

Biology

**An Introduction to
Biomes**

PCHS

Ecology/Biosphere

I.

Main Idea: Terrestrial Biomes are major life zones characterized by vegetation.

Main Idea: Climate effects the type a vegetation that will grow in area.

Main Idea: Climate therefore plays an important role in the distribution of biomes around the globe

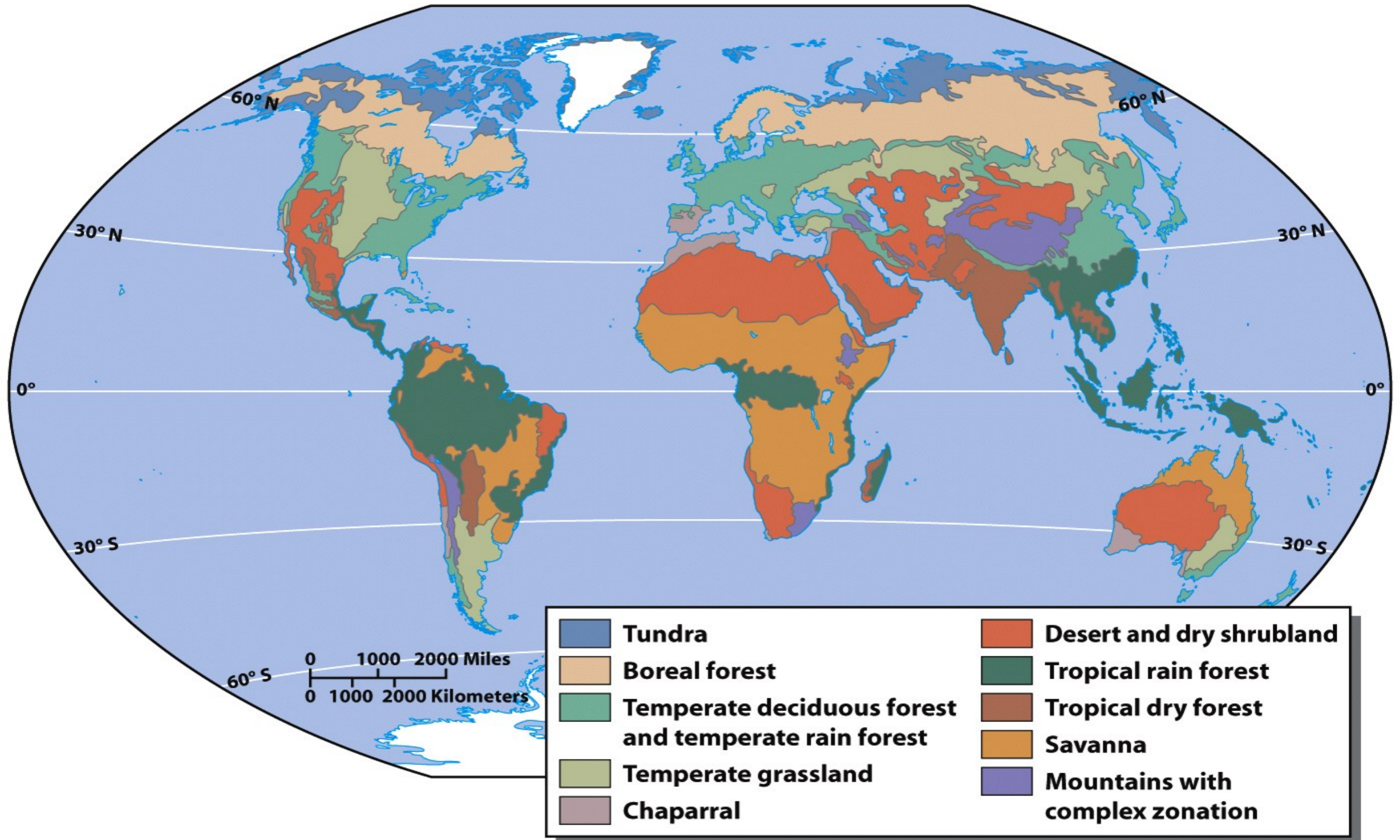
Can you give any examples of biome and its climate?

STRUCTURE AND DISTRIBUTION OF TERRESTRIAL BIOMES

A. Climate & Terrestrial Biomes

- General: Terrestrial Biomes are correlated with *latitude*
- Specifically: Terrestrial Biomes are very much dependent on *Temperature and Precipitation* (see climograph)

Terrestrial Biomes



B. Terrestrial Biomes

- Have their own climates
- Have their own unique composition of species from microorganisms to mammals
- Have vertical layering, providing different habitats
- They do not have distinct divisions, instead “gray” areas called ecotones divide one biome from another

C. Disturbances & Biomes

- Biomes are dynamic, stability is the exception
 - Fire, storms and human activity are constantly changing the resource availability and community structure

How are fires beneficial to ecosystems?

Answer: Fire ecology differs in each biome. In general fires will destroy build up of underbrush making large fires less likely, they are necessary for some seeds to germinate, they help recycled nutrients back into the soil, encourage succession, change soil properties, etc



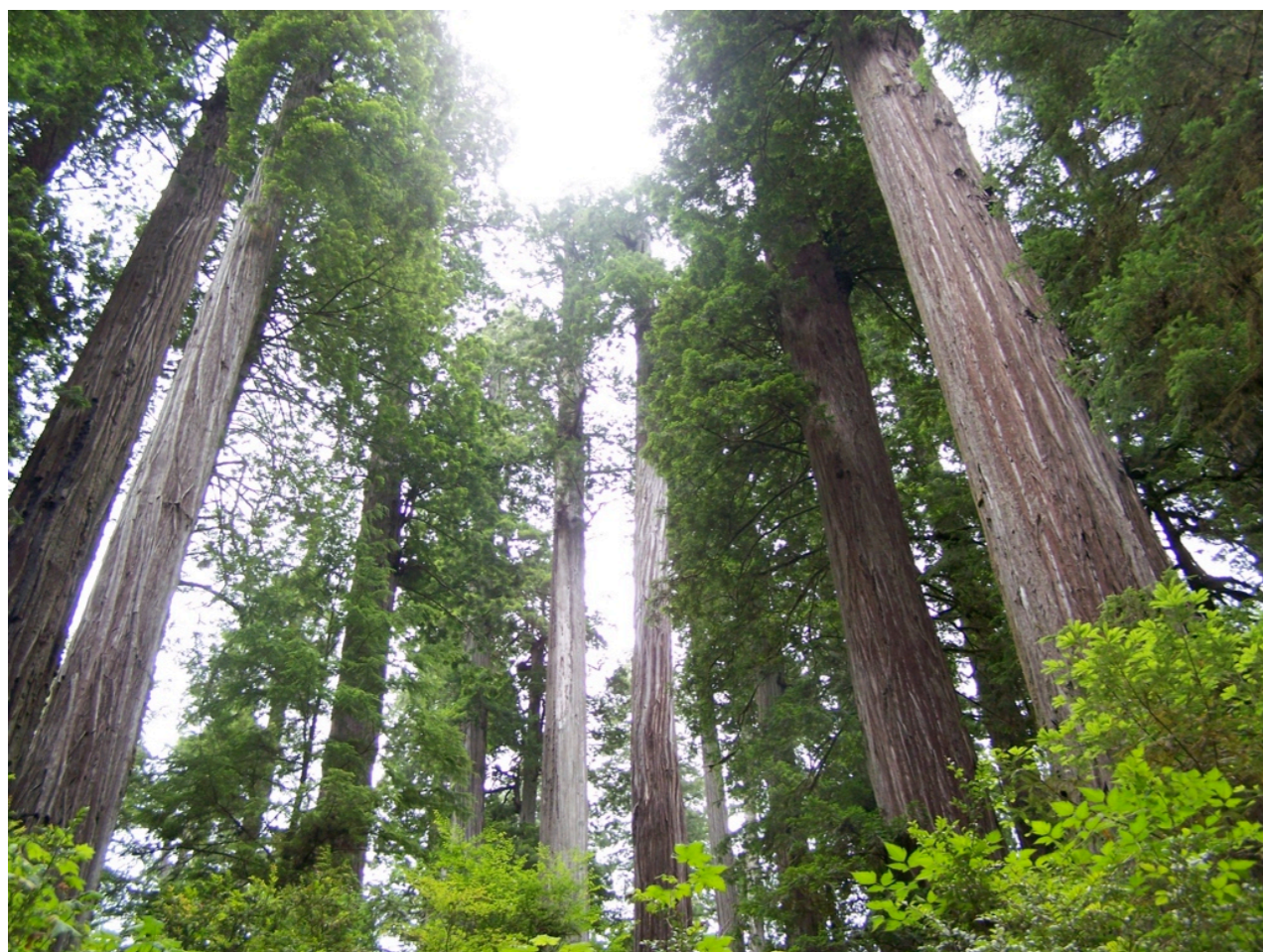
Can you name this tune? Who was the original singer?

“Ring of Fire” By: Adam Lambert Johnny Cash!

These remarkable trees below the Sequoia and Redwood are the largest (and very old) trees on the planet. They are found in area where forest fires are common and necessary for their survival. Examine the pictures below.

What adaptations might explain how these trees are fire tolerant?

Thick bark & Check out the height of the first branches



- *Sadly human activity is severely changing our distribution of biomes*
- **Boreal Deforestation** (1 million acres are logged annually in Canada alone)
- **Desertification** (land the size of Rhode Island annually turning into deserts)
- **Wetlands** (221 million acres in colonial times...today only 104 million acres)
- **Coral reefs** (25% of reefs worldwide are damaged and seriously threatened)
- **Tropical Deforestation** (a century ago these forests covered a land area about the size of the United States...today less than 50% remain. The net loss per year is occurring at a rate of a football field in size per second!)
- **Aquatic Biomes** (see picture of the Aral sea on the next slide)

What are the downsides to this destruction?

loss of biodiversity, loss of potential medicines, loss of carbon sinks, loss of food, loss of fertile soil, increased soil erosion, sediment pollution in rivers, changing rain patterns, floods, droughts

Aral Sea



(a) 1976



(b) 2008

Ecology/Biosphere

II.

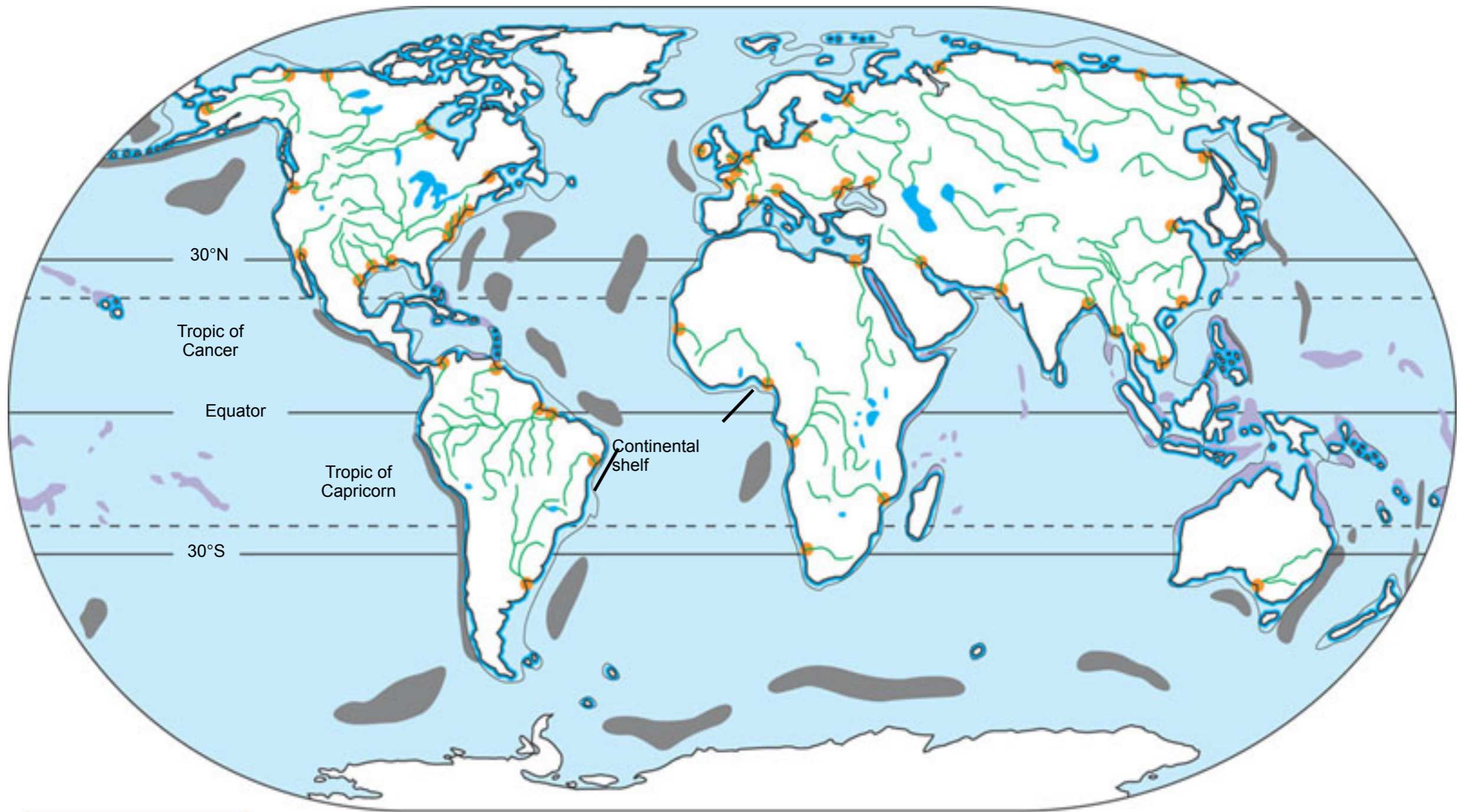
Main Idea: Aquatic biomes show little latitudinal correlation instead they are characterized by their physical factors

Can you give any examples of physical factors that are important in these biomes? What do think will be the most important one?

MARINE & FRESHWATER BIOMES

- Water evaporated from oceans provides most of the earth's rain
- Ocean temperatures effect global climate
- Marine algae & photosynthetic bacteria provide most of the world's oxygen and consume most carbon dioxide
- **Light and Nutrients are the most important abiotic factors; effecting the distribution and abundance of living organisms in an aquatic biome**

Marine & Freshwater Biomes

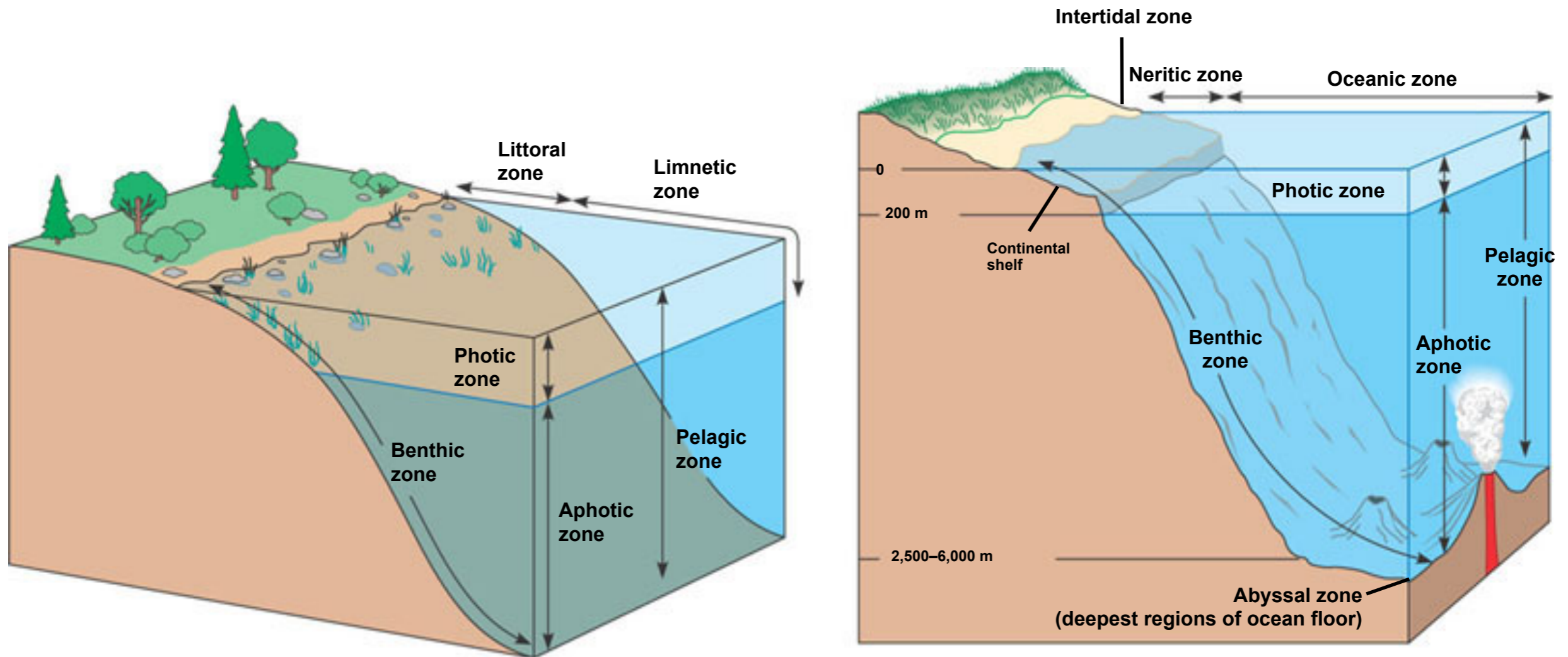


Key

- | | | | | | | | |
|--|-------------|---|----------------------|--|-----------------|---|--|
|  | Lakes |  | Rivers |  | Estuaries |  | Abyssal zone
(below oceanic pelagic zone) |
|  | Coral reefs |  | Oceanic pelagic zone |  | Intertidal zone | | |

A. Aquatic Biome Zones

- Aquatic Biomes are layered by their physical and chemical properties
- They are stratified vertically and horizontally



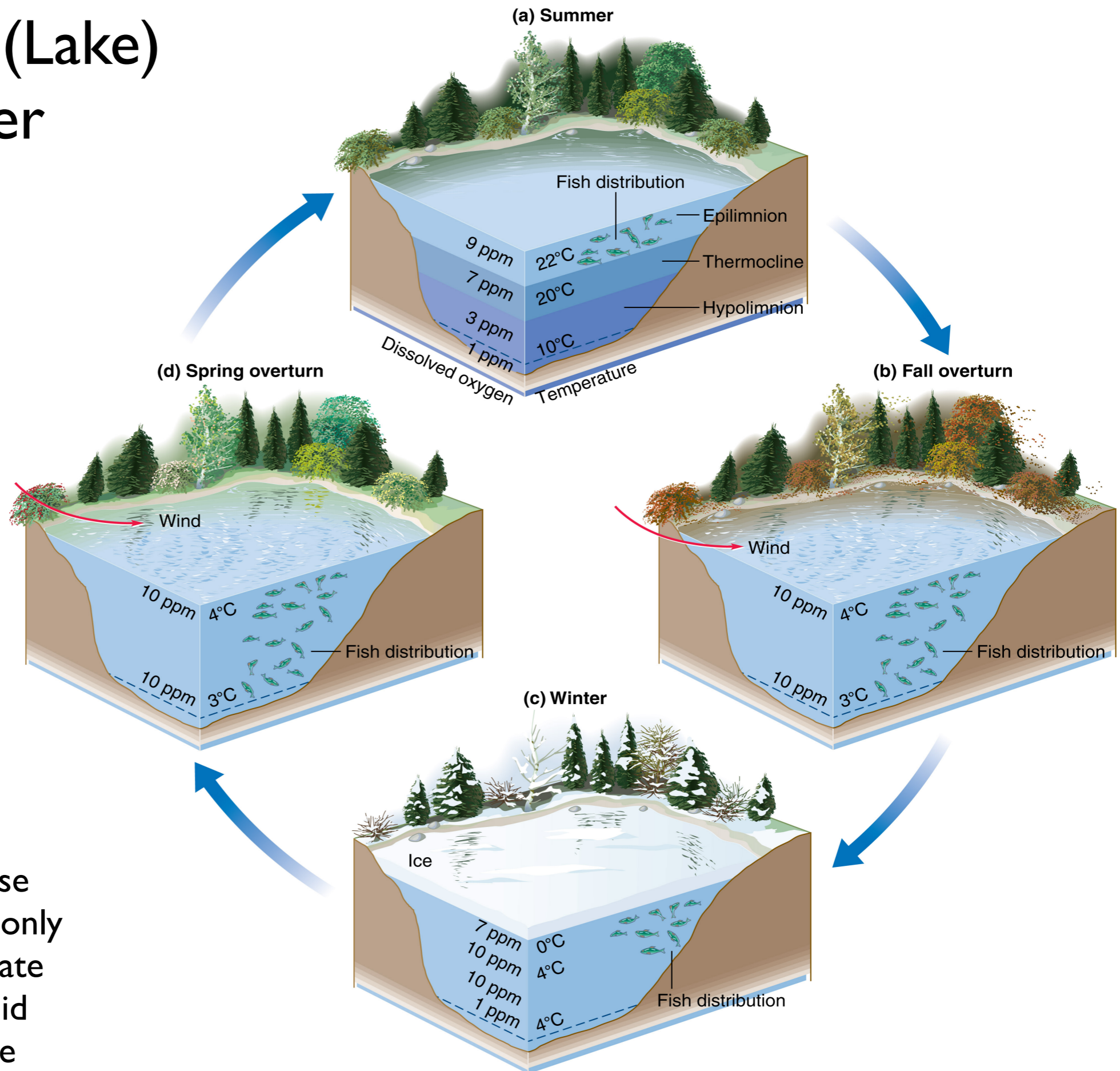
A. Aquatic Biome Zones

- Key Aquatic Biome Zones
- Pelagic = open water
 - Photic = light penetration
 - Aphotic = no/little light penetration
- Benthic = the bottom; shallow or deep (like the soil!)

Aquatic life is distributed according to the *water depth, light penetration, distance from the shore*, and whether they are found in *open water or at the bottom*.

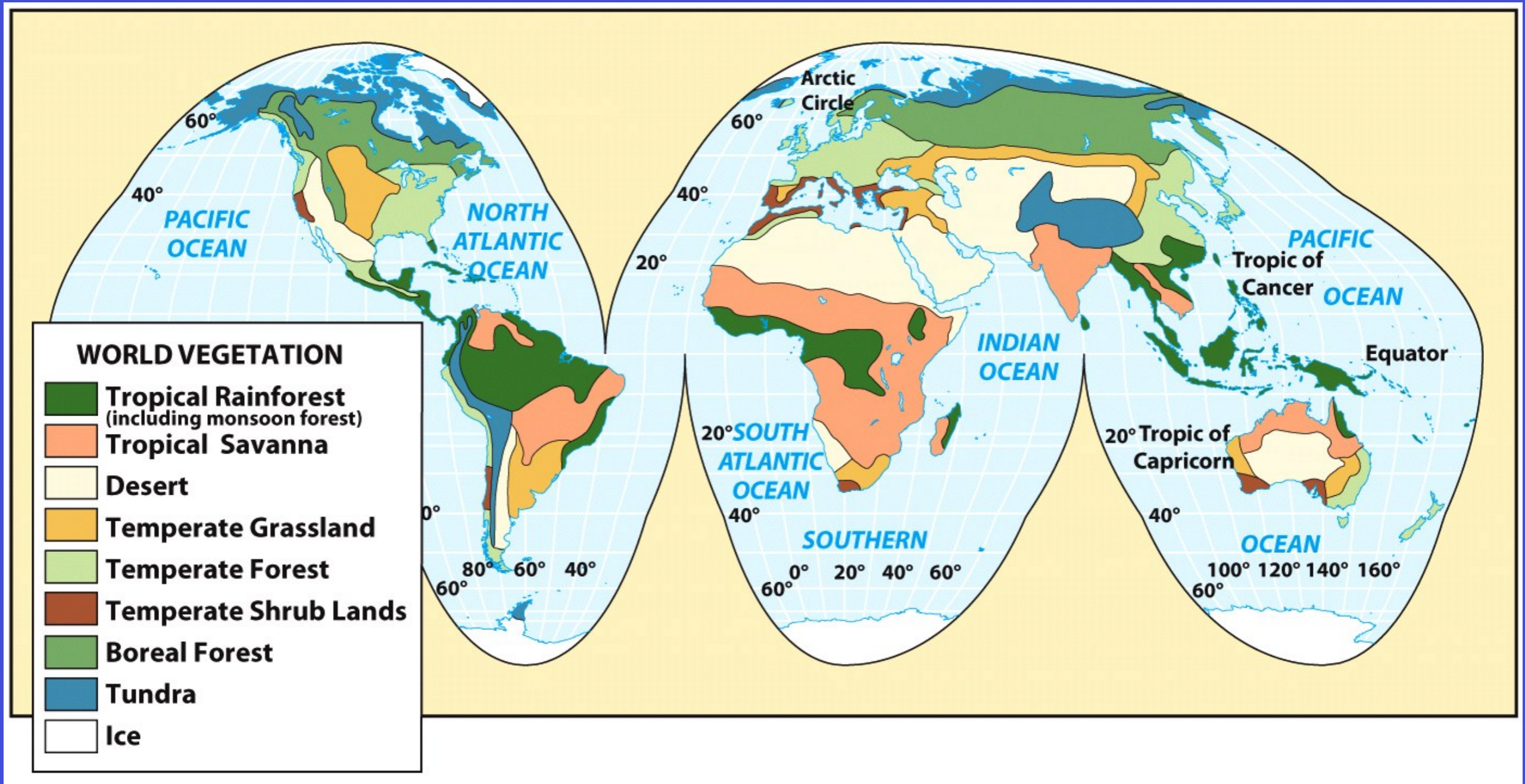
Freshwater (Lake) Turnover

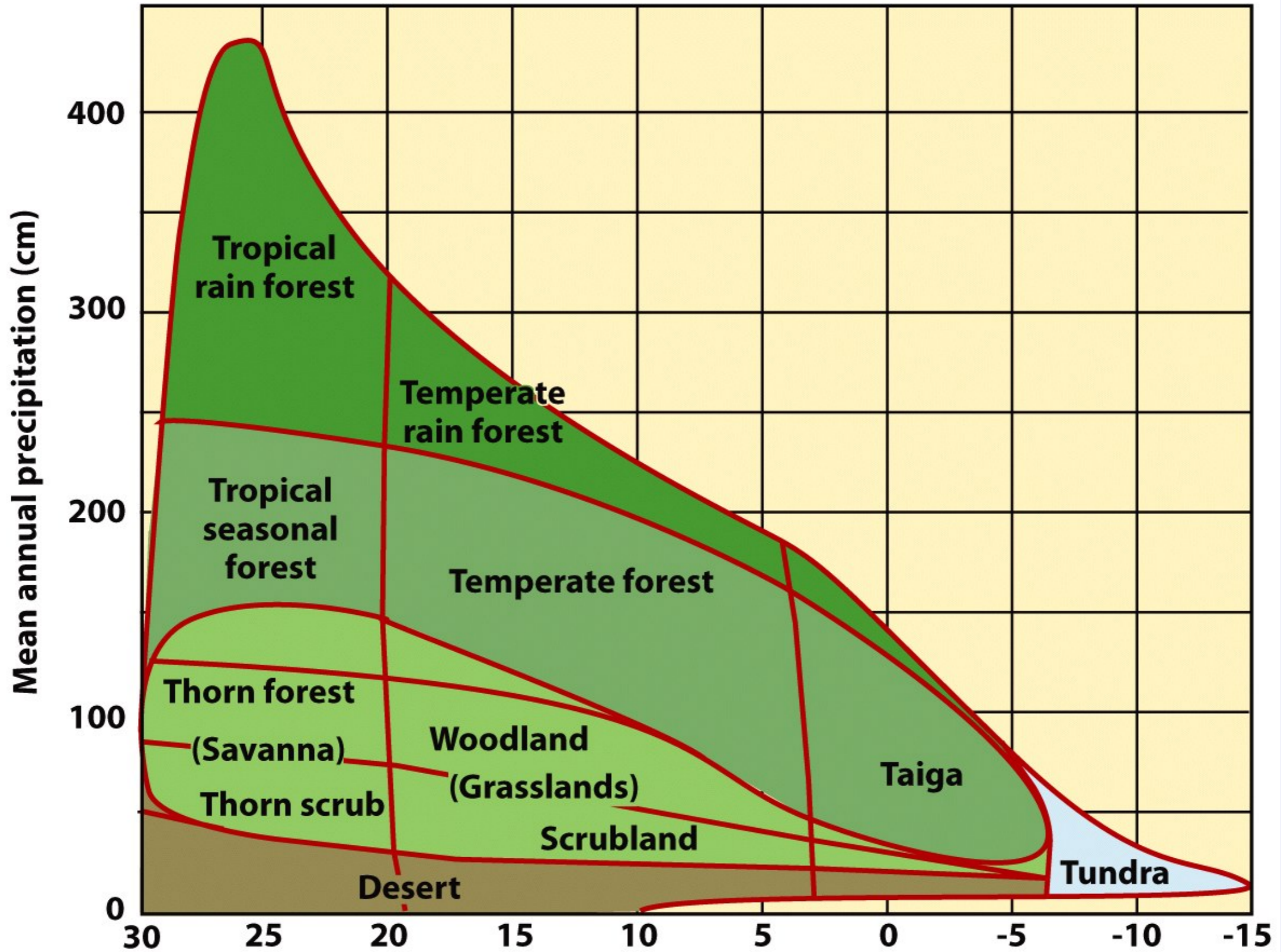
- Seasonal mixing of oxygen and nutrients in lake



Note: Water is most dense of 4 degrees Celcius. The only substance whose liquid state is more dense than its solid state. This explains why ice floats.

Terrestrial Biomes: **A closer Look**





Mean annual temperature (°C)

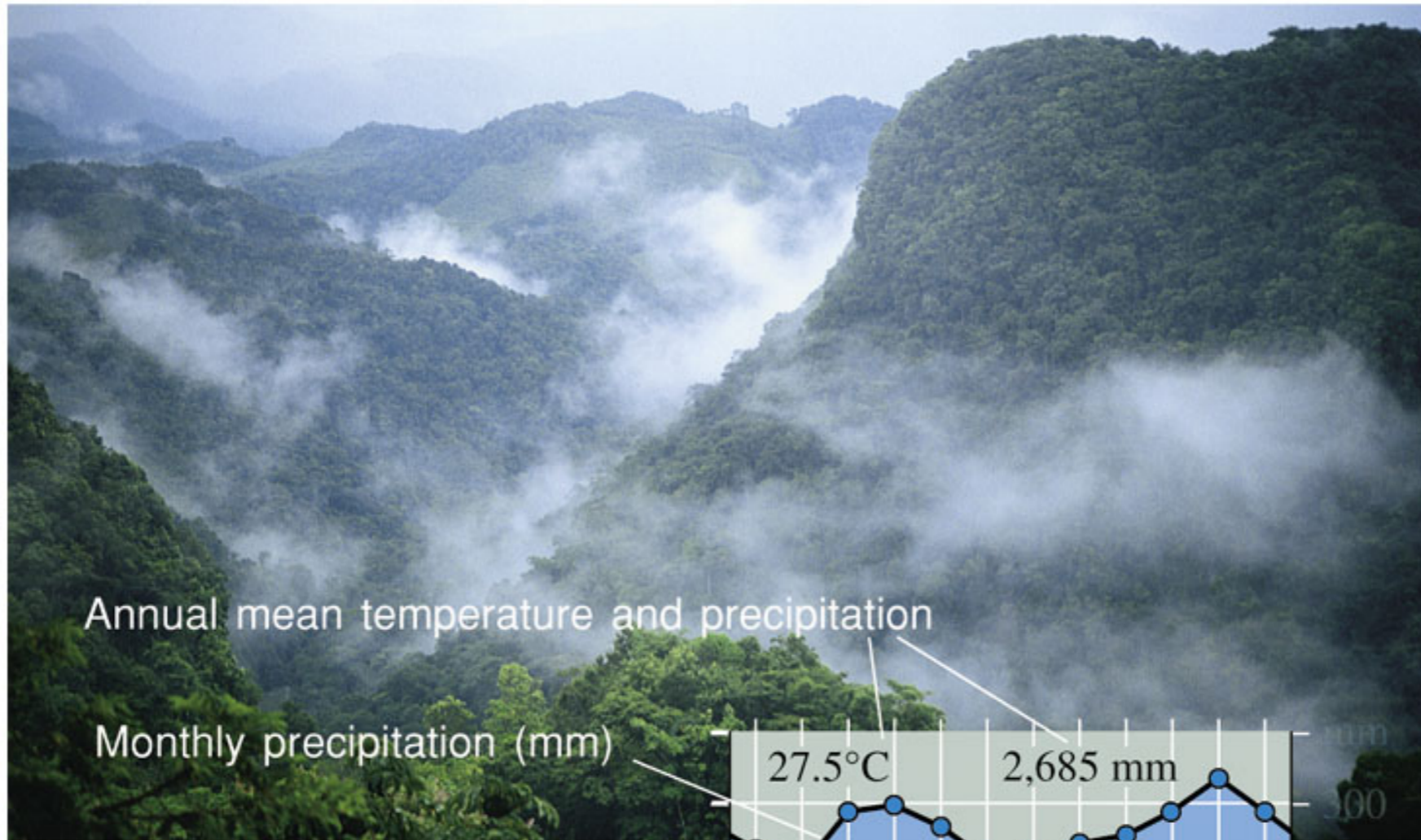
Tropical Subtropical Warm temperate Cold temperate Arctic-alpine

Earth's Terrestrial Biomes

- **Biological diversity varies among biomes**
 - Generally declines with increasing latitude
 - The more favorable the temperature and precipitation for life the more diversity.

Tropical Rain Forests

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



Annual mean temperature and precipitation

Monthly precipitation (mm)

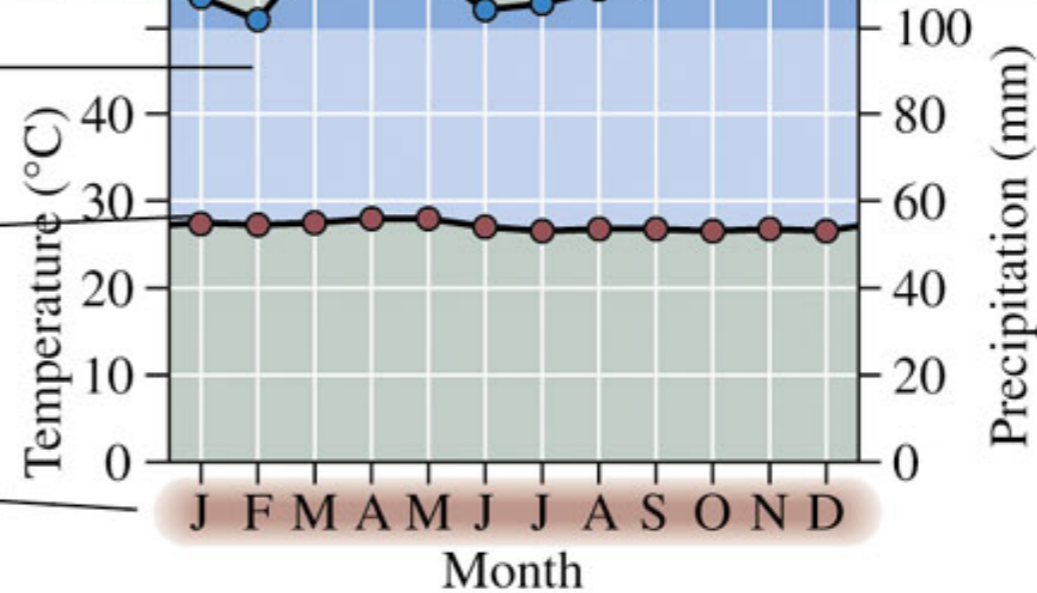
27.5°C

2,685 mm

Moisture surplus (blue)

Monthly temperature (°C)

Shaded months are above freezing



© Vol. 60/PhotoDisc

TROPICAL RAIN FOREST

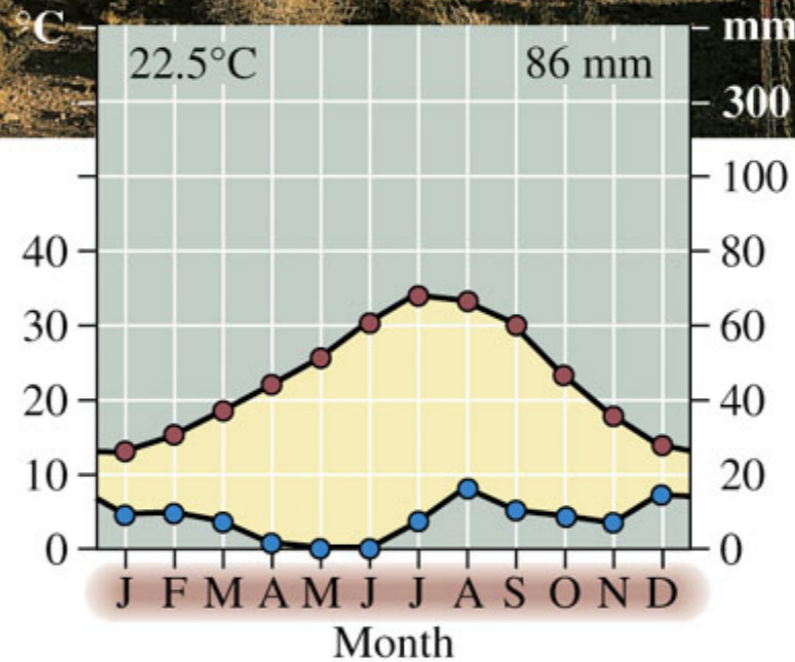
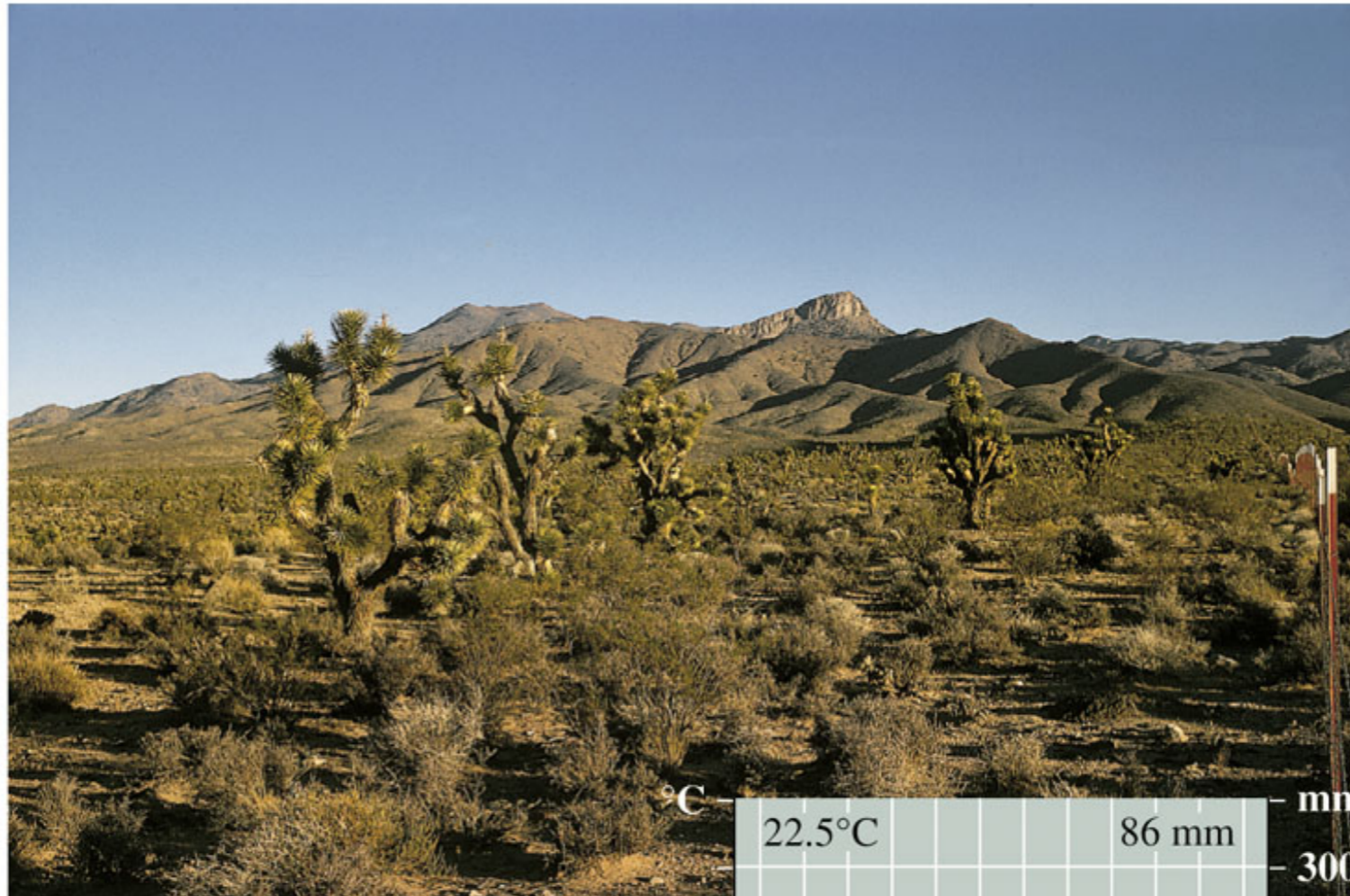
- **Distribution:** equatorial and subequatorial
- **Precipitation:** abundant and constant
- **Temperature:** high and little variation
- **Plants:** broadleaf evergreens, epiphytes, tremendous layering
- **Animals:** mammals, birds, reptiles, amphibians, insects, highest biodiversity
- **Human Impact:** deforestation
- **Point of Interest:** very poor soil, high turnover rate / decomposition, 50-65% of all terrestrial species live here

TROPICAL RAIN FOREST



DESERTS

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



© William P. Cunningham

DESERT

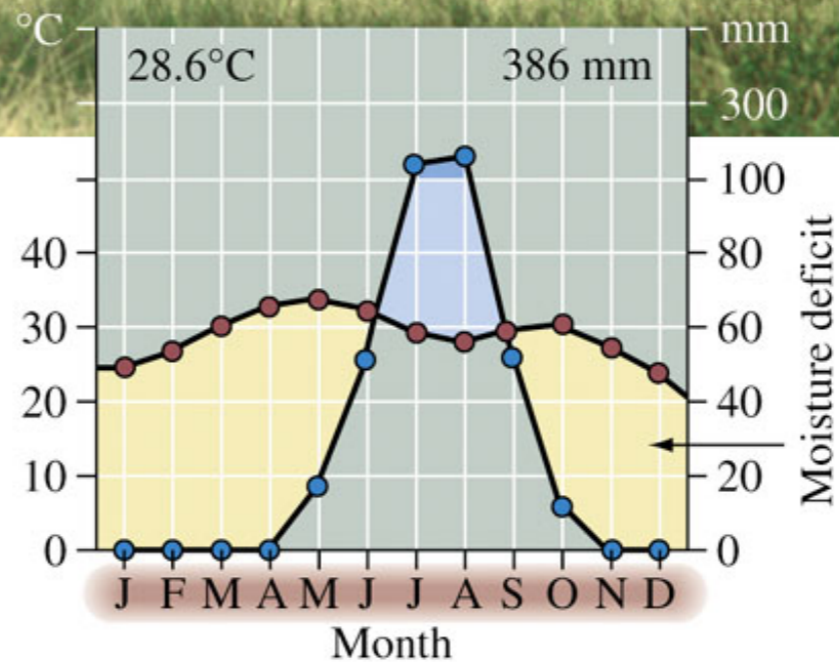
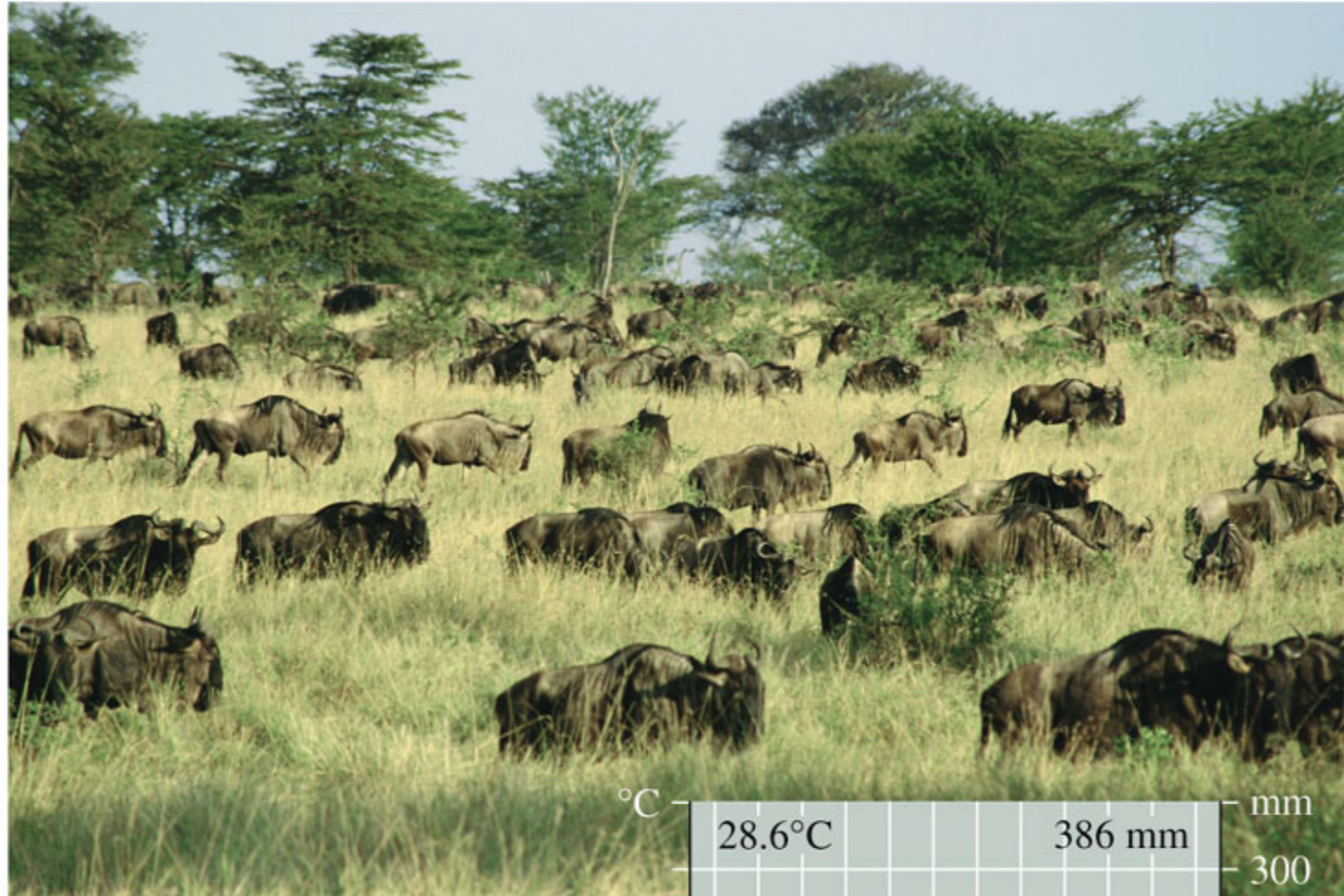
- **Distribution:** 30 degrees N and S latitudes, interior of continents
- **Precipitation:** low and extremely variable
- **Temperature:** extremely variable both seasonally and daily
- **Plants:** succulents, shrubs, herbs, adapted to dry conditions
- **Animals:** snakes, lizards, birds, rodents, scorpions, beetles, adapted to dry conditions, adapted to extreme heat
- **Human Impact:** reduction in biodiversity
- **Point of Interest:** deserts are defined by precipitation not temp

DESERT BIOME



SAVANNAS

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



© Vol. 6/Corbis

SAVANNA

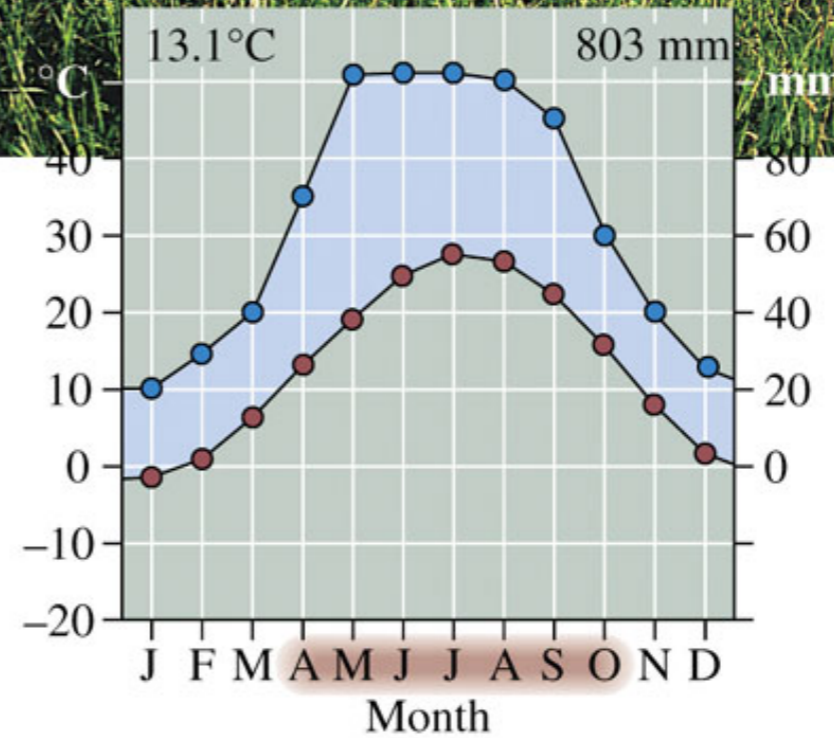
- **Distribution:** equatorial and subequatorial
- **Precipitation:** low and seasonal
- **Temperature:** warm year round (somewhat seasonal)
- **Plants:** grasses, small nonwoody plants, few scattered trees, adapted to dry conditions
- **Animals:** large herbivores, and their predators, many insects, migratory
- **Human Impact:** cattle ranching and overhunting
- **Point of Interest:** earliest human civilizations, fires common

SAVANNA



GRASSLANDS

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



© Mary Ann Cunningham

TEMPERATE GRASSLANDS

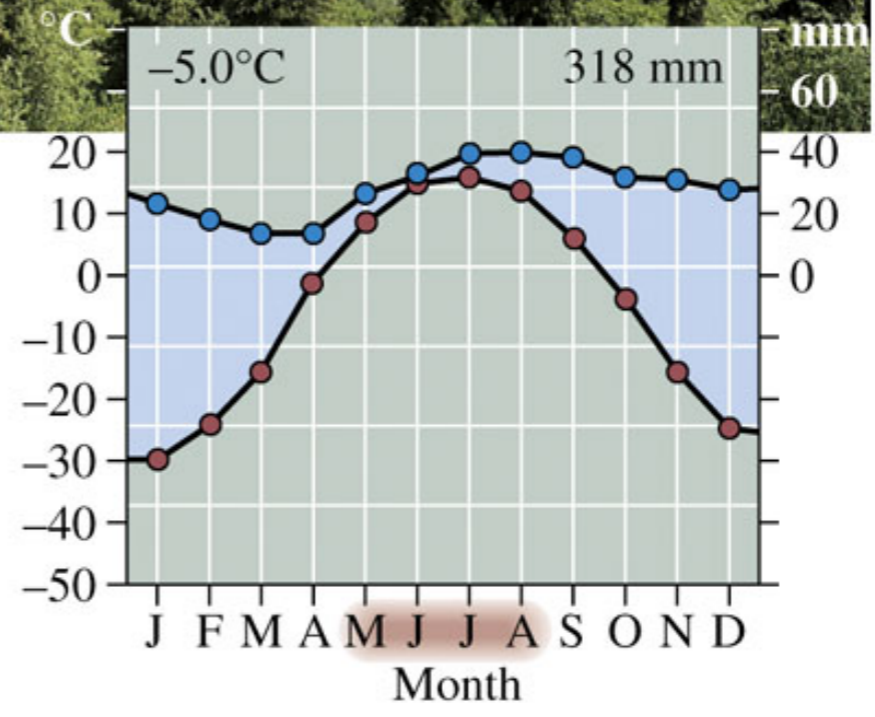
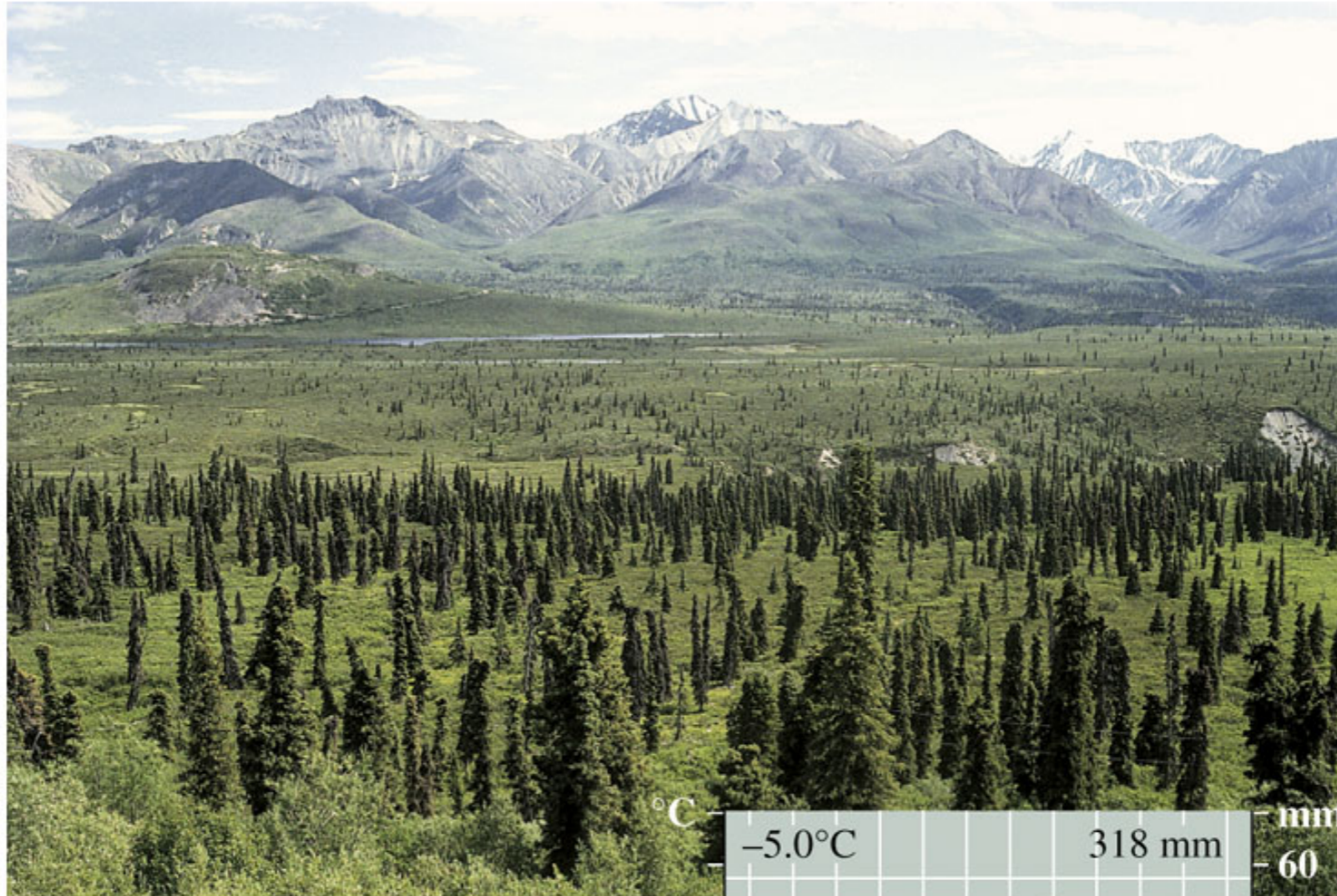
- **Distribution:** s. african (veldts), s. american (pampas), russian (steppes)
n. american (plains and prairies)
- **Precipitation:** low to moderate, highly seasonal
- **Temperature:** very cold winters and very hot summers
- **Plants:** grasses and small nonwoody plants, adapted to droughts and fires
- **Animals:** large grazers and burrowing animals
- **Human Impact:** very fertile soil much has been converted to agriculture and even into deserts
- **Point of Interest:** most fertile soil on earth, produces most food



Temperate Grasslands

TAIGA / BOREAL FOREST

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



© William P. Cunningham

TAIGA / BOREAL FOREST

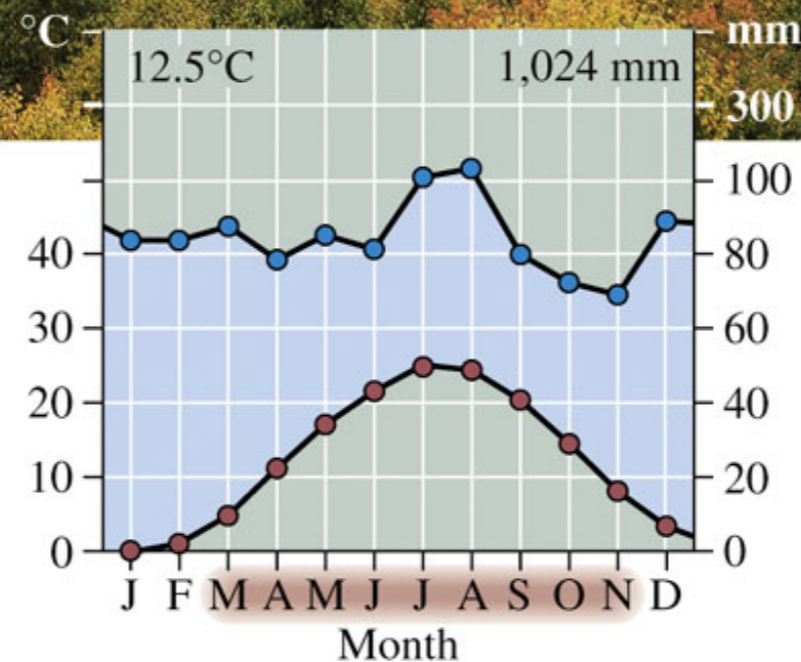
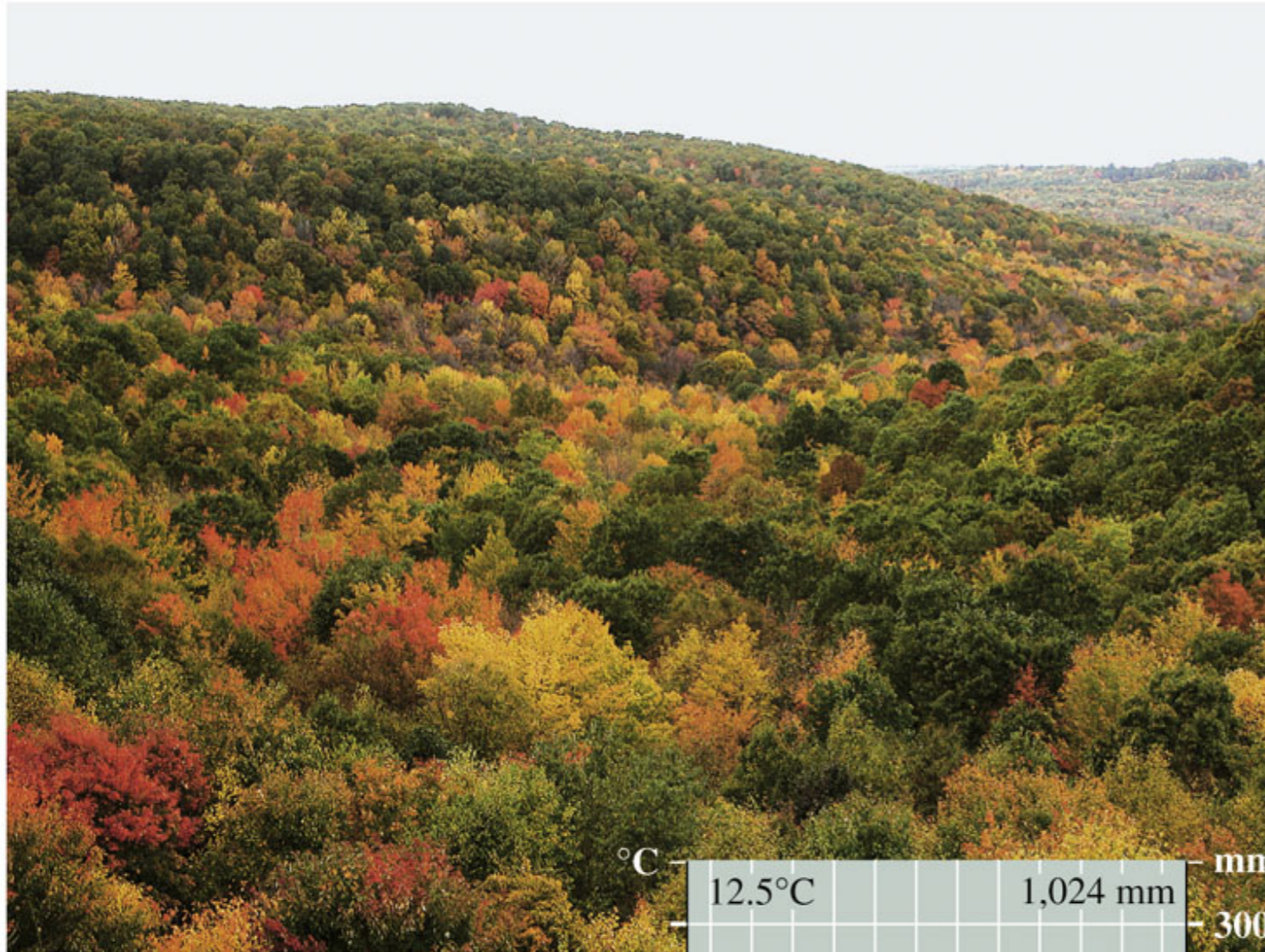
- **Distribution:** northern north america and eurassia
- **Precipitation:** moderate, periodic droughts
- **Temperature:** usually cold, summers may get hot in the day
- **Plants:** conifers (evergreens with cones and needles), shrubs, herbs
- **Animals:** moose, bear, tigers, migratory birds, insects
- **Human Impact:** logged at an alarming rate
- **Point of Interest:** largest of all biomes, low biodiversity

TAIGA / BOREAL BIOME



TEMPERATE DECIDUOUS FORESTS

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.

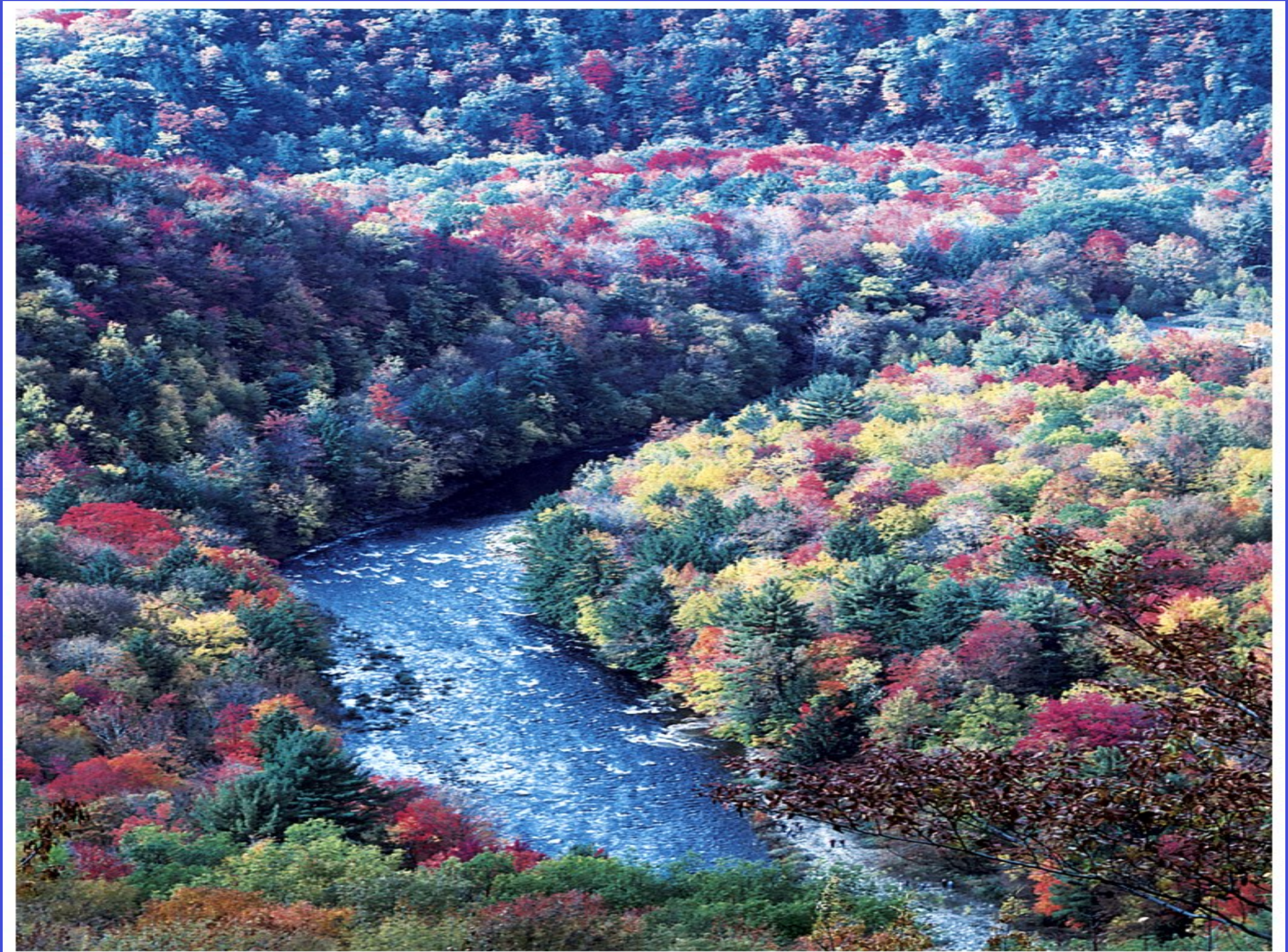


© William P. Cunningham

TEMPERATE BROADLEAF FOREST

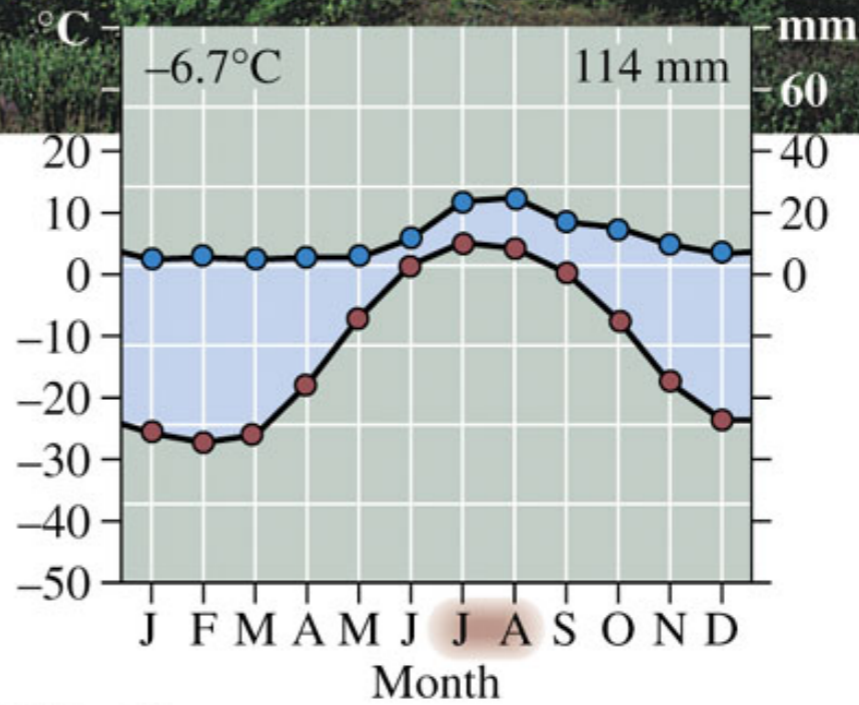
- **Distribution:** midlatitudes of the northern hemisphere
- **Precipitation:** moderate to high, fairly constant
- **Temperature:** variable, cold winters and hot summers
- **Plants:** deciduous trees, shrubs, herbs, layered
- **Animals:** hibernating mammals, migratory birds, insects
- **Human Impact:** heavily settled, was completely wiped out in the U.S. but now making a comeback
- **Point of Interest:** forest that gives us the beautiful colors of fall

TEMPERATE DECIDUOUS FOREST



TUNDRA

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



TUNDRA

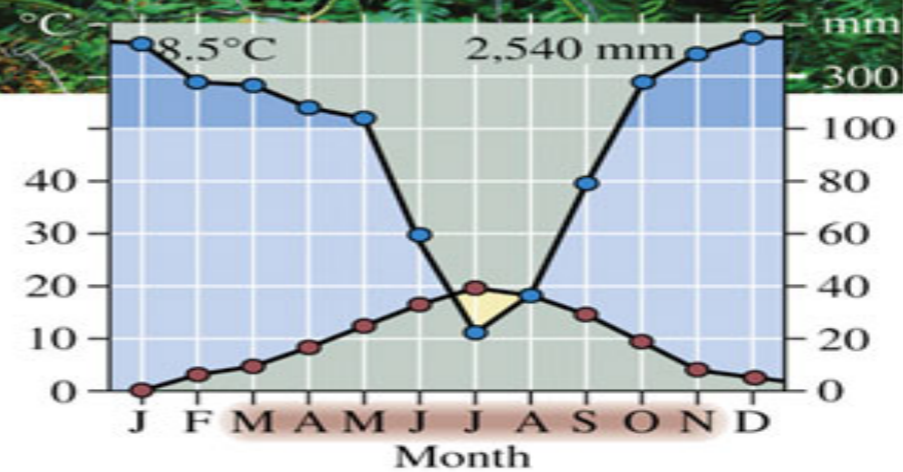
- **Distribution:** arctic and high mountain tops
- **Precipitation:** low in arctic, moderate in mountains
- **Temperature:** very cold, windy
- **Plants:** moss, lichens, grass, small shrubs
- **Animals:** oxen, caribou, reindeer, bears, wolves, foxes, migratory birds
- **Human Impact:** mineral and oil extraction
- **Point of Interest:** permafrost; ground is frozen solid, least disturbed

Tundra Biome



TEMPERATE RAIN FOREST

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



© Vol. 90/Corbis

TEMPERATE RAIN FORESTS

- **Distribution:** Pacific west coast from California to Alaska
- **Precipitation:** abundant
- **Temperature:** mild and cool, very humid
- **Plants:** conifers, redwoods, giant sequias
- **Animals:** bears, birds, insects
- **Human Impact:** battles continue over these “old growth” forests
- **Point of Interest:** contain world’s tallest, largest and oldest trees

Temperate Rain Forest



ADDITIONAL BIOMES

- Temperate Shrublands (Chaparral)
- Temperate Woodlands
- Tropical Dry Forests
- Tropical Seasonal Forests
- Cloud Forests

Aquatic Biomes: A Closer Look

WETLANDS

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.



(a) Swamp, or wooded wetland

Trees © Vol. 16/PhotoDisc



(b) Marsh

No Trees © Vol. 16/PhotoDisc



(c) Coastal saltmarsh

No Trees © William P. Cunningham

WETLANDS

- **Physical Environment:** habitat inundated with water all of the time or some of the time
- **Chemical Environment:** high nutrients, low oxygen
- **Geological Features:** different types exist but n/a
- **Photosynthetic Organisms:** lilies, cattails, woody plants (in swamps), mosses (in bogs), most have adaptations for living in saturated soil
- **Heterotrophs:** birds, alligators, insects, otters, frogs, herons, crustaceans, dragonflies
- **Human Impact:** high capacity to filter pollutants and nutrients, among the most productive biomes on earth

WETLANDS



OLIGOTROPHIC LAKES / PONDS



OLIGOTROPHIC LAKES / PONDS

- **Physical Environment:** standing bodies of water lakes (large), ponds (smaller), rocky bottoms, cold, clear
- **Chemical Environment:** low nutrients, high oxygen, low decomposition rates
- **Geological Features:** become eutrophic over time, less surface area relative to their depth
- **Photosynthetic Organisms:** littoral zone has rooted and floating plants, limnetic zone has a variety of phytoplankton and cyanobacteria
- **Heterotrophs:** zooplankton, invertebrates, fish
- **Human Impact:** fertilizer run off and waste dumping causing algal blooms, oxygen depletion and fish kills
- **Point of Interest:** n/a

OLIGOTROPHIC LAKES / PONDS



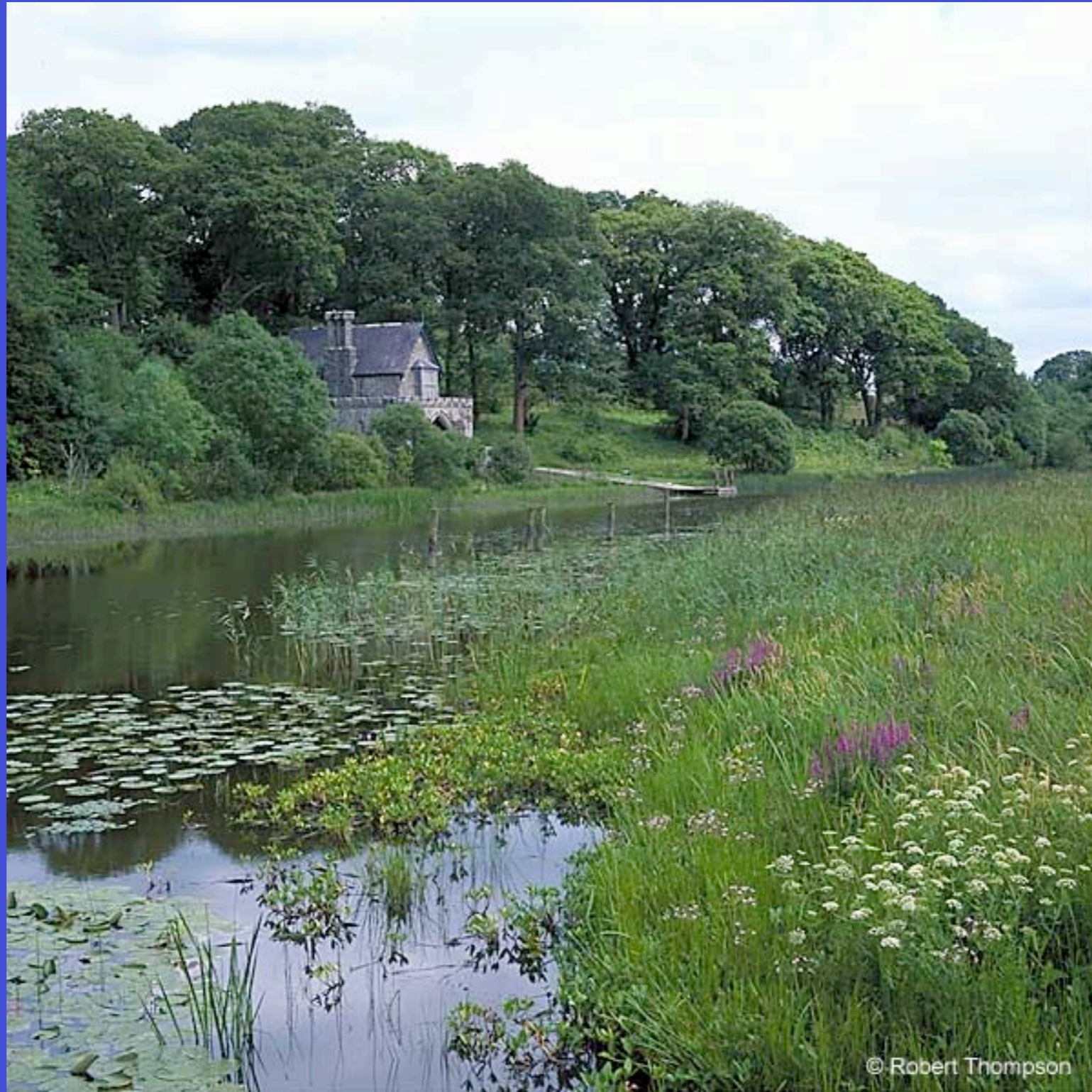
EUTROPHIC LAKES / PONDS



EUTROPHIC LAKES / PONDS

- **Physical Environment:** standing bodies of water lakes (large), ponds (smaller), muddy bottoms, warm, murky
- **Chemical Environment:** high nutrients, low oxygen, high decomposition rates
- **Geological Features:** more surface area relative to their depth
- **Photosynthetic Organisms:** littoral zone has rooted and floating plants, limnetic zone has a variety of phytoplankton and cyanobacteria
- **Heterotrophs:** zooplankton, invertebrates, fish
- **Human Impact:** fertilizer run off and waste dumping causing algal blooms, oxygen depletion and fish kills
- **Point of Interest:** cultural eutrophication often shows up on AP exam

EUTROPHIC LAKES / PONDS



© Robert Thompson

STREAMS / RIVERS



STREAMS / RIVERS

- **Physical Environment:** currents are most prominent feature, headwaters: cold, clear, turbulent, swift; tributaries: warmer, turbid, slow
- **Chemical Environment:** salt and nutrients increase moving away from headwaters, oxygen generally decreases
- **Geological Features:** headwaters: narrow with rocky bottoms and alternating depths, tributaries: wide with sediment bottoms
- **Photosynthetic Organisms:** phytoplankton and rooted aquatic plants
- **Heterotrophs:** fish and invertebrates
- **Human Impact:** negative impacts from dams and pollution
- **Point of Interest:** rivers are ranked from 1-6 for rafting difficulty

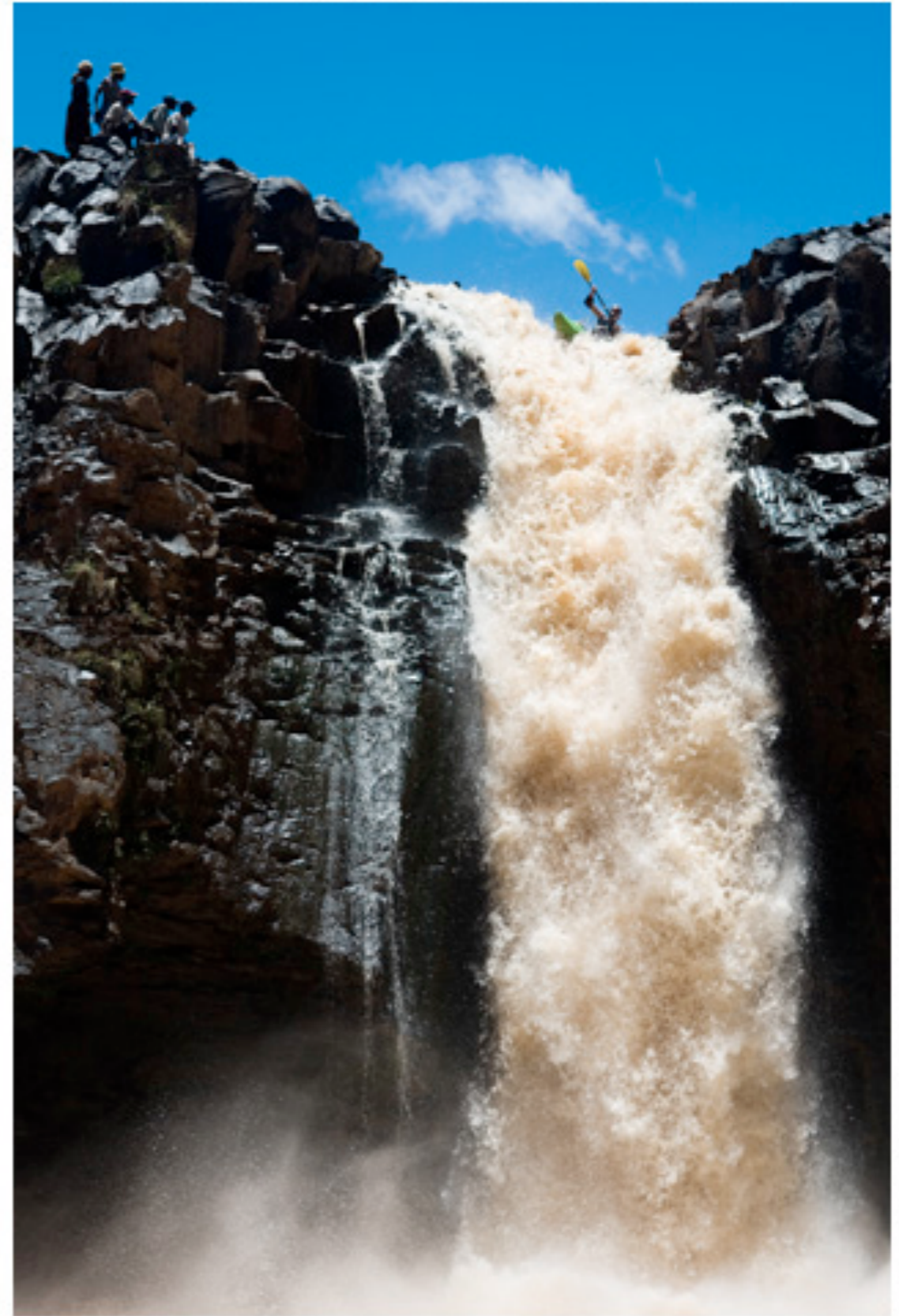
RIVER Classifications





© by Ian Garcia

Tyler Bradt, 65/70ft Tomata Falls, Rio Alseseca, Mexico.



© Pat Camblin (as seen in portfolio ks28)

Tyler Bradt Mazyfalls Madagascar

World Record... 186 feet!





STREAMS / RIVERS



ESTUARIES

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.

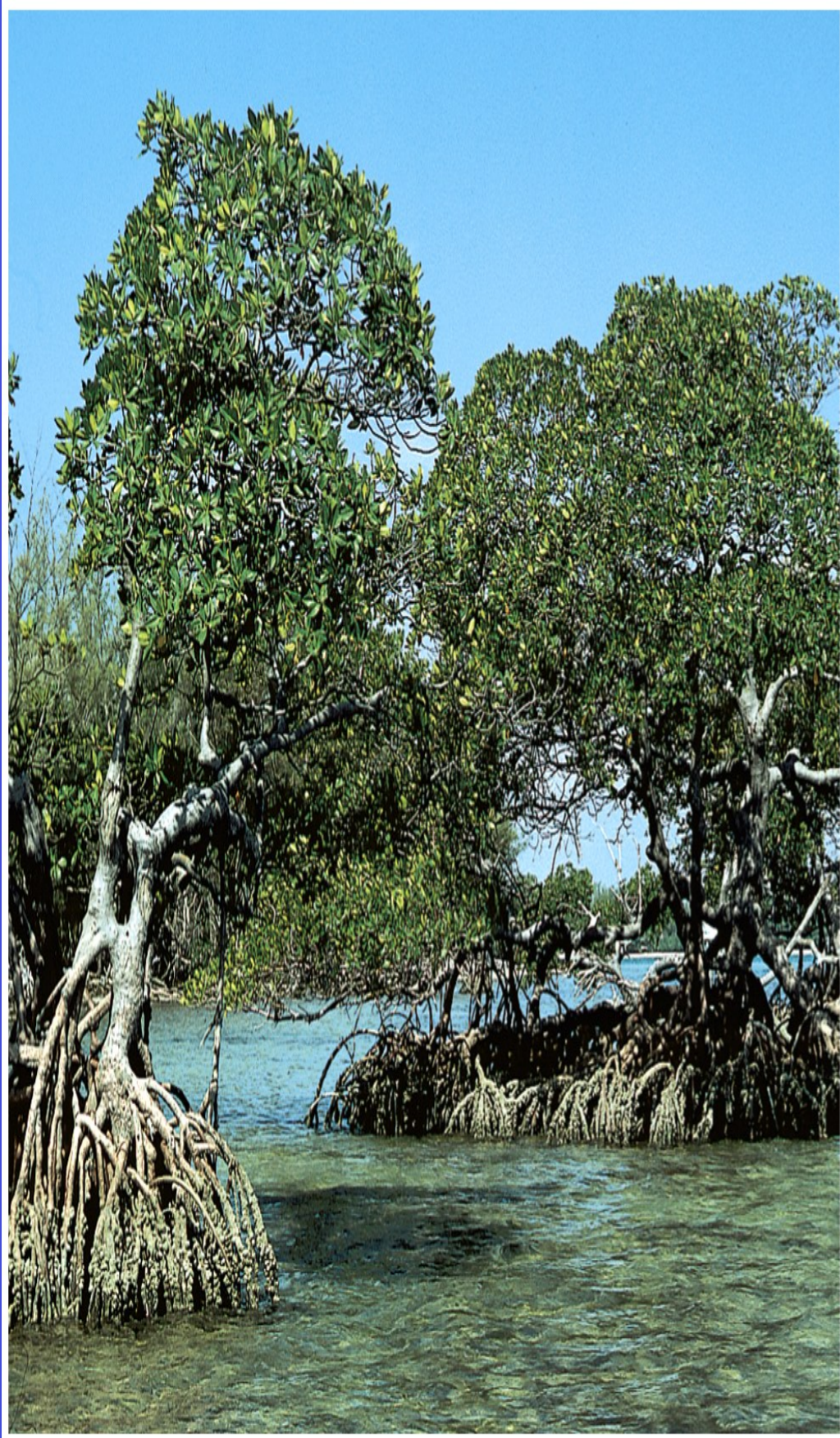


© Andrew Martinez/Photo Researchers

ESTUARIES

- **Physical Environment:** transition between river and sea, higher density sea water on bottom, less dense fresh water on top
- **Chemical Environment:** salinity varies spatially and temporally
- **Geological Features:** tidal channels, mud flats, islands, natural levees
- **Photosynthetic Organisms:** saltmarsh grass, algae, phytoplankton
- **Heterotrophs:** invertebrates, fish, birds, waterfowl, marine mammals
- **Human Impact:** filling and dredging for development, pollution
- **Point of Interest:** highly productive biome, crucial breeding and feeding grounds for many species

ESTUARIES



INTERTIDAL ZONES



INTERTIDAL ZONES

- **Physical Environment:** periodically submerged and exposed by the tides
- **Chemical Environment:** oxygen and nutrients generally high
- **Geological Features:** rocky or sandy substrates, shape of bay or coastline also influences magnitude of tide
- **Photosynthetic Organisms:** marine algae, sea grass
- **Heterotrophs:** mollusks, crabs, starfish, crustaceans, sponges, sea anemones, small fish
- **Human Impact:** oil spills
- **Point of Interest:** Bay of Fundy has a tidal range of 55 feet

INTERTIDAL ZONES



OCEAN PELAGIC ZONE



OCEAN PELAGIC ZONE

- **Physical Environment:** open blue water
- **Chemical Environment:** high oxygen, low nutrients, thermally stratified
- **Geological Features:** covers 70% of earth's surface, ave. depth 4000m
- **Photosynthetic Organisms:** phytoplankton, photosynthetic bacteria
- **Heterotrophs:** zooplankton, krill, jellies, invertebrates, fish, mammals, sea turtles, squid
- **Human Impact:** over fishing and pollution
- **Point of Interest:** photosynthetic plankton account for over 50% of photosynthetic activity on earth

OCEAN PELAGIC ZONE



CORAL REEFS

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.

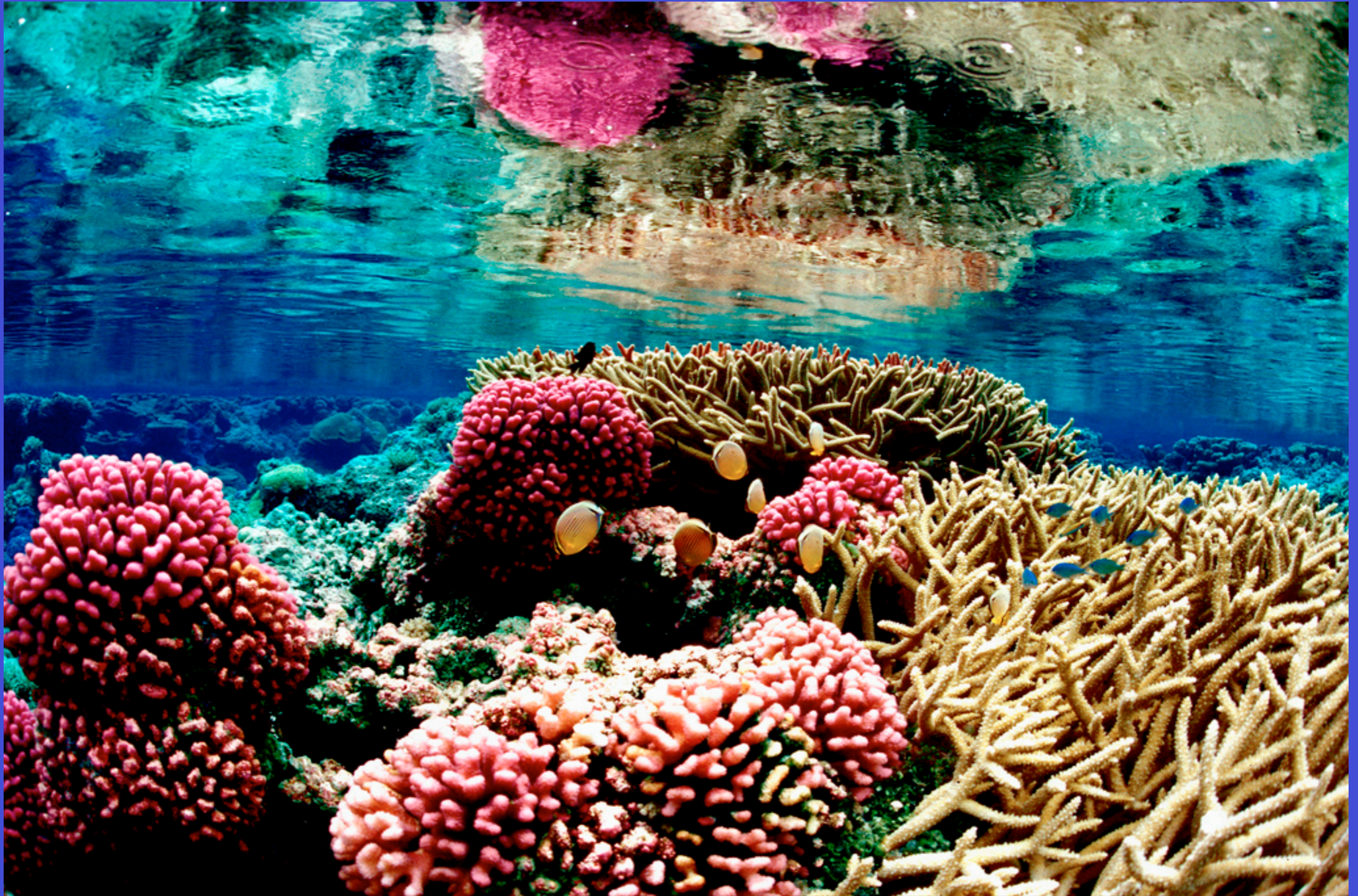


© Vol. 89/PhotoDisc/Getty RF

CORAL REEFS

- **Physical Environment:** photic zone of stable tropical marine environments, high clarity water, calcium carbonate skeletons
- **Chemical Environment:** require high oxygen concentrations
- **Geological Features:** solid substrates required for attachment
- **Photosynthetic Organisms:** unicellular algae living mutualistically with the corals, also red algae, green algae
- **Heterotrophs:** corals, invertebrates, fish, high biodiversity
- **Human Impact:** over fishing and coral bleaching
- **Point of Interest:** see next page for different coral formations, Charles Darwin was of the scientists to explain reef formations

CORAL REEFS



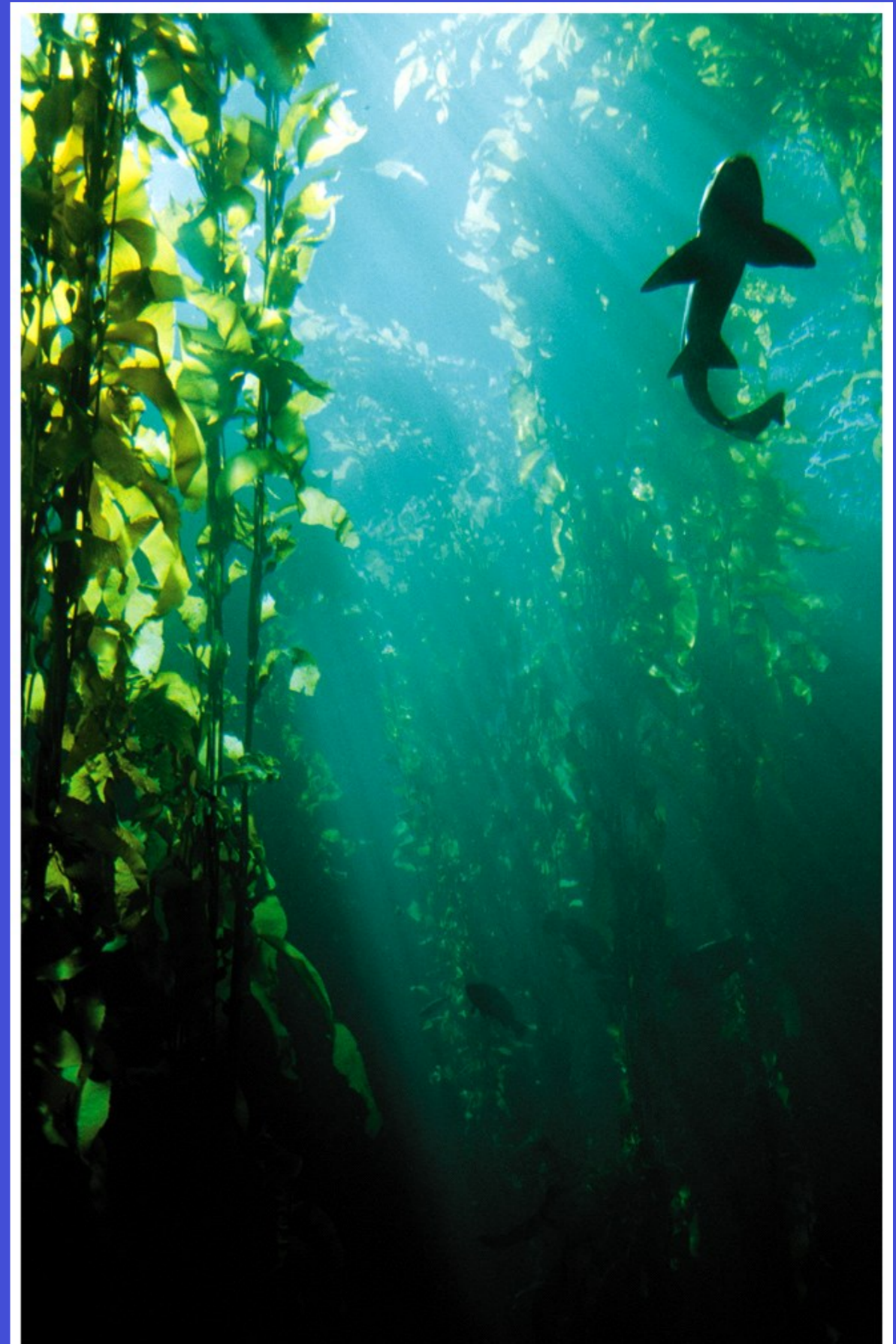
MARINE BENTHIC ZONE



MARINE BENTHIC ZONE

- **Physical Environment:** seafloor (shallow or deep), most is deep with no light, high pressure and very cold
- **Chemical Environment:** sufficient oxygen
- **Geological Features:** mostly soft sediments, a few places are rocky
- **Photosynthetic Organisms:** seaweeds and filamentous algae, deep benthic communities near geothermal vents have chemoautotrophic bacteria
- **Heterotrophs:** invertebrates, tube worms, fish, arthropods, echinoderms
- **Human Impact:** over fishing and pollution
- **Point of Interest:** the first cell may have originated in this zone (bya)

MARINE BENTHIC ZONE



Ecosystems: Human Disturbances



Nonpoint Source Pollution (runoff from land)
Example: Agricultural runoff (fertilizers, pesticides, and livestock wastes) pollutes water.



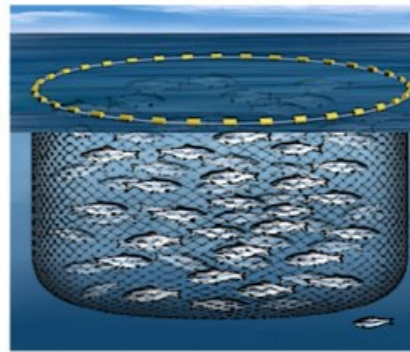
Invasive Species
Example: Release of ships' ballast water, which contains foreign crabs, mussels, worms, and fishes.



Overfishing
Example: The populations of many commercial fish species are severely depleted.



Bycatch
Example: Fishermen unintentionally kill dolphins, sea turtles, and seabirds.



Aquaculture
Example: Produces wastes that can pollute ocean water and harm marine organisms.



Point Source Pollution
Example: Passenger cruise ships dump sewage, shower and sink water, and oily bilge water.



Coastal Development
Example: Developers destroy important coastal habitat, such as salt marshes and mangrove swamps.



Habitat Destruction
Example: Trawl nets (fishing equipment pulled along the ocean floor) destroy habitat.



Climate Change
Example: Coral reefs and polar seas are particularly vulnerable to increasing temperatures.

Human Disturbance

Copyright © The McGraw-Hill Companies, Inc. Permission required for reproduction or display.

TABLE 5.1

Human Disturbance

Biome	Total Area (10⁶ km²)	% Undisturbed Habitat	% Human Dominated
Temperate broad-leaf forests	9.5	6.1	81.9
Chaparral	6.6	6.4	67.8
Temperate grasslands	12.1	27.6	40.4
Temperate rainforests	4.2	33.0	46.1
Tropical dry forests	19.5	30.5	45.9
Mixed mountain systems	12.1	29.3	25.6
Mixed island systems	3.2	46.6	41.8
Cold deserts/semideserts	10.9	45.4	8.5
Warm deserts/semideserts	29.2	55.8	12.2
Moist tropical forests	11.8	63.2	24.9
Tropical grasslands	4.8	74.0	4.7
Temperate coniferous forests	18.8	81.7	11.8
Tundra and arctic desert	20.6	99.3	0.3

Note: Where undisturbed and human-dominated areas do not add up to 100 percent, the difference represents partially disturbed lands.

Source: Hannah, Lee, et al., "Human Disturbance and Natural Habitat: A Biome Level Analysis of a Global Data Set," in *Biodiversity and Conservation*, 1995, Vol. 4:128–55.

Stop and Think

What biomes would expect to be most challenging for organisms?

Can you think of any general or specific adaptations found in each biome?

Mammals generally get larger as move towards the poles can you guess why?

Can name any animals that live in high elevations? Can guess what adaptations they might have that allow them to be successful in this niche?

If you were drifting in life boat and needed to catch a fish for food. Would it be wiser to drop you only bait deep into the ocean or drag it on the surface? Why?