



## Daniel Pauly

### FRONTIERS OF KNOWLEDGE AWARDS

Ecology and Conservation Biology

12th Edition

The BBVA Foundation Frontiers of Knowledge Award in Ecology and Conservation Biology has gone in this twelfth edition to marine biologists **Carlos Duarte**, **Terence Hughes** and **Daniel Pauly** for “their seminal contributions to our understanding of the world’s oceans, and their efforts to protect and conserve marine biodiversity and oceanic ecosystem services in a rapidly changing world,” in the words of the award citation.

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## BIO

**Daniel Pauly** (Paris, France, 1946; of French and Canadian nationality) obtained a PhD in Fisheries Biology from the University of Kiel in 1979. That same year he took up a research position at the International Center for Living and Aquatic Resources Management (ICLARM) in Manila, where in fifteen years he would rise to the rank of Senior Scientist and Program/Division Director. In 1994 he was appointed a tenured professor in the Fisheries Centre (now Institute for the Oceans and Fisheries) at the University of British Columbia in Canada, where he is now University Killam Professor, the highest academic rank the institution can bestow.

Since 1999 he has also been Principal Investigator of the Sea Around Us, a project based at the Institute for the Oceans and Fisheries devoted to studying the impact of fisheries on the world’s marine ecosystems. Pauly is the author of over one thousand publications, between books, papers and reports, and is also co-developer of such widely-used software and modeling resources as Ecopath, the online encyclopedia FishBase, and the catch time series of the Sea Around Us.

## CONTRIBUTION

The three laureates, through their independent efforts, have transformed our vision of the ocean, revealing its potential as an intense and effective carbon sink, while drawing the world’s attention to the fragile state of coral reefs, and providing critical tools to ensure the sustainability of global fisheries.

For committee chair Emily Bernhardt, Professor of Biology at Duke University (United States), they are “at the absolute forefront” of the scientific drive to understand and confront

three of the biggest threats to the world's oceans; threats that they were the first to highlight and around which they would help to launch a global research enterprise. "Their work is cross-disciplinary and cross-border," she adds, "and does not stop at certifying the damage, but goes beyond that to seek and propose solutions."

Spaniard Duarte, currently Tarek Ahmed Juffali Chair in Red Sea Ecology at the King Abdullah University of Science and Technology (Saudi Arabia), has experimentally established that coastal ecosystems such as seagrass meadows and mangroves have a striking capacity to absorb atmospheric carbon, exceeding even that of the Amazonian forest. The committee noted that his research was at the roots of the Blue Carbon Initiative, a global program focused on mitigating climate change through the conservation and restoration of coastal and marine ecosystems.

Hughes, Director of the Centre of Excellence for Coral Reef Studies at Australia's James Cook University, is recognized for "his efforts to describe and draw attention to the global loss of fragile coral reef ecosystems as a result of widespread warming, acidification, pollution and disease."

Pauly, University Killam Professor and founder of the Sea Around Us Project at the University of British Columbia, in Canada, has spent his long career exploring the worldwide decline in fish stocks. His method for obtaining records of global fish catches includes data at times overlooked in the official statistics, such as artisanal fishing or discards, which turn out to have far more weight than first suspected to the extent that they have significantly worsened the global tally of overfishing. "Professor Pauly's research," the citation reads, "demonstrates the interdependencies between fisheries science, marine ecology and conservation around the world."

The three scientists stand out, says the committee, for their contributions to our "fundamental understanding" of marine ecology, and their leadership in applying such knowledge to guide "effective conservation management of critical marine habitats and fisheries."

### **"Blue Carbon" to mitigate climate change**

Carlos Duarte, who spent part of his career in Spain – at the Institute of Marine Sciences in Barcelona, the Blanes Centre of Advanced Studies and the Mediterranean Institute for Advanced Studies in Mallorca (all CSIC) – expressed his satisfaction yesterday at joining the list of awardees in this category, which he described as "practically a genealogy of worldwide research in ecology."

His longstanding interest in the impact of environmental change on marine ecosystems led him to the discovery, reported in a seminal 1996 paper, that seagrass meadows, mangroves, macroalgae and salt-marshes are heavily vegetated coastal ecosystems that,

through photosynthesis, absorb large quantities of atmospheric CO<sub>2</sub> and bury it in seabed sediments.

These ecosystems, which Duarte has termed “the hidden forests of the biosphere” accordingly act as powerful carbon sinks. “For the first time,” he explains, “we were able to calculate that, globally, these ecosystems produce major carbon surpluses, and these surpluses have to find their way into sediments.”

A decade later, his research would produce the first global estimate of the effectiveness of these sinks based on real rather than inferred data, leading to the conclusion that “despite accounting for just 0.2% of the ocean’s surface, they are responsible for 50% of the burial of carbon in marine sediments.”

It was this finding that led Duarte to coin the term Blue Carbon in 2005, in reference to these ecosystems. The United Nations invited him to lead a report into the utility of vegetated coastal habitats as a possible solution to climate change, a strategy that has since won the attention not just of scientists but also of political leaders and conservation managers.

“When people talk about nature-based solutions to climate change, they are talking about blue carbon,” Duarte insists, adding that “I have been contacted by lots of countries interested in estimating their blue carbon resources, so they can mitigate climate change with mangroves and seagrasses.”

### **The reef sentinel**

Terence Hughes is a world authority in the study of coral reef ecology and the damage being done to it by climate change and other threats like pollution and overfishing. By the mid-1990s, various papers of his authorship in high-impact journals had alerted the world to the degraded state of reefs in all quarters of the globe.

“Coral reefs,” he explained yesterday after hearing of the award, “are not just beautiful places where wealthy people can enjoy a holiday. We should not forget that 400 million people depend on them for their livelihoods and their food security.”

Hughes’ research has focused on the coral bleaching caused by climate change. Bleaching occurs when reefs are exposed to stressors such as warming ocean waters and, if it is severe and prolonged enough, many of the corals will die. It will then take at least a decade to replace them.

Studies he led have shown that mass coral bleaching was unknown until the 1980s, but that since then repeated bleaching episodes at the regional scale and large-scale coral death have become something of a norm as temperatures continue their advance.

There is no doubt that Australia's Great Barrier Reef, the planet's largest, is in a critical state due to rising temperatures. In fact, it has suffered four bleaching events since 1998, two in the consecutive years of 2016 and 2017, causing damage on an unmatched scale. Last year, a paper by Hughes appearing in *Nature* showed that coral larvae births on the Great Barrier Reef slumped by 89% in 2019 with respect to the historical average, due to the unprecedented dying-off of adult corals after the temperatures spikes of 2016 and 2017.

"Although overfishing and pollution also cause deterioration, the greatest threat facing reefs today is without doubt climate change," affirms Hughes. "And this is not a risk that might affect them in future, but something that is harming them right now."

While it is obviously vital to understand the relationship between climate change and coral reef degradation, Hughes believes that part of the challenge is a "crisis of governance" involving factors to do with politics, the economy and, definitively, "how society conducts its decision-making." For this reason, he works alongside economists, political scientists and other researchers in the social sciences to develop strategies to combat the reef deterioration being driven by climate change.

"It is still not too late. The window of opportunity to save reefs remains open, but it is closing rapidly, so we have to act now to reduce pollutant emissions and stop wasting time."

### **The largest fish database**

Among Daniel Pauly's signal achievements is the creation, in 1990, of the world's largest online fish database, FishBase; an ecological resource setting out information on some 34,000 species that is consulted and cited by researchers around the globe. Not only that, Pauly has led the introduction of new data-gathering methods on worldwide fisheries, and developed equations and models to assess the fishing stress suffered by a given population and draw up reliable estimates.

His work, reported in numerous papers in top scientific journals, has shown that fisheries are the major driver of change in the marine ecosystem. "They are the most important factor, more than pollution, although this may change in the future with global warming," said the new laureate yesterday after hearing of the award.

Others contributions singled out by the committee are his development of a powerful computer-based method to estimate the population dynamics of fishes, and "a demonstration of climate-change induced fish migrations." One conclusion of this work is that fishes are moving around five kilometers closer to the poles each year.

For Pauly, "the degradation of marine ecosystems is extremely serious, we are losing the ability of the oceans to supply us with food." However, he too is confident that humanity can save the situation if we make the decision to act.

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