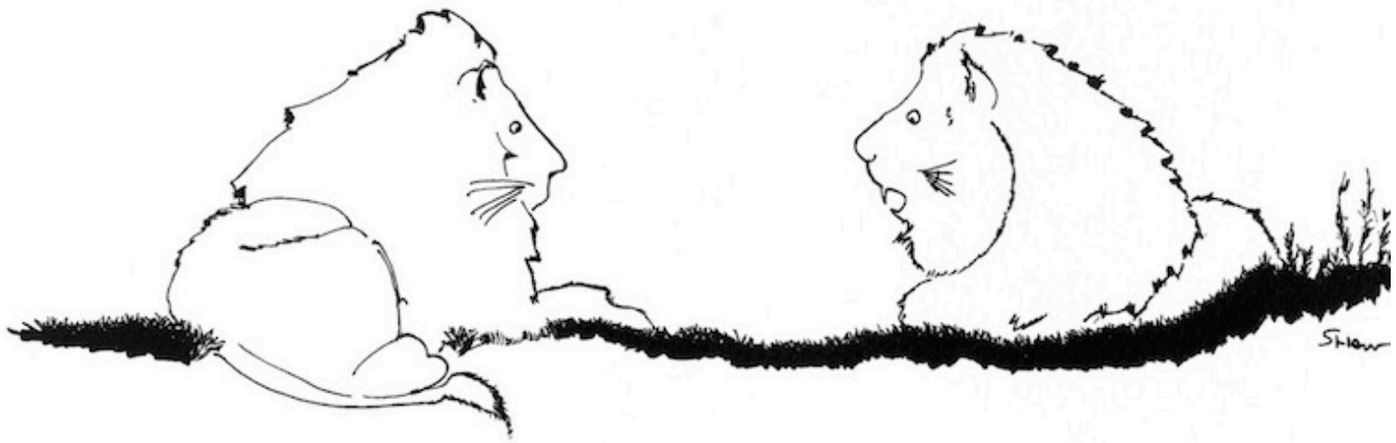
Fundamentals of Ecology

Password:
ecology



"I'm trying to eat more vegetarians."

Course Organization

Find everything on 2 websites + ZOOM

- Course site: http://jdyeakel.github.io/teaching/ecology/
- Schedule
  - Syllabus
  - Links to readings, etc
  - Section activities
- Catcourses page
  - Assignments
  - Exams
  - Grades
  - Communication
- Zoom (links on Catcourses & course website)
  - Lectures & Discussions
  - Synchronous!!!

Fundamentals of Ecology

"The Earth is what we all have in common"
-Wendell Barry

Fundamentals of Ecology :: Fall, 2020

Welcome!

Welcome to the course website for ***Fundamentals of Ecology***. Of course, this semester we will be running this course entirely remotely, with both lecture and discussion section occurring on ZOOM (links below). This course will be conducted ***synchronously***, meaning that it is mandatory that you attend lectures and discussions *at the times they occur*. This will be the primary site that will host course information and changes to the schedule, as well as your Discussion Section activities. The Catcourses, or Canvas, site for this course will be used for assessments (homework and exams) and of course grades. See the syllabus for details and the schedule for information regarding important dates and content.

Info

- Syllabus
- Schedule

- **Lecture**: TR 9:00-10:15 on ZOOM
- **Section BIO/ESS-148-02D**: F 1:30-2:20 on ZOOM
- **Section BIO/ESS-148-03D**: F 2:30-3:20 on ZOOM
- **Section BIO/ESS-148-04D**: F 4:30-5:20 on ZOOM

- Prof. Yeakel Office Hours: TBD
- TA Irina Barros Office Hours: TBD

Fundamentals of Ecology

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Fundamentals of Ecology (BIO/ESS 148) :: Syllabus, Fall 2020

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> To Course Schedule

- **Lecture Time**: Tuesdays and Thursday, 09:00 - 10:15AM
- **Lecture Location**: Zoom Link
- **Discussion section times**
  - Friday 1:30-2:20 Zoom Link
  - Friday 2:30-3:20 Zoom Link
  - Friday 4:30-5:20 Zoom Link
- **Instructor**: Justin D. Yeakel
- **Teaching Assistant**: Irina Barros
- **Course Websites**

Everything that we do this this course will revolve around two principle websites. In some cases, information will be duplicated on both sites (link to readings), and I will attempt to cross-link as necessary.

*The **CatCourse Website (Canvas)**: Turning in assignments, grades, lectures, links to readings*
*The **Ecology Course Website**: Basic course information, discussion section activities, links to readings*

- **Course Schedule**:
  Course Schedule

- **Course Description**

This course fulfills an upper division requirement for the Ecology and Evolutionary Biology (EEB) emphasis track of the Biological Sciences Major, as well an upper division requirement for the Earth Systems Science Major. This course provides an introduction to ecology - the scientific study of how organisms interact with each other and their physical environment. Prerequisite: BIO 001 or BIO 005 or ESS 001 or ESS 005 or consent of instructor. Normal Letter Grade only.

- **Course Requirements & Grading Procedures** {WORD OF THE DAY} ecology
  - ***Class Attendance and Participation Policy***
    - This course is delivered ***synchronously over ZOOM***, meaning that lecture & discussion attendence *at the time of the lecture & discussion* is required.
    - Attendance and participation in the discussion section is required and will be a component of the student's course grade.
  - ***Required and Supplemental Readings***
    - **Required Textbook**: W.D. Bowman, S.D. Hacker, and Cain, M.L. 2017. Ecology, 4th Edition. Sinauer Associates, Inc., Publishers. Sunderland, MA. (or 5th)
    - Readings will also be assigned for the Discussion section and instead of the book for some lectures. These are required and will be provided on the course website.
    - Note: other editions (1st, 2nd, 3rd) of this textbook may be used but are not recommended.

Physical book, ebook from Campus Bookstore

- ***Course Assignments and Projects***
  - Late assignments (e.g., homework) will not be accepted.
  - **Homework**: Throughout the semester, homework assignments will be assigned, consisting of exercises provided by the Teaching Assistant/Instructor. ***Homework assignments will be delivered via Canvas***
  - **Discussion Activities**: All students are required to go to their respective Discussion Sections and participate/engage in the discussions and activities conducted in the section. Your discussion grade will take into account both participation and responses to Discussion assignments. ***Only otherwise notified, Discussion Activity scores will be delivered via CatCourses***
  - **Exams**: There will be 3 "midterm" exams during the semester and 1 comprehensive final. There will be no make-up exams or early exams. If you are sick during an exam, you must supply a note from your doctor verifying your illness. Your grade for the missed exam will be based on your average score from the other exams. You cannot miss more than one exam for an excused illness and taking the final is mandatory in order to pass the course. ***Exams will be open-book + open-note and delivered via Canvas***
- ***Grading***: Your final grade will be based on the following: lecture attendance: 5%; discussion section participation & activities: ~~10%~~ 15; homework: ~~20%~~ 15; midterms: 45% (three, 15% each); and comprehensive final exam: 20%.
- Grades will be given using the approximate framework: A: 90 - 100%, B: 80 - 90%, C: 70 - 80%, D: 60 - 70%, F: < 60%. This framework is subject to change given the distribution of the final grades.

Fundamentals of Ecology

"The Earth is what we all have in common"
-Wendell Barry

Fundamentals of Ecology (BIO/ESS 148) :: Schedule, Fall 2020

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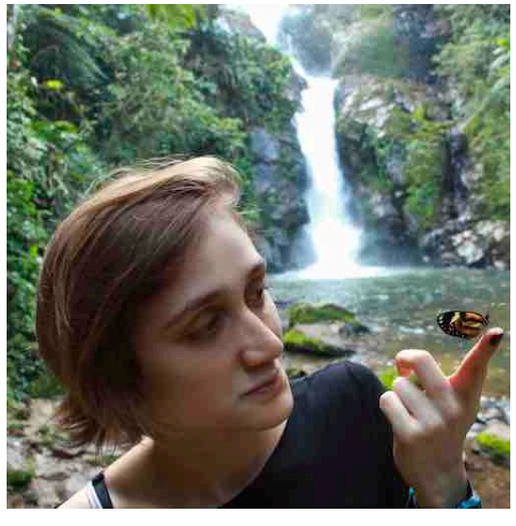
Please note that the schedule is subject to change at any time. Check back frequently for updates!

T = Tuesday
R = Thursday
F = Friday
L = Lecture
D = Discussion

Date	Lect/Disc_#	Lecture_Topic	Description	Required Readings	Assign.
8/27	**(R-L1)**	Web of Life	Introduction & Roadmap	Bowman Ch. 1	
		No Disc	No Discussion section		
9/1	**(T-L2)**	Scales 1	From cells to communities	Bowman pgs 22-23 & 46-47; Ch. 2.1 pg 37	
9/3	**(R-L3)**	Scales 2	Thinking like a mountain	Leopold; excerpts)	
	(F-D1)	Disc 1	Investigating ecological problems with R	What does ecology have to do with me?	
9/8	**(T-L4)**	Biosphere	Distinguishing among the major Earth's biomes	Bowman Ch. 3	
9/10	**(R-L5)**	Energy 1	Variation in temperature and water	Bowman Ch. 4	
	(F-D2)	Disc 2	Temperature as an ecological constraint	Gunderson & Leal 2015	HW-1 due
9/15	**(T-L6)**	Energy 2	Variation in energy	Bowman Ch. 5	
9/17	**(R-L7)**	Allometry	Allometry & Macroecology	TBD	
	(F-D3)	Disc 3	Macroecology	West & Brown	HW-2 due
9/22	**(T-L8)**	Evolution	Ecology as the driver of natural selection	Bowman Ch. 6	
9/24	**(R-L9)**	Life history	Life history diversity and tradeoffs	Bowman Ch. 7	
	(F-D4)	Disc 4	Life History	Leslie Matrix	HW-3 due
9/29	**(T)**	***EXAM 1***			
10/1	**(R-L10)**	Behavior 1	Optimal foraging theory, marginal value theorem	Bowman Ch. 8	
	(F-D5)	Disc 5	Foraging	Sinervo et al.	

Discussion sections
with Irina Barros



Dig into natural history, ecological data, and ecological models

- What types of questions do ecologists ask and how does ecological science progress?

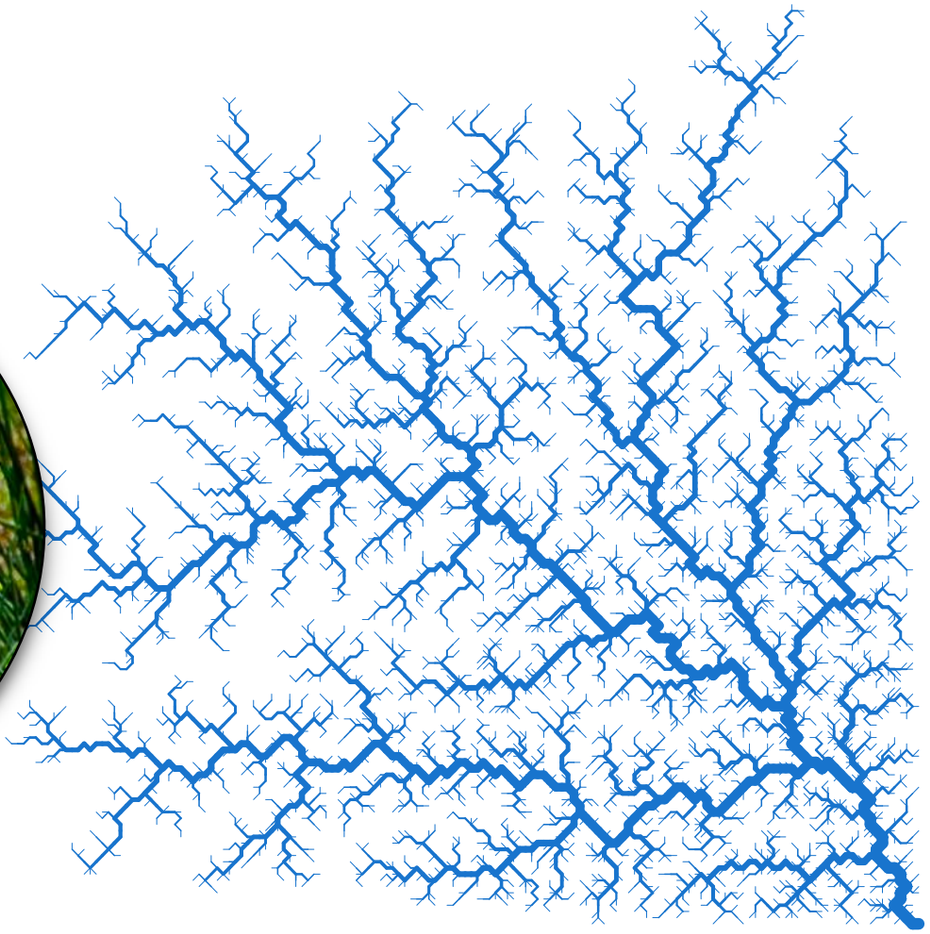
- How do ecologists figure things out?
  - Empirical: Laboratory, Field
  - Theoretical investigations

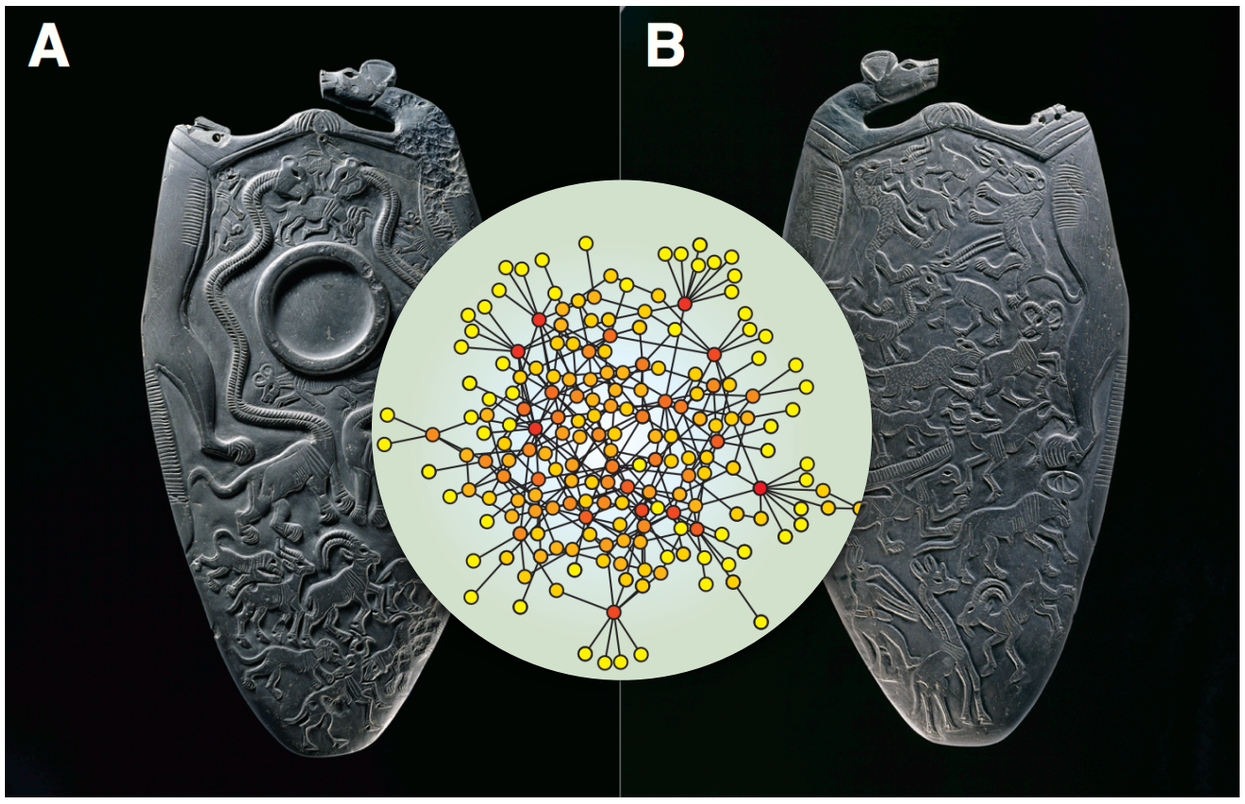
- How is a scientific paper written?

- How are data displayed and communicated?

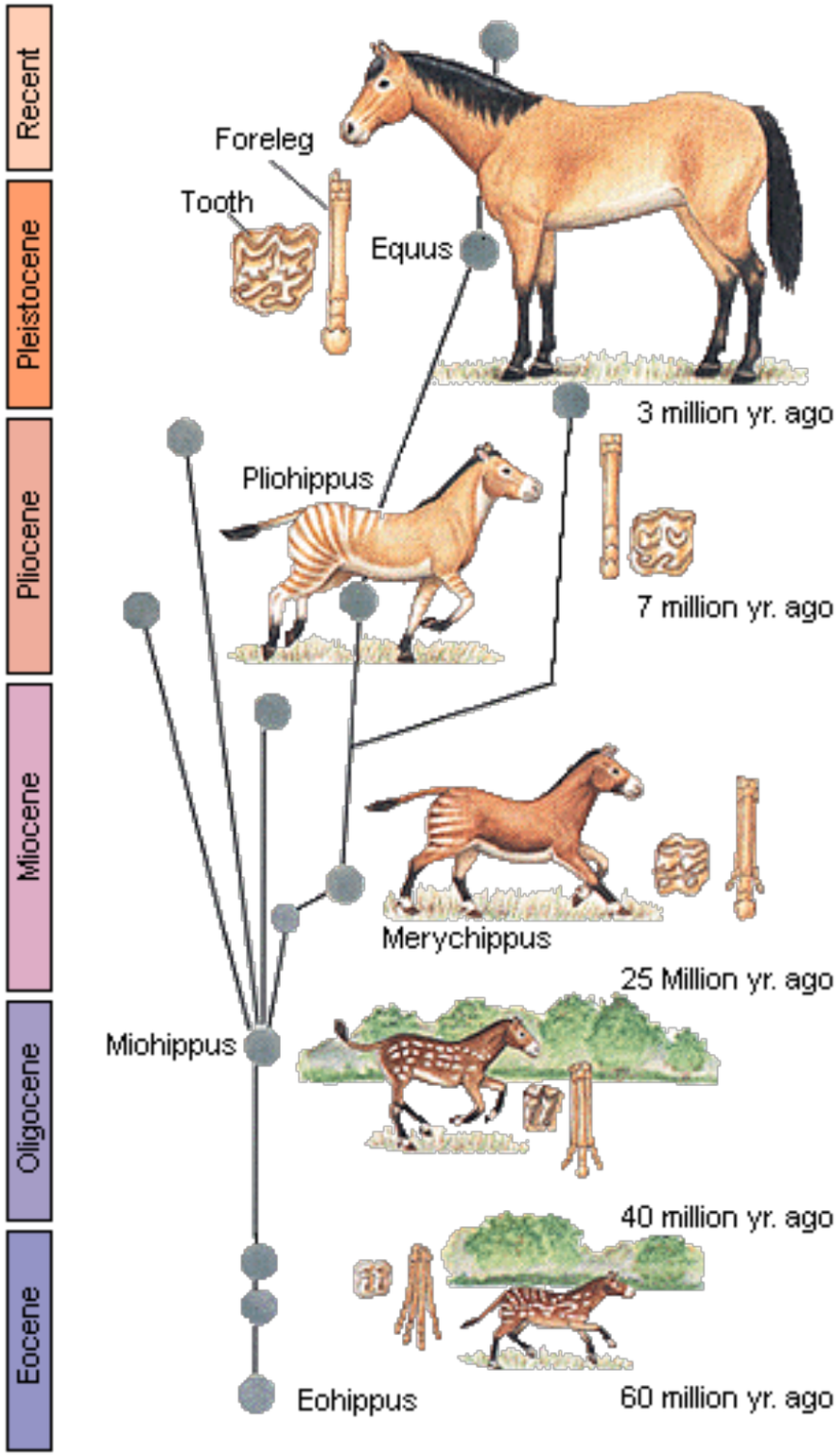
Sections: http://jdyeakel.github.io/teaching/ecology/

Who am I and why am I here?

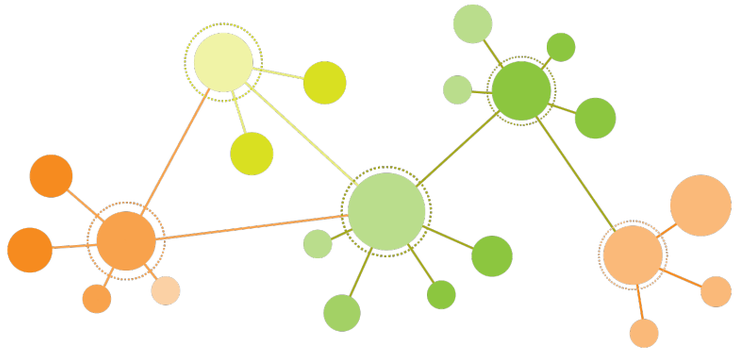




Evolution of body size
Grassland expansion



Understanding how ecosystem engineers impact communities



Ecology : "The study of the house"

- How do organisms interact with each other and their environment
  - Direct interactions
  - Indirect interactions

"The Balance of Nature"

~ requires a "stable ecosystem"

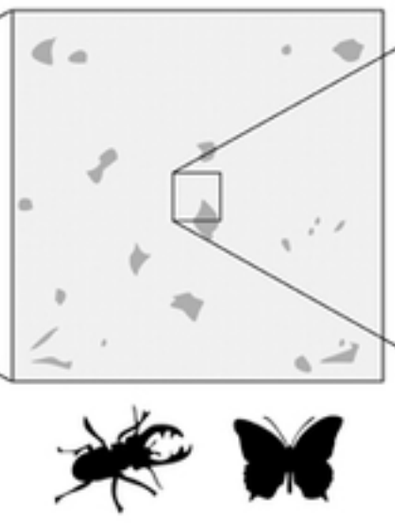
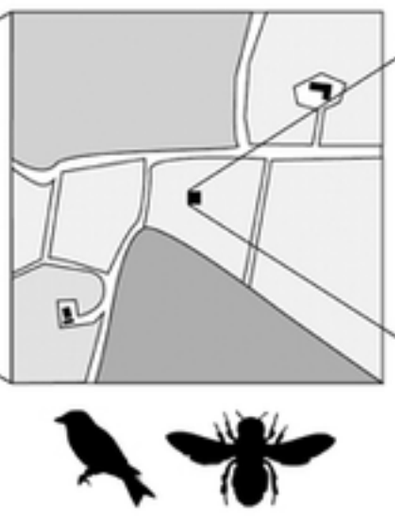
~ every species plays a specific role

~ Gaia hypothesis - planet regulates itself as a living being

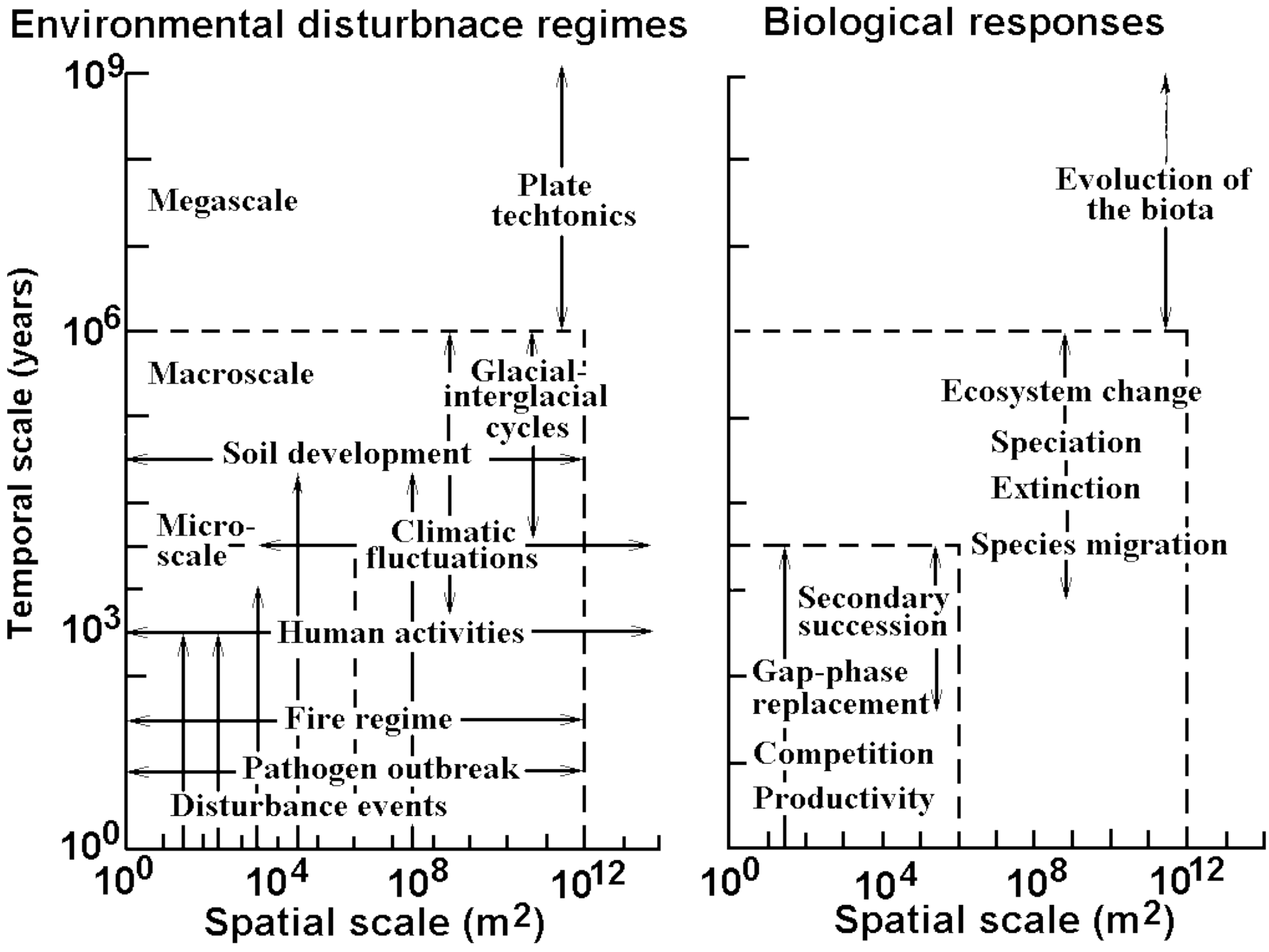
Ecosystems are examples of Complex systems

- Financial system
- Internet
- Electric grid
- Metabolic systems

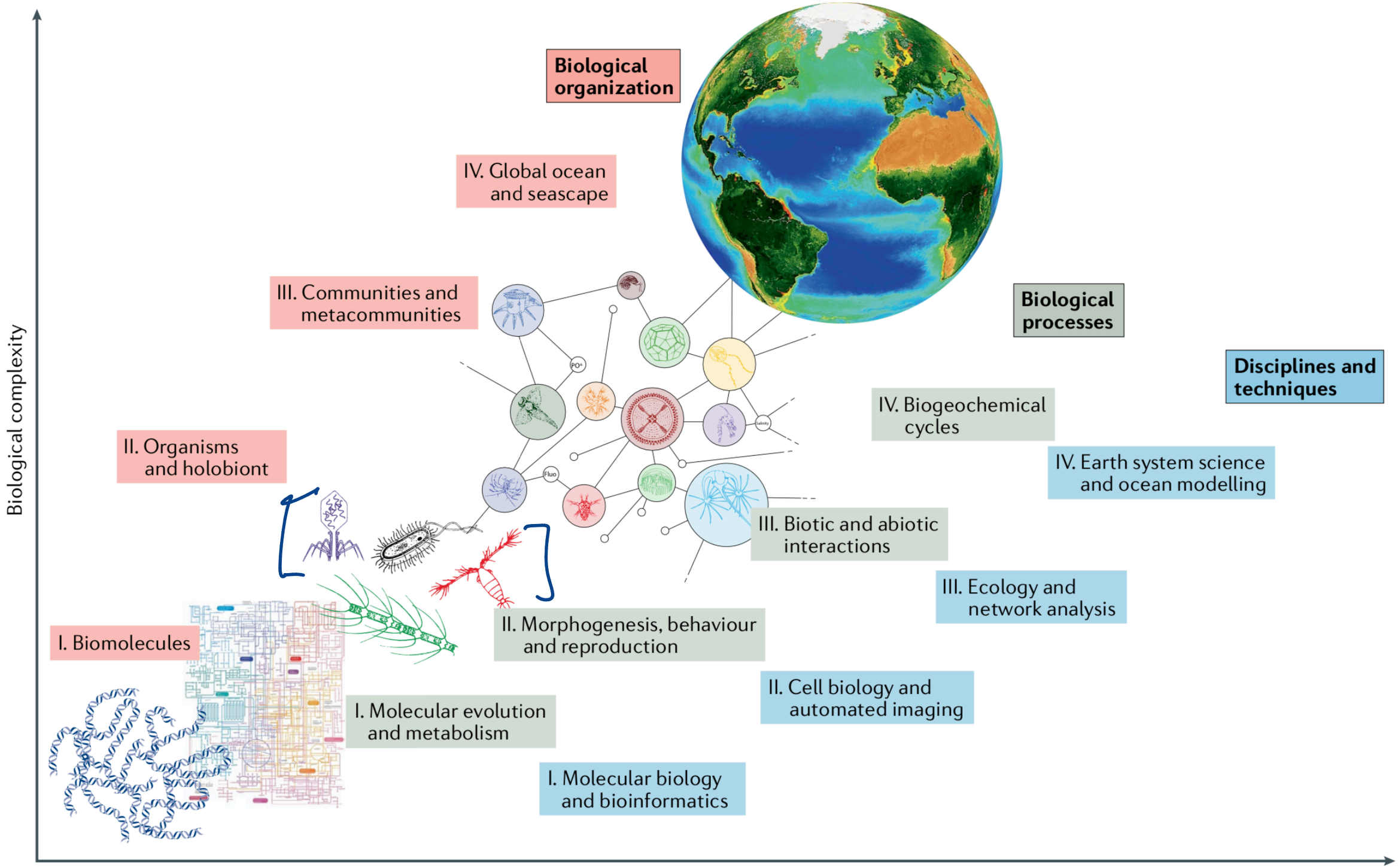
Ecology across scales: Spatial

Spatial scale	Ca 100 - 500km	Ca 50 - 100km	Ca 1 - 5km	Ca 1 - 5m
				
Examples of typical organisms and ecological processes	Iconic, large-ranging species Habitat specialists Species sensitive to disturbance Self contained and/ or unique ecosystems	Habitat specialists limited by dispersal between seasons Metapopulation dynamics Source-sink dynamics	Species limited by resource segregation within seasons Mobile specialists Habitat generalists Central place foragers	Soil fauna Community shifts
Typical ecosystem services	Watershed/potable water Carbon sequestration	Pollination and biocontrol adjacent to habitat fragments	Pollination and biocontrol over entire landscapes	Soil quality

Ecology across scales: Spatial + Temporal



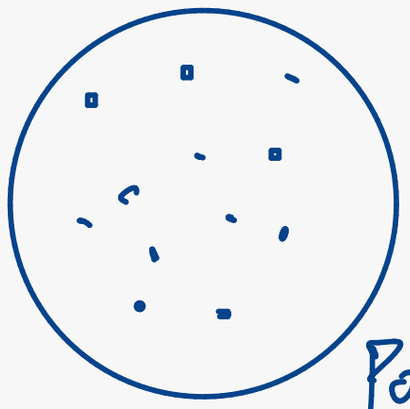
Ecology across scales: Spatial + Temporal

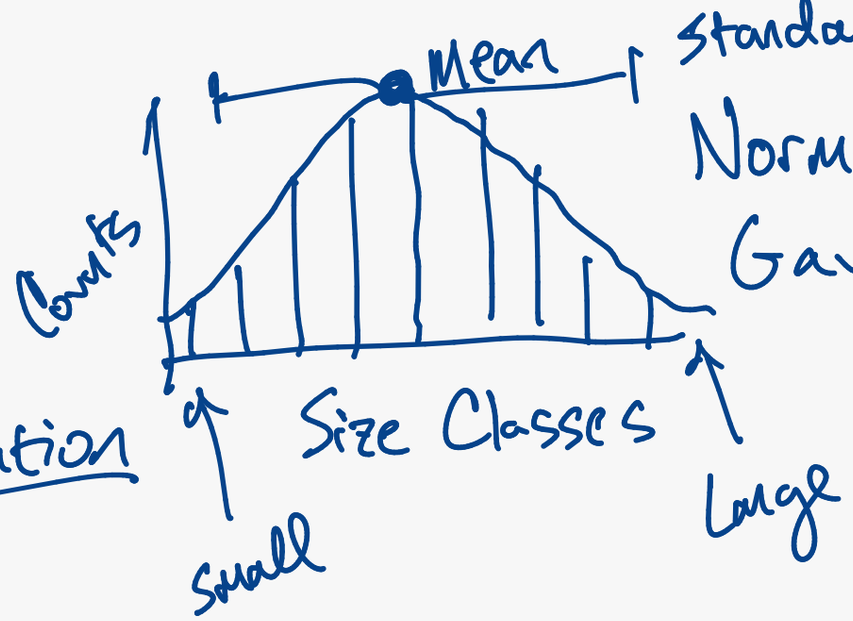


Individual interactions

- traits
- behaviors
- physiology
  - energy

How far do you travel to find food?
What type of food do you gather?
specialist?
generalist?





standard deviation

Normal Distribution

Gaussian Distribution

Population

Intraspecific Variation

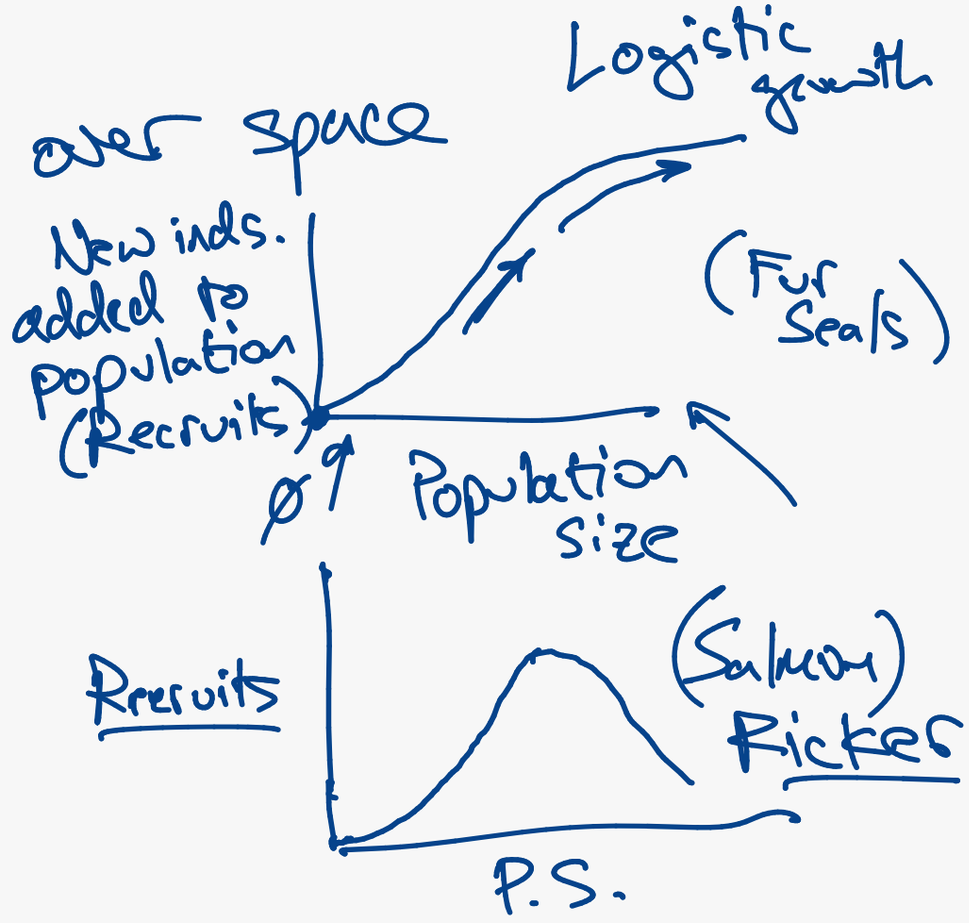
Gene pool ⇝ Genotypes / phenotypes

Distribution / Density of individuals over space

Abundance

Regulation of populations

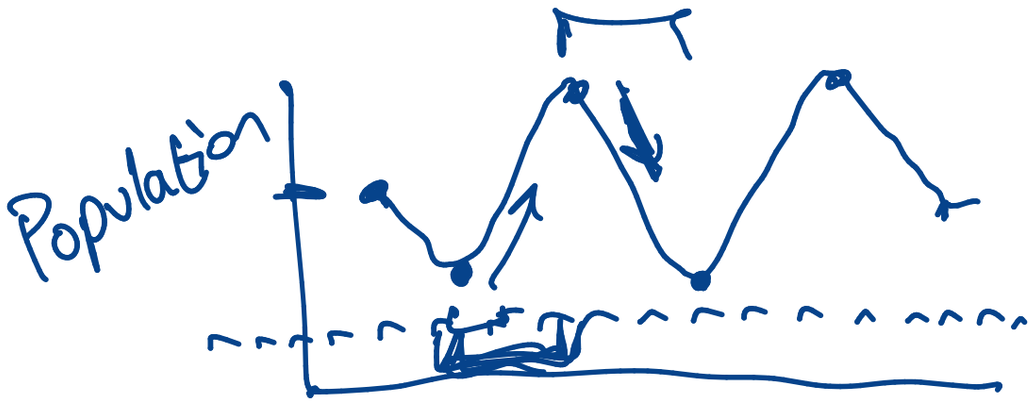
Beverton - Holt



Population interactions

1 species

Many interacting individuals



What drives changes in population size?

ecology

Community interactions

(A)

(B)

(D)

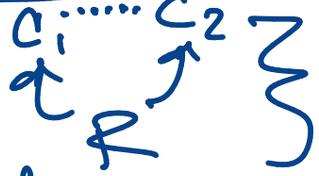
(C)

Many species in the same habitat

- Biodiversity
- Changes in biodiversity
  - over space
  - over time
  - colonization
  - extinctions

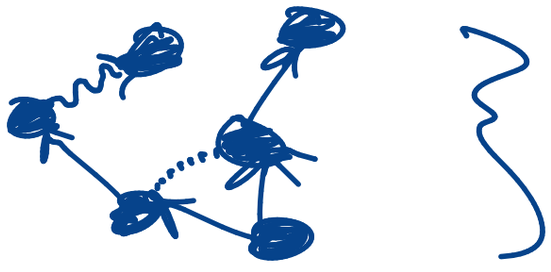
Interactions btw. species

- Competition

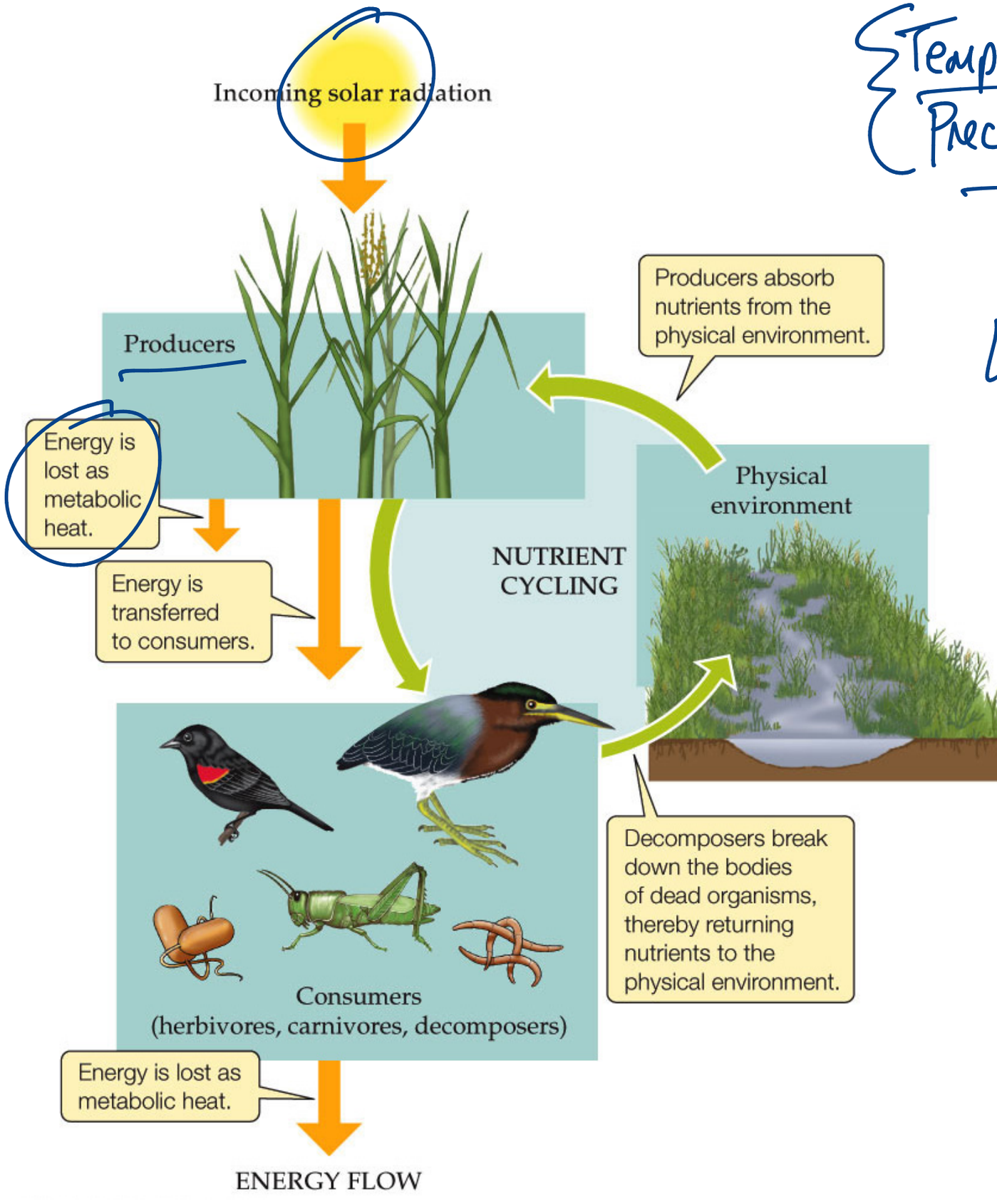


- Predation

- Mutualism
- Commensalism



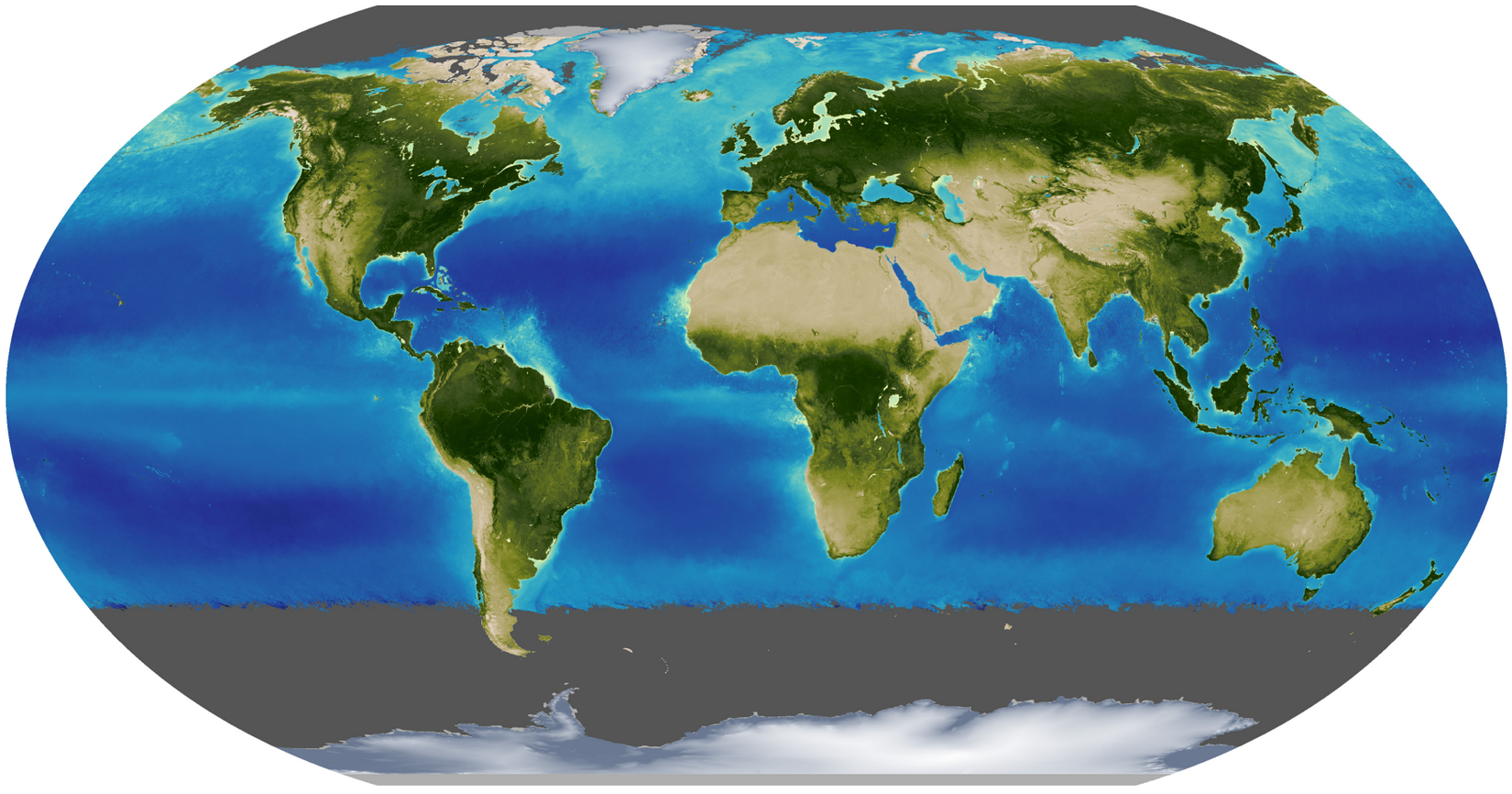
Biotic/Abiotic interactions



Temperature
Precipitation

Living systems ⟷ Abiotic environment

⟷ (ecosystem engineers)



Biosphere

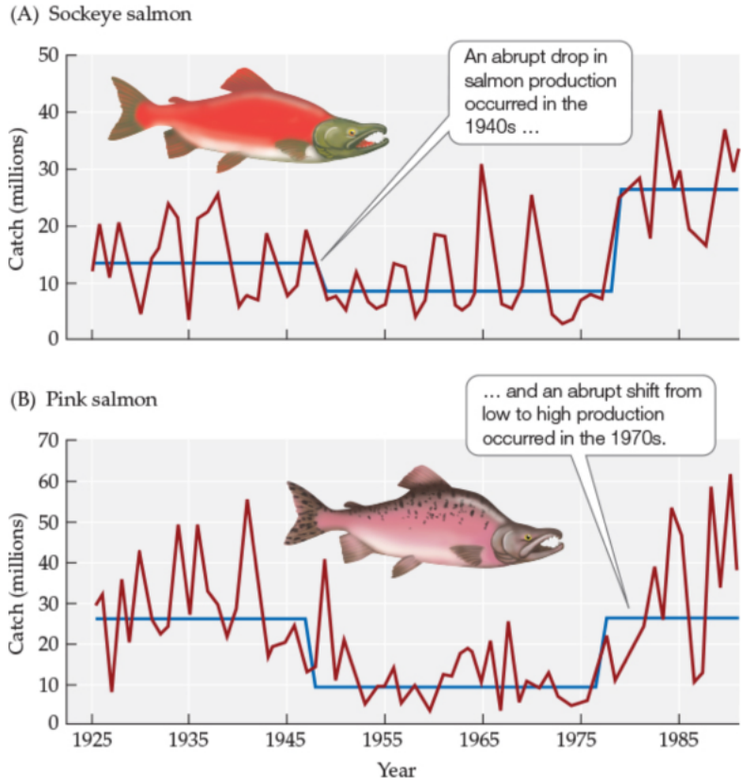


FIGURE 2.2 Changes in Salmon Harvests over Time Records of commercial harvests of (A) sockeye salmon and (B) pink salmon in Alaska over 65 years show abrupt drops and increases in production. Red lines represent annual catch; purple lines are a statistical fit to the data. (After S. R. Hare and R. C. Francis. 1995. In *Climate Change and Northern Fish*

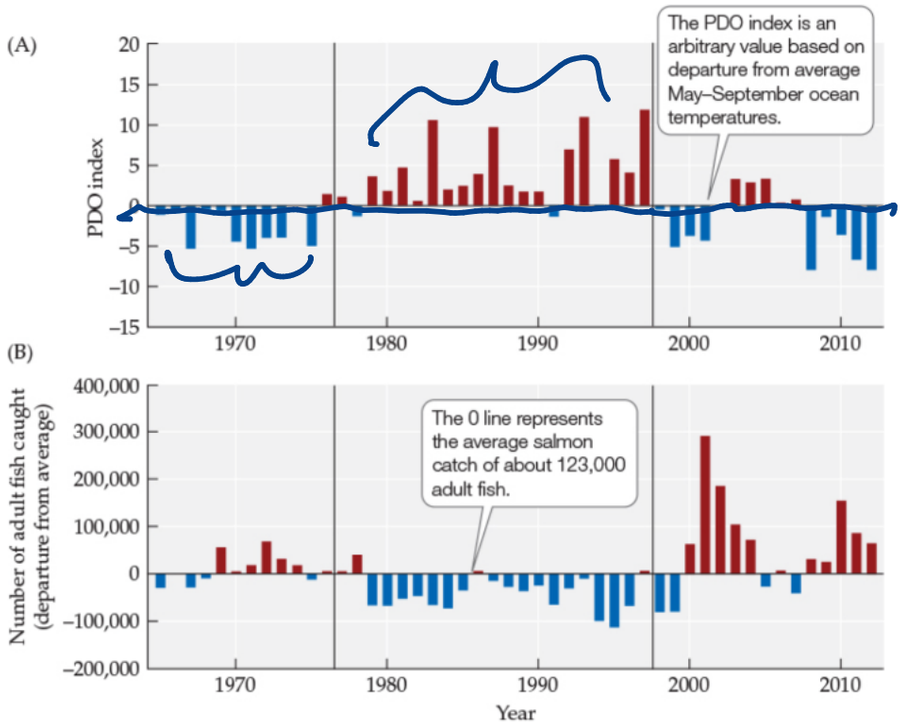
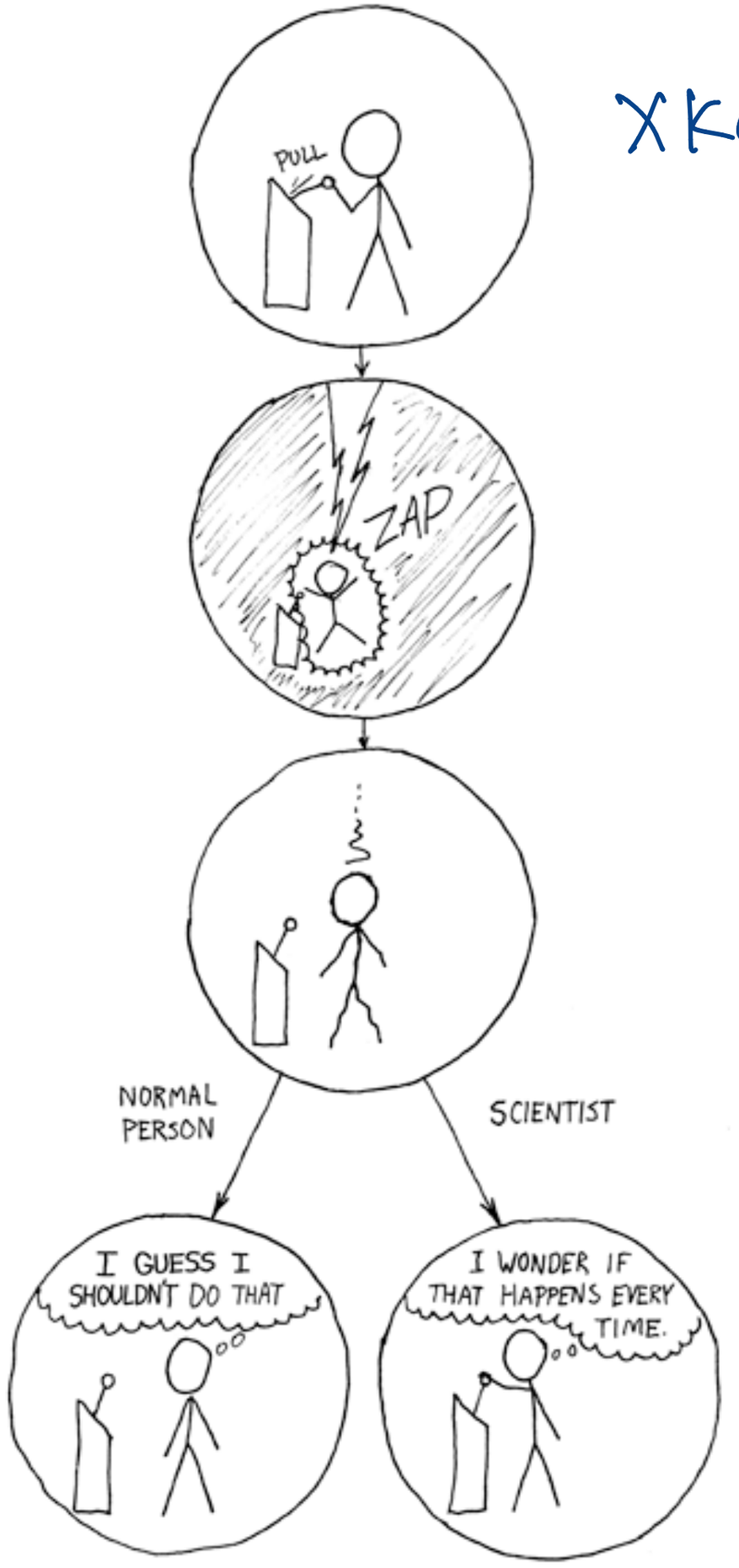


FIGURE 2.26 Effect of the PDO on Salmon Catch in the Northwest United States (A) Summer average PDO index, 1965–2012. Red and blue bars indicate ocean temperatures that are warmer or cooler than average, respectively. (B) Departures from the average (123,131 fish) in numbers of adult Chinook salmon returning to the Columbia River (Washington and Oregon) to spawn, 1965–2012. (After W. T. Peterson et al. 2013. *Ocean Ecosystem Indicators of Salmon Marine Survival in the Northern California Current*. National Marine Fisheries Service: Newport, OR.)

Pacific Decadal Oscillation (PDO)

How do we science?



XKCD

How do we science?

Observe the world

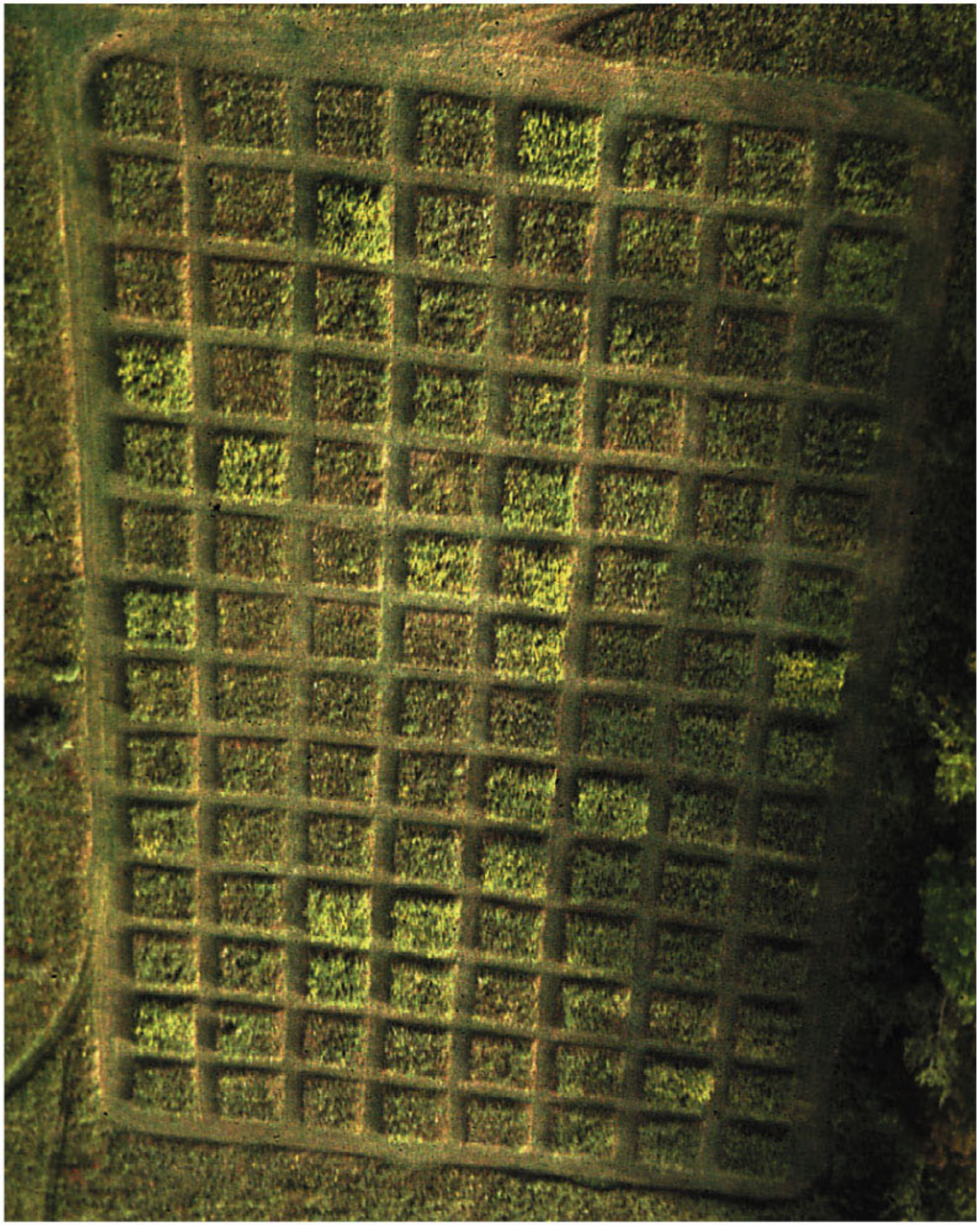
Generate theories & make predictions

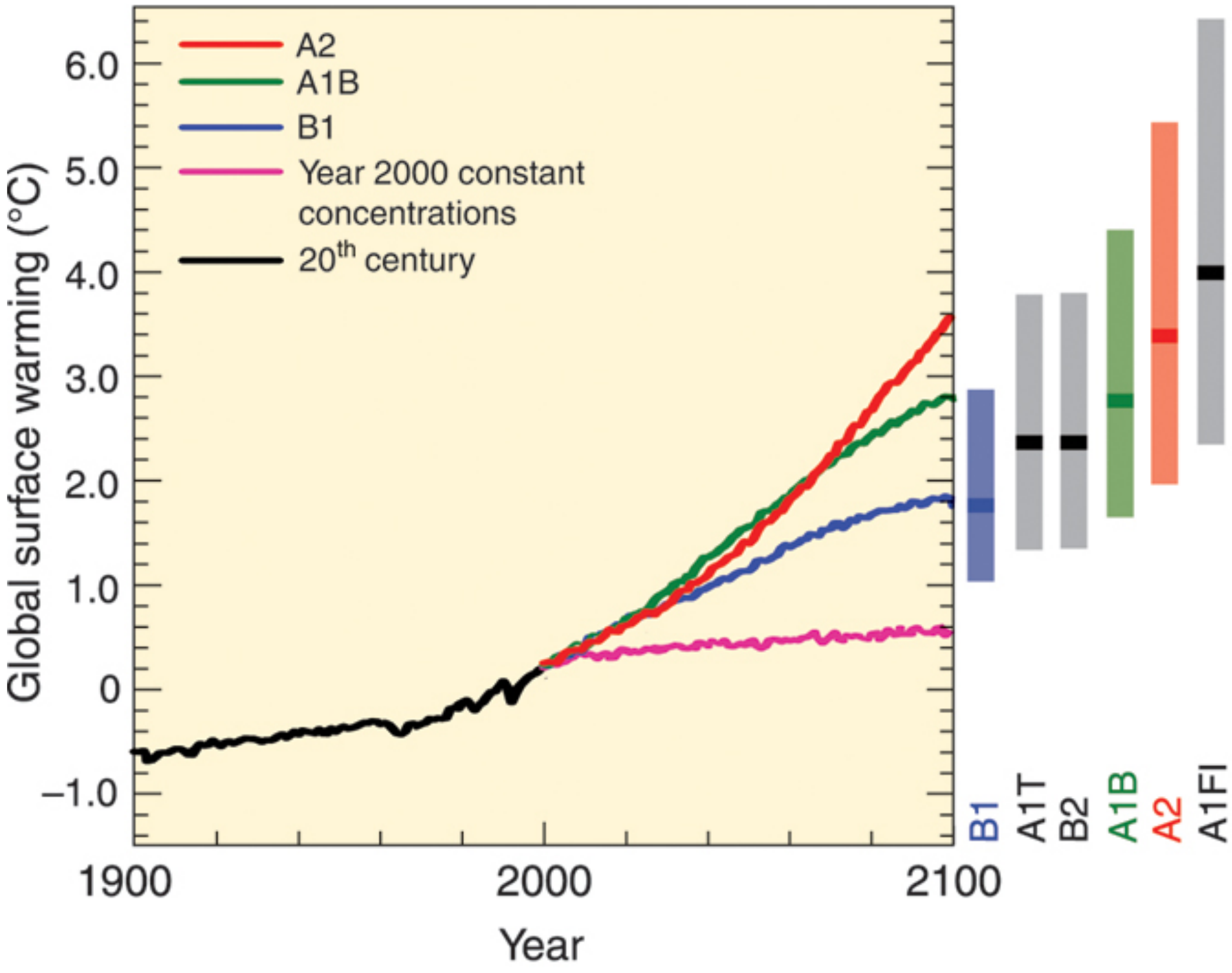
Models tell us what questions to ask

Observe the world

Update theories... make them better

salmon




A2
A1B
B1
Year 2000 constant concentrations
20th century
Global surface warming (°C)
6.0
5.0
4.0
3.0
2.0
1.0
0
–1.0
1900
2000
2100
Year
B1
A1T
B2
A1B
A2
A1FI