ENVIRONEWS

INTERNATIONAL SOCIETY OF ENVIRONMENTAL BOTANISTS

Newsletter

LUCKNOW (INDIA) VOL 12 No 3 JULY, 2006

IN THIS ISSUE

ELECTRIC SHOCK

Caution: E-smog ahead! An invisible 'smog' of electric and magnetic fields (EMFs) envelops us all the time whether we're driving, walking through a computer-clustered office, watching TV or just cooking up a meal in the kitchen. Electricity pylons, mobile phones, microwave ovens, hairdryers, toasters.... all bathe us in e-smog. It affects everyone living in electrified parts of the world and, like 'conventional' smog, can hit you like a sudden illness. A recent WHO report calls e-smog "one of the most common and fastest growing environmental influences" responsible for "giving children cancer, causing miscarriages and suicides, and making many people allergic to modern life".

Before electrical gadgets became common-place, the human body had only natural EMFs to deal with. Electric currents flowing deep within Earth's molten core generate magnetic fields, while thunderstorm activity in the atmosphere produces electric fields. And in the body there are the tiny electrical impulses like nerve signals and the electrical activity of the heart (evidenced by EEGs and ECGs). But today electrical appliances trigger imperceptible EMFs that interact with the body.

Two forms of e-smog cause the most concern: the non-ionizing electromagnetic radiation emitted by broadcast towers, radar installations and microwave appliances, and the magnetic fields surrounding electrical devices and power lines. Although the fields rapidly decrease with distance, gadgets like shavers, used close to the head, give high exposures. Electric blankets and clock radios near beds produce even higher doses, as people are exposed to them for many hours while sleeping. But e-smog being invisible, silent, and odourless, there's no reliable method to monitor it and scientist can't decide on whether to back studies suggesting a link between exposure to EMFs and certain types of cancer, primarily leukemia and brain cancer.

As another 'pollution' sign clutters our technology-driven world, only a global research effort can give more definitive answers. The bigger question is: 'how many of us can rewind to a lifestyle without today's bare necessities'?

By Prakash Chandra

(Source: Hindustan Times dated 29 May 2006)

- Informative news, views and popular articles/write-ups on current environmental researches/issues are invited for publication in ENVIRONEWS.
- Environews is published quarterly on the first of January/April/July/October; and is supplied free to all members of ISEB.
- Environews is also supplied in exchange for scientific literature published by reputed organisations.
- All correspondence should be addressed to : **The Secretary, International Society of Environemental Botanists,** National Botanical Research Institute, Lucknow - 226 001 (India).
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LETTERS

Thanks for your e-mail messages. I have passed it on to my colleagues here in Turkey. There has been a response with a few questions.

1. When is the next conference due? 2. What about the venue?

The reason I ask these questions is that **some of my younger colleagues are enquiring from me about the possibilities to organize the next event (ICPEP-4) here in Turkey.**

Could you kindly enlighten me on the possibilities in this connection.

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Thank you very much for your messages and news. I found ***Environews*** Newsletters mentioned by you in the web site and was very glad to read information concerning ICPEP-3 and my presentations. Thank you for your attention and kindness. We have got good news concerning extension of our project for a while and it gives me possibility to continue my investigations in Azerbaijan and Germany. I hope to be successful in this respect.

I am going to be a member of ISEB and I will apply very soon. But now I would like to ask you if it is possible, please, send me by mail a copy of ***Environews*** Newsletter (Vol 12, No 1, February, 2006). It will be useful for my report (my participation in ICPEP-3 and its Satellite Session) in our Institute.

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I am happy to note that the activities of the ISEB continue to progress under your most able supervision. I shall appreciate it greatly if you arrange to send your quarterly newsletter ***Environews*** regularly to my present address indicated below. Kindly convey my regards to all the members of the society.

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Thank you very much for this valuable and very good ***Environews***. I hope that you will let me take part in the future issues. With my grateful thanks and deep appreciation.

Prof. M.N. Rashed
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We are a small Dutch grass root NGO working in India. We do educational media projects. We derive some of our working capital from trade through fair trade network. Since we're operating in the fair trade network we're obviously very much concerned with producing in a environmental safe way. Therefore we guide the producers that we buy from towards environmentally safe and clean production. One of our producers is working hard on complying to all our demands in regard to clean production. He has a problem though avoiding water pollution in his production process. We want to advise him on this matter, but we lack expertise in this field. Therefore we're looking for experts who can give us pointers on how to deal with the problem of chromium pollution. Can you help us there?

I came across the ISEB website on the net looking for some information on environmental impact of the production of copper and brass items. Your organization seems to have some expertise in this field. We would like to know how to tackle the problem of chromium water pollution in the production of brass items. Do you have any information on that? Could anyone give us pointers on how to tackle this problem?

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II BIODIVERSITY CONSERVATION AWARDS

I am pleased to inform you that our Foundation has just announced the second edition of its Biodiversity Conservation Awards, in the following three categories:

i) BBVA Foundation Award for Scientific Research in Ecology and Conservation Biology;
ii) BBVA Foundation Award for Biodiversity Conservation Projects;
iii) BBVA Foundation Award for Knowledge Dissemination and Sensitization in Biodiversity Conservation

These awards, with a total purse of more than one million euros, are international in scope, while reserving a special prize for the Latin American community in view of the region's significance for global biodiversity.

The awards are intended to recognize excellence in research, practical interventions and the advancement of social awareness in the conservation of biodiversity and the natural environment. We hope with this initiative to contribute to the prestige and public image of researchers, professionals and organizations working in their fields to further the study and preservation of the biodiversity heritage.

The detailed information can be accessed on our website: http://www.fbbva.es

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I am very happy to know about new ISEB website. Meanwhile, I will express my gratefulness for you. I will visit the site regularly to keep abreast with the activities of the Society. Professor Huixian JIA of the Gansu Agriculture University wishes to convey his warm regards and thanks to you.

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Thank you for including the information on the Environmental Bioindicator Meeting in the ***Environews*** April 2006. The meeting was successful and had a broad international representation. There were several papers on plant bioindicators. These and other abstracts will be made available soon. We would encourage similar papers for publication in our journal.

You may be aware that we have formed an international society, which is named as the **International Society of Environmental Bioindicators**. Dr. Ed Zillioux is President. The Society is developing a web site and we would be happy to include a link to **International Society of Environmental Botanists.**

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It is with great pleasure that we invite the International Society of Environmental Botanists (ISEB), as an IUBS Scientific Member, to participate at the 29th General Assembly of the International Union of Biological Sciences (IUBS), which will be held on 9-13 May 2007, in Washington DC, USA.

At the invitation of the National Academy of Sciences, USA, a three-day Symposium, *"Biological Sciences for the 21st Century: Meeting the Challenges of Sustainable Development in an Era of Global Change"* will be held on the occasion of this Assembly. This symposium aims at exploring how some of the most exciting new developments in biological sciences could be harnessed to address world-wide challenges of promoting sustainable development.

At the General Assembly, which represents the highest authority of the Union, scientific programmes, activities and collaborations will be discussed, future plan of action will be approved, and new IUBS Officers and Executive Committee Members will be elected for the next triennium (2007-10). IUBS Scientific Members are welcome to send more than one delegate to the General Assembly. However, there will be only one vote per Scientific Member at the Assembly.

In view of this General Assembly, Scientific Members are requested to send, no later than 31 December 2006, their reports of activities, proposals for new scientific programmes, and nominations of candidates for the election of Officers and Executive Committee Members.

More information on the General Assembly and the Symposium will be available online at the websites: *www.iubs.org* and *www7.nationalacademies.org/IUBS*. Further messages concerning the General Assembly will be done by e-mail and we will appreciate it if you could check your e-mail address on the IUBS Website and up date when needed.

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NEWS FLASH

Dr. R.K. Trivedy, a Life Member of ISEB has joined as Professor and Head, Department of Environmental Sciences, University of Pune, Pune-411007 (Maharashtra), India.

Dr. Kamla Kulshreshtha, Scientist, Eco-education Section at the National Botanical Research Institute (NBRI), Lucknow and Joint Secretary ISEB has been honoured by Lions Club Lucknow 'Intelligentsia' for her exemplary work in the field of Environment. At a function organized on June 5 on the occasion of World Environment Day, six other distinguished environmentalists of Lucknow were also honoured.

UNEP ANNOUNCES CANDIDATES FOR SASAKAWA PRIZE

Five candidates have been short-listed for UNEP Sasakawa Prize worth US $ 200,000 for 2006. This prestigious prize is given annually to a group or individual with an established track record of achievement and the potential to continue to make outstanding contributions to the protection and management of the environment. The UNEP has acknowledged the exemplary work of those candidates in the field of environmental conservation and sustainable development related to this year's World Environment Day theme of deserts and desertification. The five short-listed candidates for the 2006 UNEP Sasakawa Prize are:

Dr. Elena Maria de las Nieves Abraham (Argentina), who is well-known regional and international expert on deserts and desertification.

Mauricio P. Bedoya (Colombia) is an architect, whose project is promoting the aesthetic, spiritual and environmental enhancement of the daily lives of the Wayuu aboriginal ethnic group in northern Colombia.

Dr. Emma Gabunschina (Russia) is a leader in the field of deserts and desertification, whose work includes a number of innovative projects to combat desertification in Russia.

Rodrigo Hernan Viva Rosas (Colombia) is a lawyer, environmentalist and community leader, whose environmental and community development initiatives are helping to reverse the poverty which leads to guerilla activity, the production of illicit crops and migration to cities.

The Tenadi Pre-cooperative Group (Mauritania), which is helping desert nomads find new and sustainable ways of combating persistent drought.

The final winner of the Sasakawa prize will be presented at a high-profile ceremony in November 2006 in New York.

Dr. Vivek Pandey Scientist, Stress Physiology, NBRI & Life member of ISEB after working in Department of Ecology & Environmental Sciences, University of Kuopio, Finland for one year has returned to India. His visit was supported by the Academy of Finland. Dr. Pandey worked in the lab of Prof. Elina Oksanen on "Protein Profiling of Ozone Stressed Finish Aspen and Birch Trees". The aim was to study differential protein expressions of birch and aspen leaves exposed to ozone stress since stress responses cause changes in the structure and activity of a protein. The University of Kuopio has a state-of-the-art Free Air Enhancement System. This facility is being used to expose trees to chronic ozone levels for long durations (up to 4 years). During his stay Dr. Pandey also learned 2 dimensional gel electrophoresis techniques along with software analysis and mass spectrometry (HPLC-ESI-MS)

NEW EXECUTIVE DIRECTOR OF UNEP

The General Assembly of United Nations has unanimously elected Mr. Achim Steiner of Germany as the new Executive Director of the United Nations Environment Programme (UNEP). His four-year term has become effective from 15 June 2006. He will succeed Klaus Toepfer, who has served the UN for more than eight years. Mr. Steiner is currently the Director-General of the World Conservation Union (IUCN).

WORLD ENVIRONMENT DAY

Lions Club Lucknow Intelligentsia celebrated World Environment Day with a difference. Seven of the well-known personalities were honoured by the club for their invaluable contribution to improve environmental conditions. People in general have been feeling and appreciating the difference they have made.

Mrs. Eva Sharma, Director, Lucknow Zoo was honoured for making Zoo a better place, whereas Dr. Kamla Kulshreshtha, Scientist NBRI received the honour for her commitments to spread awareness about hygienic conditions in rural areas. Hariyali's Sunil Srivastava's efforts not only to plant saplings but to take care of them on the various roads in Lucknow were recognized. The contributions of Dr. Hem Chandra of SGPGIMS for Biomedical waste management and those of Mr. Mewa Lal for Solid Waste Management were honoured. Mr. Sandeep Pandey (Social Activist winner of 2002 Ramon Magsaysay Award) and Dr. Krishna Gopal, Scientist ITRC were also the recipients of the honour conferred by Lion Club Lucknow Intelligentsia for their commendable contribution to society.

Dr. Krishna Gopal, in his acceptance address told audience about contamination of drinking water and associated health problems, whereas Mr. Mewa Lal explained about solid waste management and sewage problems and its ill effects. Mrs. Eva Sharma drew the peoples' attention to environment conservation in context to wild life. She appealed people coming to zoo not to feed and tease animals. Mr. Sunil Kumar of Hariyali told about the religious importance of trees.
Earlier Lion Dr. Neeraj Bora, in his inaugural address congratulated the members of Lions Club Lucknow Intelligentsia for their activities in the field of environment and also appreciated this way of celebrating World Environment Day.

Chief Guest of the evening Dr. K.J. Ahmad, Secretary, ISEB also congratulated the honoured personalities and appreciated the thought of Club's President Lion Yash Pal Kapoor to celebrate World Environment Day in this way. "This will definitely motivate people to come forward and contribute to improve the environment in their area", Dr. Ahmad mentioned. He also asked concerned authorities to take care of the environment while developing city's roads and dividers. It may be noted that all standard rules and regulations are not followed during widening of roads and construction of dividers.

WELCOME NEW LIFE MEMBERS

Ms. Anamika Tewari working as CSIR-SRF with Dr. U.N. Rai in the Ecotoxicology & Bioremediation Group at NBRI has joined as a Life Member of ISEB. Ms. Tewari after her Post-graduation from CSJM University, Kanpur joined Industrial Toxicology Research Centre Lucknow where she worked on the 'Genotoxic assessment of municipal sludge using plant models on the blood and bone marrow of Swiss albino mice' for more than three years and published research papers in reputed international journals.

Ms. Fozia Bashir joined ISEB as Life Member. She is M.Sc. from Hamdard University, New Delhi, India and currently working on "Effect of Agrochemicals (pesticides) on growth structure and some physiological aspects of *Glycine max* (L.) Merr." at Environmental Pollution Laboratory, Department of Botany, Faculty of Science, Hamdard University (Jamia Hamdard), New Delhi-110062

GREENING YOUR ENVIRONMENT - RECYCLE THE WASTE: MAKE YOUR OWN COMPOST!

Jamal Masood

INTRODUCTION

Compost is not only an alternative to chemical fertilizers or manure but is also one of nature's best protective covering to increase the soil's water-holding capacity in clay as well as sandy soils thus preventing evaporation of moisture. Compost inhibits growth of weeds, enhances soil quality/fertility, and encourages healthy root development. Micro-organisms feed on the organic matter provided in compost and naturally produce Phosphorus, Nitrogen and Potassium which keeps the soil in a healthy, balanced condition.

In addition to benefiting the plant life, composting also benefits the environment. Compostable materials usually have high moisture content (up to 80%) and incinerating it is not only wasting energy but is also expensive. With increase in population the complexity of waste disposal is spiralling toward a catastrophic situation. The landfills are overflowing, and new sites within an economically transportable distance from the urban areas are getting more and more difficult to find. Moreover landfills pollute both air and groundwater.

As per EPA estimate, the garbage in municipal landfills in USA consists of yard (garden) waste like grass clippings and tree branches, paper and cardboard, plastics, metals, glass, food, and other wastes, out of which about 65% is organic waste which could be composted. Once we dump our garbage into a landfill we are permanently losing good organic material, which could otherwise be composted and recycled. In Indian scenario this ratio could be higher. Our packaging material waste is much less than USA and our vegetative waste is higher because most of the Indians buy and peel fresh vegetables/fruits.

It is therefore time that we give a serious thought to the subject; stop throwing good organic materials and start making our own compost to literally green the surroundings around us, conserving the landfill space and protecting the environment.

COMPOSTING AT HOME

Most of the developed countries like USA, Canada, UK, France, Germany, Australia, New Zealand etc. give wide publicity to composting at home. Their municipal/county/local council offices issue pamphlets and circulars from time to time to encourage the urban population to recycle their organic waste and convert it into compost. Metallic/Plastic composting bins, tumblers and wooden boxes for composting and other related tools like pile thermometer, turning hoe etc are readily available in these countries at local hardware stores. Lot of useful information about composting is also available on the internet.

INDIAN SCENARIO

Here in India, hardly any thought is being given to composting in urban areas. Neither any publicity nor incentives are provided. It is still felt that we should give a serious thought to this issue and even though the composting tools are not available to us but with limited resources we should still make compost at home. In houses with some open space composting can be done in open pit or trench or heap or it can be carried out in plastic/metallic 200 litres oil drums, which can be purchased from market/junk shop. Composting can even be done in a cylinder made of wire mesh or old discarded wooden boxes.

There are two very common misgivings about composting in the minds of most of us, especially those who dwell in flats. These are mainly foul smell and cost factor in composting. But these misgivings are wrong on both the counts. If done properly, compost will give a sweet (non-pungent) smell and it is almost free of cost. Needless to say composting will however require some time and effort on our part.

COMPOSTING MATERIAL

For a compost to be correctly and efficiently formed it is necessary to have right amount of Carbon to Nitrogen (C/N) ratio (approximately 4:1 by volume). Carbon gives energy for maintaining proper heat in the heap and nitrogen for forming protein, the backbone of the macro- and micro-organism - the main characters in turning garbage into compost. High carbon will slow down decomposition and high nitrogen, will cause unpleasant odours due to release of excessive nitrogen into the air in the form of ammonia and nitrous oxides.

As a thumb rule, all organic materials which will readily decompose are suitable for composting. Almost all garden/kitchen wastes can be composted. In addition many items which are fully biodegradable like paper, hair, cotton rags, feather etc. can be part of compost. However, there are some exceptions. Meat, poultry, fish, fatty items and milk products can be composted but it is better to avoid these items as these break down quite slowly, cause bad odour/stench and attract unwanted animals like rodents, stray cats and dogs.

Given below is the list of the most common items which can be composted as well as negative list which should not be included. As a convention, the positive list is divided in two parts "Greens" materials rich in Nitrogen and "Browns" - materials rich in Carbon. The "Greens" also have high moisture content and "Browns' tend to be dry. To achieve good results, and speed up decomposition, all coarse materials should be chopped or grounded into small pieces before adding to the heap.

GREEN (NITROGENOUS) LIST

- Algae, Moss and Seaweed. rinsed and dried in open air.
- Bird and farm animal droppings/manure. (Avoid fresh dropping also avoid droppings of

carnivores).
- Bread pieces/crumbs.
- Egg shell.
- Feathers.
- Grass Carpet or Sod (matt of grass and grass roots).
- Grass clippings.
- Hair (Both human and animal).
- Leftover cereals/rice.
- Leftover fruits and vegetables including cooked vegetables.
- Rotted fruits and vegetables.
- Tea leaves and Coffee grounds.
- Vacuum bag contents.
- Vegetable and fruit wastes e.g. peelings, cores, tops of vegetable like carrot, beet root, turnip etc.

BROWN (CARBONACEOUS) LIST

- Cardboard - duly shredded.
- Corncobs and corn stalks.
- Dead insects.
- Dead plants.
- Dry flowers.
- Nutshells.
- Paper including newspaper- duly shredded. However it is better to recycle paper than to compost it. Small quantities can always be composted.
- Plant leaves and trimmings.
- Sawdust and wood shavings.
- Shredded untreated wood.
- Straw and hay.
- Vegetable stalks.
- Washing machine lint
- Wood-fire ash

RED LIST (ITEMS WHICH SHOULD NOT BE USED)

- Coal/Charcoal including its ashes.
- Dead animals/pets/birds.
- Diseased animal's carcass.
- Diseased plants.
- Egg yoke and white.
- Excreta of humans and carnivorous pets.
- Fish/seafood scraps including scales and bones.
- Garden wastes recently sprayed with pesticides.
- Garden wastes with thorns or toothed leaves, hairy, stinging, or prickly plants including rose cuttings etc.
- Glossy/chemically coated paper.
- Meat, meat scraps and bones.
- Milk and milk product.
- Non organic materials, as these are not biodegradable - metals, glass, plastics. stone, lime etc
- Toilet waste or septic tank sludge.
- Used Paper tissues.
- Woody Branches, roots (unless chipped).

COMPOSTING PHENOMENA

Composting is a combination of bio-chemical and physical factors. To begin with, composting is started by macro-organisms who initially chop/grind the organic materials into smaller pieces. These grinders are found in soils and are mainly earthworms, roundworms, hookworms, pinworms, snails, slugs, millipedes beetles, ants, mites, springtails, wood louse, etc. Once the organic material is broken into small particles, the micro-organisms (also known as decomposers) take over. The most effective decomposers are bacteria, fungi, protozoa, and actinobacteria (actinomycetes), These are the *mesophilic* bacteria who thrive best at temperatures of about 20 to 40 °C. Given the right conditions of temperature and humidity, these decomposers start multiplying and colonizing in the organic material thereby initiating the composting process.

With the decomposition of organic matter, heat is generated and the central core of the compost pile reaches a temperature averaging about 60 °C. The *thermophiles* (organisms that thrive at a temperatures above 50°C) take over now and this is when the active phase of composting starts. This is the phase, which if not handled properly, can cause bad odour. For proper and odour free composting it is necessary to aerate the compost so as to maintain adequate supply of Oxygen, lack of which encourages the growth of anaerobic microbes that produce disagreeable odours. Aeration is usually achieved by turning the compost over. Earthworms also improve aeration by tunnelling through the heap.

A secondary but a very beneficial part of this stage is that at temperatures above 50 °C the weeds/disease causing agents (pathogens) like fly larvae etc. are destroyed and compounds, which are toxic to plants also break down.

As the Oxygen supply in the central core of the compost decreases it begins to cool. Turning the pile replenishes the Oxygen supply and exposes the organic matter not yet thoroughly decomposed. This results in renewed heat generation and continuation of the *thermophilic* stage. In due course, the active composting phase subsides, temperatures gradually decline to ambient temperature and turning or mixing has no further impact on temperature cycle.

With drop in temperature, *mesophilic* micro-organisms recolonize the pile and composting process continues to occur that make the remaining organic matter more stable and suitable for use with plants. This is known as curing stage. During curing, organic materials continue to decompose and are finally converted to biologically stable humus. The final finished product has a dark colour, a crumbly texture and an earthy smell.

Total time for compost to be fully ready for use in plants can be as less as two months but to be sure that the compost is fully cured and safe for use, it is better to give it 4-6 months. This however varies from climatic conditions, contents of compost etc. and can be as long as 12 months.

SOME USEFUL HINTS

Any pile of organic matter will eventually rot, irrespective of method used for composting. However there are few important factors which should be kept in mind for achieving good quality of compost in lesser time. These are but not limited to;-

- In warm areas shelter the pile in a shadier spot so that it doesn't dry out too quickly. In cooler areas the pile should be kept in sunny spot to take advantage of solar heat.
- In areas, which experience heavy rain, a well drained spot should be chosen. If possible pile should be kept under a tree or some sort of shelter to prevent ingress of rain.
- To allow easy access to the beneficial organism into the pile, it should not be made over hard brick or concrete surface
- A compost heap should be built up

in layers of about 150mm and to distract flies each layer especially the top most layer should be covered with saw dust or wood ash or even plain garden soil.

- Heap should be kept damp not wet i.e. it should feel moist to the touch when squeezed but should not give off water.
- Water-logging should be avoided as this inhibits decomposition and will make the compost smell. If it is too wet, absorbent material such as paper, sawdust, straw etc. should be added to the heap.
- It should be frequently turned so that it is properly aerated and sufficient heat is generated to destroy not only pathogens but also weeds and other seeds.
- No insecticides should be sprayed over the heap as these will prevent the decomposition process by killing fungi, earthworms, bacteria which are the main players in process of composting.
- To speed up the process of decomposition, some mature compost, animal manure, or bone meal can be added
- It may be worthwhile to have two piles so that the material can be built up in one while composting process is taking place in the other pile.

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KEYSTONE SPECIES: THE CONCEPT, THEIR ECOLOGICAL SIGNIFICANCE AND DETERMINING THEIR KEYSTONE STATUS

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KEYSTONE SPECIES AND THEIR ECOLOGICAL SIGNIFICANCE

The concept of keystone species was first introduced by Paine in 1966 while establishing the importance of predation in maintenance of the prey species diversity in the rocky inter-tidal zone of pacific coast in North America. Paine stated that 'keystone species' were the species whose activity and abundance determine the integrity of the community and its unaltered persistence through time *i.e.* its stability. According to De Levo and Levin (1997), keystone species are individual species or groups of species whose removal from the ecosystem may result in dramatic changes in the structure and functioning of that ecosystem.

The keystone species play a central and critical role in maintenance of community structure and ecosystem functioning. If an ecosystem can be returned to a state in which the keystone species flourish, then all the other species, which depend on them, will also flourish. The importance of biodiversity in environmental management beside socioeconomic development and well being of human society, has led to the development of various techniques for conservation of floristic and ecological diversity. Some simple ways of managing the natural systems should be evolved so as to retain and conserve the identity of a landscape or region for a better tomorrow. One of the simplest ways of doing so is by identifying species, which play the key role of holding together the entire biological community or ecosystem. These species are known as 'keystone species' in ecological term.

The central core of keystone concept is that only a few species have uniquely important effect on the community or ecosystem by virtue of their uniquely important traits and attributes. Only those species can be considered as keystone species that had a significant effect on 'time window' of other species. For example, changes in climate may differentially affect the growth rate of emergent species in a forest, which in turn could affect other species. In most of the cases, it is indeed groups of species rather than individual species that assume importance and these species groups could be referred to as the 'keystone groups' or 'functional groups'. Keystone species or 'keystone species groups' play a vital role in maintaining ecosystem and regulating the biodiversity. Loss of vital function, and changes within the ecosystem or community would follow if such species groups are removed from the system. These species are 'responsible' for the existence of an ecosystem of certain type and create possibilities for the development of other types of communities. Biodiversity within an area can be characterized by measures of species richness, species diversity, taxic diversity, and functional diversity, each highlighting different perspectives. Functional diversity refers to the varieties of functions carried out by different species and groups of species known as functional groups. According to Smirnova (1998), there is a correlation between structural and taxonomic diversity. The maximum taxonomic diversity could be expected in a climax landscape, which develops due to the structural diversity of population mosaic produced by all key species of the biota and the spatial and temporal heterogeneity of these mosaics. The population dynamics of keystone species define the pattern of succession of vegetation. Turnover cycles of matter and energy flows in an ecosystem are dominated by the life activity of keystone species, and these activities determine the major shifts in ecosystem structure at the spatial and temporal scales. Population mosaics of keystone species have largest spatial-temporal dimensions, and population mosaics of subordinate species are thereby determined by the keystone species. Keystone species are responsible for the existence of the ecosystem and maintenance of its species diversity. So the biodiversity in any ecosystem can be manipulated by perturbations in such uniquely important species.

In recent years the overly expansive usage of the 'keystone species' concept has led to redefinition of the term.

According to current interpretation, keystone species are only those species, which have a large disproportionate effect due to their greater biomass and/or abundance in the communities in which they occur. Moreover, those species, which drive ecosystem processes or energy flows, are generally referred to as 'key species', but only a few of them are 'keystone species'. It needs to be emphasized that the term 'keystone species' should be applied to those species whose role in nature includes the potential to affect the abundance of other competitively dominant species. A major research challenge for ecologists is to predict which species in the community would become keystone species.

Keystone species differ from one ecosystem to the other in time and space. The structural organization and function of ecosystem will alter when keystone species disappear for some reason or when a new and stronger keystone species comes up. It needs to be underlined that keystone species are only those species whose populations either support or essentially alter the main vegetation pattern of the ecosystem. Under such comprehension in a forest ecosystem only trees can be considered as the keystone species.

Trees are the key species that drive the system in many tropical and temperate forest ecosystems, and out of these key species, only few species or groups of species are keystone species, which play a crucial role in the maintenance of ecosystem stability through their keystone roles and functions.

In forest ecosystem it is rather difficult to ascertain the effect of species upon each other, and in many cases dominant species seem to be driving the whole community. Amongst the dominant species again there is a wide degree of differences in relation to their contribution toward the community make-up. One of the possible ways of characterizing keystone species in the forest ecosystem is through the competitiveness of the species along the successional gradient and focusing on their role, which supports or contributes towards maintaining an existing type of vegetation.

The keystone species of the temperate zone are trees, which create and support forest communities, as well as pathogens and herbivores that destroy forest communities and create possibilities for the development of other types of communities. The desired level of solar energy, water and nutrient are the most essential resources for the existence of organisms in a given community. Thus the term keystone species can be applied to those species, which directly or indirectly affect energy flows, and hydrological and nutrient cycling and recycling, Based on this viewpoint, trees can be considered as keystone species of forest ecosystem; they are responsible for the existing vegetation playing a role of habitat modifier by manipulating nutrient status, water availability, and light gradient of the system. Trees also suppress light demanding species and help the shade-tolerant species to successfully colonize the area. Thus the canopy trees can be considered as keystone species in forest ecosystem.

The current level of conceptual understanding of the effects of biodiversity on ecosystem processes is so primitive that at this stage it is possible to recognize the linkages at the level of functional groups only. In any ecosystem there are diverse types of functions performed by different species or species groups. However, no two species or individuals are identical. It may be noted that species diversity within the functional groups or genetic diversity within the species has important ecosystem consequences.

Although certain species have much greater influence than others on an ecosystem structure, not all ecosystems include the same species that exert such pervasive influence on them. In fact most ecosystems are somewhat sensitive to the loss of a few species, though some losses have greater impact on the system than others. Nevertheless, identification of such species, which would function as keystone species in an ecosystem can help in the conservation of that ecosystem. The fact that some species matter more than the others, becomes especially clear in the case of 'keystone species' or 'ecosystem engineers' or 'organisms with high importance value for the community'. These terms may differ in usage, but all refer to those species whose loss or removal results in disproportionately greater impact on the community when compared to the loss of other species. Members of the functional groups maintain and determine the resilience of the ecosystem by spreading a wide range of ecological niches exploited by the component species.

The contribution of individual species toward ecosystem development varies in time and space, and accordingly, not all species are equally important when we look at the community stability and functioning. The community function may be maintained by a species or summed effects of a few species. Some species undoubtedly play more significant role than others in ecosystem function. The varieties of functions that a species can perform are limited and consequently, an increase in species richness also increases functional diversity, producing an increase in ecological stability.

Within a community it is not possible to substitute species for one another, rather there are a good number of combinations of species that can produce similar ecological roles. There is no intrinsically unique level at which biotic diversity affects ecosystem processes. Based upon their ecological roles and the specific ecological niches that they exploit, species can be divided into 'functional groups'. A functional group refers to a group of species, which perform ecologically similar roles in ecosystem processes.

Biodiversity *versus* ecosystem stability and functioning has been a matter of academic concern for sometime now. It is only recently that attempts have been made to clearly delimit the role of biodiversity in ecosystem function, and the role of individual species in community stability and its functioning. The relationship between biodiversity and functioning of ecosystems is far more complex and only fractionally

understood. To determine the ecological importance of biodiversity one must focus attention on the aspects of biodiversity that control resilience, i.e. the ability of the system to maintain its characteristic pattern and rates of processes in response to the variability inherent in its climate regime. A species may regulate biogeochemical cycles, alter disturbance regimes, or modify physical environments, and thereby it could be assumed that biodiversity has, a direct link with ecosystem stability.

A community is an entity composed of functionally interdependent species. The internal structure of a community is made up of important functional groups of species. Each of these species occupies what we call as ecological niche that depicts the ecological conditions in which the species occurs and determines its functional position within the community. When several species have similar niches, and also similar function they form together a functional group. A few or several of such species have a critical functional role that has a direct or indirect effect on the stability and survival of the community. Such species or the groups of species are certainly the 'keystone species'. The loss of such species would result in widespread changes in the community structure and function, and may often lead to species loss or elimination.

DETERMINING THE KEYSTONE STATUS OF SPECIES

All species are important for the existence of an ecosystem and for the maintenance of its various functions, but as mentioned earlier, all are not equally important. The identification of species and groups of species, which play key role in maintaining the ecosystem stability and resilience by influencing the structure and function of an ecosystem is a stupendous task, and very few attempts have been made in this direction.

Communities viewed in terms of functional groupings in general prove to be much more stable than when viewed in terms of species composition. In defining ecosystem or plant communities it is difficult to separate the effects of human and natural disturbance. The dynamic view of communities defines the complexity of characteristics of the community by emphasizing on its spatial heterogeneity and a non-linear causation. The community and ecosystem can be understood and managed better when the species are grouped to the degree possible into classes that possess similar characteristics and behaviours. This can be possible through a detailed study of community structure, which will also provide a better understanding of species distribution and their status in natural ecosystems. Here, it may be mentioned that the grouping of plants in different life forms by Raunkiaer was one of the most widely accepted functional groups classifications.

Depending on the focus of study some may find the floristic composition most important, while others may find the persistence of certain processes and functions (such as biomass production, nutrient cycling, evapotranspiration, and energy flows) more important in the maintenance of the community. However, advocating the integration of both community dynamics and structural organization of the ecosystem with its functional processes appears to be more reasonable. Functional grouping of the components of vegetation can be done adopting various criteria such as phytosociological associations, life form, overall morphology position in the canopy, phenorhythmics or phenology, biomass and nutrient partitioning, structure of organs such as leaves or roots and the physiological characteristics. In many ecosystems dominant species seem to drive the system and play a critical role. These species could be considered as keystone species. Studies of their ecology, spatial distribution and their relationship with other components of ecosystem are important from functional perspective.

The question as to how species diversity is maintained in natural communities, and which species or group of species plays more important role in influencing ecosystem functions, has been agitating the minds of many ecologists during the past two decades. Several investigations were carried out to answer this and related questions in the tropical and subtropical forests in various parts of the world. Sustainable forest management requires a knowledge of not only the species composition but also of the functional relations due to which these floristic components are existing in the forest ecosystem. There are many ways that help to quantify the functions of different species and their drastic effects when they are eliminated from their natural habitat or ecosystem. Species such as 'indicators', 'ecosystem engineers' etc. were identified by different researchers to see the effects of species or group of species on certain ecological processes.

The keystone group includes those species or group of species, which greatly influence the presence or absence of other species. In the animal kingdom quite a few of these species have been identified and listed from different ecosystems, however, only a few examples are available from forest community. Some species, which contain high levels of nitrogen, phosphorus and potassium in their leaf tissue in spite of their growth in a highly infertile soil serve as keystone species in terms of nutrient conservation in some protected forest ecosystems of Meghalaya.

Generally, under the climatic conditions of India, the outcome of succession is the dominance of a plant community by a few tall long-lived tree species with a few understorey species surviving within their shade. The intermediate disturbance hypothesis recognized the keystone role of climax species in suppressing community diversity due to gradual reduction of species number as succession proceeds. The other extreme is the elimination or exclusion of long-lived, potentially dominant trees and shrubs due to suppression of their seedlings by certain fast growing weedy herbs and shrubs, which serve as keystone species in this kind of situation. It has been shown by several researchers that in high light and productive environment fast growing herbs and shrubs can quickly suppress the slower growing tree seedlings. There is also some evidence to suggest that the elimination of keystone weeds can lead

to the invasion by tree species. In the successional forests of north-eastern hill region of India a number of species have been categorized as keystone species. Species like *Alnus nepalensis* can play a very important role in nutrient cycling through nitrogen fixation, while many bamboo species (*Dendrocalamus hamiltonii, Bambusa tulda and Bambusa khasiana*) play a keystone role in conservation of nutrients like nitrogen, phosphorus and potassium in jhum fallows in northeast India. Similarly, the invasion of introduced nitrogen fixing shrub *Myrica faya* in Hawaiian Island has been shown to produce large-scale effects on nitrogen cycling by greatly increasing the amount of this essential plant nutrient in soil.

Some keystone plant species have been identified based on the phenological attributes and their 'mobile links'. These keystone mutualists are typically plants that provide criterion support to large complexity of 'mobile links' (mobile links are animal pollinators and dispersers on which plants depend for seed production and propagation). During periods of resources scarcity, certain plant parts/products dubbed 'keystone resources', assume major importance as mainstay of primary consumers. In many tropical forests there seem to be a very few plants that regularly produce edible reproductive structure (fruits, seeds, flowers) during the period of minimum fruit availability. Such plants can certainly be referred to as the keystone species since they sustain the myriads of primary consumers including pollinators and dispersers. In view of the above considerations, the identification of keystone species and study of their population dynamics in forest ecosystem are important for biodiversity manipulation and management as well as for the maintenance of the forest.

During the course of ecological studies on the sacred groves of Meghalaya, the senior author and his collaborators at NEHU, Shillong have identified keystone species and keystone groups based on their phytosociological characteristics such as IVI, position in the canopy, growth form/life form, important association with other species (e.g. epiphytic growth), phenological associations linked with phenological behaviour of plants (such as 'mobile links', food resources availability for primary consumers), successional characteristics such as light demanding or shade-tolerant nature of species, biomass and nutrient allocation pattern in different plant parts, shoot/root ratio of seedlings, and their role in nutrient cycling (litter quality, nutrient release, and nitrogen fixation). The pioneering researches made in this direction by the Ecology Group at the North-Eastern Hill University, Shillong need to be further intensified.

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NEWS AND VIEWS

PINE FORESTS SLOW CLIMATE CHANGE

The fresh fragrance released by trees in northern pine forests is a significant component in slowing climate change, according to researches carried out by Swedish scientists. These particles help to cool the planet by bouncing energy from the sun back into space. The forests produce enough microscopic particles to load the atmosphere around them with 1,000-2,000 particles per cubic centimetre of air.

The particles, called monoterpenes, give pine and spruce forests their characteristic aroma. They either affect climate directly by bouncing sunlight back into space or by seeding clouds, which do the same thing. We have misjudged the trend of climate change because the particles are not in the models in a comprehensive way.

While particles have a lifetime of up to a week, the greenhouse gases have a lifetime of years to decades. So we can't possibly use particles in mitigation technique to stop climate change.

By James Anderson in The Guardian (Source:Clean Energy Nepal)

IMPROVED STOVES COULD SAVE MILLIONS OF LIVES

Cooking with wood, dung, coal and other solid fuels on traditional stoves each year kills 1.5 million people who breathe in the poisonous fumes, the U.N. health agency said in a report.

On average, if 100 million more homes used cleaner fuels for cooking, there would be 282,000 fewer deaths from respiratory diseases every year, according to a 42-page World Health Organization report on household energy and health.

In addition, spreading the use of liquefied petroleum gas (LPG), biogas and other cleaner household fuels could yield a sevenfold economic benefit in health and productivity gains worth US$105 billion (euro83.19 billion) a year.

"Making cleaner fuels and improved stoves available to millions of poor people in developing countries will reduce child mortality and improve women's health," said WHO Director-General Lee Jong-wook. "In addition to the health gains, household energy programs can help lift families out of poverty and accelerate development."

Three billion people -- more than half the world's population -- cook with solid fuels on open fires or simple stoves inside their homes. Sub-Saharan Africa and South East Asia are particularly affected, with 396,000 and 483,000 annual deaths respectively.

It would cost US$13 billion (euro10 billion) a year to give access to LPG to half the people currently using solid fuels. However, this would generate an economic benefit of US$91 billion (euro72 billion) annually due to reduced illness and deaths, less time spent collecting fuel and wood, and shorter cooking times, the report said. LPG prices are affected by rising oil prices and could lead to higher costs but other cleaner fuels such as ethanol gels, plant oils or biogas would lead to the same benefits at better costs, the study said.

About 90 percent of the cost would be borne by families, who can install better ventilated and fuel-efficient stoves for as little as US$6 (euro4.75). But donor investments are required for designing appropriate technologies and setting up local businesses, WHO said.

Getting half the people who use traditional stoves to use improved ones, would save US$34 billion (euro26.94 billion) a year in fuel. Women and children can spend up to four hours a day in search of firewood. Using gas, more time would be available for children's schoolwork and leave mothers freer for childcare, agriculture or other income-generating activities as a way to break the vicious cycle of poverty, the agency said.

By Erica Bulman
Source: Associated Press, 5 May 2006

BIODIVERSITY LOSS

Due to human activities, many of the world's great biological systems are in a state of collapse, and tens of thousands of animal and plant species are becoming extinct every year. Even if we stop now, the planet is expected to take about 10 million years to recover.

Human beings have become 100 times more numerous than any other land animal of comparable size in the history of the planet. We appropriate an astonishing 40 percent of all the solar energy captured in land plants, sharply reducing the resources available to other species. Extinctions today are estimated at 1000 times the natural rate, about 27000 a year, leading to a massive species loss similar in scope to the five major such periods in the last 500 million years. But unlike previous huge die-offs caused by climate, geology or stray meteors, the current crisis is the result of human activity. After each of these previous periods, it took life roughly 10 million years to establish a comparable level of diversity, albeit with a very different mix of species each time. Life will regenerate no matter what we do, but at a pace of 10 million years, time is not on our side.

The worst thing that can happen in the 1980s is not energy depletion, economic collapse, limited nuclear war, or conquest by a totalitarian government. As terrible as these catastrophes would be for us, they can be repaired within a few generations. The one process ongoing in the 1980s that will take millions of years to correct is the loss of genetic and species diversity by the destruction of natural habitats. A study in 1975 showed that 60% of the Cape Floral Kingdom, which has the highest known concentration of plant species in any region around the world, had been destroyed in the previous 150 years.

WASTE ACCUMULATION AND POLLUTION

Humans are accumulating and dumping waste much faster than it can be broken down by natural processes, if it can be broken down at all. This results in burying waste in landfills, dumping at sea, or incineration, all of which lead to pollution - of soil, groundwater, or air.

Incinerators reduce the volume of solid waste but they do not make the problem of toxic substances in the waste disappear - incinerators emit a wide range of pollutants in their stack gasses, ashes and other residues: for example, they are still a number one source of dioxins (a carcinogen) worldwide. The filters used to clean incinerator stack gases also produce solid and liquid toxic wastes.

Americans throw away enough aluminium every three months to rebuild their entire commercial air fleet, and enough office paper each year to build a 4 meter high wall of paper from New York to Los Angeles (about 4000km).

In the USA, over 2 000 million zinc-carbon and alkaline-manganese batteries are discarded every year, needlessly adding to solid waste problems and causing serious environmental pollution in landfill sites and the surrounding water.

Volvo worked out that for every one ton of car they made, they generated 61 tons of waste. 50 million new cars are produced every year, and 11 million are junked each year in the US alone.

FRESH WATER

Fresh water use world wide is fast outstripping its availability-a dangerous situation given the current exponential population growth. Yet in many water-scarce countries inefficient use continues amongst certain sectors of the society. Human consumption of water has risen six fold in the past century, double the rate of the population growth, while half of the world's wetlands have been destroyed, and lakes and rivers have been poisoned by fertilizers, silt and sewage. Water scarcity may soon limit economic development, particularly in parts of China where supplies are already inadequate to meet the needs of people, industry and agriculture.

In India, with a population of 1 billion, the extraction of water from aquifers exceeds recharge by a factor of two, a dangerous situation in a country where population is expected to grow by another 600 million by 2050. By 2025, between 2.4 billion and 3.2 billion people will face severe or chronic water shortages around the world compared with the 505 million people affected today.

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Printed and Published by
Dr. K.J. Ahmad
for International Society of Environmental Botanists, National Botanical Research Institute, Rana Pratap Marg, Lucknow-226 001, India
Executive Editor :
Dr. H.M. Behl
Editors:
Dr. R.D. Tripathi
Dr. Mrs. Kamla Kulshreshtha
Dr. Amit Pal
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Printed by Maruti Scanners, Lko. Tel.: 0522-4001895, 5524982, 9839055651