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COMMENTARY

A vision for an expanded role of ornithological societies in conservation

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ABSTRACT

Professional societies of biologists, including ornithological societies, have struggled to determine the appropriate way to apply the expertise of their memberships in conservation, largely because of a tension between issue advocacy and pure science. Within societies, some argue for using science to promote conservation, and others worry that such advocacy will render the science less credible in the eyes of decisionmakers. This debate excludes other important applications of science in conservation. We outline a vision for an expanded role of ornithological societies in avian conservation that includes pure science and emphasizes one of these other applications, science arbitration. Science arbitration involves evaluating the science relevant to an issue and providing the results to decisionmakers without taking a position on the outcome. We perceive a great need for science arbitration as judges, politicians, and other decisionmakers typically lack access to current, relevant scientific information in an objective form and as a result must act as their own arbiters despite a lack of appropriate expertise. The ornithological societies are in a unique position to fill this void in the area of avian conservation. We describe an additional role in which the societies may also wish to engage, Honest Broker, which is similar to Science Arbiter but also includes development of policy alternatives based on the science evaluated. We provide examples of the kinds of activities in which we envision the societies engaging, and outline a process for approaching science arbitration as the scholarly activity it should be.

Keywords: advocacy, decisionmaking, Honest Broker, policy, review panel, Science Arbiter

Visión de un rol expandido de las sociedades ornitológicas en conservación

RESUMEN

Las sociedades profesionales de biólogos, incluyendo las sociedades ornitológicas, han luchado para determinar el modo apropiado de aplicar la experiencia de sus miembros en conservación, principalmente debido a una tensión entre incidencia política y ciencia pura. Al interior de las sociedades, algunos argumentan usar la ciencia para promover la conservación y otros se preocupan de que dicha incidencia haga que la ciencia sea menos creíble a los ojos de los tomadores de decisiones. Este debate excluye otras aplicaciones importantes de la ciencia en conservación. Presentamos la visión de un rol expandido de las sociedades ornitológicas en la conservación de las aves que incluye ciencia pura y enfatiza una de estas otras aplicaciones, el arbitraje científico. El arbitraje científico incluye la evaluación de la ciencia relevante para un tema y brinda los resultados a los tomadores de decisiones sin tomar una posición sobre lo que se concluya. Percibimos una gran necesidad de arbitraje científico ya que jueces, políticos y otros tomadores de decisiones típicamente no tienen acceso a información científica actual y relevante de una forma objetiva, y como resultado deben actuar como sus propios árbitros a pesar de la falta de pericia apropiada. Las sociedades ornitológicas están en una posición única para llenar este vacío en el área de la conservación de aves. Describimos un rol adicional en el cual las sociedades también pueden desear involucrarse, el de Agente Corredor Honesto, el cual es similar al de Arbitro Científico pero también incluye el desarrollo de políticas alternativas basadas en la ciencia evaluada. Brindamos ejemplos de este tipo de actividades en las cuales visualizamos que podrían involucrarse las sociedades y bosquejamos un proceso para abordar el arbitraje científico como la actividad académica que debería ser.

Palabras clave: Agente Corredor Honesto, Árbitro Científico, incidencia política, panel de revisores, toma de decisiones

INTRODUCTION

Professional societies of biologists struggle with their role in conservation. Because of their understanding of the science that relates to issues in conservation, members of these societies have expertise that is directly relevant to policy decisions. As biodiversity decreases and global change increasingly threatens the biodiversity that remains, calls for action are aimed directly at these societies and their members (Czech 2007, Nelson and Vucetich 2009, Arlettaz et al. 2010, Scott and Rachlow 2011). Although most members have a keen interest in conservation of the species and ecosystems they study, they differ in their views concerning the scope of conservation activities that are appropriate for scientists and their professional societies to undertake (Barry and Oelschlaeger 1996, Noss 1996, McCoy 1996, Rykiel 2001, Robertson and Hull 2001, Murphy and Noon 2007, Lackey 2007, Scott et al. 2007, Wilhere 2008, Nelson and Vucetich 2009, Scott and Rachlow 2011, Parsons 2013). This lack of consensus has constrained the abilities of these societies to contribute to conservation in meaningful ways, and has generated conflicts among members within societies (e.g., Hagan 1995, Johnson 2006).

Recent discussions of the future of ornithological societies in North America reignited the debate about the appropriate role of scientific societies in conservation within the ornithological community. Among the topics considered was an expansion of involvement in conservation, a role to which many society members objected. In this paper we outline a vision for an expanded role of ornithological societies in avian conservation and argue that this vision is consistent with the views of those on both sides of this recent debate.

To present our argument we find it useful to employ the terms of Pielke (2007). Pielke presents four idealized, possible roles of science and scientists in decisionmaking: Pure Scientist, Issue Advocate, Science Arbiter, and Honest Broker of Policy Alternatives. These categories primarily have been used in reference to the roles and activities of individual scientists rather than of their professional societies. However, they can be applied validly to the roles of scientific societies, as the disagreements within societies have divided along lines consistent with these categories.

The *Pure Scientist* "focuses on research with absolutely no consideration for its use or utility, and thus in its purest form has no direct connection with decision-makers" (Pielke 2007). In this context, a Pure Scientist might conduct research relevant to avian conservation, but would not involve themselves in the use of their work in the conservation arena, or in making their science accessible to decisionmakers. A society limited to pure science would focus solely on encouraging the pursuit of research without concern for its conservation value.

The *Issue Advocate* "focuses on the implications of research for a particular political agenda" (Pielke 2007). An Issue Advocate might align themselves with a particular interest group seeking a particular outcome of a decision, for example an outcome that results in protection of habitat for bird species rather than conversion of that habitat to other land uses. A society focused on issue advocacy would have a position, and use valid scientific data in ways that would best help it to implement that position. This is different from an all-out advocacy organization that does not claim a scientific basis for its position, and might choose to ignore or even discredit science if the science did not support the organization's position.

The *Science Arbiter* "seeks to stay removed from explicit considerations of policy and politics like the Pure Scientist, but … has direct interactions with decision-makers" (Pielke 2007). In essence, the Science Arbiter evaluates the science relevant to an issue in avian conservation and provides the results of the evaluation to the decisionmaker without taking a position on the outcome. A society engaged in science arbitration seeks to provide scientific information to decisionmakers but without engaging in policy and decisionmaking.

Finally, the *Honest Broker* "engages in decision-making by clarifying and, at times, seeking to expand the scope of choice available to decision-makers" (Pielke 2007). Thus the Honest Broker evaluates the relevant science like the Science Arbiter, but in addition (and unlike the Science Arbiter), facilitates policy alternatives based on that evaluation. A society acting as an Honest Broker not only provides scientific information to decisionmakers but also actively engages in the application of the science to decisionmaking and may engage in dispute resolution concerning science and decisions.

The Debate: Pure Scientist versus Issue Advocate

Debates within professional societies of biologists typically have been about whether the society should engage in conservation under the Pure Scientist or Issue Advocate model, with much less discussion on the possibility of other roles. Central issues in the debate have been scientific credibility and objectivity (Hilborn 2006, Noss 2007, Scott et al. 2007, Meyer et al. 2010, Ruggiero 2010, Queenborough and Comita 2011, Goodwin 2012, Wilhere 2012). Members have argued that presenting science in response to potential decisions and/or appearing to have a position, i.e. acting as an Issue Advocate, results in the loss of credibility and objectivity of the science of the society, as perceived by the public, policymakers, and peers, thereby compromising the potential for the society and its science to impact conservation decisions into the future.

The expertise of biologists renders them especially well-equipped to provide informed input about the consequences of policy alternatives related to conservation, and many feel compelled to do so (e.g., Soulé 1986). Many biologists chose this field of science because of their love of nature and their personal values motivate them to somehow contribute to preservation of biodiversity. For some scientists, engaging in advocacy is not just appealing but seen as a moral obligation (Norton 1987, Odenbaugh 2003). But other biologists are equally compelled not to venture into advocacy and to preserve the independence and purity of their science, and often cite the perception of advocacy as a deterrent (Hilborn 2006, Ruggiero 2010, Meyer et al. 2010). If scientific input is perceived as value-laden it may not be considered credible; that is, if the biologist appears to advocate then the science may be discounted as no longer pure. Certainly this can be the view of policymakers and stakeholders, especially as those untrained in science may not distinguish between advocating for science versus advocating a position (Brosnan and Groom 2006, Yamamoto 2010). Many biologists experience this conflict in their work (Brosnan and Groom 2006). In the words of Hagan (1995), "if we conduct our science with proper objectivity, we may even find our own science in conflict with our personal values."

Scientists do not always share this view that the tradeoff between advocacy and credibility is inevitable, either in personal choices or in the activities of their professional societies. This debate has raged for decades in the Society for Conservation Biology (e.g., Hagan 1995, Barry and Oelschlaeger 1996, Meffe 2007). Other professional societies have managed to be more successful in navigating their role in conservation, and have engaged in conservation activities that, for the most part, have been embraced by their membership. For instance, The Wildlife Society has a long history of involvement with management and conservation policy, and the Ecological Society of America, which traditionally focused on more academic or pure ecological science, gradually expanded its role to weigh in on several conservation issues (see below).

We argue that limiting the roles of scientific societies to be either Issue Advocates or Pure Scientists is no longer sufficient or necessary. Although it is true that adopting a dual role as Issue Advocate and Pure Scientist is at best problematic and perhaps impossible for most professional societies, alternatives to these roles exist and these alternatives may be more palatable and appropriate to some organizations. Scientific societies have a choice about whether to limit or expand their roles. Here we argue for a particular, expanded role, a combination of Pure Scientist and Science Arbiter, and potentially, in limited circumstances, Honest Broker. The recent changes to journal publishing (a joint editorial and production office) for the American Ornithologists' Union and the Cooper Ornithological Society provide an opportunity to execute our vision and thus we direct our argument specifically to those two societies (hereafter OS, Ornithological Societies), but it applies to other professional ornithological societies as well.

The Case for the Pure Scientist and Science Arbiter Roles for the OS

Pure Scientist. The Pure Scientist clearly is an appropriate role for the OS. Members of the OS have historically carried out and will continue to perform scientific research that advances our understanding of the natural world, without regard for conservation policy. This approach is essential to science itself. It is also not unusual for pure science to discover information that ultimately becomes valuable to decisionmakers; often this knowledge would never have been realized had the research criteria included conservation relevance. Focusing the role of the OS only on conservation-relevant research would be detrimental to science. But it would be equally limiting and naive to consider that pure science will not or should not have conservation-policy value. In fact, many OS members do include conservation relevance as a criterion in designing their research. We view this deviation from the idealized Pure Scientist as appropriate and desirable provided it does not result in the OS taking policy positions. With this constraint, non-idealized and idealized pure science can coexist comfortably. Many OS scientists will be content to operate as idealized Pure Scientists, and will want a limited or no role in conservation. Others will desire to conduct conservation-relevant research. We argue that this spectrum of pure science by its members should continue to be encouraged by the OS as one of their most important contributions to conservation.

Issue Advocate. We contend that the Issue Advocate role is not one that is currently appropriate for the OS as organizations, although some members may elect to adopt that role as individuals. Organizations that advocate effectively for avian conservation already exist, for example the American Bird Conservancy and The National Audubon Society, and there are numerous other organizations that advocate for conservation generally, e.g., the International Union for Conservation of Nature, the World Wildlife Fund, and Defenders of Wildlife. The resources and personnel of these organizations make them much better equipped to engage in effective advocacy than the OS. Historically the OS have engaged in advocacy primarily by adopting resolutions in support of avian conservation, an activity whose effectiveness can be questioned in comparison to the advocacy and other activities of the organizations mentioned above, but which was fitting considering the capacity of the OS. For example, at its 1997 annual meeting the American Ornithologists' Union (AOU) passed resolutions calling

for the protection of migratory birds and their habitat, control and management of feral and free-ranging cats, and maintenance of population viability requirements, and in 2012 the Cooper Ornithological Society passed resolutions calling for the banning of lead ammunition and the protection of habitat surrounding Lake Teshekpuk in Alaska.

The strengths of the OS lie outside of issue advocacy, in the science produced by their members. Our view is that the OS should adopt roles grounded in their unique strengths and avoid the role of Issue Advocate, including passing resolutions addressing conservation policy and regulations. Nevertheless, we note that some professional scientific societies have successfully incorporated an Issue Advocate role along with other roles. For example, the Ecological Society of America (ESA) has for many years combined science-based issue advocacy with science arbitration. In issue advocacy, ESA releases two types of position documents to advocate for specific policies and decisions. The organization provides short (2–4 pages) statements that articulate the Society's position on critical national or international issues and include ecology-based policy recommendations, e.g., ESA's position statements on climate change (ESA 2010) and on ecological impacts of economic activities (ESA 2009). Prior to release the statements are reviewed by the ESA's Public Affairs Committee and approved by the ESA's Governing Board. The ESA also produces policy or position papers. These are technically detailed documents designed to capture current ecological knowledge about a particular topic, and to provide specific policy recommendations. The documents are peer-reviewed by outside reviewers and by the ESA's Public Affairs Committee, approved by the ESA's Governing Board, and in many cases published in the Society's journal *Ecological Applications*. Topics have included policy statements and recommendations on invasive species (Lodge et al. 2006), genetically engineered organisms and the environment (Snow et al. 2005), and meeting ecological and societal needs for freshwater (Baron et al. 2002). For example, the ESA's policy paper on invasive species was authored by 10 scientists and provided specific recommendations covering a wide range of U.S. policy and management, including prevention, early detection, availability of legal authority, establishment of a National Center, and funding and incentives for slowing the spread of invasive species (Lodge et al. 2006).

Influencing "wildlife management and conservation policies, laws, and regulations" is part of the mission of The Wildlife Society (TWS), conducted through its Government Affairs Program (http://www.wildlife.org/policy). This program's stated objective, to provide unbiased reviews of conservation policy and strategies and science-based input to policymakers, represents science arbitration, as do many of the products of this program such as Technical Reviews and Fact Sheets. However, other activities such as identifying policy priorities and issuing Position Statements clearly represent issue advocacy. TWS and the ESA have not lost their credibility as scientific societies as a result of their involvement in issue advocacy. Whether their position statements are viewed as more credible than those of other types of organizations advocating positions on the same issues is debatable. Regardless, we perceive no potential for the pure science and issue advocacy roles to coexist in the OS because of the tension between these two roles among members.

Science Arbiter. We propose that the OS actively embrace the role of Science Arbiter (and potentially, in limited circumstances Honest Broker; see below) in order to expand their role in science beyond that of the Pure Scientist, while remaining faithful to scientific integrity, scholarship, and the scientific process. We believe that this will allow the societies to be more inclusive and address the range of scientific activities of many of its members. Surveys of members consistently reveal a demand for more involvement in conservation, especially from younger members. There is much concern in the OS about a diminishing and increasingly older membership. Rather than alienating a generation of scientists that, ironically due in large part to the actions of the previous generation of scientists, is more aware of conservation and seeks a stronger connection between its science and conservation, the OS should find a way to leverage the scientific knowledge of its more experienced members to work with the added sensibilities of the next generation of scientists. An expanded role in conservation for the OS is potentially a means to increase the value of society membership, especially for younger scientists, and reinvigorate the OS more generally. It also offers the OS a new way to support scientific advancements.

Scott et al. (2008) make the case for professional societies to act as Science Arbiters. They discuss the pitfalls of issue advocacy and the benefits that can be derived from making science accessible to decisionmakers in an objective form through science arbitration. Taking on the role of Science Arbiter would allow the OS to make science, in its pure and most objective form, known and available to decisionmakers. We propose that the OS adopt this role as described by Scott et al. (2008) in the area of avian conservation.

The Science Arbiter: Need, Opportunity, and Examples

We perceive a great need for science arbitration as decisionmakers typically lack access to relevant scientific information in an objective and reliable form (Brosnan 2000, 2007). Moreover, we live in a rapidly changing natural world, and at a time where new science is emerging at an increasingly fast pace, and consequently the gap

between science and decisionmakers is growing. Many decisionmakers receive their scientific information from parties with a vested interest, i.e. Issue Advocates, and they are often bombarded with additional and ancillary information by other interest groups and their lobbyists. Conservation decisions being contested in court are governed by the adversarial advocacy method of the courtroom and not by the objectivity of science—hardly the best setting for a scientific review. Faced with the prospect of attempting to evaluate science beyond their expertise or accepting the interpretations of Issue Advocates, some decisionmakers try to seek guidance and reviews. For instance, Judge Redden of the Ninth Circuit Court, who ruled on numerous conservation and Endangered Species Act cases, was renowned for hiring his own "court" scientist to sit in his courtroom and provide him with scientific input on cases involving complex scientific information in which each side claimed scientific support for its position (Brosnan 2007).

Generally, however, decisionmakers lack the range of in-house expertise needed to conduct a definitive evaluation of the science. Because so much of science is increasingly specialized, they rarely know whom to call for reliable expert information. As a result, judges, politicians, and other decisionmakers must act as their own arbitrators of science when they would much prefer that others provide this service for them. Our vision is that the OS be viewed as the place to go to fill this void in the area of avian conservation.

In addition to the widespread recognition that science has a role in natural resources decisions (Noss et al. 1997, Possingham et al. 2001, Groves et al. 2002, Holmes and Clark 2008), several environmental and conservation statutes explicitly require that decisions be made on the best available science. The U.S. Endangered Species Act (Section 4) requires the USFWS and NOAA Fisheries to determine whether to list a species as threatened or endangered solely on the best available scientific and commercial information. The Magnuson-Stevens Fishery Conservation and Management Act states that conservation and management measures shall be based upon the best scientific information available. It also requires fishery managers to establish science-based annual catch limits and accountability measures for all U.S. fisheries.

Peer review is seen as the gold standard for scientific quality, but not all available science has been peer-reviewed. For decisionmakers, beyond recognizing the significance of peer review, there is frequently limited guidance on what constitutes the best available science in environmental policy, how to interpret seemingly diverging opinions among scientists, or how to extrapolate from studies that appear relevant but perhaps peripheral to the question at hand (Bisbal 2002, Sullivan et al 2006, Brosnan, 2007). By providing a scientifically rigorous review that articulates the state of the knowledge, the OS can make a significant contribution to decisionmaking and to applying standards to the use of science. Scientists are trained to assess the levels and sources of uncertainty in their data, but decisionmakers are not, and reviews that communicate the levels of scientific certainty are valuable and appreciated by decisionmakers (Brosnan 2000, 2007, McEathron 2008)

Some federal agencies have applied checks and procedures to their science, e.g., the U.S. Forest Service has focused on science consistency checks. Natural resources agencies also at times conduct their own reviews. But agencies (and their personnel) frequently wear many hats, acting as scientists, managers, regulators of the resource, and resource users. Conflicts among these roles can compromise capacity for science arbitration. Agencies must also be cognizant of their multiple mandates, to which they are required to adhere by law. The advantage enjoyed by the OS is that they can provide an external and independent review of avian issues, without these conflicts, which can help and support regulatory agencies that are faced with complex and challenging decisions. By virtue of their distance from the policy decisions, OS reviews can be a valuable and timely resource when conservation decisions must be made.

Examples. The National Research Council (NRC) represents the nation's highest level of science arbitration, and indeed was created to assist the federal government in this capacity. The OS are uniquely qualified to provide a similar service at relatively (compared to the NRC) low cost in the area of avian conservation. Relatively few professional societies have filled this "mini-NRC" role, prominent among them with respect to avian conservation, the ESA, and TWS (Table 1). Other scientific entities also have assumed this role, for instance the Sustainable Ecosystems Institute (SEI) had a specific program area devoted to facilitating science-based decisions as Science Arbiter and Honest Broker. However, these organizations do not have the standing capacity for providing science arbitration dedicated to avian conservation that the OS do.

We emphasize that the role of Science Arbiter is different from that of conducting a scientific review for a scientific audience. The process must often be managed or led by individuals who understand the science–policy interface, and how policies and regulations affect the use of science. In their reviews, both NRC and SEI used dedicated staff for this role (McEathron 2008). The staff frequently buffered scientists against the full brunt of policy pressures, and explained policy issues to scientists and vice versa. SEI engaged its scientists with decisionmakers and stakeholders in a transparent and often public review process. Higher-level NRC panel scientists have less direct engagement with policymakers, but NRC staff recognize the policy interface and actively manage communication of

TABLE 1. Examples of Science Arbiter and Honest Broker activities depicting the activity, the organization seeking the assessment (Sponsor), and the organization conducting the review (Arbiter). Table 1 is designed to illustrate the concepts and is not a comprehensive review. The lines between Science Arbiter and Honest Broker can be blurred in situations where there are strong policy implications (see text). Here we include level of engagement of scientists as a defining criterion, identifying the Honest Broker as a more comprehensive science–policy engagement, where science can be used to resolve conflicts and mediate among competing scientific conclusions in order to facilitate a decision.

Activity	Sponsor	Arbiter
SCIENCE ARBITER		
Eight reviews of the historic range of variability of Rocky Mountain Ecosystems (project initiated 1999, review of Gage and Cooper 2013)	U.S. Forest Service Region 2	ESA
Scientific review of USGS GAP Analysis Program including how GAP modeling and mapping might serve conservation needs (2008) www.gap.uidaho.edu/Bulletins/17/Bulletin17.pdf and http://www.esa.org/esa/?page_id=145	USGS	ESA
Scientific review of conservation assessments for the Greater Sage-Grouse and Gunnison's Sage-Grouse; a conservation strategy for the Greater Sage-Grouse (review was included in decision on listing by USFWS for ESA) http://www.esa.org/esa/?page_id=145	USFWS	ESA
Independent Science Review of the Pallid Sturgeon Assessment Program (2004–2005) http://www.brosnancenter.com/uploads/4/8/6/7/4867822/pallid-sturgeon.pdf	Pallid Sturgeon Assessment Team (multi-agency)	SEI
Review of USGS Comprehensive Sturgeon Program to ensure it is technically sound, scientifically defensible, and policy-relevant (2008) http://www.brosnancenter.com/uploads/4/8/6/7/4867822/review_of_comprehensive_sturgeon_research_program.pdf	USGS	SEI
Scientific review of the role of hatcheries for the anadromous Atlantic Salmon (*Salmo salar*) in the Gulf of Maine	State of Maine, NOAA	SEI
Scientific review of Golden-cheeked Warbler (*Setophaga chrysoparia*) Population and Distribution Modeling and four associated manuscripts (2011) http://irnr.tamu.edu/media/252336/summary_gcwa_review.pdf	Texas Agrilife associated with Texas A&M University	TWS
Scientific Review of USFWS Ivory-billed Woodpecker (*Campephilus principalis*) Draft Recovery Plan (2007)	USFWS	TWS
2011 Scientific Review of Draft Land-Based Wind Energy Guidelines (which provides recommendations on measures to avoid, minimize, and compensate for effects to fish, wildlife, and their habitats) (2011) http://www.fws.gov/windenergy/wind_comments/wildlife_society.pdf	USFWS	TWS
Scientific Review of U.S. Fish and Wildlife Service's Draft Eagle Conservation Plan Guidance (aims to assist wind energy developers and facility operators to avoid, minimize, and mitigate adverse effects on Bald Eagles *Haliaeetus leucocephalus* and Golden Eagles *Aquila chrysaetos*) (2011) http://wildlife.org/policy/peer-reviews	USFWS	TWS
Scientific review of the status of the Red-cockaded Woodpecker (Ligon et al. 1986)	BirdLife International	AOU
Scientific review of the biology, status, and management of Cape Sable Seaside Sparrows	South Florida Ecosystem Restoration Task Force	AOU
Scientific review of the status of the California Condor and efforts to achieve its recovery	Audubon California	AOU
HONEST BROKER		
Scientific Review for resolving science and addressing potential species conflicts in Everglades Restoration (two review programs) http://www.brosnancenter.com/uploads/4/8/6/7/4867822/everglades2007finalreport.pdf	South Florida Ecosystem Restoration Task Force	SEI
Northern Spotted Owl Status Review (2003–2004) http://www.fws.gov/sacramento/es/Five-Year-Reviews/Documents/doc743.pdf	USFWS	SEI
Resolving science in determining subspecies status of Preble's meadow jumping mouse (*Zapus hudonius preblei*) http://www.fws.gov/mountain-prairie/species/mammals/preble/prebles_sei_report.pdf	USFWS	SEI

the science to a non-scientific and often highly partisan audience.

There are different models to manage the science–policy barrier in reviews that are relevant to the OS. For instance, the independent science review of the endangered pallid sturgeon (*Scaphirhynchus albus*) assessment program represents a more intensively managed review (Table 1). In convening a team the review manager invested heavily prior to the review to assess the questions and concerns of the decisionmakers, translate them into scientific questions, and identify the necessary reviewer skills. The SEI review team had regular facilitated meetings with the interagency leaders to ensure that the review confined itself to the science while maintaining its policy relevance. The scientific review team examined a large volume of scientific and agency documents, and met formally with the assessment team, the researchers, and other participants in a facilitated forum. In their review, panelists provided a scientific evaluation and made suggestions for how the science could be strengthened, including development of conceptual models and statistical analysis. They did not make any policy recommendations.

McEathron (2008) carried out an independent evaluation of the pallid sturgeon review to assess its effectiveness, and concluded that scientists and users were satisfied with the process and its ability to maintain scientific integrity while providing needed and useful information to agencies. Among the conclusions were that "all agency staff responded that they were satisfied with the process and the panelists chosen. Many of the comments agency staff made focused on the fairness of the process." The review manager's expertise in the science/policy of endangered species played a key role in protecting the scientific review from being drawn into legal and policy issues surrounding the management of the pallid sturgeon.

By contrast, other reviews require less management and can be equally valuable to decisionmakers. For example, in 2008 the ESA, at the request of USGS, conducted a review of the USGS Gap Analysis Program (GAP) (Table 1). The purpose of GAP is to provide broad geographic information on the status of ordinary species (i.e. those not threatened with extinction or naturally rare) and their habitats in order to provide land managers, planners, scientists, and policymakers with the information they need to make better-informed decisions. The focus on ordinary species eliminated many of the more contentious legal and regulatory challenges frequently associated with threatened and endangered species.

The Science Office of the ESA managed the peer review. In this case, the ESA identified a panel of experts in conservation biology and policy and charged them with reviewing GAP's existing standards and project protocols to develop thorough understanding of these programs. The panel issued a report to USGS which discussed the current needs of conservation in practice and assessed how GAP's mapping and modeling programs might be modified to be of the most benefit. For instance, the panel suggested that creating national-scale data quickly was imperative to allow GAP to be better poised to participate in other national efforts, such as global climate change research and monitoring (Gergely 2010). The review process appears to have been well received by the USGS.

A Model for Science Arbitration for the OS

Some members initially will be uncomfortable with our proposal to develop science arbitration as a major activity of the OS and with the level of engagement with policymaking involved, preferring that the OS restrict themselves to the Pure Scientist role, which by definition has little or no engagement in decisionmaking. However, it is naive to believe that the science the Pure Scientist produces is not employed in decisionmaking or to believe that if it is used it will remain "pure." Often the science is used by Issue Advocates to support a position, sometimes in ways that the scientist who produced the science considers inappropriate or misleading. The Science Arbiter role is a vehicle to ensure that the best available science is used in an objective and appropriate manner. It is a way to make the science produced by OS members accessible to decisionmakers in its pure form. In the United Kingdom the British Trust for Ornithology is able to restrict its role to pure science because there are other organizations dedicated to providing decisionmakers with access to science in its pure form (S. Baillie personal communication). In the absence of a similar structure in North America, it falls to organizations that produce the science, such as the OS, to provide this important service to society.

On the other hand, some OS members may object to our call for the OS to refrain from engaging in advocacy in any form. Science, if viewed as objective and provided to decisionmakers in an effective way, has incredible power in the policy arena. We contend that the OS can have a much larger, positive effect on avian conservation through science arbitration than through advocacy. We further contend that any level of advocacy will cost the OS their reputation as a credible source of science arbitration, and increase the chances that the OS will be viewed as yet another advocacy group rather than the place to go for high quality, policy-relevant information. We believe that science arbitration can be done in a way that is true to the scientific standards of the OS, while making enormous contributions to avian conservation, thus alleviating the legitimate concerns of some OS members. In this section and the next we outline our vision of such a process.

The role of Science Arbiter is not an entirely new one for the OS. The AOU has engaged in such activities occasionally in the past through its Committee on

Conservation (Table 1). In fact the charge of the Committee "to provide objective, independent review of science relevant to critical, often controversial, issues" in avian conservation can be viewed as a mandate for science arbitration. However, virtually every such effort within the AOU in the past has led to controversy within the society, focused especially on publication of the findings. The typical pattern has been that the AOU approved these activities initially but then balked when it came to publishing the resulting reports due to their content (i.e. such reports do not constitute the original, pure science normally published in the society's journals) and the tension between science and advocacy. Some have eventually been published after lengthy, sometimes contentious debate (Walters et al. 2000, 2010, Askins et al. 2007) whereas others were never published (e.g., a scientific review of a management plan for Double-crested Cormorants [*Palacrocorax auritus*], http://www.aou.org/committees/docs/ConservationAddn5).

In order to expand their role in science arbitration and accommodate more such activity, we propose the OS must commit to this role by developing an effective process for conducting reviews of science. This process must maintain standards for quality and objectivity, as the NRC has done. The model developed by Brosnan (2000), based on lessons learned from successful and unsuccessful attempts at science arbitration, is well-suited to the OS and to the types of activities we envision. Key elements of this process are (1) clearly stated goals for the peer review, (2) clear roles for reviewers, (3) impartiality, (4) a balance between expertise and independence among reviewers, (5) training of reviewers, (6) a specified reward structure, (7) an emphasis on early involvement over post-hoc evaluation, (8) administration of reviews by individuals with expertise in the science–policy interface, and (9) a panel structure. Most critical is that the process provides the means to meet the gold standard of best available science, i.e. peer-reviewed publication, as science has more power and respect among decisionmakers and the public if it is peer-reviewed and published. Also, peer-reviewed science has greater legal standing than non–peer-reviewed science.

A Scholarship Threshold for Science Arbitration. To be successful within the OS, science arbitration must be approached as scholarly activity. The activities we envision involve objective reviews of the best available science relevant to important policy issues in avian conservation. That scientific reviews carried out through the Science Arbiter role have the potential to make legitimate scholarly contributions has been largely overlooked in the debates over the roles for scientific organizations and scientists. But, scholarly articles that have been published in peer-reviewed journals have emerged from these reviews, for instance from ESA and SEI reviews (e.g., Baron et al. 2002, Wilhere 2002, Snow et al. 2005, Gutierrez et al 2007).

There is untapped potential for scientists and professional societies to advance science and produce manuscripts of publishable quality through science arbitration activities. The OS have a unique opportunity to define and adopt a scholarship threshold for these activities, and should undertake, support, and publish only those that meet this threshold. The defining criteria for this threshold would be much the same as for pure science: impeccable logic, thorough treatment of existing science, objectivity. In carrying out these reviews the OS also must adhere to strict transparency standards. The NRC has transparency and conflict-of-interest policies that can be used by the OS in their work.

We envision that OS reviews could be submitted for publication, subjected to peer review, and if they passed this scrutiny, published in an OS journal. The OS must commit to publishing the results of science arbitration projects, including creating and implementing a peer-review process specific to these reviews. Such a process would require that the reviews meet the threshold standards of scholarship, and that they also adhere to the central tenets of objectivity, credibility, and absence of advocacy. With its new focus on conservation and applications, *The Condor: Ornithological Applications*, a journal jointly produced by the Cooper Ornithological Society and the American Ornithologists' Union, is a natural outlet for these papers. In fact, we view the development of a new focus for this journal as providing a unique opportunity for the OS to create the essential parts of their science arbitration process related to publishing.

An added benefit of providing opportunity for peer-reviewed publication of the products of science arbitration activities is that it offers a valid scientific incentive to scientists to engage in conservation, i.e. it provides the reward structure essential to a successful process. Frequently, academic scientists who engage in conservation activities are not provided with the academic currency necessary for promotion and tenure. The opportunity to publish a peer-reviewed manuscript is an incentive to scientists to engage in these types of reviews. Once the OS has established a peer-review process for publishing these reviews, it could be made available to other societies or organizations that carry out science arbitration, with the option of rejecting such submissions if they fail to meet the established standards of scholarship.

The OS as Occasional Honest Brokers. In this paper we focus on the Science Arbiter role, but in some instances the OS may find it appropriate to take on the Honest Broker role. At the very least the OS will need to understand when a review calls for an Honest Broker in order to evaluate whether to respond. The lines between Science Arbiter and Honest Broker are often blurred in situations where there are strong policy implications, e.g., contested decisions on whether or not to list a species as

threatened, or where land-use regulations are invoked. In distinguishing between the two roles, we use the level of engagement with policy as a key criterion, which is consistent with Pielke's (2007) distinction. For instance the ESA's review of conservation assessments by USFWS (Table 1) was used to inform the listing decision of the sage-grouse (*Centrocercus urophasianus* and *C. minimus*) in that the conservation assessment document (as reviewed by ESA) was used, but ESA scientists were not fully engaged with how the assessment was employed throughout the listing process. Thus we call the ESA's role in that instance Science Arbiter. By contrast, we define the Honest Broker role as a more comprehensive science-policy process requiring much greater engagement of the review scientists with decision-makers, stakeholders, and other scientists, and requiring more management of the review process.

As the OS begin to engage in conservation-relevant reviews, they will need to assess carefully whether reviews fall into Science Arbiter or Honest Broker categories. The Honest Broker role is, by definition, a role that is invoked when there is conflict. The conflict can be over a conservation or regulatory decision or over science, but it invariably concerns a decision where science has played a role in the outcome. The Honest Broker is in effect a mediator of science-based conservation decisions. The outcome of an Honest-Broker process is invariably a policy or regulatory decision followed by implementation of one or more actions. Thus, this role focuses on a wider spectrum of scientific information and questions including quality of science, uncertainty and risks, and how these relate to contested agency decisions. The Honest Broker is fully engaged with policy, helping to facilitate, but not advocating for, alternative and science-based solutions. But those solutions, themselves, will be constrained by regulations. This role includes both articulating the science (i.e. science arbitration) and then putting that science to use, often in conflict resolution and decision-making. The Honest Broker role involves articulating the consequences of policy alternatives, based on relevant science, but it does not include taking a policy position.

To undertake such a role, it is essential to have a translational scientist or policy professional who understands science and policy, including differences among statutes, policies, and regulations and in how scientists and policy-makers perceive and use information (Brosnan 2000). SEI's scientific reviews for the Everglades (Table 1) illustrate the Honest Broker role. SEI was asked to help resolve the apparent conflicts between management regimes for different endangered avian species, which had undermined ecosystem restoration, were the subject of several lawsuits, and had led to regulatory-decision disputes among stakeholders. Using an open and transparent process the SEI convened scientists and policy-makers, facilitating their collective participation in a full review of the science and its application to restoration decisions. SEI did not advocate a policy, but the extensive interaction of policy-makers with the science and its implications facilitated the development of a set of science-based solutions that allowed restoration to proceed without pitting one species against another.

Proposed Activities

To provide additional detail about our vision of an expanded role of the OS in conservation, in this section we describe specific activities in which we propose the OS engage. These activities include the roles of Pure Scientist, Science Arbiter, and Honest Broker, but explicitly exclude Issue Advocate.

Sponsored Reviews. The first activity is the Sponsored Review. The objective of the Sponsored Review is to articulate, review, and synthesize the available science relevant to current issues in avian conservation, i.e. to engage in science arbitration in avian conservation. Our concept of the Sponsored Review is that the OS provide reviews and syntheses that are requested and funded primarily by government agencies, but also by nonprofits and other organizations in order to make the best available and relevant science accessible to decisionmakers. Prior AOU initiatives on Cape Sable Seaside Sparrows (*Ammodramus maritimus mirabilis*; Walters et al. 2000) and California Condors (*Gymnogyps californianus*; Walters et al. 2010) are good examples of our concept of Sponsored Reviews (Table 1). Sponsored Reviews may also provide opportunity or respond to a need for the OS to act as an Honest Broker, if for instance the science is necessary to inform a particular decision or to resolve conflicting interests or conservation disputes.

Sponsored Reviews are potentially useful to a diversity of stakeholders. In addition to government agencies, they are also a valuable tool for nonprofits, foundations, and other sectors that must make conservation decisions including how to invest in the most effective conservation initiatives and how to comply with or implement conservation regulations or agreements. Sponsored Reviews can also help governments and organizations in forecasting and anticipating conservation issues, as they often provide early access to peer-reviewed emerging science. OS members, particularly those engaged in conservation science, are often aware of emerging issues or science that are relevant to avian conservation. Thus the OS should seek opportunities and funding to initiate reviews. The reports resulting from Sponsored Reviews would be evaluated through the peer-review process established for possible publication in *The Condor: Ornithological Applications*.

Conservation Working Groups. The second type of activity we propose, labeled Conservation Working Groups, involves the OS in a proactive Science Arbiter

role and takes the form of scientific review initiated and funded by the OS. The objectives of this activity are to identify emerging issues in avian conservation, review and synthesize the available science relevant to those issues, and provide the resulting information to appropriate decisionmakers, other scientists, and/or user groups.

The basis for convening a Conservation Working Group would be to address an emerging or currently critical conservation issue that has little or no potential for outside funding. Reviews may serve as scientific catalysts to draw attention within the scientific community to areas in need of further research. They may serve as important scientific sources for decisionmakers and in some cases offer an early alert on emerging conservation challenges. The product of a Conservation Working Group would be the same as that of a Sponsored Review, namely a report that would be considered for publication in *The Condor: Ornithological Applications* through a peer-review process as described above. Previous AOU initiatives on grassland birds (Askins et al. 2007) and Red-cockaded Woodpeckers (*Picoides borealis*; Ligon et al. 1986) provide good examples of the concept of Conservation Working Groups.

The Science Arbiter role as envisioned in Sponsored Reviews and Conservation Working Groups could and should include young OS members at an early stage in their career partnered with senior scientists. The Conservation Working Group model in particular offers opportunities for graduate students and post-docs to engage with more senior scientists in thorough and rigorous scientific reviews that have conservation value. This provides the OS with another means to meet the demand of young members for more involvement in meaningful conservation activities. We believe the societies will reap benefits in increased retention and recruitment of young ornithologists.

Other Proposed Conservation Activities. Several other proposed activities would support the mission of the OS as a key player in science arbitration. The OS could produce an Annual List of Avian Conservation Priorities**,** a prioritized list of the most important avian conservation issues that need addressing. Sutherland et al. (2011) and Fleishman et al. (2011) provide examples of how such lists might be generated. For each item on the list appropriate actions would be identified, including but not limited to research necessary to fill knowledge gaps and guide conservation solutions, seeking funding for a Sponsored Review, forming a Conservation Working Group, sponsoring a symposium on the topic, and conveying the nature of the issue and its importance to appropriate decisionmakers.

The OS might also form an Avian Rapid Response Team with diverse expertise in avian conservation to provide a rapid response to government agencies seeking help in reacting to unforeseen events that impact birds such as oil spills, other forms of environmental contamination, and devastating extreme events such as floods, fires, and hurricanes. This activity would not result in Sponsored Reviews, but would contribute to developing relationships with government agencies and, by providing rapid access to the best available science, would strengthen the reputation of the OS as the source of science arbitration for bird conservation.

Conclusion

We believe that the OS have a key role to play in advancing the science of avian conservation and providing that science to decisionmakers through the Science Arbiter role. We are not the first to advocate for this role for the OS. The last of Fitzpatrick's (2002) 10 goals in his perspective on the potential contributions of the AOU to avian conservation is a call for science arbitration. Were the OS to adopt our recommendations they would address Fitzpatrick's (2002) other 9 goals by producing science relevant to avian conservation generally and those goals specifically, and making that science accessible to decisionmakers responsible for conserving bird populations. However, the OS would not be involved in management of those populations or determining policy except through their activities as Science Arbiters and Honest Brokers.

We caution that the Science Arbiter role requires engaging appropriate expertise, consideration, and approach. The concerns of some society members over loss of credibility are well-founded, as there have been pitfalls in the implementation of conservation science reviews (Brosnan 2000). We believe the vision we outline is compatible with the views of those on both sides of the recent debate over the role of the OS in conservation, and that the process we describe will ensure that the Science Arbiter role is scientifically credible, objective, and successful. We also believe that the OS have a unique opportunity to set standards and provide opportunities whereby these reviews make valid contributions to the scientific literature. Such opportunities will also benefit junior scientists who are evaluated on their peer-reviewed publications. We feel that by expanding their scientific role the OS have the opportunity to be the voice for avian science in conservation and to attract and retain an upcoming generation of avian scientists.

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