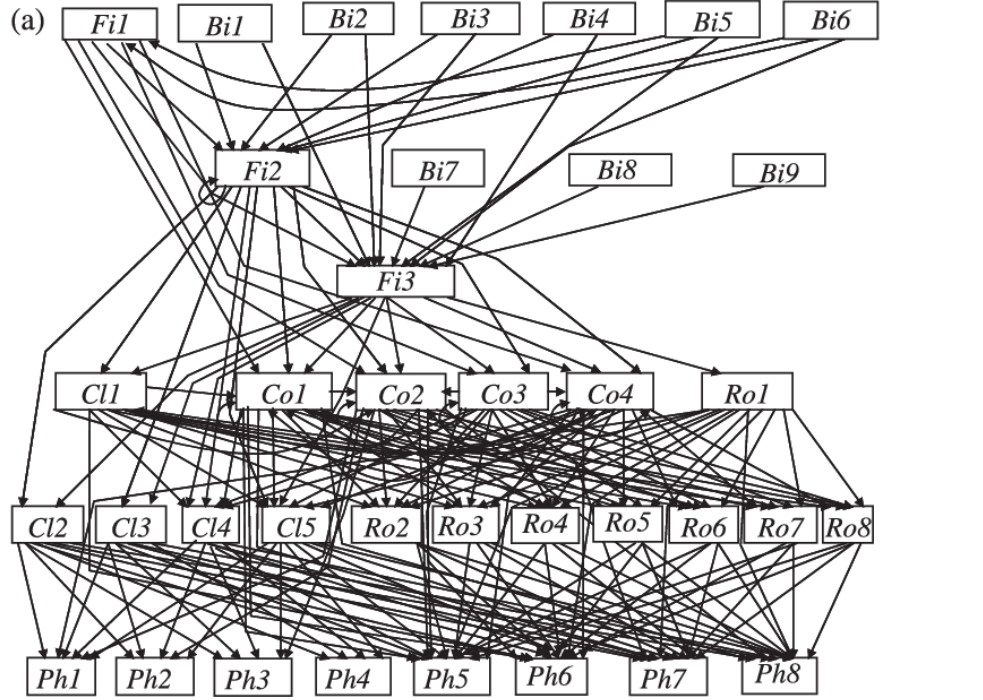
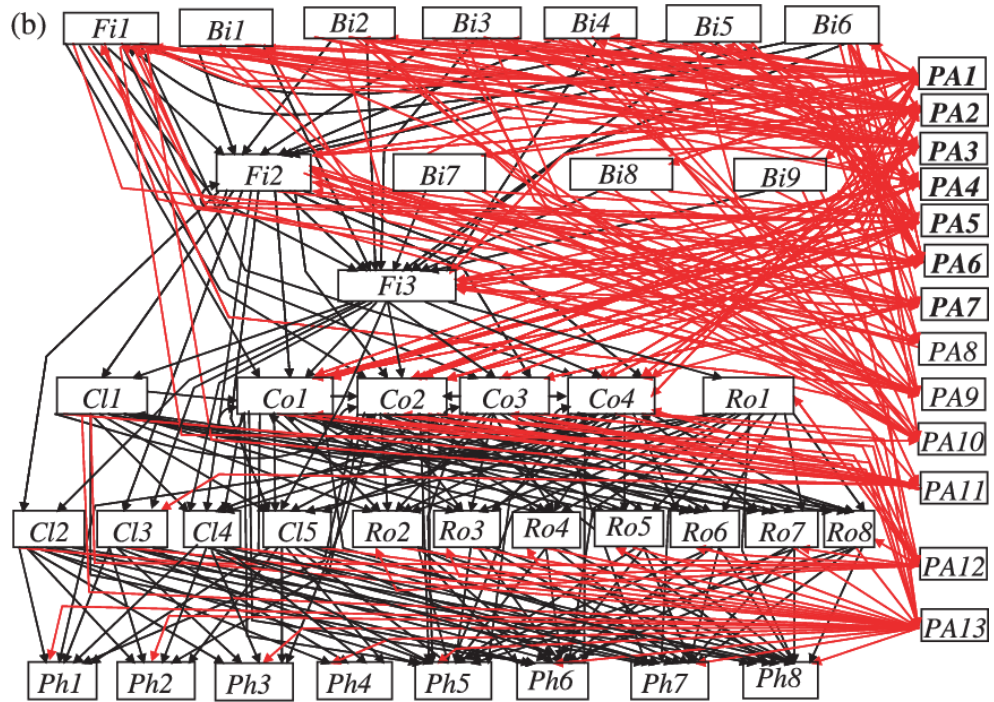
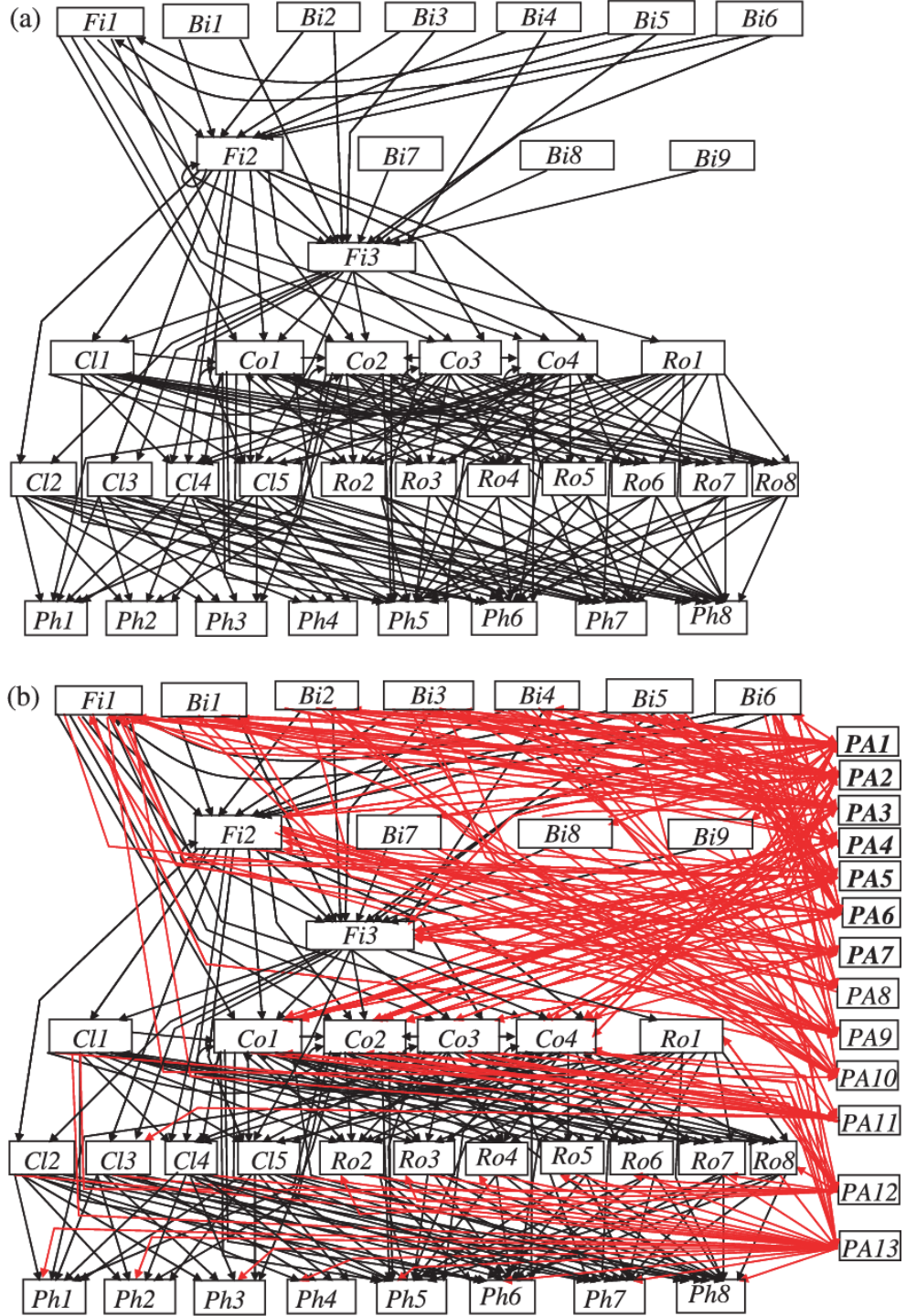
Parasitism


(a)
Fi1
Bi1
Bi2
Bi3
Bi4
Bi5
Bi6
Fi2
Bi7
Bi8
Bi9
Fi3
Cl1
Co1
Co2
Co3
Co4
Ro1
Cl2
Cl3
Cl4
Cl5
Ro2
Ro3
Ro4
Ro5
Ro6
Ro7
Ro8
Ph1
Ph2
Ph3
Ph4
Ph5
Ph6
Ph7
Ph8


(b)
Fi1
Bi1
Bi2
Bi3
Bi4
Bi5
Bi6
Fi2
Bi7
Bi8
Bi9
Fi3
Cl1
Co1
Co2
Co3
Co4
Ro1
Cl2
Cl3
Cl4
Cl5
Ro2
Ro3
Ro4
Ro5
Ro6
Ro7
Ro8
Ph1
Ph2
Ph3
Ph4
Ph5
Ph6
Ph7
Ph8
PA1
PA2
PA3
PA4
PA5
PA6
PA7
PA8
PA9
PA10
PA11
PA12
PA13



Pelagic food web of Lake Takvatn (a) without and (b) with parasite-related links included. From Amundsen et al. 2009

The ten principles of ecology

1. Evolution organizes ecological systems into hierarchies.
2. The sun is the ultimate source of energy for most ecosystems.
3. Organisms are chemical machines that run on energy.
4. Chemical nutrients cycle repeatedly while energy flows through an ecosystem.
5. dN/dt = B-X+I
6. dS/dt = D-X+I
7. Organisms interact – do things to each other - in ways that influence their abundance.
8. Ecosystems are organized into webs of interactions.
9. Human populations have an outsized role in competing with, preying upon, and helping other organisms.
10. Ecosystems provide essential services to human populations.

We're moving into the realm of community ecology (multiple species interactions)

Community: what factors influence the number of species in an area?

- A community is…

Individuals

Population

Interaction

Community

Ecosystem

Landscape

Region

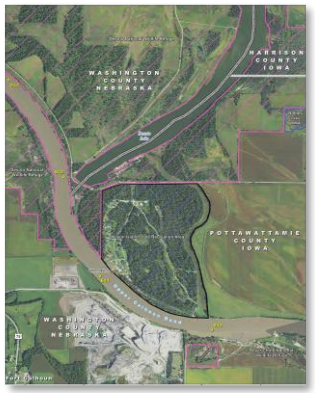
Biosphere













Modified from Molles 2005

We're moving into the realm of community ecology (multiple species interactions)

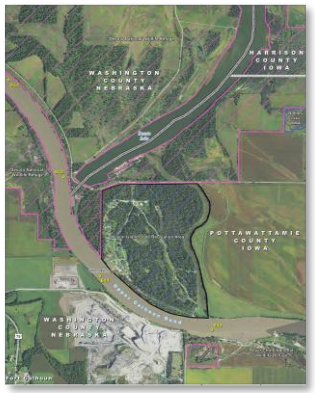
Community: what factors influence the number of species in an area?

- A community is the assemblage of many populations that live in the same place at the same time

Individuals | Population | Interaction | Community | Ecosystem | Landscape | Region | Biosphere








Modified from Molles 2005

Topics for today

1) How does parasitism differ from predation, and how common is parasitism in nature?

2) Examples of parasitism

3) How is parasitism altered by global change?

Interspecific interactions: Parasitism

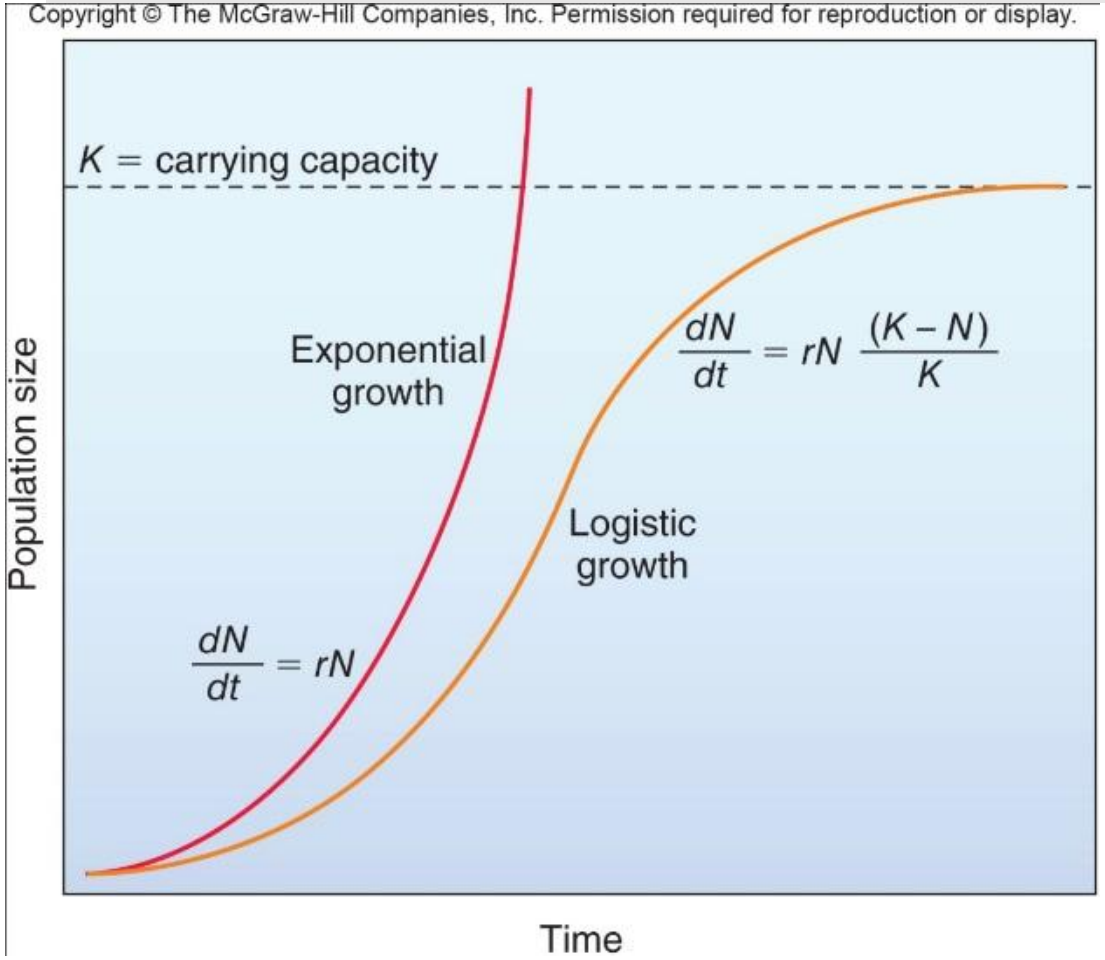




In **parasitism** (+/– interaction), one organism, the **parasite**, derives nourishment from another organism, its **host**, which is harmed in the process

All pathogens fall into this category

Interspecific interactions: Parasitism



Parasitism is one of the things that can prevent populations from reaching incredibly large population sizes

How does parasitism differ from predation?

Parasitism: the parasite exploits the host, which is affected adversely

Predation: the predator kills and consumes the host

Predation leads to immediate mortality whereas parasitism may not lead to mortality or will at least take some time for mortality to occur

How does parasitism differ from predation?

Table 1. Variations in life history traits along a parasite-predator continuum reflecting an increase in body-size, population growth rate, and host-fatality from microparasite through predator.

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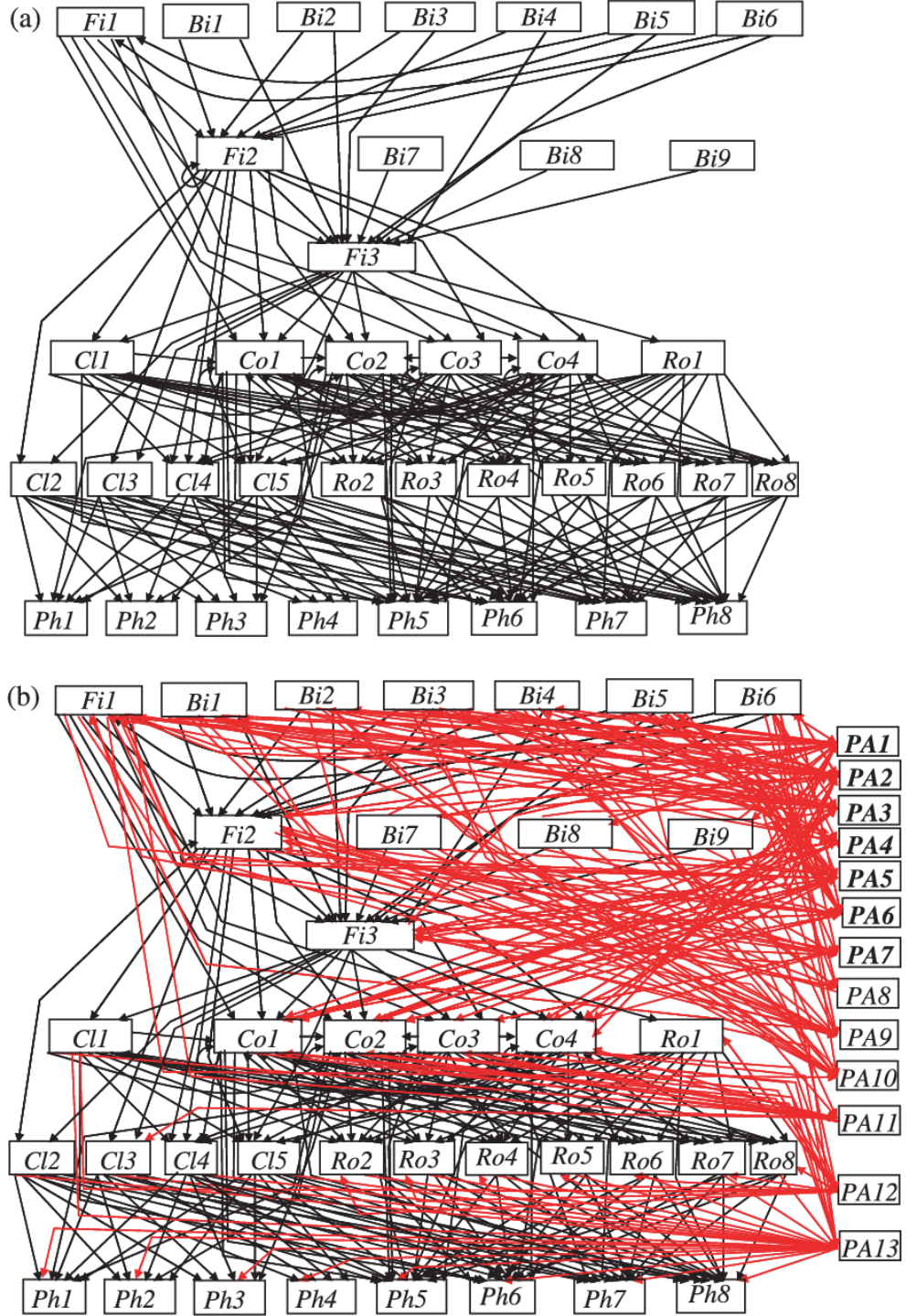
Microparasite examples are bacteria and viruses; macroparasite examples are multicellular eukaryotes; parasitoid examples are often larva developing inside hosts

How common is parasitism in nature?

Parasitism is VERY common (remember, this includes pathogens)

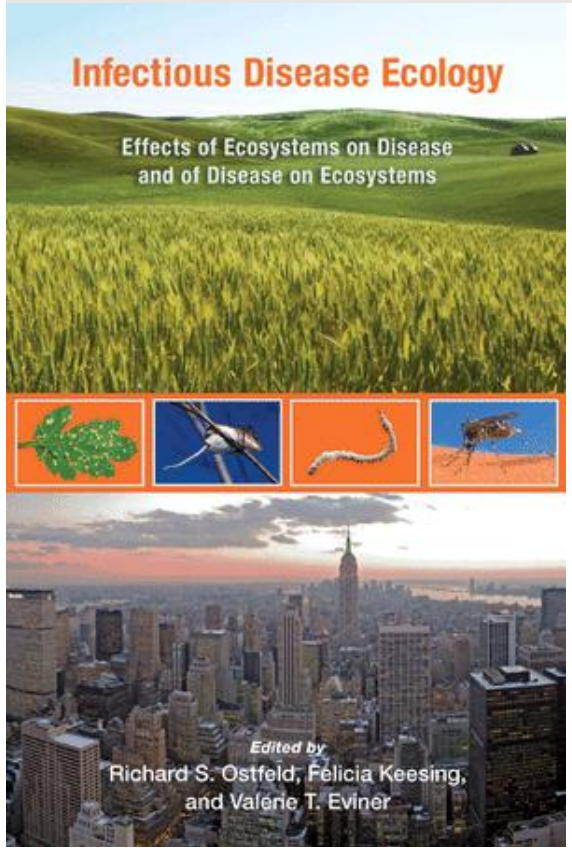
Almost every organism contains some parasites and most species are parasitized by many different species

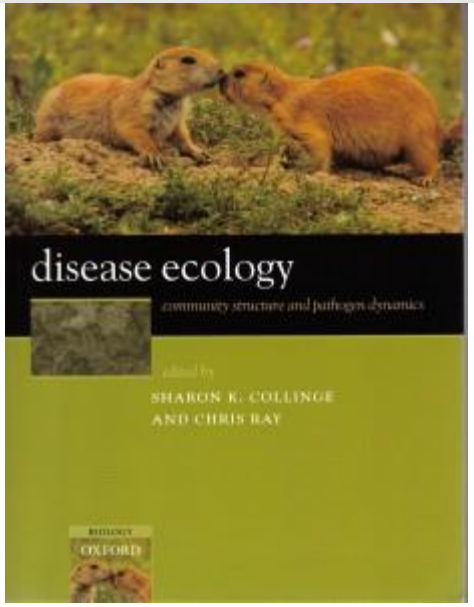
Often overlooked because of modern medicine and animal husbandry practices – but parasitism does take a toll on humans and agriculture.



Pelagic food web of Lake Takvatn (a) without and (b) with parasite-related links included. From Amundsen et al. 2009

How common is parasitism in nature?





Disease ecology is a large and growing subfield within ecology

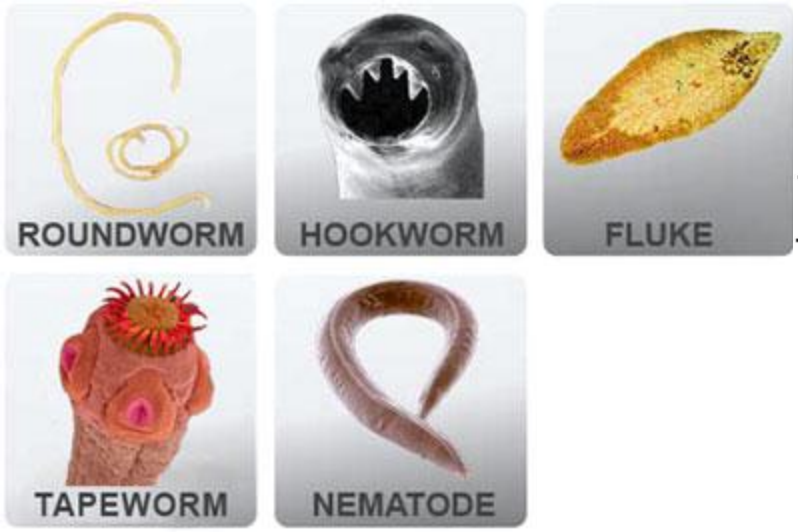
Disease Ecology

By: A. Marm Kilpatrick (*Ecology & Evolutionary Biology, University of California at Santa Cruz*) & Sonia Altizer (*Odum School of Ecology, University of Georgia*) © 2012 Nature Education

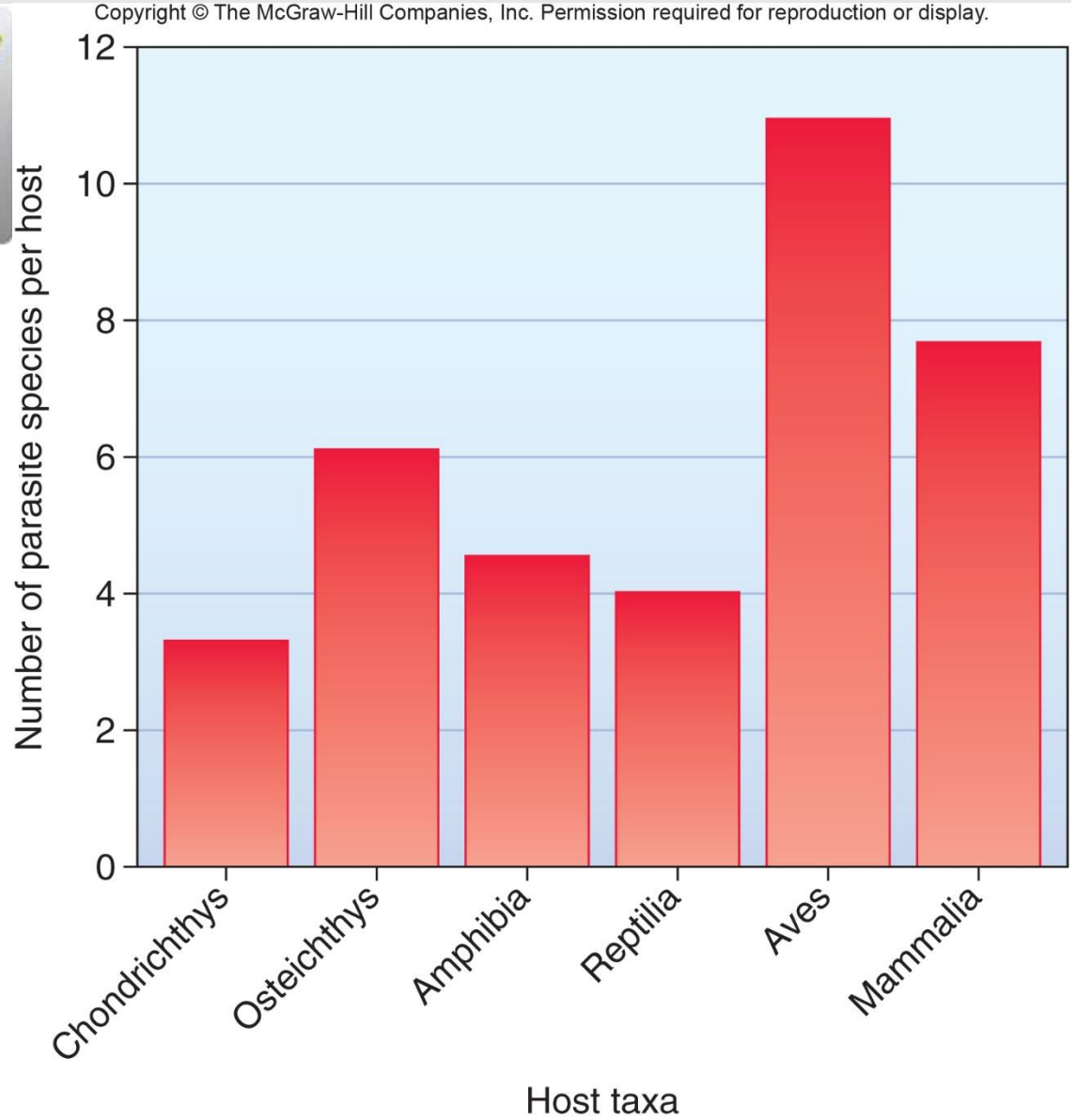
Citation: Kilpatrick, A. M. & Altizer, S. (2012) Disease Ecology. *Nature Education Knowledge* 3(10):55

How do climate, evolution, and free-living hosts interact to determine the dynamics of pathogens and the burden of disease?

How common is parasitism in nature?



Graph to right shows number of helminth parasite species per vertebrate host, on average



Topics for today

1) How does parasitism differ from predation, and how common is parasitism in nature?

2) **Examples of parasitism**

3) How is parasitism altered by global change?

Table 1. Variations in life history traits along a parasite-predator continuum reflecting an increase in body-size, population growth rate, and host-fatality from microparasite through predator.

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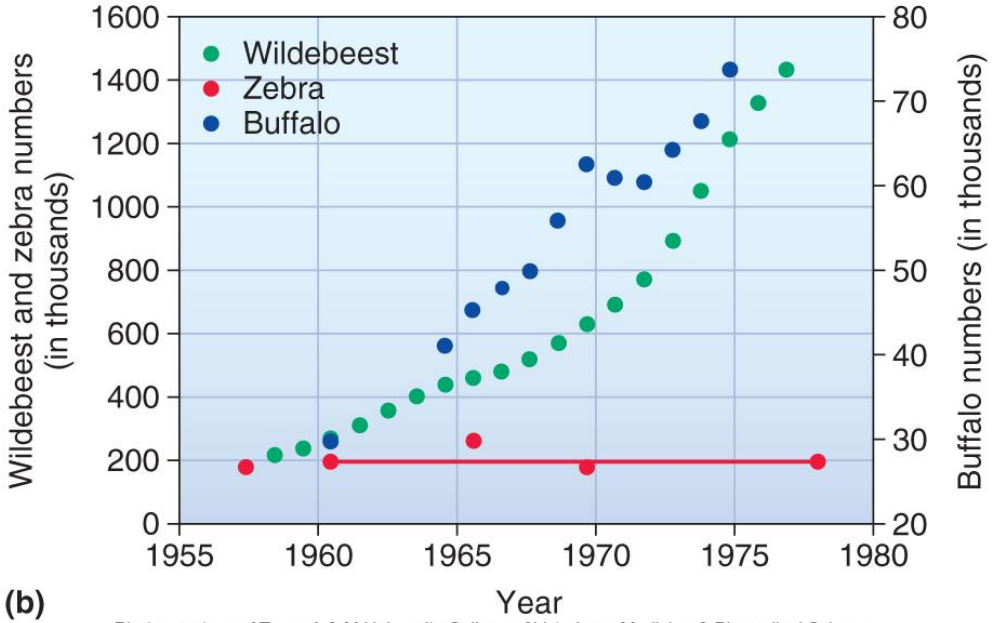
Microparasites

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(a)

Fig. 15.13



(b)

Photo courtesy of Texas A & M University College of Veterinary Medicine & Biomedical Sciences

Rinderpest is a virus that caused about 80% mortality to cattle across Africa in late 1800's

This virus spread from cattle to buffalo, wildebeest, giraffe, warthog, and other grazers

Cattle were vaccinated and buffalo and wildebeest populations rebounded (zebra was not affected by Rinderpest)

Microparasites



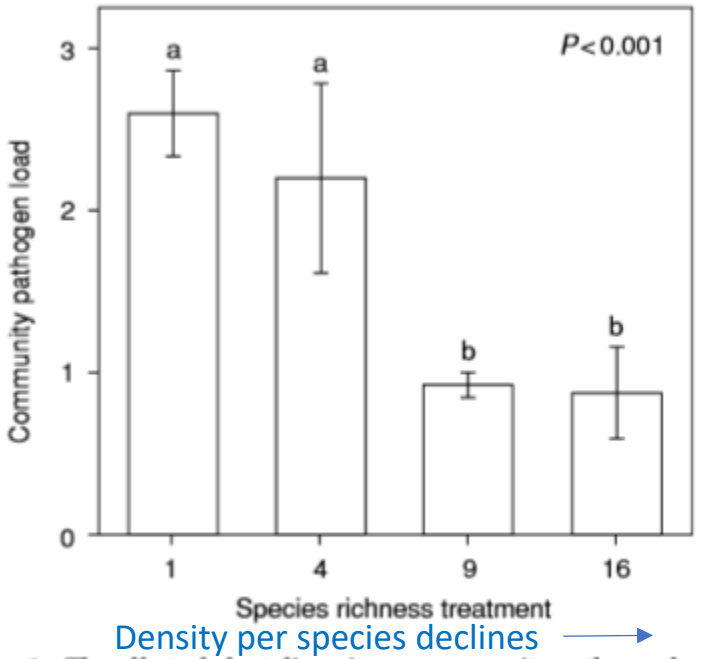


Fig. 1 The effect of plant diversity on community pathogen load (the percent of leaf area infected across the plant community). Data shown are means ± SEM. Different letters indicate significant pairwise differences.

Plants are also attacked by viruses and bacteria, but fungal infections can be especially common

Insect fungi

These infections are less common as the density of an individual species declines (e.g., at higher plant diversity)

(Mitchell et al., 2003)

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Macroparasites: ectoparasites





This includes **ectoparasites** like ticks, leeches, and fleas (not shown)

Ectoparasites often have more potential hosts (less specialized) than macroparasites that live inside the host

https://www.youtube.com/watch?v=CrrSAc-vjG4

Dodder, start at 8:08 end at 11:30

Macroparasites: ectoparasites

Ectoparasites, like ticks, may also spread diseases to their hosts





www.caryinstitute.org/discover-ecology/videos-audios/tick-borne-disease-ecology



1-year lag

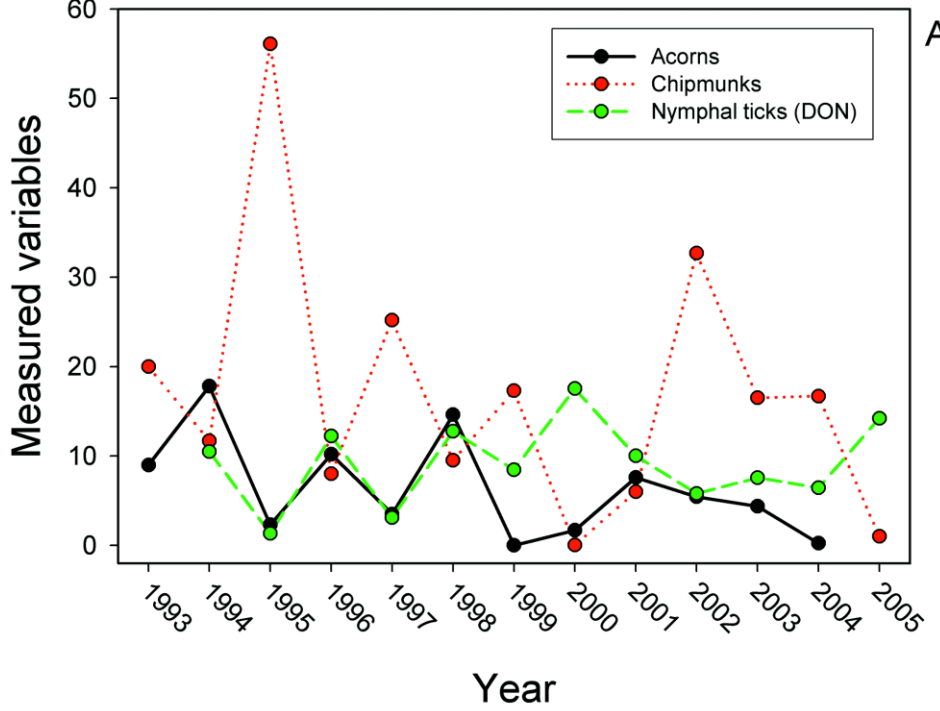


2-year lag

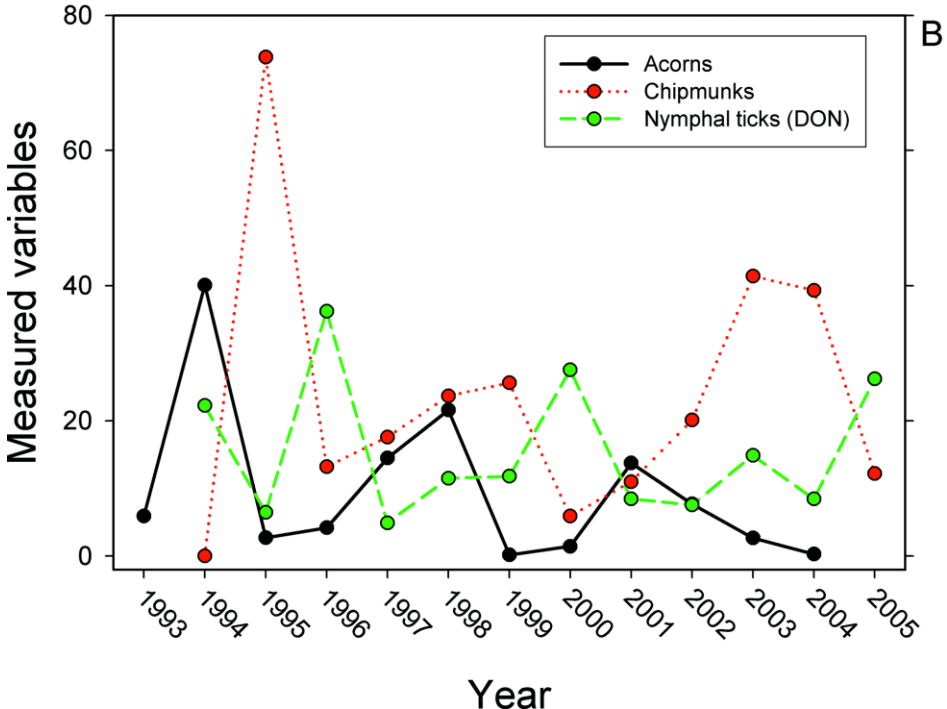
1-year lag



Ostfeld et al. 2006

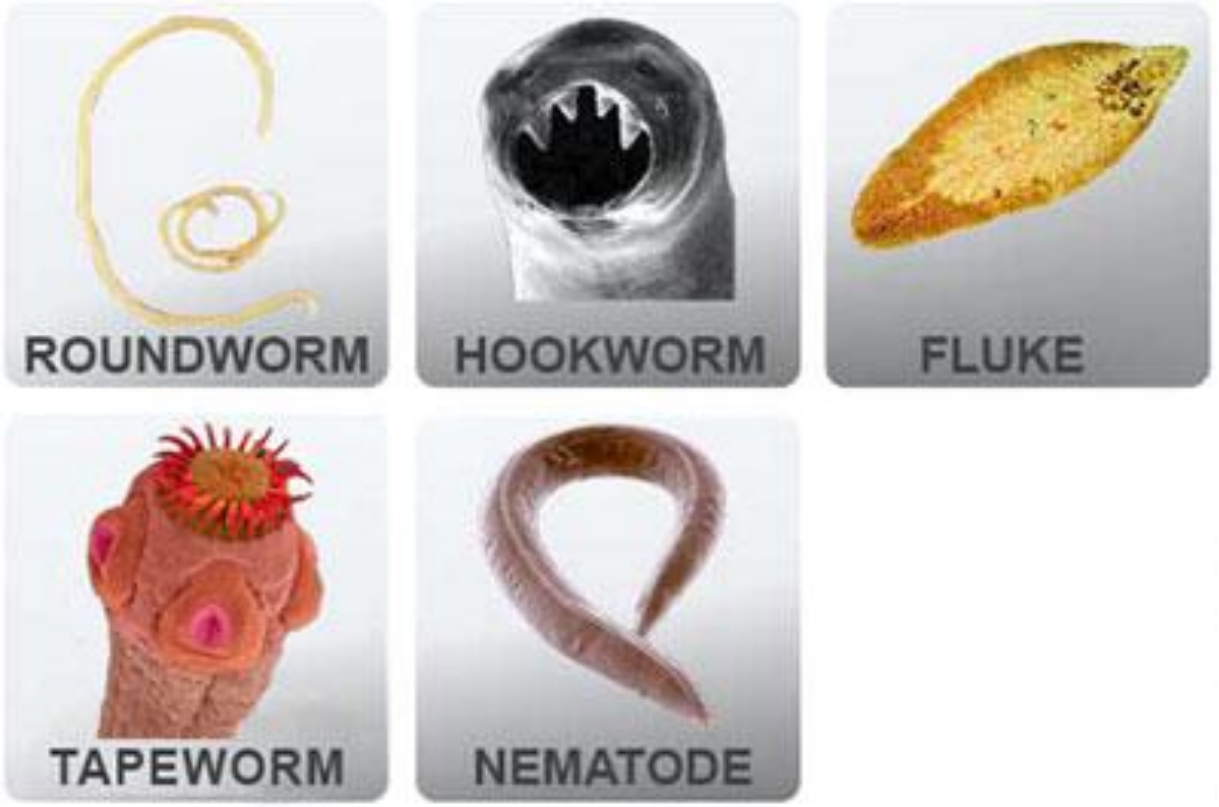


Henry Farm plot



Teahouse plot

Macroparasites: endoparasites



Macroparasites that live inside the host are **endoparasites**

Endoparasites generally specialize on one or a few host species and they often have intermediate hosts

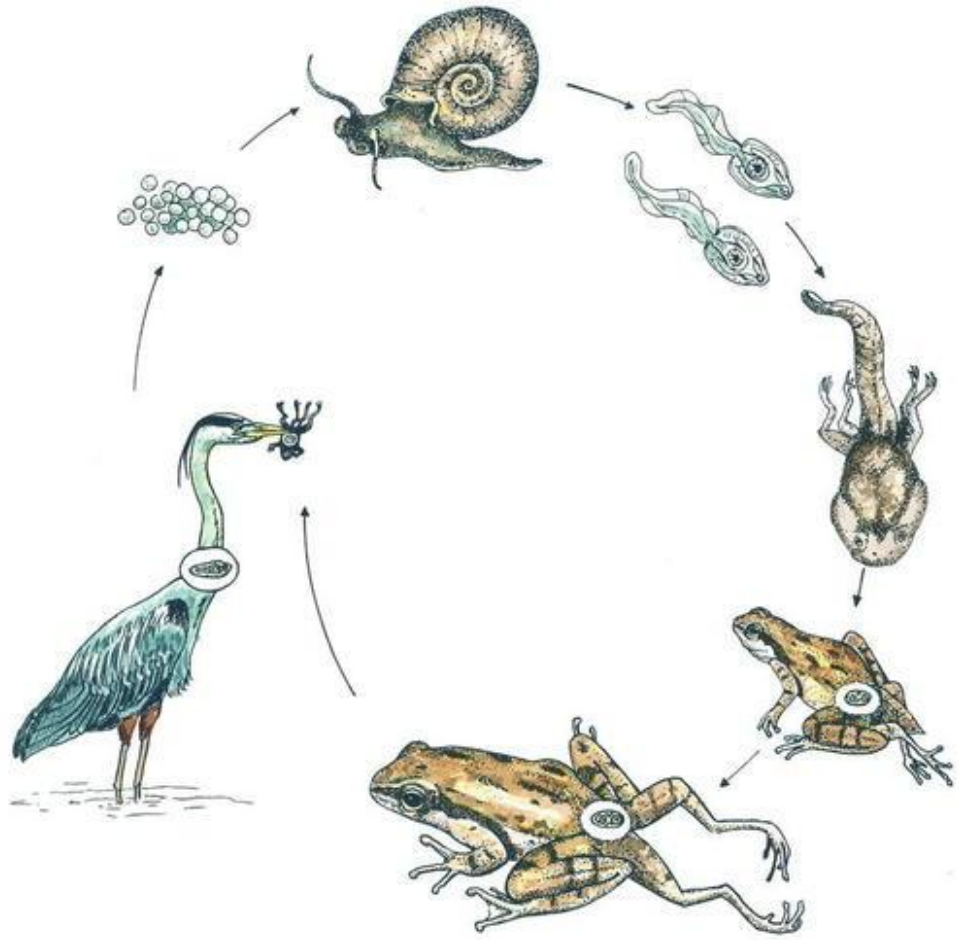
Mystery of limb malformations in frogs



Goodman and Johnson 2003

Macroparasites: endoparasites

Macroparasites that live inside the host are **endoparasites – many have complex life cycles with multiple hosts**

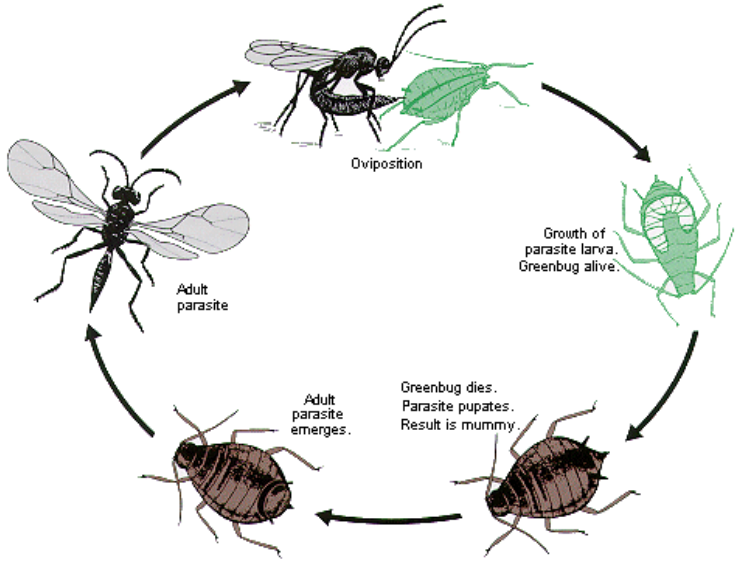


Blaustein and Johnson, 2003

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Parasitoid



The life cycle of an aphid parasite. *Lysiphlebus testaceipes*.



[Aphid wasp]





The wasps (of the genus *Glyptapanteles*) control their caterpillar prey. Wasp larvae are deposited in the caterpillar which continues to grow and feed normally until the 4th or 5th instar, whereupon up to 80 fully grown larvae emerge from its body to pupate. Just before the wasp larvae emerge from the caterpillar, though, they produce a toxin that causes the caterpillar to act as a bodyguard until the larvae pupate. The caterpillar takes up position near the cocoons of the pupae, arches its back, and ceases to move or feed. It will occasionally spin silk over the pupae and, when disturbed, it will thrash violently.

Researchers are still not sure how the caterpillar is engaged in this final duty. "It's a behavior that's induced by a parasite that is not even *in* the host anymore," says Edward Levri, an associate professor of biology at The Pennsylvania State University.

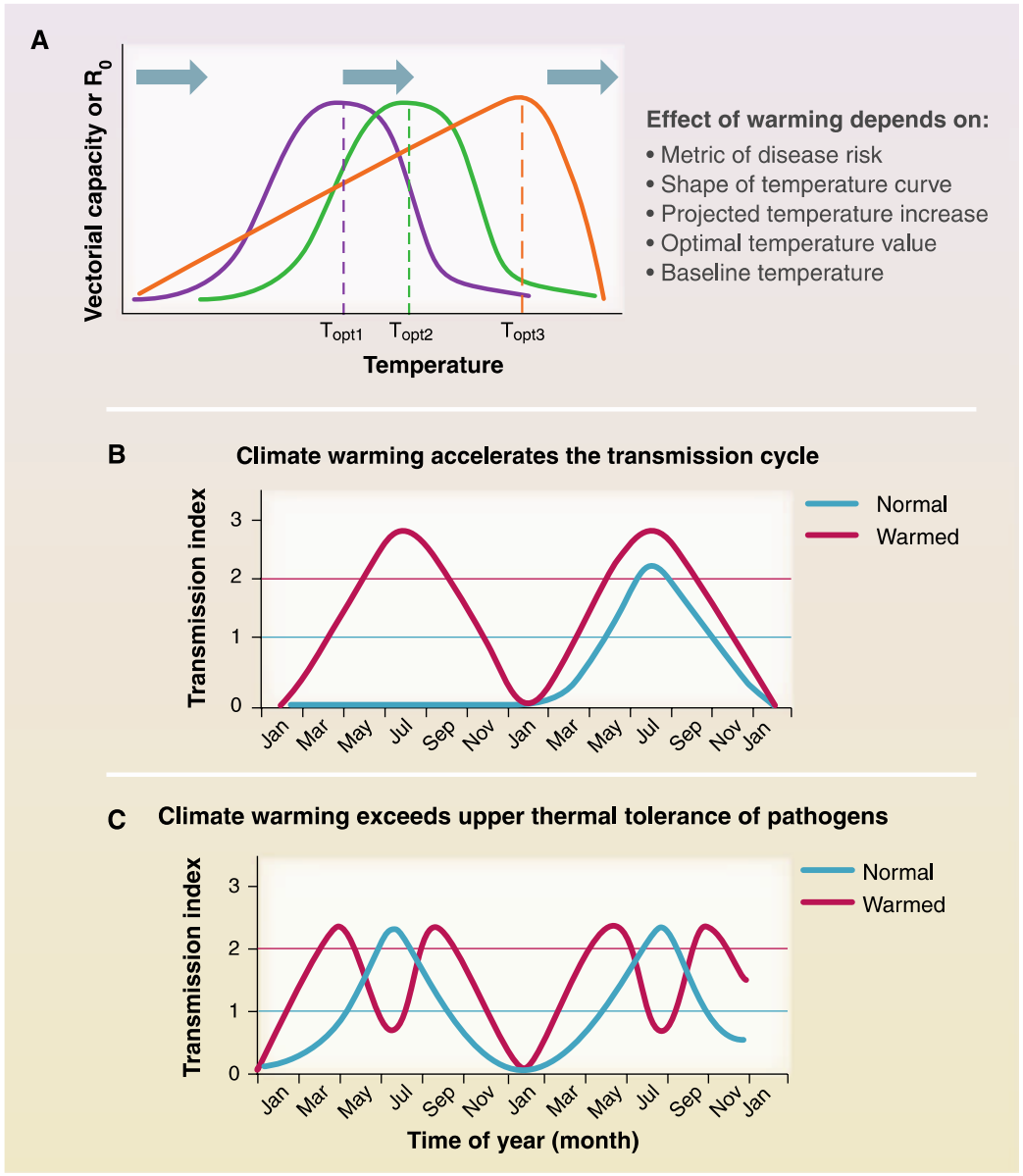
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1) How does parasitism differ from predation, and how common is parasitism in nature?

2) Examples of parasitism

3) **How is parasitism altered by global change?**

Predicted pathogen responses to climate change



(Altizer et al. 2013)

Many parasites do better under warmer temperatures

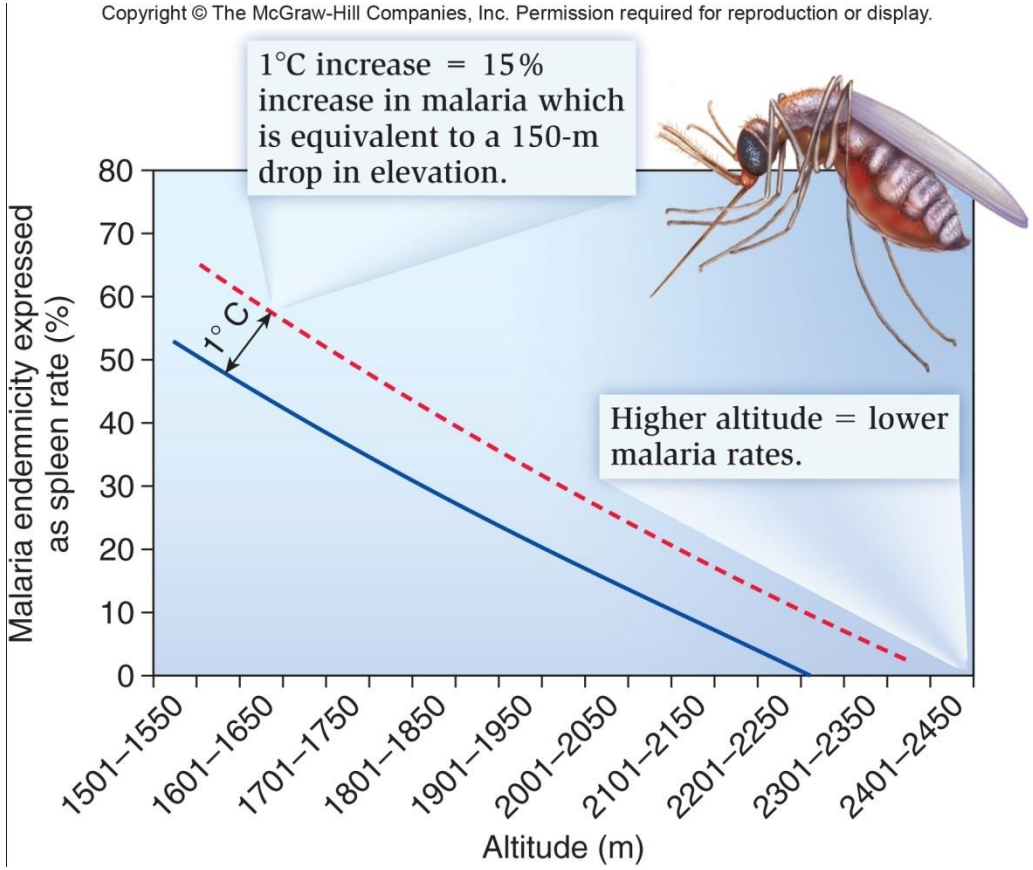


Figure 15.15 Relationship between malaria endemicity, expressed as percentage enlargement rates in the spleen, and elevation in Ethiopia.

(Pascual and Bourma, 2009)

Many parasites do better under warmer temperatures

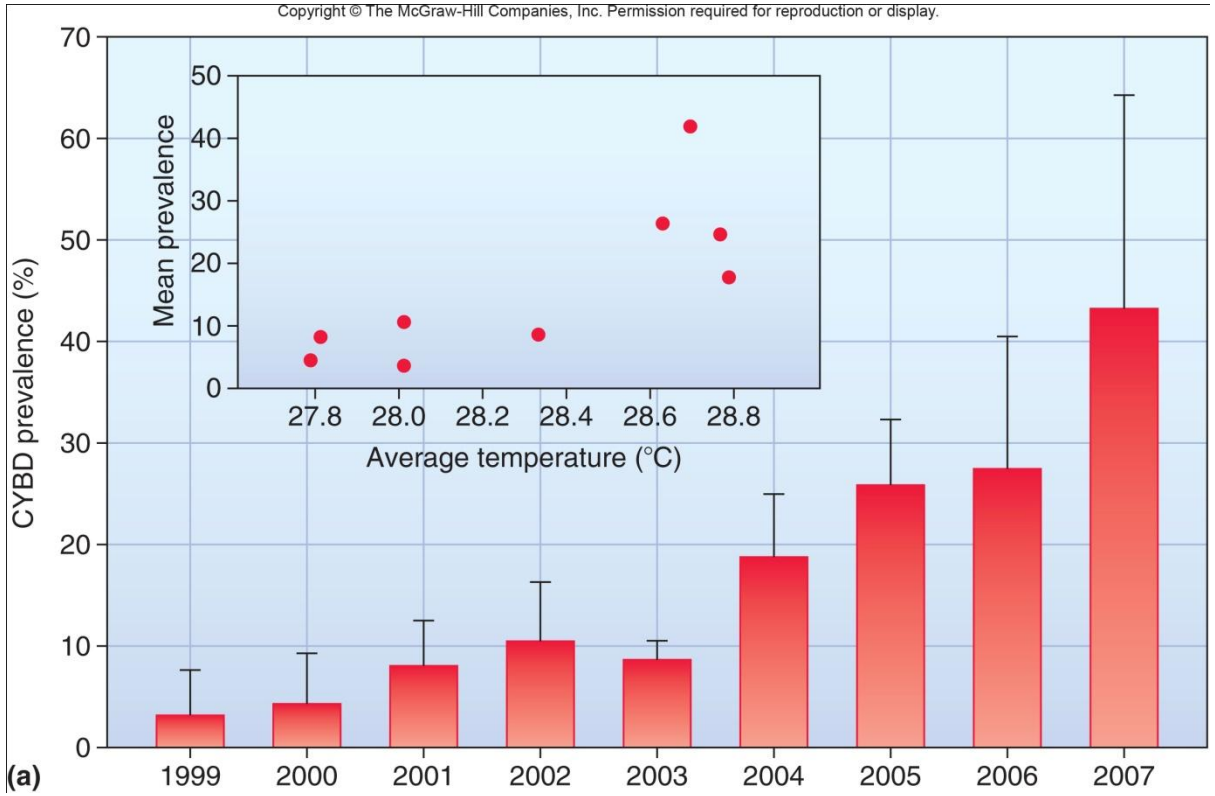


Figure 15.16 Increase in the prevalence of Caribbean yellow banding disease, CYBD, in Montrastraea coral off the southwest coast of Puerto Rico at La Parguera, 1999-2007.

The inset shows the relationship between increased average water temperature and mean prevalence of the disease. (Harvell, et al., 2009)

Increased nutrient availability can also increase pathogen abundance

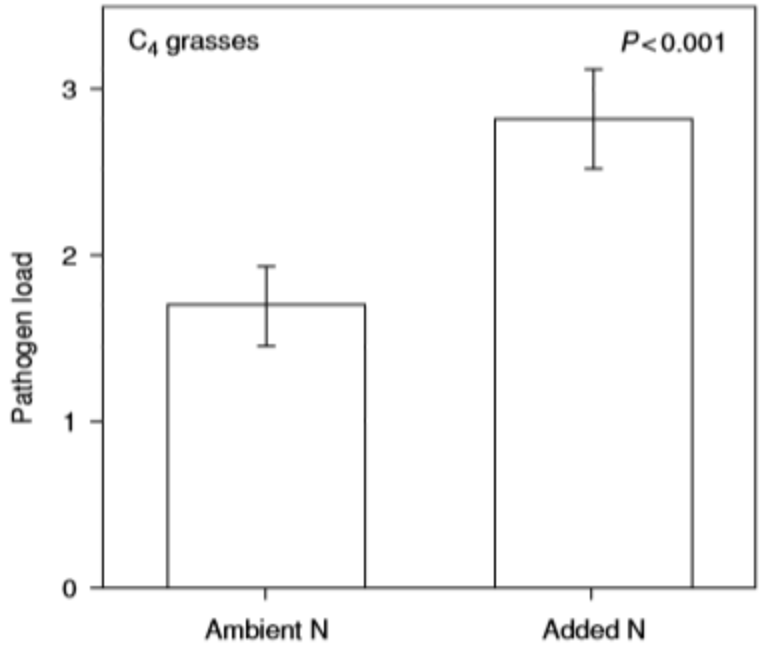


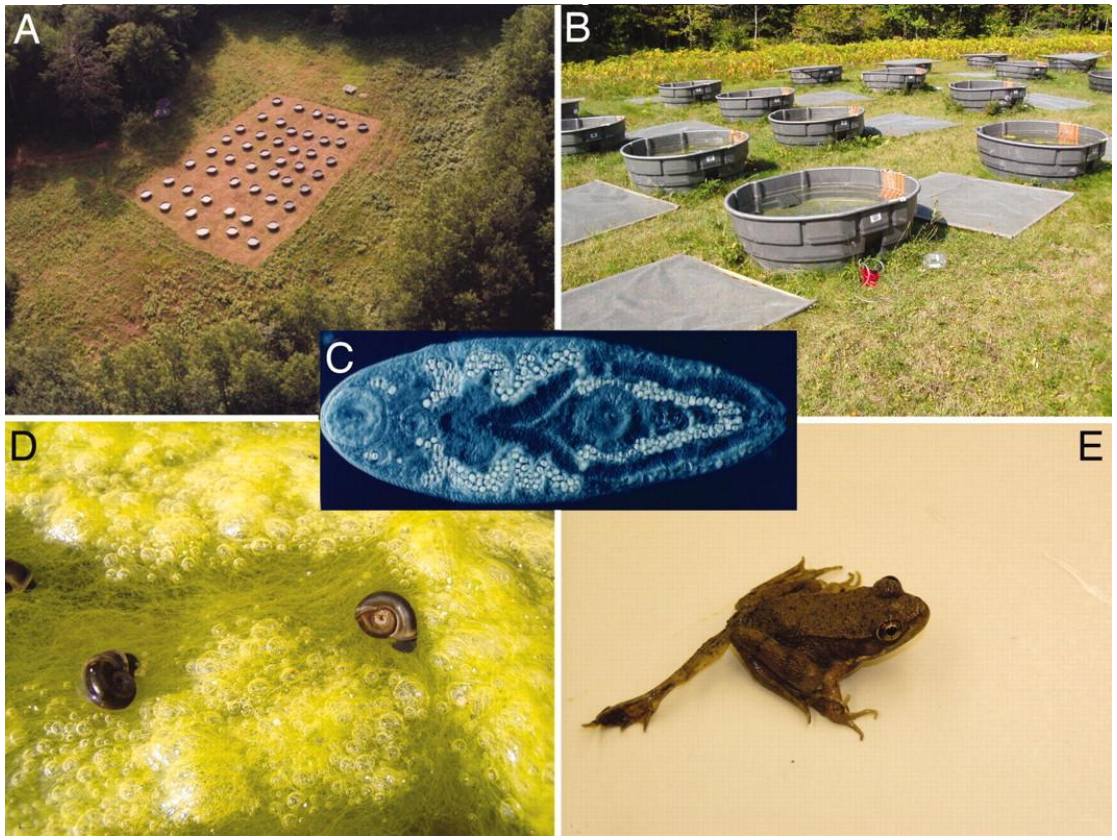
Fig. 5 The effect of nitrogen addition on C_4 grass pathogen load. Data shown are means ± SEM.

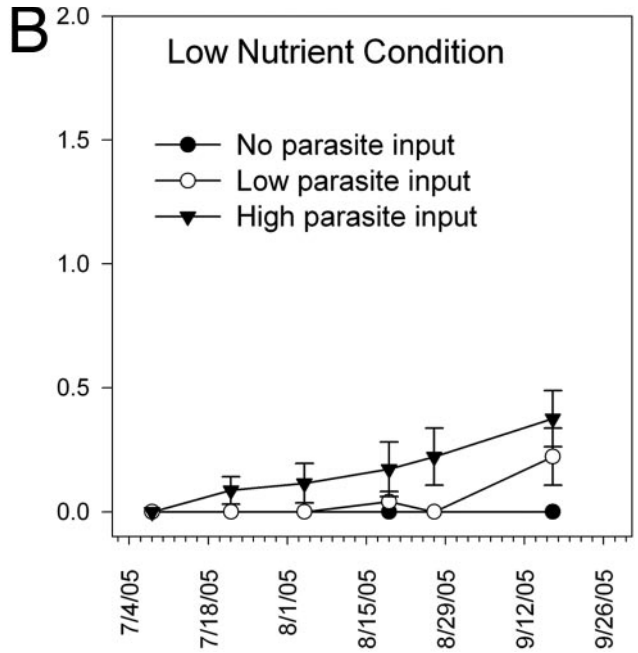
In this example, increased nitrogen increases plant pathogen abundance. Increased nutrients can also increase pathogen abundance in the ocean and freshwater.

(Mitchell et al., 2003)

Increased nutrient availability can also increase pathogen abundance and infection

Eutrophication of aquatic environments affected amphibian infections by *Ribeiroia* trematodes





(Johnson et al., 2007)

Review

1. Name two ways that predators differ from parasites.
2. Amensalism involves a (+/-/0) and a (+/-/0) interaction between two organisms.
3. How would you expect parasite population growth to be affected by host population growth?
4. How could you apply the red-queen hypothesis to host-parasite interactions?