be returned to your host country after the study is completed unless an arrangement has been made to retain duplicates here.

Having selected an area that you wish to visit, the first thing that you need to do is to identify the organisms that you wish to study and to be quite certain that they will be active when you arrive at your study site. There is little point in visiting a savannah to study frogs or flowering plant phenology in the middle of the dry season, when the organisms that you hope to study will be inactive. This does not mean, however, that destinations in East and Central Africa, South America or Australia are not worth visiting in the long vacation, which frequently coincides with their dry season, because there are still plenty of things that you can do there. By contrast the semi-arid savannahs of West Africa and India receive much of their annual rainfall between June and September, which makes them very suitable for the study of animals and plants during their period of maximal activity. Even though you may have the whole animal and plant kingdoms potentially available for study, it is wise to choose your organisms with care, ensuring that your generally inexperienced team can identify them and obtain a reasonably complete data-set in the time available. Such projects may range from general topics, to more detailed and specialised ones, depending on your interests, but the paramount rule must always be "keep it simple".

Top tip

In conducting a general survey it is vital that you locate literature sources that will enable you to identify your material accurately. This can usually be done through a university library, either at home or in your host country. Cooperation with your overseas counterparts is very valuable, because they may often be able to provide you with taxonomic assistance.

General surveys usually require large numbers of people in the field, together with the attendant problems of transport and logistic support. It is often therefore simpler to have a specific objective of studying a single group of organisms, or even a single species, providing you are sure that it will be abundant. There is little point in setting out to study a single, rare, endangered species if you are going to spend most of your time simply trying to find it. It is not possible to outline every organism that you could study, but the following headings will outline the general principles of deciding "what to study" and "how to study it" (Magurran, 1988; Wilson et al., 1996).

Vegetation studies

As the activity and distribution of most animals are, to a large degree, dependent on their habitats, the study of vegetation is often a vital preliminary component of most ecological studies. Simple vegetation maps are of great value to conservation authorities, and can be carried out by small teams. Before you leave, you may be able to obtain or arrange to view aerial photographs or even satellite images, which will act as a good baseline from which to carry out your survey.

Top tip

In conjunction with a vegetation study it is of great interest to select a genus or species of plant in your research area and to investigate the animals associated with it. Comparative investigations of a number of related plant species often yield information that is of great ecological, evolutionary and conservation value.

Within such a programme of fieldwork, you may wish to use simple techniques to study the structure of the local vegetation. This can be accomplished by using standard techniques, but it is worth remembering that studies of woody vegetation can still be carried out in a dry season, which is impossible with herbaceous components of the vegetation.

Quadrats are quite valuable in studying the vegetation of small areas, but stratified transects are often a more efficient method of investigating habitat components on larger study sites. Tree and shrub density can be studied using the "point-centred quarter" method of Curtis (1959). Additional information on tree bole cover can be estimated using the Bitterlich stick (Cooper, 1963; Agnew, 1968). Having carried out these measurements on your transect(s), it is quite easy to convert this to a strip of predetermined width to obtain greater detail on structure and composition. The number of transects that you need will depend on the size of the area under study and its habitat heterogeneity.

Under suitable climatic conditions, studies of the phenology (leaf production, flowering and fruiting) of local trees and shrubs can be of immense interest and value to local and international agro-forestry bodies.

Methods of vegetation study and analysis may be consulted in Greig-Smith (1983), Gauch (1982) and Ludwig and Reynolds (1988).

Animal studies

There are a vast number of different methods available for studying and sampling animals, which are well summarised in Southwood (2002). A good point to remember is that small animals provide much larger data-sets than large animals. With only 6 or 8 weeks actually working in the field, it will not be possible to obtain complete data on, for example, the African elephant, whereas the same period spent studying rodents would yield really valuable information, even if it reflects the situation in only part of a single season. The general picture for the major animal groups is summarised below.

Invertebrates

Arthropods are ideal objects for study by small expeditions, because they are generally abundant, and many are active even in the dry season as adults or their immature stages. They may be sampled using sweep nets or beating trays, mark–release recapture, pit-fall traps or by "fogging" with pyrethroid insecticides. Interpretation of the data collected by these methods may be consulted in Southwood (2002). Social insects such as termites and ants are particularly valuable as objects of study, because their discrete nests enable the investigator to concentrate their studies in a small area, whether this concerns mound ventilation, foraging behaviour, or even the other organisms that use or share the mounds or nests.

Expeditions working on sand or fine alluvial soils will find the tracks of both invertebrates and vertebrates on the soil surface, whereas slightly raised ridges will indicate the presence of sub-surface predatory adult arthropods or their larvae. These "signs" provide an excellent opportunity to study the activity and foraging behaviour of these creatures.

Vertebrates

Fish surveys are of great value to the museums and fisheries authorities in many less developed countries. They may be sampled directly using nets or lines, when the necessary permits have been obtained, or you may simply be able to cooperate with local fishermen to study their catches. Even many of the most arid regions have permanent or seasonal rivers, lakes and seasonal water bodies that are worthy of investigation (Coad, 1998).

Top tip

Studies of dangerous reptiles should be avoided, unless you have experience in handling them, or are accompanied by a local expert.

Reptiles and amphibians are interesting creatures to study, although the latter are much more seasonal than the former. Simple species lists, and their local abundance and distribution in relation to local habitat structure can provide valuable and often unique data. It may be necessary to kill some animals if you wish to study their feeding behaviour, but this will usually require special permission and should always be kept to a minimum (for all animals).

Behavioural studies of activity rhythms, in relation to sex, size and diurnal climatic variables, are easy to accomplish and provide interesting and valuable data. If it is your intention to study local movements of your study animals it will be necessary to mark them. Good guidelines for humane methods of marking animals may be found in Stonehouse (1978).

Birds are popular study creatures because they are generally easy to observe and identify. Behavioural studies are often limited by the seasons, but liaison with local ornithologists should help you to decide which species can be studied during the period of your fieldwork. Species lists and their relative abundance are of considerable interest, especially if it is possible to relate this information to local habitat and climatic variables.

Mammals provide good opportunities for the field biologist, but you should remember that large mammals will be less common than small ones. If you have transport and the local authorities are interested in obtaining information on the abundance and distribution of large mammals, this can be accomplished by carrying out regular road transects in a vehicle or even by walked transects. This information may be related to factors such as habitat type, habitat structure and time of day. Clearly, in a few weeks of fieldwork you will obtain only a picture that has relevance to the season in which you carry it out. Riney (1982) and Bothma (1989) provide valuable information on the study of large mammals and their habitats. GPS/GIS (global positioning system/geographic information system) techniques are increasingly being employed in these studies, providing information on position and even abundance (Packer et al., 1998).

Small mammals provide an opportunity to observe a fairly diverse fauna in most savannah environments. Although it may be necessary to kill some animals if you wish to study feeding or reproduction, a great deal of valuable work can be carried out on distribution and abundance, using simple mark–release recapture techniques. Special precautions should always be taken in handling small mammals in respect of rabies and other potentially hazardous parasites and diseases.

TABLE 25.1 **TOP REFERENCES FOR THOSE WANTING TO STUDY THE EFFECT OF ORGANISMS ON SAVANNAHS**

Organism	*Reference*
Termites	Goudie (1988)
Ants	Humphreys (1981)
Worms	Humphreys (1981)
Birds	Mitchell (1988)
Anteaters	Mitchell (1988)
Elephants	Laws (1970)

SOURCES OF ADDITIONAL INFORMATION

Geomorphological research

In this section, attention is drawn to certain geomorphological phenomena that are of special interest, and references will be given to work that has previously been undertaken on such phenomena in savannah environments. A good general introduction to savannah landforms is given by Thomas (1994).

Past flood estimation

From time to time savannah areas, in spite of the fact that they are not normally as wet as the humid tropics, are subjected to very powerful storms, such as tropical cyclones or other major atmospheric disturbances. Such storms can cause extensive

Figure 25.1
Sediment coring is physically hard work but can reveal much about the palaeoecology of a region (© Andrew Plater, Liverpool University)

flooding and, for engineering purposes (e.g. bridge or dam construction), it is valuable to have an estimate of the sort of flood discharges that can come down a particular river under such circumstances. Unfortunately, in many areas long-term gauging records are not available, and in some cases the record may have been disrupted by past flood events themselves! For this reason geomorphologists and hydrologists have developed techniques for estimating past flood discharges that do not depend on gauging records.

A good example of this technique, together with details of how calculations are made, is provided by Gillieson et al. (1991). Another related method of estimating the discharges of past flood events is to look at evidence for bent or damaged trees along a gorge and to try to estimate the date of the damage by dendrochronology (tree-ring analysis) (see Hupp, 1988).

Dune system descriptions

Savannah areas, being at the transition between dry (desert) and moist (rain forest) environments, have been subjected to major climatic changes during the course of the Quaternary era. During dry phases, when desert margins extended towards the equator, desert dunes were more extensive and they now underlie large areas of savannahs, as in the Kalahari, West Africa, North-west India and much of Australia.

From a geomorphological and palaeoclimatological viewpoint, it is of value to describe the form, sedimentology and age of such ancient dune systems. Examples of the type of work that can be undertaken are provided in Thomas and Shaw (1991).

Extinct lake surveys

The imprint of past moister conditions is equally evident in lake basin areas. When conditions were wet the lakes reached higher levels (leading to the creation of shorelines) and had different chemical and biological conditions. Thus, it is important to seek evidence for high lake shorelines or to obtain cores from sediments laid down during different stages of their history. Such cores can be extracted from lake beds by a range of coring devices and using rafts. The analysis of the cores is a complex matter, requiring input from pollen analysts, chemists, diatomists, etc. Dating is also an expert matter, but there is no doubt that, if we are to understand the past history of savannah areas, these are among the most productive methods. A good example of recent work in this area includes that of Hooghiemstra (1989).

Studies of erosion

Savannah areas have been the subject of considerable erosional activity, because of either the intrinsic nature of tropical rainfall or the effects of vegetation degradation promoted by human activities. Such erosion may be evident as a general reduction in the level of the land surface or through the development of erosional scars (gullies). It is important to know the age, rates and causes of such erosion. A range of useful work can be done in the field:

- Surveying of gully systems to compare their extent with those shown on old maps and air photographs.
- Archaeological examination of gully systems to determine their age and history.
- Measurement and dating of degree of root exposure of trees by dendrochronology.
- Estimation of rates of sediment accumulation in reservoirs behind dams of known age.
- Instrumentation (e.g. with erosion pins) and detailed survey of gully systems so that sequential measurements can be undertaken by future teams.
- Experimental run-off and sediment generation using rainfall simulation techniques on different land surfaces.

The following publications give good examples of the type of work that can be undertaken: Price-Williams et al. (1982), Biot (1990) and Dunne et al. (1979).

Indeed, soil erosion is but one manifestation of the possible role of humans in modifying and degrading savannah environments. Savannah areas are one of the prime environments that are subject to desertification – the spread of desert conditions into areas where under normal climatic circumstances they would not exist. Deforestation, over-grazing and related processes expose savannah surfaces to wind and water erosion, landslip formation, accelerated sedimentation and various other deleterious geomorphological processes. There is a great need for "ground truth" on the status of areas subject to desertification and for field surveys connected with current and past remote sensing imagery (including air photographs, some of which may go back four or more decades). An excellent general discussion of desertification is provided by Grainger (1990), whereas Mortimore (1989) demonstrates what can be done by painstaking research in a specific savannah area of West Africa. This includes the use of air photography and ground survey to monitor accelerated deflation and dune reactivation. Social aspects are expanded in Chapter 4.

Organisms other than humans play a major role in the moulding of savannah environments, be they small (e.g. termites) or large (e.g. elephants), yet their contribution to landform development has not received the attention that it deserves. The whole area of what is called "biogeomorphology" has been reviewed by Viles (1988).

In some of the world's savannah areas there is extensive development of various phenomena associated with the solution of limestone bedrock. Savannah karst phenomena have probably not received as much attention as those in more humid areas, but major cave systems (possibly dating to earlier more humid phases) do exist. The karstic phenomena of the Napier range of north-west Australia were the subject of the classic investigation of Jennings and Sweeting (1963) and comparable work needs to be done in other areas. Moreover, because of the high rates of evaporation in such areas, a whole suite of limestone precipitation forms develop, called tufas or travertines (Viles and Goudie, 1990) and these deserve further study, particularly with regard to the role of organisms (such as mosses) in their formation.

Landform surveys

In the eyes of many visitors to savannah environments the most typical landforms are miscellaneous types of isolated hill (inselbergs, bornhardts, koppies, tors, etc.), which have developed in a range of rock types, including granites, migmatites and sandstones. The development of such features is closely related to the type, structure and mineralogy of the rocks in which they are developed and there is considerable scope for trying to establish the precise relationship between rock type and inselberg form and distribution. An example of this type of work as part of an undergraduate project is described in Gibbons (1981), whereas some of the methods of determining rock properties are described in Pye et al. (1986).

Another characteristic landform type of savannah areas is the Dambo (see Thomas and Goudie, 1985). These are small channels, seasonally waterlogged, grassy valleys, often with rather rectangular patterns. They are especially widespread in Central Africa (e.g. in Zimbabwe, Malawi and Zambia) but are also known from West

Africa (the *fadama* of Nigeria and the *bolis* of Sierra Leone) where they are as much a part of the landscape as the magnificent inselbergs and endless plains. Little is known about the distribution and form of these features in some parts of Africa, and our knowledge of such features in northern Australia, India and South America is slim indeed. They present considerable research opportunities and offer scope for collaboration with plant scientists.

To conclude, savannah areas, in spite of their very considerable extent and importance, have not always received the same level of attention from geomorphologists that they deserve. They do not have some of the specifically climatic-related landforms of some other major biomes (e.g. the active dunes of hyperarid regions or the glaciers of cold areas). Nevertheless, they present many challenging geomorphological problems and phenomena and, especially in the dry season, can offer a congenial and productive environment in which to work.

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