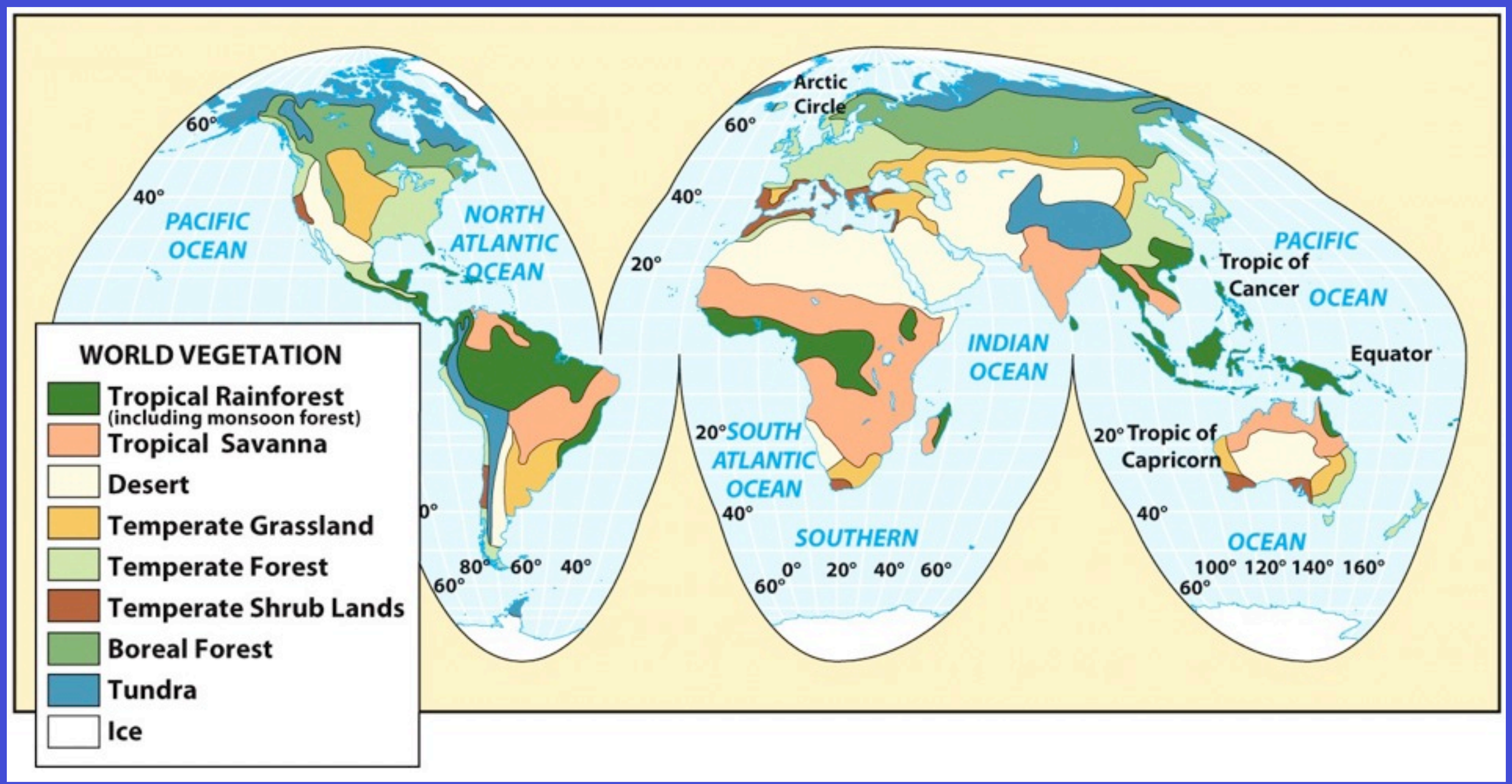
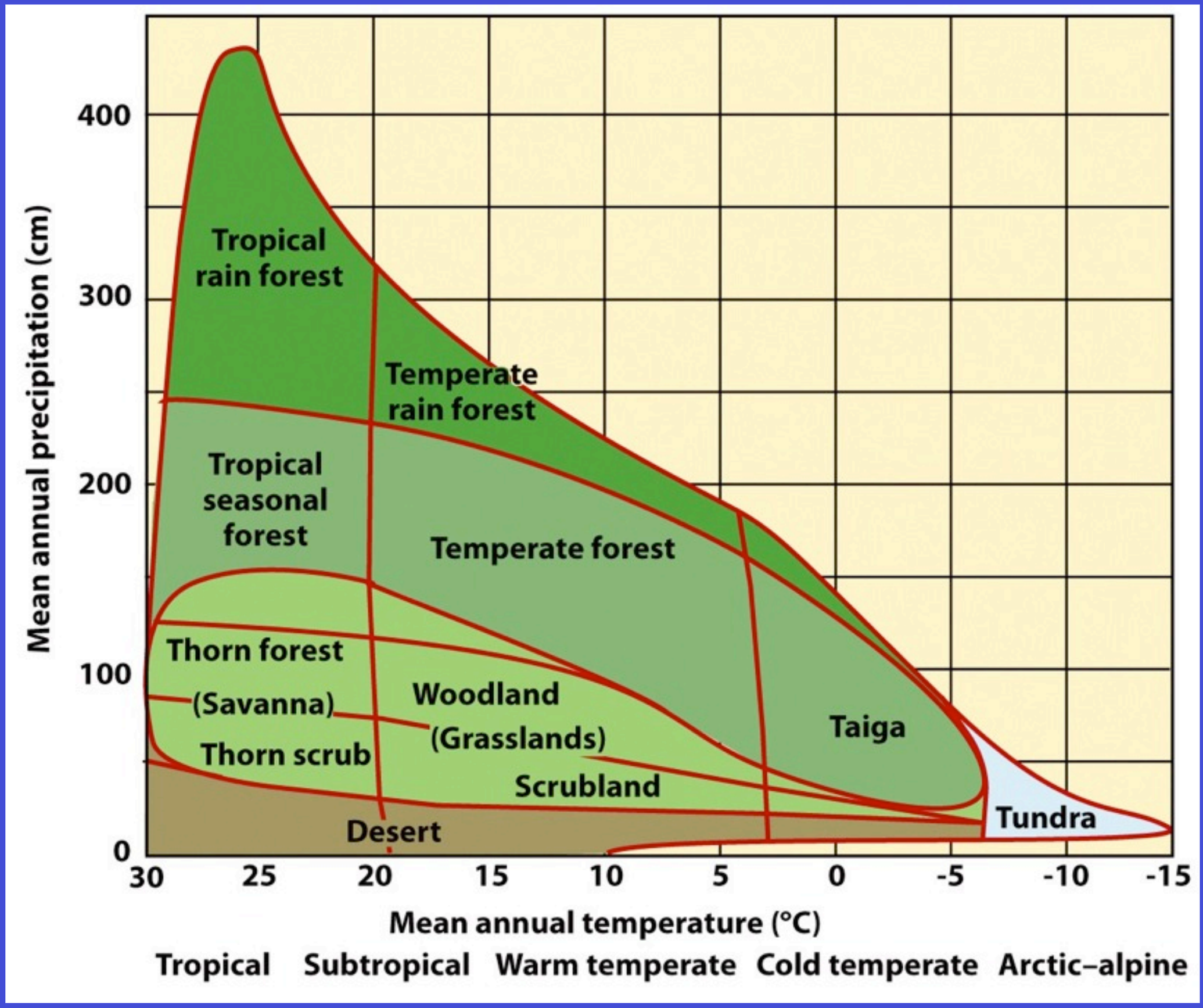
Terrestrial Biomes

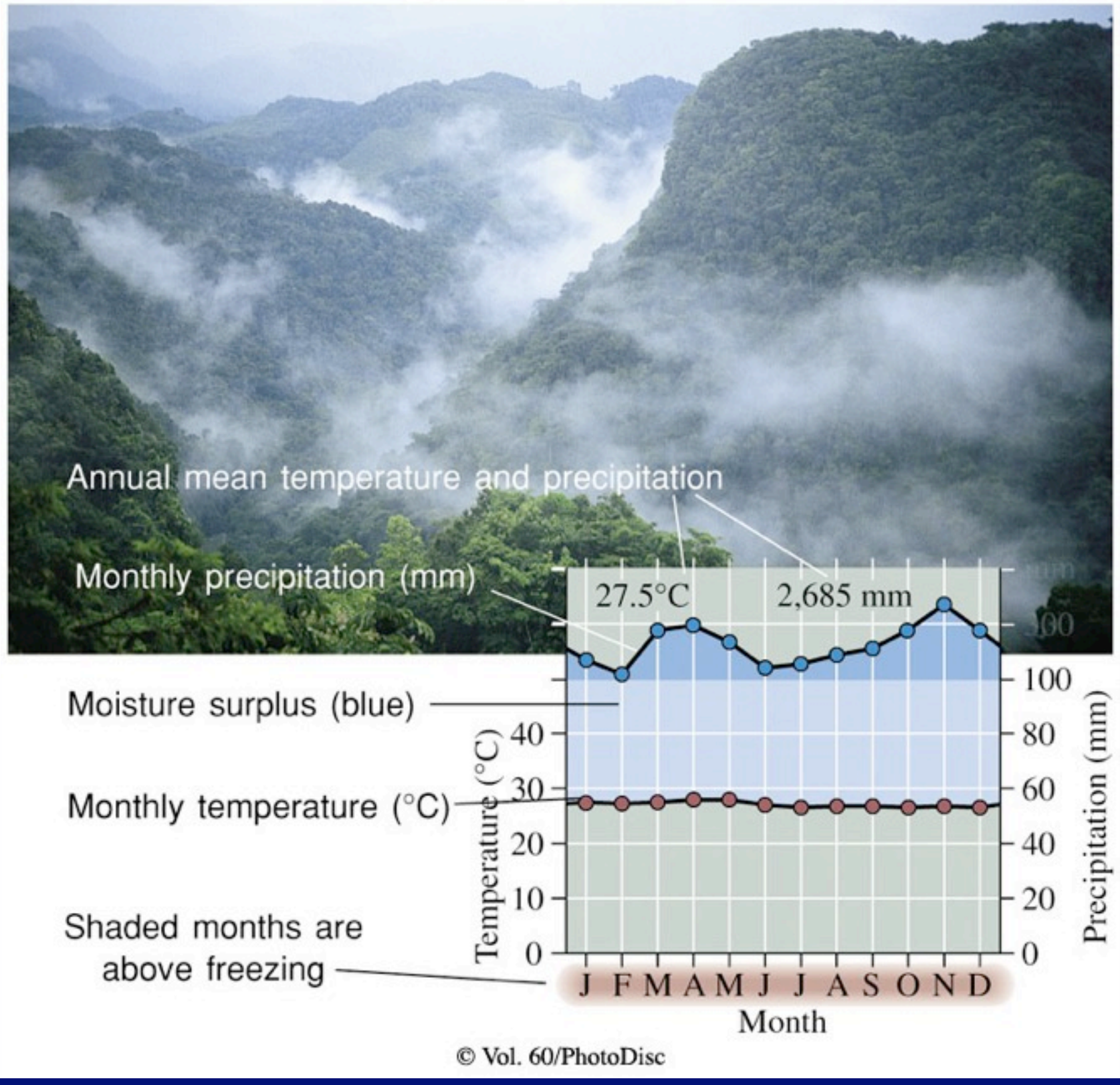

WORLD VEGETATION
Tropical Rainforest
(including monsoon forest)
Tropical Savanna
Desert
Temperate Grassland
Temperate Forest
Temperate Shrub Lands
Boreal Forest
Tundra
Ice
60°
40°
PACIFIC OCEAN
NORTH ATLANTIC OCEAN
80° 60° 40°
60°
Arctic Circle
60°
40°
20°
INDIAN OCEAN
20° SOUTH ATLANTIC OCEAN
40°
SOUTHERN
0° 20° 40° 60°
60°
PACIFIC OCEAN
Tropic of Cancer
Equator
20° Tropic of Capricorn
40°
OCEAN
100° 120° 140° 160°
60°


Mean annual precipitation (cm)
400
300
200
100
0
Tropical rain forest
Temperate rain forest
Tropical seasonal forest
Temperate forest
Thorn forest
(Savanna)
Thorn scrub
Woodland
(Grasslands)
Scrubland
Desert
Taiga
Tundra
30
25
20
15
10
5
0
-5
-10
-15
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
- Two theories
  - –The more favorable the temperature and precipitation for life the more diversity.
  - –Greater the variability of climate, the lower the diversity

Tropical Rain Forests

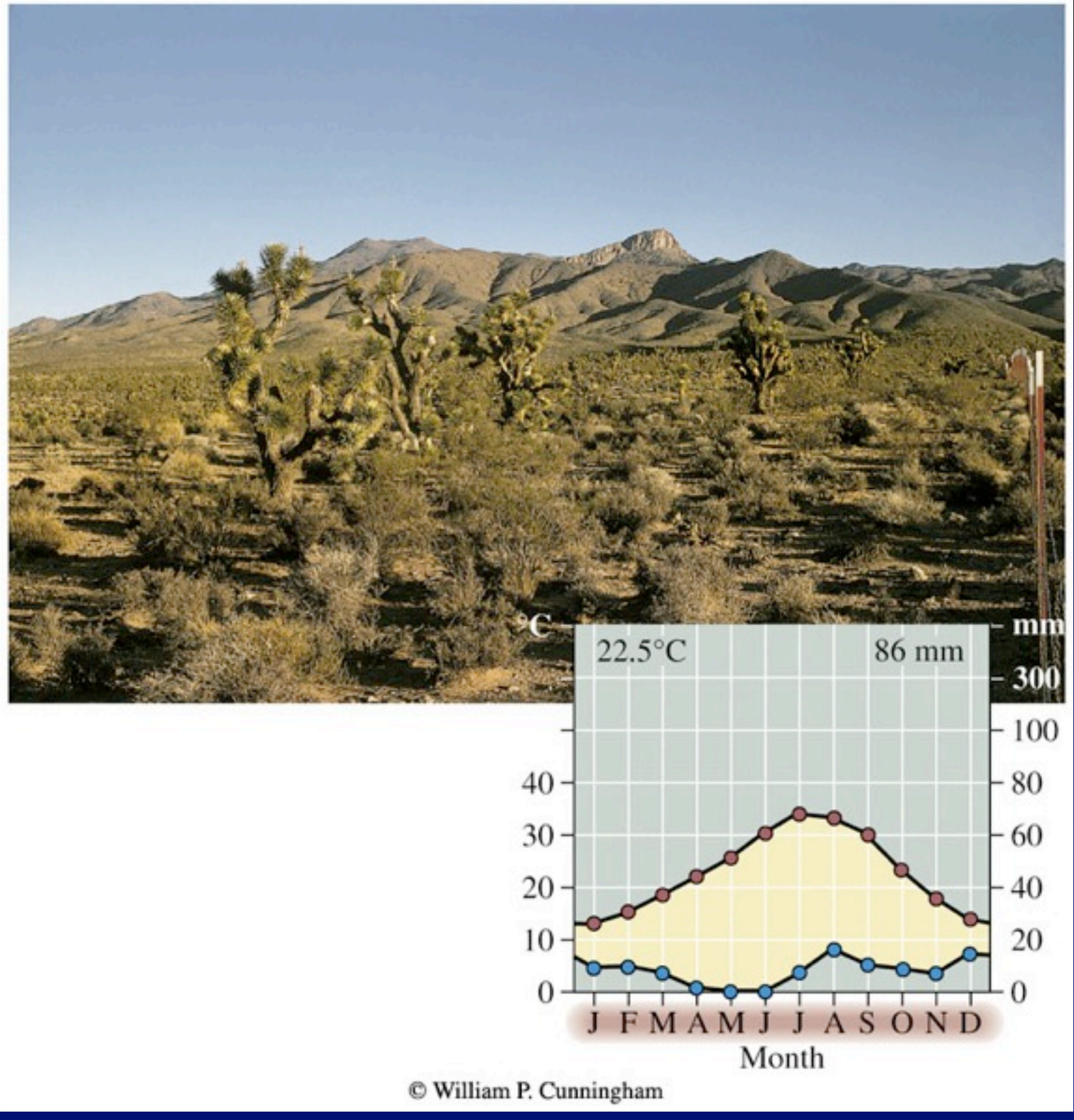


TROPICAL RAIN FOREST

- 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



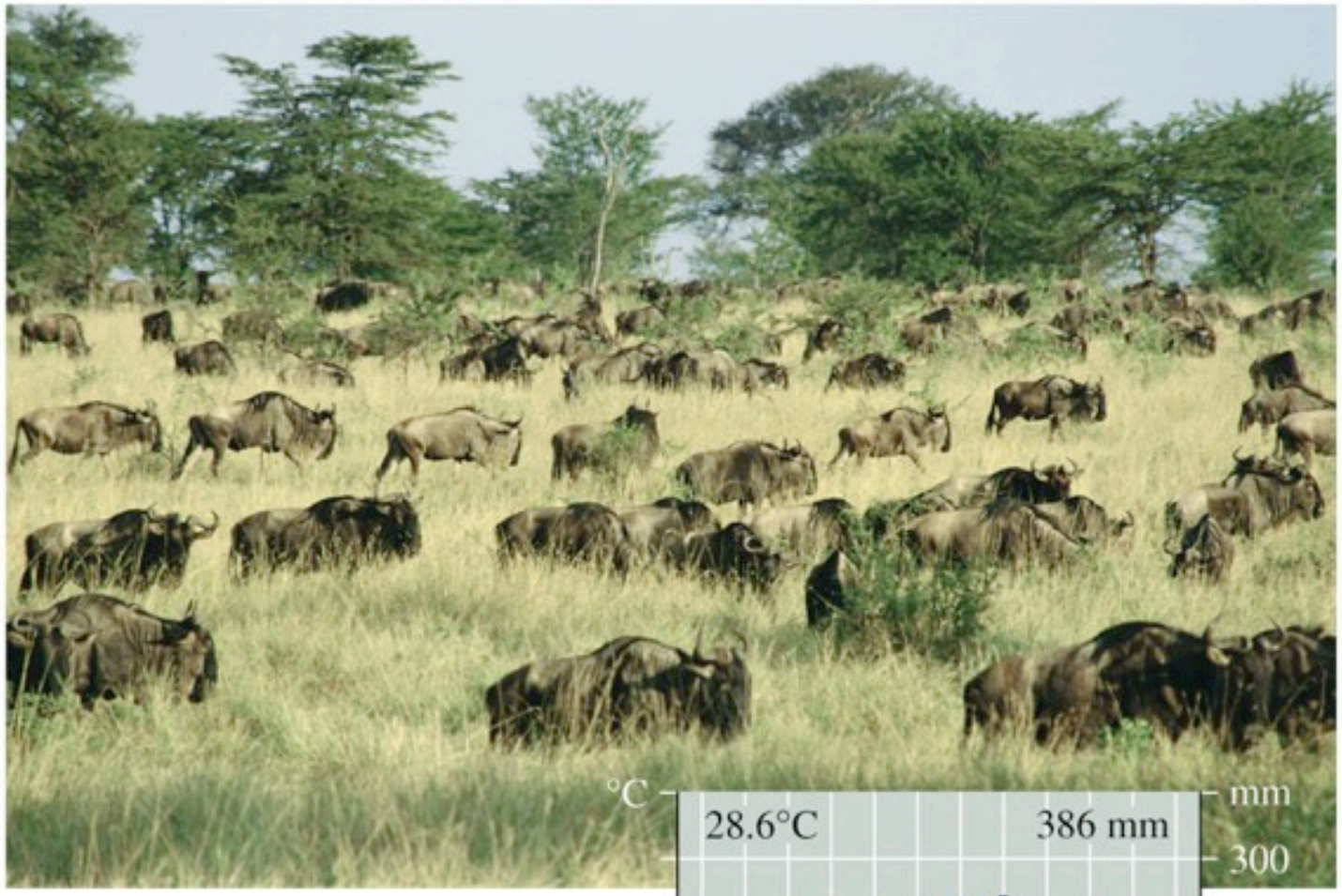
© William P. Cunningham

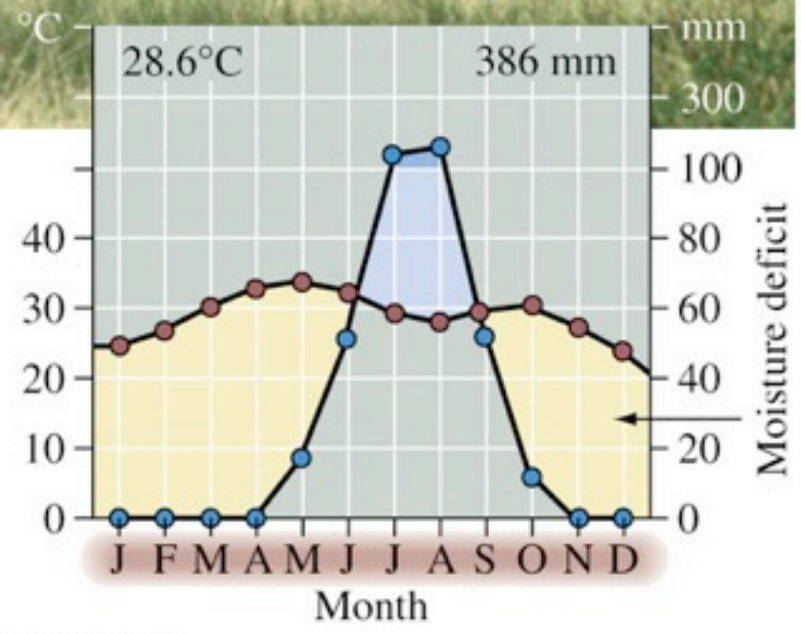
DESERT

- 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 biodivesity
- Point of Interest: deserts are defined by precipitation not temp

DESERT BIOME

SAVANNAS



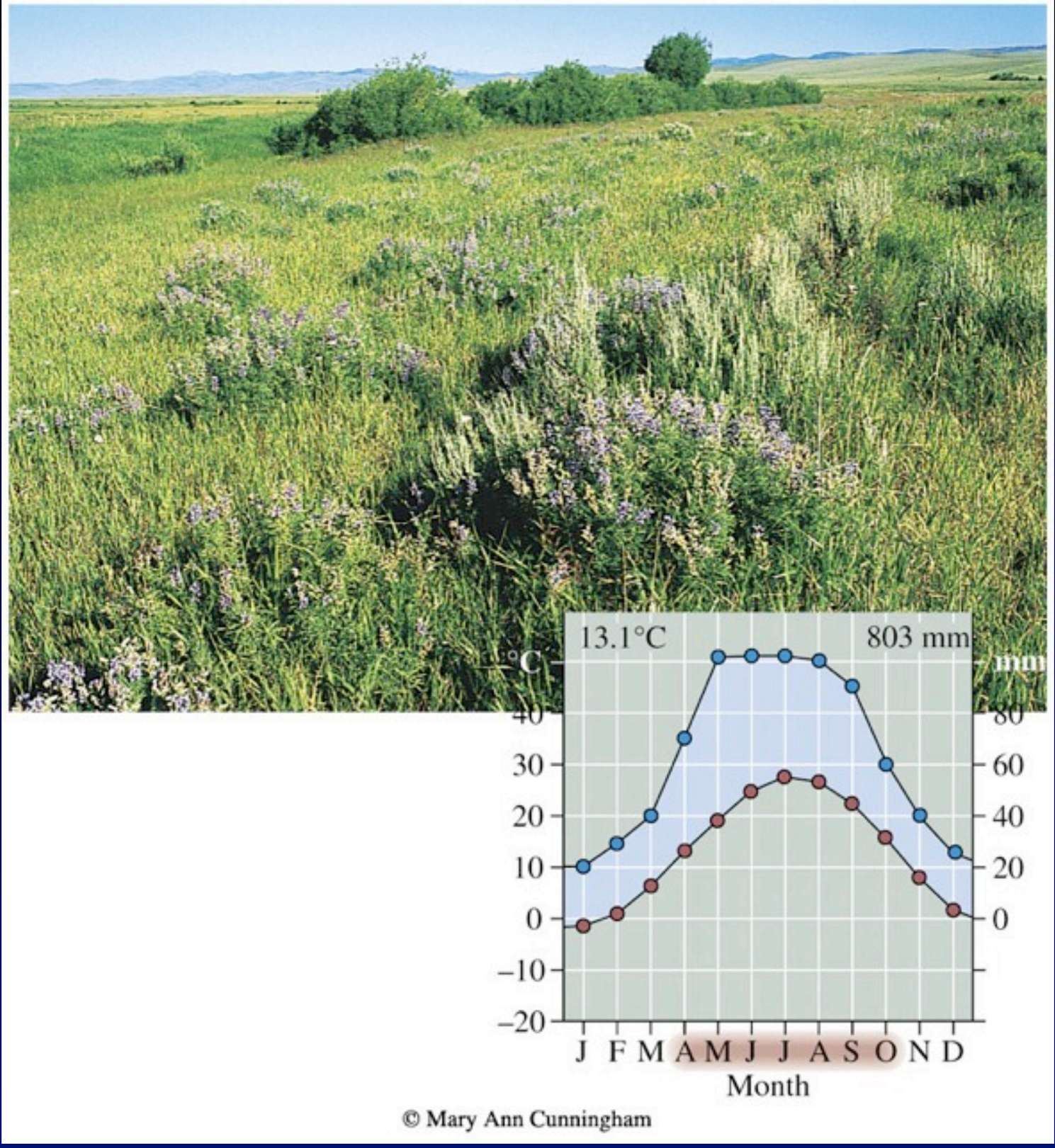


SAVANNA

- 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



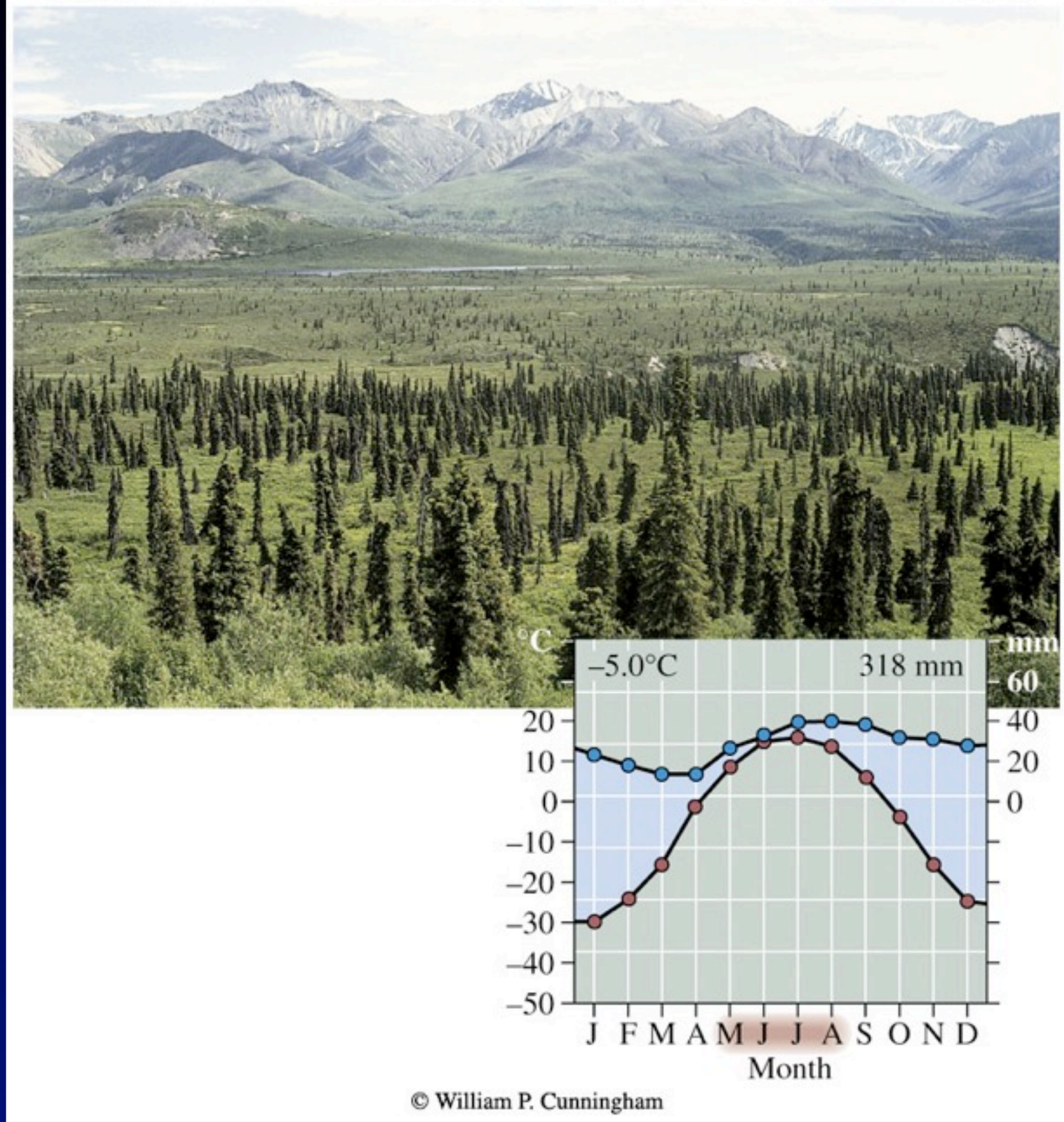
© Mary Ann Cunningham

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



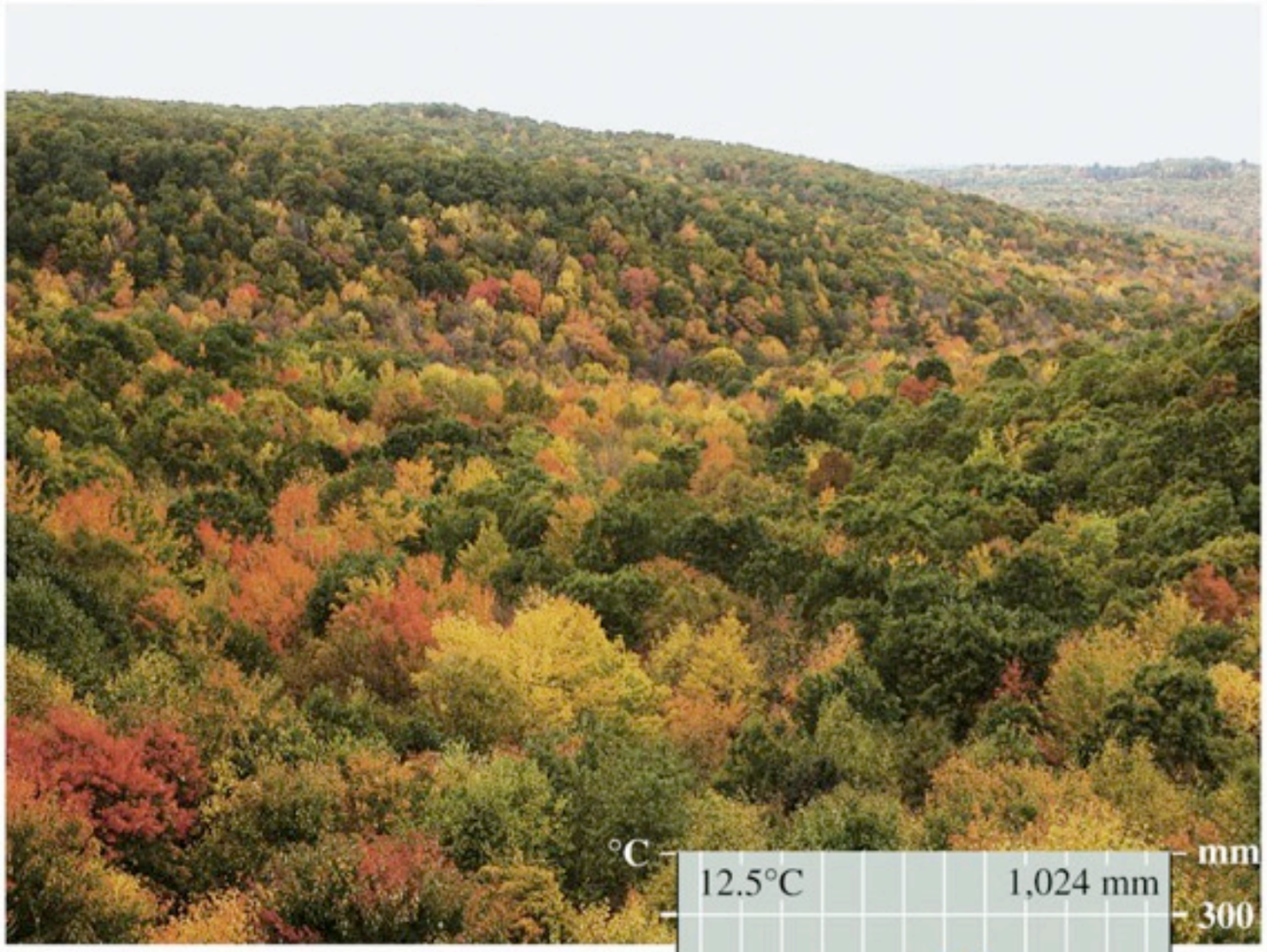
© William P. Cunningham

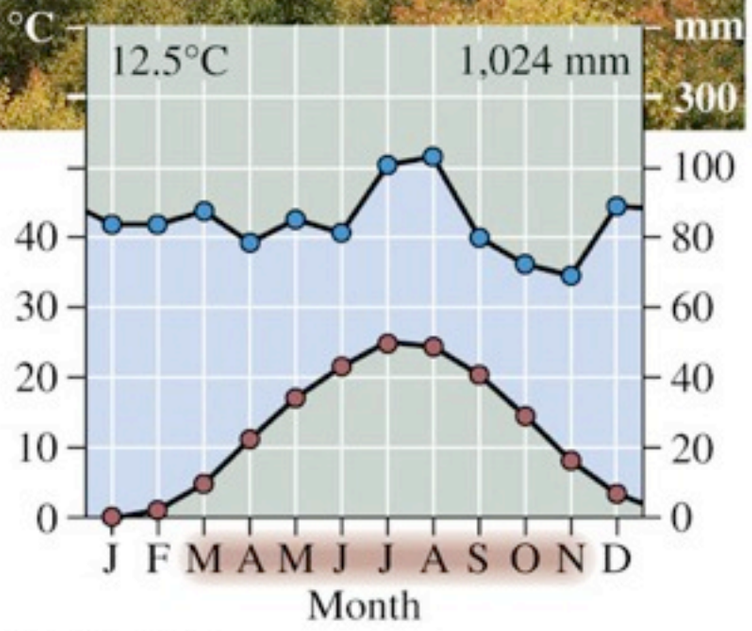
TAIGA / BOREAL FOREST

- 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





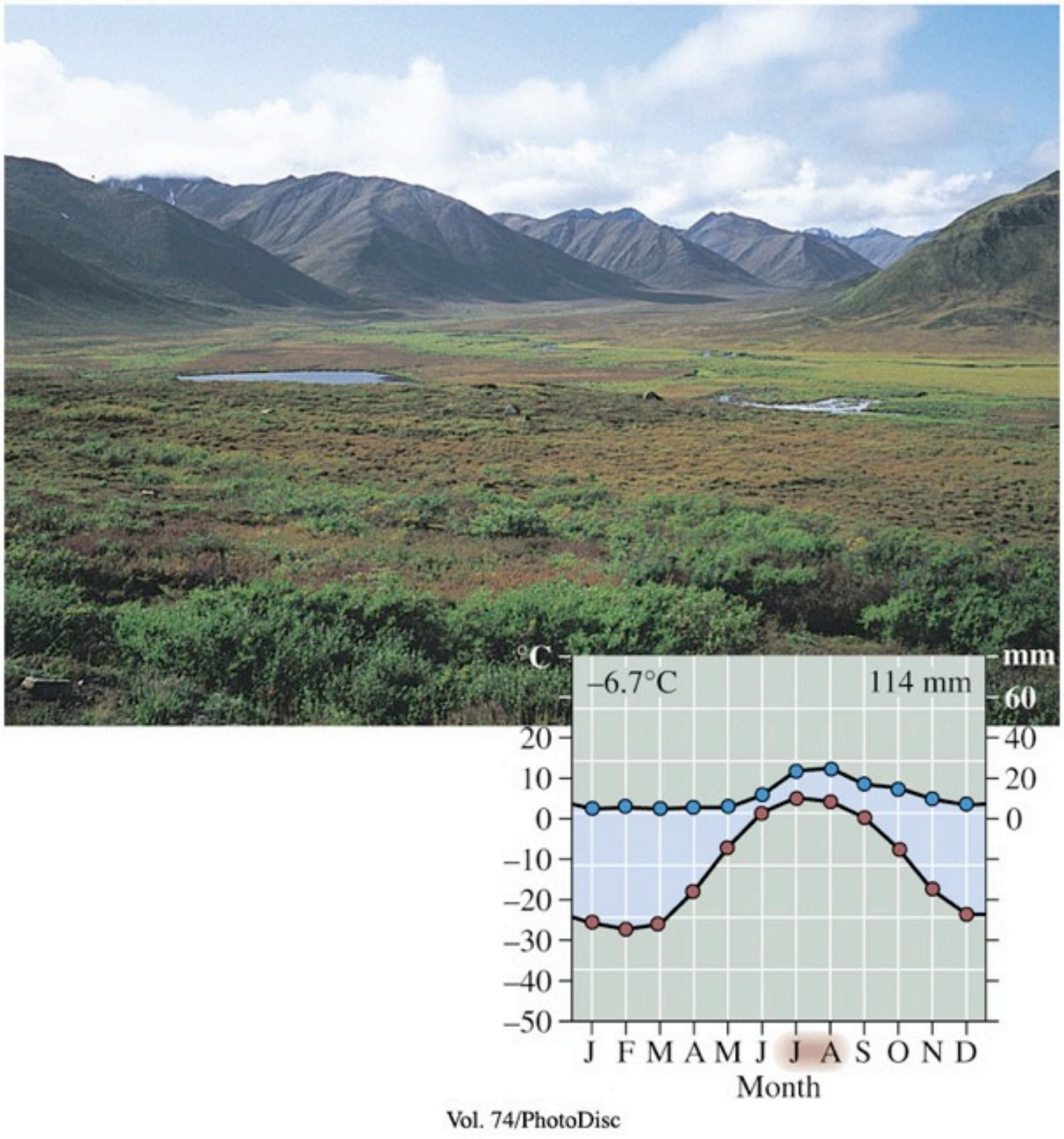
© William P. Cunningham

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



Vol. 74/PhotoDisc

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 distrurbed

Tundra Biome

TEMPERATE RAIN FOREST

© 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

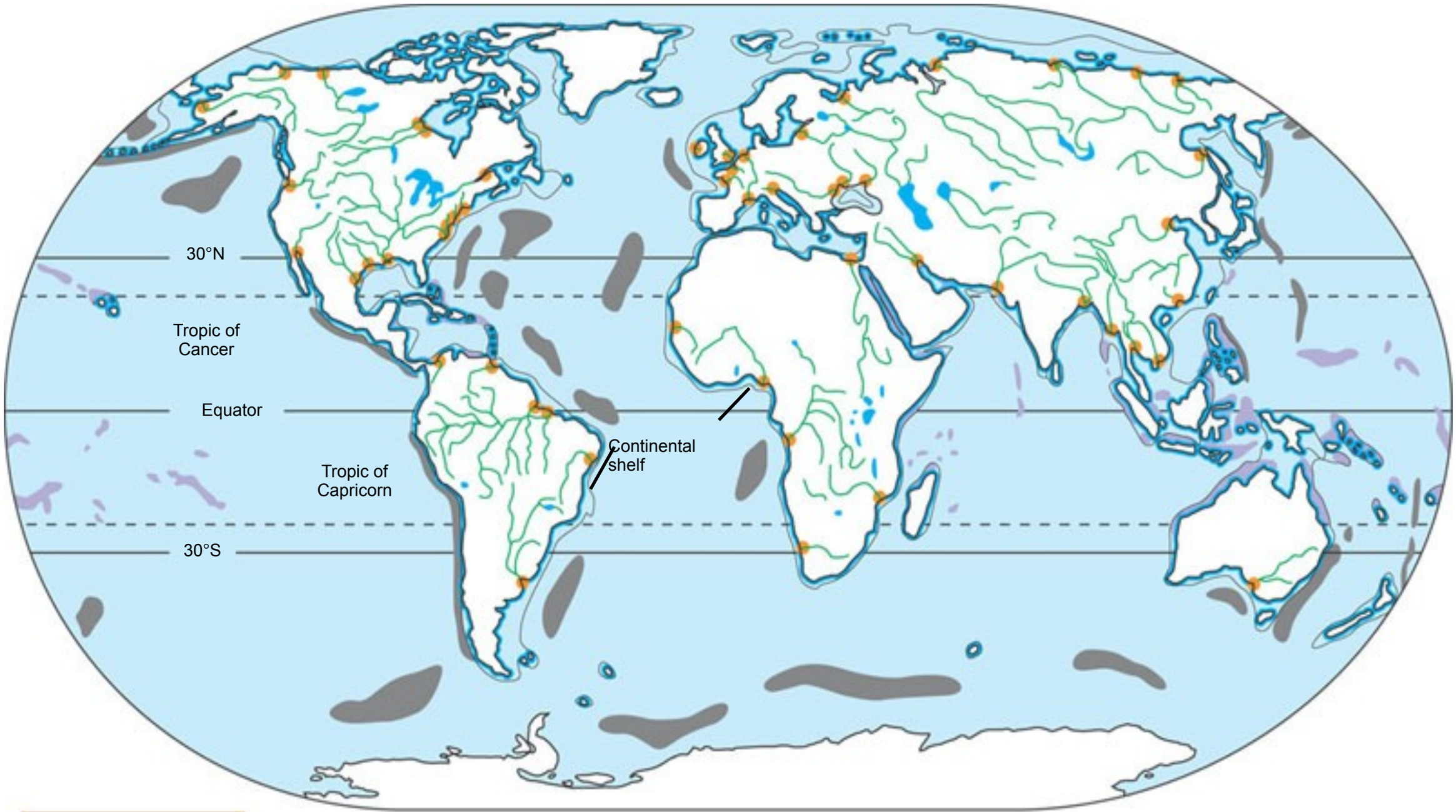
Temperate Rain Forest

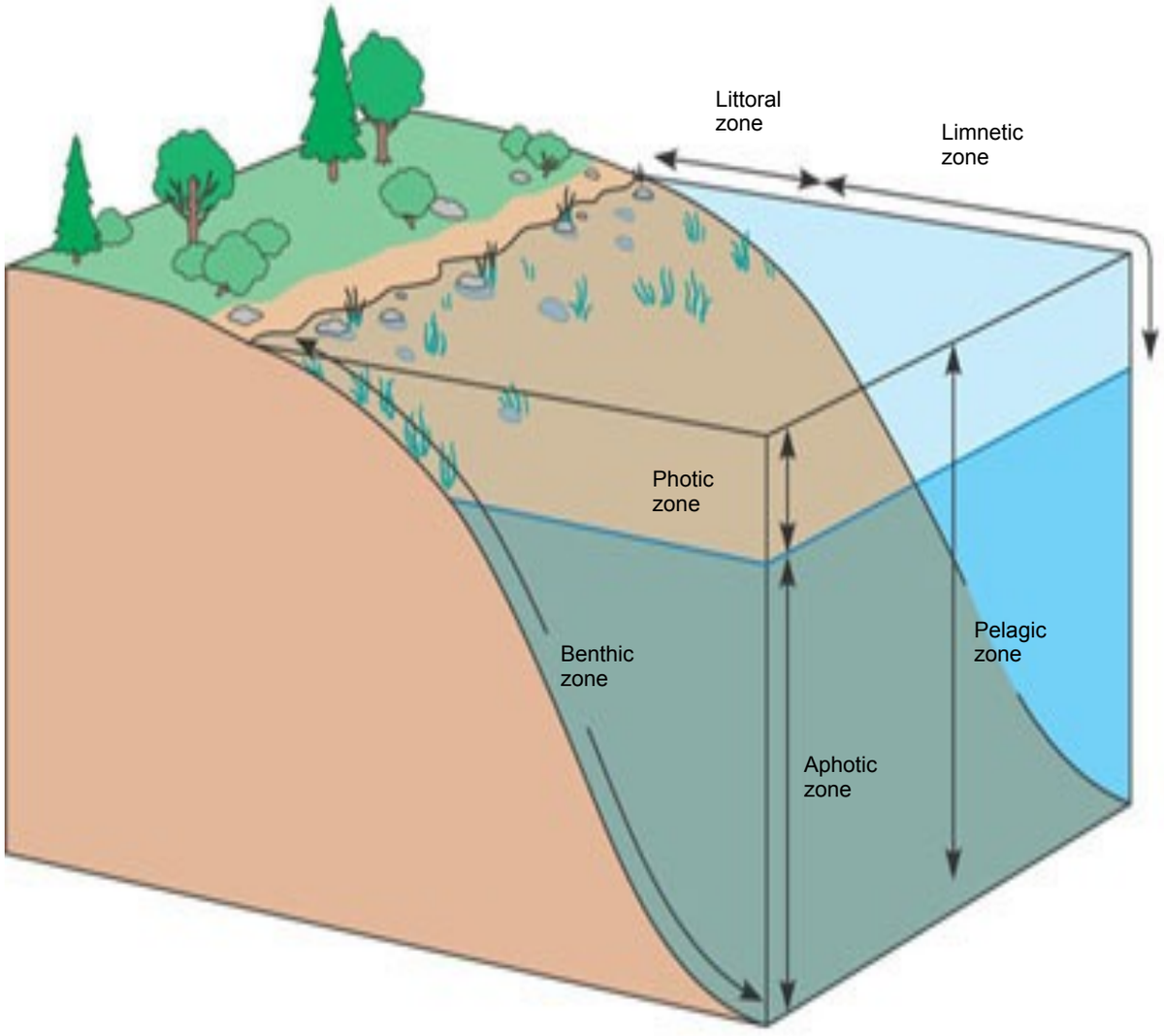
ADDITIONAL BIOMES

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

Aquatic Biomes

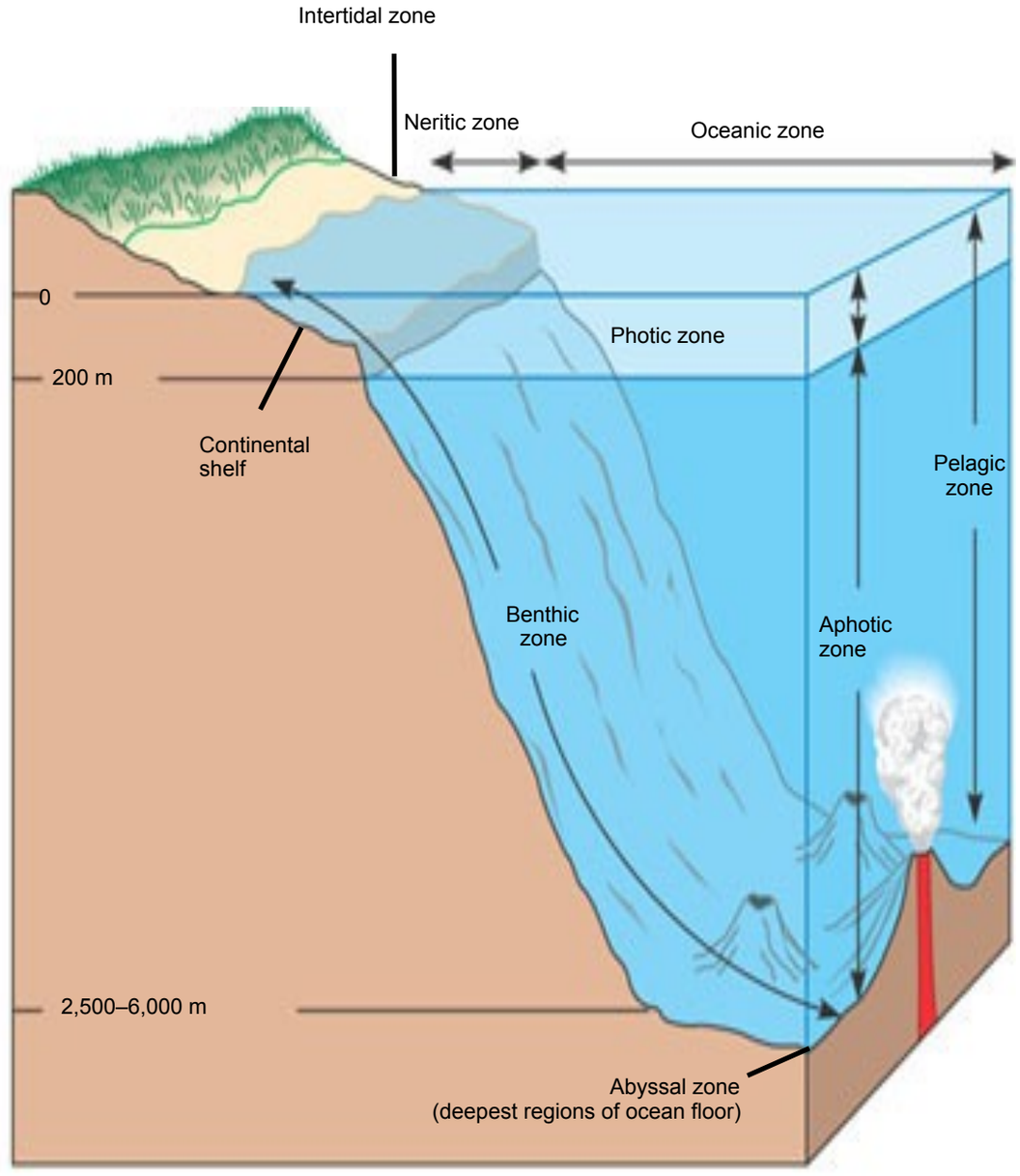
Marine & Freshwater Biomes





(a)

Zonation in a lake. The lake environment is generally classified on the basis of three physical criteria: light penetration (photic and aphotic zones), distance from shore and water depth (littoral and limnetic zones), and whether it is open water (pelagic zone) or bottom (benthic zone).



(b)

Marine zonation. Like lakes, the marine environment is generally classified on the basis of light penetration (photic and aphotic zones), distance from shore and water depth (intertidal, neritic, and oceanic zones), and whether it is open water (pelagic zone) or bottom (benthic and abyssal zones).

WETLANDS

(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 exists 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

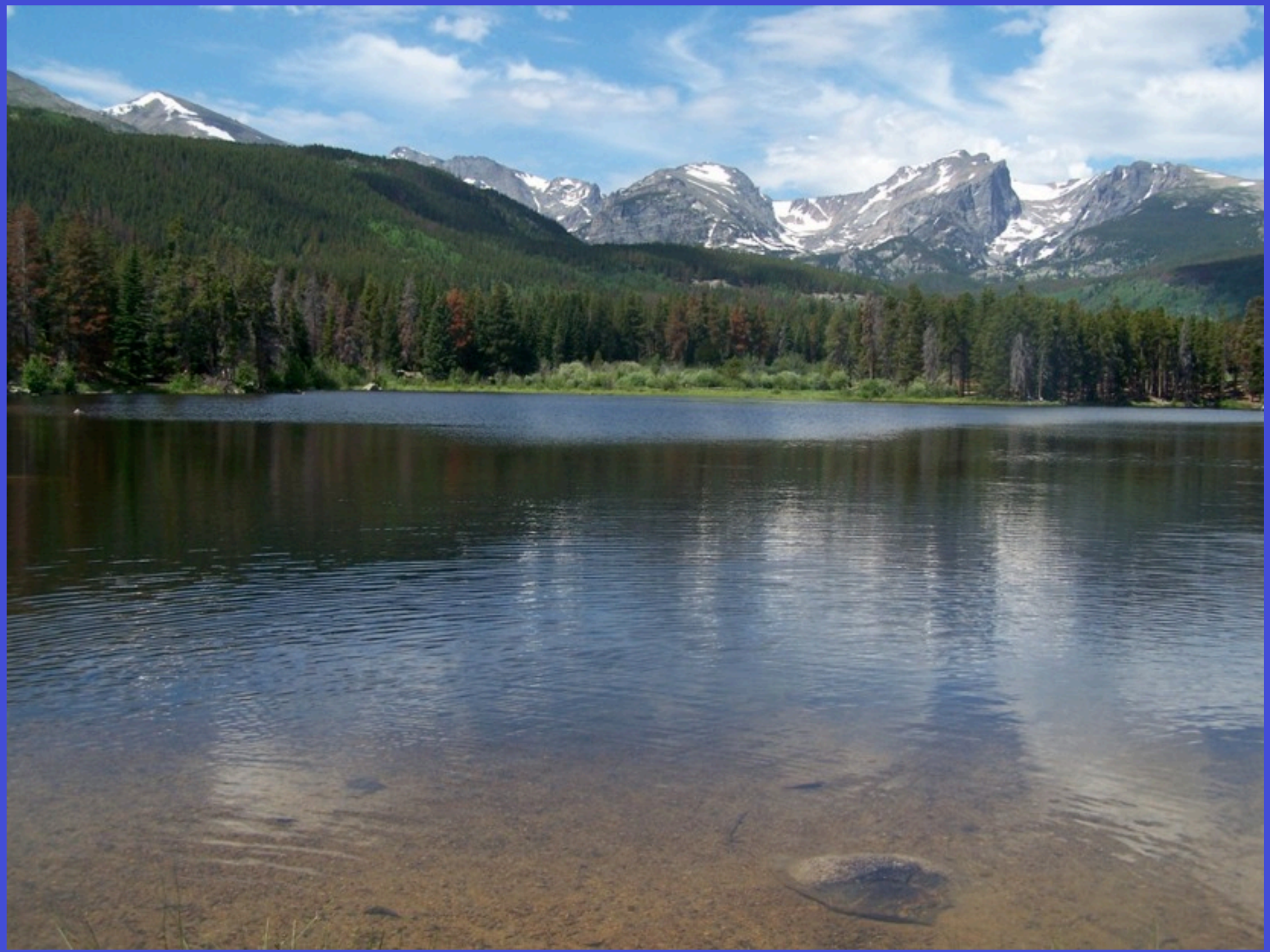
- Photosynthetic Organisms: littoral zone has rooted and floating plants, limnetic zone has a variety of phytoplankton and cyanobacteria

- 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

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

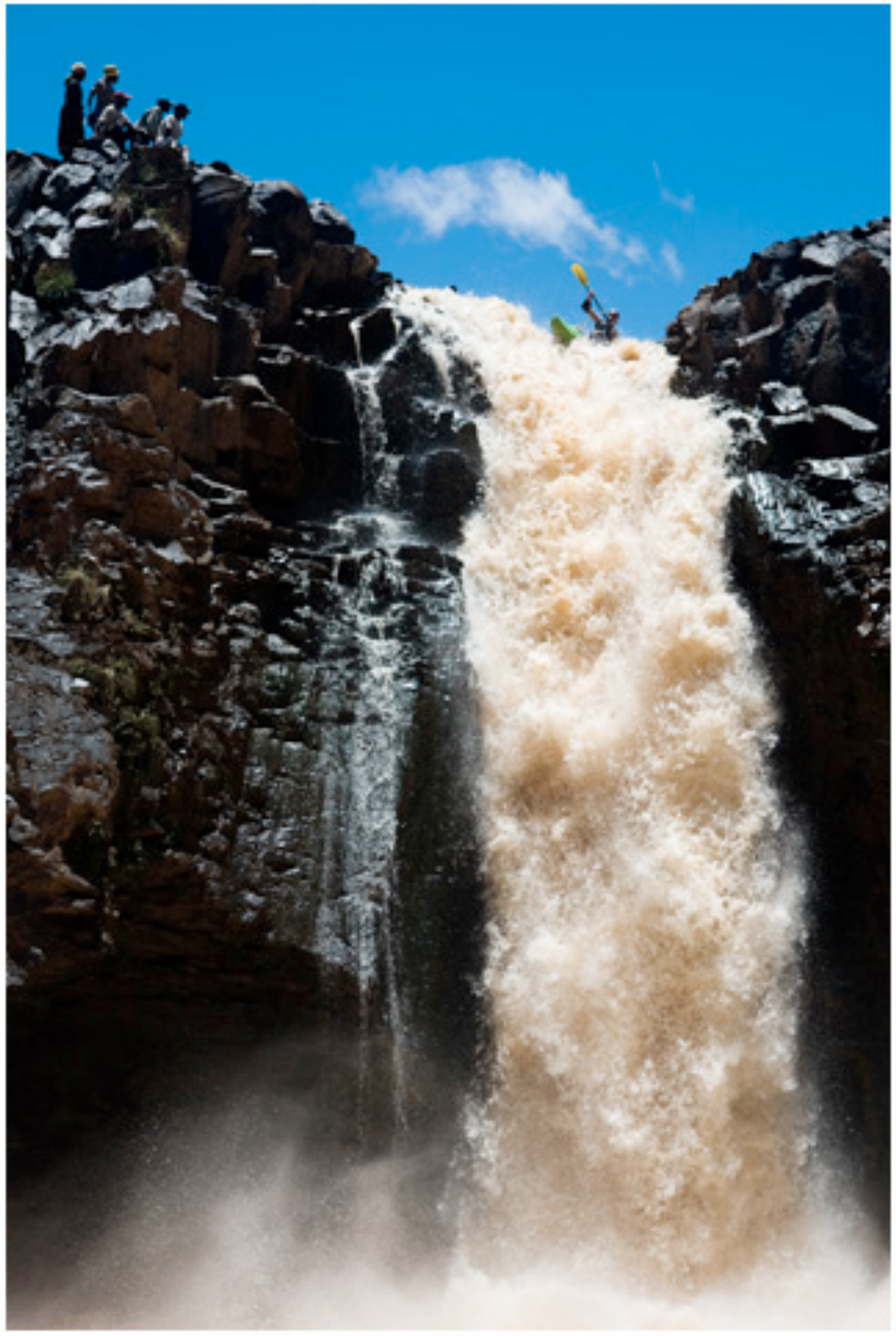
RIVER Classifications

Tyler Bradt Exclusive Interview kayaksession.com

© by Ian Garcia

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

Tyler Bradt Exclusive Interview kayaksession.com



© Pat Camblin (as seen in portfolio ks28)

Tyler Bradt Mazyfalls Madagascar

World Record...186 feet!

STREAMS / RIVERS

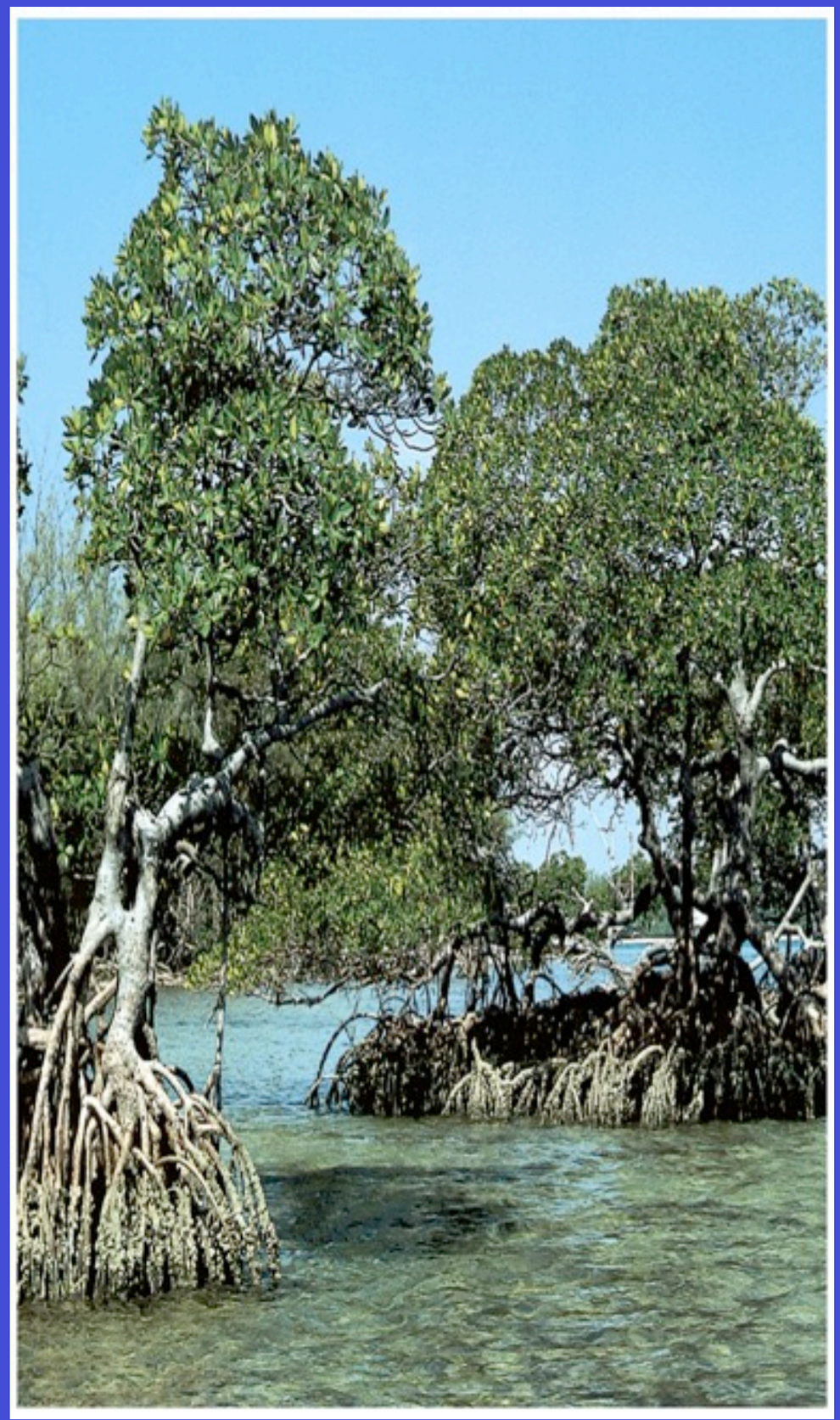
ESTUARIES

© 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

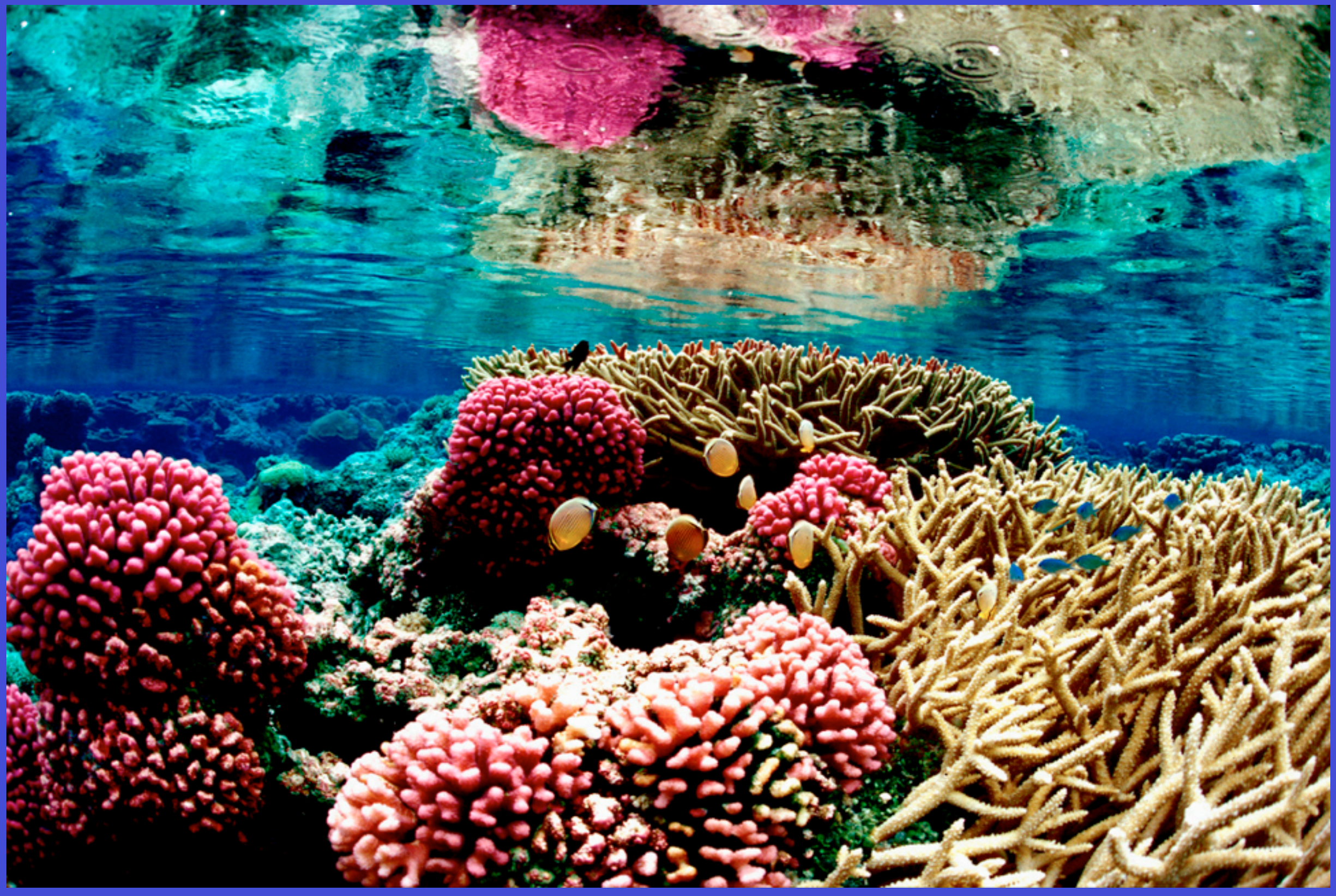
CORAL REEFS

© 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

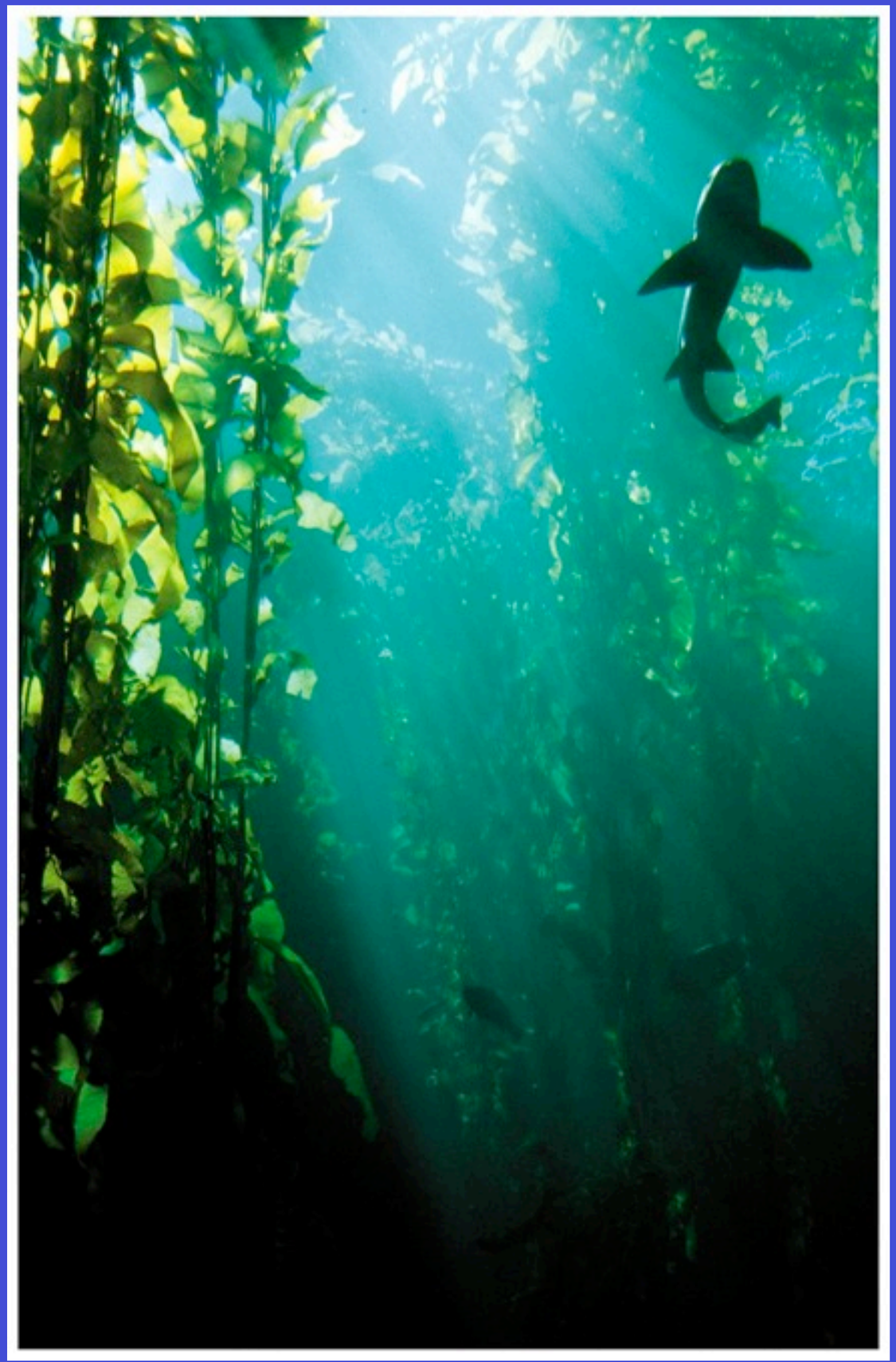


MARINE BENTHIC ZONE

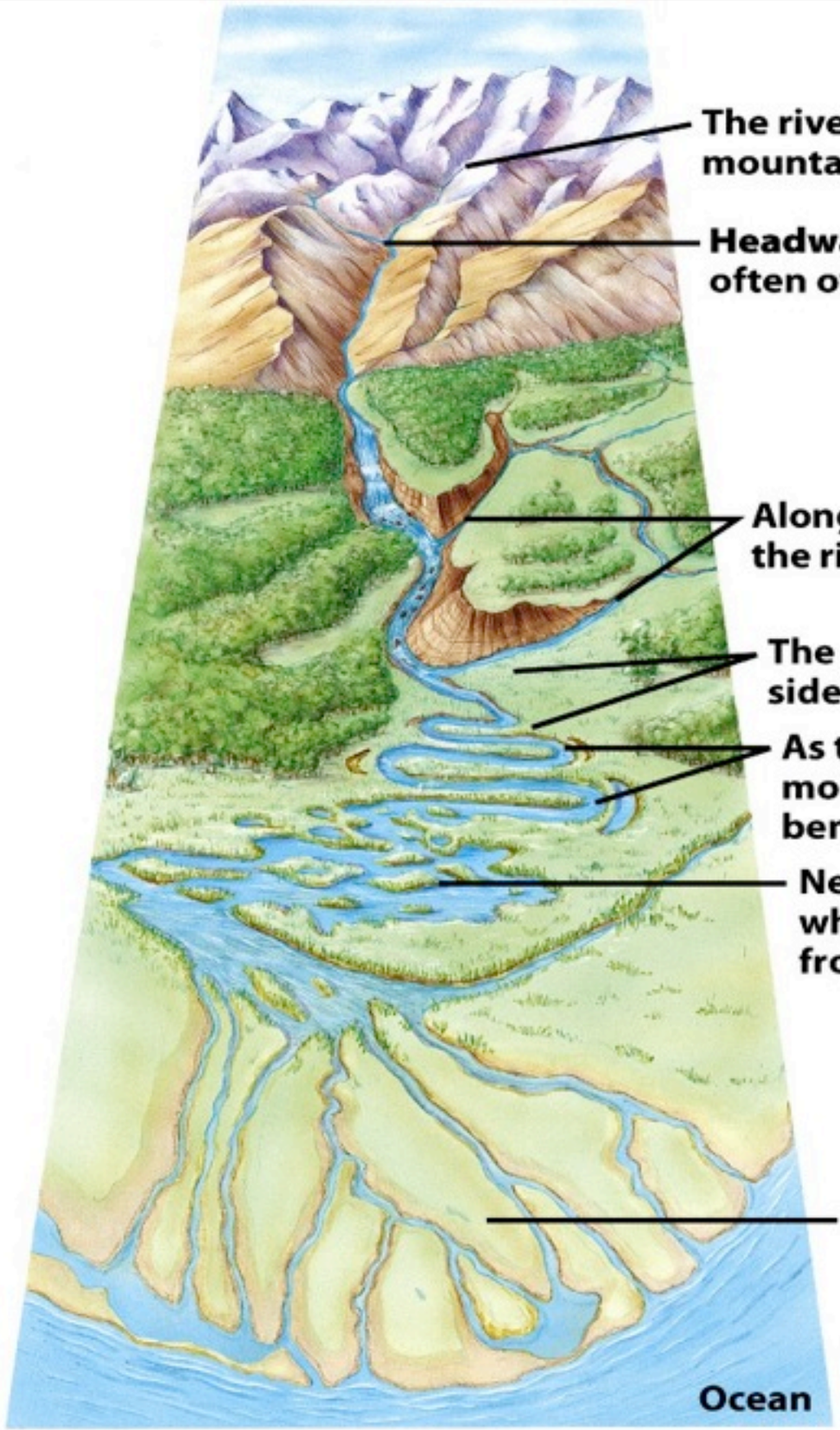
MARINE BENTHIC ZONE

- 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



Additional Points of Interest



The river begins at a **source**, often high in the mountains and fed by melting snows or glaciers.

Headwater streams flow downstream rapidly, often over rocks (as **rapids**) or bluffs (as **waterfalls**).

Along the way, smaller **tributaries** feed into the river, adding to its flow.

The **flood plain** is the relatively flat area on either side of the river that is subject to flooding.

As the river's course levels out, the river flows more slowly and winds from side to side, forming bends called **meanders**.

Near the ocean, the river may form a **salt marsh** where fresh water from the river and salt water from the ocean mix.

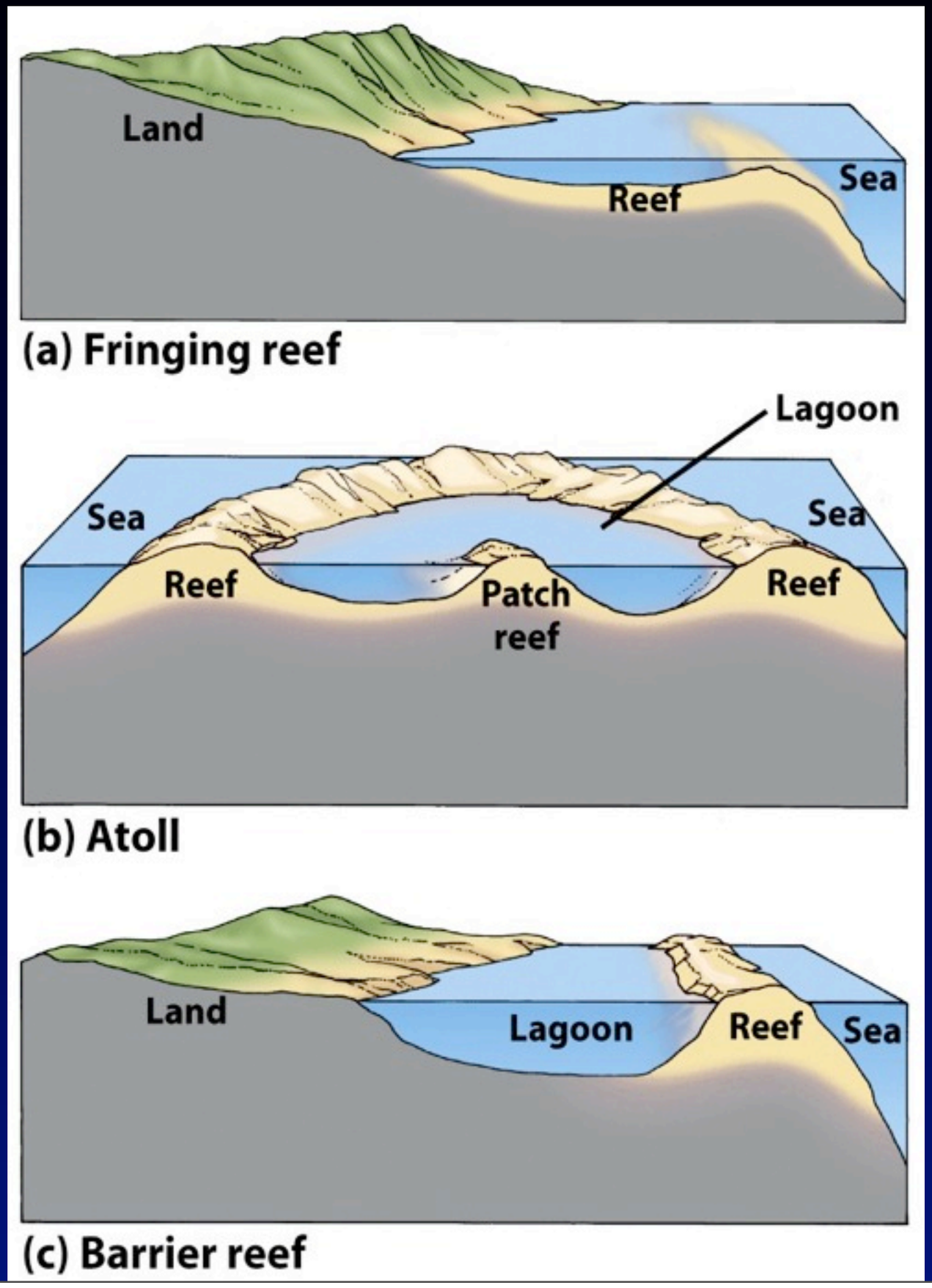
The **delta** is a fertile, low-lying plain at the river's **mouth** that forms from sediments deposited by the slow-moving river as it empties into the ocean.

Coastal Zones

- Communities vary with depth, light, temperature and nutrient concentration.

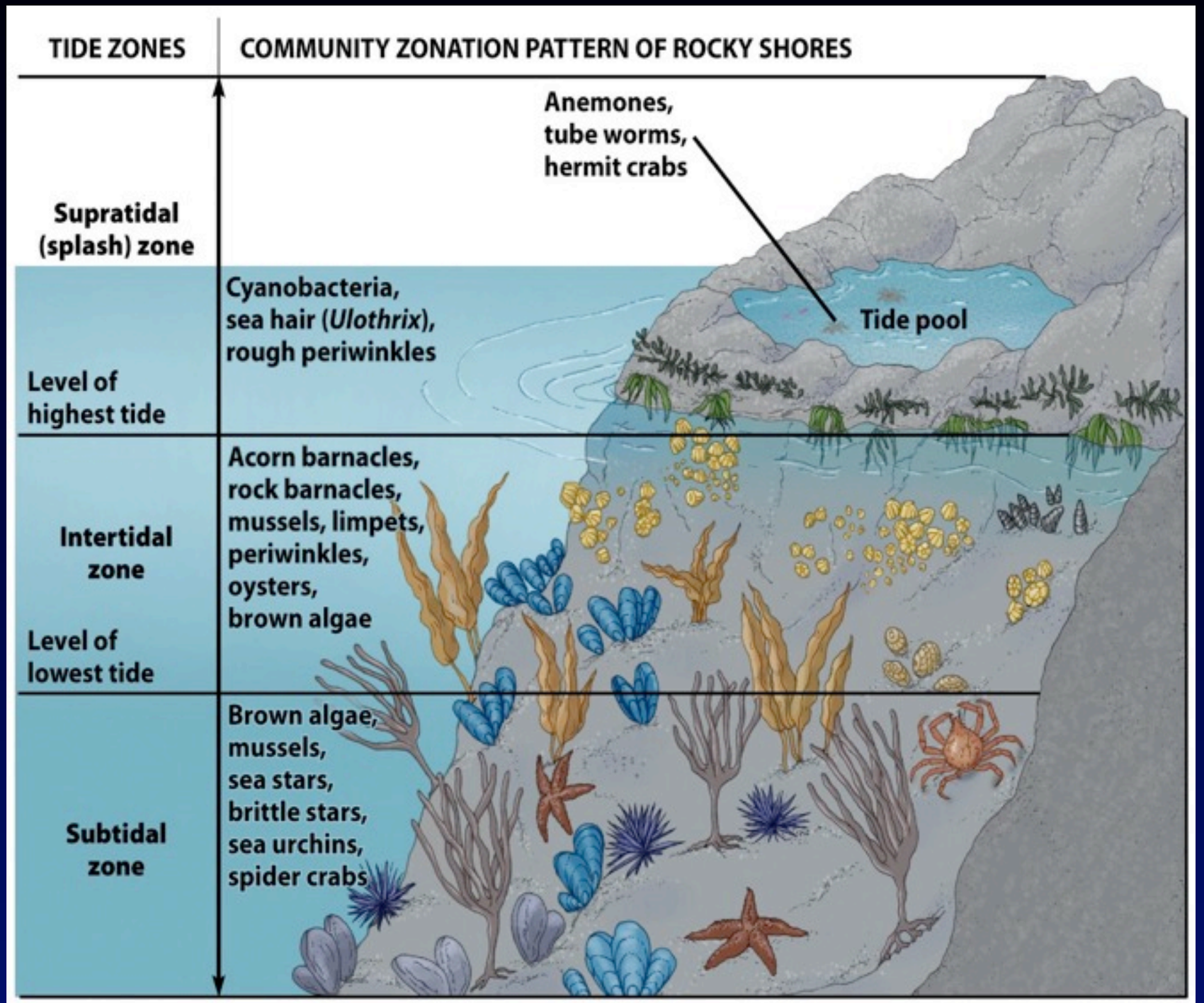
- Coral Reefs - Aggregations of coral polyps that live symbiotically with algae. Their calcium rich skeletons build up the reef.
  - Light must penetrate for algal photosynthesis.
  - Threatened by trash, sewage, urban runoff, industrial waste, introduced pathogens and global warming. Global warming causes coral bleaching in which corals expel their algal partners and then die.
  - One third of coral reefs have already been destroyed and 60% of the remaining reefs will probably be dead by 2030 (2006 UNESCO Conference).

CORAL REEFS


Land
Sea
Reef
(a) Fringing reef
Lagoon
Sea
Sea
Reef
Patch
reef
Reef
(b) Atoll
Land
Lagoon
Reef
Sea
(c) Barrier reef

Tide Pools

- Depressions in a rocky shoreline that are flooded at high tide but retain some water at low tide
- Wave action prevents plant growth, but animals can be found in tidal pools.


TIDE ZONES
COMMUNITY ZONATION PATTERN OF ROCKY SHORES
Supratidal (splash) zone
Anemones, tube worms, hermit crabs
Tide pool
Level of highest tide
Cyanobacteria, sea hair (Ulothrix), rough periwinkles
Intertidal zone
Acorn barnacles, rock barnacles, mussels, limpets, periwinkles, oysters, brown algae
Level of lowest tide
Subtidal zone
Brown algae, mussels, sea stars, brittle stars, sea urchins, spider crabs

Mangroves

- Mangroves are trees that grow in saltwater along tropical coastlines.

- Help stabilize shoreline
- Nurseries for fish, shrimp
- Can be cut for timber

Barrier Islands

- Narrow islands made of sand that form parallel to a coastline
- Provide protection from storms, waves, tides
- Since they are made of sand, they should not be built on, but they are. Oftentimes, storms destroy the buildings.

USGS

Ecosystems: Human Disturbances

Human Disturbance

- By some estimates, humans preempt about 40% of net terrestrial primary productivity.

- Conversion of habitat to human use is single largest cause of biodiversity loss.

- Temperate deciduous forests are the most completely human-dominated biome. Tundra and Arctic Deserts are the least disturbed.

- About half of all original wetlands in the U.S. have been degraded over the past 250 years.

Human Disturbance

TABLE 5.1

Human Disturbance

Biome	Total Area (10^6 km^2)	% 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.

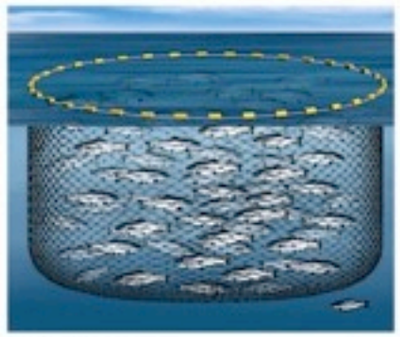
Source: Hannah, Lee, et al., "Human Disturbance and Natural Habitat: A Biome Level Analysis of a Global Data Set," in *Biodiversity and Conservation,* 1995, Vol. 4:128–55.

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.