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Voices

Scientific impact in a changing world

Measuring scientific success has traditionally involved numbers and statistics. However, due to an increasingly uncertain world, more than ever we need to measure the effect that science has on real-world scenarios. We asked researchers to share their points of view on what scientific impact means to them and how impact matters beyond the numbers.

Michael E. Mann
Department of Meteorology and Atmospheric Science, Penn State University

Redefining scientific impact

What does "scientific impact" mean to me? When I was a graduate student in the mid-1990s, I measured it by peer-reviewed journal articles, talks, and citations. But "impact" has since come to mean something quite different to me.

When my co-authors and I published our original "hockey stick" article in 1998, presenting the now-iconic curve demonstrating the unprecedented planetary warming we have caused over the past century, I soon found myself in an unrecognizable realm—one where facts, logic, and reason no longer prevailed.

The "hockey stick" was inconvenient to fossil fuel interests because it laid bare the threat of human-caused climate change and our continued addiction to fossil fuels. So, they—and their abettors—did their best to discredit it, through right-wing media outlets, hostile congressional hearings, investigations by fossil fuel-friendly politicians, and threats against my livelihood and life (I recount the details in *The Hockey Stick and the Climate Wars*).

In the process of defending myself and my work, I have ultimately become a public figure and spend much of my time now communicating the science of climate change and its implications to the public and policymakers through speaking engagements, op-eds and commentaries, and numerous media interviews.

While it is not quite the career path I originally signed up for, I've come to embrace this opportunity to inform the larger conversation about the greatest challenge we face as a civilization. This is how I now define my scientific impact.

Lindsay J. Hall
Quadram Institute Bioscience, Norwich Research Park; School of Life Sciences, ZIEL – Institute for Food & Health, Technical University of Munich

A circular scientific impact journey

Reflecting on scientific impact has led me to the realization that my appreciation of "impact" has almost come full circle since I first heard the term as an undergraduate, though my thoughts on the subject have definitely developed! As a bright-eyed and bushy-tailed microbiology student, I thought all the work we did *could* and *should* have impact, particularly for improving human health. What I did not appreciate until later, however, was that in some cases this may takes years, or even decades, but without fundamental blue-sky research we cannot make great leaps. The SAR-CoV-2 pandemic provides a terrible but perfect example of basic science underpinning the incredible and rapid advances in studying, tracking, and developing new vaccines against the virus.

At the beginning of my independent career, I initially found having to write grant impact statements a mundane task, as I only wanted to write and do the "science." Quickly though, I realized that understanding where the proposal could lead is a central component of scientific work, and an early appreciation of this may lead to more impactful work. I also now appreciate that impact can take many forms, for example, by bringing a microbiome therapy to the clinic; by creating a company, based on the basic science, that has economic and employment impact; through training and mentoring team members; and even by inspiring the next generation of scientists through effective communication and public engagement. All of these "impacts" have helped me to appreciate what is possible.

Nicholas K. Dulvy
Earth to Ocean Research Group, Simon Fraser University

Lifting the lid on the oceans

This may be the most important decade of our generation—we have but 10 years to not only halt climate change but also to halt and reverse biodiversity loss. Consequently, 2021 is an important year to review conservation progress and develop the 2030 Kunming Biodiversity Targets.

Technology has revolutionized our capacity to track threats to biodiversity on land, but the oceans remain vast and inscrutable. Our understanding of marine biodiversity is often biased toward either the most charismatic species or those we have killed and eaten. We have fisheries assessments for only around 350 species, and fisheries catches are often crudely identified.

Data from fisheries, and other sources, are used to derive IUCN Red List Assessments (http://www.iucnredlist.org) that distill the natural history, threats, conservation actions, and extinction risk of each species. These hard-won Red List Assessments provide the scientific basis for conservation priority setting and fisheries management. Repeated assessments can track the decline or recovery of species, forming the foundation for the Red List Index used by nations to track their progress toward the 2030 targets. One of the three lineages of fishes—sharks and rays—has now been assessed twice, in 2008 and 2020. Through these assessments, we may finally have the data to lift the lid on the oceans. However, because it is people that drive change, real-world impact will come from forging a consensus in the community about each species' status. The conservation community, through their knowledge and actions, will shape the very future of life on earth and in our oceans.