Exam 2 Study Guide - Biology 130 – Summer 2011

Animal behavior

Causes for behavior

- "proximate" - environmental stimuli that trigger behavior, e.g., day length, visual stimuli
- "ultimate" - why does stimulus trigger behavior - generally believed to be due to natural selection (adaptive behavior)

Behavior results from both genes AND environment

- Whether an animal CAN exhibit a particular behavior is determined by genes
- Whether an animal DOES exhibit this behavior can be dependent on environment.
  – An animal may not exhibit a possible behavior in certain environments

Lovebird study

- Genetic component - illustrated by intermediate strips and tucking behavior in hybrid
- Environmental component - illustrated by loss of ineffective tucking behavior by hybrids in later seasons.

Fixed action pattern

- Sequence of behavioral acts that is unchangeable and usually carried to completion once initiated
- Fixed action pattern is stimulated by a **sign stimulus**
- many animals only use a relatively small subset of sensory information to trigger behavior, humans are more complex

Digger wasp study

- Fixed action pattern is cueing on visual landmarks to locate nest
- sign stimulus is pattern of landmarks around nest

Why is there multisong behavior?

- attracting mates?
- What does song repertoire have to do with being a good mate?
- Postulate that repertoire increases fitness by making older more experienced males more attractive to females.
- Testable hypotheses:
  – males learn more song types as they get older
    females prefer males with large repertoires

Learning

- Experience based modification of behavior

Vervet monkey alarm calls

- Different alarm calls for leopards, eagles, snakes
- Infant monkeys give indiscrimate alarm calls but eventually learn to give the right call at the appropriate time

Imprinting

- A type of learning that is limited to a sensitive period of an animals life and is generally irreversible
-

Imprinting in goose hatchlings

- Bonding occurs after hatching
- imprint of "mother"

–important for eliciting care, developing species identity

- during sensitive period can be experimentally imprinted on the wrong mother.

Associative learning

- Classical conditioning - Pavlov's dogs, arbitrary stimulus related to reward or punishment
- Operant conditioning - trial and error learning, learn to associate own behavior to reward or punishment

Bioluminescence

Bioluminescence

- Bioluminescence is widespread across most forms of metazoan marine life.
- Light is typically generated by the organism itself and only rarely due to bacterial symbionts. Example bacterial symbionts: anglerfish, bobtail squid
- Light emitters (luciferins) enzymes (luciferases)
- Based on the chemical mechanisms known, luminescence has evolved independently more than 40 times.

bioluminescence

- It serves a variety of functions, both offensive and defensive, even within a single organism.
- a bioluminescent flash can be seen from tens to hundreds of meters away

–Even a single-celled dinoflagellate 0.5 mm long can send a signal to a large fish 5 m away—the equivalent of a 2 m tall human being able to communicate over a distance of 20 km.

Functions of bioluminescence

Offensive – lure prey, stun prey, illuminate prey

Defensive – startle, counterillumination, smokescreen, distractive body parts, sacrificial tag, burglar alarm

Mating attraction/recognition

Bioluminescence

•Luciferin/luciferase normally emits blue light
Chemical reaction: Luciferin + oxygen → LIGHT + oxyluciferin. This reaction is catalyzed by the enzyme luciferase.

Dragon fish red light emission

•Light in the photophore (a light-producing organ) doesn't start out deep
•red. Initially the light has a short wavelength (red is long-wavelength
•light). This light is absorbed by a fluorescent pigment inside the
•photophore, which takes the energy and re-emits it as red light

sacrificial tag

•In this situation, an organism may lose part of its body to a predatory encounter.

•These lost tissues can continue to glow for hours afterward even within the predator's stomach

•the glowing tissue can draw attention to the predator, making it risky to consume bioluminescent prey.

cookie-cutter shark

•relatively small species feeds by taking bites out of the bodies of much larger fish, cetaceans, and squid

•unclear how it might get close enough to attack these fast-moving prey.

•hypothesized that an optical "flaw" in the counterillumination pattern—a dark band below the mouth—looks like the silhouette of the prey of one of these larger species. When the fish or squid draws near to attack this apparent prey, it is instead attacked by the shark.

Diving

Adaptations for Diving:

•Rapid breathing prior to dive -known as apneustic breathing
•Lungs remove 90% of O_2 from air (as opposed to 20% for humans)
•Elastic tissue in lungs helps them expand the lungs temporarily during apneustic breathing
•Marine mammals have more blood than non-diving mammals for their size (means more hemoglobin to carry oxygen)
•Muscles contain more myoglobin to hold oxygen in tissues
•The heart rate slows dramatically during a dive – known as bradycardia
•Blood flow is reduced to extremities and digestive system
•Muscles employ anaerobic respiration as necessary (results in lactic acid build-up)
•Marine mammals can tolerate more lactic acid than other mammals

•Rib cage and lungs collapse during dive to force air into tissues and prevent decompression sickness

•

Some animals just go anaerobic for extended periods of time

Turtles and lungfishes rely on liver glycogen during submergence

•After maximal submergence liver glycogen not fully depleted

–*Additional glycogen stores in other tissues

–More efficient fermentation pathways

–*Reduced metabolic rates

Metabolic depression extends turtle anoxia tolerance

Some animals learn to breathe through their skin

Lake Titicaca frog

hellbender

Mammalian divers

•Weddell SealUp to 10 ft long 1000 pounds
•can dive over 2000 feet deep and stay submerged for 1.2 hours

Marine symbiosis

Type of symbiotic associations

Mutualism - partners mutually benefit (+ +).

Commensalism - one partner derives some benefit while the other is unaffected (+ 0).

Parasitism - one partner benefits at the expense of the host (+ -)

•Degree of intimacy

–* Ectosymbiont (or Episymbiont) - a symbiont that lives attached to the surface of its host cell (including inner surfaces and chambers, such as the gut cavity or ducts of endocrine glands).

– * Endosymbiont - a symbiont that lives within its host, some are within the host cells and are intracellular symbionts.

•Dependence on the symbiosis

– * Facultative symbiont - independent, able to exist in a free-living condition.

– * Obligate symbiont - dependent, so highly adaptive that they have lost the ability to exist independently.

Evolution by association

•By forming a symbiotic association, the capabilities of both partners are added together. This can be faster than “slow” evolution of new capabilities.

•We have seen an example of this before with the evolution of eukaryotes

Some examples of symbiosis that we may not normally think about

- Domestication of plants and animals
  - Flowers such as tulips
  - Crop plants – Red delicious apple cultivars are very abundant plants
  - Cats – There are many domesticated cats. Domestication in cats appears to have evolved once in Mesopotamia
- Domesticated plants and animals are likely more numerous than their wild counterparts
-

Types of symbiosis

- Mutualism, commensalism, parasitism
- not always easy to determine which type it is

mutualistic symbioses

Algal-invertebrate symbiosis

Examples already discussed: Algal-invertebrate symbiosis

- Sea anemones
- Corals
- Upside down jellyfish
- Lake Palau jellyfish
- Tridacna clams

Some considerations

- The algal symbionts are usually acquired from the environment, and usually one species of algae is always present in a given host species. How does the host recognize the symbiont?
- Foreign cells in animals are usually destroyed. Why aren't the symbionts destroyed?
- The algae are somehow induced to release sugars and amino acids to the host. How?
- What does the host give to the algae?

Coral bleaching

- Not clear if it is due to pollution, temperature, disease?
- Corals lose their symbionts and die.

Chemoautotrophic bacteria-invertebrate symbiosis

Riftia pachyptila – giant tubeworm with special hemoglobin that brings chemicals to the symbionts which are chemoautotrophic bacteria (make sugars and other compounds from chemical energy)

Symbiont transmission

- Often "horizontal" –symbionts come from environment
- In some cases it is "vertical" –symbionts are in the eggs – clam symbioses such as Solemya – if this is the case then the symbiont may

have no free-living existence and may be on its way to evolving into an organelle

shipworms

- Actually bivalves burrow in wood
- Wood is poor in nitrogen
- Bacteria in the gill fix N2 gas into amino acids

Sea slug *Elysia*

- When it feeds on the alga Vaucheria litorea, it will turn green, by putting the algal chloroplasts into its own gut cells. Is this mutualistic?

Deep sea vent – a variety of symbioses found at deep sea vents

Alvinella pompejana – deep sea worm that lives in hot water and keeps a covering of bacteria on its back that may insulate it from heat

Scaly foot gastropod

- Has iron scales secreted by the foot.
- Gills have chemoautotrophic bacteria symbionts

Yeti crab

- Has hairs that are covered with bacteria may be involved in nutrition

Commensal symbioses

Clownfish/sea anemone

Cleaner shrimps

Decorator crab

- It is usually found covered in seaweed that acts as camouflage

•Pea crabs

- Small crabs often found in oysters and other bivalves

tongue-eating isopod (*Cymothoa exigua*).

- isopod gets into host's mouth and grabs onto tongue with seven hooklike legs. Over time, the tongue degenerates, leaving the parasite hanging on to its stub.
- This change actually has very little effect on the fish, because it can still hold prey with the parasite. The isopod doesn't just replace the tongue physically, it also replaces it functionally.
- Is this commensal or parasitic? What additional information would be necessary to evaluate this?

Whale barnacle *Coronula diadema*

- the whale's skin is drawn into the spaces between the plates, permanently stitching the barnacle's shell to the whale.
- Is this commensal or parasitic? What additional information would be necessary to evaluate this?
-

Parasitic symbioses

Remora –usually attaches to sharks, rays, turtles
Sea lice

•Parasitic copepods on hammerhead shark

eye maggot

•The eye maggot of sprat - a parasitic copepod attaches to eye

Roundworms in fish muscle
Parasitic castration

•Common parasitic castrators include larval trematodes in snailsan individual parasitic castrator can usurp all the reproductive energy from a host

Adaptations to hot and cold.

What are some measurements or experiments that can be used to determine whether the vent worm can survive temperatures above 60 degrees C? What would such a measurement prove? What does the measurement not prove?

Chapter 11
Between the Tides

What is the intertidal zone?
•The intertidal zone is the area between the mean low tide and mean high tide.
•By contrast, the subtidal zone is the area that is always submerged.

Problems Associated with the Intertidal Zone
•Due to the exposure seen in the intertidal zone, organisms face a variety of challenges, including:

- –Desiccation (water loss)
- –Temperature changes (can be extreme)
- –Salinity changes (can be extreme)
- –Interrupted feeding
- –Wave action and tides
- –Oxygen availability and build-up of CO_2
- –Limited space

•

“Clamming up” consists of closing shells or otherwise walling yourself off from the environment in an attempt to conserve moisture (such as an oyster closing its shell or a snail walling itself off using its operculum).

•While moisture can be conserved in this way, there is a down side – no exchange of gases or feeding occurs.

Changing Temperatures

•The wide variety of temperatures that must be tolerated by organisms in the intertidal can be severe.

•Imagine, one morning the temperature may hover around 60 degrees with an afternoon spent in temperatures exceeding 100 degrees.

Limited Space

•In some intertidal communities, proper space may be limited.

•This is particularly true in rocky intertidal environments where the amount of surface area is limited.

Zonation in the Intertidal

•Zonation in the intertidal consists of upper intertidal (most exposed) to middle and lower intertidal (least exposed).

•Competition will be greater in the lower intertidal because it is the least “severe” of the zones since it is exposed to a lesser degree than the upper intertidal.

•The lower intertidal is always more species rich for the same reason (although species will vary greatly by location).

Competition

•Some organisms are better competitors than others are will exclude other organisms if the community is left undisturbed.
•If a habitat is disturbed, organisms move in and are later excluded in a predictable pattern known as succession.

•Top carnivores in any community that have the ability to change community composition significantly are known as keystone predators.

Intertidal ecology experiments: be prepared to interpret data from intertidal experiments
Experiments can be done to remove or exclude some animals or predators
Animals can be transplanted to determine whether they can survive in areas where they are not normally found

Chapter 12
Estuaries

Types of Estuaries

•Bar built estuary-
–Built by the accumulation of sediments into sand bars or barrier islands
–Ex: North Carolina (seen in lower part of the photo to the right near Cape Hatteras)

•Fjords –
–Deep channels cut in the coastal zone as a result of retreating glaciers
–Ex: Alaska, Norway
–Puget sound is a type of glacial fjord

Puget Sound
•Over millions of years canadian glaciers formed and retreated at least 4 times

•20,000 years ago, glacier 1 mile deep
•After glaciers was a large lake
•Sea levels eventually rose and filled the estuary
•

Development of Estuaries

- •Estuaries are the best developed in areas where the coastal plain is flat and the continental shelf is wide. i.e. East Coast US
- •The opposite is true in areas with steep, narrow continental shelves and coastal plains, i.e., Washington, west coast US

Physical Characteristics of Estuaries
•Salinity-

- –Can vary from 5 – 30 ppt
- –Salinity varies according to distance from saltwater (tides) or freshwater (river) input
- –Can also vary as a result of storms
- –Depth also contributes to salinity
- –The diagram to the right illustrates that the salinity is not uniform (saltwater is heavier and sinks below freshwater) – this is known as a salt wedge

Dealing with Salinity Changes

- •Organisms in the estuaries are normally euryhaline (can tolerate a wide variety of salinities)

Dealing with Salinity Changes

- •Flowering plants in the estuarine community must either expel excess solutes (such as *Spartina* and mangrove trees using salt glands) or concentrating solutes in specific tissues(such as in "pickleweed"

Mudflat ecology

- •Only the upper few mm of the sediment is oxygenated, the rest is anoxic and rich in hydrogen sulfide
- •Very little hard substrate which is preferred by many organisms
- •Burrowing organisms can oxygenate their environment and also provide oxygen for other organisms that live in their burrows
- –Still can have problems when exposed at low tide – anoxia and shorebirds
- •Seagrasses can provide substrate and also oxygenate the sediment

Communities within an Estuary

- •"Oyster reefs" are found in many estuaries
- •These congregations of oysters are the platform on which dozens of other species grow and thrive
- •The oysters provide the only hard substrate in many estuaries

•**<u>Saltmarsh</u>**

•The vegetated area of an estuary

•*Spartina* species predominate near the water in most estuaries *Zostera marina*
Eel grass
seagrasses

Worldwide Distribution of Saltmarshes and Mangrove Forests

•Some mangrove tree species possess pneumatophores, or vertical root extensions, that assist the plant with the exchange of gases