

# 'Modern Portfolio Theory' optimizes conservation practices: study

May 15 2012

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Using wetland habitat conservation in the Prairie Pothole Region as a case study, applied economists Amy W. Ando (right) and Mindy L. Mallory demonstrated that adapting a theory from the world of finance could help to optimize conservation activities in the region. Credit: L. Brian Stauffer

While climate change is likely to alter the spatial distributions of species and habitat types, the nature of those changes is uncertain, making it more difficult for conservationists to implement standard planning models. Research from applied economists at the University of Illinois shows that adapting a theory from the world of finance could help to optimize conservation activities.

Using wetland [habitat conservation](#) in the Prairie Pothole Region as a case study, Amy W. Ando and Mindy L. Mallory demonstrated that adapting "Modern Portfolio Theory" for conservation purposes could either maximize the expected returns for a given level of uncertainty or minimize uncertainty for an expected level of return.

"Adapting Modern Portfolio Theory for conservation provides planners with a set of options that can help them reduce outcome variation under climate change," said Ando, an expert in natural resource and environmental economics.

According to the research, which was published in the [Proceedings of the National Academy of Sciences](#), Modern Portfolio Theory can help planners make strategic conservation investments that manage risk more effectively than simple diversification schemes.

By diversifying strategically across space to reduce future outcome variation for a given level of conservation success, Modern Portfolio Theory allows [conservationists](#) to "take advantage of the way these outcome variables co-vary with each other across different scenarios," said Mallory, an economist whose research focuses on commodity markets, risk modeling and time-series econometrics.

The researchers discovered that employing Modern Portfolio Theory instead of simple diversification in the Prairie Pothole Region – a mosaic of shallow wetlands that serves as a breeding ground for almost 200 species of migratory birds, stretching from Montana to Iowa in the U.S. – can achieve a value of the conservation-objective-per-dollar-spent that is 15 percent higher for the same level of risk.

Modern Portfolio Theory-based portfolios also can have 21 percent less uncertainty over benefits, or 6 percent greater expected benefits, than the current portfolio of Prairie Pothole Region conservation, according to the study.

"In this case, Modern Portfolio Theory shows conservation planners how to choose a portfolio that sacrifices a little bit of your expected conservation benefits but also reduces the uncertainty for your overall outcomes in the future," Ando said. "So if you don't like risk, you can

reduce it."

The results of the paper show conservation groups and federal agencies how to cost-effectively divide conservation effort between sub-regions of the Prairie Pothole Region to reduce conservation-outcome uncertainty. There is a trade-off between uncertainty and the expected value of habitat quality, the researchers say. Planners, however, can choose the portfolio that best satisfies their risk preferences given their assumptions about the likelihood of [climate change](#).

"In one climate scenario, you might have one tract of land that yields the best results," Ando said. "In another climate scenario, the other tract of land might be better. So if you have a little bit of both, you've hedged your risk."

Ando says previous research in the field suggested some approaches to cope with such uncertainty but ultimately didn't harness all of the benefits of risk diversification.

"When you're doing this kind of analysis it's important to pay attention to costs," she said. "Because if you only focus on the conservation benefits and ignore costs, then you can end up choosing land that might have great benefits but is really expensive. And if you have a limited budget to spend on conservation, then you have a small amount of land that you're able to buy. So you have high benefits per acre, but you don't have many acres. If you build costs into the analysis, that enables you to pick a diversified portfolio of lands that have a pretty good ratio of benefits to costs. You can get the most [conservation](#) for your budget.

"I think the main contribution of the paper is providing a nice clear demonstration of how you can do portfolio analysis for a spatial land-conservation problem, and what the potential use could be of the results of that kind of analysis."

**More information:** "Optimal portfolio design to reduce climate-related conservation uncertainty in the Prairie Pothole Region," *Proceedings of the National Academy of Sciences*.

Provided by University of Illinois at Urbana-Champaign

Citation: 'Modern Portfolio Theory' optimizes conservation practices: study (2012, May 15) retrieved 11 July 2024 from <https://phys.org/news/2012-05-modern-portfolio-theory-optimizes.html>

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