BIOINVASION

ENVIS Newsletter on Biological Invasion

Vol. 2, No. 2, July 2021

Mimosa diplotricha

Ministry of Environment, Forest & Climate Change

AMRITA VISHWA VIDYAPEETHAM

श्रद्धावान् लभते ज्ञानम्

Environmental Information System

India

ABOUT ENVIS

Ministry of Environment, Forest and Climate Change's (MoEFCC) Environmental Information System (ENVIS) resource partner at Amrita Vishwa Vidyapeetham is established to disseminate scientific, technical, and semi-technical information on various issues related to biological invasion/Invasive Alien Species and conduct related research and extension activities.

Some of the objectives of the ENVIS Centre are:

- To promote, implement, and coordinate Green Skill Development Programme (GSDP), an initiative to skill youth in environment, forest, and wildlife sectors and enable them to be self-employed. E.g., lantana craft and furniture making, herbal kitchen gardening of native species.
- To implement and coordinate National Environment Survey (NES) a Grid-based Resource Information and Decision Support System (GRIDSS) for sustainable management of natural resources to fill in data gaps with respect to various environmental parameters such as emission inventory and pollution; forest and wildlife (flora and fauna); wetlands; rivers and other water bodies; public health, etc.
- To implement and coordinate a Community-driven Environmentally Sustainable Village Programme (CESVP) with the objective of mobilizing communities on environmental issues, creating decentralized models of development to empower local communities and build an awareness driven atmosphere in villages to adopt environmentally sustainable practices at community level.
- To build a repository and dissemination centre in Environmental Science, Information and Management (ESIM).
- To support and promote research, development and innovation in ESIM.
- To promote national cooperation and liaise with agencies concerned for exchange of environment and biological invasion related information.

Dr.Maya Mahajan

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Mimosa diplotricha

Mimosa diplotricha (syn. M. invisa) is a small, often scrambling, neotropical shrub that has invaded many countries in the old tropics and many oceanic islands. It is known as the giant sensitive plant, giant false sensitive plant, or nila grass. It forms impenetrable spiny thickets that invade highly disturbed sites, but agricultural systems in particular. The weed forms a thorny mat over the natural vegetation, preventing animals from accessing and utilising natural vegetation. The shrub produces large quantities of seeds at an early age and has a persistent seed bank. In recent decades, it has spread to new regions and has the potential to invade more tropical areas.

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Invasive Alien Species of wetlands

D.Dalini,

FCRI,Thoothukudi.

Abstract:

" Invasive Alien species", the trending subject in case of our wetlands, which may be either native or exotic. Any exotic or native species which aggressively affects its living environment and hamper the growth of other useful organisms is termed as invasive species. My study intends to bring idea about the difference between alien species, exotic species and invasive alien species,also about particular invasive species such as *Eicchornia crassipes, Salvinia molesta, Pistia sp, Procambrus Clarki, Oreochromis niloticus, Clarius garipienus and Cyprinus carpio,* their impacts and pathways. Also it explains outbreaks and case study in several areas about these invasive species and several management measures to control those invasive species.

Introduction:

Wetlands are dynamic aquatic ecosystems found all over the world. They are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres. Globally wetlands are considered as one of the most productive ecosystems. The primary factor that distinguishes wetlands from other land forms or water bodies is the characteristic vegetation of aquatic plants,adapted to the unique hydric soil. Wetlands have also been described as ecotones, providing a transition between dry land and water bodies. Five major wetland types are generally recognized:

- lacustrine (wetlands associated with lakes);
- marine (coastal wetlands including coastal lagoons, rocky shores, and coral reefs);
- estuarine (including deltas, tidal marshes, and mangrove swamps);
- riverine (wetlands along rivers and streams); and
- palustrine (meaning "marshy" - marshes, swamps and bogs).

In addition, there are human-made wetlands such as fish and shrimp ponds, farm ponds, irrigated agricultural land, salt pans, reservoirs, gravel pits, sewage farms and canals.

Major challenge faced by the present day wetlands are alien species,which may occupy the whole area and inhibit the growth of native species and hinder the ecosystem.

Alien species and invasive alien species:

Alien species is a species, subspecies orlowertaxon,introduced outside its natural past or present distribution, which includes any part,gametes,seeds,eggs,propagules of such species that might survive and subsequently reproduce.	Invasive Alien Species refers to an alien species whose introduction and/or spread threaten biological diversity of the region/habitat. In recent past, Invasive Alien Species have been emerging as the second biggest threat to global biodiversity after habitat destruction.

List of invasive alien species:

- Water hyacinth. (*Eicchornia crassipes*).
- Great Salvinia. (*Salvinia molesta*)
- Water lettuce. (*Pistia sp*).
- Nile Tilapia. (*Oreochromis niloticus).*
- African catfish. *(Clarius garipienus)*
- Cray fish. *(Procambrus clarkii)*
- Common carp. (*Cyprinus carpio.)*

Impacts of invasive alien species in wetlands:

a) Water hyacinth:(*Eicchornia crassipes*)

E. crassipes can form small colonies, "floating islands" or extensive mats that can cover thousands of hectares of previously open water. When invasive, water hyacinth forms a complete covering of the water surface that excludes most light and air for submerged organisms thus depriving them of essentials for survival. A significant reduction of general aquatic biodiversity and a change of fisheries results.

The mats can have serious mechanical impacts on water supply systems, drainage canals, inflows to hydropower generators, movement of shipping and river flows The hyacinth also increases evapotranspiration well above that of open water and causes significant water loss to reservoirs and wild waters.

The crowding of plants at the edges of water bodies prevents peoples' access to the water for, e.g., collecting water and fishing as well as access of fishing boats. Invasive water hyacinth often forms mats upon which other wetland plants can grow and where disease vectors and vermin are often a threat to local communities adjoining wetlands.

The costs of water hyacinth invasion is often in millions of dollars and its control is expensive and time consuming.

Fig.1.Water hyacinth.(Source:Google)

b) Great Salvinia (*Salvinia molesta*)

Invasive Salvinia forms mats that can cover water surfaces and expand at an alarming rate (being able to double its surface area in a few days when conditions are optimum). It can completely cover a small water body so that light and air are unavailable to submerged organisms with consequent damage to fisheries and biodiversity. It can prevent peoples' access to open water and slow down or prevent water transport; mechanical blockage of waterways, irrigation canals and inlets to water supply and hydropower facilities are all recorded as being caused by Salvinia Other water plants can use Salvinia as a substrate so that a floating "sudd" or complex of wetland vegetation can form which further enhances the deleterious effect.

Fig.2.Great salvinia(Source:Google)

c) Water lettuce(*Pistia sp*):

P. stratiotes can form thick and extensive mats that can block both sunlight and air from reaching a water surface and so have impacts on aquatic biodiversity and fisheries. Water lettuce can accumulate at barriers in flowing water and cause damage or blockage to, e.g.,irrigation canals and inlets to hydropower installations. It can grow together with Water Hyacinth and Salvinia to worsen the effects of both

Figure:3;Water lettuce(Source:Google)

d) Nile Tilapia:(*Oreochromis niloticus*)

The negative effect of the Nile tilapia on the native fauna of worldwide has been extensively reported. The Nile tilapia changes native community structure, reduces abundance of planktonic micro crustaceans, lowers water transparency and increases the abundance of microalgae.Also it causes local extinction of native species, predation of eggs and young of other fish species , alteration of the dynamics of nutrients and eutrophication, destruction of vegetation from the lake bottom and introduction of parasites.

Figure:4;Nile tilapia (Source:Google).

e) African catfish:(*Clarius garipienus*)

Clarias gariepinus has all the qualities of an aggressive and successful invasive species.Its high fecundity, flexible phenotype, rapid growth, wide habitat preferences, tolerance to extreme water conditions and the ability to subsist on a wide variety of prey can devastate indigenous fish and aquatic invertebrate populations and affected the wetlands in a massive manner.

Figure.5 African catfish(Source:Google).

f) Cray fish:(*Procambrus clarkii*)

Procambarus clarkii can destroy native wetland vegetation and the snail and crustacean fauna of aquatic ecosystems. It has been held responsible for the disappearance of water lilies and submerged vegetation as well as many species of snails in wetlands of Eastern and Southern Africa where it has become invasive. It is possibly a threat to the existence of smaller fish of biodiversity value. Its habit of burrowing can result in damage to dams and reservoirs

Figure:6 Procambrus clarkii(Source:Google)

g) Common carp:(*Cyprinus carpio*)

Common carp cause many problems primarily because of their destructive feeding habits. These can result in loss of local species of fish and invertebrates as well as important submerged vegetation. Their potential for reproduction is excessive - large females being reported to lay as many as a million eggs

Figure.7 Common carp (Source:Google)

Apart from these species,there are various other species which is causing invasiveness in wetland environment and causing threats to useful species.

Case study of various invasive Alien species of wetlands:

- Studies from Ganga river have disclosed that there is a constant increase in the yield of alien varieties such as *Cyprinus carpio, Pangasianodon hypophthalmus.*
- In Yamuna, the occurrence of tilapia, African catfish, Silver carp and Gambusia is higher and the biomass is spiralling every year.
- In Kerala, the high occurrence of tilapia species in inland waters was reported, due to which the native species such as Puntius dubius and Labeo kontius faces local extinction
- Invasion of ornamental sucker mouth catfishes *(Pterygoplichthys multiradiatus and Pterygoplichthys pardalis)* resulted in the decline of commercially important inland native fish in Kerala and Tamil Nadu, respectively.

Different pathways of Aquatic invasion:

- Accidental introduction by human being eg.,Hobbyists release the healthy ornamental fish when they get bored of them, or when they become too large to be accommodated in their aquaria.
- Natural calamities like flood introduces both flora and fauna into the new habitats. For instance, Invasive alien species escape during monsoon floods from the local breeding sites.
- E. crassipes,native to South America has been introduced to other continents as an ornamental and has now spread to most of the major water systems (rivers, lakes and wetlands) of the continent.
- Water lettuce is spread along water systems by flow and wind and can be moved by aquatic animals (hippos, other marsh mammals, waterbirds) and human visitors to infested waters. Pistia is also moved on boats and wheeled vehicles that have come into contact with infested waters.
- S. molesta can be spread by water currents, by birds and mammals, by boats and vehicles that enter infested waters. It can grow from small fragments and so has been spread to most water systems.
- P. clarkii was introduced to man-made wetlands to control bilharzia snails from where it spread to other wetlands.

- Carp, like most other fish in production systems, are known to escape from aquaculture, especially as larvae or young fish. They are then able to disperse in natural systems - both upstream and downstream.

Management measures to control invasive species:

Invasive Alien Species management is a herculean task, preventing the entry and periodical monitoring of the alien species in a new habitat are the important steps to be followed to get rid out of the Invasive Alien Species menace. Several steps followed to keep the invasive species out of our wetlands are,

- Stringent measures need to be taken to monitor the aquarium fish trade and the accidental release of exotic species into inland waters.
- Creating awareness among public and policy makers and to encourage research in management of Invasive Alien Species. In particular, awareness should be created on the ill effects of the introduction of aquarium fish species to the wild.
- A detailed and in-depth study needs to be designed to quantify the economic and biodiversity loss due to the invasion of ornamental fishes in inland waters.
- *E.crassipes,Salvinia sp,Pistia sp,Azolla sp* etc can be controlled by the effective application of herbicides.Care should be taken that the herbicides should not harm the native flora and fauna of particular wetlands.

Conclusion

Invasive species are everywhere: in our gardens, lakes, and on our restoration sites. We spend time, money, and energy trying to manage invasive species, yet often they seem to persist. Lately, some scientists have proposed that we just *"learn to live with" i*nvasive species.

An invasive species, either native or non-native, is one that spreads aggressively, often displacing other plants or animals. A species may overtake an area due to certain advantages it has over other species, such as an ability to persist or even flourish in the face of disturbance, a lack of natural predators in a novel environment, and/or a particularly fecund life history or reproductive strategy. These advantages give those invasive species an "edge" over other organisms.

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Celebration of International Day of Forests

In connection with the International Day of Forests 2021, Environmental Information System (ENVIS RP) Resource Partner, Amrita Vishwa Vidyapeetham, Coimbatore conducted various events and Environmental Education (EE) programs for high school students in Coimbatore districts of Tamil Nadu. The ENVIS team recognized the importance of working with government schools regarding environmental initiatives and education. The following programs were conducted in Government High School, KG Chavadi, Coimbatore on the occasion of World Forest day. All the participants have strictly followed the standard COVID protocols.

- Talk on: Biodiversity Conservation and Impacts of Biological Invasions in Western Ghats
- Film Show: Film on Biodiversity of western Ghats - Save our Shola
- Competitions: Essay writing, Drawing (Theme – Forests and Biodiversity)
- Tree Plantation: In school premises

Presentation on "Biodiversity Conservation and Impacts of Biological Invasions in Western Ghats"

Dr G. Magesh (Program Officer, ENVIS RP) had delivered a lecture on the importance of biodiversity, forest and how biological invasions affect forest ecosystem and biodiversity. In the talk, he also covered how young students can contribute to preserve forest and improve biodiversity. Also he highlighted the importance and significance to celebrate international day of forests. During the feedback session students expressed their gratitude saying that the talk has impacted the student community to develop awareness about the conservation of forests and biodiversity.

Short film on forest conservation

A short film was shown to the students to raise awareness on forest conservation and how can they prevent loss of biodiversy.

Conducted various competitions like essay writing, painting, and elocution

Essay writing, painting and elocution competition on theme Forests and Biodiversity were conducted and distributed the certificate to the contestant. It was a pleasure to see many students come forward and participated with great eagerness and interest.

Speech by student on Forest Day

Drawings by students

Tree planation program in the school campus

With the help of the school's eco-club members and staffs, the ENVIS team planted tree saplings in the school campus.

Congraluation to all the winners!

For painting, Vinith Kumar .V won first place. The second position has secured by Vinith Kumar.V For the speech competition Nivedha. M won the first place. For Essay Writing Competition, Shamni secured the first and Dhanushya bagged the second position.

Tree planting in school premises

Competition Winners

Drawing Competition

First Prize

Vinith Kumar .V

Second prize

Munishwaran .P

Speech Competition

First Prize

Nivedha. M

Essay WritingCompetition

First Prize

Vinith Kumar .V

Second prize

Dhanushya

Certificate distribution for the competition winners

A Microscopic Look into the Commensalic Nature of Wetlands

D.Hema Karthika R,

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Generally, wetlands refer to the landforms submerged in water a part of the year or throughout the year. Wetlands are of various types including Marshes with freshwater or saltwater dominated by grass species, Swamps that are deeper and similar to streams, Bogs created due to water from the rain, and finally, Fens with mineral-rich freshwater.

Wetlands act as a home to all living forms like animals, plants, and other lower forms of life including microorganisms, etc. The role of plant species in wetlands is to provide shelter to the birds residing in the wetland and the water in the wetlands allows fishes and other aquatic

Wetlands: "Areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres." (Ramsar Convention, 1971, Article 1.1)species to sprawl. The microorganisms in the wetlands degrade the plant and animal matter and involve themselves in carbon sequestration.

The species which are non-native to the ecosystem but have been found thriving in the ecosystem are said to be invasive species. These generally affect the lifestyle of the other organisms in an ecosystem. We all know that plant species like *Eichhornia crassipes* commonly known as the water hyacinth is an invasive species to the wetland ecosystem which leads to silting of the wetland.

The second one namely *Salvinia molesta* is an aquatic fern commonly known as giant Salvinia or Kariba weed which creates a dense mat on the surface of the water and thereby preventing.light from reaching the organisms thriving at the floor.

In this article, we will be discussing the microscopic species which are generally not considered invasive but are a threat to wetlands in many countries. The invasive microorganisms that are thriving in the wetlands affect the normal ecosystem of wetlands and lead to climate change, etc. In extreme cases, it leads to the destruction of the entire wetland ecosystem.

The first species we will be discussing is the micro-organism *Didymosphenia geminata* which belongs to the class Bacillariophyceae. It is a single-celled alga that natively belongs to Asia and Europe. It was found to be invasive in South America and Oceania [8]. The *D.geminata* species secretes an extracellular stalk composed of polysaccharides and proteins, which attach to the substrate or rocks acts as a support for the species to thrive in the ecosystem but, this stalk makes *D.geminata* species harmful.

This is because these stalks resist degradation and release harmful toxins like polyphenols on forceful degradation.

The other reason *D.geminata* species are said to be harmful is that they are fouling, which creates a dense mat on the surface of the water, affecting the native algal and macroinvertebrate species, and leading to sedimentation, increased organic matter and nutrient recycling.

The eradication of *D.geminata* species is hard because they are identical to other diatoms species and cannot be easily detected by genetic fingerprinting and there is no proper method to completely kill the organism. Recent research has been developed to slow the rate of proliferation of the organism.

The second microorganism on the list is *Gonyostomum* semen which belongs to the class Raphidophyceae[5]. It is a freshwater alga that is globally distributed and is found to be invasive in the Nordic region. The *G.semen* species are motile and contain two flagella; one for movement and the other secretes a slimy substance on the surface by a trichocyst. They contain sizeable green oval chloroplast.

The *G.semen* species are said to be harmful because they induce algal blooms and lead to eutrophication . The slimy substances [6] secreted are harmful to human beings as well. Research on the slimy substance showed that they cause skin irritation. The G.semen species are introduced into the wetland ecosystem anthropogenically from agricultural pesticides. The eradication of *G.semen* species is entirely not required because they act as a source of food for certain zooplanktons but their concentrations can be reduced by the process of filtration.

The third microorganism on the list is the cyanobacterial species *Cylindrospermopsis raciborskii* which belongs to the class Cyanophyceae.

It is an invasive cyanophycean which was first observed in Indonesia and India but has now spread to all continents except Antarctica [3]. The introduction of the species to the wetland ecosystem can be done by the migratory birds which might have carried the akinetes in the feet or guts and tropical fishes may carry the vegetative form of the *C.raciborskii* species.

The *C.raciborskii* species are said to release a highly potent hepatotoxin, *cylindrospermopsin*. It is a cyclic guanidine containing alkaloids. On releasing this harmful toxin, they induce cyanic blooms on the surface of the water and also result in allelopathic activity - which is an inhibitory effect on the photosynthetic activities of the other algal species. They are also reported to alter the nutrient dynamics, the dominant structure, and productivity of other organisms in the ecosystem.

The eradication of the *C.raciborskii* species is not possible because they tend to change the physiological plasticity and adapt themselves to any environment that has warmer conditions. Thus, it makes the *C.raciborskii* a notorious invasive species.

Eutrophication: The gradual increase in the concentration of phosphorus, nitrogen, and other plant nutrients in an aging aquatic ecosystem such as a lake. The productivity or fertility of such an ecosystem naturally increases as the amount of organic material that can be broken down into nutrients increases.Akinetes: An enveloped, thick-walled, non-motile, dormant cell formed by filamentous,heterocyst-forming cyanobacteria

The last microorganism on the list is *Rhizodomus tagatz*i which belongs to the class Spirotrachea and order Tintinnida[7]. It is widely found in arctic regions mostly in the coastal seas. They were found to be invasive in parts of Japan, Europe, and North America [2]. The *R.tagatzi* species are said to be invasive because they tend to promote the phytoplankton blooms. For example, Raphidophyceae which tend to settle organic carbon and lead to the development of anoxic layers.

The *R.tagatzi* species have been transported to Japan during the Shellfish cultivation process as noted from the previous papers[3].

Though the *R.tagatzi* species harm the environment they cannot be completely destroyed from a wetland ecosystem because they are the only heterotrophic planktons that feed on the phytoplankton and act as a source of food for the crustaceans and small fishes.

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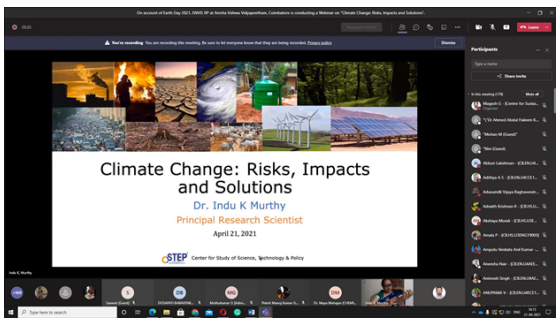
Webinar on Climate Change: Risks, Impacts and Solution

ENVIS RP, Amrita Vishwa Vidyapeetham, organized a webinar on "Climate Change: Risks, Impacts and Solution". With guest speaker, Dr Indu K Murthy (Principal Research Scientist, The Center for Study of Science, Technology and Policy (CSTEP)) the webinar took place on 21st April 2021, 04.00 pm to 05.30 pm. The webinar was a roaring success with 200 participants (academicians, researchers and students).

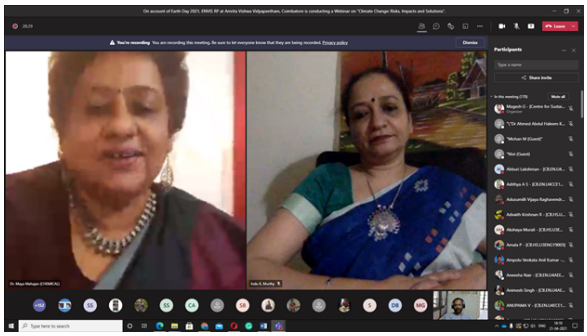
Dr Maya Mahajan, ENVIS Coordinator & Associate Professor of Amrita Vishwa Vidyapeetham welcomed the resource person & the participants, highlighting the significance of the webinar - on Climate change and its Imapacts. Dr Maya moderated the session by asking questions on key points. She expressed her appreciation and gratitude to Dr Indu K Murthy for accepting the invitation.

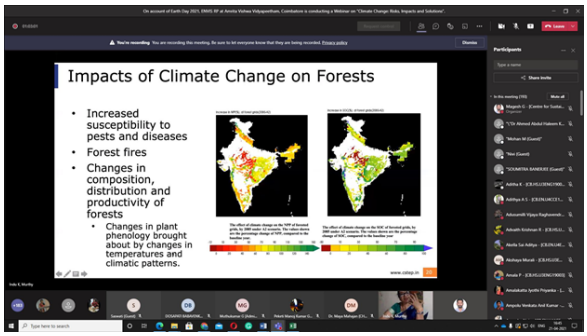
Dr Indu K Murthy (Principal Research Scientist, The Center for Study of Science, Technology and Policy (CSTEP)) delivered the keynote speech. She pointed out the major impact of climate change on atmosphere, ocean, agriculture, forest ecosystems, biodiversity as well as the human health and infrastructure.

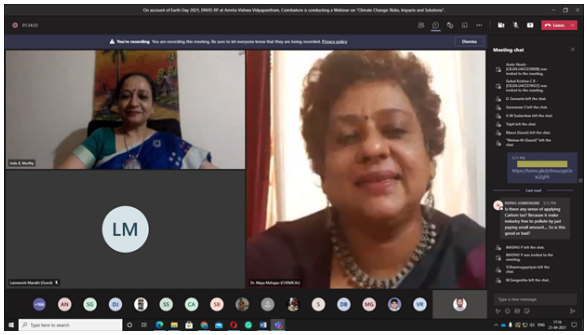
She also touched the need of mitigation and adaptation measures to tackle the impacts of climate change and suggested best environmental practices to be followed for the restoration of environment. She highlighted the importance of taking measures to address the climate change at global level.

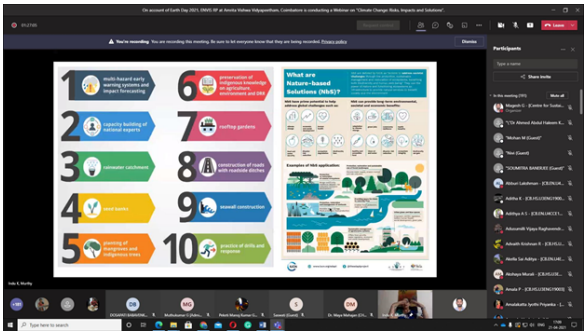


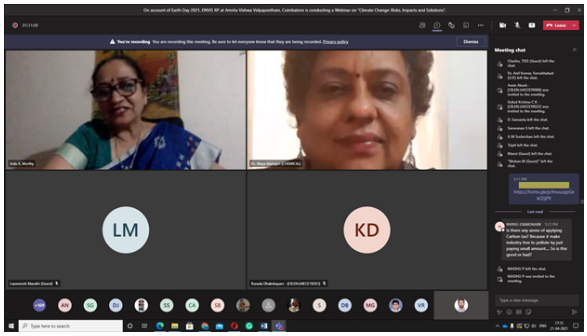
The webinar was structured with the general introduction to climate change, its risks and impacts, and a panel discussion with the presenter followed by a Q&A session. After the session, feedback from the participants was collected through a google form. Around 200 participants from Kerala, Tamil Nadu, Karnataka, Andhra Pradesh, Telengana, Maharashtra, West Bengal, UP, MP, Punjab attended the webinar. Dr Magesh G., Programme Officer of ENVIS RP conveyed vote of thanks to the chief guest, moderator and all the participants for making the webinar, a grand success. The webinar received positive responses & the participants appreciated the organisers for bringing to light this important & relevant conversation!

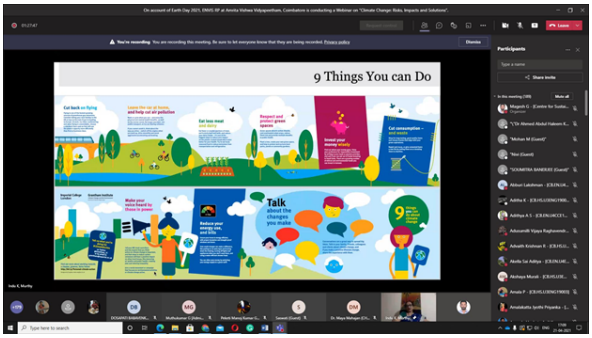












Invasive Alien Species in Wetlands

Vismaya K Sachithanandhan

KARUNYA INSTITUTE OF TECHNOLOGY AND SCIENCES

An Invasive Alien Species (IAS) is defined by Convention on Biological Diversity (sixth Conference of Parties; Decision VI / 23) as "an alien species is a species, sub-species or lower taxon, introduced outside its natural past or present distribution, which includes any part, gametes, seeds, eggs or propagules of such species that might survive and subsequently reproduce". Some of the exotic species introduced outside their natural range may turn invasive and cause huge loss to local diversity and economy. Invasive alien species have been emergingas the second biggest threat factor to globalbiodiversity after habitatdestruction, and it is expected tosoon surpass the damagecaused by habitdestruction and fragmentation factor.

Global Invasive Species Program (GISP) stated that invasive species has the potential to affect the ecosystems in several ways including changing the density, diversity and distribution pattern of the native species. Further, some of the invasive alien species can indirectly and directly affects the human health and also damage the livelihood of the native / regional community and ultimately destabilize the regional economy.

Moreover, it is predicted that intensive invasion can cause deleterious ecological changes, which can alter the natural nutrient cycles of the ecosystems which can also leads to global climate change.

India has diverse topography and different climatic zones, which support diverse wetland habitats throughout the subcontinent. Wetlands in India cover 58.2 million hectares, including areas under paddy cultivation. From biodiversity point of view Indian wetlands support vast group of species. They are remarkably rich in diversity and harbour unique taxonomic groups. Wetlands are defined as the lands transitional between terrestrial and aquatic ecosystems where the water table is usually at or near the surface or the land covered by shallow water.

They are recognised as the kidney of the earth because they pool water and sequester pollutants. Moreover, wetlands can stabilize the regional water supply, purify the sewage and recharge the ground water and act as a local and global climate stabilizers. Mostly wetlands support unique aquatic and terrestrial species of plants and animals, many of which are endemic to that habitat/region.

The introduction of invasive alien flora and fauna is considered to be a major cause for species endangerment and extinction in aquatic ecosystems including inland wetlands. Aquatic invasive species pose major ecological and economic threats to rivers, lakes and waterways worldwide through displacement of native species, alteration of hydrological cycles, affecting nutrient cycles and altering food web dynamics, introducing new diseases and parasites and hybridization with native species.

Besides impacts on ecosystems and biodiversity by invasion results in large economic loss too. The Western Ghats hotspot is globally a significant centre of diversity and endemism for freshwater species where close to 16% of the 1,146 freshwater taxa assessed are threatened, 1.9% were near threatened.

Impacts of invasive alien species on Indian inland wetlands

The Indian inland ecosystems and biodiversity are constantly degraded due to invasion of several exotic flora and fauna.

- **Impacts of Water hyacinth on Indian wetlands**

Water hyacinth (*Eichhornia crassipes*) was introduced as an ornamental plant in several regions of the world including India. In most of the habitats of Africa and India, this species is still spreading even after century of its initial introduction. Recently water hyacinth has also been labelled as the world's worst weed and has garnered increasing international attention.

A freshwater lake formed by the Brahmaputra River is heavily infested by water hyacinth and it has been identified causing heavy siltation in the wetland. Besides, navigation in the Brahmaputra river has beenseverely affected, it has also blocked irrigation channels andobstructed the flowof water tocrop fields.

In West Bengal, water hyacinth causes huge annual loss of paddy by directly suppressing the crop, inhibiting rice germination and interfering with harvesting. Besides, the dense growth entangles with boat propellers and hampering fishing. It also pollute the water and changes the water chemistry by decreasing the dissolved oxygen level. In Kerala, the inland water transport along the inland backwaters has been severely hampered by the invasive water hyacinth.

Impacts of exotic fishes on Indian inland wetlands

Several fish species are introduced into India for ornamental, aquaculture and other purposes. In due course of time few of the species managed to escape into wild and turned as invasive to the system.

- **Impacts of common carp Cyprinus carpio**

Common carp (Cyprinus carpio) was introduced into India during 1939 and 1957 in order to increase the aquaculture production and now it contributes 7.17% of inland production. Gradually this species was introduced from cultured ponds to reservoirs and lakes and later it was escaped to several India Rivers and turned as an invasive. The invasive carps destroy aquatic plants directly by uprooting or consuming the plants, or indirectly by increasing turbidity and thereby reducing light for photosynthesis. They also compete with indigenous species for food and space and displace the indigenous species.

- **Impacts of African catfish Clarias gariepinus**

African catfish (Clarias gariepinus), was introduced into India from Bangladesh with the aquaculture species tag. C.gariepinus is known for its behaviour of slowly crawl on the land with the aidof their strongpectoral fins andenter in to adjacent wetlands during monsoon (Burgess, 1989).

C.gariepinus is an omnivorous predatory fish, feeds on a variety of food items from microscopic zooplankton to large fishes. It was reported that this African catfish can prey on native fish into half of its length. It was also reported that this species also devour on small reptiles, amphibians and birds.

Table 4. Impacts of exotic species on native varieties of Ganga River

S. No	Name of the Exotic species	Identified and expected impacts
1	*Aristichthys nobilis* Bighead Carp	Led to decline of *Catla catla*, and high chance of hybridization
2	*Cyprinus carpio* Common Carp	led to decline of Indian major carps
3	*Oreochromis niloticus* Nile tilapia	Naturalized population of tilapia declined
4	*Clarias gariepinus* African Catfish	The carnivorous habit leads to the decline of small animals and directly and indirectly leads loss to biodiversity.
5	*Hypophthalmichthys molitrix* Silver Carp	Competing with *Catla catla* for all resources
6	*Gambusia affinis* Mosquito fish	Large scale consumption of natural zooplankton leads to food scarcity for the local fish species

Source: Singh *et al.*, 2013

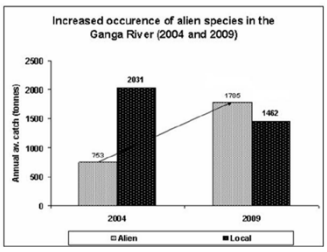


Table 5. Common Impacts of invasive species at Kashmir lakes

Kind of Impacts	Consequences
Economic Impacts	Productivity reduction in agricultural, livestock sector and land values Imbalance in the ecosystem services Hampering of transportation
Social Impacts	Poor revenue through recreation (tourism) Health impacts
Environmental Impacts	**Ecosystem functions** Impairment of water quality Alteration in nutrient cycling Change in habitat morphology Reduction in water flow **Ecosystem structure** Local/ regional native species xtinctions Loss of biodiversity Reduced ecosystem stability

Globally wetlands support unique aquatic and terrestrial species of plants and animals, and most of which are endemic to that habitat/region.

Due to their biodiversity richness wetlands are considered as "biological supermarkets" because they support a large and complex food web and rich in biodiversity, provide unique habitat for large number of wildlife and loaded with immeasurable genetic wealth. In addition, wetlands also provide unique values continuously to the society.

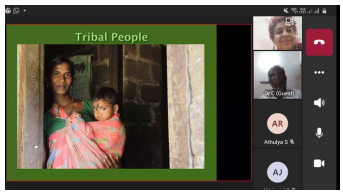
Wetlands have also been shown to enhance a variety of ecological, biological and hydrological functions, which provide economic, aesthetic, recreational, educational and other values to society continuously i.e., ecosystem services. Therefore, devastation of a wetland results in several socio economic problems and instantly reflects on the GDP (Gross Domestic Product) of a nation. Due to the aforesaid reasons wetland conservation in India is essential.

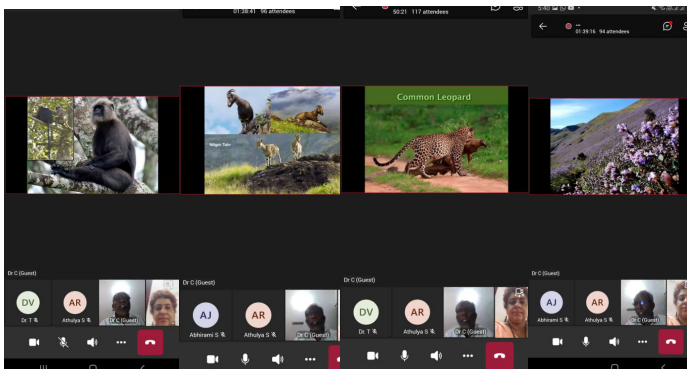
Webinar on Biodiversity of Southern Western Ghats

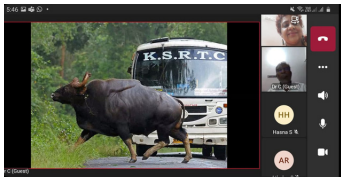
ENVIS RP, Amrita Vishwa Vidyapeetham, organized a webinar on "Biodiversity of Southern Western Ghats" on 22nd May 2021, between 04.00 pm to 06.30 pm to mark the International Day for Biological Diversity. Dr G. Christopher, Scientist & Research Coordinator, Advanced Center of Environmental Studies and Sustainable Development (ACESSD), Mahatma Gandhi University, Kottayam, Kerala was the guest keynote speaker.

Dr Maya Mahajan moderated the session by asking questions on key points. The webinar was followed by panel discussion with the presenter and Q&A session. She expressed her appreciation and gratitude to Dr G. Christopher for accepting the invitation and delivering the lecture. After the session, feedback from the participants was collected. The webinar was a roaring success with participants numbering 200 (academicians, researchers and students) from various parts of the country. Dr Maya Mahajan conveyed a vote of thanks to the chief guest, organisers and all the participants for making the webinar, a grand success. The webinar received positive responses & the participants appreciated the organisers for bringing to light this important & relevant conversation.

Dr Maya Mahajan, ENVIS Coordinator & Associate Professor of Amrita Vishwa Vidyapeetham welcomed the resource person & the participants, highlighting the significance of the webinar topic - Biodiversity of Southern Western Ghats. Dr Christopher delivered the keynote speech with the general introduction to biodiversity of Western Ghats and various types of forest ecosystems and the species found in different forest types. Discussing the birds, fishes, mammals, reptiles and amphibians found in the Southern Western Ghats region. He concluded the session by mentioning the significance and need of conserving the biodiversity of Western Ghats.







Invasive Exotic Catfish *Clarias Gariepinus* in West Bengal – a Bane

Subrato Ghosh

Fishery Extension Officer, Government of West Bengal

Kolkata

Importance of freshwater wetlands:

Wetlands are the key life support systems of many indigenous plant and animal species. West Bengal (WB) in eastern India has freshwater wetlands viz., lakes, dams, swamps, beels. The East Kolkata wetlands have been recognized as Ramsar site. Freshwater wetlands (open and closed-type) and perennial floodplain wetlands are usually situated near to rivers. These are aquatic biodiversity hotspots, also crucial resources for income generation, livelihood and well-being of local fishermen and fish farming communities. Wetlands ('Beels' in Bengali vernacular) offer vast potential for capture fishery, are home to nutritious small indigenous fishes (SIFs). Water here is rich in nutrients and offer convenient environment for growth of major carps and economically-important indigenous fishes.

Beels play an important role to preserve piscine biodiversity. Such ecosystems act as natural reservoirs and natural resources of fishes, where they take shelter when rivers dry up, and again on maturity they come out for breeding in rivers during rainy season. Beels are auto-stocked with fish seeds from rivers. Thus fish stock is maintained and balanced in natural waters. Total area of beels in WB is about 42000ha. Many beels of large size (4-15ha) in different districts of WB are under possession of Primary Fishermen Cooperative Societies who maintain it for pisciculture (where big-sized major carp fingerlings are stocked) and improved fisheries management. Resource-rich progressive fish farmers have taken some small and medium-sized wetlands on lease for fish farming.

Pisciculture in wetlands provides significant income for sustaining livelihoods of thousands of families living around it. Prohibition of filling up of any wetland irrespective of its size, on any grounds, has been made mandatory by WB State Fisheries Department. 'Wetland Day' is celebrated in WB on 16th June every year to sensitize and aware rural people on importance of wetlands.

Introduced exotic finfishes in India

India has witnessed introductions of exotic finfishes for food or other beneficial purpose since middle of 19th century. Combining pre- and post-independence periods, exotic freshwater fishes introduced into Indian freshwater bodies (warmwater and coldwater) are T*inca tinca, Carassius carassius, Cyprinus carpio (European and Chinese strains), Osphronemus goramy, Salmo trutta, Salmo gairdneri, Gambusia affinis, Ctenopharyngodon idella, Hypophthalmichthys molitrix, Puntius javanicus, Tilapia mossambica, Salvelinus fontinalis, Onchorhynchus nerka, Salmo salar, Clarias gariepinus, Piaractus brachypomus, Mylopharyngodon piceus, Pangasianodon hypophthalmus, Aristichthys nobilis, Oreochromis niloticus.*

Introduction of *C. gariepinus* and *A. nobilis* is considered accidental and unauthorized and C. gariepinus is the only fish among afore-mentioned twenty-one which is invasive and has quite a few unacceptable features; the glaring instance that speaks in favour of impact of exotic introductions resulting in disappearance of native fish species.

Certain fishes out of total 765nos found in natural open freshwater bodies in India have attained threatened status, being vulnerable or endangered. Intentional and non-judicious introduction and accidental undesirable entry of some exotic finfishes and dominancy of carnivorous fish *C. gariepinus* have had significant impact on diversity of indigenous fish species in beels and floodplain wetlands in WB. Total 106nos threatened fishes identified in WB in inland and marine ecosystems

Features of *Clarias gariepinus*

The exotic catfish *C. gariepinus* (Burchell, 1788) (Silurformes:Clariidae), native to Africa, is cultivated as foodfish in earthen pisciculture ponds in some places in Andhra Pradesh and WB. Fish traders call it 'Thai Magur' because it is said to have got access into India from Thailand via Bangladesh. Although unofficially, but still Thai Magur has already taken entry into our country. It is gigantic in size, an unofficial and undesirable fish, can grow upto 130cm in total length and 12.8kg in body weight, attains 700-1000gm in six months of culture.

The native and much more preferred *C. batrachus* (Desi magur) and *C. gariepinus* can be distinguished by presence of blunt occipital process in the former while it is pointed in the latter. Colour of *C. batrachus* is greenish/blackish, with four pairs of barbels of equal size while colour of *C. gariepinus* is grayish olive to blackish with sometime black patches, faint grayish with whitish abdomen. Two depressions found on dorsal part of head and three 'V' like depressions observed on posterior region of its skull.

Barbels are larger and unequal in length. C. gariepinus was introduced into WB probably during 1993, spread to other states for pisciculture. It has gained entry in Ganga, Yamuna, Sutlej and Godavari rivers, found in freshwater lakes, streams, floodplain and normal wetlands in some states.C. gariepinus is carnivorous and bears adaptability to different environments.

It can live in turbid pond waters, dry conditions, is a voracious predator and eats almost anything. Major food items are smaller-sized freshwater fishes, aquatic invertebrates, aquatic insects.

Large-sized specimens can consume a duckling whole and are efficient predators. Scientists of ICAR-National Bureau of Fish Genetic Resources, Lucknow found remains of several fish species, insects, frogs and even birds in gut content analysis of river-caught *C. gariepinus*.

C. gariepinus culture in ponds

Farm-produced *C. gariepinus* is marketed mostly in live state. Department of Fisheries, Government of WB has enforced strict prohibition on pond culture of *C. gariepinus.* It has been banned by policy framers rightly citing ecological disaster and the issue of predation on indigenous fish populations that has been extensively discussed. *C. gariepinus* culture is being done in some places of Bashirhat-I Block, North 24 Parganas; Bishnupur-I Block, South 24 Parganas; Kaliachak-I and Kaliachak-II CD Blocks, Malda. It has good demand in Nagaland, Assam, Haryana, Punjab. Juveniles of *C. gariepinus* in clandestine manner come into WB from Bangladesh for stocking in grow-out ponds. This fish when newly stocked and grown with major carps *Labeo rohita, Catla catla, Cirrhinus mrigala, H. molitrix, C. idella and C. carpio* in grow-out ponds showed a loss to carp production over previous years. Possibility of entry of adult *C. gariepinus* from ponds into natural water bodies cannot be ignored.

In India, C. gariepinus is passing through a phase of controversial identity. Many fish farmers had earlier raised voice in favour of its rapid growth in pond systems, tolerable to less-favourable pond environment and low market price affordable to common buyers. Extensive culture can be done in swamps, marshes, wetlands, derelict water bodies where carp culture is not possible.

But farmers soon understood that *C. gariepinus* is voracious feeder and carnivorous in nature.

Fast growth of it results at the cost of heavy feeding and predation. Large-sized specimens do not sale well in markets owing to their poor meat quality. Smaller-sized specimens are sold in some market in disguise of high-priced *C. batrachus.*

Because of biting habit, *C. gariepinus* is nuisance in village ponds to persons who take bath therein. In most cases, farming of *C. gariepinus* has led to failure. High food intake requirements and low consumers' preference have been major constraint for non-viability of its farming. Fish eating communities in Kolkata and other districts of WB do not consider it tasty and dislike buying it.

Epilogue

Some exotic fishes have caused harm to indigenous piscine germplasm in Indian inland waters like in other countries. *C. gariepinus* is identified as invasive causing threat to native piscine biodiversity in freshwater ponds old in existence and wetlands in WB and other states. Alterations of ecological communities by this alien species may change functioning and overall health of wetland ecology. For conserving our native fish species in nature, C. gariepinus is simply and strictly unwanted that is reported to cause ecological problems.

Intelligentsia in Indian fishery and aquaculture are completely in opposition to ongoing practices of farming exotic catfishes like *C. gariepinus* and *A. nobilis* in some places of WB.

They believe that if introduction of such catfish species and their propagation continues, then time will come when people will completely lost remembrance of the need of re-establishing methodologies regarding rearing of threatened indigenous catfishes like *C. batrachus, Mystus vittatus, Heteropneustes fossilis, M. cavasius, Ompak pabda* which is a resource of our own and high-valued fishes.

Even if then the need is felt, it will not become possible to give effect to our desires. Much questions have been raised about the ethics and ecological impact, when fish like *C. gariepinus* with offensive qualities and aggressive nature get released into open waters.

C. gariepinus devours fish of every kind and wouldn't let others to survive in open freshwater bodies. In nature, minor carps and SIFs grow by consuming thousands of plankton; and adult *C. gariepinus* consumes all of them. Being highly predacious, it has been believed to disturb aquatic ecology with a view of the possible future evil consequences. Its import into India is now prohibited, seed production and propagation not legally permitted.

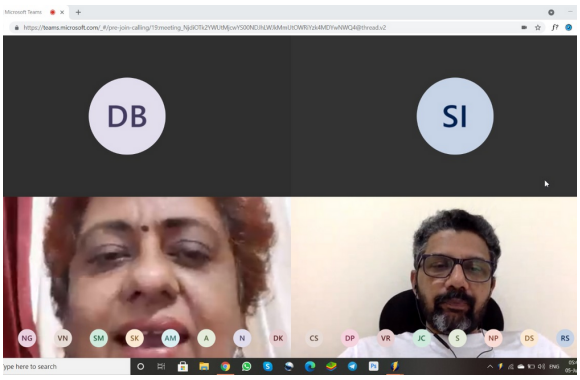
As discussed, some private fish farmers continue to rear and market it even though ban has been imposed. In order to restore fish biodiversity resource in beels and other inland aquatic ecosystems, we must contend against introduction and ongoing farming practices of *C. gariepinus* and A. nobilis in WB.

Webinar on Ecosystem Restoration

On World Environment Day, ENVIS Resource Partner on "Science based management of biological invasion/invasive alien species in India," Amrita Vishwa Vidyapeetham (AVVP), Coimbatore, Tamil Nadu, has successfully conducted a webinar on restoration of ecosystems. A talk on "Necessities of ecosystem restoration in India" was delivered by Dr.Jayahari and a lecture on "Role of ecosystems in combating climate change and natural disasters" was given by Dr.Maya Mahajan. Around 250 Participants from various fields including students took part with a representation from all across the country.

After the lectures by speakers there was a panel discussion followed by Q&A session. In addition to the Q&A sessions after presentations, feedback from the participants was collected. Generally, participants received the webinar positively and appreciated the organisers for arranging one of the relevant topics through the webinar. Dr Magesh concluded the session by proposing a vote of thanks.

Dr Magesh G, Program officer, ENVIS, introduced and welcomed the speakers and participants. Dr Jayahari spoke about the role of ecosystems in combating climate change and natural disasters. Dr Maya Mahajan discussed in detail climate change, carbon sequestration and the various ecosystem services provided by the environment. She concluded the session by stating the importance of restoring the ecosystem.

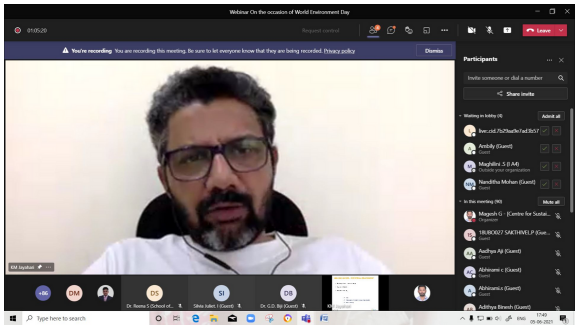


About the speaker:

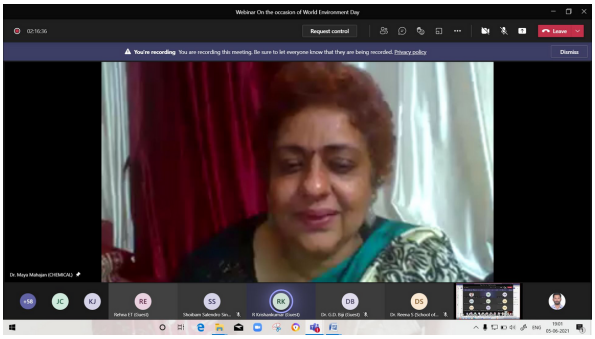
Dr.Jayahari works as Senior Manager, Sustainable Landscapes and Restoration program at World Resources Institute, WRI. He has pursued his PhD in Forestry (with specialization in Wildlife Biology) from Forest Research Institute, Dehradun. Dr.Jayahari worked in different capacities in institutions like Kerala Forest Research Institute, WWF India, Winrock International India, and major focus on Natural Resource Management and Biodiversity Conservation. He has initiated and implemented many conservation programs primarily in Western Ghats and Eastern Himalayas.

Prior to his current role at WRI India, he played an instrumental role in building some spatial databases in India, like India Observatory at the Foundation of Ecological Security, and Restoration Opportunity Atlas of India at WRI India.

He also provided consultancy services to national and international organizations like Tetra Tech, ICLEI South Asia, etc.

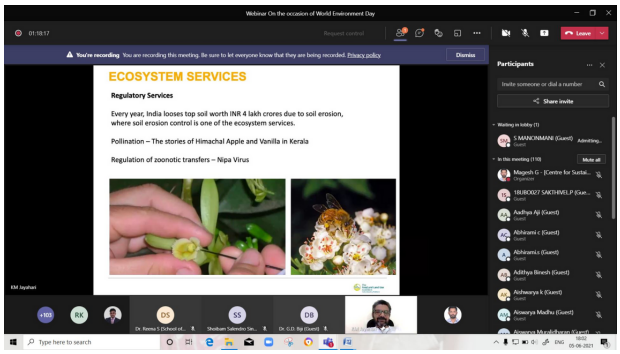


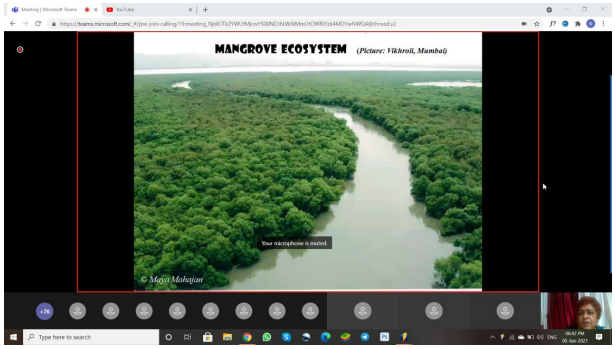
Dr Maya Mahajan is Associate Professor in Centre for Sustainable Future at Amrita Vishwa Vidyapeetham, Coimbatore and the Co-ordinator for ENVIS center on Biological Invasion. She has done her doctorate in Invasive alien Species in different forest types in Nilgiri Biosphere Reserve. She has more than 25 years of experience in research, training, advocacy and management in various sectors of Environment and Development – including Biodiversity Conservation, Biological Invasion, Sustainable Development, Participatory Forest Management, Sustainable livelihood, Wetland Ecology, Forest Ecology, Environment Education etc.

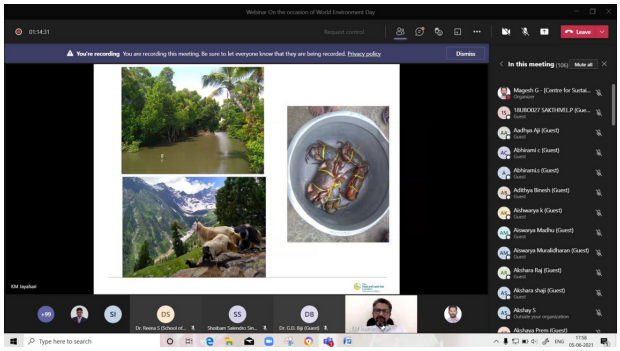


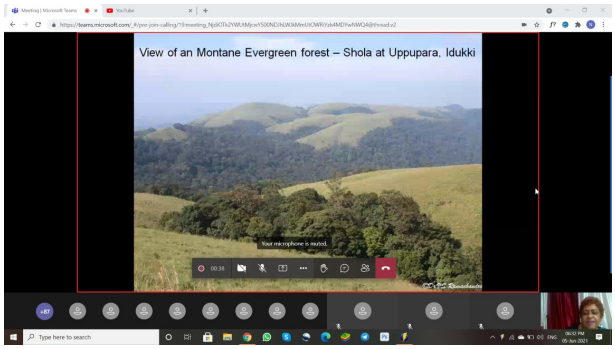
Dr Maya Mahajan established the Siruvani Lantana furniture and craft centre by training tribals in lantana craft and furniture and this helped in conservation of Siruvani forest by controlling Lantana invasion. She has received international women achiever award in Environment and sustainability in 2018 and Kovai Wonder woman award in 2019.

Glimpses of Webinar:

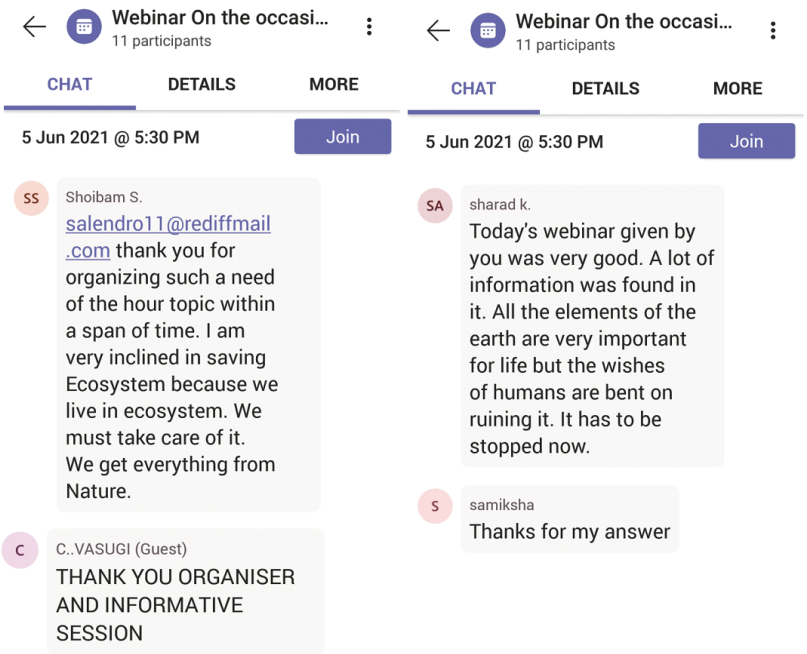






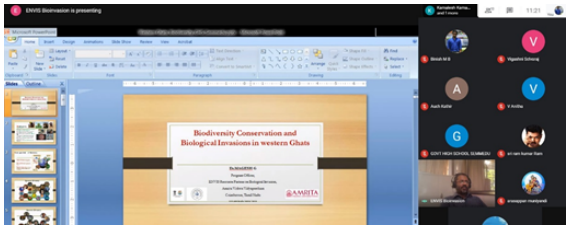


Feedback from participants:

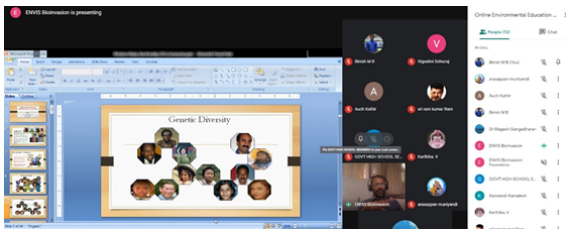


Environmental Education (EE) Program for School Students

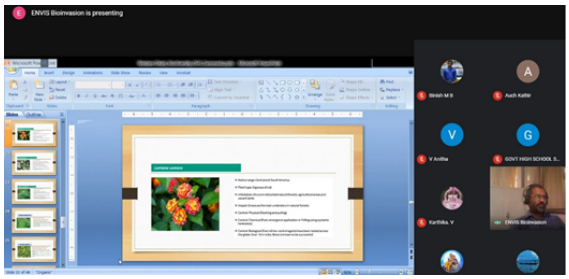
The quality of the earth continues to deteriorate; it is crucial to develop environmentally literate citizens. Environmental education (EE) provides the methods and content that can lead to environmental literacy and a more sustainable future.



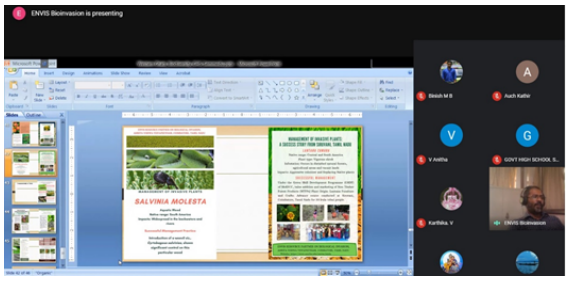
Through EE, people develop questioning, analysis and interpretation skills; knowledge of environmental processes and systems; skills for understanding and addressing environmental issues.



By recognising the importance of working with schools regarding environmental initiatives and education, theEnvironmental Information System (ENVIS) Resource Partner at Amrita Vishwa Vidyapeetham, Coimbatore conducted an Environmental Education (EE) programs for high school students in Coimbatore districts of Tamil Nadu.



An online environmental awareness class was conducted in a government school (Government High School, Semmedu, Coimbatore). Mrs. Janaki (Headmistress, Government High School, Semmedu) welcomed the ENVIS team and the students to the program.



Mr. Binish M. B (Information Officer, ENVIS RP) gave the brief introduction of the program. Dr. G. Magesh (Program Officer, ENVIS RP) interacted the students with the basic ideas of biodiversity, Western Ghats and biological invasion. In his talk he concluded with how the student community can contribute to preserve biodiversity.

National Level Painting and Article Writing Competition on a Theme "Restore our Earth"

As part of environmental education programme the ENVIS RP, Amrita Vishwa Vidyapeetham conducted National level Painting and Article writing Competition on a theme "Restore our Earth". The result of Painting completion is as follows.

Winners of National level Painting Competition on a theme "Restore our Earth"

First Prize

Abhigyan Krishna

Delhi public School, Ranchi

Second Prize

Deepshikha DE

Delhi public School, Noida.

Third Prize

Sirigiri Naga Pavan Sathvik Reddy

Amrita school of engineering, Chennai

Third Prize

Anjali Muragali

Swami Vivekanand
kannada medium school,

Sankeshwar, Belagavi

Consolation Prize : 1

S M Felciya Suson

Kongunadu Arts and Science College

Coimbatore

Consolation Prize : 2

M.Iswariya

K.C.S.Kasi Nadar College of Arts and Science,

Chennai

Consolation Prize : 3

P.Muthumari

SPKCEES, Alwarkurichi,

Tirunelveli.

Winners of National level Article writing Competition on a theme "Restore Our Earth"

First prize:

Mugdha Kumari pandey

Jpm college chapra,

Bihar

Second prize:

Nandhana J

Kongunadu arts and science college,

Coimbatore

Third prize:

Vishnupriya B

Kongunadu arts and science college,

Coimbatore

Recent news on Biological Invasions

KFRI Scientist is 'National Focal Point' for U.N. body

12 June 2021 (Source: The Hindu)

T.V. Sajeev, Senior Principal Scientist, Kerala Forest Research Institute (KFRI), Peechi, has been nominated by the Ministry of Environment, Forest and Climate Change (MoEFCC) as the national focal point for the Asia-Pacific Forest Invasive Species Network (APFISN).

The APFISN is a network of 33 member countries in the Asia-Pacific Forestry Commission, which is a statutory body of the Food and Agriculture Organization of the United Nations.

Dr. Sajeev currently coordinates the nodal centre for biological invasions at the KFRI. He had been active in developing management strategies against the invasion of the Giant African Snail and the Red-eared Slider Turtle, which came to India from Africa and Mexico respectively and caused both economic and ecological impacts.

He is also the member of a committee constituted by the Madras High Court to evolve strategies to manage invasive alien plants in the Nilgiris. Recently, he had detected the Barnacle Wax Scale Insect, Ceroplastes cirripediformis, an invasive pest of horticultural crops, native to southern United States and the Caribbean Islands, which was established in Kerala recently.

Reference:

https://www.thehindu.com/news/national/kerala/kfri-scientist-is-national-focal-point-for-un-body/article34797148.ece

Checking Spread of Invasive Alien Fish as India Faces Climate Extremes

19 May 2021 (Source: Mongabay)

man displays an alligator gar caught from a river in Kerala. The fish can measure up to three metres in length and could put the native fish species at risk. Photo from Smrithy Raj.

Degrading quality of natural water bodies and rivers, coupled with climate change impacts, could set the stage for alien (invasive) species to take root, multiply and alter aquatic flora and fauna in biodiversity hotspots, warned scientists, documenting alien fishes in the Western Ghats.

- Extreme climate events may aid the spread of alien species in biodiversity hotspots, such as the 2018 and 2019 flood-driven release of alien species like the alligator gar from illegal aquaculture farms in Kerala to its natural water bodies.
- Compliance and enforcement of existing environment protection laws in India can check the spread of alien species. An exclusive policy on invasive alien species and overseeing agency may give more teeth to management of such species.
- Countrywide assessment of impacts of IAS on the economy,
- Biodiversity and food security are needed to understand the nuances of the issue.

In a paper, scientists at the University of Kerala reiterated concern over the expansion of alien, or non-native species in biodiversity hotspots triggered by extreme climate events, such as the flood-driven release of alien species from illegal aquaculture in Kerala, an Indian state on the southwest tip of India that sees the onset of the southwest monsoon as it sweeps into India in June.

"In India, there are no specific policies to address the issue of invasive alien species (IAS), though it is part of several existing biodiversity legislation and regulations," explained Smrithy Raj, lead author of the paper and a PhD student working on alien species at the university.

The National Biodiversity Strategy and Action Plan published in 2014 has several suggestions for the regulation of the introduction of invasive alien species and their management but none of the suggestions is put into practice; besides, there is no national mechanism or an institutional mechanism to foresee and enforce this, said Raj. The researchers call for monitoring tools such as environmental DNA to keep tabs on these hardy non-native species in Indian waters.

Gaps also remain in the countrywide assessment of impacts of IAS on the economy, biodiversity and food security. There is a need to better understand the factors that trigger alien species to become invasives and pathways of introduction to natural ecosystems, and for strict enforcement of environmental laws and awareness among local communities, experts said.

Invasive alien species are species that are introduced, accidentally or intentionally, outside of their natural geographic range and that become problematic, states the International Union of Conservation of Nature. For a species to become invasive, it must successfully out-compete native organisms for food and habitat, spread through its new environment, increase its population and harm ecosystems in its introduced range, states the Convention on Biological Diversity (CBD).

High magnitude floods in August 2018 and 2019 resulted in the escape of at least ten alien fish species that were recorded for the first time in the water bodies and rivers snaking through the Western Ghats following the floods. Illegal farming systems, aqua-tourism destinations and amusement parks, and reservoirs facilitated the escape of alien species.

Among the species that popped up in water bodies were megafishes such as the arapaima (Arapaima gigas), also called 'river monster', that normally live in the Amazon lowlands waters and the torpedo-shaped alligator gar (Atractosteus spatula), one of the largest freshwater fishes in North America. They were not listed in the species allowed to be imported to the country.

The future management of IAS should consider and integrate climate change as a major factor, adds Bijukumar, another co-author of the study, sharing that "we need to come up with strong policies on importing dangerous (large-growing carnivorous) fishes such as arapaima and alligator gar into the country."

Bijukumar, professor and head of the university's Department of Aquatic Biology and Fisheries adds that many existing farming and rearing systems have very little biosecurity related infrastructure to prevent the escape of captive fish into adjoining natural ecosystems during floods and ECEs.

The issuance of specific guidelines by state fisheries departments and other environment and biodiversity agencies is needed "to make sure that such fish are not being held in ponds or other farming and rearing systems adjacent to rivers and natural water bodies."

Most of the alien species that enter India are principally for ornamental trade. West Bengal is the largest ornamental fish producer in India, followed by Tamil Nadu; the trend is catching up in Kerala, fanned by a swelling rank of aquarists, many of who are not aware of the potential pitfalls of dumping exotics in water bodies after they exceed the length of their tanks.

Identify invasive specie

A list of IAS compiled by the Centre for Biodiversity Policy and Law (CEBPOL), National Biodiversity Authority (NBA) and updated in 2018 identifies 169 species as invasives with the break up identifying aquatic ecosystems harbouring the highest number of intruders at 55 species. The Zoological Survey of India under India's environment ministry has listed 157 animal species including 99 marine species as invasive and 19 species of freshwater fishes.

S. Sandilyan, fellow at CEBPOL, who led the IAS list compilation, suggested a mapping exercise of aquaculture farms in flood-prone areas so that aquaculturists can be advised to prohibit the culture or stocking of alien varieties in the flood/monsoon season as a stop-gap measure. For example, in the low-lying area of Kolathur in Chennai, a hub of ornamental fish trade, monsoon floods, like the one in December 2015, wash away the breeding stock and adult alien fishes into water bodies.

Researchers note that many local community members, residing near beels (flood-plain wetlands) in Assam, grow the carnivorous African catfish (Clarias gariepinus) in their backyard drain or nalas, feeding them with household sewage and that it has a "great chance" to escape to the nearby beels during the flood or heavy rain. The Indian government banned the breeding of the species in 2000 but the practice still thrives in many parts of the country.

A traditional physical barrier in use at East Kolkata Wetland to minimise the intrusion of Pterygoplichthys in the pisciculture bheries (ponds) from sewage feeder channel. Photo by Ajmal Hussan.

In Manipur, the recent reports of the emergence of Amazon sailfin catfish in water bodies have concerned experts. Ichthyologist Rameshori Yumnam based at the Manipur Unversity also attested to the accidental release of exotic fishes from aquaculture farms to rivers during floods. "Due to improper management of aquaculture farms these fishes leak out of farms into rivers during floods. For northeast India, we do not have a comprehensive list of IAS; due to lack of awareness often people are also not able to tell if a fish is indigenous or exotic," Yumnam said.

African catfish and suckermouth catfishes (Pterygoplichthys species) are among those included in the list that was compiled by CEBPOL.

Ajmal Hussan, scientist at the ICAR-Central Institute of Freshwater Aquaculture at Kalyani in West Bengal, informed all four common species of this genus (Pterygoplichthys pardalis, P. multiradiatus, P. anisisti and P. disjunctivus) have been reported from inland water bodies of the country.

"The suckermouth catfishes are highly resilient, have armoured bodies and thrive very well in polluted waters. While we have not yet studied the consequence of extreme climatic and environmental events like abnormally high temperatures, flooding etc. on its spread and establishment in natural water bodies in Bengal, what we have seen is that the nutrient load in water bodies (pollution) appears to speed up their proliferation," Hussan told Mongabay-India.

For the fisherfolk community, based in the East Kolkata Wetlands, considered as the world's largest wastewater fed aquaculture system where city sewage feeds traditional practices of aquaculture and agriculture, the suckermouth catfish is of particular concern. So far, said Hussan, only P. disjunctivus and P. pardalis, and many intermediary forms (likely hybrids of these two species) have been reported in the wetlands, observed Hussan.

"We first came to know about the suckermouth catfish in the wetlands around 20 years ago. Since then they have expanded exponentially. They have a spiny exterior that injures the native fishes that we cultivate in our ponds and they modify the pond ecosystem so that other organisms cannot survive properly," 53-year-old fisher Shyamal Mondal told Mongabay-India.

Sneaking their way through sewage feeder canals, the fish embraced the shelter and breeding refugia provided by water hyacinth, another invasive aquatic species that was introduced to India by the British in the 1890s.

Mondal says five years ago, the yield of fish per year from ponds in a bigha of fish pond area (0.13 hectares in Bengal) in the wetlands used to be 1200 kg but now it has retreated to 800 kg, attributing the decline largely to the invasives that use up space and compete with native fishes for resources in the aquacultures.

Mondal and his fellow farmers have been trying to innovate to control their populations but nothing seems to work. "We have tried dredging ponds, capturing the catfish and started afresh; but because they are in every pond, they seem to come back to the dredged ponds once we re-start cultivation. Because the wetlands are vast (12,500 hectares), you would have to dredge all the ponds simultaneously to manage their expanding populations," he adds.

They are usually averse to consuming the fish; setting up bamboo fences and netting to stop their spread hasn't borne fruits - the hardy fishes disrupt the barriers with their spiny bodies. They usually cull the catfishes when they come through in their bycatch. Even using them as ingredients for fish meal for animal feed hasn't worked out yet.

More breed exotic than native

It is also important to understand when to declare a species as invasive. "All aliens (species) are not invasive species, but all invasives are aliens. Most aliens are in a lag phase in India (adjusting to their environment); we have to examine what kind of environmental factors trigger them to be invasive; for example, climate change is a factor," Sandilyan observed. Additionally, a population may be invasive in one Indian state but not in other states, which is why "we have to periodically revise and update the list of IAS."

There are learnings from other regions that put the significance of management of IAS into perspective. In England, the Salmon and Freshwater Fisheries Act of 1975 clearly states that the transport of native and non-native fishes within the political boundaries without proper procedure is illegal. Apart from established IAS, Norway also conducts ecological risk assessments of several species known as "door knockers", which are alien species with the potential to establish in Norway.

Given the multifaceted nature of the problem, Sandilyan feels a shift in tone is inevitable, i.e. a new law or regulation on IAS management is crucial; but that would entail attention to a few focal points and having an implementing/monitoring agency are necessary. "One is strictly regulating ornamental species trade, both online and conventional. We have to educate pet owners to be more responsible. If you want to introduce a species in India we have to develop indigenous risk management tools/kits. We have to stop the introduction of alien aquaculture species and also plants," he added.

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Aquatic conservation biologist Rajeev Raghavan, the other co-author of the Western Ghats paper debunks the "myth" that aquaculture production can be augmented only with farming alien species.

"The use of many 'harmless' species in aquaculture can be justified as long as they remain in the culture system. In rivers, Ganges and Yamuna, exotic fishes like Cyprinus carpio and Nile tilapia support the local fishery as well. But in a holistic perspective, the indigenous species supported the livelihood of hundreds of fishers in the basin, and when these species declined, it currently supports a lesser number of fishers in the basins," said Raghavan, based at the Kerala University of Fisheries and Ocean Studies (KUFOS).

Before their introduction, the economic benefits of exotic species have to be assessed comprehensively taking into account the ecosystem services provided by the indigenous species and their support to local fishery coupled with their role in the local food web (as predator and prey), he notes.

Indian aquaculturists are lured to breed exotic fishes because the Package of Practices (PoPs) for these fishes are well developed in the species' home countries such as Vietnam; unlike those for breeding native freshwater fish in India."

We have strong PoPs for legalised exotic shrimps being grown in coastal and brackish water environment, and we need the same attention for native freshwater fishes," said Jitendra Kumar Sundaray, head at Division of Fish Genetics and Biotechnology at ICAR-Central Institute of Freshwater Aquaculture, Bhubaneswar, Odisha.

"Secondly, we need a licensing system for aquarium traders, just as we have for diagnostic labs to regulate their activities and ensure vigilance," added Sundaray who is working with collaborators on developing eDNA tools to monitor invasives in water.

Reference:

https://india.mongabay.com/2021/05/checking-spread-of-invasive-alien-fish-as-india-faces-climate-extremes/

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