8 MONITORING REQUIREMENT AND POSSIBLE LOCATION OF CORRIDORS

M O Hill

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8.1 MONITORING REQUIREMENT

For most organisms, the requirement for migratory corridors is so doubtful that the main requirement of monitoring must be to see whether corridors serve any useful function at all. For this purpose, we require better information on the dynamics of spreading populations. Examples considered above show that corridors play a large part in species' spread where they are themselves a large part of the species' habitat. This applies particularly to fishes such as the zander and to aquatic plants which spread by vegetative fragments along canals.

Almost any organism with suffiently small propagules will spread effectively if it has safe sites in which to land. This has been demonstrated by the remarkable propensity of bryophytes and lichens to appear in new localities long distances from the nearest source (Bremer & Ott, 1991; Gilbert, 1992; Söderström, 1992). Orchids and Pyrolaceae behave similarly. Particularly notable is the spread of Pyrola rotundifolia in sand-dune systems in western Britain. In many dune systems, it simply appeared and there was no indication of its origin. Wind, cars or birds could easily have been the agents of dispersal.

Given these facts, the following proposals are recommended.

8.2 REGULAR OBSERVATIONS OF PARTICULAR COLONIES

Colonies of rare species that are expected on climatic grounds to expand will be selected.

The first stage is to get a complete enumeration of the rare species of interest and to select ones that are likely to show a large climate sensitivity. Species with a definite biotope requirement such as deciduous woodland, heathland or calcareous grassland would be suitable. Species with southwestern distributions are particularly likely to expand, because these presumably have a strong requirement for warmer winters. Some species with more distinctly southeastern distributions should also be selected for study, because the effects of climate change on rainfall are not known. If the climate becomes drier, particularly in summer, then southern species will be favoured, and at least some southwestern species with a high moisture requirement will not benefit.

Species selected as climatically suitable for study need then to be considered in terms of their likely population dynamics. Plants with long-lived clones (e.g. Stemless thistle Cirsium acaulon), although potentially interesting, may take a very long time to expand and therefore present considerable practical difficulties. Invertebrates and short-lived plants are likeley to be more satisfactory from this point of view.

Another requirement is that species chosen for study should be easy to find. If a species is at all cryptic, the chances of spotting new colonies as they are appear is much diminished. The practical requirement, that colonies should be accessible, is not much of a constraint in lowland England.

It is also necessary that species should live in recognizable colonies and that they should not have obvious means of long-distance dispersal. Orchids, for example, often live in colonies but, as noted above, are adept at long-distance dispersal and therefore unsuitable.

Even when all these conditions are met, the likely timescale is long. Not only must we wait for the climate to warm, but we must wait for populations to respond. Therefore, studies of this type should be carefully planned, concentrate on a few interesting species, and, if possible, have other objectives such as investigation of genetics and population dynamics.

8.3 MONITORING OF POPULATIONS OF UPLAND AND MONTANE SPECIES

Populations of upland and montane species are undoubtedly at risk from climate change. Few species with a requirement for cold winters are present in England and Wales. However, cloudberry *Rubus chamaemorus*, which is absent from many western bogs, is present in large quantity in the Pennines and be expected to retreat, possibly quite rapidly.

There is, as already observed, rather little that can be done to help declining montane species. It is useful to be aware which species are directly affected by warmer weather and which are subject mainly to competitive exclusion. If a species is directly affected by warmer weather then there is no point in attempting to preserve it. Competitive effects, on the other hand, can sometimes be mitigated. The most obvious example is control of woody vegetation by grazing, so that steppe species such as Pasque flower *Pulsatilla vulgaris* are able to persist in grassland biotopes that lie outside the steppe biome. In England, the most spectacular example of species survival outside their main range is on the limestone of Upper Teesdale. This locality also contains a few southern species such as *Hippocrepis comosa* (Pigott, 1956) and is therefore particularly suitable for monitoring.

Perhaps the most important gap in knowledge for montane plants is information on their regeneration dynamics. Some species can persist for hundreds, perhaps thousands of yers outside the region where effective sexual reproduction is possible. *Rubus chamaemorus* is a good example. But for most species, such information is lacking. A better knowledge of population and community dynamics is the main requirement here.

It may be added that for less popular groups such as mosses, our knowledge of the dynamics of montane communities (and also of lowland communities) is exceedingly poor. Valuable montane mosses occur in large numbers on the limestones of Pennines, often on cliffs and in ravines. Likewise, moisture-loving mosses (and some ferns) occur on cool slopes in the north and west. Maintenance of tree-cover may be important for their survival in some localities, but so little is known about their regeneration that this is hard to assess.

8.4 REGULAR OBSERVATIONS AT SELECTED SITES

In the previous sections, the emphasis has been on observations of particular species, to achieve a better understanding of their dynamics and the constraints on their populations. There is also a place for regular monitoring of selected sites.

Monitoring schemes for the wider countryside must rely on sampling, and the use of selected sites has much to recommend it. However, selection presents problems. If, for example, sites are selected for monitoring butterflies because they are good for butterflies, and if they subsequently deteriorate so that records are discontinued, then it is impossible to get a good overall indication of change. In the meantime, other sites may have become favourable, so that there is no net change, only movement.

For this reason, an effort should be made, with all site-oriented monitoring schemes, to maintain a "core" of sites that will be surveyed repeatedly even if amateur surveyors find them unattractive. Species enumerations for National Nature Reserves can make a large contribution here, as can enumerations for local reserves.

In collecting and maintaining such data, quality is a vital concern. If a monitoring scheme tries to do too much it will achieve quality will fail and the scheme will become worthless. Standards of data quality should be set, and data which achieve these standards should be maintained in a form where they are fully available both to the public and to statutory conservation agencies.

8.5 ANALYSIS OF NATIONAL AND LOCAL DATA FOR SYSTEMATIC CHANGES

Climatic changes of the magnitude anticipated for the next 100 years will undoubtedly result in distributional changes at the national scale. The examples considered in Chapter 5 show that for insects such changes can, following a spell of warm weather, be very rapid.

It should in principle be possible to give much clearer indications of the climatic requirements of species. Indeed, a climate-profile (at the European level) of all species in the British flora would be a perfectly attainable objective. Given such profiles, the species composition recorded by monitoring schemes such as the BSBI Monitoring Scheme could be assessed for change. Individual species changes can rarely be interpreted, but systematic change in particular directions certainly can.

Similar analyses are possible for the more popular invertebrate groups. Systems should be developed further to interpret the meaning of national datasets. The question "What does this species list mean?" can often be answered by automatic analysis, e.g. by submission to an expert system such as TABLEFIT (Hill, in press).

The essence of any such approach is to clarify what it is that nature conservationists want to know. Merely to observe change will generally not be enough. Successful conservation must be able to use this information.

8.6 PREDICTIVE MODELLING

Because of long timescales and the difficulty of maintaining monitoring schemes, and because an answer may be wanted sooner rather than later, rapid understanding will best be achieved by predictive modelling. At the very least, monitoring schemes should be set up to verify the predictions of models. This will allow better targetting of observations and will also allow the models to be tested for the future. Clearly, human-induced global climate change is not going to stop in the year 2100 (say), but will continue for hundreds and probably thousands of years. The requirement for properly tested predictive models, far from going away, will increase.

Predictive models are still at a rather crude stage and require better understanding of both population processes, climate requirements and the effects of climate on species. The area of greatest development at the ecological scale is forest stand models. With these, timescales of change are beginning to be understood and the crucial role of disturbance appreciated (Prentice, Sykes & Cramer 1991, 1993).

For nature conservation purposes, the role of predictive modelling will be to answer questions such as:

What structural changes can be expected at this site?
Do we expect gradual change or change driven by extreme events?
Will this species soon be threatened?
Do we need to create corridors?
Are species introductions necessary?

Many of these questions cannot be answered at present, but active research, sponsored by DoE and NERC, is developing a basis of expertise and knowledge which will allow answers to be made.

8.7 FIELD EXPERIMENTS

In the present state of knowledge, the main experiments that are required are not so much construction of corridors - a costly and time-consuming activity - but field observations and experiments to assess the rate of colonization and spread of animals and plants and to get a better understanding of their population dynamics. Such experiments are needed particularly to provide information for predictive modelling.

For example, it might be expected that the southern heathland plants *Agrostis curtisii*, *Erica ciliaris* and *E. vagans* will spread if the climate warms. If the rate of such spread is to be predicted, then information on their distance of dispersal and establishment success is required. All of them are likely to be fire-regenerated; this has been demonstrated by Gray (1988) for *A. curtisii*. In the first place, an indication of their rate of neighbourhood diffusion (Chapter 3) can be obtained. This would require controlled introductions and controlled disturbance by fire.

Long-distance and medium-distance transport are much harder to observe because they depend on rare events, which cannot be studied by simple monitoring. It is likely that transport from one heathland area to another was effected in the past by movements of livestock. Nowadays the agency is more likely to be wheels of vehicles. If so, then the effectiveness of any corridor may depend on how much it was used for vehicles. In the British context, use by the military for tank excercises could be crucial.

Perhaps therefore the most useful sort of experiment would be to find small impoverished heathlands and to disturb them with vehicles that have come from richer heathlands elsewhere.

In woodlands, likewise, there is still much information to be obtained by experiment. The rate of neigbourhood diffusion can be studied by species introductions and inferred from observations of spread from long-established woods into adjacent new woodland.

Here too, long-distance spread is likely to be episodic. Almost certainly, corridors will be ineffective except for mammals such as Dormouse <u>Muscardinus avellanarius</u>. For plants, transport of seeds in mud or accidental introductions from garden populations are far more likely to move plant propagules from one site to another than is spread down a corridor. Clonal growth is three orders of magnitude too slow to allow plants to migrate in response to climate change.

In conclusion, experiments to establish migratory corridors should not be set up until there are clear hypotheses that they can be designed to test. Evidence from insects and plants, considered above, suggests that corridors will be of little help in moving species around the countryside. Insects will mostly find their own way from place to place and plants are more likely to be transported by agents such as man, deer and birds.

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