

# Science-policy intermediaries from a practitioner's perspective: The Lenfest Ocean Program experience

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Scientists often lament their lack of influence on environmental policy-making. Some proposed solutions, like teaching scientists to communicate more effectively, can be helpful, but are not necessarily sufficient. Instead, connecting science and policy may often require a separate kind of expert: full-time intermediaries who facilitate the complicated exchange of information among scientists, policy-makers, and other stakeholders. In this paper, we describe intermediary efforts by the Lenfest Ocean Program, a grant-making program that funds peer-reviewed research and connects scientists and decision-makers who can take action on an issue. We present case studies of intermediary work on three topics: first, sustainable methods of harvesting bull kelp in the US Pacific Northwest; second, the design of catch share programs in US fisheries; and third, management of forage fish. These case studies suggest that science-policy intermediaries can help scientists make meaningful contributions to public discourse.

*Keywords: boundary organizations; usable science; scientific engagement; knowledge broker; science communication; decision-making.*

## 1. Introduction

Scientists often contend that public policy is disconnected from their research results. In response to this concern, some have advocated that research scientists become more skilled in discussing their findings with the public or become more policy-savvy (Bubela et al 2009; Nisbet and Scheufele 2009; Lubchenco 1998; Nisbet and Mooney 2007; Baron 2010; Leshner 2012; Smith et al., 2013; Carney 2014). By engaging directly in public discourse, the scientific community hopes to improve the chances that decision-makers adopt science-based policies. This approach rests on a perception that policy-makers are often uninformed about research findings, and that a better understanding of science would lead them to different decisions.

Such a view does not necessarily represent the policy process fairly. As others have already pointed out, when research findings are disregarded, it is not always because

decision-makers are uninformed (Nisbet and Scheufele 2009; Cash et al. 2006; Kahan 2010; Fischhoff 2007; Kahan et al. 2012; Lymn et al. 2010; Owens et al. 2006; Sarewitz 2004). Rather, decision-makers have to adjudicate between a wide range of interests, values, and perspectives—whether social, economic, or environmental—and determine which are most compelling in a given situation. If the politics surrounding an issue remain unsettled, science-based policy prescriptions may be infeasible or polarizing to a political debate (Fischhoff 2007; Sarewitz 2004; Stirling 2010). Even if the politics are not contentious, attention can fluctuate dramatically depending on what else is in the public eye. It is often a real challenge to navigate scientific findings into public discourse in the midst of so many other types of considerations.

Scientists have meaningful contributions to make to policy-making, but we believe they can make only so much progress on their own. Even those armed with

communications or policy training may not have the time, resources, networks, and expertise to identify and engage with interested parties, determine which research findings are salient for a particular policy deliberation, make their findings clear to a non-technical audience, monitor policy developments, and sustain these efforts for long enough to shape policy.

We suggest that a separate kind of expert—one who has the time and expertise to engage with both science and policy—can play a vital role at this interface that scientists themselves rarely can. This is the aspiration of science-policy intermediaries, or boundary organizations. These are enterprises and individuals that specialize in facilitating the complicated and erratic flow of information among scientists, policy-makers, and various stakeholders, while generally refraining from advocating for specific policy positions (Smith et al. 2013; Cash et al. 2003; 2006; Owens et al. 2006; Stirling 2010; Clark et al. 2011; Kirchhoff et al. 2013; Miller 1986; Guston et al. 2000; Cash 2001; Guston 2001; Miller 2001; Bocking 2004; McNie 2007; Pielke 2007; Buizer et al. 2010; Nesshöver et al. 2013; Meyer 2010; Cook et al. 2013; Pietri et al. 2011). In essence, they serve as brokers for scientific information (Pielke 2007; Meyer 2010). An intermediary enterprise likely includes individuals with a wide variety of expertise, including in science, grant-making, interdisciplinary work, policy analysis, facilitation, public engagement, and communications.

A variety of groups and individuals may engage in different aspects of intermediary work. These include government agencies, communications experts, non-profits, foundations, research institutes, and scientific professional societies. But so far limited attention has been paid to the distinctive role of science-policy intermediaries, making it difficult to understand the spectrum of work that they do, the time spent doing that work, or their impact (Smith et al. 2013; Cook et al. 2013; Pietri et al. 2011). Indeed, the type of work can be so varied that those involved in intermediary work are unlikely to fall within conventional expert roles or academic disciplines, and they generally lack peer communities.

This paper describes the science-policy intermediary work of the Lenfest Ocean Program. This grant-making program, with support from the Lenfest Foundation and managed by The Pew Charitable Trusts, has developed a model for intermediary work based on the concept of a full-spectrum, full-time boundary organization. The Program funds peer-reviewed scientific research on policy-relevant topics concerning the world's oceans and fisheries. In addition to traditional philanthropy, the Program commits significant resources to engaging and communicating with management bodies to connect its supported research results to decision-making about ocean ecosystems, without advocating for specific policy positions.

In this paper, we first describe the Lenfest Ocean Program model in greater depth and then provide three examples of its work. These case studies describe a variety of intermediary approaches, the energy invested in the efforts, and some successes that we believe are at least partly attributable to the efforts of a full-time intermediary organization. The progression of case studies also shows the difficulties we faced in measuring success and how we have worked to develop a more systematic approach for doing so. We hope that this detailed description can help to illustrate the depth, complexity, and extent of science-policy intermediary work and provide some insight into how to build upon these efforts.

## 2. The Lenfest Ocean Program's approach to science-policy intermediary work

The mission of the Lenfest Ocean Program is to support scientific research that is useful to decision-makers. The Program's approach can be divided into three components: first, to make grants motivated by questions facing the marine policy community; second, to craft targeted strategies to connect the supported research and relevant policies; and third, to evaluate and improve its work.

We begin our grant-making process with comprehensive background research into various marine policy and management deliberations to identify persistent challenges and emerging policy issues. Rather than soliciting proposals on a particular issue, we analyze trends in the scientific literature and consult with policy experts, scientists, resource managers, and others to develop policy-relevant research questions and identify scientists with the appropriate expertise to conduct the research. Once a grant is given, the scientists conduct the research, analyze the results, develop the conclusions, submit the findings to a peer-reviewed journal, and serve as the spokespeople for the findings.

When a project is underway, we spend considerable time monitoring policy developments and crafting a framework for engaging with relevant stakeholders. We revisit ongoing and emerging policy issues to find key audiences and opportunities by speaking directly with issue experts, such as those working within governments and environmental nongovernmental organizations (NGOs). We also attend policy briefings and scientific meetings, follow social media discussions, and read relevant scientific literature that helps to frame the issue. We collaborate with our grantees to develop communications and policy outreach approaches based on our assessment of the pressing policy issues and usefulness of different ways of engaging audiences. These approaches may include non-technical summaries of scientific reports or journal articles, information graphics or video to explain complex issues, efforts to engage print, broadcast, and social media to draw attention to scientific findings, or briefings at scientific or policy

meetings. All materials are reviewed by the grantees at regular intervals in the process. In each case, we focus the briefings and materials on the needs of the specific audience, whether a science advisory body, local resource manager, or international policy-maker.

Finally, we assess the impact of the research and our outreach efforts in policy deliberations. This is one of the most challenging parts of intermediary work. Policy does not change often or in short periods of time. Even if policy changes, it can be difficult to understand how intermediary work contributed to the change, because of the complexity of the policy-making process and the number of actors involved. Further, in the case of our work at the Lenfest Ocean Program, we are not advocating for particular policy positions, but rather that decision-makers use the research findings to inform their deliberations. We try to capture the various uses of the research by asking questions such as:

- Has the research addressed the appropriate policy question?
- Have the research findings and outreach products reached and engaged target audiences?
- Did the policy discussions include consideration of the research results?
- Do any policy changes appear to be based at least in part on the results?

We use a variety of approaches to answer these questions, including analyzing the extent and type of media coverage, finding credible anecdotes about the use of the research findings in policy deliberations, and conducting surveys of those who used the findings in some way.

### 3. Examples of the Program's science-policy intermediary work

The following examples of the Lenfest Ocean Program's science-policy intermediary efforts illustrate our approach. Each is a snapshot meant to highlight elements of a full-spectrum approach to connecting research and policy-making, and some of the challenges involved.

#### 3.1 Finding sustainable harvest solutions for bull kelp in the Pacific Northwest

One of our earliest projects played a key role in bull kelp management decisions in the US Pacific Northwest. Bull kelp is a large marine plant that grows in the coastal waters of Washington and Oregon. In 2006, commercial demand for kelp was increasing, but it was unclear how effectively bull kelp could replenish itself during widespread harvesting because so little was known about it. At the time, advocates in the region pressed for better information about bull kelp biology to help managers define options for sustainable removals. The Lenfest Ocean Program

supported a team of scientists to conduct an extensive review of the population biology, ecological importance, and harvest history of bull kelp to address this need.

During the project, we developed a strategy to engage with targeted decision-makers, in consultation with regional stakeholders and the scientists. The resulting report and peer-reviewed publications explaining bull kelp biology and potential responses to extraction were lengthy and highly technical (Springer et al. 2007, 2010). We therefore worked with the scientists to summarize the research in a way that would resonate with policy-makers (e.g. 'harvesting bull kelp results in an effect similar to cutting off a flower rather than mowing the lawn'). Because of the background research done at the grant-making stage, we were able to highlight the relevant message for resource managers: the conventional practice of cutting off the top few meters of bull kelp was problematic because the reproductive organs are on top of the plant. The research publications and our research summary did not advocate policy changes, instead explaining the biology of the species, the challenges in sustainably harvesting bull kelp, and the need for improved data collection (Springer et al. 2007, 2010). We also helped to draw regional attention to the findings with outreach to the media.

In this example, we used a relatively straightforward intermediary approach: we funded research to fill a knowledge gap and communicated the results. There was a relatively simple message from the research that was directly relevant to the deliberations about harvesting bull kelp. But we still devoted considerable efforts to translating complex results and ensuring that the decision-makers and stakeholders had the information they needed when they needed it, and in an easily accessible form.

Partly because of these efforts, we were able to attract attention from the media and advocates. The press covered the findings in Oregon and California, including with a prominent article in *The Oregonian* (Larson 2007). The report and summary were used by conservation groups in Oregon, including the Pacific Marine Conservation Council, who were actively supporting protective state regulations for kelp. Following efforts by a variety of advocates and resource managers, Oregon adopted an administrative moratorium on commercial kelp harvest in state waters in October 2008 (Oregon Department of State Lands 2008).

This example also showed that even when policy changes, it can still be difficult to understand why and how much intermediary work contributed to it. In this case, it was unclear how much the Program-supported research and policy outreach efforts led directly to the prohibition of commercial harvest. Attention to the project from the media and advocates suggested that the findings were a factor in the outcome, although years of work by advocacy groups on the issue had likely shifted management attitudes already. This early project spurred us to



think about how to systematically describe the effectiveness of our efforts to connect science and policy.

### 3.2 Informing catch share program design

In a subsequent project, the Lenfest Ocean Program's intermediary efforts contributed to longer-term management deliberations. In 2008, we supported a research project on catch shares, a fisheries management measure in which individual or groups of fishermen are allocated a percentage of the total catch. Management bodies have implemented catch shares in part because they are presumed to encourage ecological stewardship. This management approach has been controversial, however, largely because of concerns about how shares are allocated, whether the ecological benefits are significant, and the socioeconomic impacts if catch shares result in fishing fleet consolidation (Schrope 2010). Following an initial review of these issues, we supported several scientists to analyze whether catch share programs led to improved ecological conditions in US and international fisheries.

As the project developed, it became clear that it was not going to produce results that could be communicated simply. For example, the research did not show that catch share programs necessarily result in more fish. Instead, it showed that catch shares reduce year-to-year variation in mortality due to fishing (Essington 2010; Melnychuk et al. 2012; Essington et al. 2012). These results were also published at a time when there were extensive and diverse ongoing discussions among scientists, managers, fishermen, and NGOs about the benefits of catch shares, making it difficult to craft a singular or simple message (Schrope 2010). Thus, we spent significant time reviewing the background scientific literature and policy documents on catch shares and speaking with a variety of fisheries experts in order to understand how to connect this research to these complicated discussions.

In collaboration with the scientists, we decided to facilitate a direct dialogue between them and federal fisheries managers focused on catch shares in the USA. This would allow those managers to ask the kinds of detailed questions they needed to answer in order to use the research within the complex deliberations on catch shares. We organized several briefings at the National Marine Fisheries Service (NMFS) headquarters for federal managers and scientists to discuss the results and methodology with the lead researchers, as well as phone briefings for others working on catch shares issues. To prepare for these briefings, we created summaries of the research for an expert audience with a sophisticated knowledge of catch share programs, but without the time to read a series of highly technical scientific papers. These summaries focused on the methodology and some of the findings we perceived to be most relevant to the policy debate (see <http://www.lenfestocean.org/en/research-projects/quantifying-the-ecological-effects-of-dedicated-access-fisheries-programs>). We also

worked with the scientists to help prepare them for the briefings and to summarize their results as clearly and concisely as possible.

In this case there was no specific policy shift following our efforts to integrate the project's findings into deliberations on catch shares. Unlike the bull kelp example, there were no major news stories about the project, and little evidence the information was directly used in decision-making. But the intent of the research was to elaborate specific details of the ecological impacts of catch shares for an expert audience, not necessarily to suggest a different course of action. US federal policy on catch shares had been set by the time the research results were out and the nuanced findings of the project did not strongly support either proponents or critics of catch shares. The discussions about catch shares were also somewhat arcane, so the mainstream media were unlikely to take notice. Thus, in retrospect, it was not surprising that fisheries managers used the findings as background for their ongoing deliberations, or to reinforce existing policy directions, rather than to make dramatic changes in policy.

This project led us to contemplate metrics of success other than discrete policy changes, especially to capture the effectiveness of the facilitation role we found ourselves playing. For example, we noted that the briefings held at NMFS attracted key catch shares policy staff who asked detailed questions, suggesting that the target audience closely considered the research. Following this project, we also began to develop and implement a more comprehensive assessment framework (see Section 3.3) to try to capture relatively subtle uses of scientific research in sustained and politically contentious deliberations.

### 3.3 Developing options for forage fish management

In a final example, we addressed an emerging fisheries management challenge in one of our largest and most sustained projects to date. In 2008, the Lenfest Ocean Program identified the need for specific scientific guidance on ecosystem-based management of forage fish. Forage fish are species in the middle of the food web that generally feed on plankton and are often critical prey for predators such as seabirds, marine mammals, and larger fish (Pikitch et al. 2012, 2014). Forage fisheries represent the largest fisheries in the world, account for one-third of wild marine fish caught globally, and are worth US\$5.6 billion annually in direct catch (Pikitch et al. 2014; Alder 2008). Forage fisheries have collapsed in the past, sometimes catastrophically, in part because of the lack of management strategies that account for their natural fluctuations in abundance. It had become clear to many that the resilience of forage fish populations may have been overestimated and that their impact on other parts of the ecosystem, including predators with significant commercial value themselves, had been underestimated.

In this case, we supported researchers at Stony Brook University (NY state) to develop a global expert group, the Lenfest Forage Fish Task Force, to address ecosystem-based forage fish management. Although forage fish population dynamics and their ecosystem role had been the subject of previous research, there was still uncertainty about how to develop management strategies to account for these attributes. Growing commercial interest in their harvest meant that management strategies also needed to account for their economic value. Thus, we and researchers at Stony Brook decided that a broad-based, interdisciplinary effort was critical to develop a practical, comprehensive, and ecosystem-based management approach. The Task Force developed the specific research approach, which included reviewing existing information about forage fish biology and ecology throughout the world, quantifying the ecological and economic importance of forage fish, and developing predictive models about the outcomes of different management options.

At the time of the inception of the Task Force, forage fish management discussions were also generally in their early stages within the USA, in other countries, and at the international level. As the Task Force developed its findings, we developed a broad-based outreach strategy with Stony Brook University staff that could inform many of these deliberations. Because we had already become familiar with the scientific and policy context during the development of the Task Force, we were able to draw on this information and conversations with scientists, managers, and advocates to identify audiences who could use the Task Force's results and recommendations and strategies to engage them.

We developed a suite of policy outreach and communication materials and planned or contributed to numerous events that highlighted the Task Force's findings. These products and briefings required extensive translation, communication, and facilitation efforts. Our team summarized the Task Force's economic analysis, food web models, scientific findings, and management recommendations using written summaries, information graphics, and video. We also worked with Task Force members, a variety of resource managers, NGOs, and governments to initiate and organize numerous briefings targeting a wide variety of policy audiences throughout the world (see Table 1). Finally, we developed a comprehensive media plan to draw attention to the findings in specific areas around the world with concerns about forage fish management. Throughout the process, we collaborated closely with Task Force scientists to develop the products and events. We sustained these efforts well past the release of the report in April 2012 and the dissolution of the Task Force, in order to build on growing interest in forage fish science and management.

In this case, our intermediary efforts were successful in informing a variety of discussions and influencing some policy

changes. Task Force members were invited to speak at numerous scientific and policy meetings, media coverage was extensive (e.g. the Task Force report was listed as one of the top ocean stories of 2012 by *Smithsonian* magazine, <http://www.smithsonianmag.com/science-nature/the-ten-best-ocean-stories-of-2012-166826575/>), and other scientists cited the report in their own research. In 2013, the Sitka Tribe of Alaska used the Task Force findings as the basis for their request to the State of Alaska for a lower sac roe herring harvest level as an alternative to a moratorium on the fishery, if a moratorium was not possible (Wilson 2013). In 2013, the Heiltsuk First Nation of British Columbia also requested that the Department of Fisheries and Oceans in Canada apply specific Task Force recommendations to herring management in British Columbia (Gladstone Reconciliation Society 2013), citing those recommendations as a basis for their request. In November 2012, following sustained efforts by advocates to encourage sustainable forage fish management, the California Fish and Game Commission adopted provisions that reflected two of the main recommendations of the Task Force: first, incorporate the value of forage fish as prey into management plans; and second, prevent new fisheries on previously unfished forage fish populations until managers account for the needs of dependent predators (Pikitch et al. 2012; California Fish and Game Commission 2012).

Despite these apparent impacts, we felt, based on difficulty measuring success in past projects, that we needed more detailed information about the effectiveness of our intermediary efforts. We therefore undertook a formal retrospective assessment of the project. This effort focused specifically on US forage fish management efforts in order to create a feasible scope of work. This external assessment measured the use and policy relevance of Task Force materials and briefings, including the report itself, outreach materials we produced, and engagement approaches. The assessment involved over 100 interviews of 12 different stakeholder groups involved in forage fish issues or the report, including US fisheries managers, NGOs, Task Force members, and our staff (Latchford and Fox 2014).

The assessment helped us understand, at least in part, how and why the report findings may have been used so extensively by decision-makers and advocates. For example, the survey suggested that the report findings generally covered key issues for forage fish management in the USA and that the summary materials we produced were perceived as accurate and helpful for understanding the Task Force report. However, although the Task Force deliberately took a broad approach to address as many potential management issues in as many geographic areas as possible, the surveys also suggested that the Task Force's recommendations were not detailed enough for some fisheries in the USA. Some respondents also felt that the report could have had more impact had it been published in a peer-reviewed journal. We facilitated a peer-review

**Table 1.** Examples of science-policy intermediary efforts for Lenfest Forage Fish Task Force undertaken or facilitated by Lenfest Ocean Program staff and Task Force members

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A 12-page summary of Task Force report written in non-technical language and making extensive use of informational graphics (2012)
Five regional and issue-specific fact sheets (2012)
A launch event in Washington, DC at which several Task Force members presented their results to a group of stakeholders, including scientists, managers, decision-makers, fishermen, and environmental groups (2012)
Video explaining Task Force results (2012)
Media outreach, including press releases targeted to different countries and a video for television outlets (2012)
A briefing for staff within National Marine Fisheries Service (federal agency charged with managing US fish species) (2012)
Task Force presentations to European Commission leadership in Brussels, Belgium to inform reform of EU's collective fisheries management policy (Common Fisheries Policy) (2012)
Task Force presentations to Cooking For Solutions conference in Monterey, CA (2012)
Task Force presentations to omega-3 (fish oil) business convention (GOED Exchange) in Boston, MA (2012)
Task Force participation in a forage fish workshop convened by Mid-Atlantic Fishery Management Council (2012)
Task Force chair presentations to Northeast Fisheries Science Center, which provides scientific guidance to US fisheries managers (2012)
Task Force presentations to Commission for the Conservation of Antarctic Marine Living Resources, which manages krill fisheries in the Antarctic, ( <a href="https://www.ccamlr.org/en/fisheries/krill-fisheries">https://www.ccamlr.org/en/fisheries/krill-fisheries</a> accessed 26 Feb 2015) (2012)
Task Force presentations to International Whaling Commission, Korea (2012)
Task Force presentations to World Fisheries Congress, Scotland (2012)
Task Force presentations at an event on forage fish in Lima, Peru, organized by Lenfest Ocean Program staff. Peruvian government officials, industry representatives, and other stakeholders within Peru participated (2012)
Task Force presentations at International Council for the Exploration of the Seas forage fish panel in Nantes, France (2012)
Task Force Chair (Dr. Ellen Pikitch) keynote presentation at 'Forage Fish Science Panel' at International Game Fish Association Museum in Ft. Lauderdale, FL (2013)
Task Force presentations to Irish Parliament and Irish NGOs (2013)
Task Force Chair testimony about the Task Force findings for US House of Representatives Natural Resource Committee (2014)
Task Force presentations to Hakai Network Herring School in Canada (2014)

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process for the report itself, but the Task Force did not wait for individual chapters to be published in peer-reviewed journals. Instead, it issued the report quickly to inform the rapidly emerging policy discussions.

Although the survey findings did not provide a complete explanation of why audiences used the information or why policy changed, they helped us adjust our approach for future projects. We now hold discussions much earlier in the project process about how to engage with stakeholders, trade-offs between specificity and broad applicability, and the merits of releasing research before it appears in a peer-reviewed journal. We now recognize how crucial these considerations are, especially for emerging resource management issues.

## 4. Science-policy intermediary work

### 4.1 Importance of full-spectrum and full-time

Prevailing scholarship for scientists interested in influencing public policy encourages them to ensure that their results are clear, relevant, timely, credible, and sensitive to stakeholder needs and perspectives (Cash et al. 2003). Scientists are advised to be better communicators, to be more policy literate, and to ensure that their research is 'actionable' and 'usable' by engaging more with stakeholders, listening better, and co-producing knowledge with those stakeholders (Kirchhoff et al. 2013; Gibbons 1999; Clark and Dickson 2003; Lach et al. 2003; Robertson and Hull 2003; Lemos and Morehouse 2005; Lundquist and Granek 2005; Reed 2008; van der Sanden and Meijman

2008; Palmer 2012; Dicks 2013). Indeed, all of these approaches may ultimately help provide managers and policy-makers with more usable and relevant research and refine their range of policy options.

But these strategies alone are not necessarily sufficient to ensure that science and policy integration occurs, and they present quite a workload. As we have suggested through the examples in this paper, the efforts required in the enterprise of connecting science and policy can often exceed the skill sets or time constraints of individual scientists. Even if a research project has considered stakeholder needs in its design and has relatively simple messages, intermediary work can go well beyond the scope of the project itself. For example, it may require evaluating the degree of political controversy about an issue, assessing who is involved in a policy deliberation, prioritizing scientific findings and messages relevant for specific policy deliberations, and engaging relevant parties over extended periods of time. It can include preparing clear and accurate summary materials of the findings for a range of audiences, situating the research findings in the context of ongoing or emerging policy deliberations and scientific scholarship, and accounting for the ability of different audiences to understand technical information (Stirling 2010; van Densen and McCay 2007; Friel et al. 2001). It also requires choosing among and capably using the proliferating and diverse communication options now available (Bubela et al. 2009).

The Lenfest Ocean Program undertakes many of these tasks in its work. We invest significant resources, time, and



**Table 2.** Examples of skill sets within a science-policy intermediary team

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Knowledge of a particular scientific field to identify key issues, appropriate research design, and researchers.
Strategic grant-making capability to identify and guide effective projects.
Analytical skills to critically appraise evidence and synthesize multiple lines of research.
Writing skills to translate scientific findings into key actionable messages for a wide variety of audiences.
Creative design skills to develop information graphics that explain complex research results.
Policy expertise related to pertinent laws, regulations, and administrative agencies to identify information needs for policy-makers and situate findings in the relevant policy context.
Knowledge of social science theory related to decision-making and impact assessment to guide outreach and evaluation efforts.
Communication expertise to identify appropriate communication approaches, including mass media and social media.
Integrative capacity, or specialized generalists who can identify opportunities to connect science and policy and coordinate an overall science-policy outreach strategy.

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expertise into connecting science and policy, using strategic grant-making, policy analysis, communications, and assessment skills (see Table 2). Our team has at least two staff with scientific and policy backgrounds identifying and funding policy-relevant scientific projects and five staff members with a combination of scientific, communications, or policy expertise devoted at least part-time to the Lenfest Ocean Program's science-policy outreach efforts. Moreover, we work together to ensure that each component (e.g. grant-making and policy outreach) is coordinated with the others.

#### 4.2 Assessing impact

Although we have tried to make the case for the contributions that a science-policy intermediary can make, it is a considerable challenge to measure the impact of such efforts (Miller 2001; Toman et al. 2004; Meyer 2011). The complexity of the policy process makes it difficult to track changes consistently over time and demonstrate which interventions influenced deliberations and final outcomes (McNie 2007; Weiss 1982; Sarewitz and Pielke 2007; Sarewitz 1996). Nor can an intermediary rely solely on academic impact to indicate effectiveness. Similarly, it can be difficult to tease out the added value of policy outreach efforts above and beyond the publication of the research findings.

Science-policy intermediaries are not unique in this struggle. Explaining impact is challenging for any effort to connect science and policy, whether by an individual scientist, a university communications officer, an extension agent, or an advocate. Nevertheless, the full-spectrum work of science-policy intermediaries puts them in a unique position to evaluate the impact of research results on policy issues. Science-policy intermediaries are likely to be involved in multiple integration efforts either simultaneously or over time, so they can apply what they learn about what works in one project to concurrent or future projects. If science-policy intermediaries wish to promote their utility, it may be worthwhile for them to consider flexible frameworks that can be used to assess the impact

of their efforts throughout the policy-making process, beyond traditional measures used by academics or advocates.

#### 5. Conclusions

As we have described in this paper, efforts by science-policy intermediaries to facilitate the uptake of scientific research into policy deliberations can often be a full-time enterprise. By centralizing the various aspects of these efforts, intermediaries allow scientists to participate in policy efforts without taking too much time or energy away from their primary research activities. Moreover, intermediaries can make scientists' participation more effective by facilitating engagement opportunities and employing communications strategies to convey research results. Thus, an intermediary should be viewed not as a competitor to the scientist with a strong interest in shaping public policy, but as a potential collaborator who can leverage the scientist's expertise to make meaningful contributions to public discourse.

Our discussion is not intended to discourage research scientists from becoming more involved in connecting science and policy. A scientist who can explain his or her research succinctly and clearly to a targeted audience, and who appreciates the dynamics of policy-making, can make invaluable contributions to science-policy intermediary efforts. Individual scientists can take advantage of a wide variety of communications training and policy exposure opportunities, including communications guidebooks and trainings and policy fellowships, or work with professional society public affairs programs, university public affairs specialists, and specialist science communications professionals (e.g. COMPASS or the Leopold Leadership Program) (Smith et al. 2013; Blockstein 2002; Kinchy and Kleinman 2003; Gold 2001; Alberts 2008; Basken 2009; Miller et al. 2009). And certainly there is a promising movement within some universities to encourage multidisciplinary and stakeholder-based efforts to connect science and policy (Hart et al. 2015). We urge,

however, that any of these efforts be undertaken with a great deal of pragmatism about the extent to which a full-time researcher can dedicate time and effort as well as develop non-science expertise to navigate the policy process.

There remains much to learn about intermediary approaches to connecting science and policy (Eden et al. 2006; van Kerkhoff and Lebel 2006; McGreavy et al. 2013; Kelly et al. 2014). The Lenfest Ocean Program model is certainly not the only feasible option. The challenge of integrating scientific considerations into the policy-making process, however, makes it apparent that this work often requires a degree of attention that is not easily reconciled with a scientist's full-time research agenda. Science-policy intermediaries devote their complete attention to forging a more dynamic relationship between scientific research and public deliberation. To scientists, who greatly value specific expertise, it should not be surprising that connecting science and policy is not a part-time, 'do it yourself' enterprise, but instead benefits from the skills and experience of practitioners who are immersed in the process.

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## Notes

1. Among other things, the Task Force recommended that fishing for forage fish should generally be half of 'maximum sustainable yield', a level often used as an upper limit in fisheries management, and that management should account for the needs of predators <<http://www.lenfestocean.org/en/research-projects/lenfest-forage-fish-task-force>> accessed 03 Feb 2015.

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