Natural History
September 9, 2013

Midterm: Oct. 20th, 2013. 2:00-3:30.

Introduction:

- Natural History is the enjoyment of **nature** (living, breathing, dynamic plants and animals). It is the real world. It is the enjoyment of **observation** of living plants and animals (**FLORA AND FAUNA**) and their interactions. It is an **observational science**. Someone with an interest in all this would be a **naturalist.**

Historical Naturalists:

- Linneaus
- Charles Darwin
- John James Autobonn
- Ernest Thompson Seton
- Roger Tory Peterson

> one phrase that ties all naturalists together: What is this? > CURIOSITY!

>Types of Naturalists; Herpetologist: studies amphibians and reptiles
Mammalogist: studies mammals
Botanist: studies plants
Entomologist: studies plants

Staying Alive:

Defenses: Appearances

Camouflage: Concealment

- Every habitat that animals live in have general patterns (i.e grass lands; vertical lines). Therefore animals tend to try and look like their background - called **Background Matching** (i.e Savannah Sparrow has vertical lines on its coat to help it blend in with vertical grasslands).

- Many songbirds have eye lines and eye stripes on their heads for camouflage: these lines are called **disruptive patterns** because they disrupt the view of the animal. Some also have breast-bands which are also disruptive patterns.

- **Coincident Disruptive Coloration** : Whenever animals has different parts of the body align fo r the sake of camouflage (i.e leopard frog)

Not only color can camouflage animals. Another way is through SHAPE:

- **Masquerade:** when an animals shape helps them camouflage, i.e *Angle-winged Butterfly* wings are shaped to look like **dead leaves** - *inch worm / walking-sticks* **mimic twigs** - *luna moth* mimics a live leaf

> masquerade can also involve not matching a piece of the immediate background but something inedible - *spittle bug* uses material to disguise itself as foam (other disguise themselves and look like a woolly substance [Wooly Aphid] and even bird droppings [Pearly Wood Nymph, Giant Swallowtail caterpillar]

> masquerades technique can also involve animals taking parts of their environment and using them as camouflage (Camouflage Looper caterpillars)

>Animals living in ponds and lakes often use color patterns for a different type of camouflage - Whirligig Beetles are **bicoloured** (white underneath and black on top) so pray in the water and flying above can not see them. Back swimmers have the opposite coloring, because they swim backwards.

> **Countershading (Self-shadow concealment)** top part shades the bottom part of the animal to make it appear more one dimensional. Animal will have a dark top and a lighter body (White-tailed dear)

- Other defense techniques:

> Scare Tactics: underwings of moths have **startle patterns** to scare prey away. Grey tree frogs have yellow patterns under their legs so when they jump, the bright color flashes to scare prey. Giant Swallowtail caterpillars have long red horn looking features that pop out of their mouthes to scare, which also smell bad (Osmetarium), Beavers slap their tails as a scare tactic. Ruffed Grouse take of with an explosive wing sounds.

> Scare Patterns can be in the form of color but also auditory

Key Animals mentioned:
Female Spruce Grouse
Ruffed Grouse
Fawn White-tailed Deer
Screech Owl juv
Gray Tree Frog
Snow Shoed Hair (seasonal colour change)
Killdeer
Canada Goose
Common Loon
Angle Winged Butterfly
Inchworm
Giant Swallow Tail

Distraction Techniques

Eye'd Butterflies: have eye patterns on the wings which are always on display and are distraction patterns to make predators think they are larger

Tailed butterflies have tails which look like antennas attached to a head (Hairstring / Swallowtail) - this means if birds attack they will attack the bottom end of the butterfly and not the head of the butterfly so it is less damaging to the insect.

Skinks: have a very bright blue tail and a yellow striped back. When the tail is touched by a predator it detaches and distracts the predator while the rest of the body runs away. This is called Autotomy (loosing part of its body to distract a predator)

Body Armor

Millipedes: roll up into a ball. They have hard exoskeletons (hard outer layer) that some predators can not bite through. Snails also have the same body armor. Their shells are made of hard calcium

Beetles: have grooves on the underside of their bodies for them to bend their antennas, and legs into so the only thing exposed is its hard back shell

Turtles: for years turtles have had hard shells to protect their softer bodies. Some cant fully withdraw into the shells (i.e snapping turtles) so they have other defense mechanisms like sharp teeth. Blanding turtles can even partially close up their shells once they have withdrawn inside. The top of a turtle shell is called a carapace, and the bottom is called a plastron

Soft Body Armors:

Tent Caterpillars: Make silky tent structures around them and they live inside in the day, and leave at night to hunt because there is no leaves inside the structure. Birds do not like to eat these structures. Caterpillars come together as a family to make these nests

Fall Webworms: Also make silk nest, but there is leaves inside of these nests.

Hairy Caterpillars: Birds and other insects do not like to eat hair (i.e Gypsy Moth Caterpillar) - Hair can also be stiff and feel like pines (i.e Woolly Bear Caterpillar, Porcupines)

Porcupines: have modified quill hairs to puncture predators.

Chemical Defenses:

IO Moth Caterpillar: have quill like hairs with chemicals inside which make you itch and burn. Milkweed Tussock Moth Caterpillars also have the same effect.

> Animals with chemical defenses are usually bright in colour because they do not need to camouflage. Warning Colouration = *Aposematic Colouration*

Giant Leopard Moth: All black until they curl up and then there is a bright red colour shown to show predators they have a chemical defense.

Yellow-jacket: (or paper wasp) Have stingers and are bright red

Red Eft: Salamander that is bright red to warn predators
Skunk: Although they are not bright in colour, their black and white fur are high in contrast. So, when they are active at night, they are bright.

Ladybugs: manufacture their toxins

Monarch Caterpillars: *SEQUESTER* poison from Milkweeds (means they take their defensive poison from a plant they are eating) - Black Swallotails sequester toxins from Water Hemlock plants. - means they do not make their own toxins, they take and store them

Fireflies: are actually a species of beetles. Photuris fireflies sequester steroidal toxins by eating photinus fireflies. Female photuris draws in males and eats them.

Chemical Defenses

- Chemical defenses can be released from different parts of the animals bodies:

Sawfly Larvae: Spit out bubbles which have a chemical defense within them

Grasshoppers: Discharge its defense orally

Blister Beetle: Exude chemical defense from their leg joints called Cantharidin (a terpenoid)

Paper Wasp: Exudes defense from its back end - Injector = stinger (wasp can sting you multiple times unlike a honey bee who's stinger will fall out of their bodies)

Skunk: Can direct the spray out of their anal gland nipples at the predator (main ingredients in this spray is Sulfur Alcohol)
> Skunks do not want to use their spray if they don't have to, so they use warnings first (i.e raise tail, stomp feet, do hand stands to appear dangerous

- Animals with any defense will want to conserve their defense and with thus try to warn the predator first.

Bombardier Beetle: releases a cloud of burning gas out of its abdomen and can direct the gas certain places - stores the gas separately from the rest of its body in a separate compartment

- Does aposematic coloration work? Yes.. Mink frog tries to eat a wasp and gets stung and avoids all the other black and yellow wasps that fell into the pond

Mimicry

- Mullerian Mimicry: When a group of mostly unrelated animals are all armed with the same type of defense and look similar (i.e Milkweed bugs vs. Milkweed Beetles - Paper Wasps vs. Bumble Bees)
> If something eats a wasp and gets stung, it will stop eating wasps and also stop eating bee's because it wont be able to tell the difference since they look the same

- Batesian Mimicry: When you have a harmless animal mimicking a dangerous animal
  - Monarch vs. Viceroy butterflies - look very similar. A monarch has a chemical defense where as a Viceroy is harmless. The Viceroy is a *mimic* and the Monarch is the *model.*
  - Bumblebee (model) and a Hover Fly (mimic)
  - Bald-faced Hornet (model) and a Hover Fly (mimic)

Things to consider:
  - In order for this type of mimicry to work, you have to have more models than mimics because the predator needs to have more bad experiences eating that color pattern than good experiences
  - Both animals have to be active around the same time of year (i.e Viceroy's can't be active in the fall if Monarchs are active in the summer)
  -

* Know for midterm*

Behavioral Defenses

Frogs: fill themselves with air to appear bigger

Play dead:

- Hog-nosed snake: puff up slightly and if that doesn't work, it plays dead. This only works for animals who do not want to actually eat the snake, just kill it (i.e deer who are scared etc) If it plays dead around an animal that wants to eat it it is actually making itself easier to eat.

- Other animals that play dead include: Blister beetles and possums

Group defense:

- White tailed deer stick together - there is power in numbers. This is called “yarding”
- Flocks of birds (i.e canadian geese)
  > this can 1) confuse predators, 2) Lowers the odds of getting caught
- Group defenses can also be aggressive :
  > Wasps send out *Attack Pheromones* to summon the rest of their hive of wasps to come and defend.
  > When under attack, some birds send out alarm calls to get other birds to help them defend, this is called “mobbing”. This can be a pre-emptive defense (getting rid of the predator before it attacks)

Natural History **Sept. 23, 2013**

Behavioural Defenses cont’d...

Group defenses cont’d

Guarding
> Carpenter ants guard aphids (smaller bug) so they do not get attacked. These smaller bugs in turn provide a sweet liquid to the aunt (honey dew)

Flag:
> White tailed deer / white tailed rabbits: flash their white tails when running away from predators. This could be for confusion or to tell the predator that they know they are being chased and they are going to keep running so the predator should give up.

All these defenses we have talked about would not matter if the animal did not have vigilance to know there was a predator around

Vigilance:
How do animals scan their surroundings?
Adaptations for scanning:
- Olfactory: smell
- Visual : seeing
- Auditory : hearing

Olfactory:

Deer / Moose: Ears scan to cover all areas - large external ears are called Pinnae

Beavers: Have smaller ears because they swim and pig ears would hold them back while swimming. One unique thing about a beaver is that they have their eyes, nose and ears positioned near the top of their heads so that when most of their bodies are submerged, they can still use all their senses

Tiger Moths: Also have ears - membrane on thorax. These membranes can detect bats and send back sounds to confuse them

Lacewings: Have “ears” at the base of their wings (membranes)

Mantids: Have one ear in front of the hind legs on the underside of the abdomen

Snakes: Do not have ears, do they detect vibrations on the ground. Also have an enhances power of smell / taste. Tongue is split so that it can sense which side of its body the danger or prey is on. This is analyzed through the *Jacobson’s Organ*
> Moose also has a Jacobson’s Organ in its nose so it can smell what side prey is on
> *Flemen*: curling back lips to expose J.O so it can sense more

Visual:

Mallard duck: can see 360 degree because their eyes are on the side of their heads so they can see all the way around them (other animals like rabbits have these)

American Bittern: eyes placed at the base of the bill so it can see ahead with the bill in the air

Nocturnal animals have eye shine which reflect light. There is a layer of the retina that throws light back forward (Tapetum Lucidum)

Flocking offers animals much more eyes to watch for danger

Natural History — September 25, 2013

Plants:

- Plants face all the same problems that animals do, however they can not run away when being attacked
- Many plants have physical defenses:

Physical Defenses:

External Armour
- Bark: trees and other woody plants have this
- Seeds: have outer shells to protect the seed (acorns, peanuts)
- Sharp Structures: some plants have thorns, prickles, spines etc. to protect the plant. (important to note that spines thorns and prickles are all different types of plant structures)
    -**Spines:** modified leaves (edges of leaves which are pointy)
    -**Prickles:** modified epidermal outgrowths (like hairs) i.e on a rose. Brand new rose buds resemble a prickle similar to the one on their stems. This is automimicry as it is mimicking itself
    -**Thorn**: modified branches (i.e hawthorns) - some birds stab mice through thorns to store them through the winter time
- **Trichomes:** little hairs that come off of a plant. There is different kinds - some have a substance that is released that traps things like caterpillars and other small bugs. Others are more gentle.
    -Glandular Trichomes: physical + chemical (burning sensation)
    -Water Smartweed: grow trichomes when they are not in the water. This is an inducible defense

Do these physical defenses work? YES
> We can tell when we look at cow fields and we see that many plants with these physical defenses are still standing while others are eaten

Structural Elements:

- **Cellulose, Hemicellulose and Pectin** (usually in cell wall) make plant tissues hard to digest. These are very tough structures for animals to eat
- **Lignin:** gives leaves stiffness, and nuts and cherry pits their hardness
- **Silica:** found in horsetail plants. Silica is very hard to digest as it it resilient in breaking down
- Calcium: some plants make calcium into defenses structures - Arum plants make **calcium oxalate crystals** in their leaves (i.e skunk cabbage - forms a bud in the fall and then generates heat to melt the snow around it in the winter. Since the crystals burn, they will burn the inside of an animals stomach)

Chemical Defenses:

- Milkweed: Cardiac glycosides (**terpenoids**) is a liquid that comes through the veins of a leaf. This tastes very bitter, and make the animal stop wanting to eat that plant.

Terpenoids

- a major group of chemical toxins. Only really beneficial to animals who are sequestering them to use as their own defense.
- **Resin**: on things like pine cones, that have terpenoids as well.
- Poison Ivy: have terpenoids in them and resin. The type of resin is called Urshiol

Alkaloids

- **Nitrogen Chemical:** Asters, buttercups,
- **Hydrogen Cyanide** is inducimilkble - can not be stored in plant tissues, only made when the plant is under attack. They raw ingredients are stored separately and when an animal bites it punctures the compartments and they release together to make HCN (produced in plants like bracken fern, roses etc.)
- Some plants disrupt digestions by interfering with digestive proteins.
- A wounded leaf sets out wound hormones when it has been attacked to warn other plants around, so those plants can prepare. This is called **Wound Hormones**

Insect Growth Hormones:

- *Malting hormone*: allows insect to change its outer appearance (phytoecdysones) - makes animals who eat this chemical transform too quickly into adults, so they die
- *Juvenile hormone*: produced in early stages of the animals life (photojuvenile) - i.e in balsam fur - keeps animals in a juvenile state and don't grow up

Warnings:

- Some plants advertise their dangers through smell. Like aposematic coloration only with scent. i.e Mustards advertise their defense.

PRACTICE MIDTERM QUESTIONS:

1. The breast bands on a Killdeer are an example of:
   a) distraction patterns
   b) startle patterns
   c) disruptive patterns
   d) countershading
   e) implant surgery

2. The Painful Beetle is defended by cardiac glycosides. It looks almost exactly like the Deathrow Bug, which is full of neurotoxins. This bug closely resembles the I-spit-toxins-in-your-face Spider, which is full of cantharidin. This is an example of:
   a) aposematic colouration
   b) Batesian Mimicry
   c) Mullerian Mimicry
   d) both (a) and (c)
   e) none of the above

3. Which of these animals **does not** use background matching as its first and main defence:
a) American Bittern
b) Ruffed Grouse
c) Gray Tree Frog
d) Red Eft
e) Savannah Sparrow

4. Mobbing is a defensive behaviour employed by:
a) Blue Jays
b) Meadow Voles
c) Yellowjacket Wasps
d) Garter Snakes
e) angry soccer fans

5. Bullfrogs, adult Painted Turtles, and Northern Water Snakes share this feature:
a) supercooling
b) they play dead when attacked
c) they bear large eyespots to startle predators
d) they are freeze-tolerant animals
e) none of the above

6. The Tree Chewer, a harmless uncommon beetle, is yellow and black and looks just like the common stinging Yellowjacket Wasp. This is an example of:
a) Batesian Mimicry
b) cryptic camouflage
c) Mullerian Mimicry
d) honest advertising
e) none of the above

7. If hibernation involves both the heart rate and body temperature falling to near zero, which animal is **not** a true hibernator:
a) Big Brown Bat
b) Black Bear
c) Black-capped Chickadee
d) none of the above are true hibernators
e) all of the above are true hibernators

8. Together an animal's eyes can see 350 degrees of combined field of views with 15 degrees of overlap. This animal is likely a/an:
a) mouse
b) owl
c) hawk
d) fox
e) hockey player

9. Which of these measurements would be best for an animal living near the **South Pole**:
SA = surface area; V = volume: TL = tail length (note: the actual units are not important)

a) SA = 120 ; V = 20 ; TL = 100
b) SA = 120 ; V = 90 ; TL = 100
c) SA = 240 ; V = 20 ; TL = 50
d) SA = 240 ; V = 220 ; TL = 50
e) SA = 360 ; V = 120 ; TL = 100

10. Bicolouration is a defence often found in animals that live:
a) on the floor of a forest
b) on the surface of ponds
c) in cattail marshes
d) on tree trunks
e) in San Francisco

11. An insect fails to moult and "stays forever young." This is because it:
a) had a meal of Balsam Fir
b) had a meal of St. John's Wort
c) had a meal of Buttercups
d) had a meal of Milkweeds
e) visited Cher's plastic surgeon

12. The common and very bad tasting Frog Lizard looks just like the very common poisonous Jumping Frog and this looks just like the orange and blue delicious and harmless Eat-Me-I-Am-Tasty Snake, which is really quite rare. This is an example of:
a) Batesian Mimicry
b) Mullerian Mimicry
c) Aposematic Colouration
d) all of the above
e) none of the above

13. The rete mirabile is used by:
a) ectotherms that overwinter as adults
b) frogs that are freeze-tolerant
c) American Bitterns to avoid detection
d) ducks to keep their feet from frreezing
e) none of the above

14. If you ate Purple Asters, you would feel the effects of:
a) cardiac glycosides
b) alkaloids
c) calcium oxalate crystals
d) HCN
e) Prince

15 Which of these is an example of masquerade:
a) an American Bittern pointing its bill in the air and freezing
b) a Chipping Sparrow showing only its head with an eyestripe above its nest
c) a Sphinx moth opening its wings and showing a set of fake eyes
d) a Giant Swallowtail caterpillar looking like bird poop
e) a Gray Tree Frog changing its colour

Natural History: Lecture 7a)

Ingestion / Digestion :

- Moose: food is processed twice - breaks down the food better to release more nutrients (**Cud** is food that is being chewed twice for further **rumination**)

- Some animals do not have a rumen to digest food twice (i.e rabbits, beavers, hares) so they intestinal pouches called **caeca** (or ceacum) - breaks down food for them but is too far down in the digestive tract for the animal to bring the food back up and re-chew it, so instead of re-chewing they eat their droppings to get the nutrients > called **coprophagy**

- Porcupines: eat a lot of plants so they have a very large digestive tract (about 26% of their weight) to compensate for not having a ceacum

Fruit / Seed Eaters:

- Waxwing birds are our most fruit-dependent birds. They are normally last to nest because the fruit is best at the end of summer therefore it is most fresh for their offspring. Since waxwings eat a lot of fruit, they have to have modifications for ingestion and digestion of all that fruit. These adaptations include:
  > having a large gaping mouth to swallow berries whole
  > a short intestine to process food quickly and get rid of seeds

- Not all animals pass seeds however i.e chipmunks harvest seeds to eat during hibernation.

- Seed eaters are **seed predators** (i.e grosbeaks have had strong beaks to crush pits and tongues to rol them back and forth)

- **American Goldfinch** - bill is modified for thistle seeds

- **Red / White Crossbill -** bill is modified to extract seeds from pinecones

- **Niche Partitioning** - different species of one animal can all live in the same place and still thrive, because they all use different resources and eat different things, so there is little competition

- **Blue Jays -** peck to open nuts

Plants and Chemical Defenses

Herbivores:

- Some can sequester (store in different compartments to use again)

- Some employ a **vein drain** > cut off the end of the plant to drain the chemicals or sever the veins to stop the flow of chemicals through the plants

- Some use **enzymes** to counter toxins: MFO's (mixed function oxidases)

- Some herbivores are **specialist** , eating only one or two kinds of food
  > Red-headed Pine Sawflies eat pine needles
  > Monarchs eat only milkweed leaves and buds

- Others are **generalists**
  > Beavers eat a variety of plants, barks, trees etc

- Other animals **switch** for a balanced diet
    > moose eat fresh leaves and twigs = rich in carbs, protein, Balsam Fir = low in sodium SO they go to ponds and lakes to get their sodium from aquatic plants (have 4-5x more sodium then land plants) - balance between water and land plants
    > sodium is stores in the rumen for the winter
    > also eat from ditches in the beginning of spring because they are eating the road salt for sodium - first sodium fix of the season because usually water plants are still frozen

Carnivores:

- Act of eating an animal: **predation**

    - AD:
        1. much more returns for the effort (proteins already packaged)
        2. Easier to digest
    - DIS:
        1. Can be hard to find
        2. Often prey is well protected
        3. They fight back

Parasitoid: eating an animal from the inside (i.e wasp inserting eggs into caterpillar)
Parasite: eating an animal from the outside (i.e ticks on a moose)
Scavengers: eating an animal that is already dead (i.e road kill)

Predation

- Locate > Capture > Immobilize

- Some challenges are presented when hunting, so animals have adaptations to overcome these challenges:
    - Diurnal birds: hunt during the day.
        > have good eye site (large eyes) - many cones in eye to give visual acuity
        > eyes magnify
        > frontal placement of eyes give depth perception
        > some have heads that can span for pray (270 degrees)

- Compound eyes: i.s eyes of a dragon flies (multiple eyes put together - called ommatidia)

Lecture 7b)

Sight is very important in hunting prey..

- Whirligig beetles can see above and below the water at the same time

- Spiders have 8 eyes
    > main eyes are called the anterior median eyes (middle)
    > anterior eyes are eyes on the side
    > posterial lateral are eyes on the back
    > **Jumping spiders** can move the retina in the back of their eyes
    > **Crab spiders** are very small, and they grab their pray with their long legs, which they hold out like a crab

Hearing is also very important (large pinnae -i.e foxes)

- **Owls** have no external pinnae, yet still hear very well > actually hear with modified feathers on their face, which gather sound and magnify it where their ear openings are > ear structures on not symmetrical - they are on different sections of the head and different shapes so they can pin point sounds differently (vertical and horizontal separation / asymmetrical ear openings)

- **Bats** also use sounds to locate prey (echolocation: throw out a sound in a high frequency and the sound will return back to them)

- **Shrews** also use ultrasound by giving out high pulses (has a poison bite)

Smell is also very important..

- Elongated snouts are the biggest features of animals who use smells
  > (olfactory / jacobson organ / flemen)
  > scent trails are easier to track at night / dusk

Touch is also very important...

- Raccoons have touch sensitive paws

- Star-nosed moles have **Eimers Organs** on the end of their noses to feel around

- Tactile sensors can be located around the mouth (whiskers - vibrissae) > birds have a similar feature called bristle feathers (rictal bristles)

- Sandpipers have pressure-sensitive cells called **herbst corpuscles** in the tip of their bill (this will alert them if their bill hits a worm) > ducks also have this on their beak and woodpeckers have them on their tongues

Heat is also important in finding prey

- rattlesnake have infrared hear sensors - sensitive enough to detect changes in temp. as low as 0.001 degrees celsius
  > heat pit lies between the eyes and nostrils

All these tools are used through active searching!

- even some spiders actively search (i.e wolf spiders / nursing web spiders) they do not make webs and wait, they go out and look for prey
- Tiger Beetles search an capture

Also used by sitting and waiting for prey!

-praying mantids let their prey come to them and then ambush
-animals who do this must camouflage into their background (background matching)
-most owls sit and wait for prey
-crab spiders also wait for prey

Traps

Webs:

- Flight intercept traps (spider webs) - the spider hides and waits to see if something gets trapped, or it will sit in the middle of the web
- **Orb Weaver** spiders make the most commonly known webs (vertical webs)
- **Funnel weavers** build webs close to the ground
- **Sheet-web spiders** (have knockdown strands)
- Webs are best seen at dawn because dew sits on spider webs - the webs are made of silk and will dry out, so they collect the dew (the silk is **hygroscopic**)
- Spiders can recycle silk and reuse it
- It takes a spider about 20 minutes to build a web
- Some webs have zig zags in the middle (stabilimentum) which throw back ultra violet light (since flowers also have these, it makes insects believe that they are landing on a flower

Tunnels:

- Some animals make tunnels for prey to fall into

Pit Falls:

- ant-lion larvae make traps for prey to fall into (mostly ants)

Lecture 8a)

Entrapment

- When an animal mimics another to get its prey - aggressive mimicry (i.e fireflies / snapping turtles tongues look like worms)
- Talons: large sharp claws (owls / hawks)
  > **osprey hawks** have special feet to catch fish (Toes are reservable to manipulate position os prey)
  > **owls** also have a reservable toe
- **praying mantids** use their legs to catch prey - snap out legs and snatch it back (raptorial legs)

Mouths

- Most mamals are equipped with large canine teeth and carnassial teeth
- **Tiger Beetles** use mandables (large claws coming out from their mouths)
- **Mergansers** bills are modified for cathing fish (small sharp projections on their bills)

- **Frogs** use their tongues to capture food (long, snaps back, and sticky) - toad tongue flip
- **Woodpeackers** also have long tongues - hyoid hornes attached to tongues to allow for extention
- **Humming bird** need long tongues to get into flowers, so they also have the hyoid

Killing Prey

- Have large canines and large temporal muscules to drive the bite
- Grab and shake prey to snap neck (foxes/coyotes)
- Tear the animals apart (usually in packs like wolves)
- Bite the animcals head and kil them (weasles)
- Bite into the neck vertabrae (cats)

Birds
- Bird hawks (accipiters) use their talons to kill prey by moving them around to peirce and squeeze vital organs

Snakes
- Many snakes swallow their prey alive - jaw can detaach to open wide, and each side of the mouth can move independantly
- Grey rat snakes and milk snakes are constrictors - prey can no longer breathe
- Rattlesnakes kill prey by poisoning them with toxins (venem is injected) also inject digestive enzymes

Other animals also use venem..

- Crab spiders and assassin bugs also use venom
- Short tail shrews have a poison bite

Once Killed

- Once a prey is captured and killed, there are parts of animals which are indigestable
- When an animal only eats part of another animal, this is called **selective feeding**
- Fishers skin porcupines to avoid eating the quills since the belly has no quills
- Some animals pass ingestiable pieces through thier body (i.e moose droppings are filled with hair and bones - called wolf scats)
- Owls swallow their prey whole - hairs and bones are rolled into a ball and then coughed out

Lecture 8b)

- Bioaccumulation of toxins - build up of toxins internally in the food system (i.e DT pesticides were sprayed on crops - peregine falcons ate small brids that ate insects - insects contained DT from the crops and this killed them)
- The number one problem facing preditory animals is **STARVATION..**
  (i.e wolf pups get seperated from pack and starve)

- Predators play an important role in adaptation - major force in natural selection and evolution > helps other species come up with defenses

Some animals **eat their prey from the inside out**

Parasitoids:
-kill the host

- Tachinid flies are parasitoids when they are larvae
- Flesh flies are also parasitoids in the larvae stage
- Many tachinids lay eggs inside hosts
- Others paralyze prey and bury them in the ground with eggs (Thread-wasited wasp)
- Digger wasps also paralyze prey for their larvae - dig whole in ground to stach away the host
- Cerceris (digger wasp) is a specialist for the jewl beetles (emerage ash beetles) - the beetle is paralyzed and the wasp larvae eat the beetle (1 beetle for each larvae)
- some do visual searching for hosts (flesh fly) - when the right host is found, eggs are laid through an overpositor (stinger like structure that inserts the eggs inside the host)
- **Ichneumonids / Megarphyssa wasps** have very long impressive overpositors - specialize in piercing through wood by using chemical on the end to "melt" through wood, and then the abdomen enlarges and two other structures form a tube to slide the eggs down where they can attach to the grub in the tree
- Pelecinid wasps lay eggs on June Beetle grubs in the ground (long extendable abdomen which extenrds into the ground)
- Some flesh flies lay eggs on fresh tutle eggs and then fly out once hatched turtles dig out of the hole

Parasites:
- do not kill host

Ectoparasites: live on the outside of the body:

- Leaches attach onto other animals (i.e moose, turtles) - slicing mouth peices to attach on (in all life stages they are parasites)
- Ticks are also parasites who feed on animals such as rabbits, and moose
  > Moose Ticks / Winter Ticks: burry their heads in the moose skin and feed on their blood - one moose can have thousands of ticks on its body. They feed on the moose all summer and then drop off in the spring a, all filled with blood. They then lay eggs in the spring. These parasites itch the moose, and cause hair loss as the moose tries to get them off (can pose a problem in the colder weather)
- Mites are ectoparasites - attach to baby dragon flies when they are layed in the water and then stay on them when the flies hatch and fly off

Lecture 9a)

Parasites cont'd..

- Many migratory birds harbour ectoparasitic flies - Flat flies hide under the wings of some birds, and are shapped in a flat way to wedge between feaathers - have claws to hang onto the host

- Clams are parasites in the larval stage - glochidium (baby calms) latch onto fish gils ans fins
  > pocket-book muscle resembles a minow

- Hypostome - mouthpart used to penetrate and hold onto host - have barbs to close up so that the host cant pick the tick out easily

Problems for ectoparasites
> host may die
> host may fight back and groom their fur/feathers

Some hosts have special tools for removing parasites:

- Harons: have modified claws to scrape and comb through feathers (pectinate toe)
- Beavers: back feet have a double split toenail to run through their hair

Endoparasites: live on the inside of the host

Definitive host: host in which the parasite will reproduce inside
Intermediate: where it spends time as a larvae

- Usually endoparasites in all life stages

- **Cuterbra** (a robust bot fly) only live in the host during larvae stage - usually live in chipmuncks and mice
  > how it gets in: female fly puts her eggs on the ground and a small rodent will walk on to the eggs and the eggs will sense the body heat and they will explode and the larave will attach onto the stomach and burrow under its skin.

- Deer have a parasitic **brain worms** - will then live in the droppings, which will then draw in snails and slugs - brain worm will burry into slug/snail. Parasite will live in the slug for awhile and eventually change its behaviour, causing it to climb into trees where it will be eaten by deer again and burrow into the brain again > uncertain why parasites tranfer hosts
  >If a moose eats the intermediate host and gets into a moose, instead of a deer, it can be detrimental to the moose - will interefere with brain activity as the spinal cord tissue has been eaten (moose will get blind staggers [appear drunk] and die)
  > brain worms have evolved with deer so they are immune to them, however moose did not evolve with the parasite

- Robins are the definitive hosts for a parasite **fluke:** leaves the robin in the form of droppings and ends up in a aquatic snail, and change its appearence (makes the tentical change colour and pulsate) which draws the robins attention

They have adaptations:

-small size
-parasitic castration: change the behaviour so the host gets no sex drive (b.c during reproduction the host would become larger and more vulnerable to be eaten. And if the host dies then so does the parasite)

Problems for endoparasites:
- Host can die
- Intermediate host may not be found
- Wrong host may be entered

Scavenging

- Most scavengers do not scavange as their only source of food > they use it as a back up plan
- Gulls scavance extensively
- Ravens also scavange (almost always in winter)
- Some scavangers are full time scavangers (obligate scavangers - feed on only dead things)
    > Full time must have cetrain adaptations..

Adaptations:
- Naked scull for sticking into unpleasent places (i.e open guts)
- Raptorial bill (rounded) to tear apart flesh
- Powerful sence of smell - large nostrils / large olfactory bulbs
- Vultures have adaptations fro finding food while in the air
    > flight mode is a gliding and soaring motion - to fly low and slow

Small animals also scavange:
Carrion Beetles burry small dead animals (mice) for their young. They do this in pairs.

Feeding on dead things: necrophagous

Lecture 9b)

Predictable Food Shortages (i. winter)
Solutions: migrations / dormacy
Some things about food are **unpredictable** as the food source can change over the season:
    > I.e food size: nuts/seed, berries/fruit, small mammals
Solutions to this unpredictable problem may be..

Fruit
-some birds move to other food-rich regions only when necessary > they do not always go south > Bohemian Waxwings move to areas with better food supply
- they are nomatic and irruptive (irruption is when one of these species arrive in huge numbers)
- Mast crops attract the group to the new area (crops filled with fruit)

Seeds
-Crossbills are seed specialists - they move to corniferus trees and delay their breeding until they find a good crop
-also nomative and irruptive

Small Mammals
-Great grey owls eat small mammals so they follow where the large amount of small mamals are.
-not really nomadic but they are irruptive