QNAS

QnAs with Catherine L. Kling

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Environmental economist Catherine L. Kling has spent her career calculating the economic value of environmental resources and using the data to help design environmental policies. She has examined what consumers are willing to pay for environmental improvements and assessed the cost-effectiveness of policies to reduce nutrient runoff in waterways and alleviate hypoxic zones in places such as the Gulf of Mexico. Kling works with an interdisciplinary team to quantify the social costs of water pollution: How it imposes economic costs, including higher cost of drinking water, lost access to waterways, and lost enjoyment of rivers, lakes, and streams. The goal is to develop cost-effective policies that take into account the real economic cost of water pollution. Kling is a Tisch University professor in the Dyson School of Applied Economics and Management and Faculty Director at the Atkinson Center for a Sustainable Future at Cornell University. She was elected to the National Academy of Sciences in 2015, and her Inaugural Article (1) calculates the effect of ozone pollution on bird populations in the United States. Kling and colleagues found that as ozone increases bird populations decline, and a program aimed at decreasing ozone levels in the eastern half of the United States has prevented the loss of up to 1.5 billion birds. Kling discussed her work with PNAS.

PNAS: Did you go into economics with the intent to work on environmental issues?

Kling: My interest evolved as I discovered the field. As an undergraduate, I took an economics course and was really struck by the logic of it. I decided rather quickly that I wanted to not only major in economics but to go to graduate school in economics. I finished my undergraduate degree in 3 years and went to graduate school at the University of Maryland. At the time, environmental economics was quite nascent, but Maryland had a graduate training focus area in it. I spent my time there building tools and learning what I needed to work in the area.

Catherine L. Kling. Image credit: Catherine L. Kling.

PNAS: Your research focus is on water pollution, but your Inaugural Article (1) examines air pollution; how did that come about?

Kling: When I moved from Iowa State University to Cornell two years ago, I started spending time at the famous Cornell ornithology lab. There, I learned about the data they have and got interested in how I might use it. They run a program called eBird, which is the largest citizen science project in the world. It's a free app that helps people identify a bird and then easily report it. It's collected nearly 1 billion points of data from around the world. There's an enormous amount of information that provides coverage over the entire world in a way that no scientist can do on their own. My first thought was to use the data to help understand the social cost of water pollution by looking at its effect on bird populations on a national scale. Then, a colleague who studies air pollution suggested we examine its effect on bird populations. There [were] already excellent data demonstrating air pollution's impact on human health, which was good reason to think it might also be a problem for birds with specialized respiratory systems and high oxygen needs to power flight.

We reached out to two Cornell ecologists who really know the bird data, and we formed our team of four economists and two ecologists. And while it's not directly related to the social cost of water pollution, it hits on a subfield called ecosystem services, which

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calculates the value to humans of natural world resources like clean water and pollinating insects. Birds provide many ecosystem services, including providing enjoyment through bird watching, fodder for cultural stories, pollination, and seed dispersal.

PNAS: The article (1) suggests a relationship between increased ozone and decreased bird populations. How would you describe the finding in terms of causality vs. correlation?

Kling: We tried to think of anything that we couldn't control for that might prevent us from saying it's causal and came out pretty convinced that this is causal. Part of the reason for that is there are known mechanisms by which birds would be harmed by air pollution—directly or indirectly. Direct harm might result from impaired respiratory function due to poor air quality. Anything that interferes with their ability to move fast, fly, forage, migrate, can be immediately life-threatening. Indirect harm can result from non-lethal effects that have serious consequences for reproduction and survival over the long term. For example, a growing body of evidence also shows that air pollution, especially ozone, can diminish habitat quality for birds by reducing the quality and/or availability of the plants and insects that birds eat. So even before we started looking at the data there was science that suggests the relationship could be causal.

PNAS: The US Environmental Protection Agency NOx Budget Trading Program (NBP), which limited summertime ozone emissions, allowed you to look at changes in [the] ozone over time. How important was the NBP to the success of this study?

Kling: It was necessary to get at causality. We could have found correlations without it. But this natural experiment, designed to help people and not birds, affected one half of the country differently than the other half. That allowed us to compare bird populations before and after the policy in locations that had the policy and places that didn't have the policy.

PNAS: The NBP was not in effect in western states that have been hit hard by climate change in terms of drought and wildfires. How does this study control for that?

Kling: We have data on the East Coast before the policy and after the policy, then we have data in the West before the policy and after the policy. By looking at the change from the before/after in a place that has the policy and comparing it to the change in a place that doesn't have it, in a relative sense, we were controlling for other factors that might be at play, like drought and wildfires. Basically, we're able to control for differences in time and place.

PNAS: How does this study fit into your overall research program?

Kling: It fits perfectly because it looks at ecosystem services. The next project we're working on relates to using this same eBird data, but instead of looking at air pollution, [it looks] at land use and a federal program called the Conservation Reserve Program. It pays farmers to take land out of production and plant native plants and trees. It's been in place since 1985, so we have many years of data on where those locations are, and we're going to match that data with the eBird data. Taking land out of production is an intentional conservation action. The questions we'll try to ask are: Do birds benefit, how much, and has it been money well spent?

PNAS: What are the implications of your work for environmental policy makers?

Kling: When we're thinking about the cost benefits of an environmental regulation, it's important not only to consider the benefits to people, but to other ecosystem impacts and services. The federal government is required to do benefit–cost analyses for all major environmental regulations. When they do those, they really need to include things like impacts on wildlife, including birds, which ecologists consider an indicator species, meaning if birds are impacted, other plants and animals are too. Once you do that, it can be a real game changer in thinking about the benefits of an expenditure on a program, adding to the benefit.

1 Y. Liang *et al.*, Conservation cobenefits from air pollution regulation: Evidence from birds. *Proc. Natl. Acad. Sci. U.S.A.* **117**, 30900–30906 (2020).