

monitoring is “Any variable or process which can be readily measured and dated may be valuable in detecting changes in ecosystems.” A corollary to “save all the parts” thus seems to be “monitor everything you can.” However, all monitoring programs are limited by time, money, and taxonomists.

Given the sensitivity of ant assemblages outlined in this chapter, we argue that ants would be an ideal animal group to monitor in an ecosystem. But what aspects of an ant assemblage should be monitored? We suggest a set of three parameters—those of individuals, populations, and diversity.

Individual-Based Changes in Ant Assemblages

Individual organisms can be collected and assessed for physiological responses to environmental change. In long-lived colonies (e.g., the harvester ant *Pogonomyrmex*) the same colony can be monitored over many years. This might be especially useful if early warnings of stressors are first reflected at the individual level.

Thus far such studies in ant ecology have been rare. However, there are a number of properties of individual colonies that might be monitored. One is colony activity. If it is sampled at the same time every year, in similar weather, a concerted decline in the numbers of foragers recorded outside a colony may suggest pathology long before the colonies die.

A second possibility is deformation of individual workers. A promising new field in conservation biology is the study of fluctuating asymmetry (Palmer and Strobeck 1986; Leary and Allendorf 1989). Organisms tend to develop symmetrically (i.e., their right and left sides are mirror images of each other). Environmental stressors can disturb this development and cause asymmetry. Yearly samples of large, long-lived species may thus detect changes in symmetry in colonies exposed to stressors compared to controls. Working on social insects has

the added benefit of holding the genotype constant as the environment changes.

Population-Based Changes in Ant Assemblages

Within any diverse assemblage there are likely to be species that are acutely sensitive to a variety of stressors (Carpenter et al. 1993; Tilman 1996). A monitoring program focusing on the population responses of these species stands a good chance of picking up the effects of stressors on ecosystem function long before permanent damage is done (Schindler 1990).

Measurements of colony density—based on quadrat sampling, coupled with hand, Winkler, or Berlese extraction (Chapter 9)—probably remain the best foundation on which to build an ant population monitoring program, because of the quadrat’s lack of ambiguity. The more indirect and relative the estimate of abundance (e.g., that arrived at using baits or pitfall traps), the harder it is to interpret changes in numbers (see Fig. 7.1).

Large-colony species like the harvester ants may be relatively easy to detect and should be part of any monitoring program. Small-colony species, such as those that nest in the litter, are also readily sampled using a quadrat-based method. Combined, the two groups of species would monitor for change on a variety of spatial and temporal scales.

Certain species may characterize pristine ecosystems (Chapter 6). If so, the abundance of those species should be an index of an ecosystem’s recovery from perturbation. Such an index (percentage recovery of target species) may be used to gauge recovery. Ordination methods, which can detect trends in (or add weighting to) target species, might be used to detect such trends (see Chapter 13).

Diversity-Based Changes in Ant Assemblages

Monitoring has often focused on some measure of diversity, be it the number of species (species