One Earth

Gold Standard for the Global Goals
1 ton of CO_2 offset

CellPress
OPEN ACCESS

Perspective

Science-Industry Collaboration: Sideways or Highways to Ocean Sustainability?

Henrik Österblom,[1,*] Christopher Cvitanovic,[2,3] Ingrid van Putten,[3,4] Prue Addison,[5] Robert Blasiak,[1] Jean-Baptiste Jouffray,[1,6] Jan Bebbington,[7] Julie Hall,[8] Sierra Ison,[3] Arnault LeBris,[9] Sara Mynott,[10,11] David Reid,[12,13] and Aoi Sugimoto[14]
[1]Stockholm Resilience Centre, Stockholm University, 106 91 Stockholm, Sweden
[2]Australian National Centre for the Public Awareness of Science, Australian National University, Canberra, Australia
[3]Centre for Marine Socioecology, University of Tasmania, Hobart, TAS, Australia
[4]CSIRO, Oceans and Atmosphere, Hobart, TAS, Australia
[5]Interdisciplinary Centre for Conservation Science, University of Oxford, 11a Mansfield Road, Oxford OX1 3SZ, UK
[6]Royal Swedish Academy of Sciences, P.O. Box 50004, Stockholm, Sweden
[7]Birmingham Business School, University of Birmingham, Birmingham B15 2TT, UK
[8]NIWA, Private Bag 14901 Kilbirnie, Wellington 6241, New Zealand
[9]Fisheries and Marine Institute of Memorial University of Newfoundland, 155 Ridge Road, St. John's, NL A1C 5R3, Canada
[10]Centre for Ecology & Conservation, University of Exeter, Penryn Campus, Penryn TR10 9FE, UK
[11]Mindfully Wired Communications, Frome, Somerset, UK
[12]Marine Institute, Rinville, Oranmore, Co. Galway, Ireland
[13]School of Biological, Earth and Environmental Sciences, University College Cork
[14]Japan Fisheries Research and Education Agency, Yokohama, Kanagawa, Japan
*Correspondence: henrik.osterblom@su.se
https://doi.org/10.1016/j.oneear.2020.06.011

There is substantial and unexplored potential for scientists to engage with the private sector for a sustainable ocean. The importance of such cooperation is a frequent emphasis of international dialogues and statements, it is embedded within the Sustainable Development Goals, and has been championed by prominent business leaders and scientists. But an uncritical embrace of science-industry collaboration is unhelpful, and candid reflections on the benefits and pitfalls that marine scientists can expect from actively engaging with the private sector are rare. In this Perspective, we draw on our collective experiences working with ocean industries in different parts of the world to reflect on how this has influenced our work, the effects these collaborations have generated, and the barriers to overcome for such partnerships to become more common. In doing so, we hope to help empower a new generation of marine scientists to explore collaboration with industry as a way to develop and scale up solutions for ocean sustainability.

Introduction

Ocean-based industries provide income, stimulate growth, and generate new opportunities,[1] but have also contributed to the degradation of marine ecosystems and the loss of biodiversity, with virtually none of today's ocean untouched by human impacts.[2,3] The rapid and simultaneous growth of multiple ocean industries within the context of a changing climate adds further complexity to efforts aimed at mitigating negative environmental impacts and social harm.[4–6]

Not only is it impossible for a single company or a single industry to bend all the trajectories of degradation and overuse of marine systems, it is also impossible for a single scientist or a single scientific discipline to fully understand the many ways in which the ocean is changing.[7,8] One consequence has been the formation of industry platforms and coalitions aimed at collaborative industry learning and action.[9,10] Another has been that scientists increasingly focus on collaborative approaches across disciplines, while a third outcome has been an increasing appetite for exploring the potential of scientists to directly engage with industry.[11]

It would seem that conditions are ideal for such science-industry engagement to flourish. The international community has produced decades of consensus language that hits all the right notes, repeatedly emphasizing the need for cooperation between the private sector, scientists, and governments (Box 1). In 2015, the Sustainable Development Goals (SDGs) were launched by the United Nations to support sustainability and human well-being,[12] including goals specifically dedicated to Life Below Water (SDG 14) and Partnerships (SDG 17), and associated targets for building up multi-stakeholder and public-private partnerships. Research agencies increasingly look for societal impact and relevance in funding proposals, whereas ocean sustainability science itself has grown transdisciplinary[13,14] and increasingly involves participatory research approaches with actors outside of the scientific community to address sustainability challenges.[15] We believe, however, that collaborative science that reaches beyond the scientific community has yet to realize its full potential.[15,16] Researchers have begun to identify principles associated with successful engagement with policy makers,[17–20] but marine scientists have rarely provided candid reflections on their experiences engaging with ocean-based industries (but see Orecchini et al.[21]).

In this Perspective, we share our experiences, and argue that improving science-industry collaboration for the ocean is essential for meeting the SDGs. We recognize, however, that an uncritical embrace of science-industry collaboration is unhelpful.

Box 1. Quotes in High-Profile Sustainability Reports that Emphasize the Need for Cooperation

"The Commission is confident that it is possible to build a future that is more prosperous, more just, and more secure because it rests on policies and practices that serve to expand and sustain the ecological basis of development. The Commission is convinced, however, that this will not happen without significant changes in current approaches (including) changes in the nature of cooperation between governments, business, science, and people (…)."[22]

"Industry is on the leading edge of the interface between people and the environment. It is perhaps the main instrument of change that affects the environmental resource bases of development, both positively and negatively."[22]

"We recognize the importance of strengthened national, scientific and technological capacities for sustainable development. (…) To this end, we support building science and technology capacity, with both women and men as contributors and beneficiaries, including through collaboration among research institutions, universities, the private sector, governments, non-governmental organizations and scientists."[23]

"We recognize that a dynamic, inclusive, well-functioning and socially and environmentally responsible private sector is a valuable instrument that can offer a crucial contribution to economic growth and reducing poverty and promoting sustainable development."[23]

"We underscore that sustainable development requires concrete and urgent action. It can only be achieved with a broad alliance of people, governments, civil society and the private sector, all working together to secure the future we want for present and future generations."[23]

"Science provides us with the knowledge that can help design transformation pathways for companies. It is like a North Star. If we know what we are aiming for, we can figure out how to get there. Such transformation pathways enable companies to reach agreed targets (in which case they are called 'science-based targets'), e.g., a certain reduction of greenhouse gas emissions, freshwater use or land expansion for productive activities, achieved by a certain time."[24]

"Science and business must work closely together as partners on our environmental challenges. We need more dialogue to develop mutual understanding and trust. And we need a recognition that science must guide business towards solutions as much as business must guide science towards operable and actionable methods and approaches."[24]

Building on our experiences as academic and government scientists engaging with industry, we reflect on whether this strategy has allowed rapid progress (a "highway" to ocean sustainability) or if things simply went "sideways," with lots of effort and little to show for it. In the following, we outline the opportunities and barriers for science-industry collaboration, and provide a tentative roadmap for scientists who are interested in engaging with industry for advancing ocean sustainability and the wider SDG agenda.

Why Collaboration Is an Obvious Opportunity

Making Sense of an Increasingly Complex Ocean Space

Hyperbole is hard to avoid when describing the complexity of the ocean. It covers 70% of the Earth's surface, and is—on average—4 kilometers deep. But anthropogenic pressures on the biosphere are so extensive that the ocean is fundamentally changing: more acidic waters, less biodiverse ecosystems, erosion of genetic diversity, rising sea levels, dead zones, shifting ocean currents, bleached corals, and more.[25,26] And although the ocean is changing quickly, humanity's relationship with the ocean might be changing even faster, as countless local communities must adapt to uncertain conditions, and multiple new ocean-based industries emerge. Since 2000, marine aquaculture has grown at an average annual rate of 5%, the volume of goods transported by container shipping has quadrupled, most major discoveries of hydrocarbon deposits have happened offshore, cruise tourism has experienced an 8-fold increase, around 1.4 million square kilometers of the seabed has been leased for exploratory mining activities, the offshore windfarm capacity has seen a staggering 400-fold increase, over 1 million kilometers of undersea telecommunication cables have been installed, desalination of seawater has reached a capacity of 65 million cubic meters per day, and nearly 13,000 genetic sequences from marine organisms have been filed with patents.[5]

This is the "Anthropocene Ocean," but how can one make sense of it? For marine scientists, this has meant a departure from disciplinary siloes to build more diverse teams of expertise. The problem-driven and action-oriented focus of sustainability science,[27] for instance, is especially appealing in the context of the ocean, as it aims to understand complex systems dynamics and explicitly incorporate multiple disciplinary perspectives. Sustainability science should also be transdisciplinary, meaning that it extends beyond academia to also incorporate the knowledge and methods of non-academic actors.[15,28] One of the world's most prominent marine scientists, Jane Lubchenco, has explicitly called on scientists to not only engage in work that is useful for society, but to prioritize efforts to communicate it with diverse stakeholders.[29]

Meanwhile, how has industry dealt with the challenges of the Anthropocene Ocean? Some could argue that it has not, as indicated by continued patterns of unsustainable use.[2] Even straightforward examples, such as the rebuilding of overexploited or collapsed fish stocks, where the benefits of long-term vision, cooperation, and science-based approaches are so concrete, have often faltered.[30,31] Many cases are far less straightforward, particularly when multiple industries co-exist in the same ocean space. But just as there is diversity among scientists, there is also diversity among individuals in the private sector. Some have recognized the long-term risk to the continued viability of their operations posed by climate change and degradation of marine environments. This awareness has often led to engagement with "green clubs" and other voluntary efforts aimed at building profiles of responsibility and encouraging other companies to follow suit. In some cases, as for example with the World Ocean Council and the United Nations Global Compact Action Platform for Sustainable Ocean Business, an analog to scientific transdisciplinarity has emerged: companies have realized there might be greater benefit from looking beyond their own sector to engage not only with other ocean-based industries, but also with governments, non-governmental organizations, and academics.

Ultimately, it is in the interest of industry to have scientific input to quantify the risks of a changing ocean to their operations, while scientists can benefit from the vast amounts of data and information that industry is collecting and generating about the ocean.[32,33] Dialogue with industry can also help scientists to better assess the relevance of their work and whether it might have societal impact.[29,34] Conversely, industry can benefit from dialogue with scientists to avoid a "blind faith in science's ability to find solutions."[22]

Some Scientists Already Speak the Language of Business

It might seem trite to suggest that sustainability scientists simply speak a different language than the private sector, but there is some truth to it. How many sustainability scientists are familiar with the terminology of accounting, organizational behavior, or finance? And how familiar will the private sector be with terms such as resilience, integrated ocean management, or stewardship? Yet great potential exists in becoming familiar with terminology outside of one's comfort zone (Table 1).

Science-industry collaboration can also draw on a secret weapon: a broad field of social science is dedicated to understanding corporate behavior and the forces that shape it. Although this field has begun to engage with sustainability science as an approach to solve social and environmental pressures,[35–37] it remains somewhat isolated from other disciplines and has struggled to incorporate environmental factors into its frame of reference.[38–40]

Activating this community of organizational researchers as a stepping stone between sustainability science and industry has great potential.[41] Sustainability scientists can benefit from the familiarity of these scholars with industry, while organizational researchers can be introduced to new dimensions of understanding enabled by embedding sustainability and environmental issues within their scholarship. Moreover, although sustainability scientists have rich experience working with individual producers, industry associations, and small businesses—typically, small- to medium-scale operators who can engage one-on-one—[42]there is substantial and unexplored potential in also engaging with larger businesses and financial actors, such as banks, insurance companies, or stock exchanges.[43,44]

Why Collaboration Is Not an Obvious Opportunity

Disciplinary Boundaries and Cultural Differences

Despite an increased interest among marine scientists to collaborate outside of academia,[45] it often represents an uncomfortable activity for scientists who might lack the training, knowledge, and support on how best to do so given the persistence of archaic university cultures and success metrics that continue to prioritize research within disciplinary boundaries.[16]

Traditionally, the main goal of university science has been to develop new knowledge, and publish findings in scientific journals.[46] As a result, academic scientists have rarely been encouraged to engage with the private sector to develop solutions to sustainability challenges. Difficulties in securing funding for applied science partnerships, along with existing academic incentive structures, might turn scientists off from working with partners outside academia, and might instead lead them to investigate other ways to influence change, such as environmental activism.[47] Scientists employed by government or industry might be constrained by the policies of their respective organizations and could therefore lack adequate support to engage with academia. Cultural differences might represent another reason for this unexplored potential, because unfamiliarity with so-called cultural peculiarities can lead to surprise and frustration when representatives from very different cultures meet.[48]

Low-Hanging Fruit or No Hanging Fruit?

Companies follow market logic and logistics, shareholder and consumer demands, and are interested in their own longevity and profitability. Sustainability initiatives among corporations range from superficial "green-washing" to profound changes in business practice. It might be challenging to distinguish between such actions, and changes at the corporate executive level have the potential to profoundly shift priorities over a short time frame. Deeply rooted stereotypes, the fear of legitimizing irresponsible business practice, or simply making matters worse by working with industry, all represent reasons to conclude that science-business collaboration is a fraught activity.

Stereotypes that abound in science are that industry is bad and that individuals in corporations are governed by incentives that are not in line with sustainability. Large corporations are often perceived as manifestation of global inequities and associated social and environmental harms.[43,49,50] Frequent news about industry lobbying for lax regulations, poor labor practices, or investigations of collusion (e.g., price fixing) does little to build industry reputation and legitimacy in the eyes of scientists. Researchers, on the other hand, can be perceived as having limited understanding of the realities outside of academia, operating with lax timelines, and primarily interested in writing papers. Stereotypes represent shortcuts for our brain to make sense of the unknown, but are unhelpful for collaboration across knowledge systems and actors.

Although history is ripe with examples of irresponsible business practice, we argue that to *a priori* discount all industry activities toward sustainability is premature and that scientists are yet to fully develop an understanding of the role of large-scale private sector actors in social-ecological systems.[51] In the following, we summarize some of our experience in working

Table 1. Examples of Opportunities for Science-Industry Collaboration and Partnerships

Business Function	Opportunities for Collaboration	Examples of Initiatives Bridging Science and Industry
Management—the practice of managing the activities necessary for organizations to function, including: Establishing and maintaining mission/values/ethics; formulating strategy and undertaking detailed planning; establishing control over activities. Assembling people and resources to execute plans; providing leadership in the process. Engaging with external parties; and communicating outcomes. Other business functions (below) come under the broader description of management.	Understand and improve how organizations function, including by ensuring that organizations understand how science can direct appropriate courses of action, and by incorporating these insights across all management functions. This might include, for instance, collaborations that enhance ecological literacy and foster capabilities to act on that understanding, such as an expanded sense of organizational accountability to support active stewardship.	The Natural Capital Project (https://naturalcapitalproject.stanford.edu) emerged from an understanding that it is possible to view ecosystems as capital assets, some of which are well managed, while other are poorly understood or rapidly degrading. By bringing together academics and private sector actors, the Natural Capital Project seeks to "integrated the value nature provides to society into all major decisions."
Accounting—the measurement, processing, quality assurance, and communication of financial information to internal users (e.g., managers of the organizations); external users who have rights to that information (e.g., shareholders and banks); and other interested parties (e.g., potential owners and business partners).	Understand and improve the measurement, processing, and communication of financial information to better guide internal and external user actions. The provision of information to support decision-making processes (including reporting that addresses natural capital impacts and dependencies). This might inform organizational management (e.g., investigation of tractable and implementable enterprise-based natural capital accounting) and provide information regarding impacts of activities (thereby enhancing accountability for stewardship).	The Natural Capital Coalition (https://naturalcapitalcoalition.org/) has developed the Natural Capital Protocol: a decision-making framework to support organizations as they seek to identify, measure, and value their impacts and dependencies on natural capital. The protocol translates science-based insights into a form that can be understood by organizations and hence "natural capital" can support internal decision making.
Finance—the process of funding corporate activities, including by determining the appropriate source of investment, the conditions attached to the investment, and the risk profiles associated with financing options. This activity has two elements: the attraction of investment to an organization (e.g., from banks or shareholders) and the evaluations undertaken to support an organization's own investment activities.	Create novel tools to support ocean stewardship (e.g., blue investment and blue bonds) as well as to identify, quantify, and communicate ecological risks associated with particular courses of action. The external provision of risk information (e.g., through credit risk ratings) could be expanded to include biosphere-generated risks to investments.	The Science-Based Targets Initiative (https://sciencebasedtargets.org/) focuses on translating global climate change targets into targets for businesses to ensure that corporate responses to climate change are proportionate to the challenge faced. Although this initiative focuses on climate change, this type of format could be replicated in other settings—e.g., such as those related to what science would suggest are appropriate wild capture fishing activities.
Allied business and management practices—there are other processes associated with organizational activities that create points of connection between science and industry. In the ocean context, a key practice is the provision of product certification.	Audit/assurance/certification technologies are used to trace and assure the quality of products. Quality assurance can be handled internally or by third parties (e.g., product certification organizations), and is important for marketing and pricing strategies.	The Task Force on Climate-Related Financial Disclosures (https://www.fsb-tcfd.org/) is another initiative that presently focuses on climate change but whose approach might be replicable in other settings. The focus is on capital markets (i.e., stock exchanges where ownership of publicly listed organizations is traded) and seeks to ensure that organizations provide information to those markets of the climate-related risks they face. This initiative is seeking to remedy the relative lack of carbon "literacy" exhibited by financial market participants.

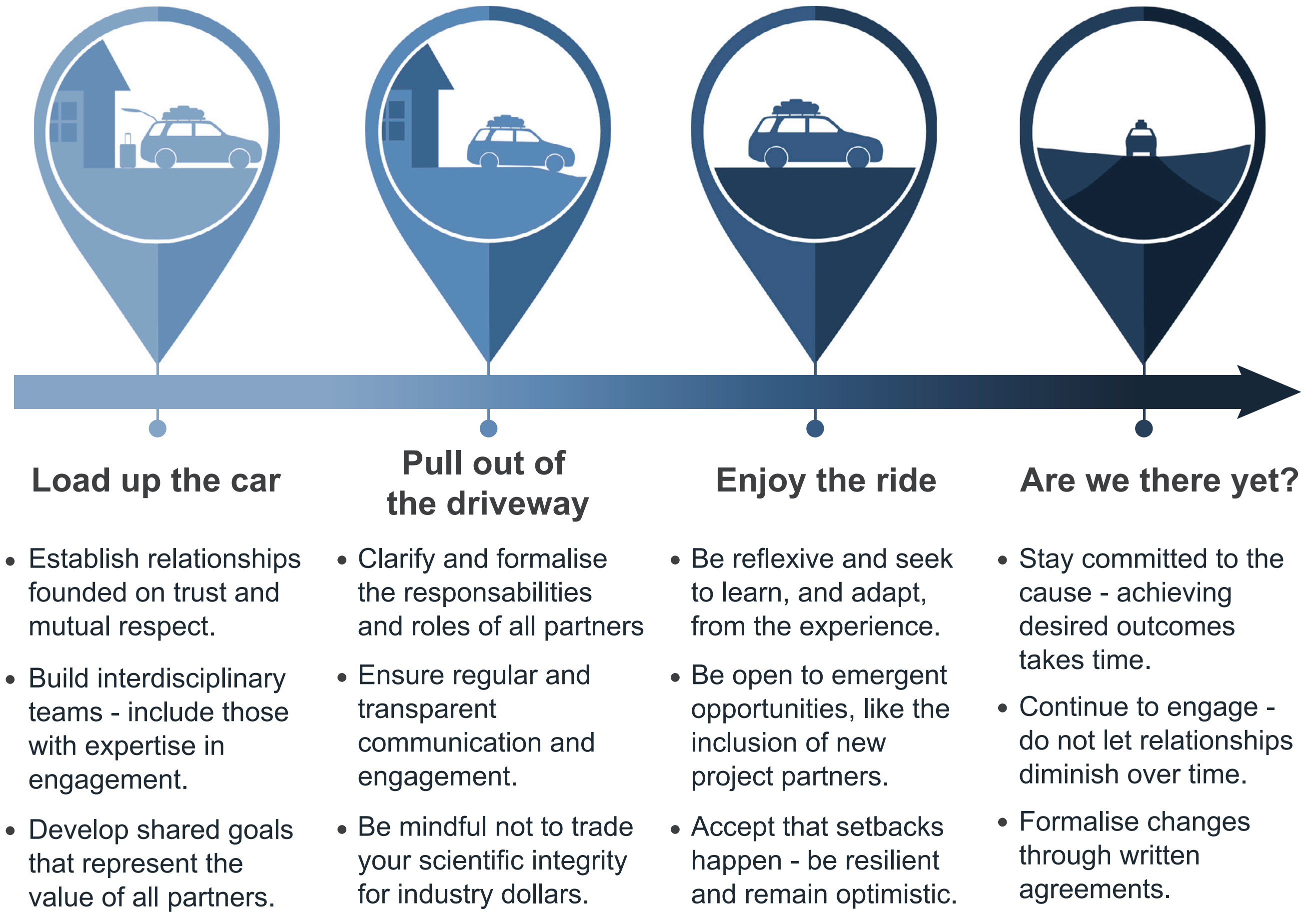

Figure 1. Key Recommendations for Engaging in Science-Industry Collaborations
The advice is based on personal experiences and shared through the analogy of a road trip that involves four distinct stages.

with industry and provide suggestions for how to explore this potential for advancing sustainability, while addressing the uncomfortable uncertainty, and concerns that the best-intentioned efforts could go sideways.

Reflections on Our Science-Industry Journeys

A range of challenges make science-industry collaborations difficult. However, we believe that overcoming such barriers is instrumental for achieving sustainable ocean futures. Here, we draw on our cumulative experiences working with medium to large ocean-based industry actors across the EU, UK, Australia, New Zealand, Japan, and the South Pacific (Table S1). Many of the points made are based on personal and unpublished experiences. These are shared through the analogy of a road trip (Figure 1) that involves four distinct stages: (1) Load up the car (what scientists can do to prepare to engage with industry); (2) Pull out of the driveway (what to do while the collaboration is getting started); (3) Enjoy the ride (how to remain reflective throughout the engagement process); and (4) Are we there yet? (the realization that this engagement is more profound and fundamental than anticipated).

Load Up the Car

Before embarking on the metaphorical road trip, it is important to make sure that all passengers and drivers share the same basic idea. Do we know what direction we are heading and what the final destination looks like? It is important to pack properly and to ensure all necessary items are easily available to avoid having to pull over early on in the trip—this would only cause unnecessary frustration. How then to identify direction and what to bring along? How to develop a shared sense of enthusiasm about the journey?

For collaboration to be successful, participants from both science and industry need to be able to attribute value to their investments—knowledge, money, reputation, prestige, power, or otherwise. The ultimate goals can be distant and uncertain, so it is important to also aim for concrete small-scale and near-future achievements that are part of a broader vision. For instance, having a combination of small achievable goals and a larger, more distant, goal was considered a critical component underpinning the success of a collaborative research project between scientists and the Southern Bluefin Tuna (*Thunnus maccoyii*) fishing industry in Australia, which resulted in the co-development of a seasonal forecast habitat model to guide fishing effort under changing climate conditions.[20,52]

In another project involving the Australian oil and gas industry and other partners, scientists were engaged to develop decision-support pathways to facilitate conservation of flatback turtles (*Natator depressus*). The project included dialogue with multiple stakeholders and sought to integrate different worldviews, values, and norms. Important "luggage" in this case was an already established relationship between one of the principal investigators, the program manager and the broader agency. The relationship had been built over several years and was founded upon trust and mutual respect, which enabled knowledge exchange and collaborative planning from the outset. This helped the research team to understand who the "keystone" actors were in the project, as well as the connections and power dynamics between them. Established relationships also helped to ensure the credibility of the project team, which involved researchers with expertise in the natural sciences, social sciences, and economics, as well as researchers with experience acting as knowledge brokers.[53] In addition, there was considerable effort by the research team internally and then with program managers to identify shared goals to work toward. In this case a Theory of Change approach was used, but other established methods are available to allow the generation of shared goals among diverse stakeholders (e.g., the ASPIRe Model).[54]

There are inherent difficulties associated with trying to navigate multiple (and often competing) goals, values, worldviews, and beliefs. Industry goals are typically focused on ensuring maximum profitability, whereas community group goals focus on social outcomes (e.g., employment rates). Conservation goals are often centered on a species or ecosystem. Navigating such diverse goals and ensuring collaboration and "buy-in" can be time-consuming, costly (e.g., travel to spend important time in face-to-face meetings with stakeholders), and at times frustrating, particularly when the personal values of researchers are challenged. In such cases, it is critical to remain open minded to the beliefs and values of others, to carefully describe research methods and timelines, and to seek to find mutual territory to initiate discussion.

Because science and industry often operate in distant and unconnected networks, initiating the conversation requires identification of, and engagement with, individuals who can bridge these networks. In the Keystone Dialogues project, which resulted in the emergence of the Seafood Business for Ocean Stewardship (SeaBOS) initiative,[11] scientists reached out to leading seafood industry actors in multiple countries through nation-specific connectors[55]. These individuals had credibility within, and connection to, both science and industry and acted as a quality assurer. They facilitated introductions and helped set up initial conversations, where short- and long-term goals and mutual interests could be explored. In addition to short-term goals, SeaBOS became guided by a broader vision of ocean stewardship, defined as an adaptive and learning based, collaborative process, of responsibility and ethics, aimed to shepherd and safeguard the resilience and sustainability of ocean ecosystems for human well-being.[11]

Time and patience are instrumental for building relationships and for deconstructing myths associated with different stereotypes. Time is required for developing the trust that underpins any successful collaboration between people,[56] and a realization of what can be achieved through collaboration. Informal meetings also have a clear purpose, especially in cultures where these play an important role in business deals. Formal and informal meetings between the Sustainable Seas National Science Challenge and fishing companies in New Zealand (who have indicated an openness to changing their practices) have been used to understand different perspectives of ecosystem-based management and their implications for both parties. These meetings have been critical in particular to clarify the use and meaning of words which were causing confusion and misunderstandings.

Conducting an inventory of relevant scientific activities and disciplines, civil society groups, and industry organizations can help to provide a landscape of individuals and initiatives with which to engage. Developing close ties with colleagues in business-related academic fields who are comfortable engaging with the natural and social sciences will also build capacity to understand, and be understandable to, business partners. A formal stakeholder analysis, such as the one conducted by Reed et al.,[57] can ensure that the full diversity of actors and knowledge bases are actively engaged from the onset.

Pull out of the Driveway

The car has started to move and you are passing through familiar neighborhoods, but with unknown terrain ahead. There is general excitement among all passengers, the car is filled with the right items, and no one is (yet) in the mood for a fight. You have a sense that this is going to be a great adventure, but there must be rules in the car or things can quickly go sideways.

Once the networks founded upon trust are established, and the short- and long-term goals are identified, it often becomes apparent that the demand for scientific support to industry grows over time. There is a risk that such accelerated demand is unfunded, and that scientists—inspired by the opportunity to make a difference—will continue to engage in-kind in their spare time, or that the original mission of science is lost in the process. It is then in danger of just becoming a science to action project, without feedback to, or time for, the transdisciplinary, curiosity-driven research that was initially envisioned. To avoid this situation, ensure that roles and responsibilities are clear, as well as what is expected from each partner—preferably in a written agreement. The importance of scientific independence and the freedom to ask questions and publish results without constraints need to be at the forefront, and transparently communicated.[58] If there is no chance of misunderstanding, then there is a lower chance of negative fallout.

There could be a risk that an industry partner primarily regards the scientist as a free source of knowledge, or a boost to their own reputation. Putting the agreement to paper will help identify where your red line is—do not trade the scientific high-ground for industry dollars (i.e., ensure that you maintain your scientific integrity). As curiosity-driven scientists, our primary objective is not to engage as unpaid consultants to companies, but rather to learn from the collaborative process and develop better science that supports the replication and upscaling of successful collaboration. Ownership of intellectual property needs to be acknowledged, as well as the freedom to publish scientific facts that are not in line with industry interests.

One of the authors of this paper was part of a team of scientists looking at individual transferable quotas (ITQs) in Australia and how they link to industry outcomes. The ultimate goal was to improve localized outcomes of ITQs for different fisheries. Even though collaborations have involved many researchers, the level of satisfaction with the social, economic, and governance outcomes of ITQ fisheries remains variable depending on the type of business. The research results might not always be what the industry is keen to hear, and disagreements do occur. If the perception arises that one is involved in a "bad bit" of research, relationships can rapidly deteriorate. But if things go well, the longer the research continues the more people get engaged. Although new energy and capacity is valuable (e.g., younger researchers and new fishers who are keen to join in and make their voices heard), the continuously changing nature of collaborators can also make it difficult to gain traction and maintain the collaboration.

The first engagements that set you up for a longer partnership are intimidating because you might feel beholden to the goodwill of your collaborators for accessing information. However, this can quickly change when the feeling of trust becomes mutual and partners recognize that they all have valuable—although not necessarily equal—contributions to offer for achieving the shared goals.

Enjoy the Ride

Now that you have set off, you are starting to look out the window and hopefully enjoying the ride. Be alert though, because there might be unexpected roadblocks or bad weather forcing you to adapt your itinerary.

The first two phases might require several years of active engagement, and a perception that there is no time for science at all. Reaching a point in the project when both scientists and industry representatives perceive that their collaboration is resulting in tangible outcomes should hopefully result in a sense of accomplishment and that progress is being made. However, there will likely be surprises that require additional skills and capacities.

Successful collaboration will increase its attractiveness to additional partners, as demonstrated by a Japanese science-industry-community partnership (Future Community Lab). Although the collaboration was initially established by a few "friendly" partners, as the project progressed, it became increasingly reported by local and national newspapers, which stimulated new partners from industry and local communities to join in, and also helped build legitimacy in the scientific community. Because it was a new kind of partnership, people needed some evidence to prove that it was effective before it would become attractive.

Over the past 2 years, one member of the author group has engaged as a science partner to the United Nations Global Compact Action Platform for Sustainable Ocean Business and has contributed to all its main deliverables. The platform brings together a group of leading actors from business, academia, and governments to advance progress toward achieving the SDGs. It took time for trust to develop, and to realize the value of stepping out of one's comfort zone in the first place. Corporations can be the largest hurdle or the biggest asset to achieving transformational change in our relationship with the planet—avoiding them might be academically safe and comfortable, but engagement offers new opportunities. In the beginning, the scientist was a semi-anonymous participant in the crowd of company and government representatives, but after 2 years of collaboration the atmosphere was different. The long-term engagement had resulted in trust, a seat (literally) at the table to present latest scientific work to the plenary group, and an opportunity to push the vision of the platform from "sustainable management of the ocean" to a higher ambition of "ocean stewardship."[59] Such results and positive outcomes generate careful optimism.

Optimism refers to the generalized positive expectancy that one will experience good outcomes.[60,61] At the individual level, it has been linked to improved psychological well-being through periods of stress, increased creativity, and greater focus toward achieving desired goals.[62,63] At the team level, optimism is associated with improved coordination, collaboration, and knowledge sharing.[64] In seeking to advance progress toward the SDGs, do not allow small wins pass you by unnoticed. Make time to share and celebrate successes. We also suggest working with partners with whom you enjoy interacting, and who share your vision for where your research is heading and what you hope to achieve.

We found that one way to appreciate the ride is to develop ways to be both reflective and reflexive. This is critical to learn what has worked well, identify new and improved strategies for what comes next, and increase your ability to participate in, and lead, science-industry collaborations. It will also clarify how far the collaboration has gone. Although reflection and reflexivity can occur in many ways, a starting point could be as simple as keeping a journal to write down your thoughts. What has worked, what has not, how you feel, what you want to try or wish to learn? Make time also to sit with your colleagues and partners, and reflect on how things are going. Our experiences have taught us that such joint reflections are best done in an informal and neutral area, away from the office.

Are We There Yet?

When the road trip begins it is easy to be inspired by the potential to reach new goals and discover new places. However, most travel to distant places is time-consuming, every so often frustrating, and can even be disappointing. The kids in the car will start screaming "are we there yet," and the driver (or other adults in the vehicle) might wish that they had not embarked on such an ambitious trip.

No matter how well you have prepared and despite many well-intended partners, there is a high likelihood of setbacks in science-industry collaboration. These can include the loss of trust among partners, broken relationships, wasted resources, or not achieving your anticipated goals. It is critical to understand that these setbacks (and any subsequent failures in delivery) are normal and should be expected. We have all experienced them, and they have tested our resolve on our journey to seek successful interactions with industry. For projects with short-term deliverables, the time taken to get agreements in place (such as the protection of industrial and academic intellectual property) and security arrangements (such as regulating access to computing systems) can lead to wasted resources. Goodwill arrangements can help to overcome some of these barriers, but only if there is already a strong, trusting relationship in place. Taking the time to be reflexive will improve data collection, learning, and development. Likewise, it is important to have some appreciation of the timescales that are required for companies to be in a position to transform their activities. Given that a science-business engagement is likely to require new forms of data collection; communication across company functionalities and business partners; piloting what might be viable; and determining the costs and benefits of undertaking new organizational routines, the long ride might often feel less exciting than the initial phases of the work. Although individual researchers might abruptly change focus and interests, academic disciplines are slower to change course. The same could be said for individual companies and their respective industries. Appreciating these dynamics is important in science-industry collaborations to maintain optimism for long-term projects and to remain patient and resolute when collaborations enter into slow or fallow periods.

To cope with and adapt to these frustrations, it is important to build and maintain your personal resilience, and specifically your psychological resilience.[65] As with optimism, an important step to build resilience is to engage with people who support and encourage you.[66] Collaborative research processes are tiring, so make sure you also take some time off and remind yourself of why you got into this field in the first place—the driving force and curiosity that give you strength to keep working.

Engagement with the seafood industry often requires optimism and patience because of its global scope, diverse actors, and systemic challenges. Since its establishment in 2016, the SeaBOS initiative has developed into one of the smallest and most recent green clubs, with ten of the world's largest seafood corporations working together with sustainability scientists to develop industry leadership for ocean stewardship. In 2020, SeaBOS member companies had operations in 95 countries, employed over 100,000 people, and produced some 10% of all marine catch. The companies have committed to reduce illegal fishing, eliminate labor rights abuses in seafood supply chains, improve traceability and transparency, address climate change, reduce ocean pollutants and the use of antibiotics, while also improving the management of fisheries and aquaculture. The work includes annual CEO and working group meetings, and continuous collaboration between science and business in task forces focusing on the above-mentioned commitments.

Since 2015, several of the author group members have engaged with these global corporate leaders. Recent (2019) milestones include the establishment of SeaBOS as a legal entity and agreement on its governance mechanisms. Although these changes are happening faster than anticipated, the transition from an initiative primarily led and driven by scientists, to a truly collaborative science-industry effort, has taken time. The initial agreement was that the science team would lead an interim SeaBOS secretariat from May 2017 to May 2018. This function was extended to September 2018. Then to December 2018. But in 2019, the companies provided financial resources to a SeaBOS secretariat, which enabled the hiring in July 2019 of a managing director tasked to coordinate member activites focused on advancing ocean stewardship, although this transition of responsibilites extended through 2019. The continuous extension of this deadline, and the heavy workload associated with the interim SeaBOS secretariat, represented a substantial challenge, especially given that it was beyond the formal training of participating scientists. As a result, scientific tasks were mostly postponed or canceled between 2016 and 2019 and many wondered whether or not it would eventually be worth the effort. Would we finally get "there"? There are now signs that the initiative is getting somewhere and that, in retrospect, it probably made sense to postpone the transition of roles and responsibilities.

Another example of science-industry collaboration characterized by a mix of progress and delays is the WKIrish process carried out by scientists within ICES (International Council for the Exploration of the Seas) in the Irish Sea. When significant reductions in fishing efforts did not improve the stock situation, fishing industry representatives asked scientists for an explanation. The scientific response was to develop a model,[67] but this required historical data on fish diets and fishing fleet effort that were not available. Industry collaborators agreed to work with scientists to fill these knowledge gaps, resulting in a model that explained much of the problem, and how the outcomes were due to interacting social-ecological changes in temperature, food-web structure, and fishing pressure.[68] The solutions to the problems could be defined, but there was initially no way to integrate such ecosystem considerations into the European fish stock assessment and fisheries advisory process. When the ICES scientists eventually identified a way to do so, it was particularly welcomed by the industry. Collaboration between science and industry thus helped identify and operationalize new approaches for fisheries management that integrated both people and nature. This example illustrates a common characteristic of all these projects, namely that scientists and industry have much to learn from each other, and that collaboration can help identify novel approaches and solutions to sustainability challenges.[46]

Conclusions

Concerns about the future of the ocean have catalyzed a diversity of major international efforts. The United Nations Decade of Ocean Science for Sustainable Development (2021–2030) is poised to begin, and has coalesced around two goals, the latter involving partnerships to generate scientific knowledge; the United Nations Global Compact Action Platform for Sustainable Ocean Business has brought together actors from across ocean-based industries to generate a set of Sustainable Ocean Principles, and a roadmap to 2030 with actions to move toward ocean stewardship; an international legally binding treaty on the conservation and sustainable use of biodiversity in areas beyond national jurisdiction (covering some 64% of the ocean) is in its final stages of development; and the High Level Panel for a Sustainable Ocean Economy has mobilized over 200 scientists from 47 countries, alongside an advisory network, including over 30 ocean-based industries, and 14 heads of state "to advance a new contract between humanity and the sea that protects the Ocean and optimizes its value to humankind."

The rapidly growing field of sustainability science, and the associated studies of transdisciplinarity and co-production of knowledge, have identified multiple ways of learning across diverse communities, while also identifying the competences required for such engagement, along with important considerations of its diverse politics and powers.[69,70] Perhaps more than ever before, failure to learn from these diverse experiences and work alongside business might represent a lost opportunity for science and the global community. Our experience suggests that there are some common elements to effective science-industry collaboration, and some shared reasons for investing the time and energy in such endeavor. We also recognize that it is not a foregone conclusion that such collaborations will continue to emerge, or that they will subsequently succeed or fail. Many of us experienced initial skepticism from colleagues and collaborators regarding our science-industry engagement and their level of ambition. By sharing our experiences, we hope to empower a new generation of ocean scientists to explore such collaborations and further build on this knowledge base as they co-develop solutions for ocean sustainability that benefit people and the biosphere.

SUPPLEMENTAL INFORMATION

Supplemental Information can be found online at https://doi.org/10.1016/j.oneear.2020.06.011.

ACKNOWLEDGMENTS

We thank the Integrated Marine Biosphere Research Project (IMBeR) and all organizers of the 2019 IMBeR Future Oceans conference, where the idea for this article was conceived. In particular, L. Maddison and J. Claydon for logistical support. H.Ö., R.B., J.-B.J., and J.B. were funded by the Walton Family Foundation (2018-1371), the David and Lucile Packard Foundation (grant no. 2019-68336), and the Gordon and Betty Moore Foundation (GBMF5668.02). Thanks to N. Cave for driving his car down to Geneva. J.H. was supported in part by the Sustainable Seas National Science Challenge, established by the Ministry of Business, Innovation and Enterprise, New Zealand (CO1X1901). A.L. acknowledges support from the Ocean Frontier Institute. This publication has emanated from research supported in part by a research grant from Science Foundation Ireland (SFI) under grant number 14/IA/2549 to D.R. S.M. was supported by the UK Research & Innovation Industrial Strategy Challenge Fund (Transforming Food Production Seeding Award) and wishes to acknowledge the support of the Fisheries Society of the British Isles in attending the conference that led to this paper.

DECLARATION OF INTERESTS

The authors declare no financial interests that could be perceived as being a conflict of interest. The Stockholm Resilience Centre is a member of the United Nations Global Compact and is contributing, primarily through R.B., to its Action Platform for Sustainable Ocean Business; H.Ö., J.B.J., R.B., and J.B. provide scientific support to companies in the seafood sector through the Seafood Business for Ocean Stewardship (SeaBOS) initiative, and H.Ö. is Chairman of the SeaBOS Fundraising Foundation (http://keystonedialogues.earth/). All of these engagements are voluntary and unpaid.

REFERENCES

1. van Putten, I., Cvitanovic, C., and Fulton, E.A. (2016). A changing marine sector in Australian coastal communities: an analysis of inter and intra sectoral industry connections and employment. Ocean Coastal Manag. *131*, 1–12.
2. Halpern, B.S., Frazier, M., Afflerbach, J., Lowndes, J.S., Micheli, F., O'Hara, C., Scarborough, C., and Selkoe, K.A. (2019). Recent pace of change in human impact on the world's ocean. Sci. Rep. *9*, 1–8.
3. Jones, K.R., Klein, C.J., Halpern, B.S., Venter, O., Grantham, H., Kuempel, C.D., Shumway, N., Friedlander, A.M., Possingham, H.P., and Watson, J.E. (2018). The location and protection status of Earth's diminishing marine wilderness. Curr. Biol. *28*, 2506–2512.e3.
4. Golden, J.S., Virdin, J., Nowacek, D., Halpin, P., Bennear, L., and Patil, P.G. (2017). Making sure the blue economy is green. Nat. Ecol. Evol. *1*, 1–3.
5. Jouffray, J.-B., Blasiak, R., Norström, A.V., Österblom, H., and Nyström, M. (2020). The blue acceleration—the trajectory of human expansion into the ocean. One Earth *2*, 43–54.
6. Blasiak, R., Spijkers, J., Tokunaga, K., Pittman, J., Yagi, N., and Österblom, H. (2017). Climate change and marine fisheries: least developed countries top global index of vulnerability. PLoS One *12*, e0179632.
7. Hughes, T.P., Bellwood, D.R., Folke, C., Steneck, R.S., and Wilson, J. (2005). New paradigms for supporting the resilience of marine ecosystems. Trends Ecol. Evol. (Amst). *20*, 380–386.
8. Österblom, H., Crona, B.I., Folke, C., Nyström, M., and Troell, M. (2017). Marine ecosystem science on an intertwined planet. Ecosystems *20*, 54–61.
9. United Nations Global. (2019). Compact. Global Goals, Ocean Opportunities (United Nations Global Compact).
10. Pretlove, B., and Blasiak, R. (2018). Mapping Ocean Governance and Regulation: Working Paper for Consultation for UN Global Compact Action Platform for Sustainable Ocean Business (United Nations Global Compact).
11. Österblom, H., Jouffray, J.-B., Folke, C., and Rockström, J. (2017). Emergence of a global science–business initiative for ocean stewardship. Proc. Natl. Acad. Sci. U S A. *114*, 9038–9043.
12. Norström, A., Dannenberg, A., McCarney, G., Milkoreit, M., Diekert, F., Engström, G., Fishman, R., Gars, J., Kyriakopoolou, E., Manoussi, V., Meng, K., et al. (2014). Three necessary conditions for establishing effective sustainable development goals in the Anthropocene. Ecol. Soc. *19*. https://www.ecologyandsociety.org/vol19/iss3/art8/.
13. Schoolman, E.D., Guest, J.S., Bush, K.F., and Bell, A.R. (2012). How interdisciplinary is sustainability research? Analyzing the structure of an emerging scientific field. Sustain. Sci. *7*, 67–80.
14. Bettencourt, L.M., and Kaur, J. (2011). Evolution and structure of sustainability science. Proc. Natl. Acad. Sci. U S A *108*, 19540–19545.
15. Norström, A.V., Cvitanovic, C., Löf, M.F., West, S., Wyborn, C., Balvanera, P., Bednarek, A.T., Bennett, E.M., Biggs, R., de Bremond, A., et al. (2020). Principles for knowledge co-production in sustainability research. Nat. Sustainability *3*, 182–190.
16. Keeler, B.L., Chaplin-Kramer, R., Guerry, A.D., Addison, P.F.E., Bettigole, C., Burke, I.C., Gentry, B., Chambliss, L., Young, C., Travis, A.J., et al. (2017). Society is ready for a new kind of science—is academia? BioScience *67*, 591–592.
17. Reed, M.S., Stringer, L.C., Fazey, I., Evely, A.C., and Kruijsen, J.H.J. (2014). Five principles for the practice of knowledge exchange in environmental management. J. Environ. Manage. *146*, 337–345.
18. Cvitanovic, C., McDonald, J., and Hobday, A.J. (2016). From science to action: principles for undertaking environmental research that enables knowledge exchange and evidence-based decision-making. J. Environ. Manage. *183*, 864–874.
19. Nguyen, V.M., Young, N., and Cooke, S.J. (2017). A roadmap for knowledge exchange and mobilization research in conservation and natural resource management. Conserv Biol. *31*, 789–798.
20. Cvitanovic, C., and Hobday, A.J. (2018). Building optimism at the environmental science-policy-practice interface through the study of bright spots. Nat. Commun. *9*, 3466.
21. Orecchini, F., Valitutti, V., and Vitali, G. (2012). Industry and academia for a transition towards sustainability: advancing sustainability science through university–business collaborations. Sustain. Sci. *7*, 57–73.
22. Brundtland, G. (1987). Report of the World Commission on Environment and Development: Our Common Future (Oxford University Press).
23. United Nations. (2012). The Future We Want (United Nations).
24. Vidal, A. (2019). What Science Means for Business. https://www.wbcsd.org/Overview/News-Insights/WBCSD-insights/What-science-means-for-business.
25. IPCC (2019). Special Report on the Ocean and Cryosphere in a Changing Climate: Summary for Policymakers (Intergovernmental Panel on Climate Change).
26. Blasiak, R., Wynberg, R., Grorud-Colvert, K., Thambisetty, S., Bandarra, N.M., Canário, A.V.M., da Silva, J., Duarte, C.M., Jaspars, M., Rogers, A., and Sink, K. (2020). The ocean genome and future prospects for conservation and equity. Nat. Sustain. 1–9.
27. Kates, R.W., Clark, W.C., Corell, R., Hall, J.M., Jaeger, C.C., Lowe, I., McCarthy, J.J., Schellnhuber, H.J., Bolin, B., Dickson, N.M., and Faucheux, S. (2001). Sustainability science. Science *292*, 641–642.
28. Kelly, R., Mackay, M., Nash, K.L., Cvitanovic, C., Allison, E.H., Armitage, D., Bonn, A., Cooke, S.J., Frusher, S., Fulton, E.A., and Halpern, B.S. (2019). Ten tips for developing interdisciplinary socio-ecological researchers. Socio Ecol. Pract. Res. *1*, 149–161.
29. Lubchenco, J. (1998). Entering the century of the environment: a new social contract for science. Science *279*, 491–497.
30. Hilborn, R., Amoroso, R.O., Anderson, C.M., Baum, J.K., Branch, T.A., Costello, C., De Moor, C.L., Faraj, A., Hively, D., Jensen, O.P., and Kurota, H. (2020). Effective fisheries management instrumental in improving fish stock status. Proc. Natl. Acad. Sci. U S A *117*, 2218–2224.
31. Boonstra, W.J., and Österblom, H. (2014). A chain of fools: or, why it is so hard to stop overfishing. Maritime Stud. *13*, 15.
32. McLean, D.L., Parsons, M.J.G., Gates, A.R., Benfield, M.C., Bond, T., Booth, D.J., Bunce, M., Fowler, A.M., Harvey, E.S., Macreadie, P.I., and Pattiaratchi, C.B. (2020). Enhancing the scientific value of industry remotely operated vehicles (ROVs) in our oceans. Front. Mar. Sci. https://www.frontiersin.org/articles/10.3389/fmars.2020.00220/full.

33. Smith, S.R., Alory, G., Andersson, A., Asher, W., Baker, A., Berry, D.I., Drushka, K., Figurskey, D., Freeman, E., Holthus, P., and Jickells, T. (2019). Ship-based contributions to global ocean, weather, and climate observing systems. Front. Mar. Sci. https://www.frontiersin.org/articles/10.3389/fmars.2019.00434/full.

34. Lang, D.J., Wiek, A., Bergmann, M., Stauffacher, M., Martens, P., Moll, P., Swilling, M., and Thomas, C.J. (2012). Transdisciplinary research in sustainability science: practice, principles, and challenges. Sustain. Sci. *7*, 25–43.

35. Bebbington, J., and Larrinaga, C. (2014). Accounting and sustainable development: an exploration. Account. Organizations Soc. *39*, 395–413.

36. George, G., Howard-Grenville, J., Joshi, A., and Tihanyi, L. (2016). Understanding and tackling societal grand challenges through management research. AMJ *59*, 1880–1895.

37. Whiteman, G., Walker, B., and Perego, P. (2013). Planetary boundaries: ecological foundations for corporate sustainability. J. Manag. Stud. *50*, 307–336.

38. Diaz-Rainey, I., Robertson, B., and Wilson, C. (2017). Stranded research? Leading finance journals are silent on climate change. Climatic Change *143*, 243–260.

39. Linnenluecke, M.K., and Griffiths, A. (2013). Firms and sustainability: mapping the intellectual origins and structure of the corporate sustainability field. Glob. Environ. Change *23*, 382–391.

40. Patenaude, G. (2011). Climate change diffusion: while the world tips, business schools lag. Glob. Environ. Change *21*, 259–271.

41. Bebbington, J., Österblom, H., Crona, B., Jouffray, J.-B., Larrinaga, C., Russell, S., et al. (2019). Accounting and accountability in the Anthropocene. Account. Audit. Account. J. *33*, 152–177.

42. Steins, N.A., Kraan, M.L., van der Reijden, K.J., Quirijns, F.J., van Broekhoven, W., and Poos, J.J. (2020). Integrating collaborative research in marine science: recommendations from an evaluation of evolving science-industry partnerships in Dutch demersal fisheries. Fish Fish. *21*, 146–161.

43. Folke, C., Österblom, H., Jouffray, J.-B., Lambin, E.F., Adger, W.N., Scheffer, M., Crona, B.I., Nyström, M., Levin, S.A., Carpenter, S.R., and Anderies, J.M. (2019). Transnational corporations and the challenge of biosphere stewardship. Nat. Ecol. Evol. *3*, 1396–1403.

44. Jouffray, J.-B., Crona, B., Wassénius, E., Bebbington, J., and Scholtens, B. (2019). Leverage points in the financial sector for seafood sustainability. Sci. Adv. *5*, eaax3324.

45. Cvitanovic, C., Hobday, A.J., van Kerkhoff, L., and Marshall, N.A. (2015). Overcoming barriers to knowledge exchange for adaptive resource management; the perspectives of Australian marine scientists. Mar. Pol. *52*, 38–44.

46. Coyle, D. (2020). Economists must collaborate courageously. Nature *582*, 9.

47. Gardner, C.J., and Wordley, C.F.R. (2019). Scientists must act on our own warnings to humanity. Nat. Ecol. Evol. *3*, 1271–1272.

48. Bryson, J., Sancino, A., Benington, J., and Sørensen, E. (2017). Towards a multi-actor theory of public value co-creation. Public Manag. Rev. *19*, 640–654.

49. Schneider, A., Hinton, J., Collste, D., González, T.S., Cortes-Calderon, S.V., and Aguiar, A.P.D. (2020). Can transnational corporations leverage systemic change towards a 'sustainable' future? Nat. Ecol. Evol. *4*, 491–492.

50. Österblom, H., Wabnitz, C.C.C., Tladi, D., Allison, E.H., Arnaud-Haond, S., Bebbington, J., et al. (2020). Towards Ocean Equity (High Level Panel for a Sustainable Ocean Economy). https://www.oceanpanel.org/sites/default/files/2020-04/towards-ocean-equity.pdf.

51. Franks, D.M., Davis, R., Bebbington, A.J., Ali, S.H., Kemp, D., and Scurrah, M. (2014). Conflict translates environmental and social risk into business costs. Proc. Natl. Acad. Sci. U S A *111*, 7576–7581.

52. Eveson, J.P., Hobday, A.J., Hartog, J.R., Spillman, C.M., and Rough, K.M. (2015). Seasonal forecasting of tuna habitat in the Great Australian Bight. Fish. Res. *170*, 39–49.

53. Bednarek, A.T., Wyborn, C., Cvitanovic, C., Meyer, R., Colvin, R.M., Addison, P.F.E., Close, S.L., Curran, K., Farooque, M., Goldman, E., and Hart, D. (2018). Boundary spanning at the science-policy interface: the practitioners' perspectives. Sustain. Sci. *13*, 1175–1183.

54. Cvitanovic, C., Colvin, R.M., Reynolds, K.J., and Platow, M.J. (2020). Applying an organizational psychology model for developing shared goals in interdisciplinary research teams. One Earth *2*, 75–83.

55. Österblom, H., Jouffray, J.-B., Folke, C., Crona, B., Troell, M., Merrie, A., and Rockström, J. (2015). Transnational corporations as 'keystone actors' in marine ecosystems. PLoS One *10*, e0127533.

56. Lacey, J., Howden, M., Cvitanovic, C., and Colvin, R.M. (2018). Understanding and managing trust at the climate science–policy interface. Nat. Clim. Change *8*, 22–28.

57. Reed, M.S., Graves, A., Dandy, N., Posthumus, H., Hubacek, K., Morris, J., Prell, C., Quinn, C.H., and Stringer, L.C. (2009). Who's in and why? A typology of stakeholder analysis methods for natural resource management. J. Environ. Manage. *90*, 1933–1949.

58. Cvitanovic, C., Howden, M., Colvin, R.M., Norström, A., Meadow, A.M., and Addison, P.F.E. (2019). Maximising the benefits of participatory climate adaptation research by understanding and managing the associated challenges and risks. Environ. Sci. Pol. *94*, 20–31.

59. United Nations Global Compact (2020). Ocean Stewardship 2030: Ten Ambitions and Recommendations for Growing Sustainable Ocean Business (United Nations).

60. Scheier, M.F., and Carver, C.S. (1992). Effects of optimism on psychological and physical well-being: theoretical overview and empirical update. Cogn. Ther. Res. *16*, 201–228.

61. Scheier, M.F., and Carver, C.S. (1993). On the power of positive thinking: the benefits of being optimistic. Curr. Dir. Psychol. Sci. *2*, 26–30.

62. Crane, F.G., and Crane, E.C. (2007). Dispositional optimism and entrepreneurial success. Psychol. Manage. J. *10*, 13–25.

63. Rego, A., Sousa, F., Marques, C., and Cunha, M.P.e (2012). Optimism predicting employees' creativity: the mediating role of positive affect and the positivity ratio. Eur. J. Work Organ. Psychol. *21*, 244–270.

64. West, B.J., Patera, J.L., and Carsten, M.K. (2009). Team level positivity: investigating positive psychological capacities and team level outcomes. J. Organ. Behav. *30*, 249–267.

65. Southwick, S.M., Bonanno, G.A., Masten, A.S., Panter-Brick, C., and Yehuda, R. (2014). Resilience definitions, theory, and challenges: interdisciplinary perspectives. Eur. J. Psychotraumatol. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4185134/.

66. Evans, M.C., and Cvitanovic, C. (2018). An introduction to achieving policy impact for early career researchers. Palgrave Commun. *4*, 1–12.

67. Christensen, V., and Walters, C.J. (2004). Ecopath with Ecosim: methods, capabilities and limitations. Ecol. Model. *172*, 109–139.

68. Bentley, J.W., Serpetti, N., Fox, C., Heymans, J.J., and Reid, D.G. (2019). Fishers' knowledge improves the accuracy of food web model predictions. ICES J. Mar. Sci. *76*, 897–912.

69. Turnhout, E., Metze, T., Wyborn, C., Klenk, N., and Louder, E. (2020). The politics of co-production: participation, power, and transformation. Curr. Opin. Environ. Sustain. *42*, 15–21.

70. Ahlström, H., Williams, A., and Vildåsen, S.S. (2020). Enhancing systems thinking in corporate sustainability through a transdisciplinary research process. J. Clean. Prod. *256*, 120691.