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# ANTARCTICA EXPEDITION AND SCIENTIFIC RESEARCH

**Dr. Pawan Kumar 'Bharti'**
Antarctica Laboratory, R&D Division,
Shriram Institute for Industrial Research, 19,
University Road, Delhi-110007, India
E-mail: gurupawanbharti@rediffmail.com

Antarctica "the white continent" is the fifth largest continent in the world with its unique wildlife, extreme coldness, dryness, windiness and unexplored territories. The word Antarctica is derived from the Greek word antarktike, which means "opposite to north" i.e., opposite to the Arctic. It is situated within the Antarctic Circle and is surrounded by Southern Ocean. James cook discovered Antarctica when he was crossing the Antarctic Circle. The world's largest ocean current, the Antarctic circumpolar current circumvents the Antarctic continent. Of the 14 million-sq.km area, 98% is covered with thick ice sheets that formed 25 million years ago and holds 75% of the earth's fresh water.

Polar science has the potential to benefit humanity, inform the sustainable use of resources, help protect the planet and generate economic and social impact. Research in the Polar Regions are important and relevant to everyday life. The Polar Regions may be at the ends of the Earth but what happens there affects us all. Understanding how the Earth works, and in particular how it is responding to ever-increasing human pressures, is one of science's greatest challenges.

The world's Polar Regions and their contiguous oceans are attracting more interest than ever before. Once regarded as barren, inhospitable places where only explorers go, the north and south Polar Regions have been transformed into high profile sites of scientific research. Be it in understanding the role of the polar realm in modulating the global climate or for studying the ecosystem adaptability and survival under extreme conditions, there has been an increasing interest in the science of the polar realm, over the past two-odd decades. . Realizing the importance of Antarctica as a pedestal for scientific research, India launched the first of her Annual Scientific Expeditions to the Antarctica way back in 1981. This was followed by the country's successful entry to the realms of Southern Ocean research in 2004 and the Arctic, three years later. To cater to the requirements of the Indian scientists in both the Polar Regions, two stations "Maitri" and "Himadri" have been established to serve as living-cum-research bases in the Antarctic and Arctic respectively. Another permanent Indian research base "Bharati" in Antarctica is recently commissioned during the austral summer of 2011-12.

The focus areas of scientific studies in the Arctic and the Antarctic have been largely confined to earth, atmospheric and biological sciences. As regards the studies of the cryosphere, the research initiatives by Indian scientists in the Antarctic comprise monitoring of the glaciers in Dronning Maudland, studies of ice dynamics and energy balance and climatic reconstructions from ice core analyses. Systematic studies if the cryospheric domain of the Arctic is as yet to be initiated. Considering the significance of the polar ice cap and the sea ice in the Polar Regions in modulating, if not driving the global climate, it is proposed to initiate during the XII Plan period, a major

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national mission of cryospheric studies of both the Polar Regions as well as of the Himalaya.

Polar scientists make observations and collect data to answer questions about the Arctic (the north polar region) and the Antarctic (the south polar region). These regions are unique and isolated. However, the Earth is a global system, so all regions are related. We can learn a lot about physical science, life science, and Earth/space science when we study the polar regions.

Scientists observe patterns in nature. They use these observations to create models. These models help us explain, understand, and predict our complex, changing environment.

**ANTARCTICA:**

Antarctica is Earth's southernmost continent. It contains the geographic South Pole and is situated in the Antarctic region of the Southern Hemisphere, almost entirely south of the Antarctic Circle, and is surrounded by the Southern Ocean. At 14,000,000 square kilometres (5,400,000 square miles), it is the fifth-largest continent. For comparison, Antarctica is nearly twice the size of Australia. About 98% of Antarctica is covered by ice that averages 1.9 km (1.2 mi; 6,200 ft) in thickness, which extends to all but the northernmost reaches of the Antarctic Peninsula.

Antarctica, on average, is the coldest, driest, and windiest continent, and has the highest average elevation of all the continents. Antarctica is a desert, with annual precipitation of only 200 mm (8 in) along the coast and far less inland. The temperature in Antarctica has reached −89.2 °C (−128.6 °F), though the average for the third quarter (the coldest part of the year) is −63 °C (−81 °F). As of 2016, there are about 135 permanent residents, but anywhere from 1,000 to 5,000 people reside throughout the year at the research stations scattered across the continent. Organisms native to Antarctica include many types of algae, bacteria, fungi, plants, protista, and certain animals, such as mites, nematodes, penguins, seals and tardigrades. Vegetation, where it occurs, is tundra.

The Southern Ocean surrounds Antarctica and serves as a connection between the Atlantic, Pacific and Indian oceans. Much of this ocean basin remains unexplord because of its severe climate. These researchers are learning about the Southern Ocean by investigating the underwater sounds made by moving ice sheets, large baleen whales, and undersea earthquakes and volcanoes.

**Opportunities for Scientific research**

The unique geological conditions of this southernmost point on Earth make it a much-coveted place for research and study. Antarctica also plays a vital role in the global oceanic and climatic systems. Due to the climatic extremes and isolation, Antarctica is easily one of the most untouched regions on earth. This makes it extremely valuable for all types of scientific research, but especially research involving climate change. Many countries have set up research stations here to study the climate, weather, geology, and wildlife of this unique region.

Polar Science is very important, as people are concerned about the core subject(s) related to Earth ecosystem and processes.

Traditionally, job opportunities in Polar Sciences include positions in academia, government, environmental consulting. Many of these industries have an aging work force and are engaged in a long term hiring trend to replace retirees. Job opportunities in the field of polar science are excellent with the right educational preparation. Polar scientists explore the Poles of Earth and its processes/phenomenon.

Earth science is a broad field, and career tracks are generally determined by specialization and level of education obtained. Earth scientists can seek work in hydrology, soil science, meteorology, oil and gas extraction or geology. Employers include government agencies, consulting firms, environmental management services and the oil and gas industry. A sampling of job titles related to Polar science may be Geoscientist, Geologist, Meteorologist, Geophysicist, Geohydrologist, environmentalist, etc.

Major research areas are:

Geology • Meteorology • Atmospheric Sciences • Snow study • Geomagnetism •Environmental Sciences • Wildlife biology • Oceanography • Ozone depletion • Climate change, etc.

Polar science is a field that requires candidates from various interdisciplinary scientific branches. Science or even social science graduates can make career in their interests.

**Indian Antarctic Programme (IAP)**

India is one such country that is studying Antarctica through 'ice cores' retrieved by drilling holes into the vast ice-sheets of the coldest, driest and windiest continent on the planet. Antarctica holds scientific interest for Indian research projects due to a number of reasons – to study the origin and eco-history of continents, climate change, meteorology and molecular biodiversity of the region. Indian scientists have discovered 20 new microbes in the Antarctic and published over 300 research publications based on Antarctic studies.

The Indian Antarctic Programme is a multi-disciplinary, multi-institutional programme under the control of the National Centre for Antarctic and Ocean Research, Ministry of Earth Sciences, Government of India. Under the programme, atmospheric, biological, earth, chemical, and medical sciences are studied by India, which has carried out 35 scientific expeditions to the Antarctic till now.

**Indian Research station in Antarctica:**

Indian has established three permanent research station in Antarctica so far. These are:

1. ***Dakshin Gangotri:***
   Dakshin Gangotri was the first Indian scientific research base station established in Antarctica, as a part of the Indian Antarctic Program. Located at a distance of 2,500 kilometres from the South Pole, it was established during the third Indian expedition to Antarctica in 1983/84. This was the first time an Indian team spent a winter in Antarctica to carry out scientific work. Dakshin Gangotri was built in eight weeks by an 81-member team, with the construction completed in January 1984 with help from the Indian army. January 26, 1984, India's Republic Day, was celebrated at the station along with Soviet and East German scientists.

2. ***Maitri:***
Maitri is India's second permanent research station in Antarctica. It was built and finished in 1989, shortly before the first station Dakshin Gangotri was buried in ice and abandoned in 1990/91. Maitri is situated on the rocky mountainous region called Schirmacher Oasis. India also built a freshwater lake around Maitri known as Lake Priyadarshini. The research station is only 5 km away from the Russian Novolazarevskaya Station and is equipped to carry out research in various disciplines, such as biology, earth sciences, glaciology, atmospheric sciences, meteorology, cold region engineering, communication, human physiology, and medicine.
Maitri is the gateway for Indian scientists to venture into interior Antarctic mountains and has been hosting summer and winter research teams every year since 1988/89.

3. ***Bharti:***
Bharti, India's latest research station operation since 2012, has been constructed using 134 recycled shipping containers, to help researchers work in safety despite the harsh weather. It is India's first committed research facility and is located about 3000 km east of Maitri. Research on tectonics, oceanography and geological structures, with focus on understanding the phenomenon of continental breakup, is undertaken here. Additionally, it also facilitates research to refine the current understanding of the Indian subcontinent's geological history (India and Antarctica were once part of the southern part of the supercontinent Pangaea, called Gondwanaland, and their coastlines have a shared history).

Bharti made India an elite member of the club of nine nations that have multiple stations in the region. The compact yet comfortable research station can accommodate 25 scientists, saving them from the outdoors where temperatures range from -89 degrees Celsius in winter to -25 degrees Celsius in summer. Made from prefabricated shipping containers from Germany, it lets scientists focus on their research, no matter what the weather outside. In line with the Antarctic Treaty System, Bharati can be completely disassembled and removed without leaving even a brick behind. It is set up on stilts to prevent snow drift from building up and locking in the scientists.

**Regulatory Authorities for Antarctica Expeditions:**
International regularity authorities are ATS, COMNAP, IAATO, while in India only NCAOR (MoES) is regulating and felicitating the all concerns.

**Participation:**

1. ***Government Institutions/Universities:***
A lot of governmental institutions are participating regularly into Indian expeditions to Antarctica and Arctic. Few of these are: GSI, IMD, NIO, SOI, DRDO, BRO, ISRO, NBPGR, CCMB, INCOIS, NCAOR, DU, BU, RMLU, etc.

2. ***Private Institutions/Universities:***
Apart from governmental organizations, a few selected private organizations are also taking interests and active participations in Indian Polar science. Top examples are Shriram Institute, Delhi and Amity University, Noida

3. ***Student***
Student can also participate in Indian polar science program and can visit even Antarctica under a valid and capable guide. NCAOR always encourage student participations in these programmes.

**Scope and Career perspectives:**

There are many institutions/consultancies, where one can build their career and/or continue the study/research work also. After pursuing a suitable degree/ diploma or PG in Sciences from a approved university or similar institutions, the candidate can choose any of the given options as per his qualification, interest and potential. The most popular occupations for professional career are given below:

- Scientist/Analyst - in Government or private Research Institute/Organizations/Testing laboratories
- Lecturer/Professor- in University or academic institution
- Scientific officer – in scientific governmental organizations or NGOs
- Geologist
- EC or FAE - for EIA studies in consultancies
- Assistant manager - in corporate various groups
- Consultant – in consultancy, NGOs or similar firms
- Writer/author – for various publishing houses or freelance
- Leader or Station commander- For particular expeditions

**Inception of IAP**
The importance of Antarctica as a pedestal for front-ranking scientific research was recognized by Indian way back in 1981 itself, when the first Indian Scientific Expedition to Antarctica was launched. Since then, India has made great strides in initiating scientific projects of both national and global relevance as well as in

catering to the entire gamut of complex logistics operations called for, in the Annual Expeditions to Antarctica. Experiments mounted by Indian scientists in such disciplines as atmospheric sciences & meteorology, earth sciences and glaciology, biology and environmental sciences have also contributed directly to global experiments mounted under the aegis of the Scientific Committee on Antarctic Research (SCAR). The Indian research station Maitri has also served as a platform for collaborative studies with some Antarctic Treaty nations i.e. Germany, Italy, France, Poland and the United States of America. It has also facilitated scientists from Malaysia, Columbia, Peru and Mauritius to work in Antarctica.

**Accomplishments**

Some of the noteworthy accomplishments of Indian scientific community in Antarctica are:

- Identification of a number of new species of bacteria from the cold habitats of Antarctica- 30 out of 240 new species discovered so far have been by Indian scientists.
- Identification of new genes from the bacteria as genes required for the survival of bacteria at low temperature.
- Identification of a number of lipases and proteases active at low temperatures and useful for the biotechnology industry.

- Preparation of comprehensive geological and geomorphological maps of various region.
- Studies of cold adaptability of human beings in the harsh environment of Antarctica, which have provided significant baseline data for use in similar studies on India's armed forces serving in the Himalaya.

**Major Objectives:**

- Continuation of the scientific programs in the Antarctica in the fields of atmospheric sciences, climate change, geoscience and glaciology, human physiology and medicine, polar biology and environmental science.
- Initiating novel programmes in the frontier realms of polar science, viz. Assessment of microbial diversity in Arctic and Antarctic: Past and Present; Environmental monitoring and health of the Indian Antarctic Stations in pursuit of Antarctica-Treaty-System and its governance; Long-term monitoring and modeling of precipitation over Antarctica; and Satellite-based monitoring Antarctic sea ice and land ice topography, with special focus on glaciers.
- Ensuring a prominent and sustained presence of India in the Antarctica through initiation of scientific research in some of the frontier realms of polar science including paleo-climate reconstruction from the Antarctic coastal water.
- Continue to play a lead role amongst the nations with a sustained presence in Antarctica.

**(PKB is a well-known environmentalist & freelance writer and Limca Book of record Holder. He was the member of 30th Indian Scientific Expedition to Antarctica during 2010-11. E-mail: gurupawanbharti@rediffmail.com)**

**Address for Correspondence:**
Dr. Pawan Kumar 'Bharti', Director
Department of Environmental Conservation & Vice President
Society for Environment, Health, Awareness of Nutrition & Toxicology (SEHAT), 20, Jamaalupur Maan, Raja Ka Tajpur, Bijnore (UP)- 246735, India • Email: gurupawanbharti@gmail.com

# MANAGEMENT OF PEST BY FARMERS USING IPM KNOWLEDGE & PERCEPTION

**R.V. Singh[1], Meenakshi Malik[1], A.K. Kanojia[1], S. Vennila[1] and Nimisha Sharma[2]**
[1]ICAR-National Research Centre for Integrated Pest Management, New Delhi-12
[2]ICAR-IARI, Division of Fruits & Horticultural Technology-12
E-mail: minaxi.2007@gmail.com

India, with its diverse climate and soil comprising several agro-ecological regions, provides the freedom to grow a variety of horticulture crops. These crops form an important part of total agricultural produce in the country comprised of vegetables, fruits, root and tuber crops, species, condiments, plantation crops, flowers, ornamental plants, medicinal and aromatic plants. Money is the biggest incentive for the farmer and horticultural crops provide more returns in terms of per unit area production, export value, value addition compared to agricultural crops.

Vegetable production plays an essential role in agriculture by providing food, nutritional and economic security to the people of with higher returns per unit area to the producers. It has an area of 0.84 million ha under vegetable which account for 15.8 million tonnes production and India holds the second position by contributing 15.70 and 14.50 per cent to global vegetable area and production. Research and management of natural resources and a balance in the development and utilization of biodiversity is an important factor as research aim at improving the productivity of limited resources while protecting the quality of soil and water and at the same time safeguarding biodiversity for posterity.

**Fig.1 : Excessive weed (congress weed) in cucumber**

For studying the constraints in the adoption of IPM in the vegetable area, U.P state is selected as Uttar Pradesh is the second largest producer of vegetables in the country after West Bengal and holds a vast potential for the development of horticulture. Agro-climatic Zone- Central Western Region (Zone 3) is traditional vegetable growing area of the state. This ecological zone consisting of districts namely Bulandshahr, Saharanpur, Ghaziabad, Gautam Buddh-Nagar, Muzaffarnagar, Meerut and Baghpat. The average annual rainfall of this zone is 600-965 mm and the soil of this region is clayey-alluvial, alluvial, sandy alluvial and sandy types. Among all the districts of the mentioned geographical area of the ACZ 3, Bulandshahr is a traditional and important vegetable growing area in the western region of Uttar Pradesh in the mentioned zone. Vegetable development, in this area, has taken place due to better marketing facilities and potential of marketing for National Capital Territory Region Delhi. The major vegetables grown in the district are-peas, chillies, okra, tomato, brinjal, cauliflower, cabbage, spinach, melon, radish, carrot, turnip and cucurbits.

Vegetable cultivation has the great potential and scope for improving socio-economic condition of small and marginal farmers providing higher yields and high economic returns in short time as compared to food grains.

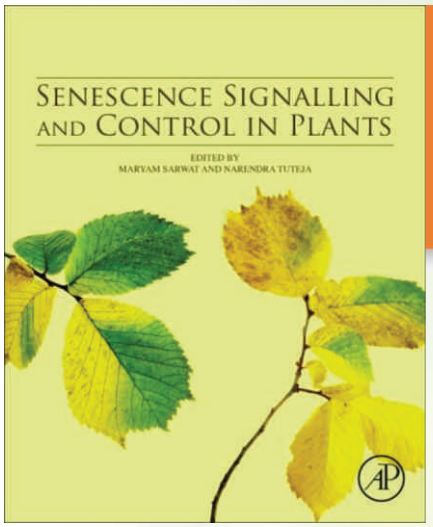
Demand is always high due to higher population density in urban area and high income of the people residing in these areas. The most of the vegetable cultivation is concentrating adjoining the urban areas. These crops have proved to be the boon to the small and marginal farmers of the district. Significant increase in area under vegetables has been recorded on small and marginal farms since it provides an international market for vegetables.

**Fig. 2: Nutrient deficiency and affected leaves of cucumber by white-flies.**

Since the 1980s, the combination of various management methods, Integrated Pest Management (IPM), gained importance in India through favour in policy and extensive promotion of IPM programmes in vegetables. Adoption of IPM methods can be driven through necessity, economics and market requirements, but sufficient supporting information and advice is key factor for IPM adoption. Many research institutions are facing difficulties to transfer the information to farmers and IPM adoptions at field level. NCIPM has developed and promoted IPM technologies to manage pests in selected vegetable crops by implementation of IPM projects in Vegetable crops through participatory approach since 2000.

The production and quality of the vegetable crops are directly influenced by the pests resulting in 25-30 per cent yield losses. To mitigate such losses farmers depend on chemical pesticides and accessing pest management information and inputs from the pesticide dealers due to poor extension support system. In this area, a better networking of research, extension, marketing and processing infrastructure are strengthening the vegetable production and export can be established. Pest control practices in the vegetable crops have been heavily dominated by the routine use of broad-spectrum insecticides to control pests. Concerns have emerged about the adverse consequences of over use of pesticides.

In spite of several socio-economic and environmental advantages of these technologies, the adoption of IPM at the farmer level is not very encouraging. However, due to technical, institutional, social, cultural, economic, educational, informational, and policy constraints- Adoption is limited. Studies on the constraints in adoption of IPM technologies in selected vegetable crops were conducted by to identify the constraints in the adoption of IPM in vegetable crops. It has been observed that the adoption of promising IPM technologies is not satisfactory due to socio-economic, technological and institutional constraints. But Participatory approaches such as Farmer Field School (FFS) and Participatory Action Learning (PAL) have proved very successful in promotion of IPM in vegetable crops and can be used to engage IPM stakeholders as to complementary groups that together could support the range of extension needs. Extension workers and trained farmers can help to facilitate the learning process, encouraging farmers to discover key agro-ecological concepts and develop IPM skills through self-discovery activities practised in the farmers field.




# Senescence Signalling and Control in Plants

Edited by: ***Maryam Sarwat***Senior Assistant Professor, Pharmaceutical Biotechnology, Amity Institute of Pharmacy, Amity University, NOIDA
***Narendra Tuteja***Amity Institute of Microbial Technology, Noida, and visiting Scientist at ICGEB, New Delhi, India

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**AUDIENCE**
Academia (Students, Faculty) in Plant Sciences, particularly Plant Biochemistry and Plant Molecular Biology, as well as those in Agriculture and Environmental Sciences.

## DISCUSSES THE STUDIES SHOWING THE IMPORTANCE OF HORMONE ACTION ON DEVELOPMENTAL SENESCENCE

**KEY FEATURES**

- Throws light on the involvement of hormones (other than the well- known hormones cytokine and ethylene) in plant senescence
- Shows the underlying mechanisms on the hormonal actions during senescence
- Exhibits the involvement of microRNAs during this important plant developmental process

**DESCRIPTION**

*Senescence Signalling and Control in Plants* discusses the studies showing the importance of hormone action on developmental senescence. It shows the involvement of various signaling components *(like EIN2, LOX2)* and transcription factors (like oresara1 or ORE1) in controlling hormonal activity during senescence. Further, the involvement of various micro RNAs (*miR164, miR319*) in regulating leaf senescence are discussed. Through this book, the authors throw light on all the reverse and forward genetic approaches to reveal the role of various other phytohormones regulating plant senescence and the molecular mechanisms involved.

Chapters on relevant topics are contributed by experts working in the area, making this a comprehensive treatise designed to provide an in-depth analysis on the subject matter.

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# ZOO SAFETY AND REGULATIONS NEEDED FOR BETTER MANAGEMENT OF THE ZOOS AND FOR PUBLIC SECURITY

**S. K. Basu**
UFL, Lethbridge AB Canada; email:
saikat.basu@alumni.uleth.ca

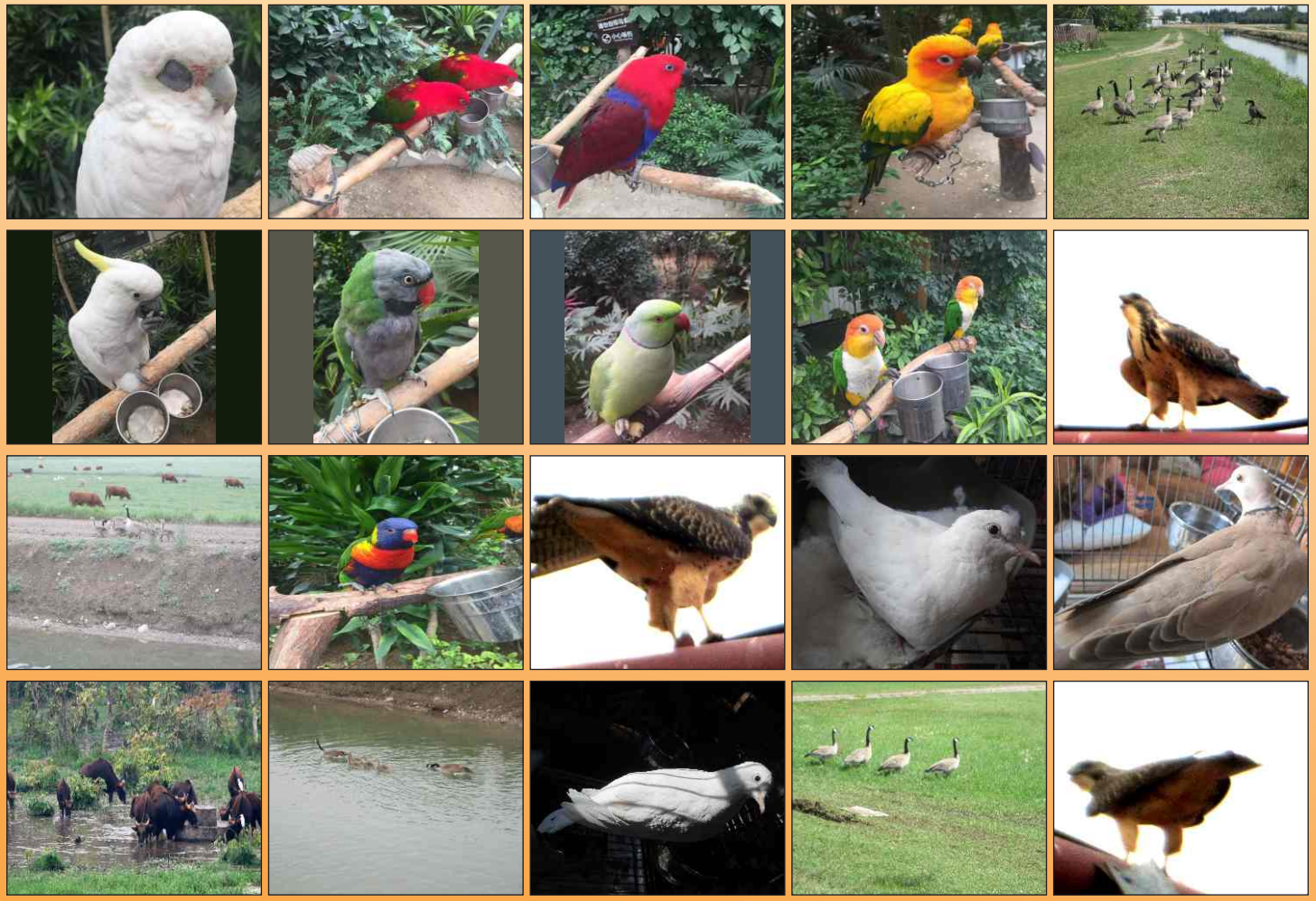
Zoos like any other organization and institution have suffered occasionally due to security issues around the globe. From time to time tragic incidents of people or children falling inside animal enclosures and being mercilessly killed by wild animals have sent shock waves around the planet. Such incidents have happened either due to lack of proper surveillance and monitoring on the part of the zoo authorities or due to complete callousness of individuals who have either accidentally fallen inside cages or moved too close into an enclosure of a dangerous animal for taking selfies or for attempting to get a close photograph or video of a caged animal.

Often it has been reported that people under the impact of alcohol or drugs or some kind of religious context have voluntarily moved into cages or enclosure of ferocious wild animals like tigers or lions; and faced brutal attacks or have been mauled to death. Sometimes trained zoo keepers have been attacked too by wild animals when they unfortunately forgot to keep the cage door closed; and they moved inside the cage or animal enclosure for servicing or cleaning or for the purpose of feeding the animals.

Sometimes animals have even attacked people unprovoked or accidentally got out of their cage or enclosure due to safety breach or through some gaps or loopholes of the zoo security system. More than animal attacks panic stricken public have been involved in stampede in a rush to get out of the zoo resulting in death and injury. Contrary to the common belief that such negligence and incidents happen only in developing and under developed nations with poor zoo management; several premier zoos around the globe and that too in highly developed nations have reported unfortunate accidents that have cost the life of the human victim(s) or the animal involved.

In many instances unattended kids or children have fallen inside cages or enclosures and lost their lives or seriously injured or the animal has been shot to protect the children. Under any circumstances, accidents and security loopholes are quite common in zoos around the world; and there is opportunity to further strengthen the security system of the zoos for better management and also to protect the public from any such unfortunate incidents. A list of important measures has been listed below for both zoo authorities and public to ensure future security of zoo animals and public:

1. Restricting the number of visitors to the zoo to prevent mismanagement and chaos. An over crowded zoo always runs the dangerous risk of unfortunate accidents as help could not be extended at the hour of need due to over crowding, confusion and chaos.
2. Placing security cameras in as many strategic locations as possible within the zoo campus for the central security



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management team to keep an eye for any possible threat or accident that may happen inside the zoo.

3. Leaving warning signs throughout the zoo and also to make public aware that getting too close to zoo animals warranties unexpected danger; as these are not docile, human friendly pets, but rather dangerous wild animals confined to cages or enclosures for public display and education.

4. Public phone booth or kiosks should be placed throughout the zoo campus with the emergency security numbers mentioned clearly in the booths for fast reporting of any incident to the zoo security authorities.

5. Zoos must have some first aid treatment centers for minor injuries and efficient transport and communication system with major health centers or hospitals for rapid treatment of any accident victims.

6. A public addressing system should be installed so that the zoo authorities could warn the public over loud speakers placed throughout the zoo campus for any emergency situation and guide them accordingly.

7. Trained security staff should be placed throughout the zoo campus to keep a direct eye on public behavior and also for the well being of zoo animals.

8. Multiple security measures should be incorporated for zoo animals on public display; that may include proper caging or security glass wall between the display animal and the public, artificially increase the distance of the animal from the public by adding fencing, barbed wires, high drains, long and inaccessible walls and other engineering measures.

9. Regular inspection of cages and enclosures for identifying possible weaknesses and security loopholes.

10. Tranquilizer guns, fire crackers, safety sprays and other detractors for animals should be kept in the zoos in case of emergency to break up the attacking animal from its human victim.

11. Appropriate tranquilizing dosages for different animals based on their body size and weight should be previously calculated and kept handy for application under emergency conditions. Animals should be killed when only no other viable options are available to protect a victim.

12. Zoo staff should be appropriately and professionally trained for handling any emergency situation within the zoo campus. They must be sensitized with various security challenges and how to address them effectively and efficiently.

13. Staff trained in handling dangerous situations and in firing dart guns to be employed by the zoo so that they can take control of the situation rather than being undecided or panicking at the crucial hour.

14. Encourage public to report any notable incident to the zoo security office immediately.

To,

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*From*
**NATIONAL ENVIRONMENTAL SCIENCE ACADEMY**
206 Raj Tower -1, Alaknanda Community Centre,
New Delhi -110019. **Ph.: 011-2602 3614**
E-mails: nesapublications@gmail.com; nesapub@yahoo.co.in



15. Strong legal and financial punishments to be placed in force for the alleged violators within zoo campus.

16. The public needs to be educated and made aware of the imminent dangers of breaching zoo security codes and their possible consequences.

17. The zoo authorities need to be more innovative, investigative and vigilant to report and monitor safety issues inside the zoos.

18. Any incident associated with zoo security and safety has to be reported, recorded, investigated and the recommendations are to be followed with utmost sincerity.

19. In simple terms, both zoo authorities and the general public need to work in close coordination and cooperation with one another to enhance zoo security in future.

***Photo credits:*** **S. K. Basu, P. Zandi & R. Roy**
***Sources:*** *Sikkim Express, Technology Times & Nagaland Post*