# Unblocking the flow of biodiversity data for multi-stakeholder environmental sustainability management: Research plan

***Project duration**:* 2 years

***Swiss institution:*** University of Lausanne

***Main partner institutions:*** University of St Gallen; Centre for African Wetlands, University of Ghana; Humboldt Biological Resources Research Institute.


**Project Summary**

Governments, businesses and civil society require biodiversity data to facilitate informed decision-making on environmental management and conservation. However, biodiversity data are fragmented, challenging to collect or access, difficult to use, and rarely available to decision makers in appropriate formats. Challenges include lack of capacity and the absence of appropriate tools for identifying indicators and for collecting, analysing and interpreting data. Causal factors include taxonomic and geographic data biases, differences in spatial scales, and governance issues such as willingness to share information, especially in risk-averse governments and businesses.

Solutions proposed to unblock the flow of biodiversity data across stakeholder groups include the development of science-policy fora and capacity building. However, few studies have linked data solutions to user needs and there is no comprehensive, openly available tool for supporting biodiversity data use. We will therefore bring together experts from conservation biology and business sustainability management to explore biodiversity data user needs across sectors and identify the reasons behind blockages to data flow and access. We will then use our research results to work with Information Technology and data connectivity experts to develop a user-friendly, open-access decision support tool to help stakeholders find the standards, guidelines, tools, methods and data they need.

The project will enhance and complement global efforts by international organisations like IUCN and GEOBON to share and publicise data sources and to make existing tools and data freely available to the managers who need them. This will ultimately help mainstream biodiversity data into decision-making and halt biodiversity loss.


## 1. Background and Context

Biodiversity is declining (IPBES, 2019; Secretariat of the Convention on Biological Diversity 2020). Effective action to reverse current trends requires effective, data-driven decision-making and adaptive management. To that end, many stakeholders require data on the state of species and habitats, the pressures they face, the benefits accrued from ecosystem services, and their management and policy responses, to facilitate informed decision-making on conservation, natural resource management, and sustainability (Stephenson et al., 2015, 2017ab, 2020; Addison et al., 2020; Stephenson & Carbone, 2021). Governments need data, for example, to develop environmental legislation and policies, manage resources across industries (e.g. agriculture, fisheries, mining), and deliver multilateral environment agreements (Stephenson et al., 2017a,b, 2020). Businesses need biodiversity information to attain sustainability targets, monitor and report their environmental impacts, and manage risk (Walls et al., 2012, 2020; Walls & Berrone, 2017; Chiu & Walls, 2019; Addison et al., 2020; Stephenson & Carbone, 2021; Salaiz et al., in press). Conservation NGOs need data to prioritize actions, monitor outcomes and impacts, and apply adaptive management (Young et al., 2014b; McKinnon et al., 2015; Stephenson et al., 2015). Most actors also need data to demonstrate contributions to global goals and policy processes, such as the Sustainable Development Goals (UN, 2021) and the post-2020 Global Biodiversity Framework of the Convention on Biological Diversity (Convention on Biological Diversity, 2020).

Biodiversity monitoring is therefore an essential element of environmental management, providing data for informed decision-making. However, it is often inadequate. Data are frequently scattered, fragmented, of poor quality, and rarely available in the right format at the right time (Nesshover et al., 2016; Kissling et al., 2018; Stephenson et al., 2017a,b; Stephenson, 2019; Hochkirch et al., 2020; Stephenson & Stengel, 2020). Consequently, government reporting on biodiversity often lacks data (Walpole et al, 2009; Bubb, 2013) and few companies report on biodiversity (Overbeek et al., 2013; Stephenson & Carbone, 2021). Conservation NGOs also struggle to collect and use data to monitor their impacts on biodiversity (Stephenson et al., 2015).

**2. Review of Existing Research**

A number of challenges have been identified that prevent the use of biodiversity data in decision-making. These include a lack of capacity and tools for identifying indicators and collecting, analysing and interpreting data (Stephenson et al., 2017a, 2020; Addison et al., 2020; Hochkirch et al., 2020; Stephenson, 2020). Advances in technological tools, such as remote sensing and environmental DNA (Taberlet et al., 2018; Zinger et al., 2019; Stephenson, 2020), have also left many actors behind. Biodiversity monitoring schemes and databases have taxonomic and geographic biases and data access limitations (Amano et al., 2016; McRae et al., 2017; Troudet et al., 2017; Fabian et al., 2019; Stephenson & Stengel, 2020; Moussy et al., 2021;), and many institutions fail to follow data management best practices (Wilkinson et al., 2016). Variability in the spatial and temporal resolution of data, a lack of willingness to share information, and the failure to link risks and dependencies to actions, also affect governments and businesses (Walls et al., 2012; Whiteman et al., 2013; Bansal & DesJardins, 2015; Stephenson et al., 2017a). Therefore, many stakeholders, from government departments to businesses, struggle to identify appropriate indicators for monitoring biodiversity, sources of existing data they can use, and the relevant monitoring tools for collecting their own data (Addison et al., 2020; Stephenson, 2020; Stephenson & Stengel, 2020; Stephenson et al., 2020). So how can these blockages be addressed and data made more freely available to inform decision-making and enhance conservation impact and environmental sustainability?

Solutions proposed so far to unblock the flow of biodiversity data often focus on developing science-policy fora to enhance knowledge transfer between data users and providers (Young et al., 2014a; Stephenson et al., 2017a,b), and building stakeholders' capacity to collect, use and share data in easy-to-interpret formats (Tittensor et al., 2014; Stephenson et al., 2015, 2017a,b, 2020; Stephenson, 2019; Stephenson & Carbone, 2021). However, few concrete solutions have been proposed to meet identified user needs (Stephenson et al., 2017b; Fabian et al., 2019). Various platforms exist for accessing or mapping data (Wilkinson et al., 2016; Stephenson & Stengel, 2020), and some efforts have been made to collect tools for certain sectors (e.g. Lammerant et al., 2019; GEOBON, 2021), but many potential users (especially those in the corporate sector; Stephenson & Carbone, 2021) still do not know which tools to use or where to find the data they need. What can be done to link existing tools with user needs?

Decision support tools or decision support systems are sometimes proposed as means to improve conservation delivery (Hoare, 2001; Kühl et al., 2008; Hedges et al., 2012; Strindberg & O'Brien, 2012; Reynolds et al., 2014) as a means of helping people assess available information and work through options to decide on the best course of action. While there is no comprehensive, openly available tool for supporting the use of biodiversity data, existing tools and data could in theory be linked to user needs if the tools and the needs are properly mapped and linked through a suitable portal. Few conservation practitioners read scientific literature to search for data (Pullin et al., 2004; Fabian et al., 2019); and few business scholars influence sustainability practices (Ergene et al., 2020). But many people are receptive to specialized reputable websites offering support online (Fabian et al., 2019).

Factors influencing the uptake of decision support tools in conservation include appropriate alignment with relevant policies and their usefulness even when some data are missing (Gibson et

al., 2017). This further underlines the importance of aligning tools and data with stakeholder needs, especially if linked to meeting policy obligations. It also underlines the importance of ensuring that the tool deals with questions that may have no clear answer or have no clear solution; for example, what to do when the user wants to access data but that data currently do not exist - as is the case, for example, with global data sets for law enforcement and prosecutions, and conservation education and training (Stephenson & Stengel, 2020). There is therefore a compelling argument for bringing together the empirical and theoretical perspectives on data access and use and finding solutions linked to user needs and policies.

We therefore propose to bring together experts from multiple disciplines to explore biodiversity data user needs globally and in three sample countries. We will use diverse approaches to identify the reasons behind blockages to data access and then use the results to support stakeholders in finding solutions. The main output will be an online tool that, through a stepwise series of questions, will guide users towards data, tools, standards, guidelines and methods. Additional bespoke recommendations and policy briefs will be produced for specific stakeholder groups as necessary.

The project builds on and complements relevant work currently being led by the implementing partners:

- The IUCN SSC Species Monitoring Specialist Group has identified current global biodiversity data sources (Stephenson & Stengel, 2020) and monitoring projects (Moussy et al., 2021) and some of the tools available specifically for the corporate sector to monitor biodiversity performance (Stephenson & Carbone, 2021)
- The Chair for Sustainability Management at the Institute for Economy and the Environment, University of St. Gallen, conducts research on environmental governance. To date, most of that research has focused on environmental performance typically measured via ESG ratings or greenhouse gas emissions (Walls et al., 2012; Walls & Berrone, 2017). This project would build and expand on that work by focusing specifically on biodiversity performance, a new frontier in business sustainability research.
- GEOBON (2021) is cataloguing monitoring tools in its "BON in the Box" database and is starting a project with Microsoft to further enhance data availability.
- The Humboldt Institute and the Centre for African Wetlands, University of Ghana are developing monitoring protocols for biodiversity in different habitat types in their respective regions.

**3. Research questions**

Our project sets out to test the assumption made by Stephenson & Stengel (2020) that "*if the conservation, science and business communities could make a greater effort to share and publicise data sources and make existing tools and data freely available for the managers who most need them, we might be able to mainstream biodiversity data into decision-making and ultimately stop biodiversity loss*".

Our ***project goal*** is: To assess the biodiversity data needs of international organizations, governments, civil society and business, to understand blockages to data flow and capacity development, and to produce a decision support tool to help enhance access to the methods and data necessary to facilitate monitoring and informed decision-making for conservation and sustainability.

Our main ***research questions*** are:

- What are the biodiversity data needs of international organizations, governments, civil society and business?
- What factors curtail biodiversity monitoring and data access?
- What solutions are needed to unblock the flow of biodiversity data and enhance its use in decision-making and how can an online decision support tool help?

We argue that in-depth analyses of user needs for biodiversity data could be mapped against existing tools, data sources and sources of technical support and advice to develop a framework that facilitates the mainstreaming of data into decision-making. Our working hypothesis is that a simple decision support system could be developed that, by walking data users through a logical, stepwise series of questions, could lead them to the precise information they need to solve their biodiversity monitoring problem (e.g. an indicator, a monitoring method, a monitoring protocol, a data source, a source of advice, target setting, etc.).

The project will be based on two theoretical frameworks. The first, focused on governmental and non-governmental conservation agencies and developed by Stephenson et al. (2017a; Figure 1), suggests the enabling conditions for data use include data availability and usability, and the willingness and capacity to use data. We will test empirically if the precise blockages proposed in the framework can be quantified by each main stakeholder group and then addressed through a web-based IT solution.

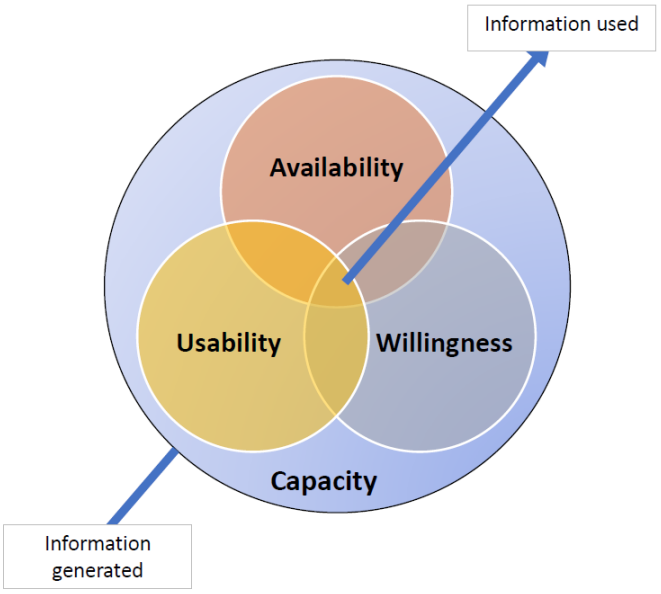


**Figure 1.** Enabling conditions for use of biodiversity data in decision-making (based on Stephenson et al., 2017a).

Secondly, for the business-specific context, we will consider the Mitigation Hierarchy, a model often used to govern biodiversity impact and avoid, reduce, restore and regenerate nature (Mitchell, 1997; Figure 2). The application of this model requires data on biodiversity states and pressures, as well as company responses. The model is also the foundational concept for two key frameworks that companies can draw on to monitor, govern, and control their biodiversity footprint, namely the Natural Capital Protocol (NCP) and the Science-Based Targets for Nature (SBTN) initiative (Natural Capital Coalition, 2016; Science-Based Targets Network, 2020). Both frameworks and their associated guidelines, as well as the broader IUCN guidelines for monitoring business biodiversity performance (Stephenson & Carbone, 2021), require companies to measure biodiversity, using relevant, rigorous, and consistent information that is material and replicable which then guides target setting and actions to reduce their impact on biodiversity. We will assess how companies use the NCP, SBTN and IUCN guidelines to measure biodiversity and make decisions to reduce biodiversity impact to determine biodiversity data needs. We will then compare and contrast these needs and challenges with those identified for other stakeholders in the public and civil society sectors.

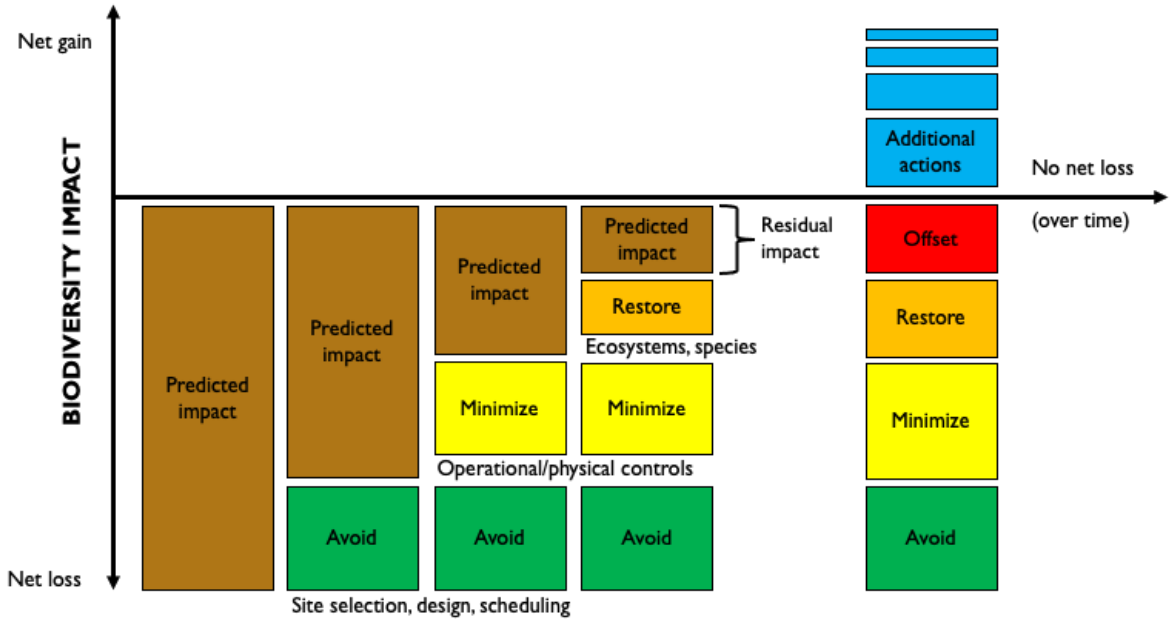


**Figure 2.** Mitigation Hierarchy – from measuring to mitigating biodiversity impact (based on Mitchell, 1997).

**4. Approach and Methodology**

The project will adopt a multi-disciplinary approach, tackling issues around biodiversity data use in conservation biology and business sustainability, and exploring web-based information technology solutions. The university departments involved reflect the project's diversity, focusing on conservation biology, business management and IT.

During three defined phases, the project will employ several research methods including:

- Systematic literature review
- Online questionnaire surveys
- Case study analysis
- Content analysis
- Panel data regression analysis.

***Phase 1: Identify data user needs/constraints***

***Step 1a. Conduct a systematic literature review*** to identify the biodiversity data required by governments, international organizations (IOs), civil society and the private sector and blockages to data access, from national levels to global policy processes, such as the Sustainable Development Goals and the post-2020 Global Biodiversity Framework.

***Step 1b. Conduct an online questionnaire survey*** of a random selection of stakeholders

***Step 1c. Conduct a large-sample analysis*** to understand data needs and relationships.

***Step 1d. Conduct "deep dive" case studies***, using literature reviews and semi-structured individual and focus group interviews, to identify the causes and effects of different data access challenges.

***Step 1e. Synthesize results and conduct statistical analyses*** to identify relationships and correlations between factors affecting data availability.

***Phase 2: Identify solutions***

***Step 2a. Hold a workshop*** to convene project partners and a representative selection of stakeholders to assess project results and identify potential solutions to the blockages identified.

***Phase 3: Produce and disseminate results and lessons***

***Step 3a. Produce papers and disseminate results***

**7. Expected results**

We will identify the biodiversity data required by multiple stakeholders locally and globally and factors affecting access, and propose solutions.

The results of this research will have implications for governance, planning, monitoring, reporting, disclosure, sustainability and decision-making across multiple stakeholders managing, conserving and restoring biodiversity. The project will contribute to academic fields of study such as conservation biology and business sustainability management scholarship. In conservation biology, the results will help frame data access and management in the context of local and global planning, practice and policy needs. This will lead to improvements in the monitoring of pressures, impacts and project delivery, and more informed natural resource management policy-making. In business sustainability, we expect to contribute to the field of corporate governance and sustainability, specifically by expanding the focus of environmental performance outcomes that have typically captured only greenhouse gas emissions or environmental ratings to develop appropriate biodiversity performance measures. In addition, we contribute to the micro-foundations literature of corporate sustainability in understanding how and why managers make decisions around biodiversity.

The findings of this study will have broad policy implications by helping stakeholders monitor and report on their contributions to the post-2020 Global Biodiversity Framework of the Convention on Biological Diversity and the Sustainable Development Goals, as well as multilateral environment agreement commitments (e.g. Convention on Migratory Species; Convention on Trade in Endangered Species of Wild Fauna and Flora). For many companies, data use also meets key legal obligations (such as the requirements imposed by various EU directives and national laws requiring environmental impact assessments for developments in most sectors) or contributes to company sustainability policies and governance. Furthermore, the increasing regulations on non-financial disclosure (such as the European Union's non-financial reporting directive 2014/95/EU) are putting more pressure on businesses to identify credible indicators for their biodiversity performance that can be shared publicly (Stephenson & Carbone, 2021). The policy context should therefore create a suitable enabling condition for our project's outputs.

The project will therefore strive to bring together the empirical and theoretical perspectives on biodiversity data access and use and find solutions linked to user needs and policies. This will improve the availability of data and monitoring tools and ultimately enhance conservation, natural resource management and sustainability.

**Bibliography**


Adams, R.J., Smart, P., Huff, A.S. (2017). Shades of grey: Guidelines for working with the grey literature in systematic reviews for management and organizational studies. *International Journal of Management Reviews,* 19(4): 432–454

Addison, P.F.E., Stephenson, P.J., Bull, J.W. et al. (2020). Bringing sustainability to life: A framework to guide biodiversity indicator development for business performance management. *Business Strategy and the Environment,* 29(8): 3303-3313.

Aguinis, H., Ramani, R. S., Alabduljader, N. (2020). Best-practice recommendations for producers, evaluators, and users of methodological literature reviews. *Organizational Research Methods.* https://doi.org/10.1177/1094428120943281

Amano, T., Lamming, J.D. & Sutherland, W.J. (2016). Spatial gaps in global biodiversity information and the role of citizen science. *Bioscience*, 66(5): 393-400.

Arndt, M., & Bigelow, B. (2000). Presenting structural innovation in an institutional environment, hospitals' use of impression management. *Administrative Science Quarterly,* 45: 494-522.
Bansal, P. & DesJardins, M.R. (2015). Business sustainability: It is about time. *Strategic Organization*, 12(1): 70-78.
Bubb, P. (2013). Scaling up or down? Linking global and national biodiversity indicators and reporting. Pp 402–420 in B. Collen et al. (eds.), *Biodiversity Monitoring and Conservation.* Wiley-Blackwell, London, UK.
Chen, C., Quan, R.C., Cao, G. et al. (2019). Effects of law enforcement and community outreach on mammal diversity in a biodiversity hotspot. *Conservation Biology,* 33(3): 612-622.
Chiu S.C. & Walls J.L. (2019). Leadership change and corporate social performance: The context of financial distress makes all the difference. *The Leadership Quarterly,* 30(5): 101307.
Conservation Measures Partnership (2020). *Open Standards for the Practice of Conservation. Version 4.* CMP, Bethesda, USA.
Convention on Biodiversity (CBD) (2020). Zero Draft of the Post-2020 Global Biodiversity Framework. CBD/WG2020/2/3. Open-ended Working Group on the Post-2020 Global Biodiversity Framework. CBD, Montreal, Canada.
Danovaro, R., Fanelli, E., Aguzzi, J. et al. (2020). Ecological variables for developing a global deep-ocean monitoring and conservation strategy. *Nature Ecology & Evolution,* 4(2): 181-192.
Eisenhardt, K.M. 1989. Building theories from case study research. Academy of Management Review, 14(4): 532-550.
Ergene, S., Banerjee, S.B. & Hoffman, A.J. (2020). (Un)Sustainability and organization studies: Towards a radical engagement. *Organization Studies*. doi:10.1177/0170840620937892
Fabian, Y., Bollmann, K., Brang, P., et al. (2019). How to close the science-practice gap in nature conservation? Information sources used by practitioners. *Biological Conservation,* 235: 93-101.
GEOBON 2021. *BON in a Box*. Website https://geobon.org/bon-in-a-box/ accessed 26 April 2021.
Gibson, F.L., Rogers, A.A., Smith, A.D. et al. (2017). Factors influencing the use of decision support tools in the development and design of conservation policy. *Environmental Science & Policy,* 70: 1-8.
Glaser, B., & Strauss, A. (1967) The discovery of grounded theory: Strategies of qualitative research. London: Wiedenfeld and Nicholson.
Hedges, S., Maisels, F. & Blake, S. (2012). Estimating absolute densities of elephant populations using dung counts along line transects: field methods Pp 172-213 in *Monitoring elephants and assessing threats: a manual for researchers, managers and conservationists* (S. Hedges, ed.). Universities Press, Himayatnagar, Hyderabad, India.
Hiebl, M.R.W. (2021). Sample selection in systematic literature reviews of management research. *Organizational Research Methods*. https://doi.org/10.1177/1094428120986851
Hoare, R. E. (2001). *A Decision Support System for Managing Human-Elephant Conflict Situations in Africa*. IUCN SSC African Elephant Specialist Group, Nairobi, Kenya.
Hochkirch, A., Samways, M.J., Gerlach, J. et al. (2020). A strategy for the next decade to address data deficiency in neglected biodiversity. *Conservation Biology*. DOI: 10.1111/cobi.13589
Holsti, O.R. 1969. *Content Analysis for the Social Sciences and Humanities*. Reading: Addison-Wesley.
Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) (2019). *Summary for Policymakers of the Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.* S. Díaz, J. Settele, E. S. Brondízio et al. (eds.). IPBES Secretariat, Bonn, Germany.
Kissling, W.D., Ahumada, J.A., Bowser, A., et al. (2018). Building essential biodiversity variables (EBVs) of species distribution and abundance at a global scale. Biological Reviews, 93(1): 600–625.
Kühl, H., Maisels, F., Ancrenaz, M., & Williamson, E. A. (2008). *Best Practice Guidelines for Surveys and Monitoring of Great Ape Populations*. IUCN SSC Primate Specialist Group, Gland, Switzerland.
Lammerant J., Grigg, A., Dimitrijevic, J., et al. (2019). *Assessment of Biodiversity Measurement Approaches for Businesses and Financial Institutions. Update Report 2.* EU Business @ Biodiversity Platform, Brussels, Belgium.
Mair, L., Byers, O., Lees, C.M., Nguyen, D. et al. (2021). Achieving international species conservation targets. *Conservation & Society,* 19(1): 25-33.
McKinnon, M. C., Mascia, M. B., Yang, W. et al. (2015). Impact evaluation to communicate and improve conservation non-governmental organization performance: the case of Conservation International. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 370(1681): 20140282.
McRae, L., Deinet, S. & Freeman, R. (2017). The diversity-weighted Living Planet Index: Controlling for taxonomic bias in a global biodiversity indicator. *PLoS ONE,* 12: e0169156.
Meyer, M.A. & Booker, J.M. (2001). *Eliciting and Analyzing Expert Judgment: A Practical Guide*. Society for Industrial and Applied Mathematics (SIAM), Philadelphia, Pennsylvania, USA.

Miles, M. & Huberman, A.M. (1994). *Qualitative Data Analysis (2nd edition)*. Sage Publications, Thousand Oak, CA, USA.
Mitchell, J. (1997). Mitigation in environmental assessment – furthering best practice. *Environmental Assessment*, 5(4): 28-29.
Morgan, M.G. (2014). Use (and abuse) of expert elicitation in support of decision making for public policy. *Proceedings of the National Academy of Science*, 111: 7176-7184.
Moussy, C., Burfield, I., Stephenson, P.J., et al. (2021). A quantitative global review of species population monitoring. *Conservation Biology.* DOI: 10.1111/cobi.13721
Natural Capital Coalition. 2016. Natural Capital Protocol. Available at: www.naturalcapitalcoalition.org/protocol
Nesshover, C., Livoreil, B., Schindler, S., & Vandewalle, M. (2016). Challenges and solutions for networking knowledge holders and better informing decision-making on biodiversity and ecosystem services. *Biodiversity and Conservation,* 25(7): 1207-1214.
Overbeek, G., Harms, B., & Van den Burg, S. (2013). Biodiversity and the corporate social responsibility agenda. *Journal of Sustainable Development*: 6(9), 1-11.
Pullin, A.S., Knight, T.M., Stone, D.A. & Charman, K. (2004). Do conservation managers use scientific evidence to support their decision-making? *Biological Conservation,* 119(2): 245-252.
Reynolds, K.M., Hessburg, P.F. & Bourgeron, P.S. (2014). *Making Transparent Environmental Management Decisions: Applications of the Ecosystem Management Decision Support System.* Springer, Berlin & Heidelberg, Germany.
Rousseau, D.M., Manning, J., Denyer, D. (2008). Evidence in management and organizational science: Assembling the field's full weight of scientific knowledge through syntheses. *The Academy of Management Annals,* 2(1): 475-515. https://doi.org/10.1080/19416520802211651
Salaiz, A., Chiu, S.C. & Walls, J.L. (in press). Sustainability agency at the top of the organization: Microfoundations research on corporate sustainability. In S. Teerikangas et al. (eds.), *Research Handbook of Sustainability Agency*. Edgar Elgar Publishing.
Science Based Targest Network, 2020. Science-Based Targets for Nature: Initial Guidance for Business. Global Commons Alliance. (Online). Available at: https://sciencebasedtargetsnetwork.org/wp-content/uploads/2020/09/SBTN-initial-guidance-for-business.pdf
Secretariat of the Convention on Biological Diversity (2020). *Global Biodiversity Outlook 5.* Montréal, Canada: Secretariat of the Convention on Biological Diversity.
Stephenson. P.J. (2019). The Holy Grail of biodiversity conservation management: monitoring impact in projects and project portfolios. *Perspectives in Ecology and Conservation,* 17(4): 182-192.
Stephenson, P.J. (2020). Technological advances in biodiversity monitoring: applicability, opportunities and challenges. *Current Opinion in Environmental Sustainability,* 45: 36-41.
Stephenson, P.J., Bowles-Newark, N., Regan, E. et al. (2017a). Unblocking the flow of biodiversity data for decision-making in Africa. *Biological Conservation*, 213: 335-40.
Stephenson, P.J., Brooks, T.M., Butchart, S.H.M. et al. (2017b). Priorities for big biodiversity data. *Frontiers in Ecology and the Environment,* 15: 124-125.
Stephenson, P.J., Burgess, N.D., Jungmann, L., Loh, J., O'Connor, S., Oldfield, T., Reidhead, W. & Shapiro, A. (2015). Overcoming the challenges to conservation monitoring: integrating data from in situ reporting and global data sets to measure impact and performance. *Biodiversity*, 16 (2-3): 68-85.
Stephenson, P.J. & Carbone, G. (2021). G*uidelines for Planning and Monitoring Corporate Biodiversity Performance.* IUCN, Gland, Switzerland.
Stephenson, P.J., Ntiamoa-Baidu, Y. & Simaika, J.P. (2020). The use of traditional and modern tools for monitoring wetlands biodiversity in Africa: challenges and opportunities. *Frontiers in Environmental Science,* 8: 61.
Stephenson, P.J., & Stengel, C. (2020). An inventory of biodiversity data sources for conservation monitoring. *PLoS ONE,* 15(12): e0242923.
Strindberg, S., & O'Brien, T. (2012). *A Decision Tree for Monitoring Wildlife to Assess the Effectiveness of Conservation Interventions. Wildlife Conservation Society Working Paper No. 41 (April 2012).* WCS, New York, USA.
Taberlet, P., Bonin, A., Zinger, L. & Coissac, E. (2018). *Environmental DNA-For Biodiversity Research and Monitoring.* Oxford University Press, Oxford, UK.
Troudet, J., Grandcolas, P., Blin, A. et al. (2017). Taxonomic bias in biodiversity data and societal preferences. *Scientific Reports,* 7(1): 9132.
United Nations (UN)(2021). Sustainable Development Goals Knowledge Platform. Website https://sustainabledevelopment.un.org/ accessed 26 April 2021.
Walls J.L., & Berrone P. (2017). The power of one to make a difference: How informal and formal CEO power affect environmental sustainability. *Journal of Business Ethics,* 145(2), 293-308.

Walls, J.L., Berrone, P. & Phan, P.H. (2012). Corporate governance and environmental performance: Is there really a link? *Strategic Management Journal,* 33(8): 885-913.

Walls J.L, Salaiz A & Chiu S.C. (2020). Wanted: Heroic leaders to drive the transition to 'Business beyond Usual'. *Strategic Organization*, doi:10.1177/1476127020973379.

Walpole, M., Almond, R.E.A., Besançon, C. et al. 2009. Tracking progress toward the 2010 biodiversity target and beyond. *Science* 325, 1503–1504.

Whiteman, G., Walker, B. & Perego, P. (2013). Planetary boundaries: Ecological foundations for corporate sustainability. *Journal of Management Studies*, 50(2): 307-336

Wilkinson, M., Dumontier, M., Aalbersberg, I. et al. (2016). The FAIR Guiding Principles for scientific data management and stewardship. Scientific Data, 3: 160018. https://doi.org/10.1038/sdata.2016.18

Yin, R. (1984). *Case Study Research.* Sage Publications, Beverly Hills, CA, USA.

Young, J.C., Waylen, K.A., Sarkki, S. et al. (2014a). Improving the science-policy dialogue to meet the challenges of biodiversity conservation: having conversations rather than talking at one-another. Biodiversity and Conservation, 23(2): 387-404.

Young, R.P., Hudson, M.A., Terry, A.M.R. et al. (2014b). Accounting for conservation: using the IUCN Red List Index to evaluate the impact of a conservation organization. *Biological Conservation,* 180: 84-96.

Zinger, L., Bonin, A., Alsos, I.G., et al. (2019). DNA metabarcoding—Need for robust experimental designs to draw sound ecological conclusions. *Molecular Ecology,* 28(8): 1857-1862.