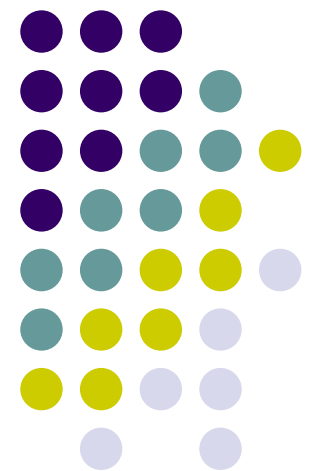


Parasites and Disease: a brief introduction

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Outline

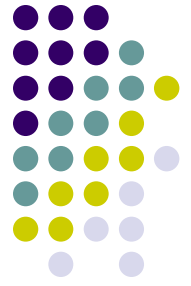


- 1. Disease**
- 2. Symbiosis**
- 3. Parasitism**
- 4. The parasitic lifestyle**
- 5. Some implications**



1.- What is Disease?

- Any impairment that interferes with or modifies the performance of normal functions” (Wobeser 1981)
- What is “normal”?
 - Human perspective
 - Epidemiologist’s perspective
 - Veterinary’s perspective
 - Ecologist’s perspective

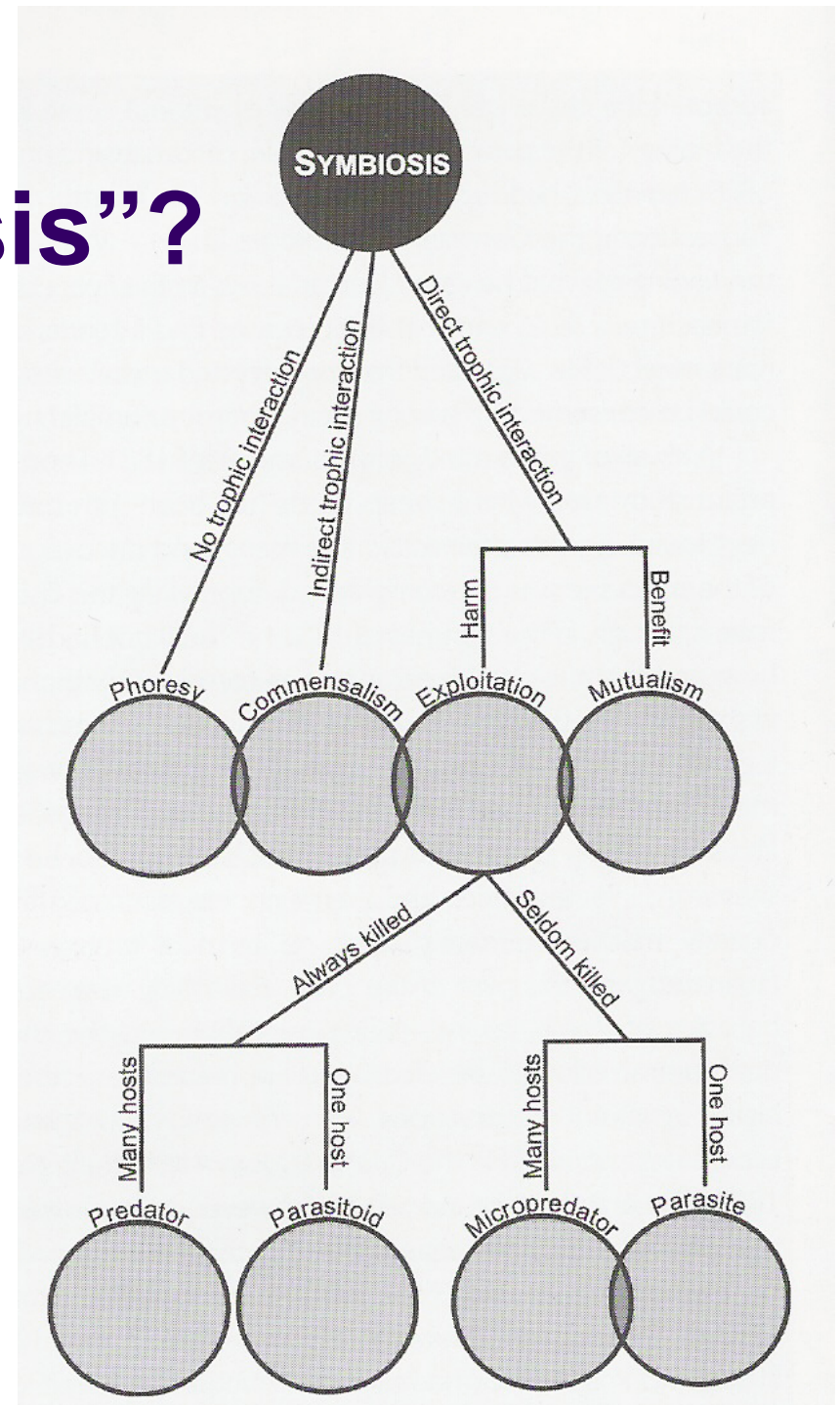


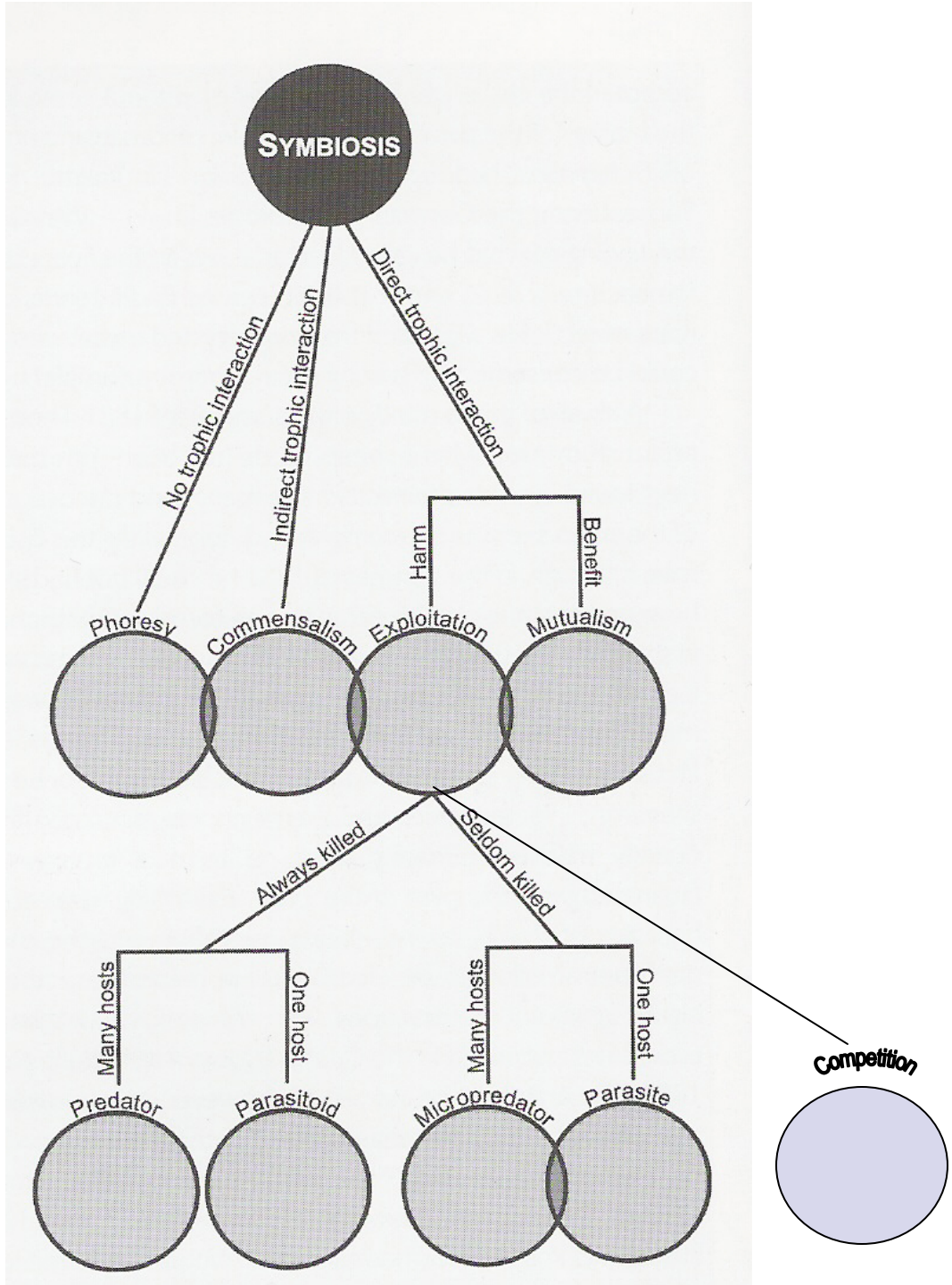
Types of disease

- Non-infectious and infectious
- Caused by abiotic and biotic factors
- This course → infectious diseases of biological origin (i.e. “parasites”) (one exception).

2.- What is “symbiosis”?

- Symbiosis.- a close association between two species.
- *Symbiosis* covers several types of intimate interactions.
- Trophic interactions and benefit/harm to the species involved.
- Parasitism is a type of symbiosis







- *Phoresis*.- symbionts that merely travel together, the “phoront” being the one carried (e.g. bacteria on a fly, fungi or nematode (free-living) on a dung beetle)
- Commensalism.- “eating at the same table”. One benefits, the other is neither helped or harmed (e.g. sharks and remoras, usually; *Entamoeba gingivalis* in human mouths).
Obligate or facultative.



- ***Mutualism.***- Both species benefit (e.g., intestinal flora in termites, ruminants, etc. fungus+ algae = lichen)
- **Cleaning mutualism.**- crustaceans or small fish service larger fish mouths, gills, skin, etc.



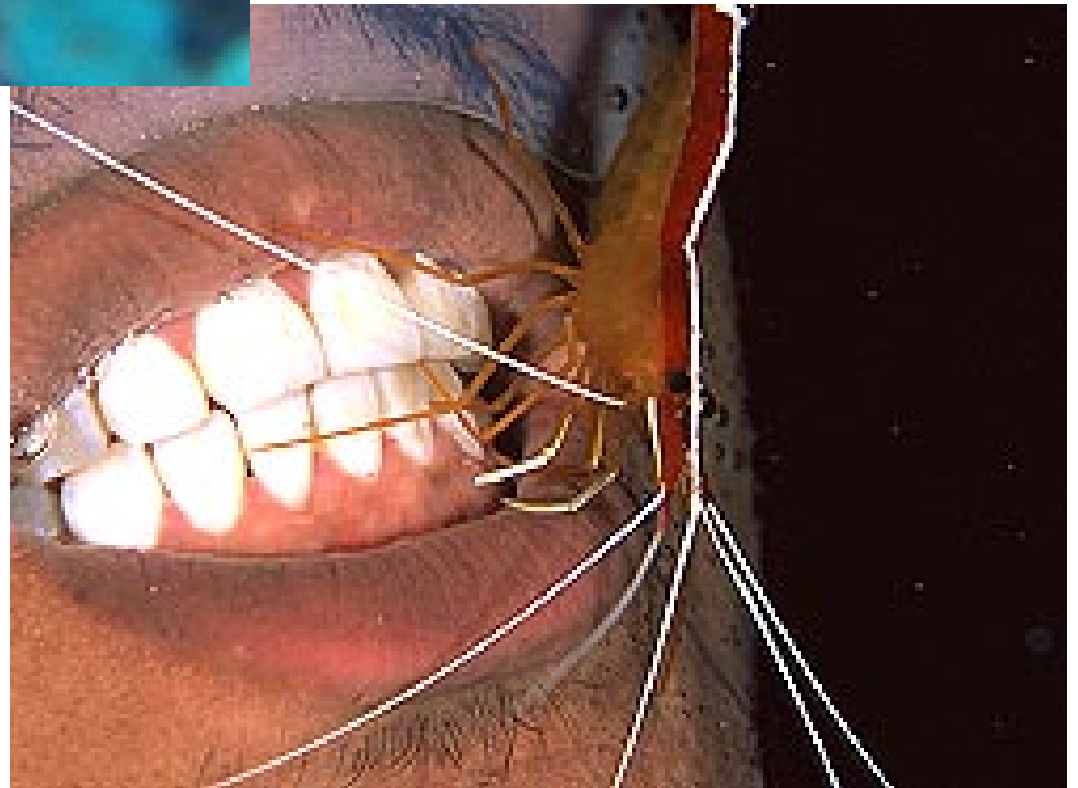
Mutualism.- clownfish and anemone



Illustration: Bob Kline

Photo: Steve Delaney/Photo

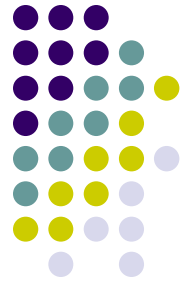
Clownfish resist anemone's nematocysts by having a thick(er) mucous layer that lacks the compounds that trigger nematocysts. (cost – increased susceptibility to fungal infections). Anemone benefits by being defended from predators and getting food scraps.



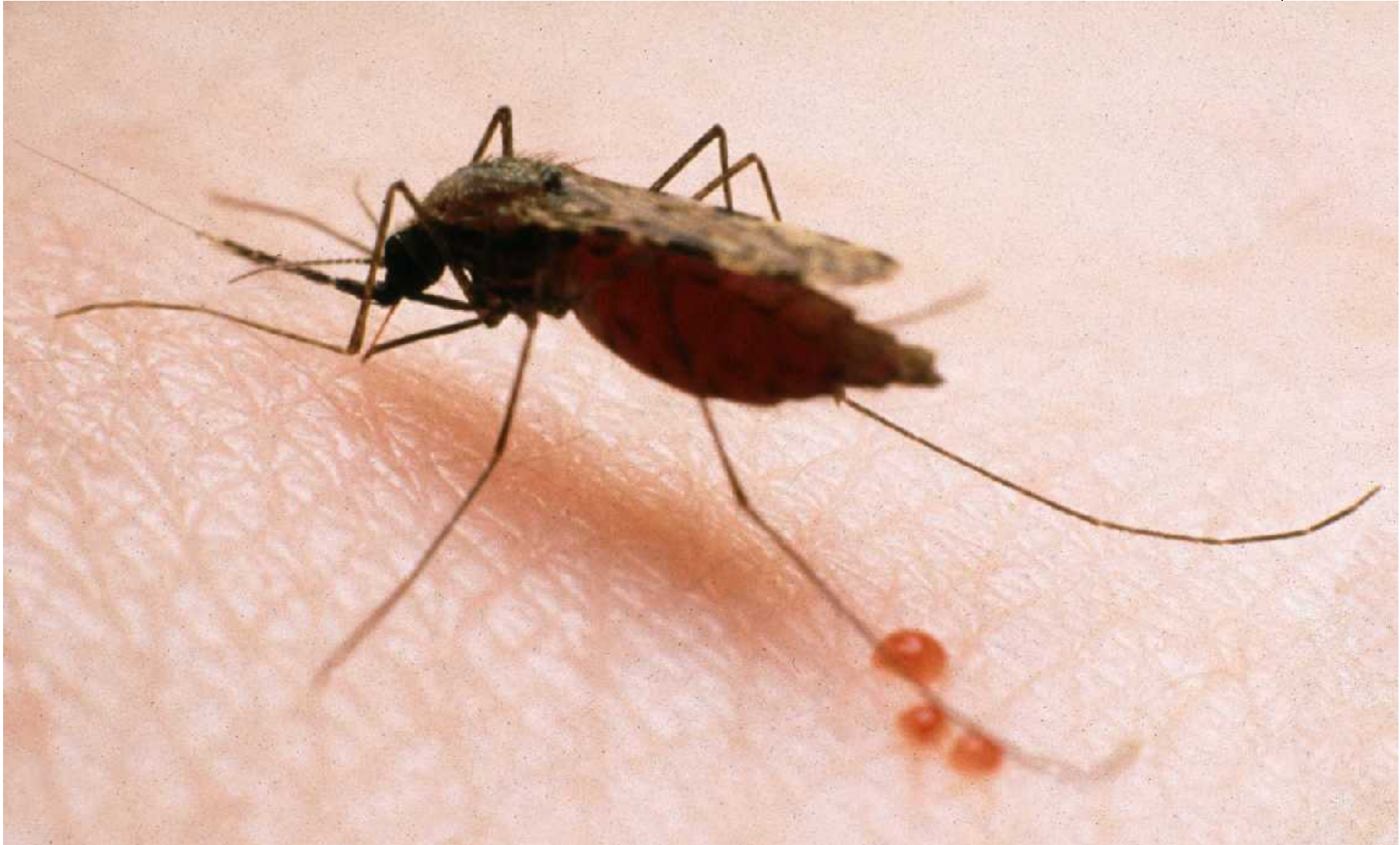
Predators.- Attacker(s) eat(s) several of the other, from the outside. Victim dies. (wolves)

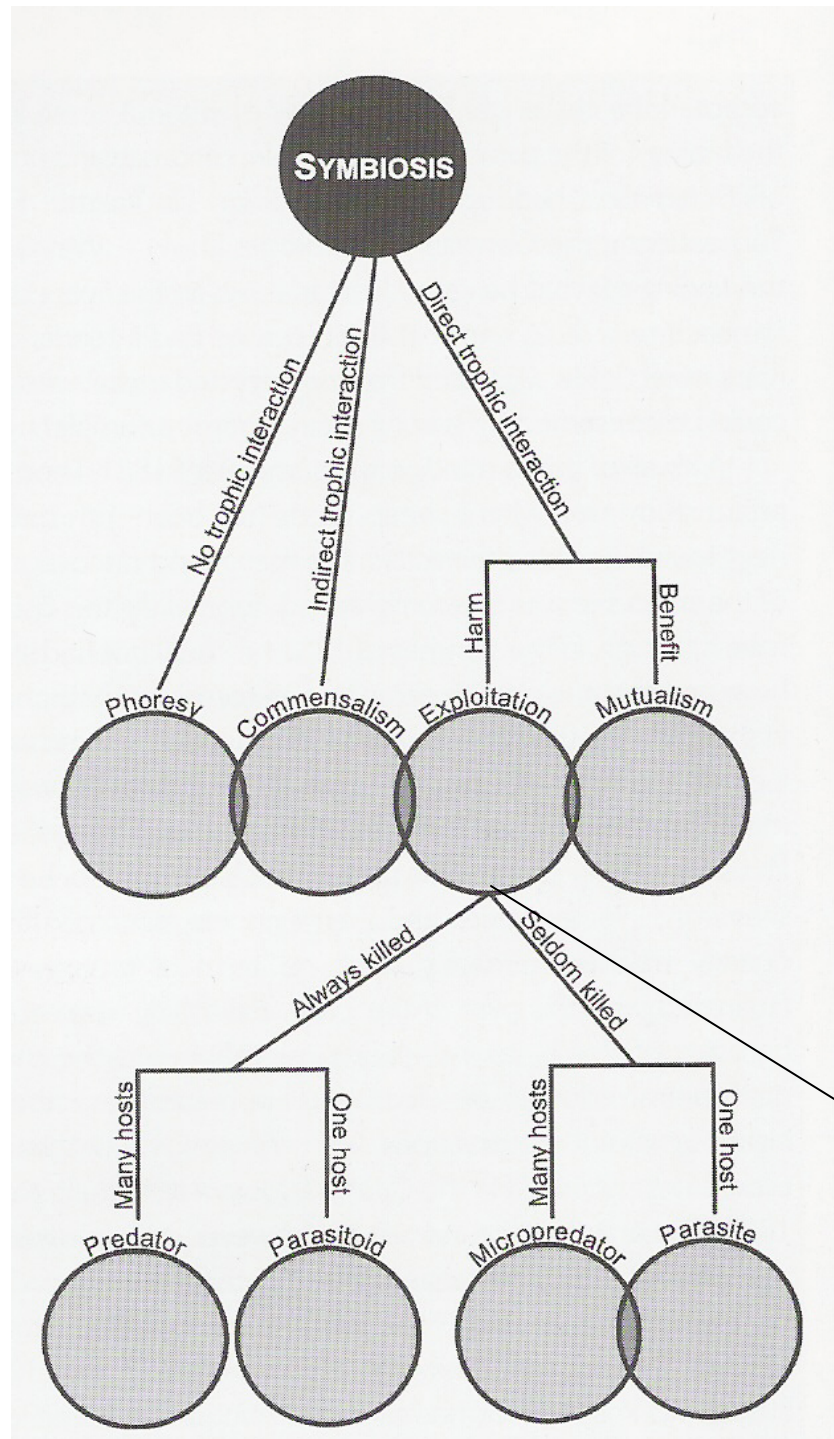


**Parasitoid.- Attacker(s) eat(s) one of the other,
form the inside. Victim dies. (ichneumon wasps)**

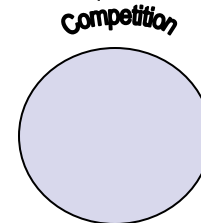


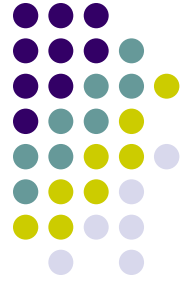
Micropredators.- Attacker(s) feed(s) on several of the other, usually from the outside, but the victim does not die. (mosquitos)





Lots of overlap!!

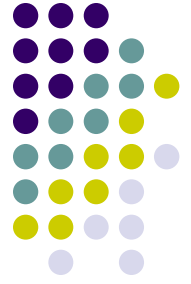




3.- Finally.... parasites

- Symbiosis in which a given parasite attacks only one host, which then lives to tell the tale.
- OR
- Symbiosis in which one (the parasite) lives on, off or at the **expense of the other** (host)
- OR
- Organisms that for a significant portion of their lives live in or on another species and benefit from this association at the **host's expense**.

OR

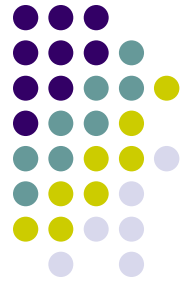


- “organisms that live in or on a heterospecific animal (the host), draw their nutrients primarily from the host, and have the potential to reduce its **fitness**.”
 - includes both endoparasites and ectoparasites, but excludes micropredators or animals that use their hosts solely for shelter.
 - Second, includes both macroparasites and microparasites.
 - Finally, parasites need not be harmful all the time, or even most of the time.
 - Why fitness???

Why “fitness”?

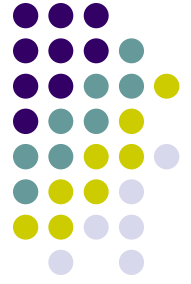


- Because harm and good are difficult to identify otherwise, never mind quantify!
- E.g., Rats, infected with the intermediate stages of a tapeworm *Spirometra*, grow larger than uninfected rats. A growth hormone is produced by the worm. Is this growth harming the host?
- Many molluscs, when infected with the intermediate stages of digenetic flukes develop thicker, heavier shells.
- Fitness is the ultimate measure of whether something is “good” for an animal. Of course, it is seldom obvious.



How many are there?

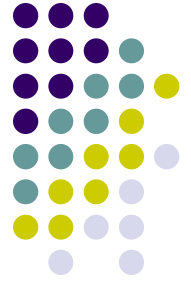
- There are 3 main living environments (1) terrestrial (2) aquatic and (3) the body of another living organism (endoparasites)
- All free-living species have parasites, most free-living species have at least one unique parasite and many parasites have parasites themselves. So there are more parasites than free-living species.



Types of parasites

- ***Ectoparasite-***
- ***Endoparasite-***
- ***Mesoparasite-*** penetrates external openings - buccal cavity, cloaca, external ear, feather shafts.

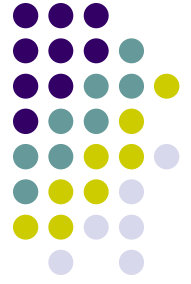
- **Macroparasites (helminths, arthropods)**
- **Microparasites (viruses, bacteria, protozoa, fungi)**
- **Obligate and facultative parasites**
- **Hyperparasites.-**
- **Homoxenous and heteroxenous**
- **Permanent, temporary and intermittent**
- **Accidental or incidental**



Types of hosts

- ***Definitive host***- sexual maturity.
- ***Intermediate host***- required by parasite to complete its life cycle. Morphological or physiological changes.
- ***Paratenic host***- optional transport host - no detectable morphological changes
- ***Vector***- host that plays an active role in transmission, definitive or intermediate host.
- Hetero and homoxenous
- Homo and heterogonic (alternating free/parasite)

4.- The parasitic lifestyle: some features



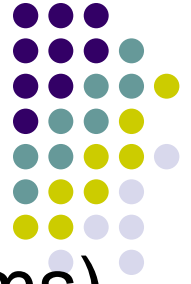
- A. The parasite can be physiologically dependent upon its host.
- B. Heavily infected hosts can be killed by their parasites.
- C. Parasite can reproduce faster than their hosts.
- D. Parasite populations are not evenly or randomly distributed amongst the host population. It is clumped.

4a.- Physiological dependancy



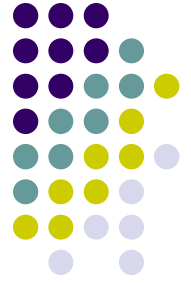
- Depending on the strength of the association.
- Close co-evolution can lead to a physiological and immunological arms race.
- In some cases the parasite can manipulate host physiology and behaviour for its own benefit, whereby the host “unwittingly” increases the parasites’ likelihood of transmission, survival or reproduction.

4b.- Mortality

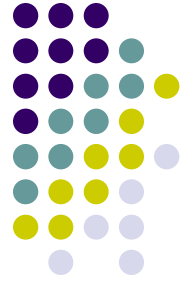


- Depends on the length (in evolutionary terms) of the association. Generally, virulence decreases with time, as parasite and host “negotiate their arrangement”.
- Nevertheless, heavily infected hosts are killed, which can have drastic consequences on host populations (unusual, however, unless hosts are otherwise weak)

4c.- The reproductive potential

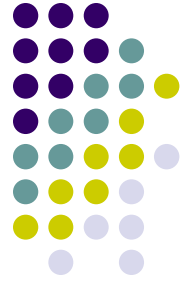


- Unlike predators, parasites have a higher reproductive potential than their hosts.
- Allows parasites to adapt quicker to changes in their environment (their environment, of course, is the host).
- In the evolutionary arms race, parasites are expected to “win”



4d.- Distribution

- Clumped frequency distribution means that whereas all animals are probably parasitized, a few end up being heavily parasitized, and being affected the most.
- Who are these lucky few? What effects they have on the population as a whole?
- Prevalence and intensity



5.- Some implications

- Adaptive radiation within a host (e.g., human lice, tapeworms along the intestine length).
- Co-evolution
- Sexual selection
- Evolution of sex
- The mammalian fetus



Summary

1. **Disease.- Just part of “normal” life**
2. **Symbiosis**
 - A. **Several types, depending on the nature of the association**
 - B. **Many grey areas**
3. **Parasitism.- a functional definition**
4. **The parasitic lifestyle.- some features**
5. **Some implications.- to life-history, behaviour, sex, etc...later in the course**

Next → “Protozoans”

