Chapter 7: Wildlife

Introduction to Wildlife

Invertebrates

Vertebrates

Introduction to Conservation Biology

Human Activity and Domestic and Introduced Animals

Introduction to Wildlife

a. primary producers
   - synthesize sugar from CO2, water and sunlight
     - plants

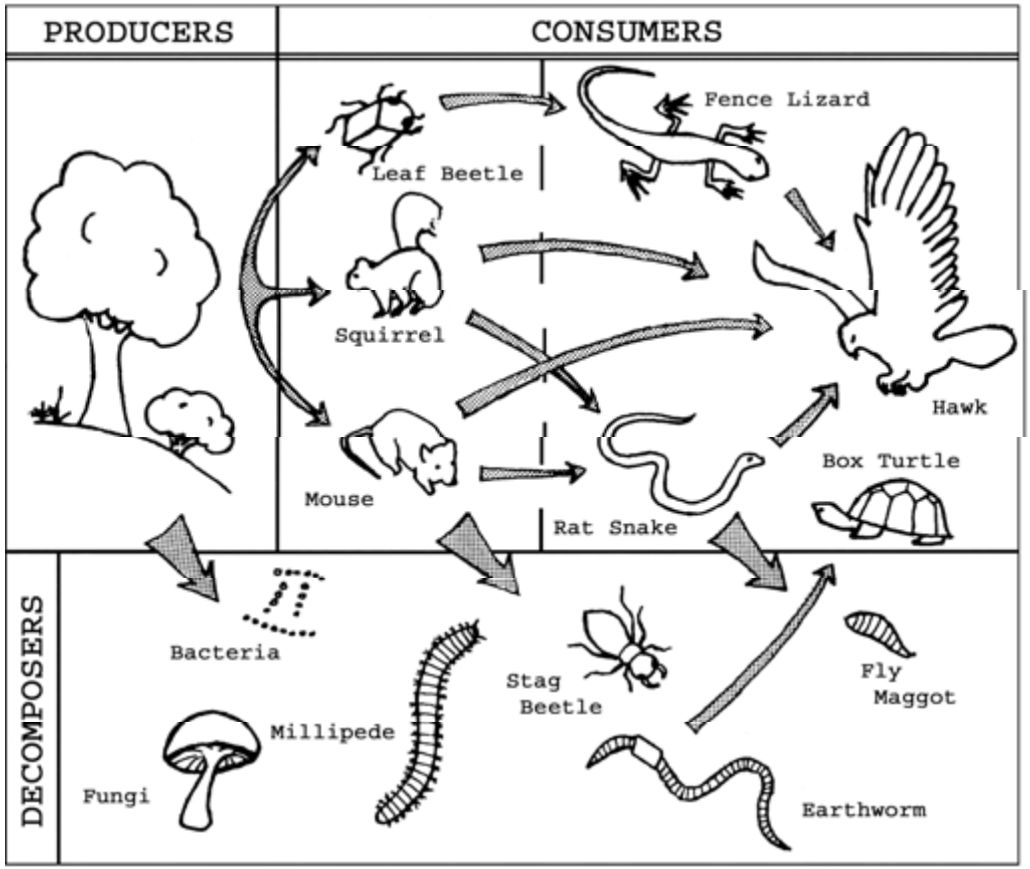
b. primary consumers
   - consume plants
     - herbivores
     - detritivores

c. secondary consumers (predators)
   - omnivores
   - carnivores
   - scavengers

Food web

Graphically describes the many interconnected eating relations among plants and animals within a system

a. lines represent direction of energy transfer (who is eaten by whom)
b. notice how the mouse is a food source for three different animals



What are animals?

They are often the first thing we think about once we develop an interest in the natural world

a. most animals are primary consumers
b. predation and competition among animals for resources (food, shelter) structure animal communities

- ex. population of snowshoe hare and Canadian lynx is tightly linked
  - high populations of hares allows for high populations of lynx
    - as hare population goes down due to lynx predation, so too does lynx population
    - when the lynx population declines, the hare population rebounds

Ways to group animals

a. daily behavior
   - diurnal: active during the day, sleep during the night
     - ex. cows, swallows

- nocturnal: active at night, sleep during the day
  - ex. raccoons, spotted owls

- crepuscular: most active at dawn and dusk, somewhat active into the day or night
  - ex. coyotes, nighthawks, hawkmoths

b. seasonal behavior
    - active year round
        - ex. people, elk, sharks

- hibernation: lowered metabolic function during winter
    - ex. bears
- torpor: temporary hibernation (twelve hours or so)
    - ex. birds, bats

- estivation: hibernation during the hot dry summer months
    - ex. frogs, salamanders, earthworms, centipedes

- orienting life cycle around the season
  - pass unfavorable season as hard-shelled egg, desiccation-resistant pupa or inactive grub

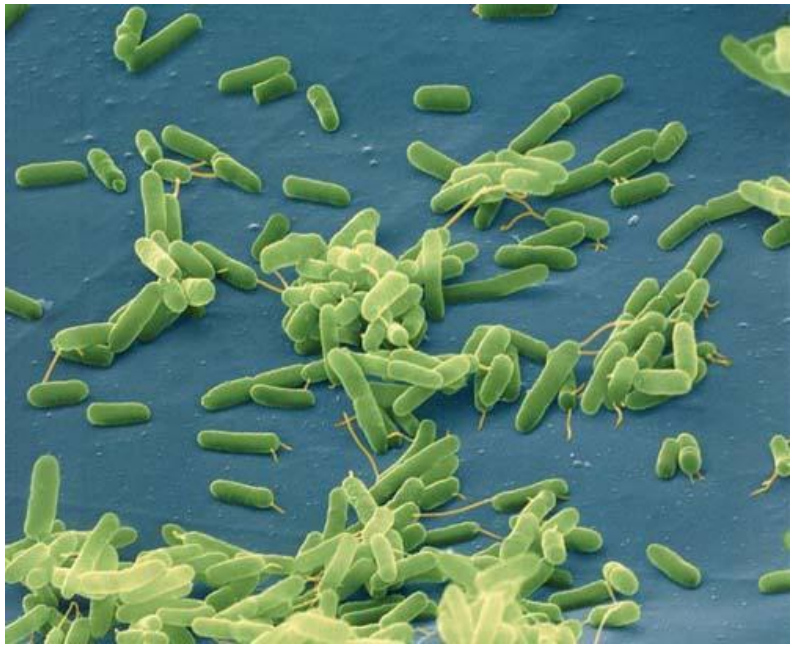
c. reproductive behavior
   - many offspring, little parental care
     - ex. insects, spiders, amphibians, fish, reptiles, small mammals

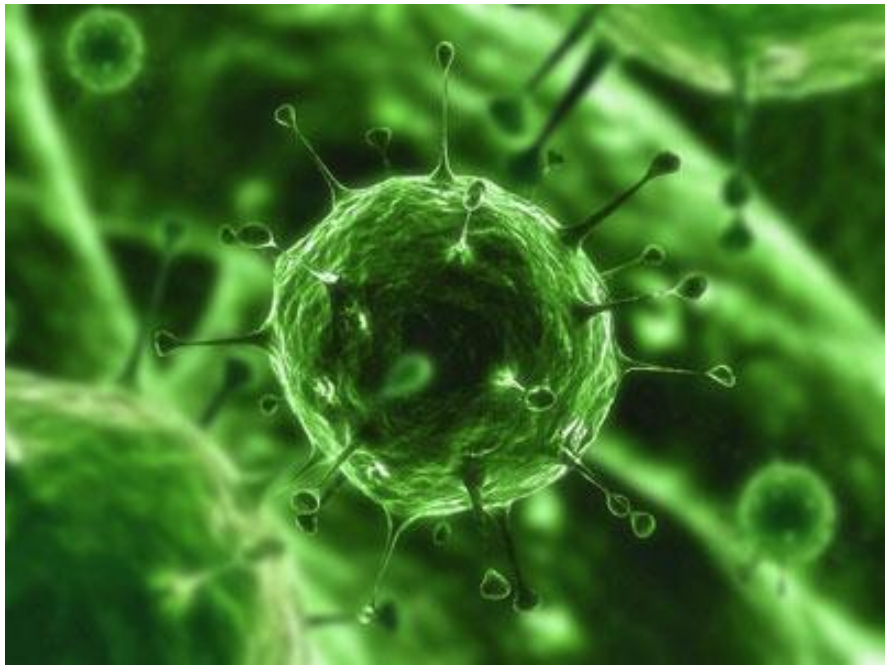
d. few offspring, intensive care
   - ex. elephants, great apes, whales, most large mammals

Evolutionary groups

a. Prokaryotes (lack cell nucleus or organelles)

- bacteria

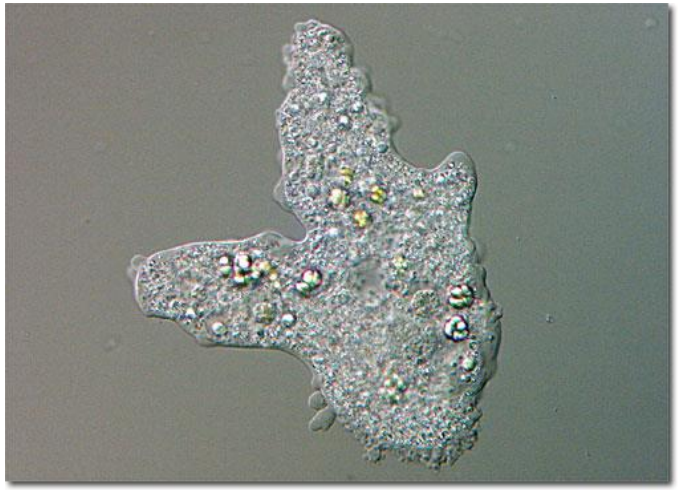




- viruses

b. Eukaryotes (possess cell nucleus and cell organelles)

- Protista



- Plantae

- Fungi

- Animalia
  - invertebrates
    - lack bony/cartilaginous backbone
    - lack internal bony/cartilaginous structure (have exoskeleton instead)
    - number of invertebrate species > that of vertebrates
    - biomass of all invertebrates together > that of vertebrates
    - ex. worms, clams, spiders, scorpions, millipedes, centipedes, insects

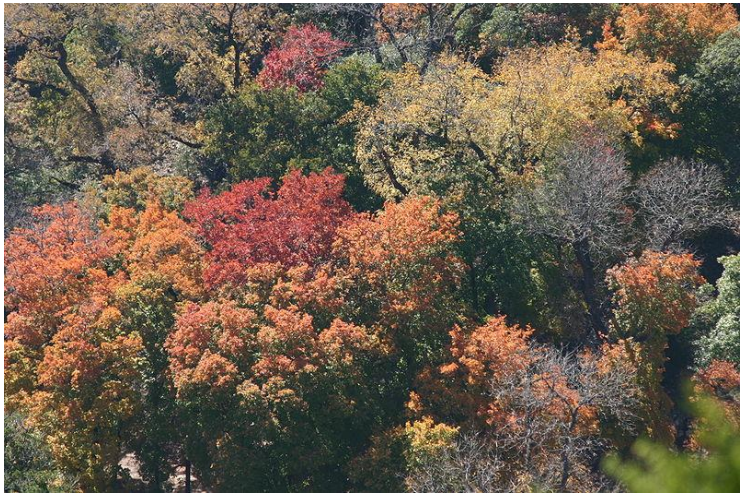
  - vertebrates
    - possess bony/cartilaginous backbone
    - possess internal bony/cartilaginous structure
    - ex. fish, birds, frogs, mammals, toads, turtles, lizards, snakes, crocodilians, salamanders, dinosaurs

Animals are architects of the environment

- ex. soil rotating effect of small burrowing mammals

- ex. beavers
  - chomp down trees
  - dam creeks and small rivers
  - effects
    - changes rivers into lakes or ponds
    - opens up grazing habitat to sunlight
    - alters water temperature and chemistry
    - alters aquatic plant and fish populations

- ex. jays
  - acorn seed dispersal /planting
  - results in growth of oak woodlands



Closer look at invertebrates

a. the most ancient common ancestor of invertebrates looked like a segmented worm, each segment bearing a pair of legs
b. the theme underlying Invertebrate evolution is reducing, increasing, or merging the segments and modifying the legs for new functions
    - antennae on moth are derived from one segment

- spider fangs & beetle mandibles derive from modified legs

- the cephalothorax of spiders is derived from four ancestral segments merged into one

Sample of invertebrates

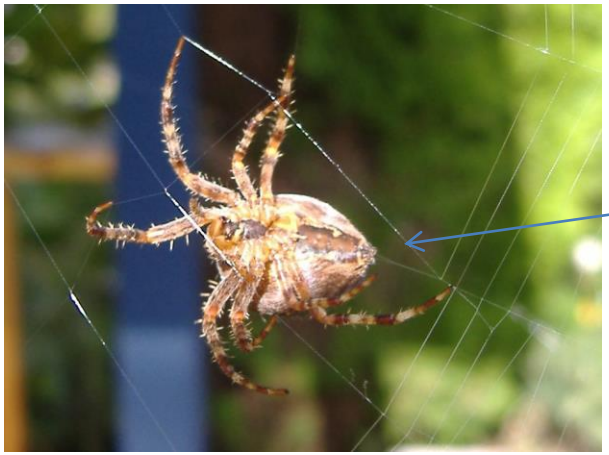
a. centipedes
   - you might not want to pick this up with your bare hands!
     - painful bite
     - fast moving, agile predator that hunts by smell and touch

- body plan is akin to ancestral invertebrate body plan
- strongly segmented (no merging of segments)
- each segment bears a pair of legs (no modification of legs)
- flattened (facilitates squeezing into or under tight places)

- lack of wax on their exoskeleton, and so highly susceptible to desiccation
- nocturnal
- prefer damp habitat (ie, northwestern CA and pretty much anywhere during wet season)

b. spiders

- very large and successful group
- two body segments
  - cephalothorax
    - four pairs of legs
    - eight eyes
    - fangs
  - abdomen



located toward the rear are six spinnerets

- venom glands to subdue prey or for defense
  - delivered via hollow fangs with hole at tip
  - usually, fangs are too small to inject venom into human skin, or the venom is too weak for hurt humans

c. insects
- no groups has more species or more collective biomass than insects do
- 2.5-30 million species
- mind boggling variety of lifestyles
- insect body plan
  - head
    - antennae
    - mouthparts
  - thorax
    - three pairs of legs
    - often one or two pair of wings
  - abdomen
    - carries the reproductive parts which function through tip of abdomen

Insect life cycles categories

a. complete metamorphosis

1. egg

2.grub (larva)

3. pupa (chrysalis)

4. adulthood
   - permanent
   - regeneration of limbs impossible at this point

Any of the four stages of their development can be used as a resting stage until climatic conditions improve

b. incomplete metamorphosis
- the form that hatches from egg looks like small, wingless version of adult
- grows larger with each shedding
- on the final shed (molt), new structures emerge like wings and reproductive organs
- ex. grasshoppers, aphids, stinkbugs, roaches, silverfish

Nymph

Adult

c. Hemimetabolous
   - the form that hatches from egg looks nothing like the adult (transformative stage)
     - mobile
     - non-feeding, relying on stored resources to grow
     - ex: dragonflies, damselflies, mayflies

Transformative stage

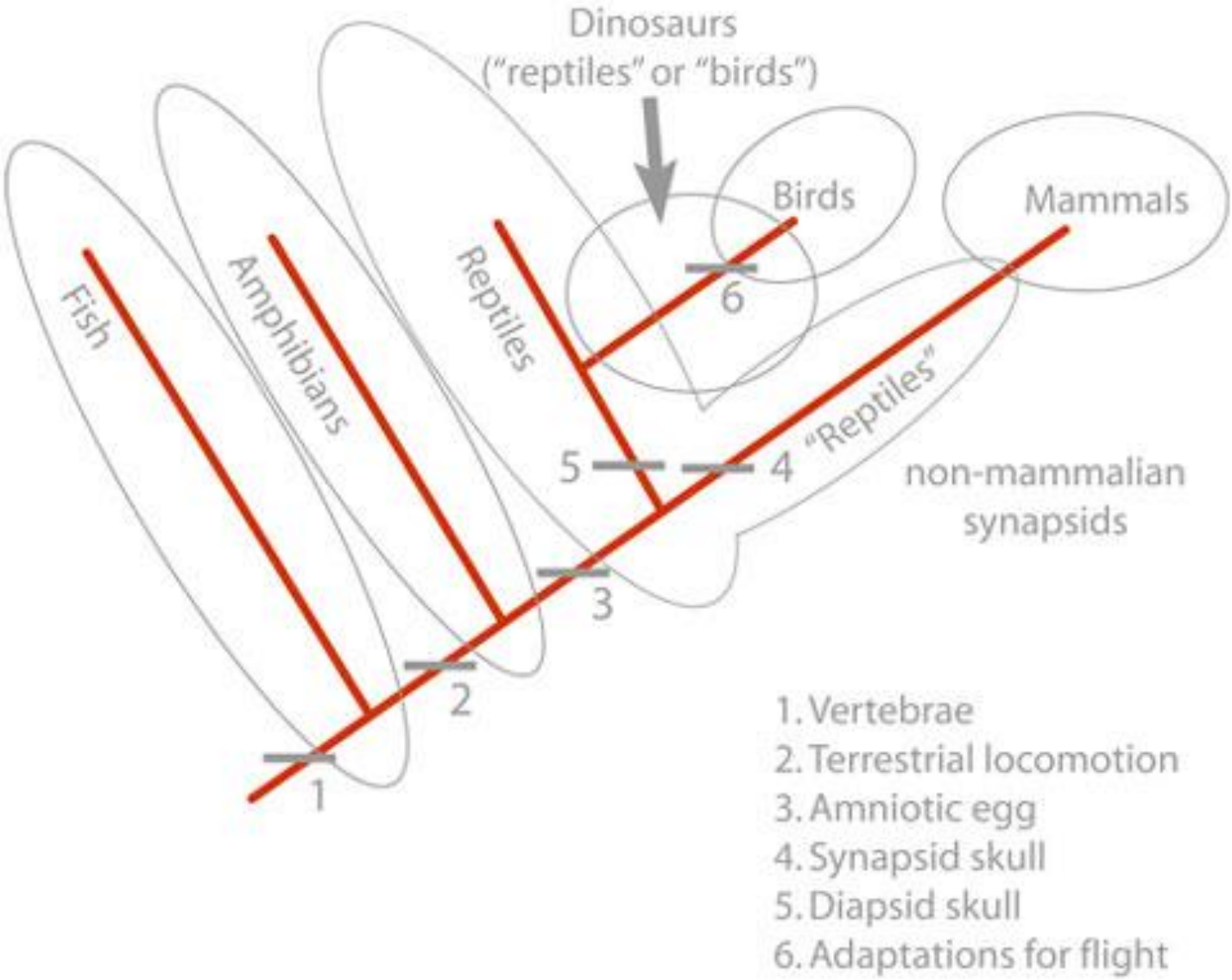
Adult

The great pillars underlying insect diversity

a. flight
   - colonization of distant lands, across water barriers, over mountains and deserts
   - transportation to safe hiding, nest and wintering sites, escaping enemies
   - mating
   - hunting

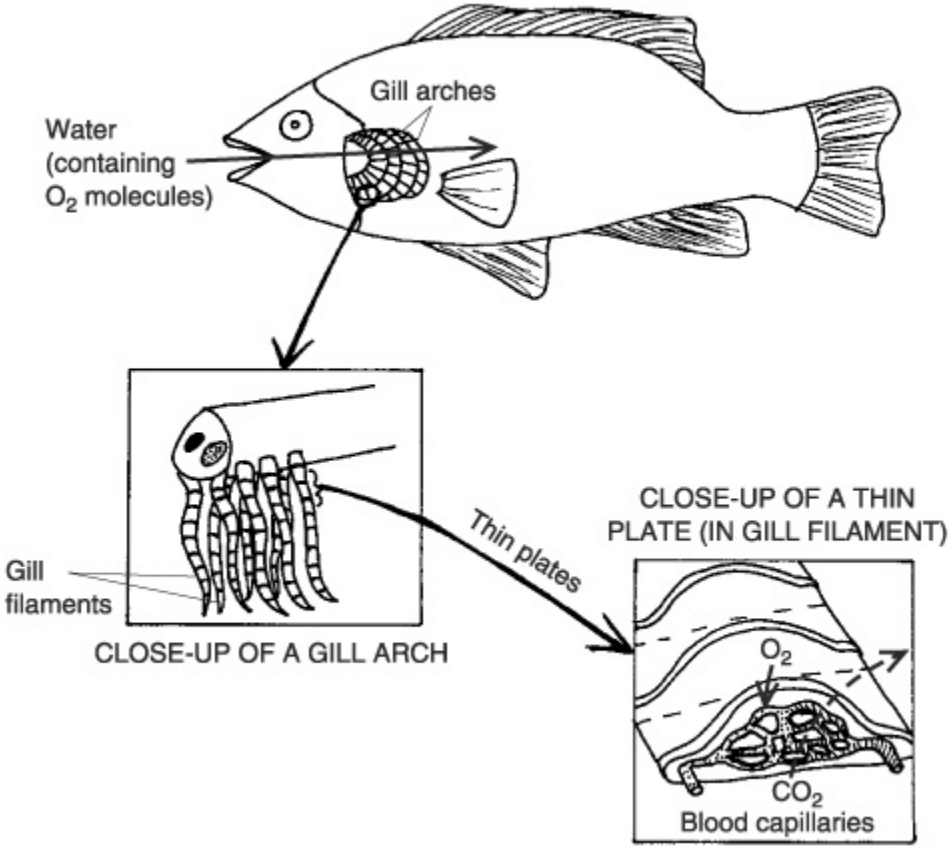
b. complex life cycles
   - juvenile occupies a very different niche than the adult
     - juvenile is often wingless, worm-like creature living in mud or pond bottom
     - the adult is often winged and lives in the air
   - juveniles and adults have different foraging lifestyles
     - juveniles and adult eat differing things (sometimes, adults do not eat at all)

Vertebrate ancestral tree

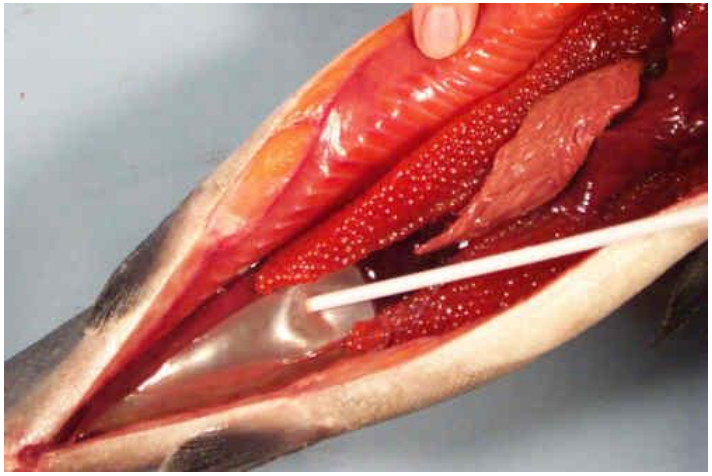


Fishes

a. one of the few ancient life forms still living today
b. evolved in the oceans and went on to colonize rivers, lakes etc.
c. extraction of oxygen from water using gills, powered by swimming (sharks) or pumping (bony fish)
    - water enters through the mouth
    - passes over the gills, where oxygen is extracted
    - passes out through gill slits



d. buoyancy determines vertical position in water column
   - dense fish use their pectoral fins to create lift (like airplane wings)
   - requires constant swimming
   - unable to swim backwards or hover



e. most fish have portions of their bodies less dense than water
   - inflatable gas bladder
   - lipids dispersed throughout bodies
   - incompressible, which allows for greater movement in the depths

e. most fish reproduce without ever touching
   - female lays eggs
   - male squirts sperm on eggs

Three main evolutionary groups for fish

- Jawless fish (lampreys, hagfishes)
- Cartilaginous fish (sharks, rays, chimera)
- Bony fish

jawless fish

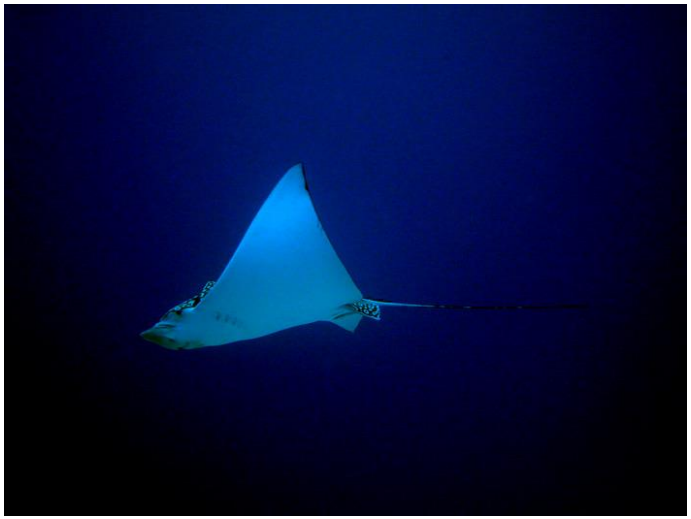
a. the most primitive surviving vertebrate on earth
b. parasitic or predatory

c. hagfish
    - bottom dwelling, deep-water marine fish

d. lampreys
    - born in freshwater but migrate to ocean at adulthood
    - use anticoagulant to induce blood flow in victim

Cartilaginous fish

a. sharks
   - muscles are attached to a cartilaginous skeleton
   - multiple gill openings
   - tooth-like denticles covering their bodies



b. rays
   - strongly flattened body plan for bottom dwelling
   - pectoral fins attached to their heads
   - intake water through an opening on upper surface of the “face”
   - novel weapons
     - barbed sting
     - electric current

c. chimeras
   - one external gill opening
   - smooth, scale-less slippery skin
   - rabbit like head!

Bony fish

a. ex. trout, salmon, coral reef fish, most fish that we eat
b. distribution
    - occur in all waters of the world, from mountain high to trench deep altitudes

c. salmon require
    - clean, cold water
    - continuous, consistent water flows
    - tree cover on stream banks
    - barrier-free migration paths to creek headwaters (for spawning)

Salmon life cycle exploits both fresh and salt water

1 Salmon begin life as eggs that hatch in streams

newly hatched

fry

2 The small frys float downstream to ocean where they grow to adulthood

adult

3 adult salmon swims back up its childhood river to mate and lay eggs

marathon

spawning

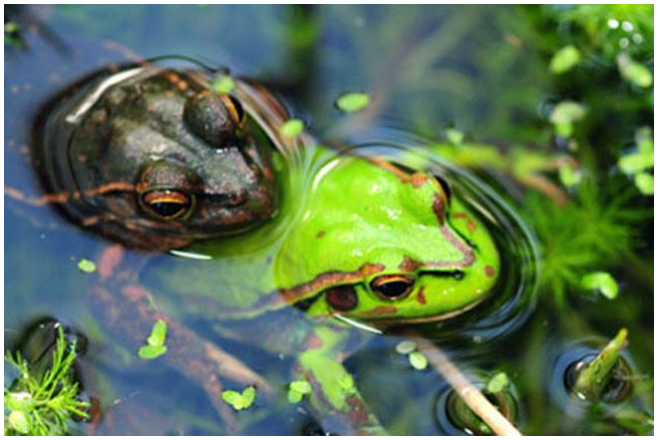
“giving back”

4 The adults die after spawning, and their carcasses fertilize the river and adjacent forests

- this fertilization provides aqueous sources of nitrogen for bears, raccoons, trees
- in a sense, salmon harvest marine resources and use them to fertilize terrestrial ecosystems

Amphibians

a. “both lives”
   - land
     - often where most adults spend their lives



   - water
     - place for breeding

b. some amphibians have cut ties to aquatic habitats
   - woodland salamanders lay their egg masses in moist cavities in logs or under rocks
   - small home ranges
     - spend entire lives within a few square meter patch of forest

c. soft, moist, water-permeable skin
   - constant danger of desiccation
     - amphibians tend to be active only during wet season, or at night or during rainstorms

   - spend dry season in cool, moist microsite (like two feet underground in a burrow)

   - some frogs absorb moisture through a seat patch (thin skin) between their hind legs

d. highly developed defensive chemistry
   - ex. Western toads and Northwestern salamanders have large, swollen glands on their skin that secrete chemicals all over body when threatened
     - strong enough to kill small predators

- ex. the newt's skin contains one of the most deadly neurotoxins (tetrodotoxin) synthesized by a bacterium living on their skin
  - one predator (garter snake) has evolved methods to detoxify tetrodotoxin
  - this arms race has driven newts to extreme levels of toxicity
  - be careful of what may climb into your coffee mug when camping!

Dinosaurs

a. roamed the earth for 80 million years
b. about 65 million years ago, they all died out very suddenly

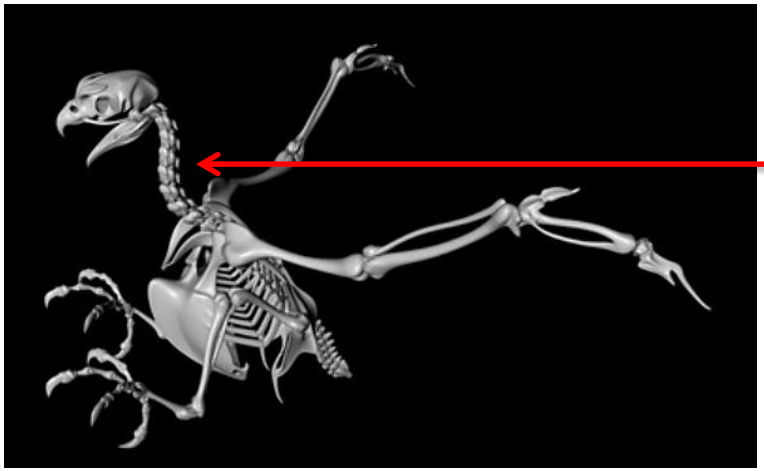
The largest arthropod ever to have lived!

c. Permian/Triassic Extinction was the most lethal of all (245 mya)
    - terrible spasm of global warming
    - temperatures driven by greenhouse gases to 160 F (71 C)
    - 97% of all species on earth wiped out

- like individuals, species have a life span
    - average is one million years
- 99.99% of all species that have ever existed are now extinct
    - *yet earth's biodiversity has never been greater than it is today*

Birds

a. feathers (renewable)
   - flying
   - staying warm (air is great insulator is trapped in between feathers)
   - drying off
   - advertising to attract mates
   - blending into the environment (camouflage)



b. nearly all physiological aspects of the bird are traced to its ability to fly
   - numerous neck vertebrae
     - allows dexterity needed to reach body parts with their bill
   - lightweight bill with bony core and cover of keratin, but no teeth
     - reduces weight in flight

- laying external eggs instead of live birth
  - a “pregnant bird” would have more difficulty flying

- hollow bones
  - the combined weight of all the bird's feathers is twice that of all its bones

c. behavioral aspects of birds are also traced to flight
   - allows for escape from terrestrial predators
   - migration elsewhere during unfavorable season
   - safe, high altitude nests

d. still some birds have given up on flight
   - penguins
   - ostriches
   - kiwis

e. song
- uses
  - mate attraction
  - defining and defending territory
  - warning of the presence of predators
  - promoting social cohesion

@sulaitman sait

- acquisition
  - learned (most common)
    - ➢ via teacher
  - innate

- dialects
  - varies slightly depending on time of year / time of day
  - it takes birds a couple of weeks to master their songs

@birds from behind

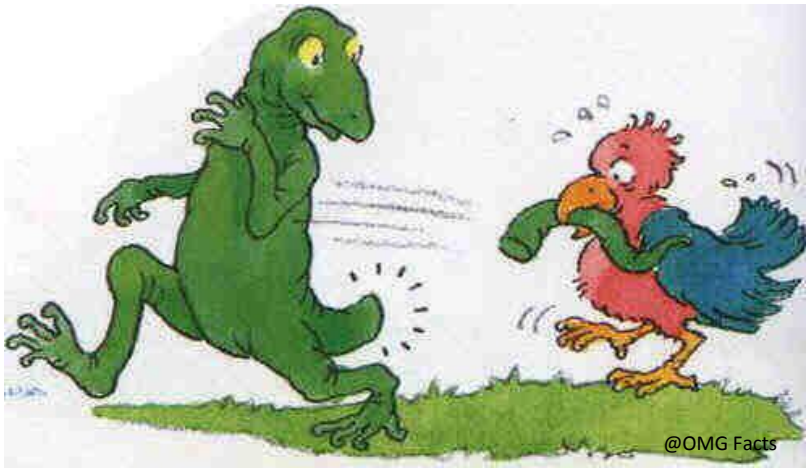
Lizards and Snakes

a. amniotic eggs
b. dry, scale covered skin
    - retards moisture loss
c. able to separate water from waste products (though this costs more time and metabolic energy than making urine)
    - scat (poop)
        - dark part made of whatever the lizard or snake has recently eaten
        - white powdery portion made of uric acid

d. ectothermic (poikilothermic)
    - mostly unregulated body temperature
    - costs very little energy
    - ex. rattlesnake lying still for days waiting for an unsuspecting rabbit to pass within striking distance
    - when food is scarce, lizards/snakes can simply wait for abundance to return
    - very often, the biomass of lizards and snakes far exceeds that of birds and

Lizards

a. ancestors of the snake
b. desert specialists
    - greatest diversity found in hot, dry habitats
c. shed their skins irregularly in patches

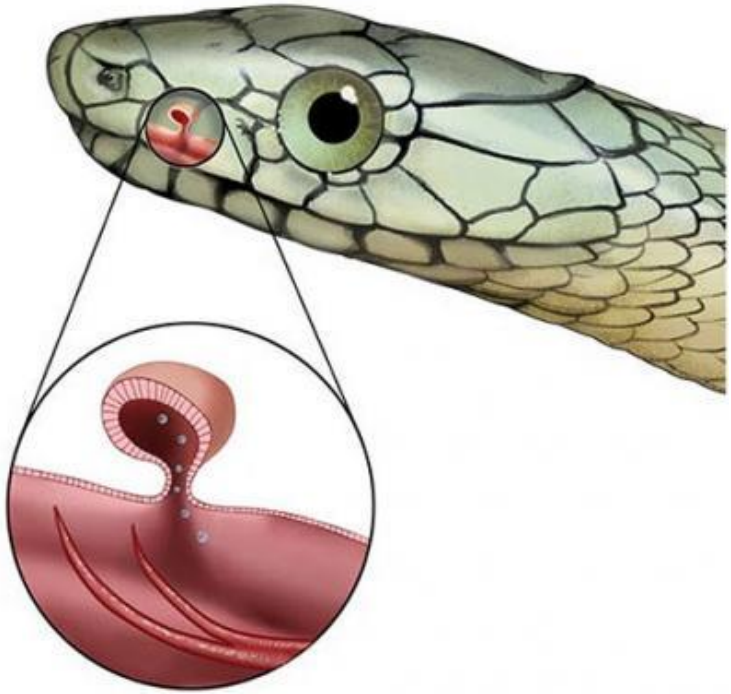


d. frequently detaches and regrows tail
    - special joints in tail vertebrae to facilitate tail loss and special mechanisms for stopping blood flow at the lost joint
    - after separation from the body, the tail still wiggles around frantically while lizard makes its getaway

e. external ear openings and eyelids
f. territorial
    - mark with chemicals from scent glands on their legs
    - defend with ritualized threat displays
    - pushups on prominent perches to show off brightly colored underbelly

Snakes

a. rely heavily on chemical cues to negotiate their world
b. when a snake flicks its tongue, the two tines (tips) reach widely to each side
c. the separation of the tines at the apex of the flick allow the tongue to gather spatially different chemical cues

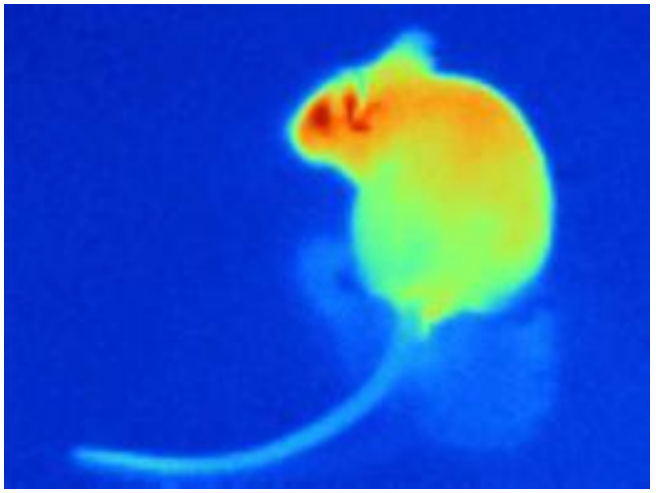


d. upon retraction of the tongue, the chemical information is deposited in a special pocket along roof of mouth (Jacobson's organ)

e. extraordinarily cryptic
f. eat infrequent but large meals
g. limbless, no pectoral girdle (only a few have pelvis)

e. paired penises
f. shed their skins as a whole package

e. cloacal scent glands in the tail that produce foul smelling fluids to deter predators
f. boas, pythons, and pit vipers use heat to gain information and form an image in their brain



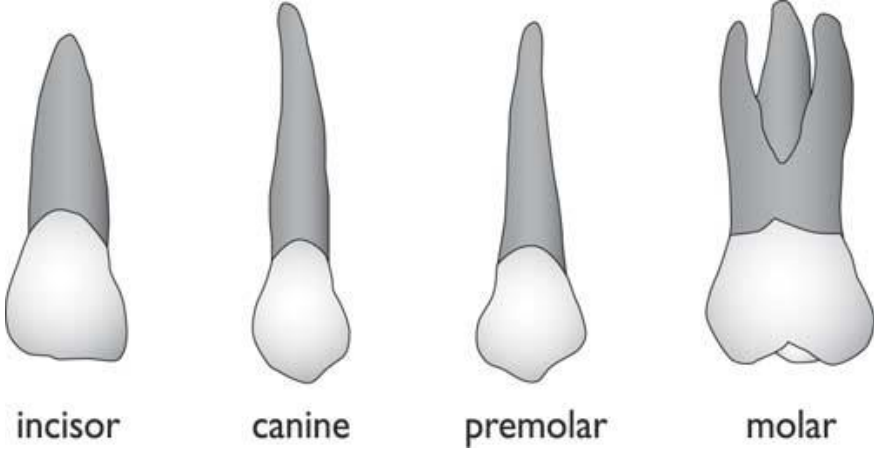
Mammals

a. fast and active
b. high metabolic rate
c. 80% calories from food used to maintain body temperature

d. skin covered with hair
   - for warmth or cooling down
   - advertisement and camouflage
   - sensation
     - though whiskers themselves are “dead”, nerve cells are attached at their base

e. lactation to nourish their young

f. high diversity in tooth form
   - between species
   - within the same mouth
     - incisors: chisel-like teeth for cutting
     - canines: best for gripping and tearing
     - molars: grinding, crushing & breaking



- taken to extreme in various species
  - elephants incisors

  - saber-tooth cats canines

How many of us are willing to live alongside dangerous mammals?

- we have completely killed off the CA state animal, the grizzly bear, from CA, Oregon, Washington, Utah, New Mexico, Arizona, most of Idaho and Montana

The fear and facts do not match up

- wolves are so dangerous and scary, that do you know how many people they've killed since records have been kept?

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Three main evolutionary groups of mammals

I. monotremes
   a. lay eggs, which they store in marsupial like pouch where they hatch and are fed milk
   b. lack teeth
   c. combined urogenital opening

II. marsupials

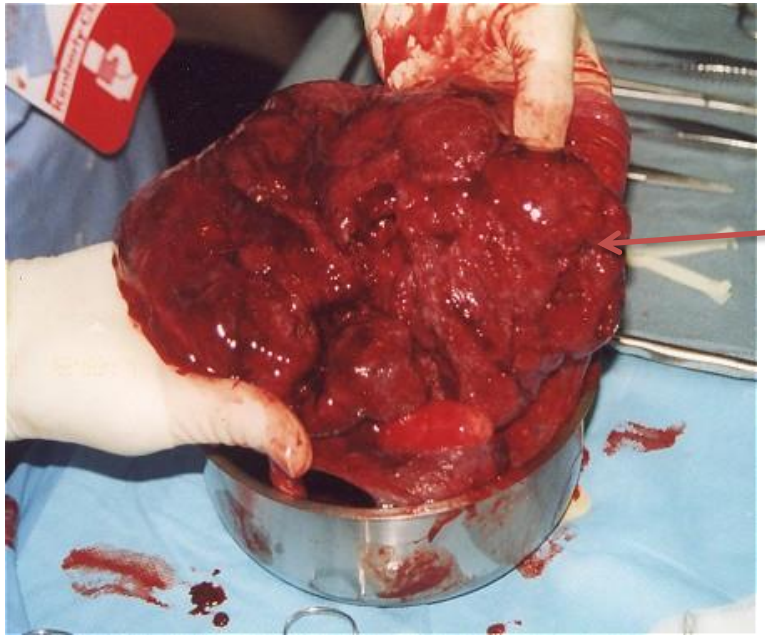
a. young are born very early in development, and then migrate to pouch where they drink milk and grow
b. possess cloaca
c. reached greatest diversity in Australia/New Zealand/New Guinea

d. roles like browsers, grazers, predators and burrowers all occupied by various kinds of marsupials
   - ex. marsupial wolf (thylacine), which became extinct by 1936

e. South America used to have a diverse array of marsupials, but the invasion of placental mammals 3 mya via the Panamanian bridge drove them to extinction
   - the Virginia opossum survived
   - if you ever see a road kill opossum, examine it!

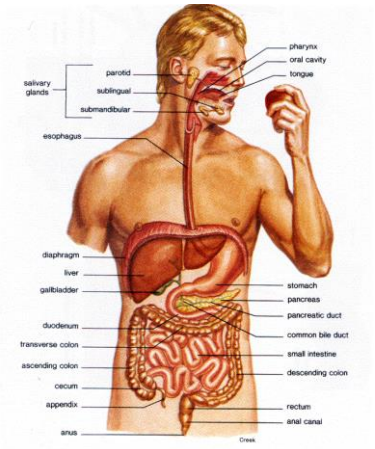
III. placentals

a. the most diverse lineage of mammals
b. most dominant group of vertebrates
c. the young undergo considerable development within the mother



d. nourished by the placenta, which allows food oxygen and waste products to pass from mother to offspring

e. digestive tract has been completely separated from urinary and genital organs (ie, no cloaca)



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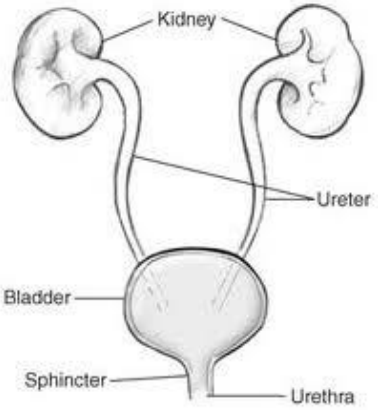


Conservation Biology

a. emerged from realization that we are currently in a biodiversity crisis
b. focuses on protecting earth's biodiversity at all scales of life
    - genes
    - species
    - natural ecological processes
    - evolutionary processes
    - ecosystems

c. relatively new interdisciplinary science with roots in ecology and wildlife ecology
    - crisis oriented
    - medical /surgical arm of ecology
    - tactical decisions made in the face of uncertain knowledge

d. allied closely with domain of social science
    - land use planning
    - landscape architecture
    - political ecology
    - indigenous peoples studies

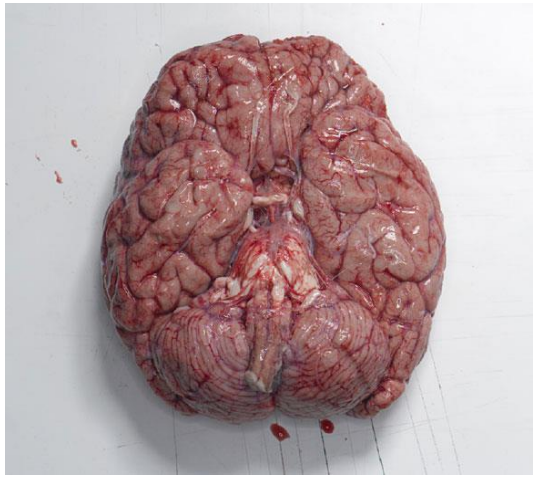
"All you need to know to be a principled ecologist" from MarineBio.org

I. All species in ecological systems are dependent upon other species for their existence

II. In spite of this interdependence, organisms within each system nearly always act to maximize their individual fitness, not for the benefit of the population, community, or ecosystem

III. Constant change is a commonality throughout all levels of organization in ecology

IV. While each successively larger scale is composed of units of the next smaller scale, it possesses properties unique to that scale



V. Ecosystems are altered by human manipulations of the environment and these changes are often irreversible

VI. The abundance and distribution of a species will depend on its interaction with its biotic and abiotic environment

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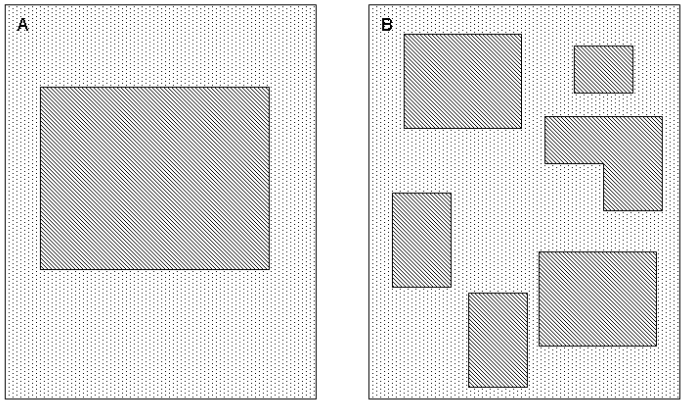
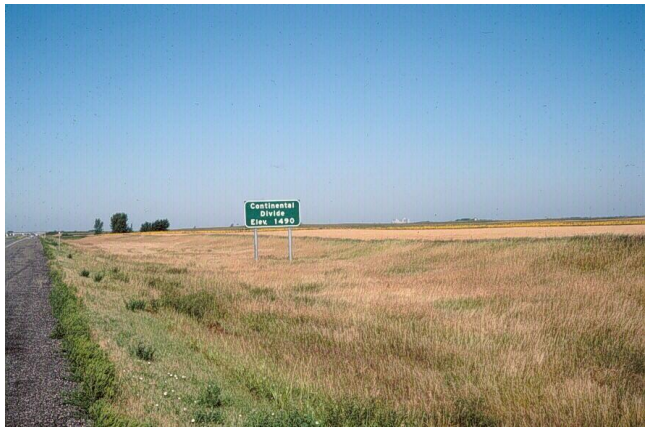
The loss of any one individual or patch of individuals rarely makes a difference to the ecosystem
It is the overall pattern of change that makes the difference
@Alternate:Words

Fragmentation

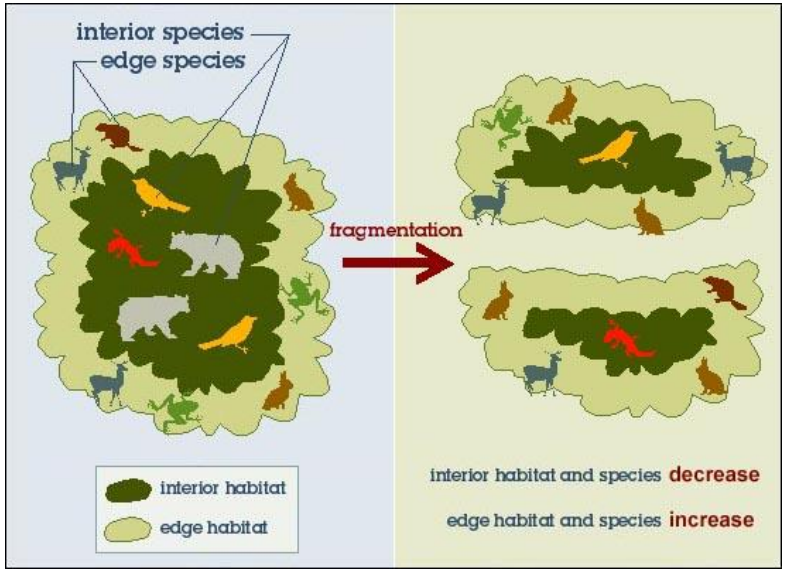
a. occurs when a single patch of continuous habitat is broken up into many small patches





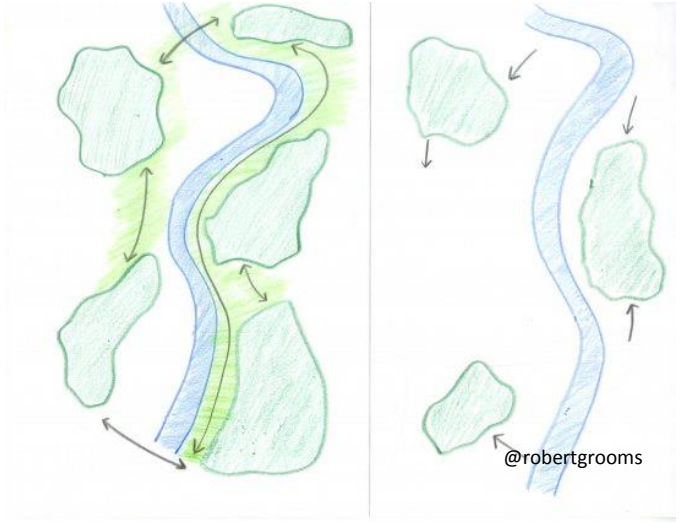
b. patches
- lack original diversity of contiguous habitat
- may not be able to provide adequate resources for certain species
- contain fewer specialists

c. effects
- changes community size
- changes species composition
- reduces core habitat
- increases edge habitat



Factors determining survival of a species during fragmentation

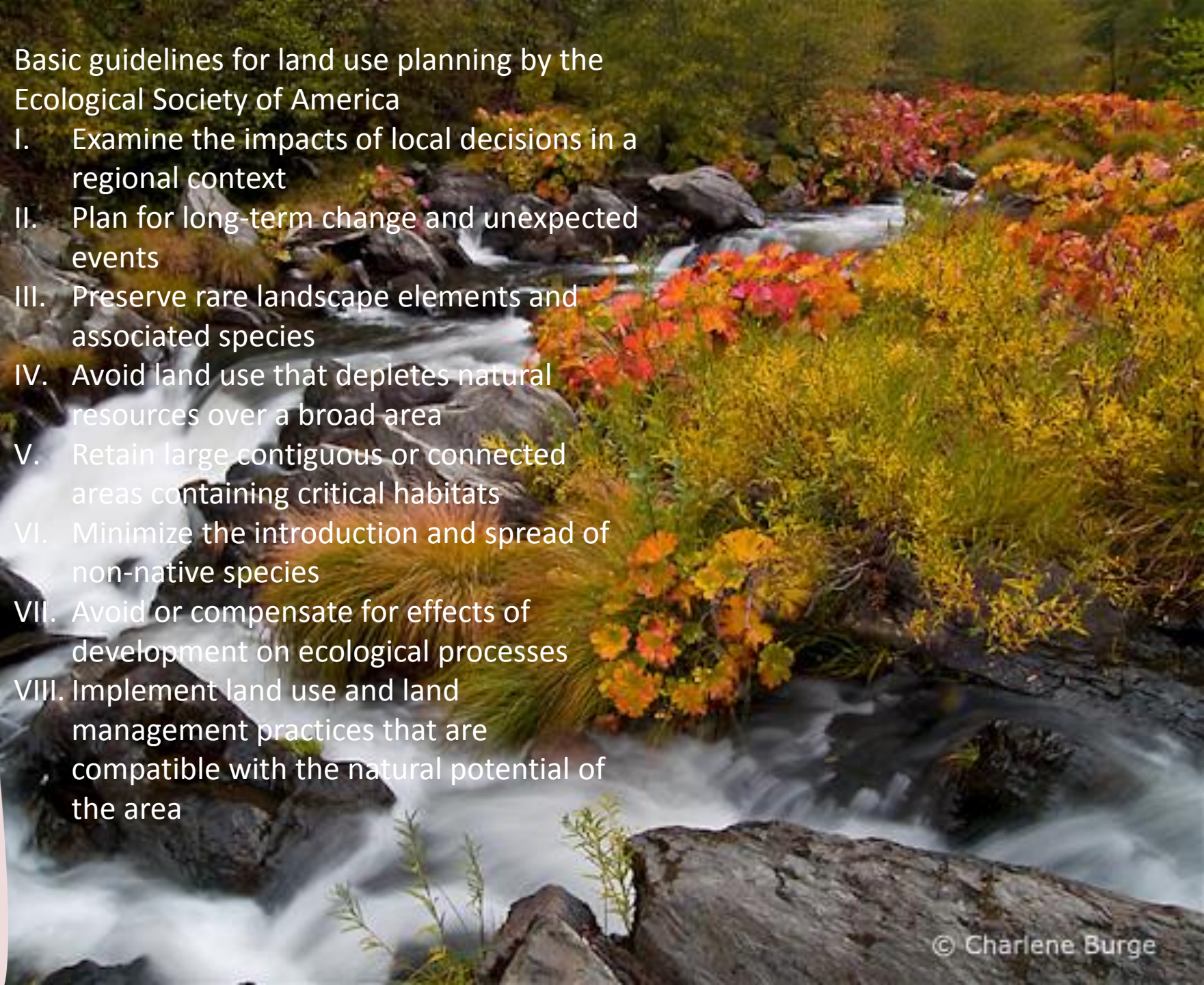
a. size of the remaining patches
   - species that require large areas will have to move among remaining patches
b. degree of isolation from patch to patch
c. location of patches relative to each other

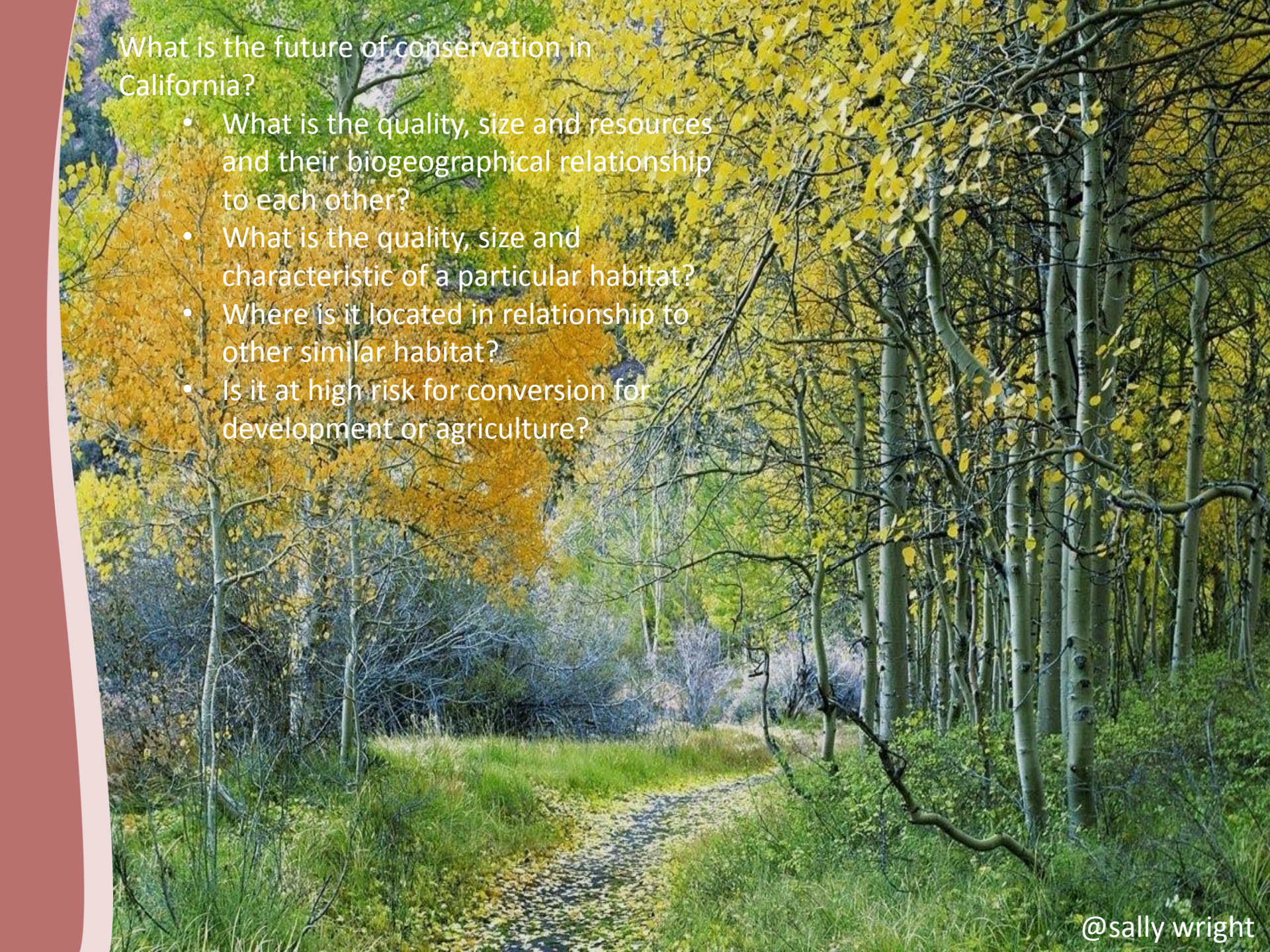


d. connectivity between patches
   - ex. extensive fragmentation has occurred across the historical range of valley oak woodland
   - further loss of habitat will reduce the number of functional habitat patches, impair connectivity, and further hurt the valley oak woodland community

Basic guidelines for land use planning by the Ecological Society of America

I. Examine the impacts of local decisions in a regional context
II. Plan for long-term change and unexpected events
III. Preserve rare landscape elements and associated species
IV. Avoid land use that depletes natural resources over a broad area
V. Retain large contiguous or connected areas containing critical habitats
VI. Minimize the introduction and spread of non-native species
VII. Avoid or compensate for effects of development on ecological processes
VIII. Implement land use and land management practices that are compatible with the natural potential of the area




What is the future of conservation in California?
• What is the quality, size and resources and their biogeographical relationship to each other?
• What is the quality, size and characteristic of a particular habitat?
• Where is it located in relationship to other similar habitat?
• Is it at high risk for conversion for development or agriculture?
@sally wright

Reversal of fortune: Bats

a. in the 1950's and 1960's, bats were commonly viewed in America as pests or as a carrier of rabies

b. but here are the facts
   - bats almost never transmit rabies to people
   - among the most helpful, efficient protectors of human health and agricultural production
     - a single bat eats 1,200 insects per hour
     - without bats we would be overwhelmed by mosquitos and other insects

c. since 1975, there has been a huge reversal of the image of bats in the public mind
   - people now fly across the country for the privilege of watching bats fly out of their daytime roosts at sunset

Human Activity and Domestic/Introduced Animals

a. human land use alters wildlife habitat
   - habitat fragmentation
   - habitat removal
   - development
   - clearcutting

b. human-induced habitat alteration affects wildlife differentially
   - species that favor open spaces and edge habitat tend to thrive
   - species that require lots of cover, cooler temperature, or continuous habitat tend to suffer

c. introduction of invasive species
   - non-native to the ecosystem
   - likely to cause economic harm, environmental harm, or harm to human beings
   - not necessarily from another country
     - pets
     - work animals
     - accidental hitchhikers on ships and cargo

- some have little impact on the environment
- others drive native species to decline and in some cases complete displacement
    - ex. bullfrogs were originally brought to California as a food source, but eventually established themselves in the ecosystem and preyed on local frogs, turtle and fish populations

- ex. horse and cow manure from pastures located too close to waterways can contaminate drinking water and create devastating algal blooms

- ex. At the urban/wildland interface, outdoor house cats and feral cats in the UK kill 78 million small mammals annually

It is easy to forget this most basic fact: we too are animals

In separating ourselves from the natural world with ever increasing levels of abstraction, we have become exceedingly powerful

But with power comes responsibility

Spending time with wildlife can remind us of an essential part of ourselves and reconnect us with the greater web of life

@batool