

Species and Landscapes and People Responses to Climate Change

Gary M. Tabor VMD MSC

Center for Large Landscape Conservation

Freedom to Roam



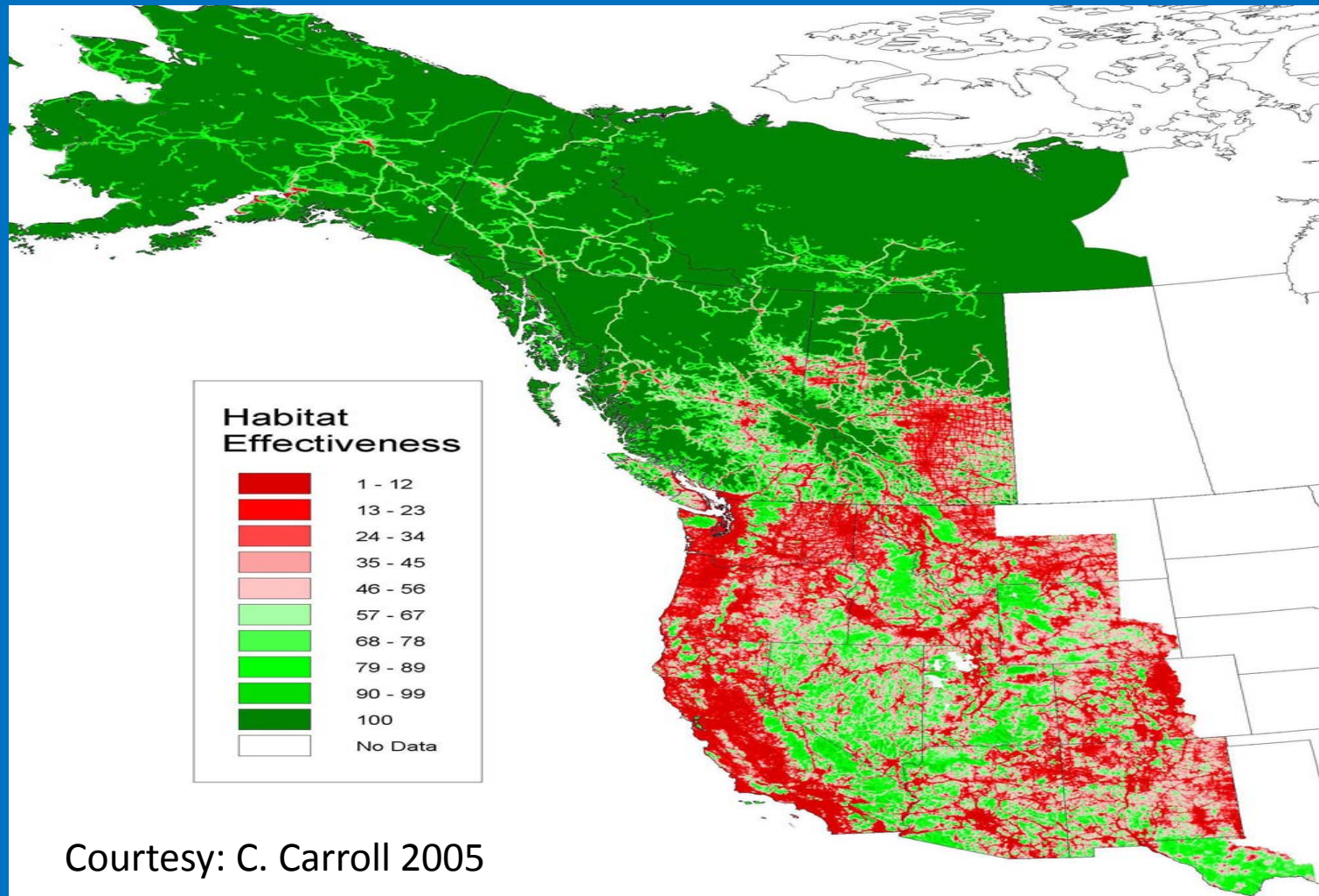
CENTER FOR LARGE LANDSCAPE CONSERVATION

www.climateconservation.org

www.freedomtoroam.org



Our concern in a word: FRAGMENTATION



Courtesy: C. Carroll 2005

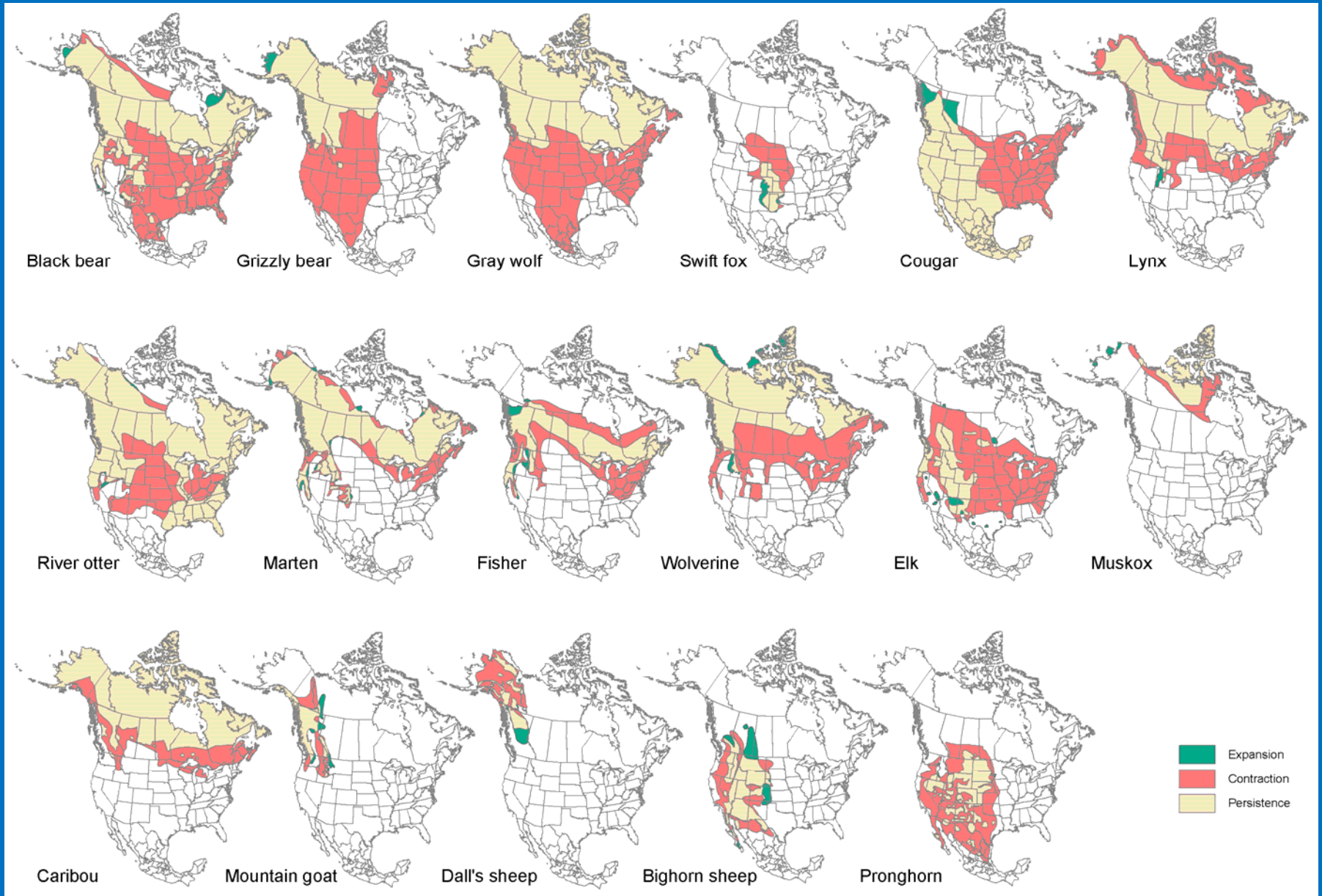
Fragmentation Pace

U.S. is losing

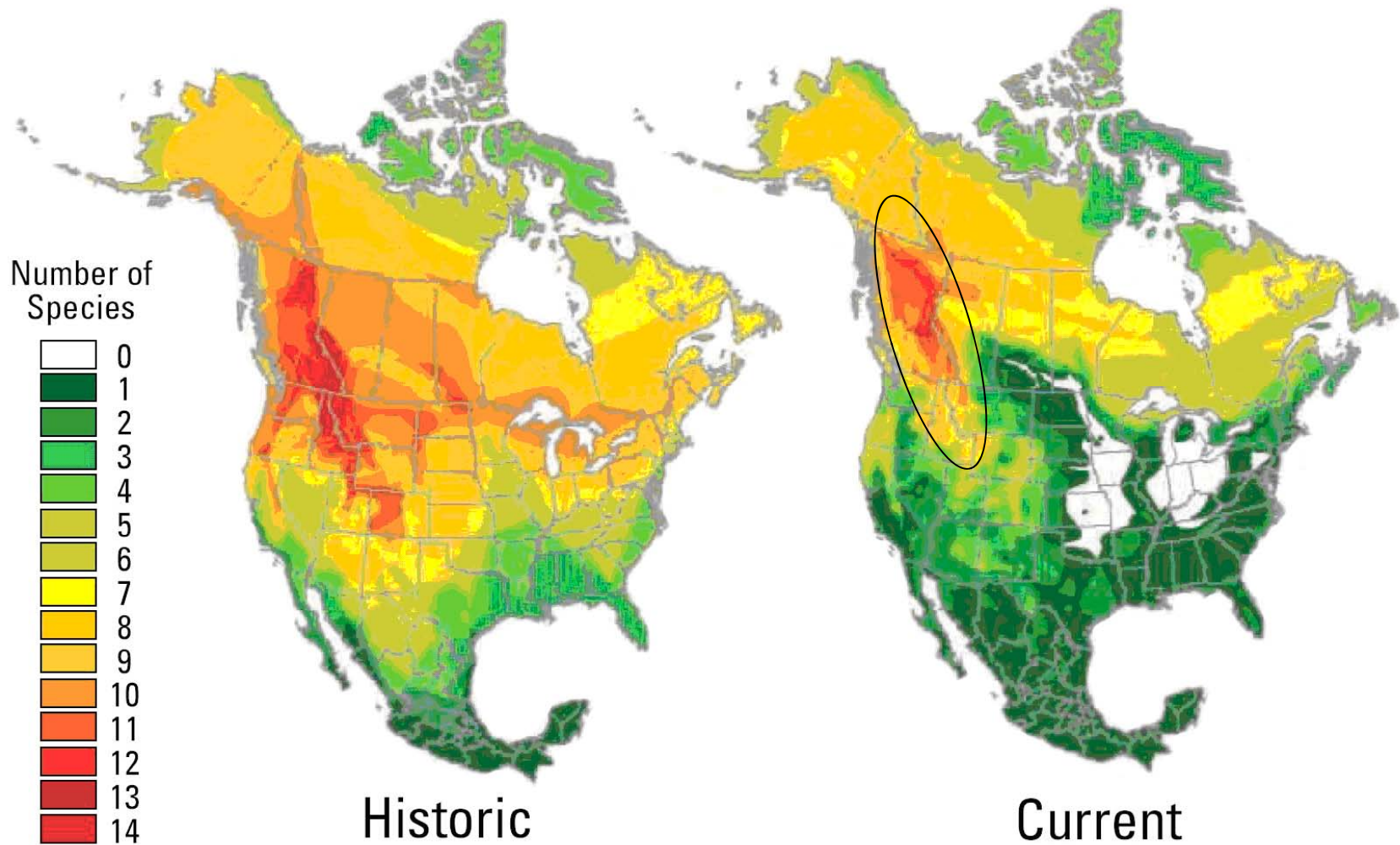
**2 million acres of natural land per year,
or 6,000 acres per day**

NRCS-NRI and U.S. Forest Service 2006

Historic expansions, contractions, persistence



Historic and Current Distribution of Carnivores and Ungulates



Source - Range Contractions of North American Carnivores and Ungulates - Andrea S. Liliberte and William J. Ripple

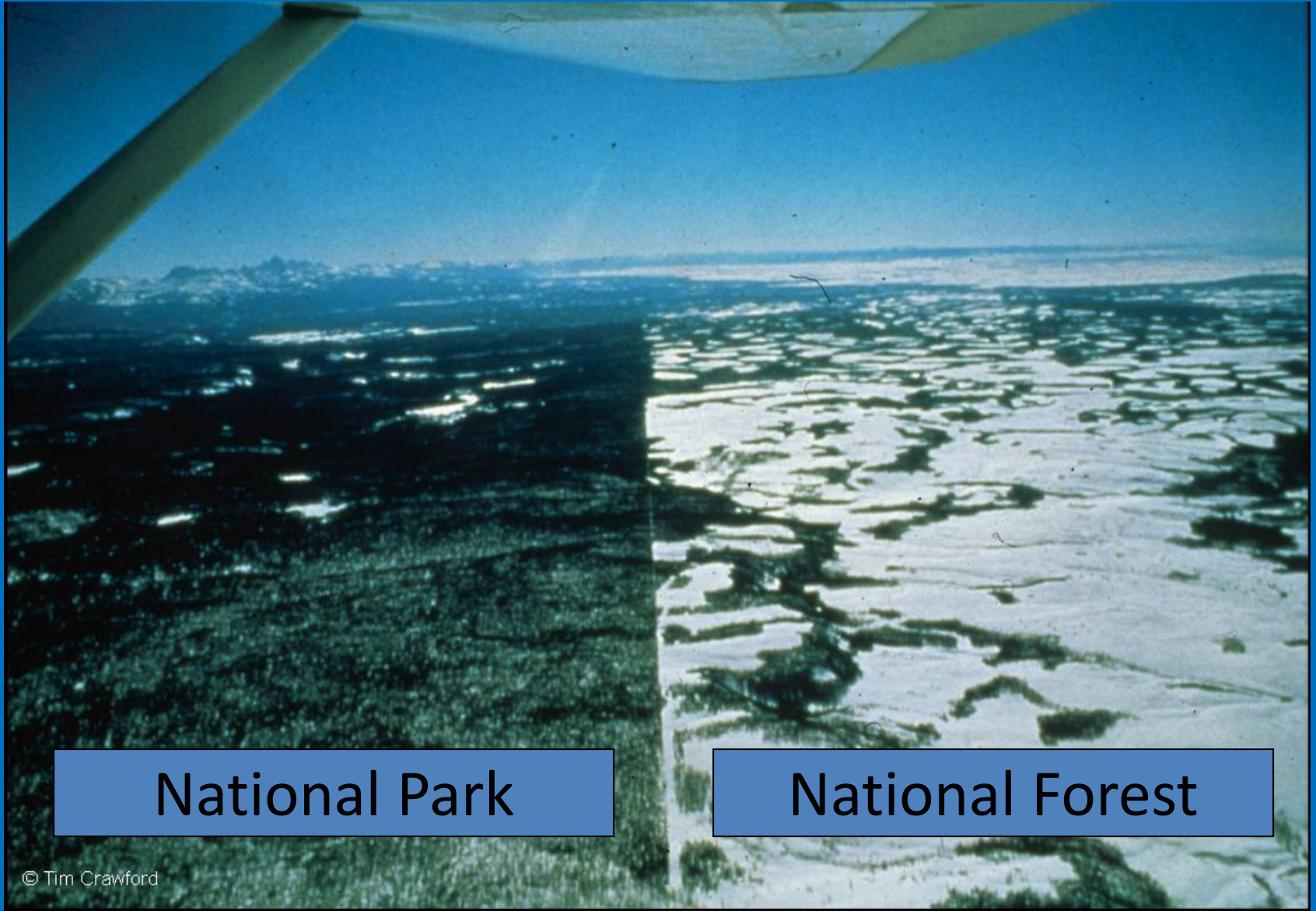
Thinking Out of the Box: Moving from Pattern to Processes

1872 Solution

Yellowstone
Postage
Stamp



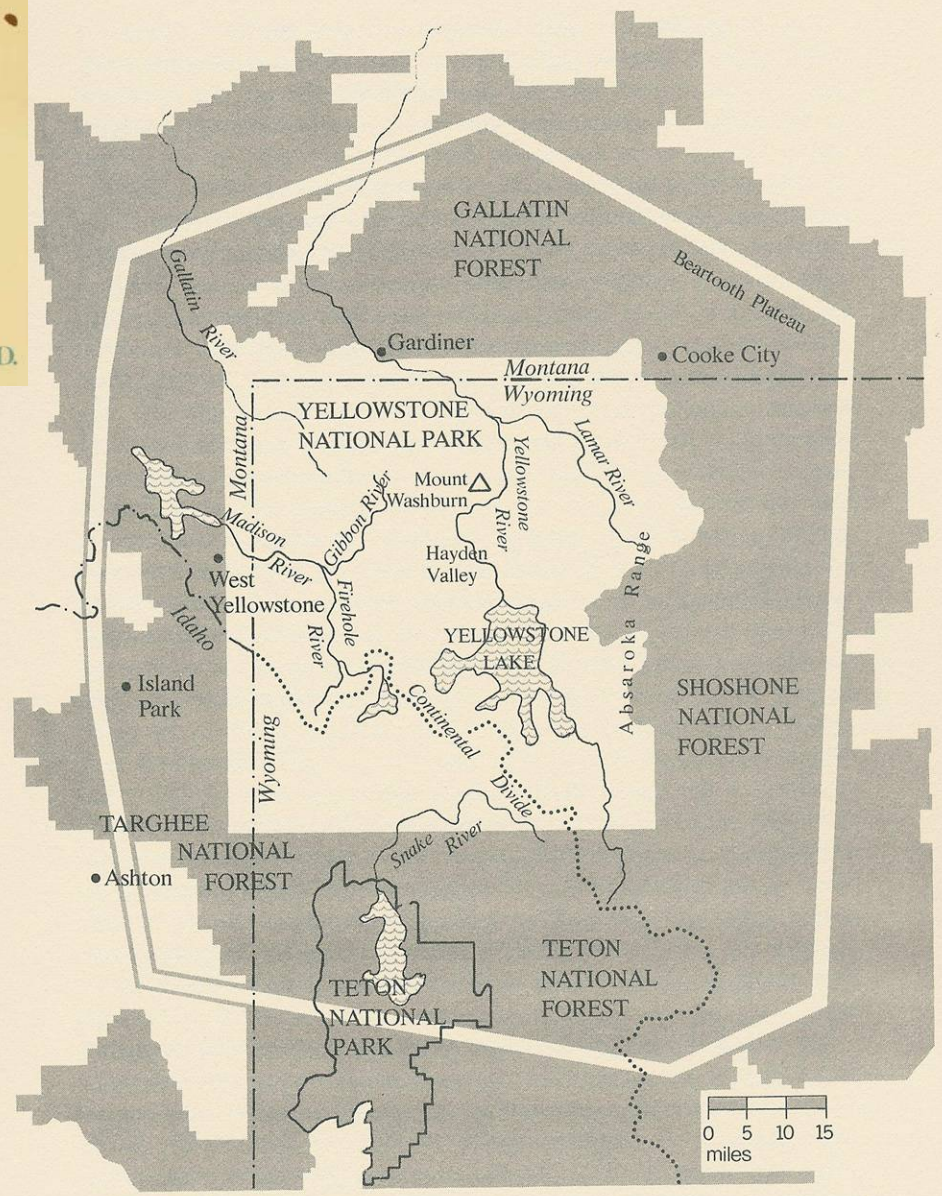
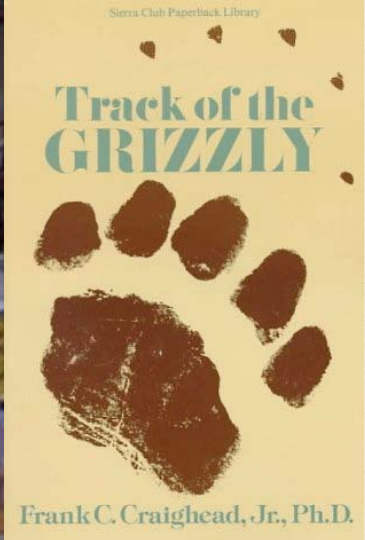
Yellowstone National Park Targhee National Forest Boundary



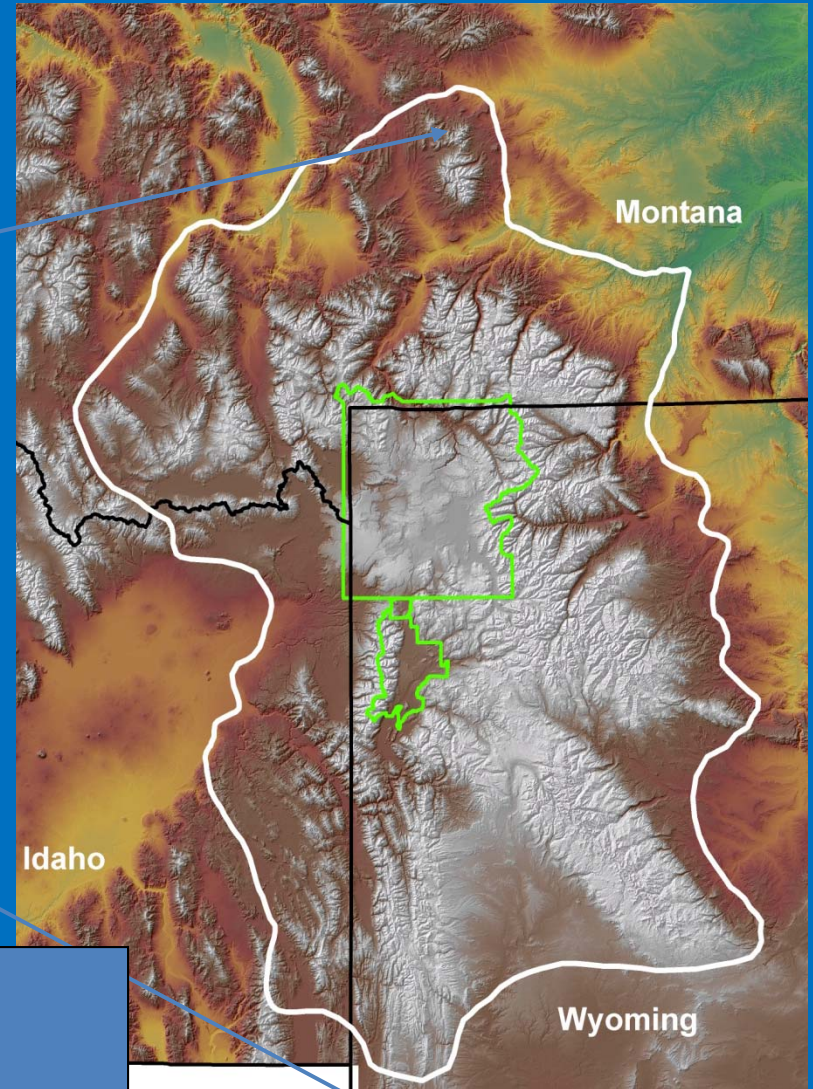
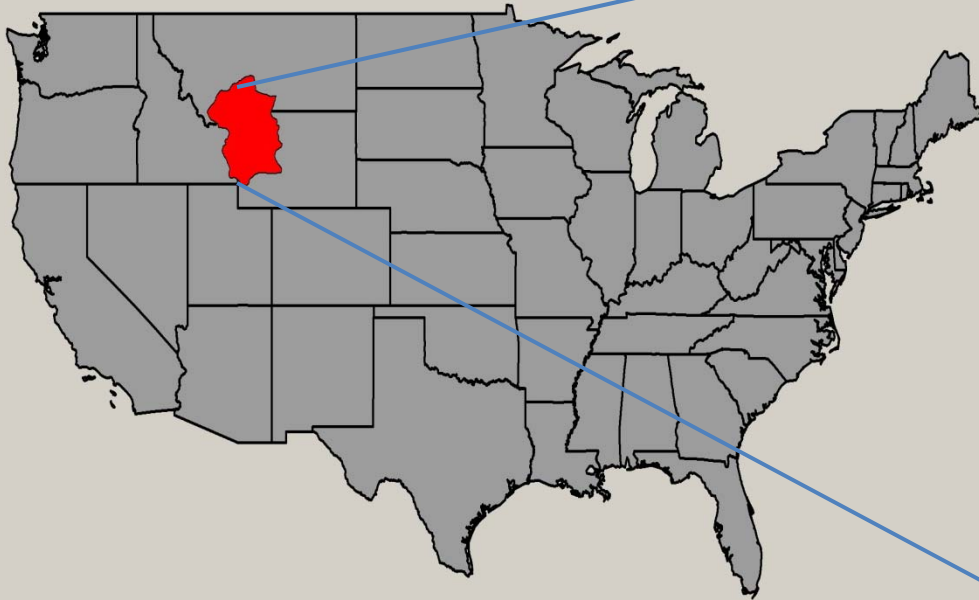
National Park

National Forest

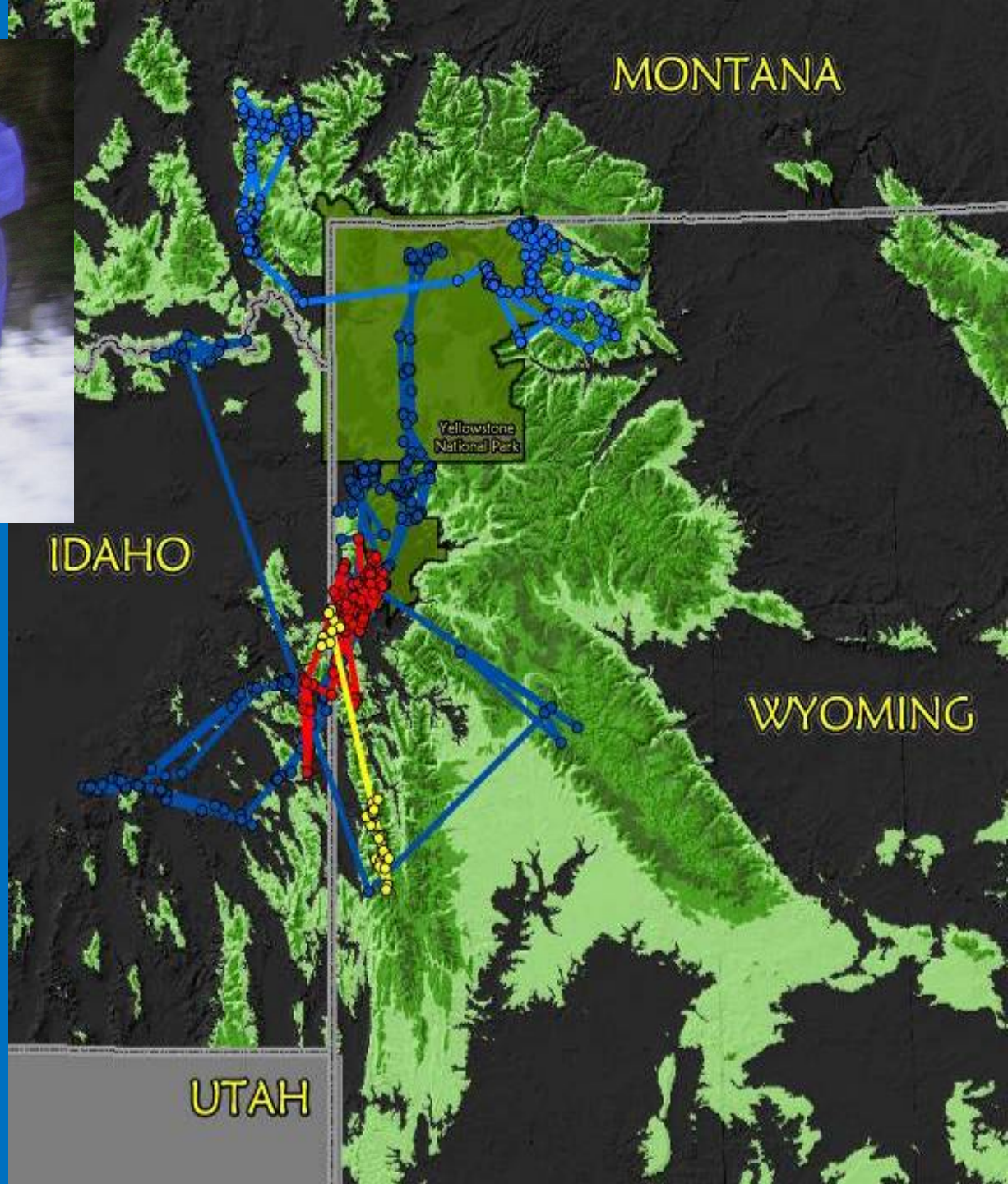
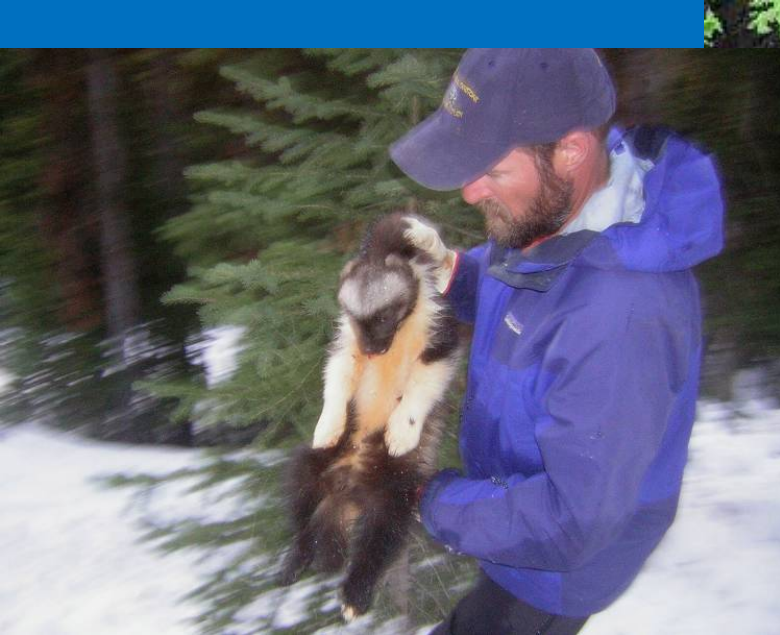




The Greater Yellowstone Ecosystem



Pattern: Square to Polygon



Courtesy: R. Inman

Wolverine Dispersal In Yellowstone



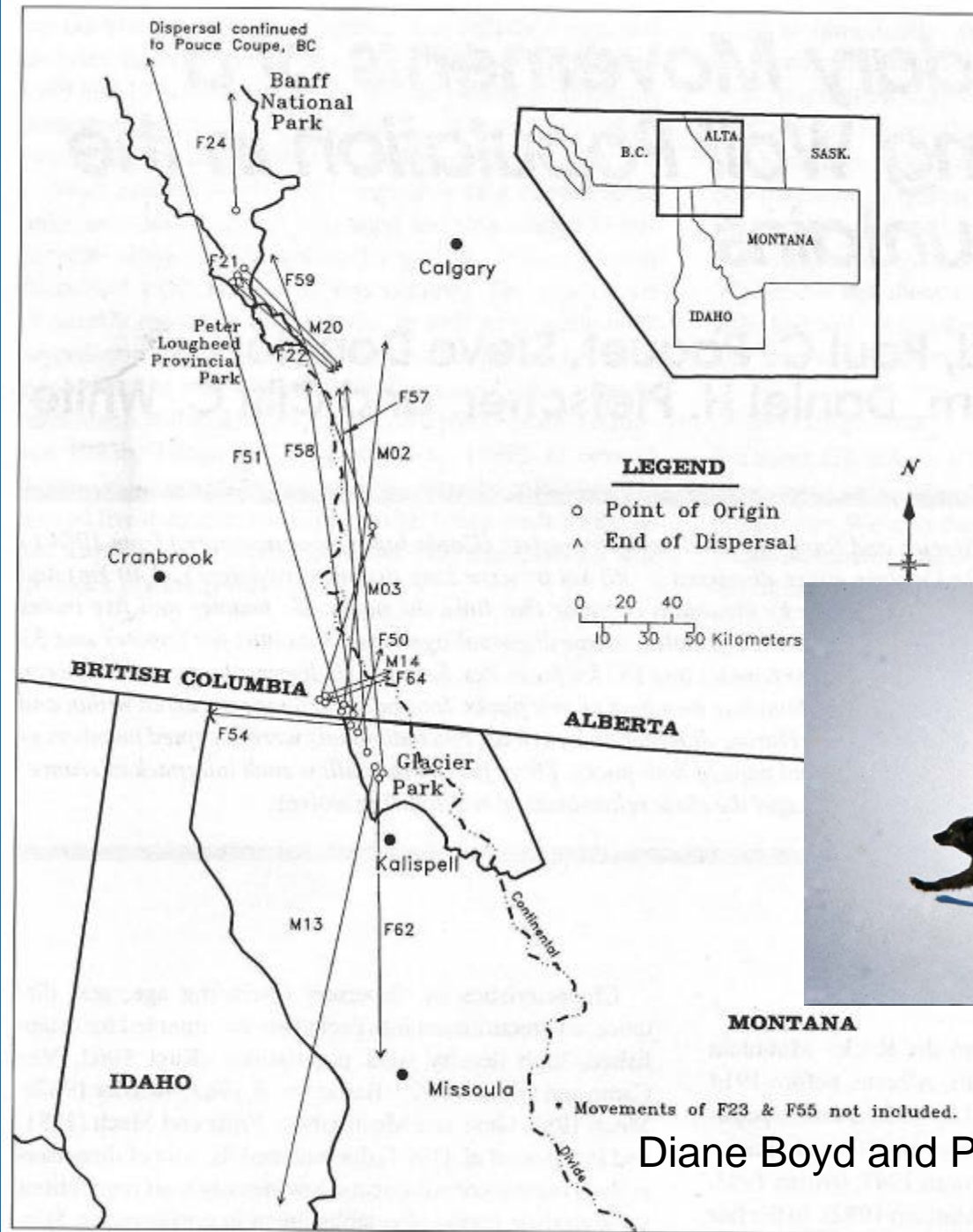
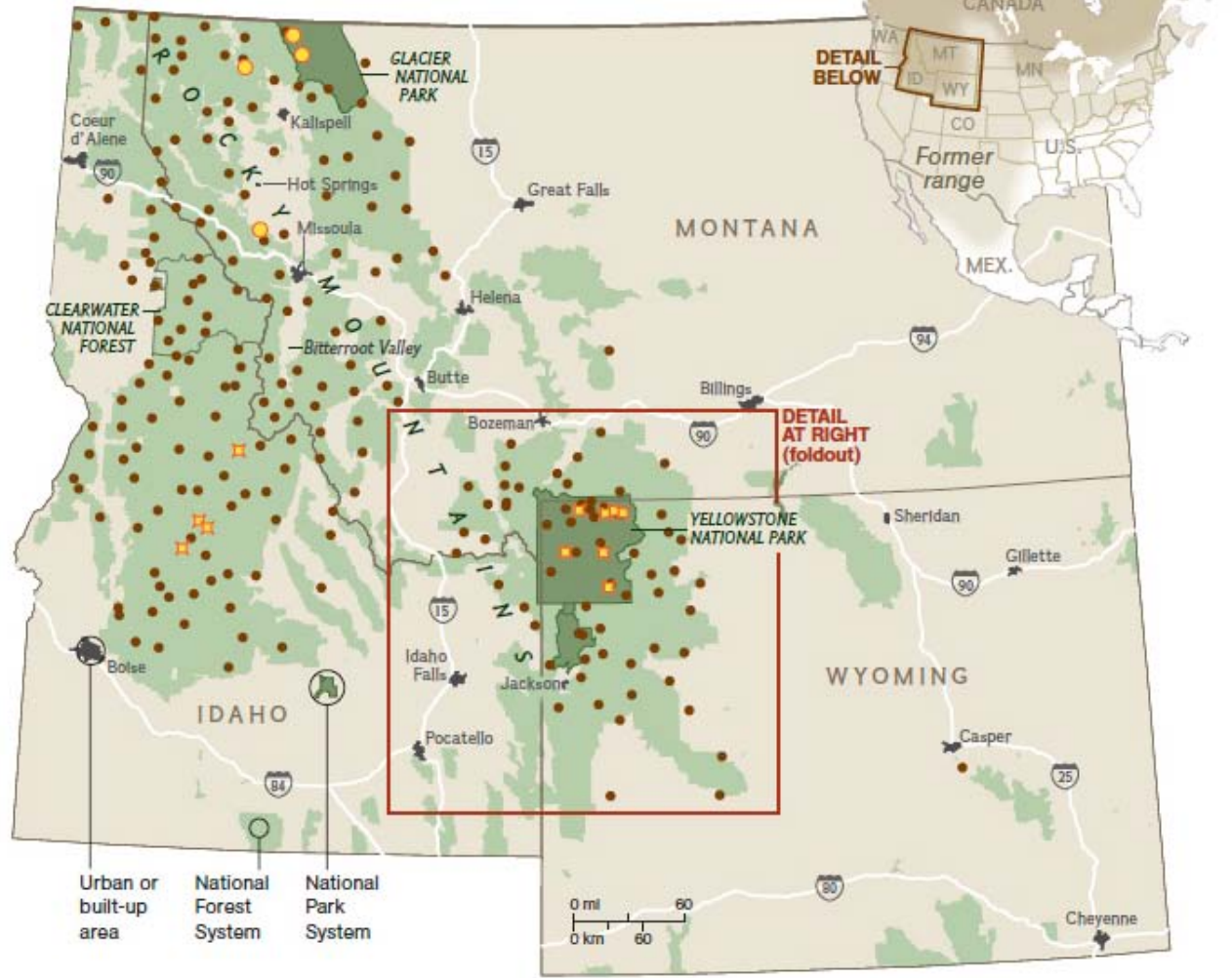


Fig. 1 Dispersal and extraterritorial movements of wolves in and near Glacier National Park and Banff National Park, 1984-1991.



Diane Boyd and Paul Paquet

- **Wolf pack (2008)**
A pack is two or more wolves that have a defined territory.
- **Wolf pack (1992)**
- ✠ **Wolf release (1995/1996)**
Wolves from Canada were relocated into Wyoming and Idaho.



Glacier National Park

Flathead Lake



Bob Marshall
Wilderness

Grizzly Bear Movement in Swan Valley, Montana

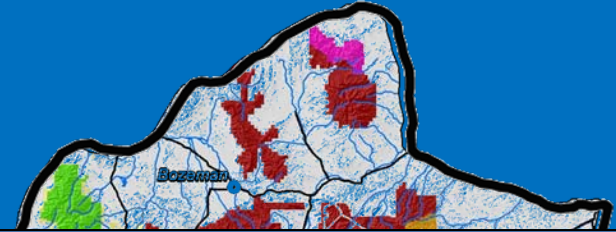
Courtesy C. Servheen and Trust for Public Land

© 2005 Google

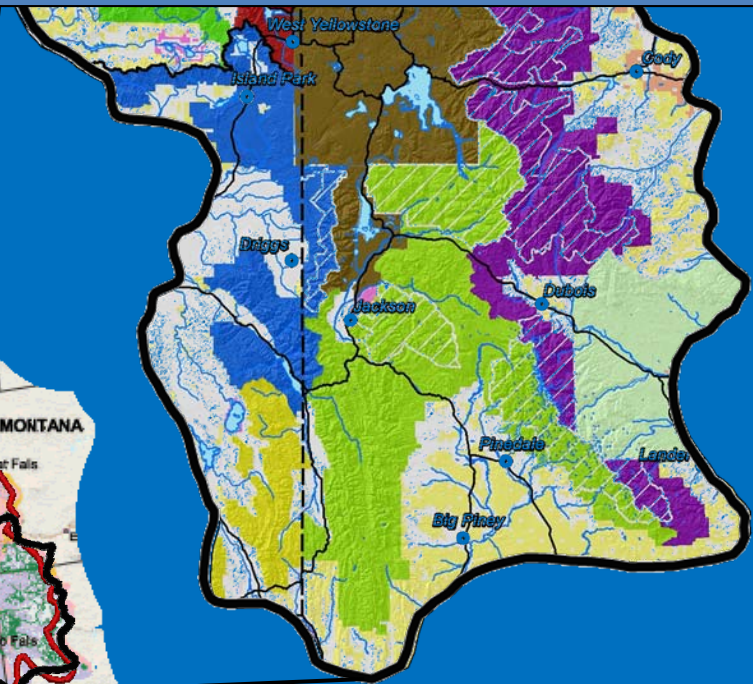
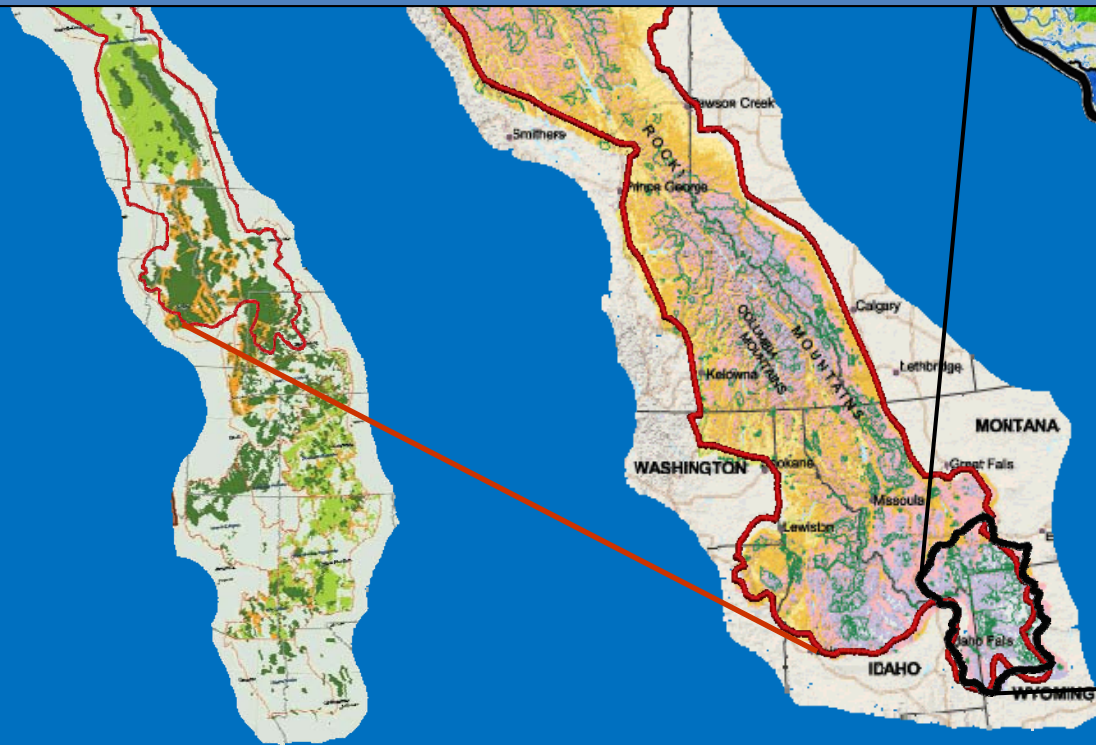
Image © 2006 TerraMetrics



Scale



What scale can ecological processes be maintained?



Spine of the Continent

Yellowstone to Yukon

Greater Yellowstone



Processes



- Ecological Connectivity
- Natural Disturbance Regimes
- Fire Ecology
- Hydrology
- Water Catchment
- Migration
- Dispersal
- Disease
- Pollination
- Resilience

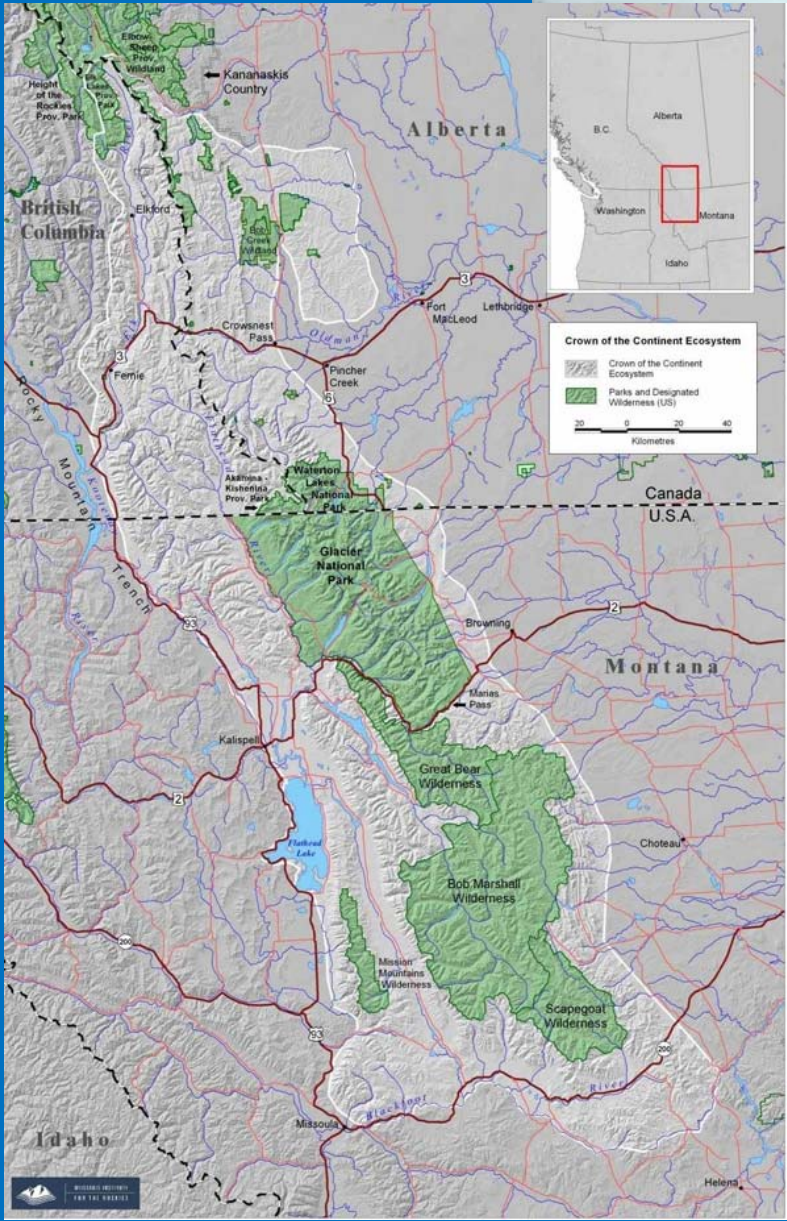


Roam Wild and Free



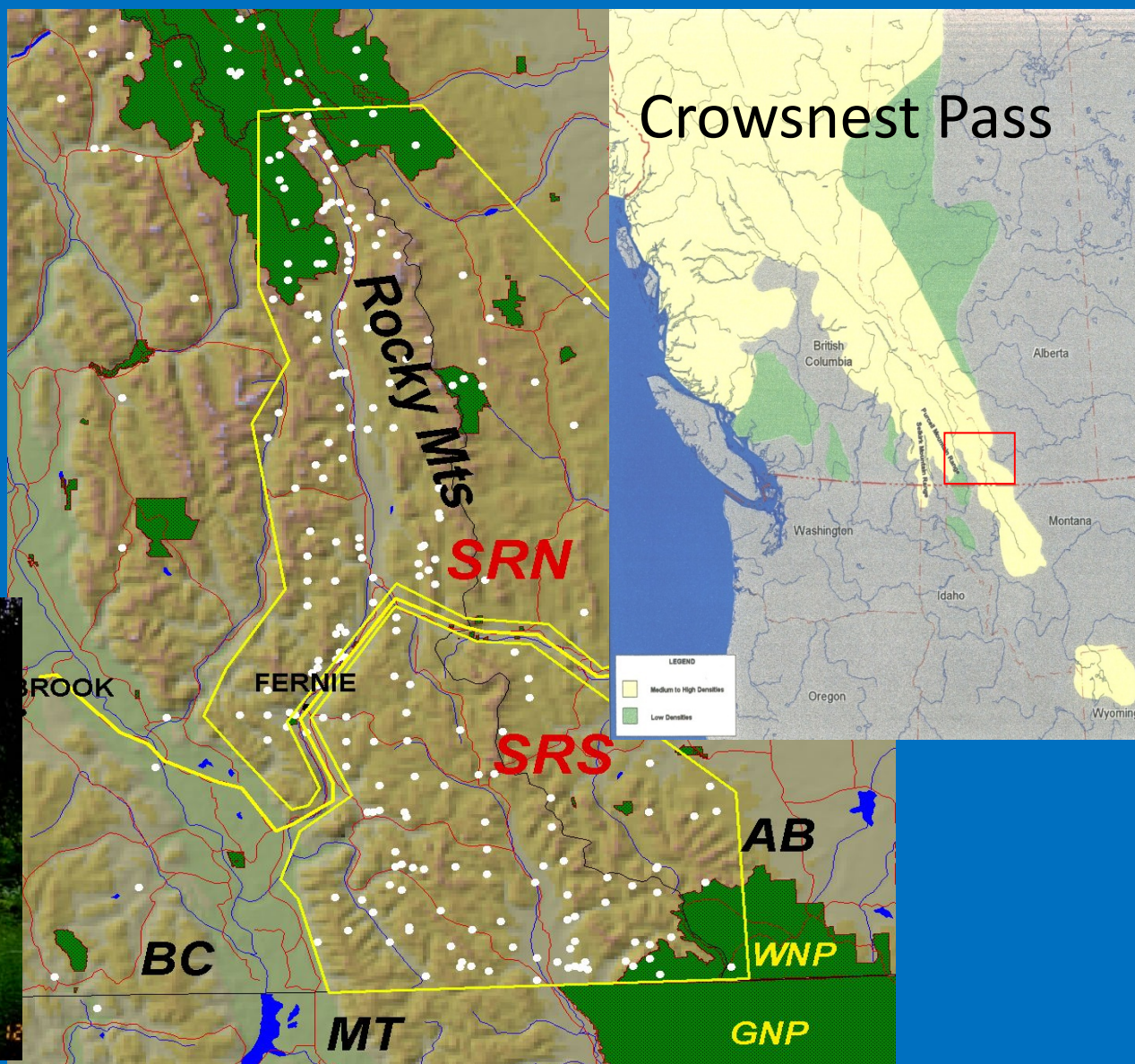
Photos: Collopy, Tabor, Karesh, Paquet, Weaver

TransCanada Highway Banff National Park

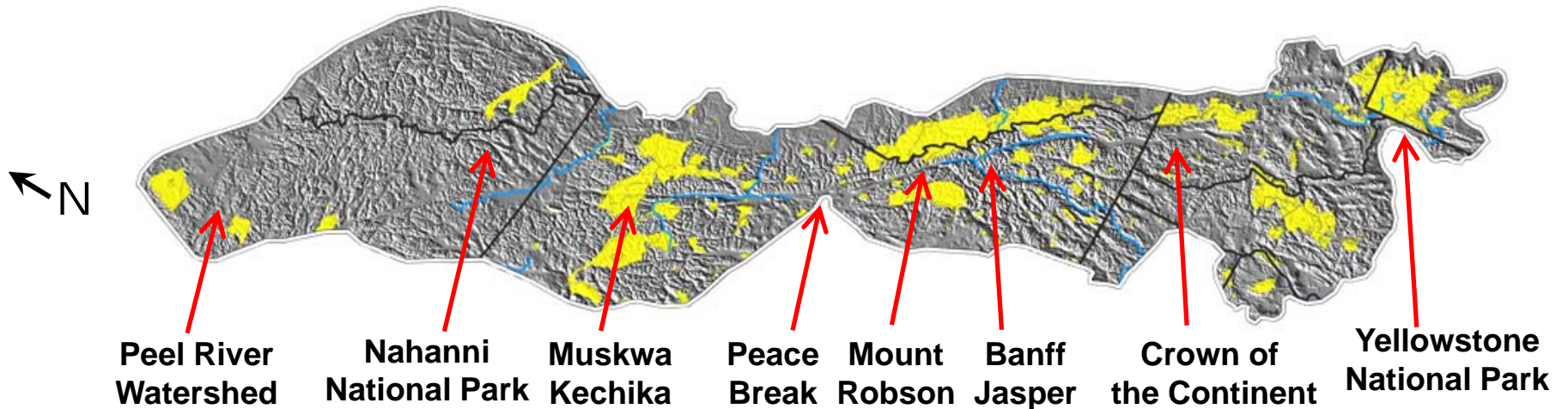
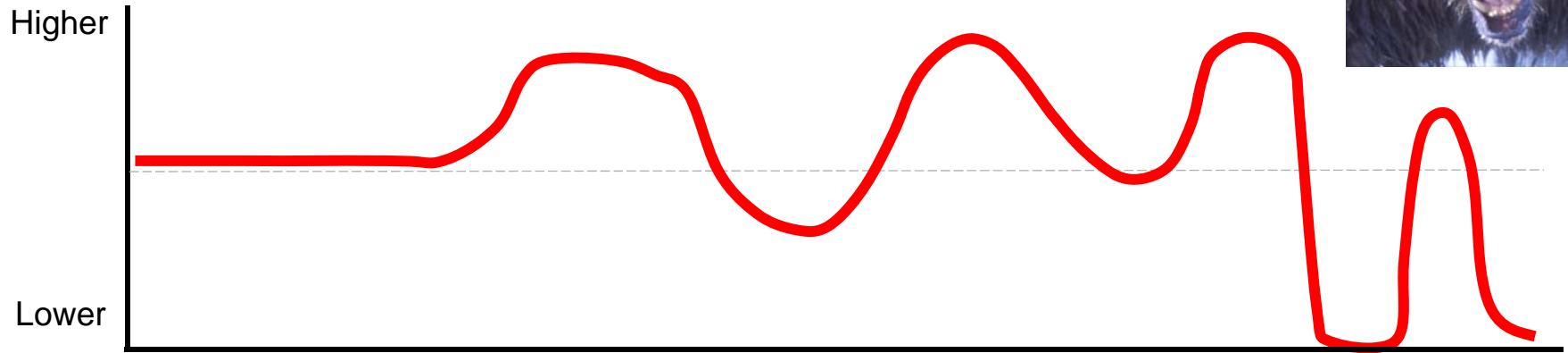


Road Rage

Continental Ecological Bottleneck



Grizzly Bear Density along the Y2Y Corridor

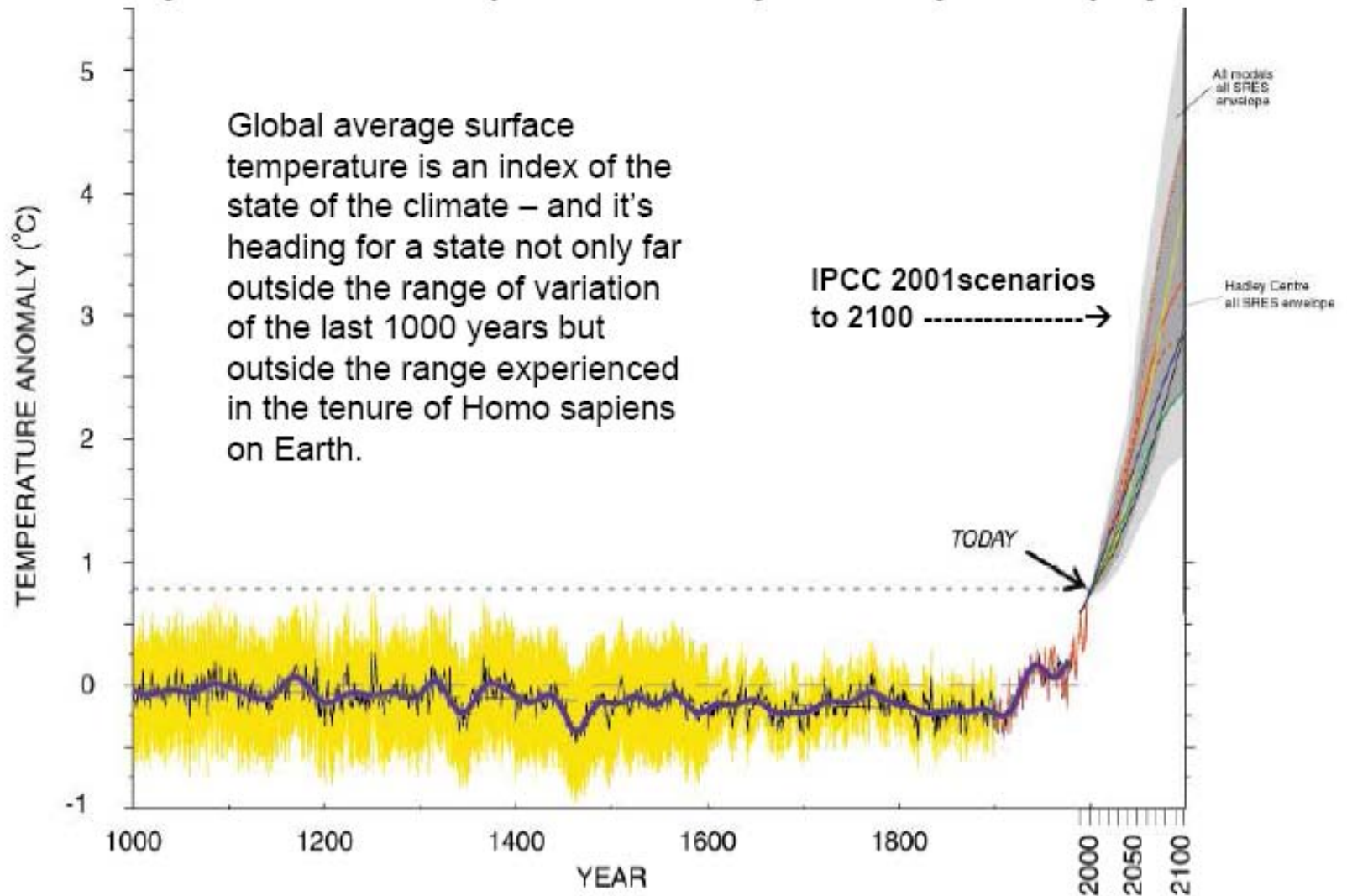


Climate Change exacerbates Habitat Fragmentation

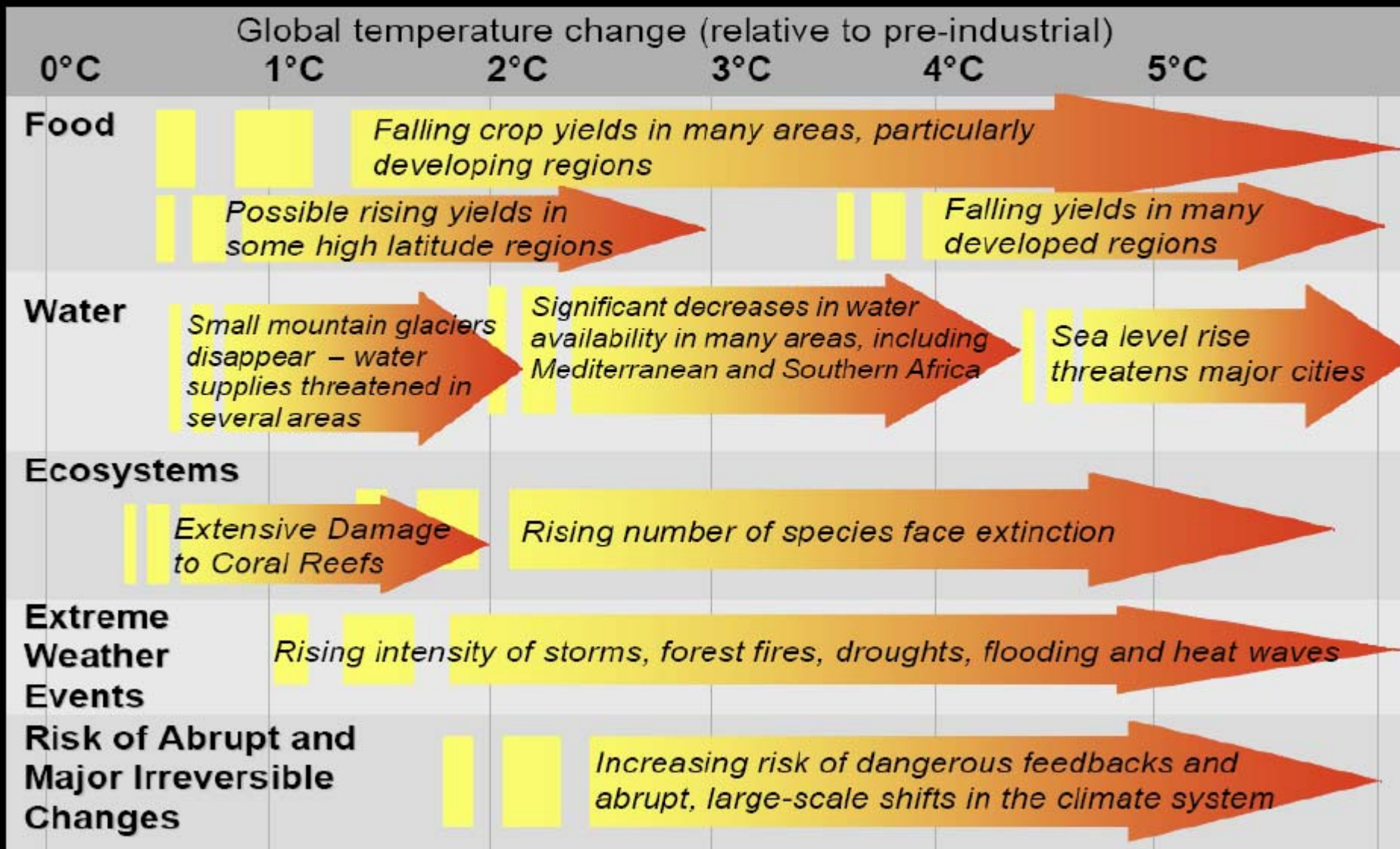
Climate Change: No Luxury of Time

Where we're headed: climate change

1000 years of Earth temperature history and 100 years of projection

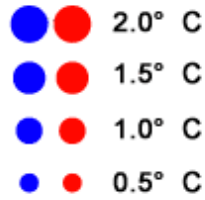


Likely Changes to Earth's Systems

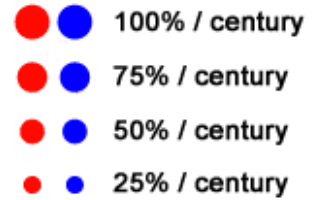


Warming is accelerating,
with the average rate over
the past 50 years twice
that of the previous 50
(IPCC, 2007)

Temperature



Precipitation



WARMER and WETTER with SEASONAL EFFECTS

Source: Climate Impacts Group, 2009

Less Faithful



Discovery News > Earth News > **Glacier National Park Loses Two More Glaciers**

GLACIER NATIONAL PARK LOSES TWO MORE GLACIERS

Climate change has claimed two more of the moving icefields at this national park, reducing their numbers to 25.

Wed Apr 7, 2010 03:25 PM ET | content provided by Matthew Brown, Associated Press

THE GIST:

- **Glacier National Park has lost two more glaciers to warming.**
- **Twenty-five named glaciers are left in the national park.**
- **All of the glaciers could be completely gone by the end of the decade.**

Glacier National Park has lost two more of its namesake moving icefields to climate change, which is shrinking the rivers of ice until they grind to a halt, a government researcher said Wednesday.

Warmer temperatures have reduced the number of named glaciers in the northwestern Montana park to 25, said Dan Fagre, an ecologist with the U.S. Geological Survey. He warned the rest of the glaciers may be gone by the end of the decade.

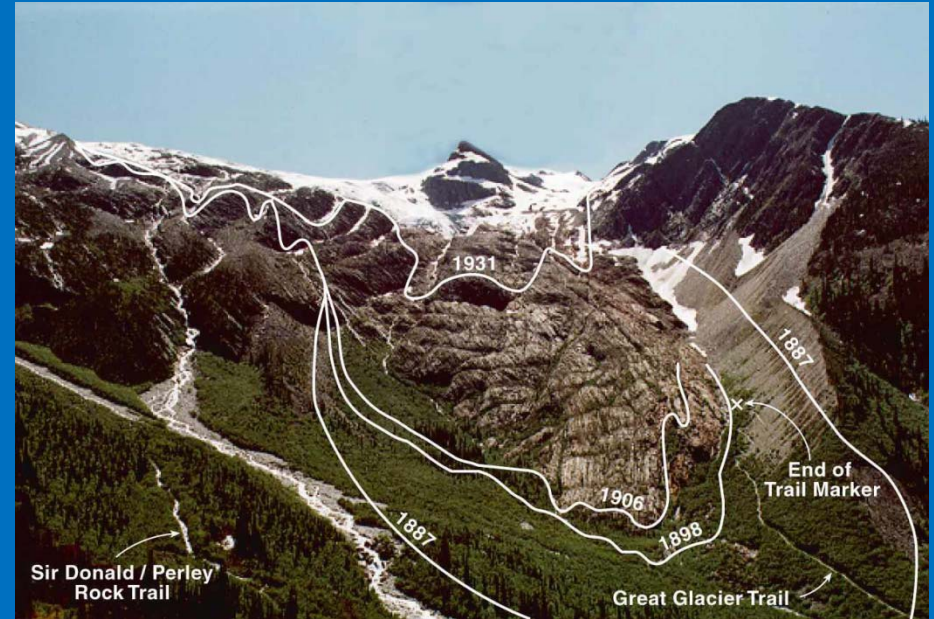
"When we're measuring glacier margins, by the time we go home the glacier is already smaller than what we've measured," Fagre said.



The park's glaciers have been slowly melting since about 1850, when the centuries-long Little Ice Age ended.

National Park Service

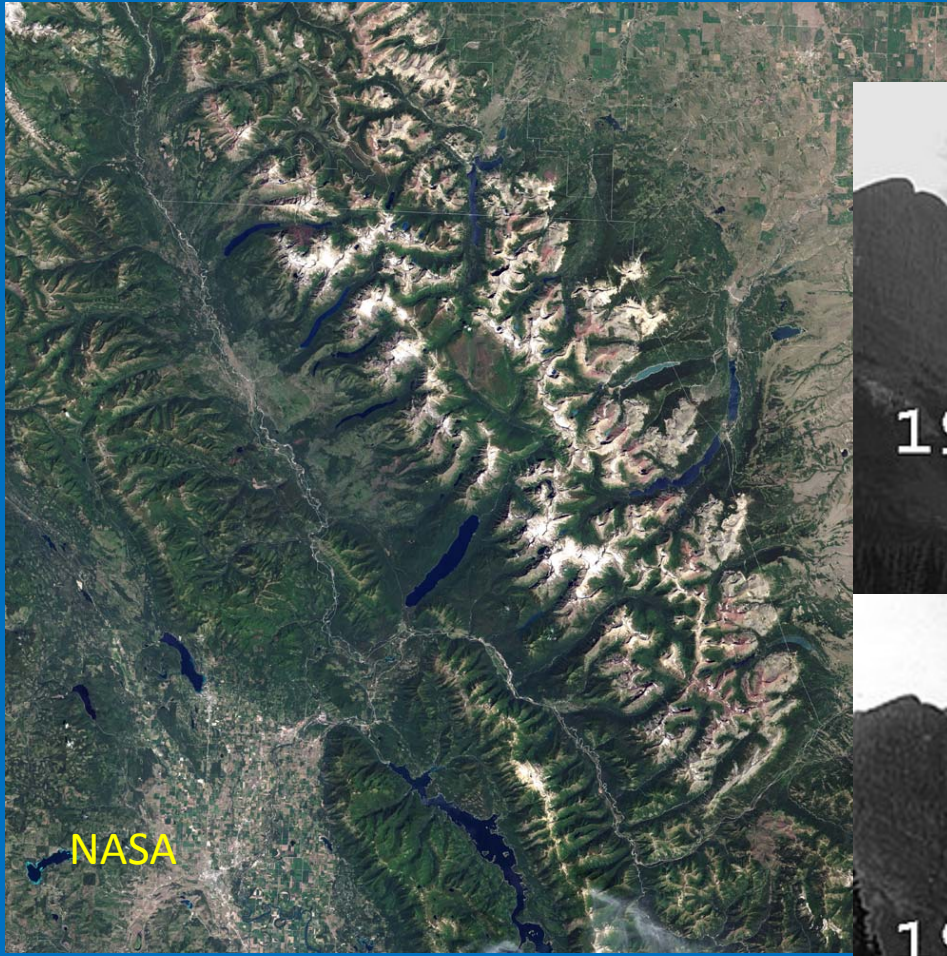
Retreated two kilometers since first photographed in 1887



Illecillewaet Glacier, circa 1898

Illecillewaet Glacier 1887-1996

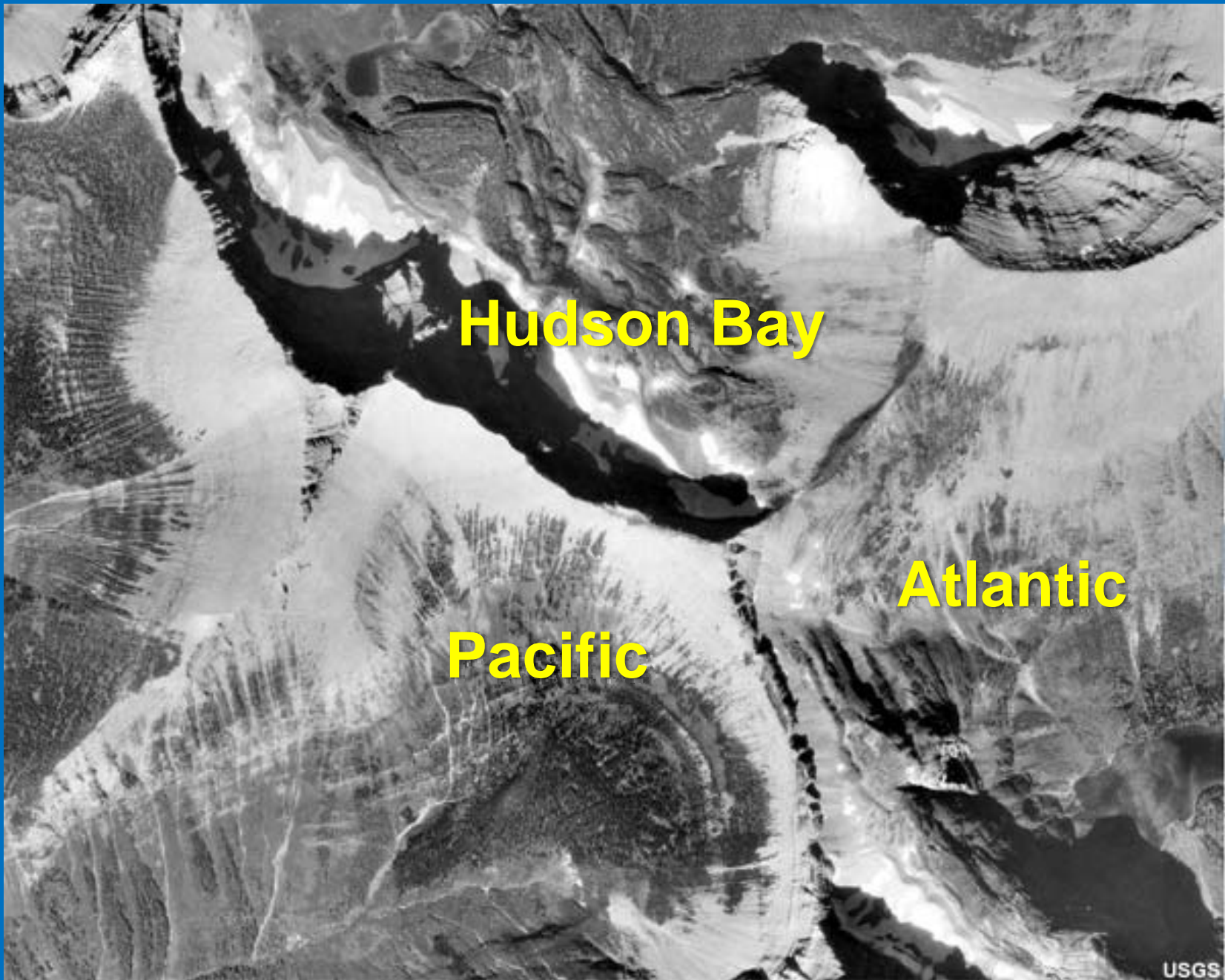
Illecillewaet Glacier, Glacier National Park, BC

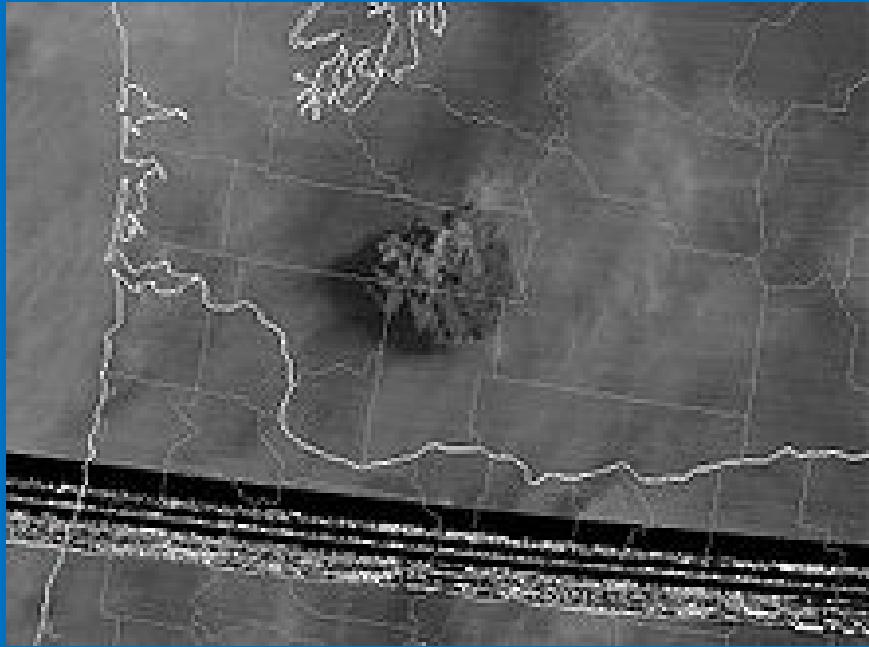


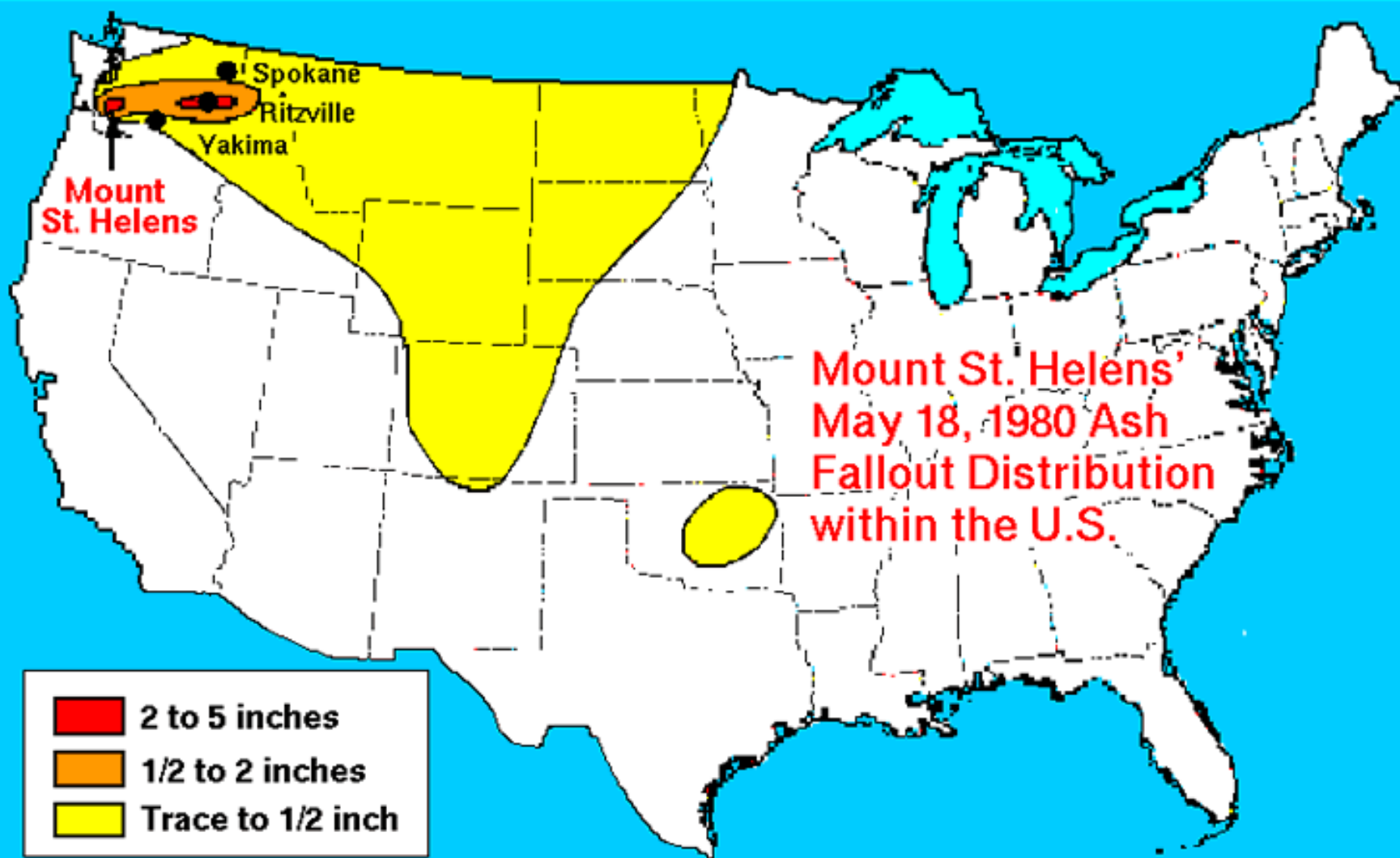
Waterton-Glacier



Grinnell Glacier



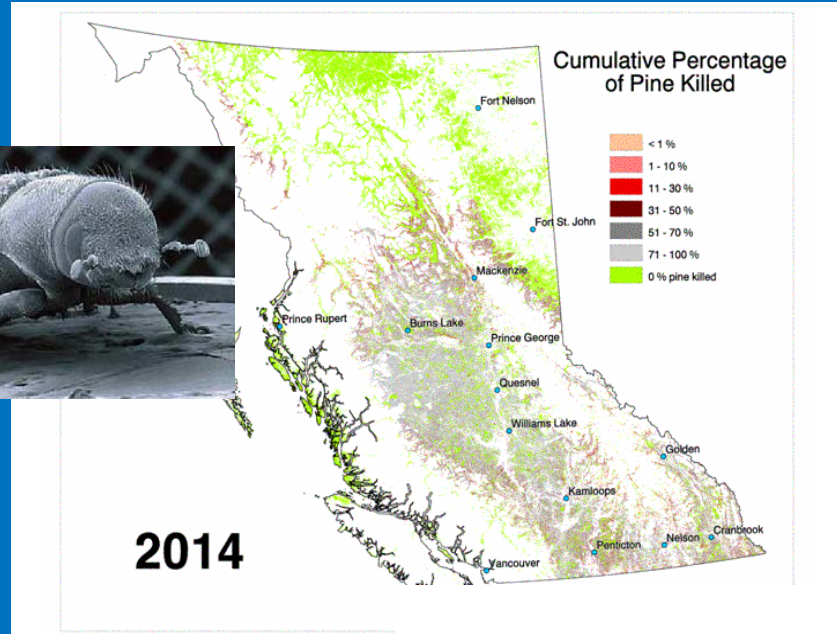
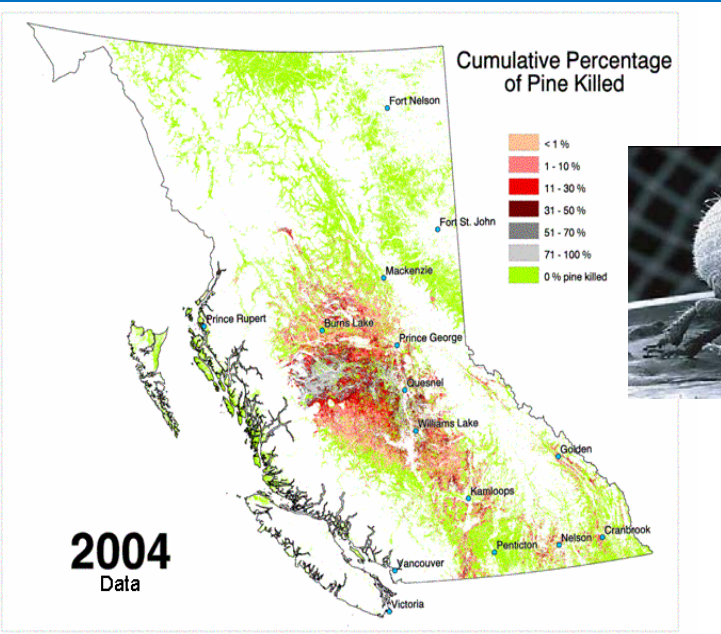
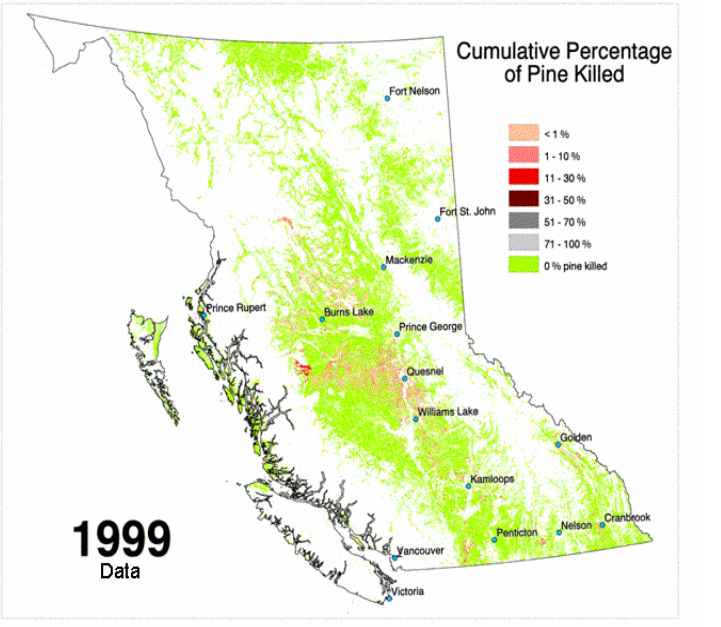
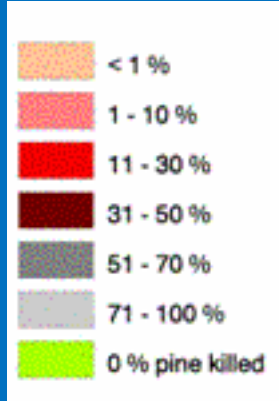




Topinka, USGS/CVDD, 1997, Modified from: Tilling, Topinka, and Swanson, 1990, Mount St. Helens: Past, Present, and Future

Other Visible Impacts

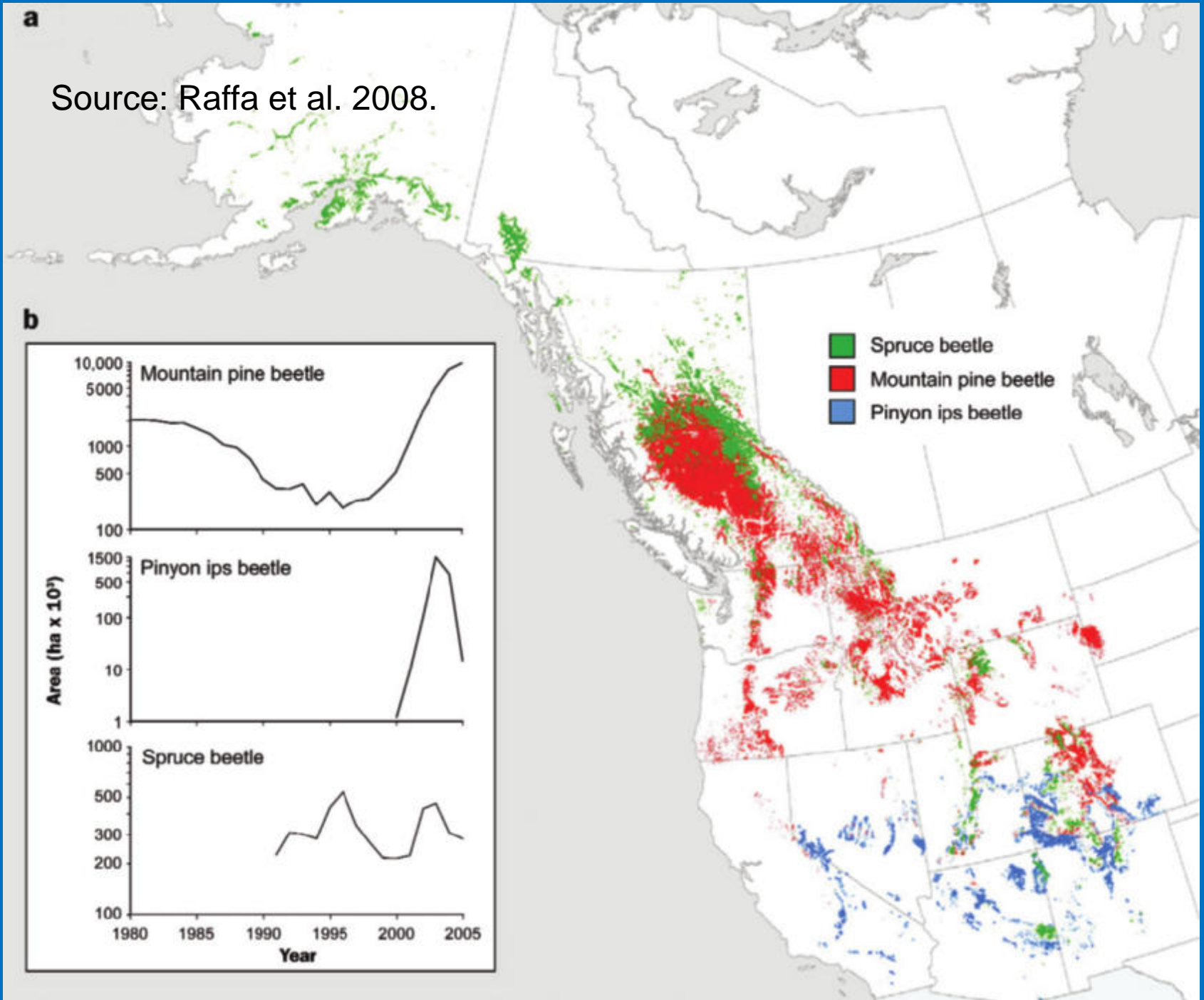
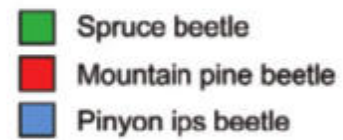
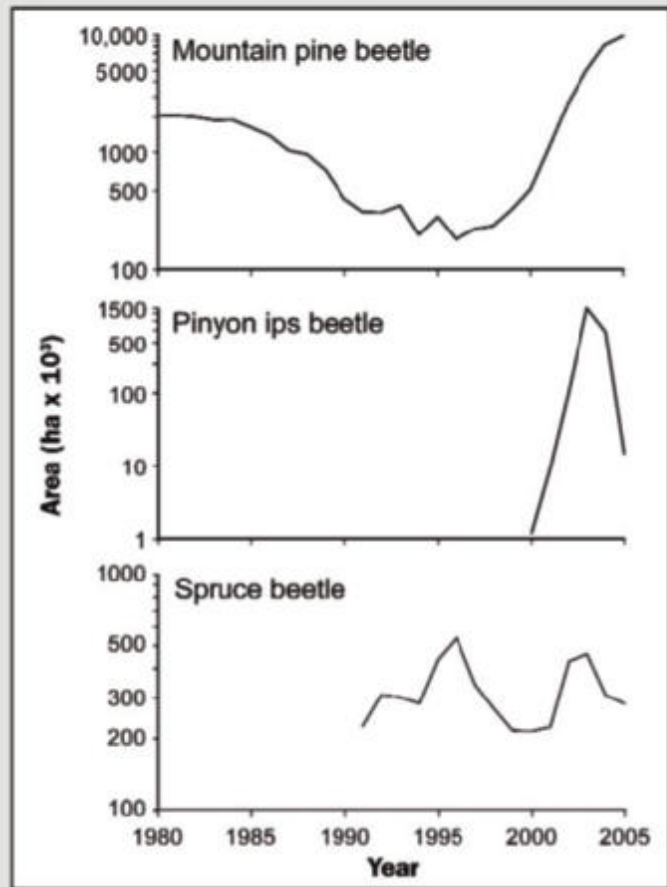
Bark Beetle Infestation



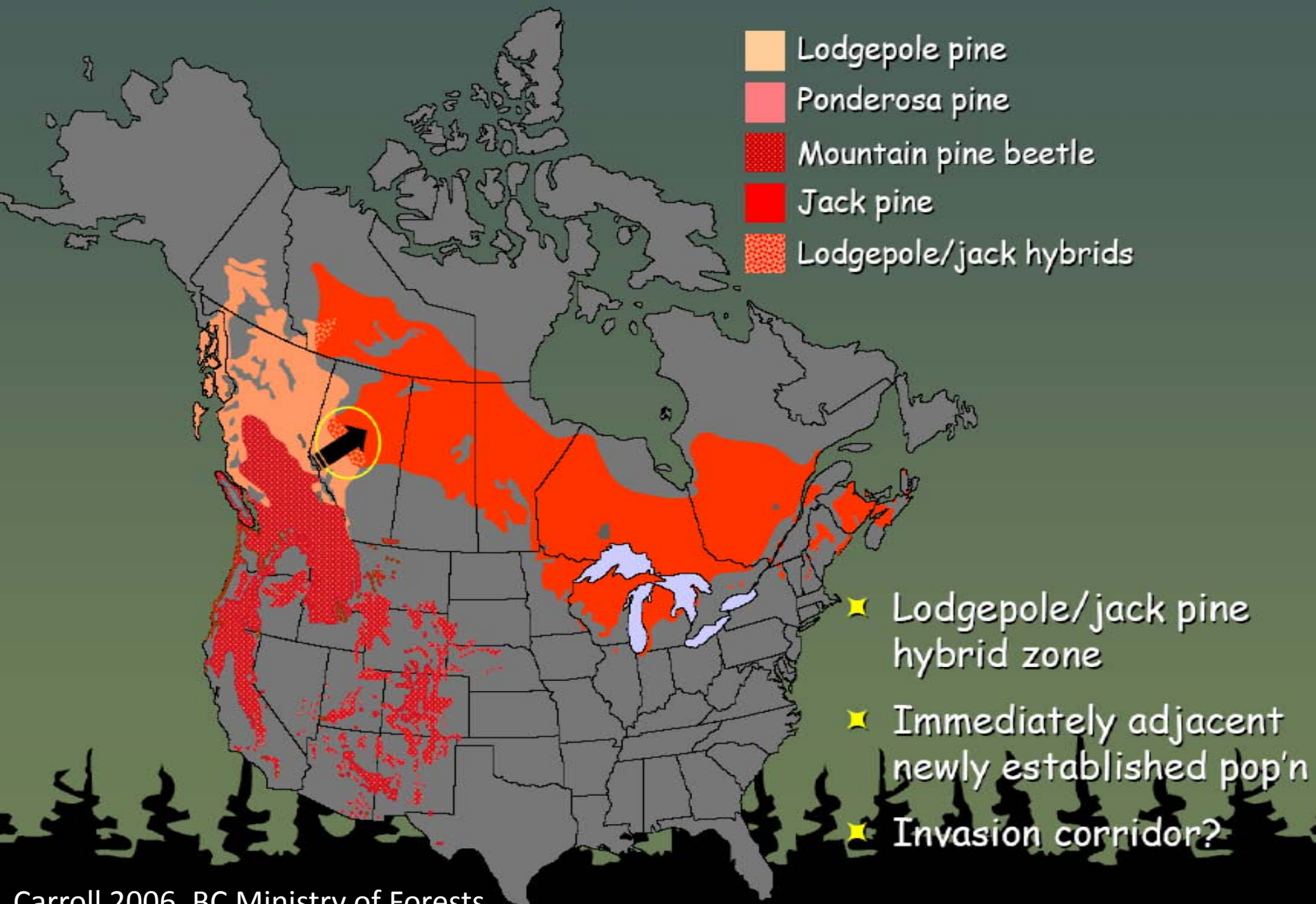
a

Source: Raffa et al. 2008.

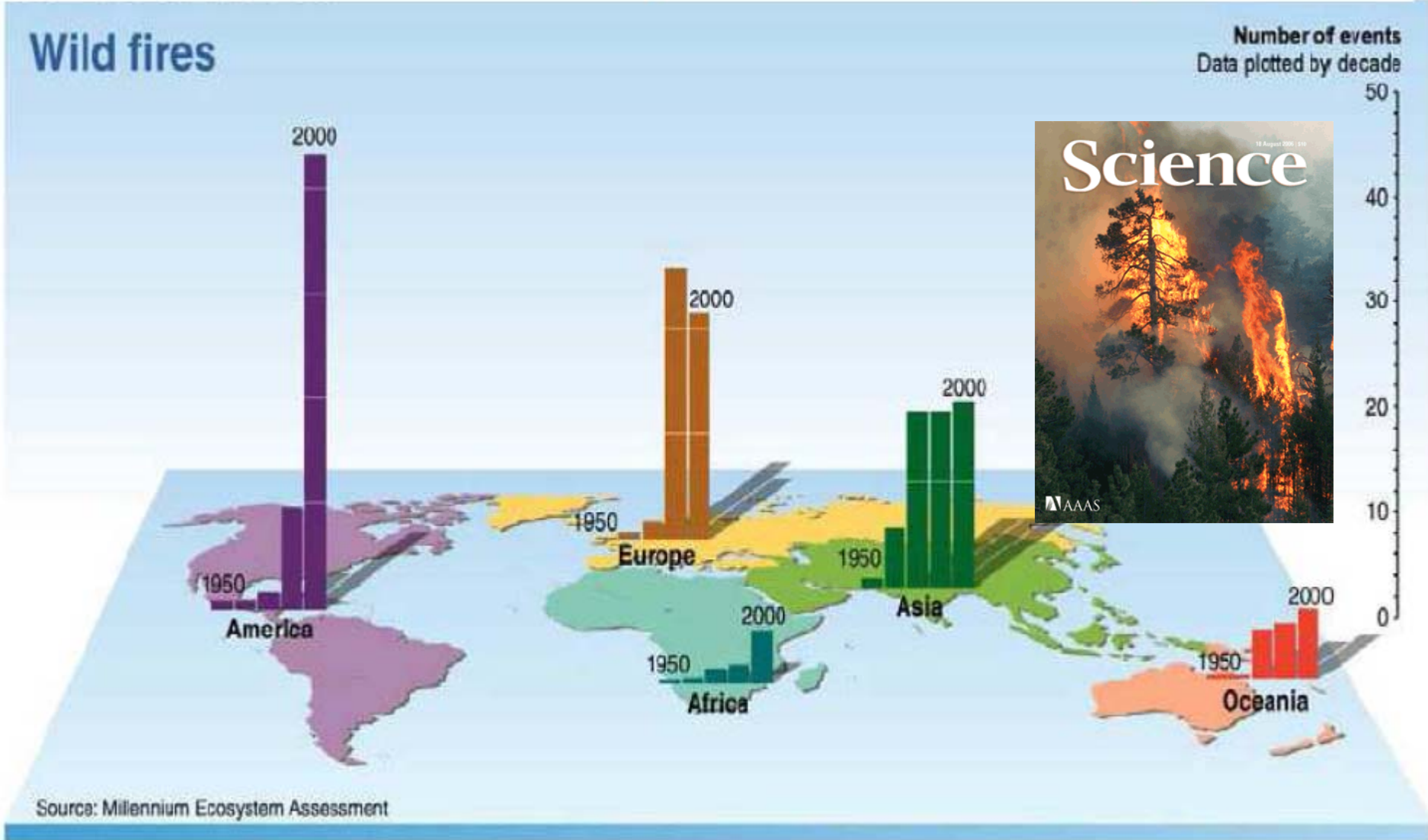
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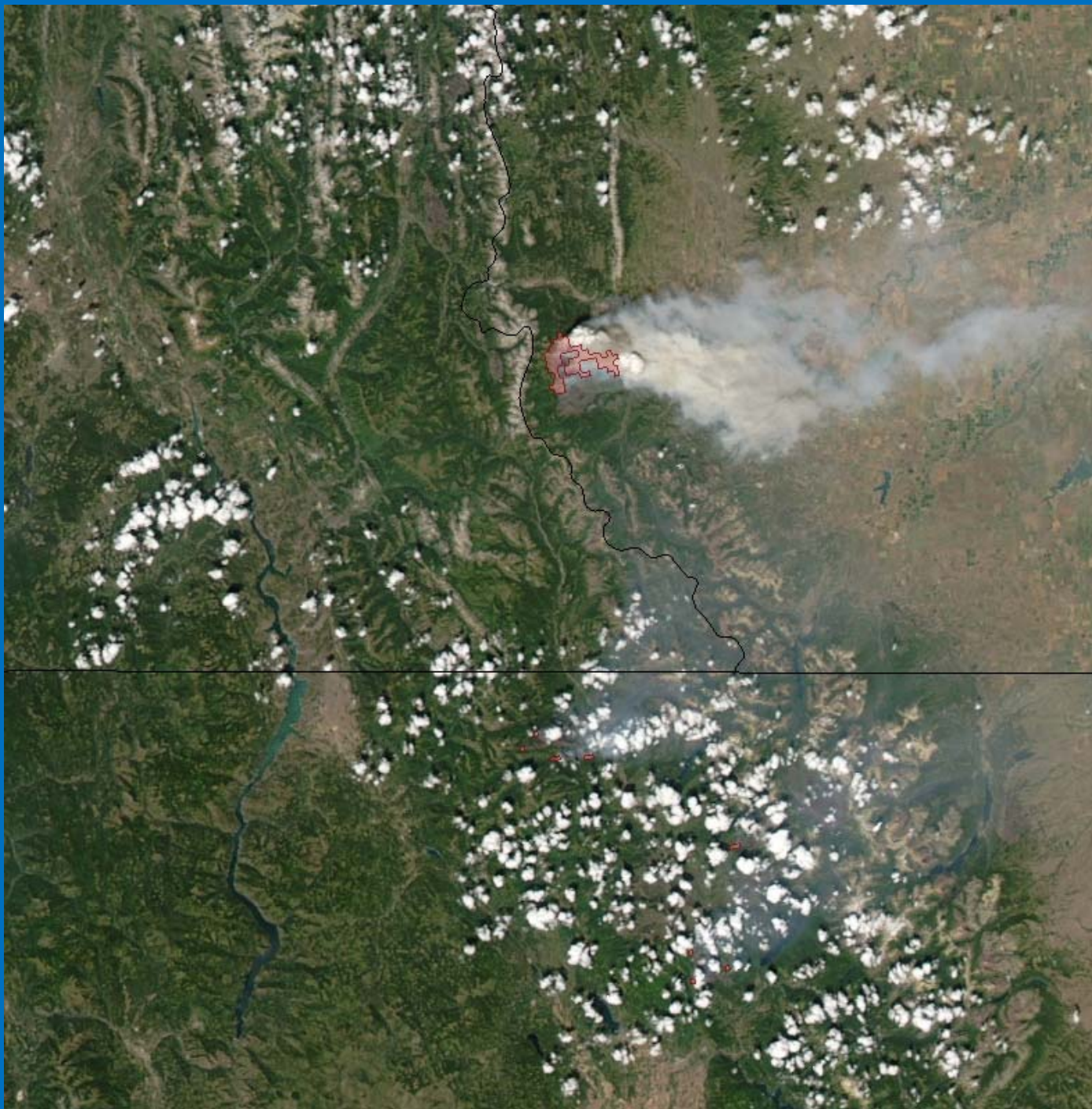
Climate change induced-range expansion: invasion of the boreal forest?



What we know about impacts: wildfires by decade

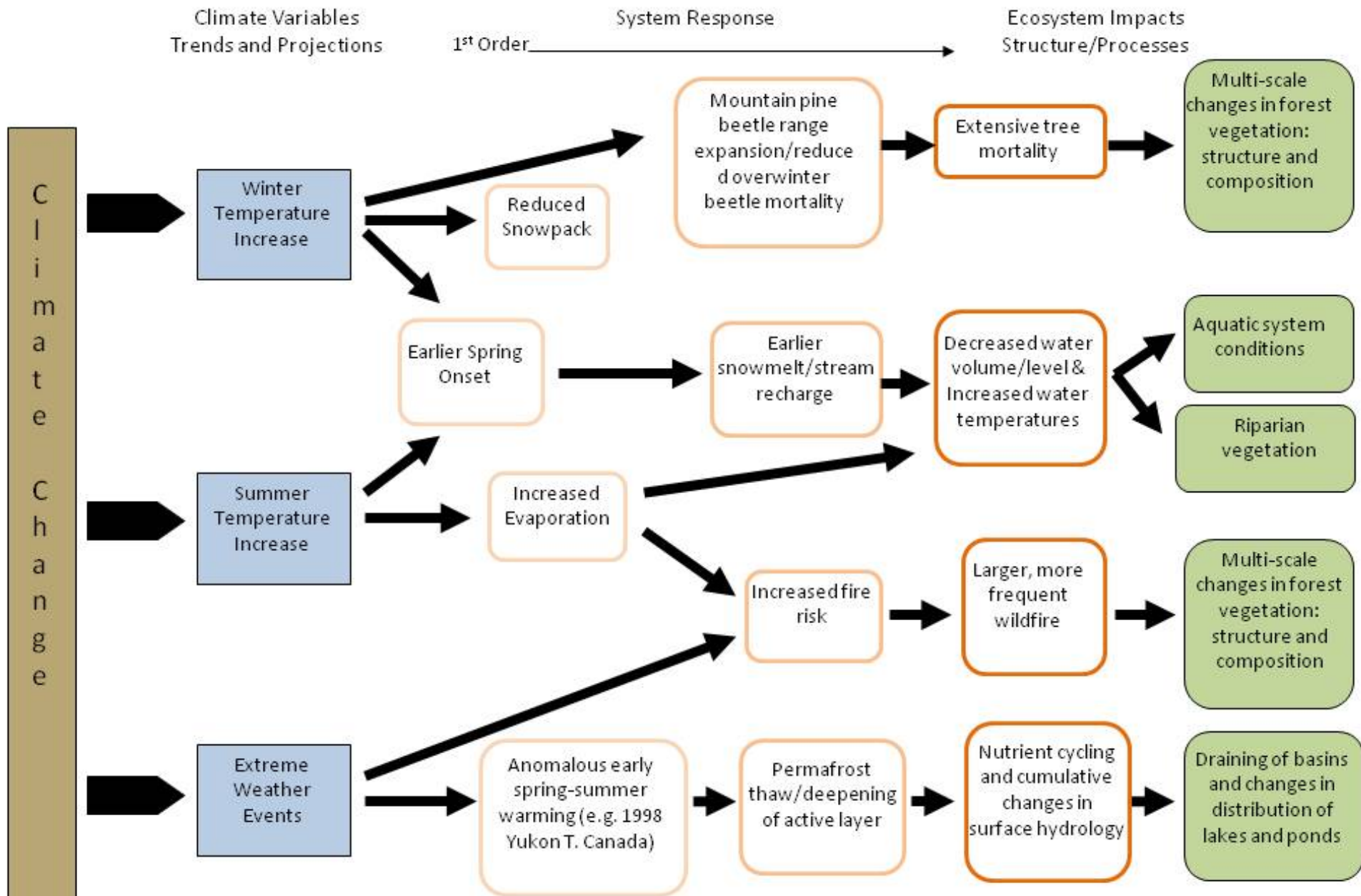


The trend has been upward everywhere.



Changing Fire regime

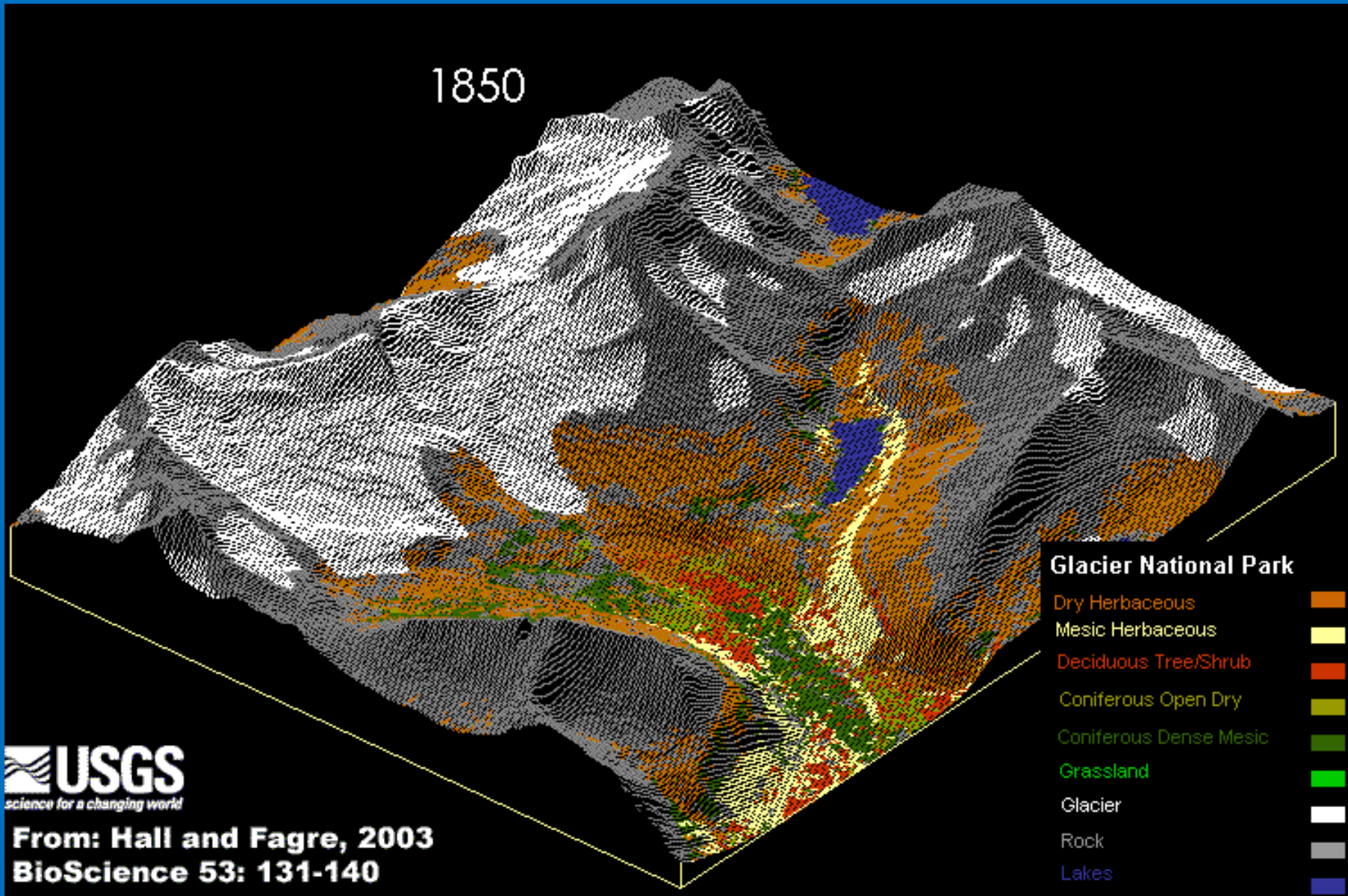
- Frequency (fire return interval)
- Intensity (heat output per unit time)
- Severity (heat output and duration)
- Seasonal distribution
- Fuel consumption & spread (fuel types, fuel patchiness, fire size)



Graumlich, Rowland and Hebda – Y2Y Report 2010

Poleward, Upward, Cooler Aspect

1850

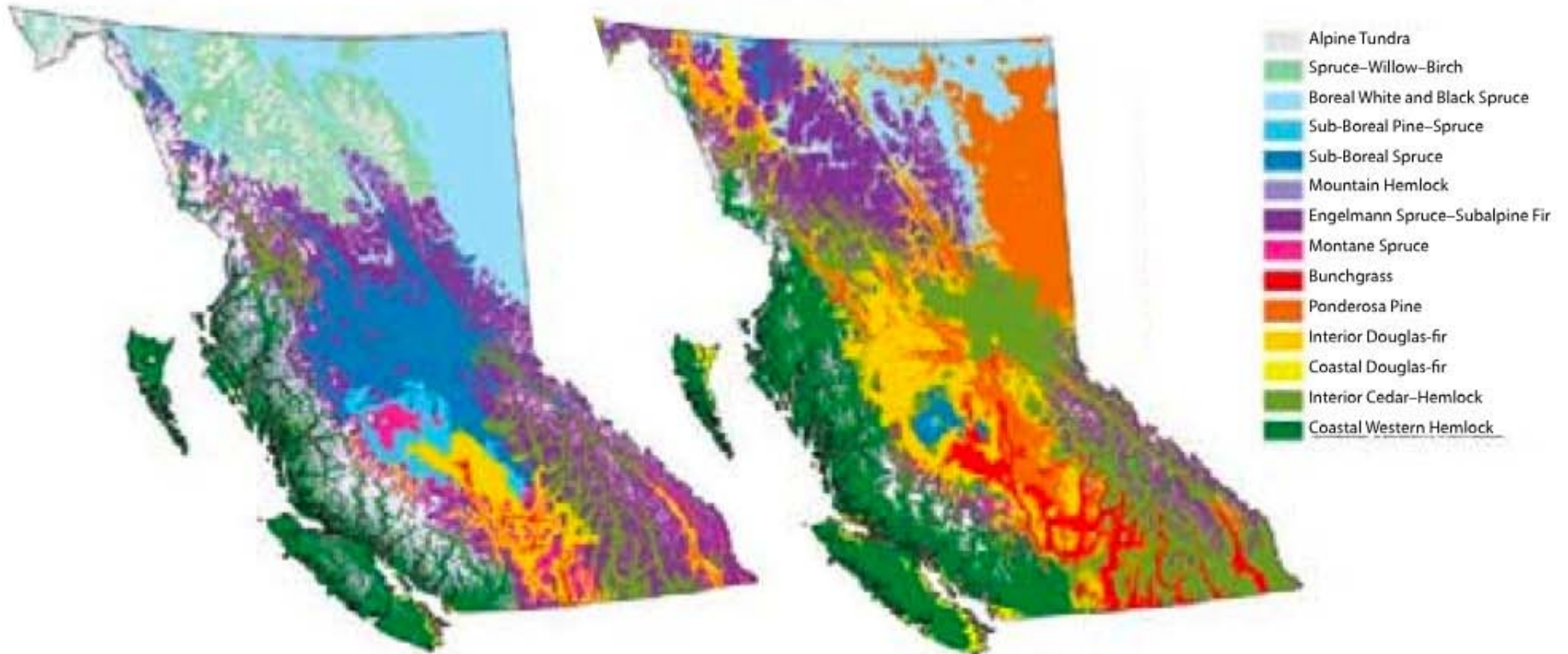


USGS
science for a changing world

From: Hall and Fagre, 2003
BioScience 53: 131-140

CURRENT

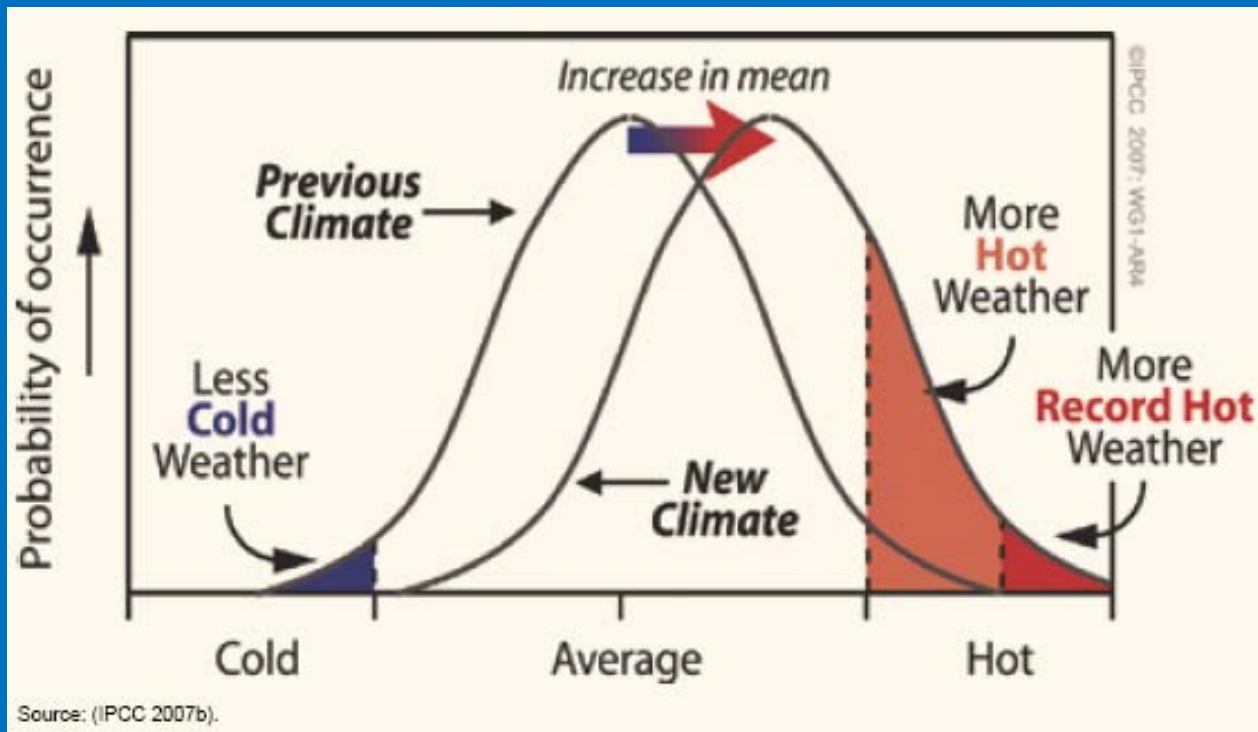
2085



Source: Biodiversity BC

The Concept of Transformation

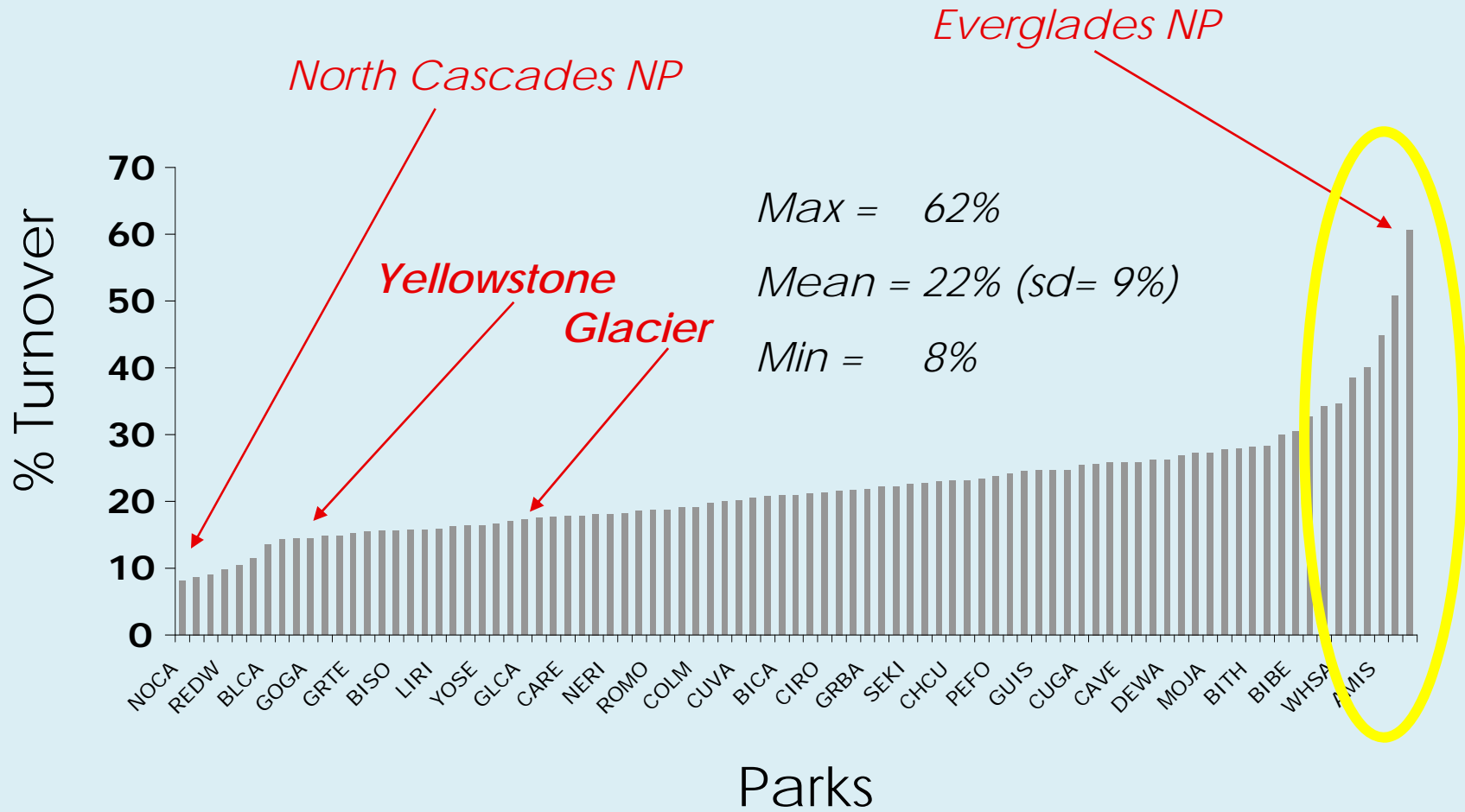
Novel Ecosystem Management



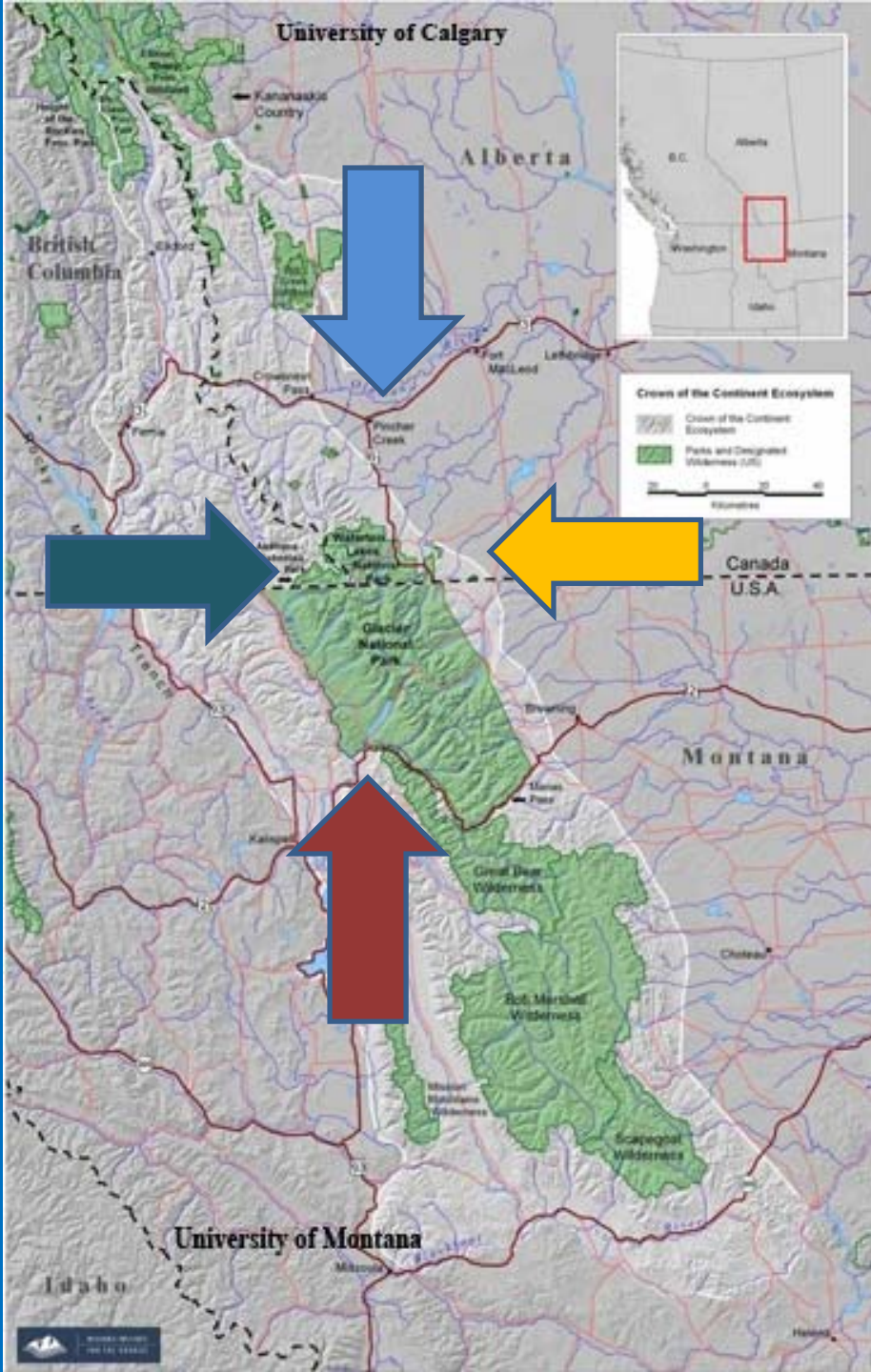
So how will species respond?

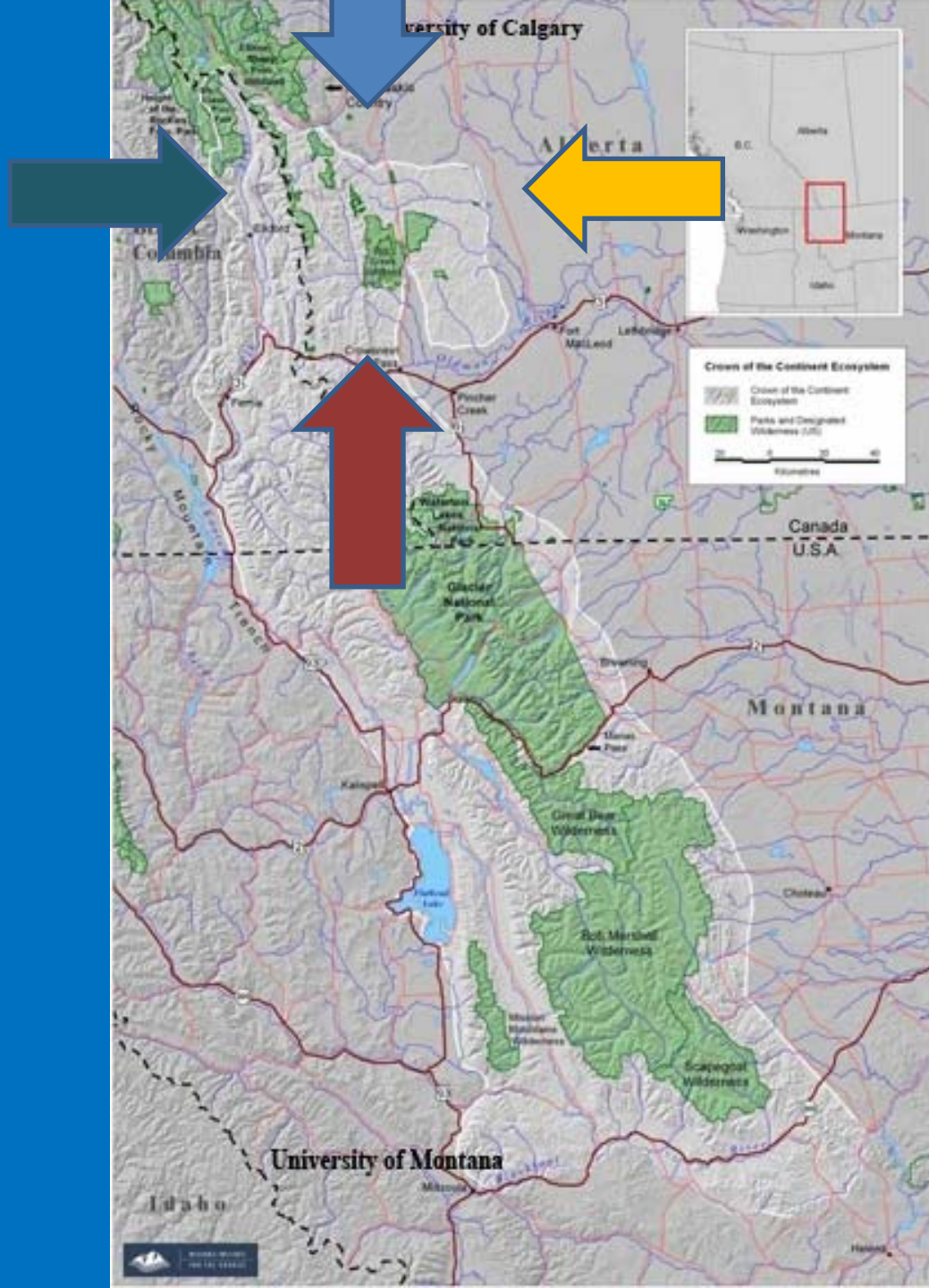


Species Turnover in National Parks



Courtesy: Josh Lawler Ph.D., University of Washington





Impact of a Century of Climate Change on Small-Mammal Communities in Yosemite National Park, USA

Craig Moritz,^{1,2*} James L. Patton,^{1,2} Chris J. Conroy,¹ Juan L. Parra,^{1,2}
Gary C. White,³ Steven R. Beissinger^{1,4}

We provide a century-scale view of small-mammal responses to global warming, without confounding effects of land-use change, by repeating Grinnell's early-20th century survey across a 3000-meter-elevation gradient that spans Yosemite National Park, California, USA. Using occupancy modeling to control for variation in detectability, we show substantial (~500 meters on average) upward changes in elevational limits for half of 28 species monitored, consistent with the observed ~3°C increase in minimum temperatures. Formerly low-elevation species expanded their ranges and high-elevation species contracted theirs, leading to changed community composition at mid- and high elevations. Elevational replacement among congeners changed because species' responses were idiosyncratic. Though some high-elevation species are threatened, protection of elevation gradients allows other species to respond via migration.



Corridors

Connectivity

Large Landscapes

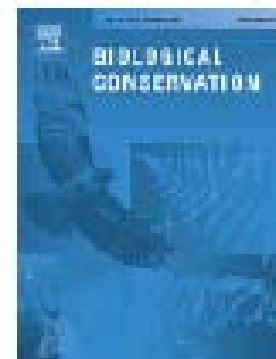


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journal homepage: www.elsevier.com/locate/biocon



Review

Biodiversity management in the face of climate change: A review of 22 years of recommendations

Nicole E. Heller*, Erika S. Zavaleta

Environmental Studies Department, University of California, Santa Cruz, Santa Cruz, CA 95606, United States

#1 Recommendation: Increase Connectivity

Mechanisms for Species Responses

- Behavioral Adaptation – Tolerance
- Phenotypic Plasticity
- Genetic Adaptation -- Mutations
- Ecological Adaptation -- Range Shifts
- Social Adaptation
- Extinction ?

So what's the human response



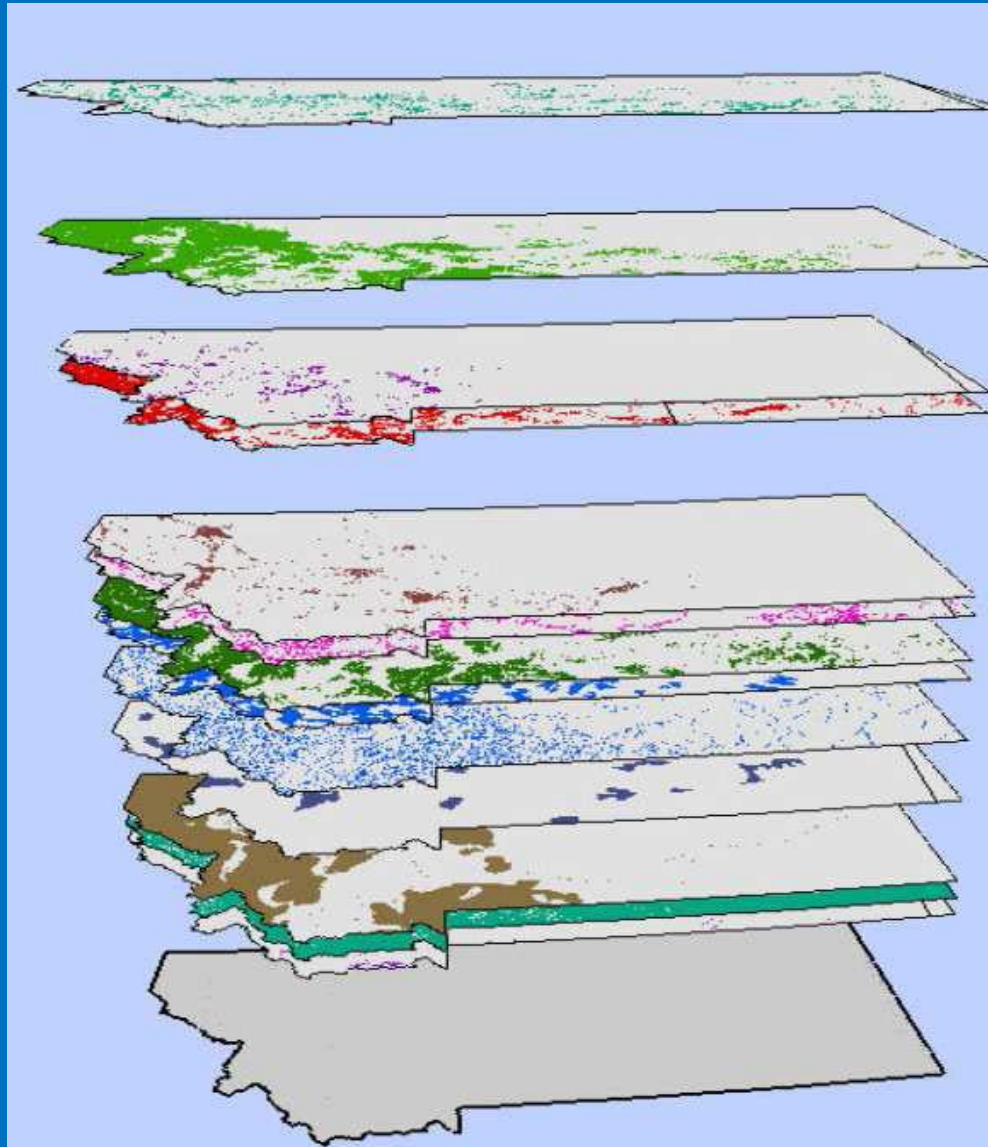
Policy Approaches that Enable Conservation Action



Western Governors Association Wildlife Corridor Initiative



Decision Support Systems

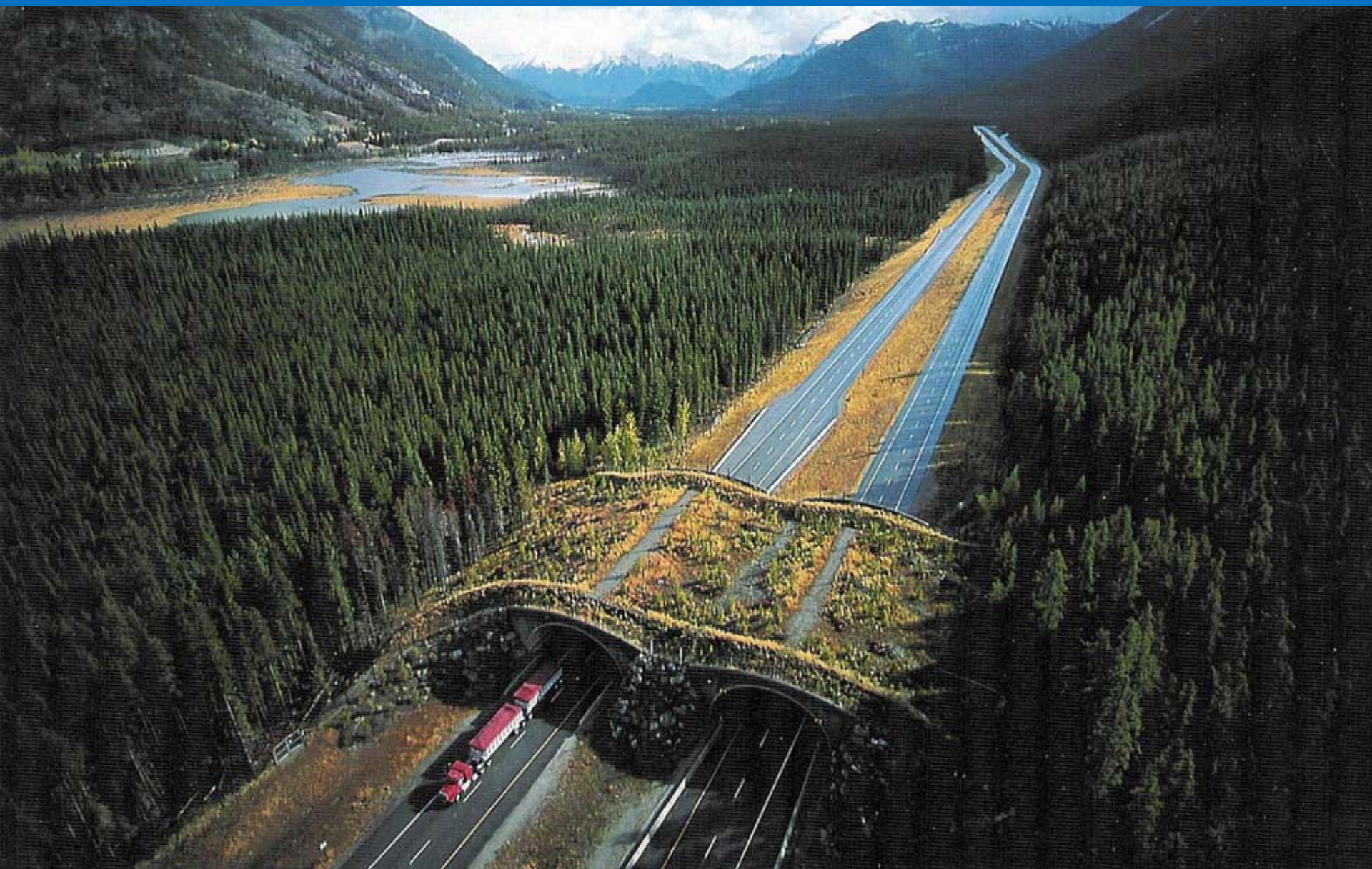


Doing the Things We know that Work

Wildlife
crossing
next **3** km

Passage
D'Animaux sauvages
sur **3** km





Feds giving \$1 million for wildlife research

The five year project will study the movement of animals across the Trans Canada Highway in the park

By Larissa Barlow, Banff Crag & Canyon, April 13, 2010



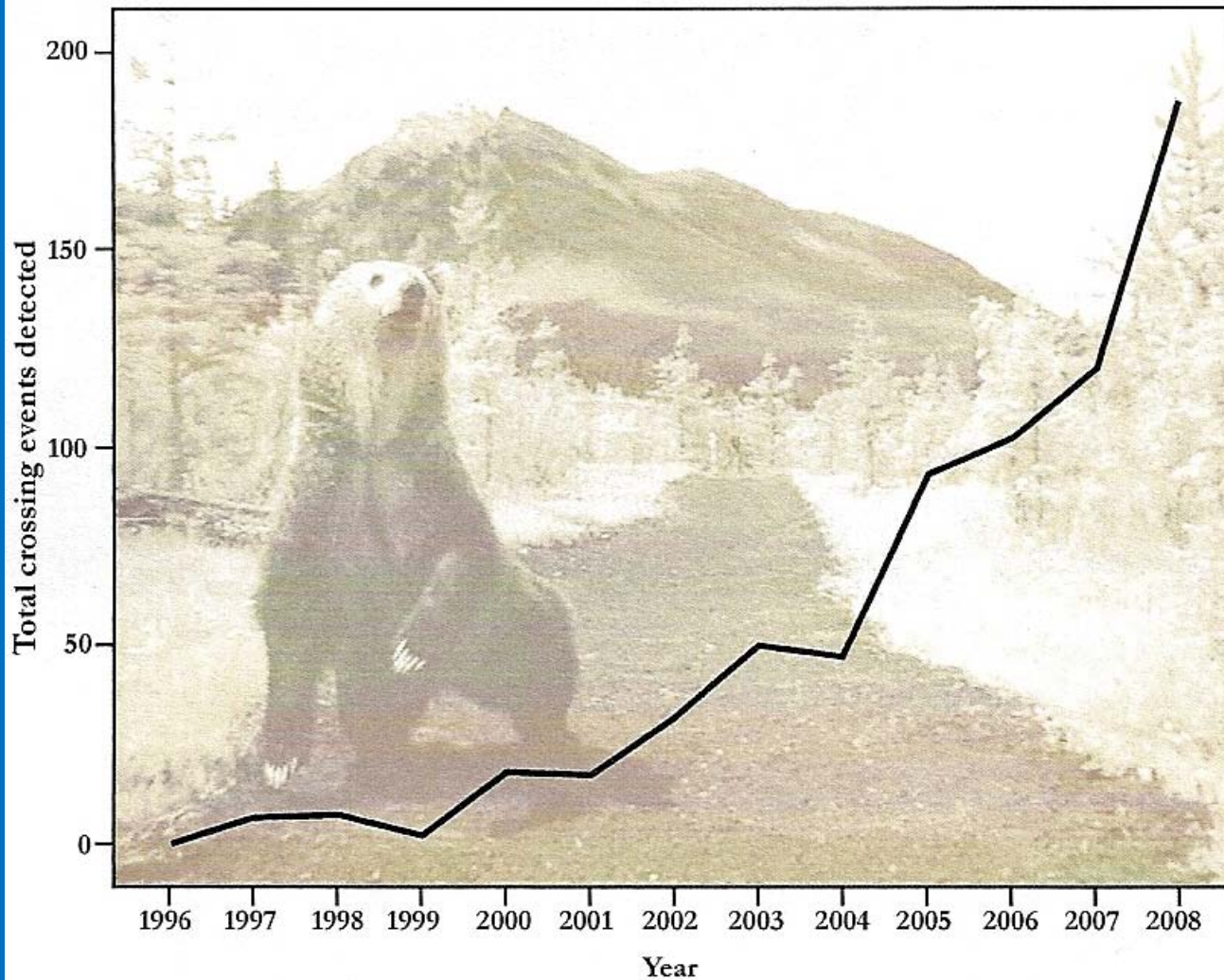


Figure 3: Total crossing events of grizzly bears detected at the Banff wildlife crossing structures, 1996-2008.

A. Clevenger and M. Huijer
Western Transportation Institute Sept. 2009

Banff National Park

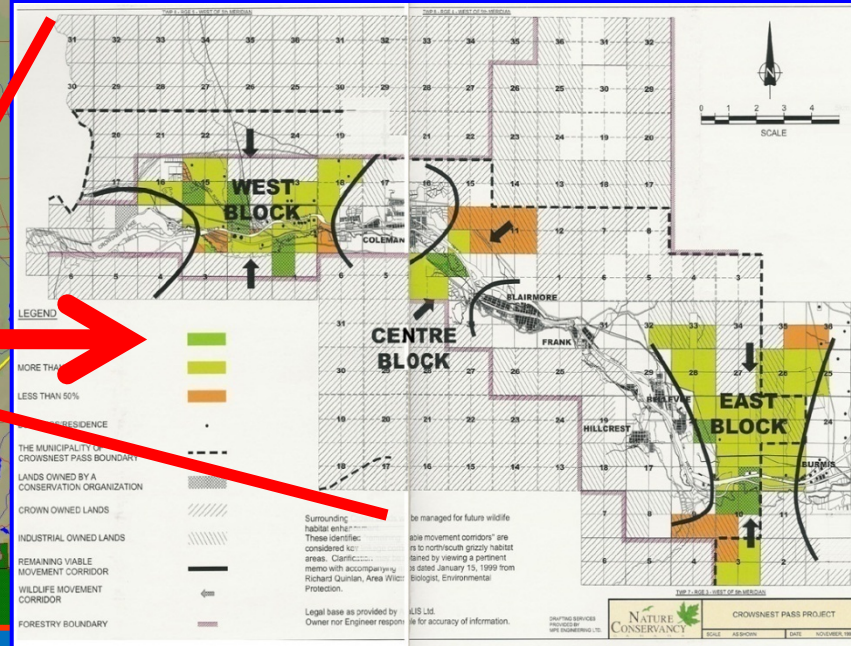
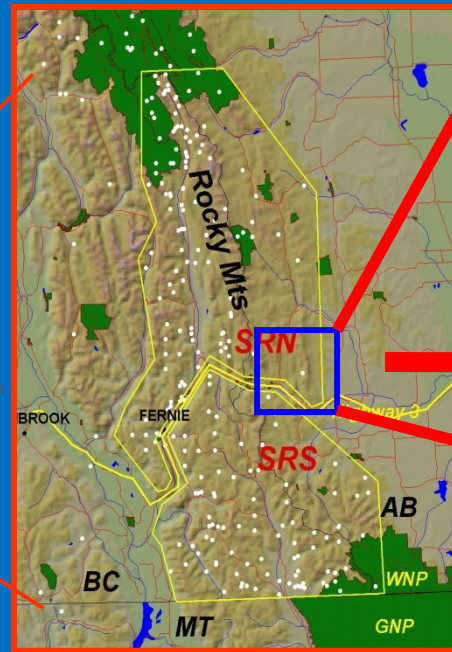
- **Total monitored crossings from Nov 1996 to March 2009**
- **Data from 23 wildlife crossing structures**

Species	No. crossings
Bear sp.	24
Black bear	1191
Grizzly bear	679
Cougar	1405
Canada lynx	4
Coyote	7202
Wolf	5113
Wolverine	4
Deer	127,553
Elk	37,722
Moose	144
Bighorn sheep	4592
Grand total	185,683

A. Clevenger and M. Huijer
Western Transportation Institute Sept. 2009

Protect Crossings- Crowsnest Pass, Alberta

Strategic Private Land Conservation



National Geographic Destinations

YELLOWSTONE TO YUKON

By Douglas H. Chadwick
Photographs by Raymond Crisman

Travel to faraway corners of the world—with about
100 full-color photographs and a personal narrative

Think and Act at Large Scales



Size Matters !



Yukon Flats
National Wildlife Refuge

ALASKA

Peel Watershed

YUKON TERRITORIES

NORTHWEST
TERRITORIES

NUNAVUT

*Nahanni National Park
Proposed Expansion*

Nahanni National
Park

Wood Buffalo
National Park

Muskwa Kechika

ALBERTA



YELLOWSTONE TO YUKON
CONSERVATION INITIATIVE

Climate Change dictates large scale conservation
and ecological connectivity to maximize resilience



Parcs
Canada

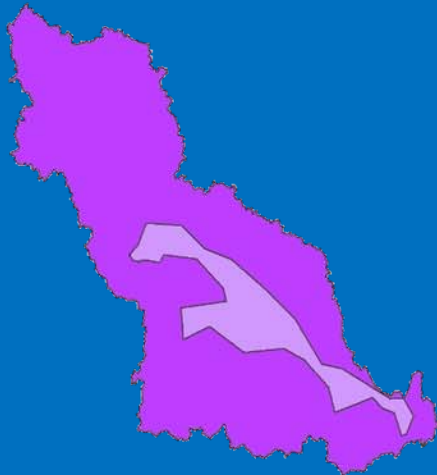
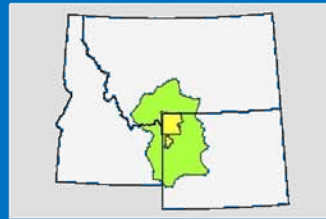
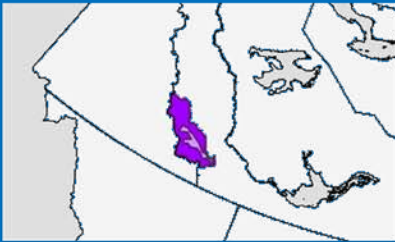
Parks
Canada

Canada

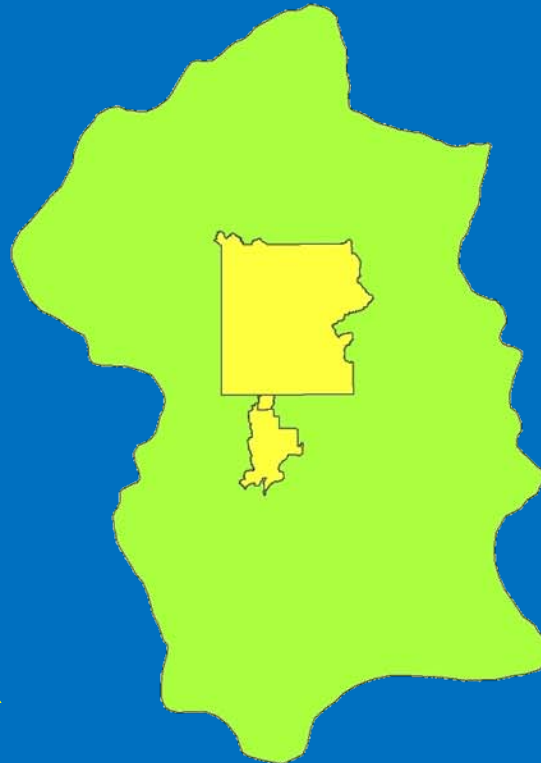
Nah?a Dehé

NAHANNI. REAL. INSPIRING.
Nahanni
NAHANNI. UNIQUE. VRAIMENT.

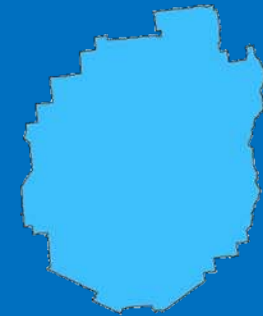




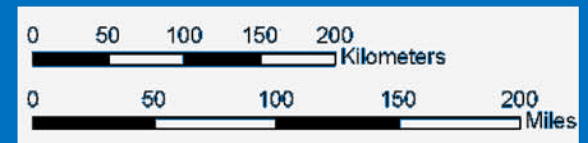
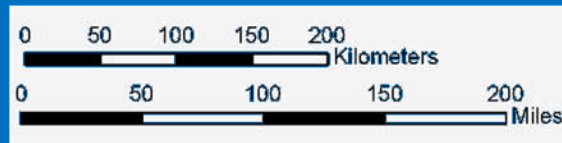
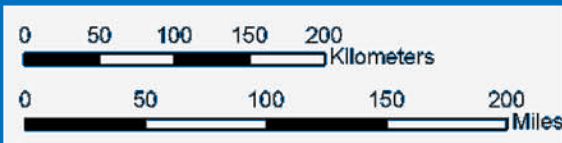
Nahanni Park



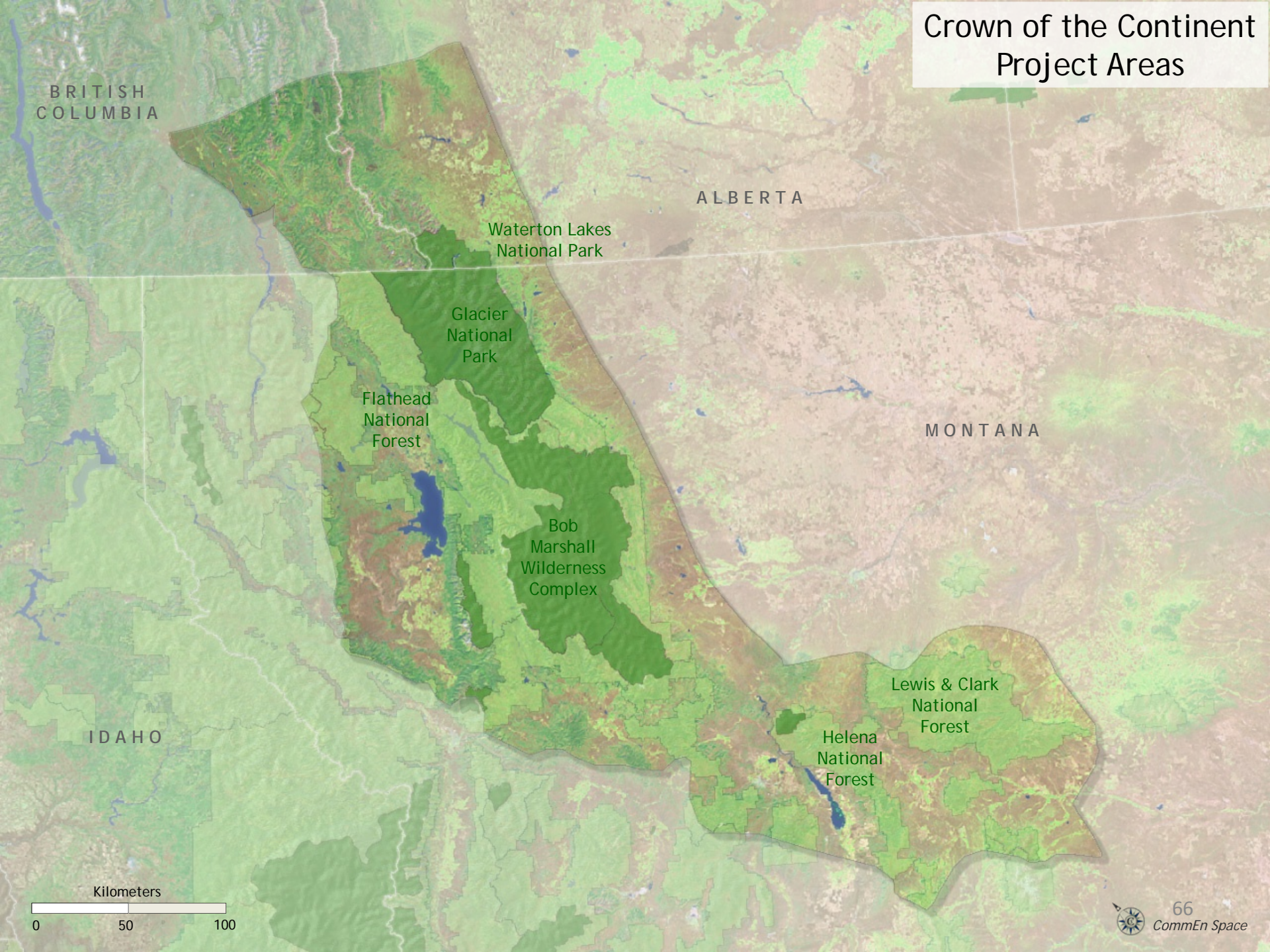
Greater Yellowstone Ecosystem



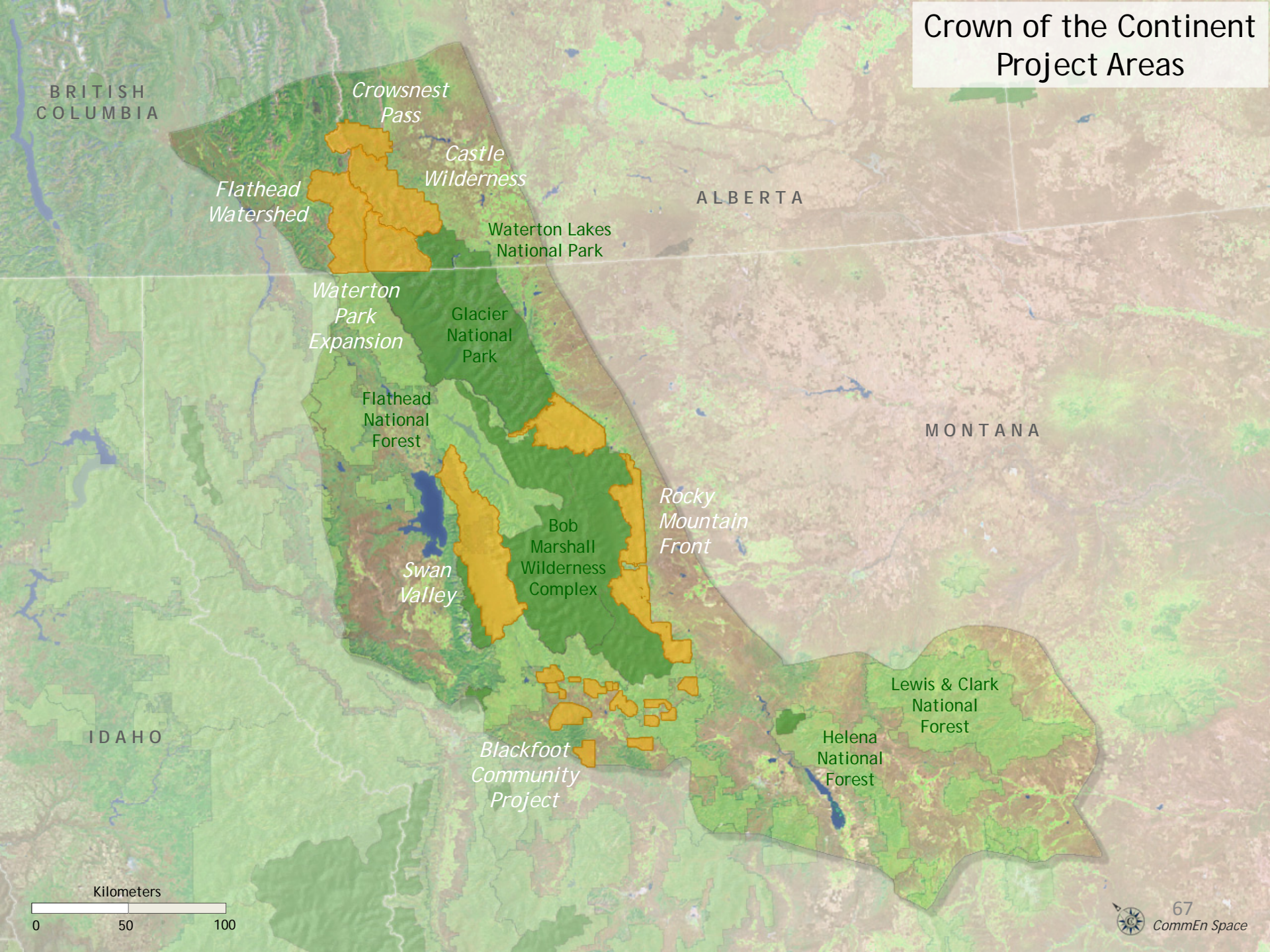
Adirondack Park



Crown of the Continent Project Areas



Crown of the Continent Project Areas

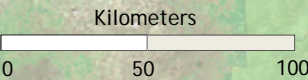


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ALBERTA

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IDAHO



DOI Great Northern LCC



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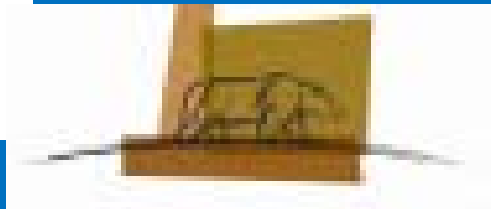


ASSOCIATION of
FISH & WILDLIFE
AGENCIES

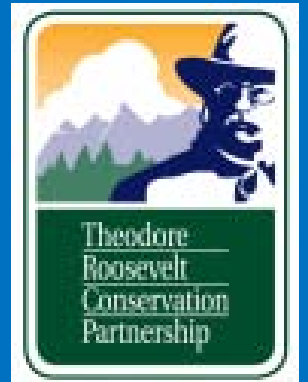
bp



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SOUTHERN CALIFORNIA
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An *EDISON INTERNATIONAL*® Company

Building resilience

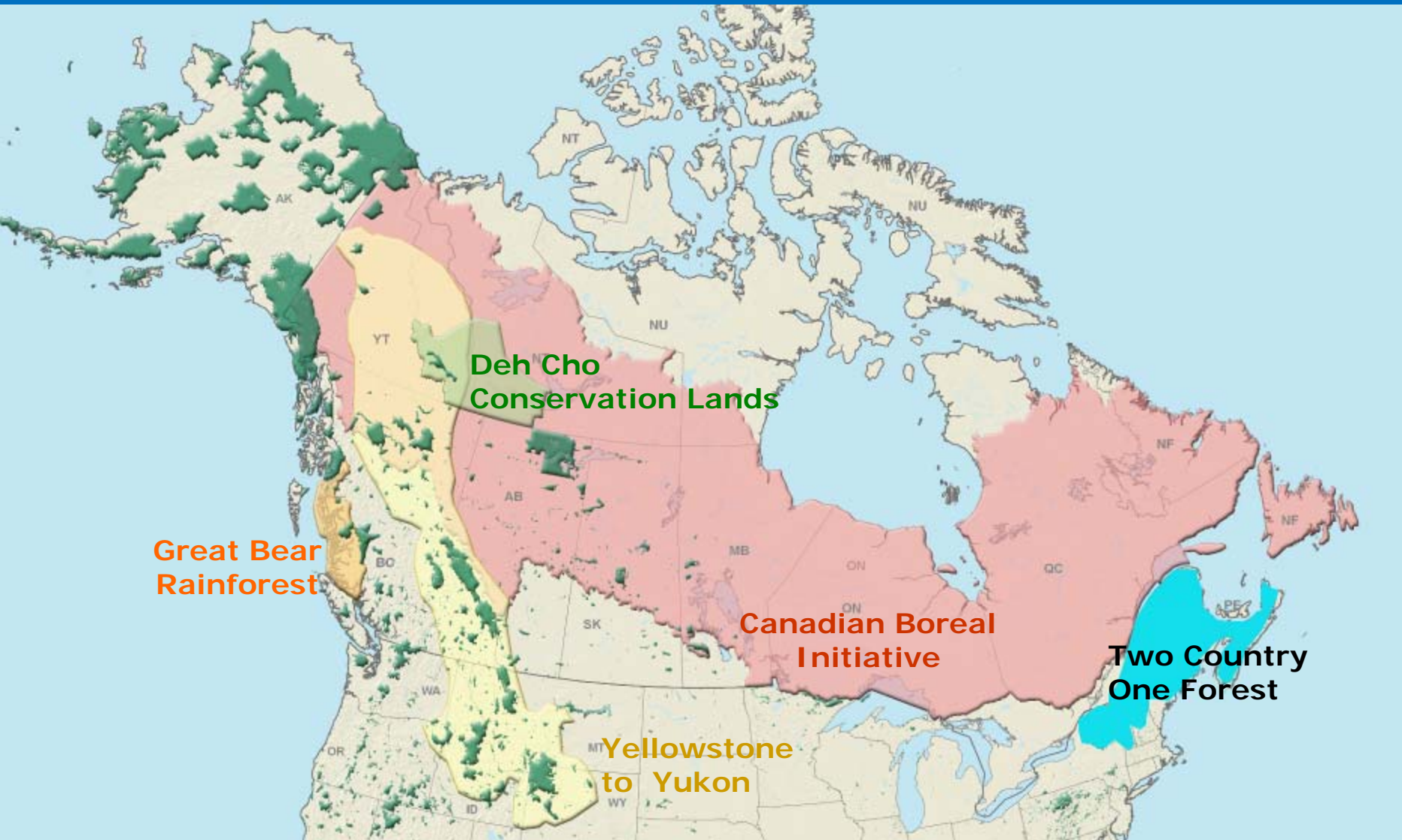
- Maintain well-functioning ecosystems
- Protect a representative array of ecosystems with redundancy
- Remove or minimize existing stressors
- Enhance connectivity (self-adapt)
- Conserve Processes like Migration
- Protect refugia
- Improve conservation outside PAs

Inspire Social Will



Conservation
across all
landscapes

Conservation Framework



Continental Connectivity