many areas that any degree of confidence can be placed on whether the changes can be attributable to climate. However, these are the sort of changes expected with a warming climate.

Birders can greatly help scientists researching the effects of global warming on bird distribution. In order to look for possible climate-associated changes it is necessary to study multiple long-term data sets from many different areas. This does not have to be an organized survey, like the BBS, but can be one person's records, collected over many years at their favorite birding location. Or it could be the records of many people compiled for a single park for example (see the end of the article for information on how you might contribute to this sort of research).

It is helpful to consider how species' ranges may change to know what sorts of changes to look for in the future. Observed evidence and model projections both show that warming is/will be more pronounced by increases in minimum temperatures than maximum (although these will increase as well). Thus, species might be expected to show northward range expansions (including colonization) before they show declines/extirpations in the southern portions of their range. Furthermore, while the average temperature (climate) increases, weather still occurs and some years will be cooler and others warmer than otherwise expected. So, colonization will most likely occur in fits and starts before a species can truly considered to be established as part of Illinois' breeding avifauna. In some cases, a species may start appearing as a vagrant, off and on, for several years before breeding is attempted. In other cases a species may start breeding in an area, then become extirpated, and then resume breeding – possibly in greater numbers than before.

How quickly distributional changes might occur is unknown. The rate of change will largely depend on whether limits to a given species' distribution are more closely linked with climate (especially temperature), vegetation, or some other factor. The rate of change will also likely be tied to the rate of change of the climate itself. If the climate changes relatively slowly, then species may be able to adapt to the new climate. However, many changes could (and are) occurring relatively quickly. One pilot study found that the average latitude of occurrence of some species of neotropical migrants has already shifted significantly farther north in the last 20 years, by an average distance of almost 60 miles (100 km) (Price, unpublished data). In another study, the arrival date of 20 species of migratory birds in Michigan was found to be 21 days earlier in 1994 than in 1965 (Root, unpublished data, Price and Root 2000). Many other species have been found to be arriving and breeding earlier, not only in the U.S. but in Europe and elsewhere (Root et al. 2003).

Shifts in individual species' distributions are only part of the story. It is unlikely that ranges of coexisting species will shift in concert. Bird communities, as we currently know them, may look quite different in the future. As species move, they may have to deal with different prey, predators, and competitors. So-called "optimal" habitats may no longer exist, at least in the short term. The potential rates-of-change of birds and the plants that shape their habitats are often quite different. While many birds may be able to respond quickly to a changing climate, some plant ranges may take from decades to centuries to move (Davis and Zabinski 1992). Thus, some species may face a bottleneck with physiological limits pressing them to move but having no habitat available to move into. This phenomenon may be especially true for the grassland birds.

Conclusion

Projected future rapid climate change is of major concern, especially when viewed in concert with other already well-established population stresses (e.g., habitat conversion, pollution, invasive species). Research and conservation attention needs to be focused not only on each stressor by itself, but also on the synergies of multiple stressors acting together. These synergistic stresses are likely to prove to be the greatest challenge to wildlife conservation in the 21st Century. Because anticipation of changes improves the capacity to manage, it is important to understand as much as possible about the responses of animals to a changing climate.

Managers may ultimately need to adapt not only in terms of wildlife conservation but also to replace lost ecological services normally provided by wildlife. For example, it may be necessary to develop adaptations to losses to natural pest control, pollination and seed dispersal. While replacing providers of these services may sometimes be possible, the alternatives may be costly. Finding a replacement for other services, such as contributions to nutrient cycling and ecosystem stability/biodiversity are much harder to imagine. In many cases, losses of the values of wildlife associated with subsistence hunting, cultural and religious ceremonies, any attempt at replacement may represent a net loss.

A high probability exists that climate change could lead to changes in bird distributions. Even a relatively small change in average temperature could impact bird distributions within the state. Some of these changes could occur (and may