Conservation science and the ethos of restraint

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Abstract
Despite aiming to make conservation science and practice more effective, many conservationists default to excessive precaution, advocating conservative actions—or even inaction. The field suffers from an understandable aversion to unintended consequences, especially for approaches involving biotechnology and “next-generation” interventions. We call this default precautionary attitude among conservationists the ethos of restraint and argue for replacing it with an ethos of responsible conservation action. Loosening the ethos of restraint will require (a) more holistically accounting for comparative risks, benefits, and costs of novel approaches; (b) gathering more data on their consequences; (c) engaging in dialogue about intended consequences and conservation values; and (d) pursuing adaptive implementation strategies. Adopting an ethos of responsible conservation action requires grasping that precaution and proaction are not diametrically opposed attitudes. Instead, we must decide what level of precaution or proaction is warranted, and what to do, on a case-by-case basis.

KEYWORDS
biotechnology, conservation values, environmental ethics, intended consequences, precautionary principle, proactionary principle, risk assessment

1 | INTRODUCTION

The thesis of this special issue of Conservation Science and Practice is that biotechnology and conservation genetics are under-utilized tools capable of slowing species loss and the erosion of biodiversity. Articles in this issue identify and evaluate successful translocations (Smith & Peterson, 2021), the potential for genetic modification to rescue species like the American chestnut (Newhouse & Powell, 2021), and the need to systematically collect and standardize evaluative data on these forms of conservation interventions (Novak, Phelan, & Weber, 2021). All these approaches resist what we call an ethos of restraint: an attitude of excessive precaution that threatens to miss opportunities for advancing conservation goals by restricting the implementation of novel conservation techniques. In this article, we identify the ethos of restraint, diagnose its causes, examine assumptions about risk and precaution that reinforce this ethos, and argue that addressing it requires developing holistic approaches to risk management and decision-making, filling specific knowledge gaps, and developing norms and practices for ethical deliberation.

This paper addresses a growing sense that progress in conservation science has stalled, especially relative to the increasing urgency of achieving its mission. As in other normative and practical sciences, such as medicine, precaution is justified when ill-advised actions could have
significant and dangerous consequences. Yet choosing not to act in order to avoid unintended consequences can also paralyze the innovation required to better understand and address ongoing environmental decline. Taking a broader approach to conservation decision-making has the potential to shift debates about novel approaches from paralysis in the face of unintended consequences to robust planning for intended consequences. Without disregarding ethical considerations or abandoning inclusive deliberative processes, planning for intended consequences could replace the ethos of restraint with an ethos that encourages responsible conservation science in action (see Barnhill-Dilling & Delborne, 2021).

2 | AN EXCESS OF PRECAUTION

Whether the goal of conservation is preserving species, ecosystems, biodiversity, or wildness, there is increasing concern that traditional conservation strategies have been ineffective in the face of rapid habitat loss, pollution, invasive species, and the environmental effects of climate change. Traditional conservation strategies, such as establishing wilderness preserves and protecting endangered species from specific localized threats, presume that threats to conservation can be contained by limiting human activities. The genetic conservation strategies that concern us, on the other hand, accept a more active role for human agency. Rather than attempting to isolate nature from human influences, they try to:

- recruit existing agents to perform conservation tasks, for instance through biocontrol;
- accelerate adaptive processes, such as through genetic engineering and hybridization;
- assist natural movement through translocation.

Many of these methods, including translocation and hybridization, are in use but remain contentious in some cases. Others, such as genetic modification, have not yet been adopted as standard forms of intervention.

One key difference between traditional conservation techniques and newer genetic interventions is that the latter typically aim to achieve lasting effects with targeted short-term interventions. For instance, traditional techniques may rely on repeated applications of pesticide, while genetic modification or gene editing for disease or pest resistance could protect endangered species into the future (Corlett, 2017). But the success that novel techniques promise is closely tied to the hazards they pose: they aim to return a natural process to a population, species, or ecosystem so that it can maintain a trajectory toward recovery without the need for constant human management. Precisely because they remove the need for continual human intervention, these techniques risk a lasting change, perhaps with fewer opportunities for redirection or retraction than traditional strategies.

Consider the intentional hybridization of endangered populations or species and related unthreatened ones. Although this approach could contribute to successful conservation outcomes, the ethos of restraint speaks against it. For instance, hybridization has been used to rescue populations such as the Florida panther, but it has been controversial because the genetic uniqueness of a species or population is sacrificed for the sake of a competing conservation goal such as regional biodiversity. It is an active intervention used to modify populations so they can be self-sustaining. However, conservation hybridization, like other interventions, raises ethical questions about human responsibility for ecological change and how what is deemed a successful outcome relates to the integrity of hands-off processes, sometimes called wildness or naturalness. Such considerations can end up decoupled from risk assessments and contribute to gridlock—but they need not. As we argue below, revisiting the categories of harm and how they are weighed, assessed, and managed opens a path for more intentional deliberations about which actions best respond to value-based concerns.

Though conservation scientists are unified on the moral imperative to reduce the rate of biodiversity loss, they differ on how ambitious to be in developing and implementing new means to achieve that goal. Knowledge gaps combine with ethical concerns to create uncertainty not only about the possible consequences of interventions, but also about the role of scientists and practitioners in addressing value-based concerns and the steps needed to develop norms of use for genetic interventions. Consider the recent debate about assisted migration. While Ricciardi and Simberloff (2009a) pointed to the risks of translocated species becoming invasive, others questioned their interpretation of the data and underlying value assumptions (Sax, Smith, & Thompson, 2009; Schlaepfer, Helenbrook, Searing, & Shoemaker, 2009; Schwartz, Hellman, & McLachlan, 2009; Vitt, Havens, & Hoegh-Guldberg, 2009). Ricciardi and Simberloff expressed higher-level uncertainty about how to proceed given their judgment of standard risk assessment tools as untrustworthy and misleading (Ricciardi & Simberloff, 2009b). Despite subsequent developments in invasion science, assisted migration has not become a standard practice, illustrating how an ethos of restraint remains prevalent.

Theoretical understanding of possible uses for genetic techniques in conservation has outstripped practical plans for implementation (see Shafer et al., 2015). Genetic engineering has been used in agriculture for
nearly two decades, and possible uses of genetic engineering for conservation purposes, including restoring the American chestnut, abound, but conservationists have not agreed on scenarios where its use would be appropriate (Thomas et al., 2013). Translocations and hybridization have become increasingly relevant interventions, but researchers note concerns about ecological risks and ethical implications that must be addressed before the science can be implemented (van Oppen, Oliver, Putnam, & Gates, 2015). Conservation scientists have yet to fully explore how synthetic biology might be used as a conservation tool and how its use outside conservation might exacerbate conservation challenges (Piaggio et al., 2017; Redford, Adams, & Mace, 2013). Other novel but rarely utilized techniques include the collection of gametes from wild animals for surrogacy in captive populations (Redford, Jensen, & Breheny, 2012), as well as increasing the genetic diversity of populations by using genetic material from cryopreserved specimens, interspecific somatic cell nuclear transfer, cloning, and interspecific surrogacy (Comizzoli & Holt, 2019). Gene drives might be used to spread adaptive traits through a population or to spread deleterious traits through populations of invasive species in order to exterminate them (NASEM, 2016).

3 | DIAGNOSING THE ETHOS OF RESTRAINT

The ethos of restraint is based in several factors, including knowledge gaps, cultural and disciplinary barriers, and a rigid distinction between facts and values. Debates about the acceptability of genetic interventions often center on evaluating the risk of harmful consequences. As Sunstein (2003) argues, there are cognitive reasons for overemphasizing certain risks and discounting others: often, people have a stronger aversion to potential loss relative to potential gains, and risks tend to be overemphasized when they are more salient. Combined with a failure to account for the systemic effects of inaction, including how hazards can materialize or increase as a result of regulation (Graham & Weiner, 1985), these dispositions can become reinforced and institutionalized (Sunstein, 2003; Sterling, 2007).

Although some conservation scientists argue we should proceed cautiously, others argue that effective conservation requires genetic interventions, but that the barriers are outside the purview of conservation science: i.e., there are cultural barriers in the wider society that must first be overcome, as well as legislative and regulatory barriers (Love Stowell, Pinzone, & Martin, 2017; Rudenko, Palmer, & Oye, 2018). Others have pointed to the difficulty of translational science and how mismatched assumptions, priorities, and norms between conservation researchers and practitioners in the field hinder implementation (Jarvis, Borelle, Bolland Breen, & Towns, 2015). Our diagnosis of the ethos of restraint shows that in addition to these external reasons, assumptions and norms internal to conservation science contribute to a culture of excessive precaution.

A restrained attitude toward novel approaches has its roots in the history of conservation. Not only have there been noteworthy mistakes made in translocating species for the sake of biocontrol (cane toads in Australia) and for erosion control and wildlife habitat (multiflora rose in the United States), there have also been reversals on conservation goals. For example, the last few decades have seen shifts from predator extermination programs to predator reintroduction (Estes et al., 2011), from fire suppression to a larger toolkit of fire control policies (Pyne, 1997), and, in general, a better appreciation of the role of disturbance, biodiversity, ecosystem interactions, and large-scale dynamism in Earth’s systems, such as climate change (Worster, 1994).

Epistemic humility is warranted. This historical awareness should lead to careful assessment of knowledge gaps, as well as nimbleness and creativity in designing interventions. But it need not establish a strict level of precaution in place of an ethos of responsible action.

Beyond sensitivity to knowledge gaps, the ethos of restraint is grounded in disciplinary norms that split the scientific investigation of facts from the normative investigation of values. In the linear view of the relationship between scientific research and science-informed public policy, policymakers solicit facts about possible actions from scientists, consult the public regarding ethical values, and then select policy actions that are both scientifically feasible and suited to public goals (Norton, 2005). According to this linear model, good science is value-free, and scientists should be restrained from advocating action or discussing values, an assumption that has been challenged for science in general and is less plausible for normative and practical sciences, such as conservation biology (Douglas, 2009; Pielke, 2007). Some, though not all, conservation scientists still feel it is necessary to hide their values or avoid advocacy (Stuart & Rizzolo, 2019). An ethos of restraint follows from uncertainty about how to address and integrate values into research and practice. On the one hand, when scientists explicitly address environmental values as driving their research and practice, they risk violating a disciplinary norm; on the other hand, a normative science like conservation biology cannot make the case for adopting novel techniques without appealing to the values that warrant such a change.
So, while the ethos of restraint is grounded in some common attitudes, it is not clear that these attitudes are always appropriate. Inaction also carries risk.

4 | THE FALSE DICHOTOMY BETWEEN PRECAUTION AND PROACTION

In an effort to address the concern that risks of inaction are underplayed in policy contexts, Holbrook and Briggle (2014) discuss two principles meant to guide policymakers where a proposed action will produce both harms and benefits, but where we lack scientific certainty as to the nature of those harms and benefits: (a) the precautionary principle and (b) the proactionary principle. Drawing the contrast in the starkest terms—Holbrook and Briggle refer to it as a “caricature”—precautionaries prefer to look at potential consequences before they act, while proactionaries prefer to act first and address the consequences of those actions later. Proactionaries tend to view themselves as “risk-takers” and to characterize precautionaries as “risk-averse.” Precautionaries tend to view themselves as “responsible” and to characterize proactionaries as “irresponsible” (Holbrook & Briggle, 2014, 61; see also Fuller & Lipinska, 2014).

However, as Holbrook and Briggle argue, this simplistic contrast between precautionaries and proactionaries is flawed. Instead of viewing precaution and proaction as diametrically opposed principles, we should view them as extremes on a scale along which we can slide freely. Rather than being anchored permanently to one end of the scale, policymakers should adjust their policymaking as the situation demands. For example, in dire emergencies, when the timeframe for initiating successful action is short and the costs of waiting for more complete data to reduce uncertainty are high, policymakers should tend toward proaction. In times of relative calm, when problematic situations are changing slowly and when both information and inclusive decision-making processes are available at low cost, they should tend toward precaution. In any case, policymakers should make their own decisions rather than allowing predetermined principles to make decisions for them (Holbrook & Briggle, 2014).

What might justify sliding toward proaction? Novak, Phelan, and Weber (2021) argue that some of the fears of unintended consequences rest on iconic historical examples of failed introductions that are poor analogues for today’s conservation interventions, and they collect data demonstrating that harmful unintended consequences are exceptionally rare for a large class of conservation strategies. We agree with Novak, Phelan, and Weber that better, more systematic and accessible data comparing harmful to beneficial consequences of conservation interventions could help conservationist scientists and practitioners update their priors on risks, benefits, and costs. In essence, such data can help shift from a regime of managing uncertainty to a regime of more robust planning armed with information about the probabilities of those outcomes (Sterling, 2007). These data can also inform improved frameworks for risk assessment and management that more holistically account for the harms of interventions versus the harms of inaction. Frameworks that consider a wider range of risks and help fill knowledge gaps can motivate other novel forms of management (Williams, Balmford, & Wilcove, 2020), including interventions that are more easily monitored or reversed (e.g., Noble et al., 2019). Better frameworks also require acknowledging the role of values in identifying types of harm, relevant timescales, and stakeholders. A more holistic risk–benefit framework can better codify the consequences of both action and inaction and make these judgments and tradeoffs more explicit (Evans & Palmer, 2018; Rudenko et al., 2018).

Although the preceding discussion of precaution and proaction applies to many policy contexts, we think it sheds especially useful light on conservation policy. The ethos of restraint in conservation freezes us at the extreme precautionary end of the scale. Even risk assessment has a hard time getting off the ground in the face of warnings of vague “unintended consequences.” While calls for more certainty and precaution can sometimes be justified, including to counteract a potential “innovation thrill” (Kaebnick et al., 2016), calling for additional research can also be a politically motivated strategy to delay technology development or revisions to governance frameworks (Evans & Palmer, 2018). But where concerns about risks and consequences can be made explicit and specific, the decision-making process may be used to increase the accuracy of predictions rather than to exacerbate gridlock (Sarewitz & Pielke, 2000). These assessments can also form the basis for adaptive systems for risk management that value feedback mechanisms and routes for learning that fill broader knowledge gaps (McCray, Oye, & Petersen, 2010).

Avoiding the precaution/proaction dichotomy in conservation science requires assembling disparate knowledge around specific conservation cases to inform improved assessments (Novak, Phelan, & Weber, 2021). Given that knowledge will always be imperfect, interventions should include management plans that seek to identify both intended and unintended consequences on timescales that can allow redirection. This means novel technologies may be phased in methodically in order to learn control techniques. Such policies may also motivate the development of techniques for improved monitoring.
Indeed, there is an important shift to be made between relying only on upstream assessment towards a system of ongoing monitoring. Rather than being paralyzed by ill-defined fears of unintended consequences, these changes can allow development of knowledge and policies to help achieve intended consequences. These approaches align with calls for more anticipatory and responsible approaches to the governance of research and innovation, which are also reflective of principles of adaptive management (Guston, 2014; Stilgoe, Owen, & McNaughten, 2013). The approach advocated here recognizes the value of balancing precaution and proaction in specific cases while emphasizing one or the other, depending on circumstances.

5 | MOVING BEYOND THE ETHOS OF RESTRAINT

We have argued that there is an ethos of restraint in conservation science and practice, and that this excess of caution regarding novel genetic interventions is motivated by incomplete knowledge about risks and means of control, disagreements about values, and higher-level uncertainty about how best to resolve knowledge gaps and address value disagreements. We have also argued that taking a more proactionary approach on a case-by-case basis is not at odds with precaution. While the ethos of restraint welds conservationists to the precautionary side of the scale, filling knowledge gaps, improving risk assessments, and addressing value disagreements permits replacing restraint with responsible action. What is needed is a way to frame this task so it is not so daunting that default presumptions stifle attempts to outline potential paths forward. Here is what we propose.

First, we must devise procedures for filling knowledge gaps. These gaps include (a) a systematic assessment of consequences of interventions (see Novak, Phelan, & Weber, 2021), (b) evaluative data on forecasting and tools for assessing benefits, risks, and costs (see Mozelewski & Scheller, 2021), (c) development of small-scale interventions, mesocosm studies, and means of control, and (d) better understanding of the indirect and social effects of technologies and conservation actions. These forms of knowledge should influence risk assessments and their use. For instance, advocates of restrained approaches often discount both the costs and uncertainties of continuous management interventions and the potential for novel interventions to be monitored and managed in the future.

Second, collecting this data and building improved assessments should acknowledge how research and implementation plans are linked to conservation goals and value judgments. Interventions should be judged on a case-by-case basis in their ecological and political context—not given sweeping acceptance or rejection based solely on the technology used—and case-based evaluation should include not only the likely short-term ecological consequences and costs of an intervention, but also its ability to generate knowledge relevant to other conservation actions and its broader effects on ways of life (Sandler, 2019, 2020). Arguments supporting the introduction of a transgenic American chestnut, for example, include its ability to address an urgent conservation need with a reliable technology in a reasonable timeframe, while also taking into account the larger ecological and social context of a decline in forest health, maintenance of the uniqueness of American chestnut, the ability to monitor and control the spread of a GM variety, the cultural value of chestnuts, and the opportunity to build long-term community commitment to forest conservation (Brister & Newhouse, 2020).

Understanding the risks, benefits, and costs of genetic interventions might also involve looking to more distant consequences: the use of IVF or stem cells to accomplish the genetic rescue of Northern White Rhinos might be defended on the grounds of developing practical techniques for the sake of additional rescues in the future and for its far-reaching goals in restoration (Ryder et al., 2020). For technologies that are still in the early stages of their development, the social effects to be investigated might include shifts in economic and political power (Preston, 2018).

Filling specific knowledge gaps to address uncertainties and develop practical knowledge will enable better informed—and, one hopes, better—decision-making. Comparisons between untried strategies and traditional conservation strategies may systematically underestimate the newer strategies. Many novel interventions are untried in the conservation context, and so there is relatively little specific data about how they will perform; but without a consensus among conservation researchers, practitioners, and stakeholders that they are worth pursuing, there is a lack of coordination to gain the knowledge and experience that would lead to improving such strategies. This dynamic can be seen, for instance, in amphibian captive breeding and reintroduction programs, where reintroduction is regarded as the ultimate goal. Captive breeding has been successful, but there is little progress to in situ interventions (Harding, Griffiths, & Pavajeua, 2015). Far more research takes place on threats to species and populations than on designing, implementing, and evaluating possible responses to threats (Williams et al., 2020). A presumption of doubt about the chances of achieving intended consequences inhibits the development of research programs on implementation practices that could
make new techniques more reliable and trusted. Giving greater priority and recognition to studies of conservation design and implementation will help replace the ethos of restraint with the freedom to decide to be more or less precautionary depending on the known reliability of a technology and the urgency of the case.

Third, we need to be prepared to weigh different values. Filling knowledge gaps is not sufficient for transforming conservation science’s cautious culture. The discipline’s presumption of caution is also tied to uncertainty about how to process normative deliberation. Conservation decisions have a normative component, and the values involved are complex. Decisions about whether and when to use genetic interventions require discussions about how to balance different environmental values, such as in the case of the Florida panther. Filling knowledge gaps related to implementation can improve assessments of benefits and costs of long term management needs, the risk of unintended consequences, and the risks that accompany inaction; but support for more ambitious conservation action also requires that a broad range of values attached to interventions be weighed (Sandler, 2019).

Treating science as value-free blocks the necessary evaluations needed to apply conservation science. First, it blocks these evaluations by mistakenly promoting the view that values do not and should not influence scientific research (Shrader-Frechette, 1996). Values affect evaluations of what counts as a problem versus the acceptability of a status quo, contribute to prioritizing research goals, and inform the imagination of practical possibilities. Unless conservationists and stakeholders are clear about their value commitments and remain open to changing their minds, the status quo gains default status. At the same time, an unspoken norm that prohibits open discussion of values can lead to masking values as facts (Yanco, Nelson, & Ramp, 2019). Narrowing the range of values that are discussed may also exacerbate misunderstanding and deadlock, while avoiding these undesired outcomes requires explicit support for understanding how ethics, values, emotions, and psychology influence conservation decision-making (Schwartz, 2020).

Openly discussing values, on the other hand, may provide an opportunity to discover miscommunication about value-laden terms (such as nature) and may lead to clarification about how to map normative goals to outcomes. Such discussions may also open up new avenues of normative inquiry. When it comes to genetic interventions, an important area of value inquiry that remains undecided is how to evaluate their naturalness. In the case of the American chestnut, different ways of defining what is natural may lead some people to assess the precise manipulation genes in the GM variety as the least disruptive intervention; others may define its loss or a hybrid variety as more natural (Brister & Newhouse, 2020). Another case is the question of whether facilitated adaptation through gene editing would affect the wildness of small mountain-dwelling rodents, called pika, threatened by climate change.

Much depends on what is meant, specifically, by wildness. There are at least seven distinct meanings, and according to one detailed account, it appears that facilitated adaptation would increase the pika’s wildness in three of these senses, decrease it in two, and be undefined or neutral in another two (Palmer, 2016). Further discussion among conservation scientists, environmental philosophers, stakeholders, and publics are needed in order to work out which of these senses of wildness are core goals for conservation action to address.

So, fourth, we need to let go of the idea that values evolve independent of scientific knowledge (Baumgaertner & Holthuijzen, 2017). In the tradition of positivist science and philosophy, values lie outside the realm of rationality; more recently, philosophers have demonstrated how value judgments are responsive to improved empirical understanding (Anderson, 2004). Values are no more fact-free than facts are value-free. In the past, conservation scientists may not have been expected to participate in stakeholder discussions about values or to interpret how their research findings relate to community values. However, scientific knowledge can help inform values discussions by describing the urgency of the situation, the variety of interventions available, risks of intervention and of inaction, and the nature of interventions. Best practices for conservation practice now emphasize designing interventions with community goals in mind, while providing communities with learning opportunities to shape both knowledge and values (NASEM, 2016, Ch. 7). Thus, the effective achievement of conservation goals may rest on conservation scientists taking an active and explicit, rather than passive, role in soliciting and attending to normative reasoning both within the discipline and with external stakeholders (Stuart & Rizzolo, 2019).

FROM RESTRAINT TO MEASURED PROACTIVITY

The establishment of decision-making approaches that address the reduction of harmful consequences while also addressing the achievement of positive intended consequences requires generating new knowledge. First, it requires identifying and addressing the knowledge gaps
that inhibit innovative practice when there are high levels of uncertainty and concerns about high-stakes errors (Palmer, Fukuyama, & Relman, 2015). Second, it requires attending to the interplay between values and empirical knowledge, such as evaluating the long-term success of conservation projects in terms of achieving socioeconomic or ethical goals. Where values commitments are either implicit or unclear, field philosophers might be able to help (Brister & Frodeman, 2020). Third, it requires the consideration of different values, establishing risk assessment processes and benefit–cost analyses that plan for adaptation and consider not only the potential harms of taking action, but also the potential benefits of success and the possible harms of inaction. These steps toward filling knowledge gaps and improving decision-making approaches could yield better coordination between conservation researchers and practitioners and improve communication with stakeholders about how to address risks in ways that would relieve ethical concerns. And, fourth, this requires updating our understanding of the relationship between facts and values.

We have argued that adopting precaution as a default principle reduces policy choices and inhibits forms of research needed for effective conservation practice. Instead, the ethos of restraint should be replaced with case-by-case evaluation of the appropriate balance between precaution and proaction. Practically, what is required is more knowledge of the effectiveness of conservation practices; support for research into novel conservation strategies; risk assessment and benefit–cost analyses that take the harms of inaction into account; translational knowledge between conservation research and practice; and creating communities of active ongoing feedback and learning. In other words, we are advocating against an ethos of conservation inaction. In its place, we recommend an ethos of responsible conservation in action.

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