26 EXPEDITION RESEARCH PROJECTS IN ARID LANDS

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In the arid zone, loosely defined as having rainfall below 300 mm/year, life survives at the limits of its capacity for adaptation. Survival of both plants and animals requires them to be specialists and species must have the capacity to cope with, or avoid, stress resulting from lack of moisture in their environment. Behavioural adaptations of animals and physiological adaptations of plants and animals able to survive in the arid zone are therefore of special interest. The study of their physiology raises general issues about the limits of adaptation of which species are capable. Although areas subject to drought, the arid zone and semi-arid zones, comprise between 30 and 45 per cent of the Earth's landmass, they have been relatively little studied. Nevertheless there are several web links to organisations working in the arid zone, and at the end of this chapter web addresses are given for the Royal Botanic Gardens, Kew, the Convention on Biological Diversity and the Arid Lands Information Centre, Arizona. For an introduction to the arid zone, see Heathcote (1983) and the Action Plan resulting from the UN Conference on Desertification (UN, 1977); a number of research papers have also been produced by Unesco on specific topics. A recent arid zone resource study in Jordan sets out problems typical of the field (Dutton, Clark and Battikhi, 1988).

Top tip

You must be thoroughly conversant with the use of all equipment before the expedition. Heat, dust, sand and being bumped around in vehicles are not conducive to the efficient working of delicate instruments. You must know what is likely to go wrong with your equipment, have spare parts and back-up repair facilities that will get the equipment back into the field in time for you to gather sufficient data.

First be warned. The arid zone is characterised not only by low rainfall, but also by rainfall that occurs unpredictably in space and time. As moisture is the main limit to biological productivity, there are long periods in arid areas when very little is happening that can easily be studied. The average 12-week expedition, unless timed on the basis of very good intelligence, will probably fall into such a time of low productivity so there will be little life to study. You will find in these long dry periods that annual plants are absent or vestigial, most perennial plants bear no flowers or seed, and are not easily identified, reptiles will be aestivating and difficult to find, and densities of small mammals and non-migratory insects will be much reduced and therefore difficult to catch.

Do not be too put off, however; instead be like the plants, animals and people of the desert – opportunist. Make the most of what is available. If a high level of biological productivity would help your project, try to time the expedition for the period of year when rain is most likely to have occurred in the previous 2 months. Look for boundaries with more productive environments, consider studies on migrants who use, but are not totally dependent on, the local resources, don't be afraid to intervene with some water of your own, combine with specialists in other subject areas to broaden research opportunities. Look at aspects of human survival in the arid zone, such as building and architecture, patterns of water use and agriculture. Seek ideas from other expeditions into arid zones. The Oman Wahiba Sands project (1988) and Jordan Badia project of the Royal Geographical Society (with the Institute of British Geographers) (RGS–IBG) carried out substantial work on a number of different projects using several teams with different skills.

PLANT PHYSIOLOGY

An understanding of drought tolerance, or its development, in economically important plant species is recognised as a key research area, but it remains relatively unstudied. This may be because countries of the arid zone are generally too poor to finance such research, and larger countries with arid zones concentrate their research in more productive cooler and wetter areas.

Perennial plants make especially good subjects for physiological research because they are adapted to survive dry periods, not as seeds but as reactive organisms. When present, they are easy to find. At first glance many perennial trees and grasses may appear to be dead, but close examination will show one or two grey-green stems at the centre of a grass clump or a few green leaves distributed at low density over a tree. These perennials will have a low, but measurable, level of metabolism (Laurie, 1988). Such plants are stressed by low moisture levels and perhaps, in addition, by the saline soils on which they are dependent. Strong sunlight is also stressful and, in many tropical arid areas, intensity of insolation is so great that it is not easily replicable in the laboratory without very costly equipment, so fieldwork on the effects of sunlight is especially important. The stresses may be lessened by fog or dew during rainless periods.

Figure 26.1 *Field research into the sustainability of wild harvesting of thyme, High Atlas Mountains, Morocco (© Rachel Kaleta)*

It is possible to design research work using any combination of these parameters. Furthermore, you can subject plants to different artificial watering regimes and measure their metabolic response. Be sure that you can secure a source of water in the field and that you have enough rain gauges and control plots to cope with changes caused by natural rainfall, which will inevitably occur when you have your experimental system, based on artificial irrigation, neatly set up!

The main problem with such work is that it requires sophisticated equipment. If you wish to have any results at the end, it is unwise to use an expedition to test such equipment and you must be satisfied that any equipment is hardy before thinking about planning a project on based it.

MAPPING AND DESCRIPTIVE WORK

Descriptive work is often appropriate for short expeditions. It is the basis upon which more complex scientific research can be built and is always useful to host governments and other agencies who often lack basic knowledge of natural resources available to people and the way in which people use those resources. Mapping can also contribute to knowledge of the distribution of wild plant and animal species and how they are used (Cope, 1980); of soils, their distribution and condition; of water, its availability and use; of livestock varieties, their distribution and how they use an area;

and of the presence of local people and their flocks and herds at various times. Expeditions can also be used for ground proofing interpretations from satellite images, although vegetation mapping from satellite images in the arid zone continues to be difficult because of the sparsity of vegetation and the overwhelmingly high reflectivity of the background soils. The Royal Botanic Gardens at Kew, England, and other major collectors will give advice and perhaps lend equipment for plant collection. On insect collection and identification, see Buttiker and Buttiker (1988).

WORKING WITH LOCAL PEOPLE

Working with local people is essential to the success of most projects, but especially when they involve the study of the use of natural resources by wildlife or by people and their flocks and herds. Local people have the most intimate knowledge of the areas in which they live and they can help fill in the gaps, giving information on what happens at times when your project members are not present to observe directly. Gaining access to such information may not be straightforward. There are a number of reasons for this; language is one obvious problem, but differences between your way of conceiving of the world and that of the local people may be even more important. People may not want to reveal the nature and extent of their resources, such as the number of animals they possess, just as you may not want to reveal the balance of your bank account. Out of politeness people will often tell you what they think you want to hear, or, if they think you are involved with government, may give you answers which have more to do with their point of view on local political issues than with the reality on the ground. Barley (1989) gives an amusing account of the problems and misconceptions of the would-be anthropologist grappling with another culture.

Work with local people should always be matched with direct observation of what actually appears to be happening on the ground. This stimulates dialogue and may reveal important information which local people regard as too "obvious" to be worth mentioning. It will also reveal if there is a difference between what people say or believe they are doing and what they actually do – a common human trait in any society.

ANTHROPOCENTRIC STUDIES

The dry period is the period that determines the minimum productivity of an arid area and this in turn determines human use of an area. Perennial plants, but especially trees, are often the key resource in determining how animals, plants, people and their livestock use areas. If there is any productivity in an area, it will be productive throughout dry periods. This is especially so for trees and shrubs, which are often large enough to buffer the effects of long dry periods by tapping into a deep water table, storing water or absorbing dew through their leaves. Groups of trees or even a single tree will attract its own fauna of insects, mammals and birds worthy of study.

The relationship of pasturalists to their environment has been a major item of study since the droughts in the semi-arid Sahelian zone and the southward progress of the Sahara aroused the interest of the world community, manifested, for example, in the World Conference on Desertification in 1977 (UN, 1977). Since then, and in spite of substantial research, the problems of arid and semi-arid zone pasturalism have remained largely unsolved (e.g. Timberlake, 1985).

Local people may move around to use different parts of an area's resource at different times of the year. These sorts of interaction are complex and normally take place over the cycle of the year, or longer irregular periods, depending on the pattern of rainfall. There are often rapid changes after rain, the speed of change being related to the speed of change in the productivity of plants. Nevertheless, the task of mapping woodlands or perennial grasses is often a very useful exercise for the host country and becomes even more useful if the use of these resources by humans, their livestock and wild animals can be related to their distribution in time and space. Even if your project is of short duration, use of resources over a short space of time is worthy of study, especially when supplemented with information from local people, about how the area is used during the part of the year when you cannot be there, and how their use changes after rainfall. Information obtained in this way can be substantial and lead to a real understanding of how people use an area and contribute to a knowledge of survival strategies of peoples in the arid zone (Pratt and Gwynne, 1977; Munton, 1988; Webster, 1988). Resource use can also be related to the social structure of human groups, kinship, access to resources, and self-regulation of resource use through time, space and mode of use.

Again artificial watering can be useful to stimulate the growth of ephemeral plants, identify them and measure the rate at which forage becomes available for livestock or wild animals under different watering regimes. Be aware that the bare area under trees and shrubs in a dry period may produce a dense cover of ephemeral grasses after rain.

VEGETATION AND LAND FORMS

Vegetation is often important in determining erosive processes and may contribute to the form of the land. It is especially important in sand binding and catching blowing sand, especially in dry periods when sand and dust are more mobile. The combined work of a botanist and a geomorphologist has potential for useful studies in dry periods (Buckley, 1987).

Edge habitats

Pay special attention to the borders between different sorts of habitats, e.g. arid lands are often situated adjacent to very productive cool seas (there is often a causal link). Warm-blooded animals, especially scavenging desert birds and desert foxes and cats, which do not have an option to aestivate and are unable to migrate long distances, often occur in higher densities at such border areas, making them more amenable to study. The densities and behaviour of animals on these edges can usefully be compared with the ecology and behaviour of the same species in true arid habitats (Skinner et al., 1984). Radio tagging is often feasible in the open arid habitats (Amlaner and Macdonald, 1980). You should be aware, however, that your own presence and the rubbish that you produce represent a major rise in local biological productivity and the opportunist birds, mammals and reptiles of the desert will change their behaviour to make the maximum use of what you bring them. You may not therefore be studying their "normal" behaviour but the behaviour determined by your presence. Other edge areas are human settlements, especially camps of nomads. Even a group of leafy trees will provide an edge where it may be possible to observe how behaviour and ecology of the same species differ on either side of the boundary or how species of antelope (such as gazelle) make use of patchy habitat (Brown, 1988).

Overall the arid zone is a fascinating area to study and the difficult physical conditions will always make work challenging and demanding. Many people are dependent on the arid zone for their survival so any information or research work is always worthwhile from the human point of view, as well as for the survival of animal and plants that have evolved to live in its difficult environment.

DESERT GEOMORPHOLOGY

The attraction of doing geomorphological research in arid regions is that geomorphology is laid bare for all to see, particularly when it comes to the work of the wind. If you are lucky and choose a windy season, you will see dunes moving at up to a metre a day, and ripples forming and reforming in front of your eyes. Even if you are not looking at active landforms, stream channels, dunes, inselbergs, soil profiles and so on are all extremely accessible.

Useful texts on desert landforms, which will provide many ideas, are Thomas (1989) and Cooke et al. (1992).

Top tip

It is always as well to be prepared for the worst (or the best, depending on how you look at it). If you are lucky enough to see a flash flood, or an extreme dust or sand storm, you might as well measure it, because you, as a geomorphologist, will have been lucky. Ian Reid and Lynn Frostick were lucky enough and have provided a model of what might be done in relation to a flood (Reid and Frostick, 1987). If it is very windy, one can look at the effects on the form and movement of dunes as I did in the Wahiba Sands (Warren, 1988).

Figure 26.2 *Aerial reconnaissance is an excellent way of getting an overall view of the landscape, in this case flying by light aircraft over the Nubian Desert (© John Radford)*

Examples of projects include the relation of the size and shape of ripples to where they occur on a sand dune. The theory of ripples has recently been thrown wide open by the research of Bob Anderson in California (1987b, 1990). He has also thrown open the discussion of slip-faces, which are active and surprisingly complicated features (Anderson, 1987a). If you can get hold of a few simple sand traps or even anemometers, you could add to the understanding of dune shapes. A day or two's measurements (if conducted properly) can add a lot to what is known in this area (Weng et al., 1991). If you have the time and facilities (and the weight allowance) to bring home sand samples for analysis, then a large area of investigation opens up (Warren, 1971; Sarre and Chancey, 1990).

Anderson (1986) has also opened up the research of wind erosion, suggesting projects on the form and distribution of pebbles and rocks eroded by the wind. There are two schools of wind erosion now – one believing that sand is the main agent, the other that dust may erode (Breed et al., 1989). Ron Cooke's (1970) work on desert pavements (the stony layer at the surface of most deserts) has shown that they too are remarkably complicated and fascinating phenomena. Although a short expedition does not have the time to do their dynamics justice, there is still a lot of interest in their morphology, distribution and associated soils, which can be studied over a short period (McFadden et al., 1987).

Stream channels in deserts and semi-arid areas are another area that is wide open for new ideas and data collection, as the work of Graf has shown in New Mexico (various references in the "Bibliography"). Surveys of channels can often reveal why entrenchment has occurred, be it because of an infrequent flood (Reid and Frostick, 1987) or some form of interference by people (Cooke and Reeves, 1976). Surveys of channels, if accompanied by observations of the alluvium into which they are cut, can also establish a history of cut and fill (Vita-Finzi, 1969).

Research on desert inselbergs has shown that measurements of rock strength can help to explain some of their characteristics (Selby, 1980, 1982). Other projects could be undertaken on the relationship between the size of debris (often huge boulders) and the form of mountain slopes (Cooke and Reeves, 1972).

There are many ways in which desert landforms impinge on the lives of people. Dunes move over fields, desert floods wash away roads, etc. Studies of this kind of problem can draw on Ron Cooke's work on these effects for examples (Cooke, 1974a, 1974b, 1982; Cooke et al., 1978, 1982). If you are lucky enough, you may find an old map or air photograph of the position of a sand dune, and see how far it has gone, rather as one of Brigadier Bagnold's sand dunes was rediscovered 57 years later and several kilometres away (Haynes, 1989).

FURTHER INFORMATION

Useful websites

Arid Lands Information Centre, Arizona: http//ag.arizona.edu/OALS/aols/alic/alic.html
Convention on Biological Diversity: http//www.biodiv.org/links/default.aspx?sbj=dls
Global Drylands Partnership: www.undp.org/seed/unso/globalpartnership/gdp.htm
RIOD International NGO Network on Desertification: www.riodccd.org
Royal Botanic Gardens, Kew: http://www/rbgkew.org.uk/scihort/eblinks/arid/html
United Nations Convention to Combat Desertification: www.unccd.int
UNDP Office to Combat Desertification and Drought (UNSO): www.undp.org/seed/unso/

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