Taking Action on Climate Change in the Crown of the Continent Ecosystem

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The Challenge of Climate Adaptation Action

Within human and natural communities across the globe, the impacts of climate change are already visible, significant, and highly likely to accelerate with time (IPCC, 2014). Yet there are few examples of successful climate change adaptation: the process of developing and implementing strategies to moderate, cope with, or take advantage of the consequences of climate change. While substantial climate change adaptation planning is occurring, there remains a paucity of examples of adaptation measures that have been implemented, monitored, and evaluated, particularly at a large landscape scale (Bierbaum et al., 2013). The uptake and implementation of effective and appropriate climate adaptation actions faces many barriers, including the abundance and complexity of climate science, the lack of usable and accessible information, uncertainty about actions that can be effective in the short term and at a scale that will make a difference, in addition to shortfalls in funding and staffing to identify appropriate actions to implement (Moser and Ekstrom, 2010; Bierbaum et al., 2013).

In the Crown of the Continent Ecosystem ("Crown"), a globally significant, transboundary landscape linking the southern Canada and northern US Rockies (**Fig. 1**), climate warming is occurring at nearly twice the rate of the global average (Pederson et al., 2010). Spanning numerous public, aboriginal, and private lands, jurisdictional fragmentation adds complexity to the above challenges of successfully implementing climate change adaptation. We describe here a new and innovative partnership between public land and wildlife management agencies, environmental nongovernmental organizations (NGO's), tribes and First Nations, academic researchers, and community stakeholders underway in the Crown region that seeks to dismantle these barriers and promote the implementation of climate adaptation strategies and actions across the landscape. This emergent initiative, the Crown Adaptation Partnership, is a stakeholder-driven process that brings together actors across all jurisdictions to establish a shared understanding of climate change threats, prioritize climate conservation targets, identify effective climate change adaptation strategies, catalyze management action, and enhance shared learning through an adaptive management approach. We believe our emerging effort provides a new model for collaborative, climate-informed conservation at a large landscape scale, and describe here the origin of the partnership, our model of success, and lessons learned to date in hopes of inspiring similar progress toward landscape-scale climate adaptation action elsewhere.

The Crown of the Continent Ecosystem

The Crown is internationally recognized for its biodiversity and landscape form (UNESCO, 2010). Packed into 42,000 km^2 of the shared Rocky Mountain region of Montana, British Columbia and Alberta are flat grasslands that rise into lush forests and then into soaring peaks. Because of this diversity of biomes, the Crown possesses the greatest floristic and aquatic biodiversity in the Rocky Mountains. No known extinctions have been recorded in the Crown, and the region hosts extensive core habitats and linkage zones

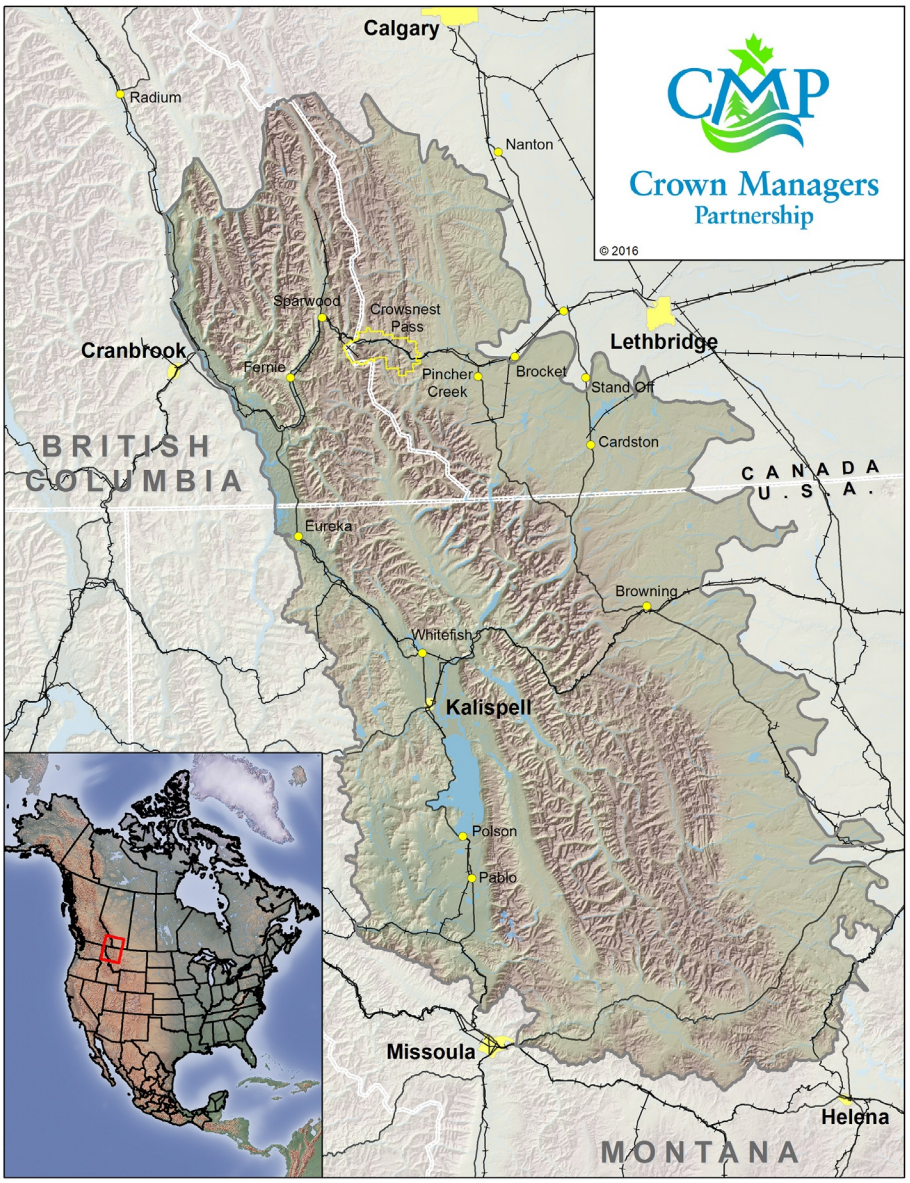

Fig. 1 The Crown of the Continent Ecosystem. Map courtesy of the Crown Managers Partnership.

for imperiled keystone species, including grizzly bear (*Ursus arctos horribilis*), wolverine (*Gulo gulo*), Canada lynx (*Lynx canadensis*), bull trout (*Salvelinus confluentus*), westslope cutthroat trout (*Oncorhynchus clarki lewisi*), and whitebark pine (*Pinus albicaulis*). Approximately 60% of the Crown is in public ownership, and a significant portion of public lands has been permanently protected through the designation of parks and wilderness areas.

Yet, draped across this remarkably intact landscape is a patch-work quilt of jurisdictions and geopolitical borders. The Crown spreads across two nations; one state and two provinces; and across numerous aboriginal lands, municipal authorities, public land blocks, private properties, and working landscapes. This jurisdictional complexity—and the recognized ecological and social value of the landscape—has driven a long and accomplished history of cross-border cooperation. The world's first International Peace Park—Waterton Glacier (now also a IUCN World Heritage Site and UNESCO Biosphere Reserve)—sits at the heart of the Crown, setting forward a vision that has formed the foundation for many subsequent forms of transboundary cooperation: "the environment does not respect borders, shared resources require shared management and Americans and Canadians can work as one to conserve our shared heritage for prosperity" (CMP, 2016).

Climate change is a pernicious threat, acting—albeit with variability—across the Crown landscape. Ecosystem-scale impacts of climate change in the Crown include changes in the timing and availability of water resources, changes in disturbance patterns and severity, including more frequent and severe wildfires, insect epidemics and diseases, the spread of noxious species, and the loss of habitat for keystone species (summaries provided by Hilty et al., 2017; Pederson et al., 2010; Halofsky et al., in press). As climate change continues to drive shifts in species' distributions, alter ecological processes, and transform ecosystems, an effective,

coordinated transboundary response to the threat of climate change at the scale of the Crown of the Continent Ecosystem is paramount.

CAP: An Emerging Landscape-Scale Multi-stakeholder Initiative

The Crown Adaptation Partnership (CAP) emerged as an organic evolution of established partnerships (Fig. 2) that collectively recognized a leadership gap in efforts to conceive, apply, and evaluate climate adaptation action at the landscape scale. As the science detailing climate change impacts in the Crown proliferated, an innovative assessment commissioned by the Crown Conservation Initiative (Nelson, 2014, summarized in Hilty et al., this volume), as well as a workshop held by the Crown Managers Partnership on climate change impacts made clear that climate adaptation actions across the landscape were patchily applied, sometimes inconsistent, and could benefit from articulation of broader landscape-scale desired outcomes (CMP, 2010). The phenomenon of increasingly sophisticated scientific analysis failing to inform conservation action has been termed the knowing–doing gap in conservation (Knight et al., 2008). As public land agency and conservation leaders, the authors of this article identified a collective need to confront and overcome the climate adaptation knowing–doing gap in the Crown.

Among the most frequently cited recommendations to protect biodiversity in the face of climate change is the adoption of a long-term, regional perspective, and improved coordination among scientists, land managers, politicians, and conservation organizations at regional scales (Heller and Zavaleta, 2009). Our team envisioned building upon our existing collaborative networks to engage multiple stakeholders at the landscape scale to use climate change science to articulate together practical and effective actions to advance climate change adaptation.

Recognizing that the most successful collaborative outcomes are stakeholder-driven (Scarlett, 2013), the CAP's first action was to convene a multiday workshop to collaboratively identify the shared needs and/or opportunities to promote collective adaptation

The Crown Adaptation Partnership Leadership Team

- *The Crown Managers Partnership*: Founded on the principals of the Waterton Glacier International Peace Park, the Crown Managers Partnership was established to address regional environmental issues, and has emerged as an enduring network of state, federal, and provincial managers who collectively define measures of ecological integrity in order to help align individual jurisdiction's mandates towards achieving transboundary conservation outcomes (CMP 2016).
- *The Crown Conservation Initiative*: A coalition of the leading non-profit conservation organizations, land trusts and science partners, in the region, the Crown Conservation Initiative unites partners around a shared conservation vision for the Crown of the Continent (Hilty et al. 2016, this volume).
- *The Wilderness Society*: The Wilderness Society has worked as a long-time partner and collaborator in the Crown through the application of science, policy, and communications coordinated across local, regional, and national levels.
- *The Northern Rockies Adaptation Partnership*: The U.S. Forest Service Northern Rockies Regional Office hosts a science-management collaboration across 13 National Forests with the goals of (a) assessing the vulnerability of natural resources and ecosystem services to climate change, and (b) developing science-based adaptation strategies that could be used by land managers to understand and mitigate the negative effects of climate change. Named the Northern Rockies Adaptation Partnership (NRAP), this ground-breaking U.S. Forest Service program is endeavoring to identify and implement climate adaptation management interventions across a huge swath of public lands based on the best available science.

Funding Partners of the Crown Adaptation Partnership

- *Roundtable on the Crown of the Continent:* As a forum to exchange ideas, build relationships, and explore opportunities to sustain the natural and cultural heritage of the Crown, the Roundtable partnered with the Kresge Foundation to fund implementation of climate adaptation strategies in the Crown through an Adaptive Management Initiative. This initiative inspired and provided early funding for the Crown Adaptation Partnership.
- *Great Northern Landscape Conservation Cooperative:* As one of 22 Landscape Conservation Cooperatives established by the U.S. Department of Interior to advance collaborative landscape conservation, the GNLCC has provided core funding to support the Crown Adaptation Partnership workshops and staff capacity.

Fig. 2 The Crown Adaptation Partnership emerged as a metapartnership between established landscape-scale entities who found a collective focus on climate adaptation was needed.

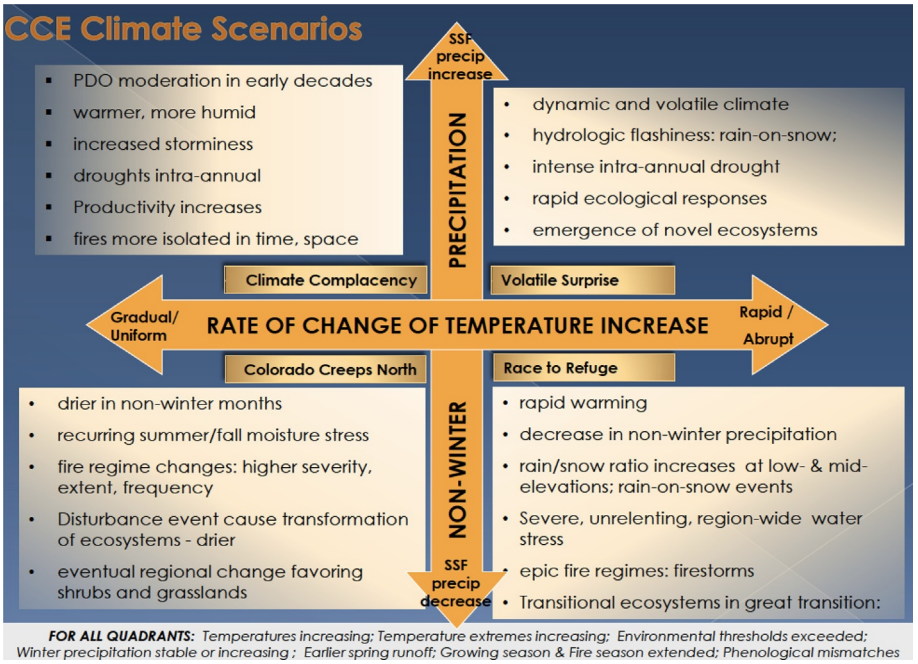

Fig. 3 Climate change scenario diagram for the Crown of the Continent Ecosystem, depicting four discrete scenarios along a range of potential temperature and precipitation spectrums.

Shared Needs
• Share messaging that allows consistent, effective communication with the public on the very difficult issues of climate change • Share the risks (often social) of working more visibly to address climate change impacts across the Crown by speaking with a unified voice and conducting coordinated activities • Create access for agency staff to participate in capacity building opportunities that NGO's have access to, and vice versa • Utilize and/or develop science at the scale of the entire landscape • Link monitoring efforts across the larger landscape
Shared Opportunities
• Identify new funding opportunities that require collaboration, or seek new public-private partnerships that can more easily direct funding to climate adaptation actions • Facilitate NGO's playing a leadership role in transmitting important messages about climate change impacts and management responses to elected officials • Develop coherent adaptation strategies across the Crown • Explicitly share (perhaps through online tools) ongoing efforts and lessons learned to facilitate learning and adaptive management at scale and to identify major gaps

Fig. 4 Shared needs and opportunities identified by multiple stakeholders in the Crown of the Continent Ecosystem to advance landscape-scale climate adaptation.

approaches across the landscape. Guided by principles of democracy, we convened a diverse and inclusive group of state, federal, and provincial agencies; tribes and First Nations; university and NGO staff, and local and community groups from across the 18-million-acre landscape, with representation at middle- and senior-management levels as well as on-the-ground biologists. In total, 46 participants representing 31 institutions attended.

To lay the foundation for discussion, we first worked through a scenario planning exercise (Peterson et al., 2003) that explored a suite of potential climate scenarios representing different ranges of temperature and precipitation shifts (Fig. 3). Workshop participants explored conservation and management priorities under each scenario, as well as potential responses. This exercise highlighted the species, ecosystems, and ecological processes likely to be consistently vulnerable to climatic changes at the landscape scale, and elevated understanding of the shared management and conservation challenges under a shifting climate.

The scenario planning exercise was followed by a series of large and small group discussions that were aimed at exploring common needs and challenges that jurisdictions faced in implementing climate adaptation action. Responses ranged from speaking with one voice (and using common messaging) about the urgent need to address climate change to build social will for action, to deploying cohesive and coordinated adaptation strategies across the landscape (Fig. 4).

Led by a skilled facilitator, workshop participants were asked directly if there was value in proactively working together in a coordinated way across the entire landscape to address the threats presented by a shifting climate. When participants responded in

the affirmative, they were then asked which natural resource targets might make the most sense for collaborative attention, and spent the rest of the workshop identifying a short list of possibilities. Recognizing that despite the high level of workshop participation, not all stakeholders were present, immediately after the workshop the CAP team circulated a follow-up survey to all participants as well as individuals who were not at the workshop, enabling a widespread vote on top priorities.

The final result of this process was the choice of six natural resource targets, which we all agreed to work on together moving forward. The six targets included (1) conserving and promoting cold-adapted native salmonid populations, (2) controlling noxious terrestrial plant species, (3) preventing the introduction of aquatic invasive species, (4) restoring whitebark and limber pine forests, (5) sustaining robust transboundary meso-carnivore populations, and (6) increasing the amount of prescribed fire projects, particularly in mixed-severity fire regime forests (CAP, 2014).

The intentional approach to invite all stakeholders, establish a mutual understanding of the ways in which varied climate futures could affect the Crown landscape, and the ways in which we asked stakeholders if there was a desire to work together and if so on what, was critical in setting up a successful collaboration. Because we had senior level (e.g., decision-makers) in the room with middle-level managers, we secured permission from those with authority to focus on collective priorities, as well as the buy-in from those who often carry out the day-to-day work and are responsible for a functional collaboration. Beyond identifying these shared priorities for action, the inaugural CAP workshop provided participants with the knowledge and peer support to become adaptation leaders within their own agencies, which is seen as a crucial step toward greater uptake of climate adaptation actions (Moser and Ekstrom, 2010).

Taking Action on Climate Change: Our Model of Success

Since the inaugural workshop, CAP has been working to address each of the six natural resource targets. To date, we have held four landscape-scale workshops, one each on native salmonids and terrestrial noxious plant species, and two on whitebark and limber pine (links to workshop reports and follow-up activities can be found at http://crownmanagers.org/). Through this experience, we have landed on a model of success that we now use as a template for collaboratively addressing each conservation target, the elements of which we describe here. This model of success provides a real-world example of the climate-smart conservation cycle described by Stein et al. (2014), and we discuss the ways in which our practical model aligns with and diverges from this ideal cycle in the concluding section.

Science Delivery: Expedite the Uptake and Use of Landscape-Scale Climate Science by Facilitating Dialogue Among Scientists, Managers, and Stakeholders

Climate change plays out at a landscape scale, so articulating appropriate adaptation actions at a local level requires an understanding of landscape-scale impacts and effective adaptation responses. Yet, landscape-scale climate science can be complex and difficult for local-scale managers to access and effectively use in decision-making. To overcome these barriers, each CAP workshop has focused on facilitating a dialogue between scientists, managers, and stakeholders. Scientists are invited to deliver to managers and practitioners both climate science impact data (e.g., vulnerability assessments) as well as tools (e.g., decision-support frameworks) that can support the uptake and application of science to decision-making. Moreover, as climate adaptation is a means for achieving conservation goals in a rapidly changing environment, not a stand-alone goal, CAP has focused on facilitating delivery of science and data by scientists in our region that can inform the cumulative impacts of multiple stressors on each of our priority conservation topics.

To use the Crown's native salmonid species—westslope cutthroat trout and bull trout—as an example: both require cold stream temperatures to thrive, and warming stream temperatures due to climate change are likely to reduce and fragment available habitat (Isaak et al., 2012; Jones et al., 2013). More acutely, however, native salmonids are threatened by habitat degradation, loss of stream connectivity, and invasive nonnative fish species that compete for resources and reduce genetic purity through hybridization (Muhlfeld et al., 2014; Kovach et al., 2016). To address these stressors cumulatively, regional fishery biologists continue to publish the results of cutting edge work that is directly relevant to these efforts (Muhlfeld et al., 2016; Kovach et al., 2015; Galloway et al., 2016), while partnering with CAP to develop indices to rank the cumulative threat to populations at the landscape scale, to help managers prioritize both populations and appropriate actions across the landscape (Muhlfeld and d'Angelo, unpublished). Additionally, partners have developed a three-step decision support framework to help managers and practitioners identify appropriate adaptation actions from a long list of potential actions, based on the relative vulnerability of species to these cumulative stressors (Nelson et al., 2016).

CAP has also stepped in to facilitate the development and delivery of new landscape-scale science where none exists. To provide managers and stakeholders with an understanding of how climate change might alter the existing distributions of terrestrial invasive plant species, CAP funded a Crown-wide analysis of predicted distributions of 10 priority invasive species under two climate scenarios (http://crownmanagers.org/terrestrial-invasive-species/). This analysis was particularly effective in showing where invasive species might threaten currently noninvaded jurisdictions, and provided stakeholders on the landscape with a common climate mapping template to work from in addressing terrestrial invasive plants in their individual jurisdictions.

Identify the Opportunities and Challenges for Adaptation Action by Jurisdiction

There are myriad jurisdictions in the Crown, each beholden to its own mission and mandates. While the CAP workshop attendees are driven by a shared vision to promote climate adaptation outcomes, the actions each jurisdiction can take are constrained or enabled by its mission. Paradoxically, this has become a great strength of a coordinated approach to climate adaptation at the landscape scale. Applying a diversity of adaptation actions in pursuit of a common strategy (e.g., not doing the same thing everywhere) is a common recommendation to bet-hedging when it comes to management uncertainty, particularly with regard to climate change. For example, lands managed by the US Park Service may be the most appropriate for actions associated with monitoring activities, or establishing controls as a counter to active management activities taken on multiple-use lands (Belote et al., 2014; Tabor et al., 2016). Untested or "pilot" actions might take place on private lands with willing landowners. For example, partners in Alberta are working with willing landowners to reintroduce beaver where it has been extirpated from its historical range to increase water storage and ecosystem function. These small pilot actions are effective in overcoming negative perceptions of beaver, and are essential in moving toward landscape-scale implementation of this particular climate adaptation strategy.

For each conservation priority, CAP has facilitated an explicit conversation about how partners can work together to overcome challenges that could impede success at the landscape level. For example, when discussing barriers to accelerating the pace and scale of restoration of whitebark pine—an imperiled high-elevation keystone forest species—managers in Alberta and British Columbia explained they are stymied by the lack of infrastructure to screen and grow blister rust-resistant whitebark seedlings for planting. This infrastructure exists in the United States, but moving plant material across the international border poses its own challenges. As a result, CAP is currently facilitating the development of interagency agreements that should help managers in Canada more effectively take advantage of US infrastructure in the future. Achievement of this level of landscape-scale coordination is a clear example of how CAP's convening role can advance on-the-ground adaptation action.

Learn From Pioneering Case Studies Across the Landscape

For each conservation priority, CAP has worked to highlight case studies of effective climate adaptation activities within or outside of the Crown landscape by inviting presentations or organizing webinars. For example, Glacier National Park has successfully completed a pilot project to translocate bull trout into high-elevation lakes that are expected to serve as climate refugia over the long term (Galloway et al., 2016). Their experience in identifying the critical factors for selecting an appropriate site for translocation provided an important case study for managers considering similar projects in other jurisdictions. As a result of this successful case study, state and federal partners are now actively pursuing translocation of native salmonids elsewhere in the Crown (L. Hoang, pers. comm.). Other innovative strategies pioneered by agency managers—including protecting areas of cold-water upwelling, targeting removal of invasive fish species in headwater refugia, reintroducing beaver, and deepening channels to decrease stream temperatures—served as important case studies during the workshop (CAP, 2015).

Case study presentations from the terrestrial invasive species workshop highlighted the importance of collaboration; working with neighbors and stakeholders to concentrate on common concerns. Several instances emerged where managers were implementing different strategies, prioritizing different species, and using contrasting measures of effectiveness (e.g., acres treated vs. extent of invasion) on adjacent jurisdictions. Preliminary climate scenario modeling of invasive plant distribution suggests that certain species will "jump" jurisdictions under future climate conditions, furthering the case for a cross-boundary, landscape-scale management approach. The case studies and climate modeling resulted in agreement that "management without borders" would be a measure of success among workshop participants. Development of a comprehensive Crown-wide Weed Management Strategy or "playbook" by which managers and practitioners prioritize species, identify and defend weed-free zones, and implement innovative weed treatments across the Crown emerged as a priority action. Managers in Alberta, British Columbia, and Montana are currently pursuing facilitation of a formal Crown Invasive Plant Network to develop this strategy.

Select and Apply Strategies

For each target, the process of selecting and applying strategies comes after workshop participants have had a chance to discuss and learn about relevant climate science available to inform decision-making, to understand and reflect on the various challenges and opportunities present across the landscape, and to hear about successful case studies. Drawing from this wealth of information, the CAP team next walks workshop participants through the process of selecting adaptation strategies that could be effectively coordinated, scaled-up, or piloted across the landscape. Emphasis is placed on developing and delivering coherent strategies and actions at the local level that roll up to landscape-scale outcomes. This formula is consistent across adaptation priorities, whether the focus has been on five-needle pines, native salmonids, or terrestrial invasive plants.

Some examples of climate adaptation strategies that have been selected for landscape-scale implementation as a result of CAP workshops include:

- Identify and protect of areas of climate refugia for westslope cutthroat trout and bull trout using best available science;
- Implement strategic and coordinated suppression of invasive rainbow trout in the transboundary Flathead watershed (an identified climate refugia watershed);

- Export successful bull trout translocation efforts in Glacier National Park to other jurisdictions;
- Develop common metrics and protocols for inventorying and detecting change among invasive plant species;
- Prioritize preventing invasions in weed-free areas, and develop common communications strategies to increase awareness of the threats of invasive plant species;
- Articulate and adopt best management practices for managing fire in whitebark and limber pine forests given climate change impacts;
- Develop a climate-smart conservation strategy for whitebark and limber pine in the Crown that details priority areas for restoration to maintain viable populations across the landscape;
- Develop a voluntary transboundary management protocol for prevention and detection of aquatic invasive species.

Armed with clear strategies for actions, managers and practitioners can return to their jurisdiction—be it public, tribal, aboriginal, or private lands—and implement projects that align with a coherent, science-based shared outcome for the conservation issue at hand.

Practice Network Learning and Adaptive Management

Climate adaptation as a community of practice is still nascent, and there are as yet few examples of successful climate adaptation implementation, evaluation, and adaptive management (Bierbaum et al., 2013). The diversity of institutions participating in CAP is a tremendous asset to encourage learning, as different actions are applied across the landscape in service of shared goals and outcomes. CAP is currently working to build an explicit learning structure, likely through the use of webinars and other on-line forms of communication where partners can share lessons learned. CAP is also currently considering the feasibility of working with partners to develop ecological metrics of success for our landscape, whereby we can measure the status and trends of ecological integrity of the Crown as a result of collective actions.

Lessons Learned

CAP began its work in 2014, and so is itself still an emerging effort. To date, we have hosted five workshops, and have provided staff capacity to assist stakeholders to work together to implement identified climate adaptation strategies. Workshop evaluations have all indicated a high level of satisfaction with the workshop template we describe in the preceding section. This template has been effective in helping stakeholders access and use available climate science, seek solutions to challenges hindering effective adaptation actions, learn from successful adaptation case studies, and identify clear adaptation strategies that can guide localized actions and complement actions taken by neighboring jurisdictions.

Despite our short tenure (2 years as of the writing of this article), the authors—the primary CAP leadership team—have identified a series of lessons that might inform other similar landscape-scale efforts:

- *Provide the context and tools for thinking at the landscape-scale*: Single jurisdictions—though increasingly being directed to take an "all-lands" approach—struggle to effectively think and work at a landscape scale. Providing a sustained venue to discuss effective means to achieve shared outcomes at the broad-scale contributes immensely to moving the needle. Essential for landscape-scale discussions is the development of seamless transboundary spatial data (e.g., roads, hydrology, land cover, fires), which has been a key initiative of the Crown Managers Partnership with funding and technical support from the Great Northern Landscape Conservation Cooperative of the US Fish & Wildlife Service. Consistent transboundary data and maps ground multi-jurisdictional discussions, and provide a landscape-scale reference for tracking change over time, regardless of the conservation priority. At each CAP workshop, there have been robust conversations about the importance of spatially explicit datasets, and where relevant datasets do not already exist, these datasets have been identified as an important gap to fill. Individual jurisdictions often have data-sharing restrictions, particularly for key species or management priorities. The CAP partnership has worked to overcome barriers to data access and data sharing, and to ensure that all data products and maps are publicly available on a user-friendly web interface. Long-term relationships and the development of value-added data products have been crucial to successfully accessing and sharing jurisdictional data.
- *Start with where the interest is*: Developing and implementing effective landscape-scale adaptation strategies begins with understanding the interests and appetites of agencies and stakeholders to advance climate adaptation action. Importantly, conservation priorities should be identified and agreed upon by stakeholders. Once these priorities are defined, delivering relevant, landscape-scale science, looking at effective case studies and strategies that have been applied successfully, defining an initial, achievable agenda, working collectively on delivering that, and enhancing, adapting, expanding in an incremental and iterative manner is an achievable order of steps.
- *Emphasize diversity and inclusiveness*: Diverse and inclusive collaboration—with organizations, agencies, tribes, and First Nations, university staff, NGO's, citizen groups, and existing collaboratives and coalitions—is critically important to the development and application of best available science and climate adaptation strategies across all management jurisdictions. Similarly, engaging a mixture of senior-level managers, middle managers, and on-the-ground biologists and partners ensures a robust problem-solving discussion that is more likely to result in coordinated action and learning across the landscape.

Step 1: Define planning purpose and scope by clarifying conservation goals, identifying conservation targets, specifying geographic scope and timeframe, and engaging partners.

Step 2: Assess climate impacts and vulnerabilities of selected conservation targets.

Step 3: Review and if necessary revise conservation goals and objectives to be climate-informed and forward looking.

Step 4: Identify possible adaptation options, articulating a broad array of alternative strategies and actions.

Step 5: Evaluate and select adaptation options, including those most likely to be effective from an ecological perspective, and feasible from social, technical and financial viewpoints.

Step 6: Implement priority adaptation actions.

Step 7: Track action effectiveness and ecological responses through monitoring, and adjust goals, strategies and actions as warranted.

Fig. 5 The climate-smart conservation cycle. Adapted from Stein, B. A., Glick, P., Edelson, N. A. and Staudt, A. (eds.) (2014). *Climate-smart conservation*: *putting adaptation principles into practice*. Washington, DC: National Wildlife Federation.

To ensure diversity, CAP has offered travel scholarships to our workshops to participants who might not otherwise be able to participate.

- *Plan for increasing needs for staff capacity and resources*: CAP was originally envisioned to act as a convener and catalyst for climate adaptation action across the landscape. However, we have found that there are important roles for CAP to play even after the initial workshop convening has occurred. Few workshop participants have the authorization or bandwidth to operate at a landscape scale, and so are reliant on CAP team members to provide the staff capacity to help deliver on workshop outcomes. As each conservation target is tackled in turn, the amount of coordination and collaboration required increases exponentially. Raising the funds to hire a full-time coordinator to provide on-going staff capacity on each of our conservation priorities has become an urgent priority.
- *Ensure strong facilitation*: Our workshops have benefitted immensely from having a skilled, objective facilitator working through an outcome-driven agenda. Following each CAP workshop, participants have consistently provided feedback in the evaluations that having an arms-length facilitator added great value to both the experience and the outcomes of the workshop.
- *Form a small yet diverse leadership team*: The CAP leadership team represents a balance of agency, NGO, and academic leaders, as well as a balance of expertise and skill sets. Our small team includes tenured land management professionals and environmental advocates, and individuals trained as scientists, policy experts, and managers, from professional and academic backgrounds. Perhaps most importantly, our team represents diverse types of leaders. Some of us provide strong thought leadership, while others of us lead with innate skills ranging from networking and broadening our partnership, to stewarding our ongoing efforts to ensure we deliver on promises. This diversity of leadership types has been defined as a key characteristic of success for landscape-scale partnerships (McKinney and Johnson, 2009).

Conclusions: Moving From Principles to Practice

By its nature, large landscape-scale conservation requires working within and across the policies (and politics) of multiple organizations, agencies, and interests. No single entity has the mandate or authority to operate at a landscape scale, and this gap must be filled by networks or partnerships that can build relationships, exchange ideas, transfer lessons, identify common interests,

explore options on how to work together, and solve problems of mutual interest (Scarlett and McKinney, 2016). CAP offers a real-world example of how multiple stakeholders can structure a partnership to advance climate adaptation action across a large landscape.

Useful guides have been developed to help managers and practitioners move through assessment, planning, implementation, and evaluation in a climate adaptation context. Chief among these is the climate-smart conservation cycle (Stein et al., 2014), a generalized framework that identifies seven discrete steps (see Fig. 5).

The model of success that CAP articulated here closely follows the climate-smart conservation cycle, and exemplifies how those steps can be applied in a real-world large-landscape context. Our own experience of moving through the climate-smart conservation cycle has led to the identification of additional components in this process that have the potential to increase the likelihood of long-term success (Fig. 6). For example, by asking diverse stakeholders from across the Crown landscape to select our key conservation targets based on an in-person climate scenario planning exercise, the scope and process for defining the planning purpose and identifying conservation targets changed significantly. Similarly, by asking partners and colleagues from the landscape to select one natural resource target to serve as a test case, we acknowledged the importance of using a prototype to start the climate adaptation process before expanding work to additional targets.

For each conservation target, we assess relevant climate impacts and key vulnerabilities by delivering landscape-scale science, but also by explicitly fostering dialog between scientists and stakeholders, to ensure science information is understood, available, and accessible. We help stakeholders identify a broad array of adaptation options by enabling a conversation about what is possible (or not) across various jurisdictions on the landscape, and we help mangers evaluate possible adaptation strategies by showcasing examples of strategies and tactics being applied in various parts of our landscape or outside of our landscape. Finally, we help to facilitate the selection of broad adaptation strategies that jurisdictions can align with when selecting local-scale actions to implement within their own discretionary authority.

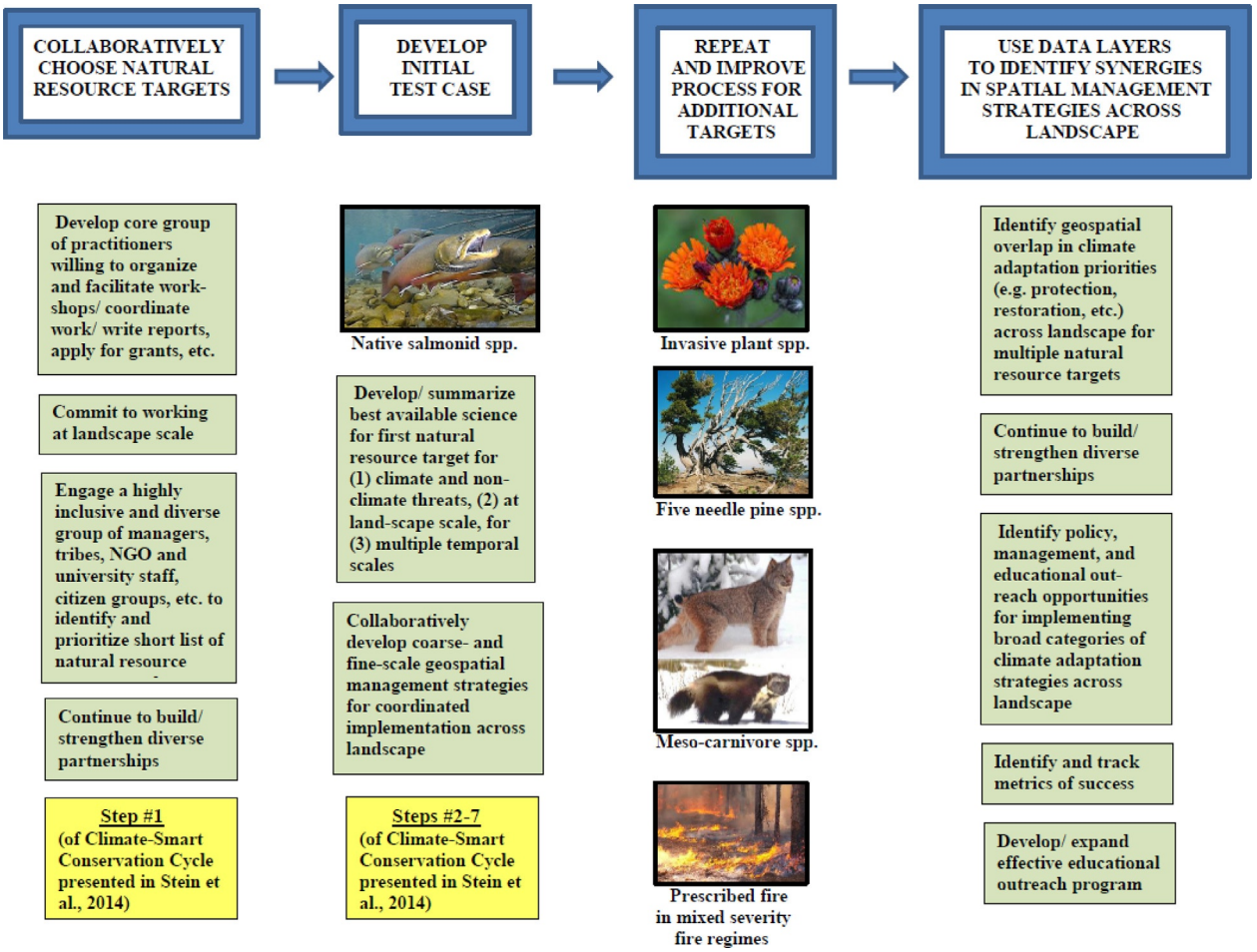

Fig. 6 Identification of additional components in the climate-smart conservation cycle that have the potential to increase the likelihood of long-term success. CAP's experience of developing and implementing a real-world example of the climate-smart conservation cycle has led us to suggest a more intentional and inclusive process for choosing and prioritizing natural resource targets to promote greater equity and engagement across the landscape (column 1); as well as more explicit thinking about the way in which lessons learned can be applied through time to improve the process and outcomes on each additional natural resource of focus (column 3) once the initial test case has been completed (column 2). Finally, we have added an additional series of steps to the process to develop clarity around potential synergies and conflicts *across* all of the natural resource targets through the consideration of coarse, geospatially-explicit conservation strategies prioritized for *each* natural resource target (column 4).

Looking ahead, CAP is focused on how we can begin to track the effectiveness of actions, and articulate metrics for success at the landscape scale. We are also mindful of the need to identify broad climate adaptation strategies (such as restoration, protection of potential climate refugia or key linkage zones) across multiple natural resource targets before cross-walking those geo-spatially linked strategies with policy, management, and educational outreach opportunities to support implementation. Knitting together existing monitoring networks, hosting online learning forums, and developing a State of the Crown report are all strategies that are currently being discussed, and are essential components to completing the climate-smart conservation cycle.

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