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TITLE: DEFENDING SCIENTIFIC INTEGRITY IN CONSERVATION POLICY PROCESSES: LESSONS FROM CANADA, AUSTRALIA, AND THE UNITED STATES.

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ABSTRACT

Government agencies faced with politically controversial decisions often discount or ignore scientific information, whether from agency staff or non-governmental scientists. Recent developments in scientific integrity (the ability to perform, use, communicate and publish science free from censorship or political interference) in Canada, Australia and the United States demonstrate a similar trajectory: a perceived increase in scientific integrity abuses is followed by concerted pressure by the scientific community, leading to efforts to improve scientific integrity protections under a new administration. However, protections are often inconsistently applied, and are at risk of reversal under administrations that are publicly hostile to evidence-based policy. We compare recent challenges to scientific integrity to determine what aspects of scientific input into conservation policy are most at risk of political distortion and what can be done to strengthen safeguards against such abuses. To ensure the integrity of outbound communication from government scientists to public, we suggest that governments strengthen scientific integrity policies, include scientists' right to speak freely in collective bargaining agreements, guarantee public access to scientific information, and strengthen agency culture supporting scientific integrity. To ensure the transparency and integrity with which information from non-governmental scientists (e.g., submitted comments or formal policy reviews) informs the policy process, we suggest that governments broaden the scope of independent reviews, ensure greater diversity of expert input with transparency regarding conflicts of interest, require substantive response to input from agencies, and engage proactively with scientific societies. For their part, scientists and scientific societies have a civic responsibility to engage with the wider public to affirm that science is a crucial resource for developing evidence-based policy and regulations that are in the public interest.

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INTRODUCTION

Effective conservation outcomes depend in part on the degree to which policy and management strategies are supported by scientific evidence (Sutherland et al. 2004). However, government agencies faced with politically controversial decisions often discount or ignore scientific information received from agency staff or non-governmental scientists. Here we compare recent challenges to scientific integrity in conservation policy-making in Canada, Australia and the United States, to determine what aspects of scientific input into policy are most at risk of political distortion and what can be done to strengthen safeguards against such abuses.

Scientific integrity is defined here as the ability to perform, use, communicate and publish science free from censorship or political interference (Goldman et al. 2017). This definition encompasses both the ability of government scientists to speak freely about their research, as well as the transparency and integrity with which information from non-governmental scientists (e.g., submitted comments or formal policy reviews) informs the policy process.

Although scientific integrity abuses arise under all political parties, they are accentuated under administrations that publicly question the value of science and the validity of widely-accepted scientific conclusions (Goldman et al. 2017). The 2016 election of Donald Trump as US president alarmed much of the scientific community given attempts to silence government scientists from speaking with the media and public and rhetoric disparaging accepted scientific concepts including climate change (Ritchie et al 2017).

Recent developments in the US recall issues that arose under the George W. Bush Administration (2001-2009), when political appointees prevented federal scientists from publicly sharing their research and expertise and manipulated scientific reports to justify policy decisions

(Goldman et al. 2017). Similar violations occurred in Canada under the latter years of the Harper administration (2011-2015) when federal scientists were systematically prevented from communicating their work to the public (Noel 2016). Scientific integrity became a key issue in Canada's 2015 election, helping result in election of a new administration publicly committed to strengthening scientific integrity safeguards. In Australia, scientific integrity violations became a prominent political issue under the Howard administration (1996-2007)(Khan 2017). When the opposition Labor party took power in 2007, it publicly endorsed the right of government scientists to speak freely about their work (Price 2009).

Canada, Australia and the US demonstrate a similar trajectory: a perceived increase in scientific integrity abuses is followed by concerted pressure by the scientific community, leading to efforts to improve institutionalization of scientific integrity protections under a new administration. However, continued violations and inconsistent application of the new policies remain even as those administrations publicly endorsed reforms (Goldman et al. 2015, Ritchie et al. 2017). And with the recent advent of a new US administration more publicly hostile to science, even such inconsistently-applied reforms appear vulnerable to abrogation through regulatory changes designed to undermine the role of science in public policy (Goldman et al. 2017).

In this review, we step back from recent crises to identify problems that transcend any one administration or country, and ask how institutional safeguards on scientific integrity can be strengthened to be more robust even under hostile administrations. While it may seem impractical to propose strengthening scientific integrity policies under unsympathetic administrations, we believe that reactive defense of existing protections must be coupled with a focus on necessary improvements to ensure long-term success in institutionalizing a culture of scientific integrity in conservation policy processes.

We build on other recent broad reviews of emerging scientific integrity issues (Chapron et al. 2017; Goldman et al. 2017), focusing specifically on how science informs conservation policy. We examine commonalities and contrasts across the three nations to determine which reforms are limited to specific contexts and which are broadly relevant. We structure the review around reforms that address distinct threats to two categories of scientific integrity issues (Table 1). Firstly, there are outbound scientific communications from government scientists to the public and media, which have been threatened by restrictive policies that limit scientists' ability to publish or publicize their research findings. Public access to websites or other sources of government scientific data have also been curtailed in some instances. These limitations on the free flow of information from government scientists to the public undermine the ability of citizens to be informed about and involved in debate on science-based policy questions.

Secondly, politicians have sought to restrict or ignore inbound scientific communication through which non-governmental scientists inform the policy process. Although science is only one source of influence on policy, democratic processes are undermined when policymakers are not transparent as to how and to what extent decisions are based on science. Lawmakers in some nations such as the US have included within environmental statutes formal opportunities for non-governmental scientists to inform the policy-making process e.g., via peer review of draft decisions. In other nations such as Australia, such opportunities are primarily via informal consultation or material submitted during the public comment period.

THE PROBLEM OF CENSORSHIP OF COMMUNICATION BETWEEN GOVERNMENT SCIENTISTS AND THE PUBLIC

When government scientists conduct research, the results are often unpredictable in terms of their policy implications. Scientific integrity requires not only a rigorous and unbiased research process, but also the ability of scientists to speak openly about their findings. Surveys of scientists across eight US federal agencies in 2005-2007 showed that 60% of respondents reported incidences of political interference in their work, with 7% reporting that they had been directed to "provide incomplete, inaccurate, or misleading information" to the public (Goldman et al. 2017).

In Canada, a 2013 survey found that 25% of government scientists reported being asked to exclude or alter information for non-scientific reasons (Professional Institute of the Public Service of Canada 2013). Under the Harper administration, government scientists communicating their work through the media faced lengthy approval processes and submission of pre-approved questions from journalists. Media "minders" often sat in on scientist's interviews and even followed scientists at conferences to discourage spontaneous commentary. These restrictions stimulated sustained public protests by Canadian scientists (Noel 2016).

In Australia, even after the advent in 2007 of a new administration publicly committed to scientific integrity, authorization was still often required before government researchers could speak publicly about their research, and was sometimes denied when agencies feared that research results conflicted with government policy (Ritchie et al. 2017). Commissioned research was routinely subject to contractual clauses allowing governments to prohibit publication of research or modify language in scientific papers (Kypri 2015).

In a recent example, news of the rediscovery of a plant species thought to be extinct for 200 years (*Hibbertia fumana*) was reportedly suppressed by the New South Wales environment department until after a pending development at the site where the plants were found was

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approved (Hannam 2017)(Figure 1). At the federal level, the Australian Government successfully requested that UNESCO remove mention of the climate change threats to Australian World Heritage areas in their 2016 report on at-risk sites (Markham et al 2016).

REFORM: INSITUTIONALIZE PROTECTIONS VIA SCIENTIFIC INTEGRITY POLICIES

Publicity surrounding scientific integrity violations in the US led President Obama to issue a Memorandum on Scientific Integrity directing federal agencies to develop policies that would strengthen safeguards on the integrity of the scientific process (Holdren 2010). Twenty-seven executive branch departments and agencies developed policies to guide and protect the process by which agencies utilize and publicly communicate science, including use of nongovernmental scientists for peer review and federal advisory committees. These policies, as well as continuing pressure from the scientific community, resulted in a reduction in reported cases of inappropriate interference in government decision making processes (Goldman et al. 2017).

In Canada, one of the first acts of the incoming Trudeau administration was to declare that federal researchers would be able to speak publicly about research within their area of expertise without prior approval in most cases (Government of Canada 2016). The government also established the new position of Chief Science Advisor, whose mandate includes safeguarding scientific integrity and accelerating shifts toward more transparent communication of federal scientific research to the public.

To date, institutionalization of scientific integrity reforms in Australia has been more limited than in Canada and the US. Although several federal and state institutions have issued statements committing the organizations to implementing a rigorous unbiased research process (ARC 2015), the policies do not generally encompass the issue of transparency in

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communication between agencies and the public. Many agencies continue to require approval before individual scientists are allowed to speak publicly about their research.

REFORM: STRENGTHEN COLLECTIVE BARGAINING AGREEMENTS

Although the adoption of the 2016 directive increased public engagement by Canadian government scientists, the new open communication policies were not uniformly applied. Scientists within government agencies are employed under different employment contracts, and protections varied widely. In response, the union representing government scientists successfully negotiated to include in their collective bargaining agreement the right of scientists to speak publicly about their research. Protections under this agreement would be difficult to reverse even if a future administration should decide to modify the communications directive.

When the Australian Labor party took power in 2007, it promulgated charters for some public research organizations that sought to protect the right of scientists to speak out and to ensure that scientific publications presented information free from political interference (Price 2009). To address perceived shortcomings of the new policy, Australia's Community and Public Sector Union, which represents staff at government research organizations, subsequently campaigned for a stronger Science Integrity Charter based on several principles: open communication, dissemination and internal and external debate of scientific work; acknowledgement of the contestability of uncertain science; and independence of public sector institutions and their staff (CSIRO Staff Association 2012). However, the proposed Charter has not been implemented to date.

REFORM: SAFEGUARD PUBLIC ACCESS TO SCIENTIFIC INFORMATION

Open access to scientific information allows the public to have confidence in conclusions from scientific research as well as to engage as informed citizens in conservation policy debates.

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Administrations vary in their commitment to public access to scientific information produced by government agencies. During the Obama administration, public access to scientific information were expanded via new federal agency scientific integrity policies as well as through new statutes. The FOIA Improvement Act of 2016 increased public access to government scientific documents and communications, and the Whistleblower Protection Enhancement Act (WPEA) of 2012 increased protections for federal scientists who expose censorship of scientific and technical information. Similarly, the 2016 Directive on the Management of Communications committed the Canadian Government to principles of open government including access to data. In Australia, some state governments such as that of New South Wales have publicly committed to transparency and open access to data (NSW OEH 2016).

Despite the new protections enacted in the US, dismissal of the scientific underpinnings regarding climate change by Obama's successor as US President raised fears that public access to government climate data and other scientific data would be curtailed. In response, scientists at several major universities developed tools and organized "data rescue" events to rapidly archive government scientific data on non-governmental servers to ensure continued public access (Holthaus 2016). Although efforts such as DataRefuge (http://www.ppehlab.org/) can play a role in defending against loss of public access to government data, they face substantial hurdles before they can substitute for stronger institutional safeguards that would mandate continued access and collection of new data.

THE PROBLEM OF BIAS AND LACK OF TRANSPARENCY IN CONSIDERING INPUT FROM NON-GOVERNMENTAL SCIENTISTS

Informed debate and provision of robust scientific evidence for decision-making requires comprehensive access to available science, much of it not done within government agencies. The

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extent and ways in which science produced by non-governmental scientists informs conservation policy decisions differs among the three nations considered here. The reforms necessary to ensure that independent scientific input is solicited and considered without political bias consequently differ depending on national context. The environmental statutes in the US contain extensive requirements for science-based decisions. For example, the US Endangered Species Act (ESA) requires in Sections 4(a)(1) and 7(a)(2) that certain species listing decisions and "biological opinions" be based solely on scientific data. In this case, external scientific peer review of draft decisions by non-governmental scientists is required by law or agency policy as a mechanism for ensuring scientific integrity. In the US, the courts also play a prominent role in adjudicating policy disputes, and litigation often hinges on whether an administrative agency provided an adequate scientific basis to support a challenged decision.

In Canada and Australia, fewer statutory requirements exist requiring independent scientific input into conservation policy outside of the public comment period. Much authority for conservation policy resides at the state and provincial rather than the federal level, and the role of science in policy often differs between the two levels. For example, in New South Wales, Australia, listing of threatened species and ecosystems is decided by an independent scientific committee, while at the federal level such recommendations must be approved by the Minister for the Environment (Nicholson et al. 2015). The Canadian Species at Risk Act (SARA) formalized the role of an independent scientific advisory body (the Committee on the Status of Endangered Wildlife (COSEWIC)) to assess species at risk. COSEWIC conducts independent scientific reviews on the status on species at risk, and makes the results publicly available, whether decisions support or reject listing (Hutchings et al. 2017).

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Below we illustrate key reforms that protect the integrity of independent scientific input into policy by describing several recent agency decisions under the ESA, the main statute designed to protect biodiversity in the United States (Figure 1). We chose the ESA because it contains clear requirements that policymakers incorporate independent scientific input, yet 73% of staff survey respondents at the US Fish and Wildlife Service (FWS), one of two agencies which implement the ESA, felt that improper political pressure remained too high despite the ESA's science mandates (Goldman et al. 2015). We also link the reforms to examples from Canada and Australia where possible.

REFORM: BROADEN THE SCOPE OF INFORMATION SOLICITED FROM INDEPENDENT SCIENTISTS

Agencies are constantly faced with the policy question 'should we act?'. This initial decision is often heavily influenced by an agency's scientific evaluation of the facts. However, in many agencies only the decision to take proactive action is subject to peer review. For example, in the US the ESA requires two federal agencies (FWS and the National Marine Fisheries Service) to make determinations about adding species to, or removing species from, the law's protected lists. FWS' current practice requires it to undertake external peer review of decisions to list a species as endangered or threatened, but does not require this review for decisions *not* to list a species.

The wolverine (*Gulo gulo*), a mid-sized carnivore threatened by loss of snow covered habitat, provides an example of this problem (Figure 1). Although FWS scientists concluded that threats to the wolverine from climate change qualified the species for listing as threatened, FWS leadership overruled these conclusions and declined to list the wolverine. A federal court subsequently concluded that the decision to deny protections was not consistent with the best

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available science, and was likely due to the “immense political pressure that was brought to bear” by the States that opposed listing (Defenders of Wildlife v S. Jewell et al., United States District Court for the District of Montana Missoula Division. CV 14-246-M-DLC. 2016). If regulations had required the decision not to list to be subject to review by non-governmental experts, these issues might have been resolved before litigation was necessary. Although increasing the number of decisions requiring outside peer review would result in increased time and resource costs for the agency, this might be offset by more robust conservation outcomes and increased success in defending decisions from litigation.

Even in the Canadian system, where scientific advice is required to inform both positive and negative listing decisions, political actions can effectively constrain the role of scientific advice in the process. While COSEWIC assessments are based solely on evidence, species receive no formal protection until the relevant Minister transmits the species at risk files to Cabinet for final approval and a consultation process concludes (Hutchings et al. 2017). This legislative loophole has allowed for political-motivated delays. Under the Harper administration, the Minister of Environment ceased transmitting COSEWIC advice to Cabinet to delay protection to as many as 198 species, subspecies, and distinct populations in Canada, including the shortnose sturgeon (*Acipenser brevirostrum*)(Noel 2016)(Figure 1).

Agencies also often seek to narrowly define the scientific questions presented to peer reviewers in order to insulate controversial scientific determinations from review. Examples of inappropriate limitations of the scope of peer review include the review of Klamath Basin water policies by the National Academy of Sciences and National Research Council, whose scope was manipulated from the outset by direction from then US Vice President Cheney (Fein 2011). A second example is the review of the proposed delisting determination for the gray wolf (*Canis* *lupus*), which was directed to solely focus on taxonomic issues, rather than encompassing the full spectrum of scientific questions on available habitat and other topics relevant to the analysis required under the ESA (FWS 2013).

REFORM: ENSURE A DIVERSITY OF INDEPENDENT SCIENTIFIC INPUT WITH TRANSPARENCY REGARDING CONFLICTS OF INTEREST

Selection of peer reviewers by agencies and contractors remains vulnerable to political interference. FWS often includes a clause in the Statement of Work for peer reviews, stating that prior “advocacy” disqualifies scientists from serving as peer reviewers (FWS 2013). This clause has been used to exclude scientists who interpret their science to the broader public or comment during a regulatory comment period. Because scientists who have taken positions supportive of agency policy are typically not considered advocates, this screening process may lend a bias to reviews.

Apparently political screening processes can subvert the effectiveness of legislation intended to protect declining species. Prior to 2009, COSEWIC recommendations to the Minister for expert appointments were routinely and quickly accepted. Under the Harper administration, there were concerns over potential political interference after scientists who had publicly commented on conservation issues were denied renewal of their COSEWIC appointments (Noel 2016). In 2013, negative coverage of the exclusion of key experts from the peer review of national wolf delisting forced the FWS to suspend the initial contractor-led scientific peer review and instead commission a more independent review by the National Center for Ecological Analysis and Synthesis (Morell 2014). The review by a panel of experts (which included scientists previously excluded from the review), found that the proposal was not based on best available evidence (Morell 2014).

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Such "no advocate" reviewer selection policies, where they still exist, should be reformed to reflect peer review policies which explicitly value a diversity of independent and qualified scientific perspectives. Examples of such policies include the US Office of Management and Budget (OMB) policy, which provides that "[o]n most controversial issues, there exists a range of respected scientific viewpoints regarding interpretation of the available literature. Inviting reviewers with competing views on the science may lead to a sharper, more focused peer review. Indeed, as a final layer of review, some organizations (e.g., the US National Academy of Sciences [NAS]) specifically recruit reviewers with strong opinions to test the scientific strength and balance of their reports" (OMB 2002).

Another problematic aspect of current US agency peer review policies involves undisclosed conflicts of interest by the large corporate contractors frequently used to manage the peer review process. Although this approach gives the appearance of providing an arms-length separation between the agency and peer reviewers, the reality is often different. Conflict of interest may result in biased selection of peer reviewers, as well as a biased summary of peer reviews being provided by the contractor. Conflicts of interest may arise when the same corporation also performs services for entities that have a vested interest in the policy under review (Goldman et al. 2015). For example, a consulting firm that has managed hundreds of government peer reviews for toxicological assessments of chemicals, but also frequently conducts reviews for the chemical industry, has been criticized for relying on a small circle of experts with industry ties as reviewers (Inside Climate News 2014). Although the FWS has recently taken steps to document conflicts of interest by individual peer reviewers (FWS 2016), the new policy does not ensure transparency concerning conflict of interest by the contractors themselves.

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Finally, it is important to note that a key difference between peer review at scientific journals and the scientific review which occurs as part of regulatory decision-making is the absence in the latter of an independent editor or arbiter who decides whether the agency has adequately addressed shortcomings identified by reviewers (Greenwald et al. 2012). Agency peer review processes, especially for highly controversial decisions, could benefit from an additional round in which an arbiter evaluates the adequacy of the agency's response to reviewer concerns. Without this process, the only recourse to address an improper decision is a legal challenge. At a minimum, agencies should be required to produce a detailed statement resembling the response to reviewers required by scientific journals, rather than a general response to public comments as required under current policies.

CONCLUSION: STRENGTHENING SOCIETAL SUPPORT FOR SCIENTIFIC INTEGRITY

Although the reforms described above can provide procedural safeguards, the most important factor in protecting scientific integrity may be consistent support from agency leaders and other political appointees. A key lesson from the Canadian experience is that undermining scientific integrity creates a cultural change in the public service that is slow to undo, even after formal policy reform. To institutionalize a culture of scientific integrity, agency leaders should be appointed who show solid track records of supporting determinations made by scientists in the face of political pressure. Policies designed to ensure agency scientists are insulated from political pressure should be compared between agencies, and best practices adopted more uniformly across agencies in order to implement a structure and culture that supports independent science (Lowell & Kelly 2016). Agency culture should encourage and reward government scientists when they publish policy-relevant research in peer-reviewed science journals, speak publicly about scientific findings, present at scientific conferences, and join and participate in professional scientific societies.

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Scientific societies can play a valuable public service by performing independent scientific reviews of draft agency decisions. An example is the review of the recovery plan for the Northern Spotted Owl (*Strix occidentalis caurina*) by three US scientific societies which identified deficiencies that led the subsequent administration to substantially revise the recovery plan (SCB 2008)(Figure 1). Agencies should engage independent non-profit scientific organizations to oversee the peer review process to increase the independence of the process from political pressure. Such organizations include academic institutes, universities and scientific societies in the relevant fields. Agencies should invite reviews from scientific societies even in cases where the primary review is done elsewhere, rather than simply passively accepting such input as part of the general public comment process.

In turn, scientific societies should work to increase engagement in the policy process by the scientific community. For example, scientific societies should encourage their members to contribute their expertise during public comment periods during agency rule-making. Recent research suggests that such public participation by scientists, if properly framed, does not negatively affect their credibility (Kotcher et al. 2017). There are complementary roles for scientific societies, public sector unions, and other non-governmental organizations (e.g., the Union of Concerned Scientists and Evidence for Democracy in the US and Canada, respectively) in publicizing and contesting integrity abuses, and some roles will be more appropriately filled by the latter groups than by scientific societies.

Scientific societies can also assist in building public support for the use of evidence in decision-making, via coalitions between scientific societies in many disciplines and other non-governmental organizations. The most prominent recent example is the global March for Science, which involves over 100 scientific organizations in over 400 events designed to defend

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scientific integrity and increase awareness of positive role of science in society (Wessel 2017). Given recent trends towards politicization of science around issues such as climate change, scientists have a civic responsibility to engage with the wider public to affirm that science is a crucial resource for developing evidence-based policy and regulations that are in the public interest (McCright & Dunlap 2011; Garrard et al. 2016).

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Table 1. Categories of policy reform discussed in this review.

A. Outbound communication from government scientists to public

1. Strengthen scientific integrity policies;

2. Include scientists' right to speak freely in collective bargaining agreements;

3. Guarantee public access to scientific information;

4. Strengthen agency culture supporting scientific integrity;

B. Inbound communication from independent scientists to government policy processes

5. Broaden the scope of independent reviews;

6. Ensure greater diversity of input with transparency regarding conflicts of interest;

7. Require substantive response to input by agencies;

8. Engage proactively with scientific societies and organizations.

FIGURE LEGEND

Figure 1. Species which provide examples of the challenges to scientific integrity discussed in this study. Clockwise from lower right: protection of the shortnose sturgeon in Canada and listing of the wolverine as threatened in the US were delayed by political considerations; the US recovery plan for the Northern Spotted Owl was revised after being critically reviewed by 3 scientific societies; news of the rediscovery of the shrub *Hibbertia fumana* was delayed until a development on the site had been permitted.