Introduction to Fish Ecology

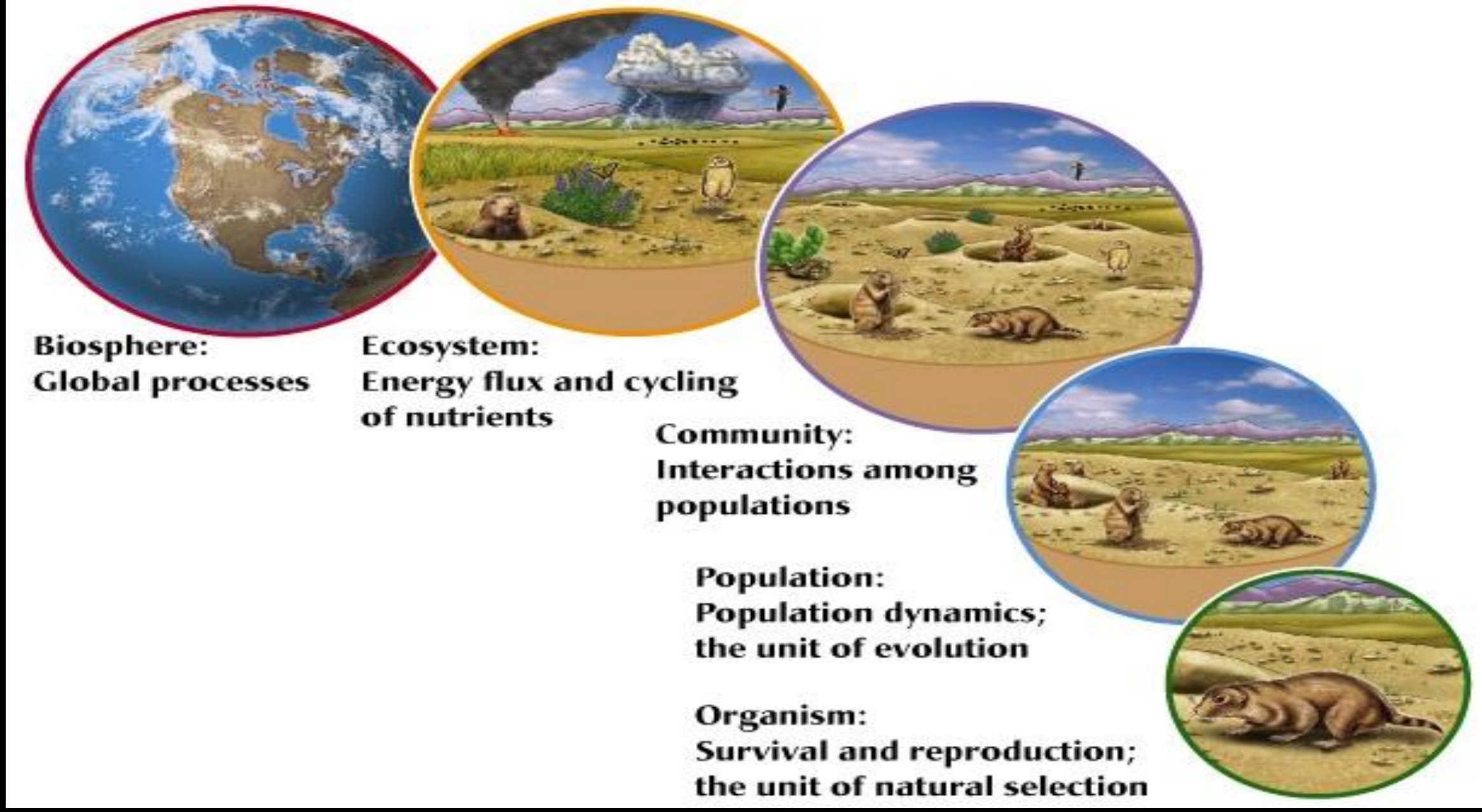
FT S273 Fundamentals of Fisheries Biology – spring 2014

Objectives for today

- Be able to define fundamental niche and realized niche
- Be able to diagram a trophic pyramid and describe the implications of moving up the pyramid
- Be able to describe how competition can impact fish populations
- List and describe the different types of Symbiosis
- Describe the role of pathogens in marine communities
- Describe the basic characteristics that separate marine invertebrate groups

Ecological Filters

Potential Fish Species
Landscape Events
Zoogeographic Barriers
Physiological Factors
Biological Interactions
Potential Community
Natural Disturbance
Natural Community
Human Disturbance
Actual Community



http://science.kennesaw.edu/~jdirnber/ecology/Lecture/LecIntro/LecIntroA.html

Niche

In ecology, a niche is a term describing the relational position of a species or population in an ecosystem.

http://answers.mheducation.com/sciences/life-science/biology/community-interactions

Niche

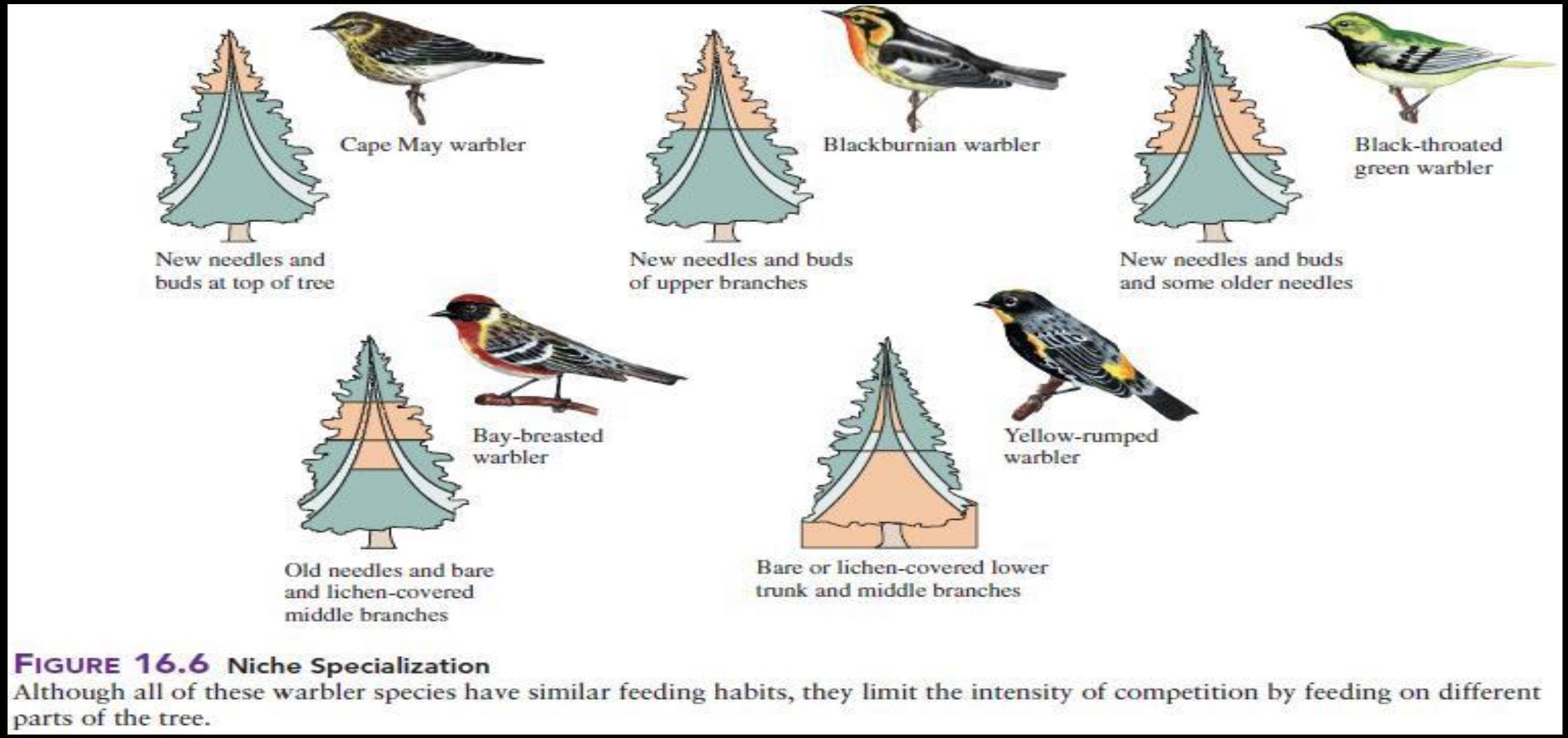
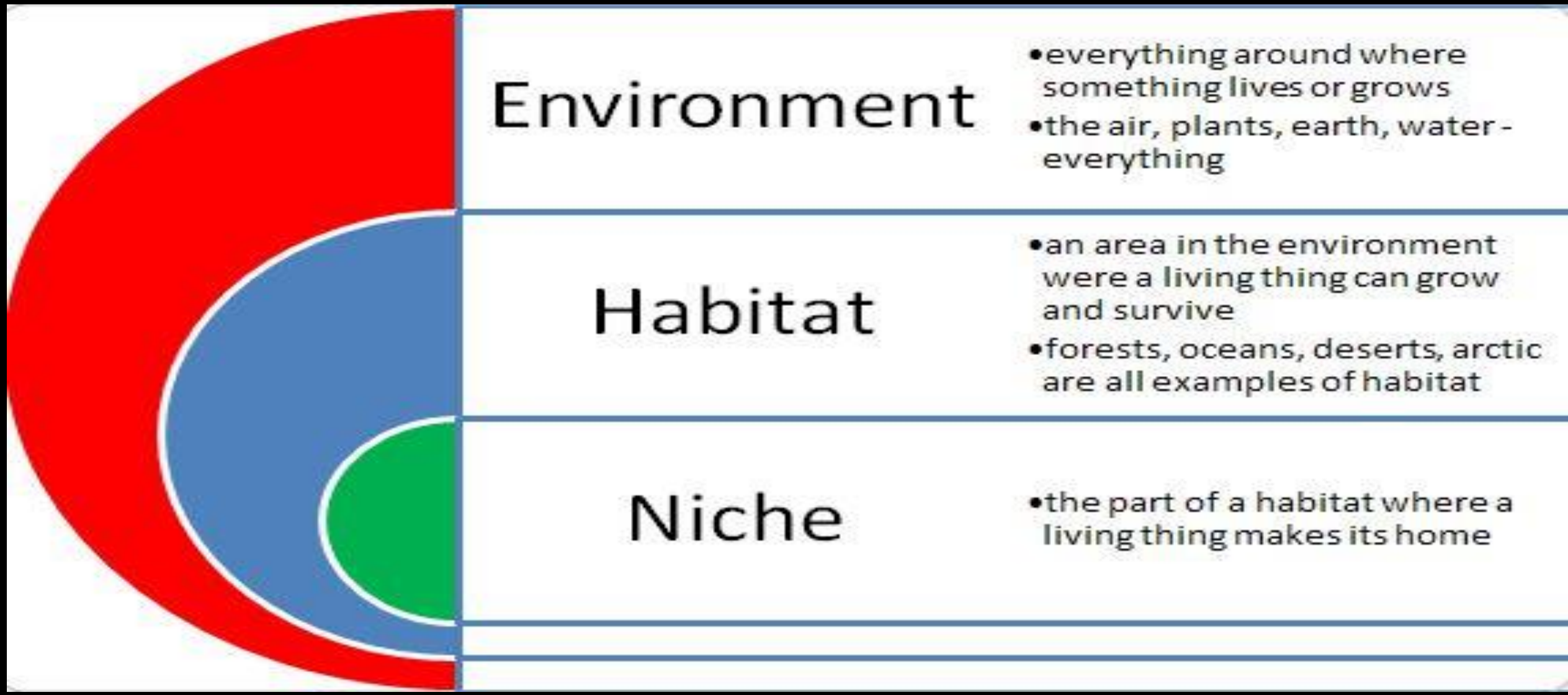
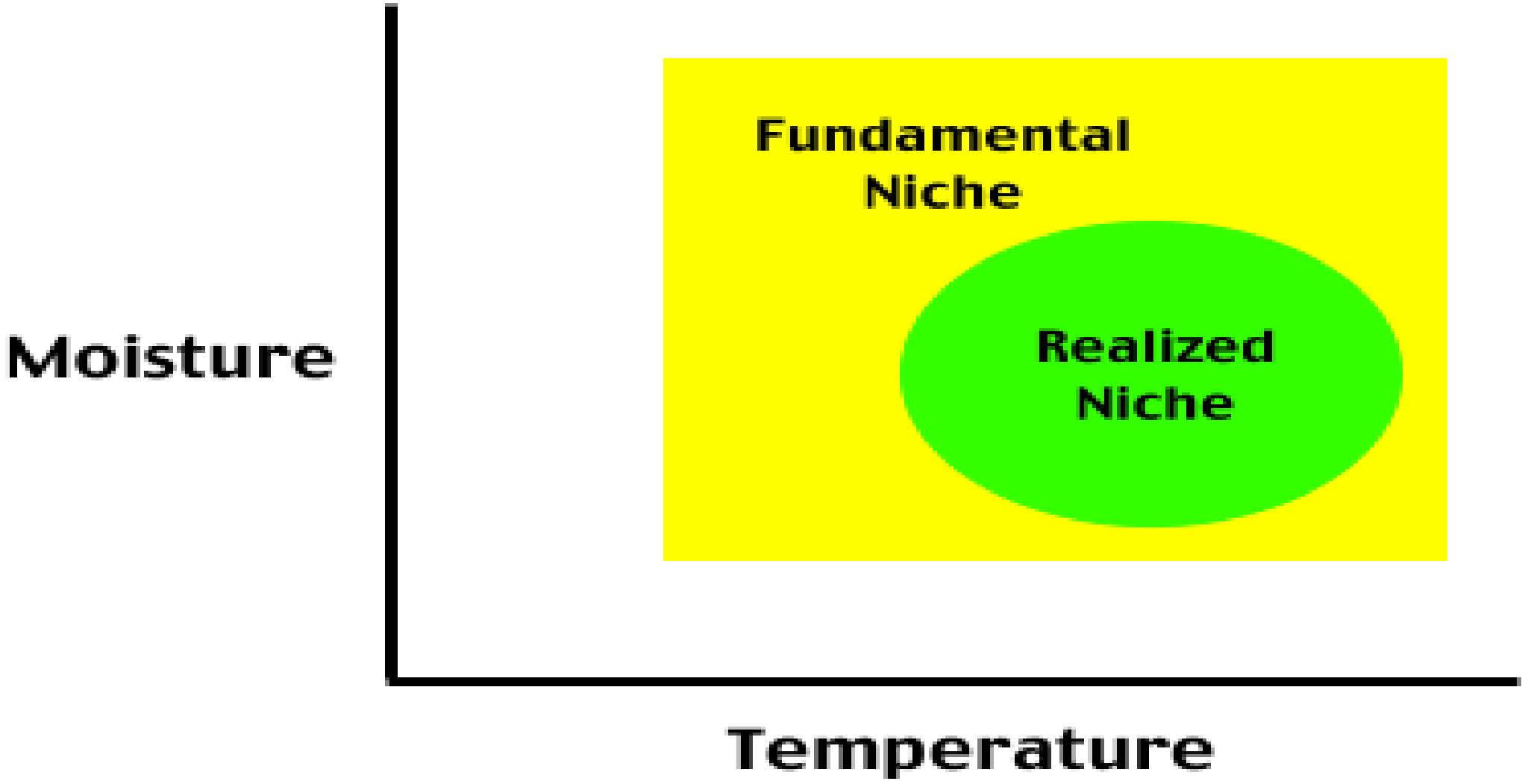


FIGURE 16.6 Niche Specialization
Although all of these warbler species have similar feeding habits, they limit the intensity of competition by feeding on different parts of the tree.

http://answers.mheducation.com/sciences/life-science/biology/community-interactions

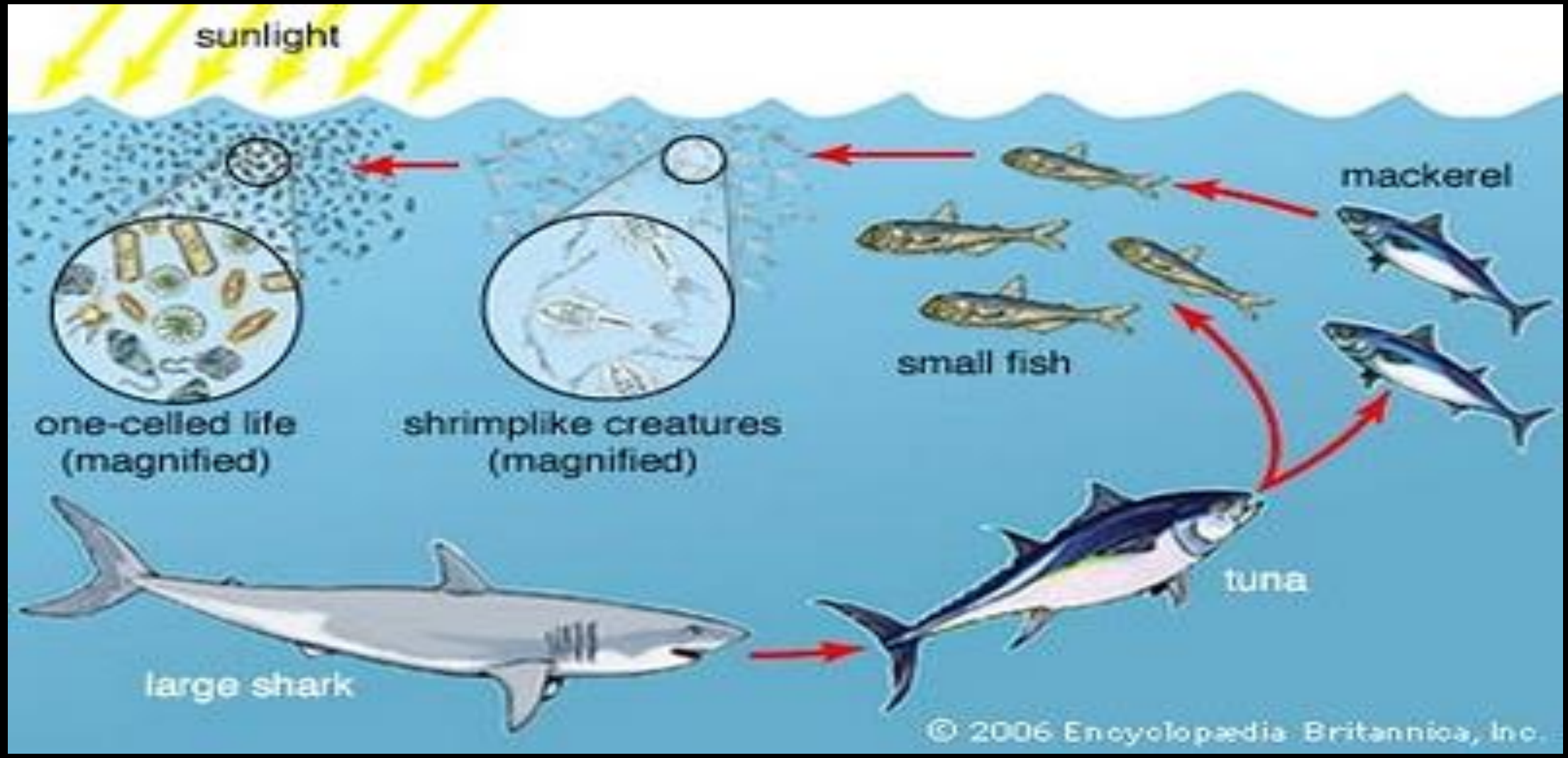


http://mspalmersclassroom.weebly.com/uploads/7/0/2/3/7023575/intro_to_habitat.jpg



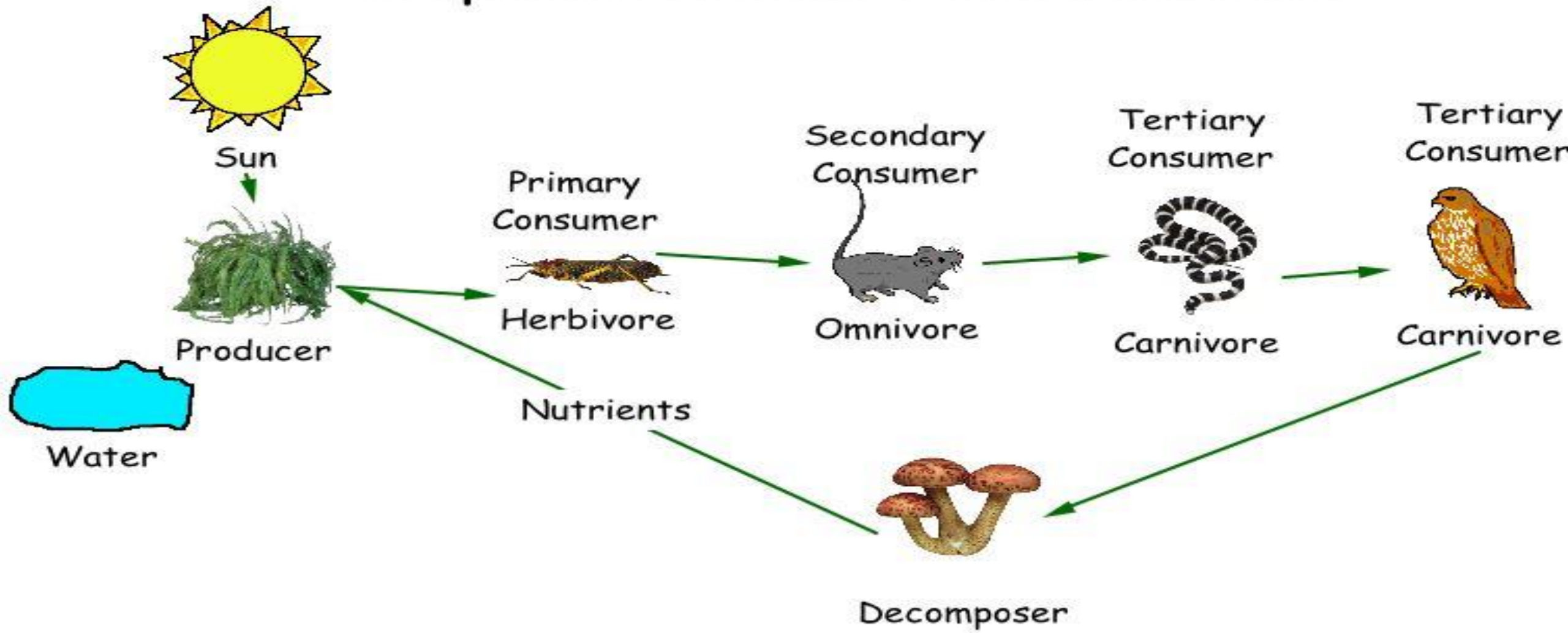
http://www.x-arc.org/bitsy-komodo-dragons-niche/

Food Webs

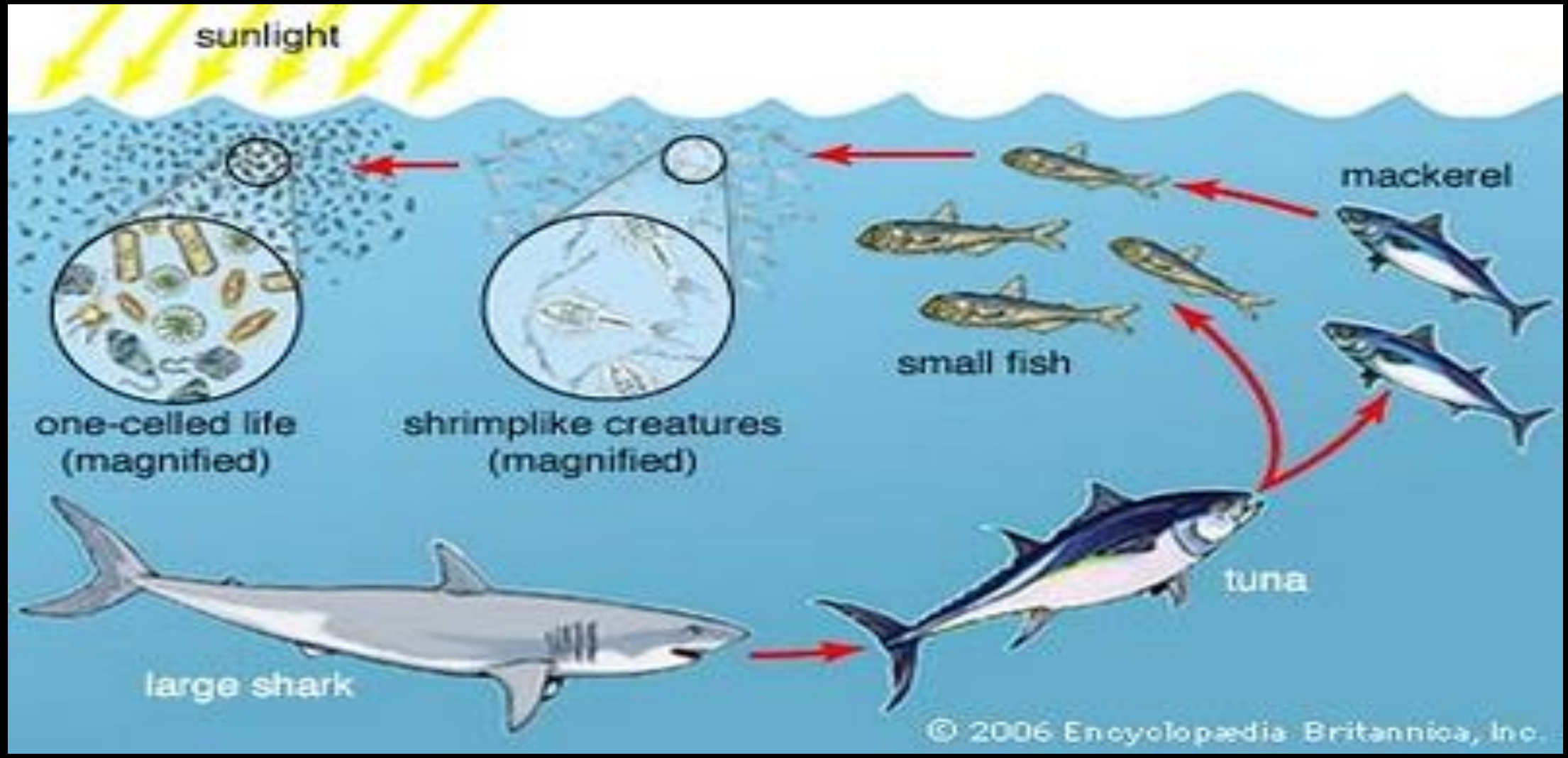


http://albertan1956.blogspot.com/2010/12/how-many-sharks-are-killed.html

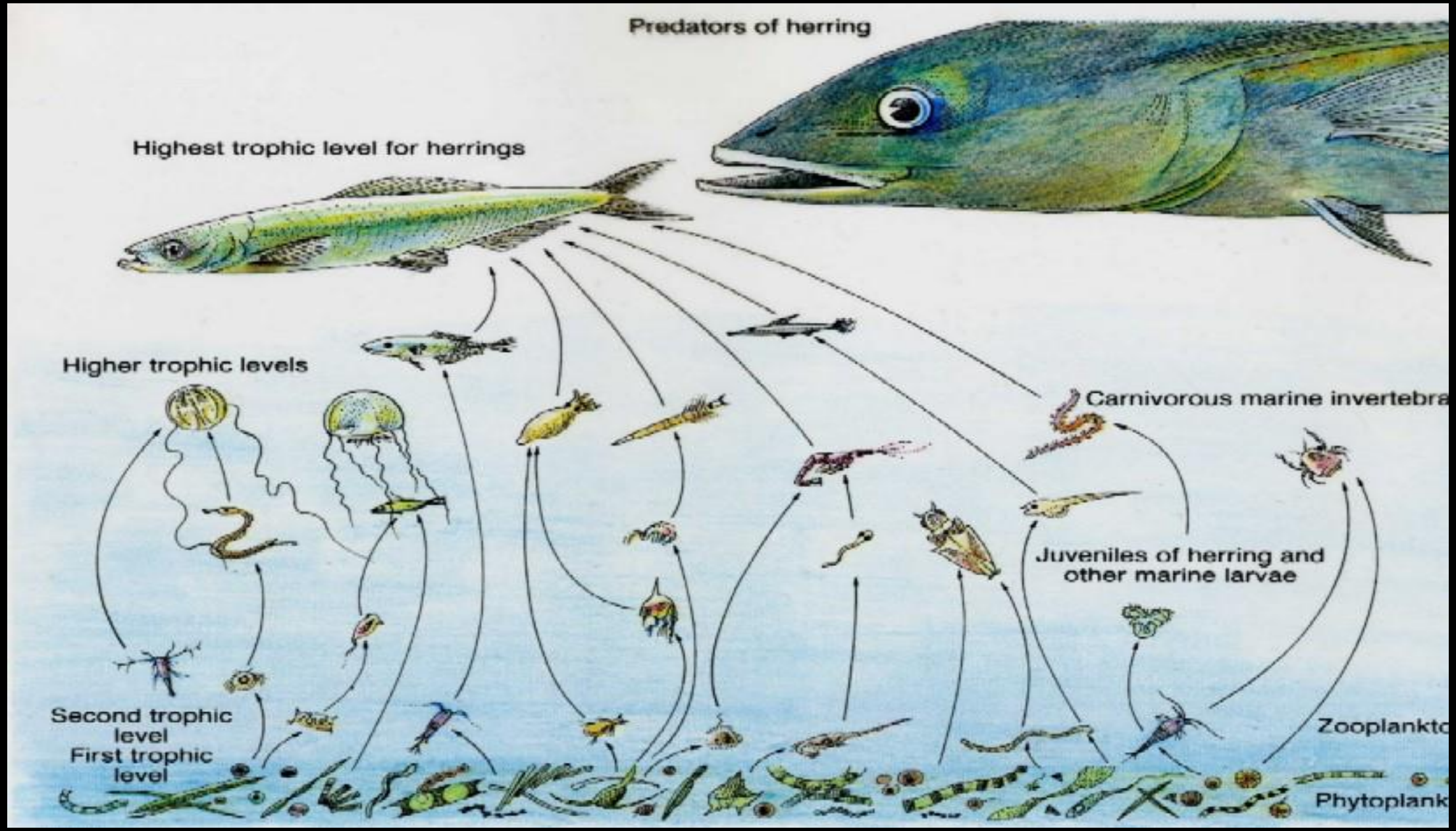
Temperate Deciduous Forest Food Chain



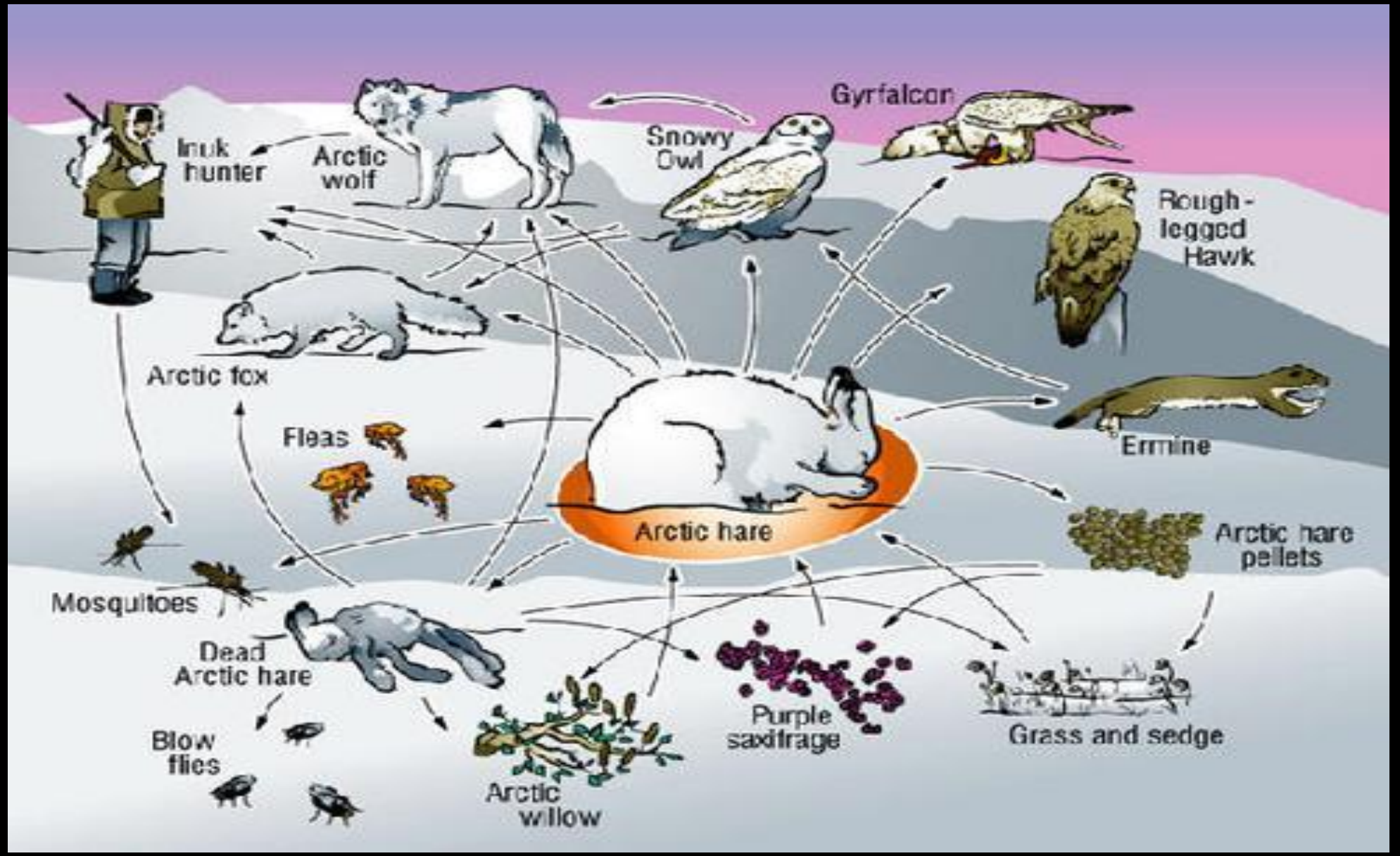
Food Webs



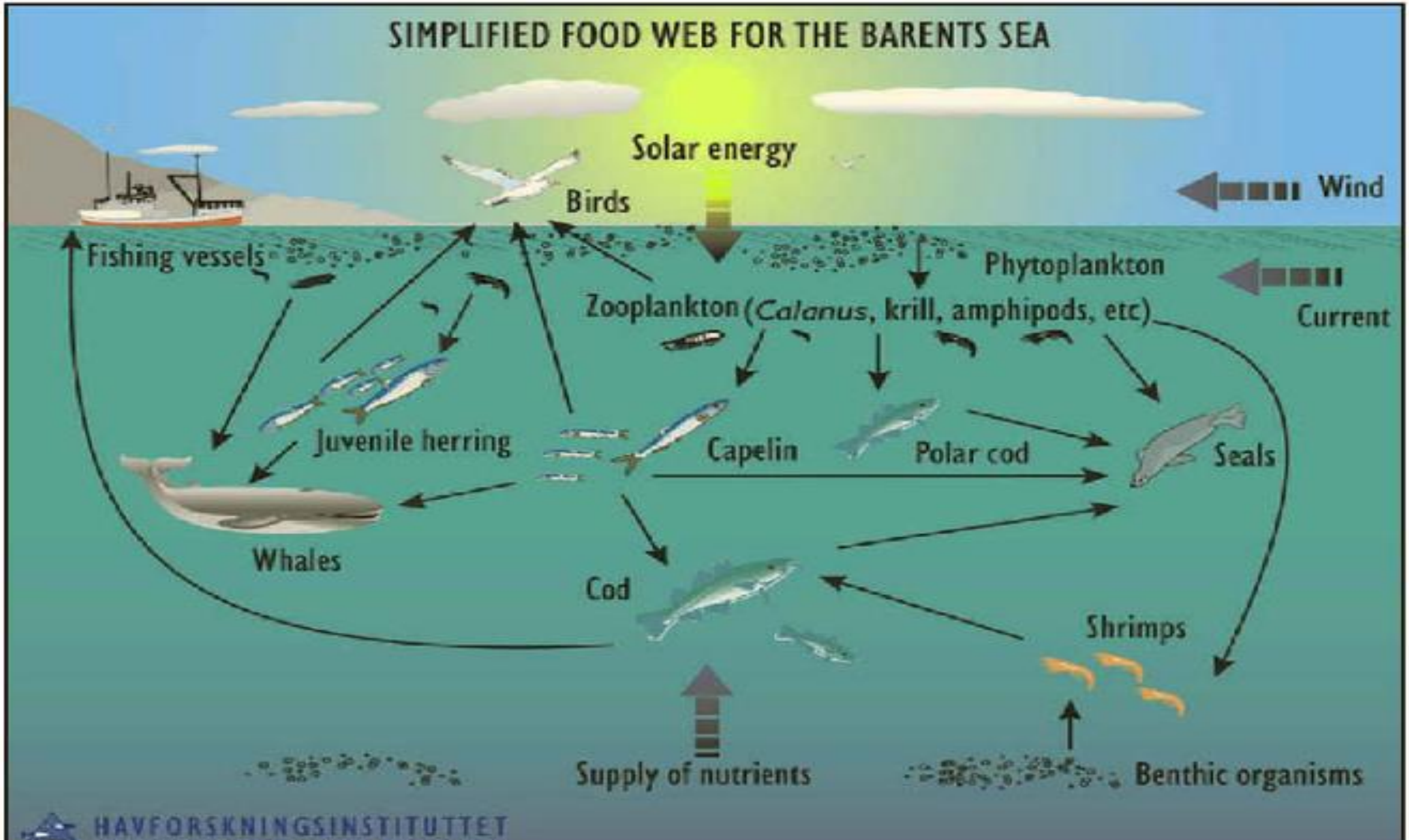
http://albertan1956.blogspot.com/2010/12/how-many-sharks-are-killed.html

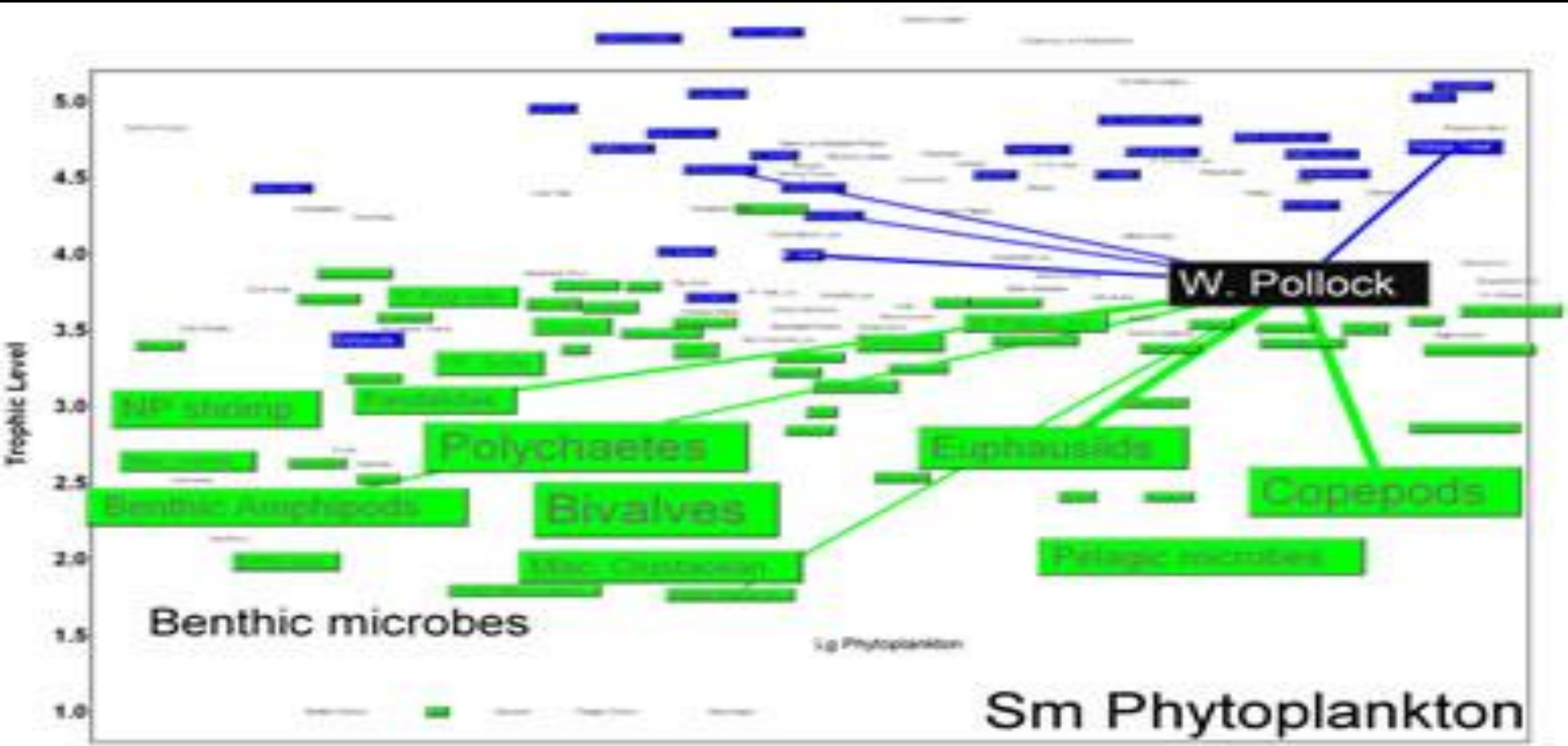


http://www.pondworld.com/complete-resource-guide-to-the-food-chain.aspx

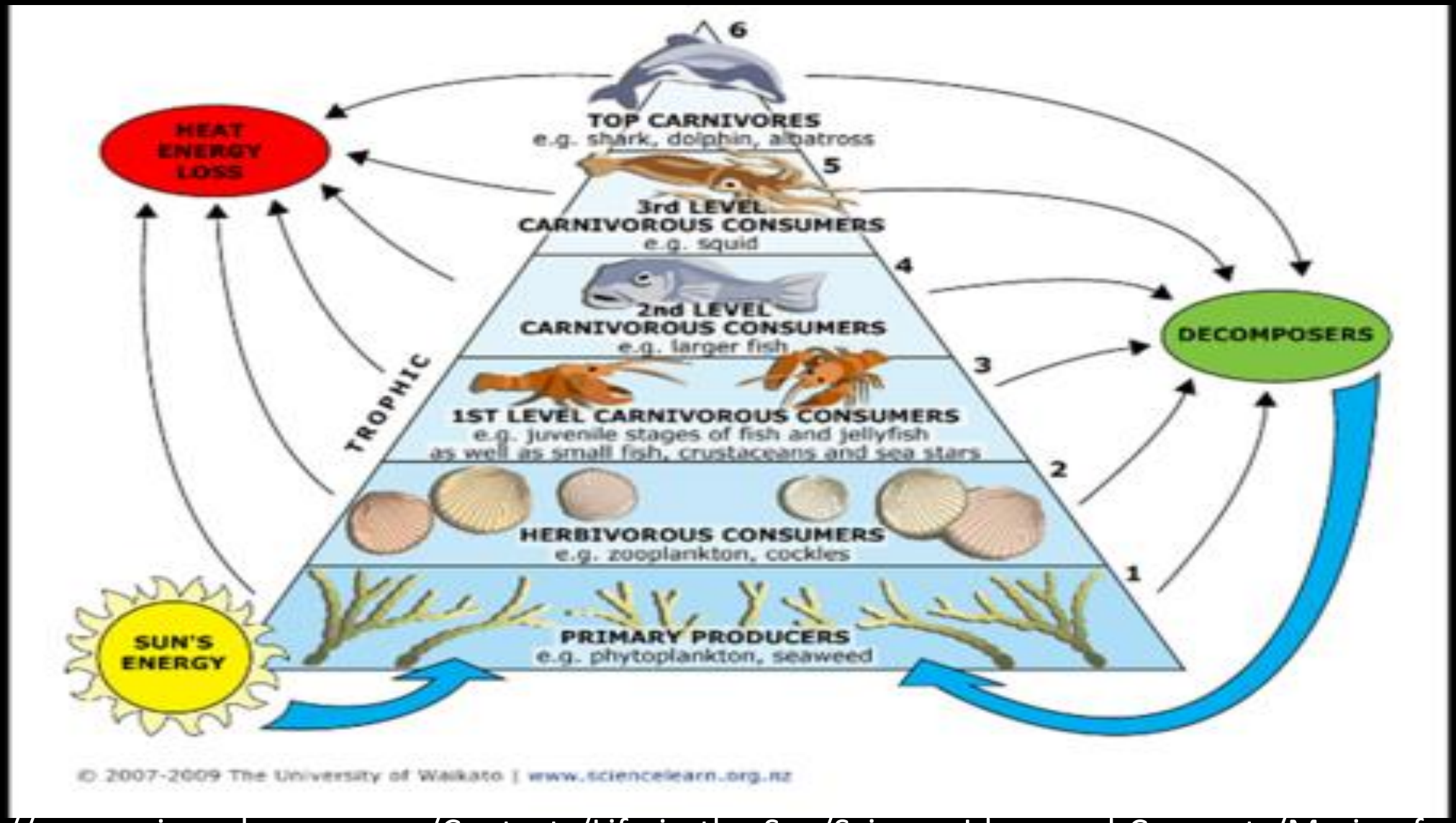


http://www.bio.utexas.edu/faculty/sjasper/Bio301M/ecosystem.html


SIMPLIFIED FOOD WEB FOR THE BARENTS SEA
Solar energy
Birds
Wind
Fishing vessels
Phytoplankton
Zooplankton (Calanus, krill, amphipods, etc)
Current
Juvenile herring
Capelin
Polar cod
Seals
Whales
Cod
Shrimps
Supply of nutrients
Benthic organisms
HAVFORSKNINGSINSTITUTTET

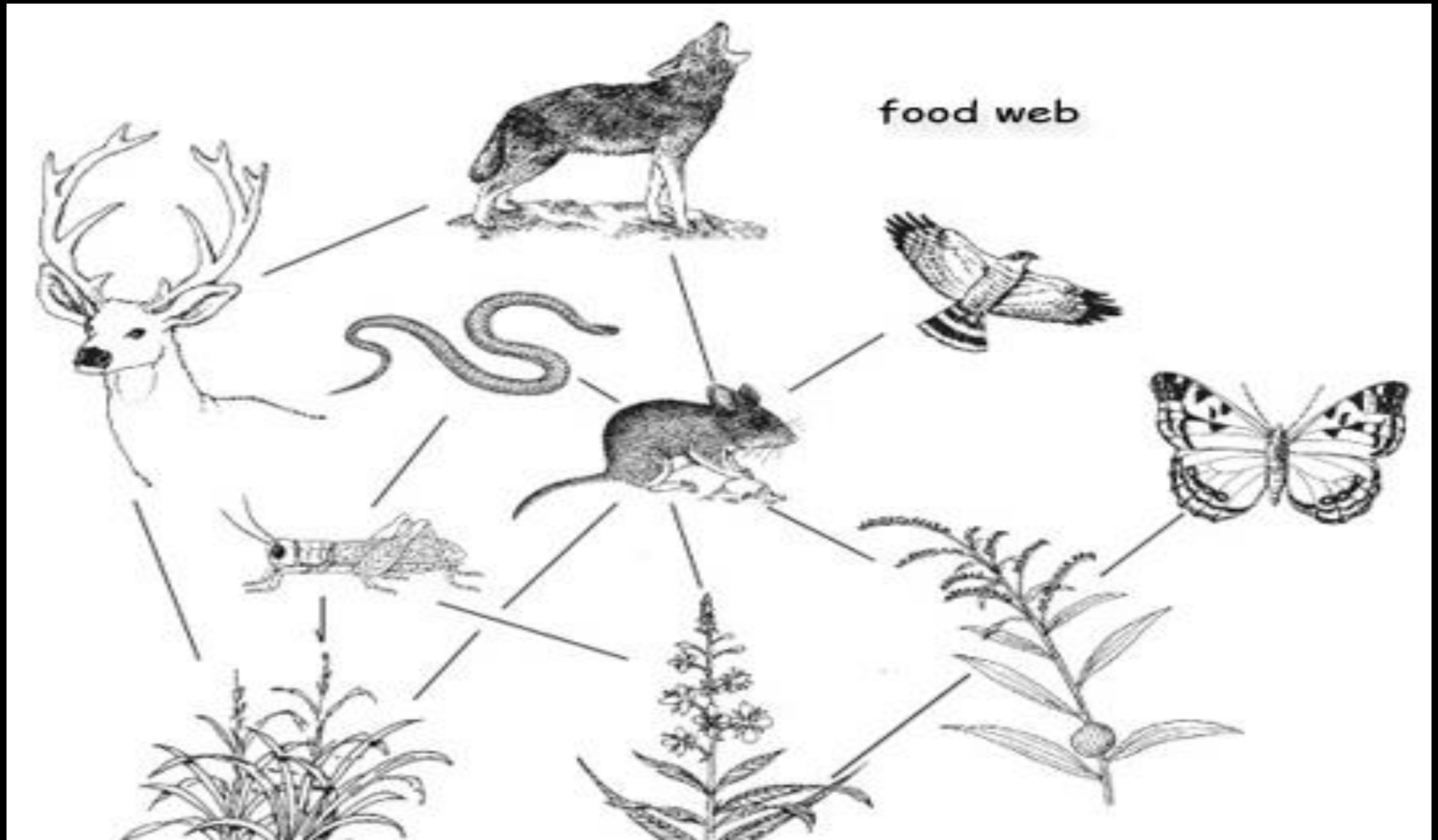

Trophic Level
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
W. Pollock
NP shrimp
Polychaetes
Euphausiids
Copepods
Benthic Amphipods
Bivalves
Pelagic shrimp
Benthic microbes
Lg Phytoplankton
Sm Phytoplankton

Trophic Cascade

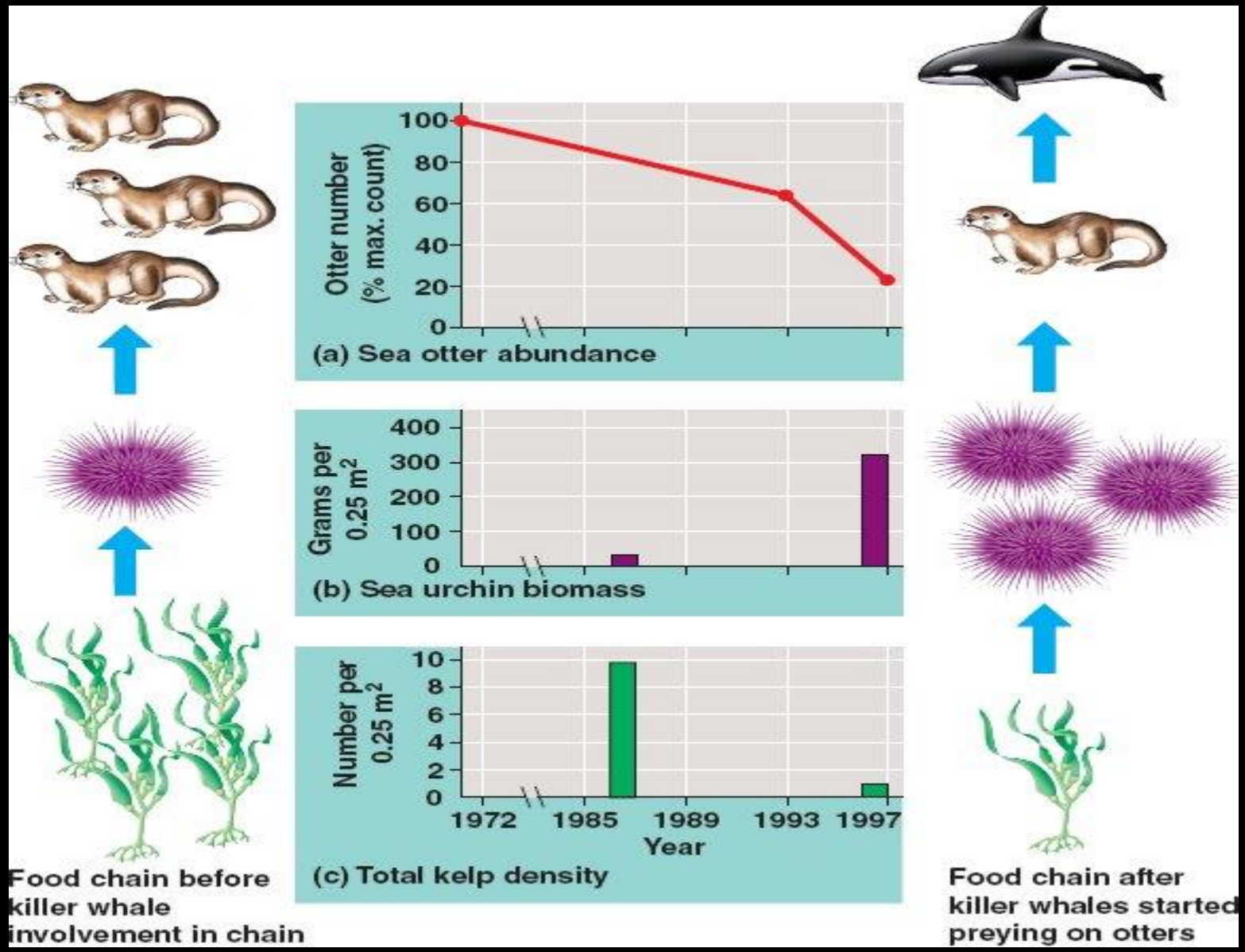


http://www.sciencelearn.org.nz/Contexts/Life-in-the-Sea/Science-Ideas-and-Concepts/Marine-food-webs

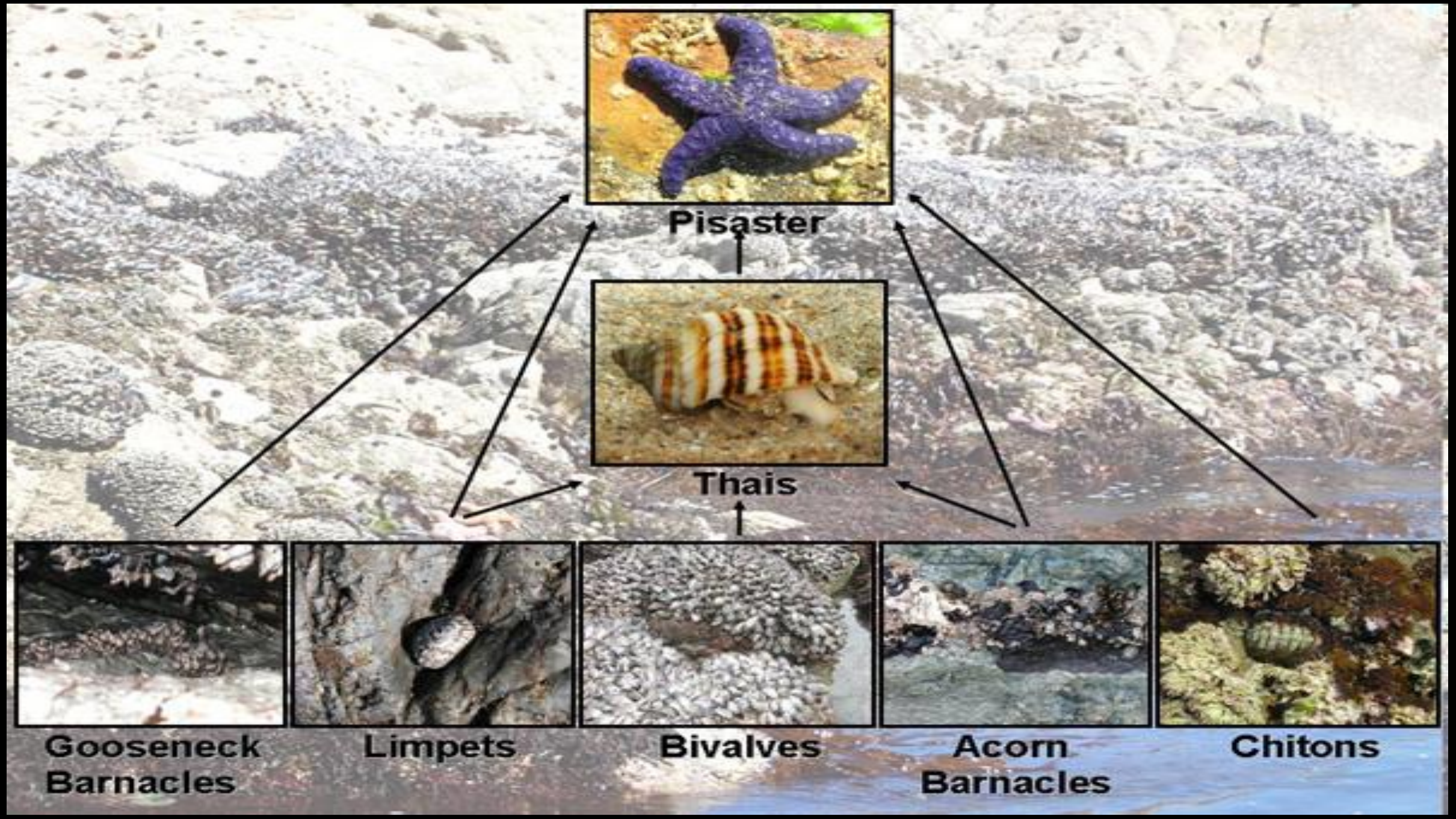
Keystone species

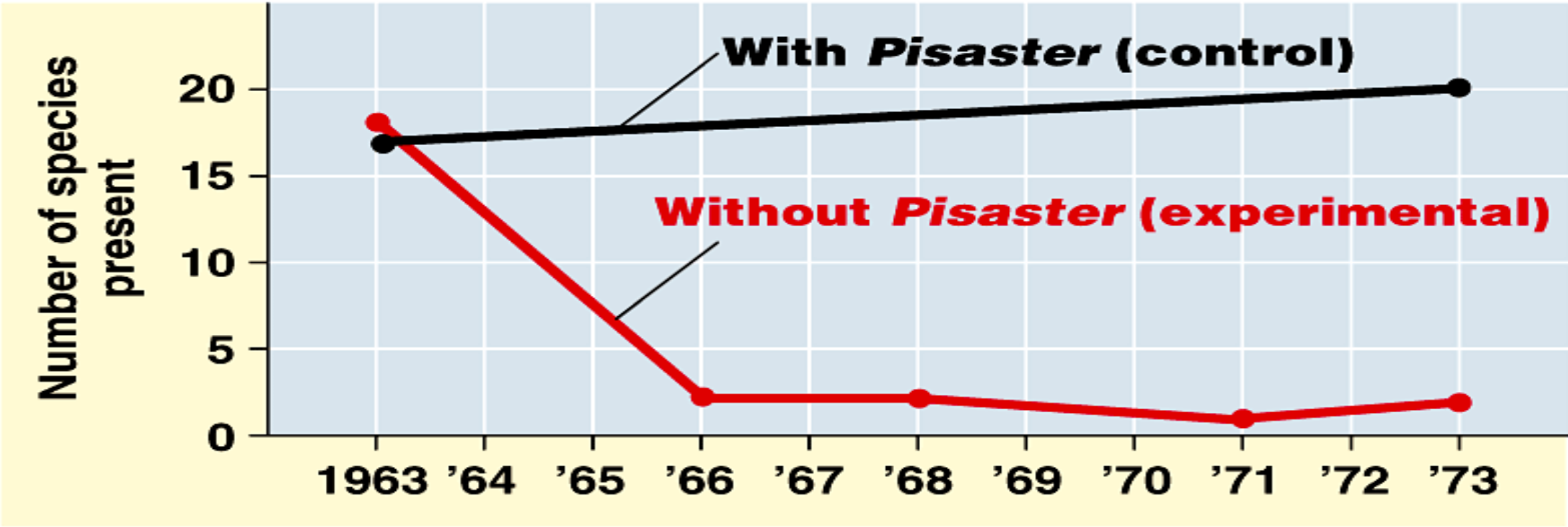


Keystone species

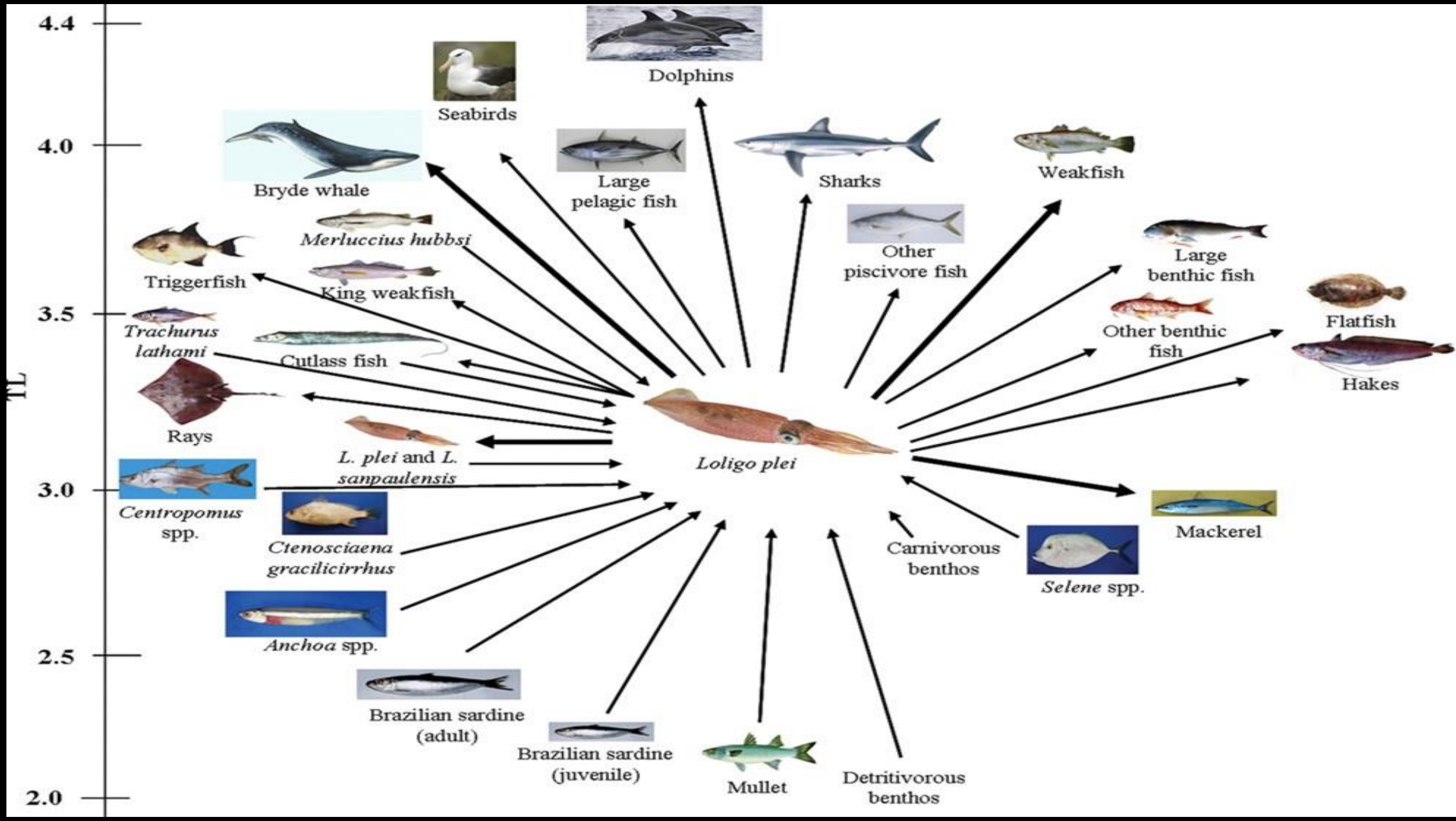


- http://bio1903.nicerweb.com/Locked/media/ch53/SAVE/keystone-sea_otter.html


Pisaster
Thais
Gooseneck Barnacles
Limpets
Bivalves
Acorn Barnacles
Chitons



(b)


4.4
4.0
3.5
3.0
2.5
2.0
TL
Dolphins
Seabirds
Bryde whale
Large pelagic fish
Sharks
Weakfish
Merluccius hubbsi
Other piscivore fish
Large benthic fish
Triggerfish
King weakfish
Trachurus lathami
Cutlass fish
Other benthic fish
Flatfish
Hakes
Rays
L. plei and L. sanpaulensis
Loligo plei
Centropomus spp.
Ctenosciaena gracilicirrhus
Mackerel
Carnivorous benthos
Selene spp.
Anchoa spp.
Brazilian sardine (adult)
Brazilian sardine (juvenile)
Mullet
Detritivorous benthos

Break 1

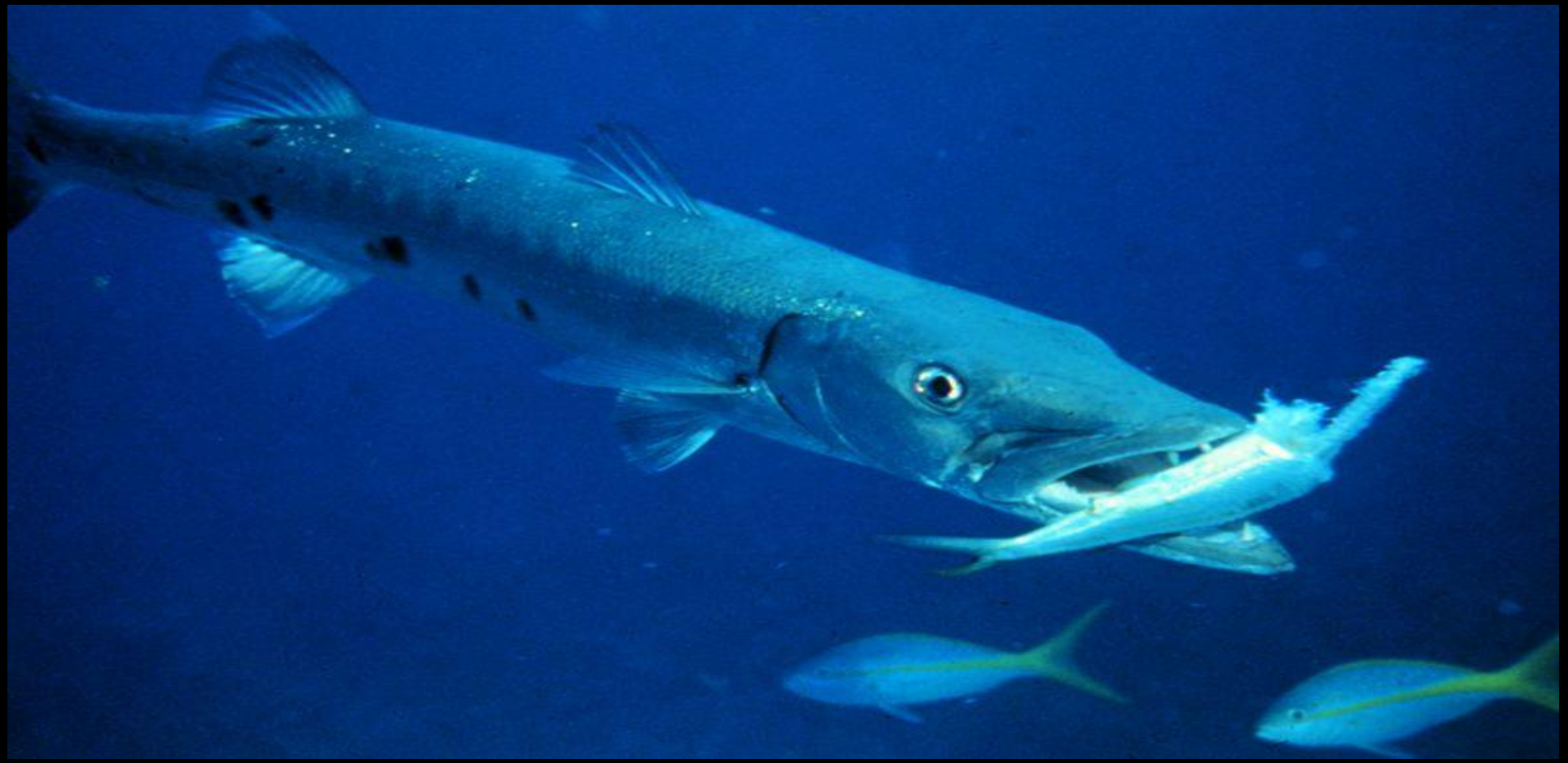
Biotic FActors

Interspecific interactions

Intraspecific interactions

http://kariecology.blogspot.com/2011/02/biological-interactions.html

Predation



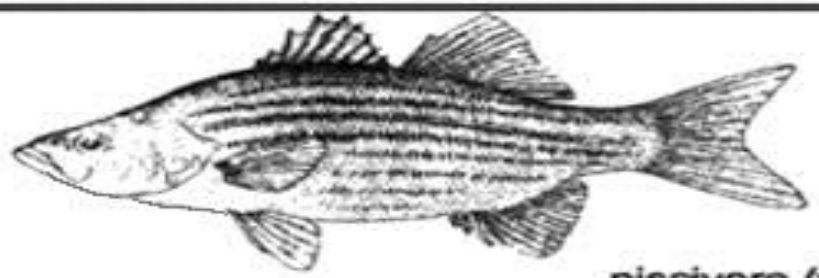
http://bioweb.uwlax.edu/bio203/s2008/sellnow_hann/Nutrition2.htm

- “‘Top-down’ means that species occupying the highest trophic level (top carnivores) exert a controlling influence on species at the next lower level (their prey) and so forth down the trophic ladder.”

TROPHIC CASCADES IN SOUTHEASTERN RESERVOIRS

TOP-DOWN CONTROLS

1. stocked



piscivore (white bass)

2. population reduced

planktivore (threadfin shad)

3. released to increase size and density

zooplankton grazers

4. cell density and chlorophyll reduced by grazers

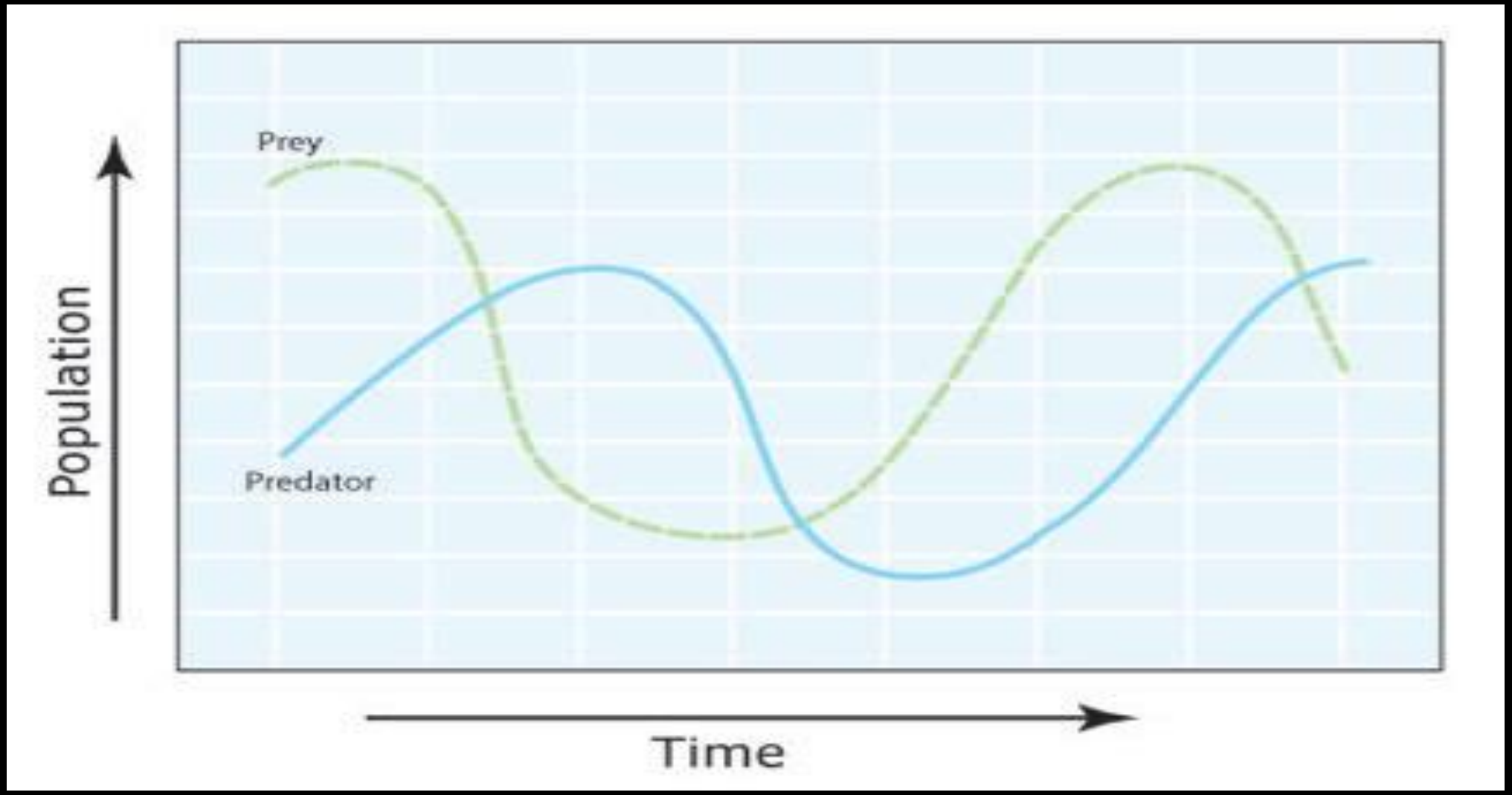
phytoplankton

5. concentrations increase by grazer excretion and reduced uptake rates

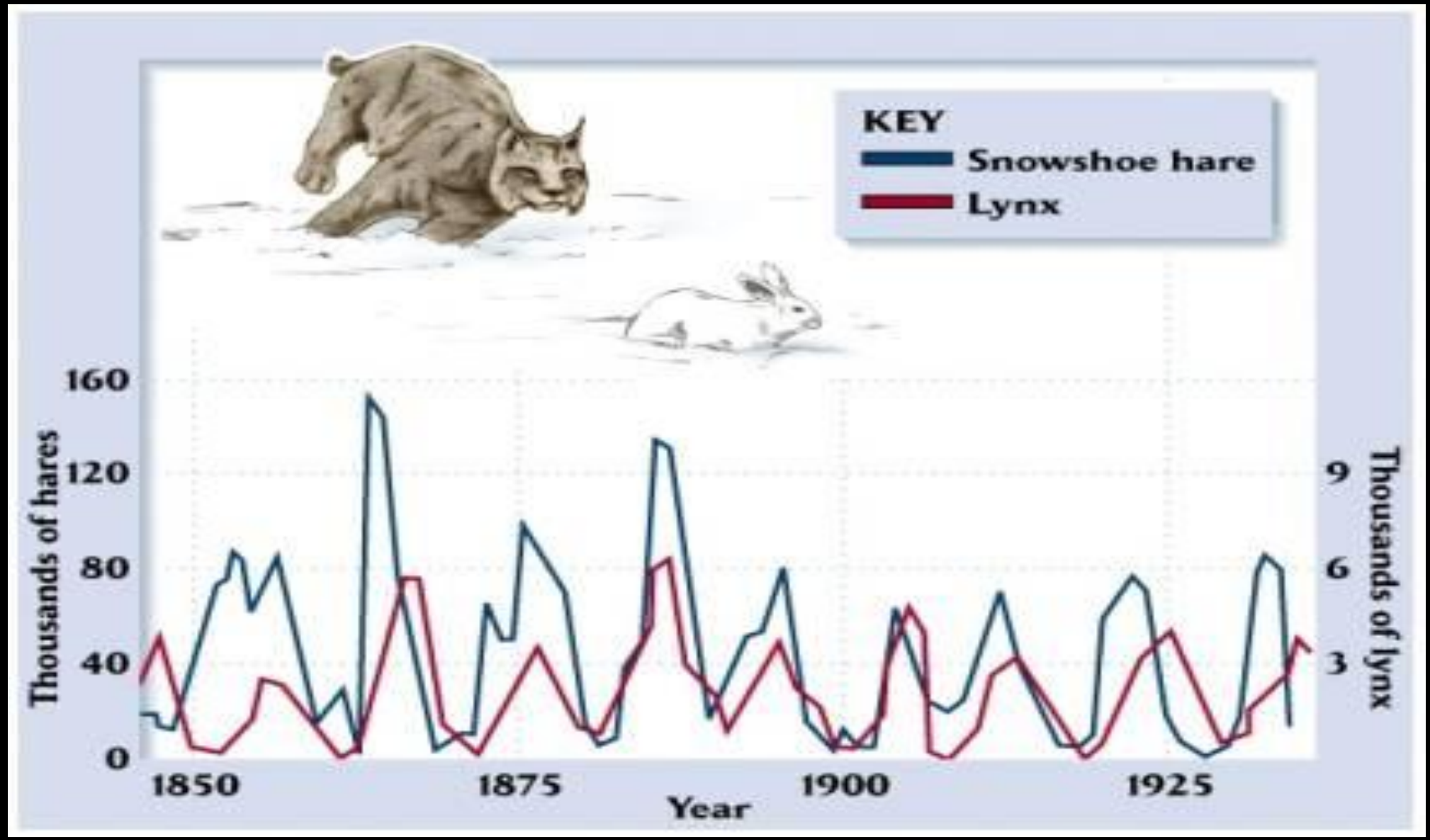
P P N
P N P

free, dissolved nutrients

Top-down regulation



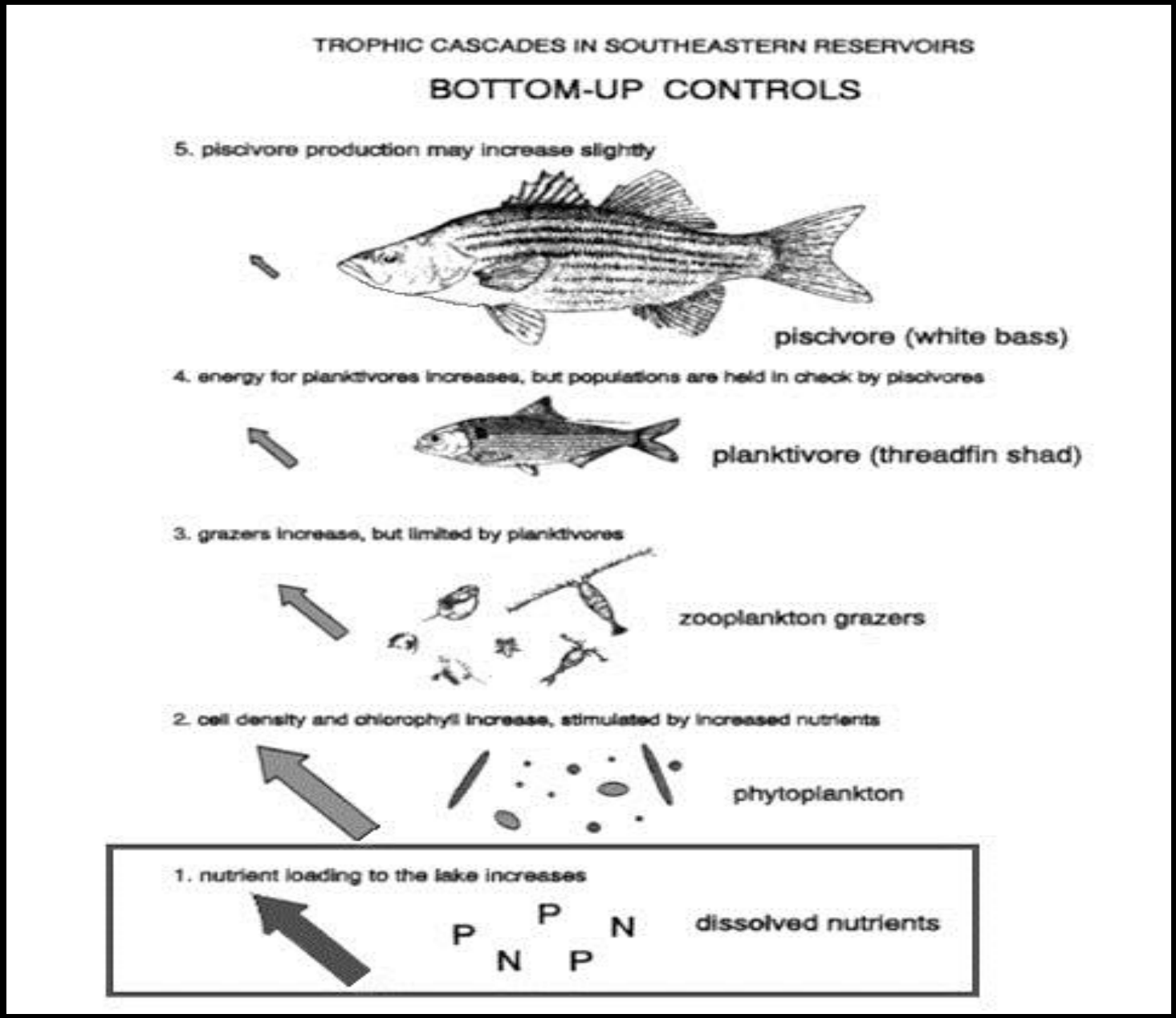
- http://www.nature.com/scitable/knowledge/library/dynamics-of-predation-13229468



http://theglyptodon.wordpress.com/2011/05/02/the-fur-trades-records/

- *Bottom-up regulation* is driven by energy moving up the food web (*tropic levels)* from plants to herbivores to carnivore

Bottom-up regulation



Competition

- http://www.dreamstime.com/stock-photography-koi-fish-competition-food-image15687182

Resource partitioning

http://blog.wildfiction.com/2012/11/feeding-fish-at-chaparral-park.html

Vol. 164: 37–45, 1998 | MARINE ECOLOGY PROGRESS SERIES
Mar Ecol Prog Ser | Published April 9

Midwater fishes and shrimps as competitors and resource partitioning in low latitude oligotrophic ecosystems

Thomas L. Hopkins, Tracey T. Sutton*

Department of Marine Science, University of South Florida, St. Petersburg, Florida 33701, USA

ABSTRACT: Oligotrophic tropical-subtropical oceanic regimes constitute the largest and most ancient ecosystem on earth, with these enormous areas being characterized by high faunal diversity. The stability and age of the ecosystem have enabled the evolution of many similar species niches where there is considerable overlap in niche parameters such as food and space, resulting in high species packing, especially in the epi- and mesopelagic zones. Competition for limited resources undoubtedly exists and has been described by MacArthur (1972, Geographical ecology, Harper and Row, New York) as diffuse competition where each species is impacted by many other species sharing the environment. Most studies of resource partitioning in the oceanic pelagial have been restricted to specific taxonomic groups, such as copepods, fishes, shrimps, or cephalopods, and intergroup relationships have not been examined. The 2 dominant (numbers and biomass) components of low latitude midwater micronekton communities, based on trawl catches, are fishes and shrimps, and the present study reveals that species from each of these 2 assemblages occur in the same feeding guilds and hence potentially compete for food resources. However, as additional niche parameters are included in the analysis, such as food size and predator vertical distribution, groups of species with matching niche characteristics become increasingly smaller. Results of this study suggest that as additional information on individual life histories is obtained, such as data on seasonality of reproduction and population dynamics, the same pattern will emerge as we have found for fishes and shrimps considered separately, i.e. that resource partitioning occurs at the species level despite the pressures of diffuse intra- and intergroup competition. This minimizes competitive exclusion and enables the maintenance of a high-diversity fauna in

Character displacement

An extreme result of resource partitioning where over time, selective pressure causes species to diverge from each other permanently via behavioral, morphological or physiological specializations.

Interference competition

http://www.eoearth.org/view/article/151816/

Exploitation competition

http://wondrouspics.com/colorful-coral-reef/coral-reef-many_fish/

Habitat Imprinting

http://tapreef.wikia.com/wiki/Aqua_Damselfish

BREAK 2

Symbiosis

Means “living together”

http://science.howstuffworks.com/life/evolution/symbiosis2.htm

Mutualism

http://pixelcurse.com/wp-content/uploads/2011/01/mutualism1.jpg

http://projectjkecology.wikispaces.com/Mutualism

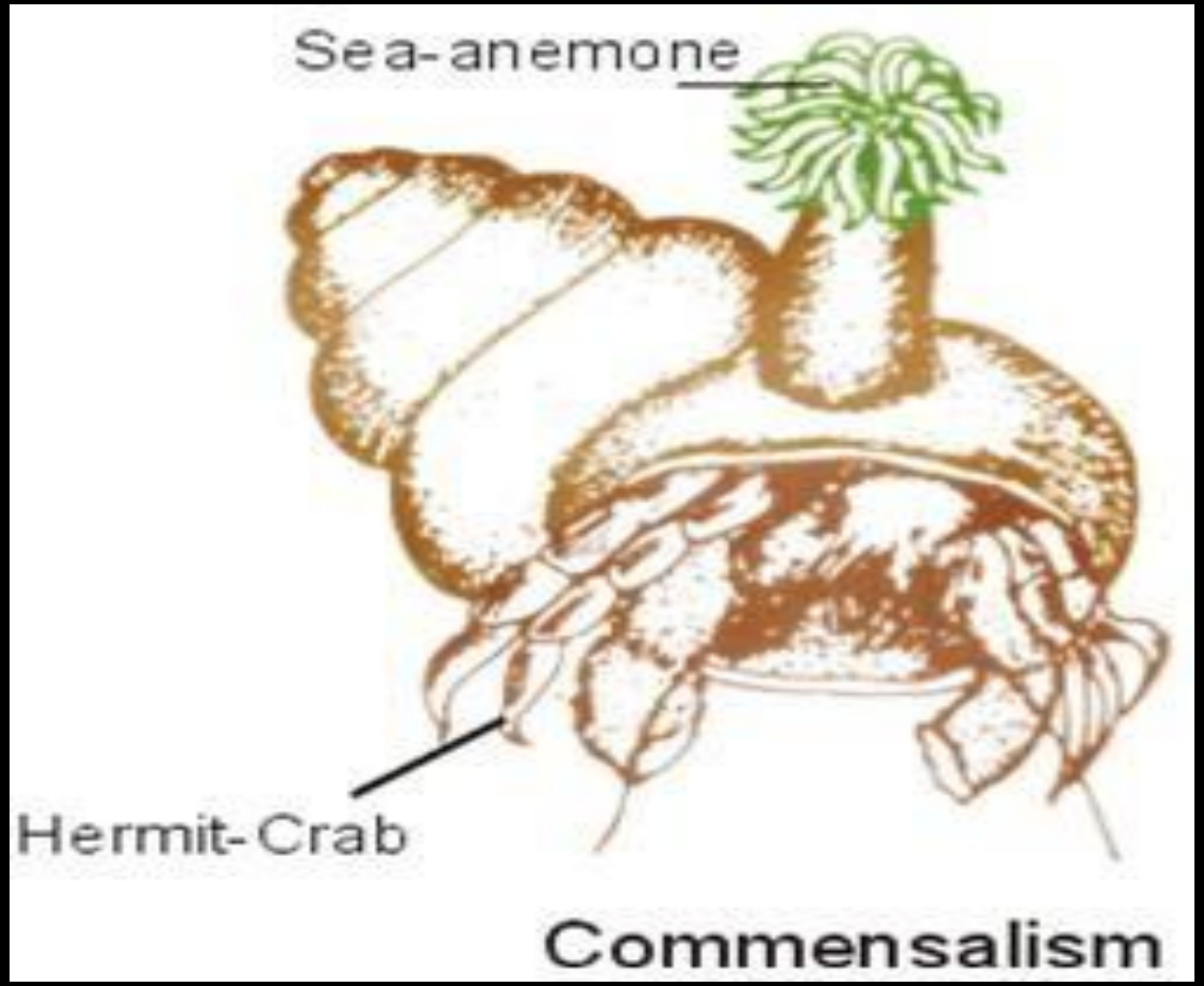
http://info.nhpr.org/node/33321

Commensalism

http://kids.britannica.com/comptons/art-108155/In-a-commensal-relationship-one-organism-benefits-while-the-other

http://marinesymbiosis.wikispaces.com/2.+Commensalism

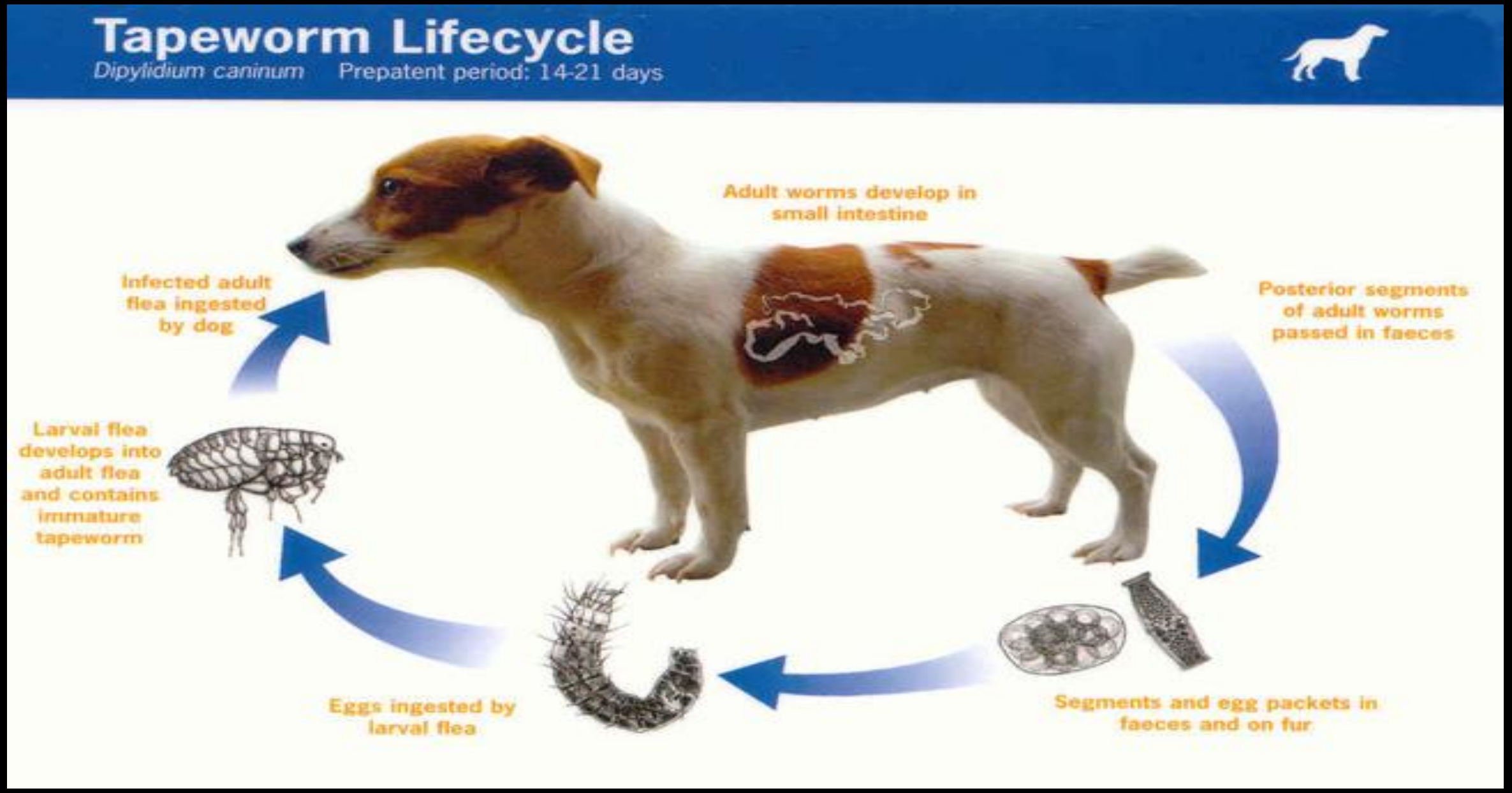
http://whs-apbio-2012.blogspot.com/2012/08/connors-commensalism.html



http://www.transtutors.com/homework-help/biology/living-organism-and-environment/commensalism.aspx

Parasitism

- http://cal.vet.upenn.edu/projects/merial/introduction/intro_2.htm



http://www.balgownievet.com.au/html/pet_illnesses/tapeworm.html

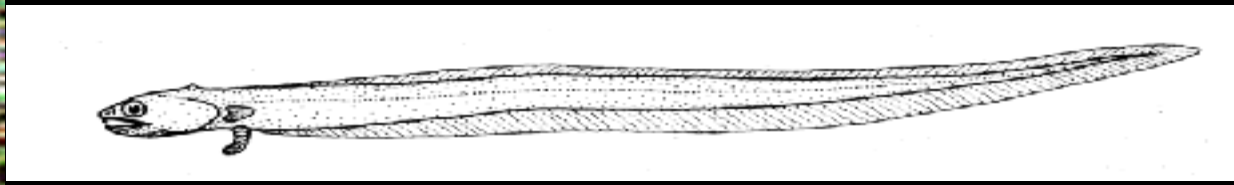
http://poobah.tumblr.com/post/213752658/mabelmoments-the-prickly-deep-sea-anglerfish

Life History Strategies

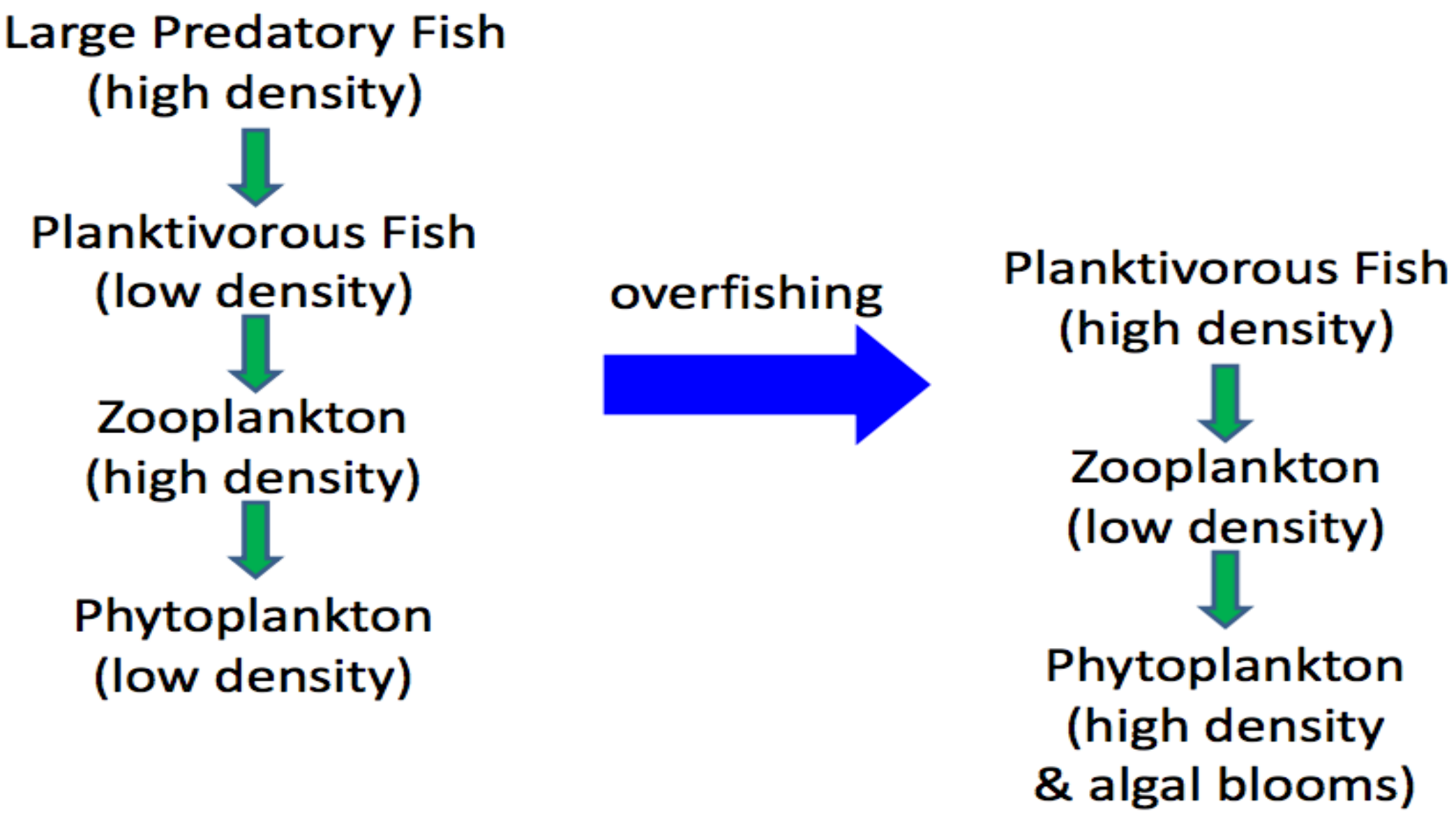
http://http://www.usbr.gov/pmts/tech_services/tracy_research/photos/sturgeon/SturgeonImagesFig5.html

Parasites and Pathogens

- These can be considered a predator on the host species. Parasites and disease organisms are a normal part of a fishes life. The causes of an outbreak, or catastrophic level of infection is attributed to a number of factors (Fig. 27.2)
- water conditions
- crowding
- nutritional status
- habitat deterioration
- human causes



http://www.eversostrange.com/2011/02/21/pearlfish/



- http://www.studyblue.com/notes/note/n/exam-2/deck/4014671

Break 3

Bioluminescence in Aquatic Marine Organisms

Maureen Blair

What is it?

- Light produced by a living organism
- A chemical reaction takes place inside the organism, where light is then produced and emitted
- Most organisms inhabit marine ecosystems
- Species include fish, bacteria, and jellyfish

The Chemical Aspects

Bobtail Squid

Dinoflagellate

Plainfin Midshipman

- 2 chemicals needed to create bioluminescence:
  - Luciferin (also called substrate) - The compound that produces the light

    AND
  - Luciferase – An enzyme, which is a chemical that interacts with the substrate (Luciferin) and effects the rate of the chemical reaction

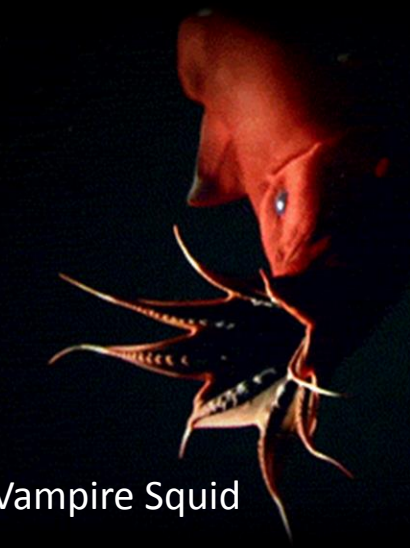
    OR
  - Photoprotein – Chemical that combines with luciferin and oxygen and often a calcium ion to emit light
- Some produce their own luciferin
  - Example: Dinoflagellate
- Others absorb luciferin from other organisms by either:
  - Consuming them as prey
    - Example: Plainfin Midshipman
  - Being in a symbiotic relationship with them
    - Example: Bobtail Squid

Reasoning Behind It

- Used to defend, hunt, reproduce, and other crucial activities

- When defending:
  - Some startle their predators by flashing light
    - Example: Vampire Squid
  - Counterillumination used to blend in with above surroundings and hide from predators lower in the water column
    - Example: Hatchetfish
  - Some detach body parts to distract while the rest of them escapes
    - Example: Brittle Stars

Hatchetfish



Vampire Squid

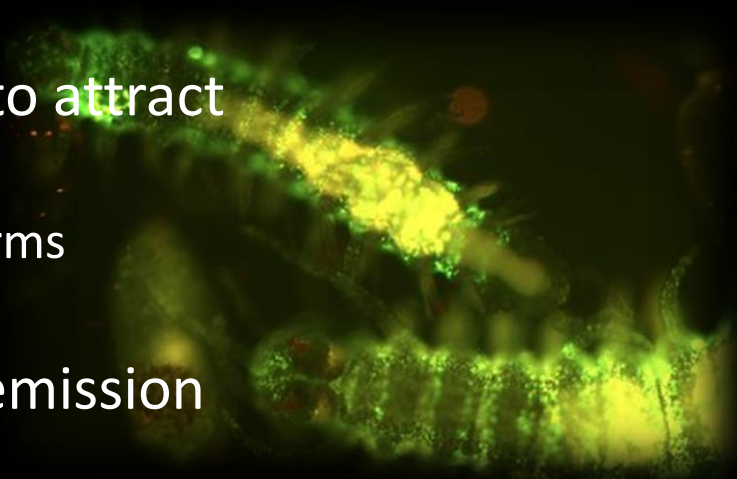
Brittle Star

- When hunting prey:
  - Some lure prey in with their light
    - Example: Anglerfish
  - Some use bioluminescence to search for their prey
    - Example: Black Loosejaw

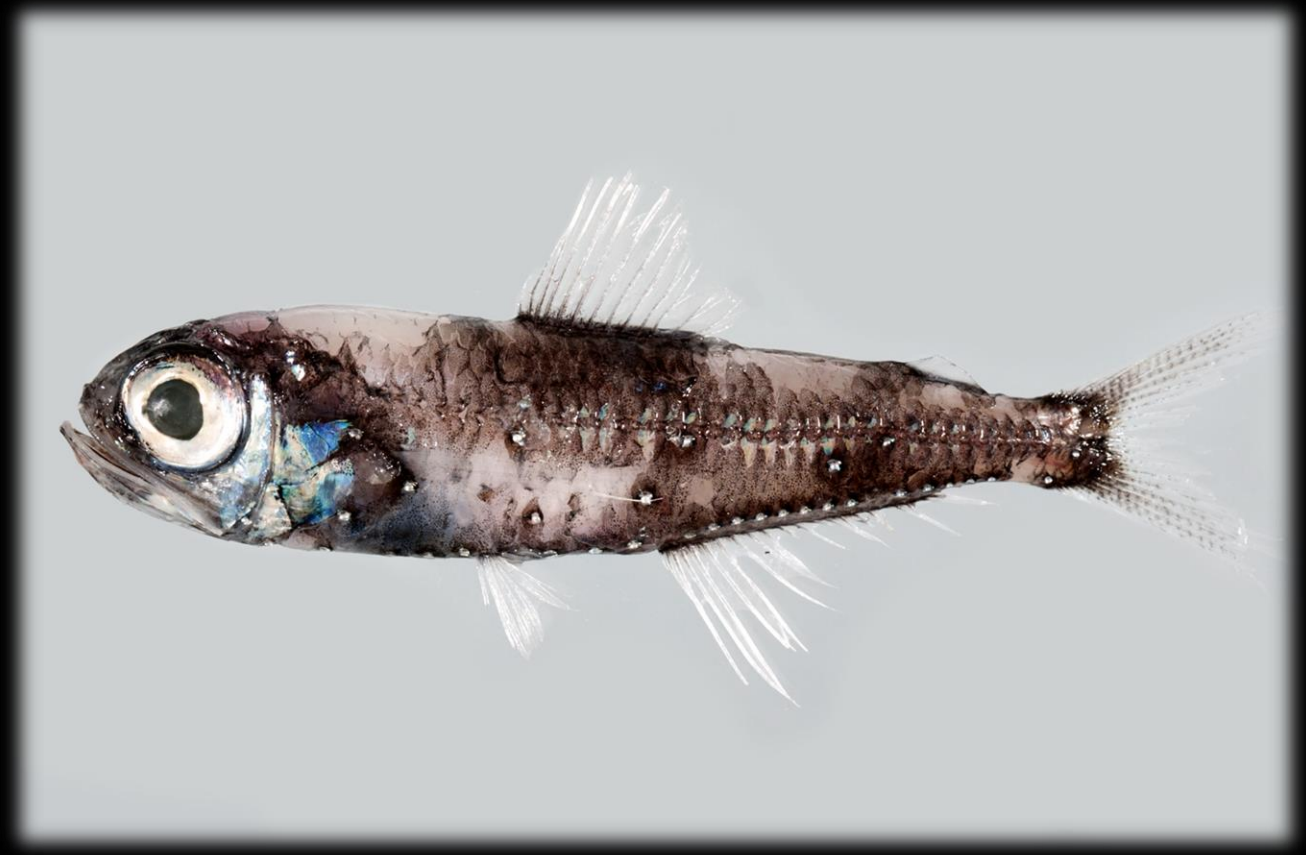
Black Loosejaw

Anglerfish

- For reproduction:
  - Some use their bioluminescence to attract mates
    - Example: Fireworms
  - Sex-specific light emission patterns



Fireworm

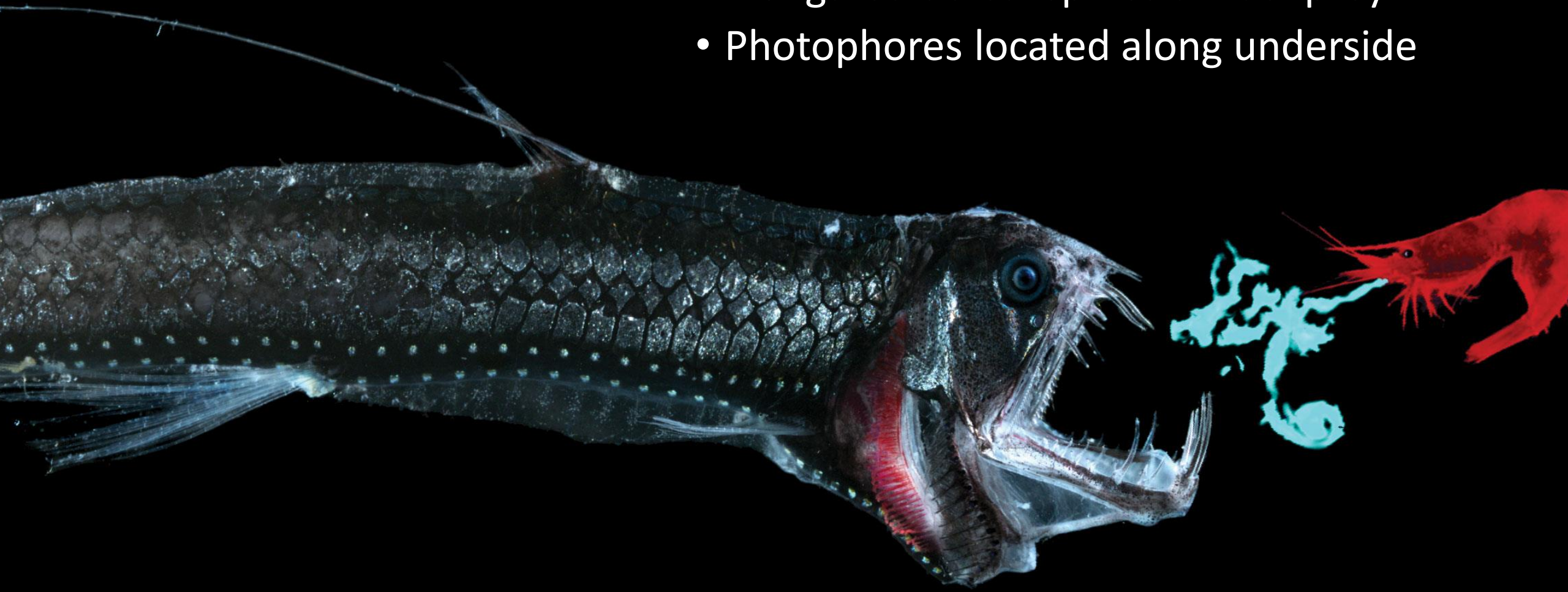


Lanternfish

- Photophores on head, underside, and tail
- Use counterillumination
- The patterns of their photophores are species specific
- Scientists suggest that they might use these patterns to recognize potential mates

Viperfish

- Large, jutting sharp teeth
- Elongated dorsal spines attract prey
- Photophores located along underside



Flashlight Fish

- Nocturnal species
- Rises in water column to feed
- Bioluminescent bacteria lives in organs underneath eyes in symbiotic relationship with the fish
- Photophores attract prey in for feeding
- Can cover the photophore by membrane extending up to cover the organ

Ponyfish

- Males show complex species-specific light organs
- Females show less developed light organs
- Males contain bioluminescent bacteria in a tissue near their throats
- Males attract females with flashing light patterns

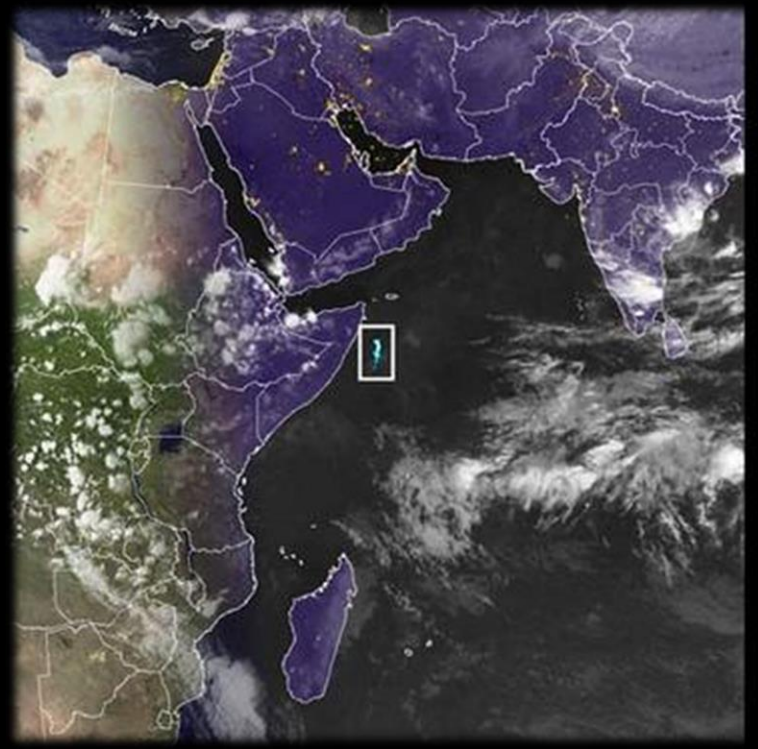
Other Bioluminescence

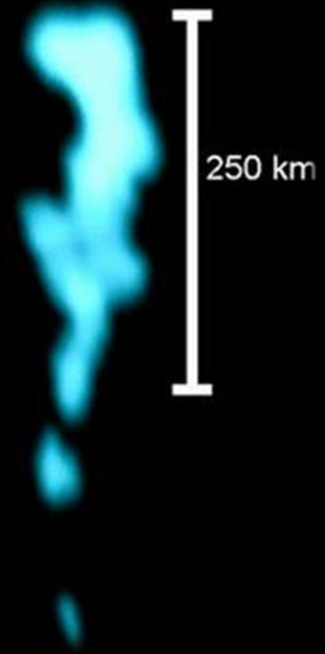
- Noctiluca *scintillans* (Sea Sparkle) - A marine planktonic dinoflagellate species
  - Appears in shallow coastal waters in high concentrations
  - Feeds on photosynthetic algae
  - Glow a blue/green color when agitated at night

https://www.youtube.com/watch?v=GFFzHs9zUg8

Milky Seas

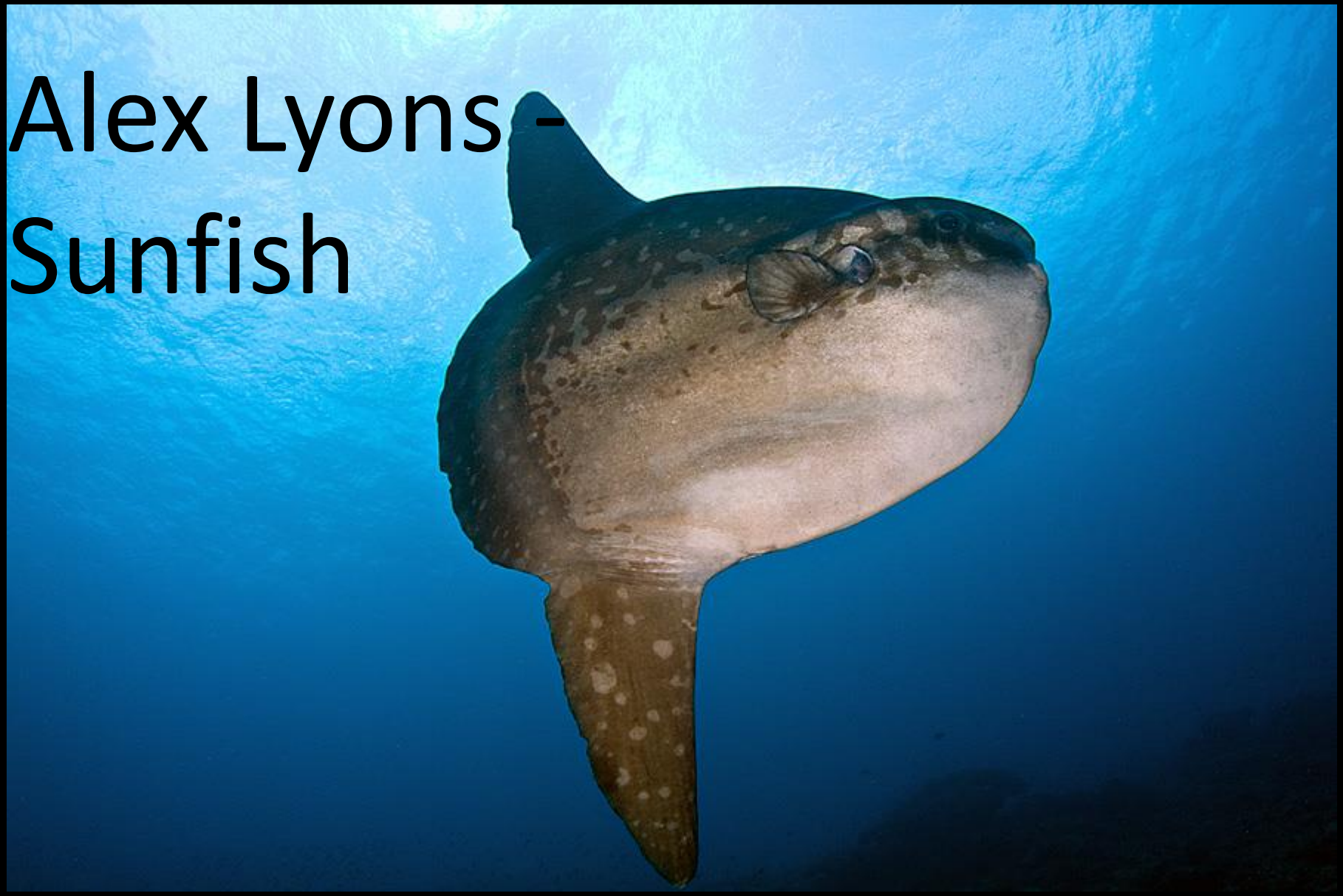
- Believed to be high concentrations of bioluminescent bacteria
- Sustain a constant glow on the water surface
- Over 70% have been reported in the Indian Ocean





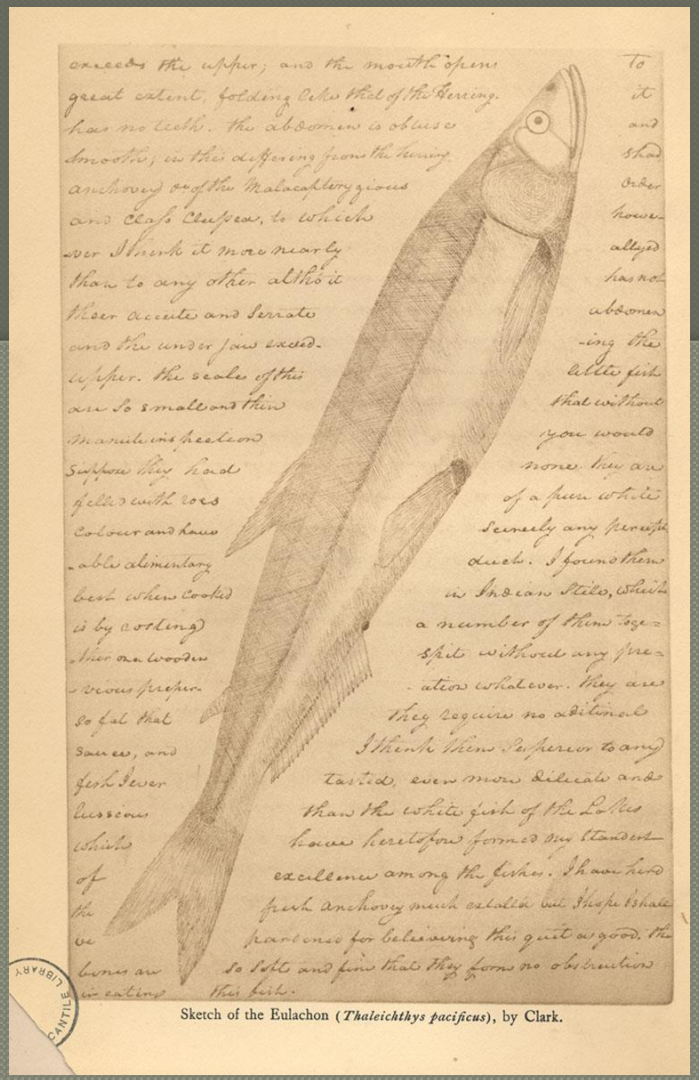

The End

Alex Lyons - Sunfish



EULACHON Thaleichthys pacificus

http://www.garyjwolff.com/candlefish.html



Sketch of the Eulachon (*Thaleichthys pacificus*), by Clark.

"Sketch of the Euchalon."
Original Journals of the Lewis and Clark Expedition 1804-1806. Vol. 4.
Rueben Gold Thwaites, ed. (New York: Dodd, Mead & Company, 1905)

http://www.umsl.edu/library/merc/exhibits/lewis_and_clark_maps/L&C_Sketch_of_Euchalon_by_William_Clark.htm

. Eulachon (*Thaleichthys pacificus*) caught Sunday, May 15th 2005 at Twentymile River, Alaska

Kingdom: Animalia
Phylum: Chordata
Class: Actinopterygii
Order: Osmeriformes
Family: Osmeridae
Genus: Thaleichthys (*latin for "rich fish")*
Girard, 1858
Species: T. pacificus
Binomial name
Thaleichthys pacificus
(J. Richardson, 1836)

http://en.wikipedia.org/wiki/Eulachon

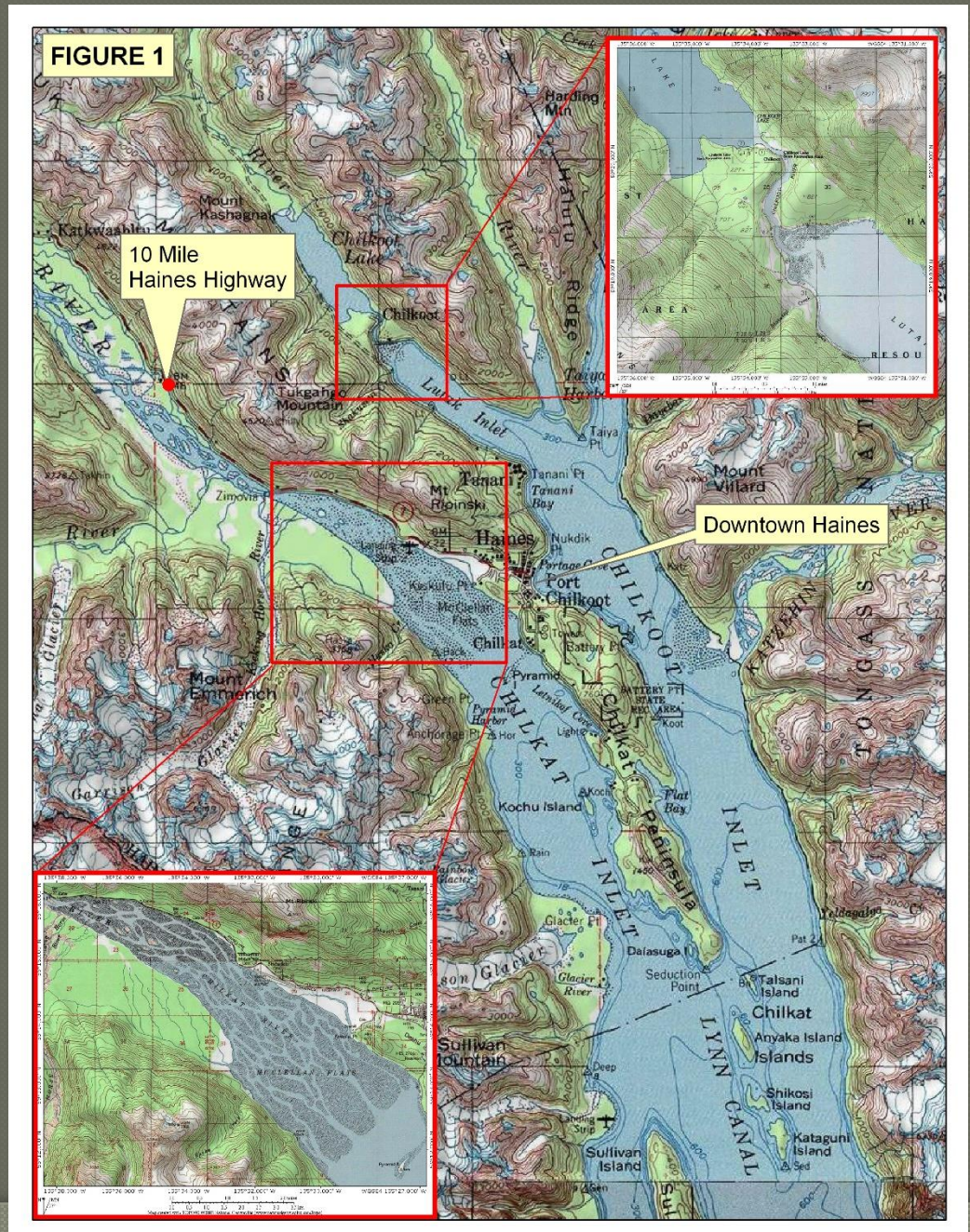
Sign at 4 mile Chilkat River, Haines, AK explaining Euchalon fishery

Aldon tending to the cook pots, at Ooligan fish camp, Haines, Ak 2013

Making Oooligan oil with CIA and family at Ooligan camp, Haines AK, 2013

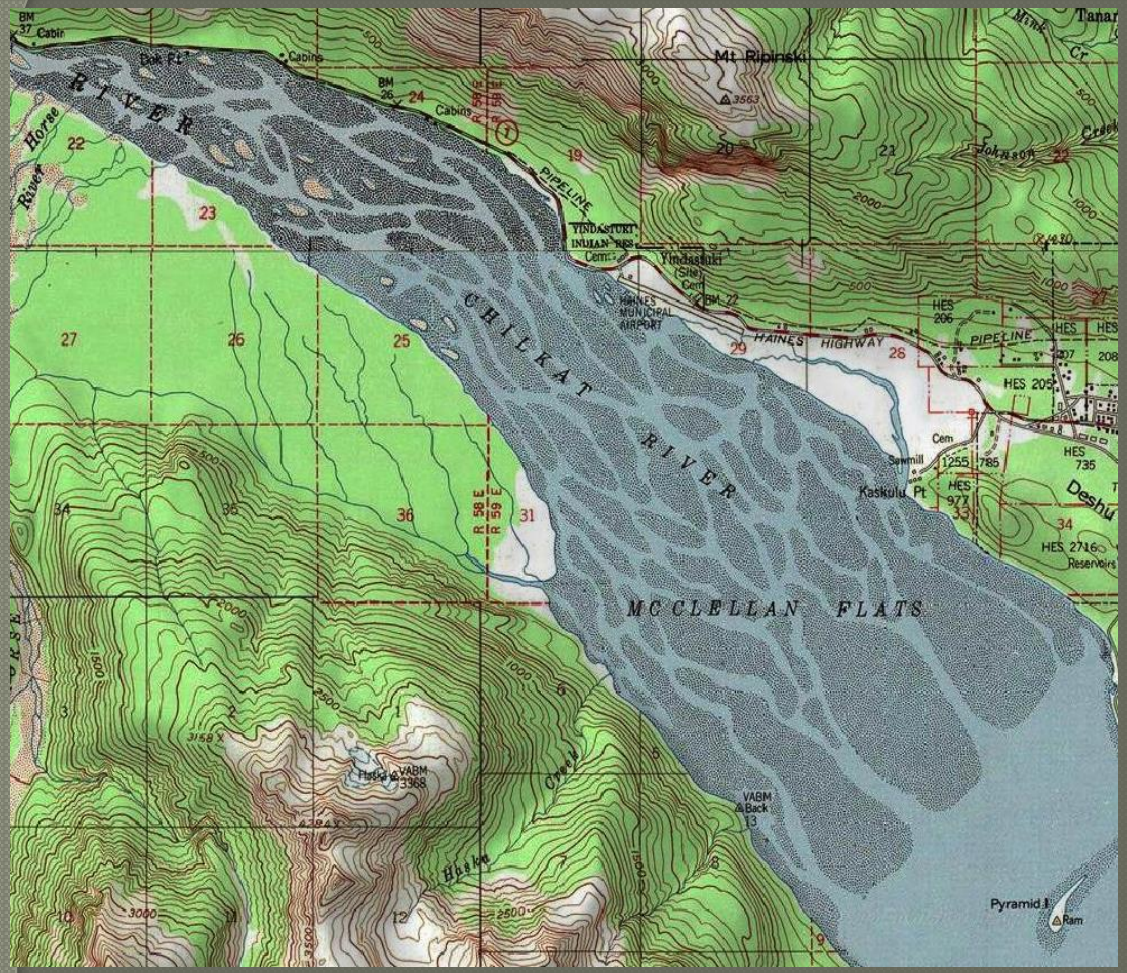
Finished product

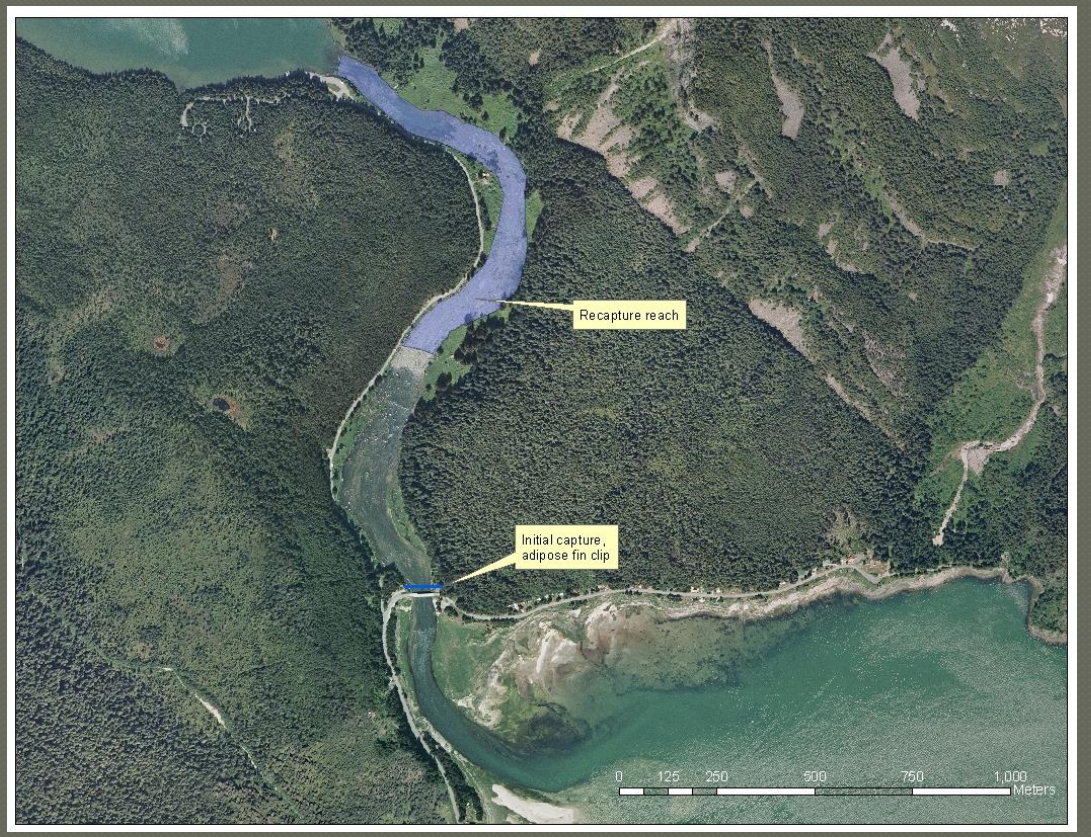
Areas of testing by the Takshanuk Watershed Council



Run timing and population estimate for eulachon in the Chilkat and Chilkoot Rivers in Southeast Alaska 2010-2012. Takshanuk Watershed Council

Run timing and population estimate for eulachon in the Chilkat and Chilkoot Rivers in Southeast Alaska 2010-20





Courtesy of Takshanuk Watershed Counc

http://www.fws.gov/alaska/fisheries/fish/Technical_Reports/t_2009_106.pdf

Genetic Population Structure of Alaska Eulachon

Alaska Fisheries Technical Report Number 106

U.S. Forest Service

Conservation Genetics Laboratory
November 2009