Royal Science Magazine

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Sustainable Environment

In This Issue

On the Cover

Vol.1, Issue 2, 2022

From the Editor

It was a memorable moment to have released the ambitious first issue of the Royal Science Magazine. We received positive feedbacks as well as, of course, some critics for improvement. We improve our focus to deliver science to common man as much as possible in a simplest way. And thus, Royal Science Magazine serves its purpose. There was overwhelming response for our quiz and competitions. RSM thanks to all the participants and as promised the participants are given e-certificates and the winners are announced in this issue. Initially, we planned to publish monthly issues. However, due to time constraint in bringing up the quality articles, RSM is released as a bi-monthly magazine.

RSM requests its readers and subscribers to share this free e-magazine with as many as possible people. So that the knowledge and information shall reach to all the people. Einstein famously said, “knowledge is power”. We are happy to kindle the interest of the youngsters towards science and technology through this medium.

Soundar
Editor, RSM

The Royal Science Forum

The Royal Science Forum is a technical professional platform that was founded in 2013. RSF strives to bring together scholars, academicians, and industry professionals. Through its several divisions, RSF's mission is to assist the international science and engineering community by disseminating information on current developments in various disciplines of science and engineering. Further, recognition of talents among students, young and expertise researchers/academicians by means of Awards is also a mission of RSF. With our potential connections, we provide details of job opportunities such as Postdoctoral Research Position, Research Associate, Junior Research Fellow, Senior Research Fellow, academic jobs and non-academic jobs. We also provide details of fellowships and scholarships for Masters and Ph.D. students. From January 2022, The Royal Science Forum releases "The Royal Science Magazine".

The Royal Science Magazine is an Outreach/Extension Magazine where the advancements in Science and Technology from all fields are presented in a simplest manner to as to reach the public. Authors are welcome to submit their contribution as per the guidelines given in the "Royal Science Magazine" section. For more details about the forum and the scientific services, visit **www.royalsci.com.**

BIOLOGY

The World's Largest Bacterium

Microbes are supposed to be so small that they can only be seen through a microscope by their very small size and shape. But a new bacterium that lives in Caribbean mangroves is unexpectedly larger. It has a single cell that looks like a thread. It can grow up to 2 centimetres, which is as long as a peanut, and is 5000 times bigger than many other microbes. Also, this one has a huge genome that isn't free-floating like in other bacteria, but rather inside a membrane, which is typical of cells that are much more complex, like those in the human body. This is why this one is so big. The bacterium was revealed in a preprint that was posted online in February 2022.

There are two types of organisms in the world: prokaryotes, which are bacteria and single-cell microbes called archaea, as well as eukaryotes, which are everything from yeast to humans and everything else that has two or more cells. Prokaryotes don't have a nucleus, but eukaryotes have a nucleus where their DNA is stored. Eukaryotes also separate different cell functions into vesicles called organelles, and they can move molecules from one compartment to another, which prokaryotes can't do.

But the new microbe makes it hard to tell the difference between prokaryotes and eukaryotes. Olivier Gros, a marine biologist at the

University of the French Antilles, Pointe-à-Pitre, came across the strange organism about 10 years ago. It was growing on the surfaces of decaying mangrove leaves in a swamp near the university. Not until 5 years later did, he and his co-workers figure out that the organisms were bacteria. They didn't realise how unique the microbes were until Gros's graduate student Jean-Marie Volland took on the task of trying to figure them out.

Some microbes, like slime moulds and blue-green algae, have visible stalks or filaments made up of stacks of cells. The group used a variety of microscopy and staining methods to make sure that the mangrove filaments were all made up of just one cell.

Bacteria may have been able to grow so big because of the water-filled sac on the other side. The idea that bacteria had to be small was first thought of by microbiologists. This is because bacteria eat, breathe, and get rid of toxins by diffusion of molecules through their cell's interior, and there are limits to how far these molecules can go. Then in 1999, scientists found a huge sulfur-eating microbe that was the size of a poppy seed off the coast of Namibia. A huge water and nitrate-filled sac makes it possible for it to be big. They can still move in and out because "only [along the cell's] edges are alive," says Carvalho, who worked on this group of bacteria. Scientists have since found other large sulfur-eating bacteria, but their long filaments are made up of a lot of different cells.

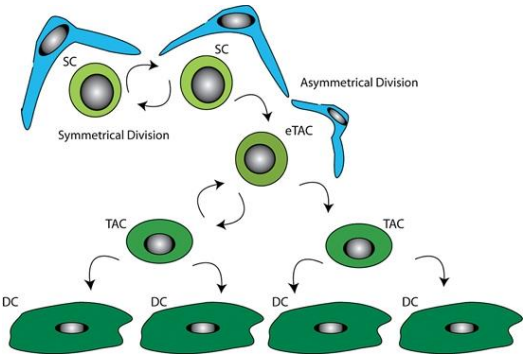
The new mangrove bacterium, like the one found in Namibia, has a huge water-filled sac that takes up 73% of its volume. That similarity and a genetic analysis led the research team to place it in the same genus as most of the other microbial giants and propose calling it as *Thiomargarita magnifica*.

The DNA-filled sac, which was also squished on the inside of this bacterium, was also very interesting. There were 11 million bases and 11,000 genes in the genome. It is typical for bacterial genomes to have about 4 million bases and about 3900 genes on them.

There are a lot of times when bacteria are thought of as small simple life forms that haven't evolved very far. Its time to change our conventional thoughts and look for more new species.

First Ever Stem Cell Technology for Treatment of Spinal Cord Injury

A group of Japanese researchers is going to do something that has never been done before. They will use a type of stem cell to try to help people with spinal cord injuries. No one has found a way to treat paralysis caused by serious spinal cord injuries, which is thought to affect more than 100,000 people in Japan alone. People who work as surgeons at Tokyo's Keio University want to find out whether iPS cells can be used to help people who have been hurt.



iPS cells are made by stimulating mature, already-specialized cells to go back to being young.

A professor at Keio University who is in charge of the research says this is a big step forward.

But there is still "a lot of work to be done" before the treatment can be used, he said in an interview. It is the goal of the first part of the study to make sure the transplant method is safe, the researchers said.

The patient will be watched by an independent group for up to three months to see if the study can go on and other people can get transplants. If the stem cell implants improve neurological function and quality of life, the team also wants to find out about that, as well.
In 2019, the University got permission from the government to start the trial. Recruitment was put on hold because of the Covid-19 pandemic.

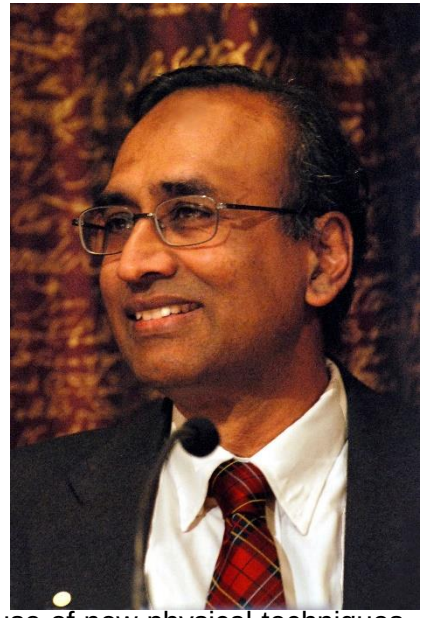
They can then be pushed to become different kinds of cells, as in the study by Keio University that used iPS-derived cells from the neural stem. The first step in the study was to put more than two million iPS-derived cells into a patient's spinal cord last month.

The team is only talking about people who were hurt 14-28 days before the operation. They are only talking about people who were hurt that long ago. The number of cells implanted was based on animal safety tests, and the researchers said that even though they will be looking for therapeutic effects, the study's main goal is to look at how safe it is to inject the cells into people.

Nobel Laureate Venkatraman Ramakrishnan

In this column, the magazine will cover on how the famous people get in the position where they are today. And this issue's famous personality is Nobel Laureate Venkatraman Ramakrishnan.

When Venkatraman Ramakrishnan heard in October 2009 that he would receive the Nobel Prize for Chemistry that year, he responded in a way that many former winners had. He refused to believe the news and accused his caller of being a terrible hoaxer, claiming he was from the Royal Swedish Academy. "I was certain," recalls Ramakrishnan, who was stationed at the Laboratory of Molecular Biology in Cambridge at the time. "This was one of the pranksters in the lab, and I assumed it was one of them. Ironically, I even complimented the man on his Swedish accent."



Venki was to receive the prize for determining the exact structure of a vital element of the ribosome, the small molecular mechanism present in our cells that converts the genetic code of living beings into the proteins from which they are formed,

In an interview to the Guardian he said, "I knew the ribosome was going to be the focus of Nobel prizes. It stands at the crossroads of biology, between the gene and what comes out of the gene. But I had convinced myself I was not going to be a winner".

"I remember reading a Scientific American article about the use of new physical techniques – including neutron scattering – as a method for unravelling the structure of the ribosome. I was fascinated. I knew ribosomes were a big fundamental problem in science and this was a method for chipping away at it."

He added that "*It takes a certain amount of courage to tackle very hard problems in science, I now realise. You don't know what the timescale of your work will be: decades or only a few years. Or your approach may be fatally flawed and doomed to fail. Or you could get scooped just as you are finalising your work. It is very stressful*."

WINNERS

The Winners of Sudoku puzzle of Issue 1 of the Royal Science Magazine are

Ms. Narmatha Rani N, College of Fisheries Engineering, Nagapattinam
Mr. Praveen M, University College of Engineering, Trichy
Ms. P. Gowshikha, College of Fisheries Engineering, Nagapattinam

The Winners of chess puzzle of Issue 1 of the Royal Science Magazine are

Ms. P. Gowshikha, College of Fisheries Engineering, Nagapattinam
Ms. S. Anvitha Sai, Chennai
Mr. R. Eswarareddy, Hyderabad

National Science Day Competition Winners

Essay Competition: Mr. V. Venkatesa Prabhu, PJTSAU, Hyderabad
Video Presentation: Mr. Arshad Sahu, Pune

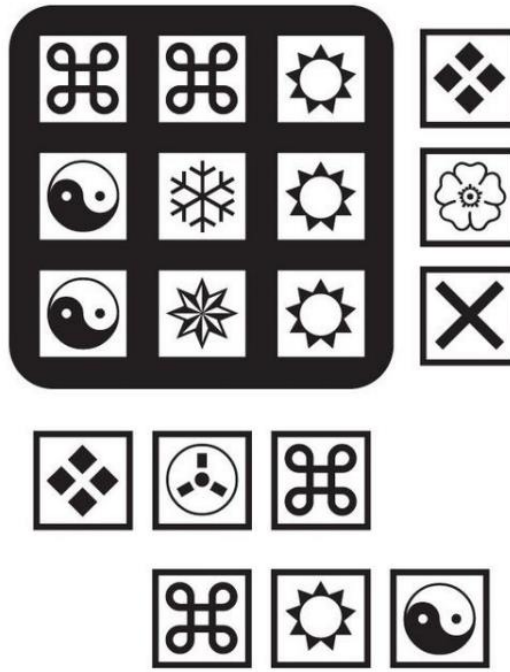
Winner of Drawing Competition (above): Ms. P. Gowshikha, College of Fisheries Engineering, Nagapattinam

Congratulations to all the Winners. The e-certificates are being sent to the winners.

FUN SCIENCE

Da Glyph Code

Check out the panel of glyphs below. It's a kind of Sudoku, but the numbers are represented by symbols.



You must work out what the three numbers at the bottom of the panel are, so you have to work out what numbers the glyphs represent first. Each row and column adds up to a number, shown as a glyph at the end of each row or column. **Send your answers by 15.05.2022 to editor@royalsci.com.** Winners will be announced in the next issue. Winners receive certificate.

Send your answers by 15.04.2022 to editor@royalsci.com. Winners will be announced in the next issue. Winners receive certificate.

Q&A Corner

Readers can send questions related to scientific phenomenon or technological functioning to **editor@royalsci.com**. The questions will be answered by the experts in the next issue.

ARTICLE

INTEGRATED FALL ARMYWORM MANAGEMENT ON MAIZE CROP

Introduction

The first report of the invasive pest fall armyworm (Spodoptera frugiperda J. E. Smith) on maize was recorded on May 2018 by the University of Agricultural and Horticultural Sciences, Shivamogga, Karnataka. Fall armyworm is known as second most destructive agricultural pest. It is native to tropical and subtropical America. Due to its migratory behaviour and high dispersal capacity the pest spread quickly to the entire India within the middle of 2019. It migrates from cooler to warmer place. The insect is capable of migrating 500 km to 1,000 km during its lifetime. Fall armyworm is a polyphagous pest, even though it is the primary pest on grasses. It is reported on 353 host plant belongs to 76 plant families. Fall armyworm attacks the maize crop from the first week of germination and causes severe damage throughout the year. It is also capable of causing major damage to more than 80 crops including rye, cashew, sorghum, paddy, sugarcane, cabbage, beetroot, groundnut, soybeans, onions, cotton, fodder grasses, tomatoes and potatoes. Among them maize is highly favourite food for them. In maize it causes more than 73% yield loss. It also causes economic damage in other cereals and millets. FAW threated millions of people in Africa due to risk of hunger by reducing food and nutritional security. It challenges the pest control practices. It develops quickly resistant to several pesticides and GM toxins.

There are two strains of fall army worm reported based on its molecular variations, such as ‘C- corn’ strain and ‘R -rice’ strain. ‘C’ strain prefers to feeds on maize, cotton and sorghum. ‘R’ strain which predominantly feeds on rice and other grasses. These two types are identical in their morphology, distinguishable only through molecular techniques. In India the molecular studies reveal that fall armyworm strain predominantly belongs to ‘R -rice’ strain (3:1 ratio) based on COI gene polymorphism. These strains exhibit partial reproductive isolation and temporal difference in mating habits.

Life cycle

The life cycle of the fall armyworm is mostly influenced by climatic factors. In higher temperature life cycle completes shortly compared to the low temperature. In its lifecycle it does not undergo resting stages, so in hot climatic condition fall army worm undergo many overlapping generation per year (12 generation per year). Its life cycle

comprises of eggs, larvae, pupae, and adult stages. The incidence of FAW on maize crop has been reported throughout the year. Its life cycle lasts 30 days during the summer and upto 60 days during the winter.

Egg

The female moth often deposits her egg masses on the under surface of the two to third leaves or inside the central whorl. It lays egg masses in a single layer or a few layers (2-3 layers) and then covers them with body scales. At initial stage egg mass are dazzling white; subsequently, it turns light yellow to light pink, and last, before the egg hatches, it turns dark black. A single egg mass includes 100- 200 eggs. A female lays 1500 to 2000 eggs in her lifetime. The egg period lasts between 2 to 3 days.

Egg mass covered with scales

Egg mass

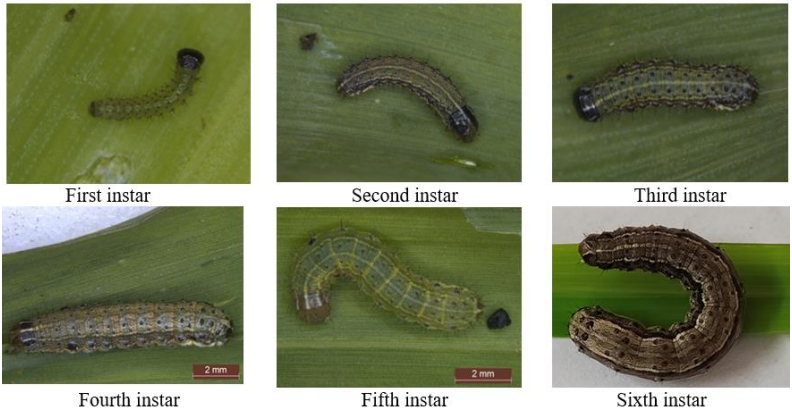
Eggs ready to hatch

Neonate emergence

Larva

The larval stage is the destructive stage on crop plants. After the egg hatches masses of neonate start to disperse on leaf surface. The neonate used to be white in colour with black head. There are six larval instars. The larval mass spread to the surrounding plants by hanging off from the silken thread secreted by them, due to ballooning effect caused by wind force larvae carried over to numerous plants from a single egg mass. Cannibalistic behaviour has been documented from third instar onwards, therefore from the third instar onwards each plant occupied by single larva rarely we can observe two larvae at different region of the same plant. The FAW larva can be easily identified by its morphological features such as ‘Y’ shape inverted pale marking on its head. On every segment of the larval body, there is a symmetrical distribution of dark black colour raised dots (2 dorsal pairs and lateral pairs). Each spot consists of single hair. The terminal segment has four

dark dots that are distributed evenly and in a square form. The larval body has longitudinal bands on the dorsal and lateral sides.



Larval stages

Pupa

The mature fall army worm larvae pupate in soil at a depth of 2 to 8 cm. Sometimes it pupates within the plant itself. Pupa is reddish brown in color. The pupa measures 2 -3 cm in length and 4.5 mm in width. During the summer, the pupal period lasts 8-9 days; during the winter, it lasts 20- 30 days.

Adult

Sexual dimorphism present in fall armyworm. The forewing of male moth with unusual patterns of various colours. The terminal end of the wing contains white inverted triangular marking. At one third portion of the forewing from thorax has golden yellow colour oval/ kidney shape marking. Similar to other noctuid moths it possess scaly wings with variegated colours such as black, light to dark brown, grey and straw colour. The female moth's forewing is uniformly grey in colour. Adult moth used to be nocturnal, hiding behind vegetation or inner side of the leaf whorl during the morning hours. The hind wing of both male and female moths used to be short and silvery in appearance. Female moths begin to lay eggs 3 to 4 days after mating (pre oviposition period). Moths can live for about 7-21 days.

Damage symptoms

- The first and second instar larvae feeds on leaf surface epidermal leaf tissue by scrapping and makes the leaf surface papery in nature without chlorophyll.

- The third to six instar larvae are voracious defoliator, they mainly feed and damages the tender developing central whorl, tassel and cob.

Male moth

Female moth

- Because of the damage to the unopened whorl, at initial stage it shows small pin head size holes on leaves later stage it causes medium to big size parallel/ random, circular/irregular holes on leaves. The holes expand in size as the plant grows.
- Heavy whorl damage causes newly opened top most leaves to ragged, torn or shredded appearance
- FAW infested area used to be filled with mass of fresh and saw dust like old larval dropping/ excreta.
- During vegetative stage, larvae used to hide inside the leaf whorl causes whorl damage, at the time of tassel and cob emergence, larvae hide between the leaf base and the stem.
- FAW larvae affects the tip and inner side of the cob and feeds on developing kernels during milky stage, affecting seed development and reducing crop productivity and nutritional status.
- Fall armyworm damage to tassel has an impact on pollination.
- FAW infestation on maize cob invites secondary fungus infestation, resulting in aflatoxins production, which reduces grain quality and quantity



Leaf chlorophyll scraped by the neonates Leaf holes



Whorl damage Shredding of leaves Whorl covered by insect excreta



Parallel leaf holes Cob damage

Crop damages

Economical Threshold Limit for FAW damage: 10% whorl and cob damage

Integrated fall armyworm management

The Tamil Nadu Agricultural University has conducted a wide range of research and has recommended the following strategies to control the maize fall armyworm.

- In the last ploughing, apply neem cake at the rate of 100 Kg / acre and plough well. Thus, the plants will grow with pest resistance.
- Seed treatment: Seed treatment should be done with the mixture of Cyantroniliprol 19.8% and Thiamithoxam 19.8% FS at the rate of 4 ml per kg of maize seed. This will reduce the damage caused by fall armyworm as soon as the crop germinates.
- In irrigated condition, cowpea, sesame, sunflower and redgram should be cultivated as border crop, grow the fodder sorghum as in case of rainfed maize cultivation. Thus, increasing the number of natural enemies.
- Release egg parasitoid Telenomus remus to prevent FAW multiplication
- Crop spacing: Irrigated 60x25 cm, Rainfed 45x20 cm.
- Installing sex pheromone traps at the rate of 5 traps per acre can be used to monitor the movement of fall army worm.
- Recommended chemical pesticides
- Only recommended pesticides should be used at the respective time. Doing so may reduce the insect resistance to the pesticides.

- Recommended insecticides should be sprayed at the recommended rate. The entire whorl region should be sprayed properly.

Crop age	Recommended pesticides	Hand sprayer	Power sprayer	Pesticide Per acre
15-20 Days after emergence	Chlorantraniliprole 18.5 SC	0.4 ml/lit	1.2 ml/lit	80 ml/acre
	Flubendiamide 480 SC	0.5 ml/lit	1.5 ml/lit	100 ml/acre
30-35 Days after emergence	Azadirachtin 1500 ppm (If necessary, when FAW damage crosses the ETL 10% level)	5 ml/lit	15 ml/lit	1 lit/acre
40-45 Days after emergence	Emamectin benzoate 5 SG	0.4 g/lit	1.2 g/lit	80 g/acre
	Spinetoram 11.7 SC	0.5 ml/lit	1.5 ml/lit	100 ml/acre
	Novaluraon 10 EC	1 ml/lit	3 ml/lit	200 ml/acre

60 DAE: Any one of the insecticides which is not sprayed previously, Emamectin benzoate 5 SG @ 0.4 g/lit or Spinetoram 11.7 SC @ 0.5 ml/lit or Novaluraon 10 EC @ 1ml /lit.

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Call For NOMINATIONS

2022 The Royal Science Awards

Life Time Achievement Award
Senior most Researchers/Academicians who made excellent contribution to their stream are given this award.

Young Researcher Award
Budding researchers (upto 35 age) who have given excellent contribution are given this award.

Best Teacher Award
Teachers of all streams who have contributed to the learning community are given this award.

Student Project Awards
Graduate students who have come up with innovative ideas and products are welcome to submit their application.

Best Thesis Award
The students from any stream who have done excellent research work at any degree/diploma level can apply for this award.

Best Extension Worker Award
This award is given to those who transferred more technologies to the common people and/or developed excellent communication/service tools such as apps, websites for communicating to the beneficiaries.

Visit www.royalsci.com to file your nominations.

Apply for the Awards
You can submit your application for the awards through the website. Applications are open throughout the year.

Benefits of the Awards

- The awardees will get an opportunity to chair and deliver invited talks in the seminars, conferences, and workshops organized by the Royal Science Forum
- Recognition among peers
- This award is a kind of motivation for further innovation and best practices.
- This award is an indicator of success and it enhances the reputation and improves the benchmark of the award winner
- As a matter of pride and motivation, it raises the visibility of the success.
- The award will be a testimony of your success
- Awards winners profile shall be included in the Book, " The most accomplished individuals from around the world" released every year

ARTICLE

GREENHOUSE TECHNOLOGY FOR FISH GROWTH

Introduction

The dilemma of global food insecurity has been worse during the past 5 decades. Fish are an excellent source of high-quality protein, vitamins, minerals and they're also a near-unique source of omega-3 long-chain polyunsaturated fatty acids. As a result, aquaculture is seen as a feasible alternative to these nations' growing food insecurity. In aquaculture, climate changes are mostly affected the fish growth. The winter season is the worst-case scenario, with large temperature variations between day and night. Temperature has been determined to have an important role in influencing the maximum concentration of most physical chemical compositions. In colder areas, the usage of a fish pond necessitates the addition of heat. However, electrical heating consumes a lot of energy and is not cost-effective in aquaculture production. A greenhouse in fish production is a covered building that provides fish with an optimum managed environment for adjusting climatic growing conditions, lowering operation costs and increasing fish output. Water is a great medium for collecting and storing solar energy in greenhouse systems, therefore a fish farming system may serve as a photovoltaic collector and thermal storage in solar infrastructure.

Greenhouse for fish production

Compared to open pond culture latest greenhouse designs can give a high range of temperature control and prevent indoor fish against climatic variations.

Construction

Shape and Orientation

Two types of shapes are widely used, they are rectangular and dome. Mostly dome shape is preferred for fish culture in green house technology. Because of the floor area contained by a dome has 30-40 % less surface area than compared to a rectangular shape. When compared to rectangular constructions, its design allows for better air circulation. This sort of greenhouse will provide more direct sunshine to the fish during the day, resulting in more constant heat source. Greenhouse orientation plays substantial role in growing of fish. Greenhouse should be positioned east-west to avoid the shade impact from one greenhouse to the next.

Materials used

Polycarbonate and polyethylene are the most commonly utilised materials for greenhouse technology. Ultraviolet stabilized low density polyethylene sheets are favored over glass or other covering materials because of their flexibility, chemical resistance, water proofing qualities, toughness, and lower cost.

Door and Vents

During overheating within the greenhouse, there are facilities for a door and vents for air movement.

Working principle

The basic of operation for a greenhouse pond would be the same for any other sort of greenhouse. During daylight hours, the greenhouse roof receives entire solar energy, which is partially reflected, collected, and transmitted via the walls and roofs. The water absorbed transmitted radiation, raising its temperature. When the ambient temperature for declines during the day, convective, evaporative, and radiative heat exchanges occur between the floor, water, and air. Temperature and humidity are checked on a regular basis, and if an unfavourable temperature is detected, it is controlled.

Water temperature

During sunny hours, the greenhouse cover receives entire solar radiation, which is partly reflected, absorbed, and transmitted within the greenhouse through walls and roofs. Water absorbs a considerable percentage of this transmitted energy, which is then used to rise water temperature.

Growth performance

When compared to fish put inside the greenhouse structure, fish stocked outside the greenhouse structure had worse growth performance.

Survival of fish

Fry raised inside the greenhouse had higher percentage survival compared to those in tanks outside the greenhouse. Outside the greenhouse, cold water temperature was most likely a substantial stumbling block to proper feeding. It causes more uneaten food was dumbed outside.

Outside of the greenhouse tanks, there is a lack of feed consumption. This would result in fish not growing as quickly as they did in the greenhouse, where proper feeding resulted in higher growth.

Conclusion

The most significant physical parameter in fish production is water temperature, which could be successfully controlled within optimal ranges with this approach comparing to the open pond, the growth of the animals in greenhouse pond is higher.

This article is written by the authors: P. Suwathi, M. Ramar, D. Kesavan, S. Monikandon, T. Anand, B. Sanjay, M. Gowsick Kumar, Tamil Nadu Dr.J. Jayalalithaa Fisheries University, College of Fisheries Engineering, Nagapattinam. The authors can be contacted at Email: *ramar@tnfu.ac.in.*

ARTICLE

MICROPLASTICS POLLUTION THREATENS SEA TURTLE POPULATIONS

Introduction

Plastics have been manufactured industrially since 1950, when the yearly production of plastics reached 2 million tonnes. Global plastics manufacturing had increased to 380 million tonnes per year by 2015. More than 7800 million tonnes of plastic were created between 1950 and 2015, resulting in 6300 million tonnes of garbage, of which around 9% was recycled. Only 12% of this garbage was burned, with the rest 79 percent ending up in landfills or the environment. A large amount of plastic garbage ends up in the water. It gets not only directly, but also through landfills where plastics are dispersed by the wind into rivers and eventually into the seas. Every year an estimated amount of 8 million tonnes of plastic enters the oceans.

Microplastics and its origin

In terms of origin, microplastics are categorized into two: primary and secondary microplastics. The manner in which the two types of microplastics enter the environment is fundamental distinction. Primary microplastics are released into the environment in their final state, whereas secondary microplastics are generated directly in to the environment by weathering and wear of macroscopic plastics into smaller particles.

The raw material used to make plastic items is one of the most significant sources of primary microplastics. The cumulative use of these particles in the European Unions was 53 million tonnes in 2013. The majority of the plastics produced, 40% were used to make packaging products, while 20% of the plastics produced were used in construction. The loss of pellets causes environmental pollution, which much outweighs the value of microplastic pollution from cosmetics.

Secondary microplastics are irregular fragments of plastic that form when major plastic products, such as bags, boxes, ropes and nets, degrade unintentionally. UV light from the sun and mechanical factors, such as waves, break down these huge pieces of plastic into smaller and smaller particles over time. Three mechanisms are involved in the release of secondary microplastics into the environment (1) Weathering and microbiological activity naturally disintegrate microplastics (2) Organisms directly decompose macroplastics into microplastics (3) Past microplastic pollution is resuspended in soil or sediment.

Microplastics and Synthetic polymers

Synthetic polymers have been a regular part of our lives throughout the years, and many natural materials have been replaced by them. Plastic materials versatile use is due to their outstanding properties such as variability, lightness, flexibility, strength, and persistence. Because of these features they are appropriate for packaging food and other items; the packaging industry accounts for more than a third of all plastics manufactured. Polyethylene (PE), polypropylene (PP), polystyrene (PS), polyvinyl chloride (PVC) and polyethylene terephthalate (PET) are the most common plastics used in packaging. As a result, there is no surprise that the volume of packaging plastics grows in proportionate to the amount of garbage produced and finally ends up in the environment and in oceans. The majority of plastic trash in water comes from land-based pollution and its accounts approximately around 80 percent. The remaining 20% of garbage comes from ocean sources primarily from fishing and trawls. According to estimates, fishing waste accounts for about 18% of marine waste. It is primarily caused by deteriorating nets, ropes and abandoned vessels. Polyolefins (PE) and nylon are the most regularly used polymers in fishing and fishing vessels.

Microplastics and its potential toxic additives

Plastic particles in the ocean, according to Carpenter and Smith could have been an entrapped source for polychlorinated biphenyls (PCBs) and bacteria. PCBs at concentration of 5 ppm were found on

the surface of microbeads from seawater by other researchers in the same year. Microplastics can be contaminated by PCBs, organochlorine chemicals, polyaromatic hydrocarbons, DDT and HCH pesticides, as well as heavy metals like copper, arsenic, cadmium, lead, chromium and antibiotics. Microplastics that have pollutants adsorbed on them can be harmful to marine organisms, especially if they reach the food chain through ingestion.

Absorption and adsorption are used to attach organic micropollutants to the surface of microplastics. Adsorption is the process of a material becoming entrapped on the surface of a particle and then being assimilated into the mass of the particle. Sorption is mediated by a number of interactions, the most prevalent of which are hydrophobic and electrostatic bonding. Microplastics can absorb and bind hazardous contaminants in the environment, but they can also release them back into the ecosystem. The kind of polymer, colour, size and degree of weathering of microplastics, as well as pH, salinity and seawater temperature have influence on binding of organic micropollutants to the surface of microplastics.

Microplastics Pollution and Sea Turtle Populations

As plastic garbage has accumulated in the marine environment number of reports on sea turtles ingesting plastic has increased. The most common type of marine debris is plastics. At least 690 marine species have been documented to have been ill or deceased as a result of entanglement or ingestion of marine plastics around the world these include sea turtles, seabirds, seals, sea lions, whales, fish and crustaceans. The researchers have evaluated the mortality rates in post hatchling sea turtles, plankton, juvenile fish and crustaceans. The researchers gathered 96 post hatchling sea turtles washed up on Florida beaches between Vero Beach and Lake Worth. The location is just south of the Archie Carr National Wildlife Refuge, which is named for the sea turtle conservationist and is home to the country's largest loggerhead and green turtle rookery.

According to the researchers more than 90% of the US loggerhead population nests in Florida. Out of 96 only 27 were used for the study and remaining of the captured turtles died. Ninety three percent had ingested plastic particles leading the researchers to believe that many perished as a result of blockages or nutritional inadequacies caused by plastic consumption. Ocean plastics have been mistaken as prey by sea turtles, such as crab or fish eggs. In case of bigger sea turtles, floating plastic bags are mistaken as jellyfish. Researchers have previously predicted that just one in 1,000 adults survive long enough

to completely mature but newer estimates imply the number may be closer to one in 10,000.

Conclusion

The researchers have alarmed that the Microplastics pollution on the Ocean might have disastrous consequences for the ocean's food web. According to the researchers we are the initial stage and we could be witnessing the first microplastics pollution associated species population decrease or extinction event. Because sea turtles can take decades to reach sexual maturity, it puts the fate of sea turtle populations in jeopardy. However, the microplastics are inducing blockages, nutritional inadequacies and possessing a significant risk to the survival of post hatchling sea turtles. To a certain extent, best practices can be followed but there is an urgent need to impose restrictions and safeguard sea turtles. To properly manage solid waste and decrease plastic pollution strict rules should be enforced. There is also a pressing need for research to address and analyze the problem of microplastic pollution in sea turtle conservation areas or zones both to determine the extent of pollution and to determine the survival of sea turtle post hatchlings.

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ARTICLE

CONSERVATION AGRICULTURE FOR SUSTAINABILITY IN FARMING

Despite the endowment of good soil, highest percentage of land under cultivation, and ample sunshine and vast human resources in the Indo-Gangetic plains of India, the crop productivity is low. Among the various factors responsible for low productivity, availability of water is regarded as the most limiting factor because crops are very much sensitive to soil moisture stress, particularly at their critical growth stages. Strategies to minimize crop water stress include irrigation and conservation of soil moisture by increased infiltration, reduced evaporation and optimum use of available soil water. Mulching in this regard seems vital option to increase the water holding capacity. Besides irrigation, tillage is one of the basic inputs of crop production that alters the rhizosphere environment by modifying most of the physical properties of the soil (Guzha, 2004). However, the extent of the impact of tillage is variable depending upon the inherent soil characteristics and climatic conditions. The efficiency of input use, viz. water, fertilizer and others depend on tillage and crop establishment practices. It is, therefore, essential that soil environment be manipulated suitably for ensuring a good crop stand and improving resource-use efficiency. Intensive soil cultivation has worldwide resulted in the degradation of agricultural soils with decrease in soil organic matter and loss of soil structure, adversely affecting soil functioning and causing a long-term threat to future yields (Pingali et al., 2004). Resource degradation problems are manifesting in several ways in the present-day agriculture. Declining soil carbon and fertility, and water table are reflecting in loss of soil biodiversity, multiple nutrient deficiencies and increasing inputs use to maintain yields. To alleviate these problems and to fulfil the basic needs of human beings and regulate farm income, withstand weather aberrations, control price fluctuation, ensure balanced food supply, conserve natural resources, reduce the chemical fertilizer and pesticide loads and create employment opportunity, crop improvements and conservation agriculture show a lot of promise (Gill et al., 2009).

In the conventional systems involving intensive tillage, there is gradual decline in soil organic matter through accelerated oxidation and burning of crop residues causing pollution, greenhouse gases emission, and loss of valuable plant nutrients. Conservation agriculture (CA) practices are recognized as a powerful tool to address the issues

related to land and environmental degradation. Thus, CA has great relevance to restore the degraded ecologies where farm income and fatigue in yield have become major concern. Conservation agriculture technologies involve minimum soil disturbance, providing a soil cover through crop residues and dynamic crop rotations for achieving higher productivity and sustainability.

The key features of these technologies include: (i) minimum soil disturbance by adopting no-tillage and minimum traffic for agricultural operations, (ii) leave and manage the crop residues on the soil surface, (iii) adopt spatial and temporal crop sequences to derive maximum benefits from inputs and minimize adverse environmental impacts. When the residues are retained on soil surface in combination with minimum soil disturbance, the enhanced biological processes lead to improved soil quality. Resource-conserving technologies including zero-tillage restrict release of soil organic C, thus mitigating increase of CO_2 in the atmosphere. It is estimated that zero-tillage saves about 30 liters/ha of diesel compared with conventional tillage, leading to reduction of 80 kg CO_2/ha/year. Zero-till farming practices provide a great potential for C-sequestration and building-up of soil organic matter, minimizing soil erosion and reducing production costs. Strategies for soil organic C restoration include conversion from conventional tillage to reduced- or zero-tillage, increasing cropping intensity by eliminating summer fallows, using highly diverse crop

rotations, introducing legumes and grass mixtures in the rotation cycle, and increasing C input into the soil.

Conservation agriculture systems are adopted globally on about 130 M ha areas. In India, these systems have been adopted on a limited scale in the irrigated rice-wheat areas of north-western plain zone. It is estimated that about 3.5 M ha of wheat is cultivated adopting zero-till seed drills. Various on-farm participatory trials have revealed little or no difference in yield of crops under zero-till system when compared with the best-managed conventional crops. Zero-tillage practices are more advantageous when crop residues are retained on the soil surface, which serve as physical barrier to emergence of weeds, moderate soil temperature, conserve soil moisture, add organic matter and solve the problem of air pollution, arising due to large-scale burning of straw residues. Soil physical properties are significantly affected by cropping systems and management practices, including tillage and organic residue management. Several long-term studies have been conducted globally to introduce conservation agriculture technologies in selected cropping systems as a main-way of improving crop yields, soil health and income, whilst reducing requirement of energy and environmental degradation. Resource-conserving technologies (RCTs), such as zero-tillage (ZT) and unpuddled transplanting have been shown to be beneficial in terms of improving soil health, water use, crop productivity and farmers income (Gupta and Seth, 2007). Zero tillage is widely adopted in wheat by farmers in the North-western IGP of India, particularly in areas where rice is harvested late. However, to get the full benefits of ZT, both rice and wheat need to be grown with a ‘double zero-tillage’ system. Important factors that are forcing a shift from the traditional puddled-transplanting system to unpuddled direct seeding of rice are shortages of labour and water, and escalating fuel prices. In wheat, ZT reduces irrigation requirements compared with conventional-tillage by using residual water more effectively (Erenstein et al., 2007).

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ARTICLE

IMPACTS OF HEAVY METALS POLLUTION IN THE MARINE ENVIRONMENT

Introduction

Water is essential for all living organisms in the world. Due to industrial revolution and anthropogenic activities environmental contamination is exacerbated. The World Health Organization state marine pollution as "The introduction by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, which results or likely to result in such deleterious effects as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of seawater and reduction of amenities".

Heavy Metals cause serious threats to human due to their severe toxicity, non-biodegradability and environmental bioaccumulation. Bioaccumulation of heavy metals such as Mercury(Hg), Cobalt(Co), Copper(Cu), Arsenic(As), Nickel(Ni), Cadmium(Cd), Chromium(Cr) create an influence in fish and invertebrates which possibly affect the feeding pattern and trophic level of organisms.

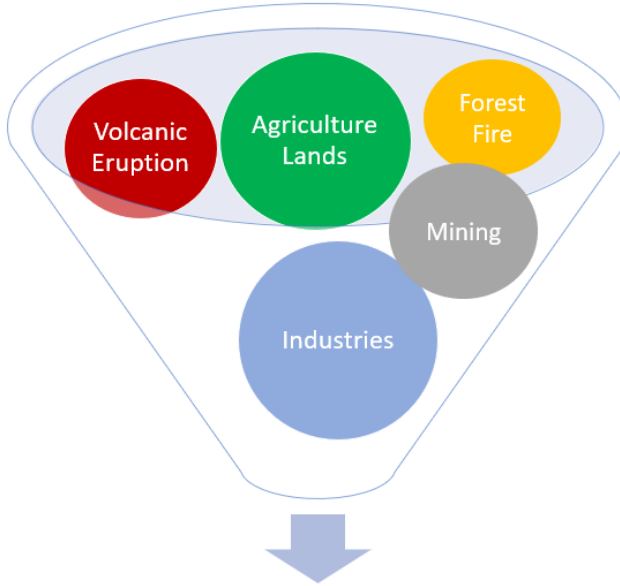
Category of Heavy Metals and Source of Heavy Metals

Heavy Metals are classified in to three groups; First group includes Cadmium, Mercury, and Lead – which are toxic at minimal concentration. Second group metals such as, Thallium, Antimony, Bismuth, Indium, Arsenic is less dangerous. Essential metals such as Zinc, Iron, Selenium, Cobalt, Copper are classified as third groups; above certain concentration it may also toxic. Some of the sources of heavy metals include Windblown soil debris, Volcanic eruption, Biogenic process, Forest fires, Marine salts which are some of the natural sources. Anthropogenic causes such as Pesticides, Fertilizers, Mining Operations, Herbicide use, Crop field irrigation with industrial and sewage water are also the source of heavy metals. Industries such as Drug manufacturing, Chlorine and caustic soda industry, Paper and pulp preservatives, Farming sector release mercury to atmosphere.

Toxic effect in the organisms

Fish ingest the heavy metals through gills, body surface and digestive tract. Heavy metal concentration hampered fish growth by

affecting the metabolic, physiological and histological changes in fish. Heavy metals accumulate in the kidneys, gills and liver of fish species. Oxygen supply into the tissue disturbs due to the accumulation of Zinc in the fish gills. In human, long-term exposure may cause disease like Muscle dystrophy, Multiple sclerosis, Alzheimer, and Parkinson. Acute lead exposure induces appetite loss, insomnia, arthritis, hallucination, vertigo. Mercury toxicity cause pink disease, acrodynia.



Effect of heavy metals in food webs

Rivers, lakes, streams which are contaminated by heavy metals cause bio accumulation in fishes. When, such fishes are consumed by higher trophic level organisms in the food chain are vulnerable to bio magnification. Due to bio magnification higher trophic level organisms may endanger or cause severe impact to humans.

Bio accumulation of heavy metals in fish

Bio accumulation of heavy metals in fresh water fish causes major environmental, ecological and social implications. Deposition of heavy metals in fish organs depend on the function and shape of tissues. Metabolically active tissues like kidney, gills, liver accumulate heavy metals than skin and muscles. Fish gills are target to heavy

metals such as Nickel. Recent studies shown that in the coastal region of Tuticorin bio accumulation of heavy metals such as Zinc, Copper, Cadmium, Lead found in aquatic organisms.

Remediation for heavy metals

Bacterial species which tolerate heavy metals are used for heavy metal remediation. Species like Pseudomonas sp., Streptococcus sp. and Staphylococcus sp., and strain from pulp and paper industry effluent are used for heavy metal remediation. Pseudomonas sp. efficiently extract heavy metals like Cadmium, Manganese and Mercury. Streptococcus sp. and Staphylococcus sp might extract Copper. Chitin and chitosan surface in the fungal cell is a biosorbents e.g. Fusarium sp., Aspergillus sp., Rhizopus sp., Penicillium sp. Algae is used in bioremediation by adsorption of heavy metal effluents.

Conclusion

Environment and human beings are interwind with each other. So that any changes in the marine environment due to the heavy metal pollution, it may cause serious impact in higher trophic organisms include human. To protect the marine environment from serious impacts industrial wastes, and other toxic effluents should be treated biologically using various useful microbes and the discharge it into the environment. Every human should keep in mind that if we care for nature then nature will take care of us.

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ARTICLE

BLUE FORESTS MOUNTED WITH PLASTIC WASTE – NEED FOR PROTECTION AND RESTORATION

Introduction

A mangrove is a tiny shrub or tree that lives in brackish or coastal waters. In 2000, the global area of mangrove forests was estimated to be over 137,800 square kilometres, comprising 118 countries and territories. The fishing potential in mangrove forests is highest and biodiversity plays an important role in coastal zones. Mangroves are vital for the health of fisheries because they serve as a major nursery for juvenile marine life. Mangrove habitats support roughly 105 species of fish, 20 species of shellfish and more than 225 species of crustaceans in India, accounting for about 60% of the country's coastal marine fish species. Mangroves and sea grasses develop in a variety of places around the world's coasts and these 'blue forests' provide a vital habitat for a variety of creatures and birds that feed on the plants. Here, juvenile fish can hide until they are old enough to look after themselves. However, a new study claims that plant covered coastal zones attract not only animals but also plastics.

Mangroves and Plastics

Plastic garbage is steadily choking the mangrove ecosystems on Javas north coast. Plastic pollution is a major issue in northeast Asia, posing a growing threat to the region's mangroves, which act as a natural barrier against coastal erosion. Over the years, Van Bijsterveldt the researchers of Netherlands Institute for Sea Research have been tracking the accumulation of plastic debris in Indonesian mangroves. The majority of the plastic waste are from household trash carried by local rivers from the inland to the seaside. The garbage eventually becomes trapped in the last stronghold between land and water. Mangroves produce an ideal plastic trap says the researcher. This trap can be highly fatal for the mangrove tree. The grey mangrove the most abundant mangrove tree on Java coast has upward growing roots that allow oxygen to circulate during high tide. These roots can be thought of as snorkels, explains the researcher. The snorkels become obstructed as plastic debris accumulates in these trees. Trees suffocate in regions where plastic is entirely covered. The researcher and his team have found 27 plastic pieces per square metre on average. Plastic had covered half of the forest floor in some places. The team discovered plastics buried up to 35 cm deep in the silt. The presence of

plastic in these top layers reduces the trees access to oxygen. Van Bijsterveldt was nonetheless impressed by the tree's tenacity. When the roots are impeded by plastics, they alter the course. They form a protective ring around the plastics. The tree gets enough oxygen to keep its leaves in good condition even when half of the forest floor is covered. However, after the threshold of 75 percent is achieved and plastic in the sediment drives it towards 100 percent the chances of survival become significantly less and trees that cannot outgrow the plastic eventually die.

Mangroves and Microplastics

A study on microplastics pollution on mangroves and sea grass was conducted by Marianne Holmer, Professor and expert in coastal ecology from University of Southern Denmark in collaboration with the researchers of Zhejiang University in China.

In the blue forests, animals swallow microplastics along with the food they seek. According to the researcher the animals suffocate, starve to death or the little plastic particles get caught in various parts of the body and are causing serious harm.

Another problem with microplastics is that they can be coated with germs, pollutants or other disease causing or encouraging substances which are then passed on to the animal or plant that absorbs the microplastics. When microplastics are concentrated in an ecosystem, animals are exposed to exceptionally high amounts

according to the study. Microplastics concentrated in a sea grass bed according to the expert are impossible to remove.

The researcher has done observations on mangroves, Japanese eelgrass (Z. japonica) and the paddle weed Halophila ovalis in three coastal locations in China. Microplastics were found in higher concentrations in blue forest samples than in non-vegetated control areas. The concentration was up to 17.6 times greater in the mangrove forest and it was the maximum. The concentrations in the sea grass beds were only up to 4.1 times when compared to the mangroves. Because the particle captured is greater in mangrove forests than in sea grass beds.

Although the research was carried out along the Chinese coasts, it might be applied to similar ecosystems around the world including Denmark where eelgrass beds are common. The researcher predicts that increasing quantities of microplastics will be discovered in Danish and global sea grasses.

Mangroves Restoration

Mangrove's restoration provides benefits in numerous ways. Healthy mangroves mean healthy fish populations and fishing business can be sustained. Mangrove Forests are also being discovered by the tourism sector as a major attraction that supports the local economy. In an effort to recreate a green belt around the shore, the Indonesian government is investing in mangrove restoration. However, rehabilitation takes time and existing forests are under stress. There is so much concentration on raising the initial quantity of mangrove seedlings that the obstacles posed by plastic trash on the actual survival of young trees are disregarded says the researcher who has seen initiatives to plant new mangroves failed. It is like attempting to empty the ocean with a thimble by replanting mangroves without addressing the plastic problem. Successful rehabilitation must be accompanied by long term trash management.

Mangroves Protection

The benefits of mangroves and its beneficial role in fisheries are numerous. But the mangroves are in threat due to the plastic waste pollution. The mangrove acts as barrier for waves, prevents erosion and also provides nutrient rich ecosystem. But building an artificial dyke for the prevention of erosion due to waves and also to maintain it is costlier. If the natural available barrier mangroves are maintained without destruction and pollution, the ecosystem will be sustainable.

Conclusion

The pollution due to microplastics and macroplastics and its interaction in the human food chain and aquatic ecosystems are known to an extent. The recent researches done by numerous researchers on microplastics are alarming the effects of plastic pollution. However, the impacts on plastic waste and its pollution on mangroves is an emerging problem that is posing threat to the natural barrier and nutrient rich ecosystem. In order to reduce the effects of plastic pollution at present we can follow some best practices. The best practices can be followed to a limit but there is an urgent need for imposing of mangrove protection areas and also to reduce the plastic pollution proper solid waste management should be adopted. There is also urgent research needed to address and asses the problem of microplastics pollution in blue forest.

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ARTICLE

MICROPLASTICS IN SEAFOOD

Introduction

Plastic manufacturing has expanded by about 8.7% per year since the 1960s, growing to a $600 billion worldwide industry. Every year, almost eight million metric tonnes of plastic enter the oceans, and conservative estimates suggest that 5.25 trillion plastic particles circulate in ocean surface waters. While some plastics enter the water through maritime operations, it is estimated that 80 percent comes from land-based sources. Through inland waterways, wastewater outflows, and movement by winds or tides, discarded plastic items enter the marine environment as garbage, industrial discharge, or litter.

The rate of decomposition and persistence of plastics in the ocean varies depending on the polymer, form, density, and purpose of the plastic. These features also determine where plastics can be discovered in the water column. More buoyant plastics, for example, are more likely to be moved across the environment by ocean currents and wind. Furthermore, when plastics are exposed to natural factors such as sunshine and wave action, they breakdown into microplastics,

which are defined as plastic particles smaller than 5 mm. Plastic items smaller than < 1 μm in size are typically included in this definition. Plastic deterioration is affected by a variety of elements, including polymer type, age, and environmental factors such as weathering, temperature, irradiation, and pH.

Microplastics source and distribution

Microplastics are a heterogeneous set of particles (less than 5 mm) that vary in size, shape, and chemical content in the marine environment. They've been discovered in sediment, on the sea surface, in the water column, and in wildlife. Polyethylene and polypropylene are the most commonly made plastic kinds. Microplastics are frequently divided into two categories: primary and secondary. Primary microplastics were designed to be smaller than 5 mm, whereas secondary microplastics are the result of the breakdown of bigger items. Primary microplastics include microbeads in personal care items. While microbeads are currently being phased out globally, the United States released an estimated eight billion microbeads into aquatic environments every day in 2015. Industrial abrasives and pre-production plastic pellets used to manufacture larger plastic objects are two more sources of primary microplastics. Microfibers from textiles, tyre dust, and bigger plastic products that disintegrate and fragment into microplastic particles, usually owing to weathering deterioration, are examples of secondary microplastics. Even if people stopped producing plastic and the amount of marine microplastics would continue to rise as larger plastic litter degrades into secondary microplastics.

Microplastics degradation in the Marine environment

Because plastic is made to be resilient, it persists in the maritime environment. Microorganisms (e.g., Bacillus cereus, Micrococcus sp., or Corynebacterium), heat, oxidation, light, or hydrolysis can all slowly degrade the plastic polymers. The environmental variables present determine the rate and extent of plastic deterioration.

Microplastics in the Food Chain

Marine Animal's Microplastic Exposure

A 2016 UN report documented over 800 animal species polluted with plastic through ingestion or entanglement, which is 69 percent higher than the 247 infected species identified in a 1977 review. In nature, 220 of the 800 species have been found to absorb microplastic waste. Plastic is consumed by a variety of taxa at various trophic levels, including marine mammals, fish, invertebrates, and fish-eating birds. During carcass dissection and laboratory investigation, plastic particles are frequently detected concentrated in an organism's digestive tract. Micro- and nanoplastics, which favour smaller particles, can survive in the body of an animal and translocate from the digestive tract to the circulatory system or surrounding tissue.

Human exposure pathways

Consumption of seafood is one way for humans to be exposed to microplastics. Global seafood consumption accounted for 6.7% of total protein consumption and nearly 17% of animal protein consumption in 2015. Microplastics can be consumed by a wide range of marine species due to their microscopic size. Direct or indirect trophic transfer ingestion is possible (e.g., up the food web). Ingestion of microplastics has been observed in planktonic creatures and larvae at the bottom of the food chain, small and big invertebrates, and in fish. Microplastics were found in the trophic transfer of predatory Crucian carps.

Farmed mussels exhibited much greater microplastic concentrations (178 microfibers) than wild-caught mussels (126 microfibers), according to Van Cauwenberghe and Janssen. Microplastics (> 500 m) were also found in commercially sold, wild-caught fish from markets in Makassar, Indonesia (28% of fish processed included microplastics) and California, USA (25% of commercial fish processed contained microplastics). Karami et al. looked for microplastics in dried fish tissue, including excised organs (viscera and gills) and eviscerated flesh (whole fish except viscera and

gills). Microplastic particle transfer from digestive tracts to the gills and liver of zebra fish (Danio rerio), a common prey fish, was demonstrated by Yifeng et al. in juvenile and adult fish. Translocation of microplastic particles has also been observed in European seabass and the common goby (Pomatoschistus microps). Together, these findings show that microplastics, not chemical constituents, are present in some seafood and suggest that the problem may be pervasive due to ubiquity in the environment and transportation of particles to animal parts commonly eaten by people.

Conclusion

Microplastics are known to be consumed by humans. We know that shellfish and other marine species fed with intact GI tracts provide particular concern because they accumulate and retain microplastics, based on the totality of study findings on microplastics to date. The toxicity of ingesting microplastics is most likely determined by their size, related compounds, and dose. The sources, fate, exposure, bioavailability, and toxicity of microplastics and their related compounds in the marine environment are all poorly understood. The majority of what we know currently comes from research done in the last decade, although interest in investigating microplastics is expanding.

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INTERNSHIPS

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Regular Staff (Characterization of Soft Matters by newly developed S/TEM), National Institute of Advanced Industrial Science and Technology, Japan

PhD in cooperative p-d block catalysis towards noble base metals, Queen Mary University of London, UK

PhD: Advancing Crystal Engineering through Ionic Liquids, Aarhus University, Denmark

Research Fellow - Mass Spectrometry, Aston University, UK

Postdoctoral Scholars - Polymer, Materials or Nanoscience Chemistry, University of California Irvine, Irvine, CA, USA

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PhD: Developing Novel Amorphous Metals for 3D-printed Biomedical Implants, Aarhus University, Denmark

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