



# Cultivating Creativity in Conservation Science

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**Abstract:** *Conservation practitioners and scientists are often faced with seemingly intractable problems in which traditional approaches fail. While other sectors (e.g., business) frequently emphasize creative thinking to overcome complex challenges, creativity is rarely identified as an essential skill for conservationists. Yet more creative approaches are urgently needed in the effort to sustain Earth's biodiversity. We identified 4 strategies to develop skills in creative thinking and discuss underlying research and examples supporting each strategy. First, by breaking down barriers between disciplines and surrounding oneself with unfamiliar people, concepts, and perspectives, one can expand base knowledge and experiences and increase the potential for new combinations of ideas. Second, by meeting people where they are (both literally and figuratively), one exposes oneself to new environments and perspectives, which again broadens experiences and increases ability to communicate effectively with stakeholders. Third, by embracing risk responsibly, one is more likely to develop new, nontraditional solutions and be open to high-impact outcomes. Finally, by following a cycle of learning, struggle, and reflection, one can trigger neurophysiological changes that allow the brain to become more creative. Creativity is a learned trait, rather than an innate skill. It can be actively developed at both the individual and institutional levels, and learning to navigate the relevant social and practical barriers is key to the process. To maximize the success of conservation in the face of escalating challenges, one must take advantage of what has been learned from other disciplines and foster creativity as both a professional skill and an essential component of career training and individual development.*

**Keywords:** creative, creativity training, effective conservation, innovative, strategic

Cultivando la Creatividad en la Ciencia de la Conservación

**Resumen:** *Los practicantes de la conservación y los científicos frecuentemente se enfrentan a problemas aparentemente intratables en los cuales los acercamientos tradicionales fallan. Mientras otros sectores (p. ej.: empresarial) enfatizan frecuentemente el pensamiento creativo para sobreponerse a retos complejos, la creatividad rara vez se identifica como una habilidad esencial para los conservacionistas. A pesar de esto se necesitan urgentemente más acercamientos creativos en el esfuerzo de mantener la biodiversidad de la Tierra. Identificamos 4 estrategias para desarrollar habilidades en el pensamiento creativo y discutir investigaciones subyacentes y ejemplos que apoyan cada estrategia. Primero, al romper barreras entre disciplinas y rodeándose de gente, conceptos y perspectivas desconocidas, uno puede expandir el conocimiento básico y las experiencias; e incrementar el potencial de combinaciones nuevas de estas ideas. Segundo, al conocer en donde están (tanto literal como figurativamente), uno se expone a nuevos ambientes y perspectivas,*

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lo que también amplía las experiencias e incrementa la habilidad de comunicarse efectivamente con las partes interesadas. Tercero, al aceptar responsablemente el riesgo, es más probable desarrollar soluciones nuevas y no-tradicionales y estar más abierto a resultados de alto impacto. Finalmente, al seguir un ciclo de aprendizaje, lucha y reflexión, uno puede disparar cambios neurofisiológicos que permiten al cerebro volverse más creativo. La creatividad es una habilidad aprendida y no una innata. Puede desarrollarse activamente tanto en el nivel individual como en el institucional y aprender a navegar las barreras sociales y prácticas relevantes es clave en este proceso. Para maximizar el éxito de la conservación frente a retos crecientes, uno debe tomar ventaja de lo que se ha aprendido de otras disciplinas y cultivar la creatividad como una habilidad profesional y un componente esencial del entrenamiento en la carrera y el desarrollo individual.

**Palabras Clave:** conservación efectiva, Creativo, entrenamiento en la creatividad, estratégico, innovador

## Introduction

Conservation professionals face enormous challenges and unexpected opportunities in a rapidly changing world. Extinction risk has been evaluated for less than 4% of the estimated 1.7 million animal and plant species, and ~30% of assessed species are considered threatened (IUCN 2012). Broad-scale and complex threats such as climate change, habitat fragmentation, and infectious disease are playing larger roles in biodiversity loss (Homer-Dixon 2000). Most conservation challenges elude a quick and easy solution, in part because lack of knowledge is not the primary barrier to success (Fischer et al. 2012a). Rather, the most intractable problems usually stem from the need to change social norms or human behavior. Often overlooked in the discussion of conservation and human behavior is creativity, a quintessential human trait. By cultivating this quality in conservation professionals, we can work with human nature to help sustain Earth's biodiversity.

Individuals working across many fields have proven that even persistent, pervasive challenges can be overcome by creative problem solving. In conservation, a number of creative, seemingly bizarre ideas have helped sustain species diversity. In the early 1970s, a "sperm helmet" was developed to collect semen from captive Peregrine Falcons (*Falco peregrinus*) by soliciting male birds to mate with the helmet, worn on a human head (Enderson 2005). In the 1980s, biologists from the International Crane Foundation donned full-length costumes and pioneered "isolation rearing" to prevent chicks from imprinting on humans (Nagendran & Horwich 1992). Today, U.S. National Park Service rangers are implanting microchips into developing ginseng roots to catch would-be poachers (Janiskee 2008). In Cameroon conservation practitioners use soccer games to build a network of relationships between National Park rangers, local hunters, and community members (e.g., Diotoh, personal communication). In Zimbabwe, land managers use rotational grazing as a means of reversing desertification and sequestering carbon (Sullivan 2013). Creative solutions with the largest conservation effects are also likely to be those that drive social innovation. These solutions will cross social

and organizational boundaries to achieve lasting change (Westley & Antadze 2010).

Where do creative ideas originate? How can we generate them more often? We define *creativity* as the ability to transcend traditional beliefs or practices to develop useful new ideas, strategies, and techniques to more effectively sustain Earth's biodiversity. This definition is intentionally broad (within a conservation context) and could include creative approaches to research, public policy, education, and outreach or on-the-ground projects. Among the obstacles to cultivating creativity in conservation practice is the notion that creativity is limited to rare, eureka-type moments in which entirely new ideas emerge. On the contrary, creative solutions most frequently arise from the hybridization of existing ideas and synergies involving many sources (Loehle 1990). Routine cross-disciplinary brainstorming can help to avoid "incorrect herding," where experts are biased against external ideas (Gunderson & Holling 2002). A vivid example of the value of cross-disciplinary idea exchange is the influence of Freudian theory on Arthur Tansley's ecosystem concept. During World War I, an unusual dream prompted Tansley to seek psychoanalysis from Sigmund Freud (Cameron & Forrester 1999). As Tansley learned about Freud's theories of brain networks, he began to see parallels with the organization of the natural world. From this transfer of ideas emerged the first concept of the ecosystem (Anker 2002)—an idea that dramatically affected the emerging field of ecology and ultimately helped spark the modern environmental movement (Worster 1994).

## Creative-Thinking Strategies

Creativity is evident in past conservation successes, yet we generally do not make a conscious effort to foster this trait in our training, research, or practice. Here, we highlight 4 strategies from psychological, neurological, and social-science research on creative thinking that, if prioritized, could increase our individual and collective abilities to address conservation challenges. These strategies are: surround oneself with unfamiliar people, concepts, and

points of view; meet people where they are; embrace risk; and value the cycle of learning, struggle, and reflection. Many of us engage in these practices to some extent, but we could do more as individuals and organizations to foster creativity. This list of strategies is not meant to be exhaustive, but it is intended to spark a broader conversation about creative practices in our field. Our goals here were to explicitly articulate the value of cultivating creativity in conservation; highlight research that reveals the importance of creativity for strategic problem solving; and draw attention to the untapped potential of creative thinking in conservation training, practice, and research.

### **Surrounding Oneself with Familiar People, Concepts, and Points of View**

The scientific community generally recognizes the benefits of specialists from different disciplines working together. Yet, although programs within major funding agencies encourage interdisciplinary approaches (e.g., National Science Foundation's IGERT program), academia has been slower to embrace these innovations (Campbell 2005). The field of conservation biology emerged from the understanding that interdisciplinary collaboration could generate creative solutions to sustaining biodiversity (Meine et al. 2006) and that conservation itself was part science and part art (Soulé 1985). A fundamental advantage of interdisciplinary research is that new combinations of ideas can kindle creativity and result in novel solutions to seemingly intractable problems. This principle applies not only to science, but also to conservation education and practice.

A well-developed body of literature indicates that exposure to novel concepts or points of view enhances creativity across multiple scales, from the individual to large corporations (West 2002; Leung et al. 2008). Groups of individuals with varied professional or cultural and socioeconomic background have a broader knowledge base and a greater capacity for generating ideas relative to homogeneous counterparts (West 2002). Diversity of thoughts and opinions expressed during group brainstorming sessions promotes constructive conflict and piggybacking on the ideas of others, processes that lead to idea generation (West 2002). This concept is creatively explored in the emerging field of ArtScience (Root-Bernstein et al. 2011) and in the purposeful convening of scientists and nonscientists within rapidly growing fields such as the new discipline of climate-change adaptation (Hansen & Hoffman 2011).

At the individual level, variety in pastimes, life experiences, and personal relationships may foster creativity in an analogous way—the diverse individual can draw from a broad range of experiences to creatively resolve conflicts with opposing pieces of information (Leung et al. 2008). Even brief multicultural experiences (e.g., 45 min viewing foreign media) can facilitate creative

story writing and idea generation (Leung et al. 2008). In the business world, diverse viewpoints provide a source of novel ideas, and continuous integration of novelty is essential for businesses to remain innovative and resilient (Westley & Antadze 2010). In the design of Pixar Animation Studios, Steve Jobs placed the bathrooms in the geographical center of his business operation, a seemingly inconvenient layout that fostered interactions and new ideas among employees from different work teams (Catmull 2008). Many Pixar employees have stories of creative insights sparked by a chance encounter on their way to the toilet (Catmull 2008). Conservation professionals can learn from business strategies that were developed to enhance creativity and that reveal how exposure to diversity is profitable even when it depletes total work hours and compromises traditional forms of productivity (Fischer et al. 2012b).

To build creativity, space for novel experiences in one's personal life and workplace needs to be created; thus, hobbies, artistic pursuits, or side interests become potential keys to problem solving in all areas of conservation (Loehle 1990). We recently (March 2011) convened a panel of 5 successful leaders from business, education, philanthropy, community organizing, and juvenile justice. Our goal was to identify key lessons applicable to our own work by engaging with unfamiliar people, disciplines, and concepts. From the discussion emerged the fundamental themes in this essay.

### **Meeting People Where They Are**

Creative insights can emerge by meeting people where they are. We define *meeting people where they are* as understanding an audience's perspective, tailoring actions and messaging to the audience's values and needs, and bringing one's efforts to the audience's physical location. For example, recognizing that the growth of protected areas (from <10,000 to >200,000 sites over the past 50 years) has outpaced capacity for conservation training, the Global Partnership for Professionalizing Protected Area Management (GPPAM) developed an innovative program to rapidly train reserve managers. The program combines the power of networks—the internet, open-source curricula, and peer-support systems—to provide low-cost, high-quality education to large numbers of students from around the world who would otherwise have no access to training (Muller 2013).

The need to meet people where they are is particularly acute for traditionally marginalized populations. Unfortunately, some conservation efforts have disenfranchised indigenous populations (e.g., Caiçaras in Brazilian rainforests, Bedouin in Syrian rangelands, and Native Americans throughout the western United States [Anderson & Berglund 2003; Brockington et al. 2008]). Engagement, collaboration, and learning from local communities may improve outcomes for both people and

conservation (Barrett et al. 2011). In efforts to meet people where they are, conservationists can also gain insight from social theorists, environmental anthropologists, and ethnographers who work at the interface between ecological and social sustainability to understand the full scope of human needs. These connections also provide a source of diversity, an essential resource for creativity (Westley & Antadze 2010). A culturally informed approach can also help identify the emotional factors that motivate people to act—an important consideration for inspiring behavioral change (Heath & Heath 2010).

Rather than a barrier to success, the need to understand other perspectives can become an impetus for creativity. For example, K. Terrell asked middle school teachers at a science workshop to write down what they knew and what they wanted to know about climate change. She summarized this information with Wordle ([www.wordle.net](http://www.wordle.net)). The resulting images (Fig. 1a & 1b) illustrated 3 key points; the teachers believed climate change was a real and important problem, were not skeptical or biased by misinformation, and mainly wanted to know how much humans affect the climate. Terrell used this information to focus her subsequent presentation on human causes and local effects of climate change, rather than correcting nonexistent misconceptions. The teachers created a final Wordle to illustrate what they had learned about climate change (Fig. 1c). Compared with the first 2 Wordle images, the third one was more comprehensive, specific, and locally relevant (and therefore more likely to be effective for students). As this example illustrates, one can give educators greater capacity to promote biodiversity conservation by understanding their viewpoints before one decides what information they need.

Obviously, meeting people where they are is more challenging when a hostile audience or high-stakes issue is involved. In the late 1990s, U.S. Forest Service Chief Michael Dombeck worked to promote the Roadless Rule, legislation that would protect vast areas of old-growth forest from road construction. Dombeck strategically framed his argument in economic terms: securing Clinton Administration support required understanding the priorities of federal stakeholders, and in this case an economic approach emphasizing the cost of building and maintaining roads was more politically defensible than emphasizing the inherent value of old-growth forest (Dombeck et al. 2003). Since its passage, the Roadless Rule has protected 23.7 million ha (58.5 million acres) of U.S. forests and over 280 species of conservation concern (Dombeck et al. 2003).

### Embracing and Managing Risk

Given the consequences of failure, it is understandable that taking risks by attempting new approaches or entertaining new ideas in conservation research and ap-

plications is minimized. Yet, avoiding such risk can stifle creativity (Sternberg & Kaufman 2010) and preclude the generation of truly novel, untried solutions. Einstein said, “If at first, the idea is not absurd, then there is no hope for it” (MacHale 2002). The key is to manage risk appropriately so that creative ideas can be tried and allowed to fail without imperiling a project or its stakeholders.

Embracing risk means first creating an atmosphere in which novel ideas are entertained by the group. Social scientist Brené Brown advocates “leaning into discomfort” when sharing ideas as a way of building tolerance for risk and enhancing individual creativity (Brown 2007). An organization’s receptivity to risky ideas can influence both institutional and individual creativity. Because individual creativity is dependent on context and group dynamics, the broader workplace culture also has a direct effect on fostering creative solutions (Catmull 2008). Individuals demonstrate greater creativity when motivated to achieve positive outcomes, rather than when motivated to avoid failure (Amabile & Khaire 2008). Creativity can be encouraged by allowing employees to focus on topics of personal interest, by promoting constructive conflict, and by maintaining a positive environment that relies on rewards to motivate behavior (Nemeth et al. 2004; Catmull 2008). In the business sector, companies such as Google invest in creativity by giving employees 20% of their time to devote to projects of interest, rather than assigned work (Mediratta 2007). What would happen if conservation organizations did the same?

Fear of risk stems from fear of failure. In the business sector, failure is accepted as an integral part of the process of creative experimentation (Amabile & Khaire 2008). Using a portfolio approach (wherein risks and returns are balanced overall), businesses combine activities to yield a high chance of success even though individual components may fail. Similarly, government agencies and conservation nongovernmental organizations balance broad educational programs to influence the behavior of private landowners (e.g., Plant Conservation Alliance) against smaller scale but more reliable efforts to buy high-value conservation easements (Doremus 2003). An experimental prototyping approach allows failing ideas to be reworked or pruned judiciously (i.e., “failing often to succeed sooner” [Catmull 2008]). For example, the International Smart Gear Competition ([www.smartgear.org](http://www.smartgear.org)) provides a venue for small-scale trials in pursuit of large-scale success. Fishers submit ideas on new technologies to reduce fisheries bycatch (incidental capture of nontarget species) for a relatively modest top prize of \$30,000 (Bazilchuck 2005). The prize is substantially cheaper than penalty-driven enforcement of bycatch regulations, and the 2011 winner was a Japanese fisher whose invention reduced seabird bycatch by nearly 90%. Ideas from the competition provide rich material for further testing of the technologies at larger scales.



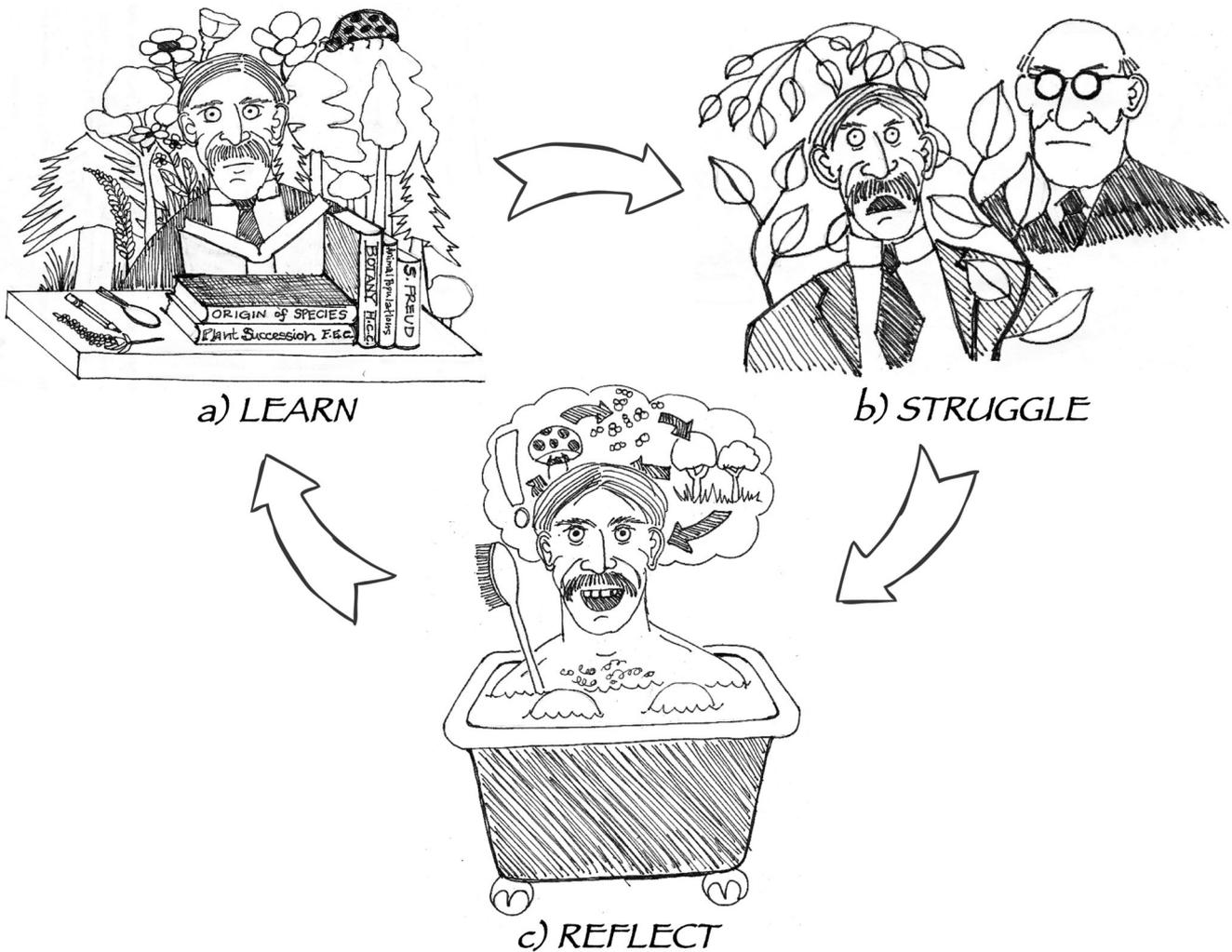


Figure 2. Artist's interpretation of Arthur Tansley engaging in the cycle of learning, struggle, and reflection. Tansley delves into the (a) ecological thinking of his time, (b) consults Freud about a strange dream while grappling to understand the natural world, and (c) during a period of relaxation has a sudden insight that leads to the ecosystem concept. Drawings by Peter Trenham.

of neural changes as the individual struggles with and reframes the problem (Loehle 1990; Sandküller & Bhattacharya 2008). Relaxed reflection (i.e., stepping away from the problem) promotes creative insights by facilitating interhemispheric brain connectivity which illuminates hidden relationships (Carlsson et al. 2000; Dietrich & Kanso 2010). Thus, in its most fundamental sense, cultivating creativity involves altering one's own neural physiology to perceive the world in new ways.

Collectively, these observations highlight the fundamental importance of 3 familiar elements of the conservation experience: cultivation of expertise, frustrating search for solutions, and the need to periodically take a break. As conservationists, under the pressure of urgency, a common pattern is to focus on the first, bemoan the second, and jettison the last. The above research suggests that all 3 are needed. Because reward systems that

focus on numeric productivity can discourage reflection and creative thinking, the pressure from some academic institutions to prioritize publication quantity over quality represents a barrier to creativity (Fischer et al. 2012b). Regardless of one's work environment, one must intentionally reframe challenges and value time for relaxed thought. In turn, the delight and surprise inherent in creative discovery provide motivation to stay engaged in the long run.

### Barriers to Creativity

Part of the creative process is learning to navigate social barriers, misaligned incentives, and systemic traps (e.g., institutional ruts) that impede the generation, testing, and implementation of creative ideas (Rogers 1995;

Gunderson & Holling 2002; Westley & Antadze 2010). Social barriers among individuals include defensiveness, feared rejection, conflict avoidance, self-interest, and stereotypes (Morris & Su 1999; Heifetz et al. 2009). Within groups, individuals communicate more effectively when they share beliefs, language, educational background, or other characteristics (Rogers 1995). It is therefore an ethical and creative necessity that conservationists understand different perceptions, view disagreement as constructive, and become skilled in recognizing and overcoming social barriers, especially those with potential to reinforce existing inequities (Rogers 1995; Dryzek 2005; Hulme 2009). Barriers to creativity are also constructed by those who actively stifle new ideas, including narrowly focused academics, agencies trapped by special interests, and powerful social or political hierarchies. Although essential to creative solutions, human foresight can create intentional barriers, especially when financial or social capital is at stake (Gunderson & Holling 2002).

Misaligned incentives such as perverse subsidies (i.e., subsidies that are harmful to both the economy and the environment) can create significant financial, political, and institutional barriers to new and creative approaches (Myers & Kent 2001). Perverse subsidies occur among a wide range of conservation-related sectors, including agriculture (e.g., U.S. Farm Bill), energy (e.g., in the United States, subsidies favoring fossil fuels over renewable energy development), infrastructure, water management, fisheries, and forestry (Myers & Kent 2001). Misaligned incentives in universities and other social-learning institutions (e.g., academia's dominant focus on publication rate) result in lost opportunities for risk-taking experimentation and creative breakthroughs. Conversely, by allocating more time and resources to creative activities, institutions could become powerful vehicles for systemic change (Carpenter & Folke 2006; Fazey et al. 2007; Fischer et al. 2012c).

Systemic traps occur across multiple scales, from small organizations to international agencies, and can impede creativity through several mechanisms (Gunderson & Holling 2002). Experts focused primarily on improving their own competencies rather than exploring orthogonal ways of thinking or untested approaches are caught within a "competency trap" (Gunderson & Holling 2002). A key strategy for avoiding this pitfall is to vary the way one's craft is practiced, while valuing humility, diverse pastimes, and multidisciplinary exchange (Gunderson & Holling 2002; Fazey et al. 2007). In the classic "rigidity trap," an organization or system loses capacity to be creative and instead perpetuates the status quo (Gunderson & Holling 2002). Teams of experts, academic disciplines, and technical bureaucracies are particularly susceptible to both competency and rigidity traps (Gunderson & Holling 2002).

A more insidious example of a systemic trap occurs when political or economic systems generate reinforc-

ing cycles of poverty and biodiversity loss (Gunderson & Holling 2002; Barrett et al. 2011). In "poverty traps," creative ideas may arise rapidly, but lack the means to move forward (Fazey et al. 2007; Barrett et al. 2011). The linkages between biodiversity loss and extreme poverty are evidenced by the 2-fold greater rate of species decline in poorer regions of the world (Barrett et al. 2011). Corruption, weak governance, lax enforcement of existing conservation protections, and economic manipulations often undermine creative conservation efforts and community well being (Laurance et al. 2011). For example, in efforts to preserve its rich biological heritage, Papua New Guinea helped develop the REDD (Reducing Emissions from Deforestation and Forest Degradation) program to link international forest conservation to carbon trading (Laurance et al. 2011). However, its citizens and ecosystems have been unable to fully realize the benefits of this program because of government and industry corruption (Laurance et al. 2011). In May 2010, the nation's parliament stripped communal groups of traditional land-rights protections "in an effort to increase certainty for resource developers by minimizing project delays from court injunctions" (Laurance et al. 2011). As a result, local communities cannot stop environmentally destructive projects, and human welfare is deteriorating along with ecosystems (Laurance et al. 2011). Conservation can be impeded by poverty, but it can also help alleviate poverty, particularly among communities that are strongly dependent on natural resources (Barrett et al. 2011). The observed relation between poverty and biodiversity loss is driving new and creative efforts, such as the development of economic instruments to encourage human-carnivore coexistence (Dickman et al. 2011) and to ensure economic and ecological well being in regions prone to natural disasters (Chantarat et al. 2011).

Collectively, social and institutional barriers may seem overwhelming, but the potential for societies to overcome these barriers and achieve creative solutions ultimately depends on the individual (Fazey et al. 2007). Effective response to global challenges such as climate change—currently hindered by all 3 systemic traps—will demand personal and institutional transformation and some degree of "creative destruction" in gridlocked systems (Fazey et al. 2007; Hansen & Hoffman 2011). Our list of barriers to creativity is not exhaustive, and other ecological, social, or technological factors—including path dependence, cognitive biases, and exploitation-exploration trade-offs—may limit the potential for discovery or application of creative solutions.

Not all creative ideas are necessarily good: many geoengineering solutions to climate change are creative, but are they worth the risk to natural processes? Similar questions appear in the current debate over deextinction, the proposal to reverse extinctions either via direct resurrection of extinct species with biotechnology or via rehabilitation of extinct processes and functions, as in rewilding

or taxon substitution (Donlan 2005). Proponents of such actions argue that humans are morally obligated to reverse their environmental effects by any means necessary and that deextinction will help prevent future extinctions by maintaining taxa that support essential ecological processes. Opponents of deextinction, by contrast, contend that a focus on deextinction will shift critical resources from extant species protection to an uncertain “fantasy” (Pimm 2013) and ignore socioeconomic realities (Toledo et al. 2011). The argument is likely to escalate as new technologies become available, additional ideas are proposed, and the extinction crisis deepens. We see this discussion as inherently healthy and important: having to weigh the benefits and risks of many creative options would be a welcome problem.

## The Future

Successful new approaches to biodiversity conservation will require a collective effort to enhance creativity in the field (Loehle 1990; Homer-Dixon 2000). Conservation professionals can do a better job of creating an environment that generates fresh insights by explicitly incorporating creativity training in the professional development of conservation scientists and practitioners. The value of this skill has been recognized in the business sector for over a decade (Driver 2001), and courses on creativity are offered in an increasing number of universities, primarily within business, education, psychology, and engineering programs (Xu et al. 2005). Nourishing creativity in conservation also requires stepping outside of our professional comfort zones, taking the time to recognize the views of diverse communities, engaging responsibly in higher risk projects, and valuing time for reflection and fun along with hard work. Each of these behaviors seems to contradict our instinctual response to a biological crisis. Investment in creativity, a perceived threat to short-term productivity, may itself appear risky. Yet the alternative—to expend our collective energy and talent by trudging along in a losing race—carries an even larger risk in the long term. We vote for the creative path. After all, it is a lot more fun. And, it just may be essential.

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