Embrace unknowns, opt for flexibility in environmental policies

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We make hundreds, possibly thousands, of decisions each day without having full knowledge of what will happen next. Life is unpredictable, and we move forward the best we can despite not knowing every detail.

It's no different in the natural world. The Earth is warming, fish stocks and species counts fluctuate and we're experiencing more extreme weather. Conservation managers need to act quickly and make decisions about how to address these issues - even though questions remain.

That's the argument of two University of Washington researchers whose perspectives article appears Feb. 27 in *Science*.

"Modern science is producing lots of new knowledge, but we question whether that knowledge is going to accumulate fast enough to be useful as systems change rapidly," said Daniel Schindler, a co-author and UW professor of aquatic and fishery sciences. "We have to learn how to manage our ecosystems and natural resources in a reality where uncertainties dominate. That often means we have to make tough decisions with lousy knowledge."

The usual path for those tasked with environmental conservation is to study certain aspects of an ecosystem, then try to predict what will happen down the road. Many scientists and funding agencies say that better understanding of a particular system will produce more accurate predictions that lead to more informed decisions.

But Schindler and co-author Ray Hilborn, a UW professor of aquatic and fishery sciences, argue that it's impossible to understand a changing, natural system in great detail, and that important policy moves shouldn't hinge on the ability to have all the facts. Instead, managers must learn to make decisions based on an uncertain future.

"We have to learn to manage what we'll never fully understand," Schindler said.

Managers must develop robust policies that would remain effective no matter how the future unravels.

"Rocket scientists have it easy: Natural ecosystems are much more complex than rockets and we must identify management policies that are robust to the uncertainty in how the natural systems will respond," said Hilborn.

The authors offer several suggestions to achieve this:

- Create policies that have legs: When developing a policy to manage fisheries or allocate water distribution in agriculture, for example, make it flexible so it can continue to effectively manage the resource, no matter how it changes in the future.
- Support policies that encourage ecosystem diversity: Opt for plans that encourage organism and habitat diversity, because casting a larger net will let the policy be most responsive no matter what happens in the future.
- Invest more in monitoring: Don't just collect data, but actively analyze the data, drawing connections to the past and assessing what that relationship might mean for the future. Do more field-based monitoring and less predictive modeling.
- Expect a future that's different from the past: Move away from a "better safe than sorry" approach to management and assume the

ecosystem will shift in unexpected ways. Design policies that can adapt based on how the ecosystem changes.

Schindler and Hilborn say these principles can guide management of any natural or renewable resource, including agriculture, fisheries and forestry, to name a few. They argue that sustainability is about achieving human connections with properly functioning ecosystems, and that it's important to set up policies that keep people engaged with the natural world.

These recommendations likely won't surprise everyone in resource management, and the authors acknowledge many among them already are working in this way, or striving to do so. It could, however, be more difficult for scientists and funding agencies that still think "mechanistic science is what produces the knowledge needed to manage the world," Schindler said.

"We are not trying to devalue the science, but it is critical to have an honest, frank discussion among all the players about what approaches we are taking to really contribute to sustainability," he added.

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