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'GREY LITERATURE – A PLATFORM AND INTERFACE FOR OPEN SCIENCE'

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The Grey Journal

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Dr. Dominic Farace
GreyNet International,
Grey Literature Network Service
Netherlands
journal@greynet.org

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TextRelease
Javastraat 194-HS
1095 CP Amsterdam
Netherlands
T +31 (0) 20 331.2420
info@textrelease.com
<http://www.textrelease.com/gjpublications.html>

About TGJ

The Grey Journal is a flagship journal for the international grey literature community. It crosses continents, disciplines, and sectors both public and private.

The Grey Journal not only deals with the topic of grey literature but is itself a document type classified as grey literature. It is akin to other grey serial publications, such as conference proceedings, reports, working papers, etc.



The Grey Journal is geared to Colleges and Schools of Library and Information Studies, as well as, information professionals, who produce, publish, process, manage, disseminate, and use grey literature e.g. researchers, editors, librarians, documentalists, archivists, journalists, intermediaries, etc.

About GreyNet

The Grey Literature Network Services was established in order to facilitate dialog, research, and communication between persons and organizations in the field of grey literature. GreyNet further seeks to identify and distribute information on and about grey literature in networked environments. Its main activities include the International Conference Series on Grey Literature, the creation and maintenance of web-based resources, a moderated Listserv, and The Grey Journal. GreyNet is also engaged in the development of distance learning courses for graduate and post-graduate students, as well as workshops and seminars for practitioners.

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Is the Production and Use of Grey Marine Literature a Model for Open Science?*

Bertrum H. MacDonald, Rachael Cadman, Curtis Martin, Simon Ryder-Burbidge, Suzuette S. Soomai, Ian Stewart, and Peter G. Wells; Dalhousie University, Canada

Abstract

Globally, grey literature is common. Large quantities of openly available grey literature have been generated since the latter half of the nineteenth century. It is a primary source of information used in many public policy and decision-making contexts, at all jurisdictional levels. In fact, public decision making and policy development would seriously falter today in the absence of such literature. Moreover, in some jurisdictions, legislation mandates transparent governance processes in which current research must be fully open. This lengthy experience with open practices in the production and use of grey literature offers insights to the open science movement.

In this paper, based on over fifteen years of interdisciplinary research, we demonstrate how open practices in the production and use of grey literature in marine environment science policy contexts could inform open science initiatives. The results from our numerous case studies about information use in decision-making processes, at local to global levels, address two conference themes, namely, the application of open science principles in promoting grey literature, and obstacles and challenges to such open access.

Information pathways in coastal and ocean management are complex and involve many actors (including researchers; managers; policy analysts; members of industry, professional associations, community groups, and non-governmental organizations; politicians; and citizens generally). Open grey literature offers numerous advantages in these settings, as an extensive variety of information needs, types, and formats are prevalent. Open grey literature can also be distributed without restriction by individuals and organizations. It can now be shared globally with ease, which is particularly beneficial to developing countries often unable to afford commercial information sources.

However, while produced and used widely, grey literature also presents challenges that open science also encounters. Openness, i.e., open access, does not ensure awareness and it does not automatically equate to usability by a wide variety of audiences. Because grey literature is assumed to be largely accessible, often limited attention is focused on promoting awareness or communicating information in broadly understandable terms. Furthermore, the massive quantity of literature can contribute to its seeming invisibility. The multiplicity of formats and content can result in perceptions of limited value of grey literature. Even though the information may be rigorously peer-reviewed, in today's information-saturated environment, open-access may be equated with uncertain quality.

Our research on the use and influence of grey literature in marine environmental decision making highlights the benefits and challenges of open access information. Thus, our findings may be particularly informative to current efforts to advance open science principles globally.

We live in a paradoxical information world. To say that we are awash with information is a substantial understatement today. Everyone, from private citizens to public decision makers, regularly encounters an overabundance of information and must implement strategies and filters to select or deflect incoming information (Walgrave & Dejaeghere, 2017). Barriers are frequently established to mitigate the deluge of information. In contrast, advocates of open science have recently been promoting *greater* access to information (Open science, n.d.; Open science, 2019; Vincente-Saez & Martinez-Fuentes, 2018). As the name implies, open science initiatives emphasize unrestricted availability to the data and information emanating from research activity. For several years, leading science journals, e.g., *Science*, have required authors to submit the raw data generated by their research, for online publication as a supplement to research papers. Granting

* First published in the GL21 Conference Proceedings, February 2020.

councils often require the same practice in their reporting requirements. Impediments preventing access are being removed by publishers today or are not set in place at all in new research work. In short, coping mechanisms are established to limit or obstruct information flow on the one hand, while on the other hand, mechanisms are being implemented to facilitate access to the original data.

As matters of concern, information overload and open science are not new phenomena. Both have existed in some form since at least the fifteenth century (Blair, 2010; Muffler-Wille & Charmantier, 2016; Ogilvie, 2003; Rosenberg, 2003; Tidline, 2002). However, the attention both are receiving currently is a reflection of the very rapid growth in the volume of data and information over the last half-century and major advances in widely available technologies that facilitate production of scientific data, e.g., faster computers, automated instruments, satellites, as well as widespread distribution and access to information (Allen & Mehler, 2019; Landhuis, 2016).

The history of science demonstrates that scientists and their professional associations have long been champions of wider access to research data and information, as well as experiencing at times the opposite pressures to control and manage access for complex reasons (Vermeir & Margócsy, 2012). The recent literature on the subject of open science illustrates numerous aspects on this topic: open access, open data, open reproducible research, open science evaluation, open science policies, open science tools, among others (e.g., Méndez, 2019; Open science definition, n.d.). However, a consensus about the definition of open science has not yet coalesced around any one of these terms. The organizers of this conference adopted the definition of open science as “the movement to make scientific research, data and dissemination accessible to all levels of an inquiring society” (following the explanation by Woelfle, Oliaro, and Todd (2011), now adopted by Wikipedia (Open science, 2019)). A recent systematic review of literature considered 75 studies on the subject and proposed the following definition: “Open science is transparent and accessible knowledge that is shared and developed through collaborative networks” (Vincente-Saez & Martinez-Fuentes, 2018). This succinct characterization of open science highlights two facets, collaborative knowledge development and wide accessibility of the results, whereas the previous definition involves widespread behavioural change that supports accessibility. Open science should consider all three descriptors in its definition.

In our collaborative research on questions about information production and its use at the science-policy interface in marine environmental and fisheries contexts (www.eiui.ca), we have observed and documented the extensive use of grey literature in decision-making processes. Collaboration in knowledge generation and numerous efforts to present information in meaningful ways to diverse audiences is evident in our findings. Large depositories of openly available marine data and information, published in various forms of grey literature, are generated specifically to support the operations of governments at all jurisdictional levels (MacDonald et al., 2013).

Today, advances in information technologies are contributing to a blurring of distinctions between some forms of grey literature and primary research literature. The publication and distribution of both now often follow similar practices. Our research has shown that the production and use of grey literature in marine environmental science-based decision-making contexts can inform open science initiatives. The results from our numerous case studies, at local to global levels, address two conference themes: the application of open science principles in promoting grey literature, and the obstacles impeding open access. Hence, this paper has two objectives: to illustrate how research about grey literature can provide insights for the open science movement, and to suggest that a sharp distinction between grey and primary literature is becoming less relevant as open science develops in theory and practice.

The Environmental Information: Use and Influence Research Program

For almost two centuries, governments in many nations have established research bodies to conduct scientific research, whether internal with a national focus or externally in collaboration with other countries (MacDonald & Soomai, 2019; Oppenheimer et al., 2019). Created for a variety

of reasons (economic, cultural, environmental, etc.), the large number of research bodies found around the world have produced a “spectrum of types of research output, including print and digital formats, largely due to the diversity of audiences that governments aim to reach” (MacDonald & Soomai, 2019, p. 29). Substantial financial resources have been required to generate this volume of research literature and related publications emanating from the governmental and intergovernmental organizations. As a measure of accountability alone, governments often wish to determine whether various types of data and information have been used and to what impact (Wells, 2003).

The initial research conducted by the interdisciplinary Environmental Information: Use and Influence research program (www.eiui.ca), in which we work at Dalhousie University, was prompted by the question of accountability: were major international reports on marine pollution and the state of the oceans ever used? That first study (Cordes, 2004; MacDonald, Cordes, & Wells, 2004), which confirmed that the reports in question were widely cited, took us into explorations of the sphere of the science-policy interface and numerous case studies of information production and use by local and national governmental bodies, international intergovernmental organizations, and environmental non-governmental organizations. Our research findings have been presented at earlier iterations of this grey literature conference, to many other conferences in North American and Europe, and in oral briefings to governmental and non-governmental organizations. In addition, we have published our research results in marine policy and ocean management journals, information studies journals such as *The Grey Journal*, and in technical reports and a recent monograph (see www.eiui.ca; MacDonald et al., 2016).

Our research has shown that information pathways in ocean and coastal management are complex and involve many actors (including researchers; managers; policy analysts; members of various industries, professional associations, community groups, and non-governmental organizations; politicians; and citizens generally). Grey literature, much of which is designed for open access, is widely deployed for information transfer and communication in marine and ocean governance settings. The flexibility of grey literature publication options responds well to an extensive variety of information needs, witnessed by the numerous types and formats that are commonly prevalent. Grey literature is usually distributed without restriction by individuals and organizations and can now be shared globally with relative ease in the internet age. This development is particularly beneficial to developing countries often unable to afford commercial information sources. In our recent book about different dimensions of information use in integrated coastal and ocean management, we highlighted the significant roles that information published as grey literature fulfills in current management practices (MacDonald, Soomai, De Santo, & Wells, 2016).

Grey Literature as a Model for Open Science Practices

The production and use of grey literature, by many actors in marine management decision making over past decades, illustrates six characteristics that advocates are calling for in open science (Table 1). Research that draws on experience with grey literature can inform the application and promotion of these characteristics in open science initiatives.

Table 1. Grey Literature as a Model for Open Science

Features of Grey Literature Relevant to Open Science
Usability of the Information
Thorough Peer Review
Designed for Diverse Audiences
Synthesized Reports for Public Policy Contexts
State of the Environment Reports
Fisheries Scientific Reports
Reports and Documents Prepared by Environmental NGOs
Environmental Assessments and Impact Assessments
Data Published as Open Access
Accessible to Public Users

1. Usability of the Information

In 2002, a group of researchers in the United States published a report that identified three key features of information that ensures its usability, namely salience (or relevance), credibility, and legitimacy (Cash et al., 2002). Grey literature is used in many marine management decision-making processes because it displays these key characteristics of useful information. We know that governmental organizations at national, regional, and international levels rely heavily on using their own publications in decision making. One of us observed this use during a career with the Canadian government as a marine environmental scientist (Wells, 2016). This phenomenon was also seen during a study of major prolific producers of fisheries information: Fisheries and Ocean Canada (DFO), the national ocean governance authority; Northwest Atlantic Fisheries Organization (NAFO), a regional fisheries management body; and the Food and Agriculture Organization of the United Nations (FAO) (Soomai, 2017a; 2017b).

DFO in Canada and NAFO at the international level have well-defined processes for producing, communicating, and using information. Scientific information produced by scientists, often commissioned for specific decision-making purposes, is the primary source of advice. The fisheries science publications (grey literature) produced by employees of these organizations are preferred in policy-making as the information presented in this manner is timely, i.e., the publications are produced in annual cycles, and is relevant because it is in direct response to the fisheries management needs and questions. The scientific advice is prepared in response to specific managerial problems, and undergoes rigorous internal peer review, thereby resulting in the production of credible information available for immediate use in fisheries decision making. The decision processes also involve external stakeholders, e.g., the fishing industry, NGOs, and academic researchers, which reinforces the legitimacy and role of the information in the broader ocean governance process.

2. Peer Review

Peer review is widely viewed as an essential quality control mechanism. Peer review methods have been evolving over the past half century, and although none are entirely fool-proof, and some are contested (Bohannon, 2013; Haider, & Åström, 2017), peer review practices are considered essential in publishing credible research results (e.g., Baldwin, 2018; Lee & Moher, 2017).

The credibility of many research reports released as grey literature depends in large measure on the application of peer review. For example, for 50 years, the Joint Group of Experts on Scientific Aspects of Marine Environmental Protection (GESAMP), a leading international scientific advisory body, has been publishing substantial reports about the condition of the oceans (MacDonald, Cordes, & Wells, 2004; Wells, Duce, & Huber, 2002). GESAMP has published over 100 reports, including major periodic assessments, such as *The State of the Marine Environment* (No. 39) (GESAMP, 1990) and *Protecting the Oceans from Land-Based Activities* (no. 71) (GESAMP 2001). Each report is drafted in one of the working groups. Report No. 64 (GESAMP, 2002), for example, was the result of six years of work by the thirteen member Working Group on the Evaluation of the

Hazards of Harmful Substances Carried by Ships. Each draft report is subjected to extensive review, by both external reviewers and detailed, page-by-page consideration by GESAMP members in the annual sessions. Report No. 71, for example, lists over 90 individuals who had various roles in its preparation (GESAMP, 2001). The extensive and rigorous treatment of GESAMP's reports is an example of the degree to which this grey marine literature is peer reviewed before publication. Given the challenges of peer review sometimes faced by the move toward open science, e.g., prevalence of predatory journals with flawed to non-existent peer review (Bohannon, 2013), the review process practised by GESAMP could be an example for addressing this issue.

3. Designed for Diverse Audiences

In part because grey literature is not constrained by particular styles, formats, or communication channels, this literature offers considerable flexibility for creators to design information products for diverse audiences. Flexibility is important when decision processes encompass many stakeholder groups and end users. For example, our case study of the publications of the Gulf of Maine Council on the Marine Environment (GOMC), an international, intergovernmental organization involving two Canadian provinces, three American states, and the national governments of both countries, highlighted a diversity of information products. They include annual reports, brochures and posters, conference background papers, conference reports and workshop proceedings, fact sheets, technical reports, serials, journal articles, and abstracts (Cossarini, MacDonald, & Wells, 2014; MacDonald, Cordes, & Wells, 2007). This range of publications formats reflects the breadth of projects that the GOMC pursues and the span of audiences that it intends to reach in the multiple jurisdictions within its ambit. Flexibility in format is a benefit when a single project aims to engage researchers, environmental managers, policy makers, and the public. Such was also the case with the *State of Nova Scotia's Coasts Report*, which was released in two languages, print and digital formats, and as a 245-page technical report, a 21-page summary, and six four-page fact sheets. Publishing this variety was a deliberate decision to provide accessible and credible information to professional, government and lay audiences (Soomai, MacDonald, & Wells, 2013).

By designing information products for different stakeholders, whose capacity to understand scientific information varies, creators of grey literature can be successful in achieving transparency and accessibility to both professional and amateur audiences, both key elements in open science.

4. Synthesis Reports for Public Policy Contexts

Synthesis reports intended for use in public policy contexts are a common form of grey literature. The major synthesis reports produced by the Intergovernmental Panel on Climate Change (IPCC) are some of the most widely known, but its reports are only one of many such publications produced each year and freely accessible.

Numerous examples of synthesis reports can be drawn from our studies.

a) State of the environment reports

- i) *The 2009 State of Nova Scotia's Coast Report* (see Soomai, MacDonald, & Wells, 2013)
- ii) *The State of the Gulf of Maine Report* (see Soomai, MacDonald, & Wells, 2013)
- iii) *The State of the Scotian Shelf Report* (see Ross, 2014; Ross & Breeze, 2016)

The rigorous and transparent methods by which these reports were prepared and distributed could inform open science efforts. For instance, a suite of methods (print and digital) was used to promote awareness and use of the respective reports and the methods were selected to reach various audiences (as described in section 3 above).

b) Fisheries scientific reports

Fisheries management organizations (e.g., DFO, NAFO, and FAO) rely heavily on their own reports (grey literature) to inform national, regional, and international fisheries management decisions and policy making (as described in section 1 above) (Soomai, 2017a, 2017b).

c) Reports generated by advisory working groups or committees.

Interdisciplinary working groups provide an important platform for multi-sectoral collaboration in integrated coastal and ocean management. Such collaboration facilitates knowledge creation and knowledge brokering at the science-policy interface. These processes can inform the

development of criteria for effective working relationships to promote open science (Eck, 2017; Soomai, Wells, & MacDonald, 2011).

- d) Reports and documents prepared by environmental non-governmental organizations (eNGOs). Environmental non-governmental organizations often operate between governments and many stakeholder groups. These eNGOs “translate” and synthesize scientific reports and documents into accessible publications intended to inform and engage stakeholders and governments. The eNGOs function as boundary organizations and their publications serve as boundary objects. This activity and the related objects could serve as an example to open science programs that wish to promote transparency and produce information that is understandable by “all levels of an inquiring society.” (Cadman, 2017; Cadman, MacDonald, & Soomai, in review).

- e) Environmental assessments and Impact assessments

Environmental and impact assessments are tools used by governments at all levels (sub-national to international) for assessing potential environmental anthropogenic impacts. Such tools are a prominent example of where grey literature is relevant to open science. For decades, impact assessment processes have used grey literature in strategic, project-based deliberations, often involving a wide range of interested parties (Sadler & Dusík, 2016). In some jurisdictions (e.g., Canada), recent legislation has explicitly embraced open science as a policy and a methodology for mobilizing the grey literature generated within such assessment processes for collective democratic deliberation (Government of Canada, 2018). For relatively undeveloped contexts, e.g., Arctic regions, such new open science policies will have important consequences for how grey literature is used in open deliberative forums, including involving Indigenous communities (Stewart, 2018). The field of impact assessment and its publications may increasingly offer valuable test cases for considering how such grey literature contributes to open science mandates.

5. Open Access to Data

Large quantities of data are frequently produced in marine environmental science research conducted by governmental and intergovernmental organizations, such as from long-term monitoring programs that produce data over lengthy periods (Oppenheimer et al., 2019). Prior to advances in digital technologies, data files were often published in technical report series. Currently, data are maintained in digital files accessible through the internet. For instance, the Gulfwatch contaminants monitoring program of the GOMC has assembled large volumes of data and communicated findings to policy- and decision-makers in the Gulf of Maine and Bay of Fundy regions of the Northwest Atlantic since 1991 (Chase et al., 2001; personal observations of Wells). The Gulfwatch program has been a flagship initiative of the GOMC and the data have been released as raw data files, data reports, data summaries, and papers published in peer-reviewed journals (Chamberlain & Wells, 2014). The Gulfwatch data have provided considerable evidence for other reports and new research initiatives (Chamberlain, Wells, & MacDonald, 2018; Elskus et al., 2019).

To support use of the growing availability of large data sets, mapping tools such as digital coastal atlases have become important for information dissemination (O’Dea, Haddad, Dunne, & Walsh, 2011). Digital coastal atlases, as publicly available, web-based interactive tools, are increasingly valued by managers and other information users for their data visualization features. Participants in our study of marine atlases in Canada, Scotland, and the United States stated that coastal web-based atlases allowed them to be more confident about their decisions, since they were able to access and analyze a large volume of credible data in a centralized location (McLean, 2014). Because the data in the atlases are publicly available, the managers were able to explain their decision-making processes more easily to the public. Digital atlases offer another example of grey literature practices that model the expectations of open science.

6. Public Users of Grey Literature

Our research about information intended largely for environmental decision-making activities shows that the costs associated with the production of grey literature are usually borne by governmental and non-governmental organizations. The publications are freely available, making the information accessible to many levels of society and thereby encouraging engagement in public

policy decision processes. Assuming the content is understandable to a diversity of audiences, accessible grey literature promotes a community understanding of science. Science literacy is also stronger when availability is not restricted by paywalls or intellectual property constraints. Furthermore, accessible information products based on available scientific literature are a key means by which members of the interested public gather and disseminate marine knowledge, often later used in various aspects of the marine governance process (e.g., ocean literacy surveys, project consultations, legislative critique, community advisory committee participation, etc.). These observations are based on our recent study of place-based coastal values of members of a New England (USA) coastal community, pointing to the importance of understanding coastal perceptions (Ryder-Burbidge, 2017) and in a recent analysis of communication strategies employed by individual and non-governmental organization science communicators using two social media platforms (Martin, 2018; Martin & MacDonald (in review)). Free access, which is common with grey literature, is a feature emphasized in open science circles (Open science, n.d.) and the movement's push to make scientific information more accessible to all levels of societal inquiry is reflected both in science communication literature and by the interested public (Bickford et al., 2015; Martin, 2018; Martin & MacDonald, in review; Ryder-Burbidge, 2017; Soomai, MacDonald & Wells, 2013; Steel et al., 2005). Many ideas and innovations intended to open-up the scientific process, disseminate results therein, and effectively deploy analytic interpretations into policy-making processes can be drawn from recent research literature (Bickford et al., 2015; Lowndes et al., 2017; Martin, 2018; Martin & MacDonald, in review; Ryder-Burbidge, 2017; Wood-Charlson et al., 2015). Funding for these initiatives, however, continues to present an ongoing challenge. Our research suggests that financial models used in the production of grey literature could also inform open science models and help to sustain the continued development of knowledge translation projects.

Challenges about Grey Literature that Could Inform Open Science

Although produced and used widely in marine science (environmental and fisheries management) decision-making processes, grey literature presents challenges that open science also encounters (Table 2). Some challenges are long standing unresolved issues, whereas others are either mitigated or augmented by digital technologies.

Table 2. Challenges about Grey Literature that can Inform Open Science Practices

Challenges with Using Grey Literature Relevant to Open Science
Access (Physical and Understandability)
Awareness
Stigma about Data and Information
Production and Distribution Costs
Longevity of Websites

Examples of challenges include:

- Access.* While large quantities of grey literature are digitally available, various formats and platforms, etc., create access difficulties. A sizeable body of grey literature still exists in print formats only, or remains in proprietary digital formats, especially in the private sector. Moreover, when the grey literature is largely technical, the information may not be understandable by non-scientific audiences.
- Awareness.* The massive quantity of grey literature can result in reports or data hidden to potential users. Initiatives to promote awareness may be limited. In fact, there may be less incentive to promote awareness since "financial" rewards to promote awareness and use are not offered. One solution may be to encourage training in search strategies to find (or not find) the required information.
- Stigma.* The mistaken view that grey literature is always of lower quality than primary literature may also apply to open access (open science) primary literature. Today, this challenge is accentuated by the growing presence of predatory journals.

- d) *Production and distribution costs borne by creators.* The production of grey literature has long followed the “creator pays” business model. While this model benefits users, i.e., the user does not pay to gain access to the literature, production and promotion costs, which are real, may pose a challenge for open science. Questions about who pays and who funds the production costs must be addressed.
- e) *Longevity of the websites holding the data and the publications.* Website longevity is assumed but websites come and go, with information loss as the consequence. To date, no initiative has solved this problem. The Internet Archive, for example, captures large numbers of websites and other publications, but digital preservation of all websites has not been achieved (Baucom, 2019; Brügger & Laursen, 2019; Hill, 2016; Shein, 2016; Thelwall & Vaughan, 2004).

Openness does not ensure awareness and it does not automatically equate to usability by a wide variety of audiences. Because grey literature is assumed to be largely accessible, often limited attention is focused on promoting awareness. Furthermore, the massive quantity of literature can contribute to its seeming invisibility; specific publications may be unnoticed among the many available on a subject. The multiplicity of formats and varied content can result in grey literature being deemed of limited value. Even though the information may be rigorously peer-reviewed, in today’s information-saturated environment, open-access may be equated with uncertain quality and questions of reliability (i.e., information vs. mis-information) and credibility arise.

Conclusions

Let us return to the question posed as a title of this paper, namely, “Is the production and use of grey marine literature a model for open science practices?” Our research suggests that it can be. We have observed and reported in publications arising from our studies that the long-standing motivations to produce grey literature and make it accessible are similar to the motivations driving open science. As seen in settings that explicitly invoke the use of grey literature in publicly deliberative moments (e.g., environmental impact assessments contexts), this similarity is increasingly being recognized (Government of Canada, 2018).

Proponents (creators) for both grey literature and open science aim to promote the use of information in order to advance research, to raise public awareness and understanding of science, and to facilitate evidence-based (evidence-informed) decisions on important societal issues.

The distinction between primary and grey literature is becoming less pronounced today, driven largely by advances in information technology and science generally. Often an immediacy to information needs overshadows the production processes. In public policy and decision processes, delays in making information available can be detrimental and costly.

Many definitions of open science are found in the literature on the subject. But a key observation from our research is that the distinction between grey and primary literature is blurring. Today, both types of literature emphasize greater open access. Moreover, it is important to note that significant marine environmental and fisheries research results must be published in a timely manner and distributed widely in formats suitable for diverse audiences.

Finally, we believe in the importance of ensuring that key marine information is published and made accessible, regardless of the location or the publishing method. Solving critical environmental problems by finding effective solutions and practicing sustainable fisheries should be the primary focus of research, management, and policy (Soomai & MacDonald, 2018). Attention given to the processes of information creation and delivery should be pursued with these urgent objectives in mind.

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