

Environmental systems and societies
Standard level
Paper 1 – resource booklet

Friday 2 November 2018 (afternoon)

1 hour

Instructions to candidates

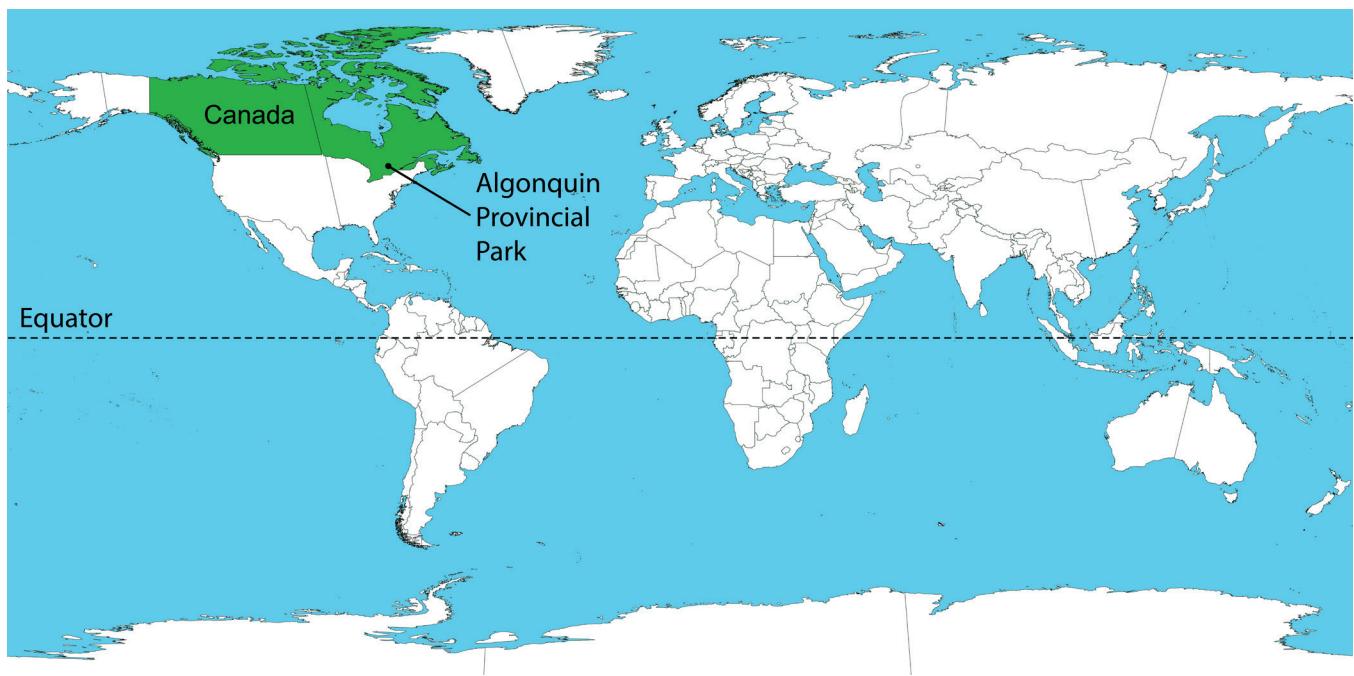
- Do not open this booklet until instructed to do so.
- This booklet contains all the resources to answer paper 1.

15 pages

8818–6302
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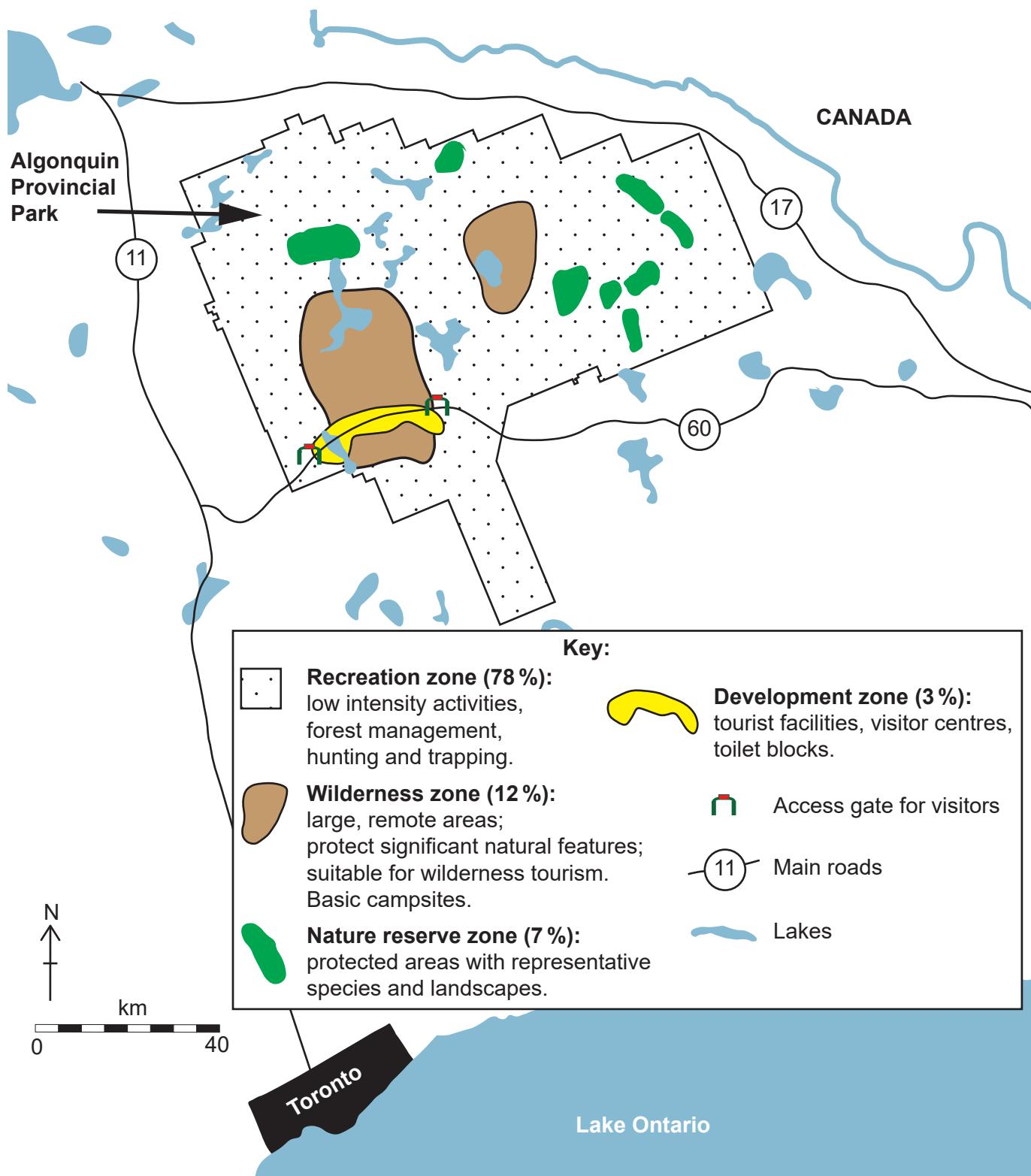
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Figure 1(a): Map showing location of Algonquin Provincial Park in Canada



[Source: adapted from Pixabay]

Figure 1(b): Map of Algonquin Provincial Park, Canada



[Source: adapted from Ontario Ministry of Natural Resources. 1998. Algonquin Provincial Park Management Plan. Queen's Printer for Ontario, Toronto, ON.]

Figure 2(a): Fact file on Algonquin Provincial Park

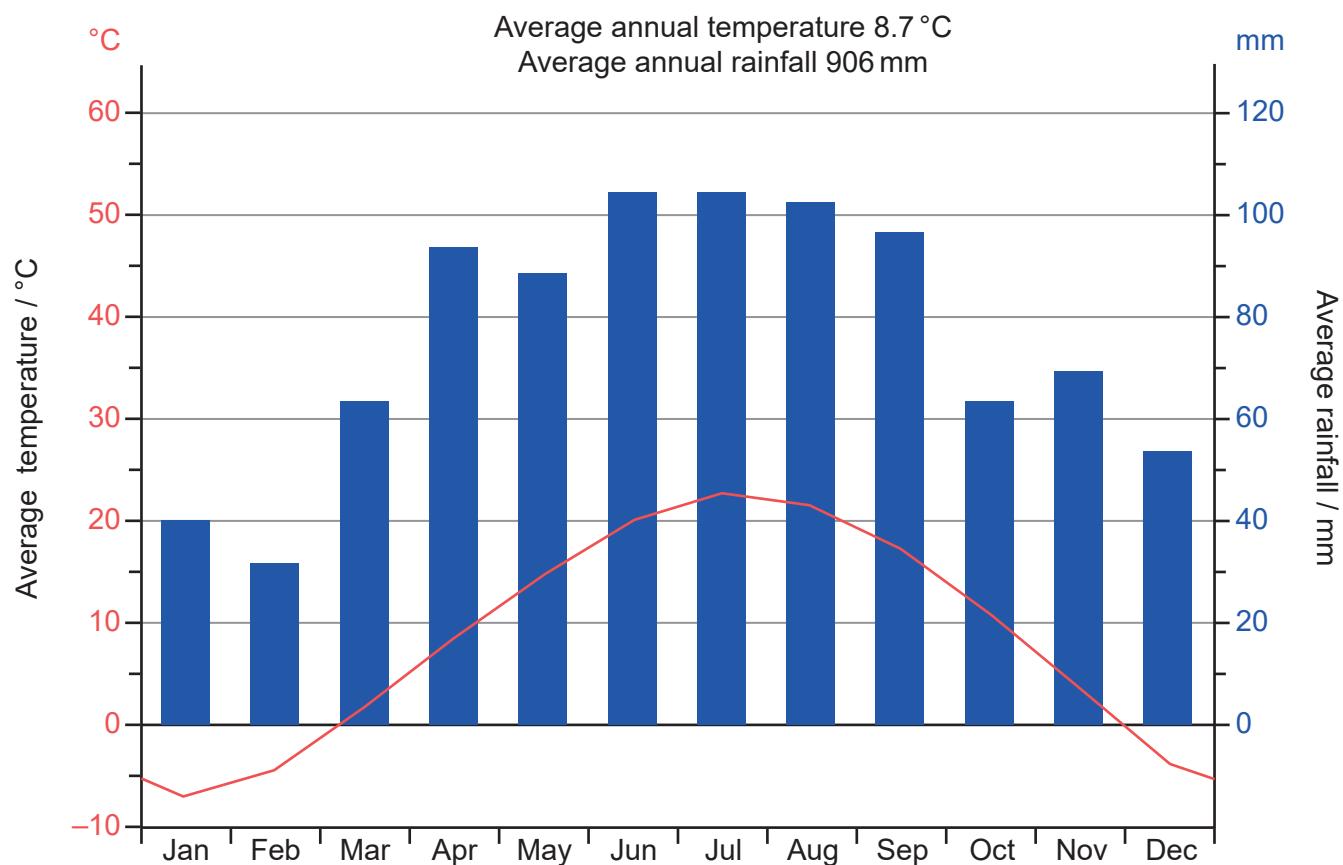
- Algonquin Provincial Park was established in 1893.
- Area: 7630 square km.
- 1 million visitors every year.
- Visitor activities: canoeing, camping and trekking.
- Visitors spend US\$150 a day on average.
- No permanent human residents.
- Different activities are permitted in the different zones: recreation, wilderness, nature reserve, development; see **Figure 1(b)**.
- The goals of the park are:
 - to protect significant natural and recreational features
 - to provide a variety of outdoor recreational activities
 - to contribute to environmental, social and economic well-being through the sustainable development of natural resources.

[Source: adapted from Ontario Ministry of Natural Resources. 1998. Algonquin Provincial Park Management Plan. Queen's Printer for Ontario, Toronto, ON.]

Figure 2(b): Plant and animal species in the park

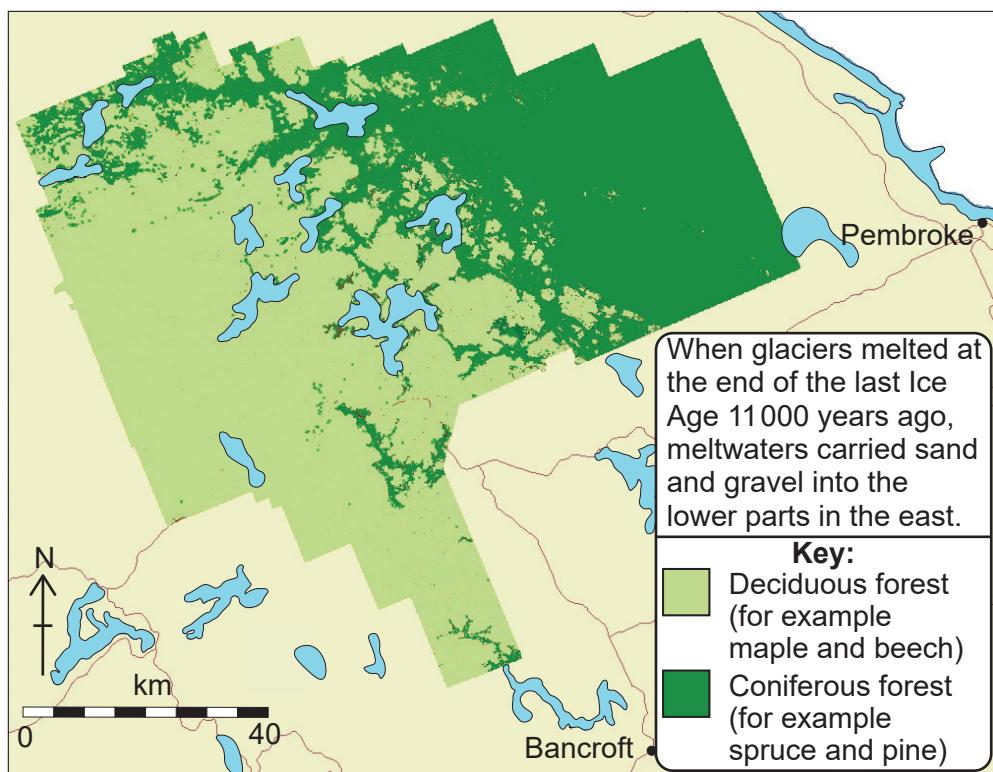
Species	Number
Plants	1000
Insects	7000
Reptiles	14
Amphibians	16
Birds	258
Fish	54
Mammals	45

[Source: Facts taken from The Friends of Algonquin Park www.algonquinpark.on.ca and Ontario Ministry of Natural Resources. 1998. Algonquin Provincial Park Management Plan. Queen's Printer for Ontario, Toronto, ON.]

Figure 3: Climate graph for Algonquin Provincial Park

[Source: <https://en.climate-data.org/north-america/united-states-of-america/illinois/alonquin-1571/>]

Figure 4(a): Vegetation in Algonquin Provincial Park



[Source: D. Puric-Mladenovic (2005) Pre-Settlement Vegetation of Algonquin park. Ontario. Faculty of Forestry, University of Toronto, <http://forests-settled-urban-landscapes.org/Presettlement/index.html>. Accessed November 2018.]

Figure 4(b): Altitude in Algonquin Provincial Park

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copyright reasons

Figure 5: Species in Algonquin Provincial Park



Brook trout
(*Salvelinus fontinalis*)
[Source: Photo via
<https://www.goodfreephotos.com/>]



Woodland jumping mouse
(*Napaeozapus insignis*)
[Source: D Gordon E. Robertson/Wikimedia Commons. File licensed under CC BY CA 3.0 (<https://creativecommons.org/licenses/by-sa/3.0/>)]



Coyote
(*Canis latrans*)
[Source: Alan Vernon]



Beaver
(*Castor canadensis*)
[Source: Steve Hersey. File licensed under CC BY SA 2.0 (<https://creativecommons.org/licenses/by-sa/2.0/>)]



Algonquin wolf
(*Canis lycaon*)
[Source: Ellie Attebery. Licensed under CC BY 2.0. (<https://creativecommons.org/licenses/by/2.0/>)]



Red fox
(*Vulpes vulpes*)
[Source: Peter Trimming. File licensed under CC BY 2.0. (<https://creativecommons.org/licenses/by/2.0/>)]



Maple tree
(*Acer saccharum*)
[Source: Photo by Tim McCabe, USDA Natural Resources Conservation Service.]

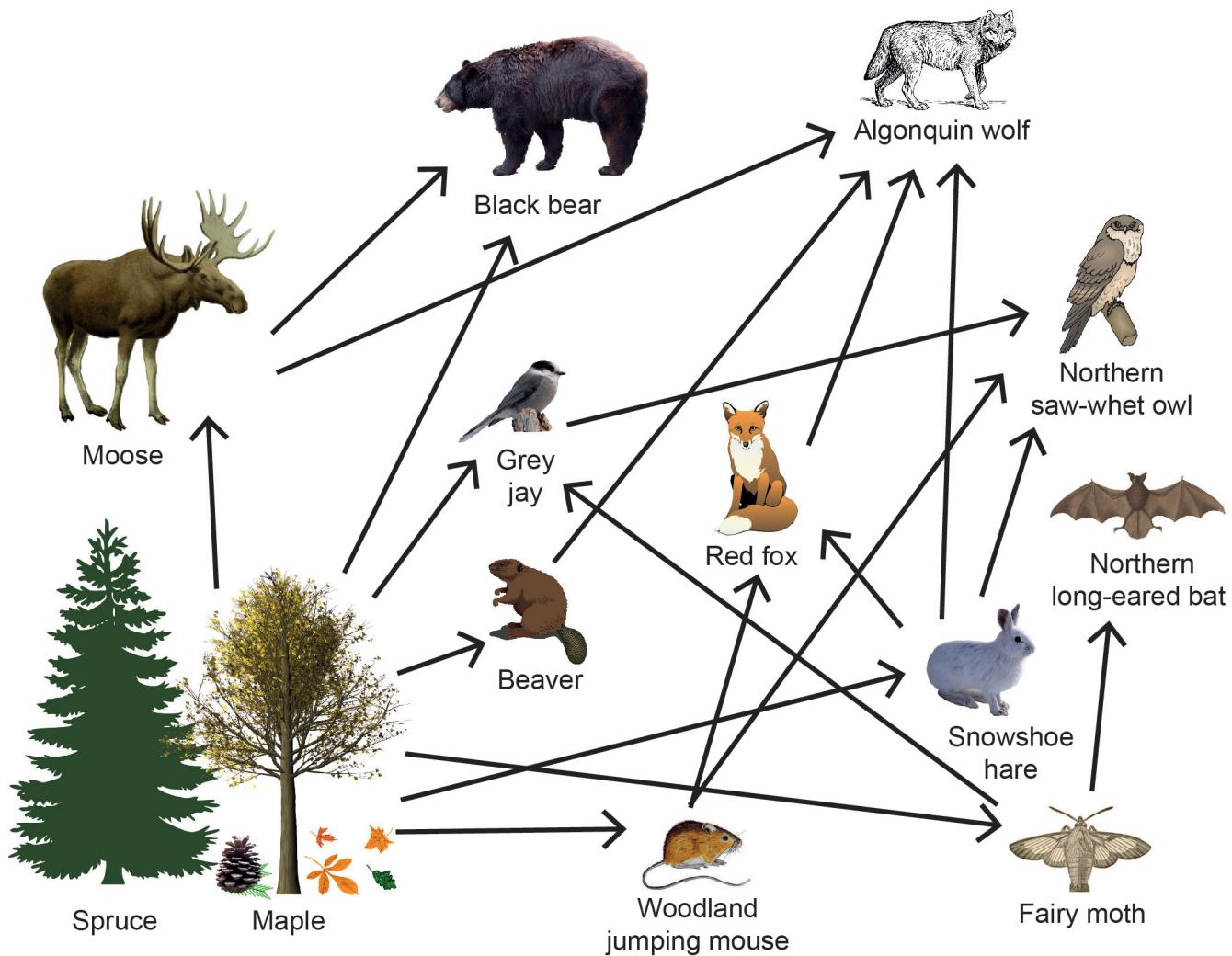


Sedge
(*Cyperaceae*)
[Source: © Copyright Evelyn Simak and licensed for reuse under this Creative Commons Licence. CC BY 2.0.]



Spruce tree
(*Picea*)
[Source: MPF/Wikimedia. Licensed under CC BY-SA 3.0 (<https://creativecommons.org/licenses/by-sa/3.0/>)]

Figure 6: Simplified Algonquin Provincial Park food web



[Source: Black bear: Public domain (<https://www.maxpixel.net/photo-1421835>)

Bat: Biodiversity heritage library/Flickr. File licensed under CC BY 2.0 (<https://creativecommons.org/licenses/by/2.0/>)

Mouse: illustration by Ryan Stephens

Hare: D. Gordon E. Robertson/Wikimedia. File licensed under CC BY-SA 3.0 (<https://creativecommons.org/licenses/by-sa/3.0/>)

Moth: <https://www.flickr.com/photos/126377022@N07/16201795130>

Mouse: Wikimedia/Public domain

Pine cone: © International Baccalaureate Organization 2018

Wolf, owl, grey jay, fox, beaver, spruce, maple, leaves: <https://pixabay.com>]

Figure 7(a): Fact file on North American beavers

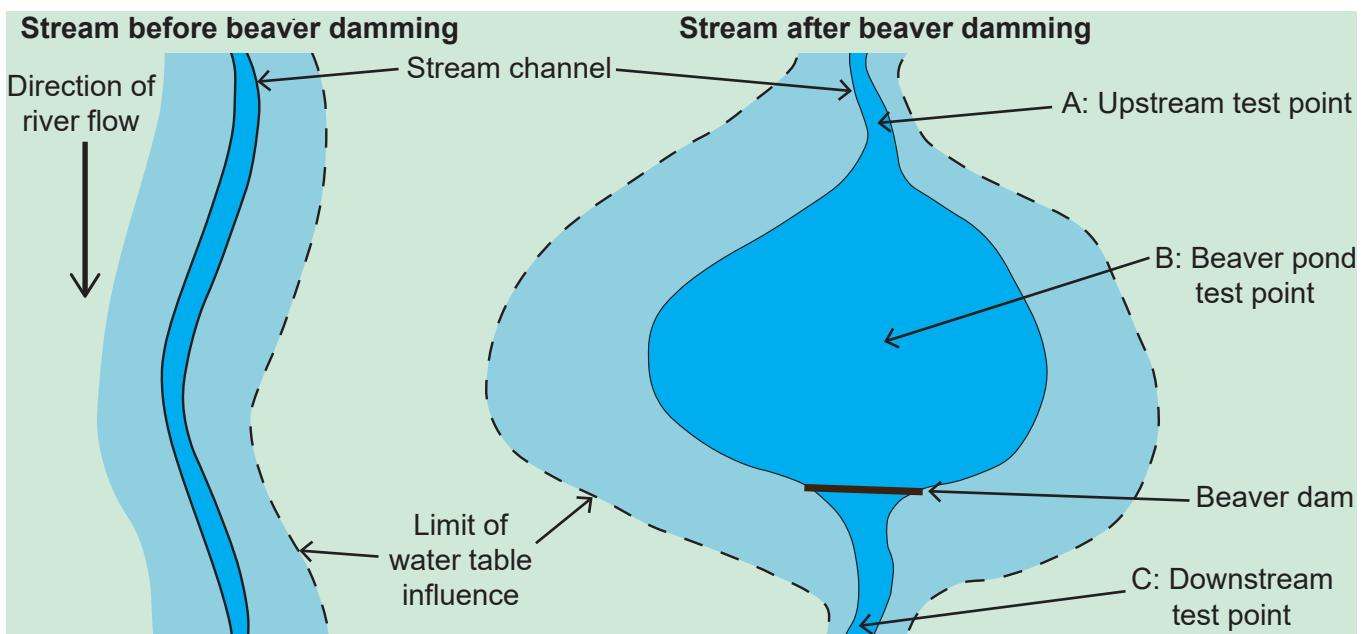
- 1 family per square km of river.
- Live in family groups, with 2 adults and up to 3 young (kits) born each year between April and June.
- Mortality rates are high due to severe weather, lack of suitable habitats and predation.
- North American beaver population:
 - estimated at 250 million before fur trade hunting
 - today approximately 9 million.
- Feed off tree bark.
- Construct lodges from wood and mud:
 - a safe place for eating, sleeping, and raising young
 - remain in lodges during winter
 - protect their own lodge from other beavers.
- Beavers are being reintroduced in Europe to help restore wetlands.

[Source: adapted from www.sbaa.ca, www.ecology.info, www.tobyhemenway.com and <http://acs7.cortland.edu>]

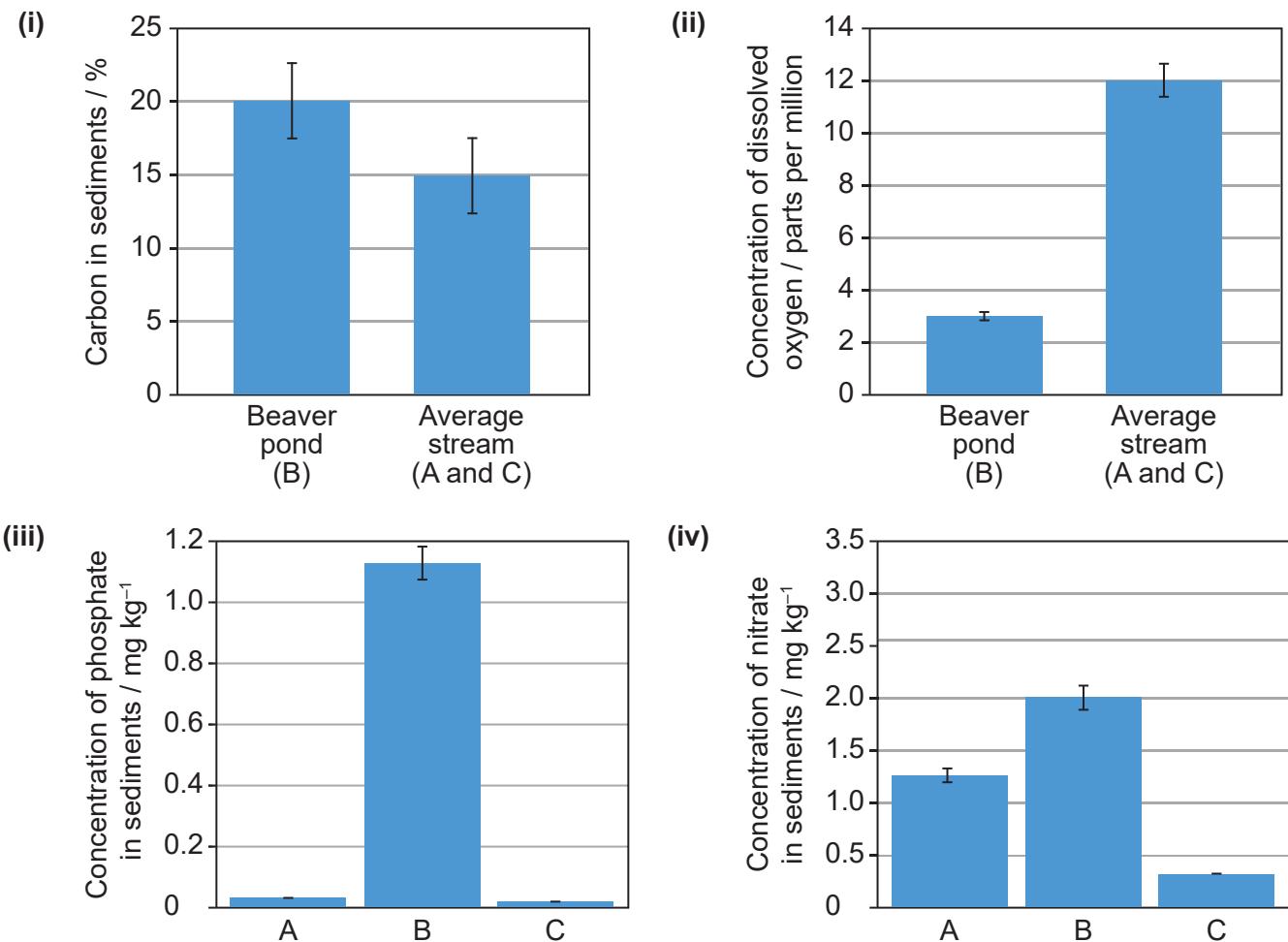
Figure 7(b): Fact file on beaver hunting

- By 1900 beavers had been hunted almost to extinction for their pelts (skin and fur).
- The IUCN classify beavers as “least concern” on the Red List.
- There are 19 registered trap lines in Algonquin Provincial Park where beavers may be trapped for their pelts by First Nation (indigenous) people.
- All trappers must have a licence, and may only trap during the hunting season using ethical traps.
- 135 000 beavers are still trapped and killed in Canada each year.
- The price for a beaver pelt was US\$19 in 2015, compared to US\$500 a pelt in 1940.
- Many landowners trap beavers on their property because of the damage they cause. (Beavers cut timbers and their dams can create floods causing millions of dollars of economic damage.)

[Source: adapted from www.couplesresort.ca, www.ontario.ca, www.sbaa.ca, www.ecology.info, www.tobyhemenway.com and <http://acs7.cortland.edu>]

Figure 8(a): River before and after beaver dam construction

[Source: © International Baccalaureate Organization 2018]

**Figure 8(b): Graphs to show nutrient and oxygen content in beaver pond and stream
(Error bars show standard deviation)**

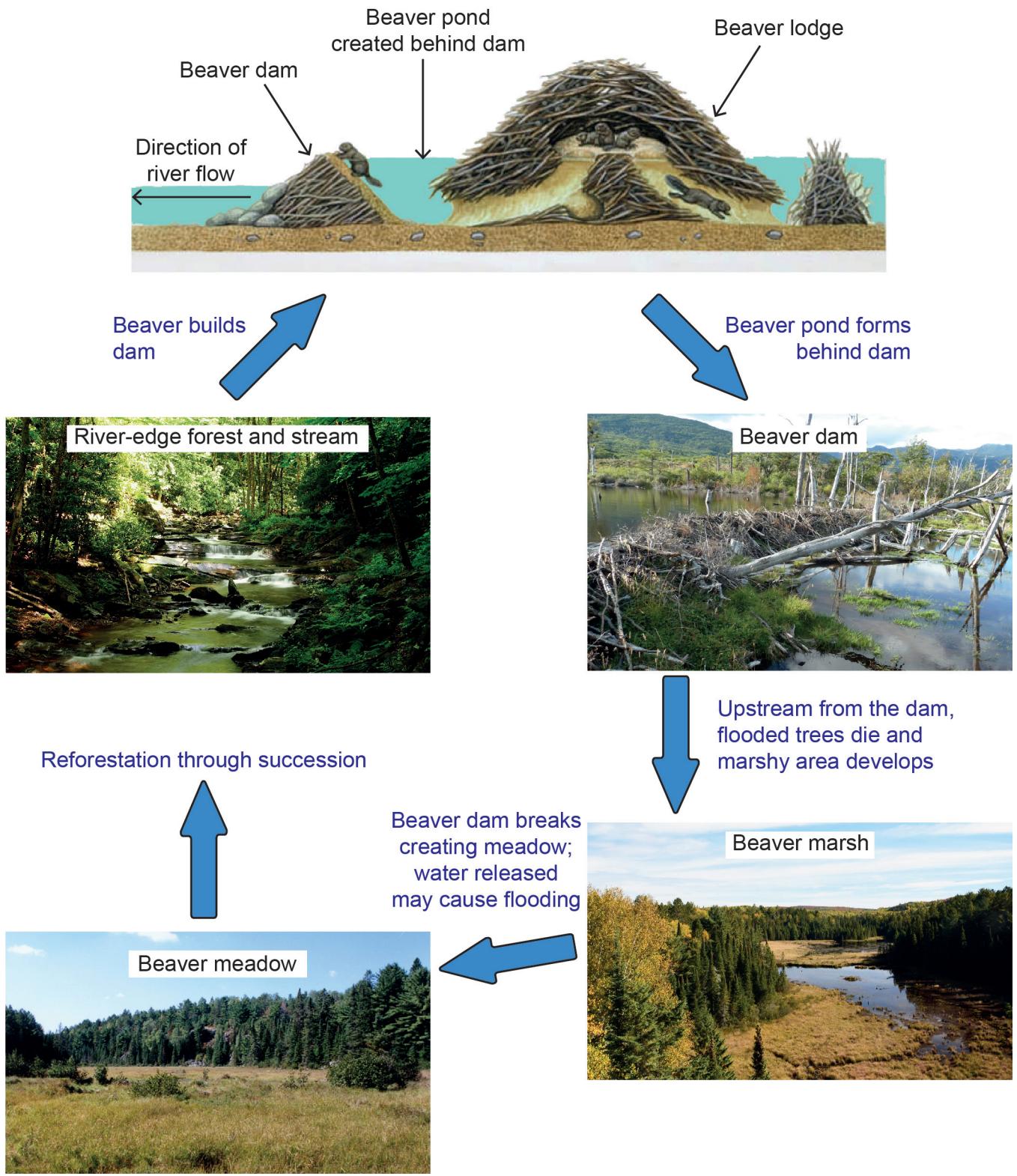
[Source: Adapted from figures taken from "The effect of beaver ponds on the nutrient composition in the water column and the sediments of Cart Creek" by Delaney Gibbs]

Figure 9(a): Fact file on beaver's role in the ecosystem

- Beavers build dams with sticks, creating ponds and slowing the flow of rivers.
- Beaver ponds:
 - are less suitable for river fish, for example brook trout
 - provide new habitats for aquatic plants, for example bullhead lily, dragon fly larva, bullfrogs and other fish, for example pearl dace.
- Dam may cause floods; if water covers the roots of river-edge trees, the trees may die and provide more nesting sites for birds.
- Marsh forms at the edge of beaver ponds.
- Grasses and sedges colonise the nutrient-rich silt at the bottom of the former pond, creating a beaver meadow.
- Beaver meadows have more light penetration, higher soil moisture, more nitrogen and a different vegetation from that of the adjacent river-edge forest.
- Dams may collapse because of heavy rains or spring melt, or if beaver is killed by a predator.

[Source: © International Baccalaureate Organization 2018]

Figure 9(b): The succession of ecosystems caused when a beaver dam is built across a river

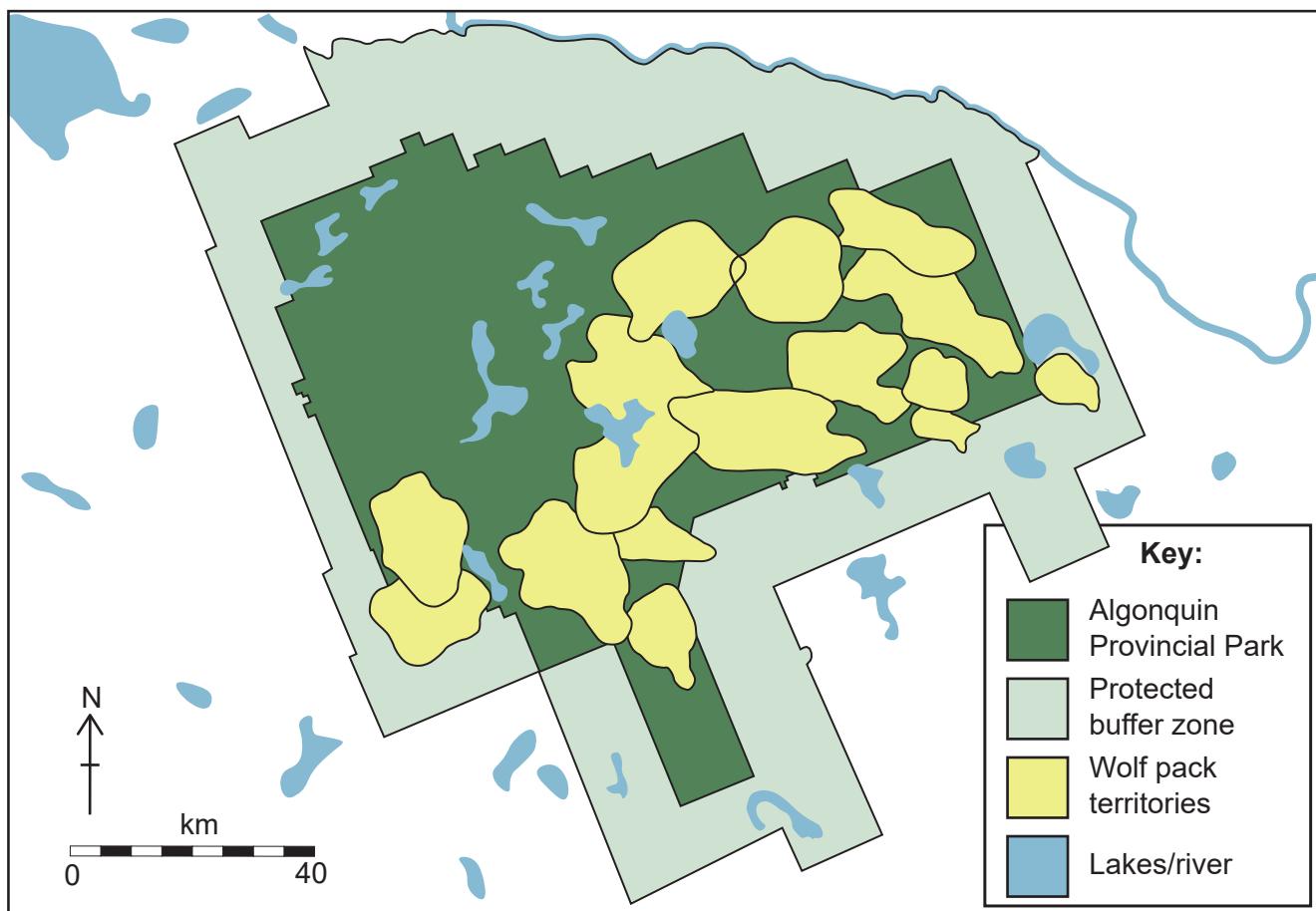


[Sources: (Top image) Adapted with permission from getdrawings.com
 (River-edge forest and stream) ForestWander Nature Photography
<http://www.ForestWander.com>
 (Beaver dam) Jon Henn
 (Beaver meadow image) Photo by Veronica C. Magee
 (Beaver marsh image) Photo taken by Łukasz Łukomski]

Figure 10(a): Fact file on Algonquin wolves

- Population of Algonquin wolves is estimated to be between 250 and 1000.
- Status in Canada: threatened.
- Wolves live in packs, are highly territorial and typically have a range of 35 km².
- Wolf faeces contain 63% beaver remains in summer and 12% in winter.
- Since 2004 it has been illegal to hunt or trap wolves and coyotes in Algonquin Provincial Park and in a buffer zone around the edge of the park; hunting coyotes outside the park is legal.
- Algonquin wolves look very similar to coyotes.
- It is easy for a hunter or trapper to accidentally kill an Algonquin wolf while intending to kill a coyote.

[Source: adapted from www.ontario.ca]

Figure 10(b): Algonquin wolf pack territories and protected areas

[Source: Modified from Biological Conservation, Vol 143, edition number 2, Linda Y. Rutledge, Brent R. Patterson, Kenneth J. Mills, Karen M. Loveless, Dennis L. Murray, Bradley N. White, Protection from harvesting restores the natural social structure of eastern wolf packs, Page 333, Copyright 2010, with permission from Elsevier <http://www.sciencedirect.com/science/article/pii/S0006320709004583>]