Extinction

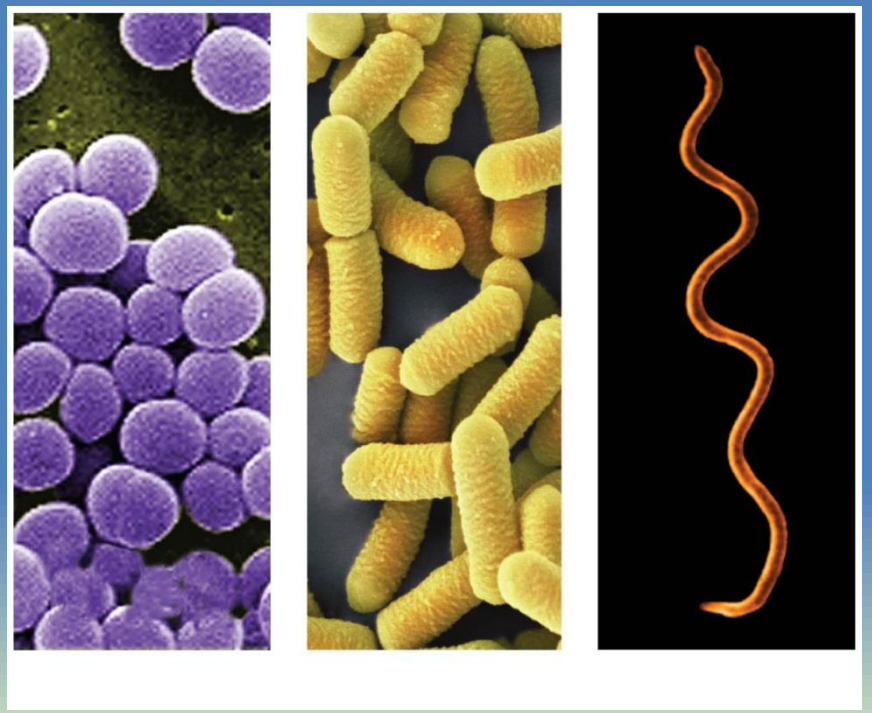
Preview

1. Historical Extinctions
2. Current Extinctions
3. Extinction Factors

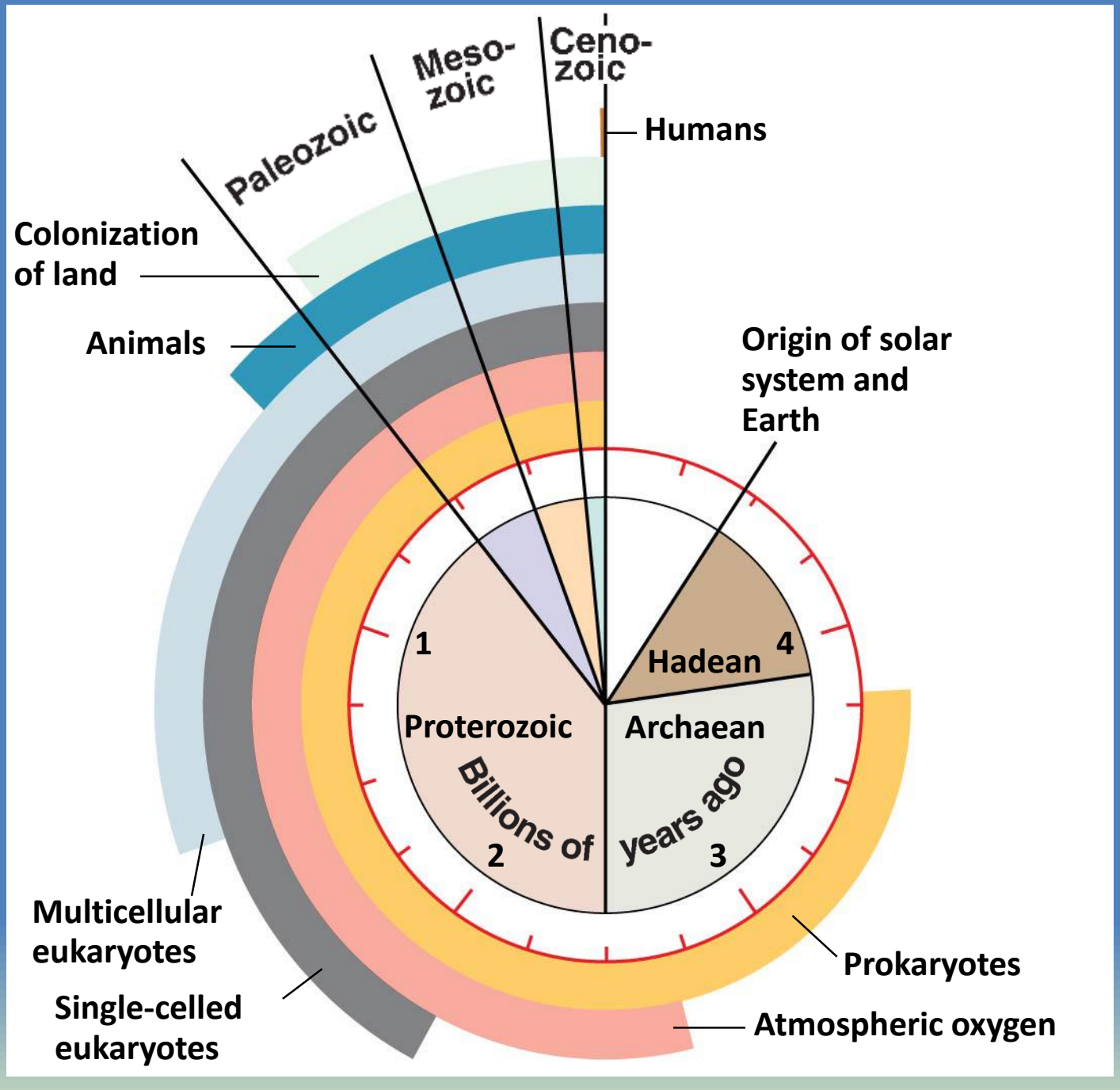
1.

Historical Extinctions

- Most abundant organisms to ever inhabit Earth are prokaryotes



1.


Meso-
zoic
Ceno-
zoic
Paleozoic
Humans
Colonization
of land
Animals
Origin of solar
system and
Earth
1
Proterozoic
Billions of
2
Hadean
4
Archaean
years ago
3
Multicellular
eukaryotes
Single-celled
eukaryotes
Prokaryotes
Atmospheric oxygen

1.

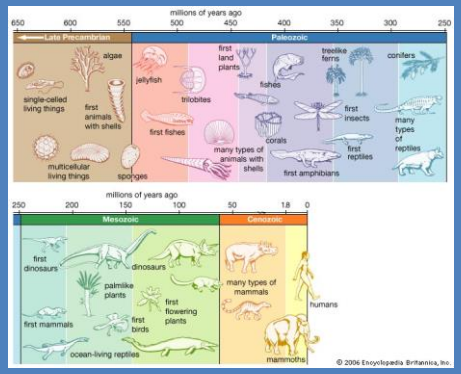
"If you wanted to squeeze the 3.5 billion years of the history of life on Earth into a single minute, you would have to wait about 50 seconds for multicellular life to evolve, another four seconds for vertebrates to invade the land, and another four seconds for flowers to evolve—and only in the last 0.002 seconds would 'modern' humans arise."

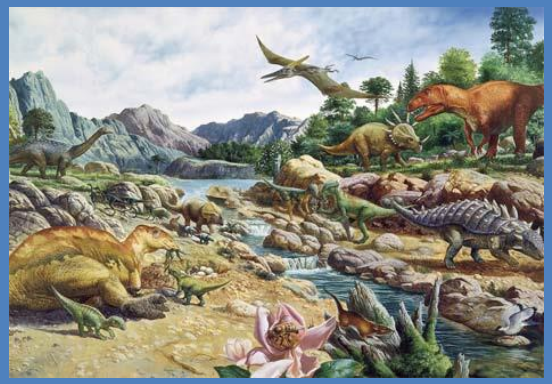
evolution.berkeley.edu; www.wikipedia.org

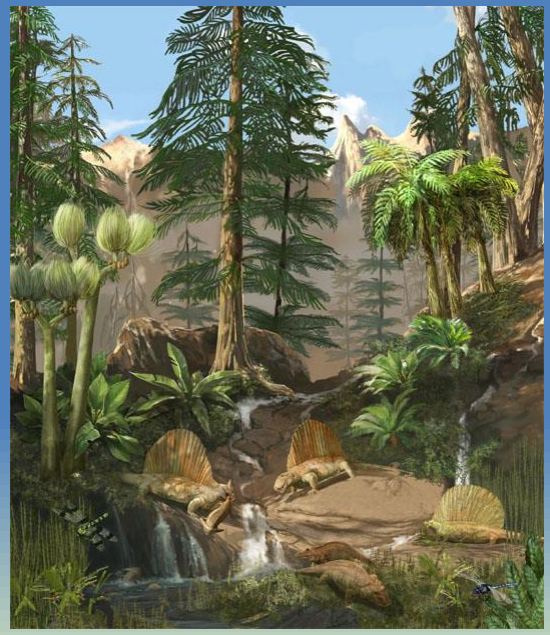
1.

Historical Extinctions

- 99% of all species have gone extinct







1.

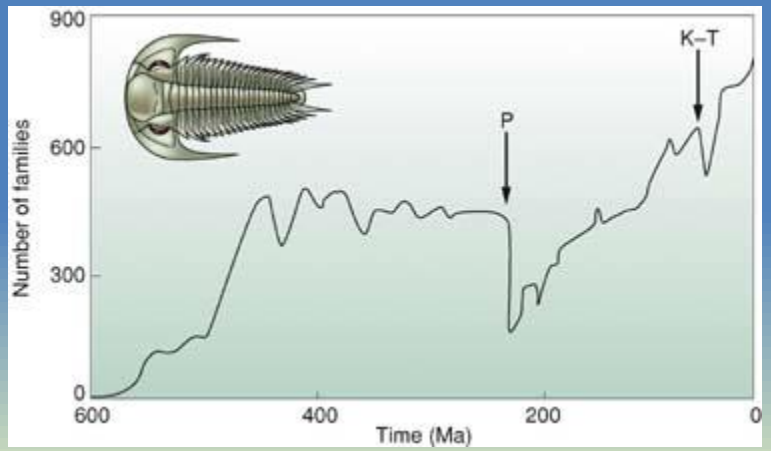
Historical Extinctions

- Two types of extinction
  - Background extinction
    - About 1 species in a million/year
    - Average species lifespan = 1-10 million years

1.

Historical Extinctions

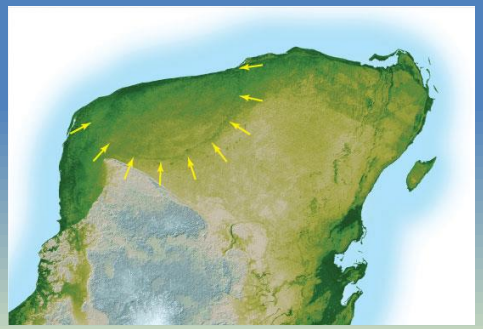
- Two types of extinction cont'd
  - –Mass Extinction
    - Occur over relatively rapid timescales
    - >50% of all species lost
    - 5 major events in history



1.

Historical Extinctions

- K-T Extinction
  - Occurred ~ 65mya
  - Asteroid strike(s)
  - Active volcanism



K-T Extinction

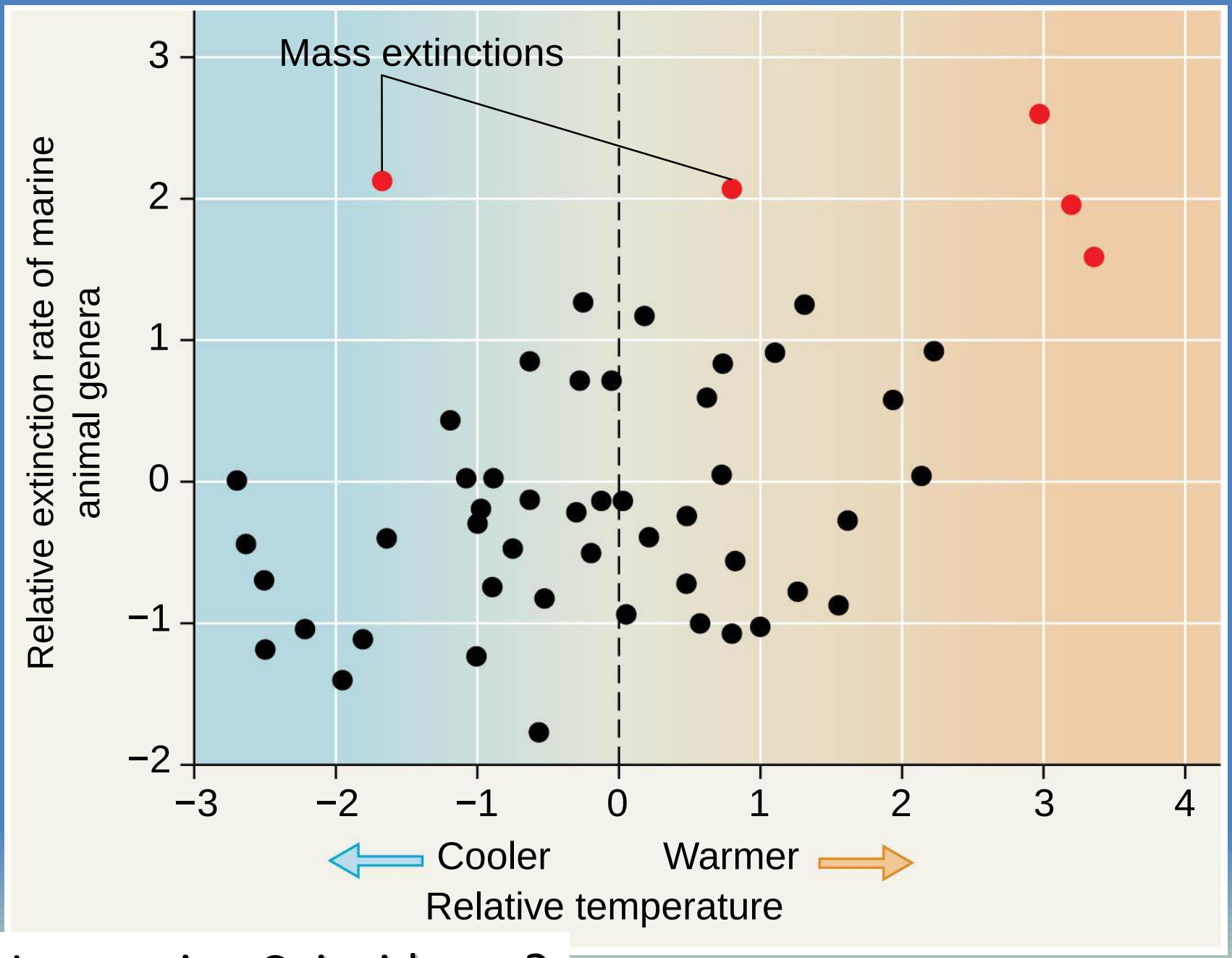
1.

Historical Extinctions

- Permian Extinction
  - Occurred ~250 mya
  - The "Great Dying"
  - Medea hypothesis

Permian Extinction

1.



An Interesting Coincidence?

Current Extinctions

- Ivory-billed woodpecker
  - One of the world's largest woodpeckers
  - Native to SE USA

Current Extinctions

- Ivory-billed woodpecker cont'd
  - Late 1800s: extensive logging and persecution
  - 1938: population ~20
  - 1967: listed as endangered
  - 1994: declared extinct by IUCN
  - 2005: record of sightings published in *Science*
  - 2005-present: no conclusive evidence

Lord God Bird

2.

Current Extinctions

- Current estimates of extinction rates 100-1000x that of background rates
- Documenting extinction
  - "Absence of evidence is not evidence of absence"
  - A species must be known to become extinct

2.

Current Extinctions

- Species-area relationship (Preston 1962; MacArthur and Wilson 1967)
  - $S = CA^z$
  - Species richness is a function of:
    - Area
    - How a species responds when habitats are
      - Growing vs. shrinking
      - Far away or close to other habitats

2.

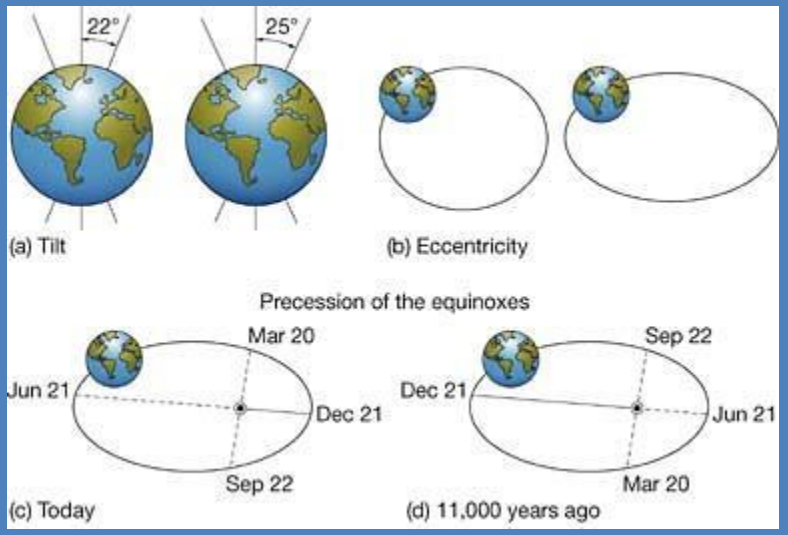
Current Extinctions

- z usually ranges from 0.15-0.35
- So, if… $S = CA^z$
  - z is 0.3
  - Area decreases by 90%
  - Species richness decreases by 50%
- We can predict diversity loss based on area lost to habitat degradation

2.

Current Extinctions

- Earth's climate
  - 3 basic cycles
    - Tilt of the axis
    - Shape of orbit
    - Earth "wobble"
  - Explain changes in global temperature and ice ages

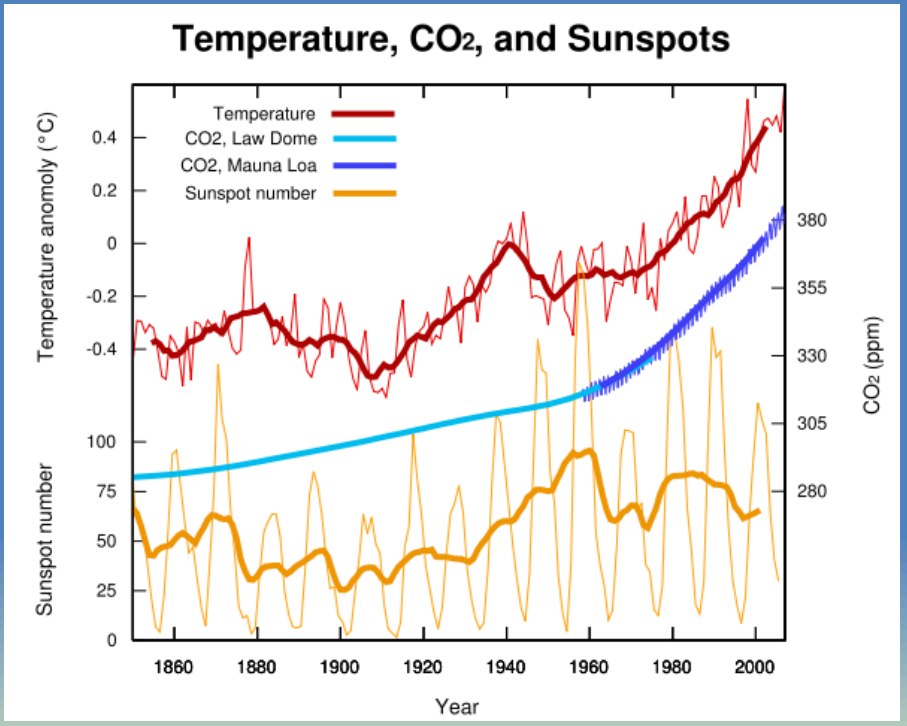


CO_2 and Climate

2.

Current Extinctions

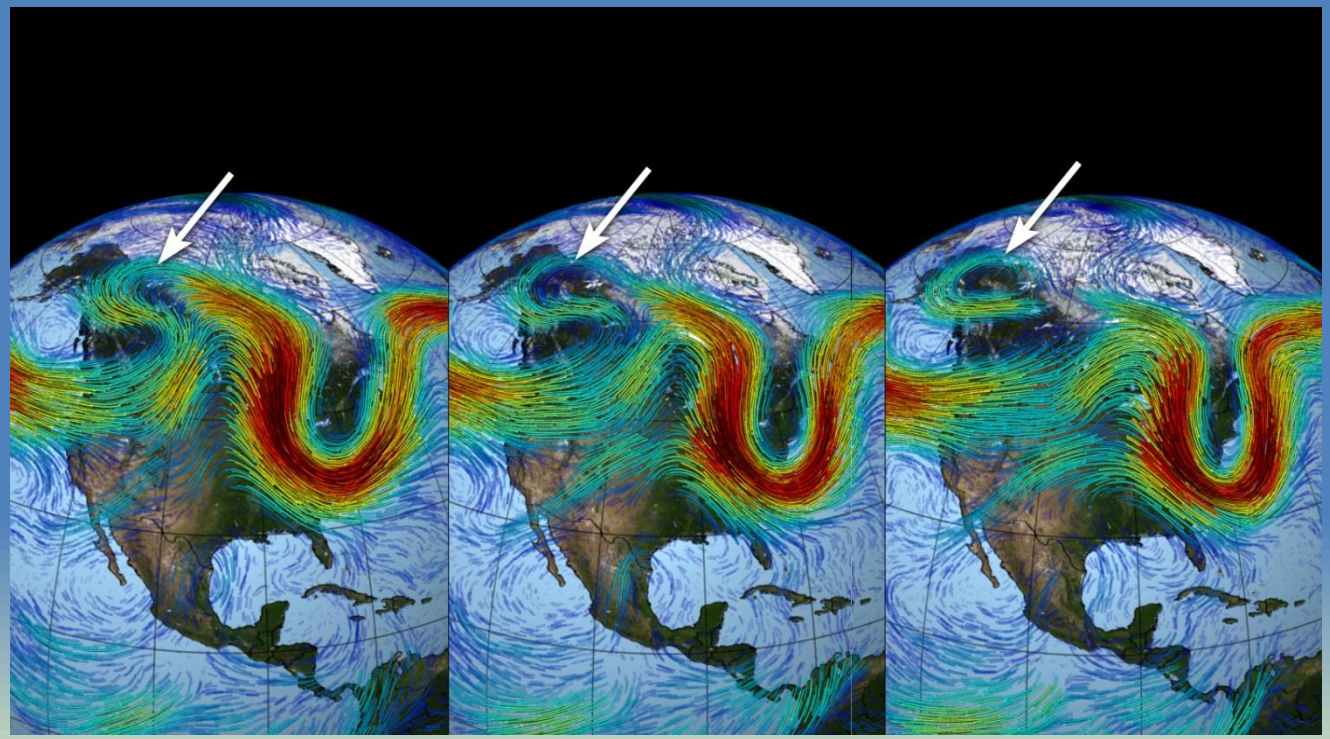
- Earth's climate cont'd
  - Sunspot activity



2.

Current Extinctions

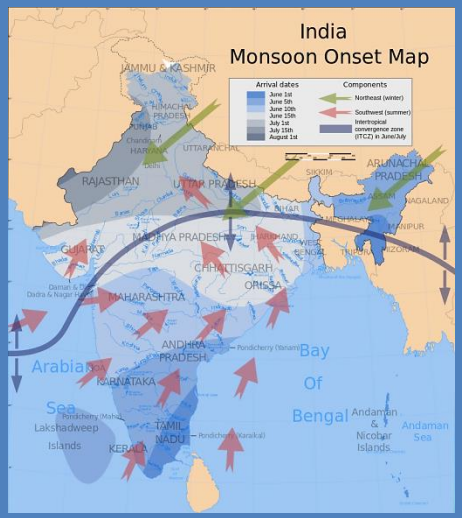
- Earth's climate cont'd
  - Changes in jet stream and currents



2.

Current Extinctions

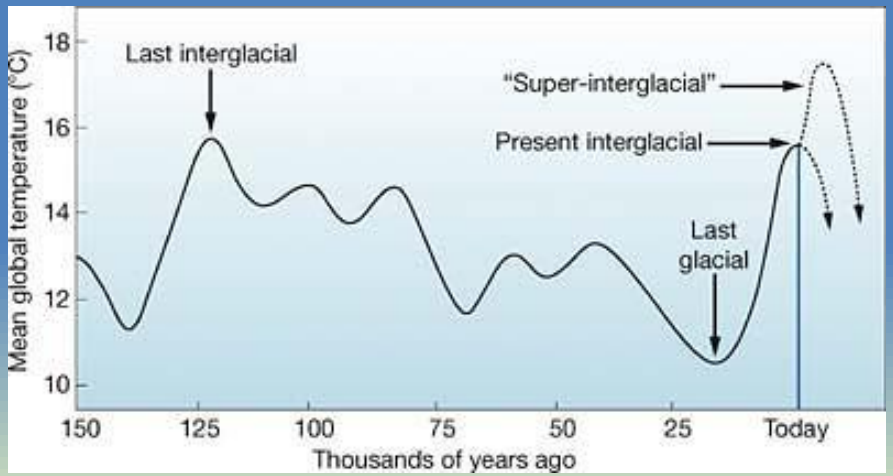
- Earth's climate cont'd
  - Large temperature swings at poles
  - Changes in precipitation nearer equator



2.

Current Extinctions

- Earth's climate cont'd
  - –Glacials vs. interglacials
    - Precipitation
    - Temperature
    - Distribution of ecosystems
    - Storage of carbon



Current Extinctions

- Responses of organisms to climate changes
  - Move to different latitude and/or elevation
  - 100m elevation = 110km latitude
  - Rates have historically been rather slow

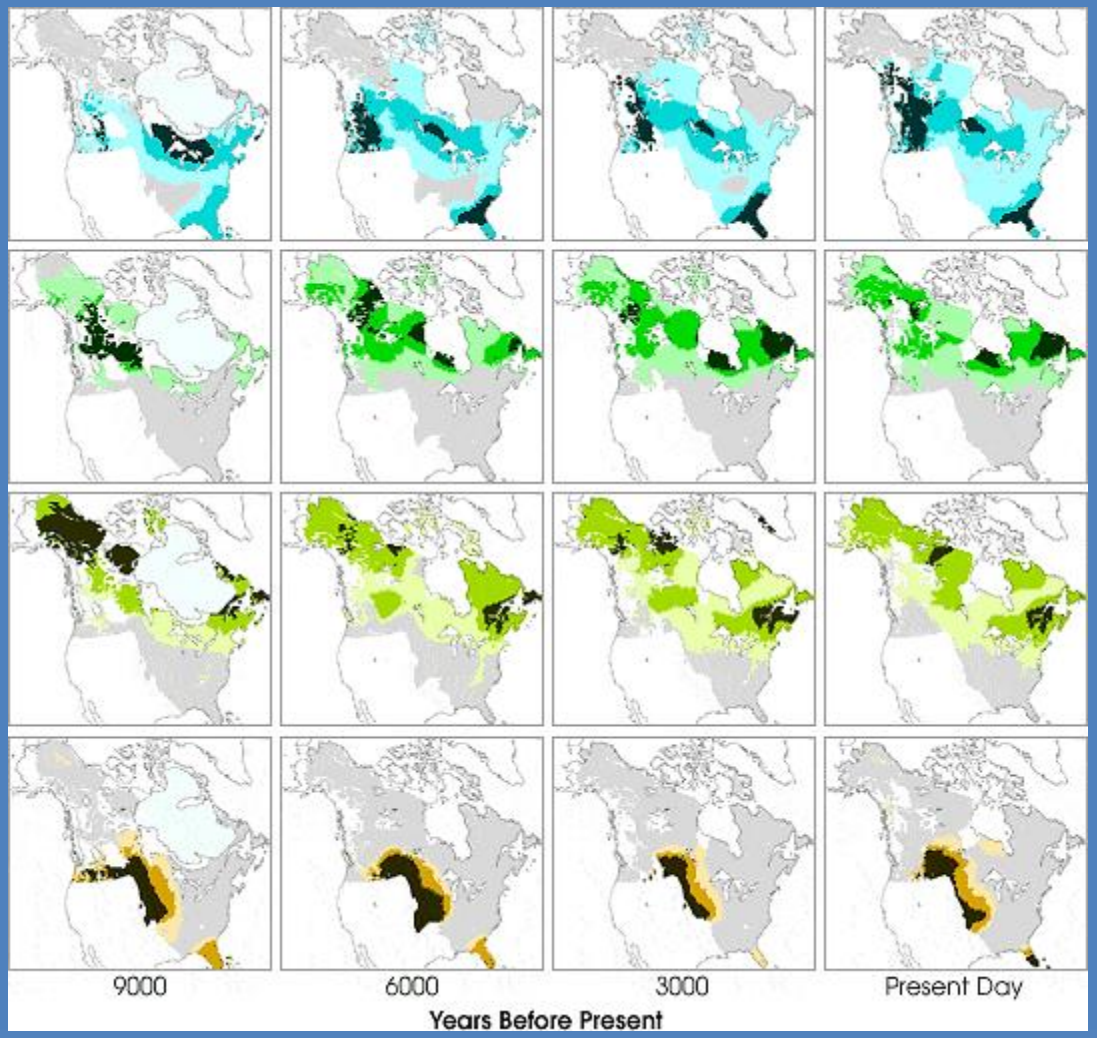
Current Extinctions

- How is current extinction different?
  - Consumption of fossil fuels
  - Loss/Fragmentation of habitats
  - Rate of change

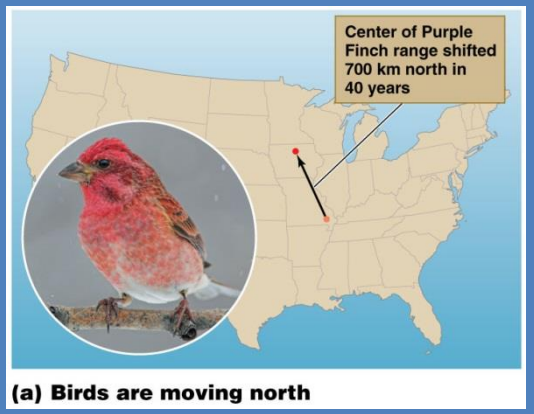
Fossil Fuels

Anthropocene

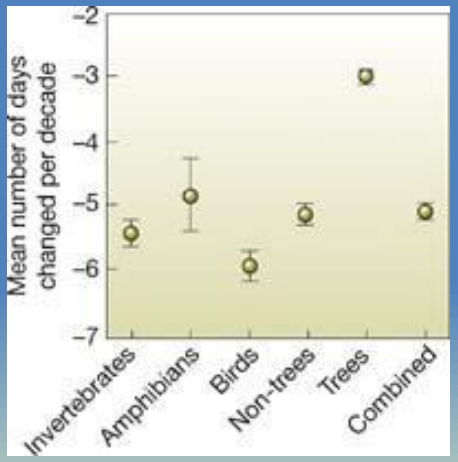
2.


9000
6000
3000
Present Day
Years Before Present

VS.


Center of Purple Finch range shifted 700 km north in 40 years
(a) Birds are moving north


Pikas are disappearing from mountains after being forced upwards
(b) Pikas are being forced upslope


Mean number of days changed per decade
-2
-3
-4
-5
-6
-7
Invertebrates
Amphibians
Birds
Non-trees
Trees
Combined

3.

Extinction Factors

- What makes species vulnerable?
  - –Philopatric?
  - –Mobile?
  - –Migratory?

3.

Extinction Factors

- Factors in vulnerability
  - Environmental change/catastrophe
  - Invasive species
  - Habitat specialist
  - Small population

Extinction Factors

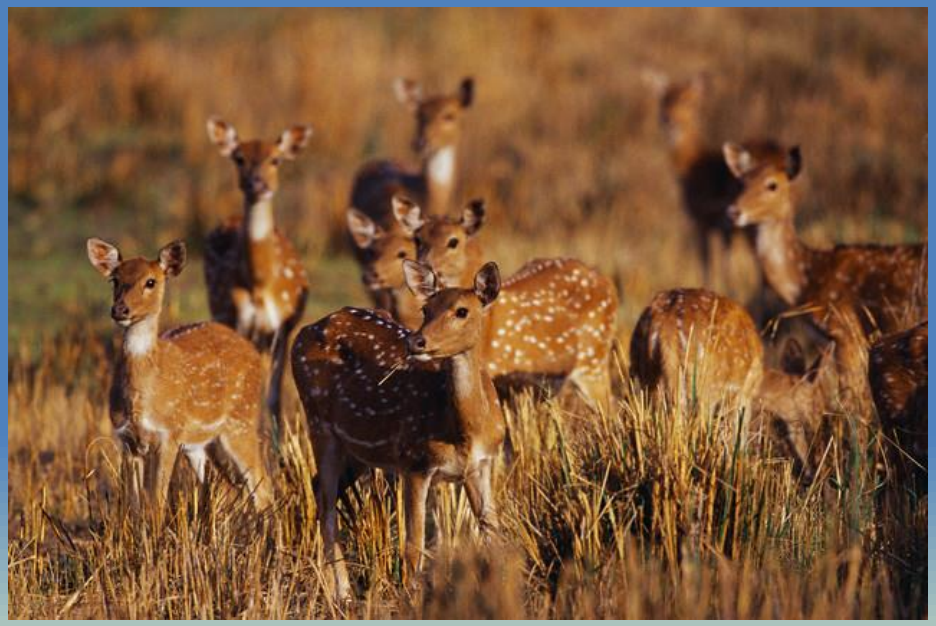
- Factors in vulnerability cont'd
  - Low reproduction rate
  - Require large home range
  - Interaction with humans
    - predator = dangerous
    - Game species
    - Reside in desirable ecosystems

Extinction Factors

- Populations
  - Group of individuals (same species) inhabiting sharing a space at a certain time
  - Are populations isolated?
  - What kinds of exchanges occur?

Extinction Factors

- Defining the boundaries
  - Political
  - Ecological
  - Genetic
  - Demographic



Extinction Factors

- Metapopulation
  - Group of populations occurring in patches across the landscape
  - Separated by unsuitable habitat or distance
  - Sources
  - Sinks

3.

Extinction Factors

- Population Viability Analysis (PVA)
  - Smallest population that can survive/persist in an area
  - BIDE
  - Survival rates, reproductive rate
  - Create model to predict fate of population

3.

Extinction Factors

- Extinction risks
  - Demographic changes
  - Environmental changes
  - Catastrophes
  - Genetic changes

Resources

Publications

Hunter Jr., M. L., and J. Gibbs. 2007. Fundamentals of Conservation Biology, 3rd Edition. Blackwell, Malden.

Reece, J.B., Urry, L.A., Cain, M.L., Wasserman, S.A., Minorsky, P.V., and R.B. Jackson. 2014. Campbell Biology, 10th edition. Pearson, New York.

Withgott, J. and M. Laposata. 2012. Essential Environment: The Science behind the Stories, 4th Edition. Pearson, New York.