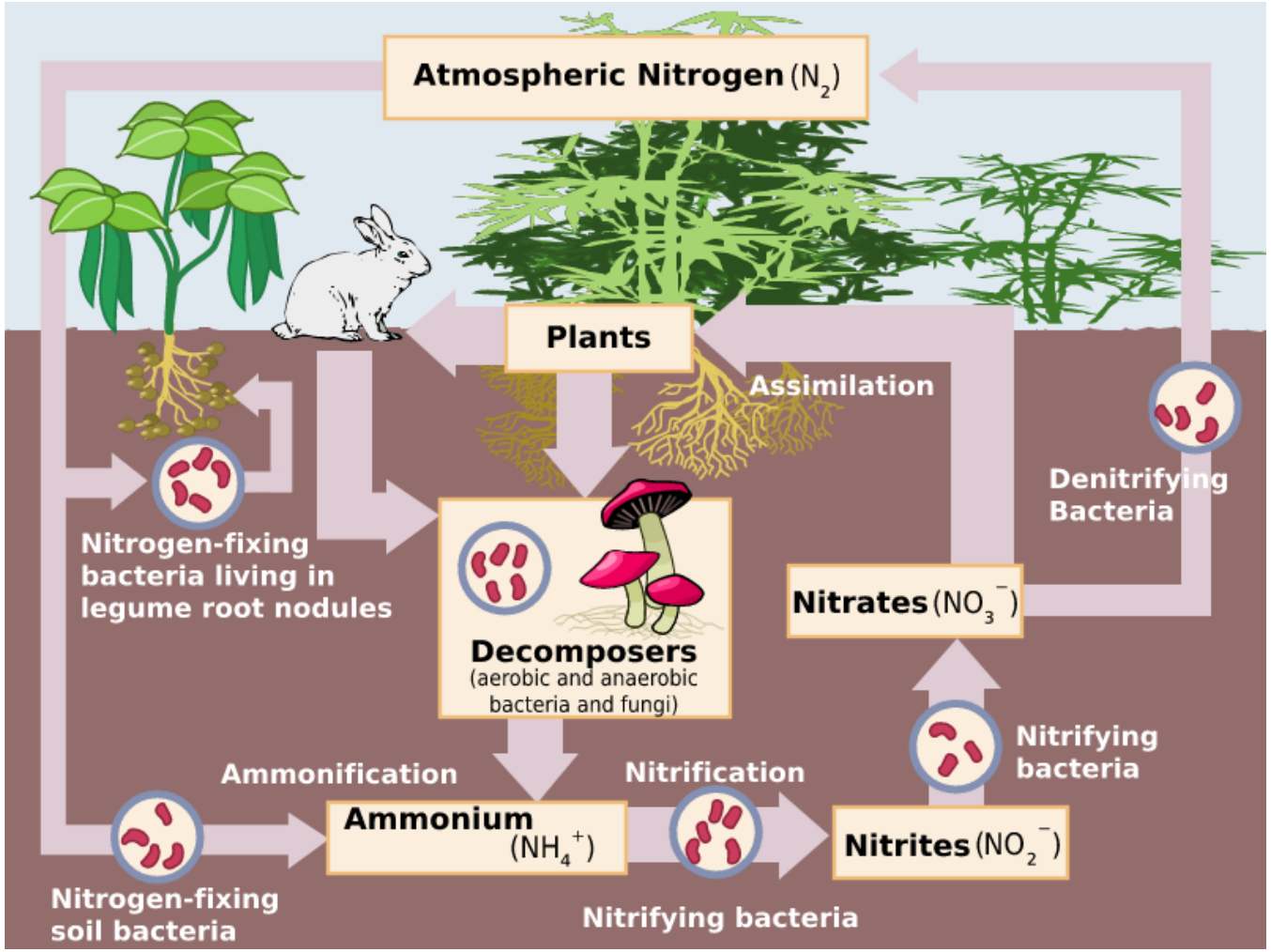
Today's class

Finish Ecosystem Ecology -

- Finish Food Webs
- Nutrient Cycling – Carbon and Nitrogen

Rory's guest lecture: bird ecology/ Competitive interactions.



https://commons.wikimedia.org/wiki/File:Nitrogen_Cycle.svg

Genetics Study Survey

Dear BIOL121 - section 224 students,
you are warmly invited to complete the end-of-term Genetics Study Survey, which you can access at the following URL: **https://ubc.ca1.qualtrics.com/jfe/form/SV_9SPECWLh7qMhC50**

- The consent to let us use your responses for the study is at the end of the survey (Q. 39)
- Participation credit is allocated by your instructors for completion regardless of whether you choose to give consent for the study :)
- Your instructors won't know your answers and won't know whether you provided consent for the study (only the project team will see them).
- Detailed information on the study and study risks is provided at the start of the survey, in class, and via email/Canvas.
- The survey will 'expire' on **Tuesday, April 18, 11:59 pm** Vancouver time. Please complete it before then to receive your participation points!

THANK YOU!

Questions or concerns, or interested in further study participation?
Please email Pam at: kalas@zoology.ubc.ca
(include "genetics survey" in the subject)

Remaining due dates

This Friday, April 14th @ 11:59 pm

- Quiz 9 – Species Concepts & Speciation
- Quiz 12 – Community Ecology – Species Interactions & Succession
- Quiz 13 - Ecosystem Ecology – Nutrient Cycling
- Worksheet #11 – Species Interactions – Barnacles
- Worksheet #12 – Food Webs

Sunday, April 16th @ time?

- **My official teaching feedback (Student Experience of Instruction)** – you should have received an email from the Faculty of Science.

Tuesday, April 18th @ 11:59 pm

- Pam's Genetic Survey Part II (1% of grade)

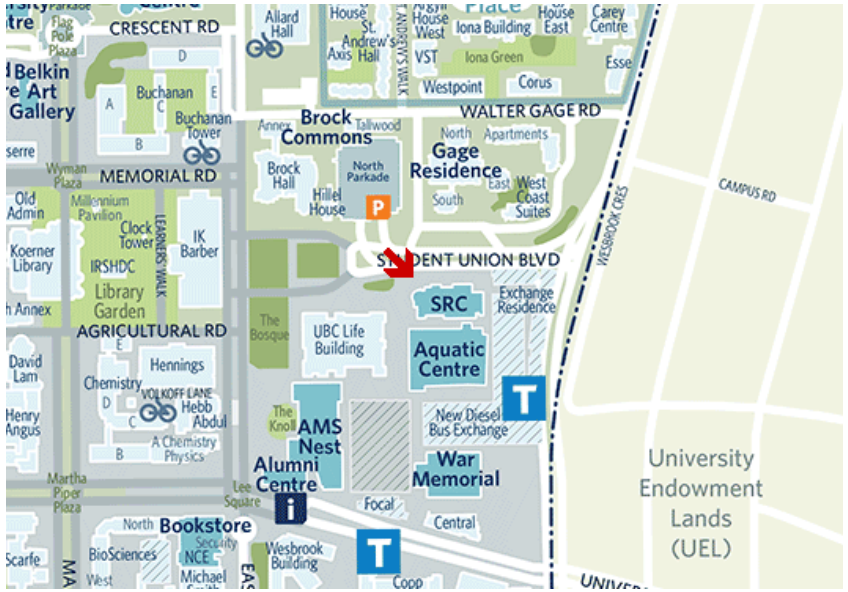
Monday, April 24th @ 11:59

- End of term informal feedback **(1%)**

Final Exam

When: Sunday, April 23rd, start time of 7:00 pm

Where: SRC Gym (https://sportfacilities.ubc.ca/src/)



The gym is divided into 3 sections (A – west side, B – Centre, and C – east side)

My two sections: Section A and part of Section B

Dr. Brett Couch: Section C and part of Section B (too)

- different exam; so very important that you look at the front page of the exam before time starts.

Final Exam

Duration: 2.5 hours (we will try to set the exam for 2 hours; so ~ double the length of a midterm exam).

Worth: 40% (but may increase to 55% or 60% if weight of midterms transferred)

Topics (cumulative):
Ecology = in previous years ~65%
Evolution & Genetics = previously ~35%

- All learning goals are testable.
- But, likely to see questions on species concepts/speciation (evolution) as not tested on midterms

A study sheet is allowed:

- One 8.5" x 11" sheet of paper, both sides.
- Any content
- But must be in your handwriting

We have not written the questions yet.

- I anticipate some explanations
- Some short answers, select all and multiple choice

You must bring your student ID to the exam (or a driver's license). ID will be checked.

Office Hours & Review Sessions

Office hours will run this week only.
If TAs choose to run extra office hours beyond this point, we will let you know.

Review Sessions:

- Ruby & Christie's Review Session – TBA

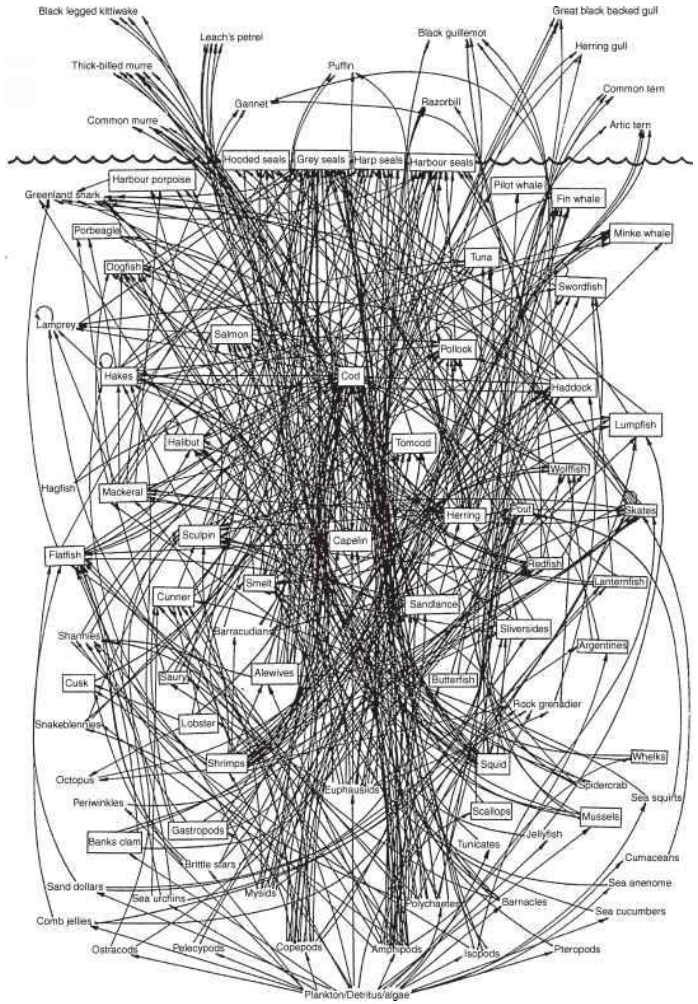
- Dr. Brett Couch is also holding a study session (bring your questions) - TBA

- My review session – Thursday's class

Last class

We started ecosystem ecology, and examined how energy flows through ecosystems.

A simplified food web (e.g. no detritivores/decomposers)



- Trophic Levels
- Producers
- Primary Consumers
- Secondary Consumers
- Tertiary Consumers
- Food chains
- Food webs
- 10% rule (and why)
- Net primary productivity

https://www.ecologycenter.us/population-dynamics-2/bottomup-forces.html

Learning goal (energy flow)

- Be able to describe the flow of energy through a food chain or food web and predict the consequences of changes to the system.

iClicker Question

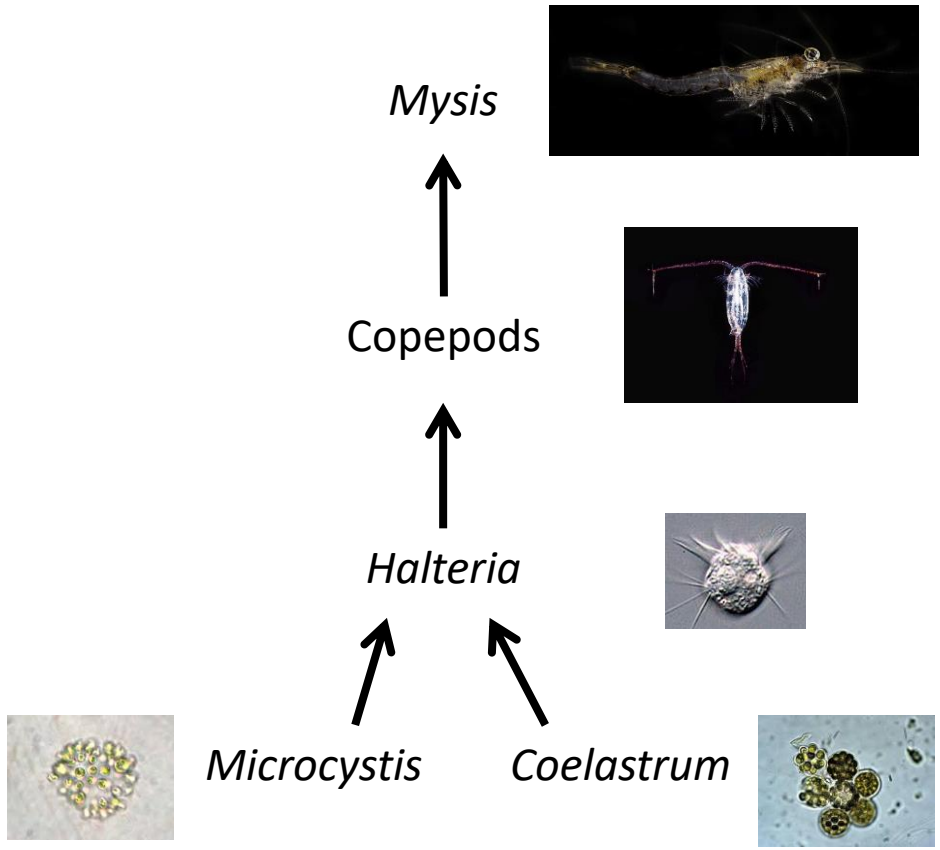
Consider this freshwater food chain. What would happen to the population size of **producers** if a parasite of *Mysis* were introduced?

A. Increase

B. Decrease

C. No change

D. It depends



Answer

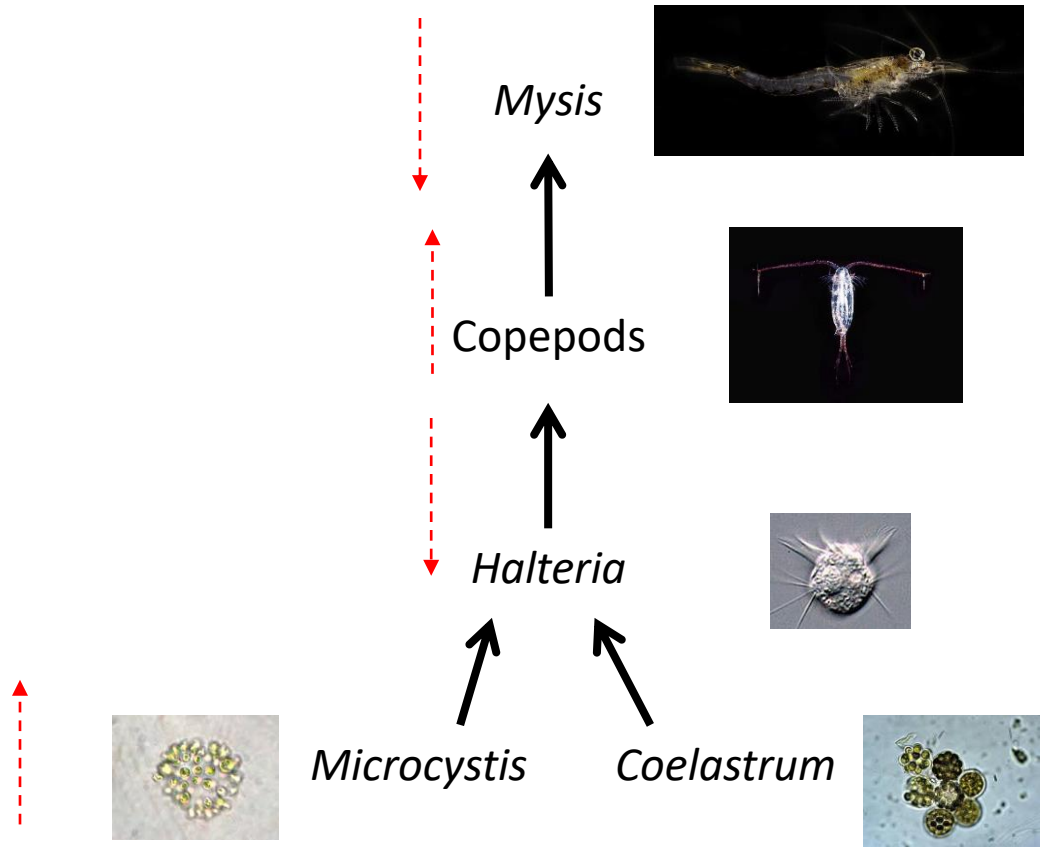
Consider this freshwater food chain. What would happen to the population size of **producers** if a parasite of *Mysis* were introduced?

A. Increase

B. Decrease

C. No change

D. It depends



iClicker Question

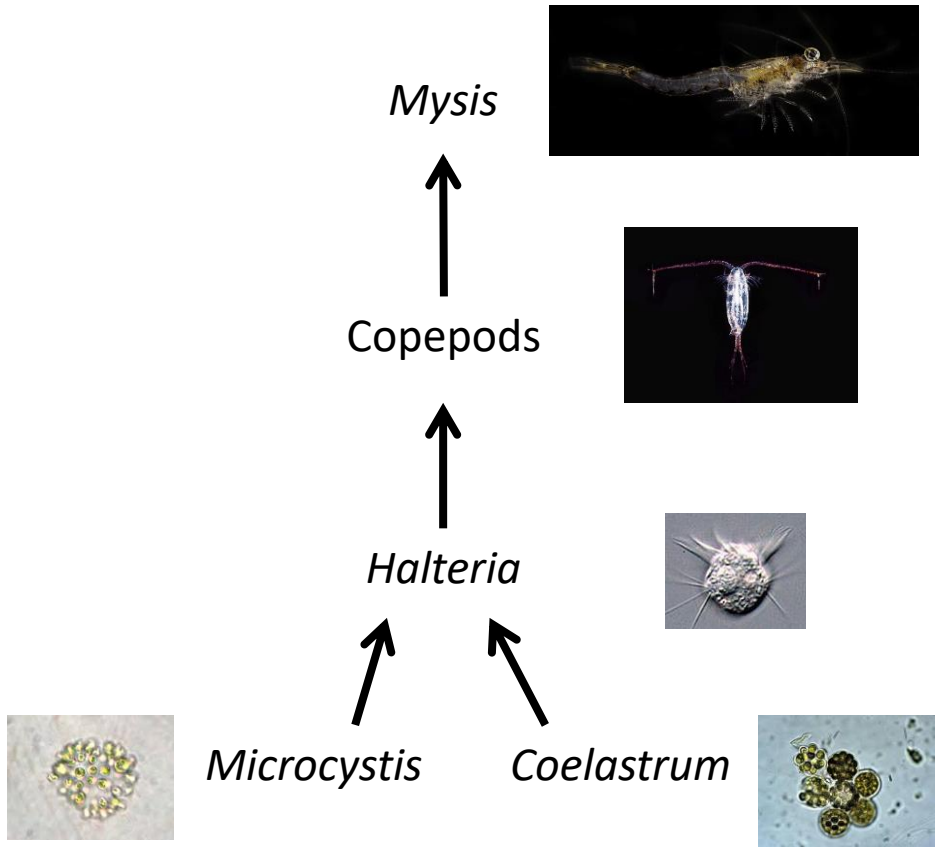
What would happen to the population size of ***Mysis*** if the *Microcystis* all died of disease?

A. Increase

B. Decrease

C. No change

D. It depends



Answer

What would happen to the population size of ***Mysis*** if the *Microcystis* all died of disease?

A. Increase

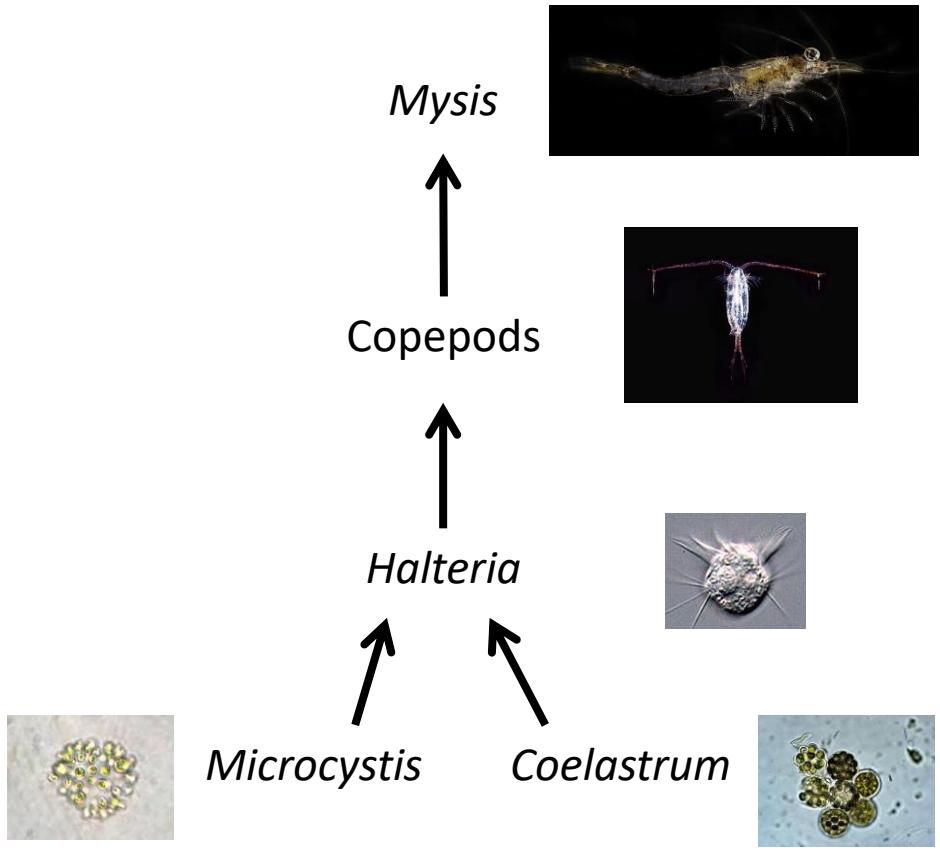
B. Decrease

C. No change

D. It depends

Do *Microcystis* & *Coelastrum* compete with each other, e.g. for space and light? If so, *Coelastrum* abundance may increase if all *Microcystis* die; so, no effect on population size of *Mysis*.

If the death of *Microcystis* has no affect on the abundance of *Coelastrum*, would expect *Mysis* population size to decrease because, fewer produces means less energy to support populations for *Halteria, Copepods* and *Mysis*.

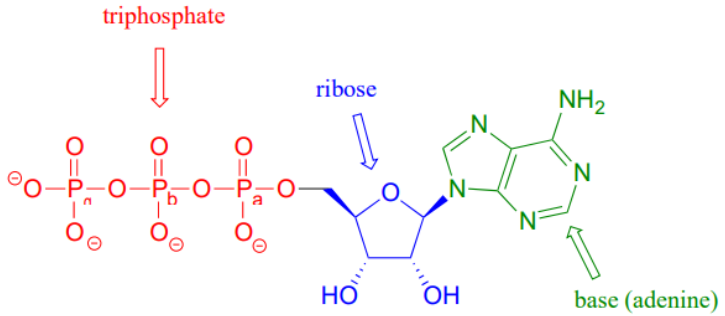


Worksheet #12

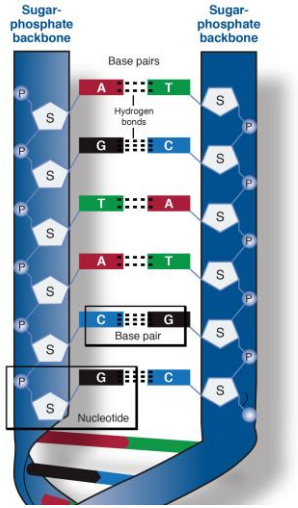
You can now complete worksheet #12 (but, not due until this Friday night)

One point of clarification – limiting factors

- You are asked what happens if you add phosphorus to a tank.
- In this scenario case, you are told phosphorus is a limiting factor (limiting population growth/abundance).
- FYI, phosphorus is found in ATP and DNA (so need for cell division).



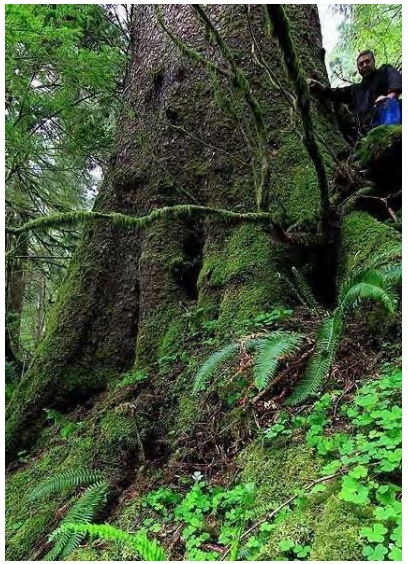
adenosine triphosphate (ATP)



iClicker Question

Where did most of the mass in these trees come from?

A. Nutrients in the soil taken up by its roots
B. The sun's energy
C. Molecules in the air
D. Not sure



Answer

Where did most of the mass in these trees come from?

A. Nutrients in thesoil taken up by its roots

B. The sun's energy

C. Molecules in the air

D. Not sure

$CO2 + H2O + sunlight = O_2 + Glucose$

Linear chain of 10,000-15,000 glucose units = cellulose – makes up most of plant cell walls

Nutrients Cycling (through ecosystems)

Nutrients: chemicals needed for growth and maintenance of life, e.g., N (nitrogen), P (phosphorus), C (carbon), O (oxygen), Fe (iron)

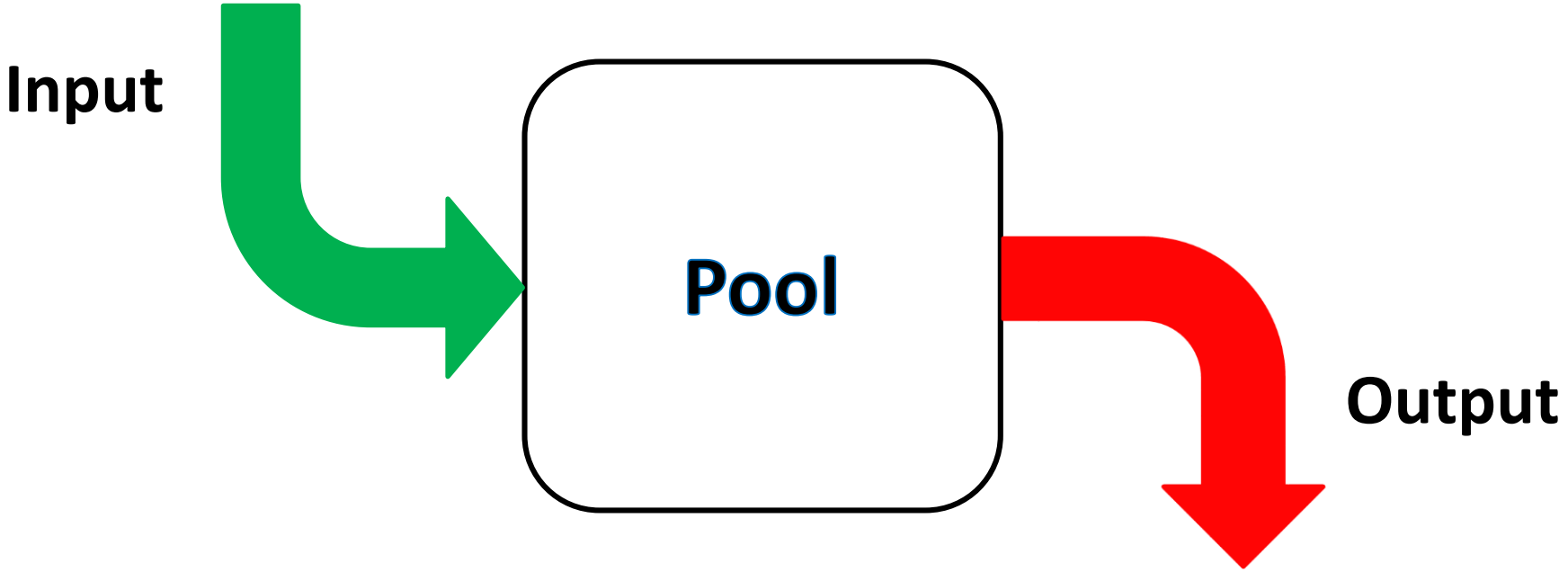
Unlike energy, nutrients do not come from outside the earth* and instead have to be recycled

We can describe nutrient cycles in terms of **pools** (where nutrients are stored) and **fluxes** (movement in and out of pools)

* Exception: meteorites (extremely rare)

Nutrient fluxes (movement) and pools

Terms not testable – but know when C and N are stored and how both C and N enters and leaves the food web.

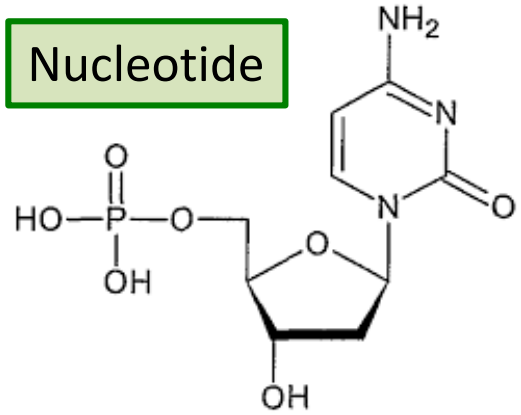


Amount of some element (e.g. N) in the pool depends on **flux** (input vs. output).

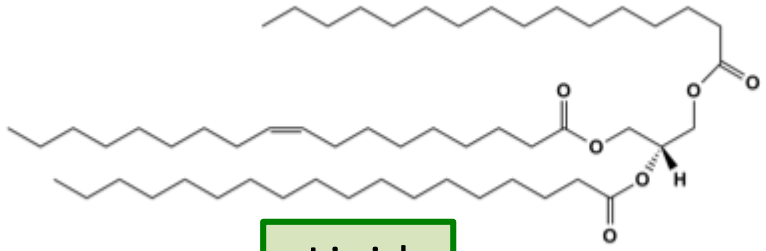
Carbon

- Essential nutrient that is required for growth and reproduction
- Basic building block of organic molecules

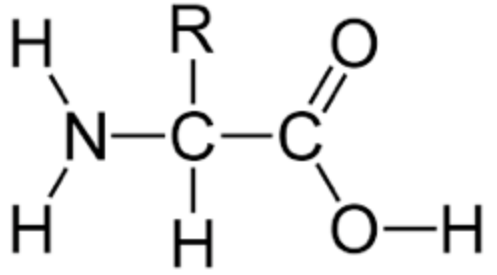
Nucleotide



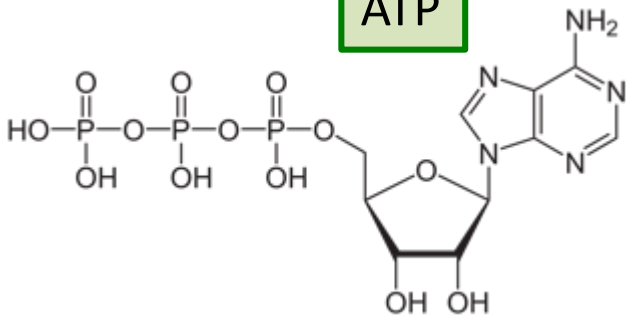
Lipid



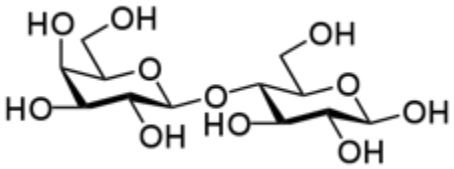
Amino acid



ATP

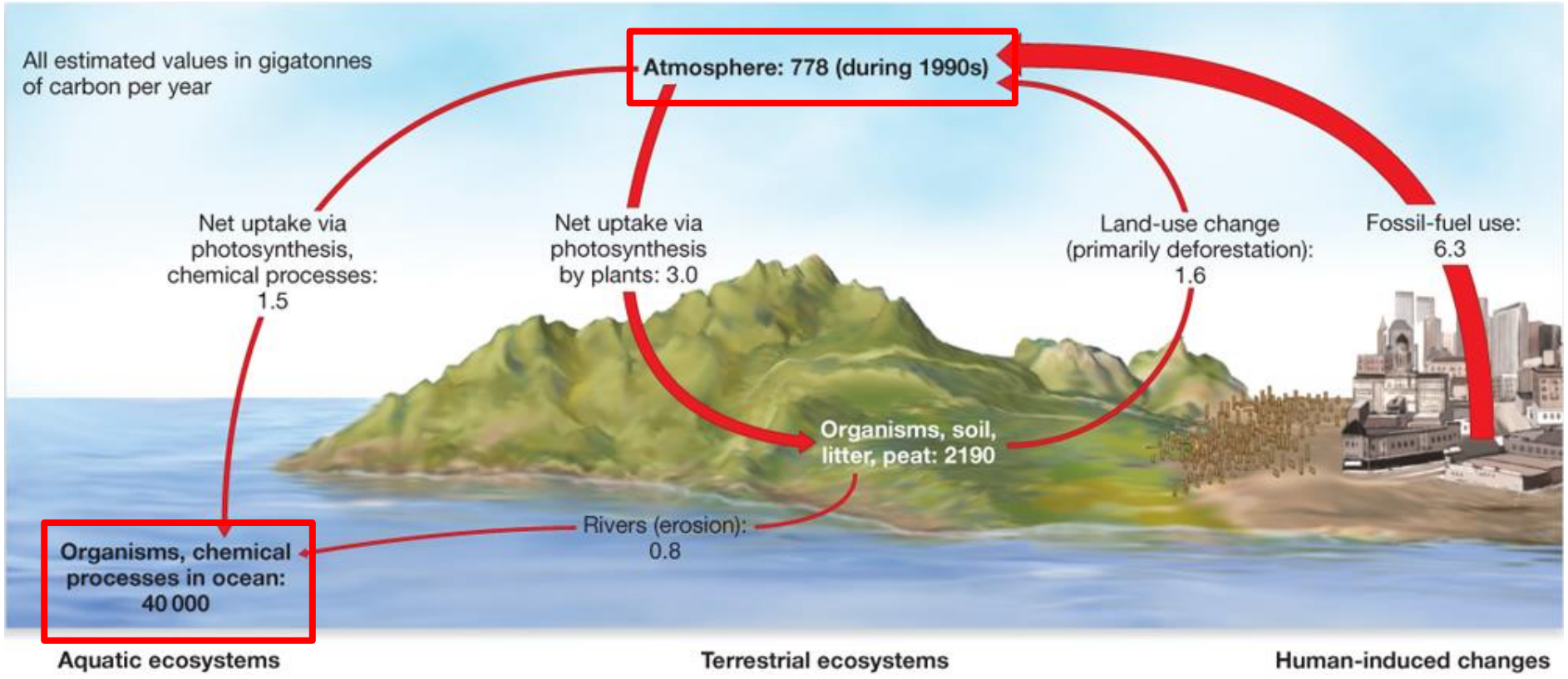


Sugar



Where is carbon **stored** (pool)?

Main reservoirs are in oceans and atmosphere
Soils, living organisms, and fossil fuels are also important pools of C



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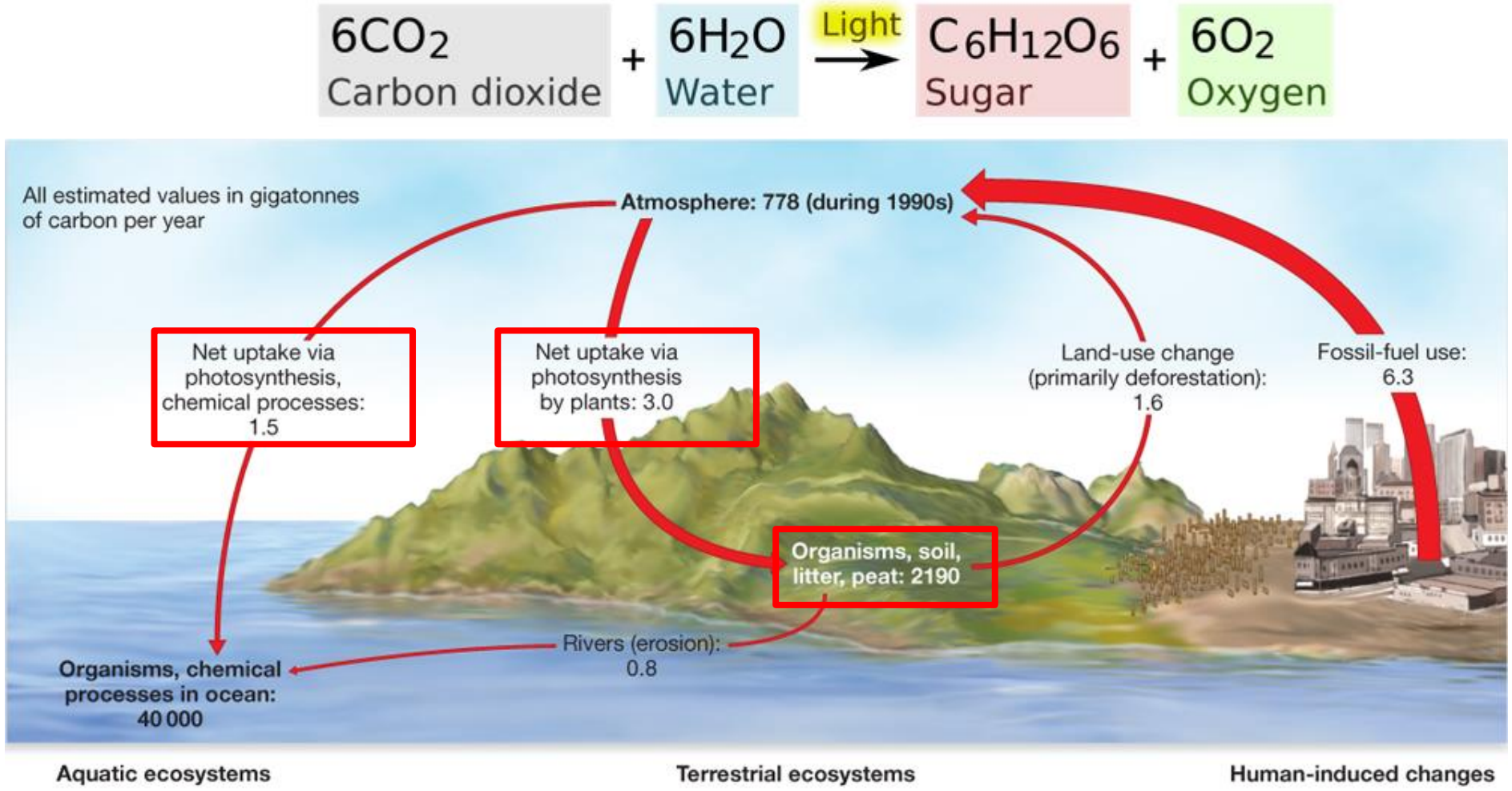
How does carbon enter **plants**?

C (CO_2)is captured by **plants** during photosynthesis, incorporated into organic molecules.



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How does carbon get into animals?

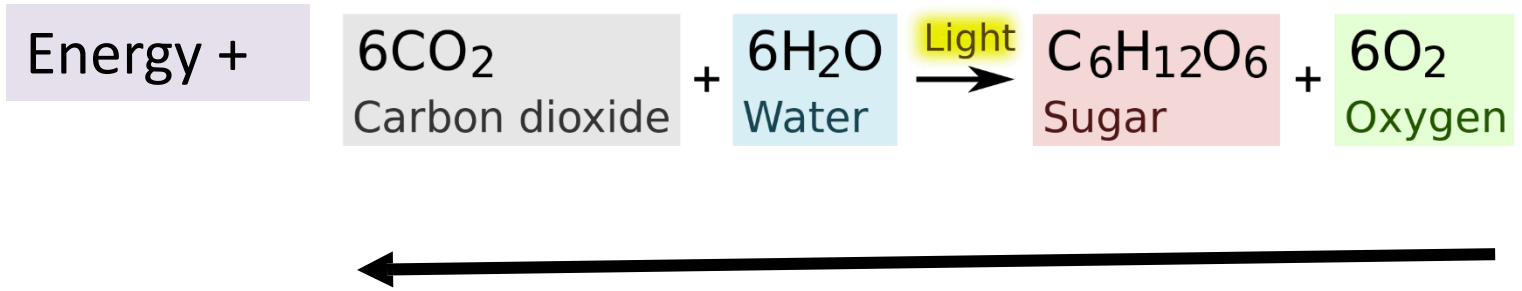
- Carbon is passed along the food chain/food web by consumers

https://rangerrick.org/ranger_rick/american-pikas/

How does carbon get back to the atmosphere?

- Cellular respiration

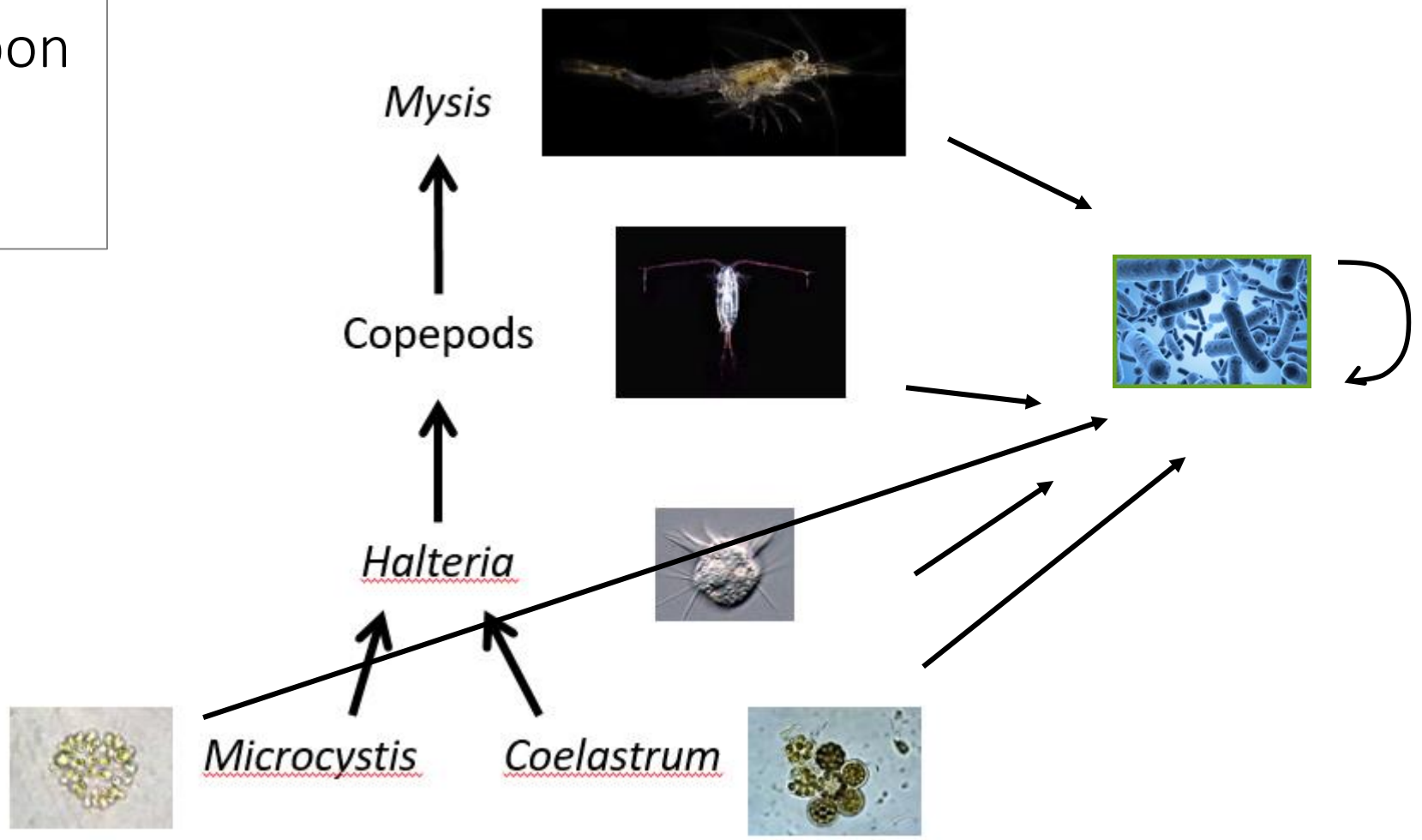
- Cellular respiration occurs in the cells of all living things: producers (autotrophs) and consumers (heterotrophs).



Formula is not testable

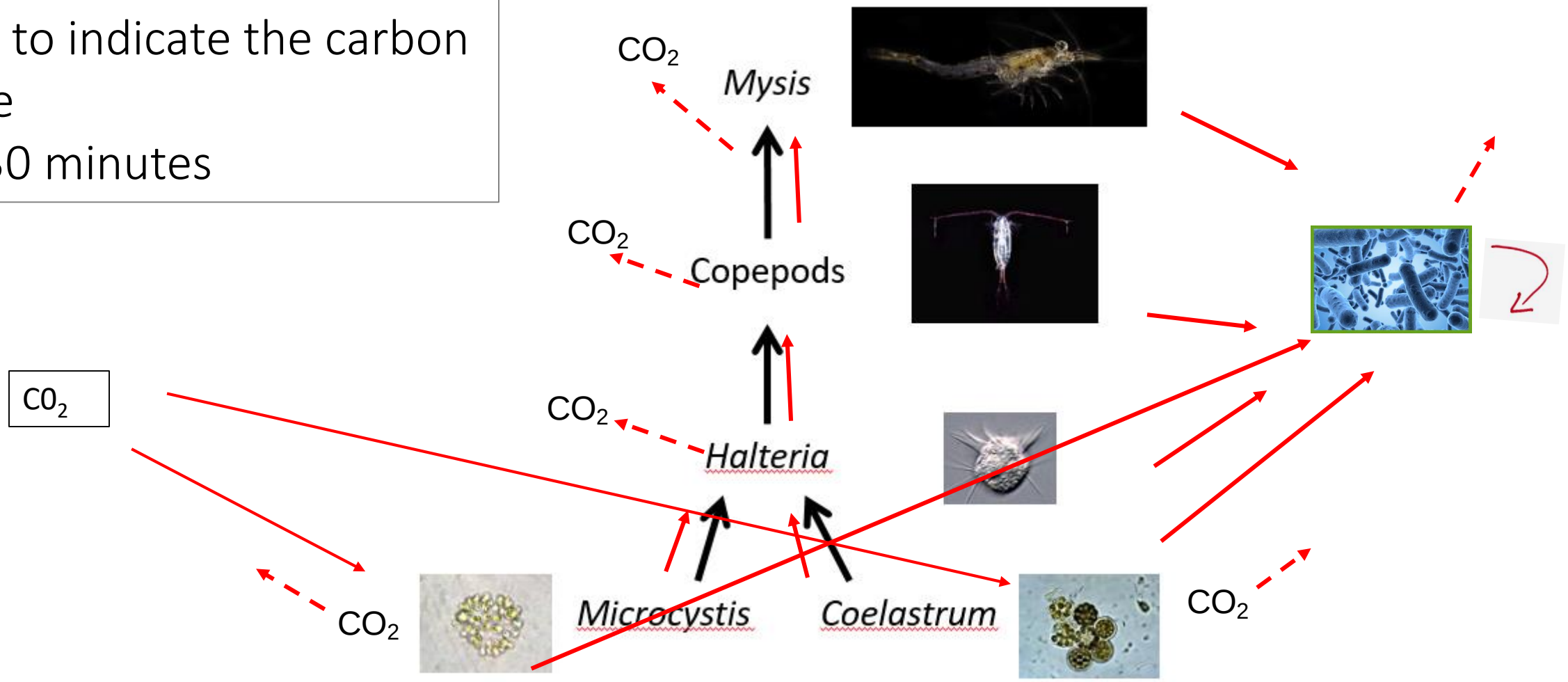
Carbon Cycle - Activity

Add arrows to this food web to indicate the carbon cycle
- 1:00 minute



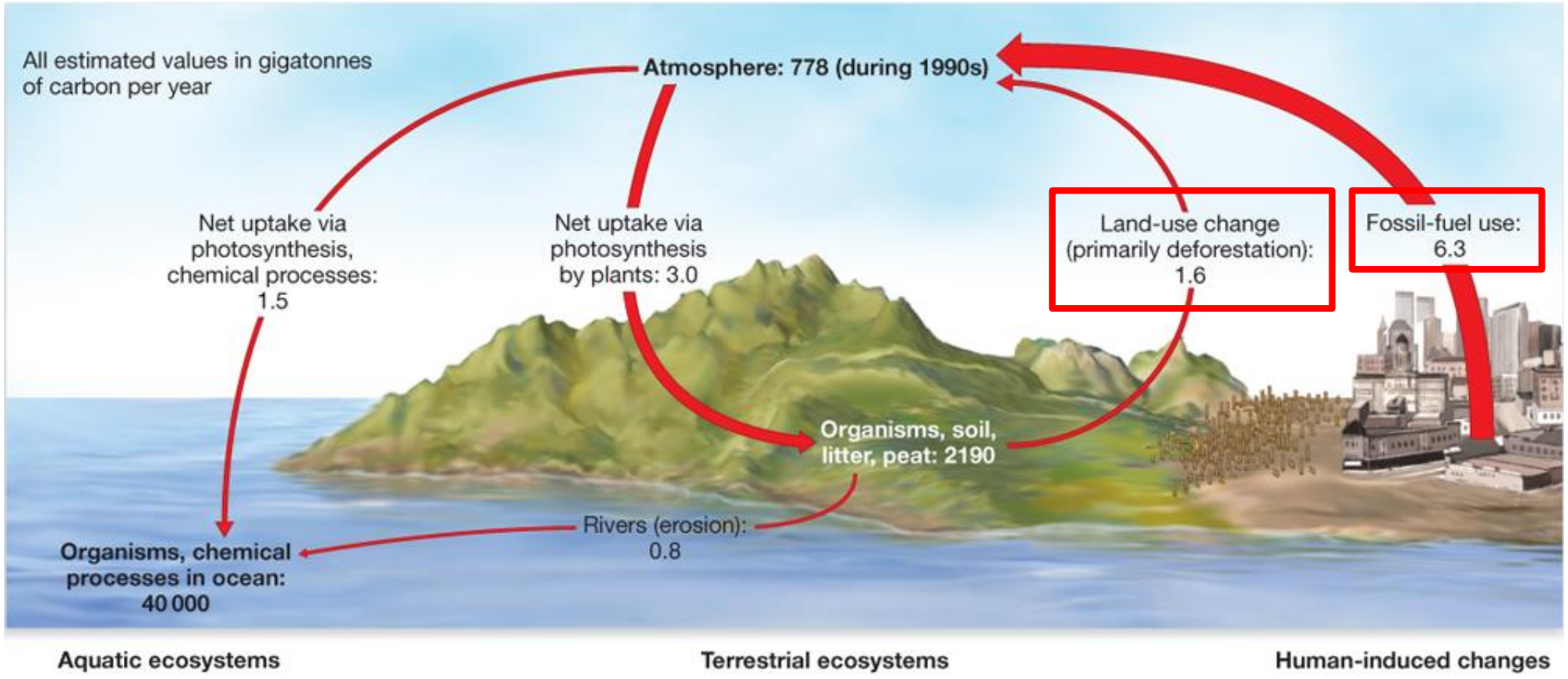
Carbon Cycle - Activity

Add arrows to this food web to indicate the carbon cycle
- 1:30 minutes



Impact of humans on carbon cycle

- Humans are also emitting carbon-based greenhouse gases to the atmosphere through deforestation and fossil fuel use



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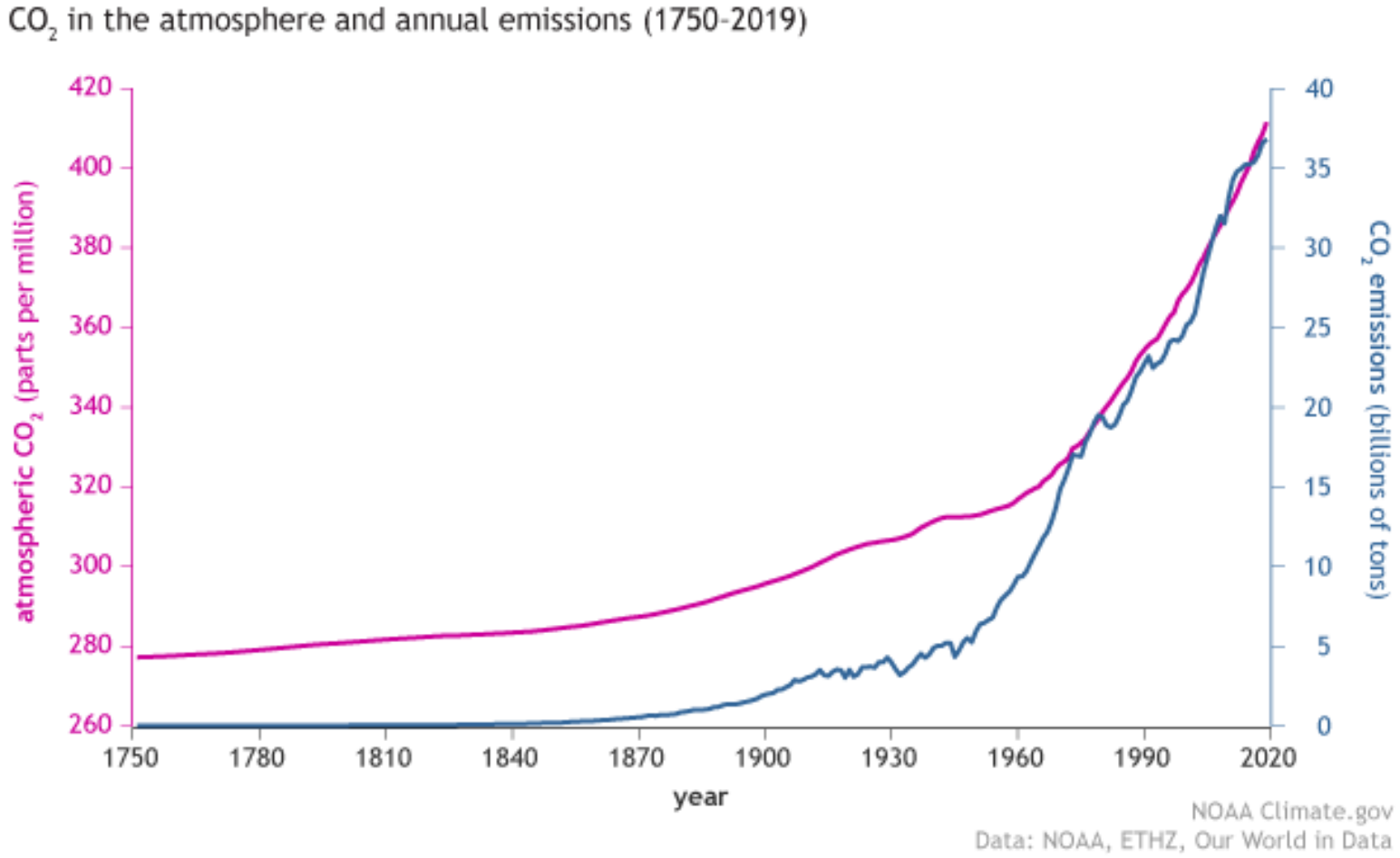
Atmospheric CO_2 has been increasing

https://news.climate.columbia.edu/2021/02/25/carbon-dioxide-cause-global-warming/



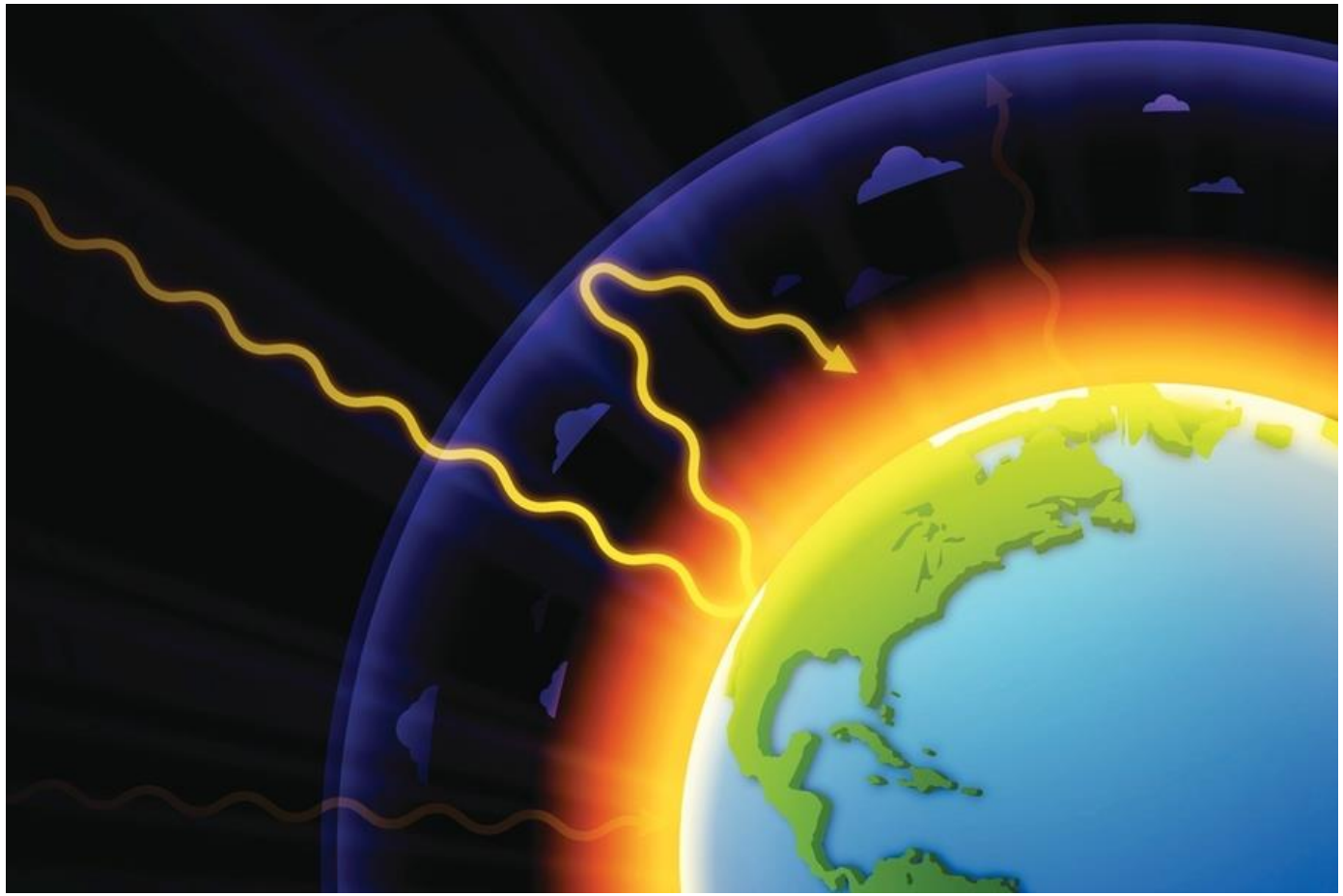
The amount of carbon dioxide in the atmosphere (raspberry line) has increased along with human emissions (blue line) since the start of the Industrial Revolution in 1750. Credit: NOAA Climate.gov

Carbon dioxide biggest contributor to human-caused climate change (not testable)

"Energy enters atmosphere as visible light and tries to leave as infrared radiation (700 to 1,000,000 nm wavelengths).

CO_2 absorbs energy at wavelengths between 2,000 and 15,000 nanometers" — a range that overlaps with that of infrared energy."

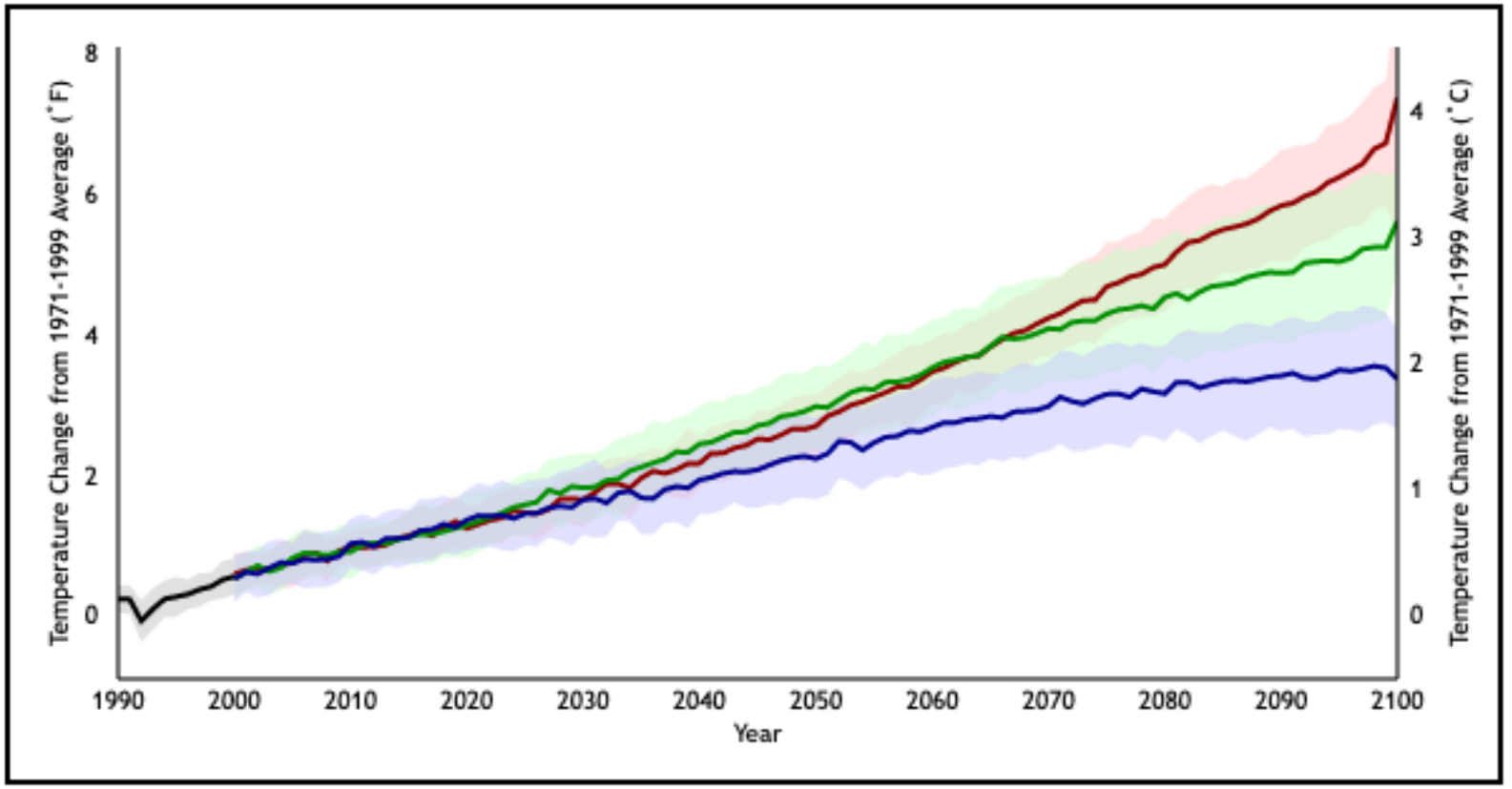
"As CO_2 soaks up this infrared energy, it vibrates and re-emits the infrared energy back in all directions. About half of that energy goes out into space, and about half of it returns to Earth as heat, contributing to the 'greenhouse effect.'"



https://news.climate.columbia.edu/2021/02/25/carbon-dioxide-cause-global-warming/

https://news.mit.edu/2017/explained-greenhouse-gases-0130

Predicted increases in temperature



NOAA- https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature-projections

Ocean acidification due to increasing [CO2]

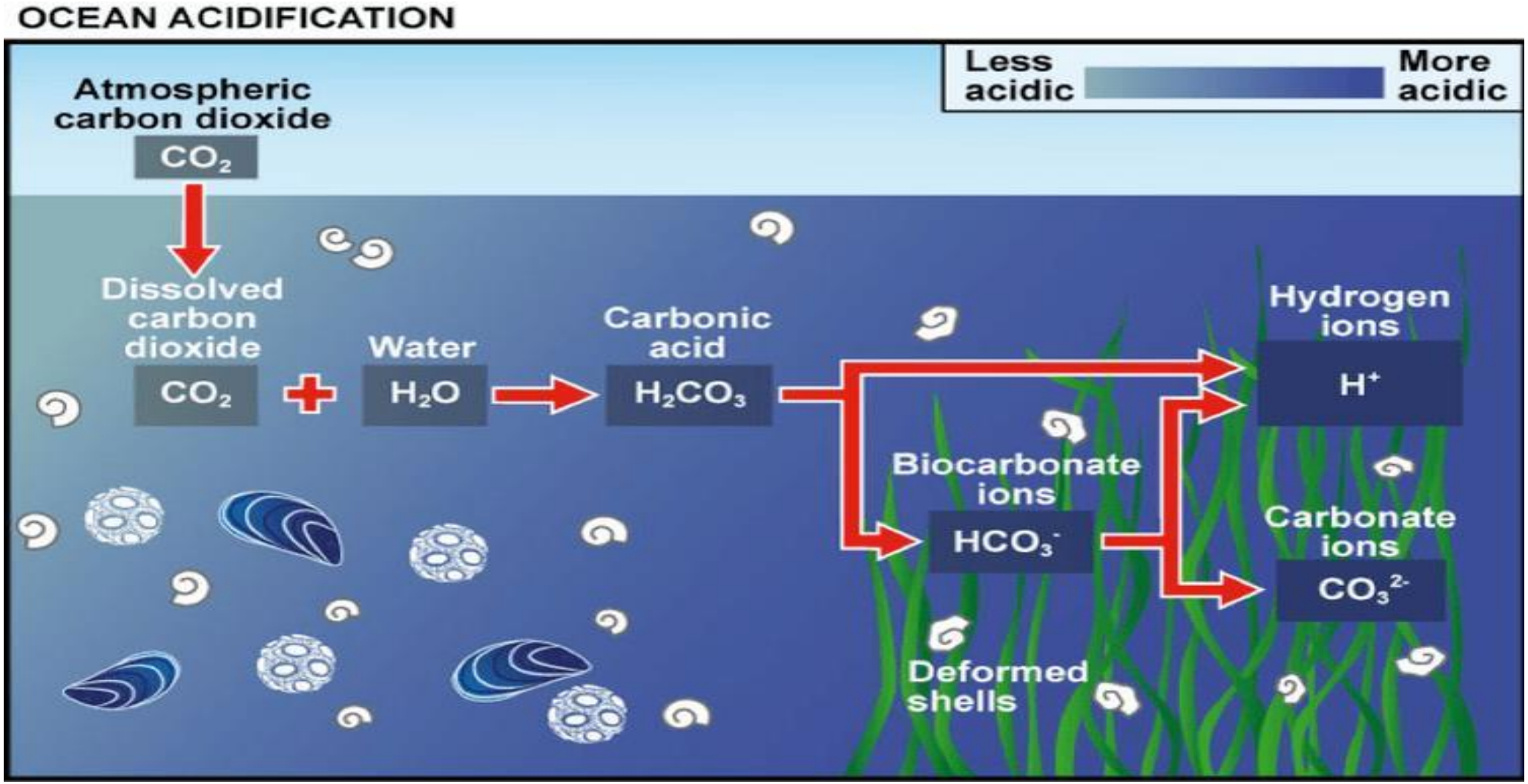


Image: https://oceanbites.org/more-intense-summer-to-winter-swings-in-oceanic-dissolved-co2/

Acidification of the ocean

The **left** hand side column shows normal oyster larvae (and their growing shells).

The **right** hand side column shows the damage to growing shells caused by the increasing acidity of ocean waters.

These weaker shells result in higher mortality rate in larval oysters.

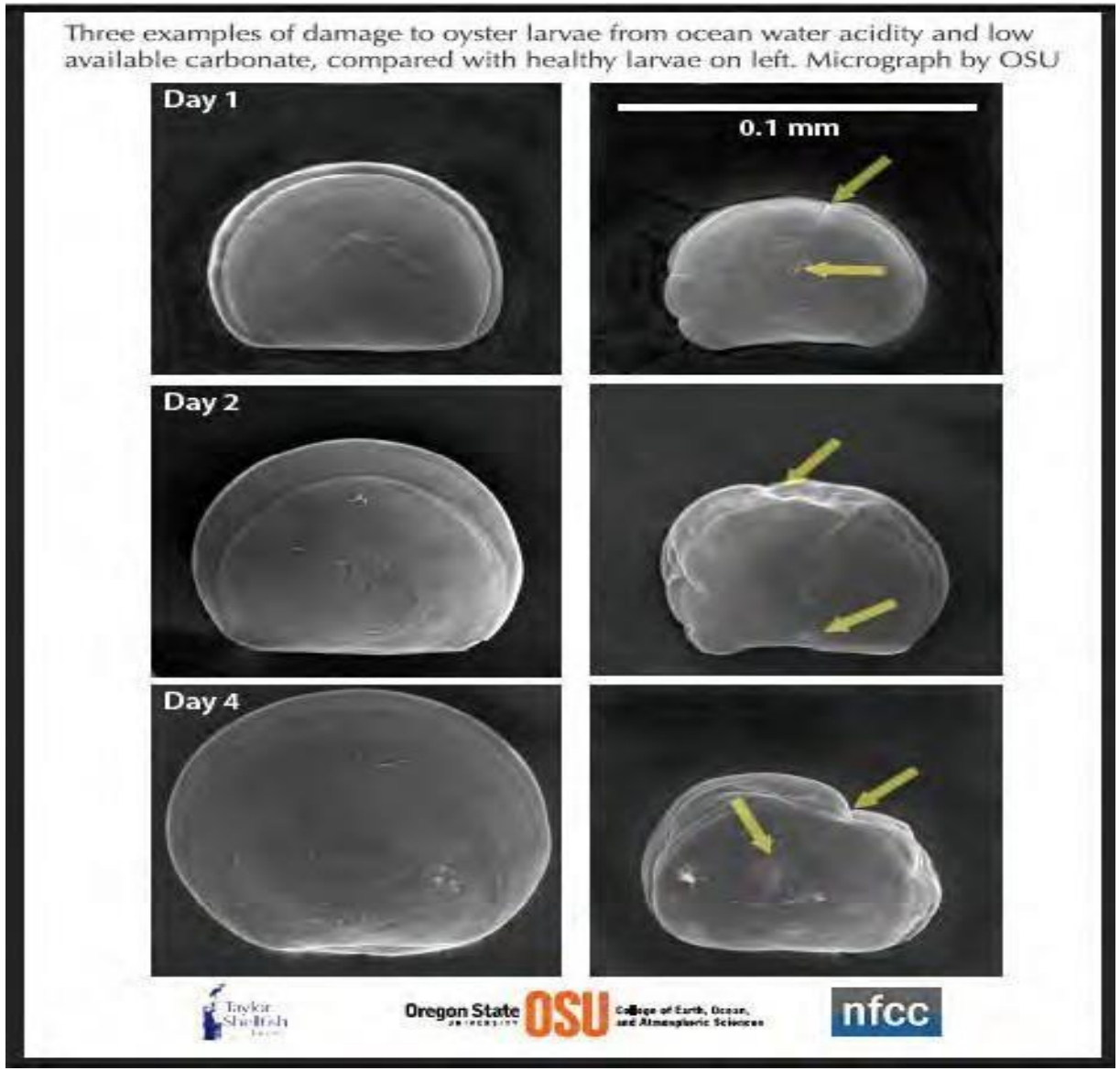
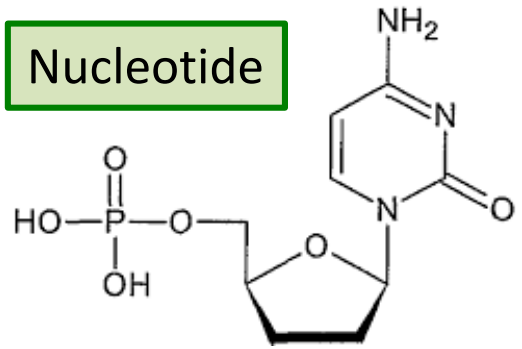


Image: Taylor Shellfish from OSU

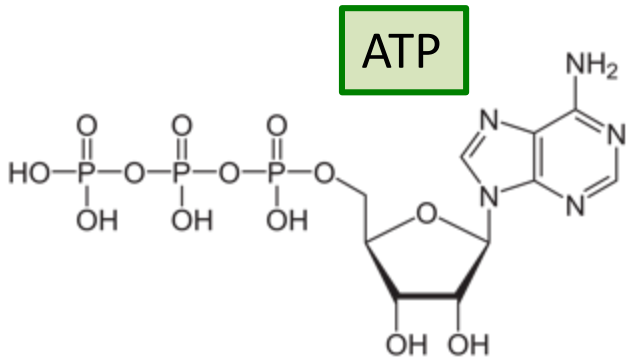
Nitrogen

- Essential nutrient that is required for survival and growth of all living organisms

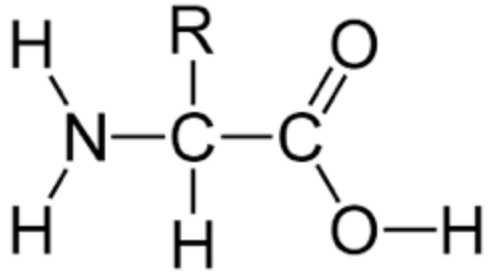
Nucleotide

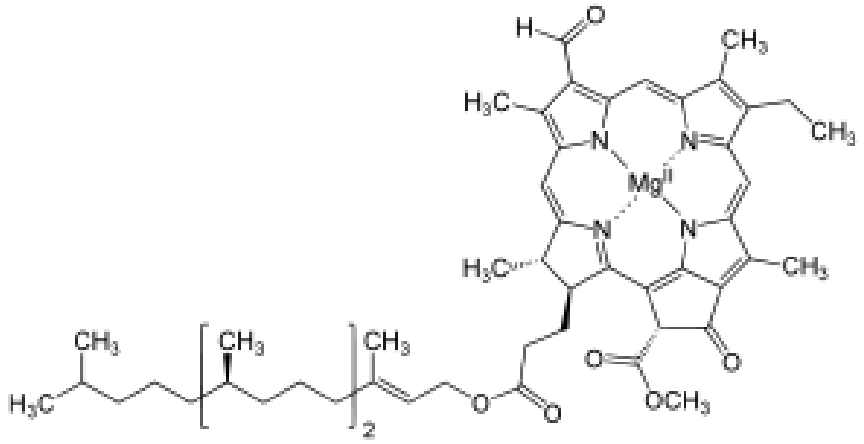


ATP



Amino acid



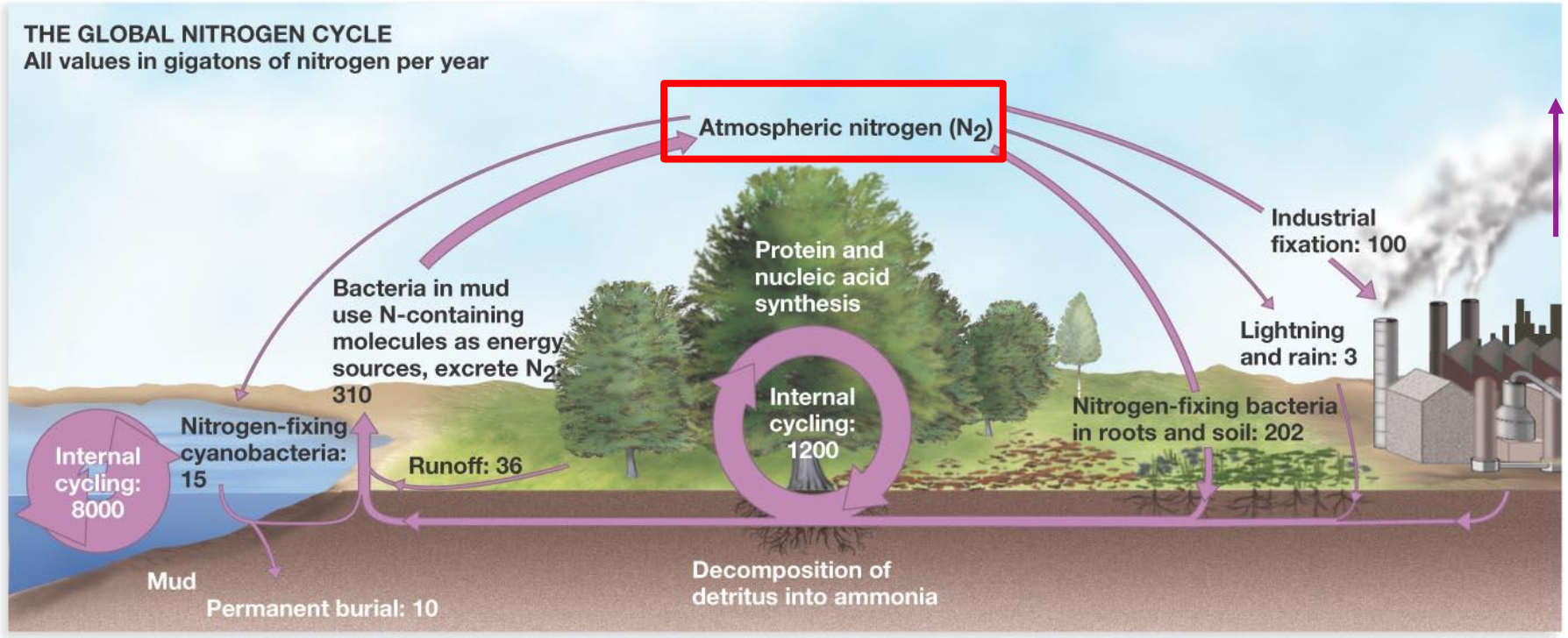


Chlorophyll – pigment that traps light for photosynthesis

Where is nitrogen **stored** (pool)?

Vast majority of nitrogen is stored in atmosphere as N_2 (~80% of atmosphere)

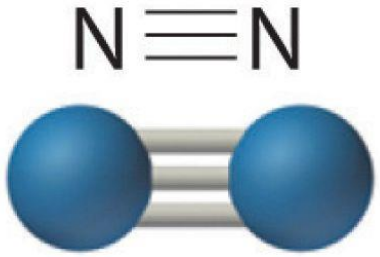
Soils, oceans, and living organisms are also important pools of N



Nitrogen – a limiting factor

Atmospheric nitrogen (N_2, di-nitrogen) is largely inaccessible by most organisms.

Why: Triple bond takes a lot of energy to break



https://socratic.org/questions/568dc3297c014929be837991

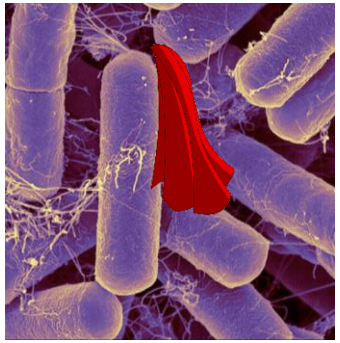
Plants and animals cannot break these bonds.

Consequently, nitrogen is a scarce resource, and often limits primary productivity in many ecosystems.

Recall - NPP = rate at which solar energy is stored as biomass by producers

Limiting factor (testable): a factor that limits the growth, abundance, or distribution of individuals and/or populations (e.g. food or nutrient limitation, pollutants, environmental catastrophes)

How does atmospheric nitrogen become biologically available?



Nitrogen fixation & Nitrification

- Both processes require certain **bacteria**

Nitrogen fixation

= a process where N_2 is converted into NH_3 (ammonia) – a biologically available form

Nitrification

= a process where NH_3 is converted to nitrites (NO_2) and then nitrates (NO_3) – also biologically available forms.

Nitrogen fixation

Some nitrogen-fixing bacteria are free-living in the soil or ocean while others form a symbiotic relationship with plants.

Nitrogen-fixing bacteria have an enzyme – nitrogenase - which catalyzes the reaction to convert N_2 to NH_3^+ - not testable

Rhizobium nitrogen-fixing bacteria on a clover plant root

Frankia nodules in red alder roots

wikicommons

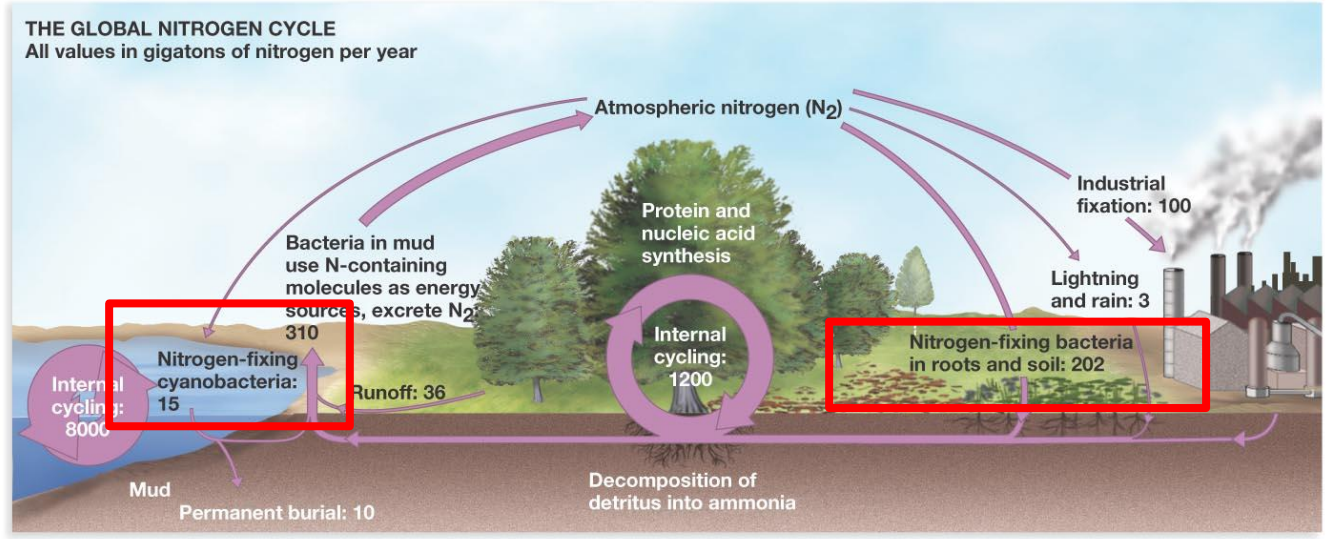
https://today.oregonstate.edu/news/nitrogen-fixing-trees-%E2%80%9Ceat%E2%80%9D-rocks-play-pivotal-role-forest-health

How does nitrogen enter **plants** without symbiotic bacteria?

Nitrogen-fixing bacteria in the soil (or water), including:

- Free-living nitrogen-fixing bacteria that convert gaseous nitrogen to ammonia
- Nitrifying bacteria that convert ammonia to nitrites and nitrates; and
- Decomposing bacteria that breakdown dead organic material/tissues into basic components

Plants can uptake biologically available nitrogen via their roots



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How does nitrogen enter animals?

Plants eaten by primary consumers (e.g. Bear 148 below) – nitrogen forms part of consumer tissues….. then passed along food chain/web.

Nom, nom, nom

Other components of the nitrogen cycle

1. Already addressed the point that when plants and animals die, their tissues are decomposed by decomposing bacteria, which releases nitrogen back into the ecosystem in a usable form.

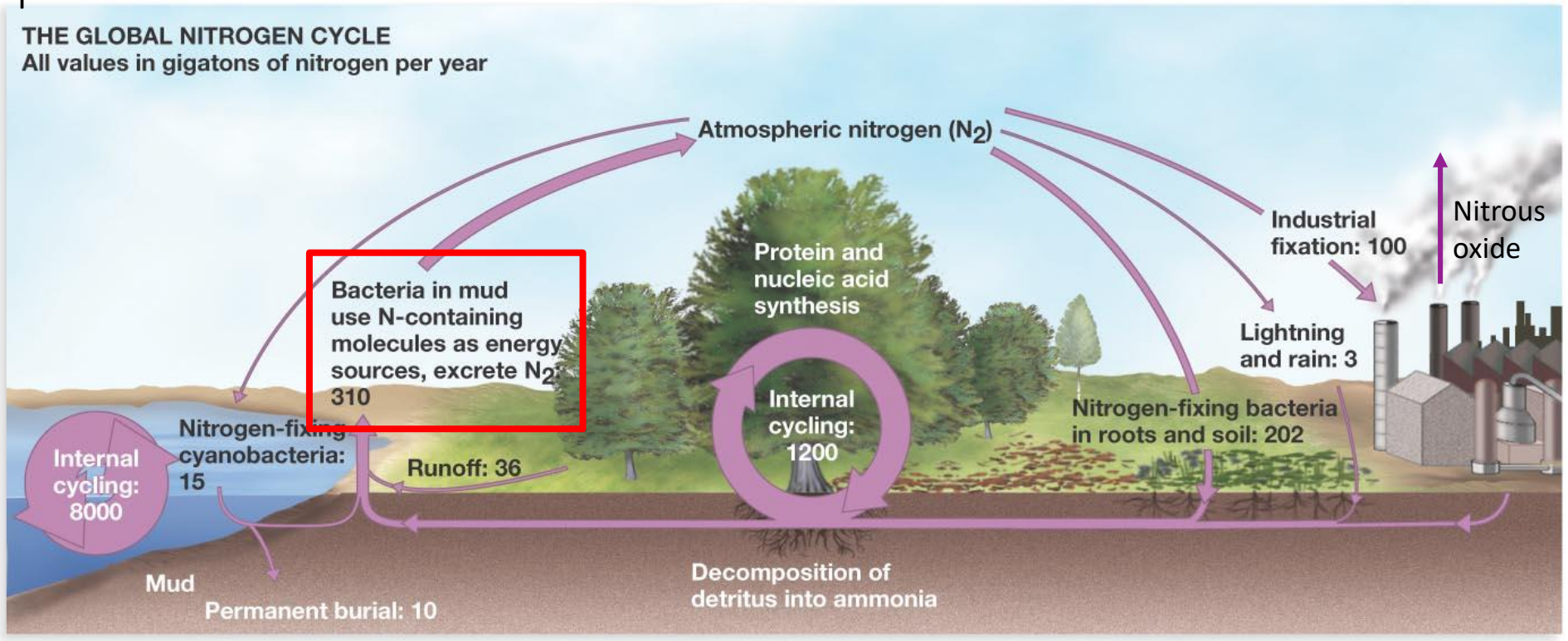
2. Also, when animals pee or poop, they release nitrogen into the environment in a usable form (e.g. urea)

How does nitrogen return to the **atmosphere**?

Denitrification

- a process that converts nitrates to nitrogen gas

Denitrifying bacteria strip O from NO_3^- (nitrates) and NO_2^- (nitrites) and release N_2 back to atmosphere



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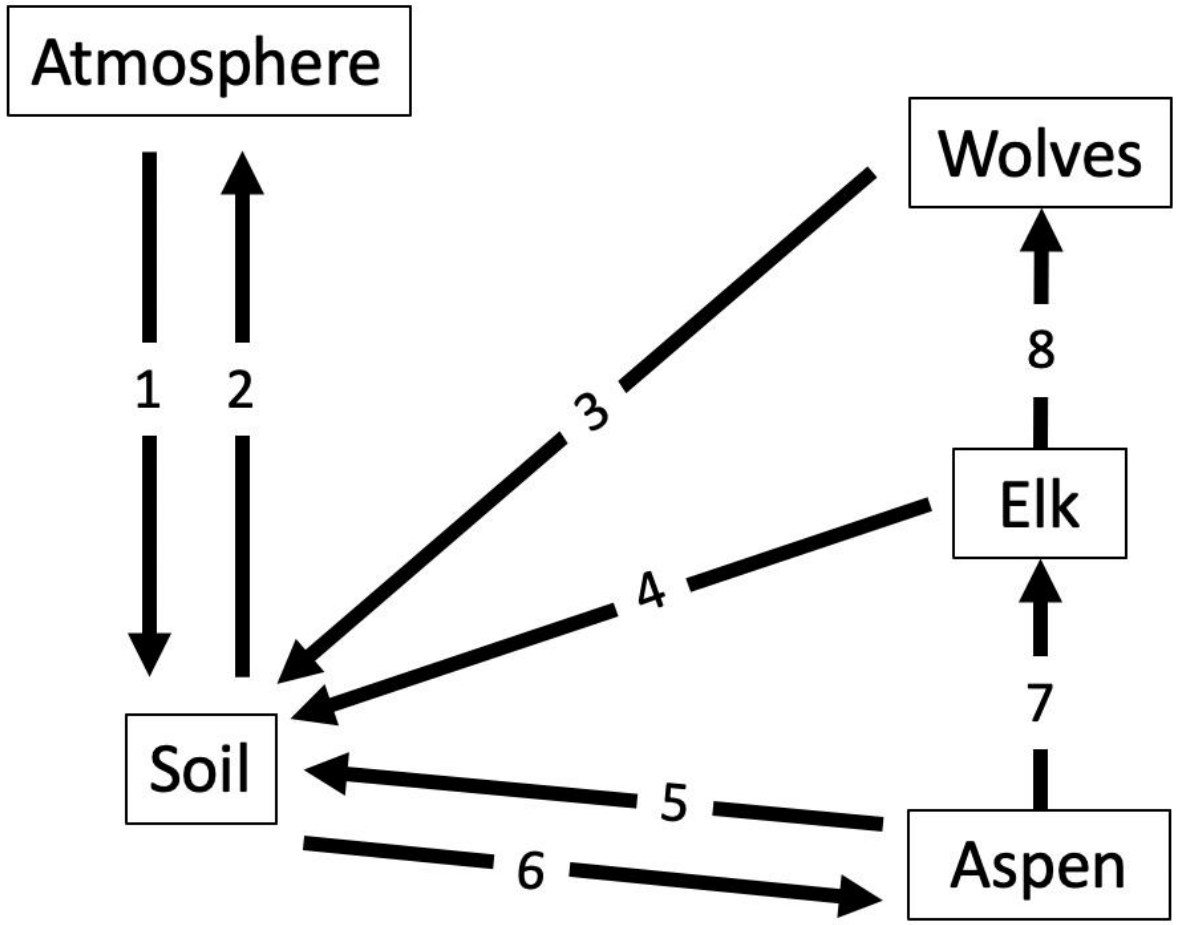
iClicker Question – Nitrogen cycle

Which process is happening at arrow 6?

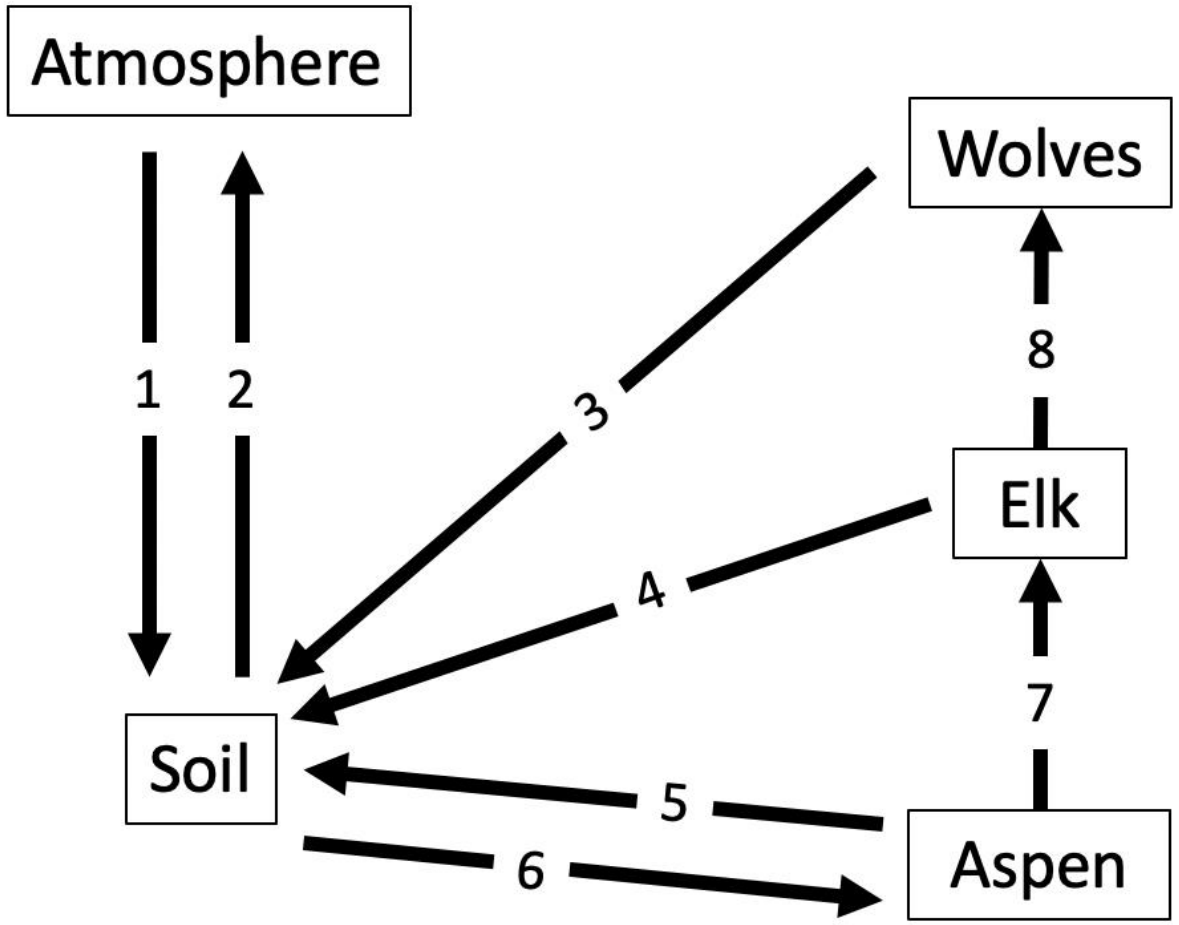
A. Denitrifying bacteria strip oxygen from NO_2 and NO_3 to produce N_2
B. The flow of usable nitrogen from primary consumer to secondary consumer.
C. The flow of atmospheric nitrogen to nitrogen-fixing bacteria and/or nitrifying bacteria.
D. The flow of usable nitrogen (NH_3, NO_2, NO_3) from soil to the roots of producers.
E. The process of decomposition



Answer

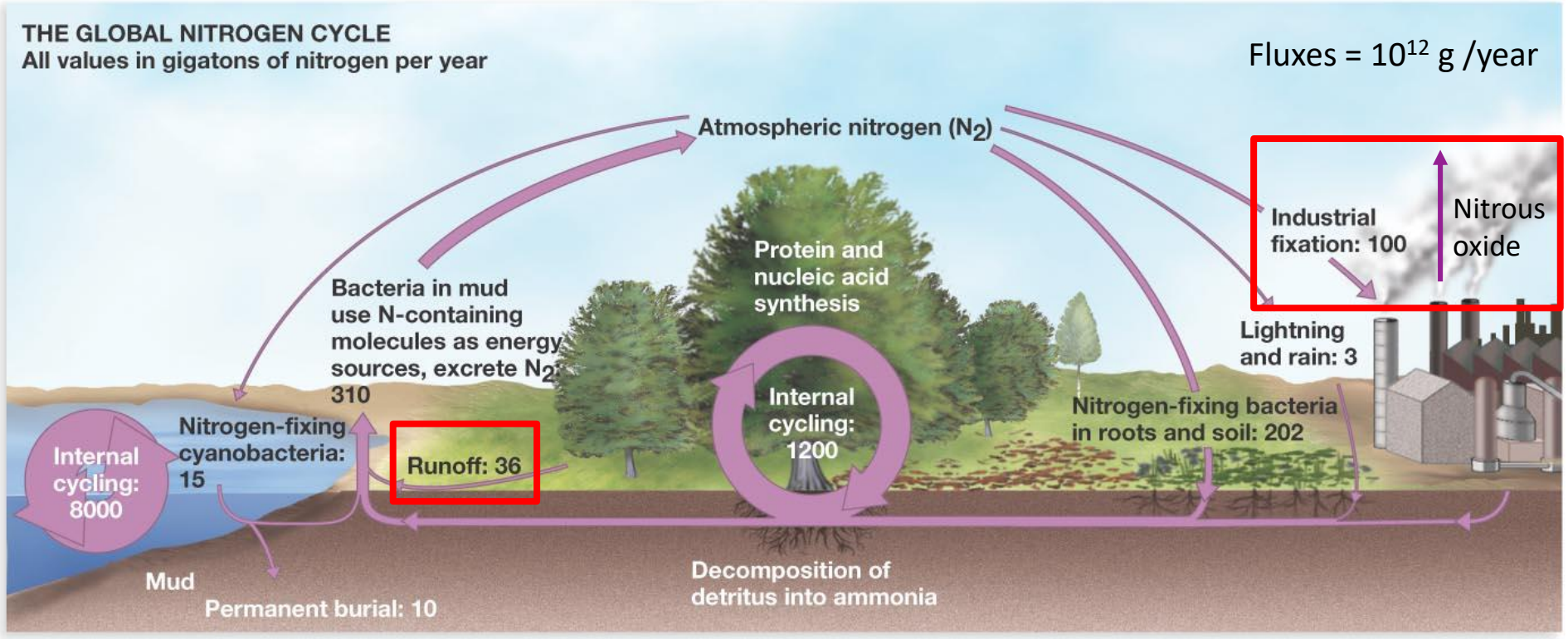
Which process is happening at arrow 6?

A. Denitrifying bacteria strip oxygen from NO_2 and NO_3 to produce N_2
B. The flow of usable nitrogen from primary consumer to secondary consumer.
C. The flow of atmospheric nitrogen to nitrogen-fixing bacteria and/or nitrifying bacteria.
D. The flow of usable nitrogen (NH_3, NO_2, NO_3) from soil to the roots of producers.
E. The process of decomposition



Humans are disrupting the nitrogen cycle

- Human activity has doubled the amount of global nitrogen fixation, e.g. converting N_2 to biologically available forms for fertilizer. (not testable)
- It is estimated that by 2030, the amount of nitrogen fixed by human activities will exceed that of microbial processes. (not testable)
- This has increased the amount of biologically available nitrogen in ecosystems.



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One ecological implication on this disruption to the nitrogen cycle

Excess nitrate is getting into water ways as a result of runoff from agricultural areas.

This is resulting in eutrophication of water bodies. Eutrophication = gradual increase in nitrogen (and other nutrients) in aquatic ecosystem.

Why is this a problem? Recall – nitrogen is an essential nutrient for plant function (e.g. production of chlorophyll, which traps sunlight for photosynthesis, and a key component of amino acids, which are the building blocks of proteins).

Consequently, nitrogen availability is typically a limiting factor in many ecosystems, i.e. limits primary productivity in ecosystems **(i.e. rate at which solar energy is stored as biomass by producers per unit of time.)**

One ecological implication on this disruption to the nitrogen cycle

The addition of nitrogen due to human activities has lead to excessive plant and algae growth due to increased availability of nitrogen.

Decreased diversity

Along the coast of Florida – eutrophication of coastal areas has lead to algae blooms

www.surfrider.org/coastal-blog/entry/floridas-toxic-algae-crisis

The algae block the sunlight from reaching the sea grasses.
With insufficient light for photosynthesis, the sea grasses died.

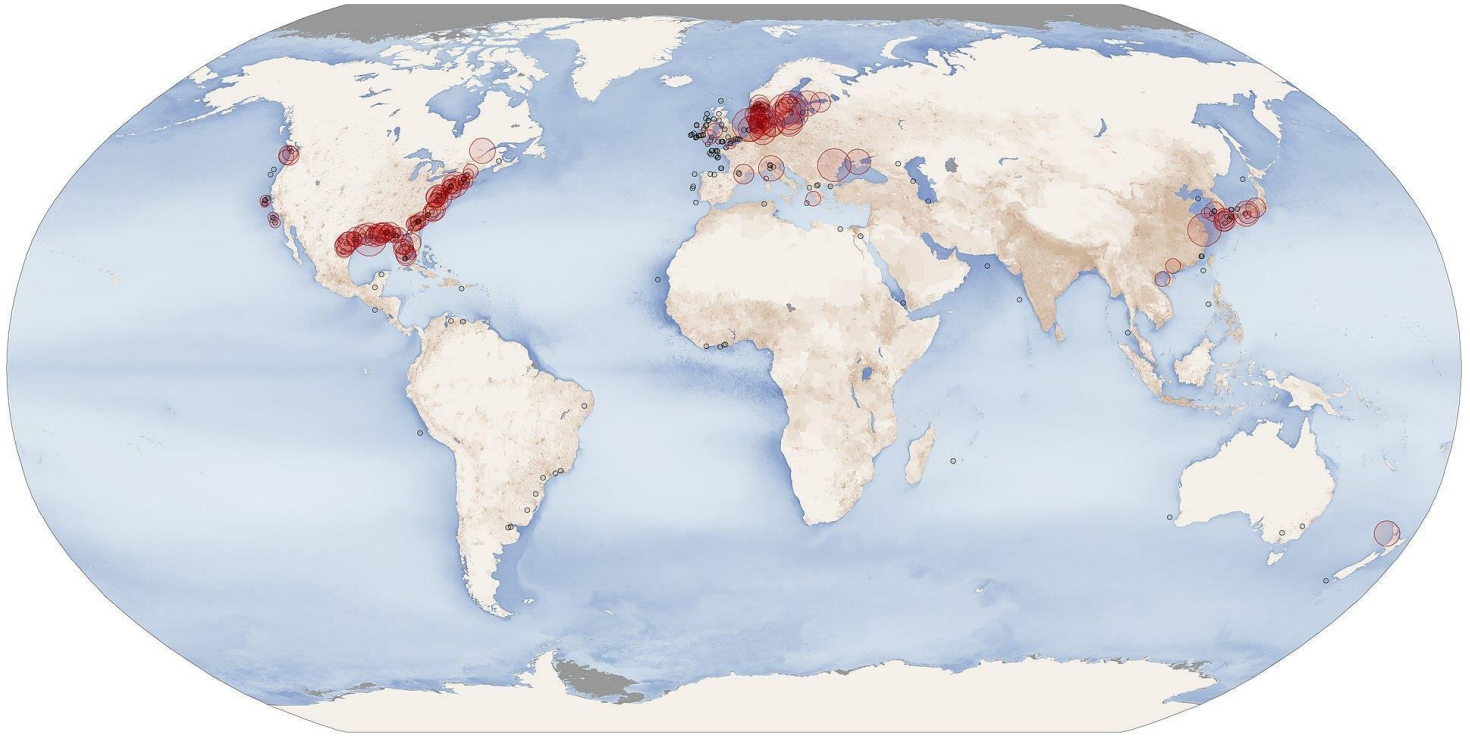
Manatees, which rely upon sea grasses for their diet, are starving to death.

It is estimated that > 1,000 manatees in Florida this year alone.

Manatees are a threatened species.

Dead zones created by nitrogen fertilizer runoff

https://en.wikipedia.org/wiki/Dead_zone_(ecology)#/media/File:Aquatic_Dead_Zones.jpg



1. Excess growth of producers due to increase nitrogen availability
2. Producers will ultimately die at the end of their lifespan.
3. Decomposers consume the dead plants and algae, using lots of oxygen (creates hypoxic environment).
4. Fish and other animals run out of oxygen and die.

Learning Goals: Nutrient Cycling

- Be able to:
  - Describe how nutrients (nitrogen & carbon) move through a food web/ecosystem.
  - Predict the consequences of changes to the system at the species and ecosystem levels.
- Understand the concept of a limiting factor

  e.g. how an abiotic factor (e.g., a nutrient) may or may not limit the abundance, distribution and/or growth of an population.

Nutrient cycling in the **Great Bear Rainforest**

The Great Bear Rainforest

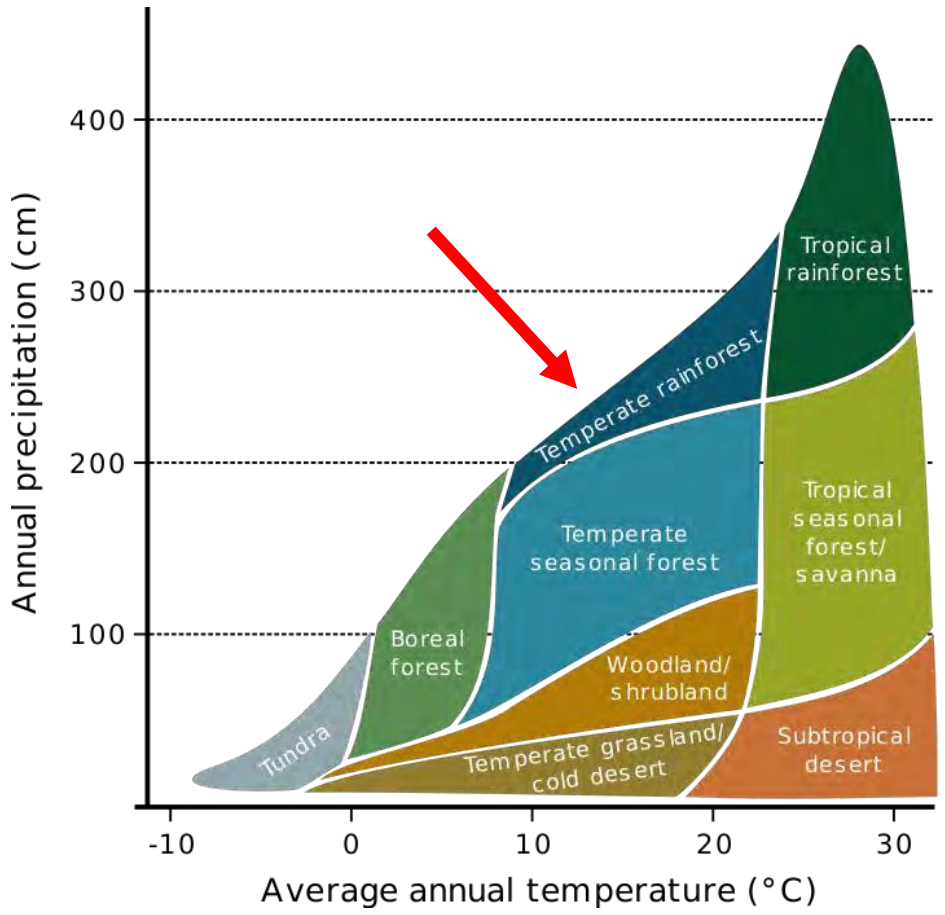
BC's Great Bear Rainforest boasts…

- The greatest biomass per unit area on earth
- Highest density of bears on earth
  > 3 bears / km^2 (Ontario = 0.6 bears/km^2)
- High biodiversity
  Including spirit bears!
- One of the largest remaining intact temperate rainforests

Why is the GBRF so productive?

In part – because of lots of precipitation and modest temperatures

Another reason – **marine nitrogen**.



Dr. Tom Reimchen's research

Dr. Reimchen (University of Victoria) investigated the source of nitrogen in Great Bear rainforest trees using stable isotope analysis*

Two stable isotopes of nitrogen: ^{14}N and ^{15}N

- 99.6337% of atmosphere is ^{14}N
- 0.3663% is ^{15}N

Dr. Tom Reimchen, UVic

Two of Dr. Reimchen's study sites: the watersheds around the Clatse and Neetkas rivers near the Heiltsuk First Nations village of Bella Bella.

* This technique not testable

Dr. Tom Reimchen's research

Dr. Reimchen took more than >550 cores of trees and identifying the isotope signature of the nitrogen…

It was discovered that up to 55% of nitrogen in trees was ^{15}N.
But it should have been almost undetectable due to the low concentrations in the air.

* This technique not testable

Dr. Reimchen's research

Dr. Reimchen hypothesized that the ^{15}N came from salmon that have tissues high in this isotope.

In the marine ecosystem, nitrogen isotopes become more concentrated at higher trophic levels (not testable)

In the air: $^{15}\delta N = 0‰$
Ocean Water $^{15}\delta N > 0‰$
Marine Algae (producers): $^{15}\delta N$ ~2-5 ‰
Animals that eat phytoplankton (1° consumers): ($^{15}\delta$ ~2-10 ‰)
Salmon (4° trophic level): $^{15}\delta N$ ~11.2‰ - 12.3‰

$^{15}\delta N$ is a measure of the amount of ^{15}N relative to air

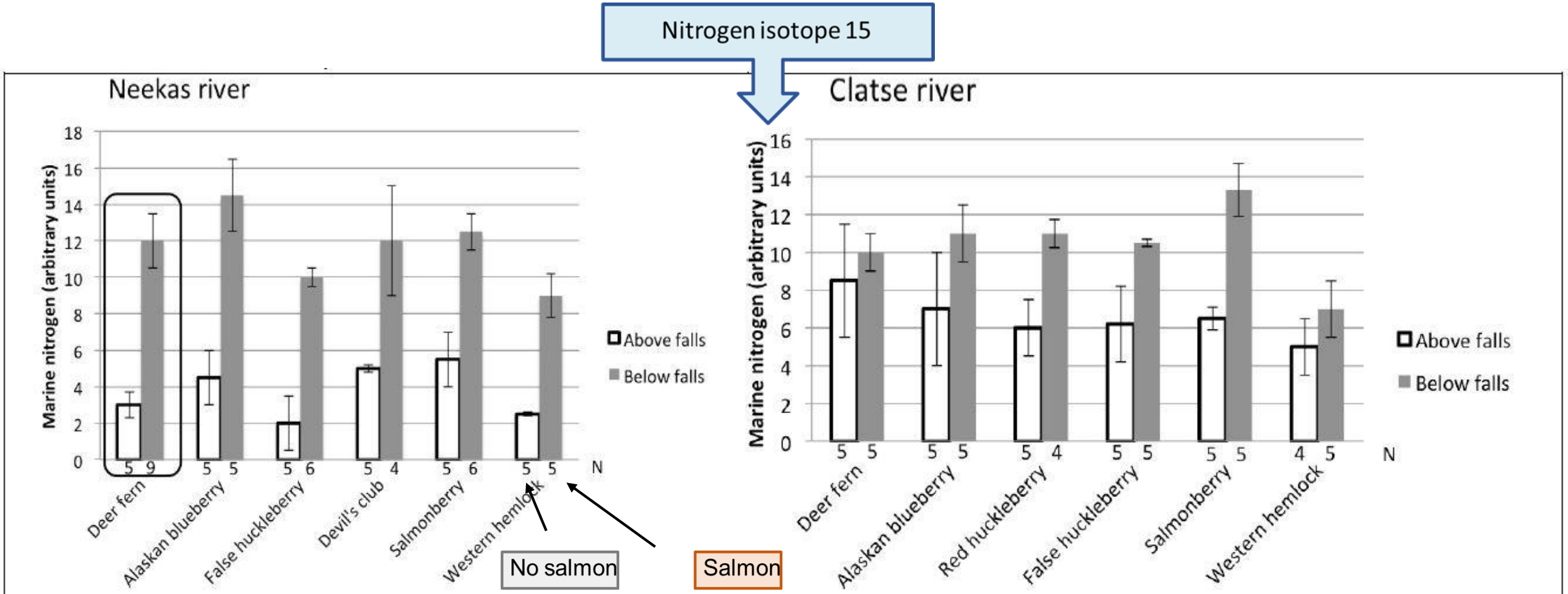
This claim would make sense if the salmon's body was close to the base of a tree. Detritivores and decomposers would break down the body of the salmon, and the tree could uptake the nitrogen.

https://watershedwatch.ca/where-to-see-salmon-spawning/

Dr. Reimchen's research

Dr. Reimchen took measurements of nitrogen isotopes (N14 and N15) from plants above and below the falls on two rivers in his study site to determine if these is a relationship between salmon abundance and the amount of marine nitrogen (N15) levels in vegetation.

Dr. Reimchen's data. Do you see a relationship between salmon abundance and marine nitrogen levels? Discuss for one minute.



Note: The waterfalls act as a barrier to salmon; salmon are found below, but not above the falls.

Modified from Mathewson et al. (2003)

Is there a relationship between salmon abundance and the amount of marine nitrogen levels in vegetation adjacent to rivers?

Example answer 1:

- Yes.
- Since the waterfalls act a barrier to salmon, vegetation below the fall is more likely to have access to salmon nitrogen than the vegetation above the fall. The vegetation below the fall has higher marine nitrogen than the vegetation above the fall.

Would you give this answer a passing mark?

A. Yes
B. No
C. Not sure

Is there a relationship between salmon abundance and the amount of marine nitrogen levels in vegetation adjacent to rivers?

Example answer 1:

- Yes.
- Since the waterfalls act a barrier to salmon, vegetation below the fall is more likely to have access to salmon nitrogen than the vegetation above the fall. The vegetation below the fall has higher marine nitrogen than the vegetation above the fall.

This answer would not receive a passing mark.
Claim is very incomplete
Evidence not quantified
Reasoning incomplete

Is there a relationship between salmon abundance and the amount of marine nitrogen levels in vegetation adjacent to rivers?

Example answer 2:

- Yes, there is a relationship between salmon abundance and the amount of marine nitrogen in vegetation adjacent to rivers.
- Waterfalls in rivers can be a barrier to salmon. While vegetation below the fall has access to salmon nitrogen, the vegetation above the fall likely has no access to salmon nitrogen. Of all 6 species of plants sampled in both Neekas and Clatse rivers, plants below the fall have higher marine nitrogen than those above the fall.
- Therefore, there is a relationship between salmon abundance and the amount of marine nitrogen in the vegetation adjacent to rivers.

Would you give this answer full marks?

A. Yes
B. No
C. Not sure

Is there a relationship between salmon abundance and the amount of marine nitrogen levels in vegetation adjacent to rivers?

Example answer 2:

- Yes, there is a relationship between salmon abundance and the amount of marine nitrogen in vegetation adjacent to rivers.
- Waterfalls in rivers can be a barrier to salmon. While vegetation below the fall has access to salmon nitrogen, the vegetation above the fall likely has no access to salmon nitrogen. Of all 6 species of plants sampled in both Neekas and Clatse rivers, plants below the fall have higher marine nitrogen than those above the fall.
- Therefore, there is a relationship between salmon abundance and the amount of marine nitrogen in the vegetation adjacent to rivers.

Better answer than #1, but would not receive full marks.
Good claim
Evidence – still not quantified
Reasoning - better but still incomplete – missing some logical steps, e.g. what is the relationship between these two variables?

Example answer 3 (best answer):

- Yes, there is a relationship between salmon abundance and the amount of marine nitrogen in vegetation adjacent to rivers.
- Waterfalls in rivers can be a barrier to salmon. While vegetation below the falls has access to salmon nitrogen, the vegetation above the fall likely has no access to salmon nitrogen. Of all 6 species of plants sampled in the Neekas River, plants below the falls contain higher marine nitrogen levels (8 -14 units) compared to the same species above the fall (2 – 6 units). The same pattern is observed in plants sampled in Clatse river with 7-13 units of marine nitrogen in plants below the falls compared to only 5-8 units above the falls.
- Therefore, there is a positive relationship between salmon abundance and the amount of marine nitrogen in the vegetation adjacent to rivers with greater amounts of marine nitrogen in plants where salmon are present compared to sites where salmon are not present.
- Assume your readers have no access to all the information available to you and write to convince them of your position/answer.

Plant growth

Dr. Reimchen also measured the width of tree rings from >550 trees near streams with waterfalls VS streams without waterfalls

Each tree ring represents one year of tree growth.

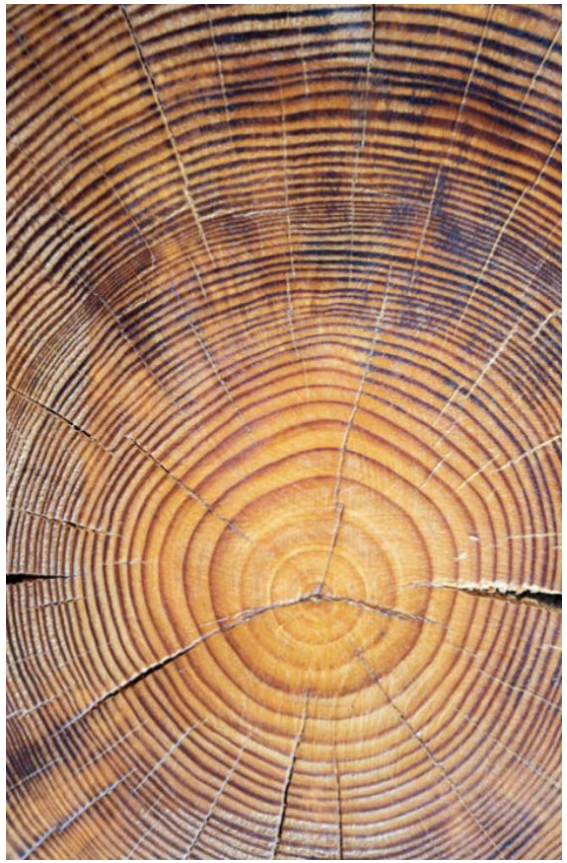
Wider rings = more tree growth

Areas with waterfalls (block salmon): rings < 1 mm wide

Areas without waterfalls (salmon): rings ~ 2.5 mm wide (more than twice as much growth)

Pattern was found up to 800m from streams

Question – how does marine nitrogen get up to 800m from streams?



Bears!

Turns out it's all about the salmon and bears!

Salmon are a very important food source to bears before winter (salmon make up more than 60% of a grizzly's diet).

Salmon return to their natal streams to reproduce and die. Bears carry large numbers of these salmon out of the water and into the forest (Dr. Tom Reimchen, U.Vic)

- Individuals bears capture ~700 primarily post-reproductive salmon over a 6-week period. They only consume ~half of the salmon they catch.

When salmon are abundant, bears will be selective and eat the fattiest part of the salmon (skin, eggs and brains).

Remaining parts will be left for other organisms.
~4,000 kg/hectare of salmon are left behind

- Scavenged by eagles, crows, insects, etc.
- Decomposed by fungi and bacteria Enriching the soil with marine nitrogen

Bears also leave behind N-rich feces

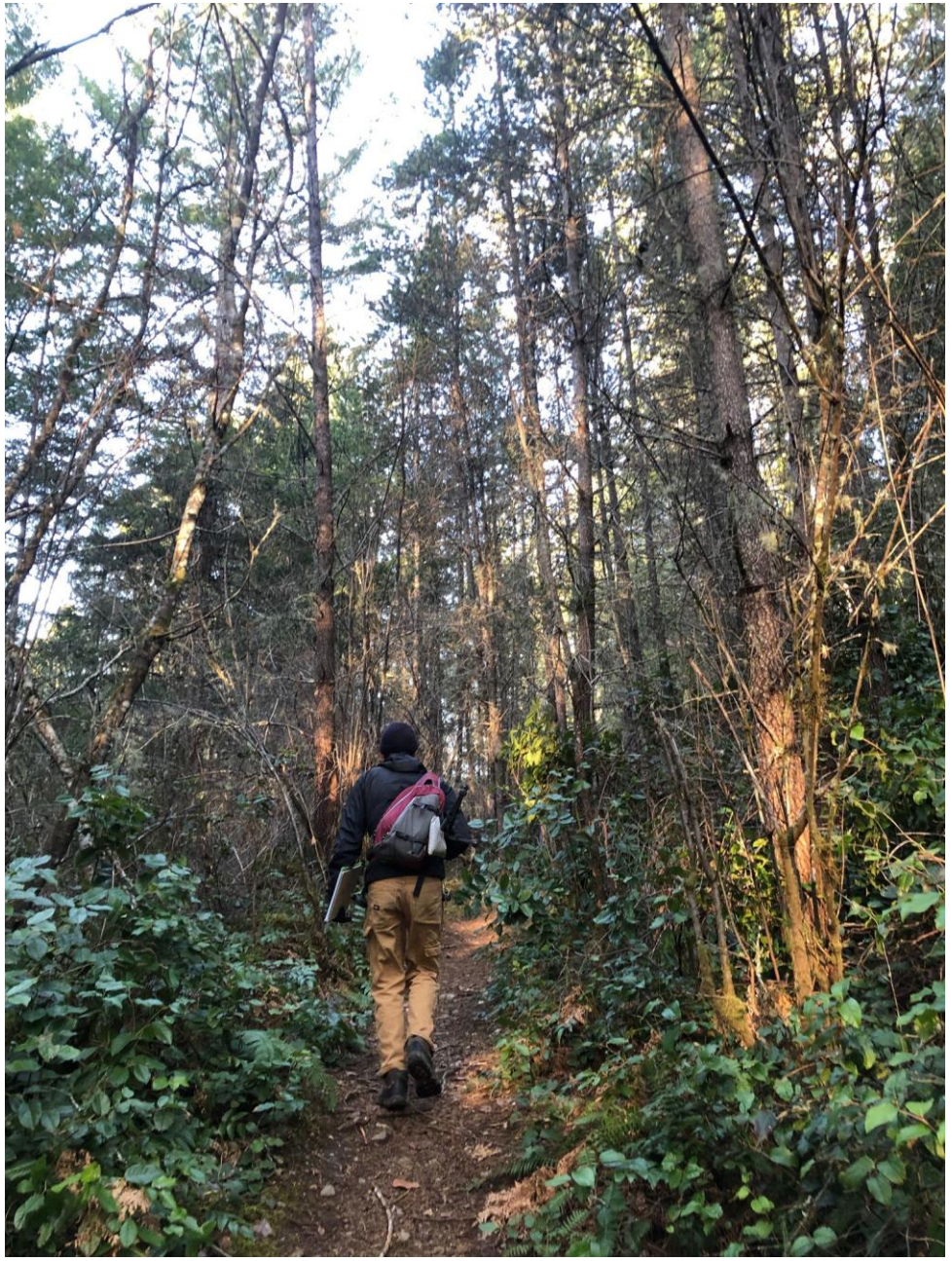
What happens to the ecosystem if water temperatures exceed the salmon's range of tolerance?

Community Science and my Research

Rory Macklin (he/him)

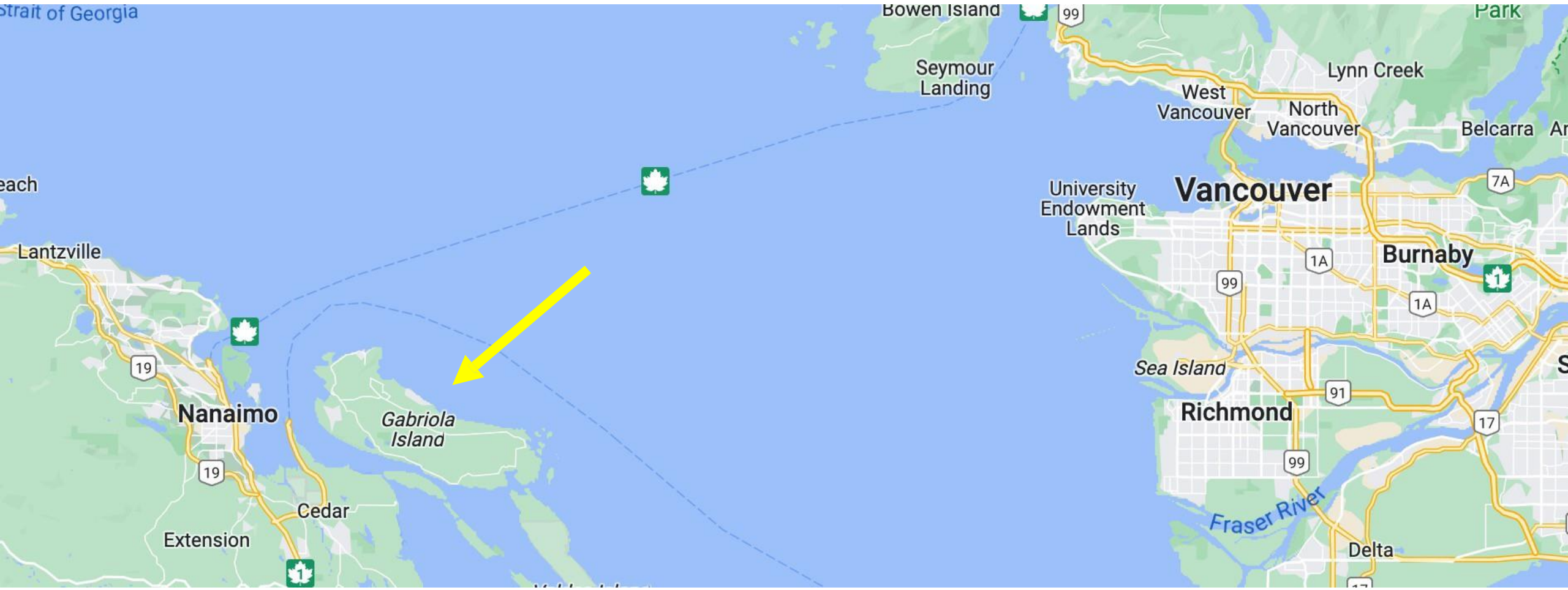
Jankowski Lab

macklin@zoology.ubc.ca



What I want to talk about today:

- Myself
- My (community-science) research (AKA the bit the exam question will be about)
- Unsolicited advice about doing (community) science and university


Strait of Georgia
Bowen Island
Seymour Landing
West Vancouver
Lynn Creek
North Vancouver
Belcarra
Park
University Endowment Lands
Vancouver
Burnaby
Lantzville
Nanaimo
Gabriola Island
Sea Island
Richmond
Cedar
Extension
Fraser River
Delta
99
1A
7A
19
91
17
1

[redacted] Vancouver Island/Coast 4 years ago

231

Kayaked yo the Malaspina Galleries on Gabriola Island this weekend... our province has some pretty darned weird shoreline!


© Rory Macklin


VOL
X
Y
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START
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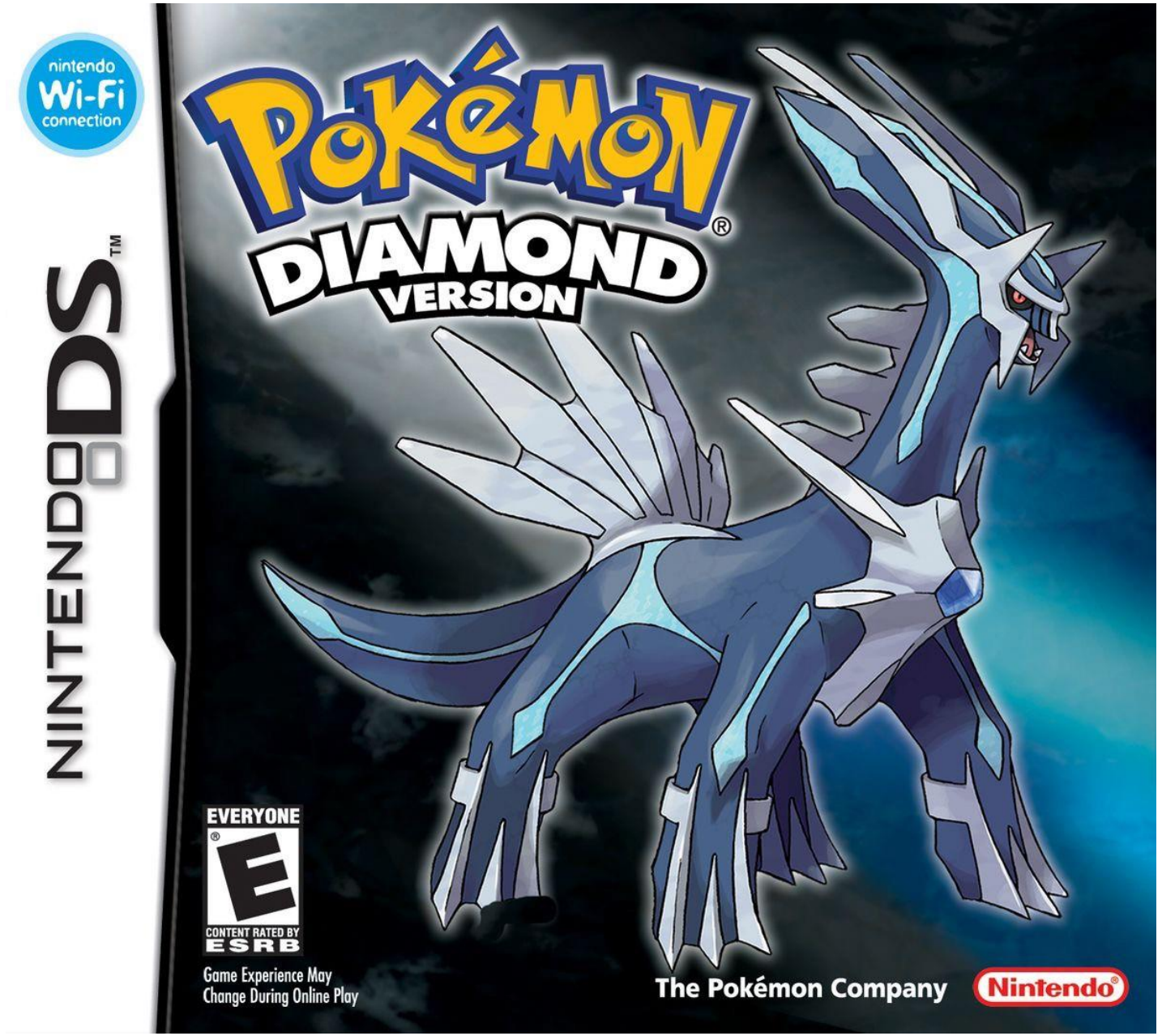
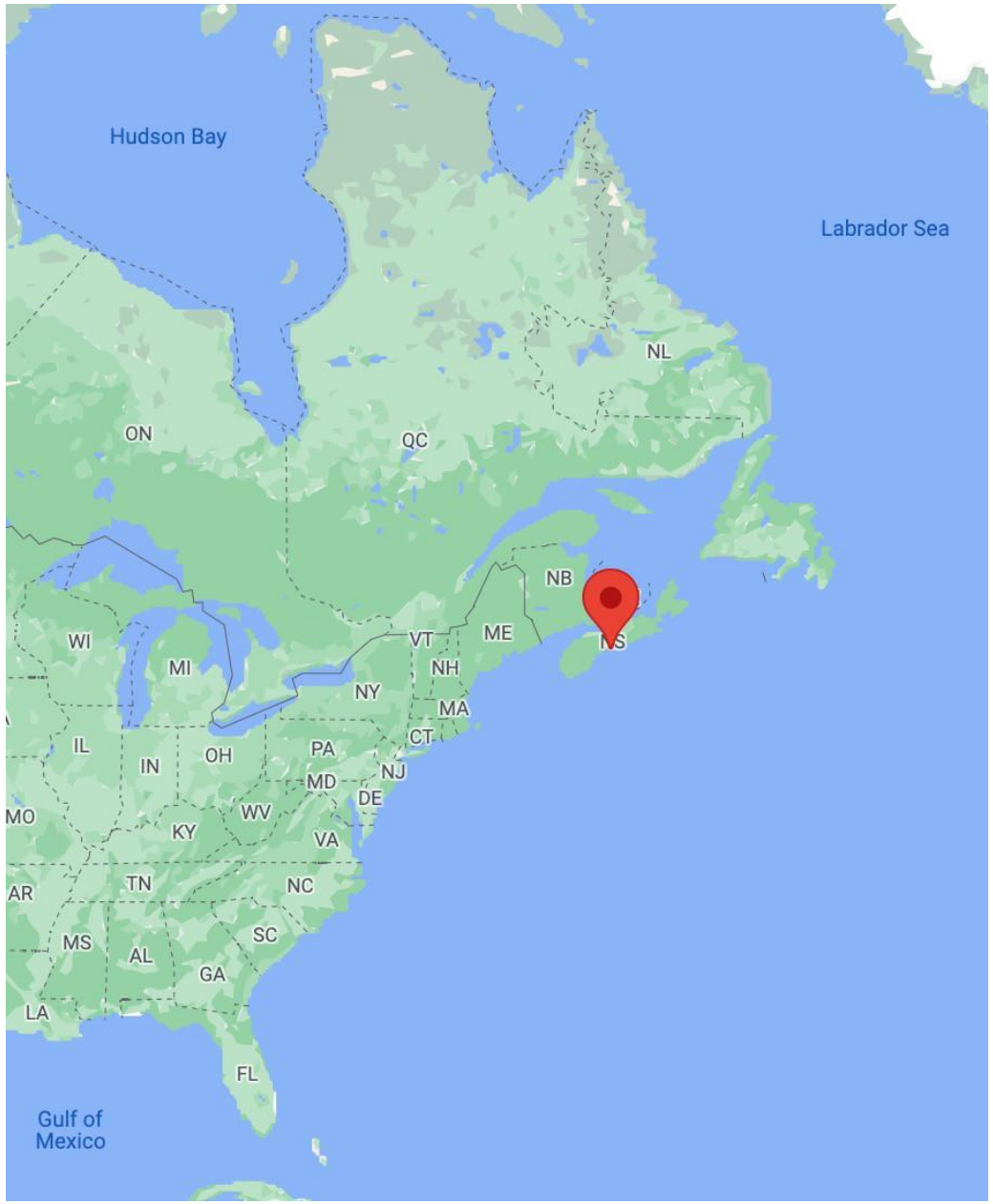

nintendo
Wi-Fi
connection
NINTENDO DS™
Pokémon
DIAMOND
VERSION
EVERYONE
E
CONTENT RATED BY
ESRB
Game Experience May
Change During Online Play
The Pokémon Company
Nintendo

Pokémon is a community science project

Hello child do my field work for me

Sure! I’m 10 and I love unpaid and dangerous labour.

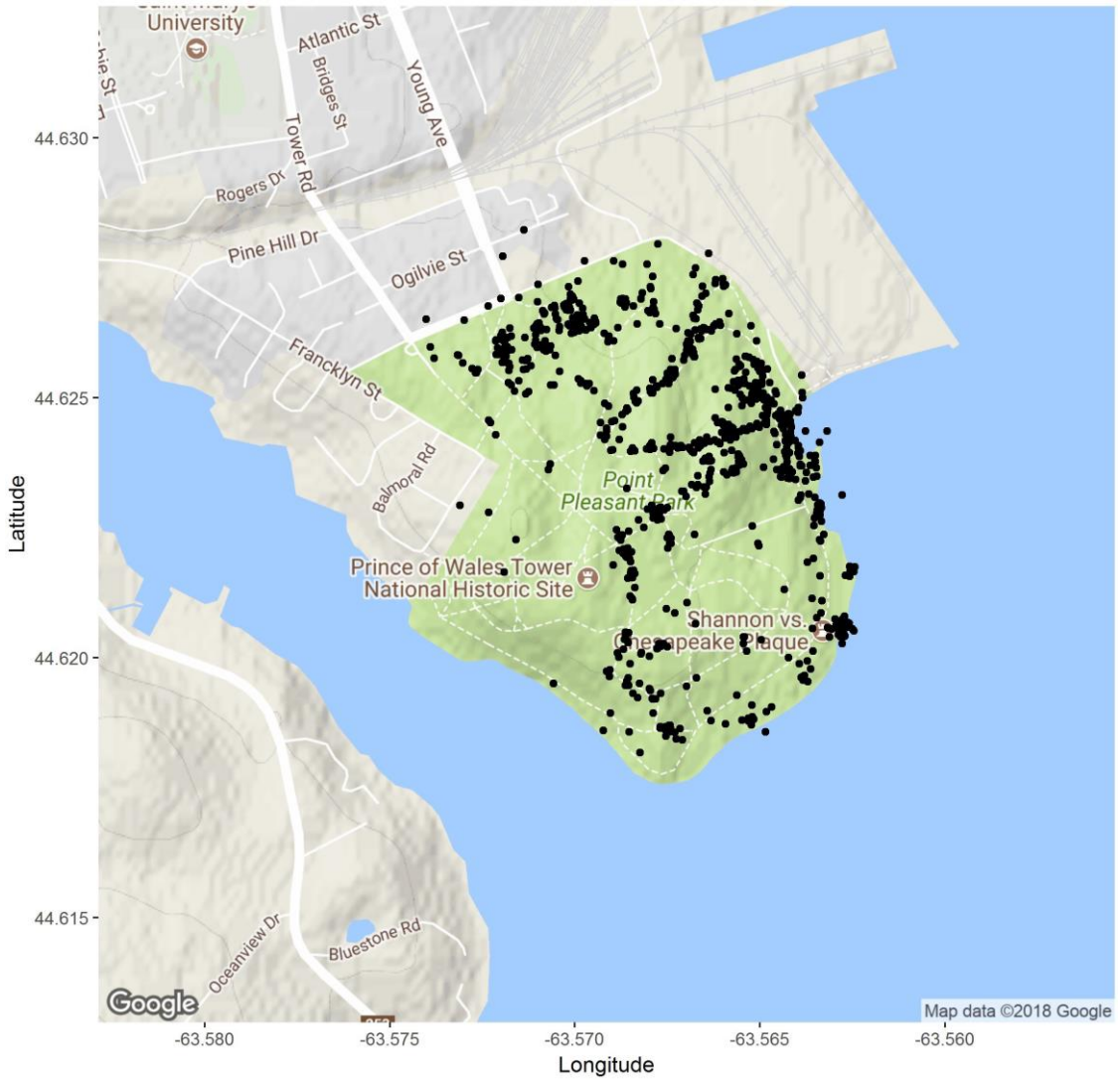
Instagram:
@uclueletaquarium



DALHOUSIE UNIVERSITY

iNaturalist

Ecology Action Centre


University
Atlantic St
Bridges St
Young Ave
Tower Rd
Rogers Dr
Pine Hill Dr
Ogilvie St
Francklyn St
Balmoral Rd
Point Pleasant Park
Prince of Wales Tower National Historic Site
Shannon vs. Chesapeake Plaque
Oceanview Dr
Bluestone Rd
Google
Map data ©2018 Google
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Latitude
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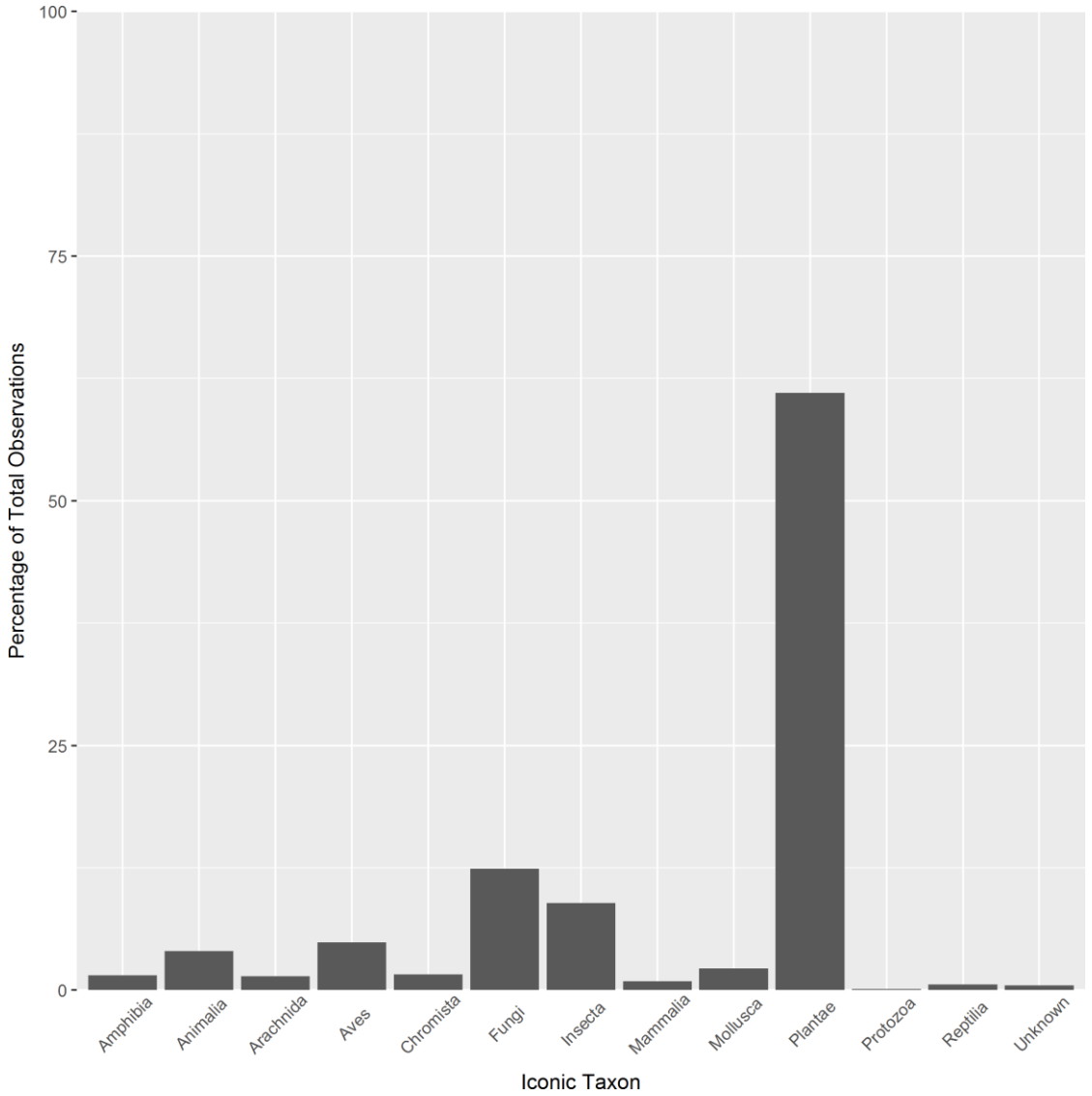
-63.570
-63.565
-63.560
Longitude


100
75
50
25
0
Percentage of Total Observations
Amphibia
Animalia
Arachnida
Aves
Chromista
Fungi
Insecta
Mammalia
Mollusca
Plantae
Protozoa
Reptilia
Unknown
Iconic Taxon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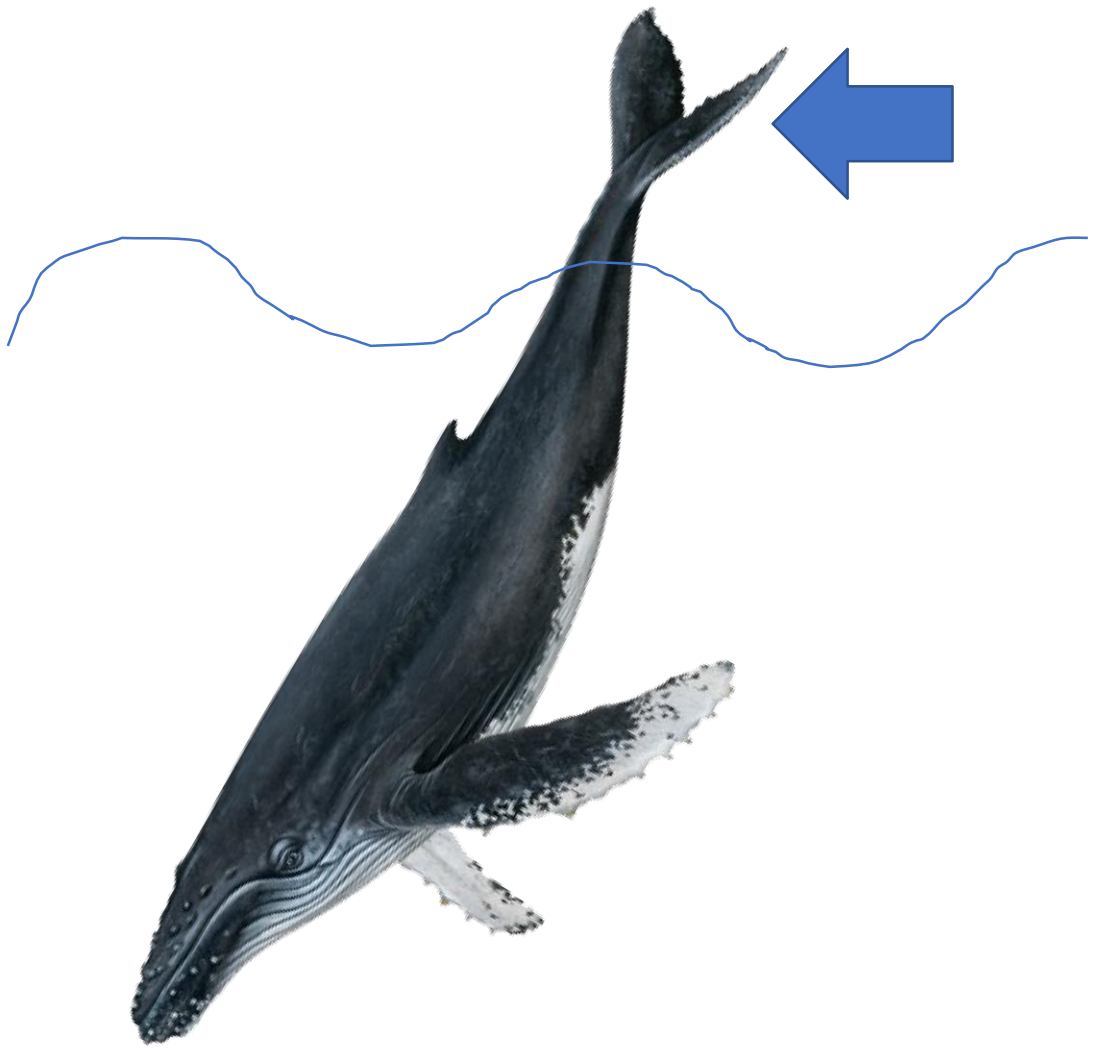


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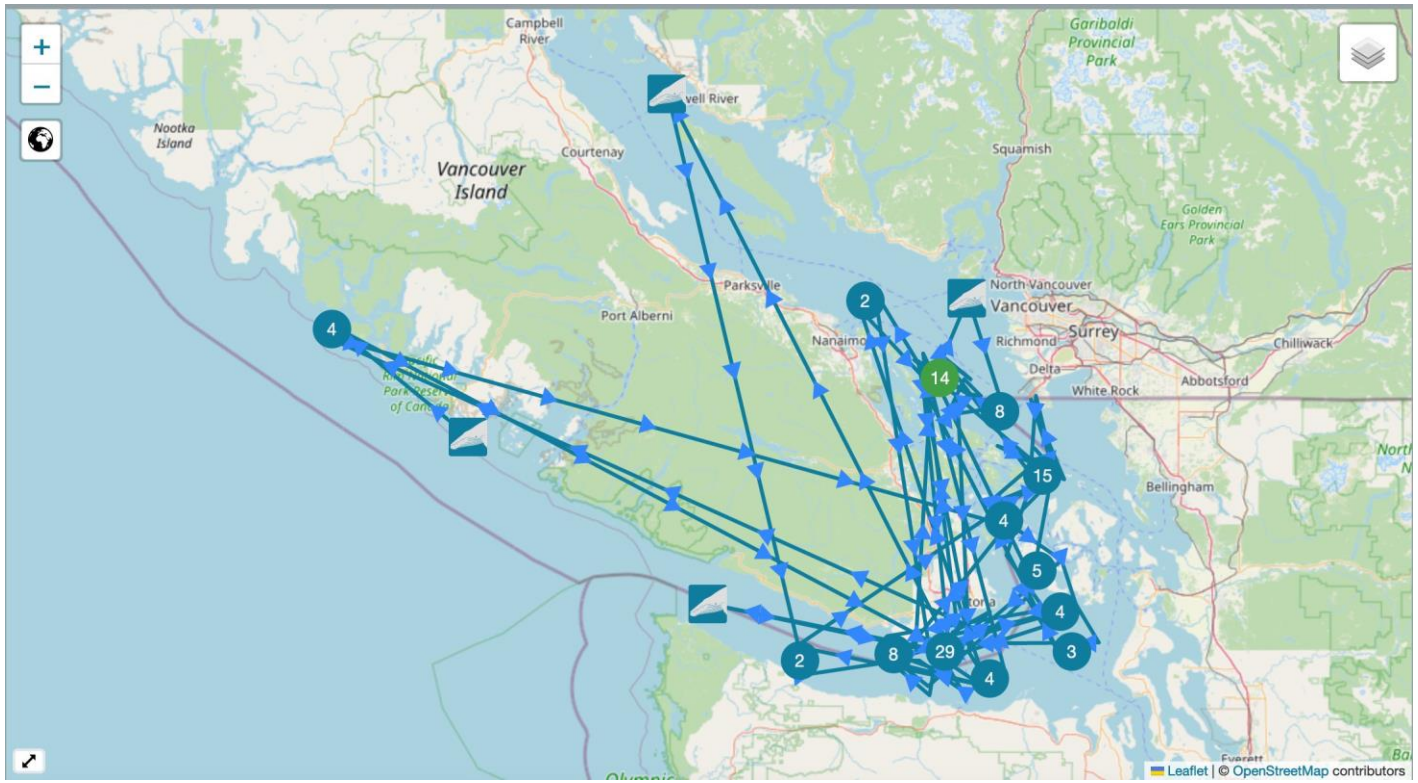
BCX1251 “Orion”



Canadian Technical Report of
Fisheries and Aquatic Sciences 3519

2023

SPATIAL PATTERNS IN THE MIGRATORY DESTINATIONS OF HUMPBACK WHALES (*MEGAPTERA NOVAEANGLIAE*) ENCOUNTERED IN CANADIAN PACIFIC WATERS, BASED ON PHOTO-IDENTIFICATION DATA AND OCEAN BASIN-WIDE COLLABORATION

by

Christie J. McMillan[1,2], John K.B. Ford[1], Ted Cheeseman[3], John Calambokidis[4], Katherina Audley[5], Caitlin Birdsall[2,6], Josie K. Byington[7], Jens Currie[8], James D. Darling[7], Joëlle De Weerdt[9], Nicole Doe[2], Thomas Doniol-Valcroze[1], Karina Dracott[6], Rachel Finn[10], Astrid Frisch-Jordán[11], Christine Gabriele[12], Beth Goodwin[13], Jackie Hildering[2], Meagan Jones[14], Edward Lyman[10], Mark Malleson[15], Pamela Martinez Loustalot[16], Adam A. Pack[17], Ester Quintana-Rizzo[18], Nicola Ransome[19], Tasli J.H. Shaw[15], Stephanie Stack[8], Jorge Urbán Ramirez[16], Janie Wray[20], Brianna M. Wright[1], and Kymberly M. Yano[21]

https://publications.gc.ca/collections/collection_2023/mpo-dfo/Fs97-6-3519-eng.pdf

Sandhill Crane, Delta, BC

© Rory Macklin

Common Raven, North Vancouver, BC

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Marbled Godwit, Dartmouth, NS

Steller’s Jay, North Vancouver, BC

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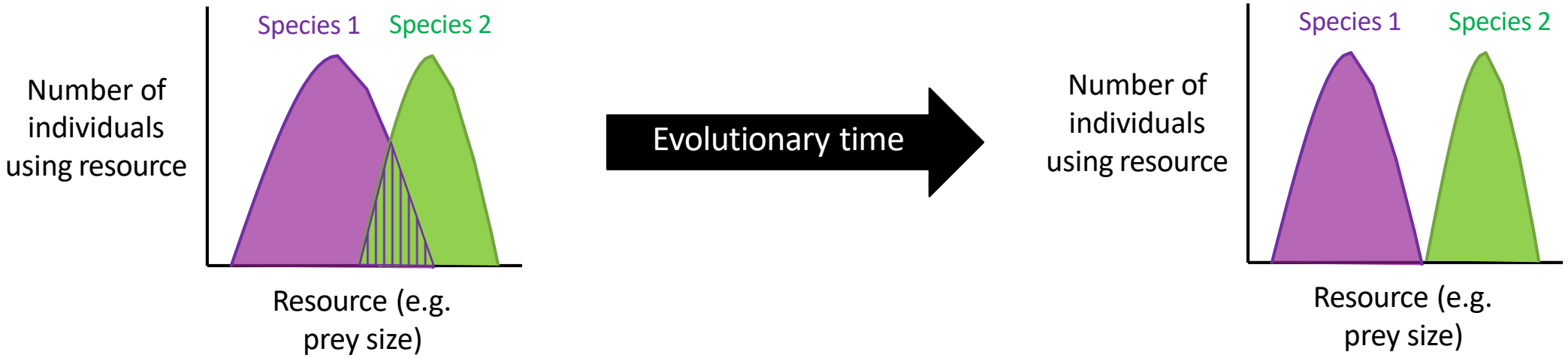
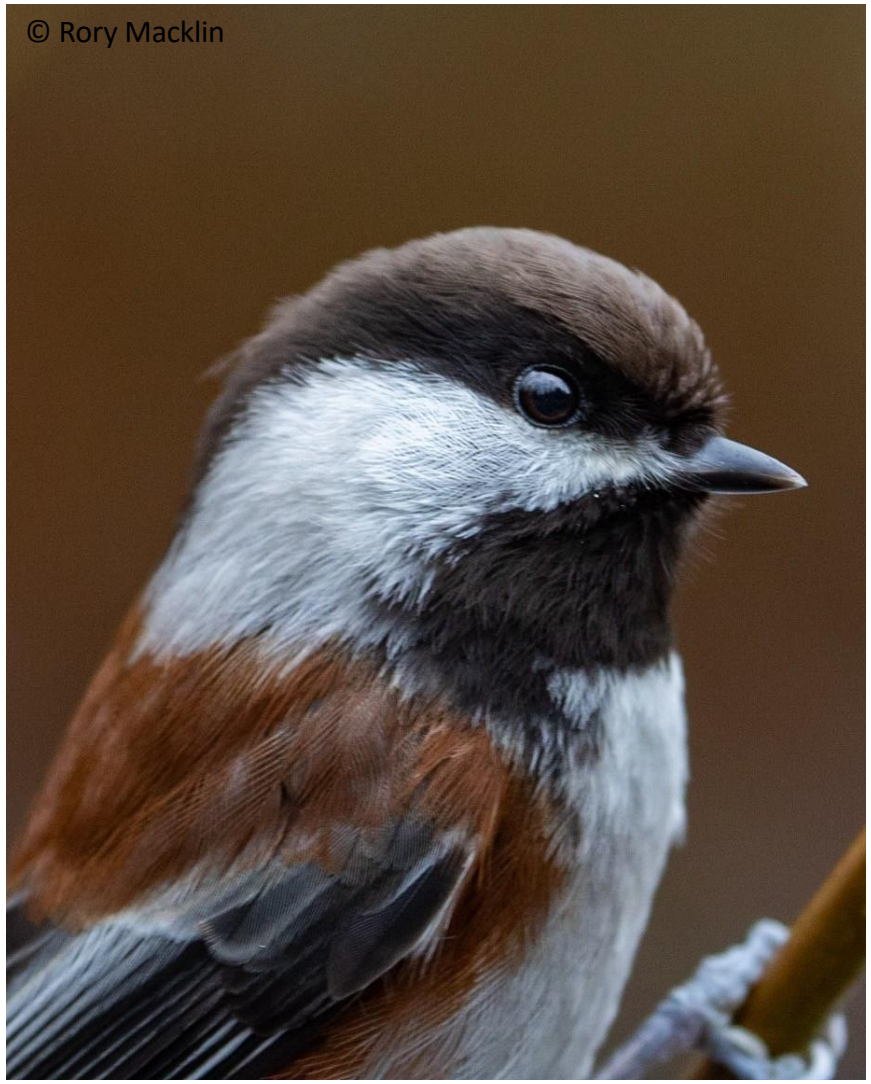
Competition over time can lead to evolutionary change



Competition can lead to negative outcomes for reproductive success for individuals of a species. Over time, selection favours individuals that use resources outside of the area of overlap with a competition.

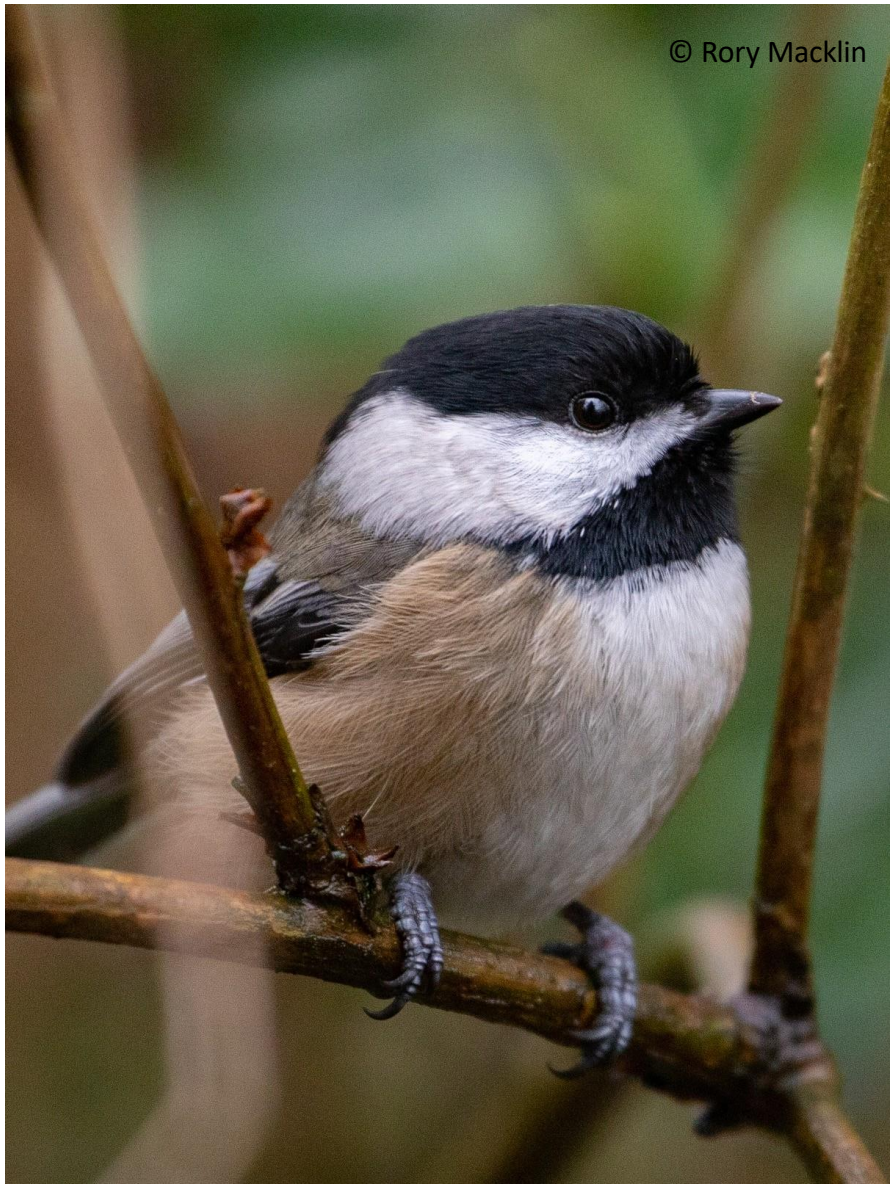
This can lead to niche partitioning, where a species fundamental niche has shifted to avoid a potential competitor's fundamental niche.



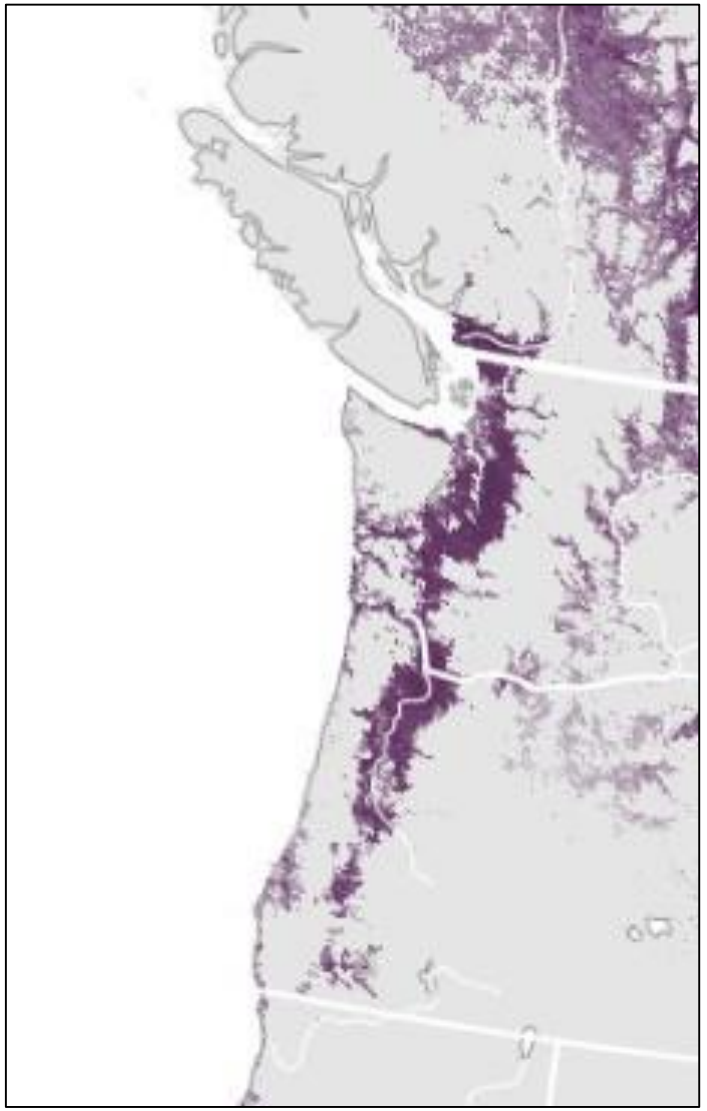
Chestnut-backed Chickadee
(CBCH; *Poecile rufescens*)

- Seen as very strongly tied to temperate rainforest
- In Vancouver, only in patches of old forest (Stanley Park, Pacific Spirit), not in the city, not in deciduous forests.

On Vancouver Island, I saw them <u>everywhere.</u>



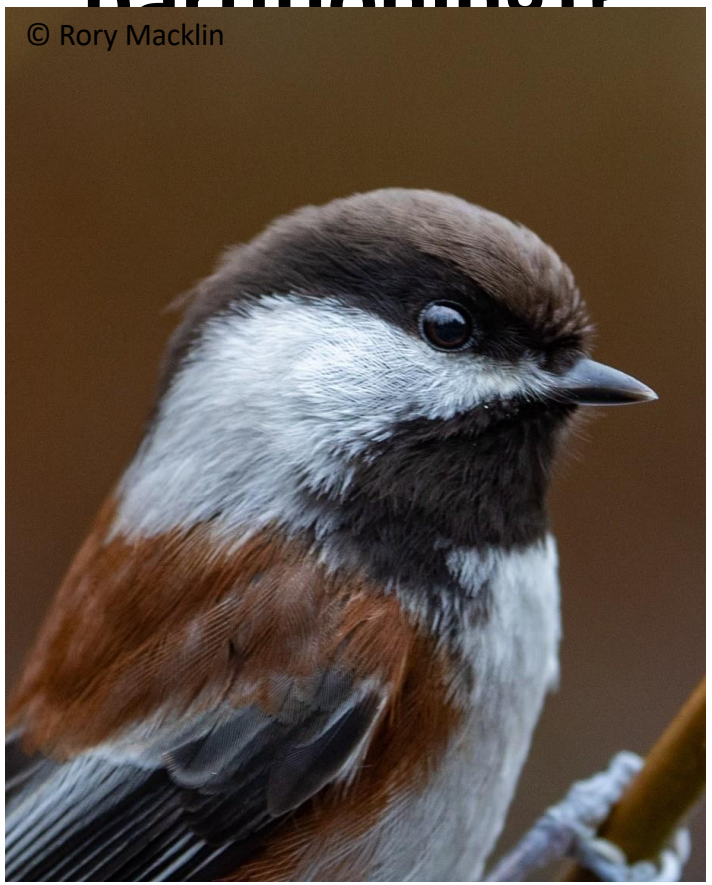
Black-capped Chickadee
(BCCH; *Poecile atricapillus*)



Fink et al. (2022)

- My thought was that the Black-capped Chickadee, which is present in Vancouver, but not on Vancouver Island could be a competitor to the Chestnut-backed Chickadee, perhaps prompting them to partition habitats between them, with Chestnut-backed Chickadees restricting themselves to coniferous forests, while Black-capped Chickadees dominated in cities and more deciduous forests.

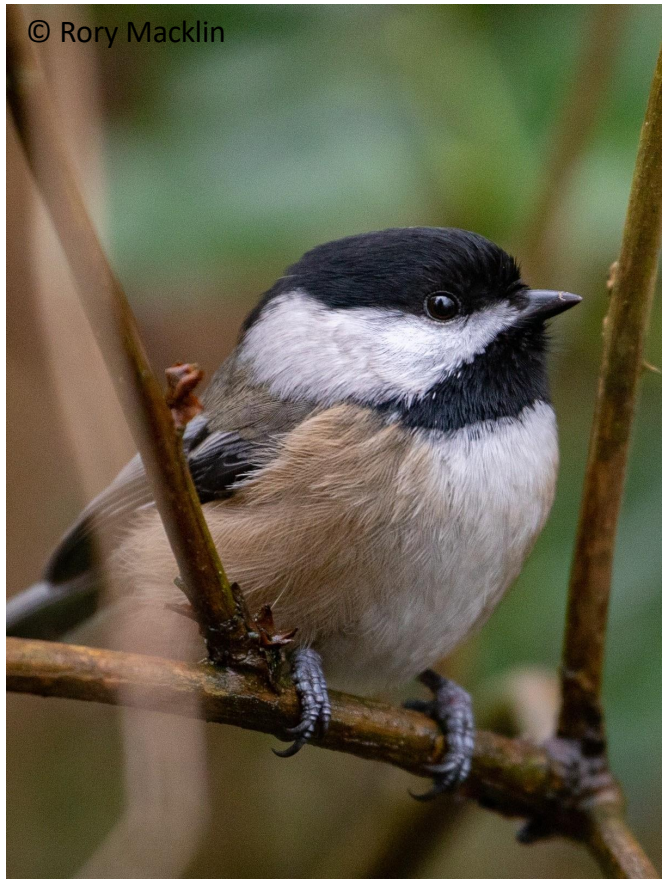
Have CBCH on the mainland restricted their range to temperate rainforest to avoid BCCH (niche partitioning)?



Chestnut-backed Chickadee
(*Poecile rufescens*)

Competition

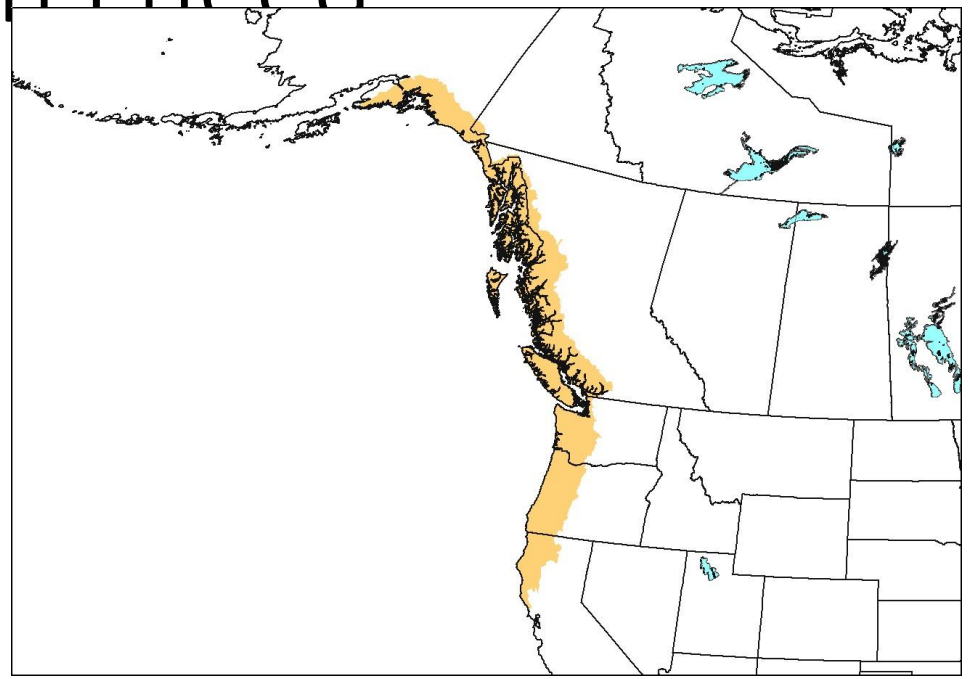
This takes a ton of data to test, especially if we want to say anything about whether fundamental niche has changed. Look to community science!

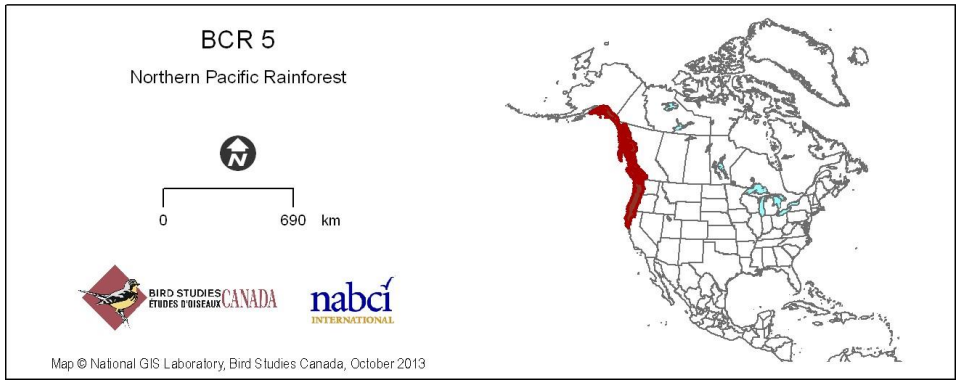


Black-capped Chickadee
(*Poecile atricapillus*)

To answer my question I need:

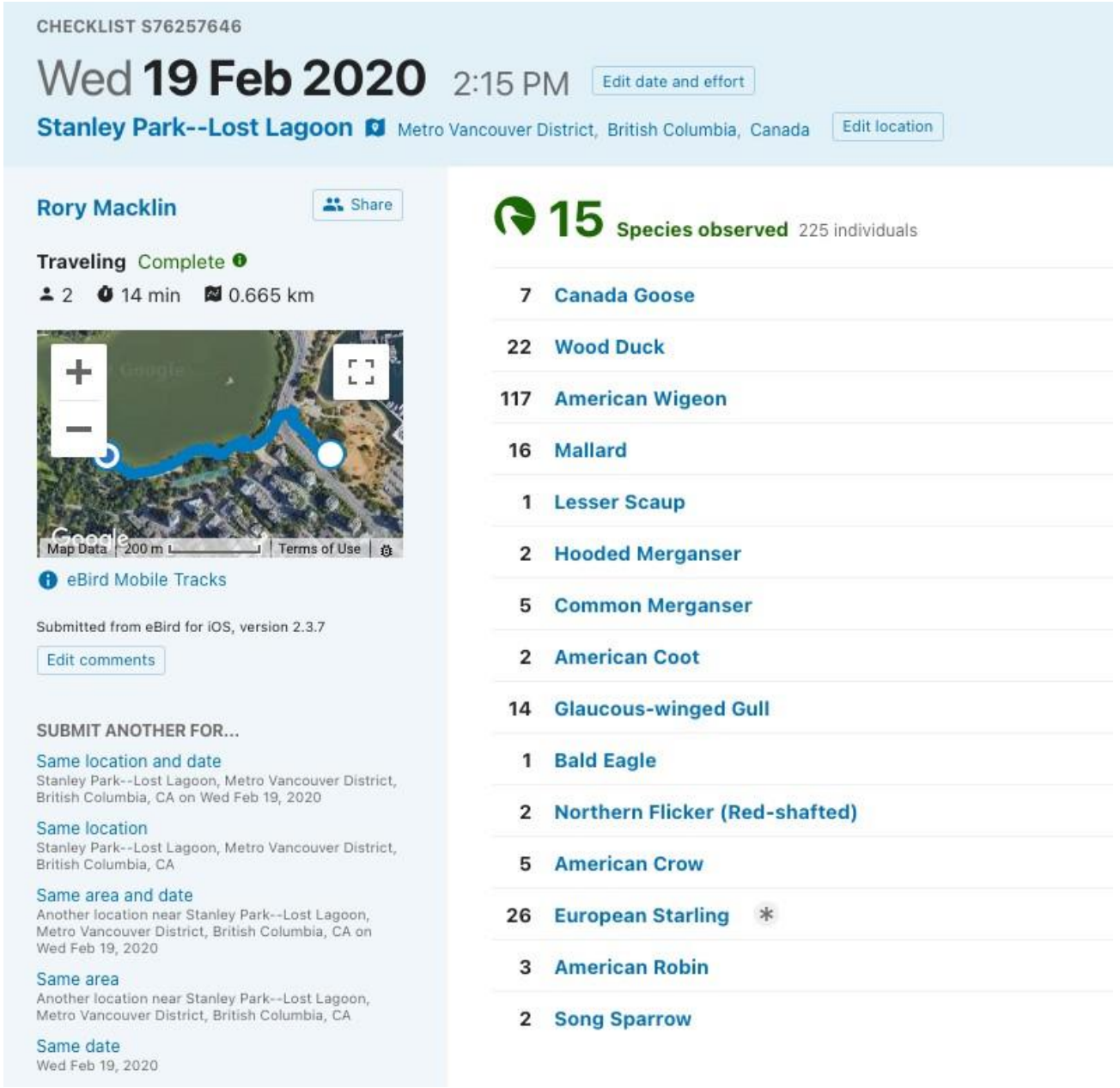
1. Multiple counts of Chestnut-backed Chickadees at sites inside and outside of the range of Black-capped Chickadees.
2. Information about the habitat at those sites (i.e. is it urban? Is it a coniferous forest? Is it a deciduous or mixed forest?)





1. Multiple counts of Chestnut-backed Chickadees at sites inside and outside of the range of Black-capped Chickadees.

eBird is a platform where bird watchers can go out, count the birds they see, and upload lists along with where, when, and for how long they went out. I used this to get counts of Chestnut-backed Chickadees where I needed them.



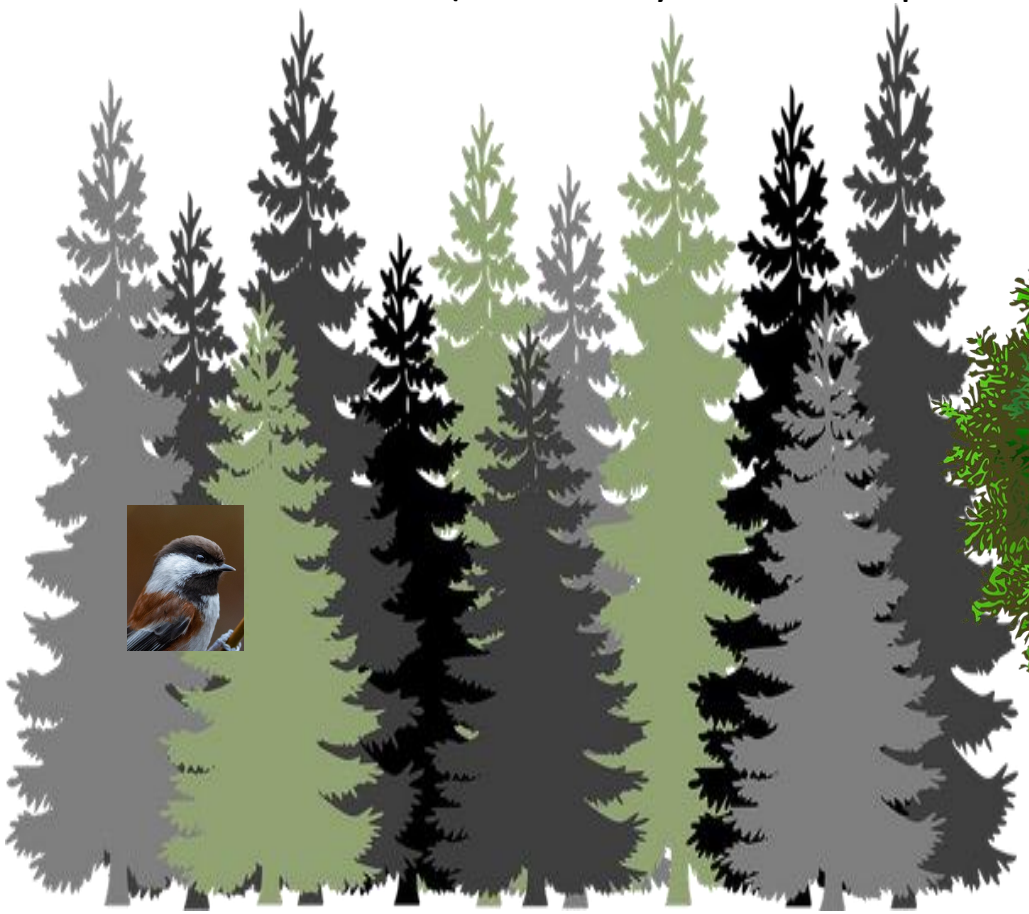
2. Information about the habitat at those sites (i.e. is it urban? Is it a coniferous forest? Is it a deciduous or mixed forest?)

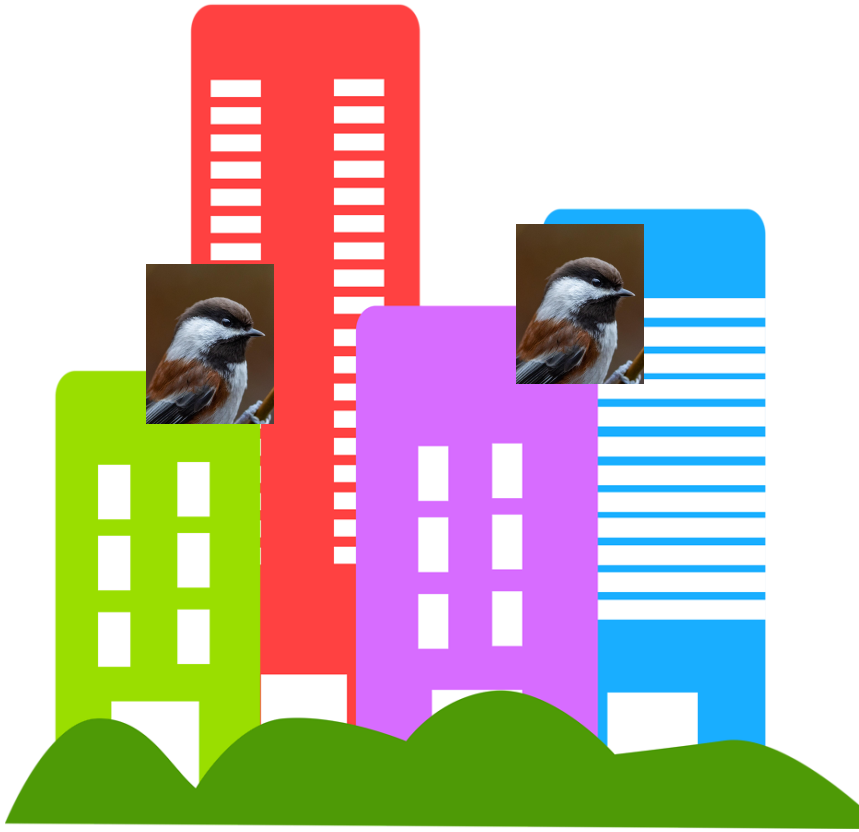
To get the second point I looked to satellites! MODIS breaks up North America into little squares and looks at images of the habitat in each square from satellites to categorize those squares into 16 habitat categories. I can locate my sites within these squares and use that information to characterize the habitat around them.

https://svs.gsfc.nasa.gov/vis/a000000/a002200/a002265/index.html

No Black-capped Chickadee (i.e. Vancouver Island)

So first, when we looked at sites with no BCCH, we found that Chestnut-backed Chickadees used a wide range of habitats, from the coniferous forests they're widely associated with, to more mixed deciduous forests and urban areas (which they seemed to prefer even more than coniferous forests)!





Unpublished data, do not distribute

Black-capped Chickadee (i.e. Vancouver)

When we looked in areas where there were BCCH, we found that CBCH lost a lot of their preference for mixed forests and urban areas, and had a higher preference for coniferous forests. They were more restricted to sites in coniferous forests (where BCCH were not found) in regions of overlap with BCCH.

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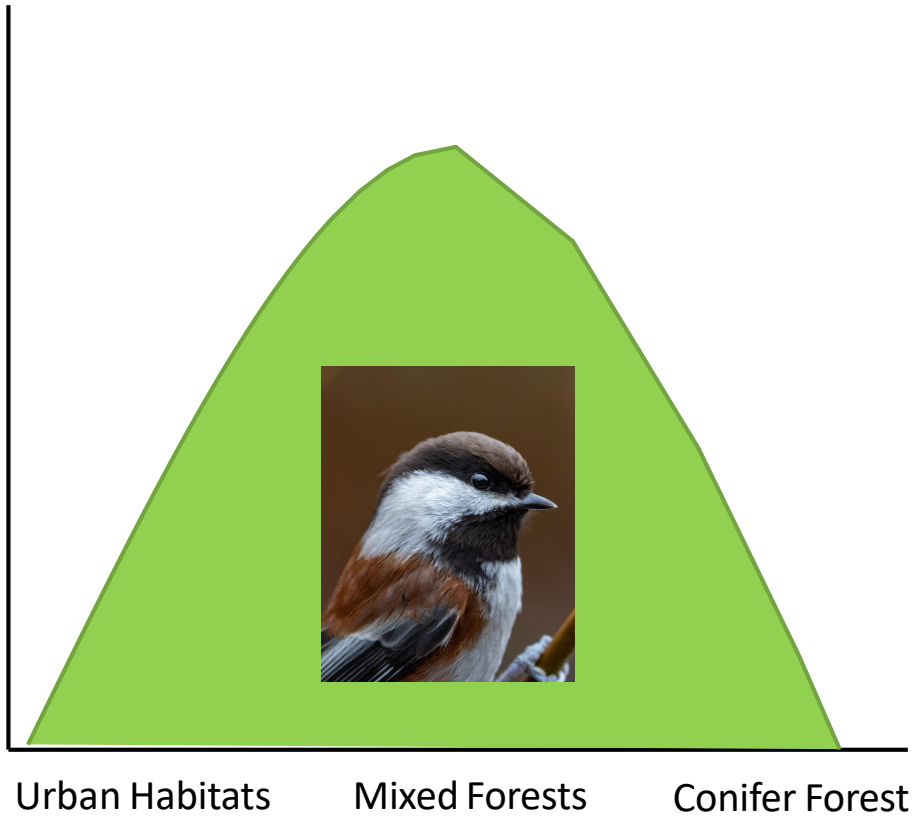
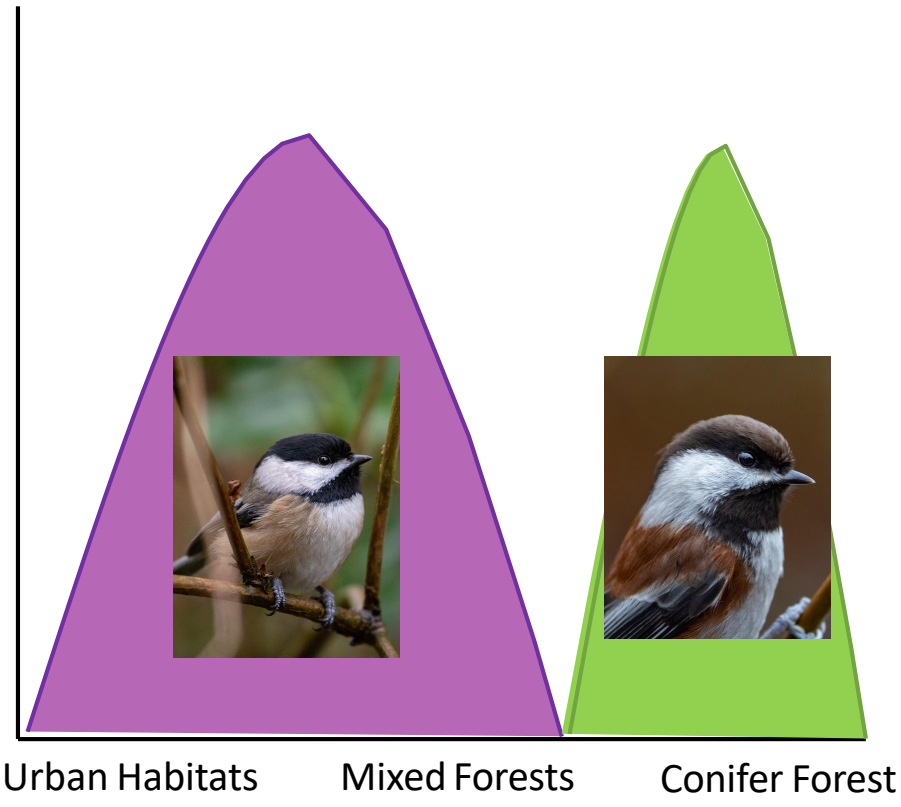
No Black-capped Chickadee (i.e. Vancouver Island)

Black-capped Chickadee (i.e. Vancouver)

Number of individuals using resource





To reframe this using Lynn's niche graphs, see above.

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Wow! Different habitat relationships inside and outside of the range of the Black-capped Chickadee

Very in-line with my experience growing up

Competition from the BCCH has made CBCH adapt different habitat preferences to avoid them!

Is this change ”locked in”? Change in their fundamental niche, or just realized niche?

All from community science!

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Unsolicited advice

- You can do science whenever – none of what I have done required me to be associated with a lab or an NGO or even a university.
- Feel like going out and collecting data on a particular thing? There's probably a community science project for it (i.e. Stanley Park Ecology Society).
- Feel like getting your hands on some data and doing whatever analysis? There's probably a community science project for it (I'll help!).
- If you are Professor Oak, make sure your work benefits the Ash Ketchums!

That’s it! Thank you!

An intraspecific competitor coming to competitively exclude the Clark’s Nutcracker on my hand thus reducing its realized hand-holding niche.