LECTURE 2_20:
MAR. 25, 2014

ENDANGERED SPECIES & PROTECTED AREAS

BIODIVERSITY AND EXTINCTION PRESSURES

Text Reference: Dearden and Mitchell (2012), Ch. 14, pp. 491-511.

Geography/Environmental Studies 1120/1140
T. Randall, Lakehead University, WA 2014

Outline

Source: Dearden and Mitchell (2012)

- **Upcoming Class Lectures:**
  - March 25 (Biodiversity and Extinction Pressures)
  - March 27 (Global and National Responses to Losses of Biodiversity & Map Literacy 6)
  - April 1 (National and Personal Perspectives/Can-do's on the Challenges Ahead – environmental challenges)
  - April 3 (Course Review and Examination Hints)
- **Final Exam**
  - Tuesday, April 8th, 9 am to noon
  - Multiple Choice and Map Literacy Components
  - Cumulative from January

Course Evaluations …

- **Online** as of 2013-14 – accessed through MyInfo
  - Feedback on course content and structure, teaching methods/approach
- Their Importance (to your professors)
  - Career development; teaching improvements
- Due date: **March 28th, 2014**
- Current response rates:
  - 1120: approximately 6-7%
  - 1140: approximately 7%

Midterm results ….

- **Multiple Choice section**
  - (mark out of 70 posted on MyInfo) .. To be adjusted to /69
  - Average: approximately 64%
- **Map Literacy section**
  - (mark out of 20, returned in class March 25)
  - Average: 16.8/20 (or ~84%) on both 1120 and 1140
  - Standard Deviation: (~20%)
- **Combined MT mark:**
  - (mark out of 100 **to be posted** MyInfo)
- **Laboratory mark (for 1140 students:**
  - (mark out of 100 **to be posted** if you've paid your lab fees)

/20 MARKS

TR evaluated (no port marks, mismatch but not precise accuracy expected)

NAME BOX

KEY MIDTERM Geog/Enst 1120/1140 WA 2014

NO REAL EXCUSE FOR SPELLING ERRORS. ; WRITE OUT NAMES IN FULL ON MAPS - EASIER FOR MARKING.

Outline

Source: Dearden and Mitchell (2012)

- Biodiversity
- Extrinsic vs Intrinsic values of natural areas;
- Importance of Biodiversity
- Stressors for Biodiversity
  - Explored via Case Study of BC
  - "Taking Nature's Pulse: the Status of Biodiversity in British Columbia" (Austin, *et* al., 2008, published by Biodiversity BC Available at: www.biodiversitybc.org)
- Map Literacy #6 (Endangered Species and Protected Areas)

Preamble: biodiversity

- UN …
  - International Year of Biodiversity in 2010
  - Decade of Biodiversity, 2010–2020
- Biodiversity loss is the most stressed process affecting the resilience of key planetary systems
- A common misperception is that this applies more to the tropics than to countries like Canada, however, Canada has many challenges in this regard
  - For example, the decline in turtle populations in Point Pelee National Park, Ontario
- Importance of biodiversity …
  - for clean air, fresh water, medicine, and many resources we use every day;

Source: Dearden and Mitchell (2012)

Valuing Biodiversity

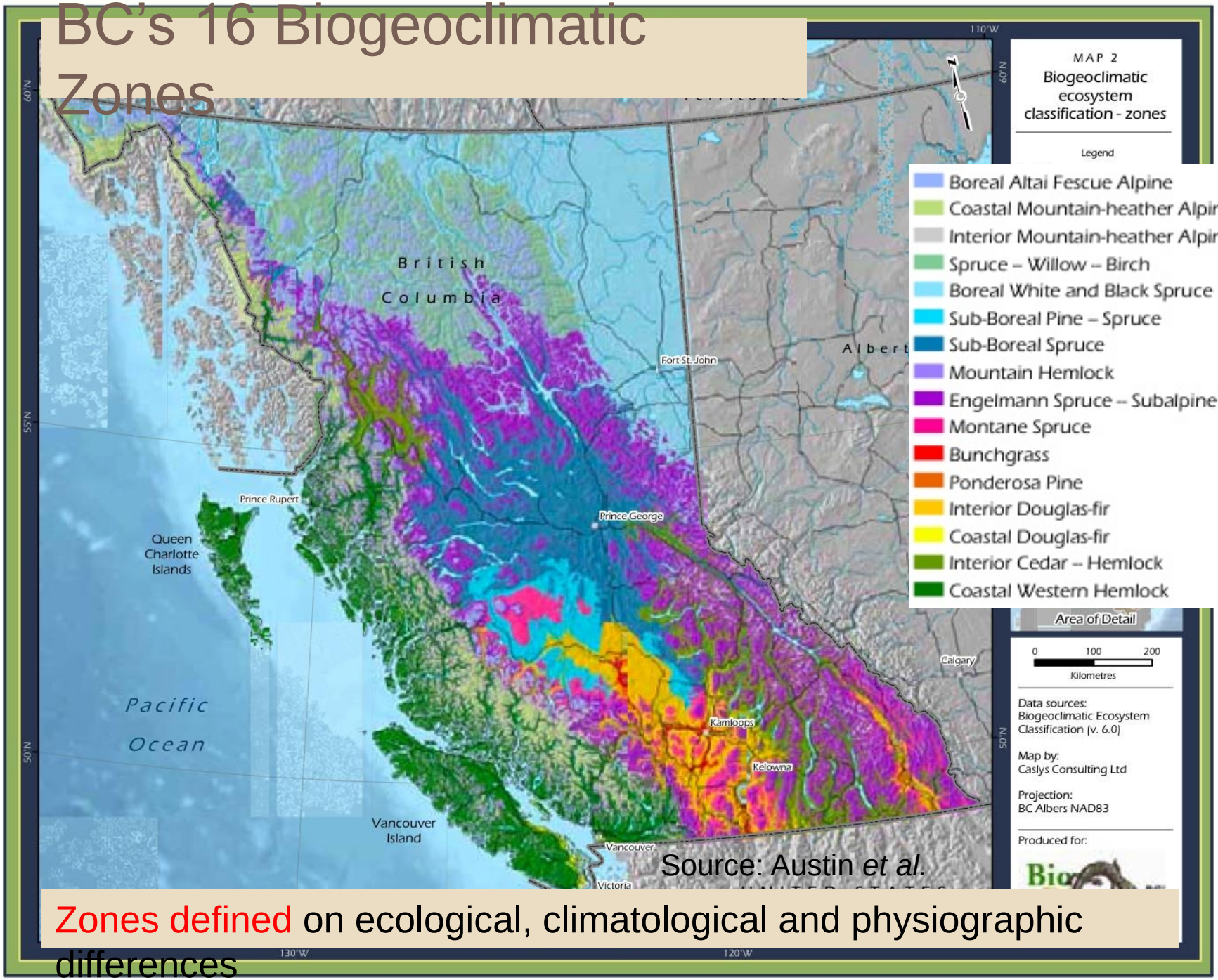
- Changes in biodiversity due to human activities
  - → more rapid in the past 50 years than at any time in human history
- Extrinsic vs Intrinsic value:
  - Defn "extrinsic" : 'not part of something : coming from the outside of something' (Merriam-Webster dictionary)
  - Humans derive **extrinsic values** from other species
  - Either consumptive (the organism is harvested) or non-consumptive (the organism is not harvested or the resource is not destroyed)
- There is no universally accepted framework for assigning value to biodiversity, but several approaches have been proposed …
  - (e.g.) economic value can be assigned to biodiversity in terms of the services it provides, however this is difficult to assess

Valuing Biodiversity

- Extrinsic vs Intrinsic value:
  - Defn "intrinsic" : 'belonging to the essential nature of constitution of a thing' (Merriam-Webster dictionary)
- While important, the extrinsic reasons for species protection should not be allowed to dominate our thinking
  - This approach could lead to protection of only those species perceived to be of higher value
- Arguments for biological conservation thus focus on the **intrinsic value** of nature in and of itself, apart from its value to humanity

Biogeoclimatic Zones

BC's 16 Biogeoclimatic Zones



Source: Austin *et al.*

Zones defined on ecological, climatological and physiographic differences

TABLE 1. AREAL EXTENT OF BIOGEOCLIMATIC ZONES IN B.C.

BIOGEOCLIMATIC ZONE	AREA (KM²)	PERCENTAGE
Engelmann Spruce–Subalpine Fir (ESSF)	170,364	18%
Boreal White and Black Spruce (BWBS)	153,367	17%
Coastal Western Hemlock (CWH)	102,253	11%
Sub-boreal Spruce (SBS)	92,346	10%
Spruce–Willow–Birch (SWB)	80,101	9%
Boreal Altai Fescue Alpine (BAFA)	76,812	8%
Coastal Mountain-heather Alpine (CMA)	52,007	6%
Interior Cedar–Hemlock (ICH)	50,915	5%
Interior Douglas-fir (IDF)	40,418	4%
Mountain Hemlock (MH)	36,572	4%
Montane Spruce (MS)	27,795	3%
Sub-boreal Pine Spruce (SBPS)	22,359	2%
Interior Mountain-heather Alpine (IMA)	17,681	2%
Ponderosa Pine (PP)	2,896	<1%
Bunchgrass (BG)	2,048	<1%
Coastal Douglas-fir (CDF)	1,310	<1%
Total	**929,244**	**100%**

SOURCE: Prepared for this report.
NOTES: Areas of ecosystem conversion (see Map 12, p.161), as well as lakes and rivers, were removed from each zone for this analysis.

Table 1: Areal extent of biogeoclimatic zones in BC.
Source: Austin *et al.* (2008)

Conservation Status Rankings (BC)

TABLE 2. CONSERVATION STATUS RANKS FOR ECOSYSTEMS IN B.C.

RANK	DEFINITION	DESCRIPTION
1	**Critically Imperilled**	**At very high risk of extinction or extirpation.**
2	**Imperilled**	**At high risk of extinction due to very restricted range, steep declines, or other factors.**
3	**Vulnerable**	**At moderate risk of extinction or extirpation due to a restricted range, recent and widespread declines, or other factors.**
4	Apparently Secure	Uncommon but not rare, and usually widespread. Some cause for long-term concern.
5	Secure	Common or very common, and widespread. Not susceptible to extirpation or extinction under current conditions.
NR	Not yet Ranked	Rank is not yet assessed.
U	Unrankable	Suitable information is not available for ranking.

SOURCE: Adapted from Anions, M. 2006. Global and Provincial Status of Species in British Columbia. Biodiversity BC, Victoria, BC. 16pp. Available at: www.biodiversitybc.org.
NOTES: For analyses in this report, range ranks (given when not enough information is available to score a specific rank) are rounded to the higher rank (e.g., S2S3 is rounded to S2; S2S4 is averaged to S3). See Section 2.3.2 (p. 51) for an explanation of conservation status rankings.
Boldface indicates that ecosystems with these ranks are of conservation concern.

Source: Austin *et al.* (2008)

Biodiversity: (threat framework)

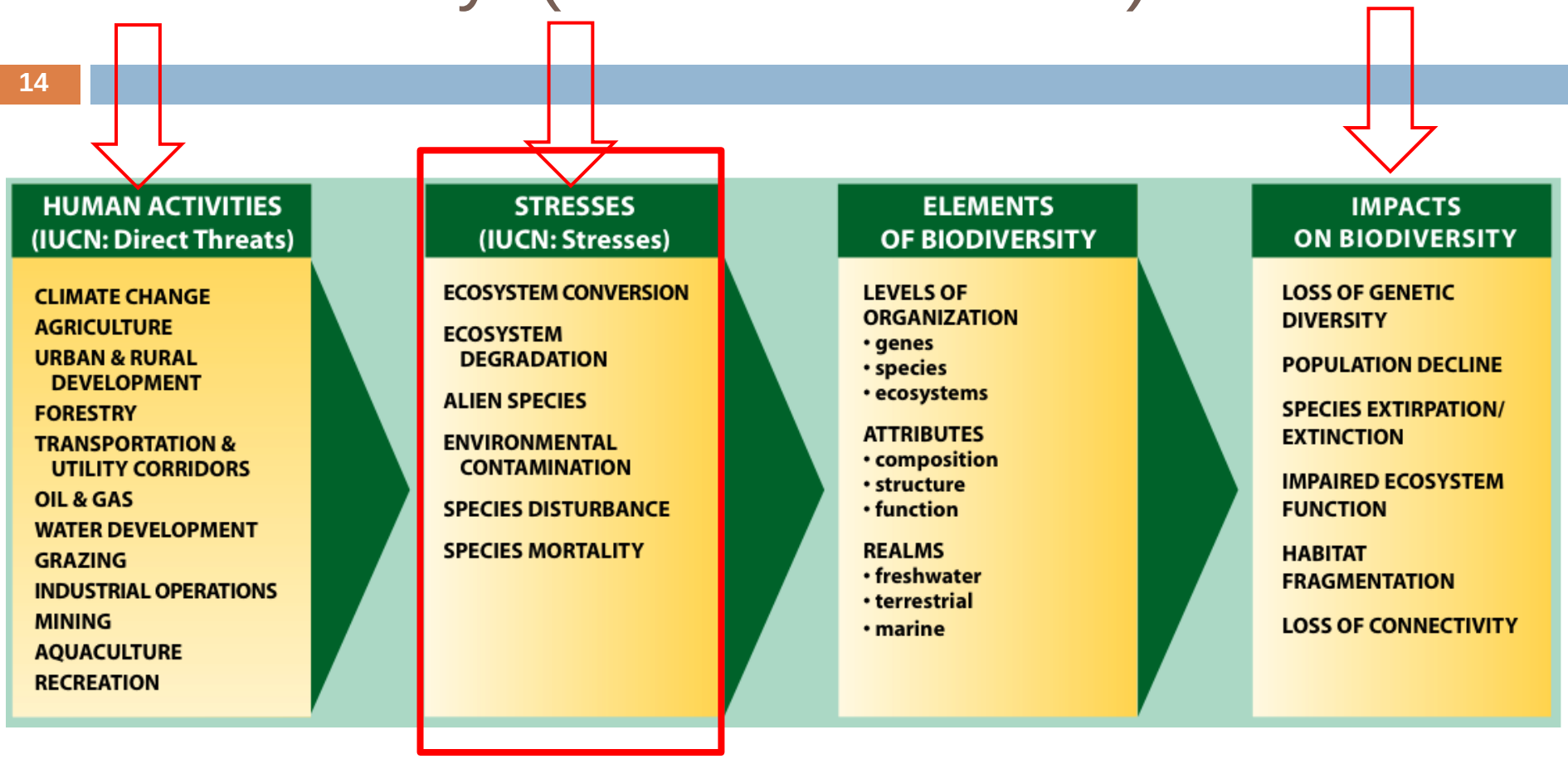


Fig. 31: The biodiversity threat framework.
Source: Austin *et al.* (2008)

IUCN = World Conservation Union

6 identified stressors on biodiversity (BC)

Major

1. Ecosystem Conversion
2. Ecosystem Degradation
3. Species Invasion

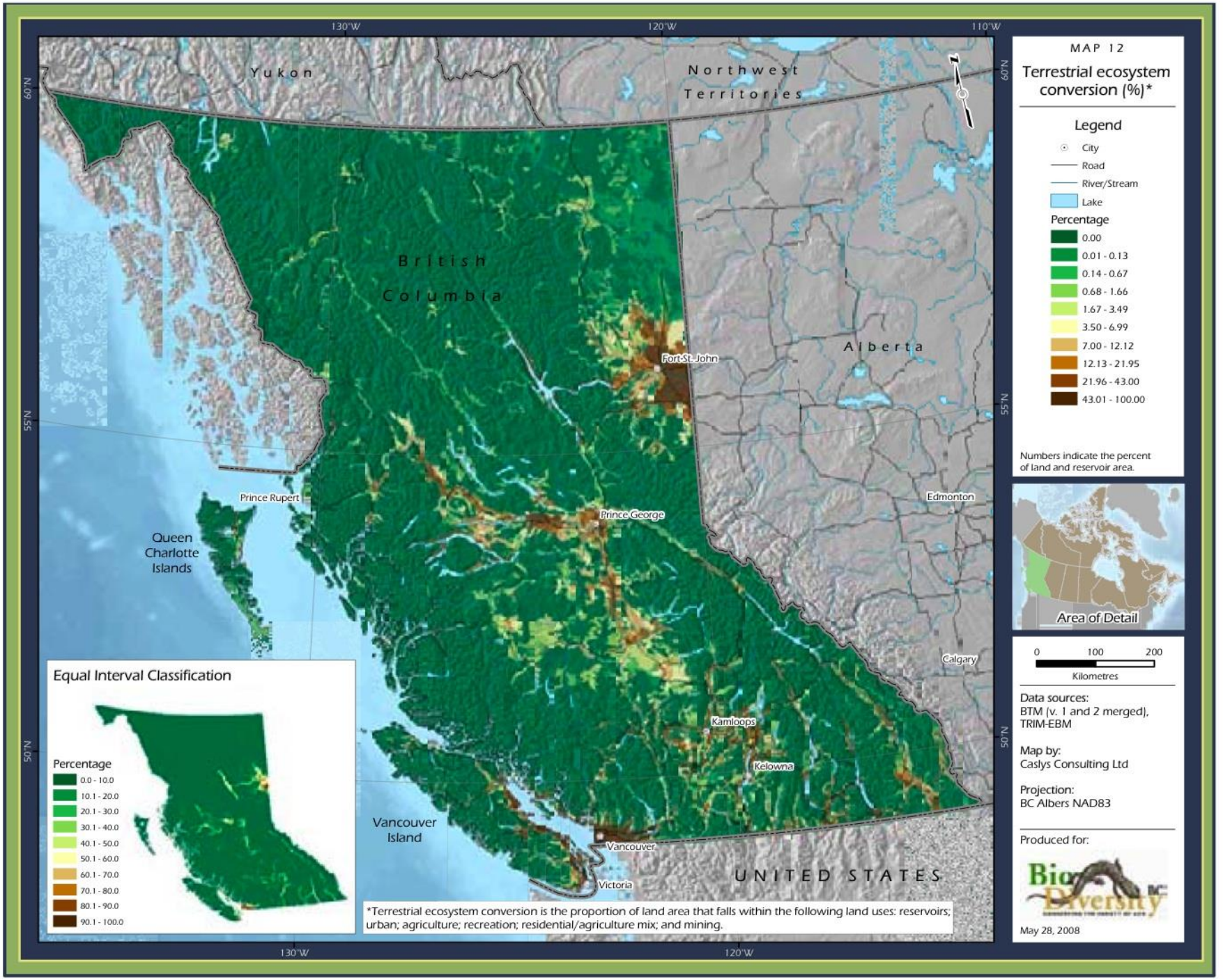
Other (lesser-ranked)

4. Environmental Contamination
5. Species Disturbance
6. Species Mortality

**"*Losses to biodiversity usually originate from more than one source / stressor*" (Austin *et al.*, 2008)

Ecosystem Conversion

- Direct and complete conversion of natural landscapes;
  - i.e., forest, wetlands, grasslands → human land uses
- Its magnitude varies spatially (map 12, next slide)


MAP 12
Terrestrial ecosystem conversion (%)*
Legend
City
Road
River/Stream
Lake
Percentage
0.00
0.01 - 0.13
0.14 - 0.67
0.68 - 1.66
1.67 - 3.49
3.50 - 6.99
7.00 - 12.12
12.13 - 21.95
21.96 - 43.00
43.01 - 100.00
Numbers indicate the percent of land and reservoir area.
Area of Detail
0 100 200
Kilometres
Data sources:
BTM (v. 1 and 2 merged), TRIM-EBM
Map by:
Caslys Consulting Ltd
Projection:
BC Albers NAD83
Produced for:
May 28, 2008
Equal Interval Classification
Percentage
0.0 - 10.0
10.1 - 20.0
20.1 - 30.0
30.1 - 40.0
40.1 - 50.0
50.1 - 60.0
60.1 - 70.0
70.1 - 80.0
80.1 - 90.0
90.1 - 100.0
*Terrestrial ecosystem conversion is the proportion of land area that falls within the following land uses: reservoirs; urban; agriculture; recreation; residential/agriculture mix; and mining.
Yukon
Northwest Territories
British Columbia
Alberta
Fort St. John
Prince Rupert
Prince George
Queen Charlotte Islands
Edmonton
Calgary
Kamloops
Kelowna
Vancouver Island
Vancouver
Victoria
UNITED STATES
130°W
120°W
110°W
60°N
55°N
50°N

Biodiversity: (impact of stresses on terrestrial and freshwater ecosystems, populations and genetic diversity)

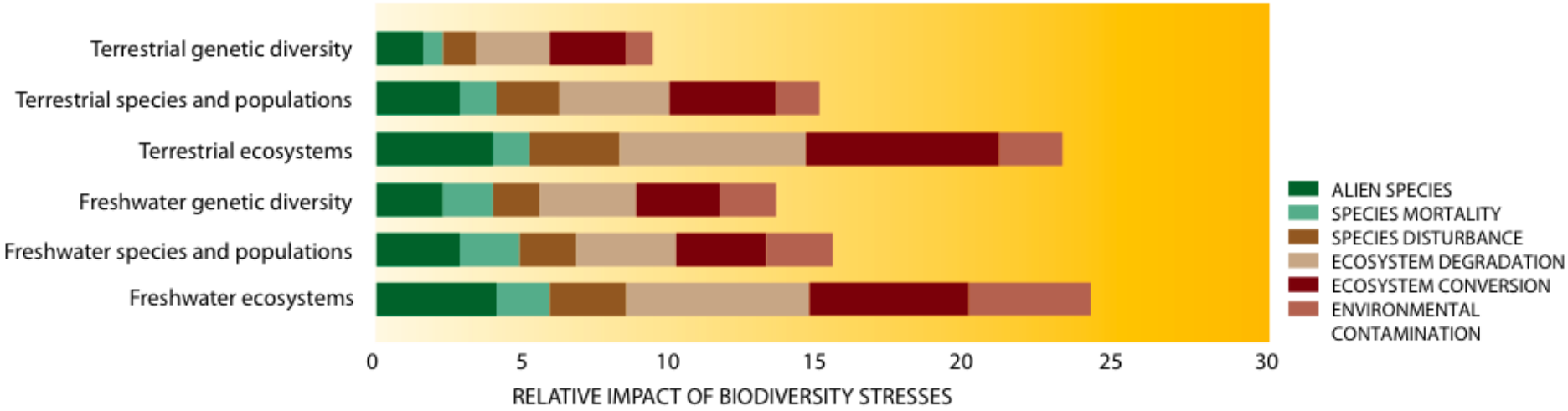


Fig. 32: Impacts of stresses on biodiversity.
Source: Austin *et al.* (2008)

Ecosystem Conversion

- Direct and complete conversion of natural landscapes;
  - i.e., forest, wetlands, grasslands → human land uses
- Its magnitude varies spatially (map 12, next slide)
- Significant conversion in:
  - Southeast coast of Vancouver Island (Coastal Douglas-fir BGC zone)
  - Southern interior's Bunchgrass / Ponderosa Pine BGC zone
- Though small fraction of Province's land has been converted (~2%) these conversions are concentrated in the three rarest BGC zones (Table 25, next slide)

Biodiversity: (conversions by biogeoclimatic zone (excerpt of table only, top 6 by %)

TABLE 25. AREA OF TERRESTRIAL ECOSYSTEM CONVERSION IN B.C. SINCE EUROPEAN CONTACT.

Biogeoclimatic Zone	Conservation Status	Total Land Area Before Ecosystem Conversion (Km2)	Area Of Ecosystem Conversion (Km2)	Area Of Ecosystem Remaining (Km2)	Percent Of Land Area Converted To Human Uses
Coastal Douglas-fir	Imperilled (G2)	2,561	1,251	1,310	49%
Bunchgrass	Imperilled (G2)	2,579	531	2,048	21%
Ponderosa Pine	Imperilled/vulnerable (G2/G3)	3,513	617	2,896	18%
Interior Douglas-fir	Vulnerable (G3)	42,721	2,302	40,419	5%
Boreal White and Black Spruce	Apparently secure (G4)	159,473	6,106	153,367	4%
Sub-boreal	Apparently secure	95,551	3,206	92,345	3%

Table. 25: Areas of terrestrial ecosystem conversion in BC since European Contact. … based on imagery taken between 1991 and 2001

Source: Austin *et al.* (2008)

Ecosystem Degradation

- Change to the structure of a natural system
  - Via… forest harvesting, water diversion
- Affecting both the composition and function of an ecosystem
- Can include:
  - Habitat fragmentation;
  - Reduced quality or extent of habitat;
  - Alteration of water flow regime (magnitude, timing of flows, …extreme is inter-basin transfers)
- This stressor occurs throughout BC (Figure 33, next slide)
  - (of the water licenses in the province, 97% are for hydroelectric power generation)

Biodiversity: (streams allocated to human uses, 1950s-2001)

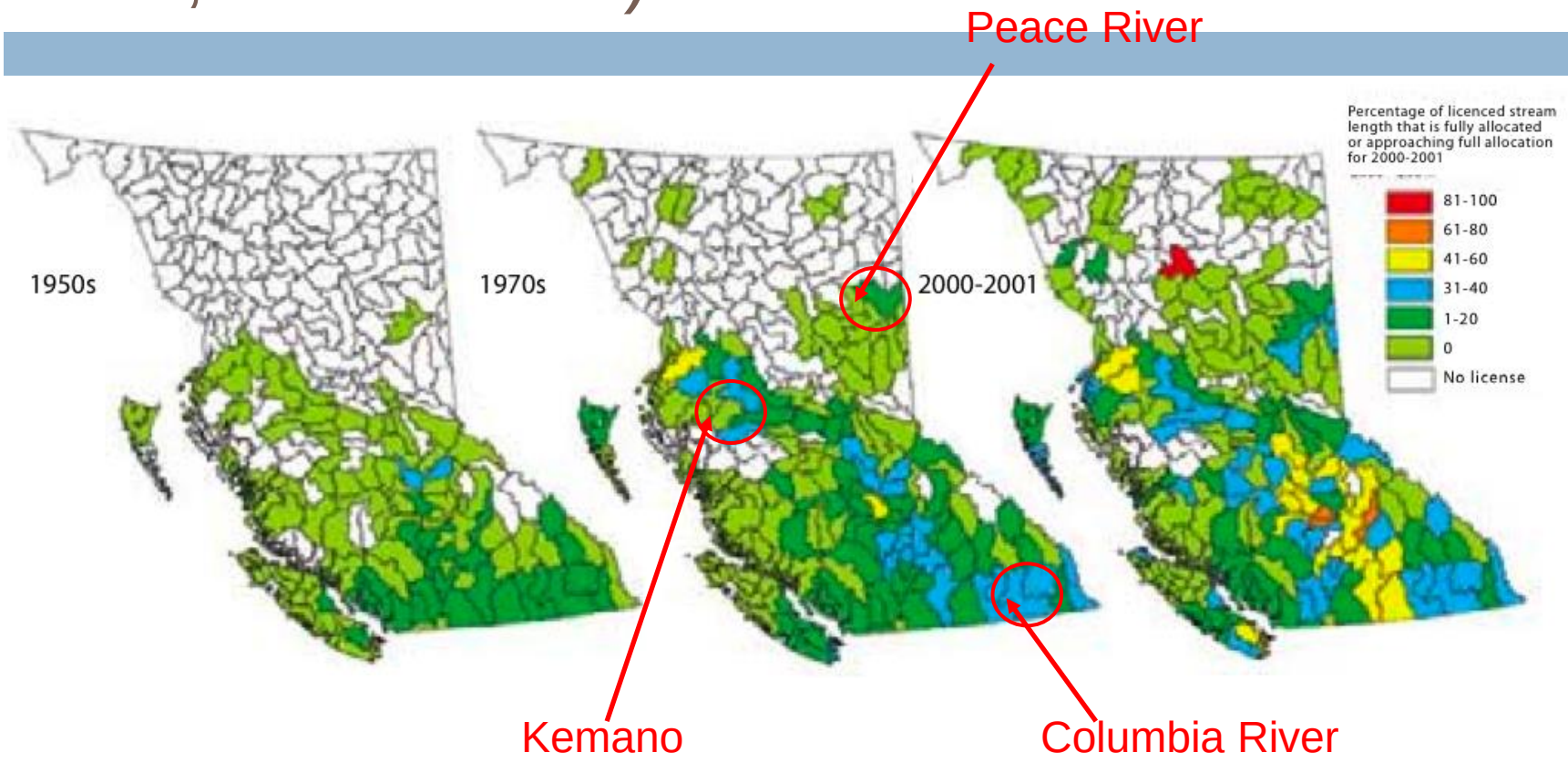


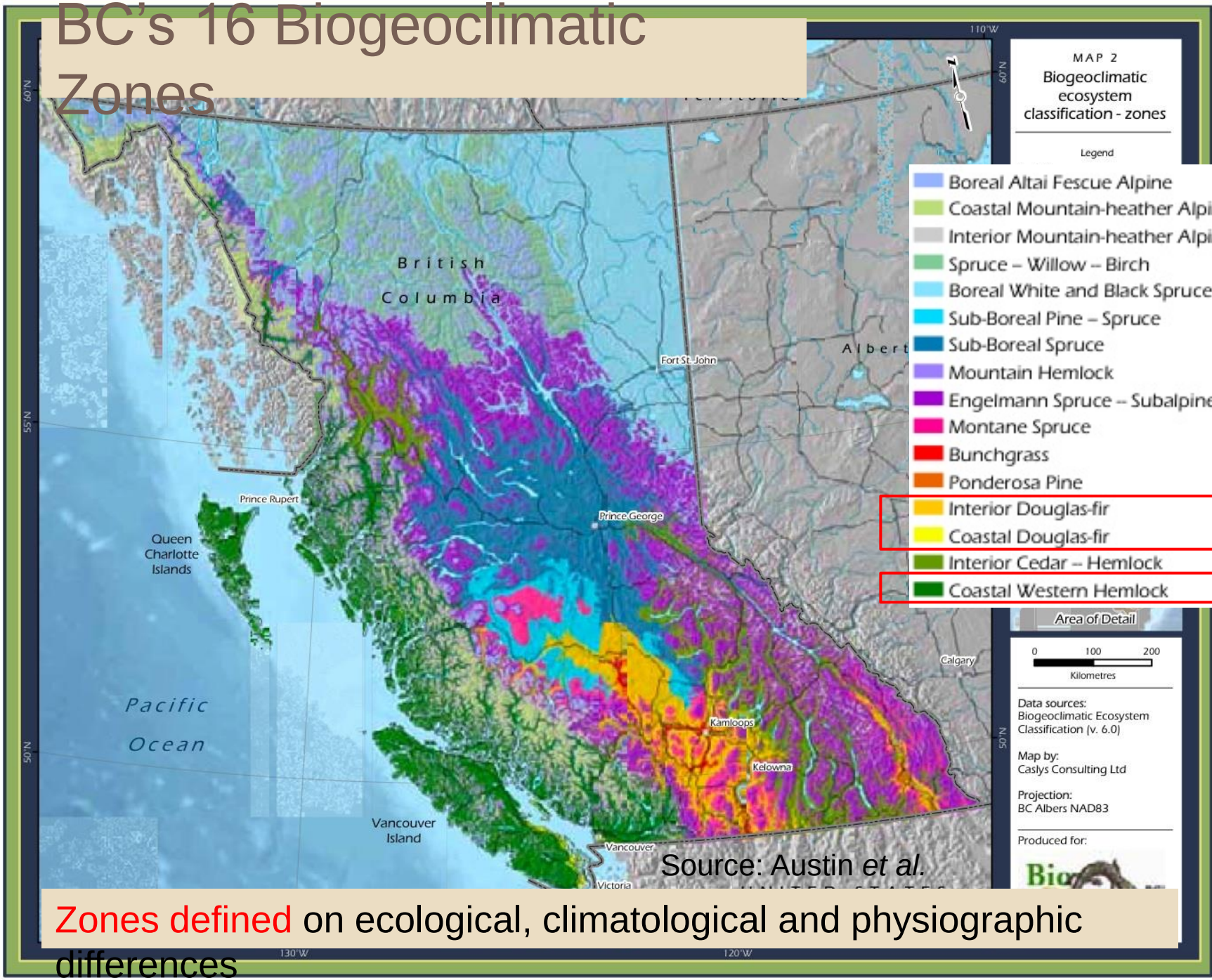
Figure 33: Streams allocated to human uses 1950s to 2001. Observed growth of hydroelectric power, including major projects mentioned previously regarding Columbia R, Kemano, Peace R

Source: Austin *et al.* (2008)

Alien Species

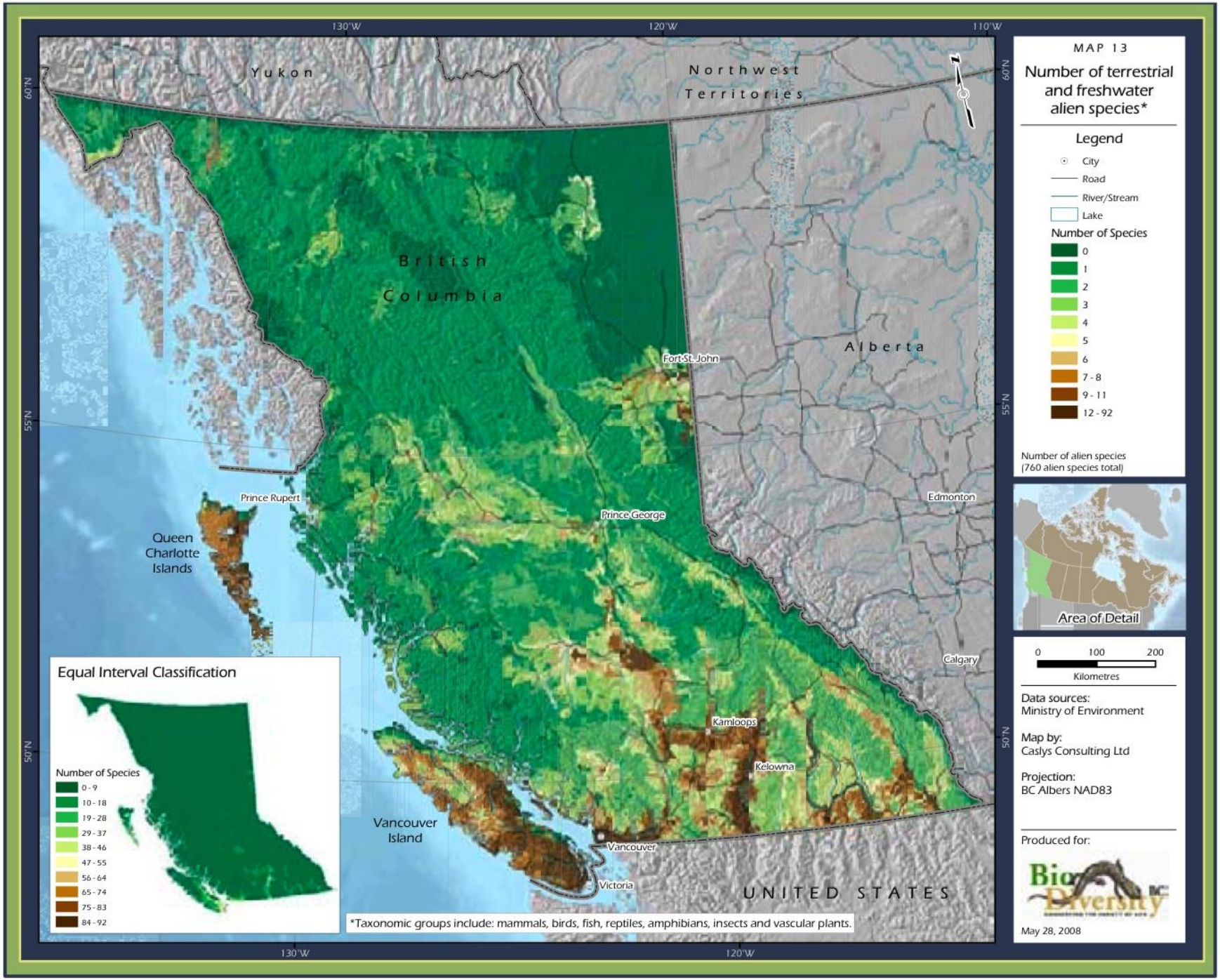
- Those species that occur outside their native range due to human introduction;
- Mechanisms of introduction:
  - **Intentional:** via agriculture, horticulture, forestry, release of pets;
  - **Accidental:** contamination on plants, species attached to transported equipment….
- Also includes the movement of species native to one part of BC that are transferred to another where they become ‘invasives’;
- Invasive alien species are those that threaten biodiversity;
- Map 13 (next slide) shows distribution of ~776 terrestrial and freshwater alien species (those with available data only)
- Biogeoclimatic zones with highest concentrations (coastal western hemlock, coastal douglas fir, interior douglas fir)

BC's 16 Biogeoclimatic Zones



Source: Austin *et al.*

Zones defined on ecological, climatological and physiographic differences


MAP 13
Number of terrestrial and freshwater alien species*
Legend
City
Road
River/Stream
Lake
Number of Species
0
1
2
3
4
5
6
7 - 8
9 - 11
12 - 92
Number of alien species (760 alien species total)
Area of Detail
0
100
200
Kilometres
Data sources:
Ministry of Environment
Map by:
Caslys Consulting Ltd
Projection:
BC Albers NAD83
Produced for:
May 28, 2008
Yukon
Northwest Territories
British Columbia
Alberta
Fort St. John
Prince Rupert
Prince George
Edmonton
Queen Charlotte Islands
Calgary
Kamloops
Kelowna
Vancouver Island
Vancouver
Victoria
UNITED STATES
Equal Interval Classification
Number of Species
0 - 9
10 - 18
19 - 28
29 - 37
38 - 46
47 - 55
56 - 64
65 - 74
75 - 83
84 - 92
*Taxonomic groups include: mammals, birds, fish, reptiles, amphibians, insects and vascular plants.
130°W
120°W
110°W
60°N
55°N
50°N

Biodiversity: (growth in alien species)

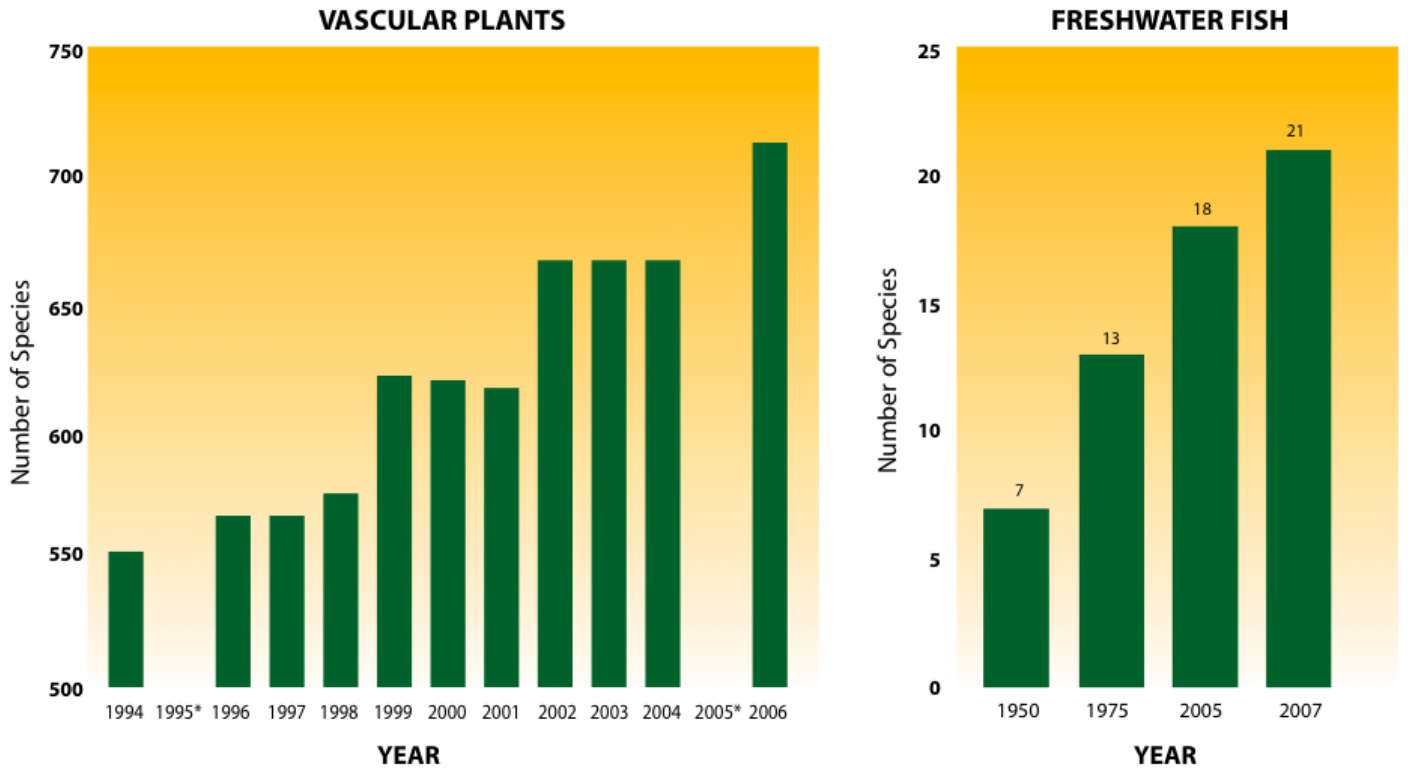


Figure 34: Alien vascular plant species (1994 to 2006) and freshwater fish species (1950 to 2007) in BC. Missing data in years with *.

Source: Austin *et al.* (2008)

Human Activities Impacting Biodiversity

- Summarized in Table 26 (next slide) for terrestrial, freshwater realms and marine overlap area

Table 26. 2003 Provincial Overview Of Top 10 Human Activities Impacting Biodiversity In B.C.

Terrestrial Realm	Freshwater Realm	Marine Overlap
Climate change	Climate change	Harvest (commercial, recreational, illegal)
Forestry (Crown land)	Forestry (Crown land)	Climate change (sea level change, hydrological changes)
Alien species	Rural development	Alien species
Recreation	Dams	Aquaculture
Dams	Alien species	Transportation/corridors - ocean traffic
Forestry (private land)	Agriculture	Forestry - ocean/lake log handling
Oil and gas	Forestry (private land)	Rural development
Grazing	Transportation	Oil and gas
Harvest	Recreation	Urban development
Rural development	Harvest	Recreation

Source: Holt, R.F., G. Utzig, M. Carver and J. Booth. 2003. Biodiversity Conservation in BC: An Assessment of Threats and Gaps. Unpublished report prepared for B.C. Ministry of Environment, Biodiversity Branch, Victoria, BC. One of the criteria for the

Austin et al. major findings (re ecosystem diversity)

1) At the broad scale, 4 biogeoclimatic zones are of provincial concern (~5% of BC's land base)
2) At a fine scale, more than one-half of the ecological communities in BC are of provincial concern.
3) BC has a majority of the global range for 6 (of the province's 16 biogeoclimatic zones)
4) Coastal-Douglas-fir is the rarest BGC zone, and is of the greatest concern;
5) Low-elevation grassland (rarest land cover type in BC) and are concentrated in the biogeoclimatic zones of conservation concern;
6) Significant areas of wetland in BC have been converted/degraded (especially in two major watersheds of greatest concern – Fraser and Columbia river drainage basins)

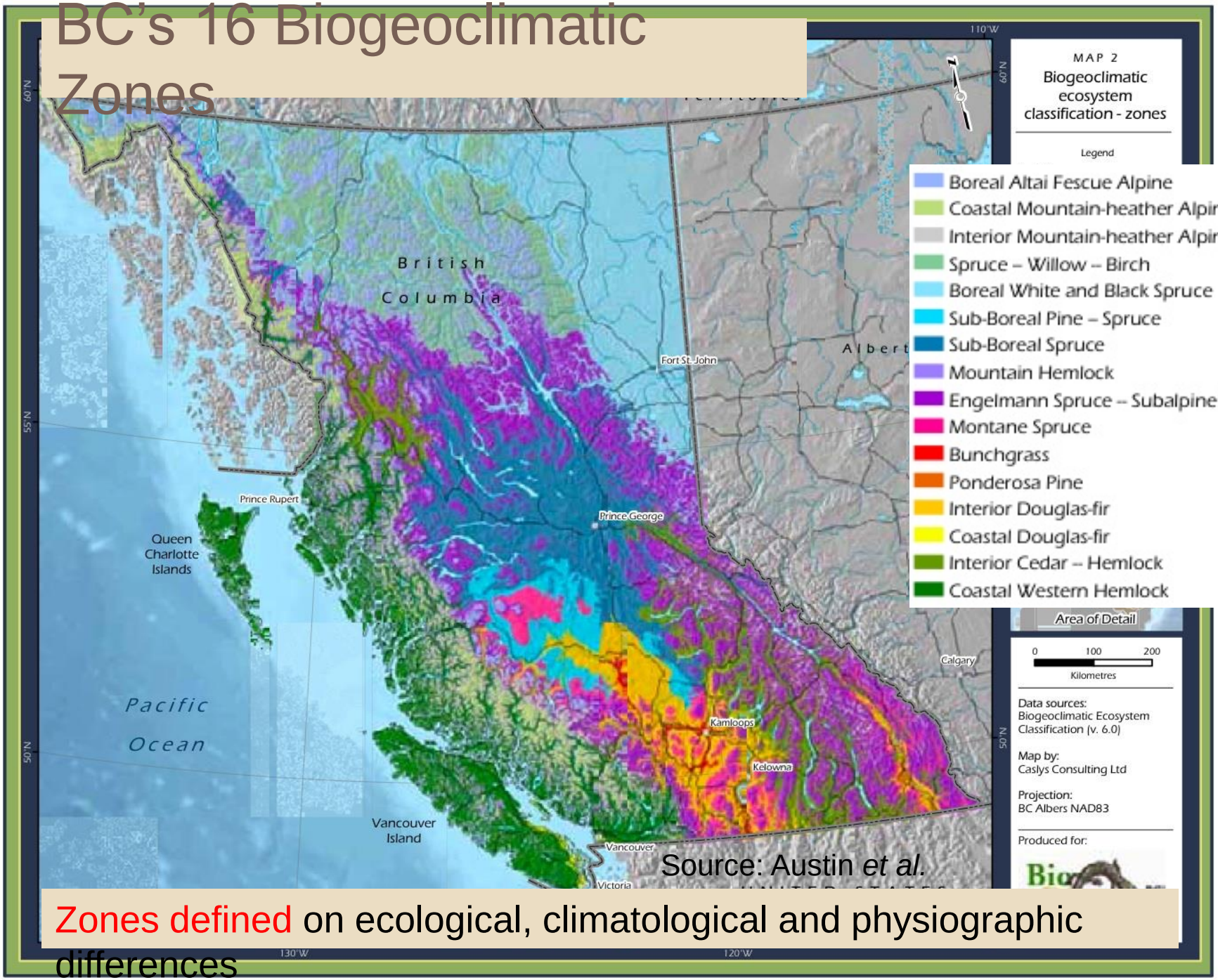
Austin et al. major findings (re species diversity)

8) 43% of species assessed in BC (to date) are of ‘provincial concern’ and are concentrated in the 4 biogeoclimatic zones of conservation concern;
9) BC has the majority of the global range for 99 species;

Austin et al. major findings (re genetic diversity)

8) BC has a high level of genetic diversity within species – critical for adaptation and resilience;

BC's 16 Biogeoclimatic Zones



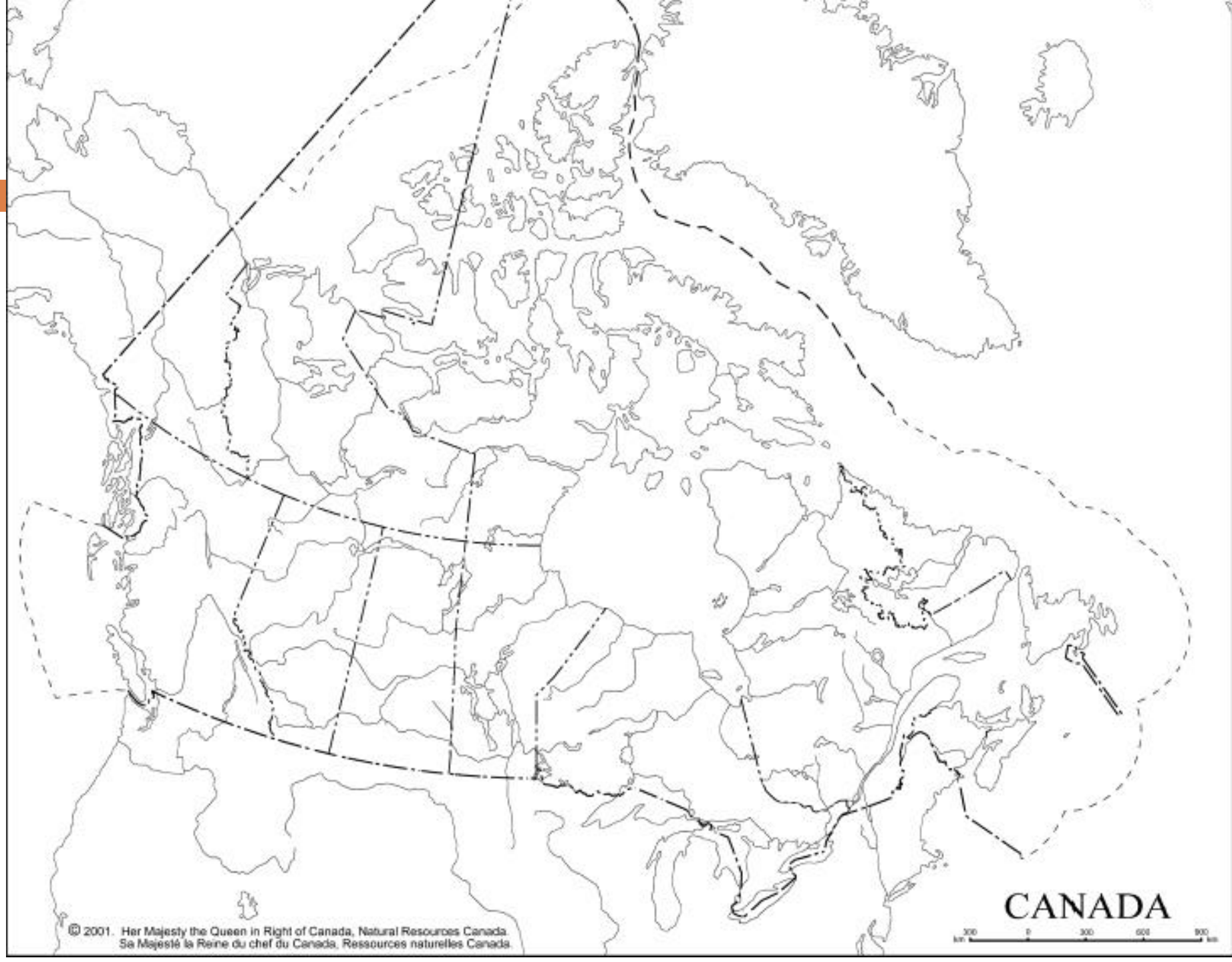
Source: Austin *et al.*

Zones defined on ecological, climatological and physiographic differences

Map Literacy 6

Endangered Species and Protected Areas lectures

March 27, 2014


CANADA
© 2001. Her Majesty the Queen in Right of Canada, Natural Resources Canada.
Sa Majesté la Reine du chef du Canada, Ressources naturelles Canada.

Map Literacy (list 6, March 27, 2014)

Communities, Jurisdictions

1. Prince Edward Island
2. New Brunswick
3. Manitoba

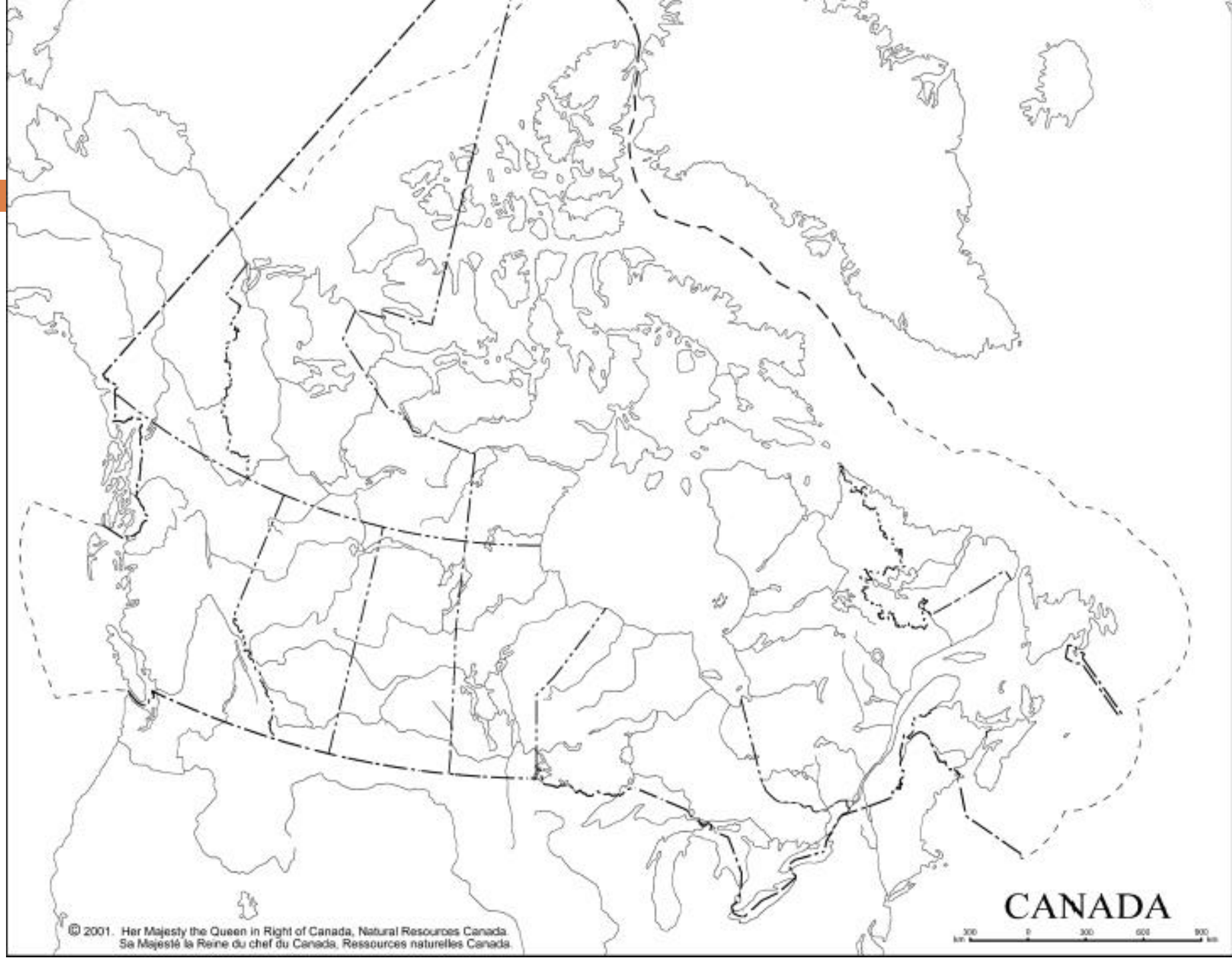
Parks & Protected Areas

1. Jasper National Park
2. Banff National Park
3. Pukaskwa National Park
4. Bay of Fundy National Park
5. Gros Morne National Park
6. Kluane National Park
7. Nahani National Park
8. Wood Buffalo National Park
9. Riding Mountain National Park
10. Lake Superior NMCA[1]

Basics (7):

- Lake Michigan; Georgian Bay

1: NMCA = National Marine Conservation Area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References

- Austin. MA, Buffett, DA, Nicolson, DJ, Scudder, GGE and Stevens, V (eds), 2008. *Taking Nature's Pulse: The Status of Biodiversity in British Columbia*. Biodiversity BC: Victoria, BC, 268 pp. Available at: www.biodiversitybc.org
- Dearden, P and Mitchell, B. 2012. *Environmental Change and Challenge*, Fourth Edition, Don Mills, Ontario: Oxford University Press {Chapter 14: 'Endangered Species and Protected Areas'}