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Investigation of Water Pollution

Investigation of water pollution; comparison of water entering and leaving Newquay zoo.

Many causes of pollution contain nutrients such as nitrates and phosphates. In excess levels, nutrients over stimulate the growth of aquatic plants and algae. Excessive growth of these types of organisms consequently clogs our waterways, use up dissolved oxygen as they decompose, and block light to deeper waters.
This is harmful to aquatic organisms as it affects the respiration ability or fish and other invertebrates that reside in water.

Pollution is also caused when silt and other suspended solids, such as soil, wash off ploughed fields, construction and logging sites, urban areas, and eroded riverbanks when it rains. Under natural conditions, lakes, rivers, and other water bodies undergo Eutrophication, an aging process that slowly fills in the water body with sediment and organic matter. When these sediments enter various bodies of water, fish respiration becomes impaired, plant productivity and water depth become reduced, and aquatic organisms and their environments become suffocated.

Pollution in the form of organic material enters waterways in many different forms as sewage, as leaves and grass clippings, or livestock feedlots and pastures. When natural bacteria and protozoan in the water break down this organic material, they begin to use up the oxygen dissolved in the water. Many types of fish and bottom-dwelling animals cannot survive when levels of dissolved oxygen drop below two to five parts per million. When this occurs, it kills aquatic organisms in large numbers, which leads to disruptions in the food chain.

Water was collected from five different sites around the zoo.

1. The stream above the zoo
2. The zoo lake
3. The stream leaving the zoo
4. The stream entering the boating lake
5. The boating lake

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The abiotic factors tested were:

- Nitrate (NO3) mg/1
  (Appendix 1)

- Ammonia
  (Appendix 2)

- Nitrite
  (Appendix 3)

- Phosphate
  (Appendix 4)

- Oxygen
  (Appendix 5)

- PH
  (Appendix 6)

- Turbidity
  (Appendix 7)

The Biotic factors that were measured are:

Species diversity

Designed to detect organic pollution impact on macroinvertebrate communities in small shallow streams. They reduce the effort in collecting macroinverbrates. The measures can be grouped into five major categories:

1. Taxonomic richness
2. Taxonomic enumeration (abundance)
3. Taxonomic diversity similarity indices
4. Biotic indices
5. Functional feeding group measures

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Biological indicators

Biological indicators can signal occurrence of pollution even if the pollution is temporarily absent at the time of measurement. Some organism's act as indicators such as Sludge worms (Tubificidae). The organisms that are not present cant live in it or feed on other organisms that can't live in it. Habitats and geographical locations need to be taken into consideration as organisms may only live in certain areas.

Biochemical Oxygen Demand (BOD)

The measure of the rate the oxygen concentration falls in a sample of natural water that is kept out of contact with the air and at a constant temperature. The fall occurs as organisms use the oxygen breaking down.

Turbidity

This is how clean the water is, the greater the amount of total suspended solids (TSS) in the water the murkier it is and the higher the measured turbidity.

Sequential comparison index (SCI)

This is for measuring the diversity without requiring any taxonomic knowledge. The organisms collected are poured in to a tray and examined. Each species is categorised into a particular run. So each letter represents a different organism.

A sequential comparison index (SCI) can be shown as: SCI = number of runs /n

Results

(Appendix 8)

Sequential comparison index

SCI no of runs 34/224 = 0.15178571

DI SCI x no of taxa (different species)
0.15178571 x 10 = 1.5178571

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Biotic Table

SITE	SCI	DI
1	0.344	1.376
2	0.0044	0.013
3	0.152	1.52
4	0.305	2.44
5	1.730	8.65

Biochemical Oxygen Demand (BOD)

1	10 – 5.6 = 4.4
2	5.5 – 0.1 =5.4
3	10 – 6.4 =3.6
4	9.6 – 6.4 = 3.2
5	9.3 – 4.7 = 4.6

The results show that the zoo lake (site 2) was very polluted above the legal amount. As the Nitrite level was very high and the Nitrate was low

Nitrate reactions [NO3-] in fresh water can cause oxygen depletion aquatic organisms depending on the supply of oxygen in the stream will die. The major routes of entry of nitrogen into bodies of water are municipal and industrial wastewater, septic tanks, feedlot discharges, animal wastes (including birds and fish) and discharges from car exhausts. Bacteria in water quickly convert nitrites [NO2-] to nitrates [NO3-].

Nitrites can produce a serious condition in fish called "brown blood disease." Nitrites also react directly with haemoglobin in human blood and other warm-blooded animals to produce methemoglobin. Methemoglobin destroys the ability of red blood cells to transport oxygen. Nitrite/nitrogen levels below 90 mg/l and nitrate levels below 0.5 mg/l seem to have no effect on warm water fish.

This can be harmful to some of the animals in zoo and should be dealt with.

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References

Colorimetric method -- APHA Standard Methods, 19th ed., p. 4-85, method 4500-NO2 B (1995).
Titrimetric method -- Developed by CHEMetrics, Inc.