Logbook

Topic- The Effect of the Acidification of Oceans on Mussels

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Topic-

-Topic gone with

~~Ax th~~ The Effect of the Acidification of Oceans on Mussels ~~Shells~~

Advantages

Not harming ~~muse M~~mussels because we are only using their shells

Figure out how the ~~co2~~ CO_2 mixing with water is making it acidic, and how it ~~e~~affects the food webs it is in.

Easy to get the ~~sheels~~ shells and other materials

Disadvantages

Time consuming (takes a month)

Or

~~The~~Is Grey Water Good for the Health of ~~Platn~~ Plants?

Advantages

Figure out if the government is lying about grey water ~~is~~being good for plants(used during ~~eal~~Calgary ~~War~~water restrictions.

See if we can water plants with grey water to save fresh/clean water.

Disadvantages

Takes a while

Will ~~e~~affect the plant's life, and might even kill it.

Background Research-

Greenland Mussels

Common name: New Zealand Green Lipped Mussel

Scientific Name: *Perna Canaliculus*

Greenshell mussels are bivalve mollusks that have two part hinged shells and a soft body.These mussels are native to New Zealand and make their homes on rocks and solid surfaces around New Zealand's coastline.They get their name form bright green stripe along their shell. They often cling to solid objects or each other using threads called byssus threads.Mussels feed on phytoplankton by pumping large volumes of water over their gills. Then, phytoplankton trapped on the gills is transported to the mussel's mouth and is eaten. It is called filter feeding.

Physical Appearance

Green mussels are bivalves and have two hinged shells closed by two muscles. A strong ligament holds the two valves together. They have ~~an~~ elongated shells with an average length of 10-15cm. These mussels have smooth and glossy shells with greenish blue color and radiating strips. They also have a fibrous beard which helps them to attach to rocks and other surfaces in the ocean.

Composition and Functions of the Shell

Composition- The main component of mussel shell is calcium carbonate which constitutes approximately 94% of the shell.It's shell also contains small amount of inorganic matter and traces of other elements such as magnesium, manganese , iron, copper and zinc, Calcium carbonate provides the hardness and durability to the shell.

Function- The shell protects the soft tissues of the mussels from external factors, serves as a food source and helps them defend against the predators. It also provides them the ability to move and feed.

Role of Mussels in the Ecosystem

Mussels play a significant role in marine ecosystems and are considered as "ecosysytem engineers" as they modify aquatic habitat, making it suitable for themselves and other marine life.

- **Mussels filter water**: When mussels feed, they draw in water containing phytoplankton and filter the water to feed on phytoplankton.It helps to clean water. Up to 350 litres of water can be filtered by one mussel in a day.
- **Mussel shells provide habitat**: Small fish, insects, and plants use mussel shells for making their nests.
- **Mussels provide food** :They act as a food source to people and many marine species such as snapper, blue cod, fur seals and octopuses.
- **Mussels add nutrients:** Mussels add nutrients to the water through their waste which is used by the aquatic plants to make food.

pH

pH is the measurement of a liquid's acidity or basicity. A pH scale is a tool for measuring acids and bases.It has numbers ranging from 0-14. A ph of 7 is considered neutral. Anything below the pH of 7 (6.9 or less) is considered acidic and anything above the ph of 7 (7.1 or more) is considered alkaline (basic).

What is optimum pH for mussel survival?

Mussels thrive best in an alkaline environment ranging form pH 7.5 to 9.3. This pH range helps them to grow them efficiently by providing them nutrients required for their growth and reproduction.

Ocean Water

Sea water constitutes the oceans and it covers more than 70 percent of earth's surface. Sea water contains 96.5% water, 2.5% salts, and small amounts of other substances including dissolved

organic and inorganic matter and some dissolved gases.Average ocean water is slightly alkaline, around the pH of 8.1.

Ocean Acidification

Ocean acidification means decrease in pH of the ocean over an extended period of time caused mainly due to the absorption of carbon dioxide from the atmosphere. Oceans absorb 30% of carbon dioxide present in the air. Then, carbon dioxide combines with water to make carbonic acid. The carbonic acid decreases the pH of water by increasing the amount of hydrogen ions and thus the water becomes acidic. The amount of carbon dioxide has increased in the air due to burning of fossil fuels and land use change. Due to increase in the carbon dioxide in the air, more and more carbon dioxide is absorbed by the sea making it more and more acidic. This increased acidity interferes with the availability of carbonates required to make skeletons of certain types of marine life such as clams, corals and mussels.

Ocean Acidification and Real Life Problems

Corals in the Caribbean and cold-water reefs off of Scotland and Norway are also facing the problem of ocean acidification. Many species and corals are threatened as the waters can hold so much carbon dioxide that due to corrosive conditions, shelled creatures dissolve in the water. This affects the food source for birds, fish, and other marine animals.

California Mussels and Lower pH

One of the studies conducted at University of California, San Diego has shown that shells of California mussels are weakening due to the acidic conditions present in the nearby Pacific ocean. The acidic conditions are eating away the shells of California mussels and these mussels are secreting calcite more than they were secreting 60 years ago.The study has concluded that if the mussels disappear, 303 living species who are dependent on them in some way will be impacted and some of them even can become extinct.

Purpose-

The purpose of this experiment is to investigate the effect of acidic water on the shells of New Zealand green mussels.

Testable Question-

If mussel shells are kept in two different solutions (Salty water solution(salt+tap water) & acidic solution(salt+water+vinegar)) for a month, what will the difference be in their weight and appearance?

~~Hypothesys~~ Hypothesis-

If mussel shells are kept in 2 different solutions(salty water and acidic salty water) for a month, I believe that the salty water shells will have little/no change because they are in water that is similar to the water they are used to(ocean water). I believe that the ones in acidic salty water will decrease in weight because the acid might break down the shells. The color of the shells might become lighter because the acid might bleach the color.

Variables (November 24)-

Independent Variables- Temperature of water and surroundings, amount of water taken, duration for which the shells kept in the water, types and number of shells

Dependent Variable- pH of the solution

Responding Variable- Weight of shells, texture and appearance of shells

Materials (November 19)-

- 18 Green mussel shells
- pH strips
- Vinegar
- Weighing scale
- Six glass jars
- Measuring cup
- Lab notebook
- Tap water
- Salt
- Marker
- Towel paper
- Sticky Notes

Procedure-

1. First take 30 frozen New Zealand green mussels.
2. Thaw the mussels for 24 hours.
3. Clean the meat from the mussels.
4. Let them dry for 12 hours.
5. Take the six glass containers with their lids.
6. Clean them thoroughly and dry them.
7. Label the three containers A and three containers B with a permanent marker(using sticky notes).

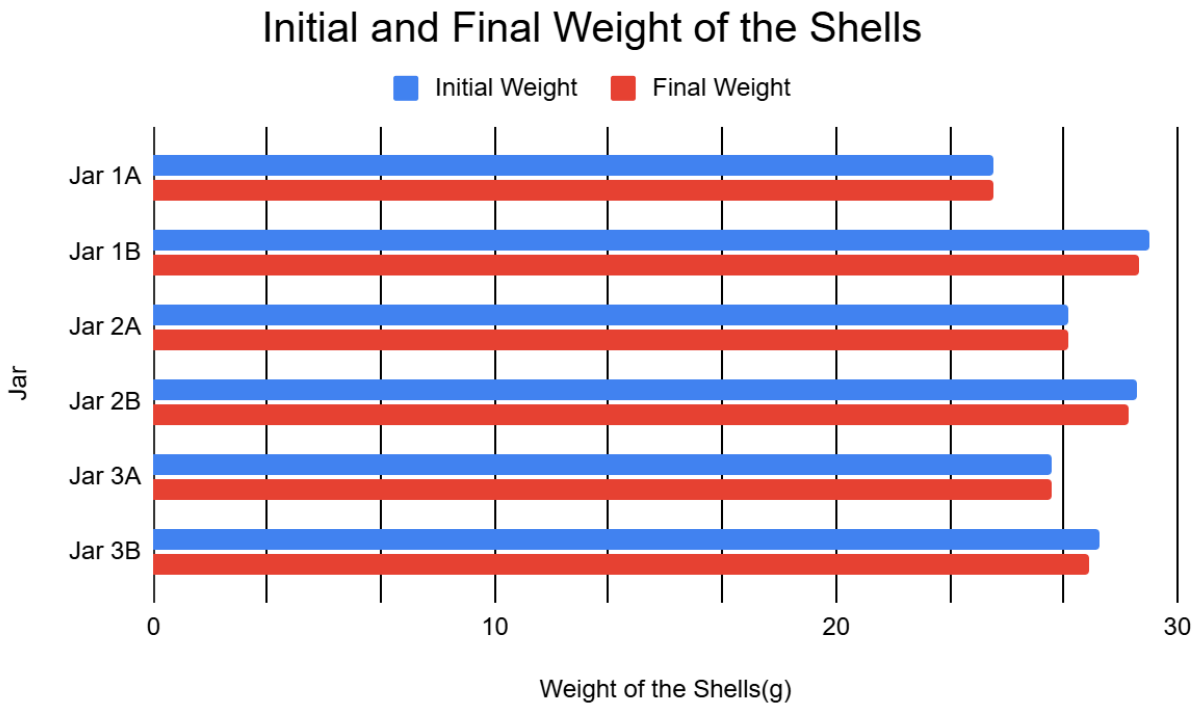
8. Preparation of salty water
    a. Weigh 35 g of sodium chloride (common salt).
    b. Place 35 g of salt in a container and add tap water until the total mass is 1000g.
    c. Prepare 10 litres of seawater by repeating step b.
9. Fill container A with 1 litre neutral salty water.
10. Preparation of acidic (pH 6) sea water
    a. Mix 2g of vinegar in 500g of sea water in a glass container
    b. Check the pH with a pH strip.
11. Next, fill container B with the 500g of acidic sea water (pH 6).
12. Take 5 green mussel shells and weigh them.
13. Note the weight and appearance (color & texture) of mussels in a notebook.
14. Place these mussel shells in container A and cover the lid.
15. Take 5 more green mussel shells and weigh them.
16. Note the weight and appearance (color & texture) of mussels in a notebook.
17. Place these mussel shells in container B and cover the lid.
18. Place the container A and B undisturbed for three weeks in a shady place at room temperature.
19. After three weeks take out the shells from container A and B by draining water.
20. Dry the mussel shells.
21. Weigh them by using a weighing scale and note down any difference in their weights in a notebook.
22. Note down any changes in the appearance of shells in a notebook.

Repeat step 8 to 22 for another two trials.

Data

Trial #	Before (Jar A)	Before (Jar B)	After (Jar A)	After (Jar B)
1	24.6	29.2	24.6	28.9
2	26.8	28.8	26.8	28.6
3	26.3	27.7	26.3	27.4

Observations- Graph



Results

The acid in the simulated acidic seawater affected the weight and appearance of the shells in all three trials. In all three trials, the shells in the normal water had no difference in weight. However,the weight of shells kept in acidic water has decreased by 0.3g, 0.2g, and 0.3g in trial 1, 2, and 3 respectively. Furthermore, the skin of shells kept in the acidic water was peeled off from some spots. Additionally the fibrous beards of shells kept in acidic water also appeared to be gone. Both the shells in the acidic seawater and normal seawater had tiny pieces broken off of them. and the shells lost their gloss after a month of being left in water.

Conclusion

The objective of this experiment was to investigate the effect of acidification of oceans on shells of New Zealand green mussels.To test it, prepare simulated sea water (water that has the same composition of water as the ocean) by mixing 35 g of salt in 1000 ml of water. Then divide the solution into two equal parts (500ml each) and label them A and B.Take 2 milliliters of vinegar with the help of measuring cylinder and add it to jar B to prepare acidic solution(pH=6).Mix it thoroughly.After this,take three mussel shells,weigh them and place them in jar A.Similarly weigh another 3 mussel shells and place them in jar B.Leave them in an area that will remain undisturbed for a month. After a month,take them out, dry them and check the difference in

weight and appearance.

In all three trials, the weight of shells in the acidic water has decreased.It happened as acid(acetic acid) in water reacts with calcium carbonate present in the shells of mussels and forms calcium acetate(dissolves in water) ,water, and carbon dioxide.

Acetic acid + Calcium Carbonate -> Calcium Acetate +Carbon dioxide + Water

It has resulted in the decomposition of shells, thereby reducing their weight. Additionally , there is a significant difference in the appearance of shells.The skin of the shells is clearly gone at some places, along with their fibrous beards. All of the above results have proved that my hypothesis, which predicted that the acid water will damage and dissolve the shells of mussels, was correct.

Application

My experiment will help us to understand the impact of acidification of oceans, due to climate change, on the shells of New Zealand mussels, coral reefs, and other aquatic species with shells. Many marine life creatures such as abalones, seashells, and sea urchins have also their exoskeleton made up from calcium carbonate.The shells of all these creatures are very important for their survival as they provide them protection, shelter and mobility.If the shells disappear or get damaged, the mussels will eventually fail to survive. Due to this the animals,fish, and humans which rely on the mussels for food will also struggle.As a result of it, the entire ecosystem which depends on mussels will get imbalanced.Additionally,due to decline in the amount of fish which depend on mussels for food, the fisheries across the world will also get damaged.

Glossary

Mollusks- Mollusks are living creatures which have soft bodies with no spinal cords and are often covered with shells.

Phytoplankton- Phytoplankton is marine microalgae.

Tissues- Tissues are groups of cells which carry out a specific function together.

Fossil Fuels- Fossil Fuels are non-renewable sources of energy such as coal, petroleum, natural gas, crude oil etc. These are hydrocarbons which are made up from the remains of fossilized plants and animals over a million of years ago.

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