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**Read about
Occurrence of Ascidians
from the Gujarat coast**



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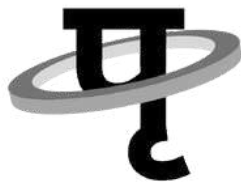


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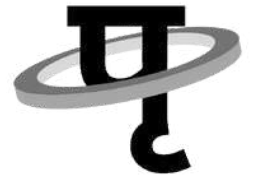
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यारक्षन्त्यस्वप्राविश्वदानीद्विवाभूमिंपृथिवीमप्रमादम्।
सानोमधुप्रियदुंहामथोउक्षतुवर्चसा॥ -Prithvi Sukta II

The people who protect the (Goddess) Earth with utmost care and no errors, are the (true) Scientists and (shine) brightly in the world.



It's the third and final volume of Prithivya newsletter for the current year and thus it urges me to take a bird's eye view of the views and news we witnessed in the field of Wildlife and Biodiversity Conservation during this year. Based on the data collected from the IMD and the DMD of the Ministry of Home Affairs, out of 273 days between January 1 and September 30, 241 days, or 88 % of the time, India experienced extreme weather events. This was supported by another study by New Delhi-based Center for Science and Environment (CSE), which states that in the first nine months of 2022, India experienced almost one extreme weather event such as thunderstorms, torrential rains, landslides, floods, cold waves, heat waves, cyclones, droughts, dust storms, hail or snowstorms per day. According to the latest Living Planet Report by World Wide Fund for Nature (WWF), there has been a 69 % decline in the wildlife populations of mammals, birds, amphibians, reptiles and fish, across the globe in the last 50 years. They have also estimated a reduction in the freshwater species populations globally by 83 per cent, which suggests that the Blue planet is experiencing a "biodiversity and climate crisis". It's time that we address Biodiversity loss and Climate crisis as ONE instead of two different issues. During this years' COP27 Summit held on 7th and 8th November at Sharm El Shaikh in Egypt, some major reconstructions of ideas regarding the climate change, took place and it would be worthwhile for the readers to understand their implications contributing towards conservation and sustainable development at a global level. Some of the major pointers include Just and Inclusive Energy transition, aiming at reliable and affordable clean energy resources to ensure energy security, enhancing the global cooperation in unlocking the potential of Green hydrogen production, transformation of the food systems including regenerative agricultural practices, reduced trade restrictions and changes in consumption and diet patterns.

As the torch bearers of the progressive India, we need to upgrade ourselves to tackle the abovementioned challenges and be a true scientist 'Bhoomi-putra' as mentioned in the shlok of Prithvi-Sukta . Instead of joining the brigade of Climate worriers, we need to be the Climate Warriors and should definitely contribute in turning these challenges into opportunities and find appropriate solutions for restoring and rejuvenating our Mother earth. We can initiate our efforts by positive communication and sharing success stories that would inspire the aspirants joining the brigade of earth protectors. Therefore, I shall end this note by giving a few illustrious examples. Let's begin with the Bishnoi community of India, which has more than 1.5 million devotees who have been fighting to protect the environment for more than 500 years. Secondly, a village of Modhera in western India's Gujarat state has become the country's first to run entirely on solar energy. Thirdly, India, the world's third-largest carbon dioxide emitter, is committed to meet half of its energy demands from renewable sources, such as solar and wind, by 2030. With these hopeful events on the horizon, Team Prithivya invites positive communicators of Science to contribute in our newsletter and wishes all their readers an Environmentally conscious New year 2023!!!

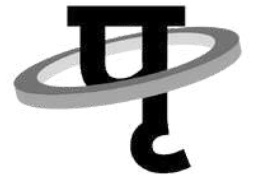


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Conservation biology is the scientific study of the nature and biological resources on the Earth. The aim of conservation studies is protecting species, their habitats, and ecosystems from extinction. The science of conservation is interdisciplinary in nature drawing on sciences, economics, and the practice of natural resource management. The term conservation biology was introduced as the title of a conference held in University of California at San Diego, in 1978. This conference resulted sought to bridge a gap between theories in ecology and conservation practices. Conservation biology and the concept of biological diversity emerged together, helping crystallize the modern era of conservation science and policy. The biology of conserving species is tied closely in researching the dispersal, migration, demographics, effective population size, inbreeding depression, and minimum population viability of rare or endangered species. It also concerned with phenomena that affect the maintenance, loss, and restoration of bioresources.

Conservation biologists work in the field and office, in government, universities, non-profit organizations and industry. They are funded to research, monitor, and catalogue every angle of the earth and its relation to society. Organizations and citizens are responding to the biodiversity crisis through conservation action plans that direct research, monitoring, and education programs that engage concerns at local through global scales.

The sources of finance for conservation organisations have changed significantly over a period of last couple of decades. The conservation organizations were traditionally funded by public funding sources, the portfolio of those public funding sources now also includes private sectors. In present day, there is a need to establish a network of conservation organizations with the public sectors which can help in understanding the flow of funding mechanisms and how it helps the ground level researchers and organizations to sustain. Wildlife and Conservation Biology (WCB) Research Foundation is established with the same objective and we are progressing in this line of networking with other global conservation organizations to create a platform for field researchers and to accelerate science-based conservation.



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Unique band pattern in Common Krait (*Bungarus caeruleus*) recorded in Ahmedabad, Gujarat

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The Big Four of India include the Common Krait (*Bungarus caeruleus*), belong to family elapidae family. This species is considered among the extremely venomous snakes, and found throughout the Indian subcontinent (Mukherjee, 2021). Despite being nocturnal, one might nevertheless come across this snake during the day. A common krait typically has a body that is blackish-brown with white bands running all over its body surface. Numerous guides and publications on snake identification have documented the common krait's typical morphology. The species belongs to the *Bungarus* genus, is largely native to the Indian subcontinent. Its geographic range includes West Bengal, South India, Sri Lanka, and the Sindh region (Ahsan and Rahman, 2017). Observations have been made that this species can be found up to a height of 1,600 metres (Gopalkrishnakone and Chou, 1990).

The length of common krait varies from 0.9m, or 2.11ft, to 1.75 m, or 5.9 ft, according to specific records (Uetz, and Freed, 2020). Males have proportionately longer tailed than females, as is the case with many other species. The neck section is typically barely noticeable, and the skull structure is typically flat. The body of a common krait is cylindrical and tapered toward the tail, which is short and rounded someplace. It has small, rounded pupils in its eyes. The head shields lack any loreals and are quite plain. On the body, the third and fourth supra-oculars meet the eye, and there are four shields along the lower lip edge.

Vertebral scales that resemble hexagons are a particularly distinctive identifying trait of all Krait species. The presence of unpaired sub-caudal scales with a colour similar to the species' belly is another one of the key characteristics of the genus *Bungarus* that is almost missing in any other Elapid of India. The top lips and belly are white, and there could be a pre-ocular white patch. (Gopalkrishnakone and Chou, 1990).According to Whitaker's (2006) description of the Common krait, the head part has seven scales, and the third and fourth supra-labials come into contact with the eyes. As the preocular meets the posterior nasal portion in this species, the loreal is missing. In addition, the eighth scale, which is larger than its neighbouring dorsal scales and has a hexagonal shape, is located on top of the dorsal body along the vertebra. The vertebral row is especially expanded and has a hexagonal shape, according to (Gopalkrishnakone and Chou, 1990). The scales are also highly polished, with



15–17 rows, and the ventral and caudal are both complete, or intact. Indian krait bite patients also have neuro-paralytic symptoms and also frequently experience abdominal pain and cramps due to internal bleeding. (Mukherjee, 2021).

During the nature trekking in the suburbs of “Bopal” area of Daskroi sub district of Ahmedabad district, we found an unusual snake in the densely populated area, after prolonged observation and identification it was concluded that the observed species is a common Krait with a rare and unusual pattern of bands on its body (Figure 2). As mentioned above, the common appearance of the common krait (Figure 1), the recorded species serves all the perspectives of the common krait except the bands on the surface and hence photographs were taken for further investigation. The species was not harmed and further observation and analysis were done with the help of the pictures. As per the photographic evidence and by cross-referring through many, it was concluded that the species is common krait (*Bungarus caeruleus*) however, the band pattern of the recorded species was quite different than the usual one. The common band pattern is of double white circular bands throughout the body, whereas the recorded species showed a chain structure of white-coloured double bands throughout the body with a tapering tail. Scales and patterns on the surface body of snakes is a vital information for Snakes identification, through common guides and handbook we may know the usual pattern of the common snakes however any abnormality or unusualness in the pattern of the known species shall be recorded for future study purposes, however certain care should be provided so it may not harm the species.



Figure 1: Common appearance of common Krait (*Bungarus caeruleus*)



Figure 2: (Recorded species) Very rare and unusual pattern of bands on Common Krait (*Bungarus caeruleus*)

**References:**

- Ahsan, M. F., & Rahman, M. M., 2017. Status, distribution and threats of kraits (Squamata: Elapidae: *Bungarus*) in Bangladesh. *Journal of Threatened Taxa*, 9(3), 9903-9910.
- Gopalkrishnakone, P., & Chou, L. M. (Eds.). 1990. *Snakes of Medical Importance: Asia-Pacific Region*. Singapore University Press.
- Mukherjee, A. K., 2021. Indian Common Krait (*Bungarus caeruleus*). In *The 'Big Four' Snakes of India* (pp. 95-103). Springer, Singapore
- Uetz, P., & Freed, P. H. J. (eds.), 2020. *The Reptile Database*
- Whitaker, R., 2006. *Common Indian snakes: a field guide*. Macmillan.

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Occurrence of Ascidians: An initiative from the Gujarat coast, India

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Abstract:

Ascidians belong to the subphylum Tunicata which represents a variety of organisms along the Indian coastal waters. These organisms are known to be a fouling community due to their rapid growth ability. Major finding of the recent research work is to provide an outline of tunicates with their diversity and distribution data along the rocky shores of Gujarat which may provide positive approach in a direction of tunicate research as these group became invasive on most of the substrates. This study reveals 13 species of ascidians along the rocky intertidal stretch with their distribution record.

Key Words: Diversity, Tunicate, Invasive, Intertidal stretch

Introduction:

Ascidians are known as tunicates or sea squirts which belong to the phylum Chordata hence it is also known as the distant cousin of humans, without a backbone. They are having tough outer protective layer 'tunic' which is made up of tunicin which gave the name tunicates to these organisms. As India is known to be a richly biodiverse country and listed among 10 mega biodiversity countries, this research will add more species to the list from the Gujarat coastal stretch. approximately 3000 described species found in all marine habitats (Cameron et al., 2000, Kott, 2005). Notable work was carried out during the last decade by different authorities in India such as Meenakshi (2003), Jaffar Ali et al. (2009), Jaffar Ali & Tamilselvi (2016), Murugan (2018), Tenjing (2018), Kaleemullah (2018) who gave an idea about taxonomic and biological diversity and their distribution. Tunicates are a fouling community that enormously grows on any substratum and may lead to competition for space with the native species. Ascidians require more and more focus due to their ability to be invasive and displace organisms, e.g., bivalves, sponges, hydroids and other ascidians (Bullard et al. 2007; Lengyel et al. 2009).

Materials and Methodology:

Field surveys were conducted along the four rocky shores of Gujarat such as Okha (22°28'N 69°05'E), Dwarka (22°13'N 68°58'E), Shivrajpur (22°33'N 68°58'E) and Veraval (21°35'N 69°36'E) during January to June 2022. Very less samples were collected during the survey and identification was mainly based on high-resolution photographs. Identification was

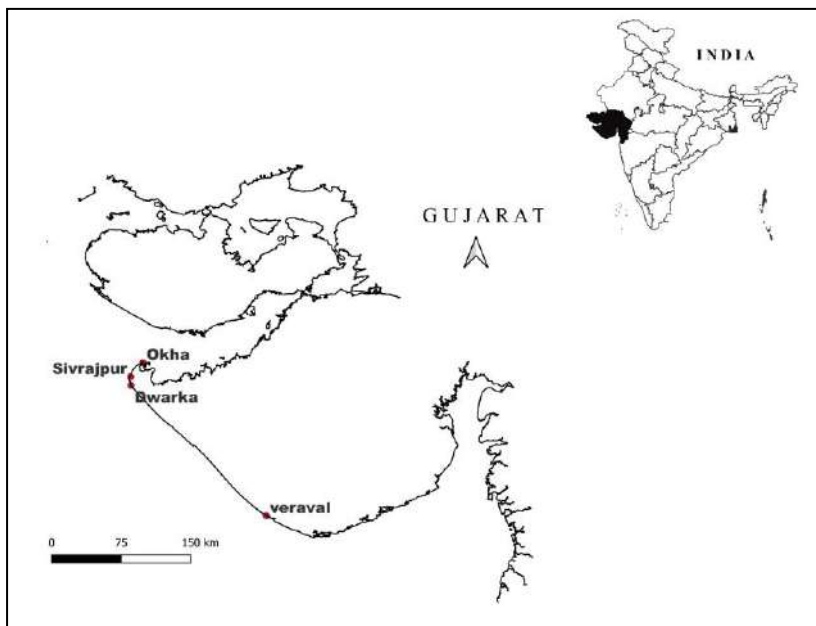


Figure 1: Map showing the sampling sites of Gujarat coastline

carried out by tunicates morphology with the help of identification features given by Meenakshi (2003). Other literature such as prominent research papers, books, and online portals Database, World register of marine species, Marine species identification portal) were also considered for the identification. Location mapping was done

by QGIS 3.10.5. (Figure 1)

Result and Discussion:

Present study on Ascidian diversity from Gujarat coast resulted in 13 species of ascidians belonging to seven different families (Figure 2). The checklist is given below in Table 1. The scientific nomenclature of the species is as per the World Register of Marine Species (WoRMS). Among seven families, Didemnidae sp. were observed dominantly and covers most of the population than the other tunicates although more species were observed from the Styelidae family. Occasional sitting of Salpidae individuals were also noted.

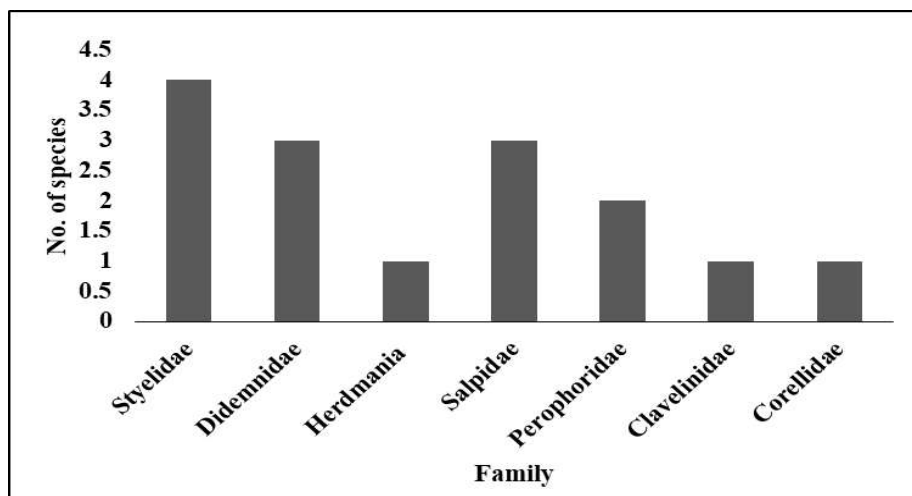


Figure 2: Number of species observed against ascidian families during the study period



Table 1. Diversity and distribution of different Ascidians along selected rocky shore of Gujarat

No.	Species diversity	Distribution			
		Okha	Dwarka	Shivrajpur	Veraval
1.	<i>Botrylloides violaceus</i>	+	+	+	+
2.	<i>Botryllus schlosseri</i>	+	+	+	-
3.	<i>Didemnum psammathodes</i>	+	+	+	+
4.	<i>Rhodosoma turcicum</i>	+	-	-	-
5.	<i>Lissoclinum</i> sp.1*	+	+	-	-
6.	<i>Lissoclinum</i> sp.2*	+	+	+	-
7.	<i>Perophora japonica</i>	+	-	+	-
8.	<i>Symplegma oceania</i>	+	-	+	-
9.	<i>Symplegma brakenhielmi</i>	+	-	-	-
10.	<i>Clavelina</i> sp.*	+	-	+	-
11.	<i>Ecteinascidia thurstoni</i>	-	-	+	-
12.	<i>Herdmania momus</i>	+	+	+	+
13.	<i>Salpa</i> sp.1*	-	-	-	+

(Note: '+' presence, '-' absence, '*' sp. or species identification yet to be done).

Discussion:

Ascidians have been an interesting population for the scientific community in last two decades (Pourquie, 2001). Colonial tunicates were dominant during the field observations. *Didemnum psammathodes* mainly observed underneath the rock and from crevices in between large rock approximately 40-60 cm in size. Similar pattern was discussed by Jaffar et al. (2016). During field surveys, Okha was observed as a hot spot for Ascidians as all the species were found dominant along the Okha coastline. Social tunicates such as *Ecteinascidia* and *Clavelina* species were also reported from Shivrajpur during survey. It inhabits underneath the rocks in small clumps. *Herdmania momus* was the only species of solitary tunicate which was very common from Okha as compared to other sampling sites. Veraval was the coast from where very fewer colonial tunicates were observed. However, a rare



Salpidae sp. was found occasionally from the intertidal belt as the species of salps were found to be pelagic. This distribution pattern is mostly influenced by substrate characteristics which also indicate the composition of tunicates (Tamilselvi and Abdul Jaffar Ali, 2013).

The present research provides a database of 13 species of ascidians with their distribution along the rocky coast of Gujarat, India. As most of the species of ascidians are sedentary, substrates play a significant role in the settlement of these organisms (Patterson Edward and Ayyakkannu, 1992). Many species were observed from artificial substrates instead of Natural substrates or habitats possibly due to anthropogenic activities or man-mediated transportation (Tyrrell and Byers, 2007). In this light, a method of stopping vessel fouling is to keep clean boat hulls regularly and detach tunicates from there. Tidal exposure was mandatory to observe maximum tunicates. It may be noted that more field visits to collect data on various environmental parameters are required to understand their effect on tunicates and their invasiveness on the coastline. This in future might help to avoid habitat loss for native species. This study is important as tunicates play an important role in evolution, ecology and economy.

References:

- Bullard, S. G., Lambert, G., Carman, M. R., Byrnes, J., Whitlatch, R. B., Ruiz, G., Miller, R. J., Harris, L., Valentine, P. C., Collie, J. S., Pederson, J., McNaught, D. C., Cohen, A. N., Asch, R. G., Dijkstra, J., Heinonen, K., 2007. The colonial ascidian *Didemnum* sp. A: current distribution, basic biology, and potential threat to marine communities of the northeast and west coasts of North America. *Journal of Experimental Marine Biology and Ecology* 342: 99-108.
- Cameron, C. B., Garey, J. R., & Swalla, B. J., 2000. Evolution of the chordate body plan: new insights from phylogenetic analyses of deuterostome phyla. *Proceedings of the National Academy Sciences* 97(9): 4469-4474.
- Edward, P. E., & Ayyakkannu, K., 1992. Benthic macrofauna of Coleroon estuary, Southeast coast of India. *Phuket Marine Biological Center Research Bulletin (Thailand)*.
- Jaffar Ali, H. A., & Tamilselvi, M., 2016. Ascidians of southern Indian waters. In: *Ascidians in coastal waters: a comprehensive inventory of ascidian fauna from the Indian coast*. Switzerland: Springer International Publishing AG Switzerland.
- Jaffar Ali, H. A., Sivakumar, V., & Tamilselvi, M., 2009. Distribution of alien and



- cryptogenic ascidians along the southern coasts of Indian peninsula. *World Journal of Fish and Marine Sciences* 1(4): 305-312.
- Kaleemullah Khan, B., Arshan, M. M. K., Akram, A. S., & Ali, H. A. J., 2018. Comparative study on DNA extraction methods for PCR amplification of COI gene from ascidians of Indian coast. *International Journal of Zoology Studies* 3(2): 132-134.
- Kott, P., 2005. New and little-known species of Didemnidae from Australia (Part 3). *Journal of Natural History* 39: 2409–2497.
- Lengyel, N. L., Collie, J. S., and Valentine, P. C., 2009. The invasive colonial ascidian *Didemnum vexillum* on Georges Bank - ecological effects and genetic identification. *Aquatic Invasions* 4: 143-152.
- Meenakshi, V. K., 2003. Marine Biodiversity-Taxonomy of Indian Ascidians. Final Technical Report. Submitted to the Ministry of Environment and Forests, New Delhi, 11-14.
- Murugan, R., & Ananthan, G., 2018. Ascidian diversity (Chordata: Tunicata) from Andaman and Nicobar Islands, India. *Oceanological and Hydrobiological Studies* 47(2): 107-117.
- Pourquie, O., 2001. A macho way to make muscles. *Nature* 409(6821): 679-680.
- Tamilselvi, M., & Ali, A. J. H., 2013. Exploration of untapped resource of ascidians along the Thoothukudi coast of India. *Mult. Res. J. VVV. Coll.* 1 (1), 139-145.
- Tenjing, S. Y., Meenakshi, V. K., Behera, D. P., Deepak Samuel, V., & Nandhini, T., 2018. Occurrence of ascidian species, *Polyclinum saturnium* (Savigny, 1816) from intertidal regions along south-west and south-east coasts of India. *Indian Journal of Geo-Marine Sciences*, 47(12): 2504-2507.
- Tyrrell, M. C., & Byers, J. E. 2007. Do artificial substrates favor nonindigenous fouling species over native species? *Journal of Experimental Marine Biology and Ecology*, 342: 54-60.

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Breeding biology of some wetland birds in Malkhed lake & Chhatri lake of Amravati, Maharashtra

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Abstract

Wetland birds not only attract the attention of individuals towards wetlands but also serve as bio-indicators and models for conducting research regarding the environmental issues of the place. The present study was conducted during the study period June 2021 to July 2022 at the Malkhed Lake and Chhatri Lake situated around the Amravati city of Maharashtra State, India. Visits were made to the area on 2 days per week in the morning from 08:00 am to 10:00 pm and 4:00 pm to 6:00pm in the evening. During the study, the nesting of wetland birds belonging to the family Jacanidae, Charadriidae, Glareolidae, Laridae, Rallidae, Rostratulidae which includes Pheasant-tailed jacana, Black-winged stilt, Red-wattled lapwing, Kentish plover, Small pratincole, Little tern, Common coot, Greater painted-snipe, Purple moorhen were observed. For the detailed study, nest characteristics and egg characteristics including outer and inner diameter of nest, shape of nest, colour, shape and length of eggs were noted. Further clutch size, incubation period and hatching success were also noted during the study. Total 25 nests were detected in 2021 out of which breeding success of three species were recorded. Whereas 18 nest which were located on the island got failed due to early monsoon unexpected heavy rain fall, hence island was submerged in water. In 2022, Total 13 nests were recorded at Malkhed Lake and 21 nests in Chhatri Lake were recorded. Breeding success could not be observed of Purple moorhen and Small Pranticole in 2022 at Chatri Lake. Many threats were recorded during the study which includes early monsoon heavy rain, soil mining, grazing, and fodder crop cultivation by locals, fishing activities, black kite, feral dogs, and house crows.

Key Words: Breeding, Wetland birds, Malkhed Lake, Chhatri Lake, Amravati, Maharashtra.

Introduction

Wetlands are an essential part of natural environments offering a number of ecosystem services and they occur naturally and can either be freshwater, brackish water or saltwater wetlands (Bassi et al., 2014). It can be described as transitional zones existing between upland and aquatic habitats. Birds are considered to be one of the potential indicators of environmental change. Wetland birds have a powerful role in the wetland ecosystem. They showcase a prominent role in understanding the present and overall status of a wetland habitat (Rais et al., 2010; Raut and Gupta, 2020). The population and frequency of birds in a particular wetland habitat depicts the areas environmental quality, level of pollution, availability of food and security of habitat. Natural and man-made wetlands serve as effective breeding sites for various wetland bird species. Water birds migrate in search of suitable climatic conditions, proper nesting and food supply. Wetlands offer optimum conditions to



the migratory birds and serve as exclusive breeding sites (Da Silva et al., 2017; Giese et al., 2018).

Around 1340 species of birds have been identified in India out of which 310 bird species are known as wetland birds (Pravin J. et al., 2021). Wetland bird species observed in the wetland habitats of Amravati region include Little grebe (*Tachybaptus ruficollis*), Grey heron (*Ardea cinerea*), Purple heron (*Ardea purpurea*), Purple moorhen (*Porphyrio porphyrio*), Common coot (*Fulica atra*), Red-wattled lapwing (*Vanellus indicus*), Yellow-wattled lapwing (*Vanellus malabaricus*), Common moorhen (*Gallinula chloropus*), Little plover (*Charadrius dubius*), Black-winged stilt (*Himantopus himantopus*), Common Sandpiper (*Actitis hypoleucos*), Blue kingfisher (*Alcedo atthis*), Open-billed stork (*Anastomus oscitans*), Black ibis (*Pseudibis papillosa*) and several other wetland bird species (Pachlore and Chandrakar, 2011). Wader birds including Little Stint, Snipes, and Sandpipers live in wetland habitats and are observed wading around shore or in open flat mud. These play a vital role in various ecological aspects (Wagh et al., 2015).

A large number of workers carried out the study on breeding biology of avian fauna of their respective regions. Some of them gave emphasis on breeding biology of wetland birds such as, Boukrouma (2016) studied breeding biology in Northeast Algeria. Harisha and Hosetti (2018) investigated the status and conservation strategies of wetland migratory birds in Komaranahalli Kere Lake in Davanagere district, Karnataka. Similarly, Khalil et al. (2019) surveyed in the Bhawalpur district of southern Punjab, Pakistan, whereas, Raut and Gupta (2020) in Makhana field of Darbhanga district, Bihar. Sharma et al. (2020) investigated in the agricultural fields of Sirsa, Haryana Siva (2021) at the Cauvery riverside, Tamil Nadu about the breeding biology of wetland birds.

The purpose of this study was, as there is a lack of data regarding breeding biology of wetland birds. Many freshwater bodies around the Amravati city are still unexplored. Scientific study is not being carried out; therefore, the study will provide the documentation of breeding biology of wetland birds and to know the threats associated to wetland birds and its habitat. The present study was undertaken to assess the occurrence and breeding biology of wetland birds in Malkhed Lake and Chhatri Lake around Amravati city, Maharashtra.



Materials and Methodology:

Study Area

Two study sites from the Amravati city including Malkhed Lake and Chatri Lake were selected for the study. Malkhed lake is situated at 20°49' N, 77°53' E, 23m East of Amravati city near Pohara-Malkhed Reserve forest. The prime water source for the lake is Kholad River. The surface area of the lake is 6,717 Km² and its height from river-bed is 19m. Chatri lake is situated at 20°53'42.6" N and 77° 46'66.2" E, 372m and covering an area of 111.232m². The lake is located at the outskirts of the city Amravati and famously known as "Chhatri Talao"



Figure 1: Map showing study area (Malkhed and Chatri Lake)

Method

Visits were conducted towards the study on 2 days per week from 8:00 am to 12:00 pm in the morning and 4:00pm to 6:00pm in the evening. The study was performed for one-year time period from June 2021 to June 2022. The breeding behaviour of the wetland birds was done using a Nikon 10 x 50 mm Binocular. Photographic observations were performed using Nikon D5300 DSLR camera with 70-300mm Zoom Lens, 200-500mm. Nest building and breeding of birds starts principally between June and July and hence the time period was selected. Nest characteristics including outer and inner diameter of the nest, shape and colour of the nest and its distance from water and the distance between two nests was also recorded during the study. Eggs laid by the water birds were observed for shape, length and width of the eggs, clutch size, incubation period and hatching success. Nest and egg parameters were measured using a 50m open reel measuring tape; nest locations were recorded using the GPS (Global Positioning System) of the camera (Kumar et al., 2020). Nest building, hatching and incubation were concluded based on direct observations and photographs.



Result

The breeding biology study of wetland birds was performed at two sites i.e. Malkhed Lake and Chatri Lake during the study period of June 2021 to June 2022. Total 208 successive visits were made to the study site during one year of the survey.

During the study period of June 2021, 11 nests of Black-winged stilt (BWS) (*Himantopus himantopus*) were observed in Malkhed Lake with the mean nest size of 152.4mm, the mean distance from water was observed to be 9 m and the clutch size was observed to two. The nests of the Black-winged stilt (BWS) were built on muddy substrate in shallow water in open land areas. In around 80% of the built nest the nest structure of almost 20-100% of the nests was made using aquatic plants, one nest of Red-wattled lapwing (RWL) (*Vanellus indicus*) were observed at Malkhed Lake with mean nest size of 203.2 mm with average clutch size of four. Three nests of Little tern (*Sternula albifrons*) were observed with mean nest size of 152.4mm, average distance from water of 6 feet and clutch size of two at Malkhed lake. Similarly, two nests of small Pratincole (*Glareola lactea*) were also observed with mean nest size of 101.6mm, average distance from water of 5 feet and clutch size of one at Malkhed Lake. One nest of Kentish Plover (*Charadrius alexandrines*), one nest of Greater painted-snipe (*Rostratula benghalensis*) was observed during the study. Similarly, 04 nest of Common coot (*Fulica atra*) with the mean nest size of 153 mm and two nests of Purple moorhen (*Porphyrio porphyrio*) with mean nest size of 123 mm were observed. The clutch size was observed to be 2 to 4. In the family wise distribution study, highest number of bird nests was observed of Recurvirostridae followed by Charadriiformes, rallidae, Jacanidae, Glareolidae, Laridae, Charadiidae and Rostratulidae.

During the study period of June 2022, 4 nests of Black-winged stilt were observed at Malkhed lake and four nests were observed at Chhatri lake with mean nest size of 152mm, the mean outer diameter of the nests was 149.3mm and the mean inner diameter of the nests was observed to be 77.3mm while, the average distance of the nest from water was 7 feet. The mean clutch size was observed to be four. The average incubation period was 24-27 days with a mean hatching success of 25%. Both the parents take turns in incubating the eggs.

During the study period of 2022 at both the study locations, seven nests of Red-wattled lapwing at Malkhed Lake and two nests at Chatri Lake with mean nest size of 201mm were observed, the mean outer diameter of the nest was observed to 112.5mm while the inner diameter was observed to be 30mm. The shape of the nests varied from round to partially round to deep round. The nests were observed both in grassy land and open land. The mean



distance of nest from water was 5 feet. The average clutch size was observed to be of two to four eggs and the eggs were arranged in a form that their small ends met in the centre which facilitated even sitting and thus better incubation of the eggs. The eggs of the water bird were in plover form broad at one end and pointed towards the other end and were dusty off white to pale olive-green colour with dark black spots; after laying the first eggs Lapwings started incubating it by sitting on them both male and female Lapwings incubated the eggs, average clutch size of four was observed in all the seven study sites. The average incubation period of the eggs was observed to be 25-28days. A total of 28 eggs were observed in seven nests during the study; the mean percentage of hatched eggs was 50% some of the eggs due to anthropogenic activities were destroyed and, in some cases, due to trampling of cattles. Predators like *Corvus splendens*; *Milvus migrans* and feral dogs are also a threat to the eggs. Six nest of Pheasant tailed jacana (*Hydrophasianus chirurgus*) was observed at Chhatri Lake, with outer diameter of nest 111mm and inner diameter 30mm and mean nest size of 115mm. The nest was flat to hold the eggs and observed floating on the aquatic vegetation. The clutch size of Jacana was four. The texture of eggs was glossy with a hatching success of 25%. The breeding of Jacana is commonly observed on floating vegetation in rainy season. The nest is built using stalks and leaves of the aquatic plants. During the preliminary period of incubation, the female protects the nest by chasing other water birds. Both male and female birds incubate the eggs. The males vigorously feed in the earlier part of the day and incubates the eggs during the hottest part of the day. Egg predators like pond herons and kites are a constant threat to the eggs and the hatchlings.

Eight Nests of Common coot with mean nest size of 152mm was observed at Chhatri Lake. Two nests of Small Pratincole with mean nest size of 101.6mm was observed at Malkhed Lake. Also, single nest with clutch size of four of Purple Moorhen and mean nest size of 123mm was observed but any further data could not be collected due to heavy rainfall

**Table 1:** Nest characteristics of different birds observed at various study sites

Year	Study site	Nesting bird Species	# nest	Nest Size in average (mm)	Nest Habitat	Nest Shape	Distance from water in average (m)
2021	Malkhed Lake	Black-winged stilt (<i>Himantopus himantopus</i>)	11	152.4mm	Island in Shallow water	Round	7.5m
		Kentish plover (<i>Charadrius alexandrinus</i>)	01	114.3mm	Island in Shallow water	Round	17.5m
		Little tern (<i>Sternula albifrons</i>)	03	152.4mm	Island in Shallow water	Round	6.5m
		Small Pratincole (<i>Glareola lactea</i>)	02	101.6mm	Island in Shallow water	Round	5m
		Greater painted-snipe (<i>Rostratula benghalensis</i>)	01	127mm	Island in Shallow water	Round	8m
		Red-wattled Lapwing (<i>Vanellus indicus</i>)	01	203.2mm	Grassland	Round	4m
	Chatri Lake	Common coot (<i>Fulica atra</i>)	04	153.4mm	Shallow water	Oval	8.5m
		Purple moorhen (<i>Porphyrio porphyrio</i>)	02	124.3mm	Shallow water	Round	7.3m
2022	Malkhed Lake	Black-winged stilt (<i>H. himantopus</i>)	04	152mm	Open mud flat	Oval	9m
		Red-wattled lapwing (<i>V. indicus</i>)	07	200.2mm	Grassland	Oval	5m
		Small Pratincole (<i>G. lactea</i>)	02	101.6mm	Island in Shallow water	Oval	5m
	Chhatri Lake	Pheasant-tailed jacana (<i>Hydrphasianus chirurgus</i>)	06	115mm	Flat Nest to hold eggs	Round	6.9m
		Common coot (<i>F. atra</i>)	08	152mm	Shallow water	Oval	8m
		Black-winged-stilt (<i>H. himantopus</i>)	04	150.4mm	Open mud flat	Oval	9m
		Red-wattled lapwing (<i>V. indicus</i>)	02	201.3mm	Grassland	Oval	5m
		Purple moorhen (<i>P. porphyrio</i>)	01	123 mm	Shallow water	Round	7.2m



Figure 4: Some glimpses of birds with nest, eggs and chicks



Total 25 nests were detected in 2021 out of which breeding success of 3 species were recorded namely RWL, Purple moorhen, Common coot as it was present on the grass land area at the peripheral side of the Lake. Whereas 18 nest which were located on the island got failed due to early monsoon unexpected heavy rain fall, hence island was submerged in water. In 2022, Total 13 nests were recorded at Malkhed Lake and 21 nests in Chhatri Lake were recorded. Breeding success could not be observed of Purple moorhen and Small Pranticole in 2022 at Chatri Lake. Many threats were recorded during the study which includes early monsoon heavy rain, grazing around the lake in the catchment area, fodder crop cultivation by locals, fishing activities, predation by feral dogs, Black kite and House crows.

Discussion

Wetlands are excellent breeding and feeding grounds for migratory avian species. They play a critical role in maintaining natural cycles and also support biodiversity of the habitat. Wetlands offer an important link in the migration of wetland birds and serve as stopover sites in their migration journey. Migratory birds in search of wetlands travel from pole to pole (Rana and Gulati, 2022). Ashoori (2011) reported the breeding biology study of BWS in 22 Bahman wetland in Boujagh National Park, Gilan Province in early April 2005 to late July 2005. The nests of BWS were built on muddy substrates in open areas in shallow water. Twenty five nests were spotted during the study with a dominant clutch size of 4. Bouakkaz et al. (2017) studied the reproductive biology and nest selection site of Kentish Plover in a semi-arid marsh area, Eastern Plateaux, Northeast Algeria. Forty five clutches were observed in the study with average clutch size of two.

Balkhande and Shaikh Azeem (2017) studied nesting pattern and breeding biology of Red-wattled lapwing in the Nanded region. The hatching percentage of the bird was observed to be 50% as the bird's nest is not camouflaged hindrances like human interference, grazing cattle's and stray dogs are likely to destroy the nest. During our study it was observed that in RWL both the parents take care of the hatchling until it grew up and flew away and breeding success rate were 75%. Similarly, Kumar *et al.* (2020) reported the breeding behaviour of Red-wattled lapwing during the breeding season of 2017-2019 in the agricultural and non-agricultural nesting grounds of Khanna city, Punjab. During the study, nest characteristics and egg characteristics were recorded. The incubation period was observed to be from 27 to 30 days while, the hatching success was observed to be higher in grassland areas as compared to island.



Diallo et al. (2019) explored the biodiversity and nesting of Black winged stilt in the urban wetland areas of Tecnopole during the study period of August 2012 to August 2017. Whereas, during our survey breeding at both the study site were observed from May to June. Maximum number of nests building and hatching was observed in the month of May to July.

Conclusion

The present study was conducted at two study sites namely Malkhed Lake and Chhatri Lake. Breeding biology of Wetland birds including Red-wattled lapwing, Black-winged stilt, Little tern, Common coot, Small pranticole and Purple moorhen, Kentish plover were observed at both the study sites. The data observations made during the study period of June 2022 was more diverse compared to the observations made during the study period of June 2021. Thus, providing a more detailed investigation of the nest characteristics and egg characteristics of the wetland birds. The rising urbanization and the increasing human interference in the natural habitat of wetland birds has emerged has a great threat to the wetland birds, decreased migration and lower survival of water birds. Observations made during the current study can be used for the conservation of water birds of the study area.

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References

- Ali, S. and Ripley, S.D., 1987. The compact handbook of the birds of India and Pakistan together with those of Bangladesh, Nepal, Bhutan and Sri Lanka. 2nd edition. Delhi: Oxford University Press
- Arya, M., Rao, R.J. and Mishra, A.K., 2014. Avifaunal occurrence and distribution of wetland birds in Sakhya Sagar and Madhav lakes in Madhav National Park, Shivpuri, India. *Journal of Environmental Biology*. 35: 703-708.
- Ashoori, A., 2011. Breeding ecology of the black winged Stilt (*Himantopus himantopus*) in Boujagh National Park, Gilan Province, Northern Iran. *Podoces*. 6(1): 87-91.



- Balkhande, JV. and Shaikh Azeem, I., 2017. Study of nesting pattern and breeding biology of Red-Wattled Lapwing *Vanellus indicus* in agricultural field near to Asna river bridge, Nanded (Maharashtra). *Research magma*. 1(6): 1-7.
- Bassi, N., Kumar, DM., Sharma, A. and Pardha-Saradhi, P., 2014. Status of wetlands in India: A review of extent, ecosystem benefits, threats and management strategies. *Journal of Hydrology: Regional Studies*. 2: 1-19.
- Bouakkaz, A., Belhassini, K., Bensouilah, T., Bensouilah, MA. and Houhamdi, M., 2017. Breeding behaviour of Kentish Plover (*Charadrius alexandrinus*) in a salt marsh from the eastern high Plateaux, northeast Algeria. *Journal of King Saud University-Science*. 29: 291-301.
- Boukrouma, N., 2016. First breeding of common coot (*Fulica atra*) at Mekhada Marsh (El-Tarf, Northeast Algeria). *Annual Research & Review in Biology*. 11(1): 1-8.
- Da Silva Mohr, LR., Perico, E., da Silva Fonseca, VS. and Mohr, AR., 2017. The breeding biology, nest success, habitat and behaviour of the endangered Saffron -cowed Blackbird, *Xanthospar flavus* (Aves: Icteridae), at an important bird area (IBA) in Rio Grande do Sul, Brazil. *Zoologia*. 34: e20783
- Diallo, AY., Ndiaye, PI., Ndiaye, S., 2019. Spatial distribution and nesting behaviour of the Black winged Stilt (*Himantopus himantopus himantopus*, Linnaeus 1758) in the urban wetland of Dakar Technopole (Senegal, West Africa). *International Journal of Biological and Chemical Sciences*. 13(1): 34-48.
- Grimmett, R., Inskipp, C. and Inskipp, T., 1999. *Birds of the Indian subcontinent*. New Delhi: Oxford University Press
- Harisha, MN. and Hosetti, BB., 2018. Status and conservation issues of wetland birds in Komaranahalli lake, Davangere district, Karnataka, India. *Journal of Threatened Taxa*. 10(2): 11290-11294.
- Fournier, A. M. V., J. D. Lancaster, A. P. Yetter, C. S. Hine, T. Beckerman, J. Figge, A. Gioe, M. Greider-Wagner, D. Jen, C. Johnson, M. R. Larreur, A. Shaw, K. Wolter, M. Wood, D. K. Wu, B. J. O'Neal, and H. M. Hagy., 2021. Nest success and nest site selection of wetland birds in a restored wetland system. *Avian Conservation and Ecology*. 16(1):6.



- Giese, EEG., Howe, RW., Wolf, AT. and Niemi, GJ., 2018. Breeding birds and anurans of dynamic coastal wetlands in Green Bay, Lake Michigan. *Journal of Great Lakes Research*. 44(5): 950-959.
- Kacergyte, I., Arlt, D., Berg, A., Zmihorski, M., Knape, J., Rosin, ZM. and Part, T., 2021. Evaluating created wetlands for bird diversity and reproductive success. *Biological Conservation*. 257: 109084.
- Khalil, S., Hussain, T., Anwar, M., Rafay, M., Abdullah, M., et al., 2019. Breeding biology of red-wattled lapwing (*Vanellus indicus*) from southern Punjab. *International Journal of Biodiversity and Conservation*. 11(2): 78-84.
- Kumar, C., Thind, SK., Joshua, Kaleka, AS., 2020. Breeding behaviour of Red-wattled Lapwing *Vanellus indicus* (Boddaert, 1783) in agricultural landscape of Punjab. *Uttar Pradesh Journal of Zoology*. 41(8): 27-51.
- Pachlore, G. and Chandrakar, M., 2011. Avifauna of wetlands of Amravati region, Maharashtra, India. *Journal of Threatened Taxa*. 3(1): 1478-1484.
- Rais, M., Kabeer, MA. and Mehmood, T., 2010. Effect of habitat degradation on breeding water birds at Kallar Kahar Lake District Chakwal. *Journal of Animal and Plant Sciences*. 20(4).doi:<https://link.gale.com/apps/doc/A254017568/AONE?u=anon~16334f88&sid=googleScholar&xid=03b7d4ec>
- Rana, S. and Gulati, H., 2022. Wetlands as the preferred roosting and breeding site of Sarus crane, *Grus antigone* (Linnaeus, 1758). In C. Massarelli, & C. Campanale (Eds.), *Limnology - The Importance of Monitoring and Correlations of Lentic and Lotic Waters* [Working Title]. IntechOpen. <https://doi.org/10.5772/intechopen.106135>
- Rasmussen, P.C. and Anderton, J.C., 2012. *Birds of South Asia. The Ripley Guide. Vols. 1 and 2, 2nd edition.* National Museum of Natural History – Smithsonian institution, Michigan State University and Lynx Edicions, Washington, D.C. Michigan and Barcelona
- Raut, SM. and Gupta, N., 2020. Ecology of bronze-winged Jacana and Pheasant-tailed Jacana within Makhana field habitat. *Zoo's Print*. 35(4): 26-29.



- Sharma, P., Narwal, G., Kaur, K., 2020. Study of breeding biology and egg parameters of red wattled Lapwing (*Vanellus indicus*) in agri-fields of Sirsa, Haryana, India. International Journal of Current Microbiology and Applied Sciences. 9(5): 3268-3273.
- Wagh, GA., Nikita, J., Wadatkar, JS., Rawankar, AS., 2015. Waders diversity of wetlands in Amravati region, Maharashtra. Wetlands-present status, Ecology and Conservation. 3-9.
- Wankhade, V., Manwar, N. and Malu, A., 2012. Evaluation of status of ecosystem of Sawanga (Vithoba) lake (Malkhed Talav), district Amravati, Maharashtra by assessment of some physicochemical characteristics of water. International Journal of Scientific and Research Publications. 2(8): 1-10.
- Xiao, H., Hu, Y., Lang, Z., Fang, B., Guo, W., Zhang, Q., Pan, X. and Lu, X., 2016. How much do we know about the breeding biology of bird species in the world? Journal of Avian Biology. 48(4): 513-518.

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A Survey-based approach to minimize energy consumption in urban cities

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Abstract:

The energy sector is responsible for releasing immense amounts of greenhouse gases worldwide. In India, the primary energy demand is expected to increase due to rising living standards, which necessitates increased demand for energy services such as electricity, cooking, transportation, etc. Sustainable living reduces an individual's ecological footprint, making it an effective response to mitigating greenhouse gases and conserving resources. Through our project, we focus on understanding the willingness of urban families to make lifestyle changes that will benefit the environment. It also entails understanding how money influences an individual's behaviour towards the environment and whether financial benefits can encourage them to reduce their energy consumption and carbon footprint at home. The results showed that although most people were less willing to adopt an entirely sustainable lifestyle, they were ready to conserve energy at home, provided monetary investments were not involved. Therefore, by making individuals aware that energy conservation can save money, they can be encouraged to minimize their carbon footprint and live more sustainably.

Key Words: Energy Conservation, Carbon Footprint, Sustainable Living

Introduction:

The energy sector involves extracting, processing, and distributing fossil fuels, thereby releasing immense amounts of greenhouse gases. These emissions are steadily raising global temperatures, which have adverse effects like climate change and biodiversity loss (Kappelle et al., 1999; United States Environmental Protection Agency, 2022). In India, the primary energy demand is expected to increase to about 1250 million toe (Tonne of oil equivalent) by 2030. This rise will most likely be driven by an increase in the standard of living, which requires a greater demand for energy services such as electricity, cooking, transport, etc. (IEA, 2021; Government of India Ministry of Power, 2022). GHG inventory analysis of Mumbai showed that the energy sector contributes the most to the city's GHG emissions, given its high domestic power demand and the fact that 95% of its electricity is generated from coal (The Hindustan Times, 2021; Times of India, 2021). Increasing consumption and diminishing resources are the primary causes of the World energy crisis that affects most parts of the World (Forbes, 2021; IEA, 2022).

Sustainable living minimizes an individual's ecological footprint; therefore, it can be an effective response to mitigating greenhouse gases and conserving resources. Reducing personal ecological footprints has recently become popular in various communities; however, the lack of social programs and policies promoting this idea negatively impacts many



people's attitudes toward the environment. In the absence of incentives or effective protocols, people may find it challenging to monitor or engage in practices that can result in environmental conservation. Studies find that financial incentives have been successful at changing specific actions, which can influence pro-environmental behavior among individuals (Maki et al., 2016; Kaiser et al. 2020).

Our daily commute, the food we eat, and everything we waste, all contribute to our footprint. The larger the footprint, the heavier the strain on the environment. This forms the basis of our project where we focus on understanding the willingness of urban families to inculcate lifestyle changes that will benefit the environment. It also involves understanding how money influences the behavior of individuals and whether financial benefits can encourage them to reduce their energy consumption and carbon footprint at home. Therefore, this project is structured in a way to motivate people to shift towards more environmentally responsible behavior while also reaping monetary benefits.

Materials and Methodology:

The study included two sequential surveys conducted with families residing in and around the Mumbai metropolitan region. Both questionnaires were generated using Google Forms and incorporated multiple-choice, nominal, Likert's scale (5-point scale), and open-ended long-answer questions. The questionnaire was divided into sections, each of which had a brief description of terms related to the questions. This served as a medium for raising awareness while assisting participants in understanding the questions better. The first survey assessed the general population's views on the overall concept of sustainable living while focusing on three factors: energy conservation, water conservation, and waste management. A total of 260 families participated in this survey. Of the 260 families, 104 families who agreed to continue with the project participated in the second survey. The questions in this survey focused on the world energy crisis, renewable energy, and carbon footprint.

Result and Discussion:

Survey 1

Sustainable Living:

According to Figure 1, individuals believed that their household activities had a greater impact on their health and well-being (4.24 ± 0.062 on a 5-point Likert Scale) than the global environment (4.07 ± 0.061 on a 5-point Likert Scale). A P-value of 0.042 ($P < 0.05$) indicates that the difference between the two means is statistically significant.

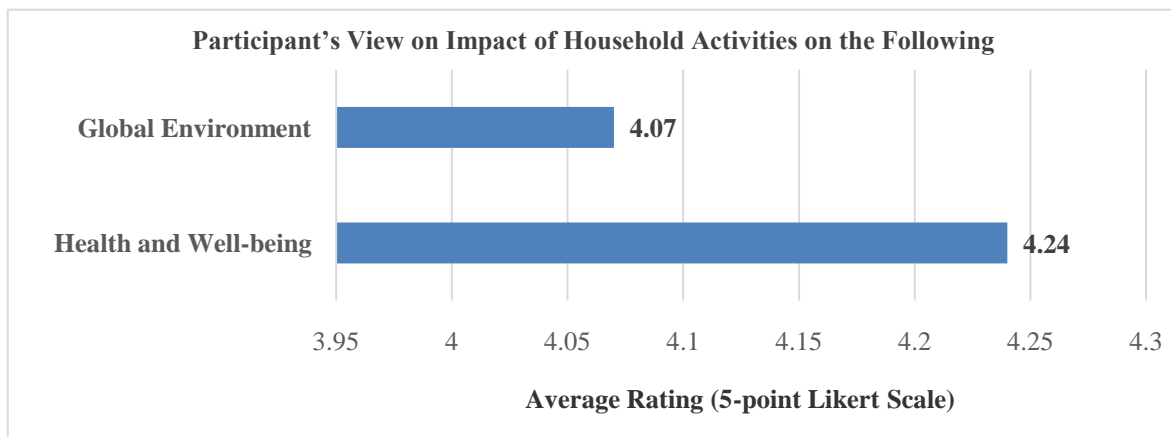


Figure 1: Impact of Household Activities

As per participant responses in Figure 2, the principal characteristic features of sustainable living and eco-homes included reusing and recycling waste (79.23%), usage of eco-friendly products (73.85%), and minimal carbon footprint (72.69%). However, little importance has been given to aspects like indoor air quality (36.54%) and reduced exposure to pollution (41.15%). Further, Figure 3 shows that while participants strongly believed sustainable living could lead to environmental sustainability (92.31%) and a reduction in ecological footprint (71.92%), they were less optimistic about its ability to promote economic growth (33.85%).

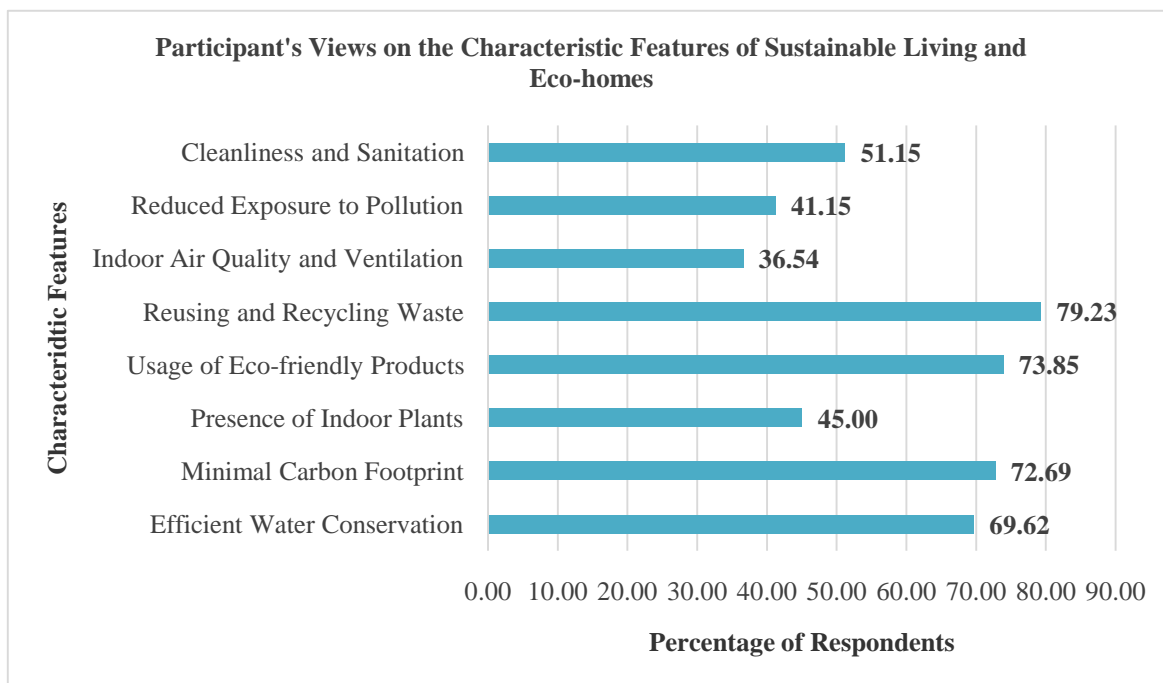


Figure 2: Characteristic Features of Sustainable Living and Eco-homes

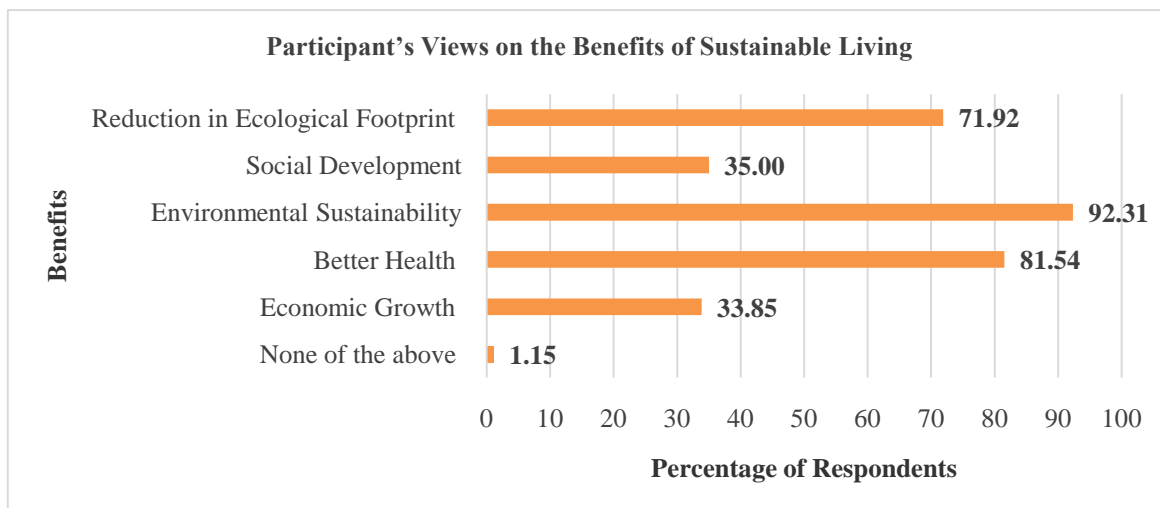


Figure 3: Participant's Views on the Benefits of Sustainable living

A mean of 4.23 ± 0.05 (On a 5-point Likert Scale) indicated that participants supported the concept of sustainable living. Yet, only 19.32% were not hesitant to work towards adopting sustainable living as seen in Figure 4. The hesitance of other participants could be attributed to a lack of proper awareness of sustainable living (53.85%) along with an unwillingness to spend money (40.00%). Moreover, 15% of the participants had a 'Why should I do it?' attitude, expressing a reluctance to accept responsibility for their actions (Figure 4).

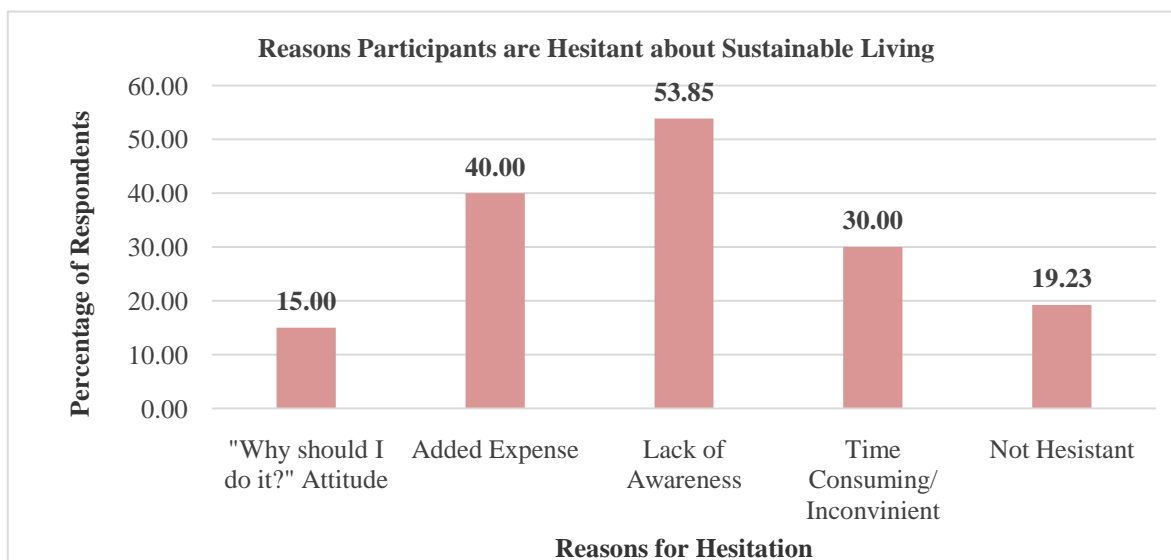


Figure 4: Reasons Participants are Hesitant about Sustainable living

Figure 5 represents the average willingness of participants (On a 5-point Likert Scale) to adopt sustainable living, conserve energy and water at home, manage waste and invest money into meeting these objectives. The results obtained after comparing these groups using



Tukey’s test have been presented in Table 1. At $P < 0.0001$, the willingness of participants to manage waste, and conserve energy and water differ significantly from their willingness to adopt sustainable living as a whole. The same difference in means can be observed in the case of their willingness to spend money. There is, however, no significant difference between their willingness to practice waste management, energy, and water conservation, indicating that participants do not have a preference among the three. Overall, this data shows that while participants are willing to conserve water and energy as well as manage their waste, they are less inclined towards the whole concept of sustainable living. Additionally, it emphasizes reluctance among people to invest money.

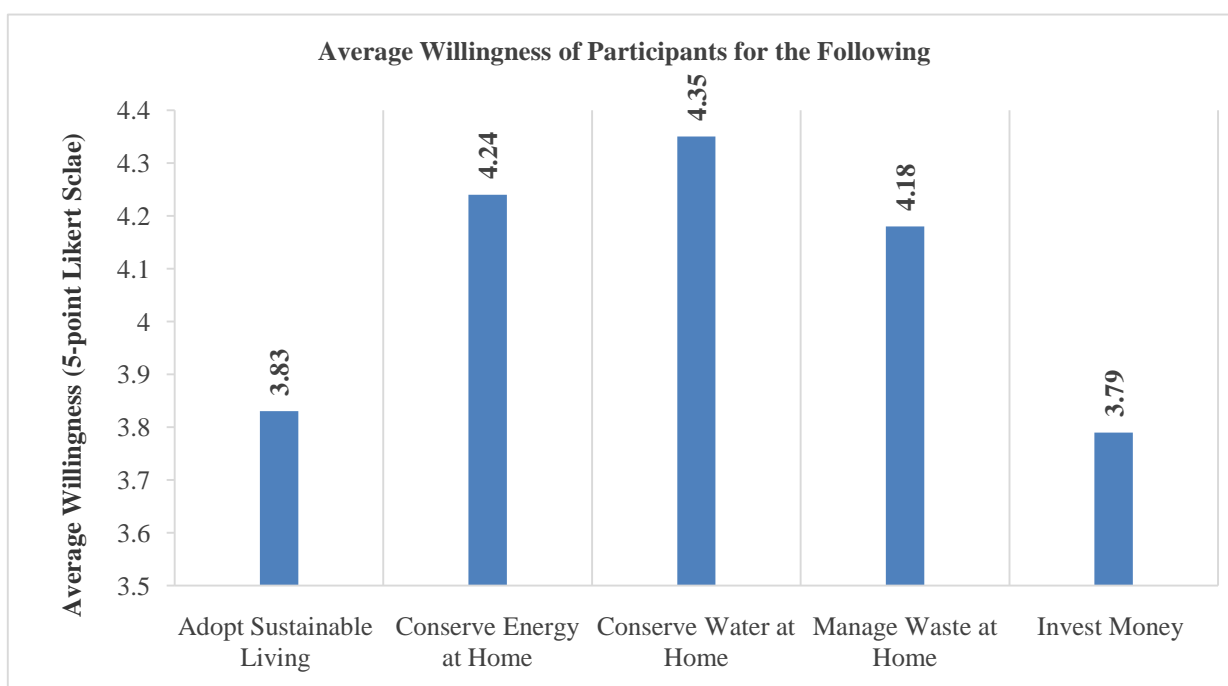


Figure 5: Average Willingness of Participants to Take Action

Table 1: Multiple Comparison of Groups (Sustainable Living) using Tukey’s Test

A – Adopt sustainable living, B – Conserve energy at home, C – Conserve water at home, D – Manage waste at home, E – Invest Money. Highly significant - **** & not significant – ns.

	A	B	C	D
B	**** P<0.0001			
C	**** P<0.0001	ns P>0.05		
D	**** P<0.0001	ns P>0.05	ns P>0.05	
E	ns P>0.05	**** P<0.0001	**** P<0.0001	**** P<0.0001



Energy Conservation: (In terms of Electricity, Cooking, and Travel):

When asked if their energy consumption had increased as a result of the COVID-19 pandemic, 59.23% of participants said yes (Figure 6), but only 31.00% stated that they were consuming more energy than necessary (Figure 7). Additionally, in comparison to water consumption and waste generation, household energy consumption increased the most during the pandemic.

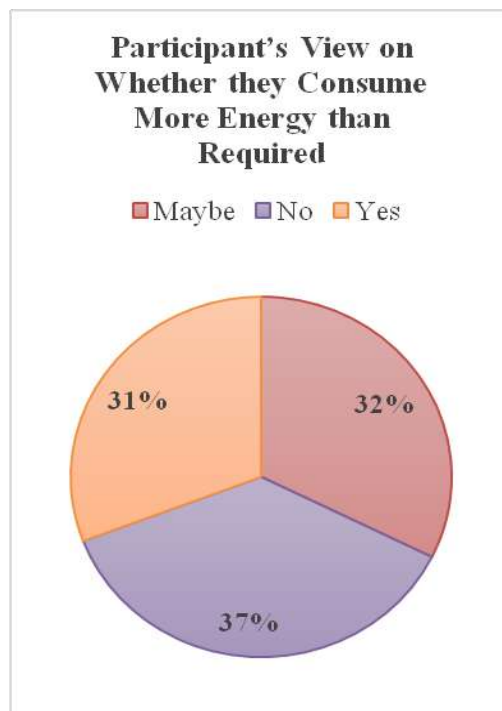
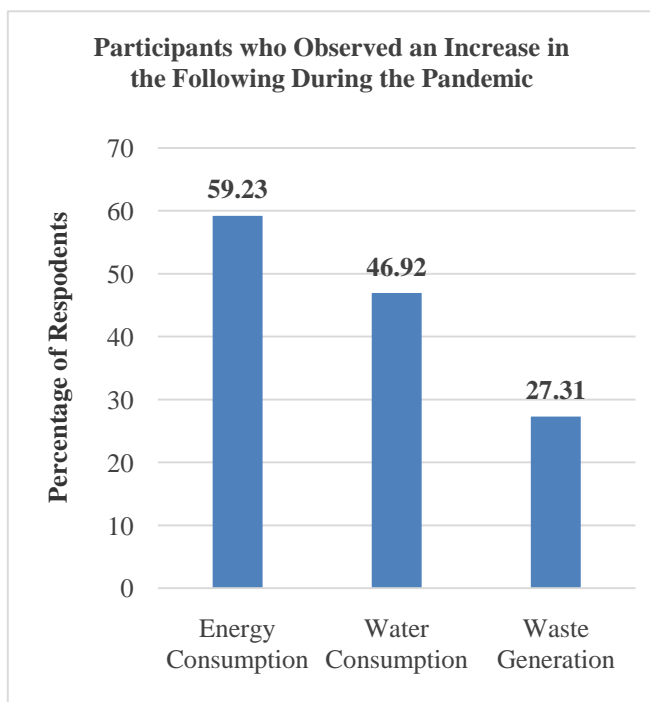


Figure 6: Impact of Pandemic on Energy, Water & Waste

Figure 7: Views on Energy Consumption

According to Figure 8, 3.46% of the participants were unwilling to reduce their energy consumption, expressing a negligent approach toward the environment. Further, 69.23% of participants stated they would be encouraged to conserve energy if it lowered expenses and saved money. Even though 69.62% of the respondents saw energy conservation as an opportunity to use alternative energy sources (Figure 8), when it came to purchasing appliances, a majority of the participants preferred to focus on other factors. These included the appliance's life expectancy, energy efficiency, brand reviews, and available discounts rather than dependence on renewable energy sources (Figure 9).

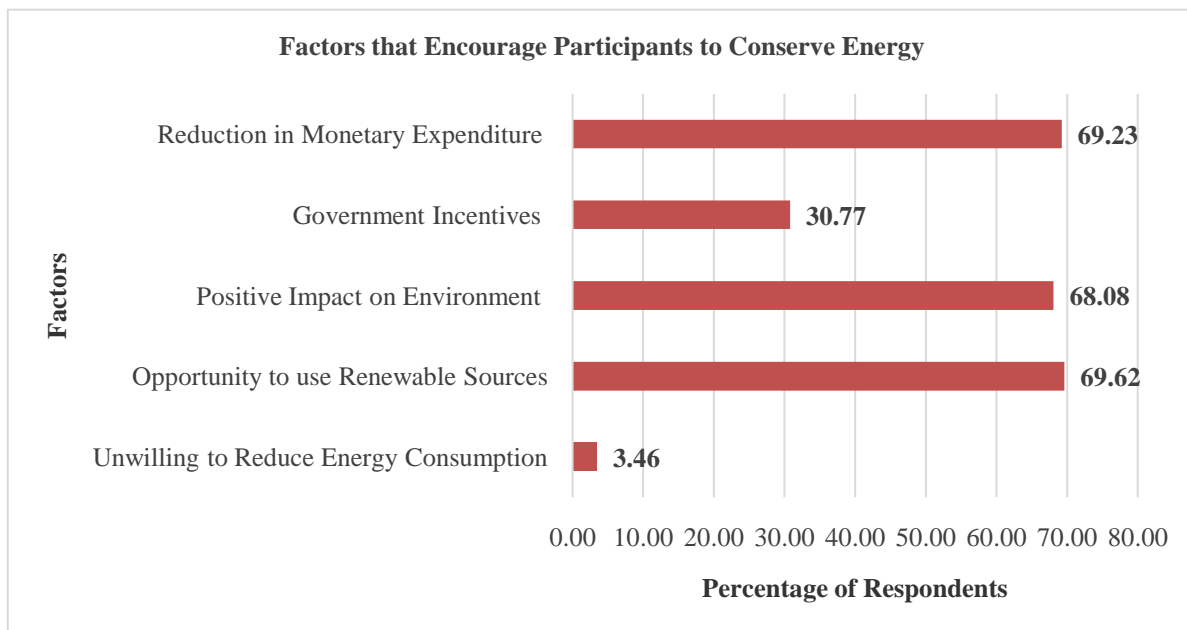


Figure 8: Factors that Encourage Participants to Conserve Energy

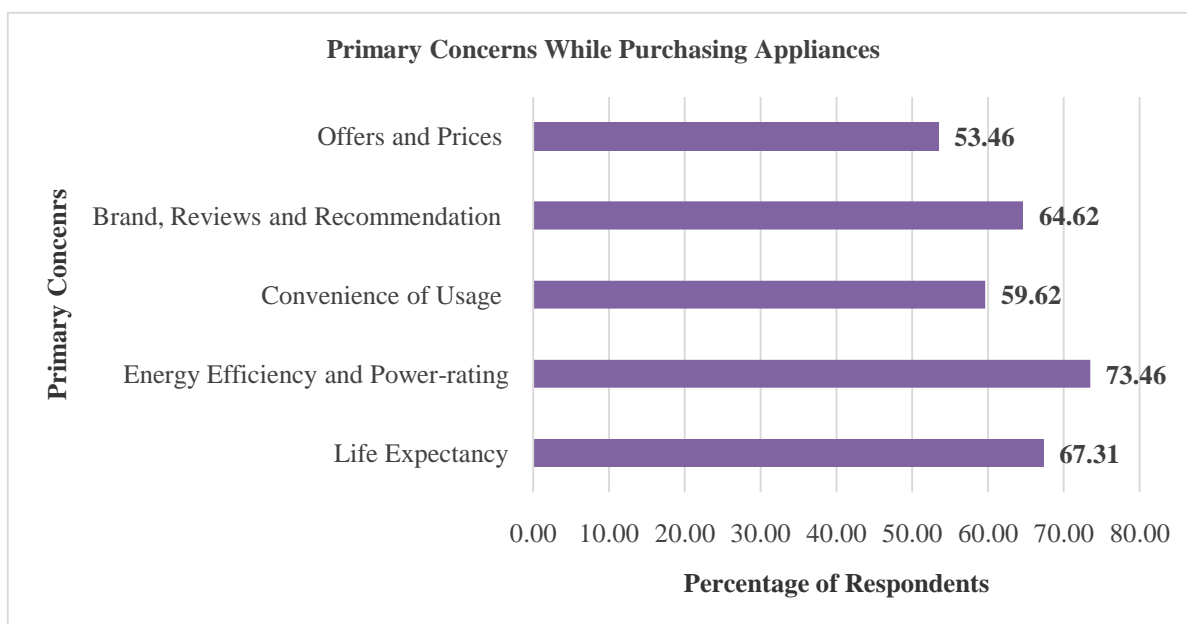


Figure 9: Primary Concerns While Purchasing Appliances

Water Conservation:

The survey found that 49% of the respondents felt they use only as much water as necessary, while 32% were uncertain of their consumption (Figure 10). Moreover, 53% always conserved water, 33% were not careful with their consumption, and 4% did not make any attempt to save water (Figure 11). Additionally, a majority of participants preferred simple conservative measures over those that would make a more impactful difference, such as rainwater harvesting or installing dual flushes (Figure 12). This highlights a need to create



awareness among the general population about effective measures to conserve and save water at a household level.

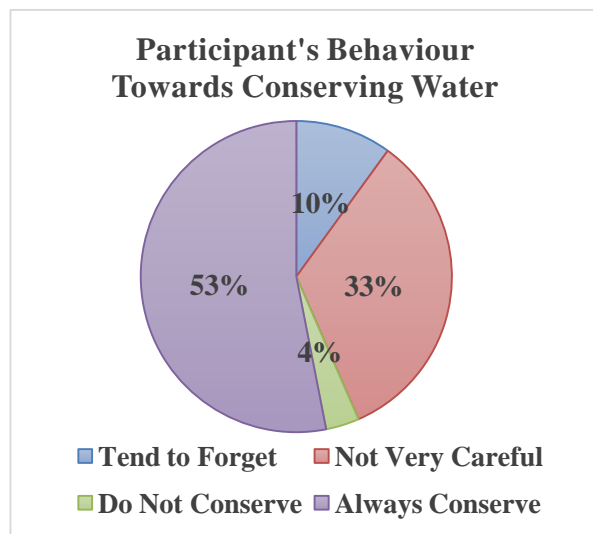
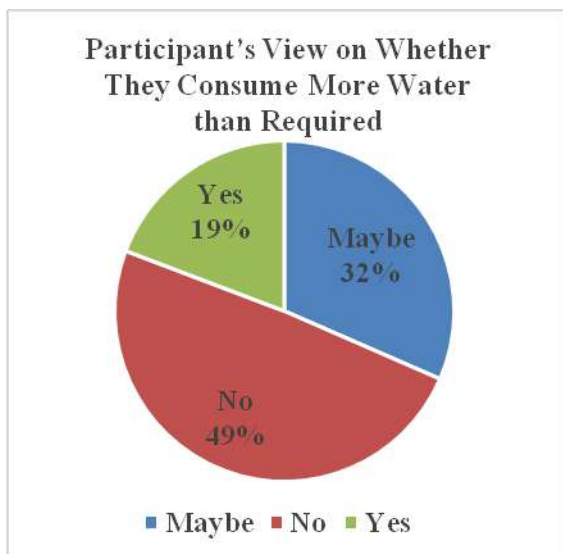


Figure 10: Views on Water Consumption

Figure 11: Behaviour towards Conserving Water

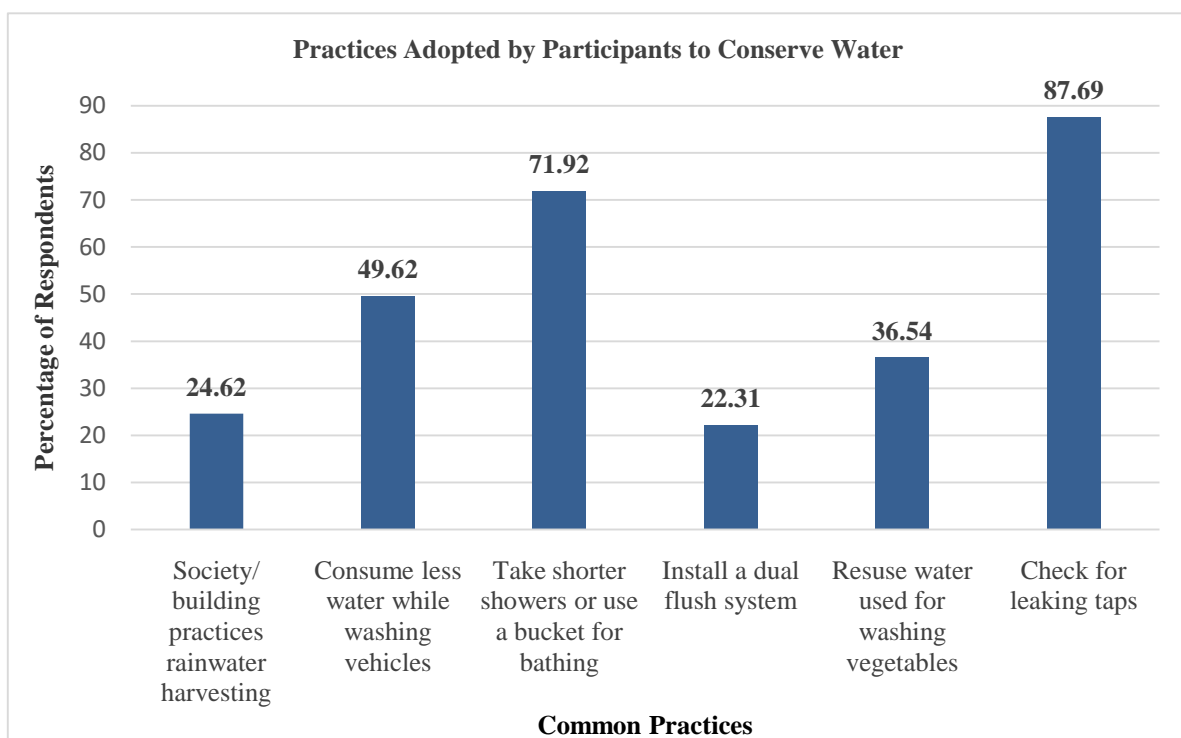


Figure 12: Practices Adopted by Participants to Conserve Water



Waste Management:

133 participants (51.12%) of the surveyed population said that they have always separated their waste. Out of the remaining 127 participants who do not segregate their waste, 80.32% reported a lack of separating bins in their houses or societies.

Furthermore, Figure13 shows the participants' average knowledge of various categories of waste as rated on a 5-point Likert Scale. Tukey's test was used to analyze the resulting mean of each category, and a comparison of the same is provided in Table 2. This highlights that the average knowledge of the surveyed population on plastic, paper, and kitchen waste differs significantly ($P < 0.0001$) from their knowledge of both biomedical and e-waste. This suggests that participants are better aware of segregating plastic, paper, and kitchen waste than biomedical or e-waste.

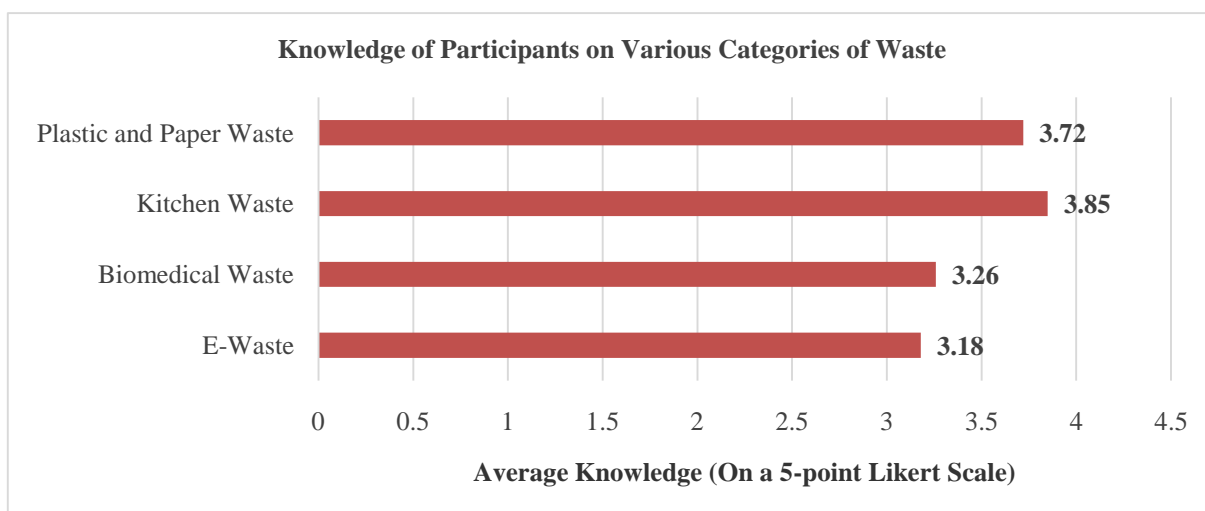


Figure 13: Knowledge of Participants on Various Categories of Waste

Table 2: Multiple Comparison of Groups (Categories of Waste) using Tukey’s Test

A – Paper and Plastic Waste, B – Kitchen Waste, C – Biomedical Waste, D – E-waste.

Highly significant - **** & not significant – ns.

	A	B	C
B	ns P>0.05		
C	**** P<0.0001	**** P<0.0001	
D	**** P<0.0001	**** P<0.0001	ns P>0.05



Survey 2

World Energy Crisis and Energy Conservation:

Among the surveyed population, 83.65% were aware of the world energy crisis, and 62.50% strongly believed that it could be solved by taking action at a household level. Moreover, 97.12% of the participants were willing to follow a set of guidelines to lower their energy consumption.

Renewable Energy:

77% of participants firmly believe that the global energy crisis could be solved by increasing our dependency on renewable energy sources. However, only 5 out of 104 people (4.81%) use devices powered by renewable energy, such as solar water heaters, geysers, and solar ovens.

Carbon Footprint Calculator:

The survey shows that 82.69% of the participants had previously heard the term carbon footprint, but only 27.88% were aware of existing websites and applications that could be used to calculate the carbon footprint. Even so, merely 14% of the total surveyed population have used carbon footprint calculators in the past (Figure 14). While some of the individuals who used available web-based calculators found it easy to use, the rest thought that the questions asked were unclear and unsuited for India. Further, only 4% of individuals succeeded in reducing their carbon footprint; 7% tried but were unsuccessful in doing so. Lastly, only 3% were continually using a calculator to record their carbon footprint.

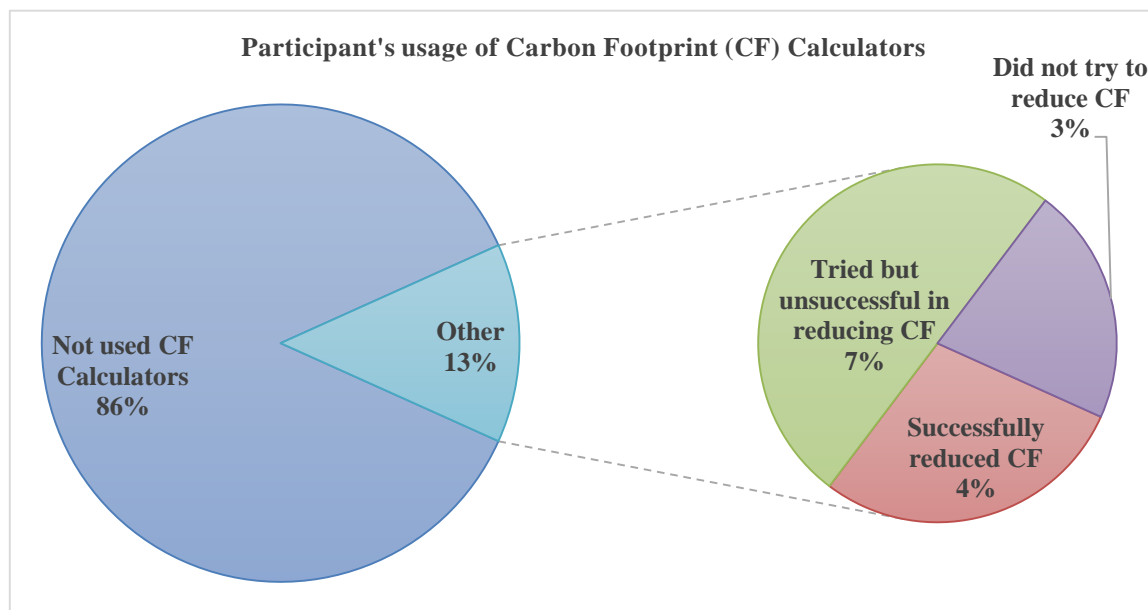


Figure14: Participant's usage of Carbon Footprint (CF) Calculators

**Conclusion:**

The following points summarize the outcome of this project:

1. There was little awareness among the respondents regarding the causes of carbon expenditure and ways in which carbon footprint could be reduced during daily activities.
2. Although most people were less willing to adopt an entirely sustainable lifestyle, they were ready to conserve energy at home, provided no monetary investment was involved.
3. By participating further in the project, they could be motivated to reduce their energy consumption which would lead to some monetary savings in the bills.
4. This project also highlighted the fact to the researchers that the reduction of carbon footprint needs to be a multi-step approach where each daily activity of the household, such as transport, fuel usage, electricity, etc., must be accounted for.

Thus, by correlating the daily expenses and carbon footprint every month using tools such as the Eco-life Carbon footprint calculator, more families could be encouraged to take a step towards sustainable living.

This project achieved its main objective of familiarizing common people with the term carbon footprint and ways to save energy during daily activities. The next phase of this project will include reaching out to more people by spreading awareness via webinars and workshops, along with offering user-friendly mobile applications to calculate carbon footprints. This would motivate people to consider changing their behavior to a more environmentally conscious one. The authors plan to collaborate with NGOs and Environmental agencies to extend this research work to other urban cities of India and, gradually, India as a whole.

References:

2021, 71% of Mumbai's greenhouse gas emissions due to electricity usage: Study. The Hindustan Times dated August 27, 2021. Website: <https://www.hindustantimes.com/cities/mumbai-news/71-of-mumbai-s-greenhouse-gas-emissions-due-to-electricity-usage-study-101630087951470.html> [Accessed on 2 December 2022.]



2021, 95% of Mumbai's power comes from coal, GHG big concern. The Times of India dated September 30, 2021. Website: <https://timesofindia.indiatimes.com/city/mumbai/mumbai-95-of-citys-power-comes-from-coal-ghg-big-concern/articleshow/86627697.cms> [Accessed on 2 December 2022.]

2021, Energy Crisis 2021: How Bad Is It, And How Long Will It Last? Forbes dated October 19, 2021. Website: <https://www.forbes.com/sites/christopherhelman/2021/10/19/energy-crisis-2021-how-bad-is-it-and-how-long-will-it-last/?sh=6335dc914c63> [Accessed on 2 December 2022.]

2021, Energy in India today. IEA dated August 16, 2021. Website: <https://www.iea.org/reports/india-energy-outlook-2021/energy-in-india-today> [Accessed on 2 December 2022.]

2022, Climate Change Indicators: Greenhouse Gases. United States Environmental Protection Agency dated August 1, 2022. Website: <https://www.epa.gov/climate-indicators/greenhouse-gases> [Accessed on 2 December 2022.]

2022, Energy Efficiency. Government of India Ministry of Power dated December 1, 2022. Website: <https://powermin.gov.in/en/content/energy-efficiency#> [Accessed on 2 December 2022.]

2022, Global Energy Crisis. IEA dated November 8, 2022. Website: <https://www.iea.org/topics/global-energy-crisis> [Accessed on 2 December 2022.]

Kaiser, F. G., Henn, L., & Marschke, B., 2020. Financial rewards for long-term environmental protection. *Journal of Environmental Psychology*.

Kappelle, M., van Vuuren, M. M., & Baas, P., 1999. Effects of climate change on biodiversity: A review and identification of key research issues. *Biodiversity and Conservation* 8(10): 1383–1397.



Maki, A., Burns, R., Ha, L., 2016. Paying people to protect the environment: A meta analysis of financial incentive interventions to promote proenvironmental behaviors. *Journal of Environmental Psychology*. 47: 242-255

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A Review on Zebrafish (*Danio rerio*) and Zebrafish embryo as a tool to study pyrethroid compounds' toxicity

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Abstract:

Now Zebrafish is the best animal model proved to study various molecules, in addition to understand biological functions, also to know the mechanism underlying the effect of any compound which can contribute to therapeutic discoveries. Pyrethroids are a class of man-made pesticides similar with the naturally available pesticide pyrethrum, which is produced by *Chrysanthemum* flowers. Pyrethroid insecticides are very commonly used residential and agricultural insecticides. As per scientific data available, it is observed that insecticides as well as pesticides have been involved in several neurological disorders in experimental animals and in humans too. Never the less, some data gap exists as their toxicity assessment is complex. Reviewing the valuable researches on effects of pyrethroid compound's toxicity on Zebrafish provides the useful information and proves that the Zebrafish are excellent model for toxicity studies. Nevertheless, comparatively less studies there on Pyrethroid's developmental neurotoxicity on the developing Zebrafish embryo. Concerning about pyrethroids, it can be assumed that, there may be higher risk of using these pesticides than currently acknowledged, as general population is using them extensively and in unsupervised manner. The precautionary step will be to guide our action on usage of pyrethroids to prevent undesirable consequences. Further research on alternatives to synthetic pyrethroids may need support from authorised institutes or government.

Key Words: Zebra Fish, Embryo, Pyrethroids, Toxicity

Introduction:

Pyrethroids

Since 1940, synthetic Pyrethroids are in use. Synthetic pyrethroids are derived from natural substances called Pyrethrins found in the extract from the flower heads of *Chrysanthemum cinerariaefolium* (Ramchandra, A.M. et al., 2019). Pyrethroids are said to be less poisonous to wildlife which biodegrade more effectively than organochlorine. Pyrethroids are used to spray inside the houses, to pervade bednets, which protect us from malarial mosquito bites. Deltamethrin and Fenvalerate are relatively less harmful to the nature and maximum non-target organisms than other insecticides (Adelsbach, T. L. & Tjeerdema, R. S., 2003). Though Pyrethroids are said as safe, they are found to be toxic to some insects like dragonflies, bees, mayflies and some other invertebrates which are the base of terrestrial and aquatic food webs (Zaveri, M., 2010). There are two different types of synthetic pyrethroids on the basis of their chemical structure; type I and II (Rehman, H. et al., 2014). Type I includes Allethrin, Bifenthrin, Permethrin, Phenothrin, Resmethrin, Tefluthrin and Teramethrin; whereas Type



It includes Cyfluthrin, Cyhalothrin, Cypermethrin, Deltamethrin, Fenvalerate, Fenpropathrin, Flucythrinate, Flumethrin, Fluvalinate and Tralomethrin (Thatheyus, A. J., & Selvam, A. G., 2013).

Zebrafish

The *Danio rerio*, commonly known as Zebrafish is a member of the family Cyprinidae. It is a tropical freshwater fish. Together with other ten species of the genera *Danio*, Zebrafish was firstly described by Buchanan Francis Hamilton in 1822 (Hamilton F., 1822). It has a short reproduction cycle which reach the maturity age within 3-6 months. Though Zebrafish is a popular aquarium fish, these days it is one of very important vertebrate models for genetic, medicine, developmental sciences, pharmacology and ecotoxicology (Scholz, S. et al., 2008; Scalzo, F. M. & Levin, E. D., 2004; Rubinstein, A. L., 2006). Zebrafish is easy to maintain in a laboratory conditions. The male and female adults are easily identifiable. One female can produce average of 190 eggs per spawning; which provide an effortless stock maintenance and enable a high number of organisms for tests (Rhaul De Oliveira, 2009).

Why and how Zebrafish?

There are some important characteristics that make Zebrafish as a model system logistically attractive are: (a) reduced size, (b) short life cycle, (c) short generation time (2-3 months: egg to reproductive adult), (d) good reproduction in captivity (e) possible daily breeding, (f) external fertilization (g) easily available non-adhesive eggs obtained from abundant spawning (h) optically transparent eggs that enable external observation of the embryo development (i) rapid embryonic development (Rhaul De Oliveira, 2009). The homology between Zebrafish and humans is also observed. This fish shows similarities in many ways including sense modalities like vision, olfaction, taste, touch, balance, hearing and cognitive behavioural and their sensory pathways. There has been continuous development of new techniques (e.g., microarrays technology, hybridizations and transgenic organisms) and involvement of large scale screening assays are various tools that contribute to the increased use of Zebrafish (Rubinstein, A. L., 2006, Zon, L.I. and Peterson, R. T., 2005; Spitsbergen, J. M. and Kent, M. L., 2003; Langheinrich, U., 2003; Chico, T. J. et al., 2008). The Zebrafish toxicity test was first published in 1984 by The International Organization for Standardization. Then, various countries propagated other toxicity testing standards through their use. It has been recorded that many environmental pollutants, including pyrethroids, hinder with the operation of the endocrine system, affect development, produce DNA damage, and induce oxidative stress in



Zebrafish (Jin, Y. et al., 2010; Jin, Y. et al., 2011; Shao, B. et al., 2012; MA, Y. et al., 2012). The “*Fish Embryo Test (FET)*” (OECD, 2006) has emerged as an alternative to determine the toxicity of substances and the Zebrafish as an excellent model for understanding toxic mechanisms of the chemicals. The embryos, including Zebrafish embryos, are not classified as animals, and for that are not subjects to welfare issues described by this directive (Nagel, R., 2002). Researchers have been paying attention, in adults and embryos assays, in the evaluation of the potential of chemical and metabolites that can cause any damage in genes. In the past few years, a wide variety of genotoxicity assays using adult fish have been used in ecotoxicological evaluations of environmental pollutants. Detection of DNA strand breaks produced by the chemical exposure remains the major approach. In another instance, few studies about fish chronic exhibition to genotoxic chemicals are available. The long-term exposure to a genotoxic chemical may induce a cascade of events resulting in changes in gene frequency in populations and mutational events (Van der Oost R. et al., 2003). The mostly used technique is the DNA microarray, which permit the simultaneous monitoring of the expression of thousands of genes. So that it can be used as a highly sensitive and informative biomarker for toxicity (Lettieri, T., 2006; Neumann, N. F. and Galvez, F., 2002).

Various researches on Zebrafish embryo and Zebrafish as a suitable animal model to study toxicity of Pyrethroid compounds

The mechanism of action of Pyrethroids in vertebrates is similar to insects, mainly involving the nervous system. There have been many experiments proved the hazardous consequences of Pyrethroids on rats and other mammals. Now focus has been moved from such experimental animals to the tiny zebra fishes due to their homology with human beings as well as no ethical issues remains to be clear.

In mammals and especially rats, two acute poisoning syndromes are described. “T-syndrome” is chiefly induced by natural Pyrethrins and type I Pyrethroids that is characterized by tremors, extreme sensitivity to sensory stimuli, ataxia, convulsions and, in some cases, paralysis. The “CS-syndrome” is induced by type II Pyrethroids that is characterized by hypersensitivity to external stimuli, choreoathetosis (sinuous writhing), salivation and sometimes paralysis (Narhasi, T. 2000).

De Micco, A. et al. investigated the developmental neurotoxicity of six common Pyrethroids; three compounds from type I (Permethrin, Resmethrin and Bifenthrin) and three compounds from type II (Deltamethrin, Cypermethrin, and I-Cyhalothrin). The study revealed that



Pyrethroid exposure to Zebrafish embryos provoked an increase in mortality and pericardial edema being dose dependent, which showed that type II compounds was the most influential. At the doses around the LC50, craniofacial abnormalities were observed in Permethrin and Deltamethrin exposure. The findings were accordant with mammalian studies exhibiting that Pyrethroids are mildly teratogenic at high doses. However, body axis curvature and spasms had been observed at lower doses, which were reminiscent of the classic syndromes occurring due to Pyrethroid toxicity. Diazepam treatment improved spasms, whereas treatment with the antagonist of sodium channel improved spasms and body curvature both, indicating that Zebrafish and mammals share similar pyrethroid-induced neurotoxicity (DeMicco, A. et al., 2010).

Awoyemi, O. M. et al. (2019) assessed the effects of the two Pyrethroid types on embryo and larval Zebrafish at laboratory concentrations and environmental relevant condition. Embryos were exposed to both types of Pyrethroids i.e. type- I (Permethrin, Bifenthrin) and type-II (Deltamethrin, λ -Cyhalothrin, Fenvalerate, Esfenvalerate). Results showed that Bifenthrin-(10 $\mu\text{g/L}$) and esfenvalerate-(1000 $\mu\text{g/L}$) notably ($p < 0.05$) reduced total distance travelled by larvae. Dose of 1000 $\mu\text{g/L}$ for Deltamethrin and λ -Cyhalothrin were lethal to larva which caused body axis curvature and pericardial edema. In comparison to control, Permethrin-(0.122 $\mu\text{g/L}$) upregulated Nrf2a and Casp-9 expressions, whereas λ -cyhalothrin-(0.053 $\mu\text{g/L}$) down regulated Nrf2a and Fenvalerate-(0.037 $\mu\text{g/L}$) downregulated GST at environmentally relevant concentrations. At laboratory concentrations, Permethrin-(1000 $\mu\text{g/L}$) upregulated Nrf2a, Casp-9 and p53 expressions, Bifenthrin-(10 $\mu\text{g/L}$) upregulated Casp-9 while Fenvalerate-(0.1 $\mu\text{g/L}$) and Esfenvalerate-(1000 $\mu\text{g/L}$) down regulated GST. The concentration dependent increase in carboxyl esterase activity was observed which positively correlated to total ROS.

Although Deltamethrin generally considered safe to use around humans, it is still neurotoxic. It is an allergen and causes asthma in some people. Kung, T. S. et al., used the Zebrafish to examine the hypothesis that developmental exposure to low doses of the Deltamethrin results in constant alterations in dopaminergic gene expression, neurochemistry, and locomotor activity. The results showed decreased transcript levels of the D1 dopamine (DA) receptor (*drd1*) and increased levels of tyrosine hydroxylase at 72 hours post fertilization. Larval fish had increased levels of one of DA metabolite i.e. homovanillic acid. Elevated larval swim activity was impaired by associated knockdown of the DA transporter. Dopaminergic dysfunction seems to promote locomotor deficits in larval Zebrafish. The results culminate the



need to understand the continuous effects of low-dose neurotoxicant exposure during development (Kung, T. S. et al., 2015).

Shabnam, K. R. et al. (2019), investigated the expression pattern of four genes, namely, you (you), yot (you-too), momo (mom) and ubo (u-boot) during early development of Zebrafish, that is, from 12 hpf to 48 hpf stages to two concentrations (100 and 200 $\mu\text{g/L}$) of Deltamethrin (DM). All four genes are known to play a vital role in development of notochord and somites. These four genes were analyzed by Reverse transcription (RT)-polymerase chain reaction and intensity of the bands showed induction in their expression after exposure to the toxicant. In spite of the expression of genes, it was noticed that DM caused abnormalities. It can be said from the results that translational pathway could have been affected.

Cyfluthrin is also a very common household pesticide. In a study by Kadiru, S. (2018), acute toxicity and developmental effects of Cyfluthrin were evaluated for embryo-larval Zebrafish at 24, 48, 72 and 96 hpf. The results showed that at 96 hpf, LC50 of Cyfluthrin to embryos was 3.443 $\mu\text{g/L}$. Cyfluthrin increased spontaneous contractions frequency and hatching rate, whereas it significantly reduced the body length in a dose and time-dependent manner. Morphological abnormalities including yolk sac edema, tail deformities and curved body axis were also observed. This study stated that short term exposure of Cyfluthrin causes lethality and significant developmental defects in Zebrafish in early life stages.

Cypermethrin (Cyp), is one of the most common contaminants in freshwater aquatic systems. Though Cypermethrin neurotoxicity has been deliberated in adult rodents, less information is available concerning the developmental toxicity of Cypermethrin in early life stages of fish.

A study by Shi, X. et al. (2011) revealed that 400 $\mu\text{g/L}$ Cypermethrin remarkably increased malondialdehyde production. Their results demonstrated that Cypermethrin could induce oxidative stress and generate apoptosis through the involvement of caspases in Zebrafish embryos. In addition, antioxidative enzymes activity including superoxide dismutase and catalase were significantly persuaded in Zebrafish larvae in a concentration-dependent manner. Cypermethrin also down-regulated *ogg1* and increased the expression of *p53* gene and the caspase-3 activity.

Jin, Y. et al. (2011) showed that exposure of Zebrafish embryos to 3 and 10 $\mu\text{g/L}$ Cypermethrin (cyp) for 3 days induces apoptosis and immunotoxicity, also confirmed an increase in the activity of caspase-3 and -9 after exposure. By analyzing mRNA levels of different genes related to programmed cell death (*p53*, *Apaf-1* and *caspase-3*), they reported



that Cyp induces oxidative stress, DNA damage, and apoptosis. These parameters were significantly increased, whereas the ratio between Bcl-2/Bax genes decreased significantly after exposure to 1 and 3 µg/L Cyp for 8 days.

Paravani, E. V. & Casco, V. H. (2018) also suggested that Cypermethrin induces DNA damage and oxidative stress by evaluating the possible genotoxic effect of Cyp and oxidative stress in retinal cells of adult Zebrafish exposed to 0.3 µg/L and 0.6 µg/L Cyp. Histological and immunofluorescence (IF) techniques were performed on Zebrafish which showed that there was presence of apoptotic cells in retina after 9 days of exposure with 0.6 µg/L Cyp. A double-stranded DNA damage marker i.e. histone γ -H2AX, was immunodetected in both the outer and inner nuclear layer after treatment of 0.6 µg/L Cyp, for 12 days; whereas the apoptotic antibody anti-caspase-3 was detected in the outer nuclear layer. From these results, it was confirmed that the activities of superoxide dismutase and catalase increased markedly after exposure to 0.6 µg/L Cyp. The similar treatment caused a positive regulation of the mRNA levels of both genes.

In a research by Chow, W. S. (2009), Zebrafish embryo-larvae were used as a model to investigate the responses of biomarker gene expression to pesticides. The biomarkers selected include the biotransformation phase I cytochrome P450 (CYP) enzymes, CYP1A and 3A65, enzymes for the antioxidant defense system pi-class glutathione S-transferase (GST) and catalase (CAT), the multiple drug resistance gene (MDR1) which encodes P-glycoprotein and the yolk precursor protein vitellogenin (VTG1) which is an *in vivo* biomarker for estrogenicity in oviparous vertebrates. Inductions of CAT and GST demonstrated oxidative-stress-inducing potential of chlorpyrifos and cypermethrin.

Due to great photo stability and insecticidal action, Bifenthrin (BF) is majorly used as a miticide in nurseries, orchards and homes. In one of the studies, the developmental effects of Bifenthrin were analysed in embryo and larval Zebrafish. The hatching process of larva was accelerated by Bifenthrin in a concentration-dependent way, associated with increased spontaneous movement. Assays for locomotor activity showed that 96 hpf larvae revealed impaired swimming behaviour after treatment with 50, 100, and 200 µg/L from 3 to 84 hpf. Furthermore, expression of vitellogenin I were remarkably induced in larvae exposed to 150 µg/L Bifenthrin for 72 hours, suggesting the disruption in the level of endocrine. In summary, these studies exhibited that Bifenthrin was developmentally toxic to early life stages of Zebrafish. It could also impair the behaviour having much importance in the assessment of their ecological fitness (Jin, M. et al., 2009).



Fenvalerate (FV) is one of the most dynamic Pyrethroid insecticides as it can constrain a wide range of insects in public health situations, animal houses and agricultural fields. Gu, A. et al. (2010) studied Fenvalerate toxicity on Zebrafish. Their results demonstrated that larvae treated with Fenvalerate for 24–96 h displayed obvious morphological abnormalities. The LC₅₀ concentrations were 131.95 µg/L, 107.18 µg/L, 21.76 µg/L, and 6.25 µg/L for 24, 48, 72 and 96 hrs respectively. Acridine orange staining showed notable signs of apoptosis mainly in the brain. Furthermore, FV induced alterations in Superoxide dismutase activity in larvae were concentration dependent and correlated to the length of treatment. FV also down-regulated the *ogg1* and *dlx2* genes' expression in a concentration dependent manner, suggestive of oxidative-DNA repair system as well as neurogenesis were impaired.

Sometimes two or more than two compounds induce more damages when introduced simultaneously. In previous study by Yang, Y. et al. (2014), embryo-larval Zebrafish were used to explore the combined effects of lethal concentrations of Permethrin and Cypermethrin. Their data exhibited that the mixture of Permethrin and Cypermethrin caused higher occurrence of morphological defects, higher inhibition in expression of proneural gene and more oxidative stress when compared to only one chemical at the equivalent doses. The results suggest that the combination of both types of pyrethroids produce a higher risk to fishes in the water column.

A commercial product called Pesguard FG161™ is a mixture of d-tetramethrin and cyphenothrin (in a 1:3 ratio), is widely used for quick control of dengue vector, i.e. *Aedes aegypti*, in the disease outbreaks. In one of the research, Zebrafish embryos were exposed to a binary mixture of pyrethroids at different concentrations. This dual mixture was extensively poisonous to Zebrafish embryos being concentration and time dependent. The most common toxic effect observed was coagulation of embryos along with lack of heartbeat and lack of somite formation (Mendis, J. C. et al., 2018).

Pyrethroids were hypothesised to affect their reproductive capacity along with other behavioural, morphological and genetic changes. In one of the research, both male and female Zebrafish, were exposed to 96-h LC₅ values of Deltamethrin (DM) (0.016 µg dm⁻³) and Achook (0.025 µg dm⁻³) for 3 months. To observe the fecundity and hatchability, the fish were returned back to normal water and permitted to breed. The results showed remarkable reductions in fecundity and hatchability compared to control group. It was concluded that lower concentrations (at 96-h LC₅ values) of both of the pesticides can have a notable impact on the reproduction of Zebrafish (Sharma, D. K. & Ansari, B. A., 2010).



For last few years, enantioselectivity of chiral pollutants has attracted researchers due to the difference in toxicology and environment fate between enantiomers. Sps (Synthetic pyrethroids) are from a family of chiral germicides having a great number of stereoisomers.

Toxicity assays of each isomer and racemate of Fenvelarate (FV) were performed using *Daphnia magna* (*D. magna*), Zebrafish (*Daniorerio*) and Zebrafish embryo-larval in a research by Ma, Y. et al. (2009). The examination of 4 day old Zebrafish embryo & larvae demonstrated that exposure to Fenvelarate enantioselectively conviced crooked body, yolk sacedema and pericardial edema; also other observation came out that the α S-2S-FV was 3.8 times stronger than the other isomers in 96-h mortality. The results showed that, in evaluating the ecological effects of SPs, the enantiomeric differences should also be considered.

In one of the studies, the individual enantiomers of beta cypermethrin were tested in Zebrafish embryo and it demonstrated that beta-Cypermethrin enantioselectively provoked yolk sac edema, pericardial edema and crooked body. The results suggest that, to evaluate ecotoxicological effects of Cypermethrin, enantio selective effects of beta-CP should also be considered (Xu, C. et al., 2010).

Bifenthrin (BF) has an adverse effect on the behaviour and development of other than target organisms. However, there have been very few researches generated on effects of various enantiomers on the locomotor behaviour for SPs in Zebrafish, and whether locomotor actions are associated with the developmental toxicities remains to be clear.

In another research, enantioselectivity of Bifenthrin (BF, 1S and 1R), on acute locomotor activity and embryonic–larval developmental toxicities in Zebrafish were primarily evaluated. Administration of 20 μ g/L of one enantiomer of Bifenthrin had distinctive effects on locomotor activity of larvae at 4dpfs under required light conditions. The results indicated that the enantio selectivity in locomotor activity might be due to differential effects on development. Moreover, 1R-BF induced the spontaneous movement and hatching process, while 1S-BF seemed to be inhibitory. The results suggest that, to achieve more comprehensive health risk assessments of chiral pesticides, there is a need to link behavioral changes to developmental toxicities (Jin, M. et al., 2010). Other research suggests that cis-bifenthrin could increase the transcription of genes related to the immune system in Zebrafish, including IL-8, IL-1 β , and CXCL-C1c (Jin, Y. et al., 2013).

Due to high lipophilic nature, Synthetic pyrethroids are demonstrated to bioaccumulate in fish (4938 ng/g) (Richards, J. et al., 2017). 3-Phenoxybenzoic acid (PBA) is an important metabolite formed after metabolism of Deltamethrin (DM). One research was conducted in



order to demonstrate the toxic reactions in Zebrafish embryos & larvae to DM and PBA. Deltamethrin treated embryos or larvae demonstrated increased mortality, delayed hatching time, decreased rate of hatched embryos, increased heartbeat rate and decreased blood flow; also reduced body and eye pigmentation in a dose dependent manner was observed. DM also induced pericardial and yolk sac edema. Together with crooked notochord, deformation of tail was also observed in hatched and unhatched embryos. Whereas in PBA exposed to embryos/larvae, increased embryos & larval length and yolk sac size were noticed. Other deformities such as yolksac edema and pericardial edema, in some embryos reduced eye and body pigmentation were too observed. These responses were not as critical as seen in parental compound suggesting that Deltamethrin is more noxious than metabolite PBA. The results give a better perception of the probable consequences of fish treated with Deltamethrin and PBA (Kuder, R. S. & Gundala, H. P., 2018).

Similarly total protein content was estimated in one of the research after exposure of 5 µg/L of deltamethrin for 6 days to Zebrafish. Alterations of various proteins in 5 different tissues named liver, brain, kidney, ovary and testis in adult Zebrafish were identified. The protein content was increased in both male and female brain, kidney and ovary while it was decreased in male and female liver tissue and testis. Compared to their control groups, protein bands being more eminent in brain, kidney, ovary and testis in deltamethrin treated groups (Shamshad Begum S. et al., 2016). Some studies have indicated that endocrine disrupters, such as SPs and 17β-estradiol, could induce the mRNA expression of genes involved in the innate immune system of Zebrafish larvae (Jin, Y. et al., 2010; Jin, M. et al., 2010).

Conclusion

The extensive research on Zebrafish (*Danio rerio*) represents it as an ideal model organism with diverse applications in the various fields of science. Specifically in developmental stages of life, researches give remarkable information unfolding various pathways. The review suggests that Zebrafish and Zebrafish embryo, as a model, gives better understanding to promote a change in conventional applications of Pyrethroid usage as well as its use in other similar toxicology studies.

References:

- Adelsbach, T. L., & Tjeerdema, R. S., 2003. Chemistry and fate of fenvalerate and esfenvalerate. *Reviews of Environmental Contamination and Toxicology*, 137-154.
- Awoyemi, O. M., Kumar, N., Schmitt, C., Subbiah, S., & Crago, J., 2019. Behavioral,



- molecular and physiological responses of embryo-larval zebrafish exposed to types I and II pyrethroids. *Chemosphere*, 219, 526-537.
- Chico, T. J., Ingham, P. W., & Crossman, D. C., 2008. Modeling cardiovascular disease in the zebrafish. *Trends in cardiovascular medicine*, 18(4), 150-155.
- Chow, W. S., 2009. Effects of Pesticides on Biomarker Gene Expressions in Zebrafish Embryo-larvae (Doctoral dissertation, Chinese University of Hong Kong).
- DeMicco, A., Cooper, K. R., Richardson, J. R., & White, L. A., 2010. Developmental neurotoxicity of pyrethroid insecticides in zebrafish embryos. *Toxicological Sciences*, 113(1), 177-186.
- Gu, A., Shi, X., Yuan, C., Ji, G., Zhou, Y., Long, Y., & Wang, X., 2010. Exposure to fenvalerate causes brain impairment during zebrafish development. *Toxicology letters*, 197(3), 188-192.
- Hamilton, F., 1822. An account of the fishes found in the river Ganges and its branches (Vol. 1). Archibald Constable.
- Jin, M., Li, L., Xu, C., Wen, Y., & Zhao, M., 2010. Estrogenic activities of two synthetic pyrethroids and their metabolites. *Journal of Environmental Sciences*, 22(2), 290-296.
- Jin, M., Zhang, X., Wang, L., Huang, C., Zhang, Y., & Zhao, M., 2009. Developmental toxicity of bifenthrin in embryo-larval stages of zebrafish. *Aquatic Toxicology*, 95(4), 347-354.
- Jin, M., Zhang, Y., Ye, J., Huang, C., Zhao, M., & Liu, W., 2010. Dual enantioselective effect of the insecticide bifenthrin on locomotor behavior and development in embryonic-larval zebrafish. *Environmental Toxicology and Chemistry*, 29(7), 1561-1567.
- Jin, Y., Chen, R., Liu, W., & Fu, Z., 2010. Effect of endocrine disrupting chemicals on the transcription of genes related to the innate immune system in the early developmental stage of zebrafish (*Danio rerio*). *Fish & shellfish immunology*, 28(5-6), 854-861.
- Jin, Y., Pan, X., Cao, L., Ma, B., & Fu, Z., 2013. Embryonic exposure to cis-



- bifenthrinenantioselectively induces the transcription of genes related to oxidative stress, apoptosis and immunotoxicity in zebrafish (*Danio rerio*). *Fish & shellfish immunology*, 34(2), 717-723.
- Jin, Y., Zhang, X., Shu, L., Chen, L., Sun, L., Qian, H., & Fu, Z., 2010. Oxidative stress response and gene expression with atrazine exposure in adult female zebrafish (*Danio rerio*). *Chemosphere*, 78(7), 846-852.
- Jin, Y., Zheng, S., & Fu, Z., 2011. Embryonic exposure to cypermethrin induces apoptosis and immunotoxicity in zebrafish (*Danio rerio*). *Fish & shellfish immunology*, 30(4-5), 1049-1054.
- Jin, Y., Zheng, S., Pu, Y., Shu, L., Sun, L., Liu, W., & Fu, Z., 2011. Cypermethrin has the potential to induce hepatic oxidative stress, DNA damage and apoptosis in adult zebrafish (*Danio rerio*). *Chemosphere*, 82(3), 398-404.
- Kadiru, S., 2018. Developmental toxicity of Cyfluthrin in Embryo – Larval stages of Zebrafish. *International Journal of Advanced Scientific Research and Management*, 3(2).
- Kuder, R. S., & Gundala, H. P., 2018. Developmental toxicity of deltamethrin and 3-phenoxybenzoic acid in embryo–larval stages of zebrafish (*Danio rerio*). *Toxicology mechanisms and methods*, 28(6), 415-422.
- Kung, T. S., Richardson, J. R., Cooper, K. R., & White, L. A., 2015. Developmental deltamethrin exposure causes persistent changes in dopaminergic gene expression, neurochemistry, and locomotor activity in zebrafish. *Toxicological Sciences*, 146(2), 235-243.
- Langheinrich, U., 2003. Zebrafish: a new model on the pharmaceutical catwalk. *Bioessays*, 25(9), 904-912.
- Lettieri, T., 2006. Recent applications of DNA microarray technology to toxicology and ecotoxicology. *Environmental health perspectives*, 114(1), 4-9.
- Ma, Y., Chen, L., Lu, X., Chu, H., Xu, C., & Liu, W., 2009. Enantioselectivity in aquatic toxicity of synthetic pyrethroid insecticide fenvalerate. *Ecotoxicology and Environmental Safety*, 72(7), 1913-1918.



- Ma, Y., Han, J., Guo, Y., Lam, P. K., Wu, R. S., Giesy, J. P., & Zhou, B., 2012. Disruption of endocrine function in in vitro H295R cell-based and in in vivo assay in zebrafish by 2, 4-dichlorophenol. *Aquatic toxicology*, 106, 173-181.
- Mendis, J. C., Tennakoon, T. K., & Jayasinghe, C. D., 2018. Zebrafish embryo toxicity of a binary mixture of pyrethroid insecticides: d-tetramethrin and cyphenothrin. *Journal of toxicology*, 2018.
- Nagel, R., 2002. DarT: The embryo test with the Zebrafish *Danio rerio*--a general model in ecotoxicology and toxicology. *Altex*, 19, 38-48.
- Narahashi, T., 2000. Neuroreceptors and ion channels as the basis for drug action: past, present, and future. *Journal of Pharmacology and Experimental Therapeutics*, 294(1), 1-26.
- Neumann, N. F., & Galvez, F., 2002. DNA microarrays and toxicogenomics: applications for ecotoxicology?. *Biotechnology advances*, 20(5-6), 391-419.
- OECD, OECD guideline for the testing of chemicals, draft proposal for a new guideline, Fish Embryo Toxicity (FET) Test, 2006. URL: <https://www.oecd.org/chemicalsafety/testing/36817070.pdf>
- Paravani, E. V., & Casco, V. H., 2018. Genotoxicity Induced by Cypermethrin in the Zebrafish Retina. *Genotoxicity-A Predictable Risk to Our Actual World*, 41.
- Ramchandra, A. M., Chacko, B., & Victor, P. J., 2019. Pyrethroid poisoning. *Indian journal of critical care medicine: peer-reviewed, official publication of Indian Society of Critical Care Medicine*, 23(Suppl 4), S267.
- Rehman, H., Aziz, A. T., Saggu, S. H. A. L. I. N. I., Abbas, Z. K., Mohan, A. N. A. N. D., & Ansari, A. A., 2014. Systematic review on pyrethroid toxicity with special reference to deltamethrin. *Journal of entomology and zoology studies*, 2(6), 60-70.
- Rhaul de Oliveira, 2009 (pp. 4-6) "Background, Aim and Scope," Zebrafish early life-stages and adults as a tool for ecotoxicity assessment, Universidade de Aveiro. URL: <https://ria.ua.pt/bitstream/10773/8838/1/6237.pdf>
- Richards, J., Lu, Z., Fu, Q., Schlenk, D., & Gan, J., 2017. Conversion of pyrethroid insecticides to 3-phenoxybenzoic acid on urban hard surfaces.



- Environmental Science & Technology Letters, 4(12), 546-550.
- Rubinstein, A. L., 2006. Zebrafish assays for drug toxicity screening. *Expert opinion on drug metabolism & toxicology*, 2(2), 231-240.
- Scalzo, F. M., & Levin, E. D., 2004. The use of zebrafish (*Danio rerio*) as a model system in neurobehavioral toxicology. *Neurotoxicology and teratology*, 26(6), 707-708.
- Scholz, S., Fischer, S., Gündel, U., Küster, E., Luckenbach, T., & Voelker, D., 2008. The zebrafish embryo model in environmental risk assessment—applications beyond acute toxicity testing. *Environmental science and pollution research*, 15(5), 394-404.
- Shabnam, K. R., Gangappa, D., & Philip, G. H., 2019. Zebrafish embryos exposed to deltamethrin exhibit abnormalities despite induced expression of related genes (you, you-too, momo and u-boot). *Toxicology and Industrial Health*, 35(1), 11-19.
- Shamshad Begam, S., Suvarchala, G., & Philip, G. H., 2016. Protein profile in tissues of zebrafish exposed to deltamethrin. *Journal of Bio Innovation*, 5(6), 914-922.
- Shao, B., Zhu, L., Dong, M., Wang, J., Wang, J., Xie, H., & Zhu, S., 2012. DNA damage and oxidative stress induced by endosulfan exposure in zebrafish (*Danio rerio*). *Ecotoxicology*, 21(5), 1533-1540.
- Sharma, D. K., & Ansari, B. A., 2010. Effect of the synthetic pyrethroid Deltamethrin and the neem-based pesticide Achook on the reproductive ability of zebrafish, *Danio rerio* (Cyprinidae). *Fisheries & Aquatic Life*, 18(3), 157-161.
- Shi, X., Gu, A., Ji, G., Li, Y., Di, J., Jin, J., & Wang, X., 2011. Developmental toxicity of cypermethrin in embryo-larval stages of zebrafish. *Chemosphere*, 85(6), 1010-1016.
- Spitsbergen, J. M., & Kent, M. L., 2003. The state of the art of the zebrafish model for toxicology and toxicologic pathology research—advantages and current limitations. *Toxicologic pathology*, 31(1_suppl), 62-87.
- Thatheyus, A. J., & Selvam, A. G., 2013. Synthetic pyrethroids: toxicity and biodegradation. *Appl Ecol Environ Sci*, 1(3), 33-36.
- Van der Oost, R., Beyer, J., & Vermeulen, N. P., 2003. Fish bioaccumulation and biomarkers in environmental risk assessment: a review. *Environmental toxicology and pharmacology*, 13(2), 57-149.



Xu, C., Tu, W., Lou, C., Hong, Y., & Zhao, M., 2010. Enantioselective separation and zebrafish embryo toxicity of insecticide beta-cypermethrin. *Journal of environmental sciences*, 22(5), 738-743.

Yang, Y., Ma, H., Zhou, J., Liu, J., & Liu, W., 2014. Joint toxicity of permethrin and cypermethrin at sublethal concentrations to the embryo-larval zebrafish. *Chemosphere*, 96, 146-154.

Zaveri, M., 2010. Study links pesticides to river contamination. *The Daily Californian*.

Zon, L. I., & Peterson, R. T., 2005. In vivo drug discovery in the zebrafish. *Nature reviews Drug discovery*, 4(1), 35-44.

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Book: Strobilanthes in the Western Ghats, India: The magnificent role of nature in speciation

Author: Jomy Augustine

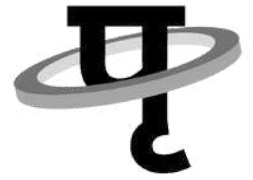
Publisher: Malabar Natural History Society, Kozhikode

Year: 2018

Nilgiris literally means blue mountains. These hills in the Western Ghats earned this fascinating name from the mass flowering of plants in *Strobilanthes* genus. One of the most distinctive features of the genus is they flower only once in a long period of time. Mass flowering of *Neelakurinji*, *Strobilanthes kunthiana* occurs once in twelve years had invited close to 1 million visitors in 2018 in Kerala alone! *Strobilanthes* is a genus that grows naturally only in tropical Asia and is the second-largest genus in *Acanthaceae*. Interestingly, this genus is seen in the Indian peninsula, Sri Lanka, the Greater Himalaya region, and the mountains of southeast Asia. The book, *Strobilanthes in the Western Ghats, India: The magnificent role of nature in speciation* by Dr. Jomy Augustine is priceless to botanists and naturalists in every aspect. The author succeeded in providing a stunning photographic guide to 55 of 64 taxa in the genus *Strobilanthes* from peninsular India. India has 160-170 species in this genus. The author shares his decades of research on the genus in peninsular India through detailed information on habits, habitats, the evolutionary trail of the genus, mass blooming and flowering periodicity, the pattern of distribution of the genus from Maharashtra to Agasthyamalai, specially dedicated plates on different kinds of stems, leaves, flowers, and, stamens and more importantly an artificial key for the identification of species of genus *Strobilanthes* based on the characters of leaves. The book serves as a complete reference book on the genus *Strobilanthes* in peninsular India; a photographic guide; a narrative on the ecological aspects of the genus; an artificial key for the identification of species of genus *Strobilanthes*; finally a perfect coffee table book. A book of this magnitude seldom happens in the world of plants. This book is a remarkable and enormous attempt by the well-known taxonomist, Dr. Jomy Augustine to throw light on the lesser-known genus, *Strobilanthes*. It is also designed to build more awareness in the public about the conservation of unique plants like *Strobilanthes* as they also contribute to the economy through tourism. Massive blooms of genus *Strobilanthes* in Nilgiris are a dream for every botanist or plant person. Hence this book is a must-have for all plant lovers.

Dr. Jis Sebastian

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Book: Wildlife of India

Authors: Bikram Grewal, Manjula Mathur, and Tripta Sood

Publisher: Princeton University press

Year: May 2022

This delightful book is a comprehensive guide to the wildlife in India. It starts off with a helpful introduction to the various geographical zones in India, how they form the major habitats and the biodiversity they support. It includes a comprehensive guide to flora and fauna identification, including common anatomical/phenotypic descriptors and what they mean in layman terms with helpful illustrations.

The book describes keystone species throughout India and the major threats they face. It includes a guide to the best wildlife-watching sites in India. Crucially, it also includes tips on enjoying a forest when you visit and how to behave in the forest.

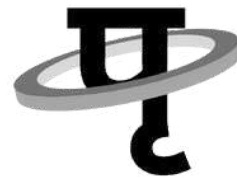
The entire book is written in very simple but engaging language that makes it suitable for children and adults alike. The stunning photography deserves a special mention and will draw even those persons who may not otherwise be interested in the subject. If you are looking to read or gift only one book on the wildlife of India, this is amongst the best out there.

Dr. Shachi Joglekar

Technical Advisor,

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Mumbai, India



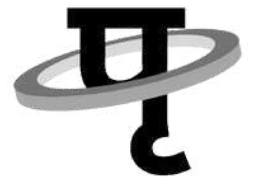
Two-Day National Conference on “Climate, Community and Conservation” September 26-27, 2022

Dr. Sagarika Damle, Dr. Nishith Dharaiya

WCB Research Foundation collaborated with Navrachana University Center for Environment Research and Innovation (NUCERI), Vadodara for a two-day National Level Conference titled ‘Climate, Community and Conservation’ held on 25th and 26th September 2022 at Navrachana University, Vadodara. The main objective of the conference was to discuss the important issues of natural resource conservation in the changing climate with the objectives of exchanging and sharing, scholarly research on a single platform, enhancing the opportunity for creating a community of practice for conservation. Researchers across the country were invited to present their work based on the central theme of ‘Community action for Climate change and Conservation of Natural resources’ which was further categorised into 4 sub themes, namely, Climate change and Mitigation measures, Community actions for Sustainable development, Conservation of Nature and Natural Resources, Advances in Conservation Science. The Conference was inaugurated by Prof. Devesh Sinha, Director, Delhi School of Climate Change and Sustainability and Professor, Department of Geology, University of Delhi, who gave an illustrative talk on ‘Ocean-Climate Connection-a Lesson for future. The inaugural function was graced by Dr. Nishith Dharaiya, the founder of WCB Research Foundation, Prof. Pratyush Shankar, the Provost of Navrachana University along with Prof. A.V. Ramchandran, Dr. Sandeep Vasant, Dr Madhvi Joshi and other dignitaries.

Distinguished speakers, Dr. Jitendra Gavli, Dr. Gururaja KV, Dr. Nita Shah, Dr. Prasoon Gargava, Dr. Prachi Thatte, Dr. Govindswami Umopathy, Prof. Pratyush Shanker, Dr. Chandraprakash Singh invited from different parts of the country delivered their talks on the different aspects of conservation biology during the two days of interactive sessions.

A total of 35 Oral presentations and 40 Posters were presented by research scholars attending the conference. Prizes were awarded to the successful candidates in the oral and poster categories. The first day ended with a delightful cultural program presented by the students of Navrachana University.

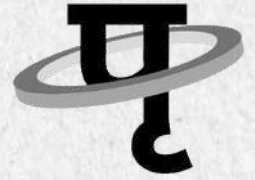


The second day of the conference was hallmarked by the presentations by five young conservation biologists shortlisted out of 22 nominations to compete for the coveted, Prof. M.I. Patel National Award-2022 of Rs. 50,000 cash prize and a Trophy, constituted by WCB Research Foundation. Out of the five finalists, Ms. Sreeparna Dutta, working for the conservation of Freshwater Turtles in Uttar Pradesh bagged the first position. The award ceremony was followed by the valedictory function presided over by Dr Ansuman Sharma, the Conservator of Forest, Vadodara circle where both the collaborative institutions expressed satisfaction over the deliberations and outcome of the two days that would inspire young researchers to pursue the field of Biodiversity Conservation and find innovative solutions to combat the threats posed by the Climate change. The organizers are grateful to The Department of Science and Technology, Govt of India, Gujarat State Biotechnology Mission (GSBTM), Gujarat Council on Science and Technology (GujCOST), HDFC Bank and TeaPost for their financial support.



Proud WCB Research Foundation Team with Ms. Sreeparna Dutta, Prof. M. I. Patel National Awardee for being an enthusiastic Wildlife biologist & conservation researcher. Felicitated at National Conference on Climate, Community, and Conservation in association with NUCERI, Navrachana University.

Achievements



Mr. Shailesh Desai, a Member of WCB Research Foundation and have recently qualified UGC-CSIR NET examination under the JRF category in life sciences subject with all India rank 37. Formerly he was involved in studying HWC and he has an immense interest in studying landscape, genetic and population ecology, especially canids of India.

Ms. Shalu Mesaria, Senior project fellow of WCB Research Foundation has awarded as "Environmental Educator of year 2022" by the WeNaturalist People of Nature Awards 2022 for her outstanding contribution in conservation education to the local people for mitigating human-sloth bear conflicts in Gujarat.



The IDEA WILD FOUNDATION of the USA has supported Mr. Pratikkumar Desai, with basic field instrument and a laptop computer for his ongoing PhD studies on sloth bear in Gujarat. Mr. Pratik is a PhD scholar at Hemchandracharya North Gujarat University and also the Director of Activities at WCB Research Foundation.

Dr. Hardik Patel, the Executive Director of WCB Research Foundation. Currently providing services in the field of Environment, Fire and Safety and has received a Gold medal in Post Diploma in Industrial Safety from Sankalchand University, Visnagar, Gujarat



New Projects



Ecological Assessment of Wadhvana Wetland to Understand Ecosystem Dynamics and Ecosystem Services



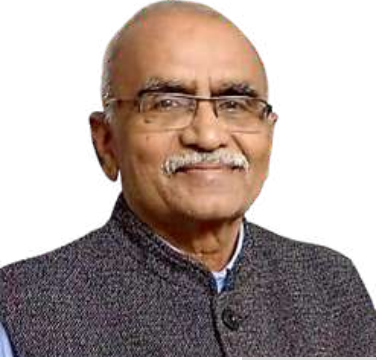
- Project leader: Ms. Shalu Mesaria
- Project fellow: Ms. Pranjali Khadilkar
- Intern: Mr. Aditya Dharaiya
- Funded by: Vadodara Wildlife Division, Vadodara

Evaluation and Monitoring of Sloth bear Corridors in Central Gujarat: Phase III



- Project leader: Ms. Shalu Mesaria
- Project fellow: Mr. Vishal Patel
- Intern: Mr. Sarthak Chaudhary
- Funded by: Bear Trust International & Vadodara Wildlife Division, Vadodara

Announcements



In the Memory of Dr. M. I. Patel

WCB Research Foundation

Dr. M. I. Patel National Award

for Young Wildlife & Conservation Biologist- 2023

WCB Research Foundation confers an award every year to young researchers pursuing their research in the field of Wildlife & Conservation biology.

If you are a wildlife biologist, conservationist, or a wildlife researcher, grab this golden opportunity and nominate yourself for the award.

The deadline to apply for the award is June 30, 2023



www.wcbresearch.in

Field based training on contemporary techniques for research & monitoring of bears & bear habitats

Jointly organized by

Wildlife and Conservation Biology Research Foundation
&
Vadodara Wildlife Division, Vadodara

Date: February 25 to 28, 2023

Venue: Jambughoda Wildlife Sanctuary

The field based training programme is designed to train young researcher, students and forest field staff with the recent techniques and its hand on experience for bear research and management. The training course will include the advanced techniques for monitoring and habitat assessment in bear landscape

COURSE OUTLINE

- Habitat evaluation & assessment
- Monitoring of bear population
- Field work, data collection & analysis techniques
- Camera trapping

WHO CAN APPLY?

- M.Sc. student, young researcher working in the field of ecology and wildlife conservation, PhD scholar pursuing their research in wildlife and conservation
- Young faculties and forest field officer

HOW TO APPLY?

The interested candidate may send an email to wcbresearchfoundation@gmail.com with following attachments before 25th Jan. 2023

- An application with a clear statement of interest
- One page curriculum vitae
- A letter of reference from immediate supervisor

Registration Fee
2000 INR

(Includes accommodation on sharing basis, Food, Training materials and Field work)

All the participants will be selected by a selection committee. Selected 25 candidates will be notified by Feb 1st 2023 for the further procedure including registration and other information.

FOR FURTHER DETAILS AND TO APPLY CONTACT

The Course Coordinator,
WCBRF Training Course
Email: wcbresearchfoundation@gmail.com
Phone: +91 8238882783/ +91 8320519905



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- Plant Diversity
- Ethnobotany
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- Wetland Conservation

Essential Qualification

B.Sc. or M.Sc. in the respective field

M.Sc. dissertation students are encouraged to apply

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Stipend: There is no any provision of stipend; however local travel and accommodation will be covered in case of ongoing WCB Projects. A Certificate of completion will be provided after the successful completion of the internship.

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Note: WCB Research Foundation charge a small token fee for the internship, that includes internship materials, fees to the mentors and helping in data analysis, report preparation and publication.

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Guidelines to contributors

Prithivya publishes original Research articles, Short Notes, and Comments about wildlife (Flora and Fauna) and conservation biology. Methodological and technical contributions are also welcome. Only submissions in English will be considered for publication. Identification of species, annotated checklists, trip reports, new species records, book reviews, letters, announcements, notices, news from the wildlife world are also welcome.

The text and captions of tables, figures, photographs and appendices should be combined in one Microsoft Word® (“.doc,” “.docx”) file format. The preferred font is ‘Times New Roman’ in 12 point, with single space.

Photographs, artwork, maps, diagrams, etc. should have at in 300dpi resolution, after the final acceptance, we may ask to send a JPEG file with maximum quality as separate attachments.

Plagiarism: Prithivya is strictly following the ethics of research and publication and we publish the articles with less than 15% of similarities. The articles submitted to Prithivya will be checked for the plagiarism and will be return to the author, in case of similarity more than 15%.

Types of Manuscript

The word counts include the Abstract, whole text and References. The Table and Figure captions are excluded from the word count.

1. Research articles: up to 5000 words
2. Short notes: 1500 words
3. Important sightings: 250-350 words with proper GPS location
4. Important findings: 250-500 words with proper justification,
5. Research paper: Up to 10,000 words (excluding appendix)

Preparation and submission of manuscripts

Submitted manuscripts should follow the standard structure of scientific manuscripts: Abstract, Introduction, Methods, Results, Discussion, Acknowledgments, and References. However, Prithivya has certain flexibility in the section structure. The MS not prepared according to these guidelines will be send back to the authors and subjected to rejection.

Title: Try to keep short and concise

Author/s name: Last name first

Affiliation of Author/s and email of corresponding Author

Abstract: 250 words, should contain a summary of all major findings of the work. Abstract is not necessary for Short Note papers.

Keywords: 4-5 words for indexing and literature searching; do not repeat words in the titles

Introduction: should provide a review of the state-of-the-art and existing knowledge on the topic as well as state the hypothesis, explain the issues or problems that motivate the research and the knowledge gaps and/or the main questions to be answered.

Methods: Include information about the study species, area, number of samples, studied population(s), methods (both field and statistical), and equipment. It should be enough clear so anybody could repeat the study.

Results: This section describes the findings of the study, without any further explanation or comment on the findings. Results are presented often in Tables and/or Figures with proper labeling/numbering. The caption of Tables and Figures should be self-explanatory. Photographs are also allowed. Species checklists should be presented as appendix.

Discussion: Summarize the main findings of the study (but do not repeat results), explain and comment the results in relation to previous research. Discuss limitations of the study and potential needs in future research.

Conclusion: Optional. It should contain 10-15 sentences, concisely stating the main outcomes of the study.

References: Strictly follow the APA style of referencing. References should be arranged alphabetically by first author. Following are some examples for references.



Unpublished sources

“(Harkirat Sangha, in litt., e-mail/letter dated 02 January 2013)”; if oral, “(Rajah Jayapal, verbally, dated 15 December 2013)”.

Journal articles

Naoroji, R., & Sangha, H. S., 2011. Threats to habitat and wildlife in Changthang and Rupshu areas of Ladakh: a case study at Hanle. *Prithiviya* 7 (1): 2–6.

Books

Futehally, Z. (ed.) 2006. *India through its birds*. 1st ed. Bangalore, India: Dronequill Publishers Pvt. Ltd. Pp. 1–214.

Book chapter

Pittie, A., 2011. Stray Feathers (1872–1899) (p. 247). In: *Priority! The dating of scientific names in ornithology: a directory to the literature and its reviewers*. Dickinson, E. C., Overstreet, L. K., Dowsett, R. J., & Bruce, M. D. (eds.). Northampton, UK: Aves Press Limited.

Website

2013. Kadalundi makes history with new gull species. *The Hindu* (Thiruvananthapuram ed.) dated February 7, 2013. Website: <http://www.thehindu.com/todays-paper/tp-national/tp-kerala/kadalundi-makes-history-with-new-gull-species/article4388171.ece>. [Accessed on 21 July 2014.]

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ETHICAL MATTERS

Authors involved in the usage of experimental animals and human subjects in their research work should seek approval from the appropriate Institutional Animal Ethics Committee in accordance with "Principles of Laboratory Animal Care". The material and methods section of the manuscript should include a statement to prove that the investigation was approved and that informed consent was obtained.

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