**The Antarctic Food Web Level 5**

**Main ideas;**

**A food web will be affected by any increase or decrease of a species population**

**Climate change and ocean acidification may be affecting the Antarctic food web, by increasing or decreasing the abundance of some species, while affecting the distribution of some other species.**

**Key words**

**Food web, abundance, climate change, sustainable fishing, sea-ice**

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| https://farm6.staticflickr.com/5133/5536987424_e684c38e92_o_d.gif | **The Antarctic Food Web**  **Plankton** form the basis for the Antarctic food web. These are marine and freshwater organisms that, because they are non-motile or too small or weak to swim against the current, exist in a drifting state in the water they live in. The term plankton is a collective name for all such organisms—including certain algae, bacteria, crustaceans, molluscs and colenterates as well as representatives from almost every other phylum of animal. The plantlike community of plankton is called **phytoplankton**, and the animal-like community is known as **zooplankton.** The chief components of marine phytoplankton are found within the algal groups and include diatoms and diaflagellates and coccolithophorids. In the oceans, phytoplankton biomass rises and falls according to multiyear cycles and appears to be sensitive to changes in sea surface temperatures, climate change, and ocean acidification.  **Phytoplankton** are tiny plants that capture the energy of the sun and turn it into food, these are the producers of the Antarctic food web. As they are so tiny, they can divide and grow very quickly when the more intense and longer lasting light of summer arrives.  **Krill**  Humpback_lunge_feeding.jpg (547×374)Krill are small crustaceans that are found in all the world’s oceans. It is a herbivore that feeds on phytoplankton and zooplankton. It uses a “basket” made from its front legs to filter out the plankton from the water. The name krill comes from the Norwegian word krill meaning “small fry of fish”. Krill are considered an important trophic level connection; near the bottom of the food chain because they feed on phytoplankton, and to a lesser extent zooplankton, converting these into a form suitable for many larger animals for whom krill makes up a large part of their diet. In the Southern Ocean the Antarctic krill make up an estimated biomass of around 379,000,000 tons, more than that of humans.  Of this, more than half is eaten by whales, seals, penguins, squid and fish each year.  Humpback whales lunge feeding on krill    *Photo; Wikipedia*    **Whales**  Whales are the largest animals to have ever lived, larger even than the dinosaurs. There are two reasons why they have managed to attain such enormous size; well over 100 tons for the largest blue whales and nearing this amount for some other whale species.   1. **They live in the ocean** and so the buoyancy of the water can support their great bulk rather than having to be propped up and moved on land by legs and muscles. Like most other animals, the density of a whale is very close to that of water. 2. **Whales tap the food chain low down** close to the producers so there are few steps and so little energy is lost meaning more is available to the whales, so they are able to grow to enormous sizes.   The alternative consequence of this is that the higher up a food chain you get, the lower the biomass of animals (that is the number of animals multiplied by their weight) because there are more steps and so more energy is lost.  A simple Antarctic food chain is the secret to the success of the baleen whales – keep the chain short and transfer as much energy as possible as efficiently as possible.    **Food web**  A food web shows the complex interactions of the plants and animals in an ecosystem or habitat, showing what is eaten by what. This is a more accurate picture of the ecosystem than the food chain.  **Antarctic food web**  The Antarctic food web is relatively simple compared to ecosystems in other parts of the world. There are fewer different species, but greater numbers of them.  The second most numerous mammal in the world (after man) is the crab-eater seal.  A key part of the Antarctic food web are krill, small shrimp-like crustaceans that the great majority of Antarctic animals, seals, whales, penguins and other birds and fish feed on.  **Producers**; Phytoplankton, which may be carried by sea currents  Sea ice algae, which live on the underside of sea ice but may fall to the sea floor.  Macroalgae, leafy seaweeds and algae that are attached to rocks and corals on the sea floor  Microalgae, microscopic algae that lives on the surface of sea floor sediments  **Consumers;**  1. Herbivores; Krill, Herbivorous zooplankton  2. Carnivores; Carnivorous zooplankton, Squid, Fish, Birds, Seals (Elephant, Leopard and others), Penguins  Top predators; Baleen whale, Sperm Whale, Smaller toothed whales  **Decomposers;** Bacteria  https://s-media-cache-ak0.pinimg.com/originals/c9/88/be/c988be3461637fb1de4ebe915a7fa943.jpg  http://www.theozonehole.com/images/tmp4krill.jpg**Further Krill Facts**  Krill often are referred to as “keystone” species because they play such an important role for many marine systems.  http://www.theozonehole.com/images/krillnoaa.jpg  Some species of krill are bioluminescent.  This means that Antarctic krill emit a yellow-green light that is thought to either camouflage the krill's shadow or aid the krill in mating or schooling at night. Krill are invertebrates that grow to about two inches in length and live in large schools, or swarms, as dense as 10,000 krill per cubic meter of water.  http://www.theozonehole.com/images/v43n2-wiebe3en_10243.jpg**Krill Life Cycle**  Currently, 85 species of krill have been identified in different oceans around the world. They live in habitats ranging from abyssal depths (5,000 m) to near shore kelp beds (10 m), and from warm tropical seas to the freezing Antarctic Ocean.  Krill start life as eggs that sink and hatch in spring. They develop through larval stages as they swim back to the surface, reaching the fourth (furcilia) stage by winter. Krill that hatch at the depth of the Antarctic shelf (300-400 metres) can swim back to surface waters before winter and find phytoplankton to eat before they use up their stored supplies. Furcilia that make it survive their first winter by feeding on algae and zooplankton on the under surface of pack ice.  *Illustration by Jayne Doucette, WHOI Graphic Services*  http://www.theozonehole.com/images/antkrill.jpg**Formation Behaviour**  http://www.theozonehole.com/images/Krill_Coronado.jpgKrill typically are found in concentrated aggregations. Usually, one to ten individuals occupy a cubic meter of ocean. However, denser patches called shoals have concentrations of 10 to 100 krill per cubic meter, and swarms have 1000 to 100,000 krill per cubic meter. This schooling behaviour is an effective defence mechanism. It confuses smaller visual predators that prefer to isolate and take single individuals.  Swarms can extend 10 m or more in diameter and often elicit a frenzied feeding response from whales and other predators like fish and birds. This is particularly true when these aggregations are in the upper water column, and escape routes are restricted by the ocean's surface.  **Where krill can be found in Antarctica**  Antarctic krill live in the surface waters of the Southern Ocean, which extends north from the Antarctic continent to the polar front -- an area where the cold water of the Antarctic submerges beneath the warmer waters of the Atlantic, Indian, and Pacific Oceans. As this deep, cold water rises to the surface of the Southern Ocean, it brings nutrients from all the world's oceans into the sunlight, making this area home to what is possibly the earth's largest assemblage of phytoplankton. It is this massive gathering of phytoplankton that allows for such tremendous swarms of krill, which harvest the miniscule phytoplankton particles with a specially developed feeding basket that filters them out of the water. The krill also find nourishment by scraping ice algae off the underside of pack ice, particularly in spring. These are successful techniques, apparently, since the total biomass, or weight, of Antarctic krill -- which is estimated to be between 100 and 800 million tons -- may be the largest of any multi-cellular animal on the planet.  **Climate Change**  In the early life stages krill require deep water with low acidity and a narrow range of temperatures for their eggs to successfully hatch and develop. The larvae then feed on algae on the underside of sea ice. The adults require suitable temperatures and enough of the right type of food (larger phytoplankton) to successfully grow and reproduce. Many of these critical environmental features (temperature, acidity, [sea-ice](http://phys.org/tags/sea+ice/) and food availability) could be affected by climate change.  Penguins are being affected by the warming of our planet. Different species of penguins have different ways of nesting and breeding and the warming of Antarctica is affecting different species in different ways. These effects are also variable across Antarctica as some parts of Antarctica warm while other areas have not warmed so quickly. For example; warming temperatures are creating changes that benefit Adélie Penguins. In southern portions of the Antarctic coast, areas of once impenetrable pack ice have loosened allowing easier access by penguins. Penguins would much rather swim in the ocean than walk on sea ice that covers it. Further north, however, along the warmer Antarctic Peninsula, sea ice habitat that Adélies depend on is disappearing. These penguins exist only where there is sea ice for at least a portion of the year. |
| http://www.thebestcareerforme.com/wp-content/uploads/Orange-Question-Mark.png | **Questions/ think pair share/ discuss**   * 1. What could be the consequences for harvesting any part of the Antarctic food web? * 2. What does the term “sustainable fishing” mean? * 2. Should people fish in the Southern ocean? * 3. What do you know about the effects of global warming on Antarctica? Could the warming of the oceans affect the food web? * <http://phys.org/news/2013-08-antarctic-seas-impact-krill-habitats.html#jCp> |
| consent-clipart-pen_and_paper_legal_document_with_pen_signing_the_paper_0515-0909-2116-0233_SMU.jpg (300×257) | **Activities**  Watch <https://www.youtube.com/watch?v=1_BqC9IIuKU> to see whales feeding on krill.  Suggested areas of research topics   1. Krill is a resource that is harvested in the Southern Ocean. List all the organisms that would be affected by a decrease in krill numbers.   <https://www.ccamlr.org/en/fisheries/krill-fisheries-and-sustainability>   1. Managed fishing of the Antarctic toothfish (*Dissostichus mawsoni*) already occurs. Find out about the Antarctic toothfish industry. Who is involved and why? How is it this fishing industry managed?   <https://www.niwa.co.nz/fisheries/research-projects/the-ross-sea-trophic-model/toothfish-fishery>   1. Examine the effect of the recent warming of the Antarctic Peninsula on the Adelie and Emperor penguin. How will other penguin species be affected?   Identify which penguin species will possibly; relocate, adapt, decline in numbers.  Give reasons.  <http://www.penguinscience.com/classroom_home.php>  <http://www.penguinscience.com/clim_change_ms.php>   1. Leopard seal and crabeater seals both live on the sea-ice. Do they compete for food? Look carefully at the teeth of each one. The leopard seal is on the left and the skull of the crabeater seal is on the right. What is their relationship within the food web?   http://www.anta.canterbury.ac.nz/resources/pengui.html  **D:\Antarctica 2015 2016\P1000512.JPG***https://upload.wikimedia.org/wikipedia/commons/2/22/Leopard_Seal.jpg*  *photo;Wikipedia*   1. Research why the Antarctic Peninsula is warming more quickly than the Antarctic continent. How could this affect the wildlife of Antarctica? Hint; some species can move to the warming areas, while those species adapted to very cold conditions may not have anywhere to migrate to. How has the temperature affected the sea-ice? What are the implications for wildlife?      1. Marine Protected Areas are proposed for areas of the Southern Ocean, the ocean south of 60˚ latitude.   Find out more at this website ;  <https://www.ccamlr.org/en/science/marine-protected-areas-mpas> |