



1969-2019

PROCEEDING

ISBN : 978-81-923628-6-1



INTERNATIONAL
CONFERENCE
ON

**ECOLOGY,
ETHOLOGY &
ENVIRONMENT
MANAGEMENT**

11th -12th JANUARY 2019

Collaborators

Published By:

Department of Zoology
Vidya Prasarak Mandal's
B.N. Bandodkar College
of Science, Thane



Available online: WWW.vpmthane.org

International Conference on Ecology, Ethology & Environment Management (ICEEE 2019)

**Proceedings of the
International Conference on
Ecology, Ethology & Environment management (ICEEE2019)
11th – 12th January 2019**

Organized By:

**Department of Zoology
Vidya Prasarak Mandal's
B. N. Bandodkar College of Science, Thane**

NAAC Re – accredited 'A' Grade
Best College Award (University of Mumbai)
Selected for FIST 'O' Level
DBT STAR College

Jnanadweep, Chendani, Bunder Road, Thane (W) 400601, Maharashtra

In Collaboration with

Society of Eco – Endangered Species Conservation & Protection

AmbaGopal Foundation

HOPE Nature Trust, Thane

Dr. (Mrs.) Madhuri Kiran Pejaver
Chief Convener

Dr. Sudesh D. Rathod
Convener

Organizing Secretary

Dr. (Mrs.) Vinda D. Manjramkar

Dr. Kiran M. Pariya

Organizing Committee

Dr. (Mrs.) Poonam N. Kurve	Dr. Abhay S. Morajkar
Ms. Komal R. Gaikwad	Mr. Harshad V. Parekar
Ms. Sheetal L. Zend	

Editors

Dr. (Mrs.) Vinda D. Manjramkar

Dr. Kiran M. Pariya

Editorial Board

Dr. (Mrs.) Moitreyee Saha	Dr. (Mrs.) Vaishali Somani
Dr. Urmila Kumavat	Dr. Amol Patwardhan
Dr.(Mrs) Kalpita Mulye	Dr.(Mrs.) Meenakshi Gurav
Dr.(Mrs.) Jayshree Pawar	Dr. Vishakha Singhala
Dr.(Mrs.) Roshan D'souza	Dr. (Mrs.) Sheetal Pachpande

Advisory Committee

Mr. Vinayak V. Dalvie HOD, Department of Zoology, Mithibai College, Vile Parle (W) EX Chairman, BOS-Zoology, Former Secretary to Governor	Dr.(Mrs)Vasanti I. Katchhi Chairperson-Interim Board of Zoology, Ex HOD – Department of Zoology & Former Principal, Bhavan's College, Andheri (W)
Dr. Raghunandan.P. Athalye Ex. Vice Principal, B. N. Bandodkar College of Science, Thane	Mr. Manoj Meshram District Mining Officer, Collectorate office, Thane
Dr.(Mrs.) Nandini N. Patil Research Guide, B. N. Bandodkar College of Science, Thane	Mr. Dinesh Singh Assistant Conservator of Forest, Sanjay Gandhi National Park, Mumbai
Dr.(Mrs.) Mangala U. Borkar Ex. I/C, EVS Dept., B. N. Bandodkar College of Science, Thane	Dr. Goldin Quadros Principal Scientist, SACON, India
Dr.(Mrs.) Anita Jadhav Ex. BOS Chairman, Zoology HOD, Department of Zoology, ICLES College, Vashi, Navi Mumbai	Dr. Pramod Salaskar Founder Secretary, Naushad Ali Sarovar Samvardhini, Mumbai

Please Note:

The authors of the papers are solely responsible for technical content of the papers and references cited therein.

Published by:

Department of Zoology
Vidya Prasarak Mandal's
B. N. Bandodkar College of Science,
Thane (W)- 400601, Maharashtra
Tel.: 25336507
www.vpmthane.org

ISBN:

Citation:

Proceedings of International Conference on Ecology, Ethology & Environment management (ICEEE2019)

Edited by:

Vinda Manjramkar and Kiran Pariya.

Published by:

Department of Zoology

Vidya Prasarak Mandal's B. N. Bandodkar College of Science, Thane.

2019

Chief Convener / Principal's Address

The responsibility of conducting the conference was accepted by Department of Zoology in July 2017 and the announcement was made in January 2018 that the International Conference will be organized by Department of Zoology. For this in discussion a very apt name came as Ecology, Ethology and Environment Management (ICEEE 2019), date decided 11th and 12th January 2019.

It was thought that the topic was very much related to current scenario of environment where other than studying the ecological parameters it is also an important to study changes in animal behaviour and accordingly managing of environment around us. Immediately after announcement we could get good response and we thought to have a little difference in conductance of conference.

It was decided to have keynotes on legal regulatory mechanism, changes in human behaviour, status of avifauna, forestry etc., along with which social forestry, Himalayan ecology and urban land use was also considered but a difference came in where we thought of taking interview with Shruti Tai and Siddharth Sonavane who are farmers but are taking care of wildlife around them. I am really happy to say Department of Zoology took great efforts in contacting all the resources for good conduction of conference and I am very sure that this conference will pass a correct message among the youngsters for conservation of the ecosystem and wildlife around us.

I am thankful to advisory board, organizing committee, editorial board for good suggestions to maintain the quality of the conference and the collaborators for giving us the helping hand.

Contents

Section I: Keynote Address

1.	Role of legal regulatory mechanism to control noise pollution hazard Adv. (Dr.) Sadhana Mahashabde	08
2.	Human behavioral changes in Antarctica Dr. Madhubala Chinchalkar	12
3.	Interview with Shrustitai and Siddharth Sonavane wild life conservationist from Bir district of Maharashtra	14
4.	Status of Avifauna in Sindhudurg District Dr.Ganesh Margaj	15
5.	Social Forestry Ecology in North East India B.P. Sahu, Satish Kumar	17
6.	Himalayan Ecology Pradeep Wahule, IFS	18
7.	Urban land use transformations and energy consumption patterns: some perspectives Kedarnath Rao Ghorpade	19

Section II: Research Papers

1.	Effect of <i>Achatina fulica</i> on soil fertility Rohit Manyar, Mayuri Chaudhari, Veena Desai and Gayathri N	21
2.	Cadmium toxicity in kidney of Freshwater fish, <i>Oreochromis mossambicus</i> (Peters) Meenakshi Sundaresan	24
3.	Relation between energy levels and temperament in dogs Sahil Kapdi, Vinda Manjramkar	31
4.	Cytotoxic and genotoxic effect of pesticides Shifa Deshmukh, Rohit Manyar and Minakshi Gurav	36
5.	Predatory potential of spiders in rice crop of North Kokan region of Maharashtra. Bhalekar S. J., Patil N.N	41
6.	Sequence comparison and phylogenetic analysis of crustacean's muscle protein Tropomyosin to study the interrelation and evolutionary aspect between crustaceans, an <i>In Silico</i> approach. Tejas Borse and Kiran Pariya	46
7.	Application of Tangential Flow Filtration for Concentration of Microbial Protease Extracted From Mangrove Sediment Derived Bacteria Sarika Chhabria Talreja ^{a*} , Chandra B. Maurya ^b	51
8.	Strategic attacking behaviour of fantails on crows Malandkar Vipra, Pariya Kiran	55
9.	Accomplishment of Sustainable Development for a Green Earth – A study of the role of law in India Srividhya Jayakumar	58

Section I: Keynote Address

Role of Legal Regulatory Mechanism to control Noise Pollution Hazard

Adv. Dr. Sadhana Mahashabde

Abstract

The 21st century world is witnessing constant and rapid growth and development in science, technology, industrial inventions etc. These inventions and developments have proven to be a huge blessing for mankind. However, at the same time it has taken a heavy toll on human health and environment. These developments have paved way to tremendous noise pollution and resultant health and environment hazards. Several legal provisions are in place to regulate noise pollution levels at national and international levels. Efforts need to be taken by various authorities and agencies to ensure the effective implementation of the noise pollution control laws. Community participation, awareness and co-operation also go a long way in tackling the issue of noise pollution.

Noise Pollution: An Environmental Hazard

Acute exposure to high noise levels and prolonged exposure at lower levels are known to adversely affect the health and social development of exposed persons. Noise pollution has physical, physiological and psychological effects on exposed persons. Direct physical effect of noise pollution is loss of hearing or deafness. The physiological effects of noise pollution include high blood pressure, headache, nausea, etc. noise pollution also has psychological effects such as stress, anxiety, annoyance, distraction and irritation. Other effects of noise pollution are cardiac ailments, fatigue and sleep disturbance, lack of concentration, loss of memory, insomnia and loss of appetite.

Dominant Sources of Noise

Industries, road traffic noise and loudspeakers used in festivities are some of the most troublesome and serious sources of noise. Apart from these sources some other dominant sources of noise include rail traffic and air traffic.

- **Road Traffic Noise-** In urban areas road traffic noise is an issue of widespread and serious concern due to reckless honking by automobile drivers. The traffic Police and many NGOs such as Awaaz Foundation have played an important role in spreading awareness amongst the masses to reduce traffic noise. The Motor Vehicles Act provides penalties for driving a motor vehicle which violates the safety standards of noise pollution.
- **Festivals-** India is a land of ethnic diversity. Several festivals are celebrated throughout the year in India. There is unabashed use of loudspeakers and firecrackers during such festivals. These festivals include Ganesh Chaturthi, Diwali, Eid, Navratri etc. The limitless noise produced during these festivals greatly exceeds the ambient air quality standards for noise as prescribed by law.
- **Rail Traffic-** The noise produced by railways depends on the kind of engine used, the speed of the trains, the kind of railway tracks and other parts of a train. The citizens living close to railway lines have to face the wrath of noise pollution by rail traffic. Research and development in technology can pave way to the production of smooth and noise free trains.
- **Air Traffic-** the noise produced by aircrafts and airplanes largely depends on the structure, design and type of the aircraft or airplane. The airports are normally constructed in the outskirts of cities or at a considerable distance from residential areas or silence zones.

International laws, Conventions and Guidelines to curb Noise Pollution

Early developments in noise pollution laws can be traced to certain elementary legislations passed by United Kingdom (UK) in 1960¹ and Japan in 1968². However, these legislations were not very comprehensive in nature. In the early 1960s, USA witnessed some organised efforts from citizens opposing noise pollution. Further the National Environmental Policy Act (NEPA), 1969 and the Noise Control Act, 1972 built a foundation of noise pollution control laws in USA. These Acts were passed after a thoughtful study relating to noise standards. The International scenario on noise pollution laws changed drastically after the passage of these Acts. Several countries across Europe followed the footsteps of USA and passed noise pollution control laws, for example, Netherlands (1979), France (1985), Spain (1993) and Denmark (1994). The International Labour Organisation (ILO) laid down the

¹Noise Abatement Act, 1960

²Noise Regulation Law No. 98 of 1968

Working Environment (Air Pollution, Noise and Vibration) Convention, 1977 for protecting workers from the hazards of noise pollution. Recently the issue of noise pollution has received international concern. The World Health Organisation (WHO) has laid down *Guidelines for Community Noise* in 2015 and *Environmental Noise Guidelines for the European Region*, 2018.

Development of Legal Regulatory Mechanism in India

Direct provisions dealing with noise pollution under Indian laws were introduced for the first time in 1981. However, prior to 1981, there were certain provisions under the Indian Penal Code, 1860, Civil Procedure Code, 1908 and the Criminal Procedure Code, 1973 that indirectly targeted noise pollution.

S. 268 of the Indian Penal Code (IPC), 1860 deals with public nuisance that is also applicable in the context of nuisance created by noise.

S. 278 provides that whoever voluntarily vitiates the atmosphere in any place so as to make it noxious to the health of a person in general, dwelling or causing on business in the neighbourhood or passing along a public way, shall be punished with fine which may extend to Rs. 500/-. Thus this provision could also be applied with respect to nuisance caused by noise pollution

Further **S. 290** of the IPC makes public nuisance punishable with fine which may extend to Rs. 200/-

S. 91 of the Civil Procedure Code provides that in case of public nuisance or other wrongful act affecting or likely to affect, the public, a suit for a declaration and injunction or for such other relief may be instituted.

Under **S. 133** of the Criminal Procedure Code, 1973, the Magistrate has the power to make conditional order requiring the person causing the nuisance to remove such nuisance.

Noise Pollution was dealt as Air Pollution under Air Act, 1981 for the first time. It included 'noise' as 'air pollutant' under S. 2 (a) of the Air ACT, 1981. It was for the first time that any legislation in India directly considered 'noise' as some kind of a pollutant.

Thereafter the Environment (Protection) Rules, 1986 incorporated permissible noise levels for several industries they also incorporated Noise Standards for fire crackers, generator sets, automobiles, etc. Moreover, they also laid down Ambient Air Quality Standards for Industrial, Commercial and Residential Areas. It has also defined silence zones with time wise noise limit.

The Noise Pollution (Regulation and Control) Rules, 2000 is the most paramount legislation directly dealing with noise pollution till date. These rules have been amended from time to time with more than 12 times so far. The Noise Pollution Rules, 2000 regulate and control noise producing and generating sources with the objective of maintaining the ambient air quality standards in respect of noise.

These Rules lay down Ambient Air Quality Standards in respect of Noise as follows:

Area Code	Category of Area/Zone	Limits in dB(A) Leq *	
		Day Time	NightTime
(A)	Industrial area	75	70
(B)	Commercial area	65	55
(C)	Residential area	55	45
(D)	Silence Zone	50	40

Role of State Government in preventing and controlling noise pollution

The State Governments play a crucial role in addressing the problem of noise pollution as they can take several actions which are necessary to curb noise pollution and are vested with considerable powers in this regard. For example, the Environment Department, State of Maharashtra issued Notification in 2009 for the effective implementation of the central Noise Pollution Rules, 2000 which was a response of the State Government to the orders in Public Interest Litigations filed before the Hon'ble Bombay High Court. The Notification demarcated the "Silence Zones" up to 100 meters radius around educational institutions, courts and hospitals and also mandated putting up Silence Zone Sign boards in the demarcated silence zones. The Notification further assigned certain duties to officers/agencies under concerned departments of the State Government such as District Magistrate, Police Commissioner, Municipal Commissioner, Deputy Municipal Commissioner, Head Masters of educational Institutions, Dean/Superintendent of Government Hospitals, Head of MMRDA, MSRDC, CIDCO, Member Secretary of Maharashtra Pollution Control Board and officers from Transport Department. The duties assigned to these officers include initiating legal action, demarcation of silence zones, making action plan for noise pollution control, corresponding rules for

enforcement of noise standards, monitoring of ambient noise levels, enforcement and maintenance of noise standards etc.

Remedies for Noise Control

Remedies to control noise pollution can be categorized into several heads such as administrative remedies, judicial remedies, legislative remedies, public co-operation, involvement of NGOs and International co-operation

- **Administrative remedies-** Administrative agencies play a vital role in noise pollution control and regulation. They can frame policies and action plans for the effective implementation of noise pollution control laws.
- **Judicial Remedies-**The Courts have a very constructive role in implementing noise pollution control laws by taking preventive and punitive action. In recent times the courts have adopted a very pragmatic approach in giving effect to the laws and policies for controlling noise pollution. Several public interest litigations have been filed before the Hon'ble Bombay High Court against noise pollution and the Court has passed very rational and utilitarian orders in these matters.
- **Legislative Remedies-**Law is the most effective tool for controlling noise pollution. The Noise Pollution Rules, 2000 regulate and control noise producing and generating sources with the objective of maintaining the ambient air quality standards in respect of noise. Moreover, there are also important provisions under the IPC, CPC, CrPC and Motor Vehicles Act, 1988.
- **Public co-operation-**Public co-operation, awareness and participation are extremely important to give effect to the noise pollution control laws. Public participation and co-operation in India is influenced by several cultural and traditional factors. Awareness needs to be spread so as to reduce the noise pollution levels particularly during processions and festivals such as Ganesh Chaturthi, Dahi Handi, and Eid etc. Article 51-A (G) of the Constitution lays down the duty of protecting and improving the natural environment on every citizen.
- **Involvement of NGOs-** NGOs can contribute greatly to reduce noise pollution. NGO Awaaz Foundation has particularly been active for several past years in many activities and initiatives to reduce noise pollution. It has come up with several initiatives and has conducted awareness drives across the country. Most importantly, it has filed a Public Interest Litigation before the Hon'ble Bombay High Court for effective implementation of Noise Pollution Rules, 2000.
- **International co-operation-** The problem of noise pollution is of global concern. The global community needs to act in unison to reduce noise pollution. All countries must lay down stringent laws to curb noise pollution. The Working Environment (Air Pollution, Noise and Vibration) Convention, 1977, the Guidelines for Community Noise in 2015 and Environmental Noise Guidelines for the European Region, 2018 are examples of international co-operation to curb noise pollution.

Conclusion and recommendations

The National Environmental Engineering Research Institute (NEERI) along with the Maharashtra Pollution Control Board (MPCB) have laid down certain recommendations for curbing noise pollution in their June 2018 Report. Certain important recommendations to curb noise pollution are as under:

- ✓ **Reduction of noise at the source-** Silencers and other devices that can reduce noise output must be compulsorily installed in motor vehicles to reduce the nuisance caused by honking. Change in the designs of engines of cars, trains and airplanes can help in reducing noise levels. Mandating timely servicing and maintenance of motor vehicles to keep them in proper condition can help in reducing noise. Drivers of motor vehicles must avoid unnecessary honking at all times of the day. Noise absorbing materials such as acoustic tiles and carpets can be used to reduce noise pollution. The noise produced at construction sites may be regulated by mandating the builders to submit a proper action plan to reduce noise at the site and strict adherence to the plan. Movement of vehicles around silence zones should be regulated particularly at night.
- ✓ **Regulating transmission of noise-** The landscaping and town-planning should be done in such a way that the industrial and other areas that are exposed to noise pollution should be situated away from residential areas and silence zones.
- ✓ **Legislation and Penal Action-** Stricter punishments should be laid down by the law making bodies for persons creating nuisance of noise pollution. Penalties should be strictly imposed on the persons responsible for exceeding the ambient air quality standards for noise as laid down under the Noise Pollution (Regulation and Control) Rules, 2000. Penal action should be initiated against persons exceeding

the noise levels during festivals and also against persons using loudspeakers after permissible hours and without necessary permissions.

Awareness and co-operation- All the above factors can be executed and implemented only with the proper co-ordination and co-operation between the legislative and administrative bodies, judiciary and the common people. This can be established by creating awareness among the common masses about the laws in place to curb noise pollution and the remedies available to the victims of noise pollution. Awareness must be spread among the people about the hazards of noise pollution and different ways of reducing noise pollution. Government authorities, monitoring bodies, NGOs and the common people should all join hands and come together to fight the evil of noise pollution.

HUMAN BEHAVIORAL CHANGES IN ANTARCTICA

Dr. Madhubala Chinchalkar

I was a part of 36th ISEA (Indian Scientific Expedition to Antarctica)-2016-2017. accompanied the team as a doctor. India has two research bases in Antarctica, Maitri since 1989 and Bharati – constructed by German Technology in 2013 and is a modern base. I was posted in 'Maitri'. It is very friendly, as the name goes; but at the same time, expedition is very challenging, testing one's endurance!

Antarctica! Great bear (or Arktike in Greek) is visible from North Pole but not from Antarctica and South Pole, so opposite of Arktike is Antarctic. About 150 million years ago, South America, South Africa, India, Australia and Antarctica were one single land mass named 'Gondwana'. After continental drift, about 37 million years ago, Antarctica was separated and so were others. Antarctica is surrounded by Southern Ocean from all sides. The ocean freezes during winter and the continent becomes double its size- 'Pulsatile continent!' Antarctica is totally cut off from the rest of the world during winter months, i.e. from March to October. Hence, staying in Antarctica during winter months is next to staying in space. Since there were no aero planes or ice breaker ships till then, humans could not reach Antarctica till the beginning of 20th century! It is a land of Superlatives. Highest, driest, coldest and windiest of all the continents. With 1959 International treaty, no human Habitat here and Antarctica is reserved only for the purpose of Science and peace. Geographic and social isolation makes this place unique. It is five times the size of India and Less than thousand people do wintering in various research stations here! Midnight sun for 3-4 months and equally long Polar night poses a great challenge to humans here

-----Manifestation of Behavioural changes-

Externalized psychological reactions peak during Mid-Winter period.

Insomnia, irritability, mood disorders, depression, social withdrawal, sleep disorders, anxiety, stress, tension, anger, confusion, musculoskeletal fatigue, impaired cognitive performance in few subjects, increased tobacco and alcohol consumption etc.

➤ **Aggravated in the following:**

Poor expertise, health problems, mental disorder and forms of abuse, interpersonal insensitivity, problems of authority, work related discord, task deficit, poor hygiene and fitness, poor field base communication and human error with equipment from violating safety procedures and poor judgment as its usage.

➤ **Why should there be 'Changes in the Human Behaviour' in Antarctica?**

The psychological disturbance in Antarctica that changes the human behaviour, referred to as the over wintering syndrome.

- ✓ Humans work in extremes of weather and photoperiod. Geographic and Social Isolation
- ✓ The annual average Solar Radiation decreases and there is seasonal variation in Electromagnetic Radiation Exposure. This alters Temporal Homeostasis and affects Sleep Wake cycles, Mood, Cognition and work performance of base personnel.

Long Polar night reduces physical activity. Polar summer with no dark photo period. Change in the circadian rhythm, raised T3 or Triiodothyronine and lower levels of Vitamin D.

➤ **Pathophysiology-**

I. Circadian Rhythm

- ✓ Photic stimuli are the primary synchronizer of the endogenous circadian pacemaker of our brain (Hypothalamus).
- ✓ Hormones like Melatonin, Cortisol etc are the mediators.

II. Polar T3 Syndrome

Seasonal alteration in Hypothalamic-Pituitary-Thyroxin Axis leading to raised T3 levels.

III. Low light exposure during the dark winter. Lower levels of Vitamin D were found to be associated with depression. Vitamin D plays important role in psychological and cognitive function.

[Some of the Psychological tests used for Assessment of Behaviour are

(BDI)	Beck Depression Inventory
(PANAS)	Positive and Negative Affect Scale
(PSS)	Perceived Stress Scale

Prevention:

Screening and selection of personnel. Training program designed to facilitate Individual Adjustment and Group Adaptation so as to minimize group conflict. Identification of optimal leadership characteristics for small isolated groups. An understanding of '**Social Dynamics and Group Micro culture**' is necessary for the organization and management of small but heterogeneous groups, organization of work activities and support infrastructure

My experiences during expedition how i handled them

My training as a doctor as well as a Psychologist helped me in my job. Members come from varied social, cultural, educational background. Empathy towards fellow members and building up of a good interpersonal relationship is the key. Summer months are busy with outdoor work. The most challenging period is that of winter! It is a real test of endurance! Physical and Psychological preparedness is the key! Regular administration of tablets of calcium, vitamin D, B complex, vitamin C, gym, yoga, workout fitness, library, musical instruments, observing nature every moment! It is full of surprises!! Cooking and helping fellow members in their work. Working together as team and sharing regularly...etc.

Interview with Shrustitai and Siddharth Sonavane wild life conservationist from Bir district of Maharashtra

Q. How did you both ventures in this area?

Shrustitai: Siddharth is her childhood friend. He is her maternal uncle's son. She used to follow him whenever he gets injured animals and both would treat the animal by cleaning wound, applying turmeric powder and do bandage. As a routine, developed interest in caring wild life and the journey of conservation began.

Q. Brief about Nav Durga award Purskar?

Siddharth: Began this project of wildlife conservation since the year 2004 and received the award in the year 2016; never worked for such awards. It was their hobby, care and love for nature.

Q. Tell about NGO that you have named differently?

Siddharth: Name of NGO is SARPRADHNEE which means mother earth. Named their daughter the same. I am a poet, qualified teacher B.A B.Ed., writes poems on animal describing the behavior, some are on snake describing their behavior.

Q. How do you raise funds for the project?

Shrustitai: Bir is draught prone district of Maharashtra; buy water tanker alternate days to satisfy the need of animals which costs about 1500 INR per tanker. We have a scheme where we move around villages convincing people with slogan such as “**Muth Bhaaar Dhanya Pakshyna Ani Ek Rupya Pannyasathi**” (handful of grains for birds and one rupee for water) got good response, people started giving grains and money in charity. Porters from Devrai station gave 20 quintals of grains. Newspapers like “**LOKSATTA**” gave their work publicity which helped them to raise fund of 15 lakhs. Siddharth writes column fortnightly related to behavior and conservation of wildlife (Nisargachya Kushit) in local edition of newspaper “**Lokmat**”. He studied till B.A., B.Ed.

Q. Tell something about your marriage ceremony?

Siddharth: Got married on 12th November 2010. We married differently in forest, without pandal, hall and band. Whereas seeds of different plants were used, saplings were distributed as a return gift and 125 trees were planted. Food was served in steel plates to beat plastic pollution. Snake was used as a garland for bride and groom.

Q. Tell something about your routine?

Siddharth: Day begins at 5.00am and ends at 11.00pm in fetching fruits, getting grass, mutton, cleaning animal sheds, giving medical attention to injured animals and rehabilitation. In the vicinity of 6kms range nothing is available; I to ride on bike for every small cause. The main task is to keeping records of each and every animal's treatment, rescue and releasing details i.e. day date, time and location.

Q. Do animals attack you while rescuing or treating?

Shrustitai: Yes. Obviously it is quiet natural they are in pain and anger they do it in self-defence, but they do under compassion of person treating them soon become friendly just like humans.

Q. Do animals come to visit you after release them in nature?

Shrustitai: Yes. They do come back; they want to stay in shelter. Even monkey came back to shelter. Every day Kites hover over the water hole after rescue. Approximately 15000 wild animals rescued and rehabilitated.

Status of Avifauna in Sindhudurg District

Dr. Ganesh Margaj

Department of Zoology, S.P.K. Mahavidyalaya, Sawantwadi, Dist. Sindhudurg -416510 MS, India

Sindhudurg district is located in the Konkan region of Maharashtra state and covers a geographical area of 5207 sq.km. The district is located between north latitude 15°37' and 16° 40' and east longitude 73° 19' and 74° 13'. The district is bounded west by Arabian Sea and in the east by Kolhapur district and in the south by Goa State and Belgaum district of Karnataka State. The area of 5207 sq. km. out of which about 386.43 sq.km is covered by forest, whereas cultivable area is 3222 sq. km. and net sown area is 1522 sq. km. The eight Taluka of the district are Sawantwadi, Vengurla, Kudal, Kankavli, Malvan, Deogad, Dodamarg and Vaibhavwadi. The population of the district as per 2001 census is 8,68,825. The district comprises of 5 towns and 743 villages. Climatic conditions in the district are strongly influenced by its geographical conditions. The district falls under the 'Assured and High Rainfall zone'. The climate is generally humid. The cold season is from December to February 4 followed by summer from March to May. June to September is the southwest monsoon, while, October and November constitute the post-monsoon season. Being a coastal district, variation in the temperature during the day and throughout the season is not large. December is the coldest month with mean daily maximum temperature at 32.7°C and the mean daily minimum temperature at 18.7°C. April is the hottest month. The relative humidity during the southwest monsoon is very high (86 to 90%). The relative humidity during winter and summer months is also above 57%. The normal annual rainfall over the district varies from 2300 mm (Malvan) to about 3205 mm (Kudal). It is minimum in the western part of the district along the coast and gradually increases towards east and reaches maximum along Western Ghats. The average annual rainfall for the period 2002-2011 ranges from 2752.19 mm (Devgad) to 3980.19 mm (Vaibhawadi). . Normal Annual Rainfall: 2300 mm to 3200 mm Major Physiographic unit are coastline, estuarine plains, lateritic plateaus, residual hills, scrap faces of Sahayadri. Major rivers are six, Gadnadi, Karli, Terehol, Tillari, Wagothan and Deogad these are the habitats of the birds.

Forest Area is 386.43 sq. km. Net Area Sown 1522.00 sq. km. Cultivable Area is 3222.00 sq. km. Southern tropical semi-evergreen forests. These forests are found mostly on the upper hill slopes, from 450 meters to 1050 meters above the msl in the Western Ghats. The main species are *Terminalia tomentosa* (Ain), *Terminalia paniculata* (Kinjal), *Memocylon umbellatum* (Anjani), *Terminalia chebula* (Hirda), *Syzigium cumini* (Jambul), *Tectona grandis* (Teak), *Delbergia latifolia* (Shisham) and *Mangifera indica* (Mango) etc. Littoral and swamp forests are found along the creeks and littorals in the Sindhudurg district. Although their comparative extent in the State is marginal, they are important for protection of seacoast and marine life. The typical mangrove species found in this area are *Avicennia spp.* and *Rhizophora spp.* etc.

There are 300 species of birds found in Sindhudurg belonging to 80 families where 15 families are dominant. Family Scolopacidae, Accipitridae, Mussicapidae having more than 20 species. The Institute for Ocean Management has identified Malvan as ecologically important areas in the state. Important bird areas are Burnt Island (Vengurla rocks) and Amboli-Tilari Reserve Forest. The forested tracts of Konkan are largely privately owned and till now stand as a good example of successful community conservation with a background of deep cultural, spiritual and sustainable livelihood concepts. The forests ranging from tropical semi-evergreen and moist deciduous to mangrove forest and a mixture of plantations and natural vegetation support a range of birds that are rare and endemic to Western Ghats or Sahayadri.

The most celebrated bird of the Sindhudurg district is perhaps the hornbill. Four sub-species found in this region, Indian Grey Hornbill, Malabar Grey Hornbill, Malabar Pied Hornbill and Great Pied Hornbill. The Malabar Whistling Thrush and brightly coloured Orange-headed Ground Thrush is equally conspicuous. Before the monsoon, the calls of Indian Pitta that migrates from the southern states every year. White-bellied Sea Eagle, as they gracefully soar over the sea in search of fish. In places like Shiroda, Malvan and Tambaldeg, Devgad. White-rumped Shama, Black-hooded Oriole and White-browed Fantail, while the deep whistle of Crested Serpent Eagle and the mysterious sounding call of Indian Scimitar Babbler. Malabar trogon, Oriental Dwarf kingfisher, Grey headed Bulbul, Yellow-footed Green Pigeon, Orange-fronted Green Pigeon, Rufous Tree-pie, Scarlet Minivet, Oriental White-eye, Indian Peafowl, Grey Jungle fowl, Blackbird, Brown-headed Barbet, Red-

whiskered Bulbul, Puff-throated Babbler, Jungle Babbler, Indian Nightjar, White-breasted Waterhen and Green Bee-eater. With “development” happening at a rapid pace, habitats are disappearing and the local belief systems of live and let live are slowly giving away to the city bred materialistic culture. The sacred groves, private forested hills, mango plantations, mangroves, grassy plateaus and wetlands all need to be conserved. Without that the juggernaut of industrial and infrastructure development may swallow this avian paradise even before it is fully explored.. Activities such as burning forests for plantations and deforestation of mangroves a detailed study is required to find out the impact on the roosting of birds.

Birds, besides enhancing the aesthetic beauty of a place form a significant component of the ecosystem. They are also the major indicators of the environmental status of a region. India has been reported to be a home for about 1263 species of birds belonging to 107 families and 23 orders (Praveen et al. 2016). Sindhudurg district was declared as a “tourism district” by the Government of Maharashtra. Sahayadri hill ranges and pristine beaches. Besides stretches of paddy fields, it has vegetable cultivations, plantations of coconut, banana, mango, cashew, jackfruit, kokum and jamun trees.

Threats to the diversity of Birds in Sindhudurg district

Industrialization, urbanization, mining, forest fire, encroachment in the wetlands, forest clearance for agriculture, cutting for firewood, plantation of rubber, sugarcane, pineapple, mango, cashew etc. are the threats for bird diversity in Sindhudurg district.

Conservation strategies for birds

Conservation strategies for the birds are as follows

1. Protection of sacred grooves
2. Alternatives for firewood
3. Enforcement of laws
4. Protection from Illegal hunting and trade
5. Awareness among the local people

Social Forestry Ecology in North East India

*B.P. Sahu ** Satish Kumar

North East India comprises of eight north eastern states –Assam, Arunachal Pradesh, Meghalaya, Manipur, Mizoram, Nagaland, Sikkim and Tripura It comprises an area of 262,230 square kilometres (101,250 sq. miles), almost 8% of that of India. The region shares an international boundary of 5182 kilometres with neighbouring countries like China, Tibet, Myanmar, Bangladesh, Nepal, and Bhutan. The NER region is characterised by humid sub-tropical climate with hot and humid summers, severe monsoons and mild winters. The region has some of the Indian sub-continent's last remaining forests which support diverse flora and fauna and several crop species. The region's high rainfall, averaging around 10,000 millimetres (390 in) and above, creates problems of ecosystem, high seismic activity, and floods. The altitude varies from almost sea-level to over 7,000 meters (23,000 ft.) above Mean Sea Level. Almost all the states of NER have more than 60% of the forest areas classified into six major types - Tropical moist deciduous forests, tropical semi evergreen forests, tropical wet evergreen forests, subtropical forests, temperate forests and alpine forests. *Jhum cultivation* is widely practiced in the region and is often cited as the reason for the loss of *forest cover* of the region. However this primary agricultural economic activity practiced by local tribes supports the cultivation of 35 varieties of crops. The region is also rich in medicinal plants and is considered as a biodiversity hub of India. The current assessment of forest cover (2017) shows an actual decrease of forest cover to the extent of 630 square km in the region. Out of the eight NER states, Assam and Manipur have registered an increase in forest cover. While Assam registered an increase of 567 square km, for Manipur it was 263 square km. However forest cover has shrunk in some states. The top five Indian states where forest cover has shrunk belong to the NER. They are Mizoram (531 sq. km), Nagaland (450 sq. km), Arunachal Pradesh (190 sq. km), Tripura (164 sq. km) and Meghalaya (116 sq. km). Shifting cultivation has always been the reason for decline in forest cover in most of the northeast states because of the hilly terrain. The shifting cultivation is linked to the topography/landscape, the socio-economic and cultural significance that it has with the tribal communities. The interventions like agro forestry that incorporate tree species with rotation period greater than 10 years has great potential to improve the forest cover as well as in checking shifting agriculture. Expanding forest cover should be prioritized in the years to come and non-conventional green cover such as home gardens and urban forests should also be considered. Expanding forest cover isn't only advantageous to enhance carbon sink but also for multiple employment and ecosystem benefits. Agro forestry has to be looked up in the context of policies.

.....
*Professor, DACE, North Eastern Hill University, Shillong

** Assistant Professor, M.S. University, Baroda

Himalayan Ecology

Pradeep Wahule, IFS

Himalayas have always been a symbol of beauty, strength and endurance and an abode of several human civilizations and human spirituality for ages. Like a great wall, it has been protecting the Indian subcontinent from the harsh climate of the far north due to its strategic geographical location. It is a home to huge biodiversity imaginable. It has a unique ecosystem which is as fragile and vulnerable especially in context with the recent times. Climate change is indeed evidently taking its toll of all the ecosystems in the world and the Himalayan range is no exception. The glaciers & ice caps here too are melting. The region has become prone to natural and man-made calamities like landslides, cloud bursts, flash floods, forest fires etc.

The talk would be essentially on the negative man-made activities which have been very conspicuous in recent times in the Himalayan region where the human civilization is in close contact.

As a government servant the speaker had an opportunity of getting posted in the Himalayan region for some time. He has some observations and experiences which he wishes to share with the audience who are primarily from the scientific community. These observations and experiences may be generalized more or less to entire inhabited areas in the Himalayan region. The problems are essentially the same all over. He wishes to have a dialogue with the scientific minds and come up with possible solutions to mitigate the negative influence of man on the fragile and vulnerable ecosystem in the Himalayan region.

He would like to bring forth pertinent issues for discussion like pollution, forest fires, waste management, shifting cultivation, road construction, multipurpose projects, biodiversity loss, lack of awareness and education etc. and at the same time try to discuss the mitigation possibilities with the scientific minds.

Urban Land Use Transformations and Energy Consumption Patterns: Some Perspectives³

Kedarnath Rao Ghorpade⁴

Introduction

Cities are dynamic and centers of main concentration of non-agricultural activities and services. The master and/or development plans have designated land uses for the different activities and services. The rapid growth in the urban population has led to increase in urbanization. One of the indicators of urbanisation is the consumption of levels of energy⁵. The generic concern of energy seems to have emerged from the statement that “the world is facing an energy crisis with major global and local implications.”⁶ Typically the energy consumption in urban areas is associated with travel demand and trips generated energy consumption and its impact of environment. On the other hand the energy studies in urban areas are focused on plot level energy consumption and the consequent energy modeling from the environment perspective. Globally, buildings are responsible for approximately 40 per cent of the total world annual energy consumption. Similar trends are reflected in India too. The Energy Statistics 2013 of India’s National Statistical Organization (NSO) shows electricity accounted for more than 57 per cent of the total energy consumption during 2011-12 in India, and building sector is already consuming close to 40 per cent of the electricity. This is expected to increase to 76 per cent by 2040. A large quantity of incremental electricity demand will come from the residential sector in India.⁷ Most of this energy is for the provision of lighting, heating, cooling, and air conditioning.⁸ Hence there is a need to research the connection between energy, the environment and sustainable development.⁹

Types of Land use Transformations

Any developmental intervention has transforms land use and consequent environmental implications. A moot point is that land use has different connotations and perspectives in the ecological sciences and urban studies literature. Broadly in the ecological sciences, ‘land use’ typically focuses on vegetation status covering; forests, land put to non-agricultural uses, barren and unculturable¹⁰ land, permanent pastures and other grazing lands, miscellaneous tree crops, fallow land and others. While in urban studies ‘land use’^{11&12} are classified or designated as residential, commercial, industrial, public & semipublic, recreational, transport & communications, agriculture & water bodies. Both the land use transformations have environmental implications in the context of energy. An attempt is being made to study the urban land use transformations with focus on energy consumption patterns in residential land use.

³ 'International Conference on Ecology, Ethology and Environment Management 2019', Bandodkar College, Thane, January 11& 12, 2019

⁴ Urbanist and Researcher. Views expressed are personal and not of the Organisation where he belongs. Utmost care has been taken to acknowledge all references and sources with no interest of plagiarism or stealing or copying ideas or thoughts.

⁵ Land Use Planning, OCDE/Gd(93)2, Group On Urban Affairs, Environment Directorate, Organisation For Economic Co-Operation And Development, Page 8, Paris 1993

⁶ Energy and sustainable development, Article 30, September 2008, International Institute for Environment and Development, downloaded on December 23, 12, 2018, <https://www.iied.org/energy-sustainable-development>

⁷ Energy And Buildings, Chapter 02, Centre for Science and Environment, 2014

⁸ Renewable and Sustainable Energy Reviews, Volume 12, Issue 9, December 2008, Pages 2265-2300

Renewable and Sustainable Energy Reviews, Abdeen Mustafa Omer

⁹ Applied Energy, Volume 64, Issues 1–4, 1 September 1999, Pages 427-440, Energy, environment and sustainable development, Ibrahim Dincer and Marc A Rosen

¹⁰ Land covered by mountains, deserts, lands which cannot be brought under cultivation except at a cost

¹¹ Draft 'Urban Development Plans Formulation and Implementation (UDPFI) Guidelines', Ministry of Urban Development, Government of India, 2014.

¹² Harland Bartholomew, Urban Land Uses, The Harvard City Planning Studies Volume IV, 1932

Section II: Research Papers

Effect of *Achatina fulica* on soil fertility

Rohit Manyar, Mayuri Chaudhari, Veena Desai and Gayathri N*

The D. G. Ruparel College of Arts, Commerce and Science, Mahim, Mumbai-400016

*gayathri.n@ruparel.edu

Abstract: Soil fertility is an important parameter for agriculture. Organic carbon, nitrogen, phosphorus, chlorides, potassium etc., are some of the essential nutrients present in soil which make it more fertile and better for plant growth. Various fertilizers and chemicals are used to increase soil quality, but if the fertility could be increased in natural way it would be prove to be eco-friendly and more effective. In our current study, we have used *Achatinafulica* (Giant African Snail) which is generally considered as pest because of its voracious feeding habits. The snails are introduced in soil to test for the changes in soil quality parameters. Significant changes in soil parameters which favor plant growth are observed. The snails are fed with the wet kitchen waste. This method can prove to be more effective, economical, less harmful and a simple way of increasing soil fertility by using something from the ecosystem itself.

Keywords: Snail, Soil quality, Soil fertility, Chlorophyll

Introduction

Agriculture is the most important occupation in our country as around 70% of our population is dependent on agricultural income directly or indirectly. Due to the increased demand for supply, farmers use various chemical fertilizers for increasing soil fertility leading to good growth of plants. But, these chemical fertilizers prove to be expensive and harmful to the ecosystem. The Giant African Land Snail is one of the largest terrestrial gastropods. They have a light to dark brown shell with vertical stripes of a darker shade of brown. They are very commonly found on moist soils and have an average lifespan of about 5-7 years. They are usually considered as pest due to their invasive nature [CPC Compendium]. But in this study we have studied whether they can be used in an ecofriendly way. Earthworms are considered to be friends of farmers; similarly, the possibility of these snails to be used for compost for enhancing the soil quality, crop yields in natural ecosystem is explored in this study. These effects can be ascribed to improvements in soil properties and greater availability of nutrients to plants. The snails are fed on kitchen waste, thus proving to be economical.

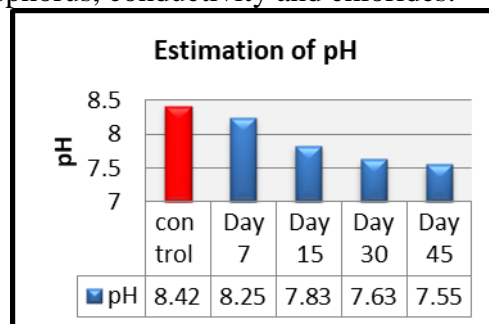
Materials and methods

Two sets of containers of size 34x23x13 cm, each with 3 kg of soil were taken for the study. One set was used as control set up & the other was taken as experimental set up. 25 snails were introduced in the experimental set up. The snails were fed daily with 50 grams of wet kitchen waste, and the excess feed was removed after 4-

5 hours, not letting it to degrade. The soil was removed from the container after an interval of 7, 15, 30&45 days and the soil quality parameters were checked. The experiment was done in triplicate. The soil parameters checked include pH (pHmetry), Conductivity (Conductometry), Chlorides (Arginometry), Organic matter (Walkey, 1947), Nitrogen (kjeldahl Method) and Phosphorus. Pot assay was carried out using soil from control and experimental containers. In each pot 50 seeds of *Vigna radiate* (green moong) were planted. After 10 days, the physical growth of plants was observed and the chlorophyll content of leaves was analyzed by acetone extraction method.

Results and Discussion

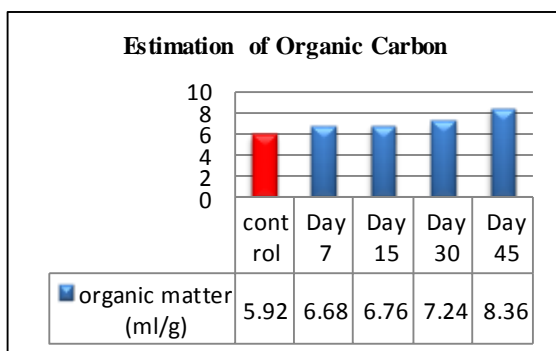
The experimental set up showed decrease in soil pH and increase in organic carbon, nitrogen, phosphorus, conductivity and chlorides.



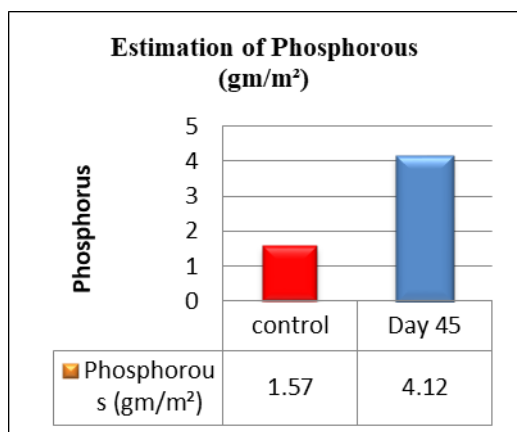
As the days of exposure of the soil to the snail increased, the pH of soil decreased in the experimental setup. pH of soil is important for the solubility of minerals and nutrients. Most nutrients and minerals are available in acidic soil than alkaline or neutral soil. Phosphorus is soluble in soil with pH 6.5. Soil pH of 6-7 is generally suitable for plant growth. The pH of

control soil is moderately alkaline, while the pH gradually decreases with the increasing days of snail exposure in soil. The increasing acidity could be because of the organic matter produced by the snails.

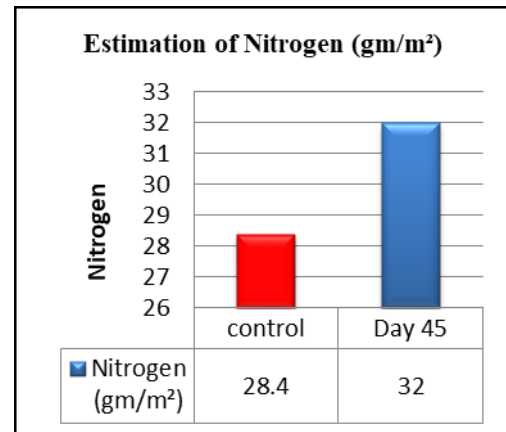
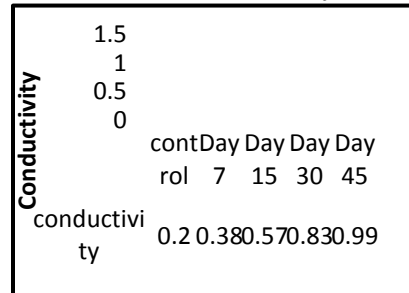
The organic matter increased continuously in the soil with snails. As the number of days increased, the organic content in the experimental soil increased. Organic matter is able to bind soil particles in more stable structure because of their high cation exchange properties. This leads to increase in conductivity of soil. The organic matter holds water which prevents soil erosion. It induces the long term productivity of soil and enhances soil quality.



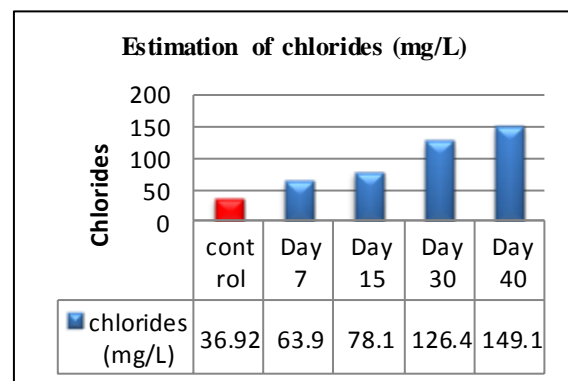
The amount of nitrogen and phosphorus in the experimental soil showed increase after 45 days as compared to the control soil. It is important for plant growth, plant metabolism and production of chlorophyll. Phosphorus is equally essential for plant growth. It plays an important role in energy storage and transfer in the plants. It is one of the components of DNA and RNA.



Estimation of Conductivity



The Conductivity of the soil increased in the experimental set up. Maximum conductivity was observed on day 45 and is almost five times as compared to the control setup. The increase in conductivity could be because of the increased organic matter, as it has high cation exchange properties. Soil conductivity (EC) is a measure of the amount of salts in soil i.e. salinity of soil. It is a major indicator of soil health. It affects crop yields, crop suitability, plant nutrient availability, and activity of soil microorganisms.

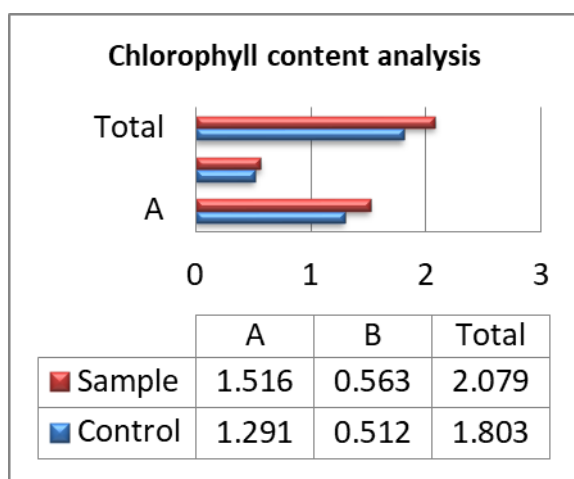
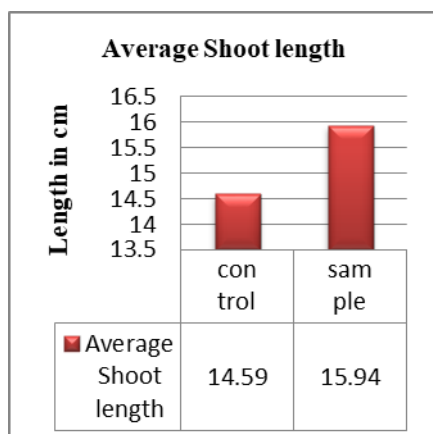
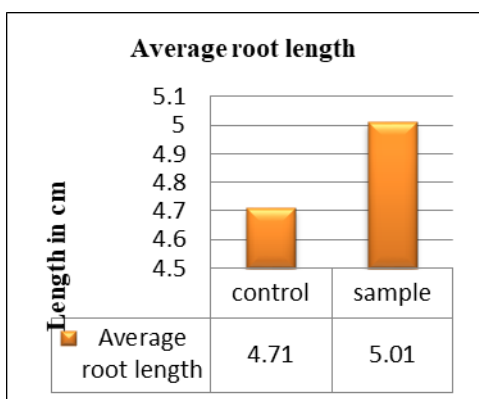


The experimental set shows gradual increase in the chloride content. The chloride content was more than double in the experimental soil after 15 days and more than four times on day 45. Chlorides are essential for appropriate functions of the plants stomata openings which controls internal water balance. It also leads to cation balance and transport within the plants, it

balances potassium ion concentration in plants. It also diminishes the fungal infections. It is also involved in chemical breakdown of water in presence of sunlight which enables the plants to make nutrients and enhance plant growth.

Pot Assay:

The plants germinated well in both control and experimental set ups. After ten days of germination, the average Root and Shoot length were examined. It was found that the average Root and shoot length of plants grown in experimental set up was higher than those in control setup.



Leaf chlorophyll concentration is an important parameter that is regularly measured as a mechanism and of plant metabolism. The

chlorophyll production is mainly depended on penetration of sun light and it is the main source of energy for plant (Srichaikul *et al.*, 2011). Chlorophyll A, Chlorophyll B and total Chlorophyll of the plant leaves from the experimental set from day 45 was observed to be more than that of control set.

Conclusion

Achatinafulica can be effective for the transformation of soil parameters to support plant growth. The current study is first of its kind wherein introduction of *A.fulica* in soil enhances soil quality and may increase long term productivity. The increase in the major soil quality parameters showed promising results. In order to conclude the effective utility of *A.fulica* from being a pest to a friend of farmer, this study is planned to be carried out in large scale in field to ascertain its effect on soil fertility.

Acknowledgement

The authors express their thanks. The Principal of the college, Head of the Department and all the Teaching and Non-teaching staff of Department of Zoology, D.G. Ruparel College, Mahim, Mumbai for their support in carrying out this work.

References

1. Hasan R, Ebrahim P, Faud T (1999): Effect of soil organic matter, electrical conductivity and sodium adsorption ratio on Tensil strength of aggregates.
2. Philip W and Martin B. (2001): Chloride in soils and its uptake within the plant: A review. *Annals of Botany* **88**: 967-988.
3. Srichaikul B., Bunsang R., Samappito S., Butkhup S., and Bakker G., (2011): Comparative study of chlorophyll content in leaves of Thai *Morus alba* Linn. Species. *Plant Science Research*, **3**: 17-20.
4. Walkey A., (1947): A critical examination of rapid method for Determination of Organic carbon in soils- Effect of Variations in Digestion conditions and of Inorganic soils and constituents. *Soil Sci.* **63**:251-257.
5. CPC International, Invasive Species Compendium; *Achatinafulica* (Giant African land snail).

Cadmium toxicity in kidney of Freshwater fish, *Oreochromis mossambicus* (Peters)

Meenakshi Sundaresan

Department of Zoology, D.G.Ruparel College, Senapati Bapat Marg, Mahim, Mumbai-400016.
Maharashtra, India, manjitsundaresan@gmail.com.

Abstract:

Kidney is an important organ – vital for excretion, osmoregulation and maintenance of homeostasis; various environmental pollutants like xenobiotic and heavy metals are known to affect its morphology. Fishes can thus act as heavy metal indicators and assess pollution in the aquatic environment. The present work deals with treatment of fishes with cadmium chloride (8ppm for 6days and 22 days).The changes brought about by cadmium toxicity to the kidney of *Oreochromis mossambicus* was studied using light microscopy. The kidney of fish consists of five distinct regions namely neck region, proximal region, central slender region, distal region and collecting tubule. The observations clearly indicate that cadmium chloride treatment affects the kidney to a great extent .The kidney of cadmium treated fishes shows swollen and degenerated glomeruli , hypochromasia, increase in eosinophilic granules of epithelial cells of proximal tubules and presence of large cytoplasmic vacuolar spaces in distal tubules with accumulation of eosinophilic material in their lumen. The collecting tubules are enlarged with drastic degeneration of their epithelial lining, Presence of large vacuoles and vesicles in their cytoplasm and accumulation of eosinophilic material in their lumen are the other effects seen.

Key words: Hypertrophied glomeruli, Hypochromasia, Eosinophilic granules, Degeneration of epithelial lining

Introduction:

The careless disposal of heavy metals in the aquatic system is a cause of concern because of their toxicity and bio magnification. Cadmium is known for its non-corrosive nature and is widely used in manufacturing batteries, paints and dyes, fertilizers and also in the plastic industries. Cadmium release in the environment is steadily increasing due to anthropogenic activities causing pollution of soil and aquatic ecosystems. Bio magnification of Cadmium takes place at trophic levels and is found to be highest in algae (Ferard *et al* 1983). It also accumulates in many aquatic organisms including fish which are a part of the aquatic food chain (A.A.Bawuro *et al*, 2018, Eneji *et al*, 2011, D. Kumar Babu *et al*, 2009). Cadmium is found to be teratogenic, embryo toxic, carcinogenic, nephrotoxic not only in fishes (M.S.Rahman *et al*, 2012) but humans too. It acts as a stressor affecting enzymes, which control all the biochemical reactions of the cell in particular and the organism as a whole. The present study has being done to evaluate the effects of cadmium chloride on the structure of Kidney in *Oreochromis mossambicus* (Peters).

Materials and Methods:

Live fish (3-5 inches) were obtained from Masunda lake in Thane district and were acclimatized for 2weeks. They were fed on

alternate days with live tubifex worms. During experimental exposure, to maintain the concentration of toxicant, test water was changed every 24 hours. The tanks were aerated with oil free air. Test water quality was evaluated employing standard methods (APHA, 1985).

In the present study, (2 sets) each with 15 fishes were maintained in 20 litres of water in a tank with exposure to sub lethal concentration of 8 ppm of cadmium chloride for a period of 6 days and 22 days. A control tank was also set up. Fishes from each tank were sacrificed by decapitation and the kidney was processed for light microscopy where tissues were fixed in Neutral formalin for 24 hours and stained with Haematoxylin eosin (Edward Gurr 1956).

Results & Observations:

The kidney in fish is multi-functional and not only helps eliminate nitrogenous wastes but is also known to possess endocrine, haematopoietic and lymphatic tissue (Roberts R.J. 1989). Ultra structural features of uriniferous tubules have been reported to differ in different species (Bulger Ruth Ellen & Trump B. F. 1968). These features vary not only with the species but also with the habits and habitats of animals. Variations are also seen with change in sex of the animal as has been seen in mature sticklebacks, *Gasterosteus aculeatus* (Hickman Cleveland P, Jr. and

Trump Benjamin F., 1969). Hence the ultrastructure of fish kidney was studied in *Oreochromis mossambicus* (Peters) (M. Sundaresan; 2014) to establish the various regions of the uriniferous tubule in fish.

Fish kidney when observed under the light microscope presents the structure of a typical vertebrate. In sections, glomeruli with Bowman's capsule, proximal and distal ends of uriniferous tubules and collecting tubules are distinguishable. Besides the connective tissue cells and blood cells, wandering cells are peculiar cells found in the interstitial regions.

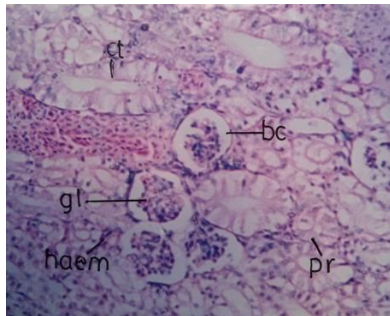


Fig 1 Light microscopic section of TS of Kidney (control) showing different regions of uriniferous tubules. Stain H/E

Key: Ct – collecting tubule; Bc – Bowman's capsule; gl – glomerulus; haem – haemopoietic region; pr – proximal region

In the present study, fish was treated with sub-lethal dose of Cadmium chloride (8 ppm for 6 days and 22 days) and the kidney tissue was processed for light microscopy to study gross and histological changes.

Gross changes:

Kidney appears pale red and pulpy. Fish shows a shrunken appearance.

Histological changes:

A) Renal corpuscle (glomeruli and Bowman's capsule).

1) Control-Glomeruli are seen distinctly. They are large and occupy more than half of the capsular lumen. Capillary wall cells and blood cells are easily distinguishable. Erythrocyte cells are oval in shape and show a deeply stained blue nucleus and pink cytoplasm (Fig 1)
 2) On exposure to 8 ppm for 6 days- Glomeruli show a drastic change. They appear enlarged (hypertrophied). The increase in glomerulus continues for the first four or five days resulting in proportional reduction in size of the lumen of Bowman's capsule. Eventually it occupies the whole of interior of Bowman's

capsule. Glomerulus appears as a cluster of cells and individual capillaries are not distinguishable. Cloudy patches are observed at various places. Loss of membrane and separation of epithelial cells are characteristic.

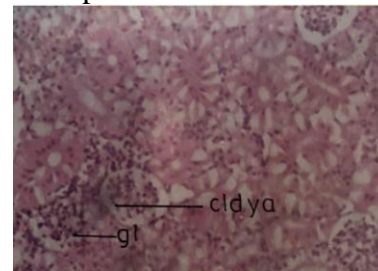


Fig 2 TS of Kidney showing glomeruli (treated fish, 8 ppm – 6 days) Stain H/E

Key: cldya – cloudy areas, gl - glomerulas

3) On exposure to 8ppm for 22days-Glomerulii are irregular and often give an extended look. Lumen of Bowman's capsule is reduced. Epithelial cells lining the tubules show vacuolation. Outer margin of tubules appears irregular owing to loss of membranous lining. Lumen of collecting tubule is filled with some eosinophilic material. Degeneration of glomerular capillaries eventually sets in which can be visualized from the scattered nature of erythrocytes within the Bowman's capsule.

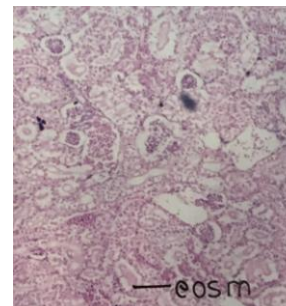


Fig 3 TS of Kidney showing glomeruli (treated fish, 8 ppm – 22 days) Stain H/E

Key: eosm – eosinophilic material

B) Proximal ends of the Uriniferous Tubule.

1) Control – Proximal ends of tubules appear round in sections. The epithelial cells are rested on a membrane. Cells are low columnar with their basal ends slightly broader than the apical ends. Apical free end of each cell is ciliated; as a result the ciliated border is seen in the form of a distinct ring around the lumen. The ring is stained deep pink with eosin. Nuclei of the cells are large, spherical and have certain deeply stainable granules which are eosinophilic.

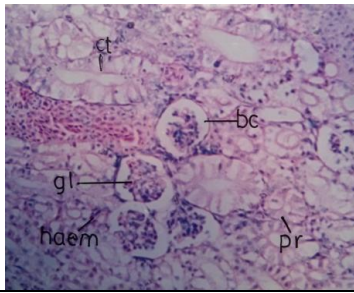


Fig 4 Light microscopic section of TS of Kidney (control) showing different regions of uriniferous tubules. Stain H/E

Key: Ct – collecting tubule; Bc – Bowman's capsule; gl – glomerulus; haem – haemopoietic region; pr – proximal region

2) On exposure to 8 ppm for 6 days- basement membrane of tubule is often separated from its epithelial cells and this leads to formation of spaces between them. Lowered concentration of cytoplasmic granules is seen in epithelial cells. Reduction in staining property (hypochromasia) of the cells leading to a cloudy appearance of the tissue.

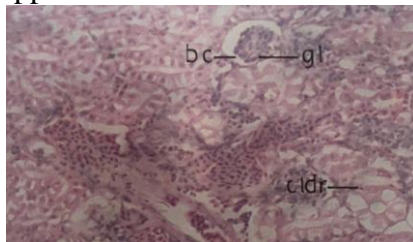


Fig 5 TS of Kidney (treated fish, 8 ppm – 6 days) Stain H/E

Key: bc – bowman's capsule, gl – glomerulus, cldr – cloudy region

3) On exposure to 8ppm for 22days- Loss of basement membrane followed by appearance of vacuolar spaces at the basal extremities of the tubules. In some epithelial cells, cytoplasmic material is totally lost and shows vacuole formation. Nuclei of cells are somewhat reduced in size and are shifted towards the basement membrane. The inner ciliated end is represented in the form of a ring. In extreme cases the tissue might contract and the membranous lining of the tubules being lost, the epithelial cells at the neighbouring tubule gave a clustered look.

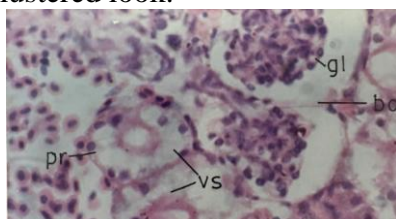


Fig 6 TS of Kidney showing proximal end (treated fish, 8 ppm – 22 days) Stain H/E

Key: pr – proximal end, vs – vacuolar space, gl – glomerulus, bc – bowman's capsule

C) Distal ends of the uriniferous tubule.

1) Control-The distal ends have an appearance similar to that of proximal ends. However, The diameter of the distal end of the tubule is greater than its proximal end. The tubules are slightly irregular in their outline. The epithelial cells are full of cytoplasmic granules. The density of these granules however is comparatively less when compared with similar cells of proximal ends. The ciliated border is totally lagging.

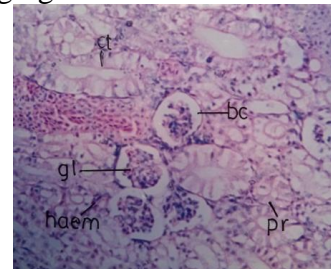


Fig 7 Light microscopic section of TS of Kidney (control) showing different regions of uriniferous tubules. Stain H/E

Key: ct – collecting tubule; Bc – Bowman's capsule; gl – glomerulus; haem – haemopoietic region; pr – proximal region

2) On exposure to 8 ppm for 6 days: The cells on the distal end of tubule are separated from each other especially at their basal extremities. The basement membrane on the outer extremities is often totally lost or is separated, giving it an irregular look. Large vascular spaces are seen at the outer extremities of the tubules. Separation of epithelial cells and secretion of eosinophilic occlusion material seen within the lumen.

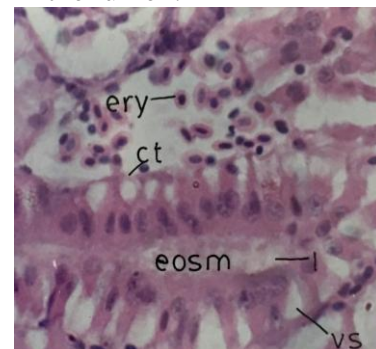


Fig 8 TS of Kidney (treated fish, 8 ppm – 6 days) Stain H/E

Key: ery – erythrocytes, ct – collecting tubules, eosm – eosinophilic material, vs – vacuolar space, l - lumen

3) On exposure to 8ppm for 22days: Distal tubules appear irregular and large sized vascular spaces are seen all over the outer extremities. Concentration of eosinophilic occlusion material increases with the period of exposure.

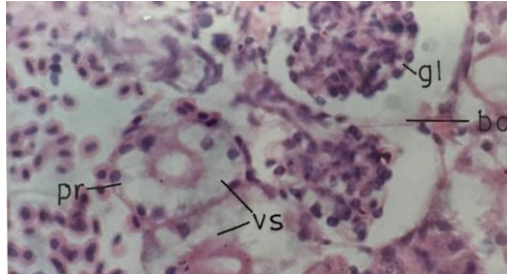


Fig 9 TS of Kidney (treated fish, 8 ppm – 22 days) Stain H/E

Key: pr – proximal end, vs – vacuolar space, gl – glomerulus, bc – bowman's capsule

D) Collecting tubules:

1) Control- These are larger tubules having irregular oval shape. Epithelial cells are slightly elongated and are loosely attached to each other. Several large vacuolar spaces are seen within the cytoplasm. Such spaces are spherical and large. Often fine eosinophilic granules maybe seen within the lumen.

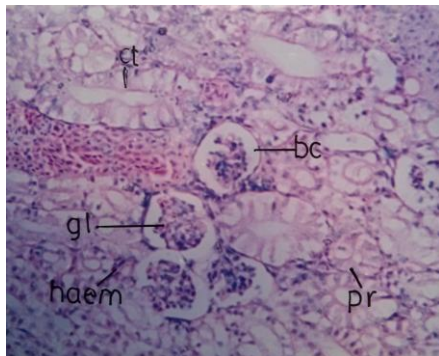


Fig 10 Light microscopic section of TS of Kidney (control) showing different regions of uriniferous tubules. Stain H/E

Key: Ct – collecting tubule; Bc – Bowman's capsule; gl – glomerulus; haem – haemopoietic region; pr – proximal region

2) On exposure to 8 ppm for 6 days: Collecting tubules are enlarged and cellular nature of the wall is lost. The epithelial lining has several large vacuolar spaces. Basement membrane is lost and the lumen is full of eosinophilic material.

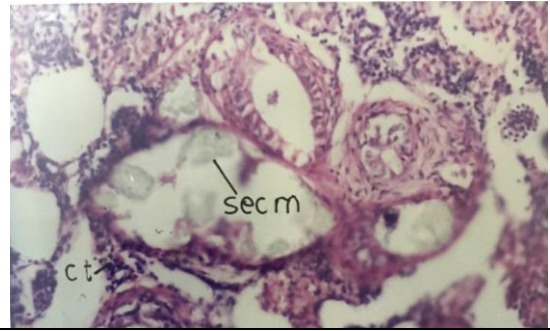


Fig 11 TS of Kidney showing collecting tubule (treated fish, 8 ppm – 6 days) Stain H/E

Key: secm – secretory mass, ct –collecting tubule

3) On exposure to 8ppm for 22days: Collecting tubules are very much enlarged. Extensive degeneration of epithelial cells is seen. The cytoplasm is totally lacking in many cells. Nuclei of epithelial cells are shifted towards the base. Vacuolar spaces prominent and striking. Lumen clearly filled with eosinophilic material. Reduction in staining property (hypochromasia).

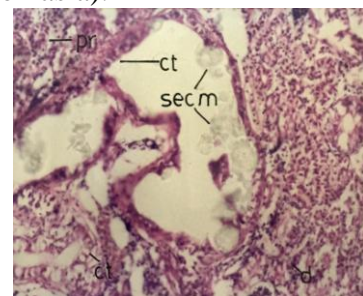


Fig 12 TS of Kidney showing collecting tubule (treated fish, 8 ppm – 22 days) Stain H/E

Key: secm – secretory mass, ct –collecting tubule, pr – proximal end

E) Haemopoietic tissue in kidney-

1) Control-Normal haemopoiesis is seen in the kidney

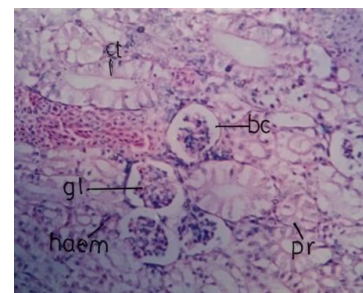


Fig 13 Light microscopic section of TS of Kidney (control) showing different regions of uriniferous tubules. Stain H/E

Key: Ct – collecting tubule; Bc – Bowman’s capsule; gl – glomerulus; haem – haemopoietic region; pr – proximal region

2) On exposure to 8 ppm for 6 days:
Haemopoiesis seems to be on the increase.
Fully formed RBCs are seen at the interstitial spaces between the tubules.

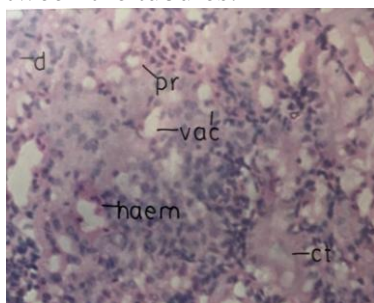


Fig 14 TS of Kidney showing haemopoietic activity (treated fish, 8 ppm – 6 days) Stain H/E

Key: d – distal end, haem – haemopoietic tissue, pr- proximal end, vac - vacuole, ct – collecting tubule

3) On exposure to 8ppm for 22days:
Haemopoietic material is somewhat reduced as the tissue cells start degenerating. RBCs where ever seen are slightly elongated.

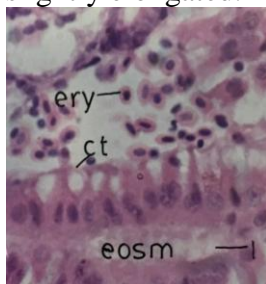


Fig 15 TS of Kidney (treated fish, 8 ppm – 22 days) Stain H/E

Key: ery – erythrocyte, ct – collecting tubule, eosm – eosinophilic material, l - lumen

Discussion:

The observation clearly indicates that the cadmium chloride treatment affects the kidney of fish to a great extent. The extent of changes is proportional to dosage and period of exposure (M. Sundaresan, 1995).

Effect of heavy metals on kidney have been studied by many workers.(Dubale M.S. And Shah Punita, 1982; Stomberg P.C. etal, 1983; A.A. Bawurao etal 2018; D. Kumar Babu etal, 2009).Conditions such as swollen and degenerate glomeruli accompanied by the obliteration or reduction in the size of lumen of bowman’s capsule (Shrivastava A. and Pandey A. K.,1986; Saravpreet Kaur etal, 2018; Imam

A.A. etal, 2013), hypertrophied nature of kidney tubules and obliteration of tubular lumen (Shrivastava A. and Pandey A. K.,1986; Md Kawser Ahmed etal, 2014), hypochromasia and cytoplasmic vacuolations and haemorrhages in glomeruli have also been reported (Studnicka M., 1983; Shrivastava A. and Pandey A. K.,1986).

Changes observed in the renal corpuscle-
The study indicates that the changes seen are more dependent on exposure time rather than the dosages. The first effect noted here is the enlargement (Hypertrophied nature) of the glomerulus. The increase in the size of the glomerulus continues for first 4/5 days resulting in proportional reduction in size of the lumen of Bowman’s capsule. Eventually it occupies the whole of interior of Bowman’s capsule. At this time the glomerulus appears as a thick cluster of cells and the individual capillaries are not easily distinguishable. Blood cell wherever present can be distinguished clearly. After this period, there onsets the degenerations of glomerular capillaries and this can be easily visualized from the scattered nature of erythrocytes within the Bowman’s capsule.

Changes observed at the proximal ends of the tubule- The changes seen here were-

- Lowered concentration of cytoplasmic granules in the epithelial cells.
- Reduction in the staining property of the cells leading to the cloudy appearance of the tissue.
- Loss of basement membrane followed by appearance of vacuolar spaces at the basal extremities of the tubules.
- Loss of cytoplasm and appearance of cytoplasmic vacuoles.

Of these the first two changes are seen during the early period of treatment and the latter two changes appear at a later period of treatment. In extreme cases the tissue might contract and the membranous lining of the tubules being lost, the epithelial cells give a clustered look. As time passes there is greater loss of cytoplasmic material leading to increase in number and size of cytoplasmic vacuoles. In still aggravated cases, entire cytoplasm and the nuclei of epithelial cells are lost. It is interesting to know that while the cytoplasm and nuclei get degenerated, the ciliated inner margins in particular remain intact.

Changes observed at the distal ends of the tubule- the changes observed here are-

- a) Loss of basement membrane accompanied by formation of vacuolar spaces.
- b) Separation of epithelial cells.
- c) Secretion of eosinophilic occlusion material within the lumen. The concentration of this material is seen to increase with dosage and period of exposure of treatment. These changes are more evident at distal end.

Changes observed at the Collecting tubule- They are more or less similar to changes observed in the distal ends of the tubule. Here too, the first to be affected is the basement membrane lining the membranes. This is accompanied by appearance of vacuolar gaps and radially arranged epithelial cells. Accumulation of eosinophilic substance is another characteristic feature commonly observed.

Reduction in staining property of all the tissue cells of treated fish is distinctly seen. Because of this reduced ability of staining (hypochromasia), the sections give a cloudy appearance.

Changes observed within the haemopoietic tissue- Observation in hemopoietic tissue yields interesting results. In fishes treated with cadmium salt in lower concentration, there is a slight increase in hemopoiesis in the initial stages (1 to 4 days). Subsequently however, Hemopoietic nature is reduced.

In fishes treated with higher dosage on the contrary there is reduction in haemopoiesis in the early stages (1 to 2 days). In extreme cases even the RBCs are seen in clumped form. During the fourth day or so, slight increase in haemopoiesis is seen. This is however for a short duration and with further exposure, when the other tissue cells start exhibiting signs of degeneration, the hemopoietic tissue too gets reduced

Acknowledgements:

Author is grateful to Dr. S.V. Shanbhag for providing valuable guidance for this research; Director, Cancer Research Institute, Parel for providing facilities for electron microscopy.

References:

1. A.A. Bawuro, B.B. Voegborlo and A.A. Adimado (2018) Bioaccumulation of Heavy metals in some tissues of fish

in lake Geriyo, Adamawa State, Nigeria. *Journal of Environmental and Public Health*; Volume 2018, article ID 1854892, 7pgs.

2. American Public Health Association (APHA, 1985) Standard methods for the examination of water and waste water (Washington DC).
3. Bulger Ruth Ellen & Trump Benjamin F., (1968). Renal morphology of the English Sole *Parophrys vetulus* *American Journal of Anatomy*; 123; pp 195-225
4. D. Kumar Babu, J. Obaiah, P. Sudhakar Reddy, G. Bhavani and A. Usha Rani (2009). Combined effect of copper, mercury and cadmium induced bioaccumulation in the selected tissues of two aquatic organisms. *J. Aqua. Bio*; 24 (2), 177-181
5. Dubale M.S. and Shah Punita (1982). Histopathology of Kidney of the Fish *Channa punctatus* Exposed to Cadmium. *J. Anim. Morphol. Physiol.* 28: 166-171
6. Edward Gurr (1956). A practical manual of medical and biological staining techniques. Leonard Hill (Books) Ltd. London.
7. Ferard J.E., Jouany J.M., Truhant R. and Vasseur P. (1983). Accumulation of Cadmium in freshwater food chain experimental model. *Ecotoxicol. And Environ Safety.* 7(1): 43 – 52
8. Hickman Cleveland P.; Jr; and Trump Benjamin F. (1969). *The Kidney. Fish physiology –Vol I* Edited by Hoar W.S. and Randall D.J.
9. Imam A.A. Mekkawy, Usama M. Mahmoud, Ekbal T. Wassif and Mervat Naguib (2013), Effects of Cadmium on Some Histopathological and Histochemical Characteristics of the Kidney and Gills Tissues of *Oreochromis niloticus* (Linnaeus, 1758) Dietary Supplemented with Tomato Paste and Vitamin E., *Journal*

- of Fisheries and Aquatic Science, Volume 8 (5): 553-580.
10. Ishaq S. Eneji, Rufus Sha A to and P.A. Annune (2011). Bioaccumulation of heavy metals in Fish (*Oreochromis zilli* and *Clarias gariepinus*) organs from river Benue, North-Central Nigeria. Pakistan Journal of Analytical and Environmental Chemistry. Vol 12 Issue 1 & 2, pages 25 - 31.
 11. M.S.Rahman,A.H.Mulla,N. Saha, and A.Rahman (2012) Study on heavy metals levels and its risk assessment in some edible fishes from Bangshi, Savar, Dhaka, Bangladesh. Food Chemistry,Vol-134,no4, pp1847-1854.
 12. Md. Kawser Ahmed, Elora Parvin, Md. Monirul Islam, Mosammat Salma Akter, Shahneawz Khan &Md. Habibullah Al-Mamun (March 2014) Lead- and cadmium-induced histopathological changes in gill, kidney and liver tissue of freshwater climbing perch *Anabas testudineus* (Bloch, 1792)Journal Chemistry and Ecology ,Volume 30, 2014 - Issue 6
 13. Meenakshi Sundaresan (Aug. 1995). P.hd. Thesis Cadmium Induced Cytological and histochemical changes in the freshwater fish *Tilapia mossambica* (Peters).
 14. Meenakshi Sundaresan (Sept. 1914) Ultra Structure of Kidney in the freshwater fish *Tilapia mossambica* (Peters).European Academic Research, Vol II , Issue VI, pg. 8563-8579.
 15. Mesequer J., Esteban M.A., Ayala A.G., Ruiz A.L., Agullerio B. (1990). Granulopoiesis in the head kidney of the Sea bass (*Dicentrarchus labrax* L.): An ultrastructural study. Archives of Histology and Cytology 53: 287-296.
 16. Roberts R.J.(1989).The anatomy and physiology of teleost. In Fish Pathology; 2nd edition, pp 13-55 London: Bailliere Tindall.
 17. Saravpreet Kaur, Kuldeep Singh Khera & Jasjit Kaur Kondal (2018), Heavy metal induced Histopathological alteration in Liver, Muscle and Kidney of freshwater Cyprinid, *Labeo rohita* (Hamilton). Journal of Entomology and Zoology Studies.,6 (2): 2137-2144.
 18. Srivastava A and Pandey A.K (1986) Effect of cadmium chloride on kidney in *Puntius sophore*, a fresh water fish. Comp. Physiol. Ecol. Vol 11; no4; pp203-207.
 19. Stomberg P. C., Ferrante J.G., Carter S.(1983) Pathology of Lethal and Sub-lethal Exposure of fathed minnows *Pimephales promelas* to cadmium: A model for aquatic toxicity assessment. J. Toxicol.Health Vol- XI, No. II, p.p 247-249
 20. Studnicka M. (1983) Histological and Ultra structural Studies of Muscle, Liver and Kidney of Brown Bullhead *Ictalurus nebulosus* after experimental contamination with Mercury. Acta. Ichthyol. Pisc: Vol XIII, No. I, pp 92-122

Relation between energy levels and temperament in dogs

Sahil Kapdi, Vinda Manjramkar

Department of Zoology, B. N. Bandodkar College of Science, Thane

Abstract

The study of dog temperament has considerable research attention. The temperament in dogs varies as they belong to different breeds and owners keeping them as pets bringing with them diverse perspectives. This paper provides some coherence between energy level and dog temperament, we organized descriptive observational studies about state of the field. The nutrition, owners behavior, also affect the temperament of dog despite their innate genetic behavior.

Introduction

There is a relation between the energy levels of dogs and the behavior displayed by them. Energy level of a dog can be measured using a scale (low, medium, high) wherein there are “Low energy dogs -these dogs are lazy by nature, they are content to snooze the day away”; “Medium energy dogs - these dogs can adapt to laying around or going for long walks”; “High energy dogs - these dogs are always ready and waiting for action. They have the stamina to put in a full workday and need a significant amount of exercise and mental stimulation. They are more likely to spend time jumping, playing and investigating any new sights and smells” (Oliver's Pet Care, 2015). Higher the energy the more alertness and activity. Higher energy level needs to be utilized through proper training and exercise, if this is not done then the dog tends to become aggressive and fierce. Dogs having low energy levels behave as if they are sedated and eventually become obese. They are not very alert, tend to react very slowly and hence do not make a good guard dog. Such dogs develop diseases related to sedentary lifestyles. They are also difficult to train and hence are least useful. At the most they can fulfill the role of cute cuddly pets.

The calmest dog breeds make great pets for people who only have time for an occasional walk, and low energy small dogs are perfect for those with smaller sized apartments. On the other hand, high energy dog breeds would be ideal for large families or people who like to go on runs and wish to take a companion with them.

In this study we will be comparing the energy levels of different dogs of same breed; however comparison cannot be made between two different breeds, although an attempt is made to compare the energy levels amongst different breeds. This data is restricted to the untrained dogs of the following breeds- Labrador retriever, Golden Retriever (Dogs that were originally trained to find live game and/or to retrieve game that had been shot or wounded.) (Kennel Club of India). German Shepherd (As part of the herding Group, German Shepherds are working dogs developed originally for herding sheep. Since that time however, because of their strength, intelligence, trainability, and obedience, German Shepherds around the world are often the preferred breed for many types of work, including disability assistance, search-and-rescue, police and military roles, and even acting.) (Kennel Club of India), Spitz (Small companion or lap dogs). The type was described as *Canis pomernanus* by Johann Friedrich Gmelin in his revision of *Systema Naturae* in 1788 (printed in English in 1792) (Kennel Club of India). However, this paper depicts the observed data of dogs going for a walk with their owners or caretakers

Rationale:

With the increasing canine population in the urban areas, the cases of people abandoning or giving away their pets for adoption have also increased. Some of the common reasons for people abandoning or giving away their pets for adoption are:

- **Over excitement,**
- **Uncontrolled chain pulling by the dog while walking,**
- **Digging, (mostly in terriers)**
- **Aggression**

Abandoning or giving away your pet for adoption whom you have raised with love and care and who has developed a bonding in the family just for the above reasons is a traumatic experience not just for the family but also to the pet dog, all these problems can be avoided in the first place if the owner is able to read the energy levels of their pet at the onset. Dogs of different breed are genetically programmed to display different energy levels. Vets and skilled trainers (behavior experts) have the knowledge of the expected behavior of dogs since they study the lineage of the pet dogs and have, an understanding of the unique characteristics of different breeds of dogs. An appropriate breed and a dog having the desired characteristics and energy levels to suit the owner's specific requirements can be selected with proper guidance from a Vet or a skilled trainer (behavior expert). Dogs develop intense bonding and eventually become family members and one cannot just give away a member of the family and not feel the pain. All the above-mentioned problems of our future canine friends are directly related to their energy levels. Proper training of both, the owner and the dog, can ensure that all the excess energy is utilized constructively. If the energy of the dog is not directed properly it could lead to aggressive and destructive behavior.

Material and Method

In the present study, data will be in the form of personal observations and interviewing the owners of the dogs living as privately-owned pets and the observed dogs were adults. A large number of the dogs were examined in situations like:

Walks with dogs on lonely streets (familiar and non-familiar)

Walks with dogs on crowded streets (familiar and non-familiar)

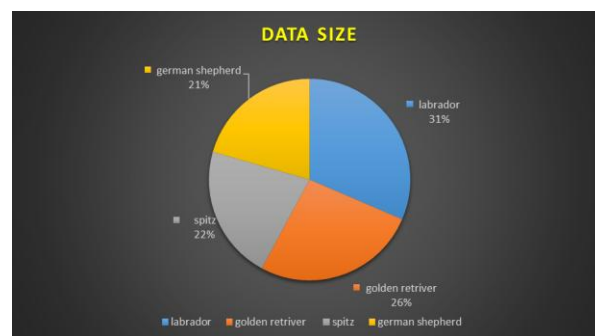
Play methods of dogs with owners

Play methods of dogs with other dogs and how the owner handled their dog's excitement

This data is restricted to the untrained dogs of the following breeds- Labrador retriever, German shepherd, Spitz and Golden retriever

Observation:

In the period of study, a total of 477 dogs were observed. Out of these 150 were Labrador Retrievers, 126 Golden Retrievers, 103 Spitz and 98 German Shepherds. The data was collected over a span of 5 months between August 2018 to December 2018.

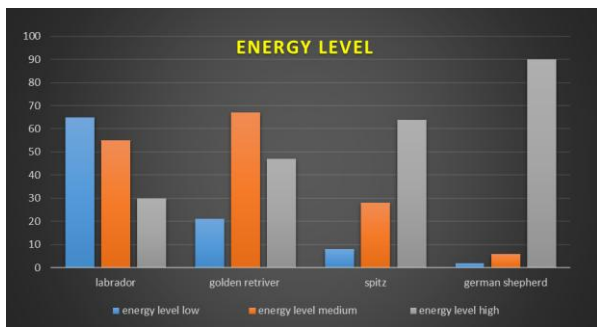


Graph 1:.Data size

The table given below shows the various behaviors exhibited by dogs of all breeds having different energy levels irrespective of which breed they belong to. Conversely, we can predict the behavior of dogs in different situations if we know their energy level using these observations.

energy level	walks on lonely street		walks on crowded streets		play method with owners		play method with other dogs	
	Familiar	Non Familiar	Familiar	Non Familiar	home	outside	first time	later
low	calm walk with owner	stressed and will depend on owner for directions. Sometimes forced to pull	calm with owner	stressed and will depend on owner for directions	wont play and will prefer sleeping	normal walking	wont engage to play with high energy dogs , engage to play with dogs with similler energy	after knowing the dog games will be licking sniffing and in rare situations running
medium	calm walk with owner. May get excited on seeing other dogs	alert with intial chain pulling and territory marking	calm but alert with owner. May get excited on seeing other known person	alert with intial chain pulling and territory marking may become aggressive depending on socialization status and the approach of unfamiliar person	will play rarely by bringing toys to owner jumping over him along with licking	normal walking with light jog or games like fetch	will readily play with dogs of simmliar or lower energy , will judge the dog with higher energy of aggression and then play	games like sniffing running chasing and in some cases mounting
high	calm walk with owner get excited on seeing other dogs	Highly alert with chainpulling throught and teretory marking	calm and alert with initial chain pulling with owner	alert with chainpulling throught and teretory marking may become aggressive depending on socialization status and the approach of unfemiliar person	always ready to play will play rarely by bringing toys to owner jumping over him along with licking and some times mounting. May become aggressive if not given attention	normal walk compulsory . Jogging runing games like fetch, pull etc	will play with any dog with full energy unknowing causing harm to other dogs	games like running chasing jumping mounting and if the other dog is of same energy may end up in friendly fights

Table 1: Depicting behavior of various dog breeds



Graph 2: Depicting the energy levels in various breeds

When the energy levels are compared between different breeds, it was observed that German Shepherds had maximum energy levels, followed by Spitz, Golden Retriever and Labrador Retriever which confirms to their genetics, yet it does not necessary hold true in all cases.

Discussion and Result

Not much research or data is available on the energy levels of dogs (breed wise). There is a direct relation between a dog's behavior and their energy levels. The dogs with higher energy level are more alert and active making them a perfect guard/ police dog. But at the same time if the owner is not able to channelize its excess energy in the right direction, the dog will become aggressive and hard to control. There is connection between nutrient and behavior of dog breeds. The owner who does not have the ability to understand their energy

levels tend to give up on their pets. High protein diet showed aggression in golden retriever also persistent feeding motivation between meals can increase stereotyped behaviour and aggression and decrease resting time. (G. Bosch 2007).

Aggression toward people and animals, running away, destructive behaviour, disobedience, house soiling and excessive barking are unwanted behaviour that make owners relinquish or abandon their dog (Salman MD, Hutchison J, Ruch-Gallie R, Kogan L, New JC Jr, Kass PH & Scarlett JM (2000). Sometimes dogs are fed frequently i.e. they are fed excessively. If their food intake is a little more than required, they tend to be over active but if it is substantially more then they tend to become obese and lethargic. This is seen in case of Labradors and Golden Retrievers as these breeds tend to eat everything that is served to them without stopping when their stomach is full.

Energy levels in dogs are also dependent of the amount of energy consumed through food and the amount of energy used up for metabolism and their activity with their owners. If the owner is active, the pet also is active and if the owner is lazy the pet also tends to be lazy since they observe and emulate the owners minutely associations have been reported between the owners' and dogs' personality. For instance, owners of highly aggressive English cocker spaniels tend to be emotionally less stable, shy,

undisciplined and more likely to be tense than owners of low aggressive spaniels (Podberscek & Serpell 1997). Owners also showed some degree of similarity with their dog in their personality profile (Turcsán, Kubinyi, Virányi & Range 2011). Despite the extended literature on dog-human relationships, only a little is known about the effects of the owners' personality on the dog-owner dyadic interaction. Dogs evolved living as pack animals having Alpha hierarchy which was maintained and scrupulously followed; Pet dogs therefore try to find an Alpha in one of the of family members (human or other dog) and follows instruction of that individual. Owners who do not know this fact of the dog's life can end up being in a confusing state of mind. Even experienced owners can misinterpret their dog's behavior (Horowitz and Horowitz 2009, Tami and Gallagher 2009) and, therefore, underestimate problems.

Some owners prefer small breeds, as they own pets just for social status, however they do not realize that the smaller breeds (as observed in our study) like Spitz, are more active as they have high energy levels. According to Banfield Pet Hospital, the smaller dog trend could also shift the focus of veterinary care, since large breed dogs are more prone to arthritis, hip dysplasia, and twisted stomachs, while small breed dogs more prone to diabetes mellitus, periodontal disease, and dislocated kneecaps. The owners of such dogs are not equipped or prepared to handle the hyper activity and end up being frustrated by their aggressiveness and unruly behavior which in fact is caused because the owner does not ensure the constructive consumption of the excess energy in such dogs and the nutritional impact. Genetically, German Shepherds are active, protective, smart, disciplined in eating and behavior habits. Spitz exhibits a wide range of behavior totally depending on how they are raised. Labradors sometimes are active and smart, however their general tendency is towards being lethargic, and this leads to obesity. Overall, it depends on how the owners nurture their pets. When it comes to a second or consequent pet, interaction and tolerance between two different species is also considered. The first is

called *instinctive intelligence*. This really refers to what a dog was bred for. For example, herding dogs were bred to herd animals. The second dimension of dog intelligence is *adaptive intelligence*. This is basically a measure of what a dog can learn to do for himself. It includes learning and benefiting from experience with his environment, solving new problems, and so forth. Adaptive intelligence can differ among individuals of the same breed. Thus, all Golden Retrievers have the same instinctive intelligence, yet while most are quite clever you will occasionally encounter one that seems totally clueless and makes the same mistakes over and over again. The difference between the various Golden Retrievers is a matter of difference in adaptive intelligence, and this can be measured by using the appropriate tests. This third type of intelligence in dogs is appropriately called *working and obedience intelligence*. It is the closest to what we might call school-learning ability, and is based upon what the dog can learn to do when instructed by humans. (Stanley Coren 1994)

Conclusion

This study provides some information about how every individual owner perceives the temperament of a dog. It provides an insight into how they should select their pet dogs (breed and energy level wise). Normally selection is done by getting information, observing dogs of some breeds in vicinity or at times there is little or no choice, Choice of breed is also dependent on the breeds economic viability and its space requirement.

References

1. Amanda C. Jones *, Samuel D. Gosling 2005. Temperament and personality in dogs (*Canis familiaris*): A review and evaluation of past research Applied Animal Behaviour Science 95 (2005) 1–53.
2. Bosch.G, Beerda B, Hendriks W. H. Van der Poel, A. F. B. and Verstegen M. W. A 2007. Impact of nutrition on canine behaviour: current status and possible mechanism Nutrition Research Reviews (2007), 20, 180–194 q The Authors 2007
3. Horowitz D., Horowitz A. (2009) A comparison of dog owners' claims about

- their pets' guilt with evidence from dog behavior. *Journal of Veterinary Behavior: Clinical Applications and Research* 4, 104.
4. Oliver's Pet Care. (2015). Dog breeds by attributes. Retrieved from <http://www.oliverspetcare.com/info/DogBreeds>.
 5. Podberscek, A.L., & Serpell, J.A. (1997). Aggressive behaviour in English cocker spaniels and the personality of their owners. *Veterinary Record*, 141, 73–76.
 6. Keenel club of India
 7. Salman MD, Hutchison J, Ruch-Gallie R, Kogan L, New JCJr, Kass PH & Scarlett JM (2000) Behavioral reasons for relinquishment of dogs and cats to 12 shelters. *J Appl AnimWelf Sci* 3, 93– 10
 8. Scott, J.P., Bielfelt, S.W., 1976. Analysis of the puppy testing program. In: Pfaffenberger, C.J., Scott, J.P., Fuller, J.L., Ginsburg, B.E., Bielfelt, S.W. (Eds.), *Guide Dogs for the Blind: Their Selection, Development and Training*. Elsevier, Amsterdam, pp. 39–75
 9. Serpell, J.A., 1983. The personality of the dog and its influence on the pet-owner bond. In: Katcher, A.H., Beck, A.M. (Eds.), *New Perspectives on our Lives with Companion Animals*. University of Pennsylvania Press, Philadelphia, PA, pp. 57–63
 10. Stanley Coren (1994) *The Intelligence of Dogs* ISBN 10: 0747212813, ISBN 13: 9780747212812
Publisher: Headline Book Publishing, 1994
 11. Stephen, J.M., Ledger, R.A., Stanton, N., 2001. Comparison of the perceptions of temperament in dogs by different members of the same household. In: Garner, J.P., Mench, J.A., Heekin, S.P. (Eds.), *Proceedings of the 35th International Congress of the ISAE*, Davis, California, USA, Centre For Animal Welfare, UC Davis. 113
 12. Tami G., Gallagher A. (2009) Description of the behaviour of the domestic dog (*Canis familiaris*) by experienced and inexperienced people. *Applied Animal Behaviour Science* 120, 159–169
 13. Turcsán, B., Kubinyi, E., Virányi, Z., & Range, F. (2011). Personality matching in owner-dog dyads. *Journal of Veterinary Behavior: Clinical Applications and Research*, 6(1), 77. doi: 10.1016/j.jveb.2010.09.016.

Cytotoxic and genotoxic effect of pesticides

Shifa Deshmukh, Rohit Manyar and Minakshi Gurav*

Department of Zoology, The D.G. Ruparel College of Arts, Science and Commerce, Mahim (W),
Mumbai 400016, *Corresponding Email: shifadeshmukh78@gmail.com

ABSTRACT

Agriculture is the main occupation of India. Being the second most populous country, its demand for food is increasing day by day. To overcome this demand farmers use various pesticides and other chemical fertilizers. Plants are the direct recipients of agro-toxics. The present paper deals with the effect of these pesticides on Mitosis of *Allium cepa*. The study reveals that overuse of this pesticides leads to chromosomal aberration which hamper the mitotic index. Cytotoxicity was inferred when the Mitotic index (dividing cells/1000 scored) of treated cells was $\leq \frac{1}{2}$ negative control. Genotoxicity was measured by analyzing 20 to 100 anaphase-telophase cells per dose of chemical for, chromosome fragments, bridges, c-anaphase, multipolar and stick chromosomes and comparing the percentage of aberrant cells at each dose with that of the control.

Keywords: Pesticides, Mitosis, Mitotic Index, Genotoxicity, Cytotoxicity

Introduction

India is the second most populated country in the world. Its demand for food is increasing day by day. To meet this demand farmers use various pesticides and other chemical fertilizers. The use of pesticide to control plant diseases and pests has been steadily increasing at an annual rate of about 14%. Since the mid-1950s usage of pesticides has increased. Overuse of this pesticides leads to bioaccumulation. It can cause mutations and carcinogenicity (IARC 1990-91; Bull *et al.* 2006). Excessive use of pesticides and fertilizers also pollute the surrounding environment in addition to deteriorating the physical and chemical properties of soil. Pesticide residues can be present in fruit and vegetables and represent a risk for human health. Several studies have shown that chronic exposure can cause birth defects and that prenatal exposure is associated with carcinogenicity (Feretti *et al.* 2007). Concern has been raised over the long term sustainability and environmental consequences due to intensification of agro-ecosystem (Shivika *et al.* 2018).

Plants genotoxicity assays are relatively inexpensive, fast, give reliable results. Chemicals which cause chromosomal aberration in plant cells also produce chromosomal aberration in cultured animal cells that frequently identical (Grant, 1978; Ma *et al.* 1994).

Allium cepa is used as a test material to determine genotoxic effect of different chemicals. Environmental agencies like the United Nations Environmental Program, World Health Organization, International Program on Plant Bioassay and US Environmental Protection Agency have advocated and validated the use of plants as a test organism. *Allium* genus, especially the use of *A. cepa* for bio-monitoring of genotoxicity is considered to be very efficient (Shivika *et al.* 2018). Use of *A. cepa* in study reveals that these compounds can induce chromosomal aberrations in root meristems (Ma *et al.* 1994). It is used as a model for Study of Mitosis as it has less chromosome number, large chromosome size and easy to grow.

In present study, two pesticides were assessed for inhibition of cell division and genotoxicity in the *A. cepa* root tip chromosome aberration assay namely: Chlorantraniliprole and Oxyfluorfen.

Oxyfluorfen is a diphenyl ether herbicide structurally related to lactofen and acifluorfen. The diphenyl ether herbicides act by inhibiting protoporphyrinogen oxidase, which is the second-to-last enzyme in chlorophyll biosynthesis. This enzyme is the second-to-last enzyme in heme synthesis, as well (Birchfield and Casida, 1997). According to Human Health Assessment - Oxyfluorfen is of low acute oral, dermal, and inhalation toxicity.

Chlorantraniliprole is a carboxamide resulting from the formal condensation of the carboxylic acid group of 3-bromo-1-(3-chloropyridin-2-

yl)-1H-pyrazole-5-carboxylic acid with the primary amino group of 2-amino-5-chloro-N,3-dimethylbenzamide.

MATERIALS AND METHODS

Preparation: *Allium cepa* was taken as an experimental material. Onions purchased from local market were taken and previous root were removed. The commercial formulation of DuPont Coragen and Oxyguard was obtained from market and 0.4 gm of each was diluted to one liter separately. Three sets were made viz. control, test for Oxyfluorfen and Chlorantraniliprole. In control only tap water was filled in 630 ml bottle and onion with slit was put into it in such a way that only its base touches water. In test bottles, the pesticides were added separately as 4µg/l, 8µg/l, 12µg/l, 16µg/l, 40µg/l, 80µg/l, 120µg/l and 160µg/l of each along with tap water (630 ml). After three to four days the roots were cut 2 inch long in the morning between 8.30 am to 9.30 am. The roots were treated with colchicine for one hour and then fixed in Carnoy's fixative. Before mounting the heat treatment with 1N HCl was given so as to make them tender. The acetocarmine stain was used with mild heat treatment. The dark coloured tips were then squashed on slide and a glass cover slip was placed on the root tip and tapped gently with a pencil to spread the cells evenly to form a monolayer to facilitate the scoring process for

normal and aberrant cells in the different stages of the cell cycle.

Scoring of slides and data analysis: The slides were viewed under light microscope using 40X and 100X objective lens with oil immersion. The most representative ones for each structural aberration were photographed using an Amscope – Microscope Eyepiece Camera Model number – MD-500

Mitotic Index (MI): The mitotic index is expressed as the number of dividing cells per number of total cells.

$$\text{Mitotic Index} = \frac{\text{Number of dividing cells (n)}}{\text{Number of Total cells (N)}} \times 100$$

Number of total cells (N) -Total number of cells in the field

Dividing cells (n) – Prophase, Metaphase, Anaphase and Telophase

Cytotoxicity: The mitotic indices of the treated cells at each dose of each pesticide were compared with that of the control group. A dose of pesticide was adjudged cytotoxic if the mitotic index of the treated cells was $\leq \frac{1}{2}$ of the mitotic index of the concurrent water treated cells.

Genotoxicity: The following chromosomal aberrations were seen such as C-anaphase, multipolar anaphases, bridge chromosome, stick chromosomes, distorted anaphase. (Asita and Matebesi2010)

RESULTS AND DISCUSSION

Concentrations(µg/l)	Total cells(N)	Inter phase	Prophase	Metaphase	Anaphase	Telophase	Mitotic index	MI as % of control
		Cells in division stages per 1000 cells						
Control	507	250	90	69	58	40	51.4	100
4	496	288	84	28	16	10	28.8	56
8	390	296	85	29	15	10	28.4	55
12	497	233	80	28	15	9	26.5	51
16	500	264	81	26	14	7	25.4	49 +
40	468	322	73	27	11	5	24.7	48 +
80	459	280	68	19	09	6	22.2	43 +
120	430	261	61	18	07	4	20.9	40 +
160	485	249	58	15	07	3	17.1	33 +

Cumulative data of 10 sets, + = Toxic (MI test $\leq \frac{1}{2}$ of Control).

Table: 1 -The results of the cytotoxicity determination are presented in the following table for Chlorantraniliprole pesticides:

Concentrations ($\mu\text{g/l}$)	Total cells (N)	Inter phase	Prophase	Metaphase	Anaphase	Telophase	Mitotic Index	MI as % of control
		Cells in division stages per 1000 cells						
Control	575	280	97	78	64	56	51.3	100
4	508	322	68	34	15	16	26.1	50
8	497	268	65	32	14	16	25.5	49 +
12	485	283	60	30	13	14	24.8	48 +
16	502	280	56	25	14	11	24.1	46 +
40	480	296	55	27	12	12	22.0	42 +
80	459	267	51	28	10	10	21.5	41 +
120	498	289	48	26	09	10	18.6	36 +
160	501	306	46	24	08	6	16.7	32 +

+ = Toxic (MI test $\leq 1/2$ of Control).

Table: 2 - The results of Mitotic index for Oxyfluorfen are as follows



Fig.1 Multipolar Anaphase (45x) at conc. $4\mu\text{g/l}$, $8\mu\text{g/l}$, $12\mu\text{g/l}$, $16\mu\text{g/l}$ (Chlorantraniliprole, Oxyfluorfen)



Fig.4 Bridge chromosome (45x) at conc. $12\mu\text{g/l}$, $16\mu\text{g/l}$, $40\mu\text{g/l}$ (Chlorantraniliprole)



Fig.2 Stick Chromosome (45x) at conc. $4\mu\text{g/l}$, $8\mu\text{g/l}$, $12\mu\text{g/l}$, $16\mu\text{g/l}$ (Chlorantraniliprole)



Fig.5 Distorted Anaphase (100x) at conc. $40\mu\text{g/l}$, $80\mu\text{g/l}$, $120\mu\text{g/l}$, $160\mu\text{g/l}$ (Chlorantraniliprole)

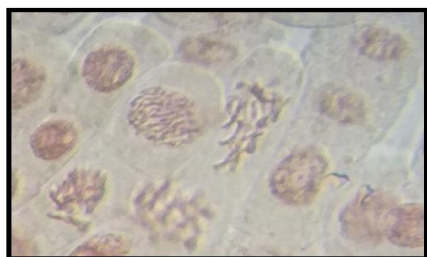


Fig.3 C- Anaphase (45x) at conc. $16\mu\text{g/l}$, $40\mu\text{g/l}$, $60\mu\text{g/l}$ (Chlorantraniliprole, Oxyfluorfen)



Fig.6 Stick chromosome (45x) at conc. $4\mu\text{g/l}$, $8\mu\text{g/l}$, $12\mu\text{g/l}$, $16\mu\text{g/l}$ (Oxyfluorfen)

Test	Concentrations (µg/l)	Mitotic index	A-T scored	Aberrations observed in Anaphase-Telophase cells scored				Total CA%
				Bridge %	Stick %	C Anaphase %	Multi polar %	
Control	100	51.4	83	1.35	-	-	-	1.35
Chlorantraniliprole	4	28.8	56	-	-	-	1.25	1.25
	8	28.4	52	1.89	3.80	1.24	1.30	8.23*
	12	26.5	45	3.65	-	-	5.01	8.66*
	16	25.4	42	-	4.57	4.99	-	9.08*
	40	24.7	36	7.01	4.09	-	5.70	16.8*
	80	22.2	33	-	4.71	3.59	6.00	14.3*
	120	20.9	28	8.00	5.73	-	6.50	20.23*
Oxyfluorfen	160	17.1	23	8.97	8	5.88	6.64	20.52*
	4	26.1	60	-	-	-	1.23	1.23
	8	25.5	57	-	1.24	-	-	1.24
	12	24.8	55	-	1.38	2.68	1.98	6.04*
	16	24.1	48	-	1.90	3.00	3.08	7.98*
	40	22.0	43	2.78	2.99	-	4.01	9.7*
	80	21.5	35	2.80	-	3.76	5.07	11.3*
	120	18.6	31	3.54	4.94	-	5.06	13.54*
160	16.7	28	4.32	6.32	8.00	2.09	16.41*	

MI = Mitotic index (number of cells in division stages out of 1000 cells); A - T (Anaphase and Telophase cells); CA % = cells with chromosomal aberrations as % A - T cells examined. CA ≤ Control *

Table: 3 - Percentage of some chromosomal aberration of onion root tip cells.

Cytotoxicity of the pesticides: The results of the cytotoxicity determination are presented. Both the pesticides were toxic at one or more of the 8 concentrations tested. They showed toxicity at higher concentration. MI as % of control with respect to treated is toxic.

Genotoxicity of the pesticides: The result for the effect of genotoxicity of pesticides is seen. The commonest types of genotoxic effects observed were C-anaphase and Stick chromosomes which together accounted for 50% and above of the total CA observed for the genotoxic. (Vellaikkannu *et al.* 2017). Oxyfluorfen is less toxic as compared to Chlorantraniliprole. High concentration of these pesticides causes various anomalies. In cells treated with Oxyfluorfen, Stick chromosome and C-anaphase was seen. In Chlorantraniliprole, Multipolar Anaphase, C-anaphase, Bridge chromosome, distorted chromosome were seen.

The mitotic indices of onion root tips treated with pesticides showed depression of the mitotic index with pesticides (Amer and Farah. 1974; Asita and Makhalemele. 2008). The commonest types of genotoxic effects observed were C-anaphase and Stick chromosome (Fig.3 and Fig.2

respectively). The presence of C-anaphase cells was evidence of the action of the pesticides concerned on the mitotic spindle (Matsumoto *et al.* 2006). The stick chromosomes have resulted in the abnormal uncoiling of chromosome during anaphase to Telophase (Qian *et al.* 2006). Bridge chromosome and multipolar anaphase were seen in higher concentration. (Fig.4 and Fig.1 respectively)

CONCLUSION

In conclusion, both the pesticides used in the present study were toxic to onion root tip cells. Chlorantraniliprole has more cytotoxic and genotoxic effect than that of Oxyfluorfen. C-anaphase and Stick chromosomes types of aberration which was evidence of the action of the pesticides on the mitotic spindle and the coiling of chromosomes during anaphase to telophase.

Mitotic index is the efficient tool to study the cytotoxic effect of pesticides. Optimization of the dosage of pesticides using this tool can help to reduce cytotoxic and genotoxic effects on plant.

Acknowledgement:

We would like to thank our Principal of D. G. Ruparel College, Department of Zoology, Head of Zoology Department, Asst. Professor Mr. Nitin Wasnik, all the non-teaching staff, Ms. Veena Desai and Ms. Chetali Pandekar for supporting us.

References

1. Amer M, Farah R (1974). Cytological Effects of Pesticides. VI. Effect of the Insecticides Roger on the mitosis of the *Viciafaba* and *Gossypiumbarbadense*. *Cytologia*. (39):507-514.
2. Asita O, Matebesi L (2010). Genotoxicity of hormoban and seven other pesticides to onion root tip meristematic cells, *African Journal of Biotechnology*. Vol. 9 (27):4225-4232.
3. Asita O, Makhalemele R (2008). Genotoxicity of Chlorpyrifos, Alphathrin, Efektovirikop and Springbok to onion root tip cells *Afr. J Biotechnol*. 7(23): 4244-4250.
4. Birchfield B, Casida E (1997). Protoporphyrinogen oxidase of mouse and maize: Target site selectivity and Thiol effects on peroxidizing herbicide action. *Pesticide Biochemistry and Physiology*. 57(1): 36-43.
5. Bull S, Fletcher K, Boobis A, Batterrshill J (2006). Evidences for genotoxicity of pesticides in pesticides applicators. *Mutagenesis*. 21 (2): 93-103.
6. Ferretti D, Zerbini I, Zani C, Ceretti E, Moretti M, Monarca S (2007). *Allium cepa* chromosome aberration and micronucleus tests applied to study genotoxicity of extracts from pesticide-treated vegetables and grapes. *Food Addit. Contam*. 24 (26): 561-572.
7. Grant W (1978). Chromosome Aberration in plants as monitoring system. *Environmental Health Perspectives*. (27): 37-43.
8. International Agency for Research on Cancer (IARC) (1990). IARC Monographs on evaluation of carcinogenic risks of chemicals to humans. (1-69): 1969-1997.
9. International Agency for Research on Cancer (IARC) (1991). IARC Monographs on the evaluation of carcinogenic risks to humans' occupational exposures in insecticides application and some pesticides.(53): 33-586.
10. Ma T, Cabrera G, Cebulska-Wasilewska A, Chen R, Loarca F, Vandererg A, Salamone M (1994). Tradescantia-Stamen-Hair-Mutation Bioassays for the International Programme on Chemical safety, WHO, The United Nations, *Mutation Res*. (310): 211-220.
11. Matsumoto S, Mario S, Mirtis I, Ana Lucia D, Cristina F, Maria A (2006). Genotoxicity and mutagenicity of water contaminated with tannery effluents, as evaluated by the micronucleus test and comet assay using the fish *Oreochromis niloticus*. *Genetics and Molecular Biology*. 29 (1):148-158.
12. Qian X, Luo W, Zheng O (2006). Joint effects of microwave and chromium trioxide on the root tip cells of *Viciafaba*. *J. Zhejiang Univ. Science*. 7(3): 221-227.
13. Shivika D, Jaswinder S, Joginder S, Sharanpreet S, Simranjeet S (2018). Assessment of genotoxic effects of pesticides and vermicompost treated soil with *Allium cepa* test. *Sustainable Environment Journal*. (28): 171-178.
14. Vellaikkannu S, Chathlingathe V and Subramani M (2017). Genotoxicity of pesticides to onion root tip Meristematic cells. *International Journal of Botany*. 2(4): 20-23.

Predatory potential of spiders in rice crop of North Kokan region of Maharashtra.

Bhalekar S. J., Patil N.N.

Department of Zoology, B.N. Bandodkar College of Science, Thane.

ABSTRACT

Spiders are ubiquitous in terrestrial ecosystems and abundant in both natural and agricultural habitats. They play an important role in regulating insect pests in agriculture ecosystems. they employ a remarkable variety of predatory strategies and are of immense economic importance to man because of the ability to suppress pest abundance in agro ecosystems. they limit the availability of habitats open to insect pests of important crops by occupying various microhabitats. They catch significant numbers of prey by using various foraging strategies. in the present study, an important crop of wada region was selected for estimating the predatory potency of web building spiders by counting the number of insects caught in the spider web. the significant difference has been observed between the different types of spiders' webs and number of insects caught. The predatory capacity of spiders can be used to suppress the density of insect pests and to limit the effect of insecticides.

Key words: Rice, insect, predatory potency, spider.

Introduction

Rice (*Oryza sativa* L) is the most important staple food all over the world. The north Kokan region of Maharashtra including Thane and Palghar District mainly cultivate rice crop. The most popular and economically valuable variety of rice 'Wada Kolam' is native of Wada and nearby area. As rice occupies most of the cultivating area of north Kokan region it always faces the major problem of insect pest. The insect pest not only damage crop but also cause yield losses up to 30-40 % depending upon severity of incidence. In present study 20 types of insect pest has been observed. Out of these 20 major insect pests infesting rice brown plant hopper (*Nilaparvta lugens*), green leaf hopper (*Nephotettix virescens*) and stem borers (*Scirpophaga incertulas*) have been identified as the major insect pests and pose challenges to rice production (Pathak and Dhaliwal, 1981). The stem borer *Scirpophaga incertulas* is most predominant species. Pasalu et al. (2000) reported yellow stem borer, *Scirpophaga incertulas* as number one in pest status as national pest. The main pest management method is application of synthetic chemical pesticides. However, the application of chemical pesticides has got many limitations and creates undesirable side effects, reduce the biological control efficiency, resulting resurgence (Heinrichs, 1994). For long effects and future benefits the Integrated Pest Management (IPM) strategies has to be followed for controlling insect pest. The natural enemies such as Parasitoid, Predators and Pathogens play an important role in regulating the insect population level in rice crop. It is reported that 80% of total predatory community

is represented by the spiders in rice fields (Wang, 1985). They are magical gift of nature to farmers for suppressing the insect pest population in rice fields (Singh et al, 2005). Several workers reported the predatory potency of spiders in rice ecosystem (Sahu et al., 1996; Bhattacharya, 2000; Sebastian et al., 2005; Motobayashi et al., 2006).

The present study was carried out in the rice field to estimate the predatory potential of certain commonly encountered spiders in rice ecosystem so that they could be identified as candidate for bio-control agents.

Materials and methods

The present study was carried out in the most famous rice variety Wada-Kolam cultivated at the Wada Taluka, District Palghar and was done in the month of June to October, 2018 during kharif season.

The predatory potency of web building spiders was estimated against insects found in the rice fields by counting the number of insects caught in the spider's web. Predatory potential of spider was studied for insect pests are as brown plant hopper (*Nilaparvta lugens*), green leaf hopper (*Nephotettix virescens*) and yellow stem borer *Scirpophaga incertula*. Four predominant spider species viz., *Tetragnatha maxillosa* Thorell, 1895 Family: Tetragnathidae; *Argiope pulchella* Thorell, 1881 Family: Araneidae; *Leucauge decorata* Blackwall, 1864 Family: Tetragnathidae and *Stegodyphus sarasinorum* Karsch, 1891 Family: Eresidae were studied separately.

Spider webs located around the paddy field then were observed for recording the data. The selection web location was based on spider's niche level. Spider web observed without

harming the spider. Number of dead insect pest counted in field and dead insect pest collected from web for further investigation. Plastic sheet spread below the web to collect dead remaining of insect pest. Data recorded daily up to 7 days for each web.

During study in most of the webs female spiders were observed along with the prey. Four species of web building spiders belonging to three families were recorded. Among them *Tetragnatha maxillosa* were found at lowest ground level and *Stegodyphus sarasinorum* were found at highest ground level (Fig.1).

Results:

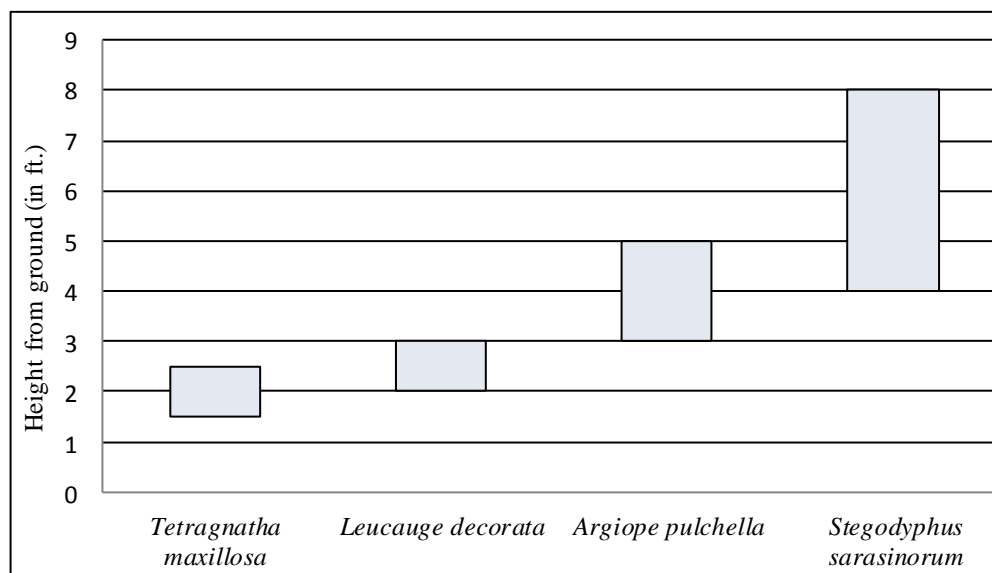


Figure 1: Spider web building preference from ground.

Mean feeding potential of female web building spiders in relation with three selected insect pests are shown in Table 1,2,3,4.

Days	Mean number of Insect pest consumption per day*		
	Green Leaf hopper <i>Nephotettix virescens</i>	Brown Plant hopper <i>Nilaparvta lugens</i>	Yellow stem borer <i>Scirpophaga incertulas</i>
1	6.66	1.66	1
2	5.33	1	0.66
3	6.33	2.33	1.33
4	5.55	3.33	0
5	4.66	1	1
6	5	2.66	1.33
7	4.33	2.33	1
Total	37.86	14.31	6.32
Mean	5.40	2.04	0.90

Note:* Average of 3 webs of each spider species.

Table 1: Feeding Potential of female *Leucauge decorata* on different insect pest of rice

Days	Mean number of Insect pest consumption per day*		
	Green Leaf hopper <i>Nephotettix virescens</i>	Brown Plant hopper <i>Nilaparvta lugens</i>	Yellow stem borer <i>Scirpophaga incertulas</i>
1	7	3	0
2	6.66	4.33	1
3	7.33	3	1
4	6.33	3.33	1.66
5	7.33	4.66	1
6	5.33	2.66	0
7	4.66	2.33	0.66
Total	44.64	23.31	5.31
Mean	6.37	3.33	0.76

Note:* Average of 3 webs of each spider species.

Table 2: Feeding Potential of female *Tetragnatha maxillosa* on different insect pest of rice

Days	Mean number of Insect pest consumption per day*		
	Green Leaf hopper <i>Nephotettix virescens</i>	Brown Plant hopper <i>Nilaparvta lugens</i>	Yellow stem borer <i>Scirpophaga incertulas</i>
1	2.66	1	3
2	1.33	0	1.66
3	2	1.66	2
4	1	2	1
5	0	0	0
6	1.66	0	2.33
7	0.66	1	2
Total	9.31	5.66	11.99
Mean	1.33	0.80	1.71

Note:* Average of 3 webs of each spider species.

Table 3: Feeding Potential of female *Argiope pulchella* on different insect pest of rice

Days	Mean number of Insect pest consumption per day*		
	Green Leaf hopper <i>Nephotettix virescens</i>	Brown Plant hopper <i>Nilaparvta lugens</i>	Yellow stem borer <i>Scirpophaga incertulas</i>
1	2.33	1	6
2	3	0	4.33
3	1.66	1.66	7.66
4	0	1	5.66
5	2	0	3.66
6	2.66	0.66	8.33
7	1	2	5.33
Total	12.65	6.32	40.97
Mean	1.80	0.90	5.85

Note: * Average of 3 webs of each spider species.

Table 4: Feeding Potential of *Stegodyphus sarasinorum* on different insect pest of rice

All four dominant spiders indicated their highest prey preference to *Nephotettix virescens*. *Leucauge decorata* and *Tetragnatha maxillosa* mostly preferred *Nephotettix virescens*. This might be due to the habit of the plant hopper which inhabit in the lower parts of

the field. *Stegodyphus sarasinorum* shows highest preference to *Scirpophaga incertulas* which might be due to higher flying habit of adult stem borer. *Argiope pulchella* shows mixed preference to selected insect prey.

Spider	Mean Predation (%) Per day			Mean feeding potential of spiders
	Green Leaf hopper <i>Nephotettix virescens</i>	Brown Plant hopper <i>Nilaparvta lugens</i>	Yellow stem borer <i>Scirpophaga incertulas</i>	
<i>Leucauge decorate</i>	5.40	2.04	0.90	2.78
<i>Tetragnatha maxillosa</i>	6.37	3.33	0.76	3.48
<i>Argiope pulchella</i>	1.33	0.80	1.71	1.28
<i>Stegodyphus sarasinorum</i>	1.80	0.90	5.85	2.85

Table 5: Mean Predatory potential of spiders on rice pest.



Figure 2: Prey preference of spider to mixed pest populations on rice crop.

Among the three of spider evaluated, the predatory potential of *Tetragnatha maxillosa* was the maximum followed by *Stegodyphus sarasinorum* and *Leucauge decorate* (Table 5). *Tetragnatha maxillosa* was the most effective predator on *Nephotettix virescens* and *Nilaparvta lugens*. Spider *Stegodyphus sarasinorum* found only more effective for *Scirpophaga incertulas*.

Discussion

Present study shows that, as the web building location change the diversity of captured pray also get changed. For integrated pest management (IPM) selection of spider species

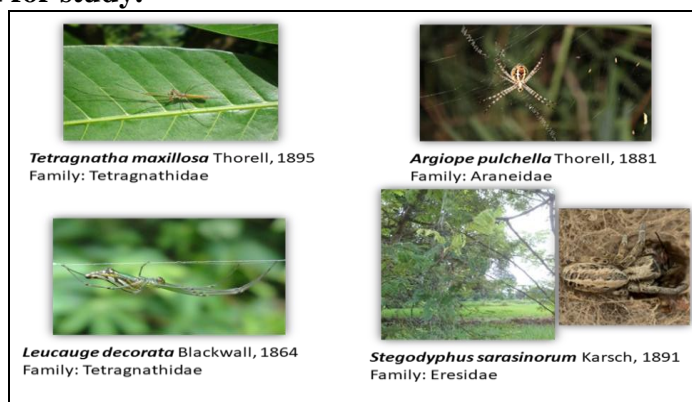
is also important. As the selected rice variety is more prone to stem borer the *Stegodyphus sarasinorum* found to be more effective. The selected spider species are found to be more efficient for rice insect pest management.

The predatory capacity of spiders can be used to suppress the density of insect pests and to limit the use of insecticides which may bring benefit to the farmers. The findings of the present study may be helpful in selecting natural enemies of pest for Integrated Pest Management (IPM) program through ecological pest management practices.

Major Rice Pests Observed during Study Period.



Spider species selected for study.



References

- Bhattacharya, S. 2000. Biodiversity of spiders in the rice field of Kalyani, West Bengal, India. Research Journal of Chemistry and Environment. 4(2): 75.
- Dale, D. 1994. Insect pests of the rice plant, their biology. In: (Ed.) Heinrichs, E.A Biology and Management of Rice insects. Wiley Eastern publication, 363.
- Heinrichs, E.A. 1994. Host plant resistance. In: Heinrichs, E.A. (Ed.), Biology and management of rice insects. Wiley, New York, 517-547.
- Matidrajan V.G. and Regupathy A. (2003). Comparative prey preference and predatory potential of three major spiders in rice ecosystem. 1. Biol. Control. 17(1): 87-89.
- Motobayashi, T. Ishijima, C., Takagi, M., Murakami, M., Taguchi, A., Hidaka, K. and Kunimi, Y. 2006. Effects of tillage practices on spider assemblage in rice paddy fields. Applied Entomology and Zoology, 41(2): 371-381.
- Pasalu, I.C.; Krishnaiah, N.V.; Katti G. and Varma, N.R.G. 2002. IPM in rice. IPM Newsl., 45-55.
- Patel M. L., et al.(2013). Feeding potential of Spiders Predaceous on Insect Pests of Rice. AGRES – An International e-Journal, Vol. 2, Issue 4: 523-526.
- Pathak, M.D. and Dhaliwal, G.S. 1981. Trends and strategies for rice insect problems in tropical Asia. Int. rice. res. paper, series no: 64.
- Sahu, S., Shatrughna, R., Sing Kumar and Pawan. 1996. Host preference and feeding potential of spiders predaceous in insect pests of rice. Journal of Entomological Research, 20(2): 145-150.
- Sebastian, P. A., Mathew, M. J., Pathummal Beevi, John Joseph, S. and Biju, C. R. 2005. The spider fauna of the irrigated rice ecosystem, in central Kerala, India. The Journal of Arachnology, 33: 247-255.
- Sellammal, M. and Chelliah, S. 1982. Predatory potential of the wolf spider *Lycosa pseudoannulata* on rice brown plant hopper. Interactional Rice Research Newsletter, 7: 17.
- Singh, R.B., 2005. Prevalence and compositions of different spiders and of land rice ecosystem. J. Plant Prot. Environ 2(1):41-45.
- Singh, R. B. and Singh, R. (2001). Feeding potential of predatory spiders against leafhopper (GLH.) of rice. Shashpa, 8 (2): 209-210.
- Wang, J.G., 1985. A preliminary investigation of spiders in paddy field in Shaoxi. Natural Enemies insect, 7(4):189-191 (C.F. Rice Abstr, 10(6):273,198).
- Wipada, V. (1988). Taxonomic study and predation efficiency of the spider genus *Tetragnatha* in paddy fields. 6, conference on insect and plant pest. Bangkok, (Thailand), 21-24.

Sequence comparison and phylogenetic analysis of crustacean's muscle protein Tropomyosin to study the interrelation and evolutionary aspect between crustaceans, an *In Silico* approach.

Tejas Borse and Kiran Pariya

Department of Zoology, VPM's B.N. Bandodkar, College of Science, Chendani Bundar Road, Thane West.

Abstract: Crustaceans such as crabs, lobsters, shrimps, prawns, barnacles etc. have exoskeleton of hard chitin. Aquatic crustaceans are important food source in terms of nutrients for human especially prawns, lobsters, shrimps and crabs. Tropomyosin (TM) as a muscular protein, present in crustaceans, invertebrates and vertebrates responsible for contraction of muscles. Being a heat stable muscular protein and has a two-stranded alpha-helical coiled protein found in cell cytoskeletons, is responsible for contraction of muscles. The protein sequence of tropomyosin studied for comparison, evolutionary aspects and interrelation between species of crustaceans. Multiple sequence alignment (MSA) and phylogenetic analysis performed on crustacean tropomyosin protein sequence through Universal Protein Resource (UniProt). The data retrieved from UniprotKB and aligned the sequences using ALIGN - CLUSTALO programme. The data studied for identical positions and identity similar positions between crustacean species. The study revealed the evolutionary aspects and interrelation between species of crustaceans.

Keywords: Tropomyosin, Crustacean, Protein sequence comparison, Phylogenetic tree

Introduction

Crustaceans form a large animal division which includes common animals such as crabs, lobsters, crayfish, shrimp, krill, etc, most crustaceans are free-living aquatic animals, but some are terrestrial, some are parasitic and some are sessile. The crustacean body is covered with a hard exoskeleton and majority of crustaceans are aquatic, living in either marine or freshwater environments, but a few groups have adapted to life on land, such as terrestrial crabs and terrestrial hermit crabs. Many crustaceans are consumed by humans, and nearly the vast majority of this output is of decapod crustaceans: crabs, lobsters, shrimp, crawfish, and prawns.

Tropomyosin is a muscular heat stable protein and has a two-stranded alpha-helical coiled coil protein found in cell cytoskeletons and is responsible for contraction of muscles. It is a common protein found in the crustaceans and according to the taxonomic classification of animals all crustaceans belong to the Phylum Arthropoda hence there may be some relatedness or common factors in those species. Bioinformatics is a computational tool used to extract knowledge or conclusions from biological data. It combines biology, computer science, information, mathematics and statistics to analyze and interpret biological data.

Bioinformatics is mostly used in genomics and proteomics the most commonly used tools are

BLAST, UNIPROTKB, FASTA etc. The tool used to align protein in this research problem is ALIGN at UNIPROTKB. The UniProt Knowledgebase (UniProtKB) is the database of proteins derived from experimentation and scientific conclusions, it consists databases of protein structure, functions and protein sequence and more additional information dedicated towards proteins. It contains abundant information about protein sequence and functional information. Sequence comparison is the method used in this research problem. A sequence alignment is a way of arranging the sequences of DNA, RNA, or protein to identify regions of similarity that may have functional, structural, or evolutionary relationships between the sequences of species. These similarities or identical regions in protein used to study the evolutionary aspect between crustacean species and studied the interrelation between species of same or different taxa. The sequence of crustaceans species were obtained from protein database (UNIPROT) and were aligned with various species of crustaceans to study the interrelation and evolutionary aspect between the species of crustaceans.

Tropomyosin is a common protein found in most crustacean species and the sequence of (TM) was studied. By using a phylogenetic analysis tool the interrelation and evolutionary aspect between major crustaceans studied by comparing the common protein's sequences. Comparison of Tropomyosin sequence leads us

to analyse relations and common factors between species of crustaceans and its evolutionary aspect.

Materials and Methods

Crustaceans include crabs, shrimp, lobsters, prawns etc. as major species of the group are an important food for humans. The species selected of crustaceans for research work are most commonly consumed crustacean species in India, Tropomyosin protein sequence of six crustacean species were selected.

1. *Charybdis feriata*
2. *Penaeus vannamei*
3. *Macrobrachium rosenbergii*
4. *Panulirus stimpsoni*
5. *Penaeus monodon*
6. *Portunus pelagicus*.

Retrieval of database

UniProtKB is a database dedicated to proteins where functional and accurate data of proteins are available.

The tools are available on their own dedicated pages on the UniProt website and are also accessible directly from other parts of the website like the **basket**, search/ tool results pages and protein entry pages. Having these tools in the UniProt website creates an integrated hub of data and analysis tools.

Tropomyosin protein sequences of selected six crustacean species were retrieved from Universal Protein Resource (UniProt) website <https://www.uniprot.org/>

Multiple sequence alignment (MSA)

The UniProt website provides a multiple sequence alignment tool for proteins called 'Align'. This tool runs the **Clustal Omega (ClustalO)** algorithm to find areas of similarity in the entries being aligned. This can be used to find conserved residues and regions that can help infer evolutionary and functional relationships (Simossis et.al. 2003).

Phylogenetic Tree

A study of a phylogenetic tree or evolutionary tree of selected six different species of crustaceans is a diagrammatic representation of the evolutionary relationship among them. The tool is inbuilt named as "Highlighted Taxonomy"

Results and discussion

Table No. 1: Records of protein sequence of Tropomyosin with information extracted from literature and curator-evaluated computational

analysis (S) and that await full manual annotation. (T)

Species	Length	Mol.wt	Entry (ID)
<i>Charybdis feriatus</i>	264	34kDa	Q9N2R3 (S)
<i>Penaeus monodon</i>	284	38kDa	A1KYZ2 (S)
<i>Panulirus stimpsoni</i>	274	34kDa	O61379 (S)
<i>Litopenaeus vannamei</i>	284	36kDa	B4YAH6 (T)
<i>Macrobrachium rosenbergii</i>	284	37kDa	D3XNR9 (T)
<i>Portunus pelagicus</i>	284	39kDa	M1H607 (T)

S: Reviewed (Swiss-Prot) - Manually annotated
T: Unreviewed (TrEMBL) - Computationally Analysed

Figure No. 1: Records of protein sequence of Tropomyosin with information extracted from literature and curator-evaluated computational analysis (S) and that await full manual annotation. (T)

The screenshot shows a table of UniProt search results for Tropomyosin. The columns include Entry, Protein names, Protein number, Gene number, Organism, and Length. The results are as follows:

Entry	Protein names	Protein number	Gene number	Organism	Length
Q9N2R3	TPM_CHAFB	264		Charybdis feriata (Cruceifis crab) (Cancer feriatus)	264
A1KYZ2	TPM_PENMD	284	TM1	Penaeus monodon (Giant tiger prawn)	284
O61379	TPM_STANST	274		Panulirus stimpsoni (Chinese spiny lobster)	274
B4YAH6	B4YAH6_FENVA	284		Lit v 1 tropomyosin Penaeus vannamei (Whiteleg shrimp) (Litopenaeus vannamei)	284
D3XNR9	D3XNR9_MACRS	284		Macrobrachium rosenbergii (Giant fresh water prawn)	284
M1H607	M1H607_PORPE	284		Portunus pelagicus (Blue swimmer crab)	284

Table No. 2: Job execution of six selected crustacean species using CLUSTAL OMEGA (CLUSTAL O) program

Job Identifier	A201902286746803381A1F0E0DB47453E0216320D2E2F564
Running Time	17.8
Identical Positions	229
Identity	80.634%
Similar Positions	16
Program	ClustalO
Default Parameters	The default transition matrix is Gonnet, gap opening penalty is 6 bits, gap extension is 1 bit. Clustal-Omega uses the HAlign algorithm and its default settings as its core alignment engine.

Figure No. 2: Job execution of six selected crustacean species using CLUSTAL OMEGA (CLUSTAL O) program

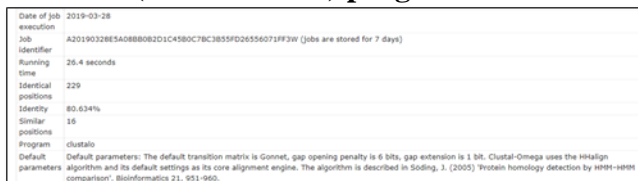
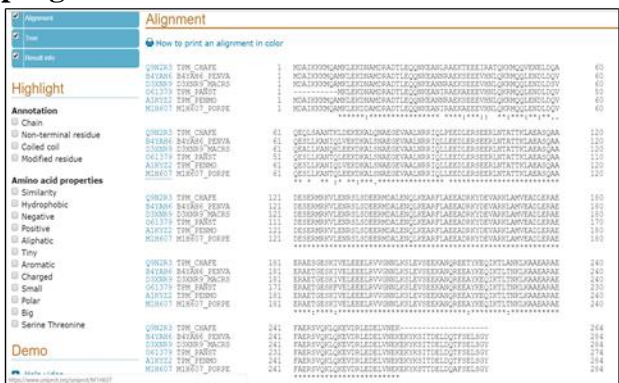


Figure No. 3: Uniprot Alignment result of six selected crustacean species using CLUSTAL OMEGA (CLUSTAL O) program

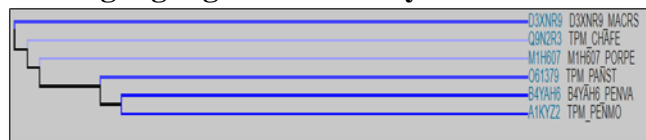


Multiple sequence alignments explained evolutionary conservation of structurally and functionally important regions of protein sequences of selected six crustacean species. To obtain meaningful results and minimize errors in the alignment, the sequences are aligned that are likely to be related to each other. The UniProt Align results appear as shown in Figure no. 03. The main page shows the sequences aligned and a left hand panel provides highlight options. These options showed the selected sequence annotations like chain, Non terminal residues, coiled coil and modified residues and amino acid properties with highlighted area across the sequences aligned.

Phylogenetic Tree

It is a kind of molecular archaeology that tries to reconstruct possible evolutionary relationships by extrapolating backward from a small dataset from surviving organisms. A study of a phylogenetic tree of selected six different species of crustaceans is a diagrammatic representation of the evolutionary relationship among them.

Figure No.4: Result of Phylogenetic tree of six selected crustacean species showing highlighted taxonomy.



Discussion:

Figure no. 4 depicts an evolutionary relationship among various taxa of crustaceans. It is a diagrammatic representation of phylogenetic tree or evolutionary tree. It is a branching diagram composed of nodes and branches. The nodes represent taxonomic units, such as tropomyosin proteins of crustaceans. A branch, an edge represents the time estimate of the evolutionary relationships among the taxonomic units of crustaceans. One branch can connect only two nodes. In a phylogenetic tree, the terminal nodes represent the operational taxonomic units (OTUs) or leaves such as entry A1KYZ2 of *Penaeus monodon* with 284 amino acid sequence length and entry B4YAH6 *Litopenaeus vannamei* with 284 amino acid sequence length. The OTUs the actual objects protein sequences of tropomyosin which compared. The internal nodes represent hypothetical taxonomic units (HTUs). An HTU entry O61379 *Panulirus stimpsoni* with 274 amino acid sequence length is an inferred unit and it represents the Last Common Universal Ancestor (LUCA) to the nodes arising from this point. Entry A1KYZ2 of species *Penaeus monodon* and entry B4YAH6 of species *Litopenaeus vannamei* are sister groups. Entry O61379 of species *Panulirus stimpsoni*, entry D3XNR9 of species *Macrobrachium rosenbergii*, entry M1H607 of species *Portunus pelagicus* and entry Q9N2R3 of species *Charybdis feriatius* are an out group to entry A1KYZ2 of species *Penaeus monodon* and entry B4YAH6 of species *Litopenaeus vannamei* which is a sister group.

References:

1. A.Faber, Margaretha & Pascal, Mariona & El Kharbouchi, Ouïam & Sabato, Vito & Hagedorens, Margo & Decuyper, Ine & Bridts, Chris & Ebo, Didier. (2016). Shellfish allergens: tropomyosin and beyond. *Allergy*. 72. 10.1111/all.13115.
2. Arthur M. Lesk Bioinformatics Encyclopædia Britannica Encyclopædia Britannica, inc. July 26, 2013 <https://www.britannica.com/science/bioinformatics>.
3. Bondad-Reantaso, Melba & Subasinghe, Rohana & Josupeit, Helga & Cai, Junning & Zhou, Xiaowei. (2012). The role of crustacean fisheries and aquaculture in global food security: Past, present and future. *Journal of invertebrate pathology*. 110. 158-65. 10.1016/j.jip.2012.03.010.
4. Calman, William Thomas (1911). "Crustacea" . In Chisholm, Hugh. *Encyclopedia Britannica*. 7 (11th ed.). Cambridge University Press. p. 552.
5. Chenna, Ramu, et al. "Multiple sequence alignment with the Clustal series of programs." *Nucleic acids research* 31.13 (2003): 3497-3500.
6. Das, Mohua & Kundu, Jayanta & Misra, Kamales kumar. (2015). Nutritional aspect of crustaceans especially freshwater crabs of India. *INTERNATIONAL JOURNAL OF ADVANCED RESEARCH IN BIOLOGICAL SCIENCE*. 2. 7-19.
7. González-Fernández, Juan, et al. "New insights into the allergenicity of tropomyosin: a bioinformatics approach." *Molecular biology reports* 41.10 (2014): 6509-6517.
8. Goujon, Mickael, et al. "A new bioinformatics analysis tools framework at EMBL–EBI." *Nucleic acids research* 38.suppl_2 (2010): W695-W699.
9. Hogeweg P (2011). Searls, David B., ed. "The Roots of Bioinformatics in Theoretical Biology". *PLoS Computational Biology*. 7 (3):e1002021. Bib code:2011PLSCB.7E2021H. doi:10.1371/journal.pcbi.1002021. PMC 3068925. PMID 21483479.
10. Hooper, S. L., & Thuma, J. B. (2005). Invertebrate muscles: muscle specific genes and proteins. *Physiological reviews*, 85(3), 1001-1060.
11. Lipman DJ1, Altschul SF, Kececioglu JD. *Proc Natl Acad Sci U S A*. 1989 Jun; 86(12):4412-5. A tool for multiple sequence alignment.
12. Mount, David W., and David W. Mount. *Bioinformatics: sequence and genome analysis*. Vol. 2. New York:: Cold spring harbor laboratory press, 2001.
13. Orr, Irit. "Introduction to phylogenetic analysis." Retrieved August 15 (2008): 2008. Chenna, Ramu, et al. "Multiple sequence alignment with the Clustal series of programs." *Nucleic acids research* 31.13 (2003): 3497-3500.
14. Reese G, Ayuso R, Lehrer S, B: Tropomyosin: An Invertebrate Pan–Allergen. *Int Arch Allergy Immunol* 1999;119:247-258. doi: 10.1159/000024201
15. Sievers, Fabian, and Desmond G. Higgins. "Clustal Omega, accurate alignment of very large numbers of sequences." *Multiple sequence alignment methods*. Humana Press, Totowa, NJ, 2014. 105-116.
16. Telmo j. R. Fernandes, joana costa, m. Beatriz p. P. Oliveira & isabel mafrá (2015) an overview on fish and shellfish allergens and current methods of detection, food and agricultural immunology, 26:6, 848-869, doi: 10.1080/09540105.2015.1039497
17. Werner, Marianne T., Christiane K. Fæste, and Eliann Egaas. "Quantitative sandwich ELISA for the determination of tropomyosin from crustaceans in foods." *Journal of agricultural and food chemistry* 55.20 (2007): 8025-8032.
18. A Phylogenetic Perspective on Molecular Epidemiology Xin Wang, Leonard W. Mayer, in *Molecular Medical Microbiology* (Second Edition), 2015

19. Bioinformatics and the Cell Modern Computational Approaches in Genomics Proteomics and Transcriptomics Xia, X. 2007 XVI, 350p., Hardcover. ISBN: 978-0-387-71336-6 Crustacea. *Oxford Reference*. Ed. Retrieved 7 Mar. 2019, from <http://www.oxfordreference.com/view/10.1093/oi/authority.20110803095651275>.
20. Bioinformatics for Beginners Genes, Genomes, Molecular Evolution, Databases and Analytical Tools
21. Chapter 2 - Fundamentals of Molecular Evolution* 2014, Pages 27-53
Author: Supratim Choudhuri.
22. "Crustacean." The Columbia Encyclopedia, 6th ed., Encyclopedia.com. 6 Mar. 2019 <<https://www.encyclopedia.com>>.
23. FIGIS: Global Production Statistics 1950–2007. Food and Agriculture Organization. Retrieved 2016-09-10.
24. Microbial Metagenomics, Metatranscriptomics, and Metaproteomics Andreas Wilke, Folker Meyer, in *Methods in Enzymology*, 2013
25. New Approaches to Prokaryotic Systematics Vartul Sangal, Paul A. Hoskisson, in *Methods in Microbiology*, 2014
26. Phylogenetic Analysis of Pathogens David A. Morrison, in *Genetics and Evolution of Infectious Disease*, 2011
27. Phylogenetic Analysis* Supratim Choudhuri, in *Bioinformatics for Beginners*, 2014
28. Sequence Analysis of Industrially Important Genes from Trichoderma Ahmed M.A. El-Bondkly, in *Biotechnology and Biology of Trichoderma*, 2014
29. Shellfish: Nutritive Value, Health Benefits, and Consumer Safety *Comprehensive Reviews in Food Science and Food Safety* Volume 16 Issue 6 25 October 2017.
30. The UniProt Consortium UniProt: the universal protein knowledgebase *Nucleic Acids Res.* 46: 2699 (2018) *J Mol Evol.* 2003;57 Suppl 1:S174-81. Standardized phylogenetic tree: a reference to discover functional evolution. Endo T1, Ogishima S, Tanaka H.
31. Whole Genome Sequence Comparisons in Taxonomy Author RainerBorriss1 ChristianRueckert2JochenBlom2OliverBezuidt3OlegReva3Hans-PeterKlenk4.

Application of Tangential Flow Filtration for Concentration of Microbial Protease Extracted From Mangrove Sediment Derived Bacteria

Sarika Chhabria Talreja ^{a*}, Chandra B. Maurya ^b

^{a*} Research Scholar, Guru Nanak Khalsa College, Matunga, Mumbai 400 019

*email id: sarikachhabriatalreja@gmail.com

^b Research Supervisor & Principal, KLE College of Science and Commerce, Kalamboli, Navi Mumbai 410 218

Abstract

Filtration is a pressure-driven segregation operation employing membranes for partitioning of components in a suspension appertaining to their size and charge differences. Contingent upon the operational modes, membrane filtration is categorized as Normal Flow and Tangential Flow filtration. In the former mode, fluid is convicted directly towards the membrane under an applied pressure while in latter, fluid is pumped tangentially along the surface of membrane.

For the present study, twenty sediment samples (B₁-B₂₀) were possessed from mangrove areas of Panji, Goa and screened for their Protease generating potentialities. Out of 20 bacterial isolates, B₂ and B₃ were found to be pertinent cultivable precursors of Proteases. Gelatin embedded growth media was studied for two chosen positive cultures. Growth curve studies proclaimed B₃ to be displaying maximal enzyme activity in shorter fermentation time; hence was considered for production. Post enzyme production, filtered supernatant was concentrated 10 fold through TFF process instead of conventional concentration methods and utilized for further investigations.

This paper explicates the essential underlying principles governing TFF process and its use in laboratory process development applications. It attempts to review the process variables, advantages and application of TFF process for concentration of microbial Protease extracted from mangrove sediment derived bacteria.

Key Words: Concentration, Filtration, Mangroves, Membranes, Protease

[1.1] Introduction

Concentration is a facile process involving the removal of fluid from a solution while restraining the solute molecules. The solute concentration escalates in direct proportion to the decrease in solution volume i.e. halving the volume effectually doubles the concentration. Filtration is a pressure-driven separation process employing the membranes for partitioning of components in a suspension appertaining to their size and charge differences. ^[10] Membrane filtration is a segregation process extensively applied in life sciences laboratories. The technique is predominantly categorized into Microfiltration and Ultrafiltration process contingent upon the membrane permeability.

In Microfiltration process, membrane pore sizes between 0.1µm and 10µm are customarily applied for sterilization, clarification and eradication of micro particulates or for cell harvestation. Ultrafiltration membranes with adequately subjacent pore size between 0.001µm and 0.1µm are used for concentration and desalting of dissolved molecules viz. Proteins, Peptides, Nucleic acids, Carbohydrates and other biomolecules,

exchanging buffers and gross fractionation. Ultrafiltration membranes are characteristically assorted by their molecular weight cut off (MWCO) in lieu of their pore size. MWCO of a membrane is defined by its ability to retain a given percent of molecules in solution.

Tangential Flow Filtration abbreviated as TFF, is an expeditious and prudent technique for segregation and purification of biomolecules. It can be applied to a capacious spectrum of biological fields like Molecular biology, Microbiology, Protein Chemistry, Biochemistry and Immunology. TFF can be used for concentration and desalting of sample solutions with variable volumes, fractionation of large and small biomolecules, clarification of fermentation broths and cell lysates and for harvestation of cell suspensions.

[1.1.1] Filtration Modes ^[6]

There are two preeminent membrane filtration approaches which might use either Microfiltration or Ultrafiltration processes:

1. Direct Flow Filtration (DFF): DFF also acknowledged as Dead-end Filtration applies the feed stream perpendicular to the membrane face and endeavors to pass absolutely entire fluid through the membrane.

2. **Tangential Flow Filtration (TFF):** TFF also ascertained as Cross Flow Filtration utilizes the passage of feed stream parallel (tangent) to the membrane (permeate) while the residuum (retentate) is reclaimed rearwards to the feed reservoir. The term tangential is descriptive of the direction of fluid flow relative to the membrane. ^[10]

[1.1.2] Process Overview ^[6]

To concentrate a sample, an Ultrafiltration membrane with MWCO, considerably lesser (3-6 times) than the molecular weight of the sample to be retained is chosen. This is significantly imperative so as to accredit unexpurgated retention and elevated recovery of the target molecule. The membrane is installed or a disposable TFF capsule is selected. The TFF system is initialized by typically flushing with water and examining for water filtrate flow rate and integrity. Sample addition is done and cross flow is established while feed and retentate pressures are set. When the desired concentration is reached, the process is stopped and sample recovery is begun.

[1.1.3] Process Variables ^[6]

Two of the influential variables implicated in TFF devices are transmembrane pressure (TMP) and Cross flow velocity (CF).

1. **TMP** is the driving force for liquid transport that accelerates the fluid through the membrane, carrying along the permeable molecules.

2. **CF** is the velocity of solution effusion through the feed channel and across the membrane. It imparts the force essential for sweeping away the molecules that can foul the membrane and constrain the filtrate outflow.

[1.1.4] Advantages ^[6]

1. **Easy to Set up and Use:** The TFF device is to be simply connected to a pump and pressure gauge(s) with tubing and few fittings before adding desired sample to the reservoir.

2. **Speedy and Efficacious:** Higher concentrations can be achieved in lesser time than the centrifugal devices or stirred cells. This is because TFF precludes rapid decline in the flux rate contrary to DFF process allowing a greater volume to be processed per unit area of membrane surface.

3. **Scale-up and Scale-down Possibility:**

Construction materials and Cassette path length enable the parameters established during pilot scale trials to be set up and used for process scale applications. Processing of sample volumes as small as 10mL to as large as thousands of ^{liters} is feasible with the pertinent TFF devices.

4. **Economical:** Cleaning and disposal after single use or reuse of TFF devices and cassettes allows the process to be more cost efficient and economical. To ratify whether the membrane and seals are intact and unimpaired, a simple integrity test can be executed.

[1.2] Materials and Methods

For screening of Protease producing organisms, twenty sediment samples (B₁-B₂₀) were collected from mangrove forest areas in the vicinity of Dr. Salim Ali Bird Century, Ribandar Ferry, Chorao, (15°, 30', 27" N and 73°, 51', 36" E), Goa, India in the year 2015. The samples were screened for their morphological characteristics and Protease generating potentialities. Out of 20 bacterial isolates, B₂ and B₃ were found to be pertinent cultivable precursors of Proteases. Media containing Gelatin as the protein source was studied for two chosen positive cultures B₂ and B₃. 16S rRNA sequence analysis further ensued that the isolates were related to *Bacillus* sp. Phylogenetic analysis confirmed B₂ as *Bacillus anthracis* and B₃ as *Bacillus safensis*. Growth optimization studies proclaimed B₃ to be displaying maximal enzyme activity in shorter fermentation time; hence was considered for production. Enzyme extracted from B₃ was processed further because it showed considerable activity as compared to B₂. ^[9] Post enzyme production using shake flask incubator, the filtered supernatant was concentrated 10 fold through Tangential Flow Filtration instead of conventional concentration methods.

For this purpose, the filtered enzyme supernatant was passed through TFF apparatus of PALL (Minimate TFF system 200-240 V AC OAPMP220) with a 10KDa Cassette. The TFF Cassette of 10KDa was connected with a required tubing and vessel. The filter sterilized water was allowed to run in order to wash the system. Sample was then added to the vessel having graduations. Concentration was judged by reduction in volume of enzyme sample in

the vessel. Sample once reached to the required volume was collected in a sterile tube.

[1.3] Results and Discussion:

The crude enzyme was concentrated to 10 fold using TFF. This concentrated enzyme was used for further studies on Growth Media variation studies, Enzyme pH and temperature Optimization studies, Molecular Weight determination using Sodium Dodecyl Sulphate Polyacrylamide Gel Electrophoresis (SDS PAGE), Stability studies, Kinetic parameter evaluation, Inhibition and Activation studies, Spectroscopic assay, Application studies in industrial bioprocesses and chemical transformations notably C-C bond formation reactions.

Alun J. et al, (1993) have assessed the range and activities of microbial enzymes present in lake waters directly in the cell suspension concentrated through TFF to investigate the relationship between physical and chemical attributes of the lake and enzyme activities. [1]

Kuwahara Hiroyuki et al, (1994) have described the development of a novel bioreactor for high-density cultures of suspended mammalian cells using external tangential-flow filtration device to separate viable cells from the spent medium. [5]

Strauss P.R. (1995) achieved the concentration of large volumes of several DNA Polymerases from *Trypanosoma brucei* using Filtron Mini-ultrasette tangential flow devices and concluded that the use of filtron systems enables overcoming routine problems associated with concentrating labile macromolecules. [8]

Hazel and Fennington (1997) have evaluated the efficiency of sequential incorporation of two approaches to virus removal i.e., tangential flow and direct flow filtration and demonstrated significant improvement in filter life on utilization of combined system. From the analysis of log titre value reduction, they concluded that TFF enabled combined system can be applied for biopharmaceuticals that necessitate multiple robust modalities of virus removal to ensure freedom from endogenous or adventitious viral contamination. [3]

Kahn D.W et al, (2000) have demonstrated the Purification of plasmid DNA by tangential flow filtration method. [4] Catherine Casey et al, (2011) have presented a novel single-pass tangential flow filtration (SPTFF) process for

protein concentration and have highlighted the major advantages of SPTFF technology in a benchmark comparison test with the conventional TFF module. [2]

[1.4] Conclusion

Membranes have invariably been an indispensable component of bio-ergonomics. Micro and Ultra filtration have been extensively utilized for sterile filtration of fermentation media, purification buffers and protein product pools. Advancements in membrane technology are presently converged on high-resolution applications, encompassing ameliorated protein-virus separation, protein purification by TFF and augmented membrane chromatography. These progressions have enabled the membranes to play a conspicuous role in the evolution of next-generation biotechnological operations. [7] However, selection of a congruous and befitting TFF instrumentality as well as its operative conditions necessitates a profound understanding of the process requirements and parameters. Once validated, a generous range of membranes, formats and equipments are available to handle various applications. [6]

[1.5] Conflict of Interest

Authors declare no conflict of interests

[1.6] Acknowledgement

The corresponding author is thankful to University Grants Commission for awarding Teacher Fellowship under FDP Scheme. Laboratory support from Principals, Smt. C.H.M College and Guru Nanak Khalsa College, Mumbai is also gratefully acknowledged.

[1.7] References:

1. Alun J., Morgan W and Pickup R.W. (1993). Activity of microbial peptidases, oxidases and esterases in lake waters of varying trophic status. *Canadian Journal of Microbiology*, 39 (8), 795-803.
2. Catherine Casey, Tina Gallos, Yans Alekseev, Engin Ayturk and Steven Pearl (2011). Protein Concentration with single-pass tangential flow filtration (SPTFF). *Journal of Membrane Science*, 384 (1-2), 82-88.

3. Hazel Aranha-Creado and G. J. Fennington Jr. (1997). Cumulative Viral Titer Reduction Demonstrated by Sequential Challenge of a Tangential Flow Membrane Filtration System and a Direct Flow Pleated Filter Cartridge. *PDA Journal of Pharmaceutical Science and Technology*, 51 (5), 208-212.
4. Kahn D.W., Butler M.D., Cohen D.L., Gordon M., Kahn J.W. and Winkler M.E. (2000). Purification of plasmid DNA by tangential flow filtration. *Biotechnology and Bioengineering*, 69 (1), 101-106.
5. Kuwhara Hiroyuki, Mitsuda Shinjiro, Kumazawa Eitaro, Takeshita Yasuyoshi (1994). High-density culture of FM-3A cells using a bioreactor with an external tangential-flow filtration device. *Cytotechnology*, 14 (1), 61-66.
6. Larry Schwartz and Kevin Seeley, Introduction to Tangential Flow Filtration for Laboratory and Process Development Applications, Scientific and Technical Report by Pall Life Sciences and Pall Corporation, 34212.
7. Robert V.R. and Andrew Z. (2001). Membrane separations in biotechnology. *Current opinion in Biotechnology*, 12 (2) 208-211.
8. Strauss P.R. (1995). Use of Filtron Mini-ultrasette tangential flow device and Filtron Microsep centrifugal concentrators in the early stages of purification of DNA. *Biotechniques*, 18 (1) 158-160.
9. Talreja S.C and Maurya C.B. (2018). Optimization Studies of Microbial Proteases Extracted from Effectual Extremophilic Isolates Screened from Mangrove Swamps. *International Journal of Research and Analytical Reviews (IJRAR)*, 5 (3), 1423-1430.
10. <http://www.millipore.com/publications.nsf/docs/tb032>, Millipore Technical Library: Protein Concentration and Diafiltration by tangential Flow Filtration.

Strategic attacking behaviour of fantails on crows

Malandkar Vipra, Pariya Kiran

Department of Zoology, B.N. Bandodkar College of Science, Thane

Abstract

Birds are one of the most magnificent species alive today. They sing, fly and are rich in colour. They vary from the heaviest Male Great bustard (18kg) to the smallest Bee Hummingbird (2g). Study of these interesting creatures can make any person fall in love with birds. Behavioural study of birds can explain everything about that species. Domestic crow (*Corvus splendens*) belongs to the family Corvidae involving altogether 117 species found all over Indian continent. They feed on almost everything edible. Crows are known as 'City Dweller' may be one of the most intellectual species. Fantails belong to the family Rhipiduridae comprising 43 species. They are insectivorous in nature and mostly catch their prey during flight. They are famous for their 360° aerobics by virtue of their fan-like tails. They seem to have a non-mutual relationship; probably benefitting mostly fantails. They may be depending on crows for their courtship needs and use spectacular tactics of flight and attack patterns. Both the birds share the same habitat; hence the present study depicts the strategic attacking behaviour of fantails on crows studied at Mumbai.

Keywords: Crow, fantail, attacking patterns

Introduction

The white-spotted fantail *Rhipidura albogularis* is a small sparrow like bird. It is found in forest, scrub and cultivation in southern and central India. The adult white-spotted fantail is about 19 cm long. It has a dark fan-shaped tail, edged in white and white super-cilium and throat. Birds are mainly slate grey above, with a black eye mask, and a white throat and eyebrow. It has whitish under parts, and a grey breast band that is spotted white. It lays three eggs in a small cup nest in a tree. It is insectivorous, and often fans its tail as it moves through the undergrowth. It is found to be highly territorial in nature in terms of their parental care. The male or sometimes female can attack the intruders if very close to the nest. These fantails are sometimes seen attacking the crows in pack attack system. The possible presence of crow happens to be singular. The ratio for the presence of fantails and crows in a particular scenario was found out to be 5:1 (max.) and 2:1 (min.). The fantails may need some kind of pheromone for courtship cycle to be completed. The pheromones are mostly used by females, stolen from crows in the form of oil from their Uropygial or preen gland.

During preening, birds gather oily secretions that contain diester waxes from their oil glands. This gland is located near the base of the tail. Birds distribute the oil over the plumage. The function of this oil is somewhat disputed. All will agree that it serves to maintain and condition their skin and feathers. It helps to waterproof the plumage particularly in water

birds. However, some authorities state the water-proofing effect is primarily achieved by dense feathers that insulate by trapping air thus maintaining an air-tight surface and - in some birds - a water-tight structure. The secretion from this gland also has antibacterial and anti-mycotic properties; as well as a potential odorant and/or pheromonal function (aids in the attraction of possible mates).

Observation

Courtship behaviour in Fantails:

The breeding cycle for white-throated fantails completes in 25 days (approx.) with an incubation period of 14 days. The cycle starts when male tries to attract females for mating. The system involves one female being under attention of possibly 4-5 males like seen in case of sparrows. If successful, the male and female mate, resulting in 3-4 eggs. Before that both male and female share the work of building a cup-shaped nest which requires 14-20 days at optimum speed and availability of material. Then the female lays eggs and start the 14-day incubation. When the eggs hatch, male takes up responsibility of feeding the fledglings and the female starts to build another nest for next brood with either the same male or different. If by chance some predator destroyed the nest before use, the couple discards it and starts to build another one. But this time they speed up making nest in just 3-4 days to meet the deadline of laying eggs which is always 90% successful in most cases. When female completes the second nest building possibly before time, she gets the right to mate with

another male as first male remains busy with the feed of first brood. So, she needs a signal to announce her ready for second brood cycle. It's an assumption that probably female fantails start attacking crows near their uropygial gland to steal preen oil in droplets. The attack is seen mostly in pack system with specific target, complex strategy including divide and rule, mutualism amongst female fantails, etc.

Absence of preen gland in Fantails

The absence of preen gland probably my one of the reason of their attacking behaviour on crows. But they are rarely seen preening near the gland region which makes the probability higher for loss of preen gland due to pollution or similar factors. It may have remained non-functional since decades (Lamarckism). If they have preen oil, they prefer to steal oil in order to compensate their low quality or quantity of own oil. That is, the use of self-oil for feather integrity if their feathers are oil specific and using crows' oil as pheromones so they do not need to worry about wastage.

Crow vision phenomenon

Crows are said to be right eyed or left eyed. The crow uses only one eye at time to focus on any target. This makes then difficult to concentrate on multiple things. Fantails take advantage of this vision asymmetry by attacking the crow in specific strategy. Fantails do not have any specific breeding season but it occurs throughout the year with varying frequency. The spring season (March – May) holds the highest frequency of broods. So ultimately the attack frequency also becomes highest in spring. The reference video was taken on May 6, 2018 in afternoon at 4.00 pm.

Months	Attack frequency
January	2
February	5
March	8
April	10
May	10
June	7
July	5
August	4
September	3
October	0
November	0
December	0

Table No. 1 Fantail attack frequency on crow

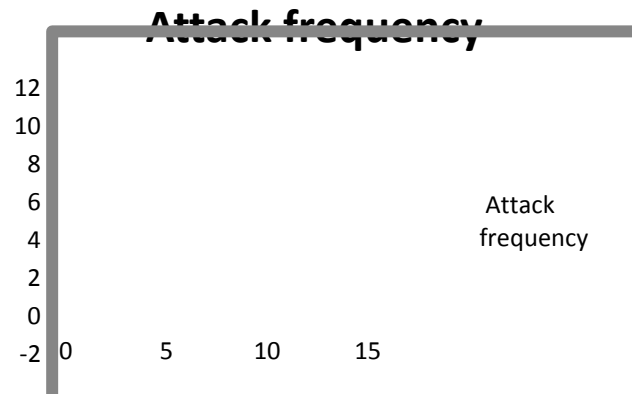


Figure No.1 Fantail attack frequency on crow
The above graph shows attack frequency being highest in spring.

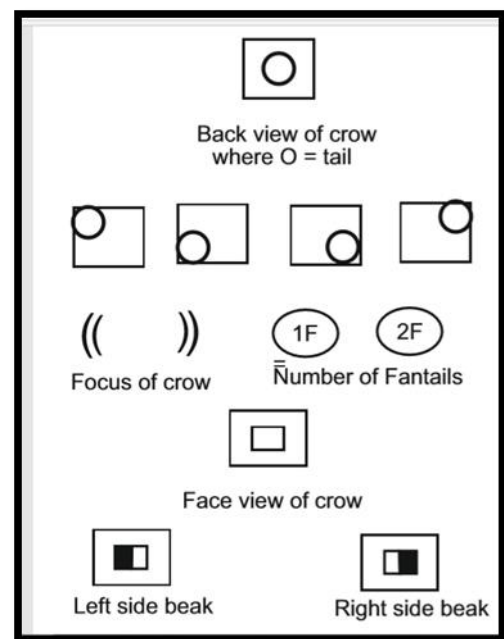


Figure No.2: Complex strategy of fantail attack on crow

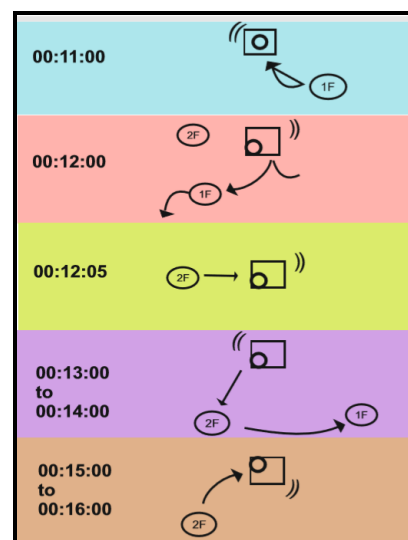


Figure No.3: Complex strategy map of fantail attack on crow

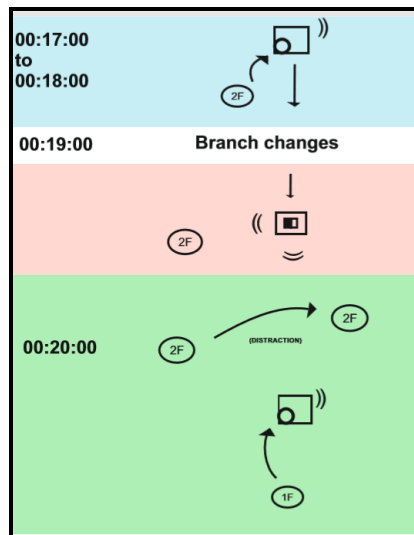


Figure No.4: Complex strategy map of fantail attack on crow

Discussion

1. The voice of the fantails in the recorded video found to be rough every second which indicates that females attack crows more than males for pheromone and feather integrity reasons respectively.
2. Target specificity: Only one crow is being attacked at a time, making them easy to attack with successful distraction.
3. Complex strategy of fantails involves twist and turns at perfect timing to confuse crow and attacking step-by-step more or less alternatively. This result in small quantity of oil stains getting stick the claws of fantails, enough to be used as pheromones.
4. They also apply divide and rule property to separate 2-3 crows if they need to attack any one of them. This requires more than 3 fantails.
5. Mutualism: Many fantail females come together to attack a target crow. They do not show any competition amongst themselves.

References:

1. The oil gland of birds By William H. Elder
2. Preening: How and Why Birds Preen By Melissa Mayntz
3. <https://www.thespruce.com/why-birds-preen-386448>
4. <https://www.beautyofbirds.com/birdoilgland.html>
5. https://en.wikipedia.org/wiki/Uropygial_gland
6. <https://www.nzgeo.com/stories/silence-of-the-fantails/>
7. <http://nzbirdsonline.org.nz/species/new-zealand-fantail>
8. Birdlife International's Bird Encyclopedia
9. <http://pdfs.semantisolar.org>
10. <https://www.youtube.com/channel/UCDyvQqoPfiYTJsKehhM-qEw>

Accomplishment of Sustainable Development for a Green Earth – A study of the role of law in India

Srividhya Jayakumar, VPM's TMC Law College, Thane
jsrividhya@vpmthane.org

Abstract: Mankind bears the solemn responsibility to protect and improve the environment for the present and future generations. Sustainable Development (SD) is a policy and a strategy to require ecological sustainability of development activities and to balance developmental aspirations with the ecological concerns. Its purpose is to ensure that the future generations are able to meet their needs. The word 'environment' derives from the French word *environner* which means to encircle or surround. Today we un mindfully surround the earth with deadly acts as if in a chakravaham and dare to destroy our home. S M Bhasker rightly cautioned: "Devotees of Earth we certainly can't claim to be. But our failure to adapt to a higher level of consciousness may plunge us into an imminent state of ecological cessation. Will the earth endure?" The sustainability of the earth is alarmingly threatened by human conduct. Law is a universally known and practiced instrument to control and regulate human conduct. This paper seeks to inquire into the role of law in accomplishing 'sustainable development' for a green earth.

Keywords: Sustainable Development, Environment Impact Assessment, Precautionary Principle, Intergenerational Equity

Introduction

Mankind bears the solemn responsibility to protect and improve the environment for the present and future generationsⁱ. Sustainable Development (SD) is a policy and a strategy to require ecological sustainability of development activities and to balance developmental aspirations with the ecological concerns. Its purpose is to ensure that the future generations are able to meet their needs.

The word 'environment' derives from the French word *environner* which means to encircle or surround. Today we un mindfully surround the earth with deadly acts as if in a chakravaham and dare to destroy our home. S M Bhaskerⁱⁱ rightly cautioned: "Devotees of Earth we certainly can't claim to be. But our failure to adapt to a higher level of consciousness may plunge us into an imminent state of ecological cessation. Will the earth endure?" The sustainability of the earth is alarmingly threatened by human conduct. Law is a universally known and practiced instrument to control and regulate human conduct. This paper seeks to inquire into the role of law in accomplishing 'sustainable development' for a green earth.

Environmental law of India – the law to protect and improve the environment – comprises of not only the special statutes but also the constitutional law and other general laws that aid, inter alia, in combating the ills that degrade our environment. International law also shapes the Indian law. Law plays an enormous role in

1. empowering the state with authority to protect the environment
2. imposing duty on the state to guard the environment
3. empowering the people with rights in respect of environment
4. imposing duties on the citizens to safeguard the environment
5. setting appropriate norms of action to achieve sustainable development
6. appointing appropriate authorities to protect environmental regimes
7. evolving appropriate doctrines, rules, principles and remedies to tackle environmental problems
8. sensitizing and educating the people to tune themselves to environmentally responsible conduct

State power and duty

Constitution of India (COI) provides for a federal structure with division of powers between the centre and states as affected by the Seventh Schedule. The subject environment is not directly allocated in the lists. But various aspects are allocated- illustratively water is in the state list, mines are in the central list and forests, wildlife are in the concurrent list. Interestingly COI has allocated functions relating to environment to Panchayatsⁱⁱⁱ and Municipalities^{iv} also. The recommended that there should be a new entry 'environment protection' added to the concurrent list^v has not been acted upon till date. It is pertinent to note that the general power of the state- the police power- to regulate and order behavior in the

society for betterment of health, safety, morals and general welfare of the people will obviously include environment protection. State's duty is clear in certain Directive Principles under the COI that require the state to ensure that the common resources of the community is sub-serving common good^{vi}, to protect and improve the environment,^{vii} improve level of nutrition, public health^{viii}. In *M C Mehta v UOI*^{ix} considering Articles 39(e), 47 and 48A, the SC recognized the duty on the state to secure health of the people, improve public health and protect and improve the environment. As the branch of the state the judiciary considered duty on itself too to protect the environment. Quashing the change in the development plan to convert recreational zone to build residences, the court said that it is the legitimate duty of courts to forbid actions upsetting the environmental balance.^x

Rights and duties of the people

Law has magnificently built an empire of rights that go a long way to attain SD. There are rights which directly ensure a wholesome environment; there are rights that help the environmental movement towards sustainable development. There are certain other rights that will have to be carefully restricted in order to progress in SD.

Judicial activism has added several rights in relation to environment : right to a wholesome environment^{xi}, right to ecological balance^{xii}, right to clean air and water^{xiii}, right to sweet water^{xiv}, right to health^{xv}, right to preservation of forests,^{xvi} right to intergenerational equity,^{xvii} right against noise pollution.^{xviii} Interpretation of the constitution with enviro vision and enviro vigil has led to recognition of these valuable rights in the absence of express provisions therein.

SC has strengthened the right to file PIL^{xix} and right to information^{xx} which have become crucial in enhancing public participation and in infusing action in the governmental authorities in the march towards SD. Right to education^{xxi} also fortifies the environment movement by enlightening the people for responsible conduct.

Right to livelihood^{xxii}, right to religion^{xxiii}, right to trade, occupation etc, freedom of speech and expression have been with reasonable vigil restricted to ensure SD. Right to livelihood of a few, it was held, cannot be permitted at the cost of general public health.^{xxiv} Right to trade was

held subject to state's power to insist on sewage treatment plants and restriction on grounds of ecological well-being.^{xxv} Judiciary has limited right to use loud speakers^{xxvi} and noisy crackers^{xxvii} with due respect to people's right to be let alone, right to sleep, leisure and right not to hear. Religion cannot sanction noise, nuisance and pollution, held the court and ruled that any religious practice that poses threat to life and health cannot be protected under Art 25(religious freedom)^{xxviii} This was in the judgment restricting bursting of crackers on Diwali day and other festive days to only 8-10 pm and issuing other directions. Mumbai HC refused permission as exceptional cases to use loudspeakers beyond 11.30pm during Ganapati and Navaratri festivals.^{xxix}

Duties - SD cannot be accomplished without active participation of the citizens. Art 51A (g) of the COI imposes duties on citizens to protect and improve the natural environment including forests, states and rivers and wildlife and to have compassion for living creatures. The duty to develop scientific temper, humanism and a spirit of enquiry and reform^{xxx} and duty to educate the children^{xxxi} also secure environmental education. Fundamental duties have been held to be collective duties on the state.^{xxxii}

It is intriguing to note that the duty of the citizen has been interpreted as a right to file PIL and seek enforcement of the duty cast on the State to set the environment right. The Court remarked that Article 51A is ordinarily a duty of the citizen but in fact it creates a right in favour of the citizens and it entertained a PIL to remedy the sanitation problem of Jaipur.^{xxxiii}

Norms setting

Law plays a key role in laying down acceptable conduct by prescribing norms – compulsory consent for industries, regulation of bio medical wastes, hazardous wastes, handling chemicals, e wastes, coastal zones etc. Noise levels, emissions, effluents standards are prescribed. Most significant statutes in this regard are the Water (Prevention and Control of Pollution) Act, 1974, Air (Prevention and Control of Pollution) Act, 1981 and the Environment Protection Act, 1986. Plastics Rules 1999 deal with manufacture, sale and usage of Plastics. The Noise Pollution Rules, 2000 provide for different zones and permitted decibel levels. There are the 1993 rules as to hazardous micro organisms handling rules. The Municipal

Solid wastes Rules, 2000 deal with landfills and air and water quality monitoring.

Under the Environment Act rules are framed for Environment Impact Assessment, Coastal Zone Regulation, Batteries Management and Handling, Ozone Depleting Substances (Rules, 2000)

Public Liability Insurance Act, 1991 requires owners of hazardous and inherently dangerous industries to obtain compulsory insurance cover to compensate, death, injury or damage to property due to hazardous substance accident. The law provides for quick settlement of claims and the amounts recoverable are laid down in the Act. This is over and above any other amount receivable under any other law. The National Environment Tribunal under the National Environment Tribunal Act, 1995 was settling the claims and now this is replaced by the National Green Tribunal (NGT) established under National Green Tribunal Act, 2010. The National Environment Appellate Authority Act, 1997 is repealed and the NGT will have jurisdiction in all matters involving questions as to environment, forests etc.

Ground water, forests, wildlife^{xxxiv} are all governed by law. Reserved forests, wild life sanctuaries and parks are created under law and activities therein are restricted in the interests of conservation.

Special Authorities

Law establishes various authorities in the mission of environment protection. The Central Pollution Control Board and the State Pollution Control Board function under the Air Act, Water Act and Environment Protection Act. These boards give consent to industries, inspect them and monitor the standards laid down by law. Ministry of Environment and Forests have several powers as to sanctioning projects after verification. NGT has a huge role to play in settling claims and deciding on permissions for projects in forests or ecologically sensitive areas.

Under the various rules for handling bio medical wastes, hazardous chemicals, municipal solid wastes etc there are appropriate authorities. Wild Life Advisory Board, Chief Wild Life Warden, Director of Wild life Preservation and Central Zoo Authority have been established under the wild life Act. There is the Animal Welfare Board established under the Prevention of Cruelty to Animals Act, 1960 to implement, advice the government, promote

education on humane treatment of animals etc. Principal Chief Conservator of Forests under the Indian Forest Service is responsible for management of forests, environment and wild life. National Coastal Zone Regulatory Authority is established. Also there is the Central Ground Water Authority. In 1997 the Central Government constituted the Aqua Culture Authority to deal with shrimp culture industry in the coastal states. The prestigious National Environmental Engineering Research Institute plays a crucial role with scientific inputs. It is established by the central government and falls under the Ministry of Science and Technology.

Green Benches: SC directed the High Courts to constitute Green Benches for the purpose of handling public interest environment matters and directed the registry to send records of pending matters to the HCs in the region where the environment issues arise.^{xxxv}

Doctrines and Principles

For the cause of the environment our judiciary has evolved a few crucial doctrines and principles. The SC expressly spelt out the need to evolve new principles and norms to tackle the new problems in an industrialized economy. It evolved and adopted the **absolute liability principle** making the inherently dangerous and hazardous industries liable for accident in all cases without any exception whatsoever.^{xxxvi}

Public Trust Doctrine considers natural resources as a legacy of mankind and their conservation as a common concern of mankind and entrusts these to the state for their preservation for the generations to come. Articles 47 requiring improvement of public health and 48A requiring protection and improvement of the environment reflect this doctrine. Enactment of the Forest Conservation Act, 1980 and Wild Life Protection Act, 1972 is in fulfillment of the duty under this doctrine. SC adopted this doctrine in M C Mehta v Kamal Nath^{xxxvii} and prevented ecologically sensitive Beas River area to be converted to private ownership for commercial gains. In M I Builders Pvt Ltd v RadheyShyam^{xxxviii} SC observed that the Public Trust Doctrine is a tenet of Article 21 (Right to life) and the court will skeptically consider any governmental allocation of resource to private parties. Underground shopping centre below a Lucknow public park was not permitted.

Bruntland Report defined SD as that development that meets the need of present without compromising the ability of future generations to meet their own needs.^{xxxix} SC observed that SD has come to be accepted as a viable concept to address poverty and improve quality of human life and therefore a part of right to life in Art 21.^{xl} Emphasizing on SD the SC said that development and environment must go hand in hand in Indian Council for Enviro – Legal Action v UOI.^{xli} In T N GodavarmanThirumulpad v UOI^{xlii} considering the blatant violation of laws in feeling of trees and mining, the SC while giving large number of orders held that economic benefit must be subordinated to environmental stability and non- fulfillment would amount to violation of Articles 14 and 21.

SC applied the **Precautionary Principle** in the Taj Trapezium case and ordered the industries around TajMahal to use natural gas instead of coal/coke by recognizing the need to anticipate, prevent and attack the causes of environmental degradation.^{xliii} The SC underlined the principle of **Intergenerational Equity** in S. Jagannath v UOI^{xliv} while giving orders in the public interest litigation against the unregulated commercial shrimp culture damaging the coasts. **Polluter Pays Principle** has been very tactfully adopted by the SC to impose compensatory fines to revive the environment. SC created an Environment Protection Fund.^{xlv} In Sterilte Industries (I) Ltd v UOI^{xlvi} SC slapped a fine of 100 crores to remedy degradation caused and improve the conditions.

Sensitizing and educating the people

UN Decade of Education for Sustainable Development (2005-14) was adopted by GA Resolution 57/254 emphasizing that education is an indispensable element for achieving SD. Awareness on environmental issues are

essential for enlightened opinion of the public and will promote responsible conduct. Principle 19 of the Stockholm Declaration (1972) requires education in environmental matters for the younger generation as well as adults. Principle 10 of Rio Declaration (1982) requires the states to facilitate and encourage public awareness so that citizens participate. Article 6 of the UN Framework Convention on Climate Convention requires the state parties to the convention to promote and facilitate education, training and awareness on climate change and its effects.

State Pollution Control Boards under the Air Act^{xlvii}, Water Act^{xlviii} and Environment Protection Act^{xlix}, have the function of organizing mass education programme relating to prevention, control or abatement of pollution.

In M C Mehta v UOIⁱ our SC directed the government to enhance public education on environmental issues through schools, mass media and cinema halls. The court recognized the duty of the state by considering the right to life and the right to know of the people and the fundamental duty of the citizens to protect the environment. In Biranganaⁱⁱ the Calcutta HC ordered All India Radio and Doordarshan to disseminate information about the harmful effects of Noise. The court also urged upon the media to publize the methods of lodging complaints with the pollution control board. In B L Wadhwa v UOIⁱⁱⁱ the SC directed All India Radio and Doordarshan to devote 5-7 minutes a day on educating the people in addition to long programs once a week.

New techniques and inputs from science and can strengthen law as a reliable and respectable tool in restoring the earth of its life carrying capacity. The culture of compliance to law is crucial.

References:

ⁱ Principle 1, Stockholm Declaration on Human Environment (1972)

ⁱⁱ Conservation Myths Help Promote Sustainability, Speaking Tree, TOI, 20/02/06

ⁱⁱⁱ Schedule 11

^{iv} Schedule 12

^v Department of Science and Technology, Government of India, Report of the (Tiwari) Committee for Recommending Legislative Measures and Administrative Machinery for Ensuring Environmental Protection(1980)

^{vi} Art 39(b)

^{vii} Art 48A

^{viii} Art 47

^{ix} (2002) 4 SCC 356

- ^x T Damodhar Rao v The Special Officer, MC of Hyderabad, AIR 1987 AP 171 at p 181.
- ^{xi} Indian Council for Enviro Legal Action v UOI, AIR 1996 SC 446
- ^{xii} Joseph Bain D' Souza v Maharashtra P No 3189 of 2004 referred in Dr. Amod S Tilak, Environmental Law, Snow white , 2009 , p 100
- ^{xiii} Subhash Kumar v State of Bihar, AIR 1991 SC 420
- ^{xiv} Attakoya Thangal v UOI, 1990 KLT 580 (Kerala HC)
- ^{xv} Occupational Health and Safety Association v UOI, AIR 2014 SC 1469
- ^{xvi} Sushila saw mills v Orissa, AIR 1995 SC 2484
- ^{xvii} H P v Ganesh Wood Products, AIR 1996 SC149
- ^{xviii} Arjun Gopal and others v UOI and Others, AIR 2018 SC 5731
- ^{xix} See MC Mehta v UOI, AIR 1988 SC 1037, Indian Council for Enviro – Legal Action v UOI, AIR 1996 SC 1446, Vellore Citizens' Welfare Forum v UOI, AIR 1996 SC 2715 etc
- ^{xx} Bombay Environmental Action Group v Pune Cantonment Board, SC, SLP (Civil) NO 11291 of 1986
- ^{xxi} Articles 21A, 41 & 45
- ^{xxii} Rural Litigation Kendra Dehra Doon v UP , AIR 1985 SC 652; Arjun Gopal and others v UOI and Others, AIR 2018 SC 5731
- ^{xxiii} Arjun Gopal and others v UOI and Others, AIR 2018 SC 5731
- ^{xxiv} MC Mehta v UOI, (Ganga Pollution case), 1992 Supp (2) SCC 633, 637:
- ^{xxv} Ibid. See also Abhilash Textiles v Rajkot Municipal Corporation , AIR 1988 Guj 57
- ^{xxvi} Venu v DG of Police, 1992 (2) KLT 86, Rabin Mukerjee v W B , AIR 1985 Cal 222, Birangana Religious Society v the State, (1996) 100 CWN 617
- ^{xxvii} Burrabazar Fire Works Dealers v Commissioner of Police, AIR 1998 Cal 121; Arjun Gopal and others v UOI and Others, 23/10/2018 SC judgement.
- ^{xxviii} Supra Arjun Gopal
- ^{xxix} Dr Y T Oke v Maharashtra, W P No 1732 of 1995, Bombay High Court, 18, Dec 1995 referred in ShyamDiwan, Armin Rosencranz (2016) Environmental Law and Policy in India. India. Oxford University Press.
- ^{xxx} Article 51A (h)
- ^{xxxi} Article 51A(k)
- ^{xxxii} AIIMS Students Union v AIIMS, AIR 2001 SC 3262
- ^{xxxiii} L K Koolwal v Rajasthan, AIR 1988 Raj 2
- ^{xxxiv} See, Wild Life Protection Act, 1972, Indian Forests Act, 1927 and Forest Conservation Act, 1980, Maharashtra Ground Water Act, 2009.
- ^{xxxv} Vellore Citizens Welfare Forum v UOI, AIR 1996 SC 2715; M C Mehta v UOI, 1997 (2) SCC 411
- ^{xxxvi} M C Mehta v UOI, AIR 1987 SC 1086 at p 1089
- ^{xxxvii} (1997) 1 SCC 388
- ^{xxxviii} (1999) 6 SCC 464. See also Intellectuals Forum v AP, AIR 2006 SC 1350; Karnataka Industrial Areas Development Board v C Kenchappa, 2006 AIR SCW 2456
- ^{xxxix} The World Commission on Environment and Development, Our Common Future (1987)
- ^{xl} Vellore Citizens, Supra n 35
- ^{xli} AIR 1987 SC 965
- ^{xlii} (2006) 1 SCC 1
- ^{xliii} M C Mehta v UOI, (1997)2 SCC 353
- ^{xliv} (1997) 2SCC 87
- ^{xlv} Ibid.
- ^{xlvi} (2013) 4 SCC 575
- ^{xlvii} S. 17(1)(d)
- ^{xlviii} S. 17(1)(e)
- ^{xliv} S. 3 (2) (xii)
- ^l (1991) 2 SCC 137
- ^{li} Supra n 26
- ^{lii} AIR 1996 SC 2969

Author Index

B

Bhalekar S. J.....41

C

Chandra B. Maurya.....51

G

Gayathri N.....21

M

Malandkar Vipra.....55

Mayuri Chaudhari.....21

Meenakshi Sundaresan.....24

Minakshi Gurav.....36

P

Pariya Kiran.....46, 55

Patil N.N.....41

R

Rohit Manyar.....21, 36

S

Sahil Kapdi.....31

Sarika Chhabria Talreja.....51

Shifa Deshmukh.....36

Srividhya Jayakumar.....58

T

Tejas Borse.....46

V

Veena Desai.....21

Vinda Manjramkar.....31