I. Introduction to General Parasitology (BLY 459) Fall, 2008

A. Organisms categorized by how they acquire energy
1. Energy from non-living sources
a. Plants - sun
b. Fungi & bacteria - decomposers
c. Bacteria - energy-containing molecules
2. Energy from other organisms
a. ALL animals
b. Two options used to acquire energy
(1) MURDER
(a) Predators
(b) Victim (= food source) was alive
(2) THEFT
(a) Herbivores
(b) Parasites

B. Most animals are parasites
1. All predators, herbivores, & omnivores harbor species-specific parasites
2. More kinds and numbers of parasites than free-living organisms
3. Estimated that 2/3 of all animals are parasites
a. If you wish to understand biology, you need to understand parasitology
b. Parasitologists should receive more respect, nicer offices and higher salaries

C. Trophic Interactions
1. Typical textbook illustrations of food chains and food webs:
a. Primary producers = plants
b. Primary consumers = herbivores (i.e. caterpillars, copepods)
c. Secondary consumers = small predators (i.e. finches, anchovies)
d. Tertiary consumers = large predators (i.e. hawks, bass)

Slides: Food chains and trophic pyramid illustrations from college freshman biology texts.

2. Things are not as simple as they seem; plants, herbivores and predators are not the only important players in the game of life

Slide: Life-cycle of a parasitic worm in an aquatic ecosystem

Slide: Food-web of a New Jersey stream showing all possible trophic interactions between fish, macroinvertebrates, and resources.

Slide: Food-web of a New Jersey stream tracking life-cycles of four species of parasitic worms

3. Typical textbook illustrations of energy flow and energy pyramids
a. Large arrows from primary producers to herbivores and smaller arrows from herbivores to carnivores
b. Primary producers have the greatest biomass, then herbivores and the carnivores the least

Slides showing textbook illustrations of energy flow and energy pyramids

4. Where do parasites fit into this scheme?

Slides Trophic energy pyramid of an ecosystem without and then with parasites illustrated

D. Equal rights for parasites
1. Parasites are victims of a “bad press.”
a Non-biological “Walt Disney” classification system
(1) “Good” organisms
(a) Characteristics

1). Big eyes
2). Furry
3). Colorful

(b) Bunnies, butterflies & Bambi

Slide: Biology & Hollywood "Good" Animals: Bambi, Thumper & Flower

(2) "Bad"

(a) Predators

1) Wolves
2) Snakes
3) Spiders

(b) Herbivores that eat garden plants

1) Rabbits
2) Caterpillars
3) Deer

(c) Germs & disease causing organisms

b. Freshman biology or Discovery Channel classification system

(1) Predators (except perhaps snakes & spiders) belong in the "good" category

(2) Reasoning: Predators remove sick animals from the habitat; thus, they keep ecosystems "healthy."

(3) Policy implications:

(a) Zoos traditionally delouse and deworm all new arrivals including endangered species

(b) Efforts to save one species (= host), may cause extinction of many species (= host-specific parasites)

2. Pro-parasite arguments

a Ecosystems exhibiting high species diversity are considered healthy/robust

(1) Parasites (2/3's of all animals) certainly contribute significantly to species diversity

(2) Environmental impact surveys almost never include parasites on their species lists

(3) Parasites as biomonitors: Disappearance of a parasite may reflect local extinction of one of the multiple hosts in parasites's life-cycle

b. Cures for cancer and other diseases?

(1) People argue that species going extinct may have possessed cures for cancer or other diseases

(2) Inter-specific competition among parasites

(a) Parasites compete for space within hosts with other species of parasites

(b) Evolutionary theory predicts that parasites develop mechanisms that counteract competitors

3 Responsible for the "health" of ecosystems?

a Parasites may enable some hosts to survive in marginal habitats.

b Some parasites increase likelihood that one host will be eaten by next host in the life-cycle.

c Parasites (= tapeworms) may make food available for some hosts (*i.e.* wolves in winter) at only a marginal cost.

Slide: Gray Wolves in Yellowstone

E. What is a parasite?

1. Traditional definition
   a A parasite-hosts relationship is one . . .
      (1) The first species (parasite) adversely affects the second species (host).
      (2) Yet the first species is dependent upon the second.
   b Characteristics of a specialized predators (*i.e.* anteaters-ants) fulfill above criteria
2. Comparison of parasitism & predation

Parasitism	Predation
Lifelong intimacy	Brief
Do not kill	Kill
Smaller	Larger
Many/host	1 predator eats many prey

Slides: One showing biomass trophic levels in an aquatic ecosystem (detritus, isopod prey, fish predator, and parasites in fish) and the other showing the relative number of organisms in those trophic levels

3. Parasites operate on a higher spiritual and moral plane than predators

Slide: Parasitism & Hollywood, Luke Skywalker & X-wing fighter

Slide: Parasitism & Hollywood: Death Star and TIE fighter

F. SYMBIOSIS

1 Defined
   a Literally "living together"
   b. This course:
      (1). Intimately living together
      (2) No judgment as to who benefits, if either.
2 PARASITISM
   a Guest benefits (+)
   b Cost to host (-)
3 COMMENSALISM
   a. Guest has access to resource, usually food (+)
   b. Host not affected (0)

Slide: Commensalism, *Urechis*: The fat innkeeper mudflat worm

   c. Special types
      (1) PHORESY
         (a) Guest carried by host at minimal cost
         (b) Example
            1) Crabs on jellyfish
            2) Do not eat host
            3) Dispersal: ride & drop off

Slide: Phoresy example, crabs riding on jellyfish medusa

      (2) INQUILINISM
         (a) Guest receives protection living within body cavity of host

(b) Guest does NOT feed on host, therefore minimal cost to host

Slide: Inquilinism example: Fish living in anus of sea cucumber

4 MUTUALISM

a. Reciprocity

b Everyone benefits (+,+)

c Zooxanthellae example

(1) Algae (dinoflagellates) inside cells of corals & sea anemones

(2) Photosynthesis provides sugars to host

(3) Guest algae receive nutrients and protection

Slide: Mutualism, example of zooxanthellae

G. Special Trophic Interactions

1 Parasitism

a HYPERPARASITE: Parasite of a parasite

b PARASITIC CASTRATORS

(1) Some parasites only destroy the reproductive organs of their hosts.

(2) Hosts usually live a normal life except that they do not reproduce

(3) Examples

(a) Larval trematodes in snails

(b) Rhizocephalan barnacles in shrimp and crabs

Slide: Example of a Parasitic Castrator, Rhizocephalans on a host crab

(4) Comparison

(a) Intimate relationship

(b) Host lives, but it is reproductively dead

(c) About 1/4 to 1/5 size of host

(d) Usually one castrator per host

c PARASITOIDS

(1) Some entomophagous insects (= insects that eat other insects) use this approach

(2) Adult lays egg(s) on/in the larval stage of prey

(3) Parasitoid hatches and consumes prey from inside while victim is still alive

Slide: Series showing parasitoid wasp infecting aphids

Slide: Parasitology & Hollywood, John Hurt plays host in movie *Alien*

Slide: The Emergence of Parasites in Movies as demonstrated by John Hurt

Slide: Cheap Thoughts by Jack O'Brien, "Who would you want on your side in a 'food fight?'"

(5) Comparison

(a) Intimate relationship

(b) Host killed

(c) Slightly smaller than host

(d) Usually one parasitoid per host

2. MICROPREDATION

(1) Comparison

(a) Brief

(b) Victim not killed

(c) Smaller than victim
(d) Moves from victim to victim

(2) Examples
(a) Mosquito
(b) Tick

Slide: Cheap Thoughts by Jack O'Brien: "Isn't It Time for a Unique Mascot?"