Crustacean Ecology

Kaylyn Flanigan

Hans Hillewaert, 2013

Identification:

This week, I had trouble deciphering the subphylum of the invertebrate presented to our Invertebrate Biology class. I knew it was an arthropod, but made it too complicated and was looking for a bizarre, blink-and-you-miss-it, classification. To my frustrated dismay, it was a crustacean (which sounds simple, hindsight is 20/20).

This particular picture is of an amphipod which is an order within the class malacostraca. The invertebrate shown in class belongs to the same class, but in the order isopoda.

Ecology

- *The study of relations and interactions between organisms and their environment*

Crustacean Distribution

Crustaceans are found nearly everywhere on the earth. They are found at the top of mountains, in marine trenches, and almost everyone in between.

Found in marine and freshwater and terrestrial ecosystems

Distribution (Creative Commons). These photographs are just examples of the environments that crustaceans inhabit.

Isopod Distribution

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Missouri Department of Conservation

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Isopods are an order of class malacostraca

1. Amphipods and isopods have been from the Andes Mountains (elevation 13,300 feet); within the Andes, Lake Titicaca - a freshwater body - also has species of crustacean[1].
2. Isopods have also been found in the desert[9].
   a. *Hemilepistus reaumuri*
3. Freshwater isopods are commonly found near the bottom of freshwater surrounded by debris and decaying matter[5]. They prefer water that is high in organic nutrients and feed on detritus and plants; they are considered scavengers, omnivores, and carnivores[5]. Some species also occupy caves; these species are nearly translucent or white and are commonly blind[1,5].
4. Intertidal species are found clinging to boat pylons and seaweed or other sea plants[6]. *Ligia exotica*, is commonly referred to as a wharf roach and can be found scuttling about debris in the intertidal zone and piers[6].
5. Deep sea isopod, *Bathynomus giganticus* is much larger than its shallow water relatives[6].

Starting from the top left: a desert isopod, a freshwater isopod, the deep sea isopod, and the Andes mountains.

Distribution Similarities

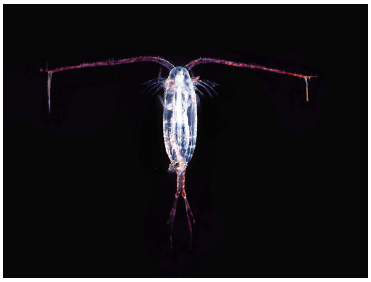
1. **Malacostraca, ostracoda, and copepoda contain species that inhabit marine, fresh, and terrestrial ecosystems[8].**

Pictures are of a terrestrial crab and a terrestrial isopod.

Distribution Similarities

1. Malacostraca, ostracoda, and copepoda contain species that inhabit marine, fresh, and terrestrial ecosystems[8].
2. **Almost every class has species in either marine or freshwater ecosystems**
    a. **Pentastomida are internal vertebrate parasites[8].**





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A cherry shrimp, skeleton shrimp, and a copepod. These pictures are examples of classes that are occupy marine and freshwater ecosystems.

Distribution Similarities

1. Malacostraca, ostracoda, and copepoda contain species that inhabit marine, fresh, and terrestrial ecosystems[8].
2. Almost every class has species in either marine or freshwater ecosystems
   a. Pentastomida are internal vertebrate parasites[8].
3. **The vast majority of crustaceans are mobile and free-living**
   a. **Barnacles and parasitic species defy this**

NOAA

This picture is of a collection of crustaceans. They are considered zooplankton and are mobile and free-living.

Distribution Differences

1. **Pentastomida, a completely parasitic class, is dissimilar to the distribution of malacostracans as pentastomida distribution is based solely on their hosts[8].**
2. Species determined distribution differences

Our invertebrate of the week is a isopod belonging to the class malacostraca. Differences that are mentioned above are in relation to the class malacostraca.

Distribution Differences

1. Pentastomida, a completely parasitic class, is dissimilar to the distribution of malacostracans as pentastomida distribution is based solely on their hosts[9].
2. **Species determined distribution differences**
    a. **Discussed in subsequent slides**

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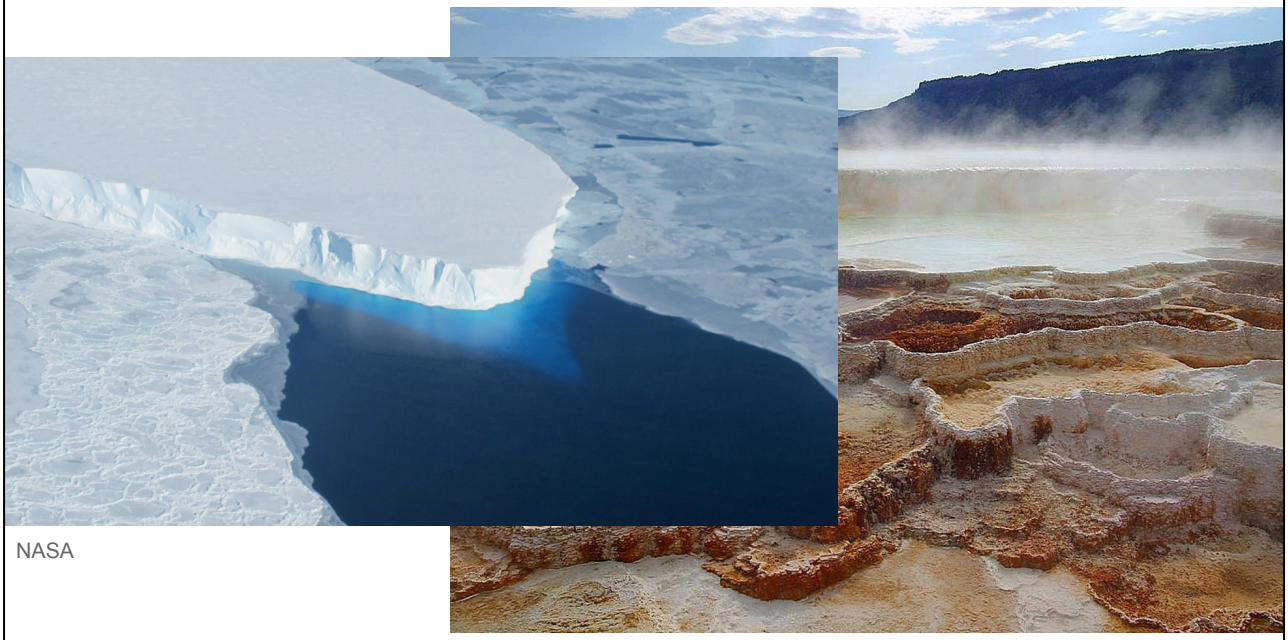
John Sullivan, 2013

What do a hot springs and sheets of ice have in common? Water, yes.
And...amphipods!

Amphipods were discovered in the hot springs of yellowstone national park - where the temperature reaches 113 - 123 degrees farenheit; astoundingly, the same species were found to be active under six-seven feet of ice in the Arctic Coast of North America[1].

Similarly, *Thermosbaena* was discovered in the Algerian thermal waters[1].



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This isn't the only crustacean that can survive in extremely cold temperatures. As the light penetration decreases, temperature also decreases.

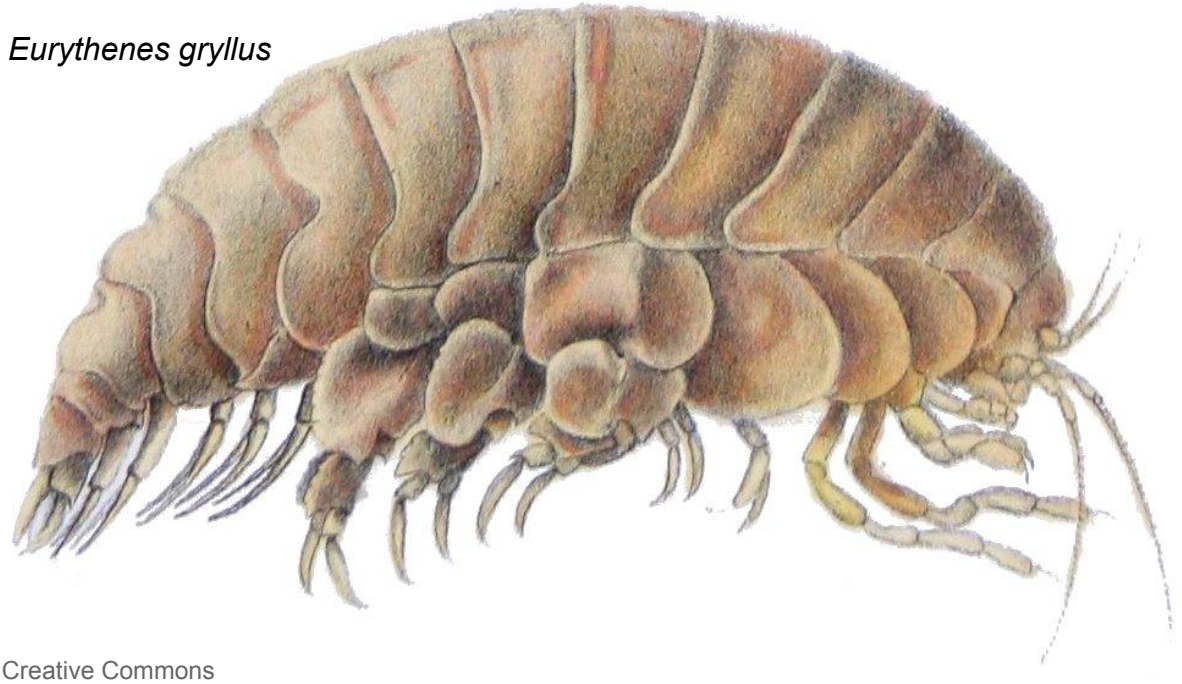
Gammarus limnaeus

Creative Commons

Gammarus limnaeus was found occupying both niches! This is fascinating because it represents the adaptability of these organisms.

This above picture is not of the exact species discusses, but is in the same genus.

Eurythenes gryllus



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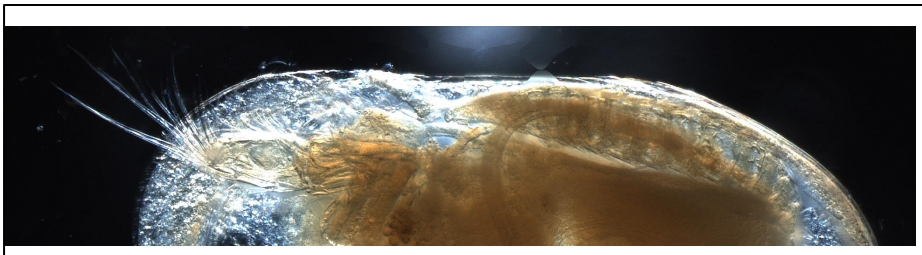
The aforementioned species isn't the only one who can survive chilly temperatures. *Eurythenes gryllus* - another amphipod - lives nearly four miles below the sea surface where temperatures are fridgid[1].

As light penetration dissipates as one moves further away from the surface, temperatures drop quickly. Four miles under the surface, *Eurythenes gryllus*, is active and thriving.

Anna Syme, 2007

Ostracod, *Darwinula sp.*, are present in the the hot springs of Arkansas national park[2,3].

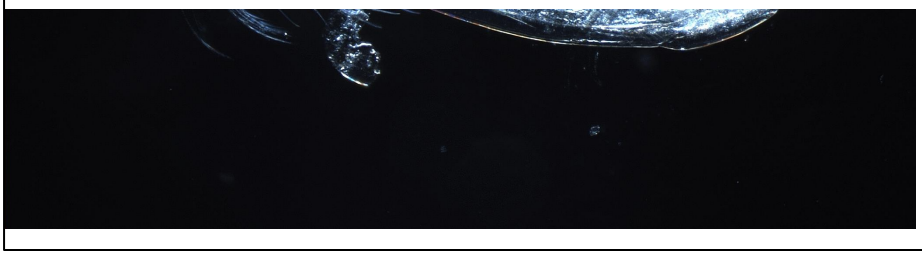
We already saw that amphipods are present in extreme temperatures, and ostracods can, too.



Interns Find Tiny Crustaceans in Arkansas National Park

Interns at a national park in Arkansas have discovered species of a crustacean that hadn't before been documented in the park's waters.

Aug. 14, 2017, at 2:33 p.m.



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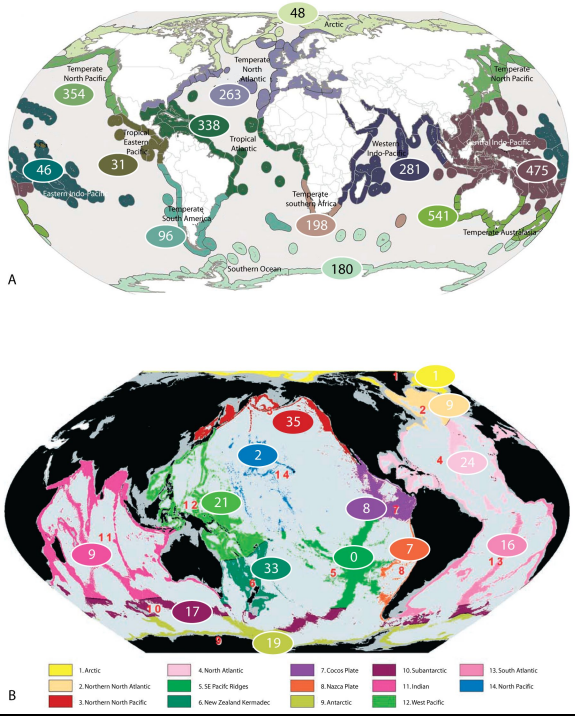
In short...



...everywhere

Poore, G., 2014.

**This figure only represents the marine crustaceans and does not account for the terrestrial or freshwater varieties.

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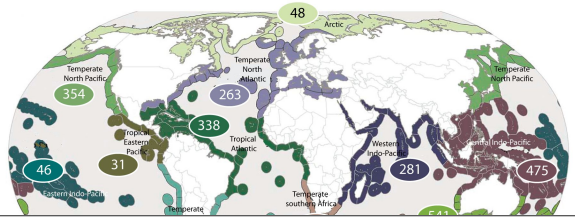
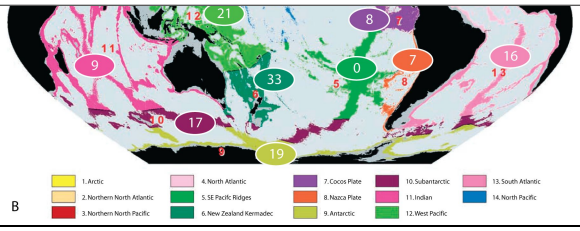


"Crustaceans are as ubiquitous as mosquitoes"

Waldo L. Schmitt



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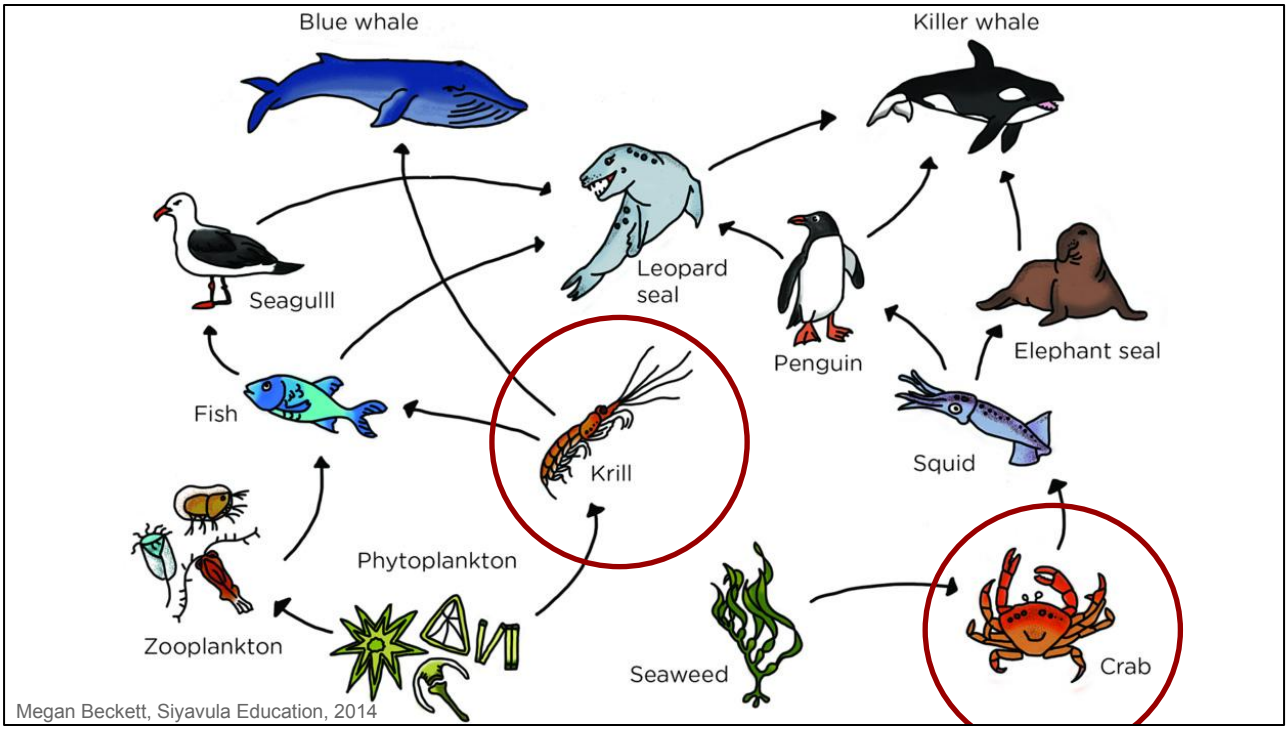
Others have said similar tidbits about crustaceans being so dispersed; however, many say that crustaceans are the insects of the sea, and while they may not be incorrect, and if we're being inclusive towards the land crustaceans, I'd rather stick with Schmitt's version.

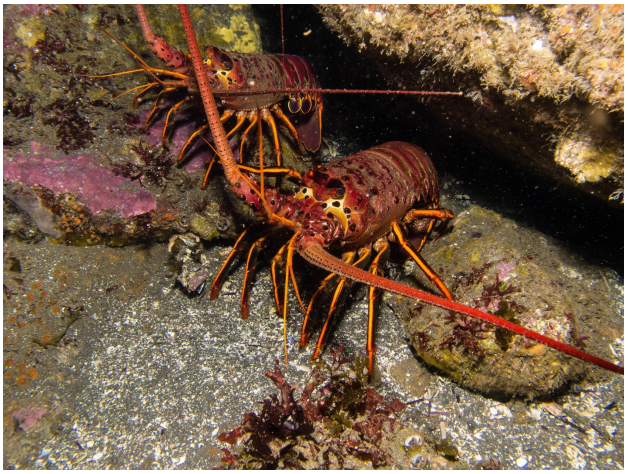


Marine food web interactions (Megan Beckett, Siyavula Education, 2014).

Isopods play an important role within the food chain by feeding on algae and phytoplankton and being preyed upon by larger trophic levels.

Crustaceans

- **Spiny lobsters (decapoda) influence density and size of intertidal molluscs**



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Boudreau and Worm conducted an exclusion experiment in which spiny lobsters were removed from the upper shore of an intertidal zone off the Southern California coast. In response of spiny lobster absence, the upper shore was observed to have an increase in both density and size of the mussels that the spiny lobsters consume[15].

Decapod predators can also be keystone species - thus having a strong impact on the ecology of the community.

Figure 2 on page 203 from Boudreau and Worm, 2013 shows a food web showing the spiny lobsters' role in the predator-prey interaction.

The picture on this slide is of a spiny lobster.

Crustaceans

- Spiny lobsters (decapoda) influence density and size of intertidal molluscs
- **Consume dead organic matter**

Kevin Litman-Narvarro

This picture is of a large backbone that has settled on the ocean floor. The animal it came from was likely consumed by many organisms, some of which could be crustaceans as they consume dead organic matter.

Crustaceans

- Spiny lobsters (decapoda) influence density and size of intertidal molluscs
- Consume dead organic matter
- **Provide important link in web - primary producers to consumers**

The bottom photo is of krill. The right is a clip from the Disney movie *Finding Nemo*.

As isopods are omnivores, carnivores, and detritivores, they perform decomposition, process particulate organic matter into labile carbon, and feed on photosynthetic organic matter to supply energy up the food chain.

Terrestrial isopods have been shown to increase decomposition of leaf litter[7].

- Contribute to decomposition
- Make photosynthetic energy available to higher trophic levels
- Consume particulate organic carbon

Food Web Similarities

- **Crustaceans are important food sources for many marine animals**
  - Either directly (krill being consumed by whales; squid consuming a crab) or indirectly (seal that consumes a squid that consumed a crab)

Food Web Similarities

- Crustaceans are important food sources for many marine animals
  - Either directly (krill being consumed by whales; squid consuming a crab) or indirectly (seal that consumes a squid that consumed a crab)
- **Detritivores (which include some isopods) consume dead organic matter whose nutrients will eventually be passed up the food web**

Food Web Differences

- **Terrestrial isopods contribute to decomposition**
  - Nutrients gained through consuming leaf litter will eventually make its way through the food web

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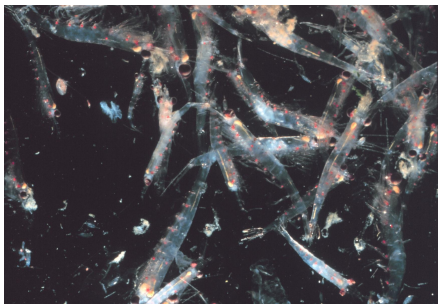
Terrestrial isopods consuming detritus.

Food Web Differences

- Terrestrial isopods contribute to decomposition
  - Nutrients gained through consuming leaf litter will eventually make its way through the food web
- **Mysidacea, krill, barnacles, and some isopods are filter feeders**
  - These species can filter out particulate organic matter. Energy obtained from this consumption is dispersed throughout the food web when they are consumed by predators



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These photos are of filter feeders. Krill and barnacles.

Species interactions (Creative Commons, 2017). A soft coral crab on a coral. The crab uses the coral for protection from predators.

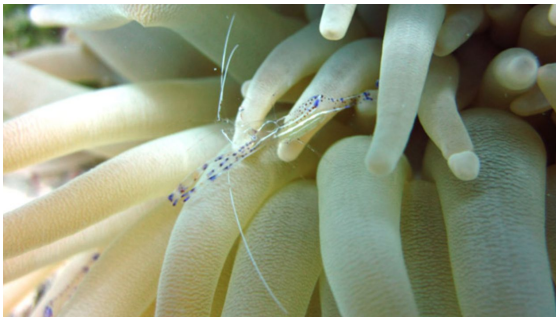
Species Interactions - Crustaceans

- Parasitism
  - *Typton carneus* (decapod) lives in fire sponges and leaves bored tunnels[8]
  - Pea crabs (decapoda) lives in oysters, sea cucumbers, and clams

This photo is of a pea crab that was found inside an oyster.

Species Interactions - Crustaceans

- Commensalism
  - Pederson cleaning shrimp
  - Barnacles on whales



Bermuda Institute of Ocean Sciences

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Notice the barnacles on the whale's tail. The Pedersen cleaning shrimp on the anenome.

Decorator Crab and sponge commensalism

Species Interactions - Crustaceans

- Mutualism
  - Carrier crab and spiny urchin

Bernard Dupont

Crab gets protection and urchin gains access to new feeding grounds

Species Interactions - Isopod

- Parasitism
  - *Cymothoa exigua*
    - Tongue-eating isopod

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https://www.youtube.com/watch?v=327-bwMQI-Y&t=2s

Parasitic isopod that replaces a fish's tongue.

Species Interactions - Isopod

- Parasitism
  - *Cymothoa exigua*
    - Tongue-eating isopod
- Commensalism
  - Whale louse

NOAA

https://www.youtube.com/watch?v=327-bwMQI-Y&t=2s

Notice the whale lice on a baleen whale.

Species Interactions Similarities

- **Crustaceans exhibit mutualistic, commensalistic, and parasitic relationships with other organisms.**
  - Aside from the class pentastomida, classes are not all parasitic/mutualistic/commensalistic

Species Interactions Similarities

- Crustaceans exhibit mutualistic, commensalistic, and parasitic relationships with other organisms.
  - Aside from the class pentastomida, classes are not all parasitic/mutualistic/commensalistic
- **Due to the variety of crustaceans, there is great diversity in species interactions**

Species Interactions Differences

- **Host choice**

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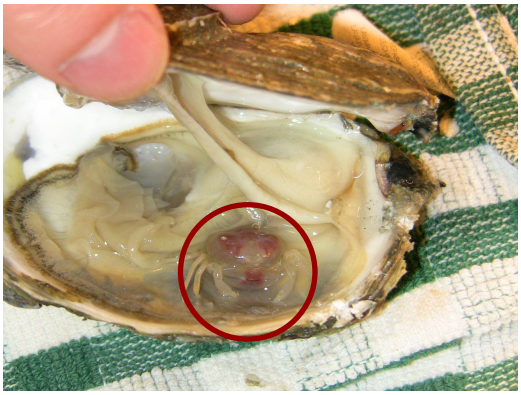

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Barnacles on whales vs. pea crabs inside an oyster.

Species Interactions Differences

- Host choice
- Reason for exhibiting a mutualistic, commensalistic, or parasitic relationship

Mutualism: carrier crab and spiny urchin[10]
- Carrier crab gets protection
- Spiny urchin gets access to new feeding grounds

Commensalism: whale louse
- Does not hurt the whale, just eats the dead skin and bacteria off them[11]
- For nutrients

Commensalism: barnacles
- Uses the migration of the whale to gain access to nutrient rich water[11]

Parasitism: tongue eating isopod
- Nutrient acquisition
- Ingests whatever the host does, could eventually starve the host[14].

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