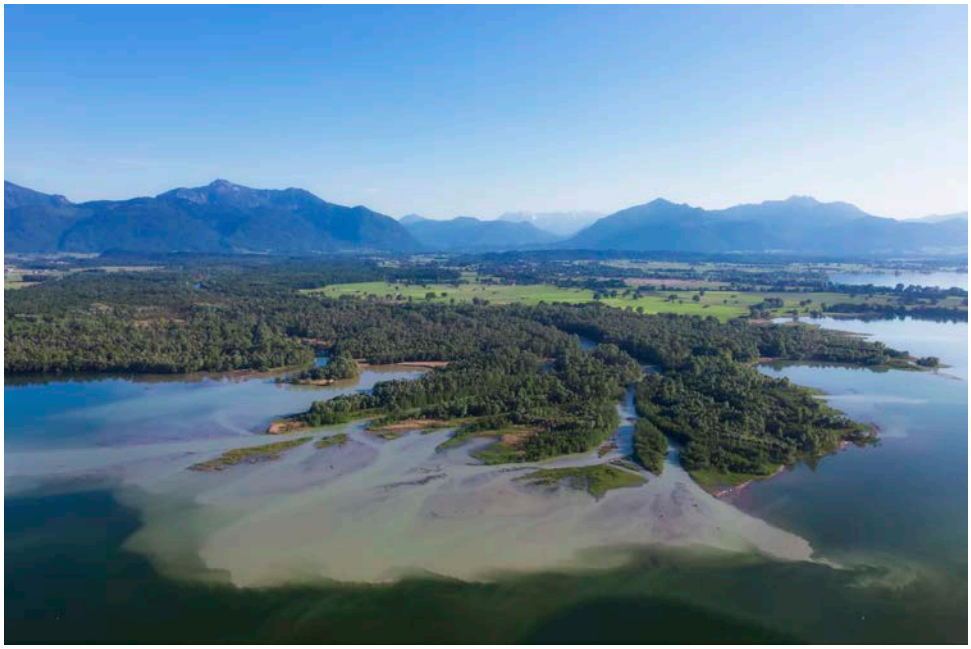
Climate Change and Ecosystems



Sackler Forum

November 8-9, 2018

The National Academy of Sciences Building
Lecture Room

NATIONAL ACADEMY OF SCIENCES

THE ROYAL SOCIETY

Sackler Forum 2018: Climate change and ecosystems

Climate change is increasingly threatening the viability and resilience of natural ecosystems and human societies. While there is a growing understanding of the impacts of climate change on ecosystems, much less is known about how ecosystems can best be managed to enhance their resilience to climate change, and how ecosystem management can be a strategy for more general adaptation to change. Ecosystem management and restoration has the potential to contribute "nature-based solutions" to both the causes and consequences of climate change. However, the effectiveness, scalability, and magnitude of different strategies need to be explored and evaluated.

This Sackler Forum will examine the latest science on how climate change can affect terrestrial, aquatic and marine ecosystems (often in interaction with other factors), in particular addressing current research frontiers such as effects of change in climate variability and extremes; interactions among multiple stressors; thresholds and the potential for abrupt change; and multi-trophic interactions. The Forum will move on to focus on scientific understanding of opportunities to assist and manage ecosystems to enhance both their resilience and societal resilience to climate change. The meeting will explore science and policy dimensions to this challenge, drawing from examples across a range of terrestrial, aquatic and marine ecosystems. A key output will be identification of priority avenues for scientific research and policy advice and implementation.

Objectives

- Bring together US and UK scientists in the fields of climate change, ecosystem ecology, land use and biodiversity to:
    - Build new opportunities for international collaboration
    - Highlight and discuss the latest research findings related both to the impact of climate change on ecosystems and how ecosystems may offer solutions for climate adaptation and mitigation.
    - Identify research gaps and future research priorities relating to climate change and ecosystems.
    - Discuss how research in this field may provide solutions to international policy challenges, such as those identified by:
        - the UN Convention on Biodiversity;
        - the UN Framework Convention on Climate Change;
        - the UN Sustainable Development Goals;
        - the UN Convention to Combat Desertification;
        - the UNEP Regional Seas Programme;
        - and the Ramsar Convention on Wetlands
- Produce a summary of the meeting which highlights the latest science and outlines future research and policy priorities.

AGENDA

Day 1: Thursday, November 8, 2018

8:15 AM ***Networking breakfast with the National Academy of Sciences (NAS) and Royal Society (RS) Officers***

9:00 AM **Opening Remarks**

Marcia McNutt, President, The National Academy of Sciences

Venki Ramakrishnan, President, The Royal Society

9:10 AM **Welcome to the Sackler Forum 2018**

Janet Franklin NAS (Forum co-chair), University of California at Riverside, USA

Yadvinder Malhi FRS (Forum co-chair), University of Oxford, UK

Theme 1: Threats and Challenges
This session will examine the latest science on how climate change can affect terrestrial, aquatic and marine ecosystems (often in interaction with other factors). In particular, it aims to move beyond long-established narratives to address current research frontiers such as effects of change in climate variability and extremes; interactions among multiple stressors; thresholds and the potential for abrupt change; and multi-trophic interactions.

9:30 AM **Keynote 1: Managing forests for carbon and co-benefits**

Chris Field NAS, Stanford University, USA

9:50 AM **Questions and discussion**

10:00 AM **Keynote 2: Aquatic ecosystems and climate change: a growing suite of threats for already challenged environments**

Nancy Knowlton NAS, Smithsonian Institution, USA

10:20 AM **Questions and discussion**

10:30 AM ***Break and refreshments***

10:50 AM **Keynote 3: Tipping points in climate and biosphere function**

Tim Lenton, University of Exeter, UK

11:10 AM **Questions and discussion**

11:20 AM **Short presentations and panel discussion: Threats and Challenges**

What new understanding is emerging around the threats that climate change poses to diversity? A focus on poorly understood phenomena, emerging threats, and complex interactions.

Moderator: Martin Solan, University of Southampton, UK

- Monica Turner NAS, University of Wisconsin-Madison, USA
  Interacting stressors, compound disturbances, and abrupt change in terrestrial ecosystems
- Camille Parmesan, University of Plymouth, UK
  Impacts of climate change on wild species: complexities and surprises
- Richard Pearson, University College London, UK
  Impacts of climate change on terrestrial distributions of biodiversity
- Steve Palumbi NAS, Stanford University, USA
  The eye of the storm: recovery rate versus time between extreme events and tipping points for coral reefs

12:25 PM ***Lunch***

Theme 2: Opportunities

This session will focus on scientific understanding of the opportunities to assist and manage ecosystems to enhance both ecosystem resilience and societal resilience to climate change and ocean acidification. The Forum will explore science and policy dimensions to this challenge, drawing from examples across a range of terrestrial, aquatic and marine ecosystems.

1:25 PM **Keynote 4: Moving times for the world's terrestrial biodiversity**

Chris Thomas FRS, University of York, UK

1:45 PM **Questions and discussion**

1:55 PM **Keynote 5: A solutions-based approach for coral reefs under ocean acidification: adaptation and mitigation**

Rebecca Albright, California Academy of Sciences, USA

2:15 PM **Questions and discussion**

2:25 PM **Short presentations and panel discussion 2: Opportunities**

What opportunities are there to manage ecosystems under climate change? What is the potential for ecosystem management to facilitate adaptation to climate change, and what are the challenges?

Moderator: Kate Brauman, University of Minnesota, USA

- Bronson Griscom, The Nature Conservancy, USA
  Improving land stewardship to deliver climate mitigation and resilience

- Sarah Hobbie NAS, University of Minnesota, USA
  Nature-based approaches to managing climate change effects in urban ecosystems
- Pete Smith FRS, University of Aberdeen, UK
  Agriculture, climate change, and biodiversity
- Callum Roberts, University of York, UK
  Building marine protected area networks to mitigate and promote adaptation to climate change

3:30 PM **Break and refreshments**

3:50 PM **Workshops and small group discussions: Threats and Opportunities**

Reflection upon and discussion surrounding the day's presentations, including own ideas and examples. What are the biggest challenges? What are the most exciting opportunities? What are the future research priorities?

5:00 PM **Workshop feedback session**

5:40 PM **Day 1 roundup**

Janet Franklin NAS, University of California at Riverside, USA

Yadvinder Malhi FRS, University of Oxford, UK

6:00 PM ***Drinks and networking (Great Hall)***

7:00 PM ***Dinner (Great Hall)***

Day 2: Friday, November 9, 2018

8:15 AM ***Arrivals and breakfast***

9:00 AM **Welcome to day 2**

Janet Franklin NAS, University of California at Riverside, USA

Yadvinder Malhi FRS, University of Oxford, UK

Theme 3: Solutions and Practical Applications

This session will focus on linking the challenges and opportunities to explore how ecosystems can provide potential for adaptation to and mitigation of climate change. Science and policy based solutions will be explored, drawing from examples across a range of terrestrial, aquatic and marine ecosystems. It will focus on practical and implementable ways of taking advantage of the opportunities highlighted in Theme 2.

9:20 AM **Keynote 6: Time for nature? Understanding the value of limits to nature's capacity to support human development in a warming world**

Nathalie Seddon, University of Oxford, UK

9:40 AM **Questions and discussion**

9:50 AM **Keynote 7: Managing working landscapes for multiple ecosystem services**

Elena Bennett, McGill University, Canada

10:10 AM **Questions and discussion**

10:20 AM **Keynote 8: Functional diversity in the face of large-scale environmental change**

Sandra Díaz NAS, National University of Cordoba, Argentina

10:40 AM **Questions and discussion**

10:50 AM ***Break and refreshments***

11:15 AM **Short presentations and panel discussion 3: Solutions and Practical Applications**

What are the policy and research priorities that can facilitate ecosystem adaptation to climate change, provide nature-based solutions to climate change, and enable these to work at scale? What are the main barriers and how can they be overcome?

Moderator: Bhaskar Vira, University of Cambridge, UK

- Sandra Lavorel, National Center for Scientific Research, France
  Climate adaptation services for transformative adaptation
- Stephen Polasky NAS, University of Minnesota, USA

Making nature count: rewriting economic and political rules to account for the value of ecosystem services

- Carlos Nobre, Institute for Advanced Studies-University of Sao Paulo, Brazil
  The Amazonia Third Way Initiative: the role of technology to unveil the potential of a novel tropical biodiversity-based bio-economy
- Andrew Norton, International Institute for Environment and Development, UK
  Social policy and research priorities to promote nature-based solutions to climate change

12:20 PM ***Lunch***

1:20 PM **Workshops and small group discussions 2: Solutions and Practical Applications**

How can this novel science be translated into solutions? What are the priorities? How can this be best communicated at a national and international level?

2:30 PM **Workshop feedback session**

3:10 PM **Forum conclusions and next steps**

Janet Franklin NAS, University of California at Riverside, USA

Yadvinder Malhi FRS, University of Oxford, UK

3:30 PM ***Adjourn***

WORKSHOP GROUPS

Group 1 

Facilitator Workshop 1: Susan Harrison
Facilitator Workshop 2: Jos Barlow
Chris Field
Brian Foster
Nancy Knowlton
Andrew Norton
Callum Roberts
Chris Sandom
Dov Sax
Daniela Schmidt
Monica Turner
Staff: Emma Woods

Group 2

Facilitator Workshop 1: Richard Bardgett
Facilitator Workshop 2: Nancy Grimm
Bronson Griscom
Sandra Lavorel
Paul Lussier
Peter Mumby
Tim Newbold
Steve Palumbi
Nathalie Seddon
Pete Smith
Cathy Whitlock
Staff: Sarah Giles

Group 3 

Facilitator Workshop 1: Dominique Bachelet
Facilitator Workshop 2: Valerie Kapos
Rebecca Albright
Sandra Díaz
Clifford Duke
Alex Halliday
Tim Lenton
Yadvinder Malhi
Richard Pearson
Stephen Polasky
Martin Solan
Park Williams
Staff: April Melvin

Group 4 

Facilitator Workshop 1: Nick Graham
Facilitator Workshop 2: Joshua Lawler
Elena Bennett
Kate Brauman
Luke Clarke
Janet Franklin
Sarah Hobbie
Carlos Nobre
Camille Parmesan
Chris Thomas
Bhaskar Vira
Staff: Amanda Staudt

BIOGRAPHIES

Sackler Forum Planning Committee

Janet Franklin (co-chair). Janet Franklin is a Distinguished Professor in the Department of Botany, University of California at Riverside since 2017. She was previously a Regent's Professor in the Schools of Geographical Sciences and Urban Planning at Arizona State University where she was appointed in 2009. From 1988-2009 she was on the faculties of Geography and Biology at San Diego State University. She received her PhD in Geography from the University of California – Santa Barbara in 1988. She specializes in Landscape Ecology, Biogeography, and Geographic Information Science. Franklin's research is focused on in the patterns and dynamics of terrestrial plant communities at the landscape scale. Her work addresses the impacts of human-caused landscape change on the environment. Human land use – agriculture and urbanization – and other large-scale human impacts such as climate change, and the introduction of exotic species, often interact with natural disturbance regimes such as fire, flooding and hurricanes, to shape plant community dynamics. How resilient are ecological communities to these impacts? Terrestrial plant communities are important elements of regional biodiversity and provide essential habitat for more charismatic animal and rare plant species. She is a Member of the US National Academy of Sciences, and a Fellow of the American Association for the Advancement of Science, the American Academy of Arts and Sciences, and the Ecological Society of America.

Yadvinder Malhi FRS (co-chair). Yadvinder Malhi is Professor of Ecosystem Science at the University of Oxford. His research interests focus on the impact of global atmospheric change on the ecology, structure and composition of terrestrial ecosystems, and in particular tropical forests, and how management and restoration of ecosystems can be used as a tool to tackle climate change. His field studies span Amazonia, the Andes, Africa and Southeast Asia. This research addresses fundamental questions about ecosystem function, diversity and dynamics, whilst at the same time aiming to provide outputs of direct relevance for conservation and adaptation to climate change. He is a Fellow of the Royal Society, and was awarded the Patron's Gold Medal of the Royal Geographical Society in 2018. He is President of the Association for Tropical Biology and Conservation.

Chris Field. Chris Field is the Perry L. McCarty Director of the Stanford Woods Institute for the Environment and the Melvin and Joan Lane Professor for Interdisciplinary Environmental Studies at Stanford University. Prior to his 2016 appointment at the Stanford Woods Institute, Field was a staff member at the Carnegie Institution for Science (1984-2002) and founding director of the Carnegie's Department of Global Ecology (2002-2016).

Field's research focuses on climate change, ranging from work on improving climate models to prospects for renewable energy systems and community organizations that can minimize the risk of a tragedy of the commons. He has been deeply involved with national and international efforts to advance understanding of global ecology and climate change. Field was co-chair of Working Group II of the Intergovernmental Panel on Climate Change (IPCC) (2008-2015), where he led the effort on "Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation" (2012), and "Climate Change 2014: Impacts, Adaptation, and Vulnerability (2014). His widely cited work has earned many recognitions, including election to the US National Academy of Sciences, the Max Planck Research Award, and the Roger Revelle Medal. Field is a member of the Harvard University Board of Overseers, the Board of Directors of World Wildlife Fund (US), and the Board of Trustees of the California Academy of Sciences. He is a fellow of the American Association for the Advancement of Science. He holds a bachelor's degree in biology from Harvard College and a PhD in biology from Stanford.

Nancy Knowlton NAS. Dr. Nancy Knowlton holds the Sant Chair in Marine Science at the Smithsonian's National Museum of Natural History in Washington DC, where she conducts research on coral reefs and ocean diversity. Earlier she held positions at Yale University, the Smithsonian Tropical Research Institute in Panama, and the Scripps Institution of Oceanography, where she founded the Center for Marine Biodiversity and Conservation. She is a winner of the Peter Benchley Prize and the Heinz Award, and was elected to the American Academy of Arts and Sciences and the US National Academy of Sciences in 2013. She co-led the Census of Marine Life coral reef program, is the author of *Citizens of the Sea*, and served as Editor-in-Chief of the Smithsonian's Ocean Portal website. She contributes to the global ocean conversation via @seacitizens and co-hosted the Smithsonian's 2017 Earth Optimism Summit, a global celebration of what is working in conservation.

Nathalie Seddon. Nathalie Seddon trained as an ecologist at Cambridge University and has over 20 years of field experience working in tropical forests, managing international teams and training students in the UK and abroad. She has published widely on the evolution of animal communication and on the origins and conservation of tropical diversity, and has received a number of awards for her work. These include a L'Oréal for Woman in Science Fellowship and a Royal Society University Research Fellowship. Seddon was made Professor of Biodiversity at Oxford University (Department of Zoology) in 2015 and has since worked at the interface of science and policy.

She has recently founded and directs the Nature-based Solutions Initiative (www.naturebasedsolutionsinitiative.org), a programme of interdisciplinary research, policy advice, and education aimed at getting science into policy and policy into action to increase the implementation of nature-based solutions worldwide.

By educating current and future decision makers and working closely with NGOs, local governments and the United Nations, her ambition is to bring the equitable protection of nature to the centre of the sustainable development agenda.

Martin Solan. Martin Solan is a Professor of Marine Ecology at the University of Southampton with broad interests in understanding biodiversity-environment interactions and the ecosystem consequences of altered biodiversity and environmental change. He champions strategic and applied interdisciplinary research in marine sediment habitats, from coastal to full ocean depth and across environmental gradients in polar, temperate and tropical regions of the world. A key component of his research is using experimental evidence and field observations to understand the functional contribution of past and present species and the ecological consequences of species loss. His research includes an interdisciplinary focus that recognises the tight coupling between natural and human systems.

Monica Turner. Dr. Monica G. Turner is the Eugene P. Odum Professor of Ecology and a Vilas Research Professor in the Department of Integrative Biology, University of Wisconsin-Madison. She has studied fire, vegetation dynamics, nutrient cycling, bark beetle outbreaks, and climate change in Greater Yellowstone for nearly 30 years, including long-term research on the 1988 Yellowstone fires. She also studies abrupt change in ecological systems, land-water interactions in Wisconsin landscapes, and spatial dynamics of ecosystem services. She has published over 250 scientific papers; authored or edited six books, including a 2nd edition of *Landscape Ecology in Theory and Practice*; and is co-editor in chief of Ecosystems. Turner is a past-president of the Ecological Society of America (ESA), a recipient of ESA's Robert H. MacArthur Award, and a member of the US National Academy of Sciences. She earned her BS in Biology from Fordham University (Bronx, NY) and her PhD in Ecology from the University of Georgia (Athens, GA).

Sackler Forum Participants

Rebecca Albright. Dr. Rebecca Albright is a marine biologist with expertise in coral reef biology, ecology, and biogeochemistry. Her research focuses on the capacity of coral reefs to cope with changing environmental conditions. Specifically, she has devoted the last 13 years to understanding how coral reef organisms are impacted by changing seawater chemistry (ocean acidification), alone and in combination with warming. She has led a variety of projects that address this central question at various scales ranging from single cells to individual organisms and ecosystem-scale processes. Her work is increasingly solutions-focused, exploring ways to mitigate global reef degradation. Albright received a BS in Biology from Duke University in 2003 and a PhD in Marine Biology from the University of Miami in 2011. She spent 6 years as a postdoctoral researcher at the Australian Institute of Marine Science and the Carnegie Institution for Science. She is currently a curator of Invertebrate Zoology at the California Academy of Sciences.

Dominique Bachelet. Dominique Bachelet is an ecologist with 39 years of combined education and work experience in the US. Her research has focused on global climate change impacts since 1989 and she has been involved in several Intergovernmental Panel on Climate Change reports since 1995. She has published over 80 peer reviewed papers and 30 book chapters, co-edited two books, and participated in model documentation and data archiving. She contributed to the development of the first dynamic global vegetation model (MC1) that included a dynamic fire model. In 2017 she was elected an American Association for the Advancement of Science Fellow in recognition of her climate change science contribution. For a decade she worked in the NGO world focusing on science information delivery and communication. With her team at the Nature Conservancy, Dominique initiated the creation of the "climate wizard" (climatewizard.org) to deliver climate projections. At Conservation Biology Institute, she worked closely with web application developers to ensure that the most relevant state-of-the-art climate change information, particularly about impacts, was delivered to the stakeholders who need it (e.g. climateconsole.org/conUS, climatemapper.org). She is currently teaching online classes at Oregon State University and working on a backlog of publications.

Richard Bardgett. Richard Bardgett is Professor of Ecology at The University of Manchester. His main research interest is the study of plant-soil interactions and their impact on biogeochemical cycles and plant community dynamics in natural and managed ecosystems, mostly in the context of global change. In particular, his research seeks to advance our understanding of the mechanisms by which complex soil biological communities influence ecosystem processes, and how plant functional diversity controls the structure and functioning of belowground communities across a broad range of temporal and spatial scales. His research also focusses on unravelling the mechanisms by which feedbacks between plant and soil communities regulate biogeochemical responses to climate change. He has written several books on these topics, including *The Biology of Soil* (2005*), Aboveground-Belowground Interactions* (2010), and *Earth Matters: How Soil Underpins Civilization* (2016), and is routinely recognized as a Highly Cited Researcher in ecology and environmental sciences. Bardgett is currently President of the British Ecological Society and Senior Editor of Journal of Ecology, and was elected an Honorary Fellow of the Royal Society of New Zealand in 2006 and a member of Academia Europaea in 2015.

Jos Barlow. Jos Barlow (Lancaster Environment Centre) has worked on the ecology and conservation of human-modified Amazonian forests since 1998, coordinating a number of major research initiatives in Brazil including the £3.6M NERC-FAPESP ECOFOR project that examined forest resilience to multiple anthropogenic stressors, including severe droughts, selective logging and wildfires. He is also one of the three founding members of the Sustainable Amazon Network, which coordinates over 80 scientists in Brazil, UK, and Australia. The network has produced over 60 influential publications, and has helped guide forest management policies in the eastern Amazon. He has been a Senior Editor of the Journal of Applied Ecology since 2013.

Elena Bennett. Dr. Elena Bennett is an Associate Professor at McGill University. She received her BA in Biology and Environmental Studies from Oberlin College (1994), earned her MSc in Land Resources (1999, U. Wisconsin) and her PhD in Limnology (2002, U. Wisconsin). She is co-chair of the Future Earth global research project ecoSERVICES. She is also Lead Author for the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services Global Assessment. Dr. Bennett was a Leopold Leadership Fellow (2012), and a Trottier Public Policy Professor (2013-2014). At McGill, she has won awards for undergraduate teaching, graduate supervision, contributions to campus sustainability, and contributions to local community sustainability. In 2012, she was selected to be one of two representatives of the Royal Society of Canada at the Summer Davos meeting of the World Economic Forum held in Tianjin, China. In 2015, she was named one of six Natural Sciences and Engineering Research Council of Canada Steacie Fellows, and in 2017, she was elected to the College of New Scholars, Artists, and Scientists of the Royal Society of Canada.

Kate Brauman. Kate Brauman is the Lead Scientist for the Global Water Initiative at the University of Minnesota's Institute on the Environment (IonE). She also leads IonE's impact goal on achieving safe water. Kate's research integrates hydrology and land use with economics and policy to better understand how water use by people affects the environment and our ability to live well in it. Through projects as diverse as payments for watershed services, global variation in "crop per drop", and worldwide trends in water consumption and availability, Brauman works with the Global Water Initiative to find sustainable solutions to pressing water issues. She received her doctorate from Stanford University and her undergraduate degree from Columbia University. She is currently a Lead Author for the global assessment of the Intergovernmental Platform on Biodiversity and Ecosystem Services.

Sandra Díaz NAS. Sandra Díaz is Professor of Community and Ecosystem Ecology at Córdoba National University, and Investigador Superior in the Argentine National Research Council, CONICET. She is interested in plant functional traits and general patterns of functional specialization, their interactions with global change drivers and their effects on ecosystem properties and the benefits that people derive from them. She has had a strong influence in the theoretical development and practical implementation of the concept of functional diversity and how it affects ecosystem properties and the benefits that different people derive from them. She has authored more than 150 scientific publications, many of them in leading academic journals, and is among the world's most cited authors in her field. She is a member of the Academies of Science of Argentina, the US, France, and the Developing World (TWAS), an Honorary Fellow of the British Ecological Society and a Fellow of the Ecological Society of America. She is a co-founder and co-leader of TRY, the Global Communal Plant Trait Initiative. She was been awarded a number of international distinctions, such as the Cozzarelli Prize 2008 of the US National Academy of Sciences, and the 2017 Margalef Prize for Ecology of the Generalitat de Catalunya. She has served in leading positions in the Intergovernmental Panel on Climate Change, the Millennium Ecosystem Assessment, and DIVERSITAS, and the International Council for Science integrated science initiative Future Earth. She is the founder and director of the international initiative Núcleo DiverSus on Diversity and Sustainability. She was a member of the Multidisciplinary Expert Panel of the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES), where she has had a prominent role in leading the IPBES Conceptual Framework. At the moment she is co-Chair of the IPBES Global Assessment.

Brian Foster FRS. Brian Foster is D.H. Perkins Professor of Experimental Physics at Oxford, where he was for many years been head of particle physics, Alexander von Humboldt Professor at Hamburg University, and Leading Scientist at the Deutsches Elektronen-Synchrotron (DESY) Laboratory. He is a Vice President of the Royal Society. He is known for his pioneering work in particle physics, in particular for his leadership of the ZEUS experiment in deep inelastic scattering of electrons from protons and in the development of electron–positron and electron–proton colliders. He is currently developing new methods of particle acceleration using plasmas. He has been popularising physics for many years, including the lecture series 'Einstein's Universe' and 'Superstrings', which combine his love of both science and music.

Sarah Giles. Dr. Sarah Giles is a Senior Policy Adviser at the Royal Society working on environment related topics. She is currently leading a programme of work titled *Living Landscapes* which aims to provide evidence to inform future agriculture and environment policy in the UK post-Brexit. Topics covered under the *Living Landscapes* programme include biodiversity, air quality, micropollution, soils and livestock. Giles also recently led the Royal Society's *Evidence Synthesis for Policy* programme which published a set of principles for good evidence synthesis for policy. These principles resulted in a high profile Nature Comment and have already been endorsed by UK government departments, academic publishers and UK Research Councils (funders). As part of her role Giles regularly communicates complex scientific information to policymakers and works collaboratively with Royal Society Fellows, other scientific experts and UK civil servants within the Department of Environment, Food and Rural Affairs. Giles has a PhD in animal behaviour and veterinary epidemiology from the University of Bristol, UK and a masters degree in veterinary epidemiology from the London School of Hygiene and Tropical Medicine.

Nick Graham. Nick Graham is a Royal Society University Research Fellow and a Chair in Marine Ecology, based at the Lancaster Environment Centre. He tackles large-scale ecological and social-ecological coral reef issues under the overarching themes of climate change, human use and resilience. Nick has assessed the impacts of climate induced coral bleaching on coral reef fish assemblages, fisheries and ecosystem stability. He has studied the patterns and processes by which degraded coral reefs recover, and how this can be influenced by management. He has also worked extensively on the ecological ramifications of fishing and closed area management.

Nancy Grimm. Dr. Nancy B. Grimm is the Virginia M. Ullman Professor of Ecology in the School of Life Sciences at Arizona State University. She is an ecologist who studies interactions of climate change, human activities, resilience, and biogeochemical processes in urban and stream ecosystems. From 1997-2016 Grimm directed the Central Arizona–Phoenix Long-Term Ecological Research program, a pioneering interdisciplinary study of a complex metropolitan region whose conceptual models of social-ecological-technological systems expanded the field of ecology and helped to advance interdisciplinary scholarship of urban systems. She now co-directs the National Science Foundation-funded Urban Resilience to Extremes Sustainability Research Network, a consortium of university researchers and city practitioners focused on improving resilience of urban infrastructure systems and communities to increasingly frequent and severe events like pluvial flooding, coastal flooding, heat waves, and drought. Grimm is past president of the Ecological Society of America (ESA) and the Society for Freshwater Science, and is Fellow of American Association for the Advancement of Science, the ESA, and the American Geophysical Union. She is editor for *Earth's Future, Ecohydrology,* and *J Urban Ecology*, was a lead author for the 2014 US National Climate Assessment, and has produced >170 scientific publications.

Bronson Griscom. Bronson Griscom directs the carbon science team at The Nature Conservancy, and leads a research program looking at the potential of cost-effective climate mitigation options including protection, restoration, and adoption of best management practices across forests, agricultural lands, and wetlands. His team focuses on the three largest options: improved natural forest management, avoided forest conversion, and reforestation. Griscom is leading a Science for Nature and People (SNAPP) working group synthesizing science to inform climate smart forestry in southern Mexico and East Kalimantan, Indonesia. His team developed the first carbon methodology to verify the climate benefits of reduced-impact logging practices across the tropics.

Prior to joining The Nature Conservancy, Griscom coordinated a successful effort at the US Department of State, as an American Association for the Advancement of Science Fellow, to make climate change funding available for forest-climate initiatives through the Global Environmental Facility (GEF). He completed a post-doc at the Canaan Valley Institute in West Virginia studying restoration of high elevation Appalachian forests. He completed a PhD in tropical forest ecology from the Yale School of Forestry and Environmental Studies in 2003, and received his MSc from New York University in plant genetics and conservation.

Alex Halliday FRS. Dr. Alex Halliday is the Director of Columbia University's Earth Institute. He joined the Earth Institute in April 2018, after spending more than a decade at the University of Oxford, during which time he was Dean of Science and Engineering. With about 400 published research papers, Halliday has been a pioneer in developing mass spectrometry to measure small isotopic variations in everything from meteorites to seawater to living organisms, helping to shed light on the birth and early development of our solar system, the interior workings of the Earth, and the processes that affect Earth's surface environment.

His scientific achievements have been recognized through numerous awards, including the Murchison Medal of the Geological Society, the Bowen Award and Hess Medal of the American Geophysical Union, the Urey Medal of the European Association of Geochemistry, and the Oxburgh Medal of the Institute of Measurement and Control. He is a Fellow of the UK's Royal Society and Foreign Associate of the US National Academy of Sciences. Halliday has also helped to lead a variety of distinguished scientific societies and advisory panels. He is the former Vice President of the Royal Society and former President of the Geochemical Society. He has served as an external board member for Britain's Natural Environment Research Council, the Max Planck Society, London's Natural History Museum, the American Geophysical Union, and more. As a professor in Columbia's Department of Earth and Environmental Sciences, Halliday divides his time between Columbia's Morningside campus and his geochemistry lab at Lamont-Doherty Earth Observatory.

Susan Harrison NAS. Susan Harrison is an ecologist known for her work on the dynamics of natural populations and the diversity of ecological communities. Early in her career, she was mainly known for testing and revising theories about the influence of naturally fragmented habitats on population persistence and community dynamics. More recently, she has become known for analyzing how plant communities respond to natural climatic variation and recent climate change. She was born and raised in Sonoma, California. At UC Davis she received a bachelor's degree in Zoology in 1983 and a Master's degree in Ecology in 1986. At Stanford University she was awarded a PhD in Biology in 1989. She was a postdoctoral fellow at the Centre for Population Biology, Imperial College at Silwood Park from 1990-1991, following which she joined the faculty of Environmental Science and Policy at UC Davis in 1991. She is a Fellow of the California Academy of Sciences and a Fellow of the Ecological Society of America, and has been a Vice-President of the American Society of Naturalists.

Sarah Hobbie NAS. Sarah Hobbie is a Distinguished McKnight University Professor in the Ecology, Evolution and Behavior Department at the University of Minnesota. She is an ecosystem ecologist, known for her studies of terrestrial carbon and nutrient cycling in ecosystems ranging from tundra to cities. Hobbie grew up in St. Paul, Minnesota. She graduated from Carleton College in 1986 with a degree in biology and earned her PhD in 1995 from the University of California, Berkeley. After her PhD, she was a post-doctoral fellow at Stanford University. In 1998, she joined the faculty at the University of Minnesota, where she is a Fellow of the University of Minnesota's Institute on the Environment and is a member of the University of Minnesota's Academy of Distinguished Teachers. Hobbie is a member of the US National Academy of Sciences, an American Academy of Arts and Sciences Fellow, a Leopold Fellow, and a Fellow in the Ecological Society of America.

Hobbie's research addresses the influence of human activities on terrestrial ecosystems. She explores the influence of human-caused changes to the global and local environment – rising atmospheric carbon dioxide, increased atmospheric nitrogen deposition, climate change, plant species compositional shifts, and urbanization – on ecosystem processes, particularly terrestrial carbon and nutrient cycling and the flow of nutrients from land to water. She is active in the National Science Foundation's Long Term Ecological Research program (LTER), and is co-leader of the Cedar Creek LTER site in central Minnesota.

Valerie Kapos. Valerie Kapos is Head of the Climate Change & Biodiversity Programme of the UN Environment World Conservation Monitoring Centre. She leads the Centre's work on impacts on biodiversity and ecosystem services of climate change and related policies, and the role of biodiversity and ecosystems in climate change mitigation and adaptation. Particular foci are REDD+ and ecosystem based approaches to adaptation (EbA). The REDD+ work focuses on supporting countries to take account of biodiversity and ecosystem services in their land use planning for REDD+, and to identify and address the potential risks and benefits of REDD+ to support the Cancun Safeguards. On EbA, the focus is on assessing the evidence for the effectiveness of EBA approaches, identifying good practice, and supporting decision makers in many sectors to incorporate ecosystems in planning and implementing options for adaptation to climate change. Kapos also coordinates the Centre's work on using spatial analysis to support area-based planning for conservation and sustainable development, and has also worked extensively on biodiversity indicators to support policy and decision making at international and national scales.

Before joining UNEP-WCMC, Kapos spent over 15 years doing field research in tropical forest ecology in Latin America and the Caribbean. She has published over 60 peer reviewed journal articles, and numerous (over 100) articles, technical reports, book chapters.

Sandra Lavorel. Trained as an agronomer, Sandra Lavorel obtained a PhD in ecology in 1991. She has been a researcher at the French National Center for Scientific Research (CNRS) since 1994, and is now a Senior Researcher. She manages a research group on the 'Dynamics of socio-ecosystems in a changing world' at the Alpine Ecology Laboratory in Grenoble. Lavorel has received numerous awards including the Silver Medal of CNRS (2013), the Alexander von Humboldt Medal of the International Association for Vegetation Science (2015), and the Marsh Award of the British Ecological Society (2017). She was elected as a member of the French Academy of Sciences in 2013.

After a Ph.D. in plant community ecology, Lavorel's career has been dedicated to linking global change impacts on biodiversity to changes in ecosystem functioning, known as the Holy Grail for functional ecology. To address this challenge, she contributed to the emergence of functional trait-based approaches, initially on plants and then across trophic levels. She has been at the forefront of their development to address questions ranging from disturbance responses, to biodiversity effects on ecosystem functioning, and to the quantification of ecosystem services.

Lavorel's current research focuses on impacts on ecosystems and their services with combined changes in climate and land management. This interdisciplinary research at the interface between functional ecology and social sciences, and with close participation of local and regional stakeholders, contributes to national and international biodiversity and ecosystem assessments. She chairs the French National Ecosystem Assessment and has been an active contributor to assessments of the International Platform for Biodiversity and Ecosystem services (IPBES). In particular she was a lead author of the Europe and Central Asia assessment where she coordinated the work on pathways to sustainable futures. She has now joined the Multidisciplinary Expert Panel of IPBES.

Joshua Lawler. Josh Lawler is Denman Professor of Sustainable Resource Sciences in the School of Environmental and Forest Sciences and the Director of the Center for Creative Conservation at the University of Washington. He is a landscape ecologist and conservation biologist driven by applied conservation questions and their real-world applications. He is most interested in how anthropogenic factors affect species distributions, population dynamics, and community composition at regional and continental scales. His research involves investigating the effects of climate change on species distributions and populations, exploring the influence of landscape pattern on animal populations and communities, and climate-change adaptation for natural and human systems. Some of his current work has begun to involve the field of conservation psychology – exploring how people make environmental decisions and what psychological benefits people gain from nature.

Tim Lenton. Tim Lenton is Director of the Global Systems Institute and Chair in Climate Change and Earth System Science at the University of Exeter. His research focuses on the coupled evolution of life and the planet, on climate change tipping points and early warning methods, and on developing an evolutionary ecosystem model focusing on the marine microbial biosphere. He is particularly interested in how life has reshaped the planet in the past, and what lessons we can draw from this as we proceed to reshape the planet now. These topics are covered in his books *Earth System Science: A Very Short Introduction* (OUP 2016) and *Revolutions that made the Earth* with Andrew Watson (OUP, 2011).

Paul Lussier. Paul Lussier most recently founded and served as Director of the Science Narratives to Network Program at Yale School of Forestry and Environmental Studies. Presently, he is a Visiting Fellow at University of Exeter where he is working on developing strategic networks of transformation with stakeholders across community, economic, business, policy, science and belief systems for purposes of generating value from natural systems regeneration, restoration and conservation.

Hailing from the private sector, Lussier has a diverse background in media, communications and cybernetics, which combined expertise is presently being applied towards tech-connected networks of regenerative farms (US/India), irrigation systems (Africa), energy systems for the cities of Detroit and Dallas) as well as Facebook, Google and Amazon. He is also developing software towards the scaling of land and sea-based farms, in which he is partnered with Microsoft. In media, Lussier is one of the founding producers of the Discovery Channel, Director of CNN Environmental News, and one of the founding strategic partners/designers of numerous crowd-sourced knowledge systems, among them, Wikipedia. In the private sector, he works with leading financial and investment institutions and individuals worldwide on ecosystem investment schemas and asset classes towards climate mitigation and adaptation. In this work, he counts among his partners a portfolio of the world's foremost hedge funds, investment and sovereign banks.

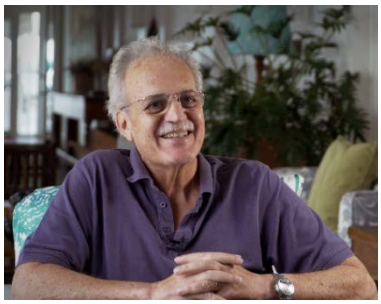
He is currently working on *DOMINION: Towards an Ethic of Partnership to Advance Our World*, a multi-media franchise involving a worldwide book (Knopf); a worldwide news series (CNN); and a global television series which captures the trajectory of value generation of natural systems towards climate mitigation, adaptation, resilience, and a fairer world. DOMINION is a combined non-fiction/fictional science-based media franchise which captures a vision of a world that integrates Sustainable Development Goals with Climate Targets towards unprecedented social, human, natural and economic value. DOMINION will emerge in 2020 and is targeted for the popular audience.

April Melvin. April Melvin is a Program Officer with the National Academies' Board on Atmospheric Sciences and Climate, and Polar Research Board. She has coordinated studies on a range of topics including evaluation of methodologies for measuring anthropogenic methane emissions, peer reviews of both volumes of the US Fourth National Climate Assessment, and evaluation of New York City's Watershed Protection Program. Melvin is trained as an ecosystem ecologist and biogeochemist and has over 10 years of experience studying the impacts of climate change and air pollution on forests in the Northeastern US and Alaska. This work has included improving understanding of how forest management affects carbon and nutrient cycling and forest succession. Prior to joining that National Academies, Melvin was a Science & Technology Policy Fellow in the Climate Change Division at the US Environmental Protection Agency, sponsored by the American Association for the Advancement of Science. As a Fellow, she coordinated research on economic damages to public infrastructure and costs of responding to wildfire in Alaska. Melvin received her PhD from Cornell University and BS from the University of Rochester.

Peter Mumby. Peter Mumby began his career helping to design marine reserves in Belize and experienced first-hand the limited scientific basis for decision-making. He then began a research pathway with a goal of providing science that can inform practical conservation and management action. His research combines field observations, experiments, remote sensing, and ecological modelling to answer questions about ecosystem resilience, impacts of climate change, marine reserve functioning and design, connectivity of ecosystems, coral reef fisheries, and marine spatial planning to capture ecosystem services. To achieve this, Mumby's students and post-docs work on a variety of taxa and processes including corals, algae, sponges, herbivory, predatory fishes, food web models, metapopulation models, and so on. He collaborates extensively with friends in other fields including economics, engineering, oceanography, and business. Mumby undertook a PhD at the University of Sheffield (UK), followed by a Natural Environmental Research Council Post-doctoral fellowship at the University of Newcastle. This was followed by a Royal Society fellowship at the University of Exeter (UK), and a move to Brisbane to take up a prestigious Australian Research Council Laureate Fellowship in 2010. He is currently a Professor at the University of Queensland (School of Biological Sciences) and Chief Scientist of the Great Barrier Reef Foundation, who are coordinating the Australian government's $444M investments into the Great Barrier Reef.

Mumby is a Pew Fellow in Marine Conservation and winner of the Rosenstiel Award for Contributions to Marine Biology, Marsh Award for Marine Conservation, and the inaugural International Society for Reef Studies Mid-Career Award for contributions to reef science. Mumby has published more than 250 journal articles, is an ISI highly-cited researcher, and has an h-index of 75. He is happiest on a coral reef with a camera in his hands.

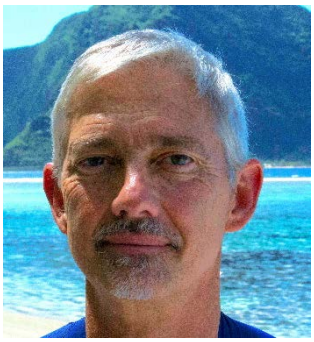
Tim Newbold. Tim Newbold is a Senior Research Fellow at University College London. His research aims to understand and predict how human activities are changing biodiversity across the whole of the Earth's land surface. Newbold's work involves analysing very large datasets and using this information to make predictions of future changes to biodiversity under different scenarios for how the future might unfold. He is particularly interested in the effects of habitat loss and climate change, and why certain species are more impacted than others by these environmental changes.



Carlos Nobre NAS. Carlos Nobre is an Earth System scientist from Brazil. He obtained a PhD in Meteorology at Massachusetts Institute of Technology in January 1983. Presently, he is a Senior Researcher with University of São Paulo's Institute for Advanced Studies, Senior Fellow of World Resources Institute (WRI Brazil) and chair of the Brazilian Panel on Climate Change. He has dedicated his scientific carrier mostly to Amazonian and climate science at Brazil's National Institutes of Amazonian Research (INPA) and Space Research (INPE). He is the creator of Brazil's National Center for Monitoring and Alerts of Natural Disasters and of INPE's Center for Earth System Science and was Director of INPE's Center for Weather Forecasting and Climate Studies (CPTEC). Nobre's work focused on the Amazon and its impacts on the Earth system. He chaired the Large-Scale Biosphere-Atmosphere Experiment in Amazonia (LBA), an international research initiative designed to create the new knowledge needed to understand the climatic, ecological, biogeochemical, and hydrological functioning of Amazonia, the impact of land use and climate changes on these functions, and the interactions between Amazonia and the Earth system. He was chair of the International Geosphere-Biosphere Programme (IGBP). He was National Secretary for Research and Development Policies at the Ministry of Science, Technology & Innovation of Brazil and President of Brazil's Agency for Post-Graduate Education (CAPES). He is a former member of UN Secretary-General Scientific Advisory Board for Global Sustainability. He is a foreign member of the US National Academy of Sciences, and member of the Brazilian Academy of Sciences and World Academy of Sciences. He was awarded the Volvo Environmental Prize in 2016, the Von Humboldt Medal of the European Geosciences Union in 2010 and was one of the authors of Intergovernmental Panel on Climate Change Fourth Assessment Report awarded with the Nobel Peace Prize in 2007.

Andrew Norton. Andrew Norton took up the position of Director of the International Institute for Environment and Development (IIED) in June 2015. From his Doctoral research in rural Mali through a career that has spanned research, academic and development institutions, he has focused on issues of poverty, inequality, participation, natural resource governance, and climate change. As Director, he is working to amplify and strengthen IIED's core messages on climate action, social and environmental justice, and helping poor people to achieve greater voice and more resilient livelihoods.

Steve Palumbi NAS. Steve is a Professor of Biology, based at Stanford's marine lab in Monterey. He has used genetic detective work to identify whales for sale in retail markets, sharks in shark fin soup, where restaurant conch come from, and is genetically mapping corals resistant to climate change. Recently elected to the US National Academy of Sciences, Palumbi is a board member for several conservation organizations and a Senior Fellow of the Woods Institute of the Environment. His work has been used in design of the current network of marine protected areas in California, seafood labelling laws in Japan and the United States, and in numerous TV and film documentaries including the 2017 PBS series Big Pacific. Palumbi's latest book for non-scientists is about the amazing species in the sea, written with his son and novelist, Anthony. The Extreme Life of the Sea tells you about the fastest species in the sea, and hottest, coldest, oldest etc. Palumbi started the video production company Short Attention Span Science Theatre, and appears in many films and TV series about the sea.



Camille Parmesan. Camille Parmesan is a Professor at University of Plymouth (UK) and University of Texas at Austin (US, where she also received her PhD in 1995). She soon joins the French National Center for Scientific Research (CNRS) in Moulis as a "Make Our Planet Great Again" Laureate. Her research focuses on the impacts of climate change on wild plants and animals and spans from field-based work on butterflies to synthetic analyses of global impacts on a broad range of species across terrestrial and marine biomes. She has also authored numerous assessments of impacts of climate change on agricultural pests and on human health, through changes in the wild animal vectors and reservoirs of diseases.

Parmesan has received numerous scientific awards, including being ranked the second most highly cited author in the field of Climate Change from 1999-2009 (T Reuters), named the "2013 Distinguished Scientist" by the Texas Academy of Sciences, elected a Fellow of the Ecological Society of America, and newly-elected Fellow of the European Academy of Sciences. Her 2003 paper in *Nature* was ranked the most highly cited paper on Climate Change (Carbon Brief, 2015). She works actively with governmental agencies and NGOs to help develop conservation assessment and planning tools aimed at preserving biodiversity in the face of climate change. She was awarded the Conservation Achievement Award in Science by the National Wildlife Federation, named "Outstanding Woman Working on Climate Change," by the International Union for Conservation of Nature, and named as a "Who's Who of Women and the Environment" by the United Nations Environment Program (UNEP). She has worked with the Intergovernmental Panel on Climate Change (IPCC) for >20 years, and is an official Contributor to IPCC's Nobel Peace Prize in 2007.

Richard Pearson. Richard Pearson is Professor of Ecology and Director of the Centre for Biodiversity and Environment Research, which is a research centre within the Department of Genetics, Evolution and Environment at University College London. Pearson completed his Doctorate at the University of Oxford in 2004. From 2005-2013 he was a postdoc and then research scientist at the American Museum of Natural History. Pearson has been identified as one of the world's most Highly Cited Researchers in the field of Environment/Ecology. His research focuses on fundamental questions relating to the evolution and conservation of biodiversity: where are species distributed? why are they distributed there? how do distributions and abundances change over time? Pearson is on the editorial boards of the journals Global Change Biology and Journal of Biogeography. He is a member of the International Union for Conservation of Nature Species Survival Commission Climate Change Specialist Group and has been a contributing author for the Intergovernmental Panel on Climate Change. Alongside his research and teaching, Pearson engages in communicating biodiversity research to a general audience, including publishing a non-specialist book on the impact of climate change on biodiversity (*Driven to Extinction* Sterling, New York 2011).

Stephen Polasky NAS. Dr. Stephen Polasky is a Regents Professor and the Fesler-Lampert Professor of Ecological/Environmental Economics at the University of Minnesota where he has a joint appointment in the Department of Applied Economics and the Department of Ecology, Evolution & Behavior. He is also a fellow of the University's Institute on the Environment. His research interests focus on issues at the intersection of ecology and economics and include the impacts of land use and land management on the provision and value of ecosystem services and natural capital, biodiversity conservation, sustainability, environmental regulation, renewable energy, and common property resources. He is a co-founder of the Natural Capital Project, a partnership between the University of Minnesota, Stanford University, the Chinese Academy of Sciences, The Nature Conservancy, and the World Wildlife Fund. He served as Senior Staff Economist for environment and resources for the President's Council of Economic Advisers 1998-1999. He currently serves on the Board of Directors and the Science Council for The Nature Conservancy, and the Science Advisory Board of the National Atmospheric and Oceanic Administration. He was elected into the US National Academy of Sciences in 2010. He is a fellow of the Association of Environmental and Resource Economists, the American Academy of Arts and Sciences, and the American Association for the Advancement of Science. He received a PhD in economics from the University of Michigan in 1986.

Callum Roberts. Callum Roberts is Professor of Marine Conservation at the University of York in the UK. His research focuses on threats to marine ecosystems and species, and on finding the means to protect them. His main research interests include documenting the impacts of fishing on marine life, both historic and modern, and exploring the theory and practical effectiveness of marine protected areas for conservation and fisheries management. For the last 28 years he has used his science background to make the case for stronger protection for marine life at both national and international levels. His research team designed half a million square kilometres of marine protection in the North Atlantic that was established by OSPAR in 2010. His team also provided the scientific underpinning for a new ocean protection target – 30% by 2030 – which is gaining widespread support as a follow on to the United Nations (UN) 10% by 2020 target. Recently, with a group of leading scientists, he showed how expanded ocean protection can help mitigate climate change.

Roberts' award-winning book, *The Unnatural History of the Sea,* charts the effects of 1000 years of exploitation on ocean life. His second book, *Ocean of life: how our seas are changing*, shows that the oceans are changing faster and in more ways than at any time in human history, setting out a series of reforms that could lead to a more sustainable future. Roberts was chief scientific advisor for the BBC television's flagship series Blue Planet II. He is currently working with the UN Ocean Sanctuary Alliance and 10 x 20 initiative to encourage nations to meet their commitments to establish at least 10% of their seas as marine protected areas by 2020. As well as being a World Wildlife Fund UK Ambassador, he is on the Board of Blue Marine Foundation and is advisor to the Pew Bertarelli Global Ocean Legacy Program. He has been a Pew Fellow in Marine Conservation since 2000 and was a visiting Professor at Harvard University in 2001.

Chris Sandom. Like many of his generation, Dr Chris Sandom's early connection to the natural world was informed more by David Attenborough's inspirational documentaries and his own travels abroad rather than the managed landscapes on his doorstep. This led to his passion for rewilding and improving nature-human interactions. Driven by his need to know and do more, he undertook his D.Phil with WildCRU at Oxford University on how wild boar and wolves could help restore the Caledonian Pine Forest. This steered him to research the causes and consequences of the late Quaternary megafauna extinction at Aarhus University, Denmark. Today, Dr Sandom is a Lecturer at the University of Sussex, UK, and a Director of Wild Business (www.wildbusiness.org), and through these positions of research, teaching and consultancy, continues his quest to help create a more natural and sustainable planet.

Dov Sax. Dov F. Sax is an Associate Professor of Ecology and Evolutionary Biology at Brown University, Deputy Director of the Institute at Brown for Environment and Society, and President of the International Biogeography Society. He received his PhD in Biology at the University of New Mexico in 1999 and a BA in Integrative Biology at the University of California, Berkeley in 1992. His research interests focus on species' responses to climate change, species extinction and species invasions. He has co-edited two books, *Foundations of Biogeography* (University of Chicago Press, 2004) and *Species Invasions: Insights into Ecology, Evolution and Biogeography* (Sinauer Associates, 2005). His current research explores how species vary in their vulnerability to changes in climate and what conservation strategies might be employed to reduce those risks.

Daniela Schmidt. Daniela Schmidt is a Professor of Palaeobiology at the University of Bristol and Faculty Research Director for the Faculty of Sciences. Her research focuses on understanding the causes and effects of global warming and ocean acidification, both in the modern era and in geological time. She is combing large morphometric datasets, CT scanning, and high resolution material properties to quantify the reaction of marine organisms to environmental change. One of her research highlights was the characterisation of the unprecedented rate of change of past intervals of rapid environmental change and the biotic response to these changes. Daniela has contributed as a lead author of Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report Working Group WGII in the Ocean chapter and is currently an Expert Group Member of European Union Science Advice for Policy by European Academies (SAPEA) of the European Scientific Advice Mechanism (SAM) on the topic "Food from the Oceans". She will be leading the IPCC chapter assessing the impacts and potential for adaptation of climate change in Europe for the 6th IPCC assessment.

Pete Smith FRS. Pete Smith is Professor of Soils and Global Change at the Institute of Biological and Environmental Sciences at the University of Aberdeen (Scotland, UK) and Science Director of the Scottish Climate Change Centre of Expertise (ClimateXChange). He led work on the mitigation of climate change in agricultural / land sector for the fourth and fifth Intergovernmental Panel on Climate Change Assessment Reports, and led the chapter on greenhouse gas removal technologies for the United Nations Environment Programme Emissions Gap Report in 2017. He is a Fellow of the Royal Society of Biology, a Fellow of the Institute of Soil Scientists, a Fellow of the Royal Society of Edinburgh, a Foreign Fellow of the Indian National Science Academy and a Fellow of the Royal Society (London).

Amanda Staudt. Amanda Staudt directs the Board on Atmospheric Sciences and Climate (BASC) and the Polar Research Board (PRB) at the National Academies. Staudt leads strategic planning, guides project development, and provides institutional oversight for both boards. From 2007-2013, Staudt was a Senior Climate Scientist at the National Wildlife Federation (NWF). In this role, she focused on communicating climate science and impacts with key decision makers and the general public, developing the intellectual and practical foundation for climate-informed conservation, and advancing climate change science education. She served on the steering committee for *Impacts of Climate Change on Biodiversity, Ecosystems, and Ecosystem Services: Technical Input to the 2013 National Climate Assessment*, and was an editor of *Climate-Smart Conservation: Putting Adaptation Principles into Practice*, a 2014 guidance produced by an expert workgroup including representatives from government, nonprofits, and academia. Prior to her time at NWF, Staudt was a Senior Program Officer for BASC, where she directed the Climate Research Committee and a number of high-profile studies, including the fast-track review of the US Climate Change Science Program Strategic Plan, and studies on weather research for surface transportation and radiative forcing effects on climate. She also spear-headed the development of the Academy's first booklet on climate change targeted to public audiences. Staudt received her BA cum laude in environmental science and engineering from Harvard College and her PhD in atmospheric sciences from Harvard University.

Chris Thomas FRS. Chris Thomas works on the ecology, evolution and conservation of biodiversity in the Anthropocene. Thomas is interested in understanding how humans have transformed the biological world, and how we might protect the world's remaining biodiversity. More broadly, he researches why some species decline and disappear but others are successful, aiming to quantify gains in biological diversity as well as losses; the topic of his recent book, *Inheritors of the Earth: how nature is thriving in an Age of Extinction*. His work has influenced the development of national and international policies for conservation and climate change, including inputs to the Intergovernmental Panel on Climate Change, conservation NGOs, and UK governmental reviews and agencies. Thomas is a Professor at the University of York, in England, a Fellow of the Royal Society, and President of the Royal Entomological Society.

Bhaskar Vira. Bhaskar Vira is Professor of Political Economy, at the Department of Geography, University of Cambridge, and a Fellow of Fitzwilliam College. He is the Founding Director of the University of Cambridge Conservation Research Institute.

Trained as an economist, Vira's research is concerned, in particular, with the often-hidden costs of environmental and developmental processes, and the need for scholarship to draw attention to the distributional consequences of public policy choices. His work brings a critical political economy perspective to contemporary debates in relation to conservation, natural capital, food and nutrition security and water, and the importance of nature for human wellbeing. Vira convenes research across a wide portfolio at Cambridge, and is a key member of the Cambridge Conservation Initiative (CCI), which is a unique collaboration between the University of Cambridge and leading internationally-focused biodiversity conservation organisations clustered in and around Cambridge, UK.

Bhaskar has played important roles in science-policy processes linked with ecosystem services and natural capital, including the Millennium Ecosystem Assessment, the UK National Ecosystem Assessment and the Royal Society Working Group on Human Resilience to Climate Change and Disasters. He Chaired the Global Forest Expert Panel on Forests and Food, and was a member of the recent Global Forest Expert Panel on Forests and Water.

Cathy Whitlock NAS. Cathy Whitlock is a professor of Earth Sciences at Montana State University (MSU) and a fellow of the Montana Institute on Ecosystems. Dr. Whitlock's research interests include Quaternary environmental change, paleoecology and paleoclimatology with a focus on vegetation, fire, and climate history. She is nationally and internationally recognized for her scholarly contributions and leadership activities in the field of past climatic and environmental change, and she has published over 200 reviewed journal articles and book chapters on this topic. Her current research sites extend from Yellowstone and the western US to New Zealand, Tasmania, and Patagonia. Since her arrival at MSU in 2004, Dr. Whitlock has built a successful research and teaching program, and the MSU Paleoecology Lab supports post-docs, graduate students, and undergraduates, and visiting scientists from around the world. Her research has been funded by grants from the National Science Foundation, Joint Fire Sciences Program, National Park Service, Department of Energy, USDA Forest Service, and US Geological Survey. She is past President of the American Quaternary Association and has served on national and international advisory committees concerned with climate change. Dr. Whitlock is also the lead author of the 2017 Montana Climate Assessment. She is a Fellow of the American Association for the Advancement of Science and the Geological Society of America, and in 2018 was elected to membership in the US National Academy of Sciences. She earned her PhD. and MS in geological sciences from the University of Washington in 1983 and her BA from Colorado College in 1975.

Park Williams. Dr. Park Williams is a bioclimatologist whose research straddles the fields of climatology and ecology. He is especially interested in the climatological causes and the ecological consequences of drought. His research aims to improve understanding of drought and its effects on terrestrial systems, including forests, the carbon cycle, agriculture, and humanity. His ultimate goal is to advance scientific knowledge in ways that are relevant to policy makers and future scientific endeavors, and also interesting to the public and other scientists.

Emma Woods. As Head of Policy at the Royal Society, Emma Woods works with some of the world's most distinguished scientists to provide expert, timely and accessible advice to decision-makers. She leads the Society's 'Wellbeing' theme, which explores the wellbeing of living systems and includes major programmes on Genetic Technologies and Living Landscapes.

In previous roles at the Society Woods has advised the UK government on the environmental risks of fracking, advised the UN on how to build people's resilience to extreme weather (including through ecosystem-based approaches), and worked on issues as diverse as geoengineering, synthetic biology and the Sustainable Development Goals. She has also worked for the UN Convention on Biological Diversity, the Foundation for Democracy and Sustainable Development, and World Wildlife Fund Madagascar, and is a Fellow of the Cambridge University Centre for Science and Policy and the Westminster Abbey Institute.

During her two degrees at Oxford University – in Biological Sciences and in Biodiversity, Conservation and Management – she conducted her own research on tarsiers in Indonesia, and on forest conservation, rural livelihoods and participatory video in Tanzania.