

## IMPACTS OF INDIAN OCEAN TSUNAMI 2004 ON THE BIODIVERSITY OF NICOBAR ISLANDS



Tsunami could possibly be the most frightening word to the coastal communities of the southeast Asian countries. The word "Tsunami", derived from the Japanese language, (*tsu*=harbour, *nami*-wave) was coined by fishermen who returned to the port to find the harbour devastated, although they had not been aware of any wave in the far off shore. The fourth largest earthquake of 9.3 magnitude in the recorded history of the world and subsequent Tsunami on December 26, 2004 had disastrous impacts on the people and biodiversity of south and south-east Asia. The fast and furious waves created by this unusual seismic event even travelled from its origin to far distances of about 4500 km in the African coast within seven hours. The coastal regions of Asian countries in the Indian Ocean, Bay of Bengal and Arabian Sea were severely impacted. Among the eighteen countries affected by the Tsunami, Indonesia, Sri Lanka, Maldives, India and Thailand were the worst hit in terms of loss in human lives, infrastructure and economy. The human death toll was estimated to be over 0.25 million and at least 2 million people were displaced.

Close proximity to the epicenter of the earthquake was attributed to the maximum damage that occurred in the island ecosystem of the Nicobar Islands. The Tsunami significantly damaged/destroyed the vegetation of the coastal area between the shore and the hills. The most curious aspect was that the mega earthquake resulted in a tilt in the landmass sinking the southernmost tip of the Nicobars by 1.6 m while the northern most tip of the Andamans lifted up by 1.2 m. Coastlines receded towards the hills, at places by several hundred meters, often resulting in very little or no land between the hills or high ground and the sea. The Megapode Wildlife Sanctuary of 0.5 ha, locally known as Megapode Island situated among the Southern Group of Islands in Nicobars got totally drowned into the sea, which is a testimony for the severity of tsunami impacts.

The impact of Tsunami to the coastal ecosystems include physical uprooting of coastal evergreen forests and mangroves, scorching of littoral vegetation due to salt stress from sea water inundation, dying out of mangroves due to permanent submergence of the pneumatophores. The Tsunami impacted certain faunal species namely, the Nicobar Megapode (*Megapodius nicobariensis*), Nicobar Long-tailed Macaque (*Macaca fascicularis umbrosa*) and Giant Robber Crab (*Birgus latro*). The indigenous people of the Nicobar Islands, the Shomphens and Nicobarese whose livelihood depend on the sea and forests were also affected.

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The destruction of *Pandanus (Pandanus lerrum)* vegetation had an impact on the day to day life of the indigenous communities, as the *Pandanus* fruits being their staple food. Impacts on marine life such as fishes, lobsters, crabs, prawns and shells also adversely affected the livelihood of the indigenous people.



Though the aftermath of Tsunami have resulted in enormous changes to the coastal biodiversity of Nicobar Islands, information regarding the same was scanty prompting SACON to conduct a study with the collaboration and financial

assistance of the Department of Environment and Forests, Andaman & Nicobar Islands. The major objectives of the project include i) assess the vegetation regeneration in Tsunami affected littoral evergreen forests, ii) assess the natural re-colonization of mangrove species, iii) monitor the population of avifauna, particularly the Nicobar Megapode and other endemic bird species and Robber Crab, iv) suggest site specific recommendations for the restoration of damaged habitats.

### Impacts on Vegetation

As an aftermath of tsunami, vast stretches of land devoid of vegetation were formed. This is because the vegetation was either totally uprooted and wiped off or scorched by the high salinity in the soil substratum. These vast open spaces are broadly grouped into two types based on the Tsunami depositions, i) sites with heavy amount of sand and coral rubble deposition and (ii) sites with no such deposition except the logs of the uprooted / dead trees. Colonization of plant species in these sites was studied.

One eighty four tree species were encountered in the littoral evergreen forests during vegetation assessment. Vegetation colonization in the no-deposition sites was much faster and these sites were established with thick vegetation of high species richness. In contrast, natural regeneration and colonization of plant species was very poor in sites with heavy amount of sand and litter deposition. While species such as *Macaranga peltata* and *Ficus hispida* were pre dominant in no-deposition sites, *Casuarina equisetifolia* and *Hibiscus tiliaceus* were found dominant in the sand deposited sites. Soil quality in the Tsunami impacted sites is an important factor influencing the vegetation succession.

In the Nicobar group of islands, large extend of mangroves existed mainly in the Nancowrie group. The mangrove vegetation of Nicobars was dominated by *Rhizophora mucronata*, *Bruguiera gymnorrhiza*, *Heriteria littoralis* and *Nypa fruticans*. The pre-tsunami records show that Nicobar Islands had mangrove in 36.67 km<sup>2</sup> covering 2.14% of its total forest area.

The tilt in landmass had resulted in complete loss of pre-Tsunami intertidal zones where mangroves occurred earlier. In contrast, the same phenomenon has resulted in the formation of new inter tidal zones at the expense of littoral forests and coconut plantations that existed close to the coast, offering suitable habitat for mangrove species to grow. Twenty five such sites have been identified and the colonization of mangrove species was studied. *Rhizophora mucronata* and *Bruguiera gymnorrhiza* were found to be the early colonizing species and most dominant mangrove species in the post-Tsunami mangrove forests. The loss of habitat and non-availability of seed source seems to be the constraints for the mangrove regeneration in the Nicobar Islands.



Five species of mangroves have gone locally extinct from the pristine mangrove forests of Nicobar Islands. However, as compensation we found five hitherto unrecorded species. Among the five

new additions to the flora, the Near Threatened mangrove tree species, *Sonneratia ovata* (Lythraceae) is a new addition to the flora of India.

### Impact on the Fauna

The bird species diversity was high in the Tsunami impacted sites than the unaffected forests. The high habitat heterogeneity in Tsunami affected sites could possibly be the reason for the high diversity. Nevertheless, the lesser abundance of endemic species in Tsunami-affected areas indicated their re-colonization from adjacent unaffected habitats, which is an indication for the resilience and recovering ability of these species.

The Nicobar Megapode is a mound building endemic bird species of Nicobar Islands that primarily inhabits the littoral forests. The peculiarity of this bird is being the



character of building incubation mounds with leaf litter and sand for breeding. More than 80% of the pre-tsunami population was recorded in a narrow stretch within 100 m distance from the coastal line. Hence, the aftermath of tsunami resulted in steep population decline of this enigmatic species. Though it is seven years from the Tsunami, Nicobar Megapode population did not recover from the loss of 70% observed immediately after Tsunami.

Among all the costal species, Robber Crab was possibly, the worst affected, since it almost exclusively inhabits a very narrow (less than 100 m) strip along the coastline. Though local extinction of this species was anticipated after Tsunami, the direct sightings and indirect evidences falsified the assumption. Sightings of just three individuals and a few indirect evidences of their presence during this study showed rarity of this species in Nicobar Islands. Despite the loss of coastal vegetation, the endemic Nicobar Long-tailed Macaque is commonly sighted in the coastal environs of Great Nicobar, Little Nicobar and Katchall.

### Conservation Implications

The high species diversity in tropical forests makes it more resilient to any disturbance. In Nicobar Islands, the rapid colonization of flora and fauna in the Tsunami impacted sites is a positive sign and a testimony for rebounding capacity of the island ecosystem. However, at few sites, scientific intervention is of importance for the speedy recovery of certain plants and animals and ecosystem functions as well. Based on the present study, restoration measures were suggested for both mangrove and littoral habitats. Potential seed collection sites were also identified for all the tree species suggested for restoration of Tsunami affected habitats. In the case of Nicobar Megapode, the Bombuka Island holding a good population should be given priority in any conservation activities.

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### INTERNATIONAL ORNITHOLOGICAL CONGRESS OF SOUTHEAST ASIA (IOCSEA), KHAOLAK, THAILAND

Prince of Songkla University, Thailand in collaboration with University of Ulm, Germany and Harrison Institute, United Kingdom organized the first International Ornithological Congress of Southeast Asia (IOCSEA), at Khao Lak, Thailand during 27-29 November 2012. Eighty one researchers participated in the congress representing 22



countries. The major themes of the IOCSEA, different issues related to Ornithology of Southeast Asia, were discussed during eight different technical sessions that were preceded by four plenary lectures. Since the initiators of the conference were looking for institutions to host the next one, various institutions including SACON offered willingness to be the next host. Such offers are under the consideration of the working committee. The congress decided to form a team of researchers, behavioral scientists and toxicologists, to examine the spatial movement of various contaminants through organisms such as birds.



**Dr. B. Anjan Kumar Prusty**, Scientist, EIA Division, SACON made a presentation entitled "A bibliographic review of bird studies in Keoladeo National Park, India: Distribution, Endemism and Threat status of birds". The presentation on bibliographic

review and underlying approaches based on examining the existing study reports and the species accumulation in the area received appreciation from the participants.

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### STUDENTS CONFERENCE ON CONSERVATION SCIENCE - NEWYORK

The 3<sup>rd</sup> International Annual Students Conference on Conservation Science (SCCS-NY) was held in the American Museum of Natural History, New York, USA from 9<sup>th</sup> to 12<sup>th</sup> October 2012. This conference is a sister conference of SCCS- Cambridge, which was started ten years back in England to promote and encourage young conservation professionals worldwide. SCCS-NY was organized by the American Museum of Natural History (AMNH) and supported by premier institutions such as Cambridge University, Columbia University Earth



Institute, Yale School of Forestry and Environmental Studies, Princeton University and several other organizations.

One hundred and twenty participants from 25 countries participated in the Conference. Research students from various disciplines made 24 oral presentations, 17 speed talks and 60 poster presentations. Mr. Nehru Prabakaran, Ph D Scholar, Division of Landscape Ecology of SACON delivered a talk on "Natural recovery of Tsunami affected littoral forests in Nicobar Islands, India". The paper was co-authored by Dr. P. Balasubramanian, Principal Scientist.

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### NATIONAL SEMINAR, 'SCIENCE FOR SHAPING THE FUTURE OF INDIA: FAUNAL DIVERSITY- CHALLENGES AND OPPORTUNITIES'



National Seminar, "Science for shaping the future of India: faunal diversity- challenges and opportunities" supported by the J & K Chapter of Indian Science Congress was organized at P.G. Department of Zoology, University of Kashmir, Srinagar, Jammu & Kashmir from 19 to 21 November 2012. The seminar covered wide aspects of biodiversity and conservation including a Plenary Lecture 'Conservation Status of Indian Endangered Wildlife Species' by Prof. B. M. Arora, President, Association of Indian Zoo & Wildlife Veterinarians. One hundred and thirty three scientific papers were presented by researchers from various institutes, colleges, universities and NGOs. Madhumita Panigrahi, Research Scholar, Conservation Ecology presented a paper entitled 'A study on the avifaunal distribution along the altitudinal gradient in Agasthyamalai Hills of Kerala, Western Ghats, India' in the conference.

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### THE SECOND INDIAN BIODIVERSITY CONGRESS; CONSERVATION STRATEGIES FOR BIODIVERSITY OF THE WESTERN GHATS



The Second Indian Biodiversity Congress (IBC 2012) was held at Bangalore, during 9-11 December 2012. The focal theme of the Congress was 'Biodiversity of the Western Ghats- Challenges and Strategies for Conservation and Sustainable Management'. IBC 2012 was attended by over 600 delegates from 23 states. Various seminars, workshops, national photography exhibition, civil society meet, documentary film festival and children's biodiversity conclave and cultural events were part of this mega event. The Congress was inaugurated by the Hon'ble Union Minister for Oil and Natural Gas, Shri Veerappa Moily. Eminent ecologists such as Prof Madhav Gadgil and Dr Vandana Shiva delivered invited lectures. Mr Jins, V J, Research Scholar, Division of Conservation Ecology, SACON presented a paper on the altitudinal distribution of reptiles.

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### SACON @ NATIONAL BIO-DIVERSITY EXPO



The National Biodiversity Expo was conducted at Kanakakkunnu Palace, Thiruvananthapuram during 21<sup>st</sup> to 30<sup>th</sup> December 2012 by the Kerala State Biodiversity



Board. The expo focused on the importance and aesthetic value of biodiversity. The exhibition aimed at enhancing the public awareness on the importance of conserving biodiversity, threats and factors leading to its loss and the multifaceted contribution of biodiversity in human well-being.

The expo took the audience on a journey through the rich biodiversity of India, its bio-geographical zones, biodiversity heritage sites, domesticated biodiversity (agricultural and animal husbandry), livelihood supports, threats, challenges, conservation measures and traditional values.

Eighty two institutions, academic, non-governmental organizations and co-operative societies participated in the Expo. SACON's stall showcased glimpses of Indian ornithology in the past, present and future. People from all walks of life visited the stall and raised many interesting questions, which were clarified by SACON representatives. The local TV news channels and daily magazines prominently covered SACON's exhibits. Shanthakumar S B, Chandran R, and Ramesh C, Research Scholars, Division of Environmental Impact Assessment, were the resource persons representing SACON.

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### MASS MOVEMENT OF BUTTERFLIES



On 12<sup>th</sup> November 2012, SACON campus witnessed an amazing spectacle of directional (Southeast to Northwest) mass movement of butterflies, mostly the Milkweed butterflies (Family Nymphalidae). The swarm was

dominated by the Blue tigers (*Tirumala limniace*). The path followed by the butterflies was about 300 m wide mostly keeping low within 5m from the ground/objects below. To estimate the number of butterflies involved in the mass movement, a 30 meter wide imaginary plane was chosen across the direction of movement of the swarm. Butterflies crossing this 30 meter stretch were identified and counted for 5 minutes at ten minutes interval on alternate days from 12<sup>th</sup> to 30<sup>th</sup> November. The movement started at around 0900 hrs and continued until 1600 hrs reaching the peak during noon hours. The intensity of butterfly movement was very high between 11.30 to 12.30 hrs. We recorded 10 species of butterflies in the swarm; Blue tiger *Tirumala limniace*, Common crow *Euploea core*, Common emigrant *Catopsilia Pomona*, Plain tiger *Danaus chrysippus*, Common leopard *Phalanta phalantha*, Lemon pansy *Junonia lemonias*, Danaid egg fly *Hypolimnas missipus*, Double banded crow *Euploea Sylvester*, Dark blue tiger *Tirumala septentrionis* and Lime butterfly *Papilio demoleus*.

63085 butterflies were counted during the sampling period. Of this, Blue tiger constituted 62% followed by Common crow (28.74%), Common emigrant (4.68%) and Plain tiger (4.66%). The other six species were recorded in smaller numbers. The highest number of butterflies counted in five minute duration was 2275 (i.e. 15 butterflies per minute crossing a 1m wide vertical plane). On the first day (12.11.2012), the estimated total number of butterflies that crossed the monitored 30m plane was 14799. The density of butterflies peaked on 20.11.2012 with 40978 butterflies crossing. During the last sampling day, on 30.11.2012, an estimated 2997 butterflies crossed the 30 m plane. On the peak movement day (20<sup>th</sup>), the estimated total number of butterflies that crossed SACON campus was a mindboggling 4,09,780 individuals!. Migration of butterflies from Kotagiri Hills to Velliangiri Hills through Anaikatty Hills was recorded by Dr. Eswaran in 2003 and 2004 as reported in his PhD Work. The ecological determinants of this butterfly movement/migration are not well understood until now. There may be several factors such as depletion of host/food plants, rainfall, temperature, solar radiation, and wind influencing the migration. A detailed study involving observations and monitoring from a larger landscape level is required for a better understanding of this fascinating phenomenon.

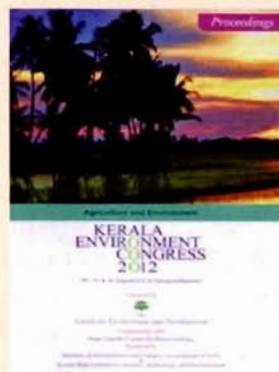
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## BOOK REVIEW

### Proceedings of Kerala Environment Congress 2012, focal theme: agriculture and environment



Editors: T Sabu, T R Vinod, M Subramonia Iyer, C Bhaskaran and Babu Ambat, Centre for Environment and Development, Thiruvananthapuram. 2012.478 pp. Price not mentioned.

Growing demand for food and other basic needs, shrinking resource base and excessive pressure from various forms of

exploitation of the natural resources for the forceful drive towards the purported economic development are among the most serious issues confronting our country today. The prevailing chemical and energy intensive agriculture practices, having great impact on environment, also faces serious constraints of water scarcity and consequences of climate change. The situation necessitates adaptive changes of not only agriculture practices and policies, but also notions about free markets and the process of reaching food to the end users in rapidly changing environmental, socio-economic, and political conditions.

In this context, the Kerala Environment Congress 2012 (KEC-2012) was held from 16 to 18 August 2012. The well produced proceedings of the congress, attempts to focus on these issues in a location specific context of the socio-economic ambiance of the Kerala state. The post-independence socio-economic developments, land reforms, universal primary education, better life style and equitable sharing of benefits, in spite of relatively lower per capita income in the state was generally considered as an achievable and popular model pathway for development in the country. In due of course of time, however, the appeal of the model to a large extent waned because of various reasons. Moreover, its failure in addressing sustainability issues especially in ensuring food security and self dependency of the state for its essential commodities are increasingly being subjected to reprehension. This is leading to fresh debates, policies and formulations. For the last couple of decades the state has become largely consumerist depending on its neighbor states for all its requirements. The large flow of foreign exchange (more than 20% of its GDP) has shored up its consumerist lifestyle. The farmlands especially under rice paddies and

coconuts in the state have been reduced to almost one third within the last 2-3 decades.

The ongoing massive changes in land use pattern and landscape, increasing urban sprawl and land degradation, reducing water availability, rising cash flow, globalized lifestyle and consumption pattern make the policy formulations most challenging and less practicable, necessitating major en-route corrections and adaptive management. This makes the location context of Kerala state in addressing the issues of environment and agriculture a surrogate context for the larger country level learning in ensuring sustainability. This mode of approach of location based adaptive management is being increasingly considered as the most productive methodology to achieve the desired output, based on the merits of manageable bottom up approach and comprehensive understanding of social, cultural and ecological fabric of a local area. In this context, the presentations and the deliberations in the KEC-2012 are significant. The sixty papers in the KEC-2012 proceedings can be broadly divided into three categories based on objectives dealing with various facets of agriculture and environment. The papers in the first group deal with various methodologies of food production and agriculture, on relevant policies and various upcoming techniques. The second group deals with monitoring and assessment inviting attention to the current state of affairs, while the third group considers various management options and future direction with goal of agricultural and environmental sustainability.

Genetically modified crops have generated an unprecedented critique world over because of its highly uncertain impact on the general health of ecosystem and its living organisms, largely due to unsubstantiated and ambivalent claims by the proponents and charges from the adversaries. In general, the ongoing debate on this issue has created a general, but restricted, notion that the field of biotechnology is providing only solutions related to the techniques leading to Genetically Modified Organisms and crops. In this context, Thomas and Pillai (Paper #1) discuss the options of non GM biotechnology based techniques balancing the environment and manmade capital. The paper points out that biotechnology could help in selective breeding based propagation of most suitable and adaptable gene towards ensuring the food security. The growing debate on organic versus conventional agriculture practices was addressed by George Thomas C (Paper #19) assessing the efficiency of sustaining the food security by these two



different practices. It speaks of the inability of organic farming practices as an alternative to conventional practices in delivering food security even though the conventional practices are of high impact to environment. It suggests improvement of the yield from agriculture practices without intensifying its impact by reducing the yield versus input, waste generation and by maintaining sustainable food habits / demand. Evaluation of the food security in the context of Kerala's agriculture practices (M P Parameswaran, Paper #24), its crisis and resistance to modifications (Harilal K N, Paper #25) in the scenario of globalization and atomisation (reduced farm size etc) were the other articles that fell in the group. However, none of the papers examined the claims of GM and other improved technique's deliverables that would help in ensuring food security for global masses, especially when the techniques related to GM crops would be under the monopoly / patent ownerships of the developers and not the farmers and their spread restricts the rights of the traditional sustenance cultivators.

Assessing the impact of imminent climate changes on agriculture and devising appropriate strategy to cope with the situation are to be the foremost exercises required to be taken up for precautionary measures in adaptive management. This assessment was the subject of paper of Raj Y E A (Paper #2), with holistic view on Indian scenario based on the long term temperature variability and its projected impact on water availability and climate conditions. This kind of assessment was also the basis of other papers dealing with assessment of environmental pollution from agriculture (Harikumar P A, Paper #8), valuation of emission reduction mechanisms such as reducing emission from deforestation and forest degradation (REDD+) framework from agriculture sector (Vinod T R, Paper #10), evaluations of rice based farming in Kerala (Sasidharan N K and Padmakumar K G, Paper #16.), home garden farming (Thomas et. al., Paper #18), effect of organic versus chemical fertilizers and lime application (Anila George and Dhanuja P A, Paper #26; Moosa et al, Paper #29) etc. This genre of studies has greater space in the proceedings with around 60% of the papers being related with assessment and evaluation of the various facets of agriculture practices starting from pesticide application to reducing the disease prevalence in the field. However, as an offshoot of the assessment better proposals for improvement were largely missing. One of the most important sub-tasks of the assessment process is to communicate the assessment and monitoring information

to end-user farmers to update the field practices appropriately. Information technology has opened up an extensive arena in efficiently carrying out effective communication. This was the subject of papers such as the one on Potential Fishing Zone (PFA) advisories for improving the economy of fish harvest (Nagaraja et al, Paper #3), policy and technical level modifications (Jiju P A, Paper #22) required in achieving the full potential of information technology for sustainable agriculture and forestry practices.

Revival and innovation of the management practices based on evaluation and assessment of current practices is to be the next important step in ensuring adaptive management aiming at food security and environmental protection and in view of the impending climate change. The revival of management practices in agriculture and soil resources (Premachandran N P, Paper #4), integrated watershed management (Nair A S K, Paper #5), energy (Menon R V G, Paper #7) and water usage (Kamalam J, Paper #6), animal husbandry (Suma K G, Paper #12), freshwater aquaculture (Jayasankar P, Paper #13, Padmakumar K G, Paper #14), marine fishery (Rani M G and Syda R G, Paper #15), geographical indication of products (Elsy C R and Adheena R A, Paper #23) for improving the economics of the crop product are some of the intensively discussed topics in this group. The paper by Joseph (Paper #11), discuss various modes of encouraging innovations for sustainability in a case study scenario in the plantation sector in Kerala.

Overall, the Proceedings is an appreciable compilation of valuable articles. However, the proceedings would have been better organized if done on a thematic basis. It also failed to address the major theme on the dynamics of agricultural land in the state with ongoing rampant land use changes in the agricultural sector. The compilation is worthy and highly relevant in the present context, especially when environment, agriculture and development are being incorrectly posited as in conflict. It is largely because of the misconception that the paradigm of development in vogue is the only route to human welfare and development where higher material / energy consumption is the major drive for development. There would be, certainly, alternative routes to development, human welfare and welfare of numerous other species.

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**SACON @ COP 11, HYDERABAD**


The Convention on Biological Diversity (CBD) entered into force on 29 December 1993, known informally as the Biodiversity Convention, is an international legally binding treaty. The main objective of the CBD is to develop national strategies for conservation and sustainable use of biological diversity. It is often seen as a key document regarding sustainable development. The convention's governing body is the Conference of the Parties (COP), consisting of all governments (and regional economic integration organizations) that have ratified the treaty. The COP meets every two years and India hosted the 11<sup>th</sup> conference at Hyderabad during 1<sup>st</sup> to 19<sup>th</sup> October 2012 at the HITEX city.

SACON was assigned the task of preparing an exhibition on the topic "Indian Ornithology - Past, Present and Future" by the National Biodiversity Authority as part of showcasing India's biodiversity during the COP 11. SACON also made a documentary of 19 minutes. The exhibition was attended by several national and international visitors apart from thousands of school and college students.

The documentary film "Indian Ornithology passage through time" was highly appreciated by the CEPA fair organizers and they screened it repeatedly. The SACON Exhibition was widely covered by the Media, with articles in Hindu, Indian Express and several local dailies.

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**Book Post**

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The views expressed in this newsletter are not necessarily those of the Editors or of the Sálim Ali Centre for Ornithology & Natural History

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