Large scale connectivity conservation and Biosphere Reserves: critical responses to climate change

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by

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Large scale connectivity conservation and Biosphere Reserves: critical responses to climate change

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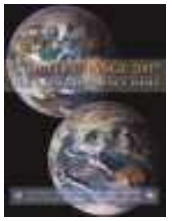
Presentation

1. Climate change threats
2. Large scale connectivity conservation:
   - a response to climate change
   - characteristics
   - science
   - methods
   - IUCN WCPA strategic direction
   - New book (Chapter 3, Yellowstone to Yukon)
3. Biosphere Reserves and connectivity conservation
4. Conclusion

1. Climate change threats

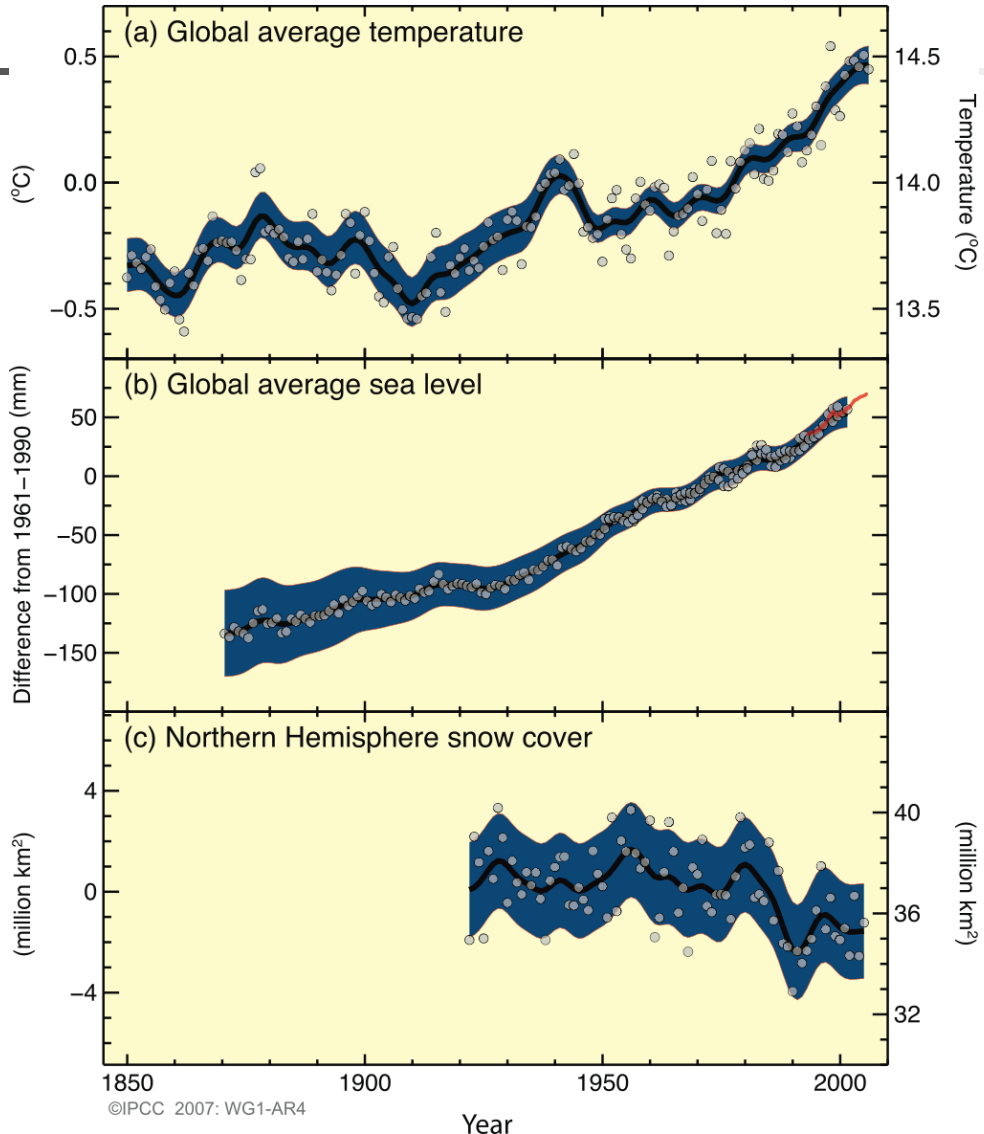
- Source of information: The Intergovernmental Panel on Climate Change (IPCC) 2007 reports

- Background about IPCC:
  - Is a scientific intergovernmental body
  - It was established by the World Meteorological Organisation (WMO) and the United Nations Environment Programme (UNEP)
  - IPCC is open to member countries of WMO and UNEP
  - Hundreds of scientists, worldwide, contribute
  - IPCC reports regularly. This presentation uses the 4th Assessment Reports, 2007
  - IPCC won, jointly with Mr Al Gore, the 2007 Nobel Peace Prize for its climate change work



The IPCC delegation with Nobel Peace Prize Diploma and Gold Medal at the Oslo Town Hall

1. Climate change: threats

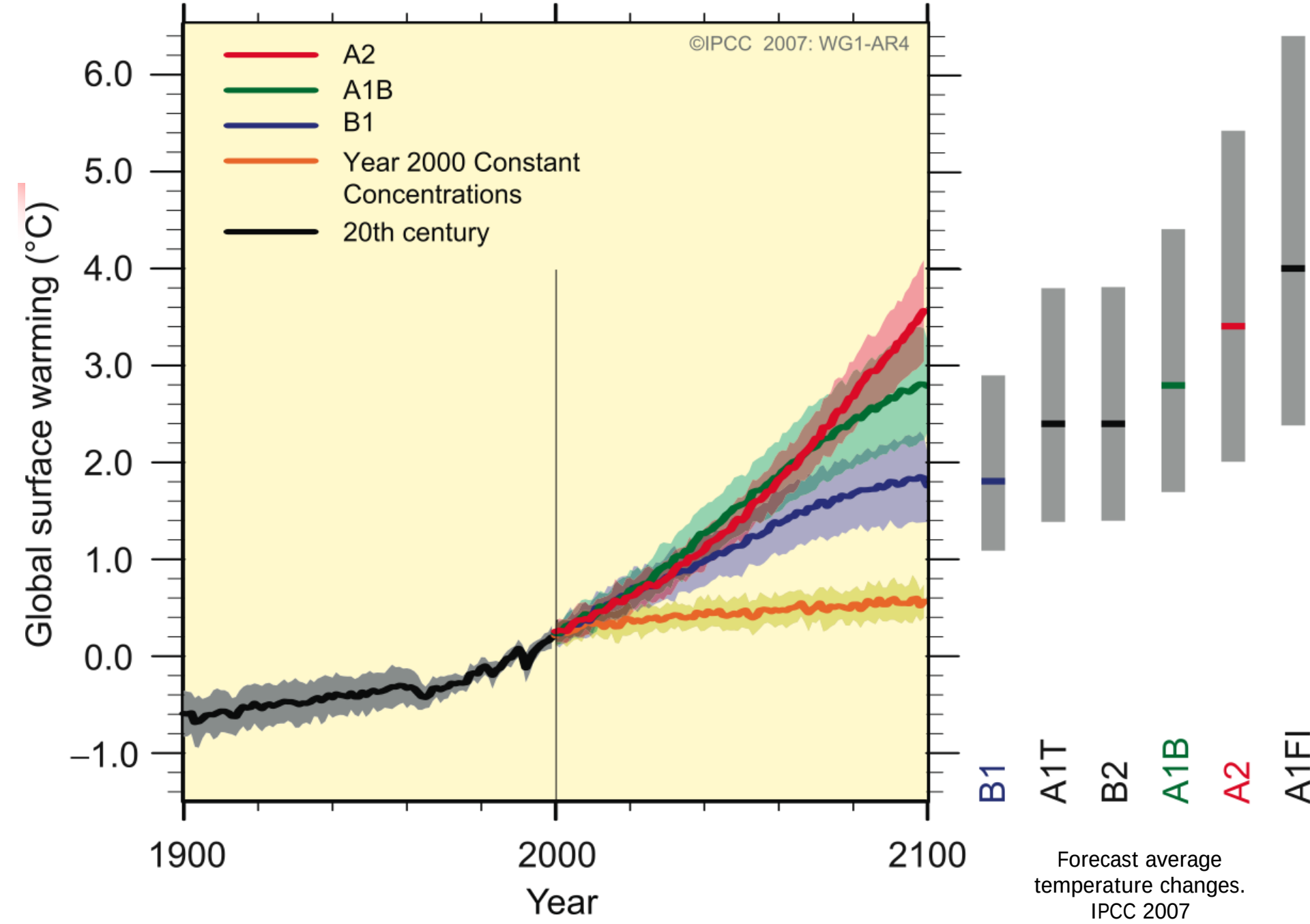


Earth: Observed changes for temperature and sea level 1850+ to 2005

(IPCC 2007)

1. Climate change threats

- IPCC 2007 forecasts:
  - An increase in Greenhouse Gas (GHG) emissions of 25-90% between 2000 and 2030
  - Warming of about 0.2^{o}C per decade for the next two decades….then forecasting is based on emission scenarios
  - Warming will be greatest over land and at most high northern latitudes
  - Snow cover (and ice) area will continue to contract



Forecast average temperature changes.
IPCC 2007

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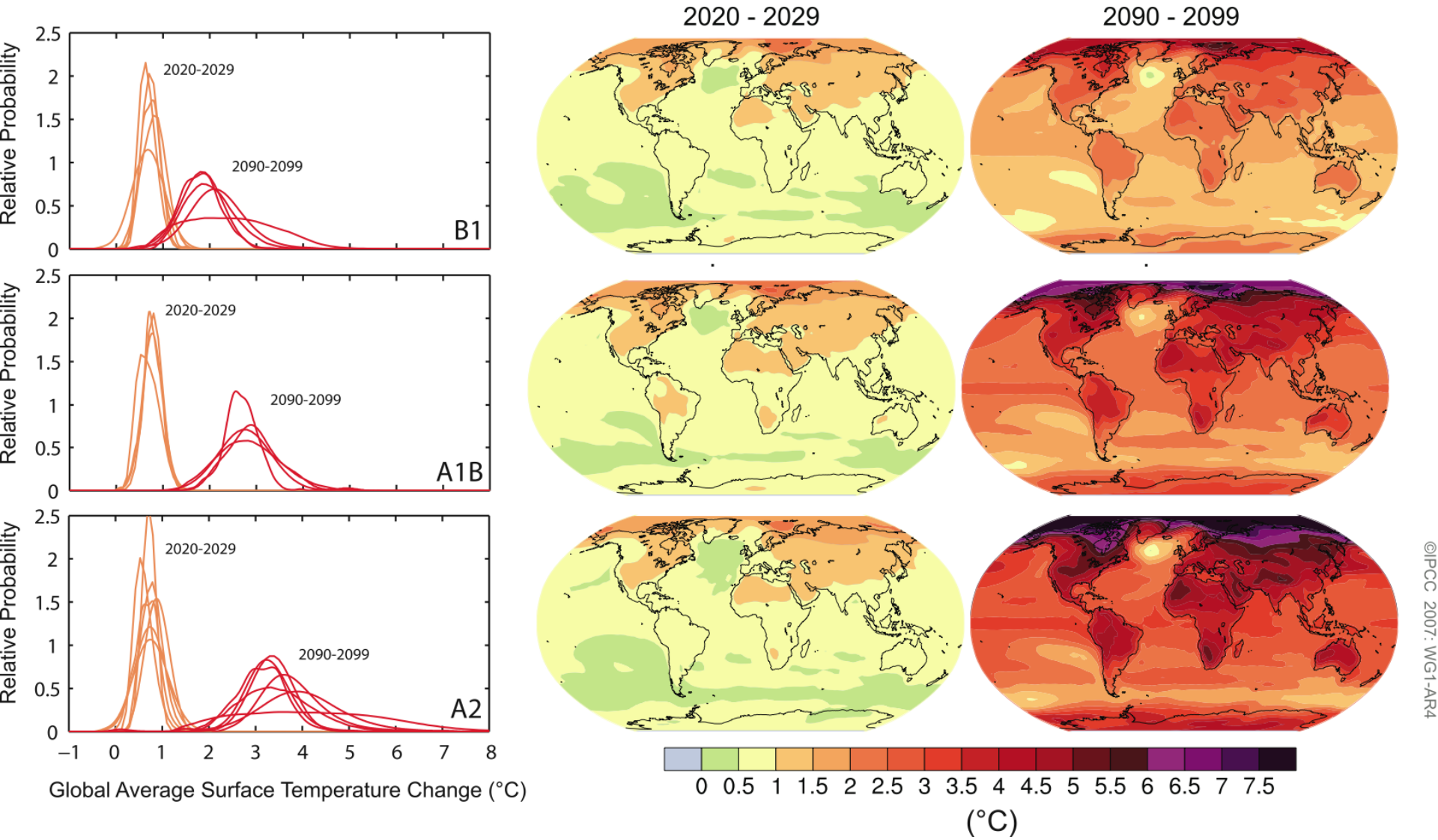
Kilimanjaro National Park, Tanzania, Africa: reduction of the ice cap of Mount Kilimanjaro.

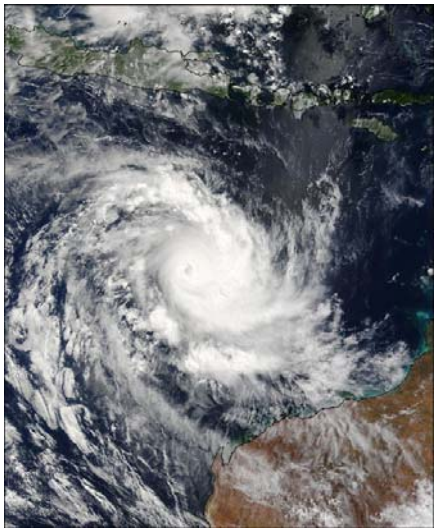
(Mt Kilimanjaro is the highest mountain in Africa (5,895 metres), and lies 330 kilometres south of the Equator)



Projected surface temperature changes for the early and late 21st Century relative to 1980-1999. (IPCC 2007)

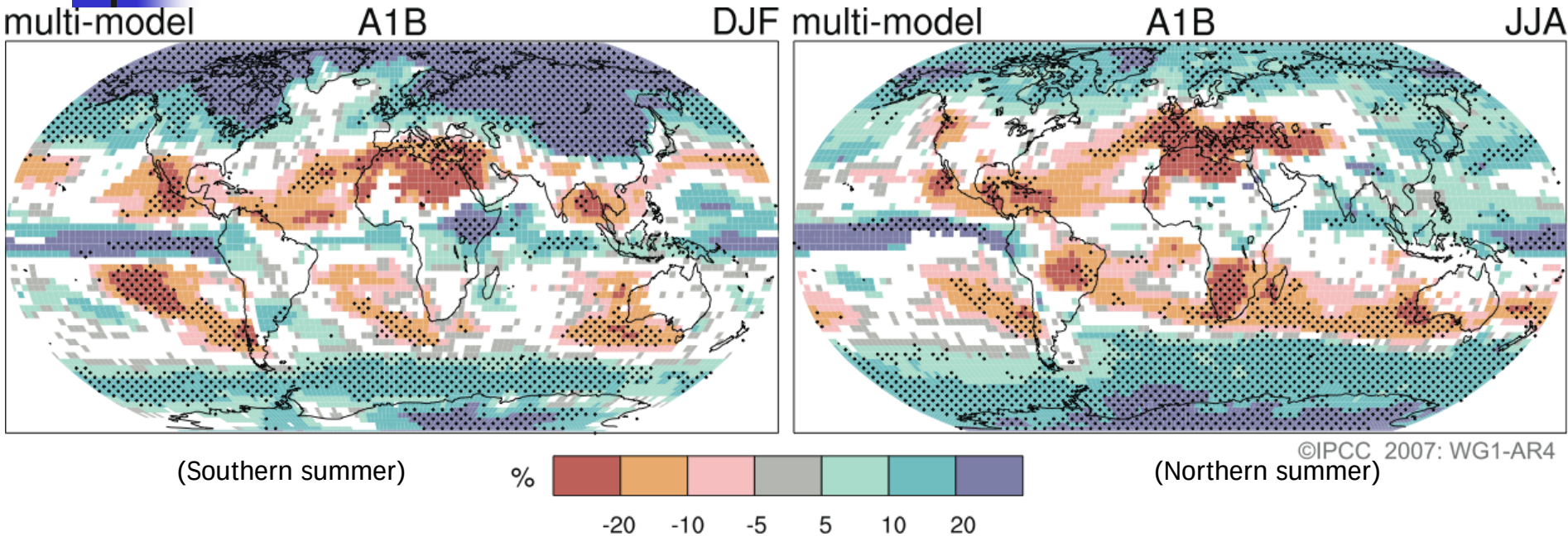
1. Climate change threats

- IPCC (2007) forecasts:
  - Increases in:
    - frequency of hot extremes and heat waves
    - frequency of heavy precipitation
    - tropical cyclone intensity
    - precipitation in high latitudes
  - A poleward shift in extra-tropical storm tracks
  - Likely decreases in precipitation in most sub-tropical areas



Tropical cyclone Inigo, near Western Australia

1. Climate change threats



Relative % change in precipitation for the period 2090-2099 relative to 1980-1999.
White areas are where there is less than 66% agreement between the models.
Stippled areas are where there is 90% agreement. **(IPCC 2007).**

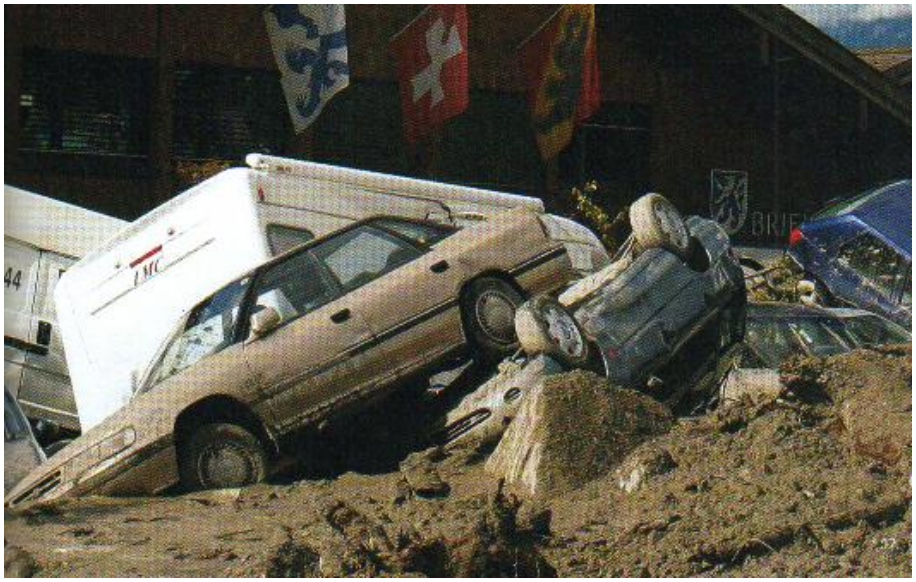
1. Climate change threats

- IPCC (2007) forecasts:
- More severe impacts to:
  - Tundra, boreal and mountain regions (warming)
  - Mediterranean regions (drying)
- and, particularly:
  - The Arctic
  - Africa
  - Small islands
  - Asian and African megadeltas

Thawing of the permafrost road base, northern Siberia, 2004 (Source: Al Gore 2006).

1. Climate change threats

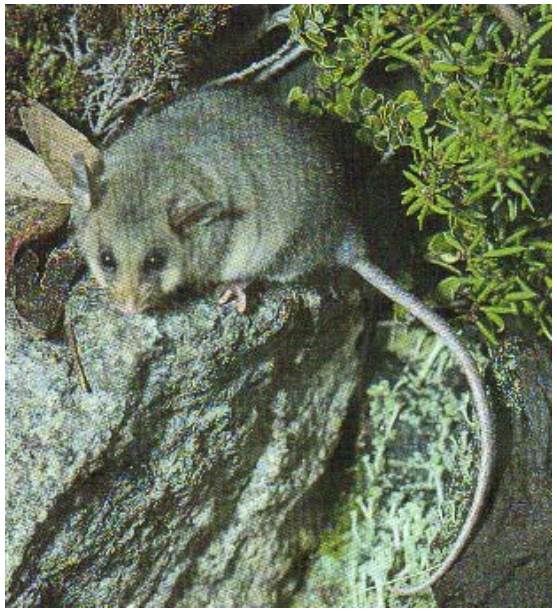
- IPCC (2007) forecasts:
- For **PEOPLE**
- Heat waves: Higher risk of heat-related mortality
- Droughts: Increased food and water shortage, malnutrition, risk of water and food borne diseases
- Floods: Increased risk of deaths and infectious respiratory and skin diseases
- Cyclones: Greater risk of death; food and water shortages and water and food borne diseases



Flooding from storms in Switzerland, 2005
(Source: Al Gore 2006)

1. Climate change threats

- IPCC (2007) forecasts:
- For **PLANTS AND ANIMALS**
- A loss of approximately 20-30% of species assessed for a 1.5-2.5 ^{0}C change
- Significant extinctions: 40-70% of species assessed for a 3.5 ^{0}C change



The Mountain Pygmy Possum, an endangered marsupial from the Australian Alps impacted by climate change

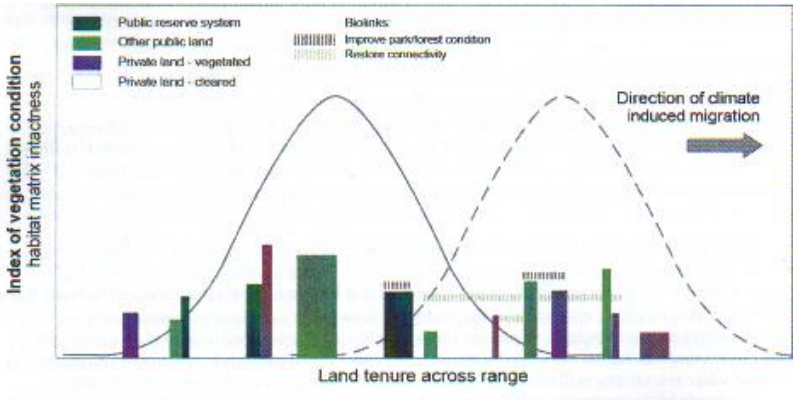
1. Climate change threats

- IPCC 2007 forecast:

- For **ECOSYSTEMS**
  (For 1.5-2.5 ^{0}C +)

- Major changes to:
  - ecosystem structure and function
  - species' ecological interactions
  - species' geographical ranges

- Negative impacts for:
  - biodiversity
  - human ecosystem goods and services (such as water and food supply)



Biome shift illustrated by Ian Mansergh and David Cheal, Victoria, Australia (2007) for an idealised north-south transect through a species range.

1. Climate change threats

- IPCC 2007 forecast:
- For **ECOSYSTEMS**
- **Resilience** of ecosystems may be exceeded due to a combination of:
  - climate change
  - associated disturbances (e.g. wildfire)
  - other changes such as landuse change, over-exploitation of resources

Lightning strike fire, Australian Alps

1. Climate change threats

- IPCC 2007 adaptation and mitigation responses:
- For water
  - Expanded rainwater harvesting; water storage and conservation techniques
- For forests
  - Financial incentives to increase forest area, to reduce deforestation, and to maintain and manage forests
- For agriculture
  - Improved land management such as erosion control and soil protection through tree planting
  - Financial incentives and regulations for improved land management
- For energy
  - Use of renewable resources

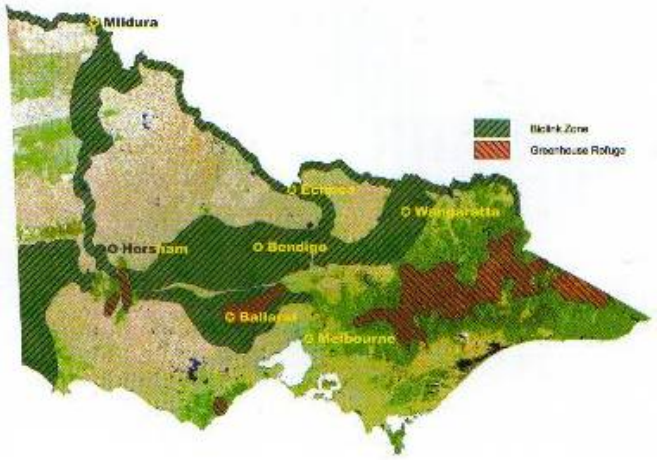
2.1 Connectivity conservation and climate change

- Connectivity conservation is a critical response to climate change
- It is a large scale land use vision
- It is the retention, conservation and active management of natural lands which interconnect core protected area lands
- It is complementary to a completed comprehensive and representative reserve system

Satellite view of southern Australia illustrating part of the natural vegetation cover of the Alps to Atherton corridor

2.1 Connectivity conservation and climate change

- Connectivity conservation has the potential to:
  - Protect catchments and therefore maximise water yields
  - Protect catchments (and people) at a times of major storm events
  - Protect healthy ecosystems when clean water and clean air are critical
  - Help conserve species in an environment of biome shift and habitat change
  - Help achieve ecosystem resilience by minimising threats

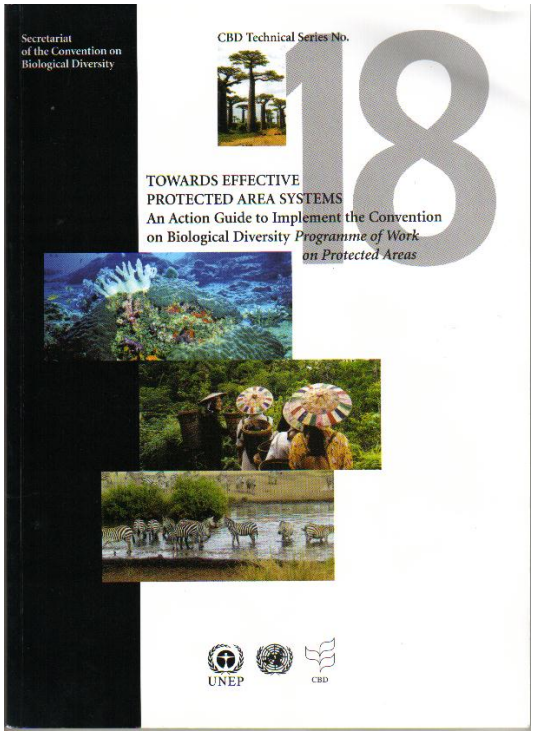


Proposed biolinks and Greenhouse refugia, Victoria, Australia (Brereton, Bennett and Mansergh, 1995).

2.1 Connectivity conservation and climate change

- It is one (of many) critical responses to climate change needed

- It is recognised as a key strategy by many organisations including:
  - The IPCC (Working Group III, 2007)
  - The Secretariat of the Convention on Biological Diversity, Programme of Work on Protected Areas (Nigel Dudley *et al*. 2005)
  - IUCN WCPA's Strategic Plan 2005-2012



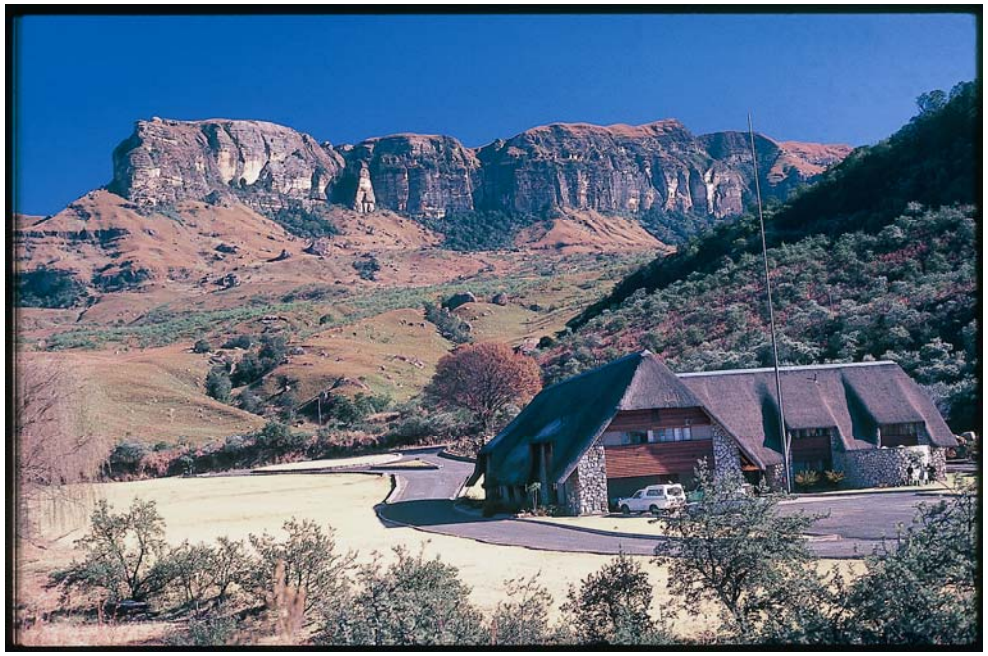
2.2 Characteristics: connectivity conservation

- **Size:** We are dealing with very large areas of essentially natural lands
  - Some are thousands of kilometres long
  - Some are hundreds of kilometres wide
  - Most are linked to mountainous areas

Mt Assiniboine, Canadian Rockies. 3,200 kilometres of Yellowstone to Yukon Connectivity Conservation. Photo by Harvey Locke

2.2 Characteristics: connectivity conservation

- **Tenure:** land ownership is typically diverse and may include:
  - Public, private and community protected areas
  - Other government lands
  - Private property
  - Community lands



Drakensbergs Mountains, 300 kilometres of connectivity conservation, South Africa

2.2 Characteristics: connectivity conservation

- **Purpose:** To conserve healthy environments and species by:
  - Conserving habitat
  - Conserving habitat linkages
  - Retaining the connectedness of ecological and evolutionary processes
  - Active management of threats
  - Retaining opportunities for change within natural settings

Antisana Volcano, Northern Andes, Ecuador. Part of Antisana Ecological Reserve and part of 236 kilometre of connectivity conservation as part of the Condor Biosphere Reserve which conserves lands in altitude from 400 metres to 5800 metres.

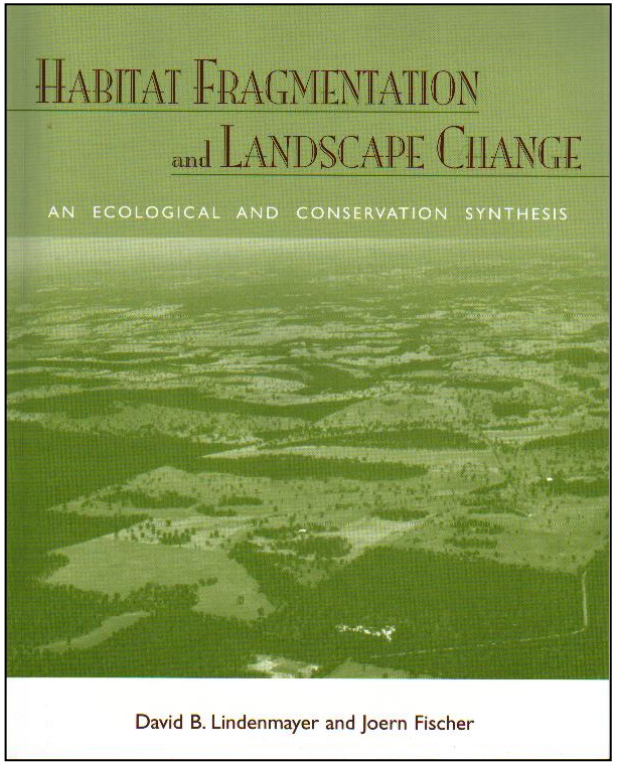
2.2 Characteristics: connectivity conservation

- **Rationale:** It is:
  - A response to minimise human caused species extinctions
  - An investment against future “other” threats given the human population is to grow from 6.3 billion to 9.2 billion by 2050
  - A response to climate change effects

Royal Chitwan National Park, Nepal, part of the 850 km (plus) Terai Arc connectivity conservation landscape of alluvial grasslands and sub tropical deciduous forests

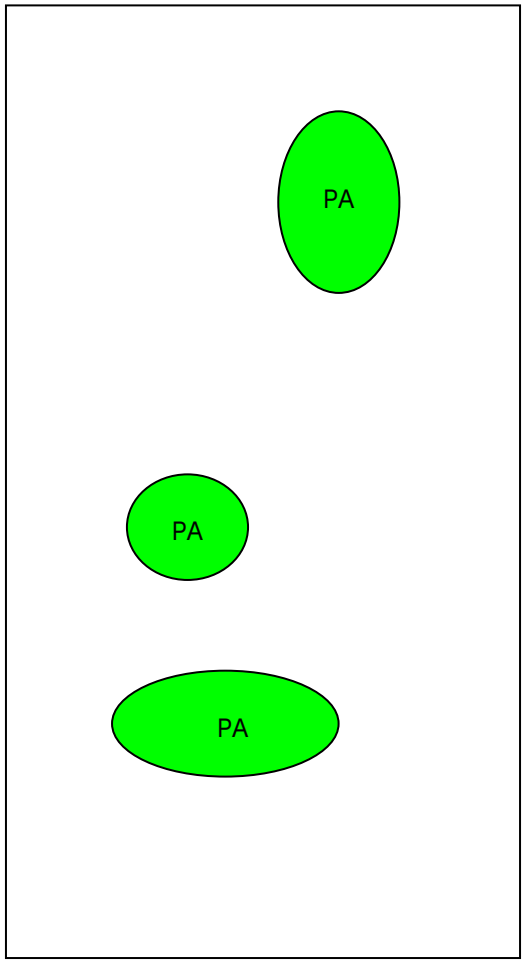
2.3 Science: connectivity conservation

- **Science:** Guidance of five strategies for mitigating the decline of species and assemblages: (Lindenmayer and Fischer 2006)
  - 1. Maintain large and structurally complex patches of native vegetation
  - 2. Maintain a matrix structurally similar to native vegetation
  - 3. Maintain buffer areas
  - 4. Maintain corridors and stepping stones
  - 5. Maintain landscape heterogeneity and capture environmental gradients



2.3 Science: connectivity conservation

- **Protected areas**
- Protected areas are the best method for maintaining natural vegetation
- “A network of nature reserves provides a regional-scale strategy to provide core habitats for many species”
  (Lindenmayer and Fischer 2006)



2.3 Science: connectivity conservation

- **But:** There are limits to protected areas
  - "Nature reserves alone cannot guarantee the protection of all native species because [typically] they are too few, too isolated and too static, and not necessarily safe from over exploitation"
  - "Given these limitations, off-reserve conservation in human-modified landscapes (...) is an important conservation strategy in addition to setting aside reserves"
  - (Lindenmayer and Fischer 2006)

Cayamba-Coca Ecological Reserve, Ecuadorian Andes, Ecuador, part of the Condor Biosphere Reserve connectivity conservation.

2.3 Science: connectivity conservation

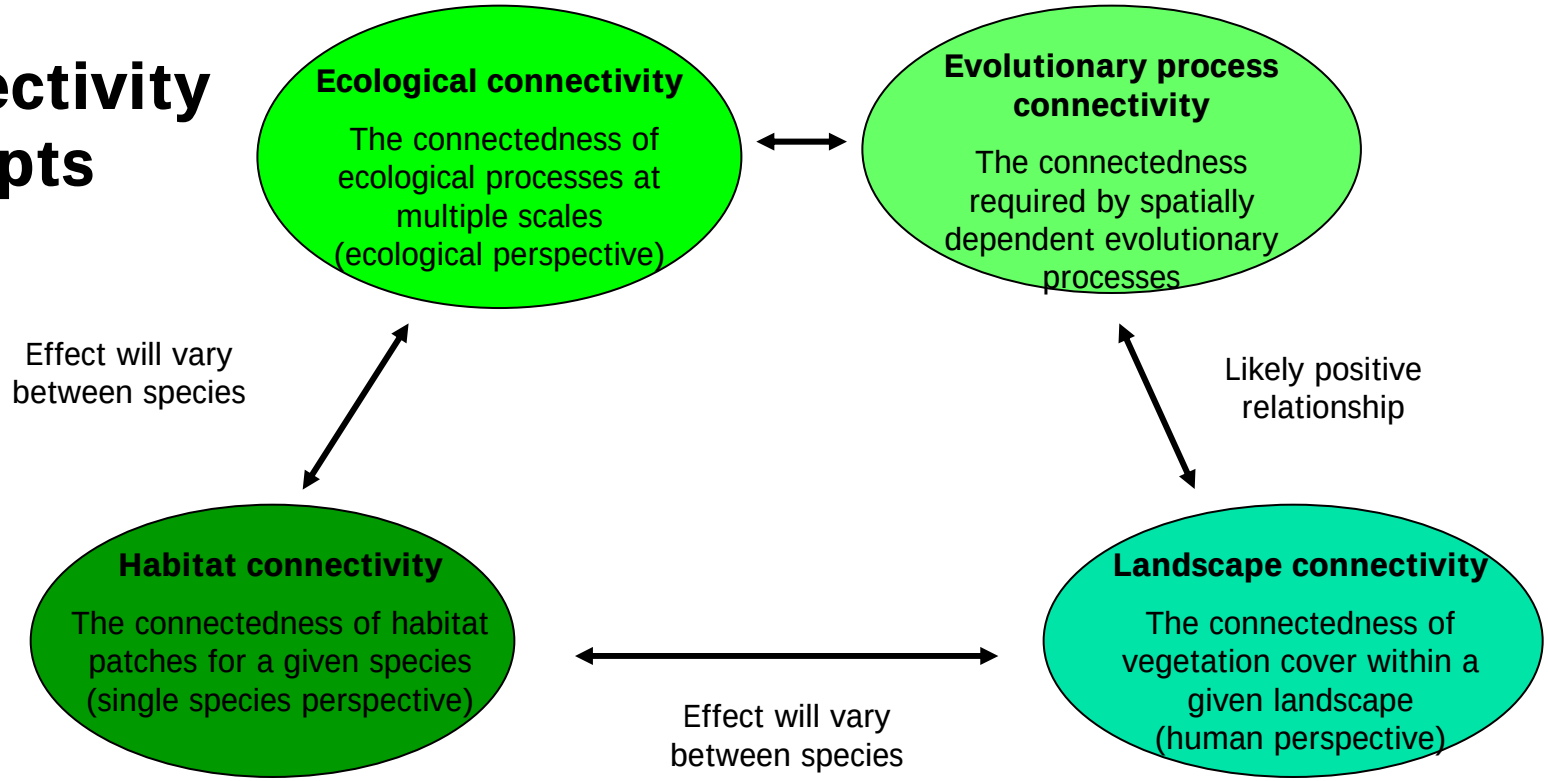
- **Landscape connectivity**:
  - Off reserve conservation can help achieve landscape connectivity
  - "Landscape connectivity can promote biological conservation because it may contribute positively to habitat connectivity for a range of different species, and because it may connect ecological processes at multiple spatial scales"

(Lindenmayer and Fischer 2006)

500 kilometres (plus) of connectivity conservation at Kruger National Park, interlinking habitats to Mozambique and private protected areas

2.3 Science: connectivity conservation

Connectivity concepts



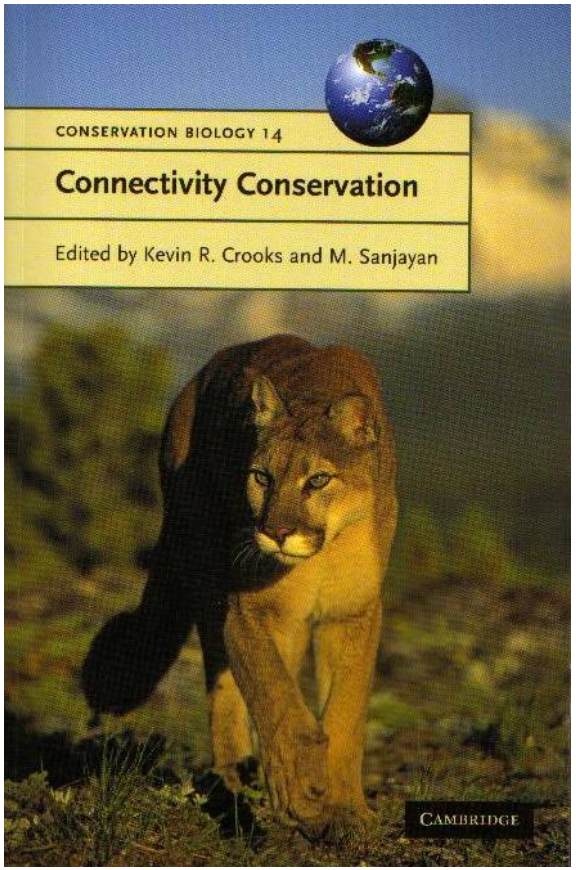
(Lindenmayer and Fischer 2006, Mackey et al. 2008)

2.3 Science: connectivity conservation

Connectivity:

- Is about the degree of movement of organisms (plants and animals) and processes (ecological interactions, ecosystem processes and natural disturbances).

- It is scale and target dependent and includes concepts such as metapopulations, landscape ecology, the flow of energy, material, organisms or information across dissimilar habitats and the flow of genetic material within and amoung wildlife populations*[1]



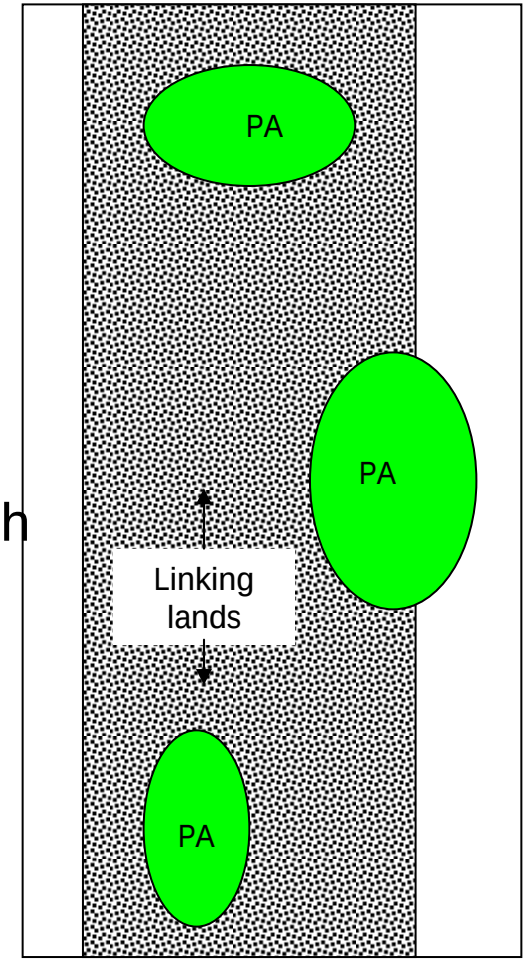
- *1 Crooks, K.R. and Sanjayan, M. (2006). *Connectivity Conservation.* Cambridge University Press. Cambridge.

2.3 Science: Connectivity conservation

Principles:

Connectivity conservation:

- Is a large scale land use concept;
- Includes landscape, habitat and ecological connectivity;
- Includes core (critical) protected areas;
- Includes (essentially) natural linking lands which complement protected areas;
- Includes active management and may include rehabilitation of some lands if necessary; and
- Involves multiple people and communities.



2.4 Methods: establishing connectivity conservation areas

Establishment:

- "(...) a more effective strategy will, in almost all cases, be to retain landscape connectivity prior to landscape modification rather than attempting to re-create it once it has been lost."

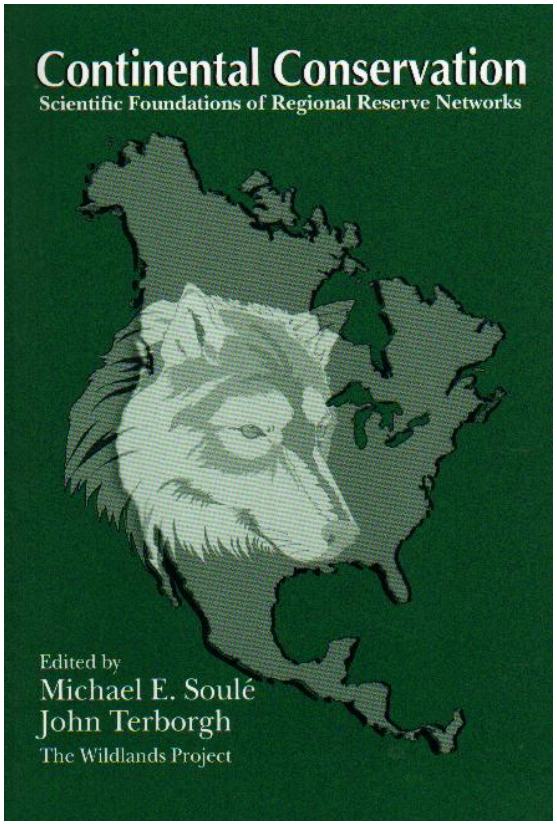
  (Lindenmayer and Fischer 2006)
- Large scale connectivity conservation initiatives aim to do just that

Elephant populations are actively managed in the Kruger National Park, South Africa.

2.4 Methods: connectivity conservation

Corridors:

- The word “corridor” has been used for many large scale connectivity conservation initiatives.
  - “Corridors are large regional connections that are meant to facilitate animal movements and other essential flows between different sections of the landscape” (Soulé and Terborgh 1999)



2.4 Methods: connectivity conservation

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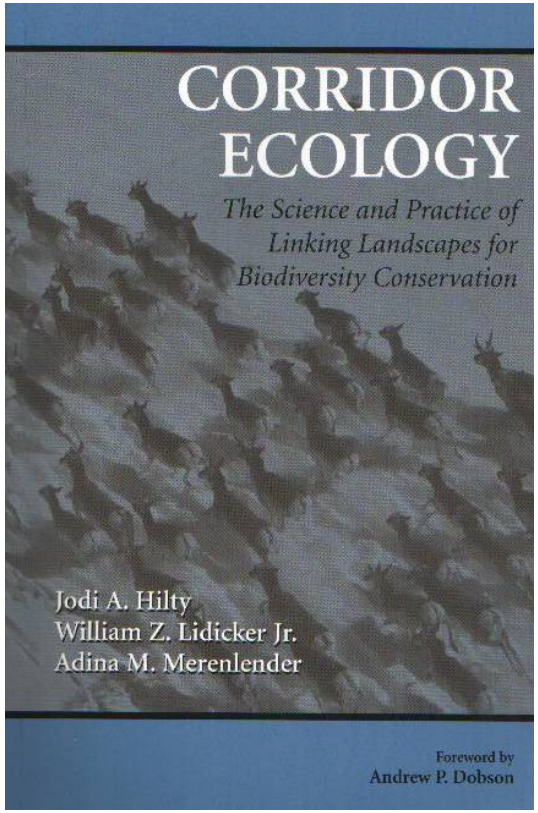
Corridors

- (Quote from Hilty and Chester)
  - "Most broadly, corridors are an intuitive and realistic tool for protecting biodiversity in a world where the landscape matrix is increasingly dominated by the loss and fragmentation of habitat due to anthropogenic influences. (...). It is the facilitation of movement that constitutes the *raison d'être* underpinning corridors".



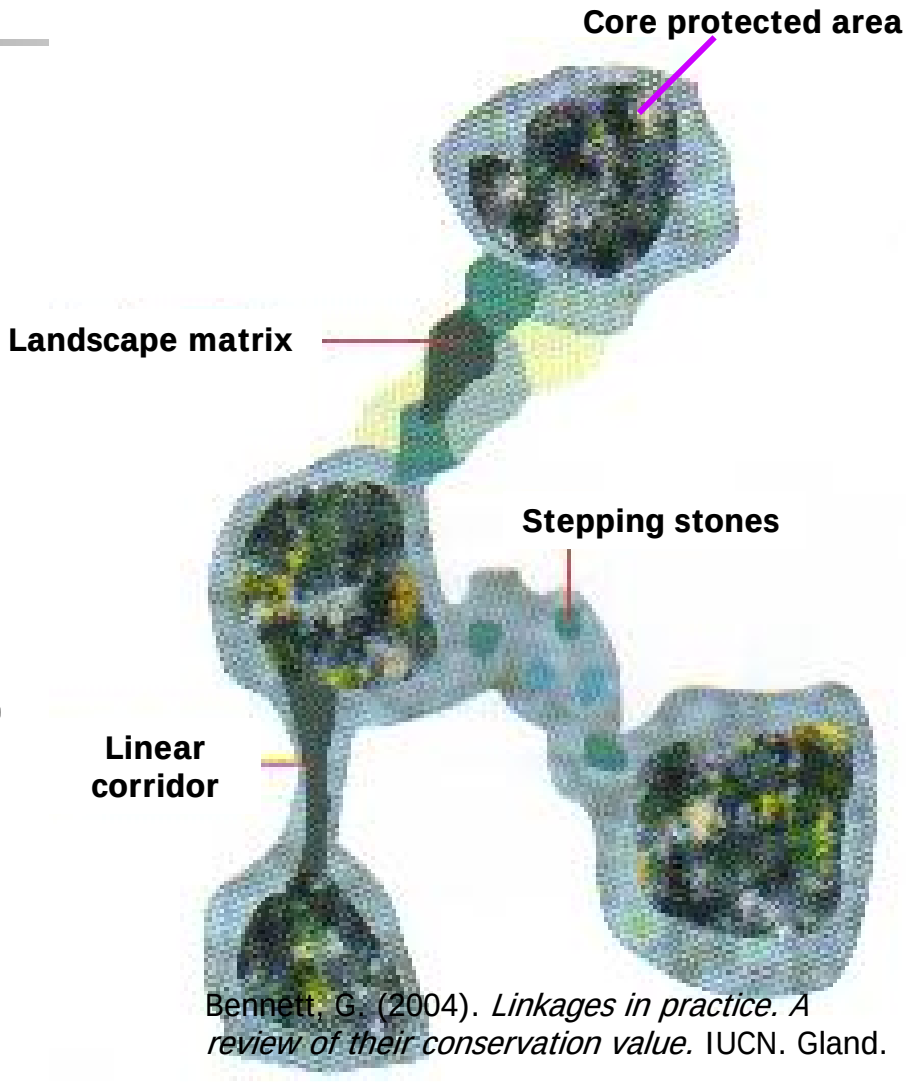
*1 Dr Jody Hilty: (co-author, *Corridor Ecology*, Island Press, 2006)

*2 Dr Charles Chester: (author, *Conservation Across Borders*, Island Press, 2006)

2.4 Methods: connectivity conservation

- **Connectivity methods**

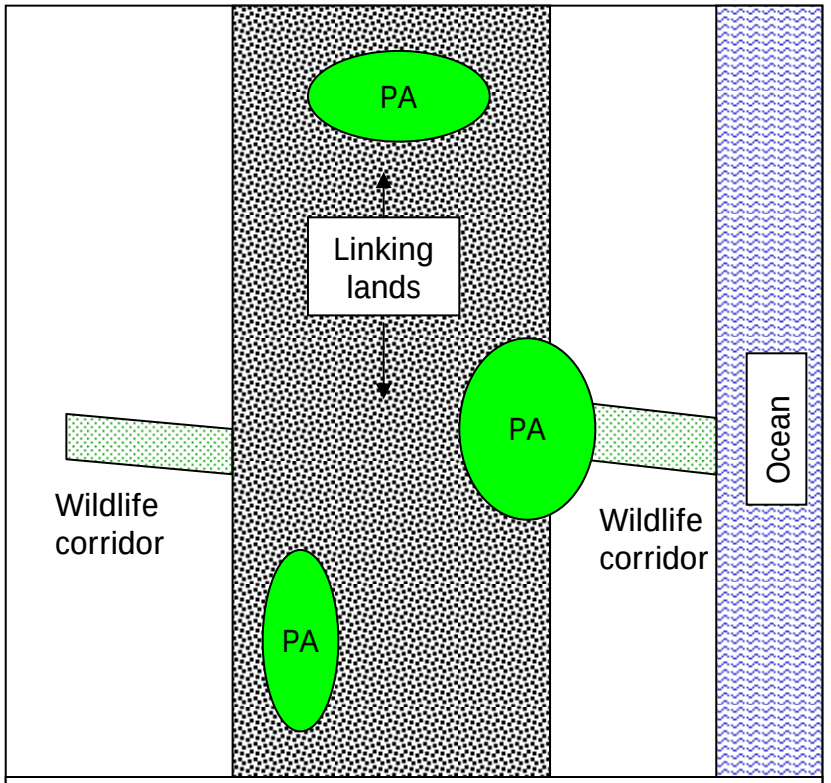
  (Ecological networks):
  - Connectivity of large natural lands
  - Landscape matrix
  - Stepping stones
  - Linear corridor (wildlife corridor)



Bennett, G. (2004). *Linkages in practice. A review of their conservation value.* IUCN. Gland.

2.4 Methods: connectivity conservation

- For large scale initiatives
- All landscape connectivity conservation methods may apply



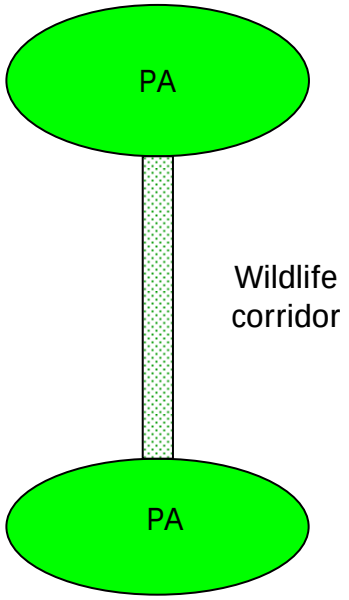
Continental scale conservation corridor "backbone" with smaller scale wildlife corridor "appendages"

2.4 Methods: connectivity conservation

Smaller wildlife corridors

(Lindenmayer and Fischer 2006)

- May promote habitat connectivity
- May facilitate ecological connectivity
- But can be controversial
  - Costs: reservation, rehabilitation, maintenance
  - May divert funding from more important investments (e.g.) consolidating protected areas
  - May also impact species (e.g. edge effects)
- Objectives must be carefully evaluated



2.5 IUCN WCPA: connectivity conservation

IUCN WCPA - two key roles:

- Encouraging and facilitating strategic, continental scale connectivity conservation initiatives, a response to climate change
- Providing best practice management information for such initiatives

IUCN/WCPA Mountain Biome Workshop - Ecuador 2006

2.5 IUCN WCPA: connectivity conservation

- **Papallacta, Ecuador, November 2006**
- 45 Connectivity Conservation international experts convened
- Aim: To work on a continental scale connectivity conservation management book.

2.5 IUCN WCPA: connectivity conservation

The Papallacta Declaration:

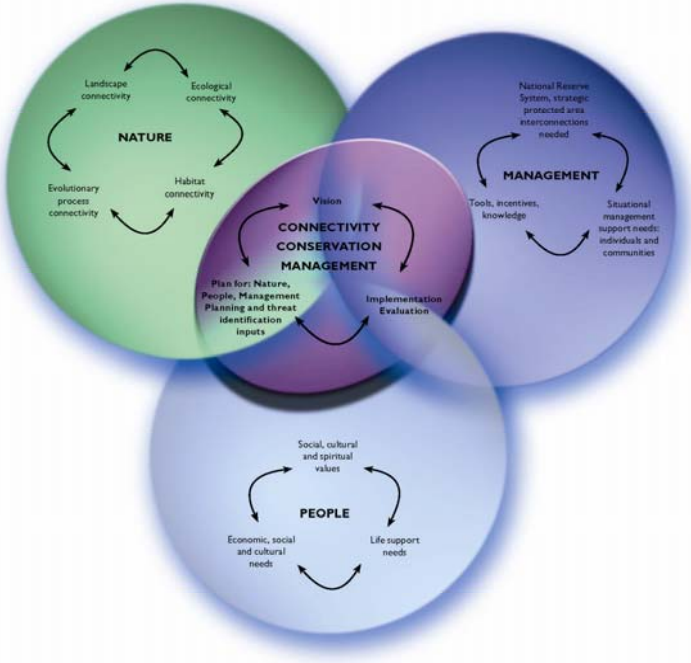
- The workshop group developed the Papallacta Declaration which stated (in part):

> *"(...) maintenance and restoration of ecosystem integrity requires landscape-scale conservation. This can be achieved through systems of core protected areas that are functionally linked and buffered in ways that maintain ecosystem processes and allow species to survive and move, thus ensuring that populations are viable and that ecosystems and people are able to adapt to land transformation and climate change. We call this proactive, holistic, and long-term approach connectivity conservation".*

(Available at: www.mountains-wcpa.org)

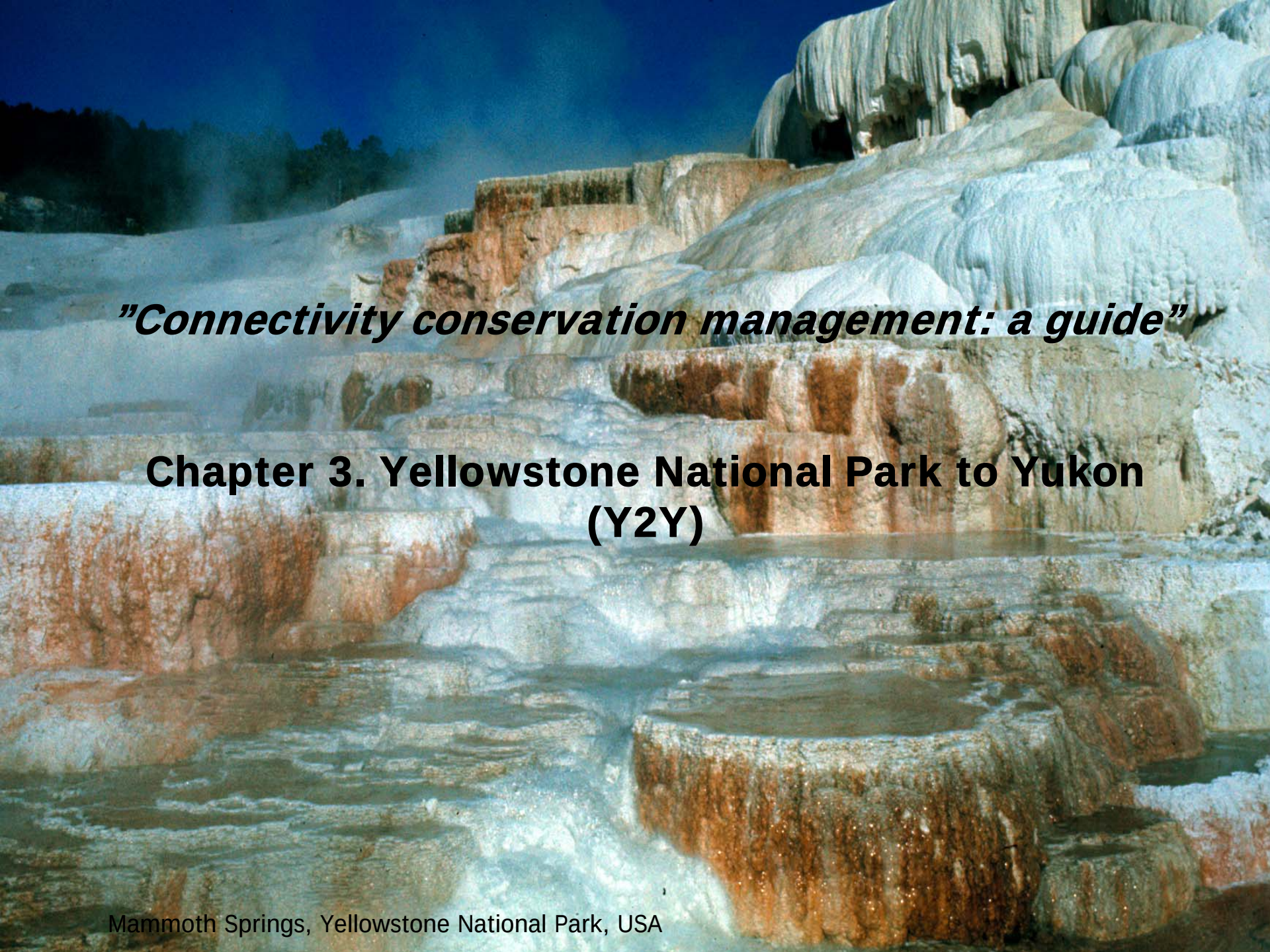
2.5 IUCN WCPA: connectivity conservation

- **New IUCN WCPA book:**
- *"Connectivity Conservation Management: A Guide"*
- Currently in preparation: To be published by Earthscan late 2008 or early 2009.
- Based on the experience and wisdom of international connectivity management expert



Connectivity conservation management conceptual framework

(Illustration from *Connectivity Conservation Management: A Guide,* Worboys, Francis and Lockwood (eds)., In preparation)



”Connectivity conservation management: a guide”

Chapter 3. Yellowstone National Park to Yukon (Y2Y)

Mammoth Springs, Yellowstone National Park, USA

Chapter 3: Y2Y

Yellowstone to Yukon

- Length: 3207 km's
- Width: 202-805 km's
- Average height: 1,067 metres

Landcover:

- 1.5% bare rock
- 18.9% tundra
- 59% forested
- 13.5% shrublands
- 4.5% grasslands
- 2.6% agricultural

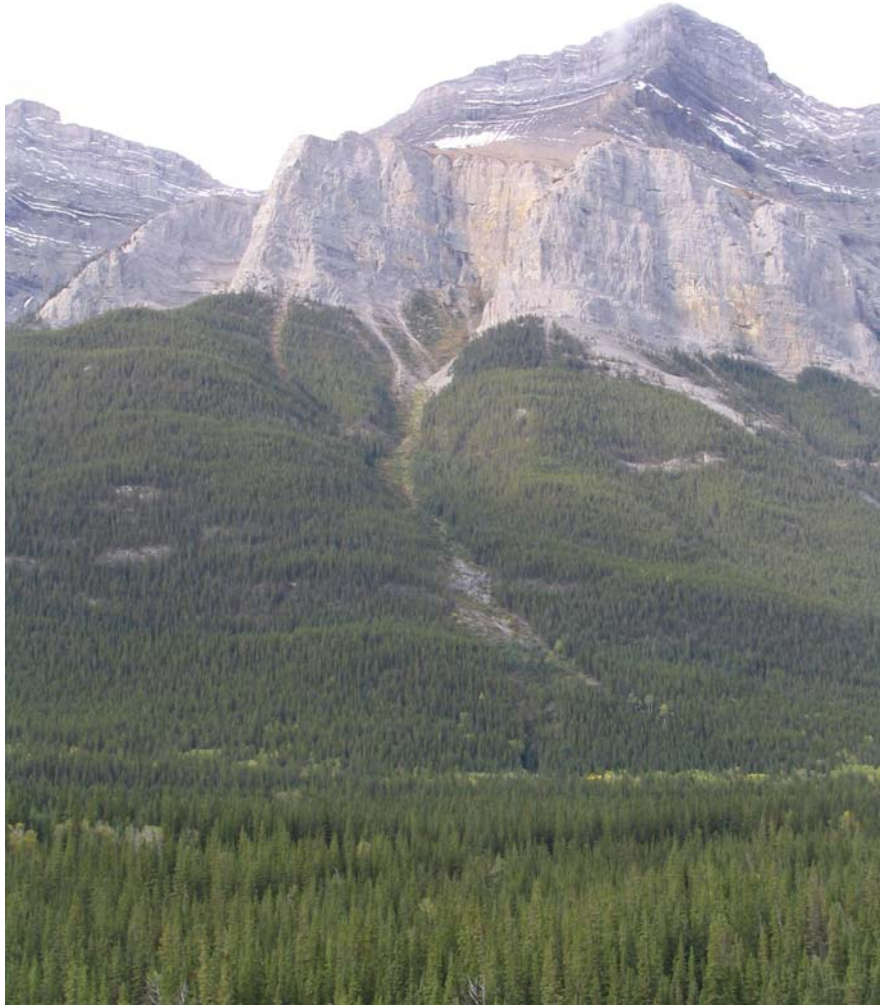
Chapter 3: Y2Y

Vision

"Combining science and stewardship, Y2Y seeks to ensure that the wilderness, wildlife, native plants and natural processes of the Y2Y region continue to function as an interconnected web of life, capable of supporting all of the natural and human communities that reside within it, for now and future generations"

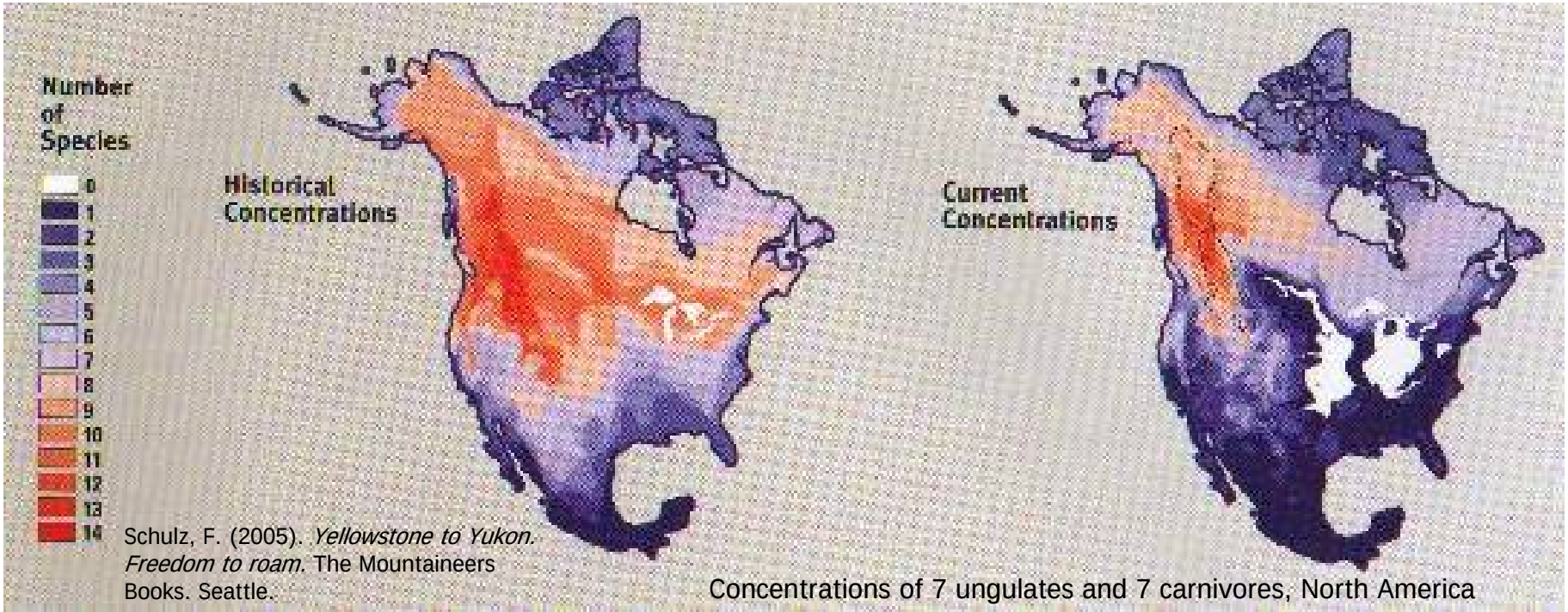
Chapter 3: Y2Y

- **Leadership**
  - Citizen led
  - Grew from the Wildlands project of the 1990's
  - 180 affiliated groups
  - Collaborated to form the Y2Y Conservation Initiative Inc in 1993
  - First co-ordinator 1996
  - 17 priority areas identified
  - Local conservation leadership within a strategic context



Chapter 3: Y2Y

- Leadership
  - Based on good science
  - A response to climate change threats and human changes
  - Supported by endangered species legislation
  - Financially supported by philanthropic organisations and donations
  - Wilburforce Foundation annual science program of grants



Schulz, F. (2005). *Yellowstone to Yukon. Freedom to roam.* The Mountaineers Books. Seattle.

Concentrations of 7 ungulates and 7 carnivores, North America

Chapter 3: Y2Y

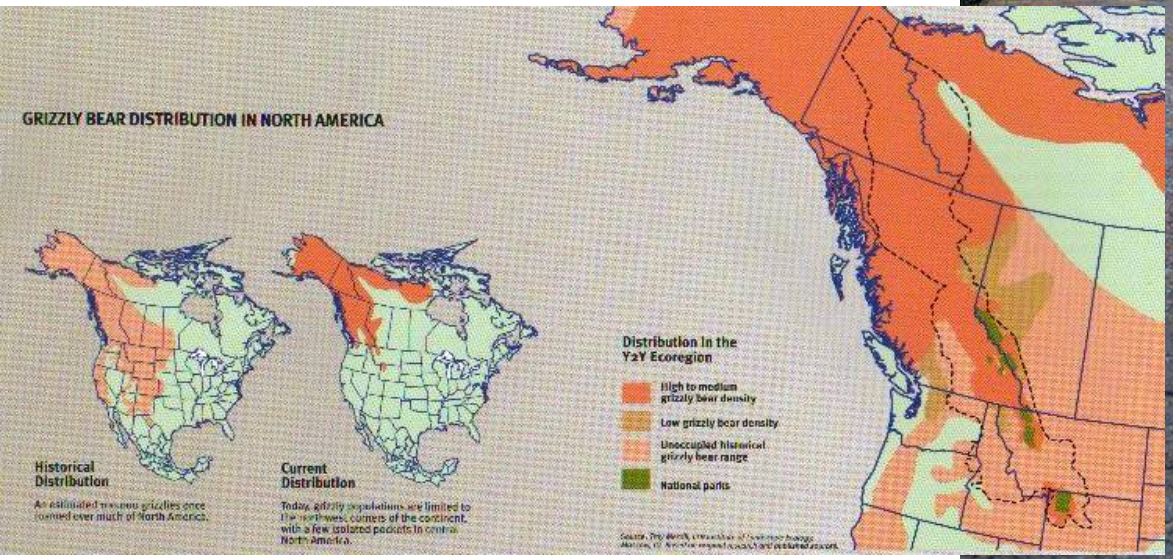
- Grizzly Bear
  - Home range research helped to identify the Y2Y connectivity conservation area
  - Critical linkages to connect the Canadian populations with the Montana populations

Y2Y Grizzly Bear

Schulz, F. (2005). *Yellowstone to Yukon. Freedom to roam.* The Mountaineers Books. Seattle.

Chapter 3: Y2Y

- **Y2Y Grizzly distribution**
  - Potential severing of the USA populations

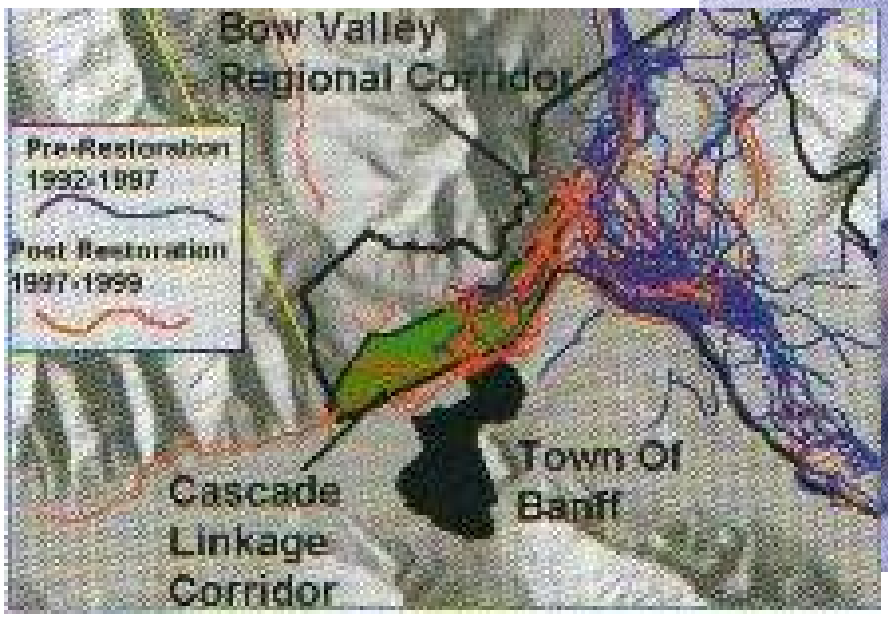


Schulz, F. (2005). *Yellowstone to Yukon. Freedom to roam.* The Mountaineers Books. Seattle.

Grizzly Bear researcher, Banff National Park

Chapter 3: Y2Y

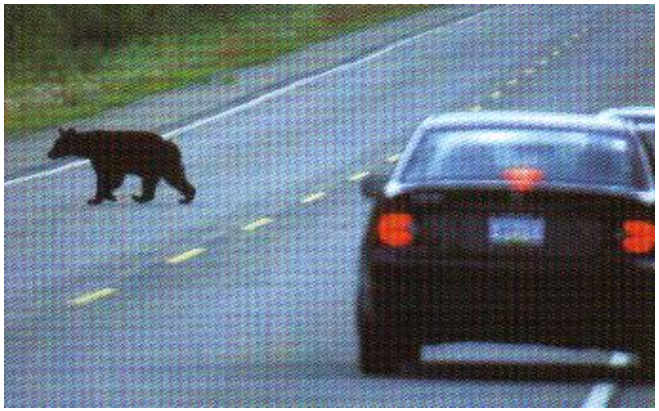
- Wolf research and connectivity around Banff township



Schulz, F. (2005). *Yellowstone to Yukon. Freedom to roam.* The Mountaineers Books. Seattle.

Chapter 3: Y2Y

- Y2Y wildlife connectivity management
  - Involvement of research
  - Identification of critical links
  - 24 wildlife crossings established for 45 kilometres of highway



Schulz, F. (2005). *Yellowstone to Yukon. Freedom to roam.* The Mountaineers Books. Seattle.

Y2Y wildlife crossing, Trans Canada Highway, Banff National Park

Chapter 3: Y2Y

- Connectivity conservation management
  - Wildlife crossing of the Trans Canada Highway, Banff National Park
  - Monitoring of wildlife movements

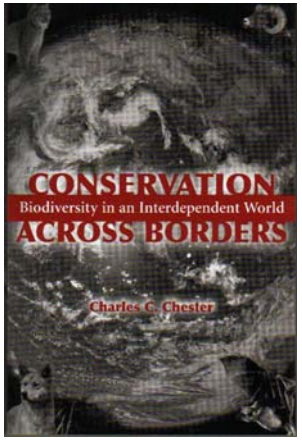
Y2Y: Near Waterton lakes National Park, Canada. Photo of private lands acquired by the Canadian Nature Conservation organisation to retain the natural grassland landscape for native wildlife including the Bison.

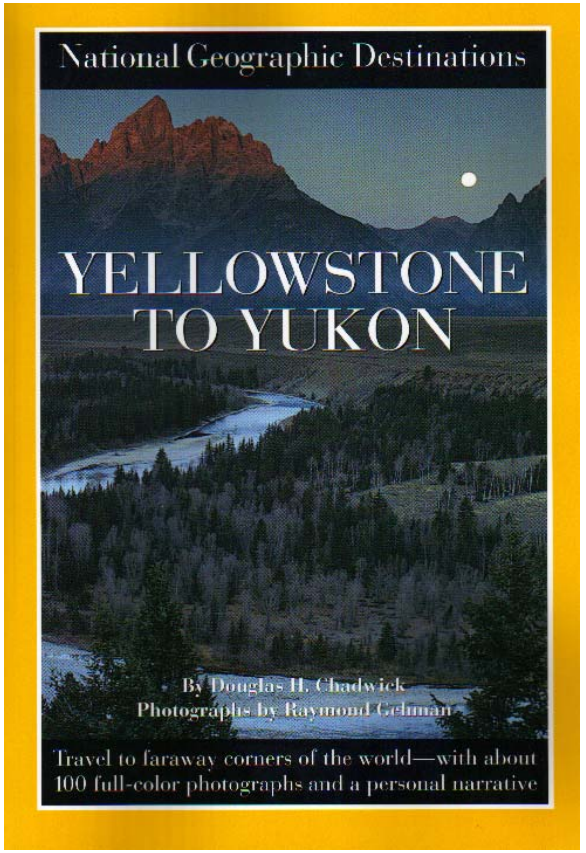
Chapter 3: Y2Y

- Securing public support
  - Worldwide interest
  - Celebrity endorsement and support (David Suzuki)
  - Karsten Heuer walked Y2Y
  - Songs written
  - Florian Schulz, photographer
  - Perseverance
  - Participation of locally credible conservation leaders

Chapter 3: Y2Y

- Connectivity conservation management included:
  - Extensive marketing
  - Involvement of indigenous communities, the media, scientists and the arts
  - Support by philanthropic organisations





3. Biosphere Reserves and Connectivity conservation

Attributes	Biosphere Reserves	Large scale connectivity conservation areas
Biodiversity conservation	▲	▲
Response to climate change, healthy ecosystems, catchment protection, landscape conservation	▲	▲
Sustainable economic and human development	▲	▲
Demonstration projects, environmental education and research	▲	Δ
Include core, transitional and buffer areas	▲	▲
Range of tenures	▲	▲
Active land stewardship with conservation management incentives	Δ	▲
Large, may include one or more IUCN Category I-VI protected areas	▲	▲
Very large scale: may include one of more Biosphere Reserves		▲

4. Conclusion

- Connectivity conservation of large scale unfragmented natural lands is a critical response to climate change
  - It will assist the health of humans
  - It will give species a greater chance for survival

- Biosphere Reserves are an integral part of the concept of connectivity conservation


Large scale connectivity conservation and Biosphere Reserves: critical responses to climate change
THANK YOU
Kosciuszko National Park, World Biosphere Reserve, NSW, Australia