are no different. Ecology has its grand theories, but they are riddled with conditional clauses, caveats and exceptions. There are clear patterns at the global and single-species scales, but the middle ground is, as biologist John Lawton affectionately put it in 1999, "a mess". It is doubtful that the generalities that underlie the complex patterns of nature will ever be phrased succinctly enough to fit on a T-shirt.

This complexity is demonstrated by work that questions a famous and elegant 'trophic cascade' in Yellowstone National Park, Wyoming, discussed on page 158. The theory goes that wolves, restored to the park in the 1990s after decades of absence, scare elk away from certain areas. That has a knock-on effect for the rest of the food chain, allowing aspen and willows to flourish after decades of being browsed nearly to death. But studies in recent years suggest that wolves alone do not control the ecosystem. Other factors — the presence of beaver dams and grizzly bears, weather, hunting by humans and even climate change — also affect the elk population and the growth of trees and shrubs.

It would be useful to have broad patterns and commonalities in ecology. To know how ecosystems will respond to climate change, or to be able to predict the consequences of introducing or reintroducing a species, would make conservation more effective and efficient. But a unified theory of everything is not the only way to gain insight.

More ecologists should embrace the non-predictive side of their science. Teasing out what is going on in complex systems by looking at how ecosystems evolved, and by manipulating the environment in experiments, is just as much a science as creating formulae for how ecosystems work.

Paradigm shifts, after all, are rare in ecology. Debates are often resolved when competing concepts combine, rather than when one pushes the other completely off the table. Take the contrasting ideas of top-down regulation of ecosystems by carnivores and bottom-up regulation effected by the nutrition available from plants. The field is slowly working towards an integrated theory to predict when the top will rule and when the bottom will be in charge — and that theory will take the time to consider the middle players, the herbivores.

Other ecological debates have followed a similar path. Disagreement over whether complex ecosystems are more or less stable than simpler ones, for example, is also settling to a consensus: it depends.

Useful practical predictions need not stem from universal laws. They may come instead from a deep knowledge of the unique workings of each ecosystem — knowledge gained from observation and analysis.

"If ecosystems all worked in the same way, they would lose much of their mystery, their surprise and their beauty."

Proposing sweeping theories is exciting, but if ecologists want to produce work useful to conservation, they might do better to spend their days sitting quietly in ecosystems with waterproof notebooks and hand lenses, writing everything down.

Ecological complexity, which may seem like an impenetrable thicket of nuance, is also the source of much of our pleasure in nature. If ecosystems were simple puzzles that all worked in the same way, they would lose much of their mystery, their surprise and their beauty. A lot of conservation work aims to protect the complexity and variability that makes ecosystems so hard to understand, and indeed to conserve.

Ecological rules are not the only reasons to promote conservation and fight extinctions. Sometimes we can argue for the conservation of particular species because ecology provides a scientific basis for it. At other times, we make the argument because there is a good chance that ecology will soon catch up and explain why the species are important.

But even if some predators do little but sit at the top of their food pyramids, creaming off a few herbivores, would we really want to live in a world without them? Answering that question really is easy. ■

Share alike

Research communities need to agree on standard etiquette for data-sharing.

Every mountaineer knows the sinking feeling of reaching a peak after a hard climb, only to see the true summit still above. Scientists who take on the tough terrain of open access may have a similar experience. After they reach the notable goal of sharing their research papers, they discover that a higher summit awaits: open data.

In many fields, making research data available online for all is a step beyond making research papers open-access. This might puzzle communities that have already agreed to share. Biologists routinely upload DNA sequences to the public repository GenBank, for example, creating a scientific commons for everyone's benefit. There are now more than 600 subject-specific repositories, with community-specific standards.

Yet even some of the most strident open-access supporters baulk at the concept of fully open data, judging by the reaction to a strengthened data-sharing policy instituted by the Public Library of Science (PLOS) this month. PLOS now requires researchers to make their papers' underlying data open online on publication, apart from data that they have a duty to keep private, such as that on human study participants (go.nature.com/rd27aa). Journals such as *Molecular Ecology* have mandated the same thing for years. But the PLOS move has provoked heated discussion and highlighted some important, yet unsettled, aspects of the practice and ethics of online data-sharing.

A few years ago, a survey found that scientists cited a lack of time and money, as well as technical barriers, to explain why they did not post data online (C. Tenopir *et al. PLoS ONE* **6,** e21101; 2011). It still takes time to prepare data, but increasingly, other excuses do not fly. General-purpose storage sites such as Dryad and figshare are cheap (or free) and suitable for all kinds of data sets; data journals provide publication venues appealing to the traditionally minded; and standards are emerging for citing other people's data sets (see *Nature* **500,** 243–245; 2013).

Harder to surmount are the feeling of data ownership and the fear of being 'scooped'. Years of toil to collect a data set that might support a decade of career-making publications could be rendered moot when another researcher jumps on the information online. This is a particular problem for early-career researchers, and for those working with unique data sets in small ecology or environmental-science laboratories.

Behind this fear is the worry that other scientists will not provide credit for the data they use. Research administrators place such importance on paper authorship that it is probably not enough for a study that leans significantly on another researcher's hard-won data set to merely cite that researcher, perhaps depriving them of a publication.

Communities need to debate the ethics of data-sharing and agree on etiquette. When a researcher relies on another's data, for example, it should be standard practice to invite the data-providers to be co-authors. Ecologists Clifford Duke and John Porter have suggested guidelines for deciding whether to extend such an invitation (C. S. Duke and J. H. Porter *BioScience* **63,** 483–489; 2013); these include noting whether the data are integral to the new analysis, whether the data are unique or particularly novel, and whether the data-provider can fully participate in manuscript-writing by approving draft and final versions. Another ecologist, Dominique Roche, has urged disclosure of data reuse, and better communication between data generators and reusers (D. G. Roche *et al. PLoS Biol.* **12,** e1001779; 2014).

It is not clear whether widespread online data-sharing will increase uncredited scooping. For now, *Nature* mandates uploading data when structured community data repositories exist, and encourages it otherwise. Before you can climb the highest mountains, you need proper safeguards and a decent map. ■

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