

TUTOR MARK ASSIGNMENT (T.M.A) 2018-19
BIOLOGY (314)

BIO-MAGNIFICATION

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TOPICS

- What is Biomagnification??
- How does Biomagnification take place?
- Some Common Chemicals involved
- The food chain
- Impact of Biomagnification on the food chain
- Impact on Humanity
- Some News articles



WHAT IS BIO-MAGNIFICATION??

- Also known as Biological Magnification or Bioamplification.
- Accumulation of non-biodegradable chemicals, or toxins progressively at each trophic level in a food chain is called Bio-Magnification.

HOW DOES BIO-MAGNIFICATION TAKE PLACE?

Toxic substances like DDT are used as pesticides, insecticides, insect repellants, some pharmaceuticals, etc. These are typically used on plants and rarely on animals.



These toxic, non-biodegradable chemicals enter the food chain when the plant gets eaten by a herbivorous animal



After it is consumed by the herbivore (primary consumer) it typically does end up getting consumed by a secondary consumer and so on.



But during the same process, due to the **10 percent law of Energy Transfer**, organisms in higher trophic level have to consume more in order to meet their energy requirements. This increases the amount of toxic material in their bodies, in turn leading to their death.

SOME COMMON CHEMICALS INVOLVED

Substances that Bio-magnify are classified in to two main groups

POPs or Persistent
Organic Pollutants

Heavy metals

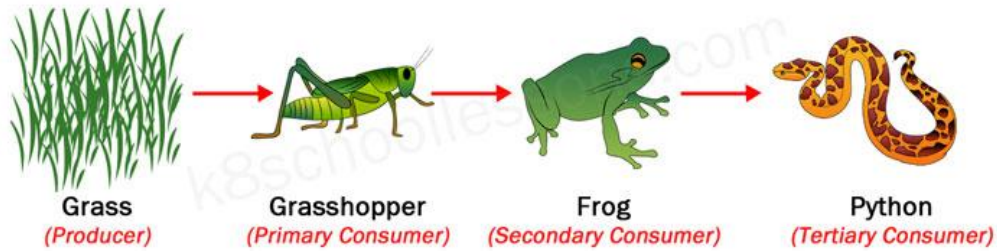
Some POPs (these are Novel Organic Substances);

- Dichlorodiphenyltrichloroethane (DDT)
- Hexachlorobenzene (HCB)
- Polychlorinated biphenyls (PCBs)
- Toxaphene
- Monomethylmercury

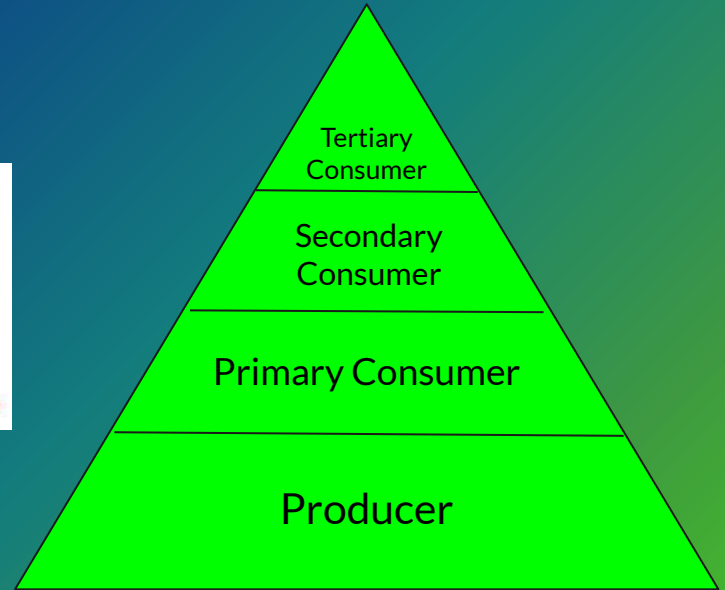
Some Heavy Metals involved include:

- Selenium, Mercury and Nickel

THE FOOD CHAIN AND TROPHIC PYRAMID



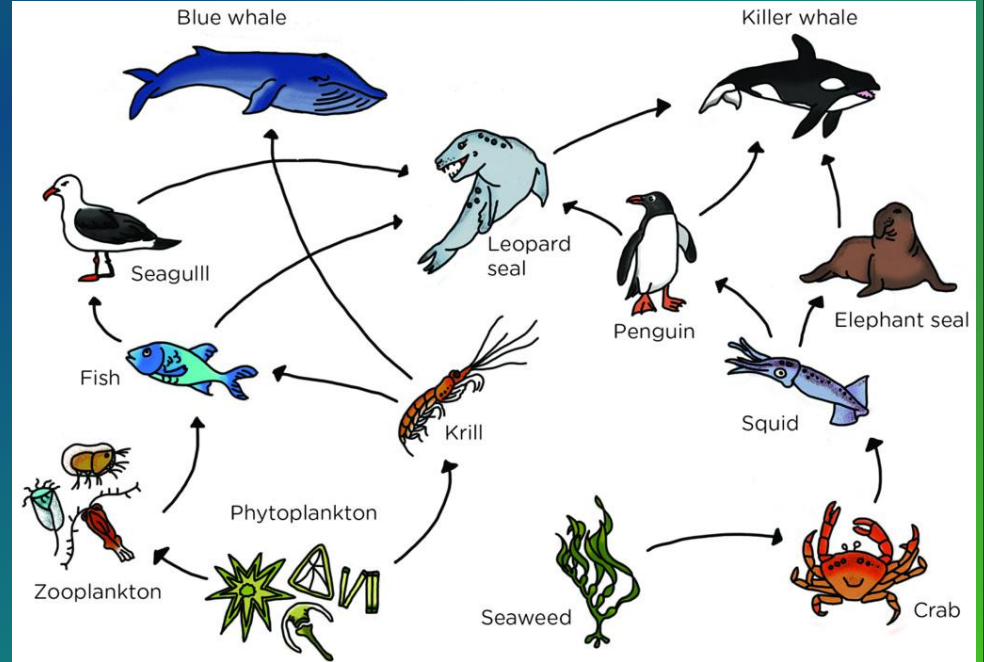
Food Chain



The Trophic Pyramid

FOOD WEB

- Several Food Chains combine together to form a Food Web.
- This causes the Biomagnification of Chemicals to affect several species in various food chains rather than just some five or six.



IMPACT OF BIO-MAGNEFICATION ON THE FOOD CHAIN

- Chemicals that Biomagnify when consumed by an organism enter the food chain.
- After it enters the food chain it impacts several other food chains that are contained in the same food web, thereby affecting several species rather than a mere five or six from the same food chain.

IMPACT ON HUMANITY

- Microplastics are bio-magnified and enter our food by various ways including water and fish. Particularly seafood and aquatic fauna have been found to contain liberal amounts of microplastics in them.
- Similarly various forms of meat containing bio-magnified chemicals enter the human body.
- The accumulation of chemicals and microplastics leads to various health issues to humans including Kidney failure, Cancer, Gingivitis and several other diseases and disorders.

Testing for microplastics in bottled water



93%

of bottled water tested showed signs of microplastic contamination



10.4

particles per litre bigger than 100 microns (about the width of a human hair)



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particles per litre smaller than 100 microns which are probably plastic

Source: Orb Media/State University of New York Fredonia



SOME NEWS ARTICLES

Assam's rare captive-bred vultures face a drug problem

Diclofenac use by quacks is a threat to 104 birds bred at Rani

RAHUL KARMAKAR
RANI

The last of the nature's scavengers in Assam, a suitable habitat for vultures, are battling toxic chemicals in livestock carcasses. And the 'meal of death' that is killing them is also delaying freedom for vultures being reared in captivity in the State.



Slender-billed vulture. • SPECIAL ARRANGMENT

The Vulture Conservation Breeding Centre (VCBC) at Rani, about 30 km west of Guwahati, is one of four in India that the Bombay Natural History Society (BNHS) set up more than a decade ago in association with State Forest Departments.

The VCBC has 104 vultures, most of them brought in as chicks from the wild. The centre has 30 adults and sub-adults: all original white-backed and slender-billed. These are two of six species found in Assam that are old enough to be set free.

But their release is getting delayed because big vials of diclofenac, a painkiller, banned three years ago but allowed to be sold if manufactured before December 2015, are yet to expire. Rampant use of pesticides by farmers and more than 70,000 tea gardens is another cause.

The digestive system of vultures, experts say, is so evolved that they can

tolerate bacteria and natural toxins in putrefying meat. But they are vulnerable to chemicals such as diclofenac, present in the carcasses of cattle that were injected with the painkiller.

Spelling doom
"Diclofenac for veterinary use was banned in 2005, but vials for humans continued to be made until BNHS pressed the government into banning those of 30 ml or more in 2015. Humans need 3-5 ml while only 30 ml or more works for crows. But quacks use the 30 ml vials for veterinary use, with fatal consequences for vultures," Sachin Ranade, the Rani centre manager, told *The Hindu*.

The centre, according to Mr. Ranade, is unlikely to release the adult vultures until the last of the 2015 stocks of the big vials expire by December 2018. Even

then, there is no guarantee that the birds will be safe.

This is because of easy availability of pesticides. Wildlife officials say dogs, jackals and leopards are usually the target of villagers who lace the carcass of dead cattle with pesticides. But vultures are the unintended victims. On March 18, at least 32 vultures, most of them Himalayan griffons, died after feeding on the carcass of a goat.

The VCBC, however, is making all efforts to save the birds. For instance, mutton is the only food given at the VCBC and goats are kept for 10-12 days before the feeding. This is to ensure that traces of any toxic painkiller or other chemicals are flushed out.

India hosts nine vulture species, five of them the highly endangered Gyps species. Assam is home to six, including winter visitors from the Himalayas – the Himalayan and Eurasian griffons.

BNHS and other organisations found in the 1990s that the Gyps populations in India and Nepal declined from about 40 million by 99.9% in just two decades.

Vultures take time to mature, pair for life, breed once a year, and live up to 70 years – making captive breeding efforts a challenge, and their decline serious.

Antibiotic resistance: vultures 'wintering in India show pattern'

E. coli in the wild birds became immune to some drugs within a few months

R. PRASAD
DHANNAI

Escherichia coli, a pathogen seen in over 90% of Egyptian vultures that migrate to northwest India to spend the winter, tend to show significant difference in resistance to antibiotics within a single season, a study has found.

"The vultures were resistant to certain antibiotics when they arrived and developed resistance to certain other antibiotics when they left. Their sensitivity to certain antibiotics also changed within a few months," says Pradeep Sharma from the College of Veterinary and Animal Science, Rajasthan University of Veterinary and Animal Sciences, Bikaner.

A team studied vultures that arrived in Bikaner in October 2011 and left in March 2012. The birds fed on cattle carcasses dumped in Jorbeer in Bikaner.

The findings of the study,



In a fix: Egyptian vultures. • R. PRADEEP SHARMA

published in the journal *Infection Ecology and Epidemiology*, are significant because migrating wild birds can spread drug-resistant pathogens and cause disease.

The resistance to multiple antibiotics was as high as about 71.5% in *E. coli* collected from vultures. Resistance of 12-13 bacterial strains to 13 commonly used antibiotics was studied.

rence in the percentage resistance to multiple antibiotics that are commonly used. What we found was a change in the pattern of resistance," says Dr. Sharma, corresponding author of the paper.

The study found a change in the resistance pattern of the *E. coli* within a single wintering season.

The vultures that use human-dominated landscapes as part of their life cycle were likely to act as "reservoirs and melting pots of bacterial resistance", the study said.

The study also showed that vultures were able to incorporate and reflect resistance determinants at the site of wintering and during the period of sampling. "So guidelines to restrict antibiotic use in both humans and animals by one country or region alone will be inadequate when wild birds can spread drug-resistant bacteria," says Dr. Sundar.

"There is not much differ-

Garbage disposal and plastics

A few months ago, the Tamil Nadu government decided to strictly implement restrictions on the sale and use of plastic carry bags. This is because of the growing concerns regarding waste generation as well as hazards due to plastic bags such as choking of storm water drains, polluting the air when burnt and just simply smothering our towns and villages filthy.

Much of the plastic in our towns simply lies around, especially bags holding biscuits and snacks as well as Gurika pouches. They look very attractive and colourful in our problem.

In some states, the minimum thickness has been set at twice this number for instance in Tamil Nadu, it should be at least 60 microns. Because of this, many supermarkets in Chennai have started charging a price of Rs. 2 for bags to pack groceries. In some customers argue over this cost, with most sales persons unable to explain why this cost has recently been added. This is a perfect opportunity to educate the public about the problems with plastic disposal. Although it is such a small commodity, it causes many problems that we are simply not able to cope with.

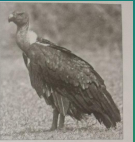
Some people argue that plastic bags are a necessity, for garbage disposal itself. There are organic plastic bags that are slowly becoming popular. It used for garbage disposal, the plastic usually completely

manufacture virgin plastics or recycled plastics of thickness less than 20 microns.

However, I am sure all of you have seen bags that violate these norms. The government is trying very hard to restrict and ban the manufacture of such polluting plastics. But what about the tons of plastics garbage already in our landfills? What to be done about them? In Tamil Nadu, there is a strong proposal to use the discarded plastics in road construction and make them water proof. Many states are trying to find local solutions to this problem.

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Some people argue that plastic bags are a necessity, for garbage disposal itself. There are organic plastic bags that are slowly becoming popular. It used for garbage disposal, the plastic usually completely



disposes (into carbon dioxide and water) in a few weeks, leaving no polluting residue. Ultimately, if we want to live in a clean environment, we should be willing to shoulder the responsibility of cleaning it up, and keeping it clean!

The value of the king of garbage disposal in nature. It is a natural scavenger keeping the Earth neat and clean. The vulture in India and all over the world is now a threatened species, listed as being critically endangered in the IUCN Red List for wild species. Perhaps it's time to adopt the vulture as our mascot: save the vulture, and seriously consider the various issues in garbage disposal.

How can you help? At least begin by discussing the issue with friends. Ask the adults in your house how they deal with waste and try to find environmentally-friendly solutions by discussing the issue with friends.

For more details on plastic waste management by the Tamil Nadu Pollution Control Board, read the article in the web-site.

Number of vulture nests declines in Wayanad

E.L.M. MANOJ

KAPRITA Even after a curb on the use of Diclofenac, an anti-inflammatory drug, acknowledged to have caused the decimation of vultures in the Indian subcontinent, the nests of vultures are dwindling in the Wayanad Wildlife Sanctuary (WWS), a safe habitat for different species of the birds in south India.

The Union Ministry of Health and Family Welfare had restricted human formulations of injectable diclofenac to single, 3 ml dose packs last year to check its misuse by veterinary doctors. A preliminary survey on vulture population, organised by the Forest and Wildlife Department in four



officials could spot only 11 nests in the sanctuary.

forest ranges under the WWS as part of the newly launched conservation program, has pointed to a considerable decline in the number of nests.

vultures, including 54 White-rumped ones and 19 Red-headed ones. It could sight only 11 nests, in three ranges of the sanctuary, P. Dharmabalan, Director, WWS, said.

While the largest number of nests was recorded at Kazhukan Kolly in Kurichal forest range, the least was found in Muthangan. No long-billed vulture was spotted during the survey, he said.

However, close to 150 vultures of different species had been recorded by a camera trap in the Sulthan Batheri range while they were feeding on an elephant carcass nearly a month ago. P.A. Vignayan, a conservationist who

recorded over 20 individual