Communicating with the public: opportunities and rewards for individual ecologists

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Many ecologists are interested in communicating science to the public and addressing societal concerns about environmental issues. Individual ecologists need to consider whether, when, and how this should be done. We propose that public outreach activities can be beneficial for ecologists at all stages of their career. There are diverse opportunities for such involvement, and these can vary enormously in terms of time and expertise required. Trends within the science of ecology, especially research focused on social–ecological systems, are likely to promote increased interactions with stakeholders and policy makers. To be effective in these interactions, ecologists should consider new approaches to communication and be aware of the potential roles scientists can play in public policy debates. Professional ecologists need to engage with non-scientific audiences; a review of such activities should be included in considerations for promotion, recognition, and awards, while also acknowledging variations in the inclinations and abilities of individual scientists. There are, however, few current standards for how much time ecologists should commit to public outreach, how time allocation might change over a career, or how to evaluate the quality of such activities. We ask ecologists to consider ways to evaluate the quality of interactions with the public and how to reward these efforts appropriately.

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Ecologists face important decisions about whether and how to engage members of the public on issues related to ecology and the environment. Many ecologists now consider communication of science to the public and policy makers as an important aspect of their careers, in part as a result of the historical involvement of scientists in promoting science in decision making, but also because of increasingly rapid environmental change and a perceived need to improve public understanding of science. Evidence for this increased interest among ecologists and environmental scientists comes from a variety of sources. Beginning perhaps most prominently with, and continuing after the publication of, the "sustainable biosphere initiative" by Lubchenco *et al.* (1991), professional organizations have emphasized the importance of public education and communication (eg Christensen *et al.* 1996; Committee to Consider the Future of ASLO 1997; Palmer *et al.* 2005; Grove 2009). Similarly, professional societies have produced tools that promote public outreach (eg The Oceanography Society 2006; Harrison *et al.* 2009). Many ecologists have also argued that remedies for environmental problems are urgently needed and that these remedies will involve more integrated participation by environmental scientists (Vitousek 1994; Lubchenco 1998; Power and Chapin 2010). In addition to calls for involvement from scientists and scientific societies, funding agencies have placed increasing importance on public outreach in the evaluation of grant proposals. For example, in the US, the National Science Foundation (NSF) established a "broader impacts" criterion in 1997 as part of its merit review process (Holbrook 2005). Similar criteria were introduced by granting agencies in the European Union and elsewhere around the world (McNie 2007). Finally, there appears to be an ongoing and perhaps more urgent request from politicians, policy makers, environmental managers, and non-governmental organizations (NGOs) for ecologists to become more closely involved in the

In a nutshell:

- Ecologists seek to respond to environmental problems in ways that extend beyond research and teaching, but they must first determine how to communicate effectively with non-scientific audiences
- Public outreach can range from short-term, focused activities to long-term, comprehensive initiatives involving both personal and group efforts
- Individual ecologists and their institutions should recognize public outreach as an appropriate and important professional endeavor, and these efforts should be considered in merit evaluations

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search for solutions to major environmental problems (McNie 2007; Samarasekera 2009; Penders *et al.* 2010). This emphasis on scientific engagement with policy makers and the general public has also been accompanied by a recognition that there may be a mismatch between the information that policy makers require and that which scientists currently supply (Bradshaw and Borchers 2000; Sarewitz and Pielke 2007). Furthermore, there is tension about the expected role of scientists in public debate (Sarewitz 2004) and concern that scientists may misunderstand the nature of their interactions with policy makers (see below and Pielke 2007).

Collectively, these various forces promoting ecologists' increased involvement raise questions about how they should engage with the public. In this paper, we consider issues related to public engagement for individual ecologists – across career stages (from graduate student to senior scientist), levels of expertise, and professional affiliations, including academia, government agencies, private research institutions, consulting firms, and NGOs. We use the term "engagement" to signify a broad range of public education and policy-oriented activities as they intersect with environmental issues. We also recognize that many public engagement efforts involve – and indeed may be most effective as – group activities. Nevertheless, individual ecologists ultimately make decisions about whether, when, how, and to what extent to become involved with public outreach, and must reflect on the associated costs and benefits, personally and professionally, before becoming involved. Finally, although these decisions remain an individual choice, we suggest that professional ecologists should collectively evaluate the quality of public engagement activities, as well as supporting and rewarding those who decide to become involved.

Issues related to public outreach

Ecologists have tried to inform the public and influence policy for a long time. For example, in 1946, ecologists interested in preserving natural areas were instrumental in creating The Ecologists Union, which became The Nature Conservancy in 1950 (Brewer 2003). More recently, discoveries brought to public attention by ecologists have motivated society to address numerous problems (eg NRC 1986; Pace and Groffman 1998). Specific examples include pesticide impacts (Woodwell 1967), acid deposition (Likens 1992), and the excessive enrichment of freshwater ecosystems as a result of nutrient inputs (Smith 1998). In these cases, as in many others, ecologists raised the initial alarm and action ensued, although often with considerable difficulty and delay (Likens 1992).

Two developing features of contemporary ecological and environmental research strongly influence how ecologists conduct their work and interact with those who fund and use the knowledge obtained from their research. First, such research is increasingly focused on places where people live (eg McDonnell and Pickett 1993; Grimm *et al.* 2000), partly because of ever-increasing domination of land and resources by human activities (MA 2005). Gradually, the place of humans within ecological systems is becoming more clearly articulated, as ecologists develop a better understanding of the multiple interactions within social–ecological systems. Although operating as scientists through collecting data, assessing evidence, and developing syntheses of findings, ecologists are also increasingly being asked to communicate their specialized knowledge to society and to explain the benefits of their research, particularly the amelioration of environmental problems (eg Kaiser 2000). Second, ongoing efforts are being made to integrate ecology with other disciplines; this trend toward interdisciplinary approaches is a hallmark and an important goal among many ecologists (Likens 1992). Interdisciplinary research facilitates direct communication and collaboration between scientists. If the challenges of interdisciplinary communication can be overcome (Kinzig 2001; MacMynowski 2007), such collaborations may facilitate further integration of ecological science into the policy and stakeholder communities. For example, "ecosystem stewardship" (Chapin *et al.* 2010) has recently been promoted as an interdisciplinary social–ecological framework that focuses on sustaining ecosystem services through building adaptive capacity and resilience. Adaptive capacity and resilience are responses in social–ecological systems that limit undesirable changes that might result from disturbances (eg storms) or directional environmental change (eg climate warming) (Chapin *et al.* 2010). Ecosystem stewardship necessarily involves continuous interaction with stakeholders, as well as ongoing reassessment and engagement in the policy process.

Ecologists who enter the policy arena – through direct interactions with policy makers (eg Figure 1) – should understand that the relationship between science and policy can be highly context dependent, and is not simply about transmitting scientific knowledge in the hope of improving policy decisions (Jasanoff 1990). Ecologists should be aware of how their role differs in cases where social values, politics, and policy are aligned versus those where they are divergent (Pielke 2007). For example, there is broad social agreement on the value of preserving life and property during severe storms. Better forecasts of storms, based on scientific advances, can therefore improve policies and decision making. Here, the individual scientist can act – in the manner of Pielke's (2007) idealized description – as a "pure scientist", who simply provides knowledge or, alternatively, as a "science arbiter", who serves as an advisor in developing policy. In situations with disagreement over values and politics, the role of the scientist differs from cases where values are aligned. When differences in values and politics are contributing to disagreements, scientists may decide to promote a particular policy choice and act as "issue advocates", who argue for reducing the scope of choices toward one preference or a small set of related preferences

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Figure 1. *Michael Dombeck of the University of Wisconsin, Stevens Point, WI, testifies to a committee of the US House of Representatives.*

(Pielke 2007). Scientists acting as issue advocates should clearly state that they are taking a position (Gregory and Miller 1998). Alternatively, scientists may be able to expand the number of available choices by serving as "honest brokers", an appropriate approach for issues characterized by high scientific uncertainty and where there is often a lack of consensus among stakeholders (Pielke 2007). The research strategy for ecosystem stewardship (see above) proposed by Chapin *et al.* (2010) reflects this latter position, given that the goals are to (1) sustain or increase biological diversity to assure potential for adaptability, (2) reduce vulnerability, (3) enhance resilience, and (4) promote transformation toward desirable trajectories and away from undesirable conditions (Chapin *et al.* 2010). Ecosystem stewardship seeks to promote or maintain alternatives and thereby expand possibilities and choices for sustaining ecosystem services in the face of possible rapid environmental change.

The common denominator of public outreach activities is communication. There are many sources of guidance for ecologists about how to communicate effectively in different forums (eg Hays and Grossman 2006; Hobbs 2006; Pouyat 2007). All of these emphasize training in communication skills to improve outcomes of public outreach. Ideally, the ecologist's efforts should be tailored to the audience's backgrounds, interests, and ability to assimilate information (Groffman *et al.* 2010). Furthermore, ecologists should be familiar with findings in the field of science communication, which indicate that many forms of communication are ineffective and that values and experience strongly influence how well information is understood and assimilated (Weber and Ward 2001; Einsiedel 2008; Nisbet 2009). Ecologists should therefore consider how to engage with the public through dialogue (Figure 2), with the attendant benefit of learning from an interactive and open discourse (Gregory and Miller 1998; Weber and Ward 2001; Groffman *et al.* 2010). The ecosystem stewardship concept once again serves as an example, because this approach explicitly includes continued interaction with stakeholders (Chapin *et al.* 2010).

Opportunities for dialogue

Scientists have many opportunities to participate in public dialogue. This may be as simple as writing a letter to a local newspaper or as complex as leading an international committee in the assessment of a major environmental issue; WebTable 1 lists various activities and approaches that illustrate how different individuals can use their specific talents to communicate with different groups. Scientists can undertake a range of activities, irrespective of career stage, and although there is considerable variation in the effort required, this can often be quite modest. For example, all professional ecologists can give talks to, or attend meetings of, school groups, the general public, and stakeholders. Other activities, such as working with management agencies, require a more sustained effort and are best undertaken by those capable of making a commitment to build the necessary relationships and trust that improve the chances of success.

Although many communication initiatives require only moderate effort on the part of ecologists (WebTable 1), here we highlight three cases where sustained inputs are essential. First, many graduate students in the US are currently engaged in outreach with elementary- and secondary-schools, through programs funded by the NSF. In these programs, graduate students work with elementary- and secondary-school students and teachers, stimulating their interest in scientific research, particularly with respect to local environments. In a program sponsored by the University of Hawaii, for instance, collaborations between graduate students and elementary- and secondary-school teachers have led to schoolchildren becoming involved in a range of research activities, from conducting field studies in native forests to monitoring and evaluating stream health, to tracking hammerhead shark (*Sphyrna lewini*) pups across a coral reef. In these programs, the elementary- and secondary-school students have made notable scientific contributions, such as documenting the spread of invasive ants, while the graduate students improved their teaching and communication skills.

The second example of sustained input comes from the publication of children's storybooks by scientists within the NSF's Long Term Ecological Research (LTER) Network. These books take several years to produce and

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require a substantial commitment from participants (see McKnight 2010). An important feature of this project is the development of a story that engages young readers, while also accurately representing the underlying science. This outreach initiative emphasizes the connection between ecologists and local communities, in which the LTER site can serve as a "schoolyard" for exploring and understanding ecology.

A third example relates to the interface between ecological science and public policy. When an environmental controversy reaches a critical stage in the decision-making process, ecologists who are involved in the issue may find the situation all-consuming (Likens 2010). However, effective communication of high-quality scientific results and syntheses is crucial in this kind of sustained and frequently intense type of activity (Cullen 1990; Bucchi and Trench 2008).


G Combes

Figure 2. *Anne Salomon of Simon Fraser University discusses prehistoric clam gardens with Les Adams, an Elder of the Sliammon First Nation in Desolation Sound, British Columbia. Salomon learns about traditional management from Adams and others and integrates this knowledge into research and current management approaches.*

These three cases provide several general lessons. First, an ecologist's most important communication efforts will generally derive from longer-term work. Second, the integrity of the effort must be high; whether the initiative involves producing a storybook or presenting science relevant to air pollution regulation, both the information and its presentation must be of high quality to maximize the impact of the message. Finally, there are also ethical considerations; when scientists speak on issues of public concern, they have an obligation to portray the science accurately, regardless of the target audience, be they children or policy makers. By "accurately" we mean that when communicating with public audiences, scientists must strive to maintain the quality of the scientific information and avoid oversimplifying or otherwise distorting it. An exploration of the ethical dimensions of public outreach is beyond the scope of this paper, but is an important consideration (Ladle *et al.* 2005).

Our focus on these longer-term engagements is not intended to diminish the importance of the many other, less demanding and time-consuming activities in which ecologists can become involved. Engagement efforts can begin in graduate school (or earlier), either in the context of formal programs or through informal efforts. Messinger and Schuette (2009) and Salguero-Gomez *et al.* (2009) summarize various engagement activities that graduate students can pursue, including volunteering for environmental organizations; working with artists, community groups, and science education programs; judging science fairs; tutoring; and incorporating volunteers into fieldwork.

How much time should individuals allot to such activities? Holdren (2008) has argued that scientists should set aside a "tithe" – a voluntary one-tenth portion of their professional effort – to public outreach. He notes, "If so much as a substantial fraction of the world's scientists and engineers resolved to do this much [a tithe], the acceleration of progress toward sustainable well-being for all of Earth's inhabitants would surprise us all". His comments imply that 10% effort is relatively high compared with current activity. We are not aware of estimates regarding how much time, on average, ecologists currently devote to such activities, so the question of allocation of time is unresolved. We are not advocating a specific allocation, because we believe that any such strategy will vary with opportunity, interest, career stage, and job requirements; we are, however, advocating that the issue should be considered at both individual and institutional levels.

Rewards – personal and professional

When contemplating whether to become involved in public outreach, scientists should consider the advantages and disadvantages associated with direct involvement with the public, in the policy-making process, and with the media. Potential rewards are diverse and may accrue over both short and long time scales (as described below). Examples include opportunities to improve communication skills and increase learning and exposure to new ideas – interactions that may facilitate one's research – as well as potential recognition from colleagues and from the public. There are also risks associated with engagement, including less available time to devote to other professional activities. In this context, Burchell *et al.* (2009) investigated British biologists and uncovered both a positive view toward public engagement and a concern about the difficulty of integrating such activities into already highly demanding jobs. Additional drawbacks include loss of personal time, possible lack of support or approval from colleagues, possible attacks by interest

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Figure 3. *Richard Ostfeld of the Cary Institute of Ecosystem Studies, Millbrook, NY, demonstrates field methods used in disease ecology studies to Congressman Patrick Murphy of New York.*

groups, the possibility that such efforts may fail, and even the potential loss of one's job. Here, we emphasize the rewards (rather than the risks) that may result from participating in outreach activities, and discuss the process of judging the quality of public engagement work and providing appropriate benefits and incentives.

A scientist may choose to become involved with public outreach to fulfill institutional expectations, to perform other aspects of his or her job more effectively, and to learn. If such activities are part of the job, then evaluation of this aspect will be an essential part of job performance reviews; but for many ecologists, this is not the case and is not part of the work for which they are reviewed and potentially compensated. Moreover, not all ecologists should seek involvement in public outreach, either because they lack the required skills or because they may have ethical reasons not to. Nevertheless, there are many potential benefits that may enhance performance in other aspects of an individual's job. Such activities can improve teaching abilities by providing "real world" examples of ecological principles in action (eg field trips with NGO staff and volunteers performing habitat restoration work) and may encourage learning through interactions (such as discussion and constructive argument) with the public. Similarly, public engagement may enhance research by revealing new applications for one's current research, stimulating new ideas for future investigations, or obtaining logistical help from non-scientists. It may also promote job fulfillment, an effect that should not be underrated in terms of contributing to improved job performance.

Broadening public awareness of one's research (eg through news stories in the media) can also attract the attention of potential funders, including private donors and foundations. Likewise, interacting with representatives from natural resource management agencies could open agency channels for funding that would otherwise be unavailable. Public outreach activities raise a scientist's profile, as well as that of his or her institution, among a broader community, helping to attract students and to facilitate networking.

Furthermore, a public audience that is effectively engaged tends to view ecology and ecologists as more approachable and relevant. Just as increasing one's skill in communicating ecological science occurs through repeat performances, additional interactions with ecologists increase the public's capacity for understanding complex ecological topics. In the "public engagement model" of science (Nisbet *et al.* 2002; Groffman *et al.* 2010), researchers have found that interactions with scientists build trust and awareness, even when it is not apparent that the public understands the principles that the scientists are explaining. Interestingly, while scientists sometimes raise concerns about losing credibility by becoming involved in public outreach, effective communication seems to increase the general public's estimation of a scientist's credibility (Lach *et al.* 2003).

Difficult issues, including those related to the environment, often require a long time to resolve (eg Likens 2010), and the costs to an individual ecologist may accrue without apparent benefit until society is ready for policy makers to move forward and to use the available science to initiate new policies. For particularly complex problems, the process is likely to include continuous interaction with stakeholders, ongoing scientific research, and repeated modification of policy as new information on the effects of policy are acquired (Figure 3). Researchers prepared to take part responsibly in this extremely important activity have the potential not only to promote positive change, but also to increase public awareness of the relevance of ecology and environmental science. These broader effects should also increase support for ecology as a whole.

How can ecologists be properly compensated for these activities? Currently in academia, most departments do not have clear standards or established means to evaluate public outreach initiatives by ecologists. In other areas – as in some government agencies – such initiatives are clearly integrated into both the mission and individual evaluations (eg US Department of Agriculture Forest Service researchers). As a result, blanket recommendations cannot be provided here. Nevertheless, we argue

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that, for those who choose to become involved, such efforts should be evaluated and rewarded. We acknowledge that implementation of our specific recommendations may ultimately require institutional and other types of changes. First, public outreach should be part of standard performance evaluations and should be reviewed regularly when it is an expected or desired element within the job description. For many positions, engagement falls within what is often termed "service", but public engagement – as we use the term here – is distinct from professional (eg peer review) and institutional (eg organization committee work) service and should therefore be evaluated separately. Second, including such activities in performance reviews provides a means of evaluating quality. For example, ecologists should be encouraged to document the effectiveness of their communication efforts and to explain the relationship between these efforts and their research. External reviewers should be provided with examples of products (eg written materials) and narratives that summarize the ecologist's efforts. Reviewers should be invited to comment on their perception of the effectiveness of the work. Finally, firmly connecting "successful" outreach activities with possible career advancement and salary increases would focus attention on this aspect of performance, where this is an agreed objective for the individual and the institution. Our profession needs to consider and discuss ways of evaluating and rewarding outreach activities, in much the same way as academia currently evaluates research or teaching. Making this transition may require altering our outlook and professional culture.

Conclusions

Public outreach is an opportunity available to all ecologists. Although there are certainly valid personal reasons to limit one's involvement in such activities, the two main drivers for ecologists that we discuss here – the need to contribute and participate in the public debate over environmental issues and the personal fulfillment (and competency) gained by doing so – should compel us forward. The demand for ecologists to engage in outreach, by informing policy and educating the public, will likely increase over time. Determining how to become involved effectively and how to allocate time to these endeavors will be key concerns for individual ecologists. Developing the means for evaluating and rewarding public outreach as part of a scientific career should also be discussed and clarified.

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