The role of the Frontiers of Knowledge Awards in identifying the global leaders in ecological research

Pablo Jáuregui and Mónica Salomone

Communications Department, BBVA Foundation, Madrid, Spain

ABSTRACT

Introduction: This paper outlines the origins and rationale of the Frontiers of Knowledge Awards, a new family of international prizes created in 2008 by the BBVA Foundation of Spain. The aim of these awards is to recognize world-class contributions in a range of scientific, technological, and artistic areas which address the central challenges of the twenty-first century. Their key distinguishing feature is the fact that they have incorporated amongst their categories the two fundamental fields of contemporary environmental research: Ecology and Conservation Biology and Climate Change. Outcomes: By documenting the winners of the Frontiers of Knowledge Awards in these two areas, as well as the reasons for which they received this recognition during their previous nine editions, we show how these prizes have helped to identify some of the leading international figures in environmental science, such as Edward O. Wilson, Daniel H. Hanzen, Jane Lubchenco, and Ilkka Hanski. Conclusion: In conclusion, we suggest that this initiative contributes to the public salience of the global ecological problems which threaten the future of our species. At the same time, the Frontiers of Knowledge Awards serve to highlight the fundamental importance of the pioneering scientists whose research can provide the only reliable basis on which global-policy makers must make informed decisions to successfully confront the environmental challenges of our time.

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Introduction: the Frontiers of Knowledge Awards

The Frontiers of Knowledge Awards were established by the BBVA Foundation in 2008 to recognize outstanding, world-class contributions in a range of scientific, technological, and artistic areas which address the central challenges of the twenty-first century. The name of the prizes symbolizes pioneering research that successfully enlarges the scope of our current knowledge, pushing forward the frontiers of the known world. The concept of “Frontiers” also alludes to the well-established fact that many of the most important scientific breakthroughs occur at the crosscutting areas between different disciplines, and that the most innovative researchers often find inspiration by crossing the borders of others fields. For this reason, the eight categories combine interdisciplinary fields of scientific research such as Basic Sciences, Biomedicine, Information and Communication Technologies, Development Cooperation, and Economics, with an artistic field of creativity such as Contemporary Music. At the same time, they also recognize scientific excellence in the two fundamental fields of contemporary environmental research: Ecology and Conservation Biology and Climate Change.

The BBVA Foundation is aided in the organization of the Frontiers of Knowledge Awards by the Spanish National Research Council (CSIC), the country’s premier public research agency. As well as designating each jury chair, the CSIC is responsible for appointing the technical evaluation committees that undertake an initial assessment of the candidates put forward by numerous institutions across the world, and draw up a reasoned shortlist for the consideration of the juries.

This article outlines the motivations underlying the creation of these awards in the categories of Ecology and Conservation Biology, as well as Climate Change, and shows how this initiative has helped to identify and provide public visibility for some of the leading scientists in these fundamental areas of ecological research.

Recognizing the scientific pioneers in the preservation of ecosystems

The BBVA Foundation’s commitment to confronting the environmental challenges of our time predates the creation of the Frontiers of Knowledge Awards. In 2004, this institution established a...
family of awards specifically devoted to recognizing scientific advances in the field of Conservation Biology, which also included categories aimed at awarding organizations which have achieved successful results in the preservation of ecosystems in Spain and Latin America, as well as individuals who have made exceptional contributions to the public understanding and social awareness of ecological problems. In 2008, however, the Foundation decided to incorporate the award which recognized outstanding research in the field of Ecology and Conservation Biology within a broader family of prizes aimed at awarding international scientific excellence and artistic creativity. In this way, an area of environmental research that addresses a fundamental concern of our time, alongside the category of Climate Change, became a fundamental pillar of the new Frontiers of Knowledge Awards.

From the outset, the aim of these prizes has been to provide public recognition and visibility to the scientists whose research on the threatened ecosystems of the planet must necessarily provide the foundation on which policy-makers should make informed decisions concerning the environment. During the course of its nine editions, the Frontiers of Knowledge Award in Ecology and Conservation Biology has recognized the contributions of some of the leading international scientists in this discipline (see Table 1), such as Edward O. Wilson, the Harvard entomologist who coined the term biodiversity and contributed in an extraordinary fashion to alert society about the importance of preserving the threatened species of our planet; Daniel H. Janzen, the biologist whose pioneering work in the ecological interactions between animals and plants has led to fundamental advances in the conservation of endangered tropical ecosystems throughout the world; Jane Lubchenco, the marine ecologist who has made key contributions to our understanding of coastal ecosystems and laid the scientific groundwork for the design of marine reserves; and Ilkka Hanski, the late Finnish ecologist whose work was pivotal to our understanding of how species are affected by the growing problem of man-made habitat fragmentation.

Likewise, in the category of Climate Change, during the course of its nine editions the Frontiers of Knowledge Awards have identified and recognized some of the most groundbreaking and significant contributions in the field (see Table 2), the relevance of which is fundamental to informing policy-makers on how to confront this global challenge. Previous prize winners have included Wallace Broecker, the first researcher who alerted about the threat of climate change more than four decades ago; Klaus Hasselmann, who developed the methods which crucially established that recent global warming has an anthropogenic origin; Susan Solomon, who specifically determined how human action alters the composition of the atmosphere and how these transformations, in turn, affect the Earth’s climate; and Veerabhadran Ramanathan, for discovering that other human-induced gases and pollutants besides CO₂ can substantially alter the Earth’s climate, and that by acting to reduce these emissions it is possible to make a short-term dent on the rate of global warming.

**Frontiers winners in 2017: the discoverers of acid rain, “tipping points,” and mathematical models of climate change**

Last February, this year’s Frontiers of Knowledge Award in Ecology and Conservation Biology was granted to Gene Likens and Marten Scheffer for contributing decisively to what the jury described as “one of the major challenges” of this scientific discipline: to understand and, where possible, anticipate ecosystem responses to human-induced alterations of

| Edition | Laureates | Contribution |
|---------|-----------|--------------|
| 2008    | Thomas E. Lovejoy and William F. Laurance | For adding to our understanding of the effects of land use change on biodiversity. |
| 2009    | Peter A. Reich | For work that radically improves our understanding of and ability to predict the response of terrestrial ecosystems to global environmental changes, including climate change and biodiversity loss. |
| 2010    | Edward O. Wilson | For coining the term biodiversity and contributing in extraordinary fashion to alert society to its importance. This U.S. naturalist is also the founder of other disciplines like sociobiology, which inquires into the biological bases of human behavior. |
| 2011    | Daniel H. Janzen | For his pioneering work in tropical ecology and his contributions to the conservation of endangered tropical ecosystems throughout the world, drawing on an understanding of plant–animal interactions. |
| 2012    | Jane Lubchenco | For her experimental work, which has advanced understanding of coastal ecosystems and laid the scientific groundwork for the design of marine reserves. |
| 2013    | Paul R. Ehrlich | For having contributed key conceptual advances in the science of ecology and conservation biology, with a long-standing influence in other academic disciplines. |
| 2014    | David Tilman | For scientifically establishing the value of biodiversity, quantifying, for the first time, how it contributes to make ecosystems more productive, more resilient to invasions, and more stable in the face of perturbations such as drought. |
| 2015    | Ilkka Hanski | For opening up an area of ecology that explains how species survive in fragmented habitats and allows to quantify extinction thresholds. |
| 2016    | Gene E. Likens and Marten Scheffer | For helping to predict the ecosystem impacts of human activity. |
the natural environment. Likens revealed the impact across North America of acid rain, a phenomenon with severe environmental consequences, and Scheffer subsequently showed that human action, though gradual, can trigger abrupt and fundamental ecosystem shifts of a potentially irreversible nature. The work of the American and Dutch ecologists is instrumental in informing decisions on how to reduce or prevent pollution risks, as well as policies to manage ecosystems safely and even to successfully restore them after serious deterioration.

Working independently, Likens and Scheffer have, according to the jury of the Frontiers Award, contributed to understanding and finding solutions for “gradual, abrupt, and potentially irreversible ecosystem change” in response to pollution and other ecological threats. Together, the two scientists “have transformed our understanding of how human activities are changing the structure and function of natural ecosystems, and provided tools to inform ecosystem management.”

The work done by Likens, founding president of the Cary Institute of Ecosystem Studies in New York, “was instrumental to develop effective policies to reduce the acid rain problem,” according to the Frontiers jury. His discovery, published in 1974, paved the way for measures like the Clean Air Act Amendment of 1990, “with great impact on environmental law and clean-energy research.” Likens was also a pioneer in the conduct of long-term experimental studies spanning an entire ecosystem (such as a drainage basin), and the use of decade-long measurements (instead of the 2- or 3-year standard length of most research projects). The discovery of acid rain in the United States dates from the early 1970s, and Likens’ continuing research in the same zone has provided proof that the resulting harm is not only intensive but lasting.

Scheffer, a professor at Wageningen University in the Netherlands, helped to identify the risk of an ecosystem suffering abrupt change, and how such transitions could be avoided. His studies, like Likens’ based on long time series of data, can serve to anticipate the consequences of global climate change, and to prime specific ecosystems to cope when they appear.

His first contribution was to confirm the reality of those critical ecosystem transitions known as “tipping points.” Prior to Scheffer’s studies, their existence had been postulated, but no examples ever found. The Dutch scientist uncovered the first empirical evidence in the early 1990s in shallow lakes in different parts of Europe. The water of the lakes had turned murky due to an excess of nutrients from agricultural fertilizers, and Scheffer was able to prove that reducing these pollutant inputs failed to restore them to their previous state. The deteriorated ecosystem had transitioned to a new equilibrium, and was in need of “shock therapy,” as he described it: no less drastic a measure in this case than extracting all the fish. Scheffer’s work, however, has provided practical utility not just for the recovery of lakes, but also for numerous other ecosystems poised to reach their own tipping points, such as coral reefs and tropical rainforests.

In the category of Climate Change, this year’s Frontiers of Knowledge Award has been bestowed upon Syukuro Manabe and James Hansen, the two climatologists who developed the first computational models with the power to simulate climate behaviors. Decades ago, these two researchers independently predicted how much the Earth’s temperature would rise due to increasing atmospheric CO₂, and the numerous models. At the end of the 1960s, while engaged in research at the National Oceanic and Atmospheric Administration, Manabe completed the first model which projected that if CO₂ concentrations doubled, global temperature would rise by 2°C. In 1981, Hansen published in Science the first paper
which incorporated global data for Earth’s temperatures and predicted how warming would affect other processes, like oceanic circulation, the loss of Arctic ice cover or droughts, and flooding. As the jury of the Frontiers Award put it, these two researchers “quantified factors controlling the magnitude of the surface temperature response to external perturbations” and developed “analysis methods that have become central to predictions of future climate change.” In this sense, their work has provided very valuable data to inform the measures which should be taken to address the challenge of global warming.

The nomination process is open online in the first half of every year through the website of the BBVA Foundation (www.fbbva.es/awards). In the categories of Ecology and Conservation Biology, as well as Climate Change, nominations for one or more candidates from any nationality will be accepted from scientific societies and organizations, national or regional academies of science, public or private R&D centers, university departments, schools or research institutes, and science museums. The award consists of €400,000, a diploma and a commemorative artwork. All nominations should be submitted through the website of the BBVA Foundation Frontiers of Knowledge Awards.

Conclusion: confronting the threats which endanger our future

It would be difficult to measure or quantify the extent to which the Frontiers of Knowledge Awards have served to stimulate international research in two key areas of global ecological research such as Ecology and Conservation Biology and Climate Change. What can be safely asserted, however, is that these prizes have undoubtedly helped to identify and channel public attention toward some of the global scientific leaders who have contributed to addressing some of the central challenges of our world. In a society often distracted by other, much more trivial issues, the Frontiers of Knowledge Awards serve to place the spotlight of the media on problems that truly matter for the future well-being of our planet. At the same time, they can crucially help to solidly inform the decisions which global policy-makers will have to make in order to successfully reduce the threats which the loss of biodiversity and global warming represent for our species.