Press release
22 April, 2025

In the Climate Change and Environmental Sciences category

The Frontiers of Knowledge Award goes to Camille Parmesan for demonstrating the impact of climate change on the geographical displacement of species round the globe

- **The new laureate's "pioneering studies" have shown that "wild species shift their geographical ranges"** in response to global warming, moving polewards and to higher elevations; a fundamental insight that "underpins the field of climate change ecology," in the words of the award citation

- **She first observed such shifts in butterfly species in the mid 1990s,** and later expanded on these studies to prove that the same climate change impact was being felt across thousands of plant and animal species on land and in the oceans, revealing "a globally coherent fingerprint" of warming effects

- **Her research has prompted the redesign of biodiversity conservation policies** towards strategies that factor species displacement due to climate change, like the creation of corridors, assisted migration and climate refuges that help preserve wildlife struggling with rising temperatures

- **Her work has major ramifications for global public health**, due to the poleward expansion of tropical diseases transmitted by species like mosquitos, as well as for sectors such as agriculture and fishing, which will need to come to terms with the warming-driven range shifts of terrestrial and marine species

The BBVA Foundation Frontiers of Knowledge Award in Climate Change and Environmental Sciences goes in this seventeenth edition to Camille Parmesan (Centre National de la Recherche Scientifique, France; University of Texas, United States; and University of Plymouth, United Kingdom) for her pioneering studies showing that "wild species shift their geographical ranges in response to climate change," said the committee in its citation.

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In the mid 1990s, the awardee showed that several butterfly species in the United States and Europe were moving northwards and upward to escape rising temperatures. Over the next three decades, she expanded on this work to show that the same climate change impact was being felt by thousands of plant and animal species worldwide both on land and in the oceans.

Professor Parmesan was thus able to establish that rising temperatures had left a "globally coherent fingerprint" on biodiversity. An insight, said the committee, that "underpins climate change ecology," one of the research fields most strongly to the fore in combatting the environmental crisis.

Her research has provided vital input to the design of effective conservation strategies "adopted by governments and agencies around the world" that factor species displacements due to global warming; among them, the creation of corridors to connect habitats, assisted migrations and protected areas that provide a refuge for wildlife affected by rising temperatures.

Born in Houston, Parmesan completed her higher education and held her first academic posts at the University of Texas at Austin (United States). She then moved to the Britain, to the University of Plymouth, and subsequently, in 2017, settled in France, taking up an appointment at the Theoretical and Experimental Ecology Station of the Centre National de la Recherche Scientifique (CNRS) as an awardee in the first edition of the Make Our Planet Great Again, an initiative launched by French President Emmanuel Macron to promote research in climate change and Earth sciences.

Parmesan's work has "major ramifications for global public health, due to the polewards expansion of tropical diseases like malaria or dengue that are transmitted by mosquitos, as well as for sectors such as agriculture and fisheries, which will need to come to terms with the warming-driven migrations of terrestrial and marine species," explains committee secretary Carlos Duarte, holder of the Tarek Ahmed Juffali Research Chair in Red Sea Ecology at King Abdullah University of Science and Technology (Saudi Arabia). "A case in point is the wine industry, where growers are already starting to plant vines at higher elevations to improve production in the face of the changes brought by rising temperatures."

"Professor Parmesan has also led the field in the application of what we now know as big data analytics. Seeking to extrapolate her initial findings on butterfly species to a global scale, she analyzed the literature on thousands of animals and plants to identify consistent trends in species displacement in response to rising temperatures. It is in this respect that we can call her work a

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cornerstone of climate change ecology," adds committee member Pedro Jordano, a Research Professor in the Department of Integrative Ecology at Doñana Biological Station-CSIC.

The birth of climate change ecology

Camille Parmesan began her research career studying plant-insect interactions. She was nearing the end of her PhD course when she responded to a NASA grant call with an "extremely risky" proposal to study the impact of climate change on Edith's checkerpoint butterfly (*Euphydryas editha*), known to be sensitive to climate variability. At that time, in the early 1990s, scientists were already expecting that increased atmospheric CO_2 would drive up temperatures globally, although the warming trend was yet to make itself felt. But Parmesan's years of experience with the checkerspot got her thinking: "Maybe this little butterfly is a better indicator than any thermometer."

Traveling the west coast of North America, from Mexico to Canada, she found places in the south (such as Baja California) where the habitat was as well preserved as further north in Canada. But while in Mexico almost all the butterfly's populations were extinct, in Canada they were mainly thriving. Parmesan, in effect, had found a far simpler pattern than she expected: the butterfly was settling in higher and higher latitudes and elevations. But, more important still, she established that this trend bore no relation to the quality of their habitat in each location. Stripping out data from the zones where habitat degradation was present, she was able to isolate the climate change effect and tease it apart from other possible drivers like habitat loss, pollution or fertilizer use. She published her findings in 1996 in a single-author paper in the journal *Nature*.

"I think that was a truly innovative leap in ecology research," she recalls today, reflecting on her decision to opt for analysis of observational data over the experimental approaches then in vogue. "The question of whether a change in climate has globally affected a wild species is not something you can address using experiments. I knew it was not enough just to show a change. I needed to be able to say this change is definitively linked to climate change and not all the other things that humans are doing." The sheer breadth of her data and the inductive reasoning she used to rule out all other effects and attribute the extinction patterns of Edith's checkerspot butterfly exclusively to climate change were precisely the factors that convinced the research community that the impact of rising temperatures on wild species was real, and, in the process, brought into being the new field of climate change ecology.

The "globally coherent fingerprint" of temperature increase

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She then set out to test the effect on other butterfly species, this time in Europe. Ignoring the criticism from certain researchers whose study environments were too small for them to observe the patterns Parmesan was seeing, she travelled from Spain to Finland collecting data as she went that pointed firmly to just one conclusion: that two-thirds of the species studied were moving northward. As an early participant in the work of the U.N.'s Intergovernmental Panel on Climate Change (IPCC), her next step was to scale up these attribution studies to thousands of animal species both on land and in the oceans.

Again the methodology she chose was a challenge to the prevailing wisdom, and the arguments that ensued with her fellow biologists and even economists on how to ground climate change attribution in robust criteria led to her 2003 paper in *Nature,* written with economist Gary Yohe. A few years later, this paper would become the most cited of all time in the climate change field, with a current tally of 14,000 citations, on the strength, says the scientist, of "taking observational data and subjecting it to a rigorous analysis."

The impact achieved with the paper led other research groups, working with species virtually unknown to Parmesan, to enlist her help in identifying the "globally coherent fingerprint of climate change," as the awardee refers to it, in broader and broader groups of species. The result of one such collaboration was the 2013 paper appearing in *Nature Climate Change* on marine species worldwide.

The researcher has lately returned her attention to Edith's checkerspot butterfly in light of signs that it may be evolving in real time in response to climate change. "This is not necessarily a good thing," she points out, "because it's evolving to deal with soil that's getting too hot by laying its eggs further north and higher up, but that's making it susceptible to other pressures."

In fact, the last few years have witnessed the first extinctions linked directly to climate change, like that of the rodent *Melomys rubicola* or the golden toad (*Incilius periglenes*). "It's all ramping up," says a concerned Parmesan. "And we're seeing changes at a pace that really I would not have predicted 10 or 20 years ago."

Lessons for biodiversity, agriculture and fisheries

After publishing her paper on attribution methodology – based on the analysis of 1,700 species – Parmesan decided it was time to take the message to conservation biology forums: **"**Climate change is above and beyond all of those local things, like invasive species or habitat destruction,

because it's an ever-driving force that is pushing the system in one direction all the time. And if you ignore it, you will drive everything extinct in areas where you're trying to protect them."

In consonance with this view, she contends that conservation strategies should not target a particular species but rather biodiversity in general. There will be species, like the polar bear, who are undoubtedly heading for extinction, so isn't it better, she argues, to have it hybridize with other species, like the grizzly, rather than try to preserve it in its pure form. "By going ahead and letting these hybridizations happen, you're keeping those genes in the pool, so if we ever stabilize climate and start cooling it down again, then you've got genes around that can then re-evolve some of these cold-adaptive species. If we do the opposite and stop them from happening, we are going to lose a lot of genetic diversity."

In the near term, the awardee explains, we will see climate change impact more and more directly on agricultural and fishing systems, whether farmed or wild: "Where you can grow things is shifting, and farmers have already realized this. And fishermen are noticing that the species they catch are not the same as before. Not only that, diseases too are moving polewards. There are even pathogens that are remerging as the Arctic ice melts. For instance, cases of anthrax have been found among the reindeer that form part of the diet of Inuit populations. The animals, it turns out, contracted the disease when the bacteria that causes it was released into the atmosphere as the tundra thawed. Then you have the fact that higher atmospheric CO_2 is lowering the nutritional value of crops, which is something that's starting to worry dieticians."

Laureate bio notes

Camille Parmesan (Houston, Texas, United States, 1961) holds a BS in Zoology and a PhD in Biological Sciences from the University of Texas at Austin (United States). She has kept up the association with UT throughout most of her career and is currently an Adjunct Professor in the Department of Geological Sciences and a Senior Research Fellow in its Environmental Sciences Institute. In 2011 she moved to the University of Plymouth (United Kingdom), where she is now a Visiting Professor in the School of Biological and Marine Sciences. This was followed by another move in 2017 to the Theoretical and Experimental Ecology Station (SETE) of the Centre Nationale de la Recherche Scientifique (CNRS), as an awardee in the first edition of the French government's Make Our Planet Great Again program. As of 2022, she is the Director of this center. Parmesan is a longstanding member of the U.N.'s Intergovernmental Panel on Climate Change (IPCC), and was a Coordinating Lead Author for its 2022 assessment report. She is a Fellow of

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the European Academy of Sciences and the Ecological Society of America and, since 2019, an Honorary Fellow of the Royal Entomological Society.

Nominators

A total of 102 nominations were received in this edition. The awardee researcher was nominated by Elvira Poloczanska, Science Advisor to the Working Group II Co-Chairs and Technical Support Unit of the Intergovernmental Panel on Climate Change, and David Schoeman, Professor of Global-Change Ecology in the School of Science, Technology and Engineering of the University of the Sunshine Coast (Australia).

Climate Change and Environmental Sciences committee and evaluation support panel

The committee in this category was chaired by **Bjorn Stevens**, Director of the Max Planck Institute for Meteorology (Hamburg, Germany), with **Carlos Duarte**, holder of the Tarek Ahmed Juffali Research Chair in Red Sea Ecology at King Abdullah University of Science and Technology (Saudi Arabia) and Frontiers of Knowledge Award laureate in Ecology and Conservation Biology (12th edition), acting as secretary.

Remaining members were **Emily Bernhardt,** James B. Duke Distinguished Professor and Chair of the Department of Biology at Duke University (United States); **Miquel Canals,** Director of the Sustainable Blue Economy Chair at the University of Barcelona (Spain); **Kerry Emanuel,** Cecil & Ida Green Professor of Atmospheric Science at the Massachusetts Institute of Technology (United States) and Frontiers of Knowledge Award laureate in Climate Change (12th edition); **José Manuel Gutiérrez**, Director of the Institute of Physics of Cantabria (IFCA), CSIC-University of Cantabria (Spain), **Pedro Jordano**, Research Professor in the Department of Integrative Ecology at Doñana Biological Station, CSIC, and Associate Professor in the Department of Plant Biology and Ecology at the University of Seville (Spain); **Rik Leemans**, Emeritus Professor in Environmental Systems Analysis at Wageningen University & Research (The Netherlands); **Ning Lin**, Professor of Civil and Environmental Engineering at Princeton University (United States); and **Edward S. Rubin**, Alumni Chair Professor of Environmental Engineering and Science Emeritus at Carnegie Mellon University (United States).

The **evaluation support panel** charged with nominee pre-assessment was coordinated by **Elena Cartea**, Deputy Vice-President of Scientific-Technical Areas at the Spanish National Research Council (CSIC) and **Teresa Moreno Pérez**, Deputy Coordinator of the Life Global Area and

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Research Professor at the Institute of Environmental Assessment and Water Research (IDAEA, CSIC); and formed by **Josep M. Gasol Piqué,** Research Professor at the Institute of Marine Sciences (ICM, CSIC); **Ernesto Igartua Arregui**, Deputy Coordinator of the Life Global Area and Scientific Researcher at the Aula Dei Experimental Station (EEAD, CSIC); **Ana M. Traveset Vilagines**, Research Professor at the Mediterranean Institute for Advanced Studies (IMEDEA, CSIC-UIB); and **Sergio Vicente Serrano**, Research Professor at the Pyrenean Institute of Ecology (IPE, CSIC).

About the BBVA Foundation Frontiers of Knowledge Awards

The BBVA Foundation centers its activity on the promotion of world-class scientific research and cultural creation, and the recognition of talent.

The BBVA Foundation Frontiers of Knowledge Awards, funded with 400,000 euros in each of their eight categories, recognize and reward contributions of singular impact in basic sciences, biomedicine, environmental sciences and climate change, information and communication technologies, social sciences, economics, humanities and music. The goal of the awards, established in 2008, is to celebrate and promote the value of knowledge as a global public good, the best instrument to confront the great challenges of our time and expand individual worldviews. Their eight categories are congruent with the knowledge map of the 21st century.

The BBVA Foundation is partnered in these awards by the Spanish National Research Council (CSIC), the country's premier public research organization. CSIC appoints evaluation support panels made up of leading experts in the corresponding knowledge area, who are charged with undertaking an initial assessment of candidates and drawing up a reasoned shortlist for the consideration of the award committees. CSIC is also responsible for designating each committee's chair across the eight prize categories and participates in the selection of remaining members, helping to ensure objectivity in the recognition of innovation and scientific excellence. The presidency of CSIC also has a prominent role in the awards ceremony held each year in Bilbao, the permanent home of the BBVA Foundation Frontiers of Knowledge Awards.

CONTACT:
Department of Communications and Institutional Relations
Tel. +34 91 374 52 10 / +34 91 374 81 73 / +34 91 537 37 69
comunicacion@fbbva.es

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For more information on the BBVA Foundation, visit www.fbbva.es