

Last Time...



Why do mosquitoes bite some people more than others?

Blood type, metabolism, exercise, shirt color and even drinking beer can make individuals especially delicious to mosquitoes.

- Type O is more attractive than A
- Larger people (and pregnant ladies) exhale more CO₂ – get bit more than children
- Attracted to lactic acid/high body temp (exercise)
- Colors that stand out (black, dark blue, red) make you easier to find

<http://www.smithsonianmag.com/science-nature/why-do-mosquitoes-bite-some-people-more-than-others-10255934/?no-ist>

Thanks Anna and Paul!

Climate change will affect the following factors

- Carbon Dioxide levels
- Temperature
- Precipitation
- Salinity
- pH (acid level)

These factors all have important effects on Life!

Climate change will affect the following factors

- Carbon Dioxide levels

- Temperature

- Precipitation

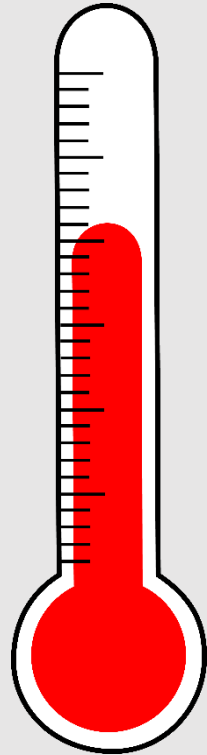
- Salinity

- pH (acid level)

Temperature

Average global temperatures have warmed about 0.6°C over the last 150 years

Likely to warm an additional 2° to 6°C by the end of this century



Temperature patterns have changed:
increased nighttime minimum
temperatures

Frost defines the growing season for some
plants



Temperature

- Temperatures below 10°C severely inhibit tomato growth
- Temperatures below 6°C render crops inedible
- Increased temperature = longer growing season!

Hurray for climate change!



Temperature

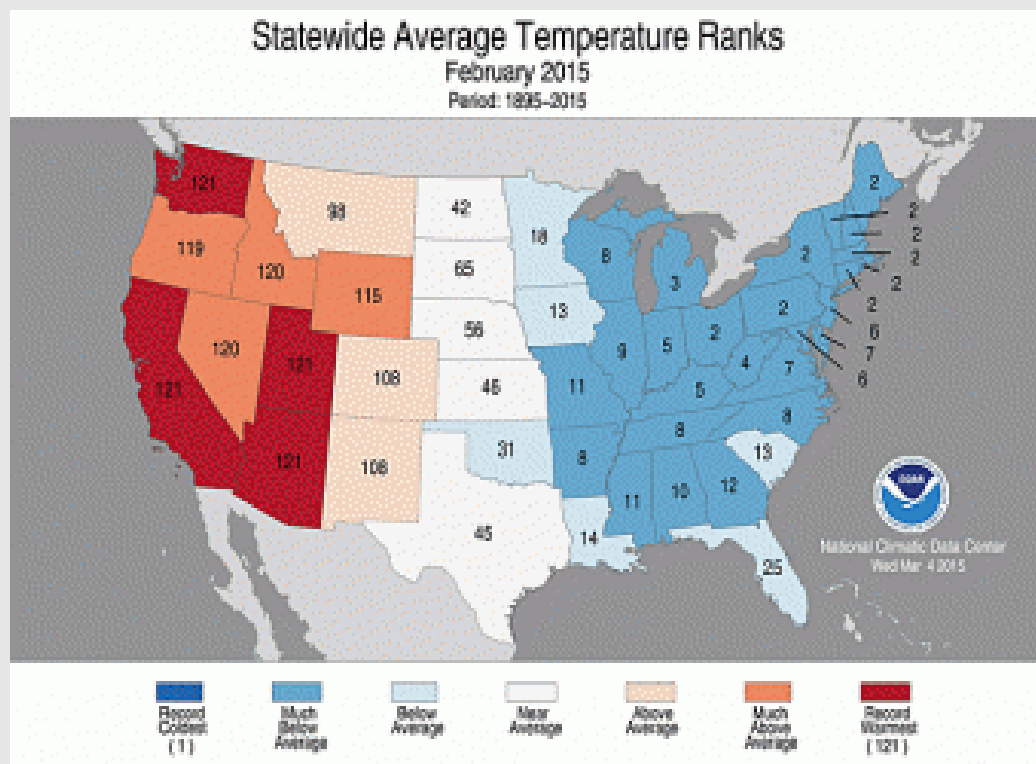
- Grapes: high temp during fruit ripening decreases wine quality
- Ideal growing locations will shift to higher latitudes and from inland to costal areas
- Total premium wine grape production in the United States might decline by up to 81% !



Today is Groundhog Day!



- Today's prediction – early spring
- Since 1993, the U.S. national temperature has been above normal 11 times, below normal 6 times, and near normal 6 times in February.



Timing of Seasons have changed: spring events occurring an average of 2.3 to 5.1 days earlier each decade

–arrival times of migrant
Species

–peak flight date

–nesting

–egg laying



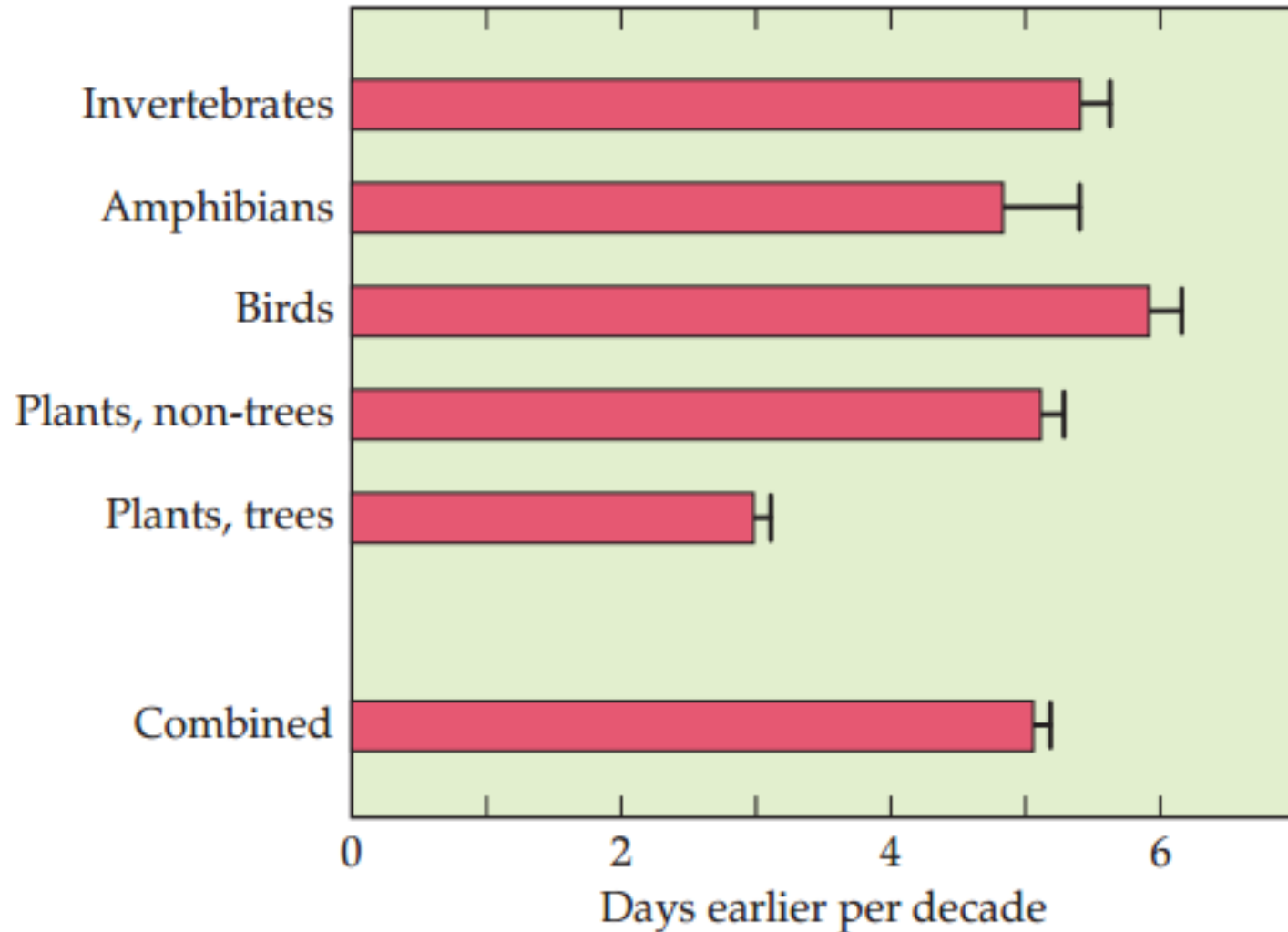
Budburst



Flowering



Shift in spring events for the past 50 years, 694 species



Autumn events delayed by 0.3 to 1.6 days per decade

- leaf fall
- hibernation
- departure times of migrants



Effect on species ranges

- Heat and drought at mid-latitudes
- Expanded growing seasons at **higher latitudes**

Species have migrated 16.9 km closer to the poles each decade

- Audubon Society, 2014: 314 species will lose more than 50 percent of their current climatic range by 2080
- Based on 40 years of “citizen science” and climate change models



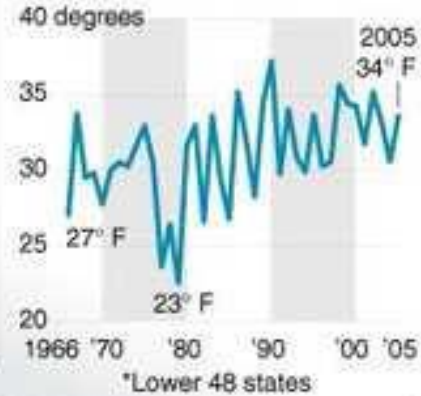
Spending winter farther north

As the temperature across the U.S. has gotten warmer from 1966 to 2005, many bird species are spending their winters farther north.

Change in winter destination,
20 species with the most movement

● Winter 1966-67 ● Winter 2005-06

Average January temperature in U.S.*



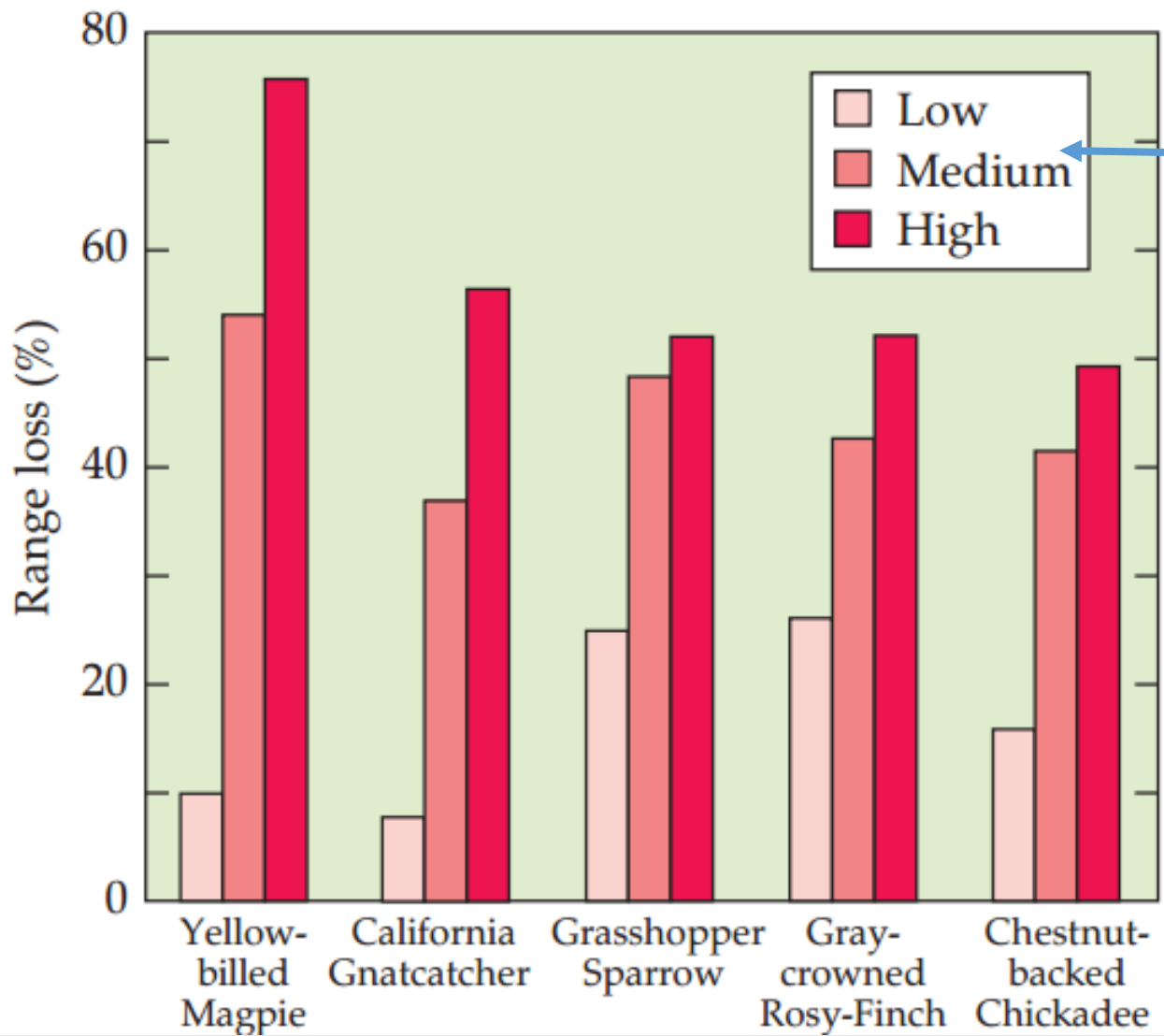
0 200 mi
0 200 km

Yellow Billed Magpie

Yellow Billed Magpie

- Exists only in CA
- Will loose 75% of range under high emission scenario
- Will loose 9% of range if pollution is reduced significantly





Effect on species ranges

- Expanded growing seasons at **higher altitudes**

Species have migrated 11.0 meters higher in elevation each decade

Alpine species move higher up the mountain





Revisiting the past to foretell the future: summer temperature and habitat area predict pika extirpations in California

Stewart et al., Journal of Biogeography, 2015.

- Surveyed 67 locations with historical records of pikas.
Disappeared from 15 percent of the sites surveyed.
- Pika populations were most likely to go locally extinct at sites with high summer temperatures and low habitat area.
- **When summer temperatures are too high, pikas are forced to stay underground to avoid overheating. Less time spent foraging means they don't have as much food to eat, which increases the likelihood of local extinction.**

Using GCMs to predict future pika range

- 34 different GCM outputs, based on different levels of human emissions of GHGs
- If only modest action is taken, the **model predicts that pikas will disappear from about 75% of sites by 2070** (51 to 88 percent, depending on the global climate model used)
- **With aggressive action to reduce GHGs, the model predicts that only about 51% of sites will suffer local extinction** (39 to 79 percent, depending on the global climate model)



Alpine Plants

- Adapted to cold, windy environment
- Grow low to the ground
- Plants from lower altitudes move up the mountain, compete for sunlight and nutrients



Effects on Species Range

Grizzly bears moving north to forage



Coming into contact with Polar Bears

- Competition for resources
- Hybridization?

2006. Polar bear mother, grizzly bear father





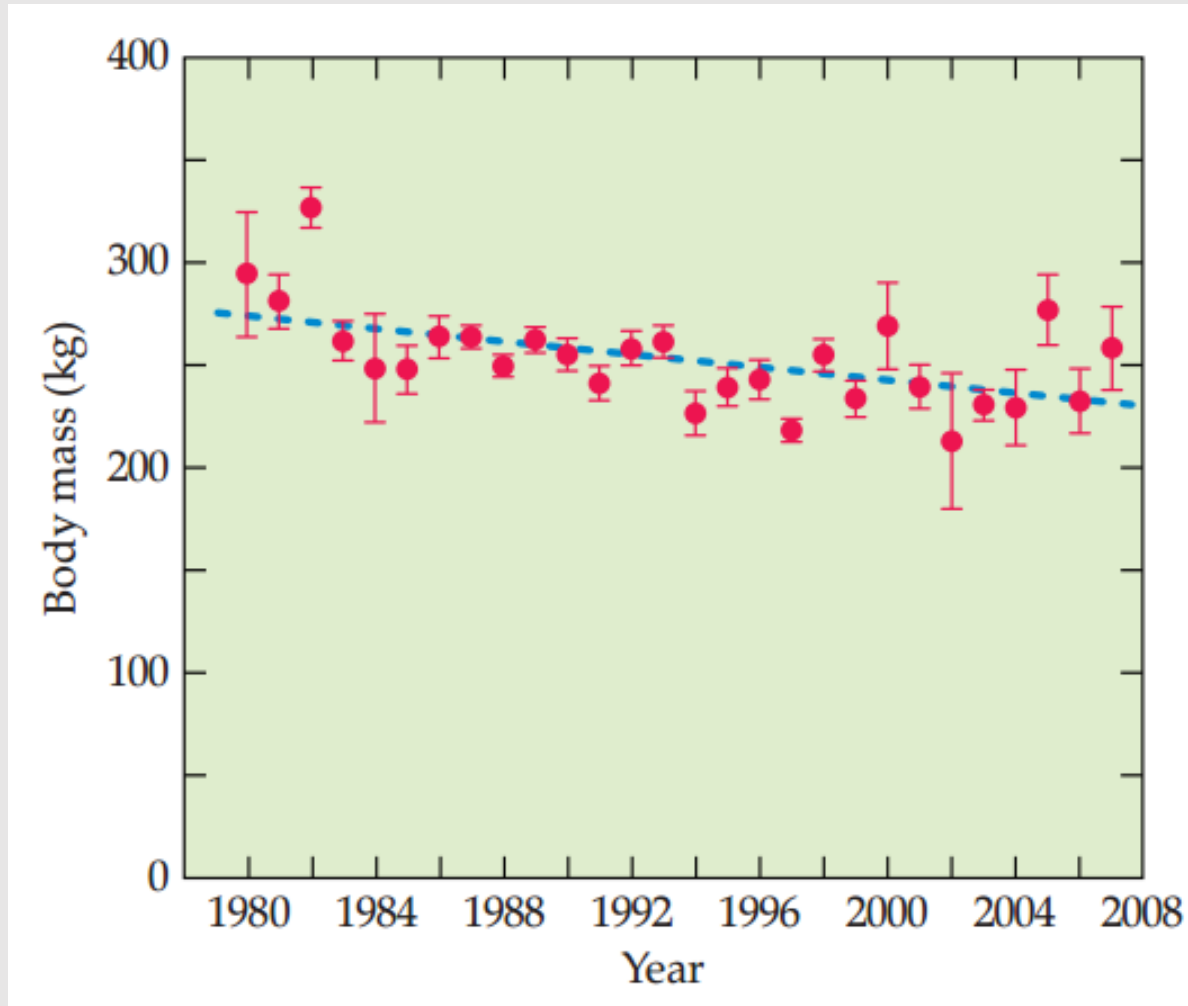
Polar Bears and Temperature Change

- Hunt seals from ice, unsuccessful at hunting in the water
- Swim south to give birth on land
- Melting ice means longer swims
 - Some Bears are drowning.



When on Land, They Scavenge

- Competition with other polar bears
- Competition with grizzly bears
- Contact with humans



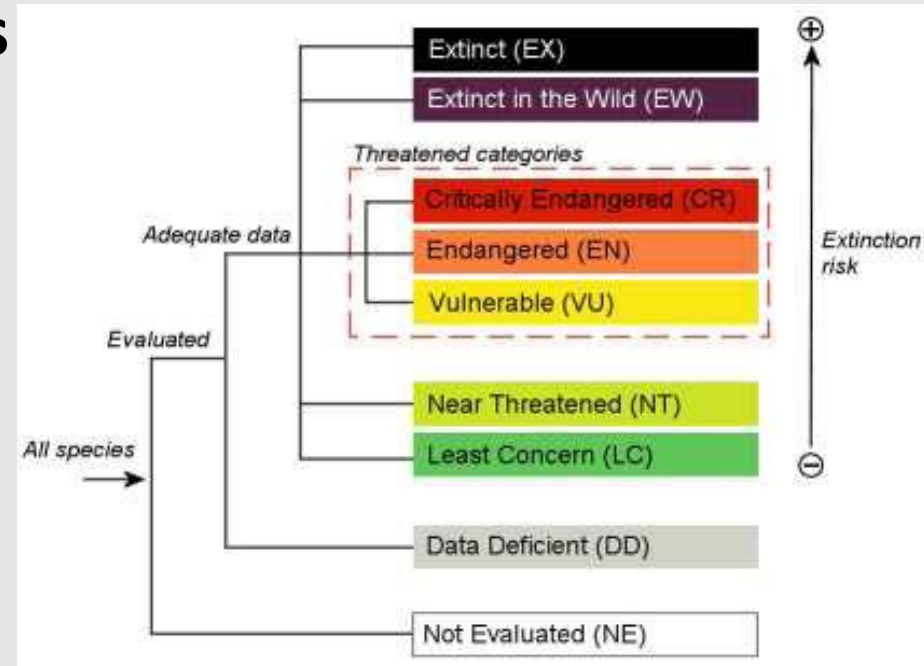


© Roger Nilsson



Polar Bears and Temperature Change

- IUCN Red List: **International Union for Conservation of Nature and Natural Resources**
- Listed as **Vulnerable**
- Based on a suspected population reduction of >30% within three generations (45 years)
- Justification for the status is climate change.



2008: US Government Listed Polar Bears as Threatened Under the Endangered Species Act

- Major threat: sea ice habitat is shrinking and is likely to continue to do so over the next several decades
- “Interior Secretary Dirk Kempthorne, however, made clear several times during a press conference announcing the department's decision that, despite his acknowledgement that the polar bear's sea ice habitat is melting due to global warming, **the ESA will not be used as a tool for trying to regulate the greenhouse gas emissions blamed for creating climate change.**”



Penguins and Temperature Change



Adélie penguin



Emperor penguins

Depend on sea ice for breeding

Adélie populations shifting to colder sites



Emperor populations declining

Extent of sea ice at breeding site has declined by 66% over the past 50 years

– Krill, a food source for penguins, rely on sea ice

Reduced quantity and accessibility of food



Krill: shrimp-like marine invertebrates





Baleen Whales

14 Species

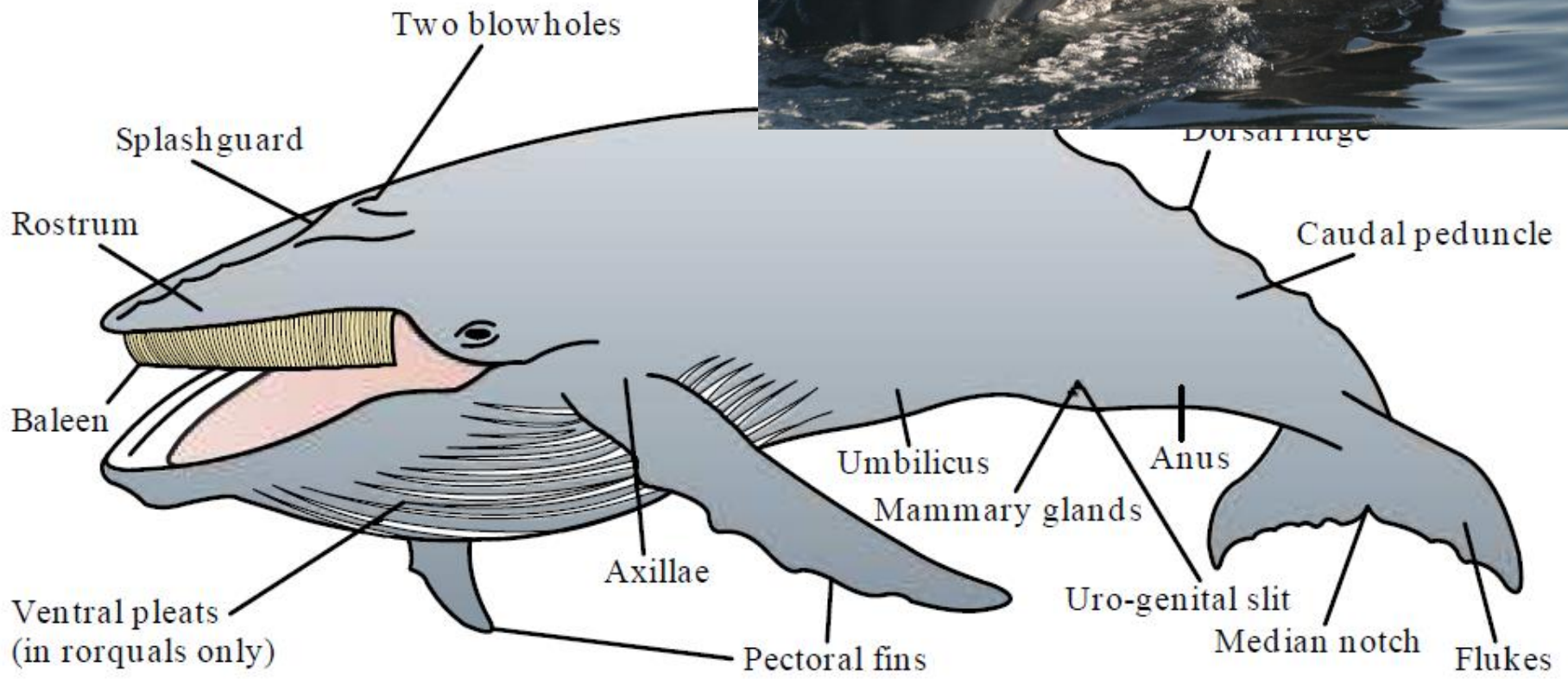


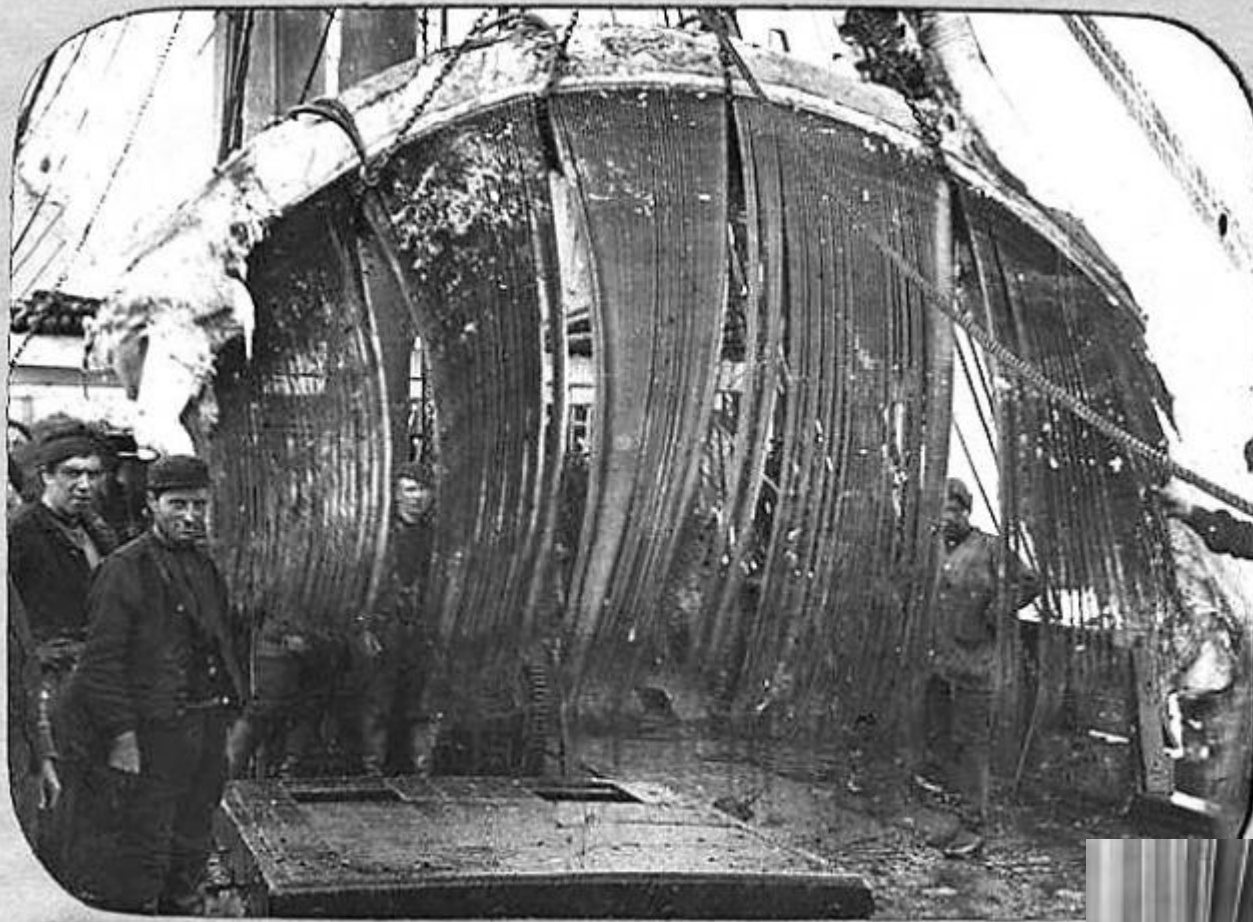
Humpback whale



Blue whale

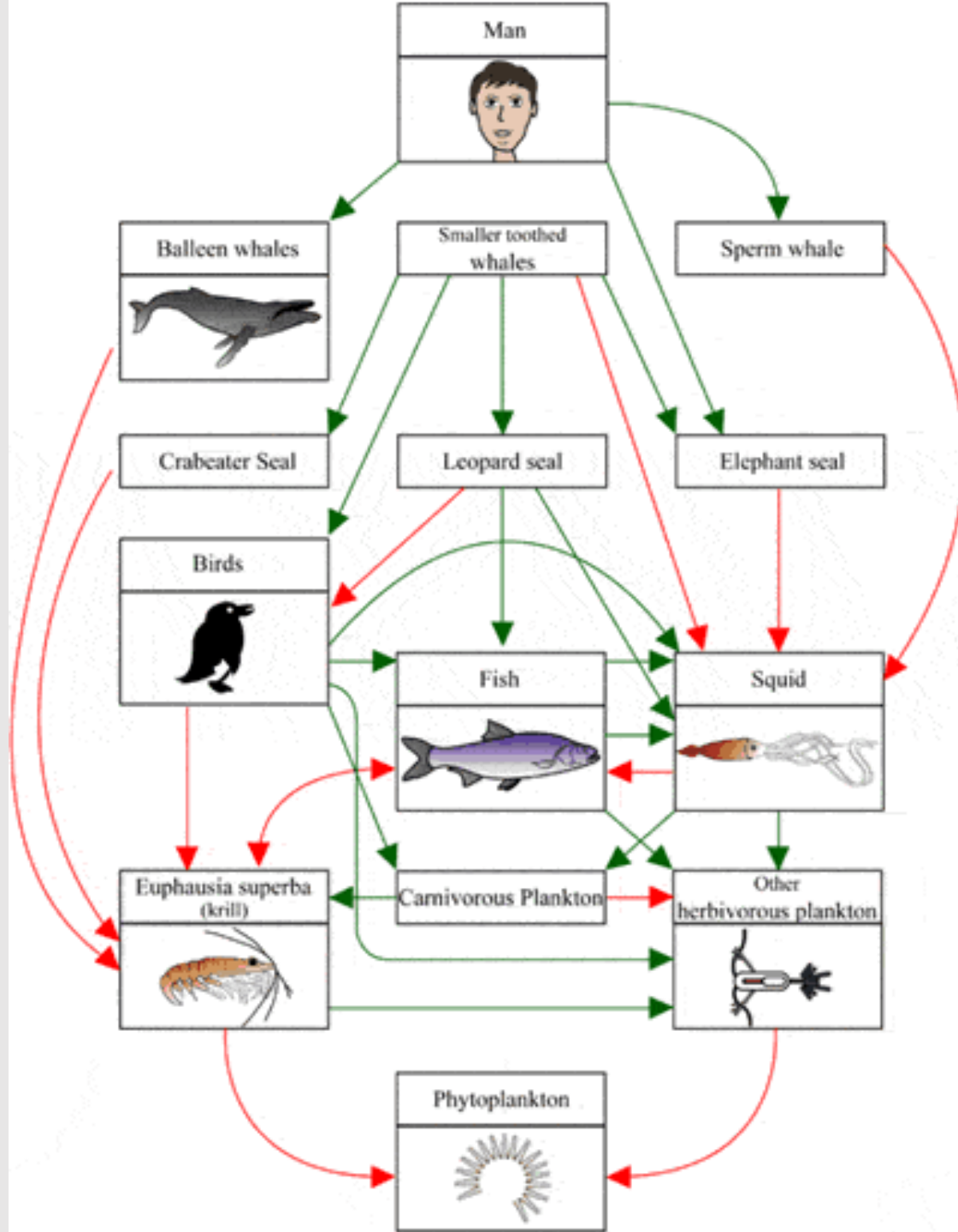
filter feed through fine-combed structures called baleen





39. Whaling—Whalebone. J. V. Regd.







Coral Reefs Temperature Change

- Marine invertebrate animals a few millimeters in diameter.
- Symbiotic relationship with algae



Symbiosis: both benefit

- Algae supply carbohydrates, photosynthetic pigments give the coral color.
- Coral provides a stable environment, CO_2 and nutrients.
- Together, they secrete calcium carbonate that forms the hard structure.
- Provides habitat for many animal species.





- Approximately 500 million people worldwide depend upon reefs. 30 million are virtually totally dependent upon reefs.
- source of food
- protect coastlines from storms and erosion
- provide habitat, spawning and nursery grounds for economically important fish species
- provide jobs and income to local economies from fishing, recreation, and tourism

contribute \$29.8 billion to world economies/year



Coral Reefs and Temperature Change

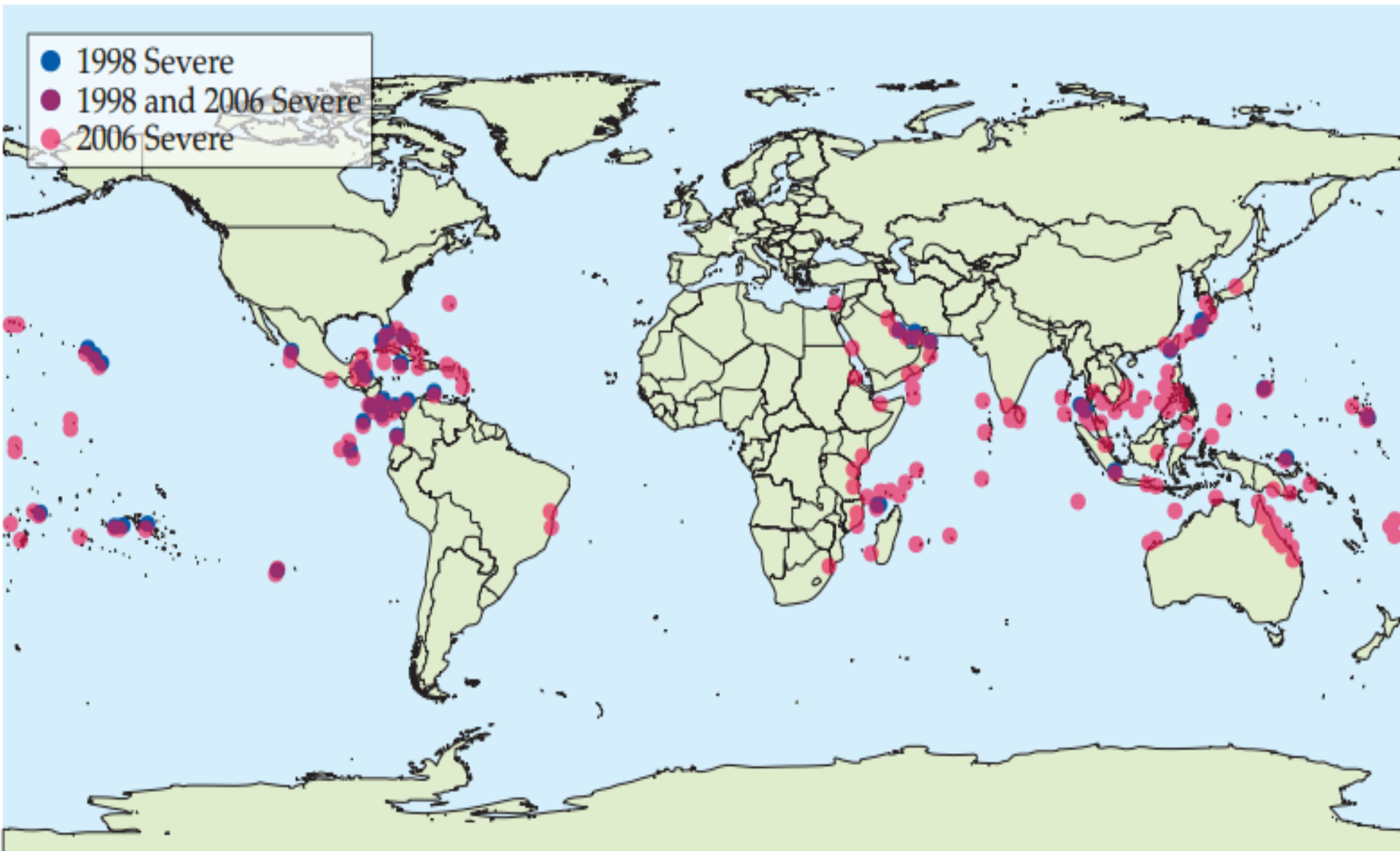
Seas warming by 1° or 2°C can cause bleaching

- Corals become stressed and expel algae
- Corals die
- Also affected by pH
- Climate change may cause **irreparable damage nearly ALL reefs during the next few decades**





Coral Bleaching



Amphibians and Temperature Change

Rely on both aquatic and terrestrial systems
Moist permeable skin functions as a respiratory organ

Pathogenic fungus infections

Warm temps = happy fungus

