

**Environmental systems and societies**  
**Standard level**  
**Paper 1 – resource booklet**

Friday 2 November 2018 (afternoon)

1 hour

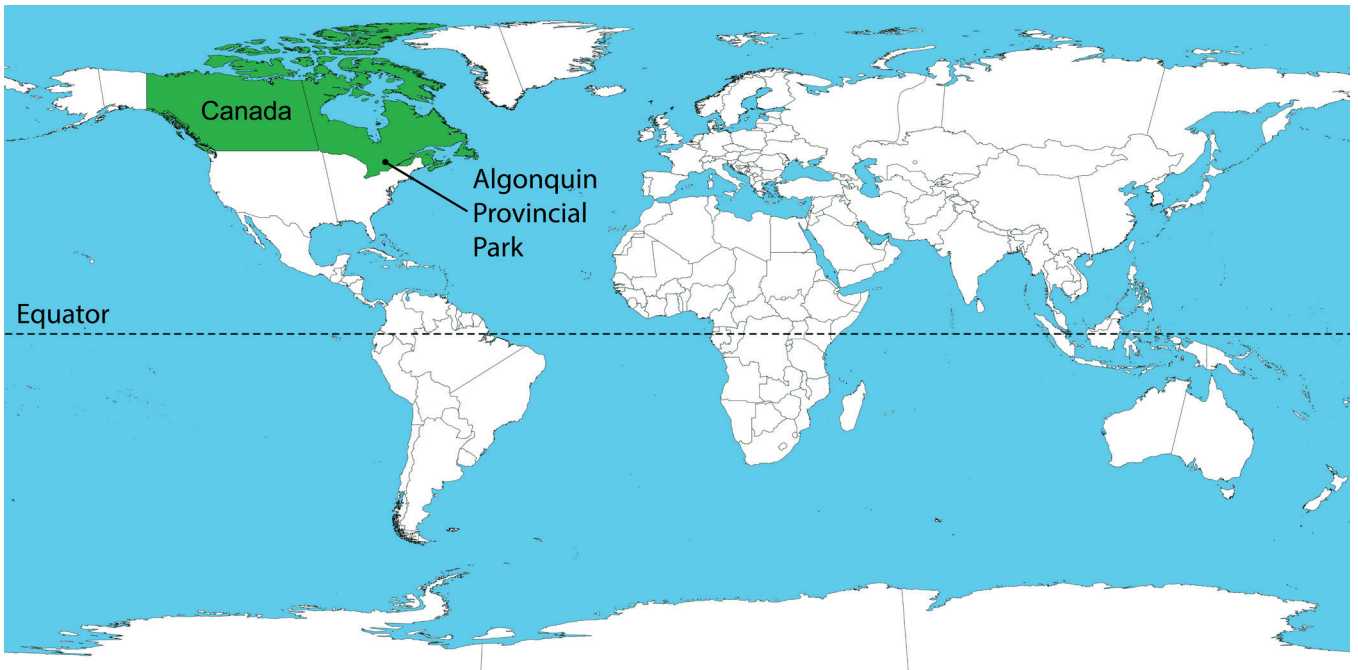
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**Instructions to candidates**

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

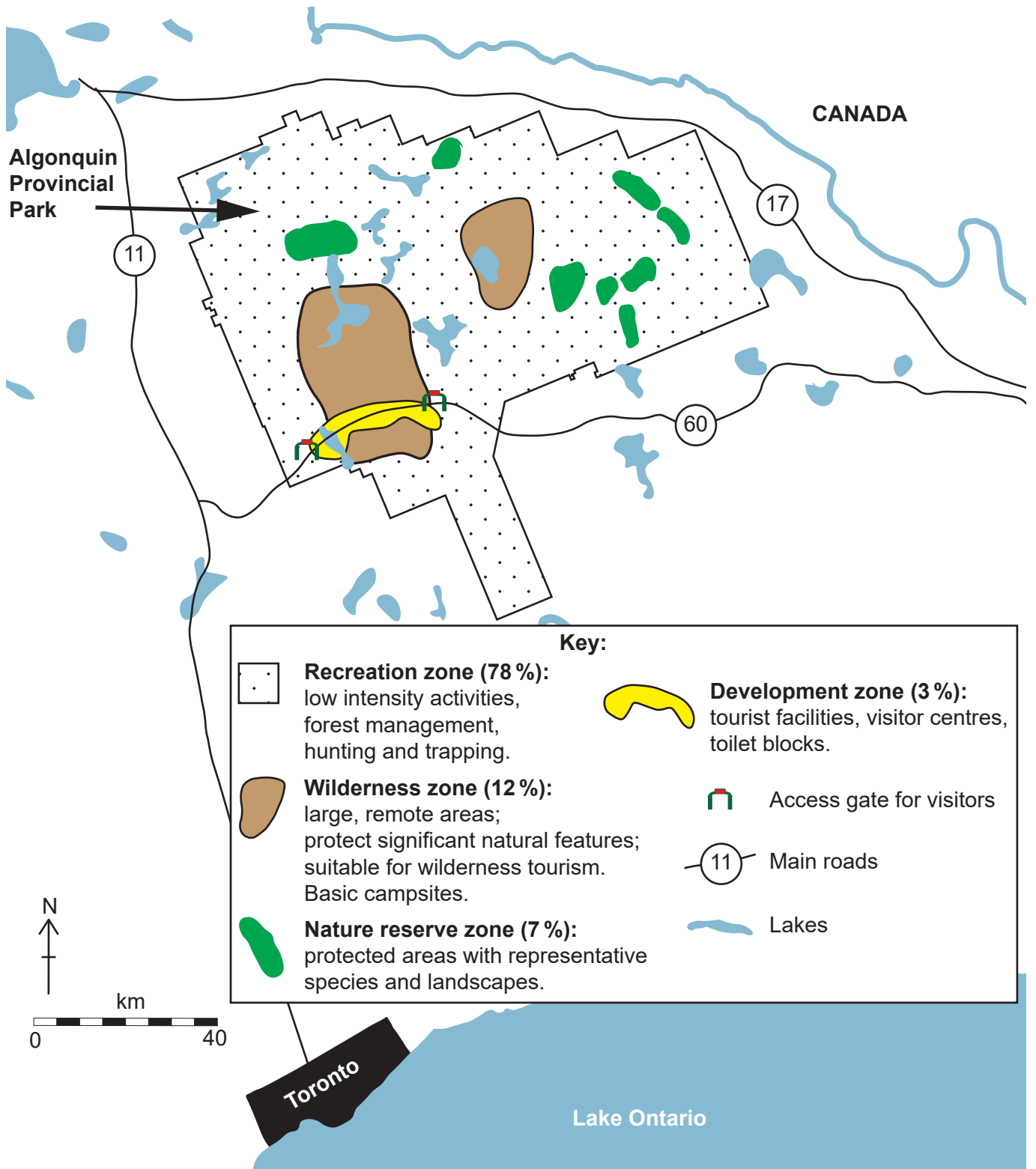
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Figure 1(a): Map showing location of Algonquin Provincial Park in Canada



[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.

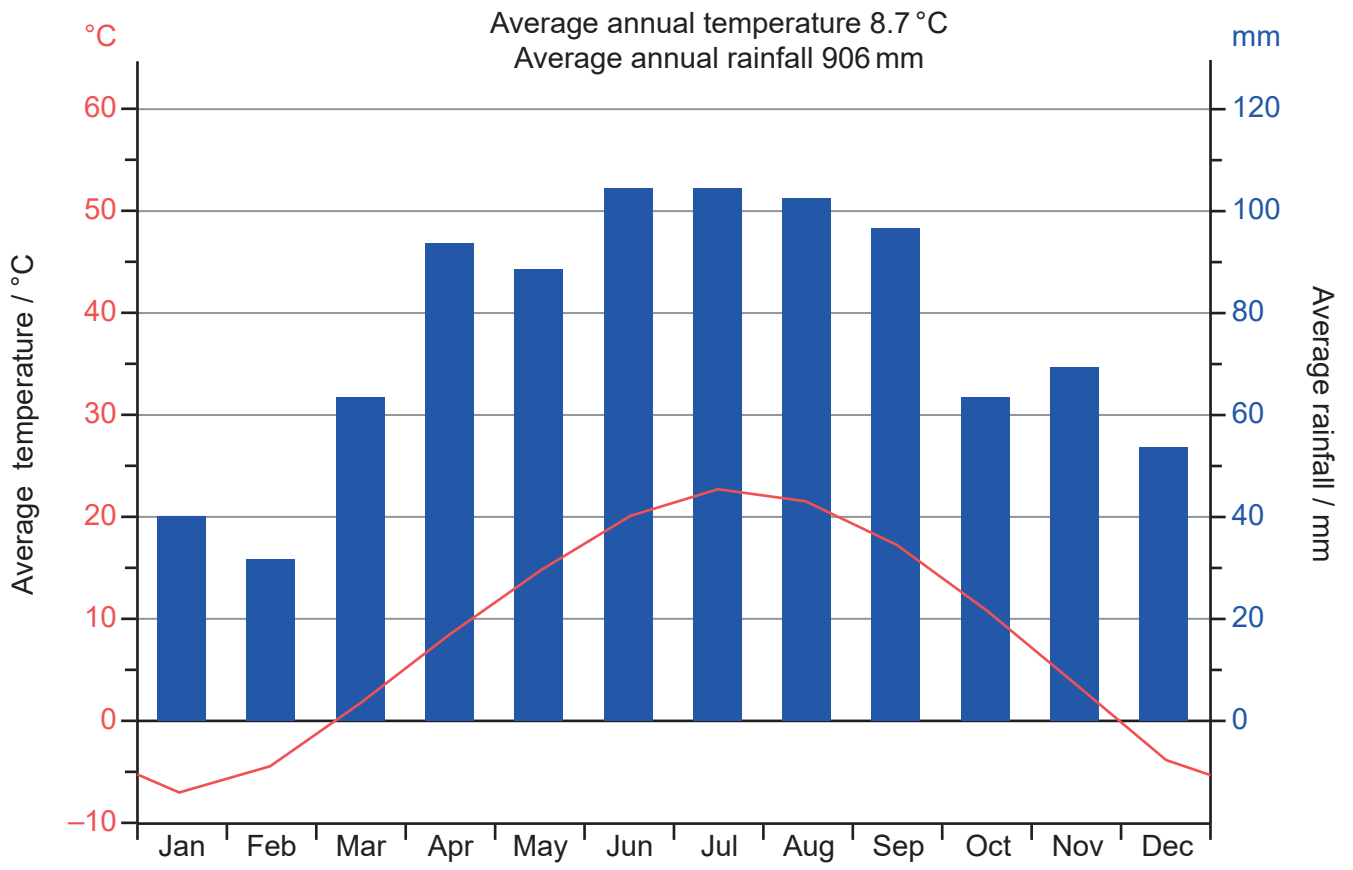
[Source: adapted from Ontario Ministry of Natural Resources. 1998. Algonquin Provincial Park Management Plan. Queen’s Printer for Ontario, Toronto, ON.]

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

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

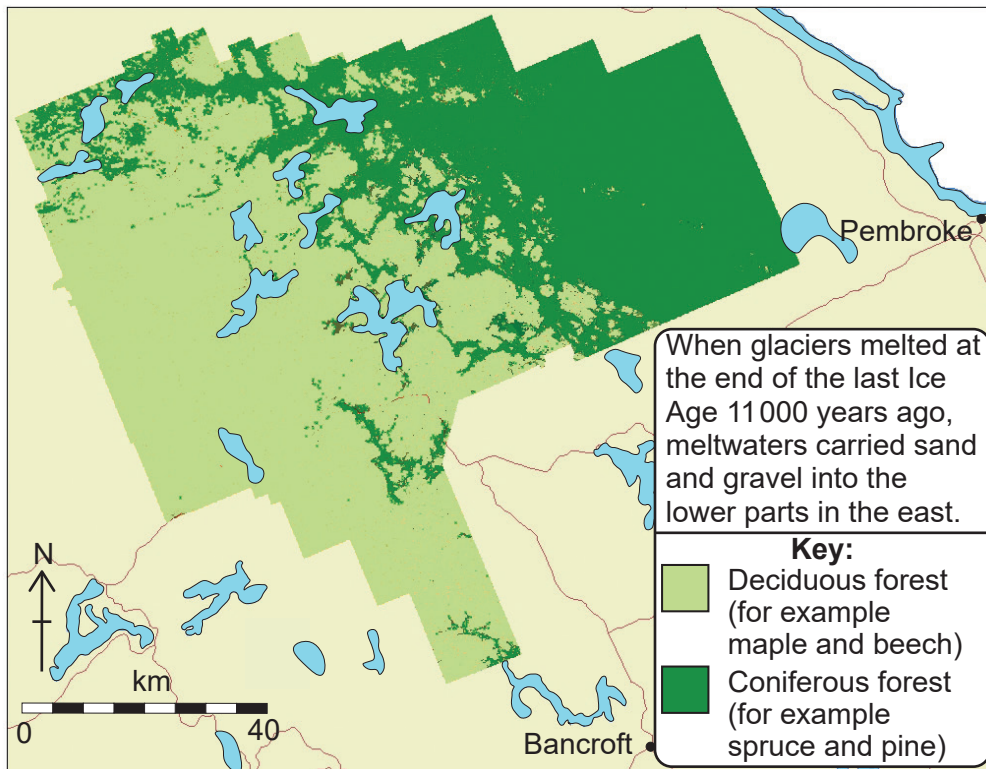
[Source: Facts taken from The Friends of Algonquin Park [www.algonquinpark.on.ca](http://www.algonquinpark.on.ca) and Ontario Ministry of Natural Resources. 1998. Algonquin Provincial Park Management Plan. Queen’s Printer for Ontario, Toronto, ON.]

Figure 3: Climate graph for Algonquin Provincial Park



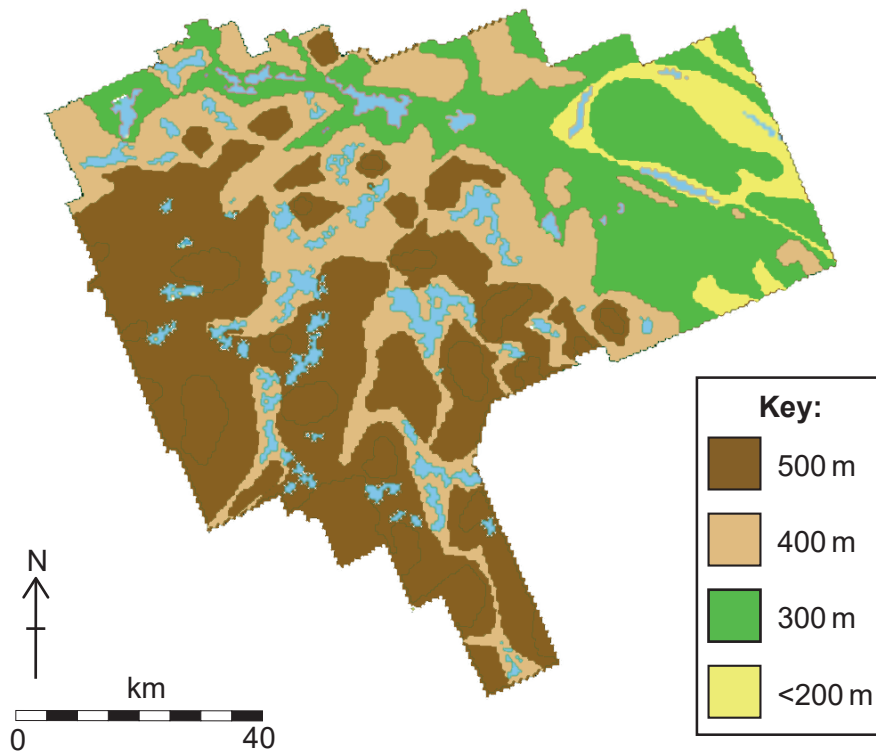
[Source: <https://en.climate-data.org/north-america/united-states-of-america/illinois/algonquin-1571/>]

**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**



[Source: Adapted by the International Baccalaureate with permission of the rights holder]

**Turn over**

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/>)]



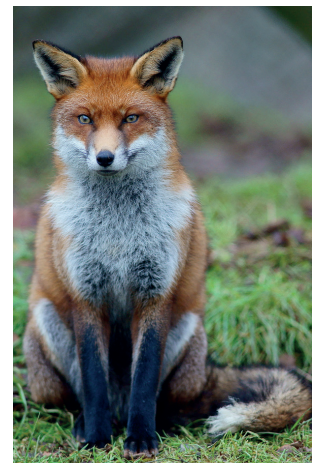
Coyote  
(*Canis latrans*)  
[Source: Alan Vernon]



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  
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Maple tree  
(*Acer saccharum*)  
[Source: Tim McCabe. File licensed under  
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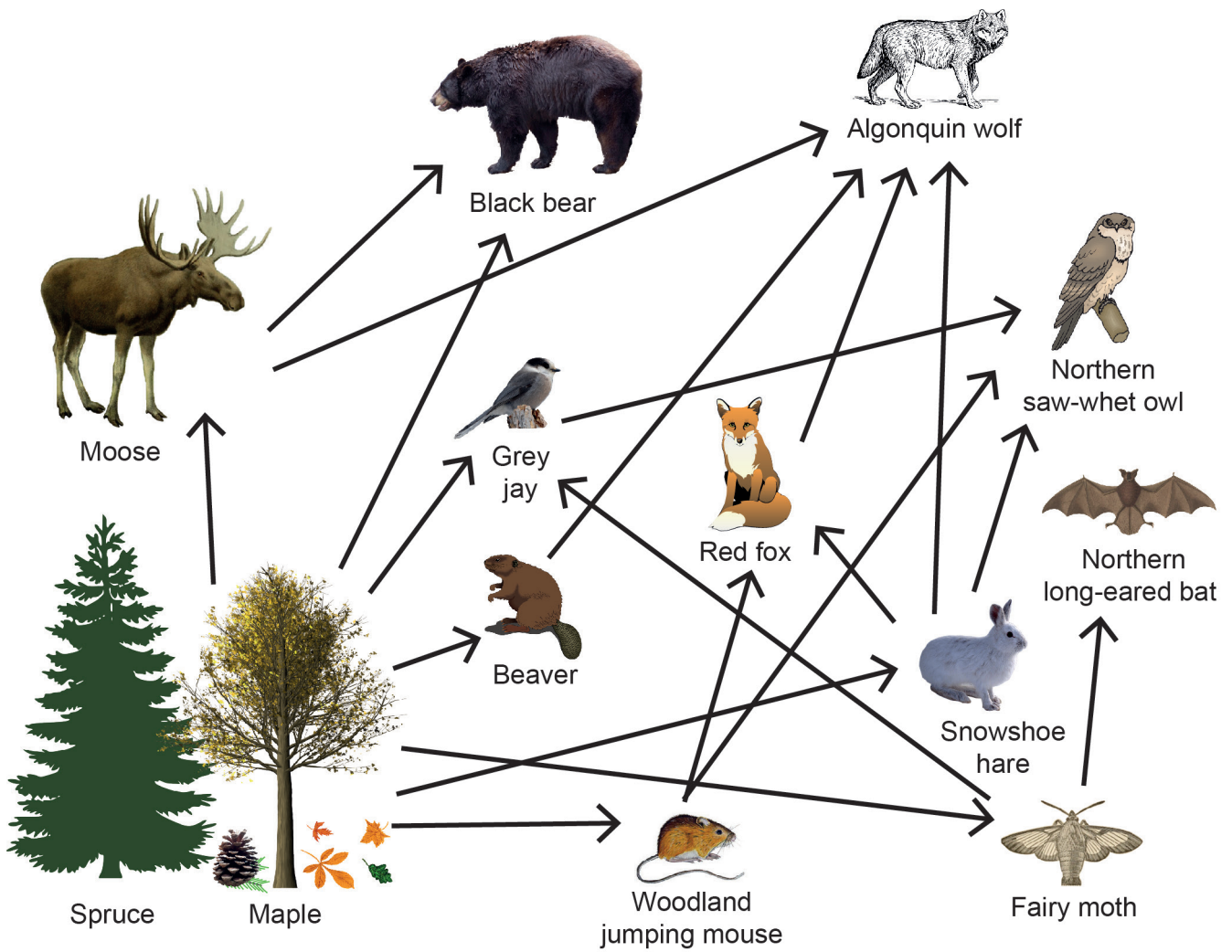
Sedge  
(*Cyperaceae*)  
[Source: Evelyn Simak. File licensed under  
CC BY-SA 2.0 (<https://creativecommons.org/licenses/by-sa/2.0/>)]



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>

Moose: Wikimedia/Public domain

Pine cone: © International Baccalaureate Organization 2018

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

Turn over

### **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.

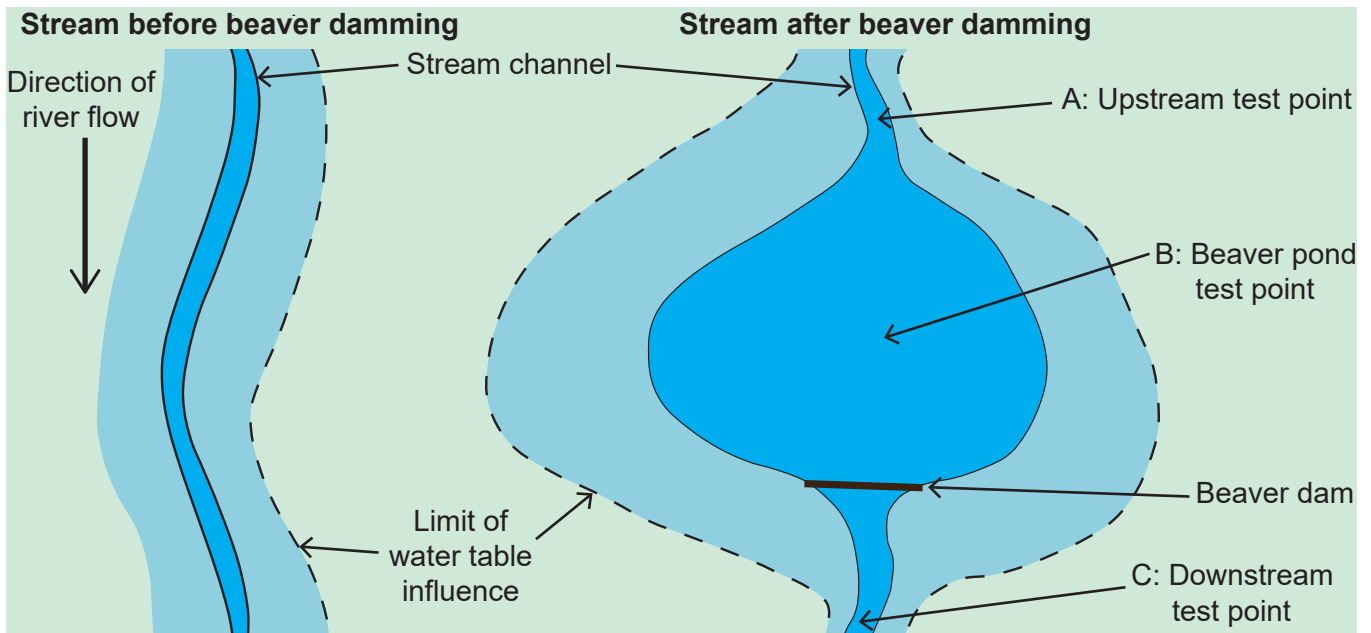
[Source: adapted from [www.sbaa.ca](http://www.sbaa.ca), [www.ecology.info](http://www.ecology.info), [www.tobyhemeway.com](http://www.tobyhemeway.com) and <http://acs7.cortland.edu>]

### **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.
- 135000 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.)

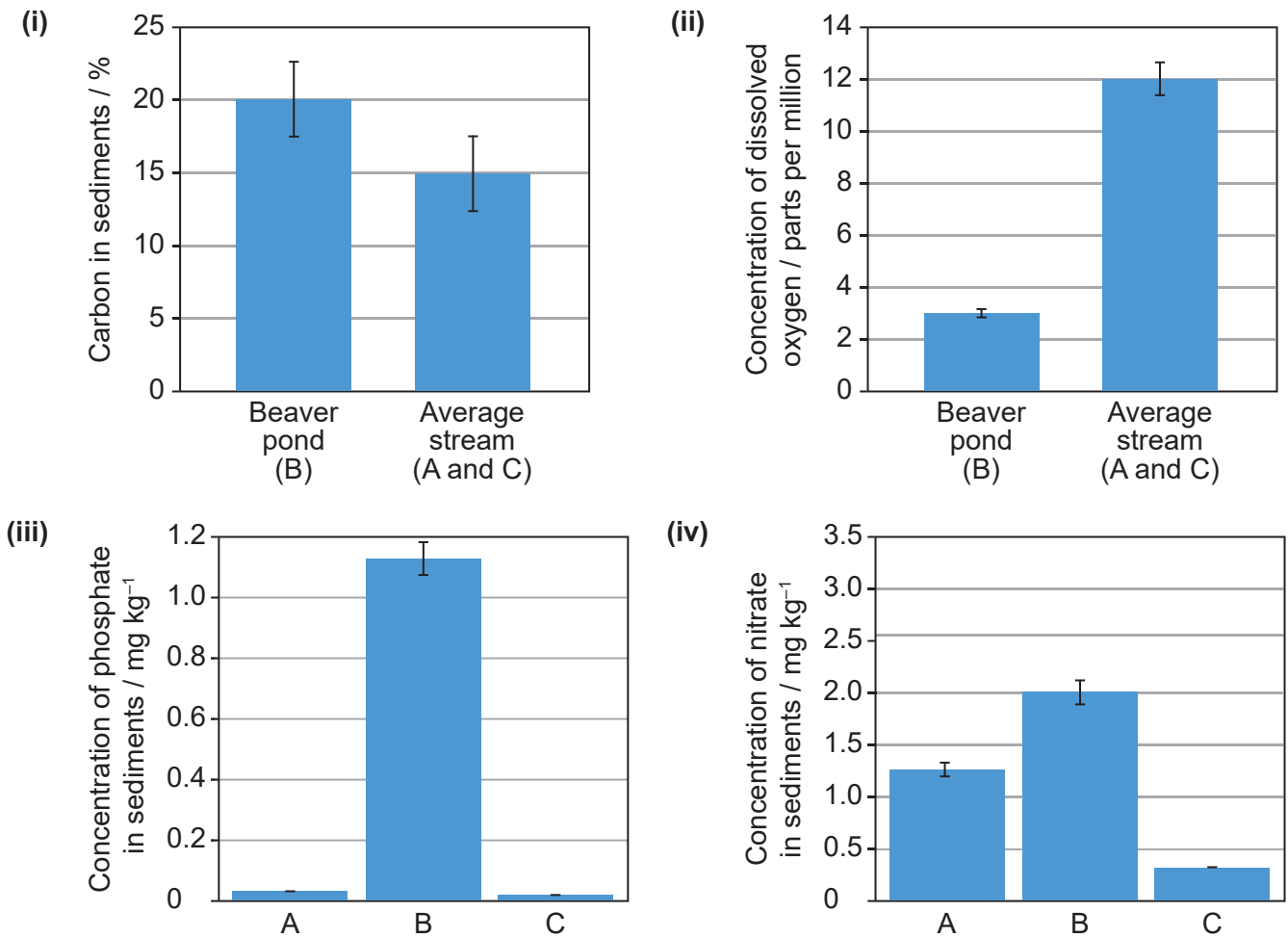
[Source: adapted from [www.couplesresort.ca](http://www.couplesresort.ca), [www.ontario.ca](http://www.ontario.ca), [www.sbaa.ca](http://www.sbaa.ca), [www.ecology.info](http://www.ecology.info), [www.tobyhemeway.com](http://www.tobyhemeway.com) and <http://acs7.cortland.edu>]

**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)



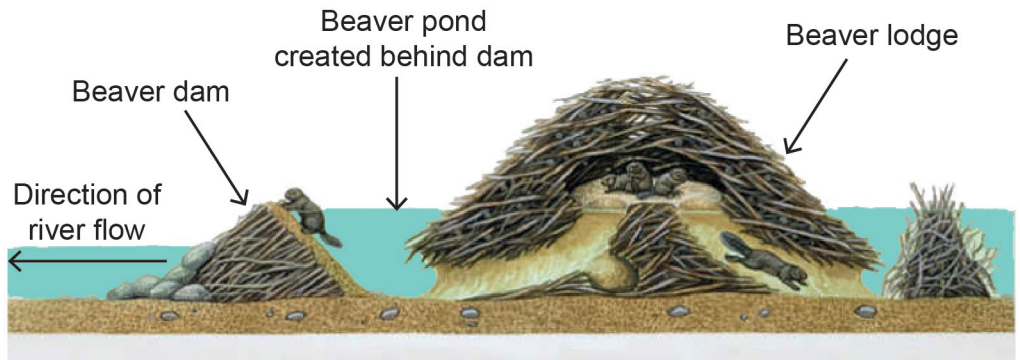
[Source: Adapted from figures taken from "The effect of beaver ponds on the nutrient composition in the water column and the sediments of Cart Creek" by Delaney Gibbs]

**Turn over**

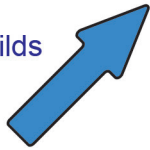
**Figure 9(a): Dossier sobre la función de los castores en el ecosistema**

- Los castores construyen represas con palos, creando lagunas y ralentizando el flujo de los ríos.
- Las lagunas de castores:
  - son menos adecuadas para los peces de ríos, como por ejemplo, la trucha de arroyo
  - proporcionan nuevos hábitats a las plantas acuáticas como, por ejemplo, los nenúfares amarillos, o a las larvas de libélulas, ranas toro u otros peces como, por ejemplo, ciprínidos.
- La represa puede causar inundaciones; si el agua cubre las raíces de los árboles de las riberas, los árboles pueden morir y proporcionar más lugares de anidación a las aves.
- En el borde de las lagunas de los castores se pueden formar zonas pantanosas.
- Las gramíneas y ciperáceas colonizan los limos ricos en nutrientes del fondo de la laguna, creando lo que se conoce como pradera de castor.
- En las praderas de castor la luz penetra más, la humedad del suelo es mayor, hay más nitrógeno y la vegetación es diferente de la del bosque de ribera fluvial adyacente.
- Las represas pueden derrumbarse debido a fuertes lluvias o a deshielos primaverales, o si el castor que la mantiene es cazado por un depredador.

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



Beaver builds dam



Beaver pond forms behind dam



Reforestation through succession



Upstream from the dam, flooded trees die and marshy area develops



Beaver dam breaks creating meadow; water released may cause flooding



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

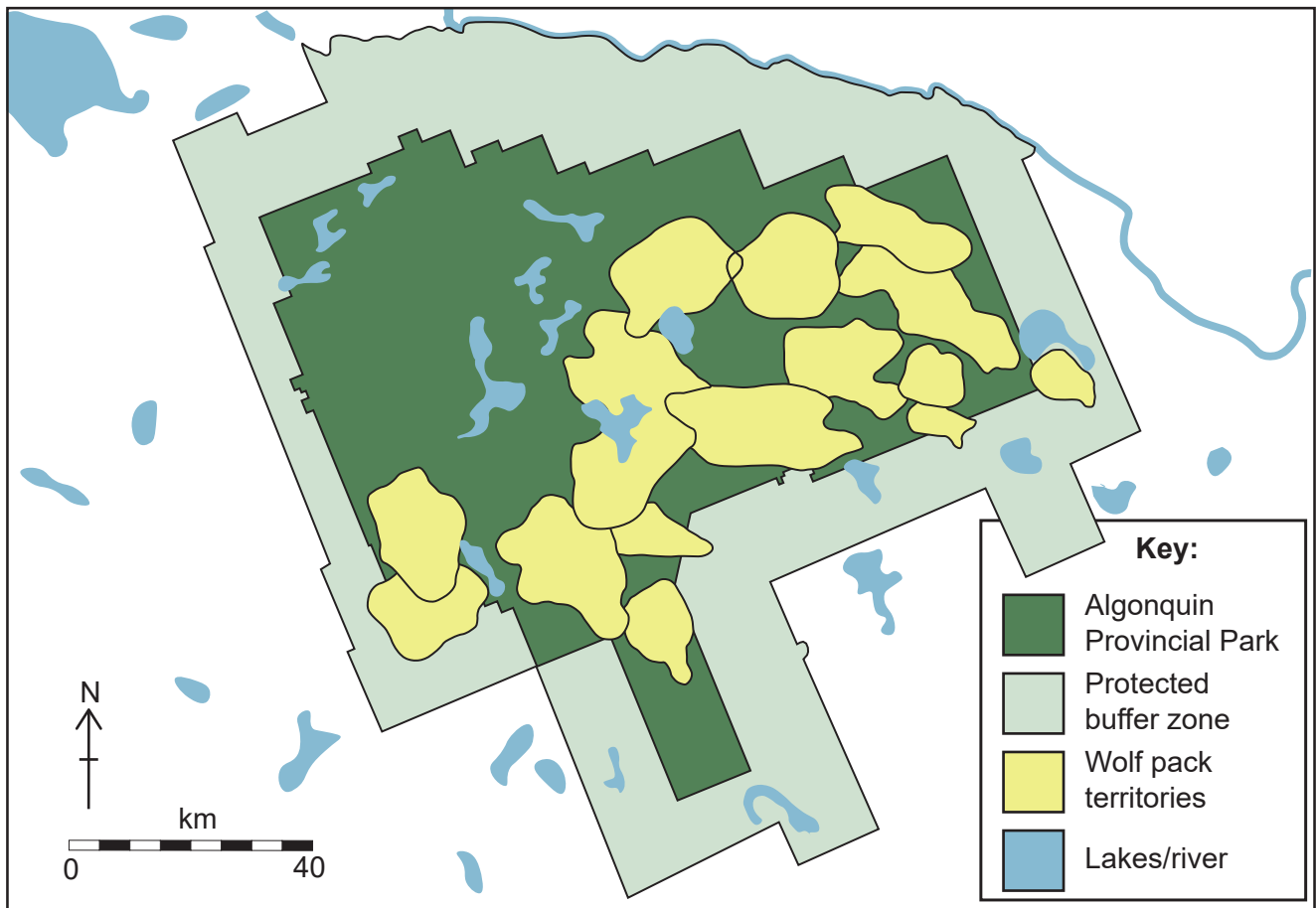
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**Figure 10(a): Fact file on Algonquin wolves**

- 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 km<sup>2</sup>.
- 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](http://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]

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