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GEORGE WRIGHT SOCIETY

P.O. Box 65
Hancock, Michigan 49930-0065 USA
1-906-487-9722 • fax 1-906-487-9405
www.georgewright.org

Climate Change Adaptation for Park Managers

David Welch, Parks Canada, 25 Eddy Street, 4th Floor, Gatineau, Quebec K1Z 5J3 Canada; david.welch@pc.gc.ca

Why adapt?

Protected areas will be impacted by climate change as much as other lands and waters in their natural regions. However, fewer mitigation and adaptation options exist for natural areas than for those that can be routinely manipulated. Park custodians must therefore adapt management practices to help maintain biodiversity and natural processes, to assist nature through its inevitable transitions, and to participate in communications and house-in-order programs. Adaptation is encouraged for several reasons:

- Climate change impacts cannot be prevented.
- Benefits will accrue from removing or halting maladaptive policies, practices, and stresses that increase vulnerability.
- Visitor activities and related infrastructure and marketing investments are tied to the timing and duration of climatic cycles and phases.
- Effective government is abetted by leadership by example. This means, for example, early achievement of greenhouse gas emission reductions from high-profile institutions such as parks.

How to adapt ... maybe

The protected area/climate change literature provides strong reasons for having parks and reserves, why there should be more of them, why they should be accorded enhanced protection, and how they might be selected. For example, the recommendations of Hannah et al. (2002) and (Hansen et al. 2003) include:

- Locate parks with climate change in mind;
- Avoid fragmentation—provide connectivity and maintain buffer zones;
- Represent vegetation types and diverse gene pools across environmental gradients;
- Determine the necessity to transplant species and control rapidly increasing species;
- Involve local communities for management of biodiversity;
- Strengthen research capacity, e.g., to model biodiversity under changing climates; and
- Conduct long-term monitoring to seek causality between climate change and biodiversity responses.

However, these and other reports provide little guidance to managers of existing protected areas, a gap this paper attempts to fill.

What to do

Core principles. I propose the following core principles for a climate change strategy for protected areas.

- **House in order and public communications.** A park agency can foster mitigation by putting its own emissions house in order, and can use its outreach and presentation activities to demonstrate leadership. Visitors are generally ready to soak up information and listen to sound arguments by credible proponents. Indirect contributions through interpretation, education, and outreach can far exceed in-house emission reductions, but credibility depends on such reductions.
- **Risk management.** Environments have a degree of resilience and in some cases can accommodate climate change by species migration or *in situ* adaptation. However, there are many other stresses impinging on ecological integrity, so I recommend a risk management approach whereby tractable stresses are reduced or eliminated. This can only happen through collaboration with stakeholders.
- **Focus on mandate, complement with partnerships.** Protected areas increasingly emphasize ecological and commemorative integrity in their mandates, outweighing tourism development, infrastructure, and regional economic development. Leave unto others the leadership of activities that are their responsibility. However, to the extent that internal capacity allows and that one's prime mandate is favored, cooperate in such activities. Education, emission reduction, and national science programs are good examples.
- **Porous landscapes.** Park agencies should promote the importance of regional ecosystems characterized by connectivity and porosity for wildlife movement. "Porosity" means not just defining wildlife corridors (connectivity), but removing impediments to movement across all lands. Examples include maintaining hedge rows and wood lots in agricultural areas, eliminating the cosmetic use of pesticides in urban areas, fostering dark sky preserves, and installing wildlife crossing alert lights on major highways, as in a Newfoundland pilot project.

Targets

Action plans need time-bound and measurable targets against which to assess progress, and to redefine schedules and activities as appropriate. I propose three time frames and related goals.

- Short-term: appropriate climate change information is available to ecosystem and asset managers.
- Mid-term: climate change is factored into all aspects of ecosystem and asset management, and reflected in park management plans.
- Long-term: parks are nested within landscapes that are porous for the movement of native species and free of other significant threats to ecological integrity.

Alarming actions

Many actions can be conceived to fulfill these principles and goals, examples of which follow. They can be grouped under categories that form the acronym ALARM:

- **A**wareness;
- **L**eading by example;
- **A**ctive management;
- **R**esearch; and
- **M**onitoring.

Awareness

Staff awareness. Full engagement in any action depends on staff having an appropriate level of understanding of climate change impacts and adaptation. Actions include disseminating summary documents, newsletters and technical reports, giving seminar and workshop presentations, and including climate change overviews in basic training components.

Stakeholder awareness. Successful adaptation depends in part on the management of surrounding natural areas. Urge your ecosystem partners to adapt in concert. Ideas include extending awareness activities, promoting ecological porosity between and around protected areas, and mitigating local and regional threats to ecological integrity.

General public awareness. The public should be made aware of the impacts of climate change upon species, ecosystems, and features, and what adaptations may be required. Interpretation programs should help visitors become aware of what they can do at home and at work, by direct actions and by spreading the word to their friends and family. Post a climate change summary on your Internet site. Work with education authorities and nongovernmental groups to deliver climate change information to children and adults alike.

Leading by example

Reduce greenhouse gas emissions. Park agencies can use their favorable public profile to promote minimizing building energy consumption through design and operational practices, reducing fleet size, switching to more energy-efficient vehicles, fuel switching, and taking advantage of emerging technologies.

Promote personal action plans for staff. Employees and volunteers can play a role through their personal actions at home and in their neighborhoods. Employers can provide transit passes rather than subsidizing parking. They can provide incentives for car pooling, cycle commuting, and telecommuting, and promote energy use reductions in homes and lifestyle choices.

Address climate change adaptation in park management plans. Given the enduring nature of parks and the long-term implications of climate change, adaptation should be addressed in management plans. For example, modify park purposes to protect processes and biodiversity rather than specific biomes and species. Review boundaries to seek opportunities for changes that optimize the protection and maintenance of ecological integrity. Endorse research and monitoring of indicators of climate change impacts. Take future climates and vegetation successions into account in ecosystem restoration projects such as fire restoration and land reclamation.

Report on natural and management adaptations to climate change. Whether reactive or adaptive, an integral part of management is the monitoring of progress towards a goal, assessing results, and modifying future actions accordingly. Documenting these processes is

essential to full debate and support. A regular report series is the best guarantee of systematic publishing, dissemination, and readership. Annual corporate reports and periodic state-of-the-park reports are often appropriate. Select indicators of climate change impacts for your park and its natural region, develop protocols, and implement monitoring, and collaborate with regional partners to report impacts to the public and policy makers.

Active ecosystem management

Adapt natural region representation strategy. As a basis for park establishment, natural region representation assures a distribution of parks across landscapes and ecotones, itself one of the best ways to protect biodiversity. It also deflects demands for land protection when there is already a park representing a specific region. Natural regions are typically based on physiography and vegetation. While physiography remains largely constant in anything less then geological time, vegetation has changed significantly in living memory. Climate change will accelerate this process to the extent that natural successions will evolve within decades. Therefore retain map entities of natural regions, but revise their descriptions to reflect the dynamics of present and future climate.

Eliminate or mitigate nonclimate *in situ* threats. The growing body of research on interactions between climate and nonclimate stresses suggests that responses are synergistic. To maintain or rebuild ecosystem resilience one must reduce the number and/or magnitude of insults faced by an ecosystem. Fortunately, many stressors are more locally and regionally controllable than climate change. In a freshwater system this may require limiting the concentration of toxic substances in effluent. In a forest ecosystem it may mean preventing fragmentation by access roads. These tasks are approachable on a local level through conservation partnerships.

Use adaptive management. The uncertainty about the exact nature of climate change impacts and responses requires a responsive, flexible approach to ecosystem management. Adaptive management allows one to proceed with only limited or uncertain knowledge. An intervention is conducted as if it were a scientific experiment, with measurable, time-bound targets set in advance, careful measurement of results as thing happen, and approaches adjusted as new information becomes available. Use adaptive management in impact abatements such as species protection or retardation of invasive pioneers.

Use climate change research results. It is not enough to have good primary science. There must be secondary products that digest and customize this knowledge for interdisciplinary professionals. Commission reports that translate the science to regional and park-specific data sets. Parks Canada has done this through the work of Scott (2003), which resulted in spreadsheets of annual, seasonal, and monthly temperature and precipitation data for several scenarios at three periods of the 21st century, accompanied by narrative projections of potential physical and biotic changes.

Park managers also need the tools to use climate change information in their decision-making processes. Climate change guidelines for environmental assessment are now available in Canada, covering projects that either have the potential to emit greenhouse gases, or projects that will be affected by climate change.

Adjust park boundaries as needed for climate change adaptation. Changes in climate

will lead to changes in habitats and species survival. Some plant species would have to migrate hundreds of kilometers to follow climate. Others might find a new home a short distance away. For the latter it may be possible to adjust park boundaries to capture the anticipated movement of habitats and species. Park boundaries could be realigned to accommodate transition zones where large changes of climate, habitat, and species distribution are expected.

Research

Understand the impact of past and future climate change. Decision-makers and park visitors alike benefit from a knowledge of Holocene landscape changes. This helps to understand the changeable nature of climate and nature's ability to adapt autonomously, even in historical times. Research the impacts of climate change on natural processes and visitor activities before committing to ecosystem restorations or visitor infrastructure development. Rate each park for its sensitivity to a $3xCO_2$ atmosphere.

Identify values at risk of being significantly affected by climate change. Identification of valued ecosystem components (VECs) provides a means to set management goals without bogging down in the minutiae of all species, all minerals, and so forth. Identify a limited suite of VECs that are sensitive to climate change, such as species at the margins of their climatic range, species with limited or excessive abilities to migrate, and temperature-sensitive features such as permafrost and ombrotrophic wetlands. Identify barriers to migration such as fragmented habitats and restricted vertical migration paths.

Monitoring

Data gathering and reporting actions. Each park should have long-term climate and climate change indicator data. These data should be reported at the park level and regional or national levels.

Promote parks as long-term integrated monitoring sites. Integrated monitoring can reveal unexpected linkages between ecosystem components and the drivers of environmental change. Each stress does not need its own unique set of indicators. Often, several stresses can be tracked from a limited but well-selected ensemble of indicators. Integrated monitoring also fosters partnerships in which many agencies share costs while reaping benefits greater than the sum of their inputs.

What not to do

Do not move parks to anticipated biomes. The presence of a well-distributed system of protected areas is one of society's best adaptations to climate change. Species will have their best chance of finding new homes in a well-managed, well-distributed, well-connected, and properly sized network. While some parks might benefit from local boundary adjustments to protect ecosystems and habitats at risk from climate change, the notion of dynamic parks must be rejected. This would open the door to other reasons to move a park, e.g., to extract minerals or fiber. Secondly, few natural areas remain for new park establishment within regions that already have park representation. Rather, the present parks are often all that remain as natural havens. Thirdly, park establishment is a lengthy process with no guarantee of success.

Do not use parks to buffer or mitigate other impacts. Parks are not an insurance policy to cover poor management of natural hazards and natural resource supply. The restoration, protection, and maintenance of natural systems precludes their manipulation to counter an anthropogenic threat. Ecosystem services may come about with the maintenance and restoration of ecological integrity, but parks should not be manipulated deliberately for flood protection, water supply, or carbon sequestration, for example. This could open the door to the commercialization of natural resources in parks.

Do not change natural regions to fit future biomes. The natural region representation approach to national park establishment has served Canada well since its adoption by the Federal Cabinet in 1976. The constancy of the number of regions and their boundaries has ever since been a cornerstone of the national park system plan. It helps to deflect lobbying to add a park just to satisfy vested local interests. If the precedent were to be set that the natural regions policy could be changed, then there could be no end to further pragmatic modifications of regions and parks.

All climate scenarios are based on assumptions about future emissions, the physics and chemistry of the atmosphere, and geographical simplifications to allow global models to operate on today's supercomputers. Vegetation response is likewise modeled on plant succession assumptions. While these represent today's best science, the placement of boundaries remains notional and subject to change as models improve and as the world develops real emission inventories rather than scenarios. To change natural region boundaries on this basis would open up a never-ending process, and create an unrealistic setting for park feasibility studies and establishment negotiations.

Conclusions

A good network of protected areas free of other stresses is already one of society's and nature's best available adaptations to climate change. Park agencies can also influence visitors and the general public, but this in turn requires well-researched and -monitored climate change impact indicators as the basis for adaptive ecosystem management, accountability, and reporting systems. House-in-order programs complement the messages that governments should send to their people. Research on the synergy between climate change and other processes can provide the knowledge to guide the mitigation of local and regional stresses, thereby restoring natural resilience of ecosystems and wild species.

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