



# ENVIRONNEWS

INTERNATIONAL SOCIETY OF ENVIRONMENTAL BOTANISTS

## Newsletter

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### The carbon dioxide has elevated consecutively in the fourth year 2015

The annual growth rate of atmospheric carbon dioxide (CO<sub>2</sub>) jumped by 3.05 parts per million (ppm) during 2015, the largest year-on-year increase in 56 years, according to US scientists. In another first, 2015 was the fourth consecutive year that CO<sub>2</sub> grew more than 2 ppm, according to researchers from US National Oceanic and Atmospheric Administration (NOAA). Carbon dioxide levels are increasing faster than they have in hundreds of thousands of years. It is explosive compared to natural processes.

In February 2016, the average global atmospheric CO<sub>2</sub> level stood at 402.59 ppm. Prior to 1800, atmospheric CO<sub>2</sub> averaged about 280 ppm.

The last time the Earth experienced such a sustained CO<sub>2</sub> increase was between 11,000 and 17,000 years ago, when CO<sub>2</sub> levels increased by 80 ppm. Today's rate of increase is 200 times faster.

The big jump in CO<sub>2</sub> is partially due to the current El Nino weather pattern, as forests, plant life and other terrestrial systems responded to changes in weather, precipitation and drought.

The largest previous increase occurred in 1998, also a strong El Nino year. Continued high emissions from fossil fuel consumption are driving the underlying growth rate over the past several years.

"Sometimes the right path is not the easiest one." is very true. It is easy to be wasteful and careless, but if we want to keep a livable environment for future generations, we must conserve and preserve. We only have one planet so let's take care of it.

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## LETTERS

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Both India and Canada are nations rich in forest resources. Canada particularly, being a circumpolar nation from the continent of North America; represents a huge land mass making her the second largest country of the globe after Russia. Canada, like Russia is also known across the globe for her vast natural resources rich in minerals, oil and gas, forests and vast agricultural lands. Last year, both India and Canada have signed a number of important agreements that will boost the trade and commerce between these two nations and will have significant impacts on the following arenas like civil nuclear deal, heavy industries, mining, tourism, culture, education and foreign investments in India that will further strengthen the socio-cultural, strategic, security and diplomatic ties between these friendly nations from two distinct continents. Canada has huge forest based resources and virgin forested lands within her national boundary representing unique ecosystems and terrestrial biomes; and as such has gathered unparalleled experience in modern forest management, forest related technologies and in successful conservation of massive primeval forests over couple centuries of dedicated research and development as well as management experiences. It is quite unfortunate that both nations missed out on some joint agreements in working towards forest management and conservation while developing bilateral relations. Some of the modern forest management and conservation practices that Canada has successfully developed would have been extremely beneficial for India in protecting her dwindling forest bases with rich biodiversity. The technology transfer would have enabled both countries to draw value experiences, research data and personnel

training in two different climatic regions invaluable from the perspective of the long term forest conservation practices. Currently, both countries have completed their ninth round of negotiations in developing a Comprehensive Economic Partnership Agreement (CEPA) to improve bilateral trade relations as there are tremendous opportunities to increase economic partnership. China's current bilateral trade with Canada is more than nine times that of India; suggesting the sphere of development available for both India and Canada to work for. While political, economic, strategic and diplomatic ties are being deepened by both nations; it will be also important to include the possibility of technology transfer related to forest conservation and management between both nations. India will gain tremendously sharing Canadian experiences and modern forest management practices in protecting her rich biodiversity and forest based resources scattered across the country. Through your esteemed newsletter, I humbly beg all the concerned government departments, scientific and administrative authorities as well as individuals to make the Indian government aware of the potential benefits of developing Joint Forest Management practices with Canada and to include forests and forest management and conservation as important parts of the economic development package under consideration by both government on the negotiating table. This will benefit both nations significantly in environment protection and conservation.

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We would like to include a summary of the activities of ISEB during the triennium 2012-2015 in our proceedings.

Thus, I would be grateful if you could send me short document (1 to 3 pages) on your activities that could be published with our proceedings.

**Nathalie Fomproix**  
Executive Director, International  
Union of Biological Sciences,  
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St. Ann's college for women Mehdiptnam, Hyderabad, Re - Accredited by NAAC with 'A' grade and a college with potential for excellence awarded by U.G.C is imparting quality education to women for the past 30 years. In an effort to promote quality education and bring in awareness on the environmental issues the department of Botany proposes to organize a two day National/International conference in the month of Dec/Jan 2017. In this regard we request you to collaborate with this program in organizing the conference. I am attaching the overview of the Department and a report on the International conference - Green Summit Issues and Concerns - 2010 for your reference. The details of the college can be noted from the website [www.stannscollegehyd.com](http://www.stannscollegehyd.com). Several faculty members of this department are the Life members of your society (ISEB).

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## WELCOME NEW LIFE MEMBER

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**Miss Mansi Bakshi**, Research Scholar, Institute of Environment and Sustainable Development, Banaras Hindu University, Varanasi, India  
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## NEWS FLASH

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**Dr. P.V. Sane** Founder President and Advisor of International Society of Environmental Botanists has been felicitated for his contribution in the area "Plant Physiology" at the 3rd International Plant Physiology Congress (IPPC), held during December 11-14, 2015 at Jawaharlal Nehru University, New Delhi, India.

**Prof. R.S. Tripathi**, FNA was conferred the coveted "Dr. V. Puri Memorial Award (2015-2016)" of the Indian Science Congress Association at its 103rd Session inaugurated by the Prime Minister of India Shri Narendra Modi at Mysore University in January, 2016. The citation reads as follows: "Prof. R.S. Tripathi has pioneered researches in Plant population ecology and gap phase regeneration of forests and has enriched knowledge in the domain of weed biology, dynamics and regulation of plant populations, ecology of invasive alien weeds, eco-restoration of degraded ecosystems and biodiversity management in NE India through his outstanding contributions." Prof. Tripathi is a Life Member and Advisor of International Society of Environmental Botanists. He is Editor of *EnviroNews* and Advisor of *International Journal of Plant and Environment*.

### Role of Cryptogam in Environmental Biomonitoring

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The biomonitoring approach, based on the sensitivity of organisms, is one of the economic tools to estimate the effect of complex air pollution on biological communities. A good ecological indicator is characterized by ease of handling, sensitivity to small variations in environmental stress, applicability to extensive geographical areas in the greatest possible number of communities or ecological environments, and an ability to be quantified.

Among lower group of plants generally moss and lichens are reliable indicators of terrestrial air quality, while algae are used for water quality assessment. Lack of significant cuticle or epidermis and leaves being only single cell thick make mosses, liverworts and lichens well suited as bioindicators and biomonitors. Due to the lack of a well-developed root system, bryophytes and lichens absorb both nutrients and pollutants directly from the atmospheric fallout. Higher plants (Tracheophytes) are also employed for biomonitoring but the ability of lower group of plants especially lichens and bryophytes sequester many pollutants beyond their physiological need and remained unharmed thus makes them efficient biomonitors three times higher than the higher plants.

#### Lichens

A number of lichen bioindicator communities have been recognized and employed for biomonitoring different forest types and habitats. The communities at disturbed habitats comprised of species of *Candelaria*, *Chrysothrix*, *Graphis* and *Phaeophyscia*. Species of lichen genera *Candelaria* and *Phaeophyscia* indicate nutrient enriched habitat whereas areas populated with *Graphis* species indicate an open, exposed and regenerated forest. Species of *Chrysothrix* are pioneer lichens to invade coniferous trees (*Pinus roxburghii*) in the lower Himalayan region after forest fire. On the other hand high altitude exhibits prevalence of Parmelioid and Cyanophycean communities which signify fairly good air quality and minimum human disturbance.

Owing to their higher sensitivity towards air pollution and microclimate, the epiphytic lichens are considered as one of the reliable bioindicators. The frequency of occurrence of lichen species on a defined part of tree, their diversity and dominance can be used as a parameter to estimate the degree of environmental stress. The ecological parameter related with epiphytic lichens can be applied to estimate the environmental contamination with reference to source of pollution and to

identify its impact, or, on a larger scale, to detect hot-spots of environmental stress. Periodical monitoring at the same sites provides assessment of the effects of environmental change. The data quality largely depends on the uniformity of growth conditions (thallus size and meteorological condition). A high degree of standardization in sampling procedures is therefore necessary.

Lichens also show high sensitivity towards phytotoxic gases such as sulphur dioxide and oxides of nitrogen. The algal partner responsible for vital activity of photosynthesis exhibits its presence of only 5-10% in composite lichen thallus is most sensitive to sulphur dioxide and oxides of nitrogen as it reduces the magnesium present in the chlorophyll and convert it into a brown pigment, phaeophytin, resulted into inhibition of photosynthesis. Excessive level of pollutants in the atmosphere, especially SO<sub>2</sub>, has detrimental effect on the physiology and morphology of sensitive species that leads to extinction of sensitive species, which ultimately results in changed lichen diversity pattern. The relationship between the presence of heavy metals and lichen species community dynamics in the natural area revealed that lichen diversity significantly negatively correlated with heavy metals like Cu, Pb and V.

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Lichen biomonitoring has been successfully employed to biomonitors airborne elements emitted by power plants using fossil fuels. The majority of the investigations of power plant emissions, airborne pollutants, and lichens as monitors have been performed in Europe. Within the radius of a few kilometers of a power station revealed that lichens contained elevated concentrations of B, F, Li, and Se relative to lichens in more remote sites.

### Bryophytes

Bryophytes are amongst the most effective and reliable indicator species for monitoring changes in the ambient environment, as like lichens they lack a protective epidermis and cuticle and, hence, are more susceptible to pollutants in comparison to the vascular plants. The moss monitoring is a significant part of forest monitoring and unique for spatial resolution, elements covered, and consideration of site-specific regional factors in the statistical analyses on the performance of data management.

Bryometer developed by Taoda in the year 1973 is a bag of mosses that respond in predictable ways to various levels of air pollution. In polluted areas, standard transplantation of certain mosses has been found to be quite useful for monitoring the intensity and trend of air pollution. By employing regular survey and calculating abundance and frequency of bryophyte species, an IAP (Index of Atmospheric Purity) can be calculated. Bryophytes have not only been used to monitor airborne pollution caused by emissions from various sources but also aquatic bryophytes species like, *Amblystegium riparium*, *Fontinalis antipyretica*, *F. squamosa*, *Eurhynchium riparioides*, and *Scapania undulata* are used to monitor water pollution.

Symbiotic cyanobacteria – bryophyte associations on the forest floor are known to contribute significantly to nitrogen budgets through the process of biological nitrogen fixation (BNF). BNF by cyanobacterial-bryophyte associations in the canopy of coastal temperate rain forests is a unique source of ecosystem nitrogen, which is dependent on large, old trees with high epiphytic bryophyte biomass.

The use of terrestrial mosses as

biomonitors in large-scale multi-element studies of heavy metal deposition from the atmosphere is a well established technique in Europe, to determine elemental concentrations in order to distinguish between different source categories. Bryophyte species *Scleropodium purum* has been utilized for active biomonitoring in urban environment to study metal accumulation in different sites exposed to rural, traffic, or industrial influences. The effects of the heavy metals copper (Cu), zinc (Zn), and lead (Pb) on the chlorophyll content in *Thuidium delicatulum* (L.) Mitt. and *T. sparsifolium* (Mitt.) Jaeg., *Scleropodium purum* as well as leafy liverwort *Ptychanthus striatus* (Lehm. & Linderb.) were examined which showed biomonitoring potential of different bryophytes.

Apart from heavy metals accumulation, sulfur dioxide, and acid rain the bryophytes are useful monitors for hydrogen fluoride and ozone estimation too. *Orthotrichum obtusifolium* is sensitive to hydrogen fluoride, whereas *Polytrichum commune*, *Polytrichum strictum*, and *Racomitrium* are tolerant of fluoride fumes. *Sphagnum* species are especially susceptible to ozone, having reduced photosynthesis, reduced growth, loss of color, and symptoms of desiccation, but that there are some remarkable reactive differences among species. Elevated ozone had no effect on germination of *Polytrichum commune* spores at upto 150 ppb.

Mosses are major component of Antarctic terrestrial vegetation. Mosses *Ceratodon purpureus* and *Bryum subrotundifolium* shows resistant to UV-A and that the latter species can rapidly change its protection to suit the UV environment. Both *C. purpureus* and *B. subrotundifolium* have sun and shade forms that differ markedly in colour and their protection from UV-A. It may be inferred from these studies that Antarctic mosses well protected from ambient UV, but are also as adaptable to incident UV as higher plants.

It has been observed that the uptake of radioisotopes by epigeal mosses occurs not so much from substrates as directly from atmospheric fallout. It is because of cation exchange activity, *Sphagnum* is used to

decontaminate water containing radioactive materials.

Bryophyte community as well as individual moss species characteristics on soil has been examined to determine relationships with proximity to three coal-fired power plants. It was observed that woody vascular plant communities were relatively uniform, whereas bryophyte coverage reduced to half. Three moss species which showed the most consistent relationship to distance from the power plants, *Dicranum scoparium*, *Leucobryum albidum*, and *Polytrichum ohioense*, mapped for presence or absence on various habitats showed that *D. scoparium* and *L. albidum* consistently were absent in the area most influenced by the emission sources, while *P. ohioense* was less consistent in its absence. Presence or absence of indicator moss species proved more useful than community characteristics for indicating relative air quality.

Bryophyte assemblages are also used as indicators of past climate and hydrological regimes. *Sphagnum* and other moss assemblages are frequently used to identify past climates. Presence of drought-tolerant species as *Tortella flavovirens* in subfossils indicates past dry climatic conditions in some areas of the Netherlands. Similarly holocene succession went from woodland to peat land. Peat served as a wick to draw up water and raise the water level, causing woodland roots to become water-logged.

### Pteridophytes

The accumulation of heavy metals by some species of ferns, makes them ideal ecological indicators of arsenic contamination. Ferns have long been recognized as potential ecological indicators of contaminated environments due to their abilities to absorb mobile arsenic through their roots. In addition, the relationship between the hyperaccumulator *Pteris vittata* L. and the non hyperaccumulator *Pteris tremula* upon exposure to arsenic has been studied in order to evaluate the movement of heavy metals in soils. The discovery of ecological indicators of arsenic contaminated abandoned mines and other environments is valuable to the field of ecosystem management.

## Algae

Algae are an ecologically important group in most aquatic ecosystems and have been an important component of biological monitoring programs. Algal communities possess many attributes as biological indicators of spatial and temporal environmental changes. Algal growth and taxonomic composition responds predictably and sensitively to changes in pH, conductivity, nutrients enrichments, organic contaminants and many other contaminants.

Diatoms have been used extensively in water quality monitoring as they exist in a wide range of ecological conditions, colonising almost all suitable habitats, providing multiple indicators of environmental change. Indices of water quality using diatoms provides the most precise data compared to chemical and zoological assessment.

The fluctuation of Algal Flora due to pollution shows distinct zonation pattern of their distribution. Cyanophyceae and euglenophyceae has been found higher in highly polluted station and diatoms and

chlorophyceae was found higher in less polluted station. These responses justify the pollution tolerant and clean water habit of algae and presents the effectiveness of algae in water quality assessment. Thus algae can utilized successfully for monitoring aquatic ecosystem.

The oldest approach for using algae to assess stream water quality is based on the indicator species concept (Saprobien system). The saprobien system is widely used in municipal and wastewater monitoring and discriminates between polluted and clean streams. The saprobic index based on diatom species assemblages, successfully divided the sampling stations into four zones of saprobic contamination: the polysaprobic zone, the alpha-mesosaprobic zone, the beta-mesosaprobic zone and the oligosaprobic zone. The zones of saprobic contamination were characterised by the occurrence of certain groups of diatom species, namely saprobiontic species, saprophilic species, saproxenous species and saprophobous species. Chemical stress in aquatic ecosystems is known to modify the

taxonomic composition of the algal population, causing a reduction of sensitive species and an increase in the number of tolerant species.

Lower group plants are thus endowed with the uniqueness to mimic the ambient environmental condition, to serve as an efficient biological proxy. Thus lower group of plants are valuable proxy for studying air pollution and climate change related studies and exhibit the relative variation (spatial as well as temporal) in the amount of pollutants between locations. The lower group plants not only successfully be used to identify areas at risk from air pollution but also provide valuable information about the screening mechanism for establishing a subset of sites where follow-up work (such as instrument monitoring) can be carried out in future. The biomonitoring approach not only provides data on the ambient environmental condition but also estimates the effect of mixed contaminants on the biological communities thus acting as early alarming biological devices/tools to predict changes in biodiversity, air pollution and climate change.

## Lead on the Plate: Phytoremediation a Promising Approach

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### How heavy metals can be defined?

In light of no general and exact definition of heavy metals, it is defined as those chemical elements having specific gravity at least 5 times than those of water. There are 53 metals with a density above 4-5 g/cm<sup>3</sup> reported as heavy metals, but it's better to consider them from their physiological effects and toxicity. At high concentrations, metals form unspecific complex compounds in the cell, which lead to various toxic effects. As per the various definitions, lead comes under heavy metals category with a wide range of toxicity to all life forms. Heavy metals are categorized into three groups based on their toxicity impacts (i) Less toxicity: Fe, Mo, Mn (ii) Average toxicity Zn, Ni, Cu, V, Co, W, Cr and (iii) High toxicity As, Ag, Sb, Cd, Hg, Pb, U.

### Sources of lead contamination to environment:

Heavy metals including lead come in

the environment from the natural, but anthropogenic activities are the major cause for their pollution. The major Pb releasing sources to environment are categorized into aerial emissions from combustion of leaded fuel, batteries waste, insecticide and herbicides. According to the latest report of Central Pollution Control Board (CPCB) New Delhi, the prevailing Pb contaminated areas in India are Ratlam (M.P.), Korba (Chhatisgarh), Vadodara (Gujrat) and Bandalamottu Mines (Andhra Pradesh).

As per the current UK air quality standards, 2.5 ug/m<sup>3</sup> lead is present in air, which is equivalent to 0.3 parts per billion (ppb) if present in elemental form. Earlier in the 20<sup>th</sup> century, there has been a dramatic rise in the release of lead in the atmosphere because of the widespread use of leaded petrol (tetraethyl lead). This can increase the octane number while increases engine performance but now a day government of many countries found other alternative ways and put some stringent laws to curb its usage so that a remarkable drop in lead

pollution can be achieved.

### How passage of Pb into environment is a historical problem?

Lead is present all around us comprising old buildings, soil, workplaces and in thousands of products being used in our everyday life. Some common sources of lead poisoning are at home, where people, especially children, unknowingly swallow and breathe fine particles of dust emanating from lead paint, toys and fumes from lead-acid batteries. Lead damages children's developing brains and nervous system, and the damage caused is almost permanent because our neurons lack the ability of regeneration. Lead enters in the environment long back as historical manner where hunters in old days shoot animals with lead shot and leave the carcass without recovering the dead or injured animals, that shot having toxic lead is ultimately ingested by other wildlife animals. This lead is being magnified as it passes up the food chain, and the top predators, especially vultures,

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eagles, hawks, get poisoned with lead and many states now banned the use of lead shots and made stringent guidelines for use of steel shot.

### **Secret of Pb entry into human body and its consequences:**

Iron deficiency in our food is one of the major factor that helps in enhanced Pb toxicity, which raises concern that pregnant women and young children in whom chances of iron deficiency are high, may be more susceptible to Pb toxicity. The Pb absorption also increased considerably with fasting or in those persons whose diet is deficient in calcium, iron, phosphorous or zinc. Absorption of Pb from different sources is dependent on the amount of Pb and the physical and chemical state in which Pb is present and is also influenced by other factors such as age and physiological condition of the body. In adults, almost 30% and in children almost 50% lead is absorbed through the Gastro-Intestinal tract. Depending on its particle size, lead can also enter through lungs. Organic lead can be easily absorbed through the skin but inorganic lead is generally not. Since lead is chemically similar to calcium present inside our body therefore it is treated like calcium and thus lead will be distributed throughout teeth, liver, lungs, brain; bone (a major place for Pb accumulator).

Blood lead level (BLL)  $> 10 \mu\text{g dl}^{-1}$  is considered as poisoning in children. Recent studies from Hyderabad also shows the abnormal cognitive functions in children at levels  $> 10 \mu\text{g dl}^{-1}$ . Generally, Pb is excreted very slowly from the body and its biological half-life is estimated at 10 years, facilitates accumulation in the fatty tissues of the body. Almost 90% lead is bound to red blood cells, shows high affinity for thiols (-SH) groups and hence impairs the activity of many enzymes. Lead can also cross blood-brain barrier and placental barrier to harm the fetus growth and development, however its excretion occurs through urine and faeces.

### **Maggi noodles contain lead: a Recent Controversy**

Maggi noodles are a popular and favorite choice of many children and if lead present in their food, then certainly it has a very severe effects on their mental as well as physical development. The recent

controversy arises in light of alarming reports of Food Safety Regulators from Uttar Pradesh found that samples of Maggi 2 minutes noodles contain traces of lead beyond permissible limits and added monosodium glutamate. Permissible amount of lead content in any food material is 0.01 ppm while the Maggi noodles samples were found to contain 17 ppm by the FSDA, Lucknow. Monosodium glutamate are flavor enhancing compounds which provide a savory taste to food but excess intake can cause headaches and other feelings of discomfort collectively known as Chinese Restaurant Syndrome. Following the reports of FSDA, Lucknow, on June 3, 2015, New Delhi Government banned the sale of Maggi in New Delhi state for 15 days; some of India's biggest retailers like Future Group, Big Bazaar, Easyday and Nilgiris imposed a nationwide ban on Maggi. Army issued advisory to its personnel asking them not to eat Maggi noodles; directed its canteens not to sell till further orders. Food Safety and Standards Authority of India collected samples of Maggi Noodles from all states for testing while Union Government referred the Maggi issue to National Consumer Disputes Redressal Commission to take appropriate action.

### **How soil health Impacted by Lead Pollution?**

Soil is an important part of our life where food production begins and for proper food production, it should remain in substantial healthy conditions. Soil health can be defined as its capacity to act as a living system which can support diverse community of its organisms from bacteria, fungi, earthworms, insects, etc that help to control plant diseases, pests and weeds by forming beneficial symbiotic associations with plants. The soil health is greatly deteriorated by the uncontrolled release of lead along with the other toxic agents. The major route in which the soil can become polluted are given below

- Rupture/leakage of underground storage tanks
- Discharge of untreated industrial wastes directly into the soil
- Percolation of contaminated waste water into the soil
- Seepage from a landfill
- Petroleum hydrocarbons

- Excess spraying of pesticides and other fertilizers

### **Phytoremediation: A promising remediation approach**

There are various methods to remove the pollutants from soil which are categorized into three main sections: Chemical, Physical and Biological methods. While conventional methods of soil clean-up including containment, solidification, air-stripping, vitrification, pump-and-treat, electro-kinetic, excavation, soil washing, etc. have proven to be effective in small areas but need special equipment's and are very labor intensive. However, due to the side effects and highly costs of physical and chemical techniques, the biological methods especially phytoremediation, seems to be promising alternative techniques to traditional methodologies. Phytoremediation is defined as an eco-friendly, cheap and large scale method which implies plants and their associated microorganisms to degrade, reduce and/or remove organic and inorganic pollutants from the soil. Although phytoremediation is a "green technology" has shown many positive results by saving money and energy but often it takes longer time to reach desired remediation levels and it also encompasses the problem of biotic and abiotic stresses. Looking on the cost effective and eco-friendly remedial measure, its application cannot be ignored. Phytoremediation practices can be achieved in several ways including phytoextraction, phytomining, rhizofiltration, phytostabilization, phytodegradation, phytovolatilization and phytorestitution.

#### **1) Phytoextraction**

It is the process where heavy metals can be removed by plant roots with subsequent transport to shoots. Plants which can grow in heavy metal contaminated soils are categorized as "tolerant", "indicators" and "hyperaccumulators". A tolerant species can grow in contaminated soils while other plants cannot. For indicator species, there is a linear correlation between metal concentration in growth media and plant tissues. Hyperaccumulators have a high potential to uptake and accumulate heavy metals which may be more than 100 fold in comparison with other common plants. Some famous examples are Indian mustard, Duckweed, Sunflower, Hydrilla, etc.

## 2) Phytomining

This technique implies growing of suitable plant species in a metal contaminated area. After harvesting the biomass, it is burnt and finally bio-ores obtained which are further processed to extract the precious metal for its use in different socio-economical benefits.

## 3) Rhizofiltration

It is a key process for removal of heavy metals from aquatic environments using suitable aquatic plants which could accumulate metals in their roots and shoots.

## 4) Phytostabilization

In this process, rather than cleaning pollutants from the soil, plants are used to stabilize metals in their root parts so that they can be prevented for their movement to surface and/or groundwater.

## 5) Phytodegradation and rhizosphere-enhanced degradation

Plant enzymes are substantially

being used for degradation of organic pollutants, which can be easily entered into the plant tissues or in the rhizosphere. The similar phenomenon occurred in plant rhizosphere by enhancing the activity of some degrading microorganisms through the release of root exudates, called as rhizosphere-enhanced degradation, which in fact is achieved by microbial enzymes rather than plant enzymes.

## 6) Phytovolatilization:

Some of the soluble contaminants of soil are taken up by the roots, transported to the leaves, and volatilized into the atmosphere through the stomata. Certain heavy metals like mercury and arsenic get inactivated once translocated from the soil into the atmosphere by bonding to free radicals present in the air.

## 7) Phytoremediation:

It is a complete remediation of contaminated soil to fully functional and

healthy soil which is an attempt to return the land to its original natural state.

## Conclusion:

Natural environment has been severely polluted in the form of heavy metals, inorganic and organic toxicants by unprecedented human activities, industrialization, population growth, urbanization etc. Several organic pollutants, such as polycyclic aromatic hydrocarbons, polychlorinated aromatic compounds and nitrogen containing aromatic compounds are resistant to degradation and represent an ongoing toxicological threat to both wildlife and human beings. Phytoremediation is an eco-friendly and cost effective alternative to traditional physico-chemical techniques for the remediation of these hazardous toxicants from contaminated sites. It can selectively degrade the pollutants without damaging the soil physico-chemical properties as well as its micro-flora.

## How air toxins hurt insidiously

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Have you been feeling tired lately? Or irritable? Listless? It's the toxic air you're inhaling. It makes you feel sick and depressed. Air pollution, mostly caused by transport, power generation, industrial or agricultural emissions and heating and cooking at home, raises risks for several illnesses, such as asthma, heart attack and stroke. But it also hurts you in far more insidious way.

### Depression:

Air pollutants contain suspended chemicals, toxins and metals that penetrate into lungs and the brain, affecting mood and memory. Outdoor air pollution increases symptoms of depression, making people feel dissatisfied, worthless, bored, unhappy and hopeless, reports a study in the journal *Environmental Health Perspectives*. People who lived in neighbourhoods with high ambient levels of suspended dust and carbon particles (suspended particulate matter, or SPM10), nitrogen dioxide and ozone had disturbed sleep and were more prone to alcohol and substance abuse, the

study found.

Then there's the indirect link to mood degeneration. Studies have linked air pollution to an increased risk of heart attacks, strokes and chronic lung disorders, which are associated with dementia and poor brain health.

### Dementia:

Suspended particulate matter (PM10 and PM2.5) and ozone raise the risk of Alzheimer's disease and dementia, reports the *Journal of Alzheimer's Disease*. The study, of close to 100,000 people, showed that even short-term exposure to particle pollution more than doubles the risk of developing Alzheimer's. Another study of close to 20,000 women living across the US published in the *Archives of Internal Medicine* showed that over time, breathing in polluted air speeds up brain decline and contributes to the equivalent of about a two-year decline in brain function. Air toxins are particularly damaging for young minds. They lower brain development in 7 to 10-

year-old children. Children from schools in polluted neighbourhoods did worse in tests of working memory, superior working memory, and attentiveness, showed the year-long study of 2,715 primary school children across 39 schools in Barcelona, Spain.

### Low immunity:

Chronic exposure to pollution warps the immune system and makes it mistake airborne particles for hostile pathogens, such as virus or bacteria, and launch an attack to seek and destroy them. Fine carbon and dust particles (PM2.5) cause low-level inflammation that disrupts the body's immune response at several levels. A study in the *Archives of Environmental and Occupational Health* found that women exposed to outdoor pollution tested high for inflammation markers (C-reactive protein, serum amyloid A, interleukin-6) and functional tests of cellular immunity (natural killer cell cytotoxicity, T-lymphocyte proliferation). This constant state of pressure overworks the immune system and makes it

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too weak to fight infection when it really occurs, report researchers in Circulation Research.

#### **Cancer:**

Polluted air causes cancer, said the France-based International Agency for Research on Cancer, after reviewing scientific data that established outdoor air pollution caused 2.23 lakh lung-cancer deaths worldwide in 2012. This puts it at the same toxic level as tobacco, alcohol, ultraviolet radiation. Air pollution also increases the risk of bladder cancer. Particulate matter, a major component of air pollution, was classified as carcinogenic.

#### **Gut trouble:**

Animal models show pollution lowers good bacteria and increase the bad ones in the gut, impairing liver function, causing intestinal swelling, and altering fat and glucose metabolism, leading to diseases such as the gastroenteritis, irritable bowel syndrome and early-onset Crohn disease, shows research in the journal Gut Microbes.

The new study from Beijing in rats, which was published in The FASEB Journal, found pregnant rats exposed to Beijing's polluted air are significantly fatter at the end of pregnancy than those exposed to filtered

air. Their offspring exposed to unfiltered air in the womb and after birth were also heavier than those who inhaled clean air. In both continuous exposure to unfiltered air caused airway inflammation in the lungs, increased tissue and systemic oxidative stress, dyslipidemia (abnormalities in cholesterol and other blood fats), and changes in fat distribution, leading to belly fat that raises risk of diabetes and heart disease. With exposure to pollution being among the highest in India and China, with large populations going through rapid industrialization, controlling it using policy, regulation and technology is the only way to lower disease and death.

*Courtesy: Hindustan Times*

## **Human-wildlife conflicts in India: A direct consequence of illegal encroachment into forests**

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Apropos to the Indian media report that in the western state of Goa, peacock may well be termed a vermin; it is important to mention that is another classical example of human-wildlife conflict; plaguing not just India but all the subcontinent nations. Rather than taking sides as a knee jerk reaction, let us try to analyze and understand the grave situation from an unbiased perspective. In spite of being the world's largest democracy, a global military power house and an impressive, expanding economy; India is still a developing nation with poor human indices, low on social development, super high on human populations beyond the carrying capacity of the land; but at the same time harbors a rich biodiversity. As a consequence, it is quite expected that the nation will face critical challenges of human-wildlife conflicts. But why are these conflicts happening across the nation so frequently? One of the simple answers is illegal encroachments into the protected forests of the nation with underlying support of various stakeholders, namely, the respective state governments

and law makers, local politicians and administrators and major industrial and agricultural groups who are desperately looking for additional land to expand business and serve for the powerful corporate India. The easiest way to incorporate these lands is by illegal encroachments covertly promoted by political parties and administration; and backed by a powerful land mafia-realtor nexus secretly operative in different parts of the nation (read every square inch of the land) more and more into forested areas. Not a single state or union territory of the nation and the adjoining neighboring countries of the entire SAARC region is immune to this perennial problem. Why are these so frequent now, such as elephants rampaging into cities and tea gardens, leopards moving into school campuses or tigers or monkeys raiding villages? The fact is that, it has always been there; only the media has become more active and educated in highlighting this with prominence in the recent times that the

reports of human-wildlife conflicts are being appearing so frequently. Furthermore; abject poverty, lack of any socio-economic opportunities, pressures of insurgency, lack of crop insurance facilities for marginal farmers in remote locations is also generating fringe groups who are completely dependent on the fragile forest resources for their survival. The extra pressure of unaccounted communities on the fragile forest base of India is reducing the forest resources drastically for the wildlife to sustain within small pockets; and they are being pushed to get into direct confrontation with the local populations for their own survival as the fundamental rule of evolution, survival of the fittest. Humans being empowered more in this process have an upper hand in lawfully exterminating the helpless wildlife. The broader question is this that it may be the turn for the helpless wildlife today; but will the human stakeholders be too far from accessing similar environmental and ecological gallows in the not so distant future?

*Too much pollution, loss of biodiversity, not enough clean fresh water, soil contamination, deforestation, global warming are just some of the Environmental issues we are facing today. We all can make some changes in our daily lives to live in a greener, more sustainable way. Let's spread the word to Go Green!*



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## NEWS AND VIEWS

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### How penguins stay ice-proof

How penguins stay ice-proof? Researchers have discovered microscopic structures in the feathers of Humboldt penguins that keep them from icing up—and that could lead to similarly ice-resistant materials. Humboldt penguins, which live on rocky beaches on the west coast of South America, swim in below-freezing waters that flow north from the Antarctic Ocean. And yet, their feathers rarely get icy. To find the penguin's antifrosting secrets, researchers examined pieces of the feathers through a scanning electron microscope. They found that the penguin's feathers are full of tiny, micrometer-scale interlocking barbs. This creates a dense net of fibers that water can't penetrate—and it also traps air bubbles that prevent heat transfer, keeping water from freezing on the feather's surface. But looking on an even smaller scale, researchers found tiny wrinkles on the surface of these barbs. These spaces also trap pockets of air, which decrease the amount of contact area between the feather and droplets. This makes water droplets less attracted to the feather's surface. Inspired by these structures, researchers created a membrane of tiny overlapping nanofibers with similar deicing powers, which may pave the way for uniquely ice-resistant materials.

**Source:** Patric Monahan

(From: *Journal of Physical Chemistry*)

### Black carbon emissions of individual cars measured under real conditions

Measurements of individual vehicle emissions are usually made in

laboratory tests. In this study, researchers followed cars driving in real conditions to measure emissions of air pollutants, including black carbon and nitrogen oxides. The study shows that diesel cars contribute disproportionately to air pollution, and highlights the value of on-road measurements.

Vehicle traffic is a major source of air pollution, linked to respiratory diseases and premature death. A recent study found transport emissions in the UK alone may cause 7500 premature deaths every year. Quantifying emissions is important for generating estimates like this, as well as developing appropriate regulations. Describing aggregate emissions from all road traffic is one way of measuring the impact of traffic on air pollution, but for a more fine-grained picture, measurements are needed per vehicle. One way of describing these emissions is by emission factors, which relate the quantity of emissions to the activity that generates them. Most emission factors are estimated by laboratory tests, which can only evaluate a limited number of vehicles and cannot replicate real driving conditions. To overcome these limitations, 'real-world' emission factor measurement techniques have been developed, which can measure emissions by following travelling vehicles (the chasing method). This method not only provides more realistic emissions estimates, it can also measure a large number of vehicles over a short period of time and capture a range of emission factors to measure a distribution, which is more representative than a single value. This research method is used to measure black carbon (BC), particle number

(PN) and nitrogen oxides (NO<sub>x</sub>). Each of these is emitted from internal combustion engines and has a negative impact on human health.

The results showed significant differences in emissions depending on the age of the car. For example, diesel cars that were in use for less than five years had a 60% lower emission factor for black carbon than those used for five to 10 years. Newer petrol-fuelled cars also had a 47% lower BC emission factor. The study also describes a simple and efficient methodology for monitoring emissions of in-use vehicles. In policy terms, the method could be used to evaluate the impact of emission reduction approaches.

**Source:** Science for Environmental Policy

### What are the barriers to solar energy adoption?

The solar energy market is hampered by multiple barriers to adoption in worldwide, according to a new review. Researchers from Sweden and Spain found that lack of government commitment as well as various sociotechnical, management and economic barriers prevent photovoltaic technologies from being more readily adopted.

The sociotechnical barriers are complex. The researchers highlighted varying product quality and quality standards in different countries, as well as consumer concerns about complexity, durability, efficiency and safety. These negative perceptions about solar technologies can create major barriers. In addition, a lack of knowledge about solar technologies leads to planners not recommending

photovoltaics for new buildings, or to improper use and poor maintenance by adopters. In some countries and regions, climatic conditions and architectural constraints make solar less suitable than in others. For instance, Scottish tenement buildings offer little roof space for solar cells. According to the researchers, this is a limitation that is difficult to address through policy measures. Within the policy category, the researchers identified a lack of stability of incentives for the adoption of photovoltaics — examples are inconsistencies between policy measures and socioeconomic factors, or the sudden removal of existing subsidies. While most countries have policy measures to support renewable energies, the market loses trust when policy decisions are reversed.

The researchers also referenced poor after-sales service; ineffective marketing and education campaigns; lack of collaboration between the building and PV industries; lack of national infrastructure; and lack of policy backing. Economic barriers meanwhile included high initial costs of the solar PV modules and high installation, maintenance and repair costs, and the low costs of competing sources of energy. Inadequate government subsidies compared to competing energy sources (including fossil fuels) and the unwillingness of banks to fund medium- or long-term investments in shrinking economies. The researchers conclude that, although several studies argue that solar PV is mature enough to compete with conventional energy sources, there are still barriers to adoption in both high-income and low-income economies.

**Source:** Science for Environment Policy

### 'Reduce, Reuse and Recycle': Scientists suggest 'novel' way to curb marine pollution by plastics

The problem of marine pollution by plastics can be resolved through a combination of actions like enforcement of rules, stressing on recycling and finding an alternative to plastics. Resolving the plastic debris problem is important. Solutions to the plastic debris can only be achieved through combination of actions, according to a study by scientists from Goa-based National Institute of Oceanography (NIO).

If marine plastic pollution problem is to be eventually resolved, the government cannot accomplish this task on their own and will need help and initiative from public, the researchers have said. Reduce, Reuse and Recycle can help to cut down on the amount of plastic waste. The NIO scientists have embarked upon a research related to pollution from micro-plastics.

One of the plastic's greatest properties is its durability which is also one of the main reasons that it presents a threat to the marine environment. Plastics in the marine environment are of increasing concern because of their persistent nature and it is a vector of toxic pollutants like POPs, which affects the oceans, wildlife and specially humans. Because of frequent inappropriate waste management practices, or irresponsible human behavior, large masses of plastic items have been released into the environment, and thereby have entered the world's oceans. It is widely cited that 80 per cent of marine plastic debris originates from land.

**Source:** Saha, S Veerasingham, V Suneel, B G Naik, P Vethamony & Badal Bhattacharya NIO, Goa, India

### Earthworms could threaten biodiversity: study

Earthworms may be a threat to plant diversity in natural ecosystems, according to a new study that found a link between the presence of the invertebrates and reductions in the abundance of trees and other plant species. Researchers visited 40 parcels in 5 sugar maple forests in the understory of sugar maple forests in southern Quebec in Canada, finding earthworms in half of all the sites. Their analysis uncovered a correlation between the number of earthworms and the abundance and diversity of certain understory species.

New shoots of red maple, striped maple, American beech, and two fern species became rarer as earthworm populations increased. The presence of earthworms does however seem to be good for ash trees and grasses. The most likely explanation is that the earthworms consume organic matter in forest litter. This results in soils that can't hold as much moisture, and that in turn interferes with seed germination and the ability of some species' plantlets to survive.

**Source:** Forest Ecology and Management.

### Trees, regardless of size, all breaks at the same wind speed. Here's why

When a cyclone named Klaus tore across southwestern France in January 2009, it highlighted a strange phenomenon: **Trees, regardless of their diameter, height, or elastic properties, don't tend to break until wind speeds reach about 42 m/s (94 mph).** This has actually been observed by several historical scientists, including Galileo and Leonardo da Vinci, both of whom suggested that a mathematical law could explain the resistance of wooden beams under

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stress. Now, using data from a new experiment, scientists say they have found that law. In a study published in *Physical Review E*, scientists hung weights from wooden rods and pieces of pencil lead to record the amount of force needed to snap the cylinder. They found that for a fixed length, increasing the diameter made the rods stronger: They could bend more before breaking. This would make tall skinny trees most vulnerable, but, trees don't grow taller without getting disproportionately thicker as well. By incorporating established laws of tree allometry—which explain the relationship of tree size parameters such as diameter and height—the team was able to mathematically explain why the trees in Klaus's path (like those seen above) gave way once the wind speeds reached 42 m/s. The equations show that changing the characteristics of the trees had meager effects: Doubling the size of a tree only increases the required wind speed by 9%; likewise, using wood more resistant to fracturing (oak versus pine) increased the critical wind speed by less than 10%. The scientists point out that their finding may reflect an optimization over evolutionary time, as wind speeds on Earth rarely exceed 50 m/s. The mathematical relationship could also explain how corals and other sedentary organisms grow in water currents.

By David Shultz  
Feb. 4, 2016 (In: Science)  
<http://www.sciencemag.org/>

### Practicing tai chi reduces risk of falling in older adults

Tai chi combines certain postures and gentle movements with mental focus, breathing, and relaxation.

Older adults who practice the Chinese exercise of tai chi are 50% less likely to experience an injury-causing fall, a new study has found. Researchers

compared the effects of tai chi to leg strengthening exercises (a physical therapy called "lower extremity training," or LET) in reducing falls.

Tai chi is an exercise practice developed in China hundreds of years ago. It combines certain postures and gentle movements with mental focus, breathing, and relaxation. Tai chi can be practiced while walking, standing, or even sitting. Deep breathing, weight shifting, and leg stepping movements are part of the practice.

After six months of training, people in the tai chi group were significantly less likely to experience an injury-causing fall than were people in the LET group, researchers said. Even a year after taking the training, people who took tai chi were about 50 per cent less likely to experience an injury-causing fall compared to people in the LET group.

**Source:** Journal of the American Geriatrics Society.

### Bacteria Devour Polluting Plastic in Landfills

A tiny microbe one day could devour the millions of metric tons of polyethylene terephthalate, or PET, that pile up in landfills each year. Researchers in Japan have discovered the world's first PET-eating bacterium, a critter that uses PET as its major carbon and energy source.

Each year, plastic manufacturers pump out more than 45 million metric tons of PET to make water bottles, salad domes, peanut butter jars, and other products—all of which sport a stamp with the number one inside a recycle symbol.

PET is the most recycled plastic. Tens of millions of metric tons of the plastic wind up in landfills each year, where the polymer's strong ester bonds

resist breakdown.

To find microbes that could pull PET apart, a team of scientists from Kyoto Institute of Technology and Kenji Miyamoto of Keio University screened 250 sediment, soil, wastewater, and activated sludge samples from a PET bottle recycling facility. After some careful microbial sleuthing, they found one bacterium that thrived on PET films and named it *Ideonella sakaiensis*.

PET can be hydrolyzed to its monomers chemically, but this process can be slow and usually requires high temperatures and pressures. Fungi that can break down PET have been identified previously, but the bacterium identified by group of scientists, appears to be more efficient than these. In fact, *I. sakaiensis* dices up polymer at a surprisingly mild 30 °C.

The researchers further found that *I. sakaiensis* uses one enzyme, which they call a PETase, to break the plastic down into the intermediate mono(2-hydroxyethyl) terephthalic acid, or MHET. Another enzyme, dubbed MHETase, hydrolyzes the MHET into the monomers terephthalic acid and ethylene glycol. The scientists think this enzymatic machinery could one day remediate PET-contaminated environments or reclaim the plastic's starting materials, which at present are derived from petroleum. This could provide huge savings in the production of new polymer without the need for petrol-based starting materials.

According to researchers PET pretreatment that would enlarge the polymer's amorphous areas would make waste more appetizing for the bacterium. Also, he notes, it might be possible to engineer the enzymes to make them faster and more practical.

**Source:** Chemical & Engineering News

## CONFERENCES

### 21<sup>st</sup> International Transport and Air Pollution Conference

24-26 May 2016; ENS-Lyone, France  
E-mail: tap@ifsttar.fr  
<http://tap2016.sciencesconf.org/>

### 5<sup>th</sup> International Conference on Agriculture & Horticulture

27-29 June, 2016 Cape Town, South Africa  
E-mail: agri@omicsgroup.com

### Eurosoil International Congress

17-22 July 2016; Istanbul, Turkey  
Contact: Ms. Işinsu Şimşek  
E-mail: isinsu.simsek@mci-group.com  
Website  
<http://www.eurosoil2016istanbul.org>

### 2<sup>nd</sup> World Congress and Expo on Recycling

25-27 July, 2016; Berlin, Germany  
E-mail: recyclingexpo@conferenceseries.net  
Website: <http://recycling.omicsgroup.com/>

### 6<sup>th</sup> International Conference on Environmental Pollution & Remediation

18-19 August, 2016; Budapest, Hungary  
E-mail: info@icepr.org

### 2<sup>nd</sup> International Conference on "Multidisciplinary Academic Research & Global Innovation"

25-26 August, 2016; Beijing, China  
E-mail: margi@globalilluminators.org  
Website:  
<http://www.globalilluminators.org/margi-2016/>

### 2<sup>nd</sup> Global Summit on Plant Science

06-08 October, 2016; London, United Kingdom  
E-mail:  
[plantscience@insightconferences.com](mailto:plantscience@insightconferences.com)

### World Conference on Climate Change

24-26 October, 2016; Valencia, Spain  
E-mail: [climatechange@conferenceseries.net](mailto:climatechange@conferenceseries.net)

### 2<sup>nd</sup> International Conference on Green Energy & Expo

28-30 November, 2016; Atlanta, Georgia, USA  
NV 89074-7722, USA  
E-mail: [greenenergy@conferenceseries.net](mailto:greenenergy@conferenceseries.net)

### 12<sup>th</sup> Biotechnology Congress

28-30 November, 2016; San Francisco, USA  
E-mail: [bioamerica@conferenceseries.com](mailto:bioamerica@conferenceseries.com)

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### Plant Growth Promoting Actinobacteria: A New Avenue for Enhancing the Productivity and Soil Fertility of Grain Legumes

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Price: € 156,99

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By Banik, R. L  
Springer 2016  
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