ENVIRONEWS

INTERNATIONAL SOCIETY OF ENVIRONMENTAL BOTANISTS

Newsletter

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IN THIS ISSUE

President ISEB's New Year Message

International Society of Environmental Botanists (ISEB) was founded on 3rd December 1994 on the campus of CSIR- NBRI under the guidance and inspiration of Dr. P.V. Sane, who was then Director of this Institute. He was unanimously elected as its first President. Subsequent Directors of CSIR-NBRI nursed this organization over the years under their proactive guidance and support. ISEB is now a 23 years' old international organization. It has a membership of over 450 spread over different parts of India. Across the globe, we have members from Bangladesh, Canada, Germany, Sri Lanka, U.K. and U.S.A. The quality of membership is a matter of pride for ISEB as scores of academicians, vice-chancellors, reputed professors, Directors of prestigious national laboratories researchers, scholars and students are represented in fair number in this Society. A highly distinguished scientist of U.K., who is a former Director of Kew Botanic Gardens Sir Ghillean T. Prance, F.R.S., is a member of ISEB for over two decades.

My own association with ISEB is quite old. I joined the Society as a Life Member long before I joined CSIR-NBRI as its Director.

EnviroNews, the quarterly newsletter of ISEB was launched on 1st January 1995 and the current issue is the 93rd issue of this highly popular scientific news magazine. While hard copies are supplied to its over 450 members, its electronic version is received by more than 5,000 individuals across the globe.

ISEB's highly popular and informative website (http://isebindia.com) has been visited by over 60,000 people, mostly in foreign countries. ISEB has launched a biannual scientific journal - International Journal of Plant and Environment since 2015 and in a short span of 3 years it has gained international acclaim and recognition.

The biggest feather in ISEB's cap is the organization of five International Conferences on Plants and Environmental Pollution (ICPEP-1 to ICPEP-5) in 1996, 2002, 2005, 2010 and 2015) in collaboration with CSIR-NBRI which were attended by over 175 delegates from more than 30 countries of the world. This has put ISEB on world map of plant and environmental sciences and is

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Happy New Year 2018

President and Members of the Executive of
International Society of Environmental Botanists (ISEB)
Wish a Very Happy, Fruitful and Prosperous New Year to all
Members of ISEB and readers of EnviroNews
With this issue, EnviroNews enters the 24th year of its publication

now known and accepted all over the world. Soon after joining ISEB as its President I asked my colleagues to immediately plan for Sixth International Conference on Plants and Environmental Pollution (ICPEP-6). This Conference is slated to be held during 27-30 November, 2018 at CSIR-National Botanical Research Institute, Lucknow.

I invite all the members of ISEB and readers of EnviroNews to attend ICPEP-6 Conference and also utilize this opportunity to visit laboratories of CSIR-NBRI and interact with our scientists and to explore the possibilities of collaborative research. On behalf of CSIR-NBRI and ISEB, I assure you of a warm hearted welcome by my colleagues and most enjoyable and fruitful stay in Lucknow.

I wish you all A HAPPY AND PROSPEROUS NEW YEAR, 2018.

S.K. Barik
President ISEB & Director CSIR-NBRI
Lucknow, India

LETTERS

First of all I would express my sincere apologies for such a delayed response to your mail. I feel greatly honored to receive your invitation to join the esteemed International Advisory Committee of ICPEP-6 to be held at CSIR-NBRI, Lucknow next year between 27-30 November 2018. I would kindly accept this invitation and would extend my full support to the event. Just as an add on – I would also like to affiliate the Internal Society of Groundwater for Sustainable Development (ISDSD, www.isgsd.org) to be a joint partner of the ICPEP -6 and provide in-kind scientific support (we are not a very big society as yet!) and also explore an avenue to publish the Volume of abstracts in our Elsevier Journal— Groundwater for Sustainable Development OR a Special Issue based on the presentation of the papers in this conference linking plants, food chain and contaminated water environments.

Please think about this and please let me know – please visit the website of our journal website:

https://www.journals.elsevier.com/groundwater-for-sustainable-development— and please encourage your colleagues to submit their manuscripts to this journal which is thematically linked with the scope. I am travelling to India next week and hope to get connected on telephone while I am in India.

And also please check the As2018 homepage www.as2018.org for the upcoming 7th International Congress and Exhibition on Arsenic in the Environment- Environmental Arsenic in a Changing World – the deadline for the submission of abstracts is towards the end of December, 2017.

Best regards

Prof. Prosun Bhattacharya
Professor of Groundwater Chemistry,
KTH Royal Institute of Technology
Department of Sustainable Development,
Environmental Science and Engineering
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WELCOME NEW LIFE MEMBERS

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NEWS FLASH

Prof. C.K. Varshney Professor Emeritus, School of Environmental Sciences, JNU and Distinguished Adjunct Professor (AIT, Bangkok), founder member and one of the Advisors of ISEB was invited to Chair a Session at Amity International Conference on Legal Dimensions of Environment, held at Amity Law School, Gurgaon, 27th to 28th October 2017. Prof. Varshney in his address highlighted the complex issue of international obligations towards climate refugees whose numbers will inevitably explode as a result of climate change induced salinity, high surges and submergence of island and coastal ecosystems from sea level rise. He further emphasized that the problem of climate migrants is a highly vexing issue that needs urgent attention from global community.

Prof. R.S. Tripathi delivered a lecture on "Ecosystem, Its Components and Diversity" under the Science Academies' Education Programme at the Lecture Workshop on "Phytodiversity in Environmental Perspective" organized in the Department of Botany, Lucknow University during 13-14 November, 2017.

Dr. R.D. Tripathi, Emeritus Scientist CSIR-NBRI and Emeritus Professor, AcSIR (former Chief Scientist, CSIR-NBRI & Professor, AcSIR) delivered a lead lecture "Bioremediation of Arsenic in Soil and Crops for Sustainable Environment and Agriculture" at the 58th Annual Conference of Association of Microbiologists of India (AMI) & International Symposium on Microbes for Sustainable Development: Scope & Applications (MSDSA-2017), held at Babasaheb Bhimrao Ambedkar University, Vidya Vihar, Rae Bareli Road, Lucknow during November 16-18, 2017. Dr. Tripathi also chaired a Session on "Young Scientist Awardees of AMI" on November 18, 2017.

Dr. Tripathi, delivered a lecture entitled "Bioremediation of Arsenic" on the occasion of Science Academies' Education Programme, Lecture Workshop, Phytodiversity in Environmental Perspective, Department of Botany, Lucknow University, Lucknow organized by Indian Academy of Sciences, Bengaluru, Indian National Science Academy, New Delhi and The National Academy of Sciences, Allahabad during 13-14 November, 2017.

Honours and Awards:

Dr. Seema Mishra, Life member of ISEB has been honoured as **"Visiting Scientist"** at the Institute of Plant Molecular Biology, Biology Centre CAS (Czech Academy of Sciences), ČeskéBudějovice, Czech Republic. She visited Desy, Hamburg, Germany from June 29- July 8, 2017 to carry out the experiments in the project 'Arsenic toxicity in Rice plant'. The visit was sponsored by Desy (Deutsches Elektronen-Synchrotron), Hamburg, Germany.

She has been selected for the membership of **"The National Academy of Sciences, India (NASI)",** Allahabad, 2017.

Dr. Seema Mishra has been awarded **"Young Woman Leadership Award"** by 'Prof. H.S. Srivastava Foundation for Science & Society,, 2016-17.

Dr. Sanjay Dwivedi, Senior Technical Officer and Life member of ISEB, visited Desy (Deutsches Elektronen-Synchrotron), Hamburg, Germany on deputation from June 29- July 8, 2017.

Sea Level Rise and Cross Border Migrants – An Arduous Challenge

Prof. C.K. Varshney
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& Distinguished Adjunct Professor (AIT, Bangkok)
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Sea level rise is one of the most complex impacts of global warming, yet it remains one of the least studied aspects of climate change. Unabated emission of greenhouse gases strongly suggested that sea level rise will accelerate in the future with a potential rise from 0.5 to 2 m at the end of the century. A report from the UNEP warned that sea level rise around the small island states could be up to four times the global average of 3.2mm per year. According to some researchers the world has already locked in 1.3 meters sea level rise and will be much more if carbon emission is to continue.

Most of the island nations lie not more than 3 meters above sea level. Satellite images reveal that many islands have either reduced in size dramatically or disappeared. A recent study found that at least eight islands in the Pacific Ocean have disappeared due to rising sea levels. Islands in Micronesia have disappeared in recent years with little to no evidence they existed at all. Several Solomon Islands had similar fates in recent decades as they were overtaken by the sea. Republic of Kiribati, Republic of Maldives, Republic of Fiji, Republic of Palau, Federated States of Micronesia, Republic of Cape Verde, Tangier Island, Virginia, and Sari chef Island, Alaska are most threatened from rising sea level.

A comprehensive study of 12,983 islands of all sizes above 2.5 hectares across the Pacific Ocean, including the Philippines and Hawaiian Islands, found that some 15 to 62% of islands would entirely disappear under sea level rise ranging from 1 to 6 meters. Indonesia, an archipelagic nation of more than 17,000 islands, faces some of the worst threats. More than 2,000 of its island are at risk of disappearing due to sea level rise. An assessment of potential consequences of

sea level rise for 1,269 French islands worldwide, revealed that up to 12% of all islands could be entirely submerged. New Caledonia and French Polynesia are likely to suffer most significant loss of islands.

Sinking islands present one of the most dramatic scenarios of the impact of climate change. Sea level rise poses existential threat to coastal communities and small island states in particular. The entire populations of low-lying States such as the Maldives, Tuvalu, Kiribati and the Marshall Islands may in future be obliged to leave their own country as a result of climate change. Bangladesh is highly prone to sea level rise and climate change. One-meter rise in sea level—a plausible scenario this century—would submerge a fifth of Bangladesh and turn 30 million into "climate migrants". Over the past two decades, Bangladeshi people have been moving out in large groups. A sizable number of Bangladeshis are living illegally in India, while many others have gone to Malaysia and the Middle East.

Indian islands too, face threat of going under water due to sea level rise. The first inhabited Indian island Lohachara, once home to 10,000 people, was submerged by the rising sea level in 1980. The New Moore Island in Bay of Bengal has been also consumed recently by the rising sea. Ghoramara Island in the Sunder ban area has lost about half of its landmass forcing two thirds of its population to move out. In Kerala the Munroethuruthu delta islands, located at the confluence of Kallada River and Ashtamudi Lake have already started to drown steadily. Andaman and Nicobar archipelagos composed of 265 big and small islands in Bay of Bengal and Lakshadweep a group of 25 small islands in Arabian Sea mostly have low elevation and do not rise more than five meters above sea level. Their topography is flat and relief features such as hills, streams, valleys, render them highly vulnerable to sea level rise.

Globally 2 billion people or 39% of the population or four out of every ten people live within 100 kilometers of a coast. Three-quarters of the world's mega –cities are by sea and seriously threatened by the rising sea level. Venice, also known as the Floating City, could disappear within 100 years from the sea-level rise. Likewise, Bangkok, a city of ten million, is sinking at a rate of 2 centimeters every year. It could be entirely under water in the span of a few decades if sea level rises faster than initially expected. Out of the ten most –vulnerable countries in the world—nations with large coastal populations and sufficient infrastructure to mitigate rising seas—seven of them are in Asia-Pacific region. India, Bangladesh and Indonesia top the list, with a combined 100 million people at risk. It is unfortunate that the island inhabitants have done little to contribute to global warming, but they are going to face some of the direst consequences of rising sea level. With sinking of islands their unique culture, art history, biodiversity will be submerged and lost forever, apart from triggering human migration at unprecedented scale.

No one wants to be forced out of their country because of disasters or the effects of climate change. Sea level rise will be particularly acute for island states, where increased intensity and severity of sea rise may overwhelm domestic infrastructure and water supplies. Ocean acidification, that could deplete fish resources and potentially undermine the physical stability of islands, is an additional factor compelling people to migrate. Thus for many islanders cross border migration is not an option, but a necessity.

The drivers of migration are multidimensional and complex. The environmental factors, and the economic, social, political and demographic considerations shape an individual's decision to migrate. Island people are highly dependent on climate-sensitive sectors such as tourism, fisheries and agriculture, among the first to suffer from sea level rise would be their economies and livelihood, which then prompt people to migrate.

The government of Kiribati had endorsed a plan to buy nearly 6,000 acres on Viti Levu, Fiji's main island to move the entire population off Kiribati. For them, moving won't be a matter of choice, it is basically a matter of survival.

We do not have a solid grasp of the dimension of climate migrant problem and future migratory patterns. Predictions about how many people will be displaced and will end up crossing national borders vary widely from 50 million or 1 billion people over the coming decades. We don't even know how many people have already moved because of coastal submergence. Systematic data collection and statistics about cross border migrants is lacking.

Climate migrant face many social and economic hurdles in integrating with new communities, which increases their vulnerability to exploitation, financial hardship and discrimination. This can also lead to instability. Many experts now agree that can be traced in part to an extended drought from 200-2010, which led the roots of the Syrian conflict to rising food prices, urban migration, and increasing resentment at the ruling Al Assad regime for corruption and poor governance.

Under present international law, there is no special provision to admit those leaving their countries for these reasons; rather they are dealt with through normal immigration channels. Accordingly, if someone from a country has to move out of his or her country because of sea-level rise or if a cyclone people to cross an international border, governments are under no obligation to treat them differently than any other economic migrant seeking permission to enter. In July 2015, Supreme Court of New Zealand explicitly rejected the request for refugee status by a citizen of Tuvalu arguing that they could no longer remain in their country because of the effects of climate change.

According to article 1.A(2) of the 1951 UN Convention relating to the Status of Refugees, the so called Geneva

Convention, a "refugee" is a person who…owing to well-founded fear of being persecuted for reasons of race, religion, nationality, membership of a particular social group or political opinion, is outside the country of his nationality and is unable or, owing to such fear, is unwilling to avail himself of the protection of that country. Thus UN does not recognize climate or extreme weather as grounds for asylum under the 1951 Refugee Commission. As a result, those migrating due to sea level rise or the deteriorating climate change are not accorded safety and legal protections given to those fleeing persecution.

Cross border migration by climate affected people is highly tragic, but sadly, the required concern and appreciation of the gravity and complexity of this inevitable human tragedy by the world community is nowhere near of what is looming on the horizon. Legal solutions will have to be found to avoid hundreds of thousands of people getting stranded in other countries without any protection, dignity or entitlement.

Two years ago in 2015, the world celebrated a great achievement—an international climate agreement. Unfortunately, the Paris Agreement lacks the urgency, depth and coordinated framework necessary for addressing the immense challenges of climate-induced migration. Currently, national and international response to this challenge is insufficient and protection for affected people remains inadequate.

The displacement of people from sea level rise is a cross border issue that extends beyond the authority of a single country. No single country—and its people—should have to bear the burden alone. The governess of statelessness has also attracted some attention in the debate on climate migration. Not having a nationality raises significant difficulties for an individual because nationality is the principal link between the individual and the international law.

In view of protection gap world community has to do more and think seriously about addressing the challenge of cross boarder displacement. There is an urgent need for an international process to formulate effective policies and mechanisms that can respond to the needs of those who will face the awful reality that they can no longer survive in their own country and will seek to enter another country. Imaginative and ingenious methods are required to mainstream migration into development planning. It is important that under the aegis of UNFCCC a fast track international process should start urgently for addressing the challenge of cross border migration in ways that preserve human dignity, ensure protection, enhance resilience and strive to ensure migration with dignity.

Ladybird Beetles: An Ecofriendly Agent for Pest Management

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Introduction

The insects belonging to order Coleoptera and family Coccinellidae are commonly termed as *Ladybird beetles, Ladybeetles* or *Ladybirds*. Majority of the ladybird beetles are predaceous in nature and are employed as biocontrol agents. However, some members of family Coccinellidae belonging to subfamilies Epilachninae and Coccinelinae are phytophagous in nature and are harmful to crop plants as pests.

The term ladybird has been coined from the species, *Coccinella septempunctata* Linnaeus (Plate-1) and the term lady refers to the virgin Mary because of the resemblance of scarlet elytral colour with Her Cloak. They are the most recognized and loved insects. The seven black spots present on the two elytra are supposed to represent the seven joys and sorrows of the mother Mary. They are called the beetles because they belong to the order Coleoptera and have the characteristic spherical body. Their forewings are thick and leathery, and provide protection to the functional and membranous hindwings. The ladybirds are most fascinating and various products of human use are designed of the ladybird shape. They are quite attracting to the children across the world. They have always been associated with good luck charms.

Life Cycle

Ladybirds are the ancient and successful group of insects that evolved in the lower Permian period, about 280 million years ago. They are holometabolous insects because their life cycle starts from the egg which gives rise to larva and passes through four larval stages. The final larval stage pupates and metamorphoses into an adult (Plate-1). Dixon (2000) described ladybirds as Aphidophagous and Coccidophagous; former have fast development and the latter have slow development which is possibly adaptive in nature. But both the groups have similar number of larval instars, except one coccidophagous species that has three larval instars rather than the usual four instars. The aphidophagous ladybirds generally lay eggs in clusters while coccidophagous ones lay eggs singly.

Food of Ladybirds

Food greatly influences the growth, development, survival, reproduction and progeny fitness of ladybirds. The diet of

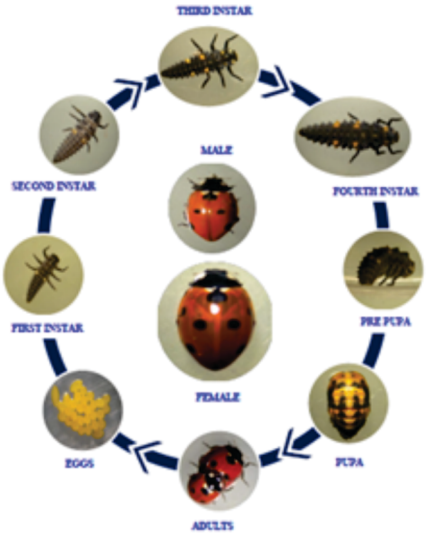

Plate 1: Life cycle of *Coccinella septempunctata*

predaceous ladybirds includes aphids, coccids, psyllids, diaspids, pentatomids, aleyrodids, and other insects and acarines. However, the non-predaceous ladybird species feed on fungi, pollens, honey dew, etc. Thus, the dietary breadth in predaceous ladybirds is an outcome of the seasonal abundance and the synchrony of their potential prey. Moreover, attributes like morphology, chemistry and behaviour of the prey, the efforts involved in reaching the prey, the host plant architecture, and the level of threats or challenges imposed by intraguild predators and other natural enemies also affect the dietary breadth of predaceous ladybirds. While some ladybirds are *stenophagic* and have a narrow prey range, the others are *euryphagic* and depend on wide prey range. The former are further termed as *specialists* as they feed on monospecific or few prey species. However, the latter are termed as *generalists* or polyphagous, based on their broad dietary habits.

Among the *accepted foods* of ladybirds, only certain foods support both development and reproduction, and are termed as *essential foods*. The rest are meant only for their survival and are known as *alternative foods*. Further, the essential food is classified into optimal, adequate and marginal, based on the differences in their nutritive values and the ways by which these nutrients are assimilated and utilized post prey consumption. Rejected foods of ladybirds are unpalatable due to their intensive/aposematic colourations and/or presence of certain allelochemicals. Consequently, they are rejected even after encounters.

Certain prey species are also harmful to ladybirds, causing their mortality, and are termed as toxic prey species. One of the toxins is cyanoglycoside sambunigrin, producing hydrocyanate after enzymatic splitting. Another potentially toxic compound is alkaloid sambucine. Thus, the aphid species that have been found to be toxic for some ladybirds either cause gradual poisoning, or an acute toxicity in ladybirds. Further, ladybirds accept some prey species which worsen their life-history parameters, although they are not toxic, and they are considered as 'problematic prey'. Moreover, the prey species selected by ovipositing females as food for their larvae are termed as 'nursery prey', and they are the species of prey on which the larvae are likely to develop the best in terms of survival and growth.

Ladybirds have a tendency for prey specialization, which could be both diet- and habitat- related. The concept of prey specialization elucidates that ladybirds reared on suboptimal diets for few generations specialize and condition themselves for the suboptimal diet. These conditioned ladybirds perform better on a suboptimal diet than those on the optimal diets. Moreover, the switching of prey after few generations of rearing on either suboptimal or optimal diets causes deterioration in their performance and fitness. Further, the prey specialization in ladybirds has been argued as a function of their size, or the size and density of their prey. The body size of ladybirds provides an important trade-off determining their dietary breadth and the prey specialization. Specialist ladybird species prefer the prey species that closely matches their size, have higher capture efficiencies and can easily reproduce at lower prey densities for longer duration of time. However, the generalist species adopt a one-size-fits-all strategy, which results in their lower capture efficiencies, making them difficult to sustain at lower prey density. Moreover, unlike the generalist species, whose adults frequently move between patchy prey habitats, the specialist species stay in the prey patches and lead a more sedentary life due to their greater tolerance of lower prey densities. They even start to reproduce earlier than the generalist species and also reproduce in the later stages of declining prey patch. Thus, their sedentary, stubborn and non-dispersing behaviour makes them the better biocontrol agents.

The analysis of how a ladybird responds to varying pest populations and how it affects pest management can be understood in terms of the *functional response*. It is the predator's feeding response against the increasing prey density, and can be analytically explained by Holling's type I (linear), type II (curvilinear), and type III (sigmoidal) responses. Ladybirds usually exhibit a type II functional response, where there is an initial increase in the rate of prey consumption with increase in prey densities up to a certain level and this rate decreases with a further increase in prey density. This happens due to satiation, as there is a threshold of prey consumption and the prey density dependent curve reaches an asymptote.

Numerous factors affect the functional response outcomes of ladybird predators. These include, generation time ratio of predator and prey, prey preference, prey switching, size disparity between prey and predator, prey density, predatory stage, walking speed of predator and prey, gender, intrinsic rate of increase of prey and predator, consumption rate, prey patchiness, predator patch allocation time, host plant, abiotic factors, and intra- and interspecific predator competition. Moreover, the functional responses of

ladybird predators are interlinked with their numerical responses. The *numerical response* of a predator is its tendency to increase its number with increasing prey density; and can be both *aggregative* and *reproductive numerical responses*. In response to increasing prey density, predaceous ladybirds show aggregative numerical response by increasing the cumulative prey consumption; however, the rate of prey consumption decreases curvilinearly due to mutual interference. The reproductive numerical response is a consequence of the functional response in predaceous ladybirds; because the females lay high number of eggs at higher prey densities, which is a direct implication of their functional response.

Effects of abiotic factors on life attributes of Ladybirds

Temperature is the most crucial abiotic factor affecting ecological, functional, and behavioural attributes of predaceous ladybirds. It sets the limits of biological activity in form of low and high temperature thresholds. The developmental rate is almost zero at lower development threshold, which increases with temperature, reaches a peak value, and then decreases rapidly as the high thermal threshold is achieved. Not much lower development threshold variation occurs in ladybirds with similar dietary habits and this is also a reason for their successful establishment in different habitats and countries. At the optimum temperature, around 25–30 °C in most aphidophagous and coccidophagous ladybirds, the peak is attained at the youngest age of the ladybird demography. Thereafter, with further rises in temperature this peak is delayed and shortened. However, in acarophagous ladybirds the optimum temperature is 30–35 °C, resulting in high values for the demographic parameters, like the net reproductive rate and the intrinsic rate of increase in population.

Not only temperature, the light also affects the life attributes of ladybirds. Various variables of light, like intensity, quality (wavelength), and duration of exposure (photoperiod) significantly affect the development, reproduction and progeny fitness. Ladybirds have a wide range of tolerance limits to these variables. They are primarily diurnal insects and depend on visual cues and presence/absence of light to undergo various essential activities, like mating, moulting, and pupation. Most ladybirds are highly sensitive to light, particularly its photoperiod and wavelength. Short day-lengths with intensities of 1500 lux are beneficial for the reproductive activities. The likelihood of female ladybirds accepting the males increases in the dark because females are unable to evaluate visual criteria to select male and thereby mating rejection displays are also minimized. However, prolonged light days could have a negative effect on the physiology of ladybirds.

There exists a photoperiod-dependent bimodal or two-peak pattern in the development of certain ladybirds, where the first peak represents fast developing and the second shows slow-developing individuals in the same cohort of eggs. The slow-developing individuals are generally more in numbers in short day-lengths; however, long day-lengths promote fast developing adults having heavier body masses and more capable of producing quantitative progeny. White light is more suitable for essential activities compared with its red or blue components of the visible spectrum.

Predation by Ladybirds

A guild is formed by the association of predators that share a common food resource. However, when the ladybirds exploit a common food resource (extraguild prey) within a guild, they often attack each other. In this struggle, one becomes dominant (intraguild predator) and overpowers the other (intraguild prey). This *exploitative competition* of food resource is more advantageous to small-sized ladybirds as they have lesser food demands. As the density of extraguild prey decreases or the density of intraguild prey increases, the frequency of intraguild predation increases. On the contrary, an increase in extraguild prey density lowers the possibilities of intraguild predation. The relative size and stage, mobility of species, aggressive strategies, mandibular structure, degree of feeding and habitat specificity, defense strategies, and density of extraguild prey determine the outcome of intraguild predation.

Majority of the ladybirds attack, prey upon, and displace other members of their family in a limited food resource struggle. Invasion and establishment of aggressive species following displacement of indigenous ones may be an outcome of such interactions. The Harlequin ladybird, *Harmonia axyridis* (Pallas) is an invasive species that has a competitive advantage over the indigenous species, such as *Coccinella septempunctata*, *Coleomegilla maculata* DeGeer, *Hippodamia variegata* Goeze, and *Adalia bipunctata* L., due to its vast prey range, and higher predation and foraging potential. This invasive species frequently indulges in either *interference competition* or the *apparent competition*. Thus, it either interferes with other competitors or may compel the inferior indigenous species to become specialist predators of less preferred prey in nature.

Ladybirds also struggle with other group of insects outside the family for the common food resource. They usually co-occur with chrysopid (Neuroptera: Chrysopidae) larvae and share the limited food resources. However, intraguild interactions between them are asymmetrical which could have positive, negative, or neutral impacts on pest biocontrol. Both chrysopids and ladybirds use chemical defenses. The ladybird larvae, pupae, and adults all use chemical substances containing volatile hydrocarbons/alkaloids to deter predators.

Ladybirds and Biocontrol of Pests

The term *biological control* (=biocontrol)

was introduced by Smith (1919) for the "topdown" action of natural enemies/biocontrol agents (viz., predators, parasitoids and pathogens) in maintaining the pest population density at a lower level than what may have occurred in their absence. Although several stories exist regarding the successful utilization of ladybirds as biocontrol agents, their use in biocontrol came into existence when the vedalia beetle, *Rodolia cardinalis* (Mulsant) was selected to control the population of scale insect, *Icerya purchasi* on citrus in California (USA) in the year 1889. Thereafter, numerous ladybird species were successfully used in the biocontrol of aphids, scale insects and mealybugs. The impact of ladybirds in terms of successful pest biocontrol is largely dependent on their voracity, prey specificity, intrinsic rate of increase, and the mean generation time ratio between prey and predator. Interestingly, the size of ladybirds attacking similar kind of prey does affect the biocontrol with the large-sized ladybirds being the better biocontrol agents. However, if the prey type is different, the small-sized ladybirds with specialization on that particular prey type are more promising biocontrol agents than the large but less specialized ladybirds.

A need for aphid biocontrol led to the introduction of 179 aphidophagous ladybird species in North America since 1900, but only 18 have successfully established. A few aphidophagous ladybirds took many years to establish. However, many established after accidental introduction, including *Coccinella septempunctata*, *Harmonia axyridis*, and *Propylea quatuordecimpunctata* (L.). The introduction and invasion of certain aphidophagous ladybird species has been implicated in the decline of some native species in the USA and elsewhere. A flightless form of *Harmonia axyridis* was also produced using a chemical mutagen followed by selective breeding. The Inundative releases of such flightless adults against aphids on glasshouse cucumbers were highly successful. However, in huge agriculture fields they were not successful because of their impaired foraging on account of being flightless. However, these adults had lower reproductive fitness and had fewer offspring despite ovipositing for a longer period.

Aphidophagous ladybirds are generally not considered as better biocontrol agents largely due to significant differences in their intrinsic rates of increase and mean generation time ratios, although the relative development rates of aphidophagous ladybirds are lower than those of aphids. However, aphid biocontrol could be benefitted if the prey is targeted early in the season, i.e. prey suppression initiation could be done when the aphid colony is young. The coccidophagous ladybirds are also successful biocontrol agents of both coccids and diaspids. *Chilocorus nigritus* (Fab.) is a highly successful and effective generalist predator of numerous species of Diaspididae with equal effects on some species of Coccidae and Asterolecaniidae. The Indian ladybird, *Cryptolaemus montrouzieri* Mulsant, is also a generalist predator of various scales and mealybugs and has been commercially exploited in both classical and augmentative biocontrol programs.

Moreover, certain specialist ladybirds belonging to genus *Stethorus* are potential biocontrol agents of tetranychid mites, especially at their high density. Similarly, the ladybird,*Clitostethus oculatus* (Blatchley) is credited for the biocontrol of whitefly, *Aleurodicus dispersus* (Russell) in Hawaii and India. While the specialists are better biocontrol agents than the generalists because of their selective feeding and persistence in the target prey habitats, the invasion of generalists in their resource space is an issue of serious concern as they become intraguild prey or they are forced to emigrate.

Conclusions

The predaceous ladybirds have a promising future in the biocontrol of insect pests of agricultural importance. While majority of ladybirds are generalists, some are specialists. There are lots of arguments on prey specialization in predaceous ladybirds. However, the resource partitioning and consistent exposure of a single prey type might have evolved the prey specialization in predaceous ladybirds. Moreover, the prey specialization in ladybirds is generally considered as a function of body size, prey size and prey density.

Mating and reproductive studies in ladybirds have provided knowledge on the optimal conditions pertaining to number and quality of mates to produce better progeny both in terms of quantity and quality. Similarly, the information pertaining to age, aging trajectories and age differences between mates not only increases the level of knowledge on ladybird physiology in general but may also help in mass multiplication of ladybirds by allowing mating with optimal age individuals. The intraguild interactions amongst the ladybird species distress the coexistence of ladybirds and displace many indigenous ladybird fauna, the biological invasions of certain dominant species could result in complete disappearance of numerous native ladybird species. Amongst the abiotic factors, temperature has a major impact on the ladybird's life attributes. Moreover, the optimization of abiotic conditions, like temperature and light is a prerequisite for the augmentative rearing of ladybirds. There is an utmost need to understand the role of ladybirds in pest management through comprehensive ecological and ethological studies supported with laboratory experimentation, and glasshouse and field studies. The use of biocontrol agents in the suppression of pest populations minimizes the use of pesticides in agriculture. Biocontrol is an ecofriendly technique which is cost-effective in the long run and self-perpetuating, and would lead to sustainable agriculture.

China and India to avoid mercury emissions in 2050

Mercury is a health concern due to its long-lasting environmental presence and toxicity. Most people come into contact with mercury by eating contaminated seafood as well as rice and other foods. Burning coal was responsible for an estimated 24% of human-caused mercury emissions in 2010, making it the second largest global source of the contaminant. Plants operating in Asia contribute the most to these emissions. For this study, the researchers explored the future impacts of the Convention on global mercury emissions and deposition.

With the countries still relying heavily on coal, China is predicted to avoid 90 tonnes of emissions and India could avoid 150 tonnes in 2050. This could avoid approximately 2 and 13 micrograms per square metre of mercury deposition over China and India, respectively. While avoided deposition over other regions is lower, there are projected decreases in the amount of mercury deposited into oceans that can sustain aquatic environments important to Europe and the US. Additionally, if stricter — yet still feasible — actions are taken, an extra combined 170 tonnes of emissions could be avoided by the two countries.

The researchers highlight that their study only discusses emissions that can be avoided through technology uptake, and that overall emissions will likely still increase as economies and energy markets continue to boom while relying on coal. They highlight the necessity of avoiding coal consumption and transitioning toward less carbon-intensive energy sources for reducing emissions from present-day levels. In fact, they estimate that a transition away from coal using just current technology could avoid approximately 6% and 36% more emissions from China and India, respectively, than the strict regulation scenario with heavy coal use.

The UN Minamata Convention, which was adopted in 2013, sets forth regulations to control mercury emissions from coal-fired power plants, along with other measures such as bans on new mercury mines. The Convention agreed upon flexible regulations instead of specific emissions limits in order to accommodate countries at different levels of technological advancement. It called for countries to "control, and where feasible, reduce" emissions in coal-fired power plants using the best techniques and best environmental practices available to them.

Source: ***Science for Environment Policy***

Plastic Ocean Pollution a Driver of Climate Change?

Though burning fossil fuels is the primary cause of global warming, fossil fuels could also be driving climate change via a completely different mechanism involving ocean plastic debris and tiny, bioluminescent fish living hundreds of meters beneath the ocean's surface.

Lanternfish (*aka* myctophids) are only a few inches long typically but so ubiquitous that they account for over half the ocean's total fish-mass. They are vital to the ocean's ability to sequester more carbon than all the world's forests do on land through a daily mass migration that plays out in all seven seas. By day, lanternfish avoid predators in deep, dimly lit waters, but they ascend nightly to the surface to gorge on carbon-rich plankton before descending back down where they deposit their carbon-rich poop. They also sequester carbon when eaten by larger fish.

Carbon sequestration by lanternfish is central to the overall role of marine environments in reducing human-caused CO_2 emissions in the atmosphere – by an estimated 20-35 percent. Thus, anything harmful to lanternfish could hinder the ocean's capacity to act as a carbon sink. Alarming evidence that small bits of floating plastic debris resemble the plankton lanternfish feast on could spell trouble for them and, consequently, the climate.

Lanternfish are consuming ocean plastics

Most plastics are still derived from petroleum and natural gas and, for practical purposes, are non-biodegradable, even though they fragment during weathering into progressively smaller pieces. Marine debris is composed primarily of plastics which accumulate in circulating ocean convergence zones called gyres. There has been concern that small plastic fragments might be mistaken for food by plankivorous sea life. More than a third of the stomachs of lanternfish captured at the ocean's surface in the N. Pacific gyre contained plastic fragments. Importantly, ingested plastics were similar in size (1-3 mm) and color (clear, white and blue) to the area's zooplankton.

Researchers confirmed that lanternfish are consuming plastics and estimated that the weight of plastic debris consumed annually by fish in the in the N. Pacific gyre alone is 10s of tons. Ingestion of plastic debris by lanternfish is thought to explain an otherwise head-scratching finding. Mass quantities of the plastics that are entering the ocean are disappearing, according to scientists who measured plastic debris in the surface waters of all five of the world's major gyres. Importantly, the missing plastic is largely debris 2-3 mm in size, matching the lanternfish's plankton diet.

Intestinal blockage, malnutrition and starvation are obvious potential dangers of consuming plastic debris, though chemicals associated with marine plastics might pose greater threats.

Oily toxic pollutants commonly found in seawater adsorb to the surface of plastics. Once ingested, the pollutants can transfer to the tissues of wildlife with potential for transfer up the food chain as smaller fish are eaten by larger ones. Threat also stems from the basic building blocks of some polymers. Polycarbonate plastic, for example, is derived from BPA (bisphenol A), an estrogen mimic so harmful to the development of lab animals that use of polycarbonate plastics in baby bottles and sippy cups was banned in the United States in 2012. The basic constituents of polyvinyl chloride (PVC) and polystyrene plastics

are known or suspected carcinogens.

The myriad of additives which impart desired properties to plastic products add another layer of concern. Phthalate plasticizers and polybrominated flame retardants are common additives which interfere with hormonal systems in mammals, for example. Because additives are not bonded to the plastic polymer, they can leach out of ingested plastics into an organism's tissues.

Source: ***The Environmental Magazine***

The world's first trees grew by splitting their guts

Scientists have discovered some of the best preserved specimens of the world's first trees in a remote region of China. At up to 12 meters tall, these spindly species were topped by a clump of erect branches vaguely resembling modern palm trees and lived a whopping 393 million to 372 million years ago. But the biggest surprise is how they got so big in the first place.

Today's trees grow through a relatively simple mechanism. The trunk is a single cylindrical shaft made up of hundreds of woody strands called xylem, which conduct water from the roots to the branches and leaves. New xylem grow in rings at the periphery of the trunk just behind the bark, adding girth so the tree can get taller.

This is not how ancient trees known as cladoxylopsids grew, however. Two specimens discovered in a desert in China's northwestern Xinjiang province in 2012 were remarkably well preserved. That's because they underwent a process in which silica—likely emitted by a nearby volcano—saturated the tree and took on the shape of the wood's internal structure as it decayed, preserving its 3D cellular structure.

The fossils reveal that, unlike modern trees with a single shaft, cladoxylopsids had multiple xylem columns spaced around the perimeter of a hollow trunk. A network of crisscrossing strands connected the vertical xylem—much like a chain-link fence spreads from pole to pole—and soft tissue filled the spaces between all these strands. New growth formed in rings around each of the xylem columns while an increasing volume of soft tissue forced the strands to spread out. All of this expanded the girth of the trunk, allowing for a taller tree. But it also split apart the tree's xylem skeleton, which required the tree to continually repair itself.

In the largest of the two fossil trunks, above the bulge, the xylem and soft tissue occupied a ring about 50 centimeters in diameter and 5 centimeters thick, with external roots making up the remainder of the 70-centimeter-diameter tree trunk. The scientists estimate cladoxylopsids could have been 8 to 12 meters tall.

This growth strategy has not been seen in any other tree in Earth's history. It's crazy that the oldest trees also had the most complex growth strategy. The trees are particularly important, because they dominated Earth during the Devonian period from 419 million to 358 million years ago. They formed the first forests and played a key role in absorbing carbon dioxide from the atmosphere. They also added oxygen to the atmosphere, affecting the climate and influencing conditions that fostered the emergence of other life forms.

Source: ***Science***

How honey bee gut bacteria help to digest their pollen-rich diet

The honey bee gut is colonized by specialized bacteria that help digest components of the floral pollen diet and produce molecules that likely promote bee health. A group of Swiss researchers have uncovered which bacterial species perform which specific digestive functions in the bee gut.

The researchers measured the repertoire of simple chemical compounds -- the so-called "metabolome" -- from bee guts. They then compared the gut metabolomes of bees colonized with each bacterial species individually and in combination. By this method, they identified what each bacterial species contributes to the bee digestion and the various strategies bacteria deploy to co-exist in the animal gut.

Of particular note, they identified one several species of the genus Lactobacillus that digests convert specific plant compounds called flavonoids -- abundant in pollen and recently linked to the health of mice and humans through their breakdown by the gut microbiota. Another bee gut bacterial species, *Bifidobacterium asteroides*, triggered the production of bee hormones that can modulate the immune system and behavior of its host.

Honey bees, a principal pollinator in agriculture and natural environments, have suffered from colony declines in recent years. The gut bacteria in bees and their pollen-rich diet are known contributors to honey bees' health, and understanding the functions of the various bacteria could have implications for colony health as a whole.

Contrary to human gut microbiota, the bee gut is composed of only a few bacterial species. This makes analyzing each member separately and determining its contribution to the overall metabolite changes in the gut feasible.

The researchers have identified many exciting metabolic functions of bee gut bacteria. The next step is to understand how these functions impact colony's health so that one day we can apply our findings in apiaries.

Source: ***Science Daily***

ICPEP-6 DELEGATES FROM ABROAD

All foreign nationals who intend to participate in the Sixth International Conference on Plants and Environmental Pollution (ICPEP-6), which will be held during 27-30 November 2018 at CSIR-NBRI, Lucknow, India must forward their duly filled Pre-registration (P.R.) form by e-mail or online latest by 1 February 2018. P.R. forms must include detailed information about their Nationality, Passport No., Date & place of issue, Date of expiry, Name/designation of the authority issuing the passport. Organizing Committee of ICPEP-6 is required to forward this information about overseas delegates to the ministries of Home and External Affairs at the earliest.

Pre-registration (till 1 February 2018)

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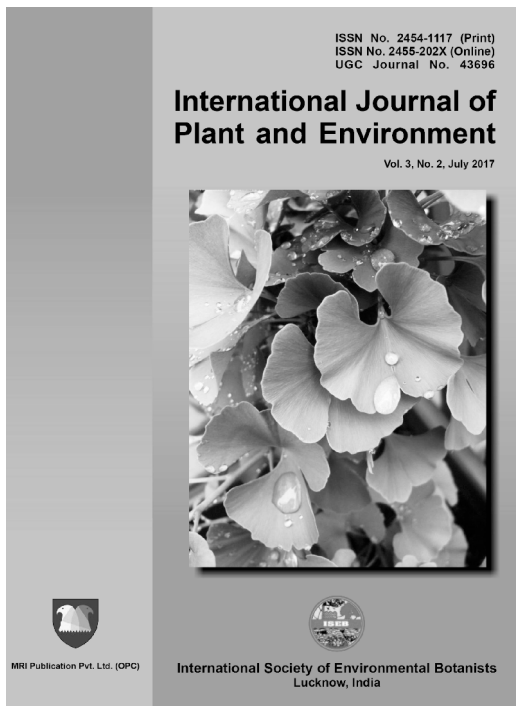

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27-28 January, 2018; Lucknow, Uttar Pradesh, India
Contact: Dr. Sanjeeva Nayaka
Organizing Secretary, Lichen Conference
Lichenology Laboratory, CSIR-National Botanical Research Institute
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International Conference for Environment & Ecology 2018
12-14 February, 2018; Gauhati University, Guwahati, Assam
Contact: icee.contact@gmail.com, ifeefoundation@gmail.com
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20-21 April, 2018; University of California, Berkeley, Berkeley, CA, United States
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2nd International Convention on Water
23-24 April, 2018; Dubai, UAE
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11-12 July, 2018; Toronto, Canada
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26-27 July, 2018; Melbourne, Australia
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4th International Conference on Pollution Control & Sustainable Environment
26-28 July, 2018; Rome, Italy
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4-6 October, 2018; London, UK
Contact: Conference Series Ltd, Kemp House, 152 City Road, London EC1V 2NX
E-mail: climatechange@conferenceseries.net

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