



ISCB 2018

International Symposium on Ciliate Biology

with

IRCN-BC

International Research Coordination Network
for Biodiversity of Ciliates

Affiliated Society of

ISOP

International Society of Protistologists

April 04 - 06, 2018

www.iscb2018.com



Organized by

Acharya Narendra Dev College

Maitreyi College

SGTB Khalsa College

University of Delhi, Delhi, India



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**International
Symposium on
Ciliate Biology**

**International Research
Coordination Network
for Biodiversity of Ciliates**

**International Society
of
Protistologists**

April 04 - 06, 2018

Venue: India Habitat Centre, New Delhi, INDIA

**Patrons
Organizing Institutes
(University of Delhi, India)**

Dr Savithri Singh
Principal
Acharya Narendra Dev College

Dr Haritma Chopra
Actg. Principal
Maitreyi College

Dr Jaswinder Singh
Principal
SGTB Khalsa College

**Core Organizing
Secretariat**

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Dr Komal Kamra
SGTB Khalsa College

Organizing Secretary
Dr Renu Gupta
Maitreyi College

Joint Secretaries
Dr Seema Makhija
Acharya Narendra Dev College

Dr Ravi Toteja
Acharya Narendra Dev College

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Delhi, India

Dr Alan Warren
Natural History Museum
London, UK

Consultative Board

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University of Delhi
Delhi, India

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AIIMS, New Delhi, India

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University, USA

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Ocean University of China
China

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University of Guelph, Canada

Prof Virginia P Edgcomb
Woods Hole Oceanographic
Institution, USA

Prof Cristina Miceli
University of Camerino
Camerino, Italy

Dr Sabine Agatha
University of Salzburg, Austria

The members of organizing secretariat would like to welcome each of the delegate to the *International Symposium on Ciliate Biology 2018, ISCB 2018*. The world of *Ciliate Biology* is an exciting area and much is still unexplored. The symposium aims to achieve the following –

1. To provide a platform for the ciliate interest group to exchange information, present latest research findings and establish collaborations
2. To enthuse a large number of Indian and foreign undergraduate and postgraduate students to take up ciliated protists as their preferred research area
3. To provide networking opportunities for students wishing to take up doctoral or postdoctoral research on ciliates

This will definitely help in bridging the knowledge and will generate interest in amateur and budding scientists. The scientific content of the symposium includes a wide array of aspects of ciliate biology: Biodiversity, Ecology, Evolution, Systematics, Genomics, Epigenetics, DNA Barcoding, Proteomics, Ciliates and Industry, Ciliates as model organisms in UG teaching and in research, other individual specializations.

Symposium is organized with **International Research Coordination Network for Biodiversity of Ciliates (IRCN-BC)**, an affiliated Society of **International Society of Protistologists (ISOP)**. The support provided by all International and National agencies is thankfully acknowledged. The success of any symposium depends on the number of participants. This symposium is witnessing participation of both International and National delegates and surely the deliberations and exchange of their research findings will be fruitful for the scientific community.

Hoping that all the participants will exploit this opportunity to the maximum and work towards strengthening of field of *Ciliate Biology*.

Komal Kamra
Convener
(SGTB Khalsa College)

Renu Gupta
Organizing Secretary
(Maitreyi College)

Seema Makhija
Joint Secretaries
(Acharya Narendra Dev College)

Ravi Toteja
Joint Secretaries
(Acharya Narendra Dev College)

Organizing Secretariat

Symposium contacts: www.iscb2018.com; iscb2018@gmail.com; komalkamra@gmail.com; r17gupta@hotmail.com



ISCB 2018 Technical Program, April 04-06, 2018

DAY 1 (Wednesday, April 04, 2018) Stein Auditorium, India Habitat Centre

- 09:00-11:00 **Session-1**
Welcome
- 09:10 **Prof Rup Lal**, Department of Zoology, University of Delhi, Delhi, India
From ciliate Protozoans to bacterial diversity, genomics and metagenomics
- 09:50 **Dr Komal Kamra**, Department of Zoology, SGTB Khalsa College, University of Delhi, Delhi, India
Mapping ciliated protist communities along a lotic water body with deteriorating water quality
- 10:30-11:00 **Inaugural Session**
Welcome Address
Lighting of Lamp
Chief Guest: Dr Mahesh Sharma, MoS, Ministry of Environment, Forest and Climate Change, Government of India
Vote of Thanks
- 11:00 **High Tea**
- 11:30-13:00 **Session-2**
- 11:30 **Key Note Address**
Dr Alan Warren, Department of Life Sciences, Natural History Museum, London, UK
What have ciliates ever done for us?
- 12:20 **Prof Cristina Miceli**, School of Biosciences and Veterinary Medicine, University of Camerino, Italy
*Genomics and transcriptomic analysis in the Antarctic ciliate *Euplotes focardii*: Molecular basis of cold adaptation and insights regarding the potential impact of climate change*
- 13:00 **Lunch**
- 13:30 **Poster Session-1**
- 14:30-17:00 **Session-3**
- 14:30 **Prof Rosaura Mayén-Estrada**, Lab. Protozoología, Depto. Biol. Comparada, Fac. Ciencias, Mexico
Some notes about the family Vorticellidae with emphasis on species ectosymbionts of Crustaceans
- 15:10 **Dr Anastasia V Shatilovich**, Institute of Physico-chemical and Biological Problems in Soil Science, Pushchino, Russia
Distribution and long-term cryobiosis of ciliates in the arctic soil and permafrost
- 15:30 **Dr Amlan Kumar Mitra**, Department of Zoology, Ranaghat College (Affiliated to University of Kalyani), Nadia, West Bengal, India
Diversity and Distribution of Ectoparasitic Trichodinid Ciliophorans (Protozoa: Ciliophora) in Freshwater and Estuarine Fishes of West Bengal, India
- 15:50 **Cultural Evening**



DAY 2 (Thursday, April 05, 2018) Silver Oak, India Habitat Centre**09:00-11:00 Session-4**

- 09:00 Prof Nageshwara Rao Amanchi**, Freshwater Ecology, Ecotoxicology and Environmental Safety Lab, Department of Zoology, Nizam College (Autonomous), Osmania University, Hyderabad, Telangana, India
Cypermethrin induced cytotoxicity effects on cell behaviour, morphology, cell physiology and cell organelles in freshwater ciliates Paramecium caudatum and Blepharisma intermedium.
- 09:40 Prof Elena Sabaneyeva**, Department of Cytology and histology, Faculty of Biology, Saint Petersburg State University, Russian Federation
Newly found Endosymbionts in ciliates: have we met before?
- 10:20 Dr Sai Elangovan S**, National Institute of Oceanography, Dona Paula, Goa, India
A Study on tintinnids (loricate ciliates) from the mangrove proximal zone waters of Port Blair, South Andaman
- 10:40 Dr Shashi**, Ciliate Biology Lab, SGTB Khalsa College, University of Delhi, Delhi, India
Description of four hypotrichous ciliated protists from Maharashtra, India; phylogenetic relationships with congeners
- 10:50 Tea**
- 11:10-13:10 Session-5**
- 11:10 Dr Antonietta la Terza**, School of Bioscience and Veterinary Medicine, University of Camerino, Camerino, Italy
Ciliated protists as indicators of ecosystem health: Opportunities, challenges, and case studies in Italy
- 11:50 Dr Ravi Toteja**, Acharya Narendra Dev College, University of Delhi, Delhi, India
Transcriptomic analysis of heavy metal induced changes in gene expression in freshwater ciliates
- 12:20 Dr Santosh Kumar**, Zoological Survey of India, New Alipore, Kolkata, West Bengal, India
Morphology, ontogenetic, and molecular phylogenetic studies on species of the genera Sterkiella and Fragmospina
- 12:50 Dr V Ratna Bharathi**, Department of Zoology, Dr VS Krishna Govt Degree & PG College (A), Visakhapatnam, Andhra Pradesh, India
Studies on physico-chemical parameters and protozooplankton abundance in Konam reservoir, Visakhapatnam district, Andhra Pradesh, India
- 13:10 Ms Harpreet Kaur**, Ciliate Biology Lab, SGTB Khalsa College, University of Delhi, Delhi, India
Morphology, ontogenesis and molecular phylogeny of a novel freshwater oxytrichid from river Yamuna, Delhi, India
- 13:20 Lunch**
- 13:50 Poster Session-2**



- 15:00-17:00** **Session-6**
- 15:00** **Prof Probir Kumar Bandyopadhyay**, Department of Zoology, University of Kalyani, West Bengal, India
Phytochemical screening for identification of bioactive compounds and antiprotozoan activity of fresh garlic-bulb over trichodinid ciliates affecting ornamental goldfish
- 15:40** **Prof Alexey Potekhin**, Faculty of Biology, St Petersburg State University, Saint Petersburg, Russia
Views and news: latest findings unravel hidden diversity of Paramecium
- 16:20** **Dr Jasbir Singh**, Ciliate Biology Laboratory, SGTB Khalsa College, University of Delhi, Delhi, India
Biodiversity of ciliate fauna especially of hypotrichous ciliates of Sikkim, the western segment of Eastern Himalayas
- 16:35** **Ms Anjusha A**, CSIR National Institute of Oceanography, Regional Centre, Kochi, Kerala, India
Dominance of aloricate ciliates in the nearshore waters of Kochi, southwest coast of India
- DAY 3 (Friday, April 06, 2018) Silver Oak, India Habitat Centre**
- 09:00-10:00** **Session-7**
- 09:00** **Dr Seema Makhija**, Acharya Narendra Dev College, University of Delhi, Delhi, India
An overview of progression of ciliate biology research at University of Delhi
- 09:45** **Tea**
- 10:00-12:30** **Valedictory Session**
Chief Guest: Dr Kailash Chandra, Director, Zoological Survey of India, Kolkatta, West Bengal, India
- 10:00** **Dr Alan Warren**, Department of Life Sciences, Natural History Museum, London, UK
Ciliates as bioindicators of marine water quality
- 10:50** **Certificate Distribution**
Vote of Thanks: Prof GR Sapra, Retired Professor, Department of Zoology, University of Delhi, Delhi, India
Group Photo
- 12:30** **Lunch**
- 13.30** **Meeting of Indian Delegates** “Towards making an Indian Society of Ciliatologists”
- 14.00** **Workshop** on “Tools and Techniques” used in Ciliate Studies (for students)
Coordinated by Zoological Survey of India
Workshop Facilitators:
Dr Renu Gupta, Maitreyi College, University of Delhi, Delhi
Dr Jasmine Purushothaman, ZSI, Kolkatta, West Bengal
Dr Nageswara Rao Amanchi, Osmania University, Hyderabad
Dr Santosh Kumar, ZSI, Kolkatta, West Bengal
Dr Jasbir Singh, SGTB Khalsa College, University of Delhi
Ms S Sripoorna, Acharya Narendra Dev College, University of Delhi
Ms Jeeva S Abraham, Acharya Narendra Dev College, University of Delhi



About the Organizers

Acharya Narendra Dev College University of Delhi

Established in 1991, Acharya Narendra Dev College has come a long way in the last 27 years. In this comparatively short journey the college has earned a repute of being one of the best Science colleges at the national level. The College is listed amongst the top 10 Science colleges in Delhi by the India Today Survey since 2010

The college is primarily a Science college with Commerce being the only other stream taught here. The College believes in the philosophy of Acharya Narendra Deva - an eminent educationist, reformer, social worker and a multifaceted personality. The college has received the Grade 'A' accreditation by NAAC (National Accreditation and Assessment Council) with a handsome score of 3.31-one amongst the highest scorers in the University of Delhi. The Department of Biotechnology (DBT, GoI) has also provided support to seven departments of the college under strengthening component of the Star College Scheme.

The crowning glory of these efforts has been recognition by the University in the form of Awards for Good Practices among all the colleges (63 colleges of DU) of the University at the mega multi-dimensional event-*Antardhvani* in the years 2013 to 2015. This award is an affirmation of the establishment of certain activities in the College down the years which has set us apart from all DU colleges and perhaps in the country. Some of these include: Research by the Faculty and Students (at the UG level); Promotion of Entrepreneurship and Skill Development; Social Outreach; Open Paradigms in Education; Theatre in Education; ELITE (Education in a Lively Innovative Training Environment) scheme that runs through the summer break. ELITE provides students nancial and infrastructural support along with mentoring for undertaking projects; SAKSHAM (Student Aid for Knowledge, Success, Honour and Motivation) is a scheme that provides financial aid (often not only free-ships, but also monthly stipends and book-banks) to needy students; EXPLORE (Excursions for Peer Learning in an Open and Rejuvenating Environment), allows students to undertake short trips, educational tours or field trips accompanied by their classmates and faculty.

The college has Radio Frequency Identification (RFID) based Library Management System that allows faster transactions for the library. The College has adopted an Enterprise Resource Planning (ERP) with the aim of maintaining transparency in the marking of attendance, internal assessments, timetables, sending notices to staff and students.

Moving ahead...

The College has been allotted 7.5 acres of land for the construction of the new campus at PSP area, Sector 5, Rohini in December 2014. The new campus will have all modern amenities for students and the College will expand its horizons by adding a range of new courses and increasing the number of students enrolled in it from the present 1800.



Maitreyi College University of Delhi

Maitreyi College, a constituent College of the University of Delhi, was founded in 1967 by the Delhi Administration. The College community is proud to bear the name of Maitreyi, who was an eminent scholar of the Vedic period and the wife of sage Yajñvalakya. She had keen interest in philosophical knowledge and cultivated a thirst for theological truths since early age. It has been our objective to weave the values of Maitreyi into the fabric of our education system which is a blend of the best of tradition and modernity. The College made a modest beginning at Netaji Nagar with a staff of seventeen teachers offering only BA (Pass) and BSc (General) courses. It has since made rapid progress both in size and stature. Presently the campus in Chanakypuri is spread over ten acres of land in lush green surroundings with extensive play grounds and open spaces. The college has distinguished faculty and an efficient and supportive administrative staff. The college has received the Grade 'A' accreditation by NAAC (National Accreditation and Assessment Council). The College has been conferred by 'Star College Status' by DBT, Govt of India.

The College offers Honours in Science, Commerce and Humanities at the Undergraduate level and also Post-graduate courses in Mathematics and Political Science. Certificate courses in Journalism, French, Spanish, Medical Coding and Web-designing are offered as non-credit add-on courses. There is provision for remedial coaching classes for benefit of students as and when they require it. For an all-round development of students, several programmes are organized to increase awareness about health and fitness, legal aid services, disaster management and self-defence.

The College has many 'firsts' to its credit- it is the first College in the University of Delhi to offer PG Diploma in Nanotechnology and the first to adopt e-learning methodology to create teaching material and evaluation quizzes for which an e-lab has also been set up. College also initiated an endeavour to bridge the gap between school and college for students with special needs through a seminar. Apart from excellence in academics, the college has established tradition of continuous achievements in the fields of sports, NCC, NSS and Cultural activities.

Professor Yogesh Tyagi, Vice Chancellor, University of Delhi laid the foundation stone of hostel recently. The new four-storey science block is set to be operational from the academic year 2018, which comprises of fully equipped laboratories, lecture theatres, class rooms and faculty rooms. The four-storey residential facility would house 94 students. It will also have a common room for recreation, gymnasium, reading room, dining hall and a kitchen, the warden's residence, and an activity room. The hostel would accommodate both national and international students and rooms would be allocated on the basis of merit and distance from the College.



Sri Guru Tegh Bahadur Khalsa College University of Delhi

SGTB Khalsa College is a constituent, co-educational institute of the University of Delhi. It was established in 1951 by Delhi Sikh Gurdwara Management Committee with the noble purpose of catering to the educational requirements of the persons displaced during the partition. The college is named after the ninth Sikh Guru whose martyrdom for the cause of secular ideals and principles of compassion are the guiding spirit of the institution. The college has come a long way since its inception. In fact, we have traversed more than sixty significant years of academic and extra-curricular excellence. The college has well maintained science laboratories and a technologically updated computer centre. All science sections have separate computer stations with local area networking link with Delhi University Science Library. The college has a distinguished faculty, the members of which have made a significant contribution not only in the development of the college, but also in the corporate life of Delhi University. The college has received Grade 'A' accreditation by NAAC.

To develop leaders and morally responsible citizens across disciplines that will make a difference globally, the college maintains an amalgamation of modernity and tradition in education. There are over nineteen undergraduate programmes and twelve Masters programmes running in sciences, social sciences and humanities. The college is also running professional courses in Electronics, Business Economics, Forensic Science and Computer Science and has evolved a Centre for e-learning to generate high quality multimedia-enriched digital content for enhancing the quality of education. The college has also started some student-centric projects, which allow students and teachers to collaborate in bringing new and exciting ideas to their fields and contribute better to the pool of knowledge in society.

Guru Angad Dev Teaching Learning Centre committed to collating teaching and research across wide multimedia and online platforms, has organized faculty Induction Programme and numerous Faculty Empowerment Workshops. There were a total of sixteen major community outreach programmes and several others in service under NSS/NCC in last four years with government and non-government agencies. The infrastructure of the College is one of the best in the University with air-conditioned classrooms with projection facilities. It has a rich ICT enabled library with air-conditioned reading-room and access to online resources of IUC as well as INFLIBNET, two cafeterias, indoor and outdoor sports facilities for 19 sports, state of the art gymnasium, career-counselling and placement cells, excellent computational facilities with 24x7 Internet in campus. The atmosphere of goodwill, trust and openness that the college provides has gone a long way to mould the character and personality of the students who, needless to state, have excelled in every field of activity. Wherever they are, they have made the college and, of course, the nation proud.



International Society of Protistologists (ISOP)

The Society is constituted of eminent scientists from all over the world who perform research on protists, single-celled eukaryotic organisms. Individual areas of research involving protists encompass ecology, parasitology, biochemistry, physiology, genetics, evolution and many others. The Society thus helps bring together researchers with different research foci and training. This multidisciplinary attitude is rather unique among scientific societies, and it results in an unparalleled forum for sharing and integrating a wide spectrum of scientific information on these fascinating and important organisms. Protists are often making headlines... both good and bad. Photosynthetic protists (microalgae) are responsible for costly and sometimes deadly outbreaks called harmful algal blooms in coastal waters around the world, but palatable microalgae also constitutes the base of the food web in most aquatic ecosystems. They may even be a means of mitigating carbon dioxide buildup in the earth's atmosphere via 'ocean fertilization' experiments now under study.

Heterotrophic protists (species with animal-like nutrition) play fundamental ecological roles in virtually all terrestrial and aquatic ecosystems, although some of these species are the cause of an enormous amount of human disease, suffering and death (e.g. malaria, African sleeping sickness, amoebic dysentery). There exists a Portal to Protistology to gain a better appreciation of the biological diversity of protists, their importance in nature and to human society, and some areas of active research. Membership applications to the Society are always welcome, as are inquiries regarding sponsorships for symposia at its meetings, research grants, and so on. The Society strongly supports the participation by undergraduate and graduate students. The Society also sponsors annual meetings. The Society of Protozoologists began its publication of *The Journal of Eukaryotic Microbiology* in 1954 with the first issue dedicated to the memory of LL Woodruff. It has been published uninterrupted since then, promoting the study of protozoa in particular, and protists in general.

ISOP is also our partner in organizing International Symposium on Ciliate Biology, 2018

For further details visit the website: <https://protistologists.org>



International Research Coordination Network for Biodiversity of Ciliates (IRCN-BC)

The International Research Coordination Network for Biodiversity of Ciliates (IRCN-BC) began as a collaboration between laboratories in USA and China that works to build a global network of researchers interested in all aspects of biodiversity of ciliated protists. The mission of the IRCN-BC is to become an “engine” for generating new research collaborations and interdisciplinary cooperation, new ideas for research proposals, and new procedures for material archiving. We focus on a variety of disciplines that can be integrated into studies of biodiversity of ciliates, e.g., functional ecology, taxonomy, phylogeny, biogeography and phylogeography, genomics, genetics, proteomics, cellular metabolism, population biology, and more.

The IRCN-BC was launched in 2012 following successful funding applications, submitted jointly by John Clamp and Weibo Song, to the National Science Foundations of USA and China, respectively. A steering committee was established to oversee IRCN-BC activities, chaired by John Clamp and comprising members from USA, Germany, UK, Brazil and China.

The main activities of the IRCN-BC have included:

- Financial support for research visits between scientists that seek to establish new collaborative research projects and networks
- Financial support for scientists to receive training in specific techniques
- Financial support for young scientists, particularly students and postdocs, to present their research findings at conferences
- The identification of 12 Grand Challenges of Biodiversity of Ciliates to focus research (<http://ircn-bc.org/Outcomes.html#GC>)
- The organisation of annual workshops and symposia on ciliate biodiversity

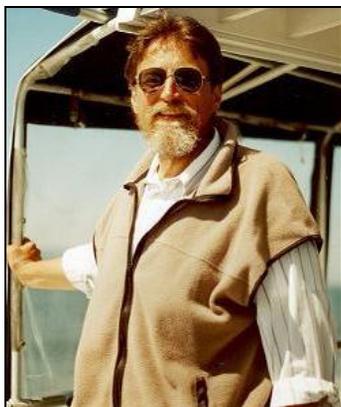
Workshops have been held in USA (2012), UK (2014), China (2015) and Guam (2016) and two IRCN-BC-sponsored symposia were held at the International Congress of Protistology, Vancouver, Canada (2013). Details of some of these activities are published in specialist protistological journals. With the end of the NSF/NSFC funding in 2016, the IRCN-BC applied to become an affiliated section of the International Society of Protistologists and this was approved in 2017. In this guise, the IRCN-BC continues to support integrative research on biodiversity of ciliates.

IRCN-BC is also our partner in organizing International Symposium on Ciliate Biology, 2018

For further details of the IRCN-BC, see <http://ircn-bc.org/default.html>



Obituary



John C Clamp

(August, 1949-February 11, 2018)

John C Clamp was born on August 5, 1949 in Nuremberg, Germany and spent his early years in Germany and France. John had a passion for science. He received his BS in Biology (1970) at Methodist College in Fayetteville, NC and MS (1972) and PhD (1984) at NC State University. He served as a teaching assistant at NC State University and visiting lecturer at North Carolina Central University (NCCU) before obtaining a faculty position at NCCU in 1984. John achieved a series of faculty promotions and was most recently an Endowed Professor. He had an active research program in evolutionary biology particularly of peritrich ciliates and was involved in many international collaborations. During his career, his dedication to scientific research afforded him the opportunity to travel to 48 US states as well as Canada, Norway, Sweden, China and Austria to advance and share his research. He is most proud of the privilege he had to teach and mentor many students and researchers. His main research interests were evolutionary biology of ciliates, particularly peritrichs and has over 90 publications in peer-reviewed journals. Two of his professional milestones were to serve as President, International Society of Protistologists, 2012-2013 and as Chair, International Research Coordination Network for Biodiversity of Ciliates, 2012-2017.

We started the endeavour of holding this symposium with Dr Clamp but he couldn't accompany us in the journey. The loss is not only for his family and friends but also to Science. He has left a mark all over the globe and his exemplary strength has led us to overcome the grief. As a mark of respect, we will strive to lead life to beliefs that he lived by.



Eminent Guests



Dr Harsh Vardhan

Minister for Science and Technology and Earth Sciences
Government of India

Biosketch

Fondly called “*Doctor Saab*” by supporters and opponents alike, Dr Harsh Vardhan is known for disarming simplicity in his personal life and transparency at the work place. As Health Minister, he initiated many reforms in the public health system of the country. He took over as Minister for Science and Technology and Earth Sciences in November 2014. He is committed to set a roadmap for the implementation of the “Make in India” programme by building a robust R&D infrastructure and promoting synergies between industry and scientific research institutions.

Dr Harsh Vardhan had pioneered the Pulse Polio programme in India. He dared to visualise a polio-free India, which could only be possible if a regular Pulse Polio campaign was held on a national scale. Dr Harsh Vardhan went around the country persuading the health ministers of all the states to cooperate in making Pulse Polio a success. Today, Pulse Polio is a fact of life in India. Dr Harsh Vardhan also tried to control tobacco consumption. He conceived the first ever anti-tobacco legislation in India, despite facing stiff opposition from the tobacco lobby whose clout and arrogance at the time knew no bounds. In 1997, under his bold leadership, the Delhi Prohibition of Smoking and Non-Smokers Health Protection Act was passed. It was welcomed by hundreds of millions of Indians who were directly and indirectly affected by the tobacco menace.

Dr Harsh Vardhan believes that a society does not become “modern” by just changing its superficial appearance. Progress and modernisation means adopting lifestyles that reflect collective maturity and vision. “*You can’t call yourself a superpower if Health for All, Universal Elementary Education and Environment Protection are mere slogans*”, he says. He is one of the few politicians in the country to enjoy broad, bipartisan admiration. Former Prime Minister Inder Kumar Gujral famously commented at an international event: “*If I have to single out one minister for an outstanding award in India, then my first choice will be Dr Harsh Vardhan*”.

Dr Harsh Vardhan has presented research papers at several national and international scientific conferences. He has also contributed to the world’s leading medical journals. He had also contributed articles on environmentalism, medical ethics and progressive issues to mainstream media. Dr Harsh Vardhan does not believe in compromises. Being a committed environmentalist, he strived to reduce pollution of Delhi’s air and water. As a doctor, he believed in forming an understanding of history behind each problem and involving the “patient” in his recovery.

Dr Harsh Vardhan is recipient of several awards and recognitions. To mention a few:

- “Doctor of the last Decade” (Swastha Ratna) by Indian Medical Association’s New Delhi branch in 2002.
- Polio Eradication Champion Award by the Rotary International in 2001.
- Director-General’s Polio Eradication Champion Award Commendation Medal by the World Health Organization in 1998.
- IMA President’s Special Award of Appreciation by the Indian Medical Association in 1994.





Dr Mahesh Sharma

Minister of State of Environment, Forest and Climate Change
Government of India

Biosketch

Dr Mahesh Sharma is an Indian politician belonging to the Bharatiya Janata Party. He is a physician by profession. He graduated from the University College of Medical Sciences. Sensing the growing medical needs of the society, soon established a chain of super/multi-speciality hospitals at Noida, Greater Noida, Behror (Rajasthan), Delhi Haridwar and Jewar with a clear vision to provide the healthcare services par excellence at reasonable cost. The multi-speciality hospital at Khurja & Dehradun are under pipeline. Being philanthropic by nature, also running a Trust in the name of “Kailash Charitable Trust” to provide the much needed medical facilities to the poor and needy persons free of charges. The trust is also providing financial support to the poor students for study purpose.

He was also invited to International Convention Centre OSAKA-Japan, in 2003 as a Speaker & Panelist to discuss about ASIAN VENTURE BUSINESS. Possessing an inborn quality of leadership and has proven capability of managing the business affairs efficiently. He is also a sportsman both by spirit and nature. He plays Golf, Badminton and Cricket as a hobby and is member of Golf Course, Noida and Constitution Club of India, New Delhi.

More than 200 National and International awards from different fields (Social work/ health awareness programmes):

- Honorary Doctorate from Amity University.
- Noida Management Association Award-2007 awarded to Kailash Group of Hospital.
- Indira Gandhi Appreciation Award 2006.
- Delhi Hindi Sahitya Sammelan Award 2004-05.
- UP State IMA Award-2002.
- Giant's International Award-2001 for Social Service.
- Delhi Medical Association Award-2001 for Community Medicine Services.
- Lion's Club Award-2000 for Social Service.
- Rotary International Award 1998 for Social Service.
- UP State IMA Award in 1989 for Best U.P. State Annual Conference Organizer.
- “Effective Personal Productivity certificate from Leadership Management International Texas (USA) in 1999.



**Dr Kailash Chandra**

Director, Zoological Survey of India
Kolkatta, West Bengal, India

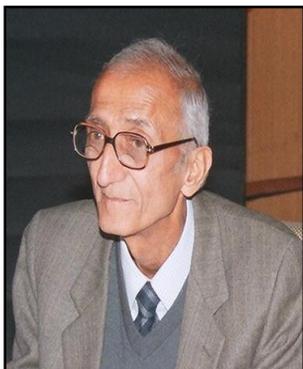
Biosketch

Dr Kailash Chandra obtained his doctoral degree from the Kurukshetra University, Haryana, India. His research interests lie mainly in the systematics of insect with special reference to Coleopterans. He has completed over 30 research projects and has contributed immensely in exploring the faunal diversity of India with publication of over 20 books, more than 100 chapters in books, about 280 research articles. He has supervised more than 30 masters and about 5 doctoral students; 8 being currently registered. Dr Chandra also participated in several expeditions including the Antarctica. He is advisor to Government of India on zoological matters and also member of various scientific associations and committees in India. He is editorial board member for various Indian and International journals.

Presently, he is the director of Zoological Survey of India (ZSI) which is a pioneer institution undertaking taxonomic research in the country and has been carrying out, over the last hundred years, surveys of the diverse ecosystems, distributed in varied and unique biogeographic zones of the country for exploring, discovering/reporting, documenting, and DNA barcoding the wealth of Indian faunal diversity from protozoa to mammalia. Over the years, ZSI has brought out numerous publications, more than 1500 scientific books and over 10,000 scientific papers, on the faunal diversity of varied ecosystems and conservation areas of the country. ZSI is the designated repository for the 'National Zoological Collection' with collections of over five million zoological specimens, including 17,000 type specimens. Identification services are also provided by ZSI to researchers, scholars, universities, institutions etc. and also support the wildlife crime control for the materials received from Forest Department and Wildlife Crime Control Bureau, Custom and Central Excise as well as Airport Authority of India. ZSI regularly arranges training programmes, symposia, seminars etc. for capacity building and public awareness.



Advisors

**Prof GR Sapra**

Retired Professor, Department of Zoology
University of Delhi, Delhi, India

Biosketch

Dr Sapra retired as professor in Cell Biology from the Department of Zoology, University of Delhi, India. He is a founder member of the Indian Society of Cell Biology and has served as its treasurer for two years. He has guided 17 PhD and more than 20 MPhil students. His collaborative work in foreign Universities includes Research Associate Scientist at the Zoologischer Institut Der Universitat, University of Tubingen, West Germany from 1971 to 1973, Research Associate at the Department of Biological Sciences, University of Maryland, Baltimore, USA from July 1973 to June 1974, Visiting Scientist at the Institut Fur Biologie III, University of Tubingen, West Germany from May 1985 to July 1985, Visiting Scientist at the Institut Fur Biologie III, University of Tubingen, West Germany from May 1989 to July 1989, Visiting Scientist at the Institut Fur Biologie III, University of Tubingen, West Germany from May 1993 to July 1993, Visiting Scientist at the Institut Fur Biologie III, University of Tubingen, West Germany from May 1996 to July 1996.

He has been principal investigator of several projects on Cytotaxonomy, Ultrastructure and Reproductive Biology of Thrips of Horticulture Importance and their role in Pollination, Cellular response towards hyperthermia and heat shock, the ageing phenomenon in some unicellular organisms, action of Cis Platinum on some unicellular organisms. He has published many research articles in reputed National and International journals.





Dr Alan Warren

Department of Life Sciences
Natural History Museum
London, UK

Biosketch

He earned his PhD in 1983, University of Surrey, UK. His title of thesis was on “The ecology, morphology and taxonomy of freshwater peritrich ciliates. He is working as researcher in Protists, Department of Life Sciences, Natural History Museum, London, UK since 1979 to present. His current and recent research interests are: (1) Biodiversity and systematics of ciliates, (2) Use of ciliates as bioindicators of water quality, (3) DNA barcoding for ciliate species identification.

He has been posted as Vice-President in International Society of Protistologists (2013-2014), as President in British Society for Protist Biology (2012-2015), as Steering Committee member, International Research Co-ordination Network for Ciliate Biodiversity (2012 to present). He is member of editorial board of various reputed journals like Protistology (since 2015 to present), Chinese Journal of Oceanology and Limnology (since 2015 to present), Boletín de la Real Sociedad Española de Historia Natural (since 2014 to present). He is also member of board of reviewers of European Journal of Protistology (since 2005 to present). He has been taxonomic editor of World Register of Marine Species (WoRMS) (2009 - 2017).

To his credit, he has more than 250 articles in peer-reviewed journals and 16 book chapters. He also curates the NHM protist collections. He also, conducts annual NHM training course taxonomic skills and field techniques for freshwater ecology and quality to provide expertise in ciliates. He has guided several research projects and has been the co-ordinator of a Darwin Initiative project.



The Speakers

The Speakers



Prof Rup Lal



Dr Alan Warren



Dr Komal Kamra



Prof Cristina Miceli



Prof Rosaura Mayén-Estrada



Dr Anastasia Shatilovich



Dr Amlan K Mitra



Prof Nageshwara R Amanchi



Prof Elena Sabaneyeva



Dr Sai Elangovan S



Dr Shashi

The Speakers



Dr Antonietta Ia Terza



Prof PK Bandyopadhyay



Prof Alexey Potekhin



Dr Ravi Toteja



Dr Seema Makhija



Dr V Ratna Bharathi



Dr Santosh Kumar



Dr Jasbir Singh



Ms Harpreet Kaur



Ms Anjusha A

OP 1

From ciliate protozoans to bacterial diversity, genomics and metagenomics

Rup Lal

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Abstract

Ciliate protozoans have been extensively used as model system to study the effect of environmental pollutants on cellular function, and also as indicators of pesticide and heavy metal contamination. We had used these organisms to study the effect of pesticides on growth and DNA and protein synthesis especially by using *Stylonychia notophora*. This modest beginning to handle microorganisms led us to use bacterial system for understanding the impact of stress on microbial community by using simple approaches of growing them in liquid media. With the advancement in DNA sequencing technologies and computational tools we went on to enter into the field of bacterial genomics and metagenomics. Our experience of handling both ciliate protozoans and bacterial system as of today will be presented.

Biosketch

Prof Rup Lal has obtained his PhD degree from University of Delhi in the year 1980. He worked as an Alexander van Humboldt Fellow (PDF) from 1988-1990 in University of Bielefeld, Germany. He has over 35 years of strong and longstanding experience in administrative, teaching and research in various capacities. Presently, he is a Professor of Molecular Biology at the Department of Zoology, University of Delhi. Prof Rup Lal has been elected as Chairman of Board of Research Studies (2008-2010), Head, Department of Zoology (2007-2010), Dean of Faculty of Science (2007-2010) and Dean of Examination (2012-2016). He has been a member of Executive Council and Academic Council and member of several national and international bodies. He has supervised nearly 60 PhD thesis and 8 students are currently working for PhD He has two US patents to his credit. He has nearly 190 publications in peer reviewed journals with 4428 ISI citations and h-index 34. He has delivered more than 300 lectures in the area of Biotechnology, Microbiology, Genomics and Metagenomics at various national and international platforms. He is the recipient of several prestigious fellowships including the Alexander von Humboldt Fellowship (Germany), DBT Overseas Fellowship and Indo-US-ASM Professorship in Microbiology and visiting scientist at the University of Cambridge, and also at University of Kaiserslautern (Germany), Oregon State University (USA), EPFL (Switzerland), University of Lausanne (Switzerland), EAWAG, Zurich (Switzerland), CSIRO, Canberra (Australia) and Helmholtz Centre for Environmental Research, Leipzig (Germany). He is the recipient of Moselio Schaechter Distinguished Service Award from American Society for Microbiology, Prof SR Vyas Memorial Award and Prof BN Johri Award on Microbial diversity by the Association of Microbiologists of India. Prof Lal served as Editor-in-Chief of Indian Journal of Microbiology (2006-2013), and is serving as an editor or member of editorial board in various leading scientific journals. He was elected as the Ambassador, American Society for Microbiology for



OP 2

Mapping ciliated protist communities along a lotic water body with deteriorating water quality

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Abstract

Increased water and soil pollution due to anthropogenic activity has disturbed aquatic and terrestrial ecosystems in many parts of the developed world. Free-living ciliated protists (ciliates) play an important role in the food web and are hence essential to maintain ecosystem balance. They also act as bio indicators of environmental health. The river Yamuna originates in the Himalayas, northern India, and traverses Delhi before entering Uttar Pradesh (UP) downstream. In the present study, physicochemical analyses based on eleven key parameters were carried out in order to assess the water quality at six select locations (DD, CP, WZ, IT, NZ, OK) along ~375 km stretch of the River Yamuna from the Himalayas to the Delhi/UP border. Collection sites were selected on the basis of entry of drains or other pollution sources. Ciliate communities at the six sites were also assessed using appropriate morphological, morphometric, morphogenetic and molecular methods. Comparison of water pollution quality shows an increasing order: DD<CP<IT=OK<WZ<NZ. More than 65 ciliate species in total were recorded at the six sites. The ciliate community structure based on species richness and abundance varied according to the water quality. Presence of some ciliate species only in a particular locale points to their use as bio indicators of respective water quality.

This work is supported by DST SERB research project EMR/001505/2015

Biosketch

Dr Kamra, a University topper in her postgraduation, has earned her PhD in ciliate biology from University of Delhi. She has a teaching experience of more than 40 years and has been a visiting scientist with Dr J Martin at University of Cordoba, Spain and with Dr Alan Warren at the Natural History Museum, London in 1992. She has successfully completed research projects funded by DBT and University of Delhi. She has been an invited and Keynote speaker in several national and international meetings and has published 26 research articles in peer reviewed journals and chapters in 6 books. She has also filed a patent 'Fluorescent Powder Compositions for Developing Latent Fingerprint'. She is a Life Member of various societies in the field of microbiology, spinal cord injuries and epilepsy. She is recipient of National award for outstanding employee conferred by the Late President of India, Dr APJ Kalam, 2004. Her current and main research interests focus on: Development biology of ciliates, ciliate diversity and ecology and biomonitoring of water using ciliates. Her recent research collaborations are with University of Camerino, Italy; International Research Coordination Network for Biodiversity of Ciliates (IRCN-BC) funded by National Science



OP 3

What have ciliates ever done for us?

Alan Warren

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Abstract

Ciliates are defined by a combination of features including the possession of cilia at some stage in their life cycle, nuclear dimorphism, and sexual reproduction by conjugation. They have been discovered in almost every environment on the Earth's surface below about 45 °C where there is sufficient water for their survival. Approximately 8,000 morphospecies are recognized, ~4,800 of which are free-living, the rest being symbionts, either commensals or parasites, mostly on the surface of their hosts but sometimes internally. In the first part of this talk I will give a brief overview of the biology of ciliates including key features of their morphology (e.g., cilia, nuclear apparatus, contractile vacuoles and extrusomes) and a summary of their functional ecology, in particular their feeding strategies. In the second part of the talk I will summarise some of the ways in which ciliates benefit humans. These include: controlling populations of bacteria (including pathogens) and of nuisance algae in aquatic habitats; recycling nutrients in soil for plant growth; serving as food for fish larvae; as hosts of endosymbiotic zoochlorellae, facilitating the removal of CO₂ from the atmosphere thereby reducing global warming; enhancing milk and meat production in ruminants; playing a crucial role in biological wastewater treatment processes; serving as model laboratory organisms, for example in the discovery of ribozymes, telomerase and the role of telomeres, thereby opening the door to the development of new treatments for major human diseases such as AIDS, hepatitis and cancer.

Biosketch

Dr Warren is a research scientist at the Department of Life Sciences, Natural History Museum, London where he also curates the protozoa collections. He earned his PhD in 1983 at University of Surrey, UK and the title of the thesis: 'The ecology, morphology and taxonomy of freshwater peritrich ciliates'. Current and recent interests focus primarily on: (1) Biodiversity and systematics of ciliates; (2) Use of ciliates as bioindicators of water quality; (3) DNA barcoding for ciliate species identification. He has more than 250 research publications to his credit. He has been appointed as Vice President for International Society of Protistologists in the year 2013-14 and as President for British Society for Protist Biology in the year 2012-15. Presently, he is on the editorial board of several journals like *Protistology*, *Chinese Journal of Oceanology and Limnology* and *Boletín de la Real Sociedad Española de Historia Natural*. Also, he is a member of the board of reviewers of *European Journal of Protistology* and is a member of steering committee of International Research Co-ordination Network for Ciliate Biodiversity (IRCN-BC).



OP 4

Genomics and transcriptomic analysis in the Antarctic ciliate *Euplotes focardii*: Molecular basis of cold adaptation and insights regarding the potential impact of climate change

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Abstract

Ciliates provide optimal model systems to study environmental adaptation. Comparative transcriptomic analysis of *Euplotes focardii*, a strictly psychrophilic ciliate isolated from Antarctic seawater, and the mesophilic congeneric species *E. crassus* revealed that in *E. focardii* the majority of the expressed genes code for proteins involved in oxidoreductase activity, as reported for Antarctic fishes and krill. These results confirm that a major problem of Antarctic marine organisms is to cope with increased O₂ solubility at low temperatures. They also suggest that an increased defence against oxidative stress likely provides an important evolutionary feature that allowed the adaptation of Antarctic organisms in their oxygen-rich environment. Gene ontology annotation also revealed that many of the transcripts encoded proteins involved in maintenance of protein homeostasis (e.g., chaperones). Quantitative PCR showed that expression of *Hsp70* genes was induced when *E. focardii* cells were subjected to oxidative stress, whereas thermal stress did not cause induction. These results argue that *E. focardii* in its current environment is well protected against reactive oxygen species and are consistent with prior reports of constitutive *Hsp70* expression as a defence against cold-induced protein denaturation. *E. focardii* appears to be poised to cope with the oxidative challenge that is likely to accompany oceanic warming over the next century, but the absence of a temperature-inducible chaperone response may place its proteome at risk. The comparative analysis of the *Euplotes* species also revealed a rapid evolution and unusual plasticity of the programmed +1 ribosomal frameshifting, a process that allows the change of the reading frame during translation. This process appears pervasive in *Euplotes* and it is not conserved in the affected genes of the two species. We are currently annotating genomics data of *E. focardii* and setting up reverse genetics in order to have a better understanding of the function of some genes that are expressed only in the cold adapted species.

Biosketch

Dr Miceli earned her PhD degree in biological sciences from University of Pisa, Italy in the year 1983. She has been working as Researcher in Animal Biology in the year 1983-1987 and as Associate professor of Zoology in the year 1987-1993. Presently working as professor of Cell Biology at University of Camerino, Italy. Current and recent research activities focus primarily on: (1) Genome organization and control of gene expression; (2) Study of molecular



and cellular adaptation mechanisms in microorganisms living in extreme environments; (3) Characterization of bioindicators in environmental monitoring. She has been recently posted as scientific coordinator of EU-COST (European Cooperation in Science and Technology) in the year 2012-2018. She has also been appointed as co-organizer for European Congress on Ciliate Biology (2003) and of FASEB Conferences on "Molecular Biology of Ciliates" in 2005 (also sponsored by EMBO) and in 2015. She has been elected as Vice-President of the International Society of Protozoology. Presently, she is a member of the Editorial Board of the Journal of Eukaryotic Microbiology and Associate Editor of BMC genomics in the section on Eukaryote Microbial Genomics.

Notes



OP 5

Some notes about the family Vorticellidae with emphasis on species ectosymbionts of crustaceans

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Abstract

The family Vorticellidae Ehrenberg, 1838 contains 21 genera, being the genus *Monintranstylum* Incertae sedis, and *Vorticella* is the genus containing the highest species number, followed by the genus *Pseudovorticella*. Taxonomic revisions of each genus are inexistent or nonupdated, and for some species its records correspond only to their original description. The records of species inhabiting as ectosymbionts of crustaceans are not updated, and for some of them, the taxonomic changes have not been considered. Moreover, genetics and molecular studies are inexistent for many species. Based on morphological published papers, including some revision works, we present the data of more than 250 free living and ectosymbiotic species of the family, from which more than 35% have been reported on one or more crustacean species, such as cladocerans, copepods, ostracods and decapods, in several habitats. We conclude that the status of the family must be revised.

Acknowledgements: To Programa de Apoyos para la Superación del Personal Académico (PASPA-DGAPA-UNAM) for the grant to RME for a short stay at PUCRS.

Biosketch

Dr Rosaura Mayén-Estrada, is a researcher in Facultad de Ciencias, Universidad Nacional Autónoma de México, working with free-living and epibiont protists, mainly attached to aquatic plants and invertebrates. The main goals of the projects are taxonomic and ecological aspects, especially of peritrich ciliates. She is teaching Protozoology as well Animal Biology, for undergraduate courses. She has many research articles and chapters to her credit and has presented her research work in various conferences.

Notes



OP 6

Distribution and long-term cryobiosis of ciliates in the arctic soil and permafrost

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Abstract

Viable resting cysts of ciliates as well as other protists were isolated from Arctic Late Pleistocene and Holocene permafrost sediments. Our knowledge about mechanisms of long-term cryobiosis remains incomplete. The species diversity of ancient viable ciliates is assumed to be a result of constant selection going not only in permafrost sediments, but also in the modern tundra soils during long-time transition of cysts into the frozen deposits. The main goal of the study was to investigate the diversity patterns of ciliate community in the permafrost sediments and in the profiles of tundra soils and to determine species that have developed adaptations to survive in consistently adverse environments. The taxonomical analysis of cultivable ciliates isolated from tundra soils revealed 38 species of ciliates from 7 taxonomical groups. A considerable part of the community (76% of ciliates species) maintained viability in the dormant state in the middle and lowermost parts of soil profile. Communities of ancient viable ciliates isolated from permafrost sediments contain 13 species that is 32% from the diversity observed in modern tundra soil. Community of ciliates isolated from both soils and permafrost were mainly represented by small typical soil colpoid ciliates: *Cyrtolophosis mucicola*, *Colpoda inflata*, *C. steinii*, *C. cucculus*, *Platyophrya vorax*. According to our results significant part of ciliates communities have adaptive and protective mechanisms enabling long-term cryobiosis in the inhospitable conditions of the arctic soils and permafrost. The transition of ciliate resting cysts through the active layer to permafrost is considered as the period of pre-adaptation of organisms and formation of communities capable to prolonged cryobiosis and forming a natural cryobank of soil biota in the permafrost.

Biosketch

Dr Anastasia Shatilovich is a senior researcher at the Soil Cryology Laboratory, Institute of Physicochemical and Biological Problems in Soil Science, Russian Academy of Science. Current and recent interests focus primarily on: 1) biodiversity and distribution of ciliates in the tundra soil and permafrost sediments 2) long-term cryobiosis of ciliates and mechanisms of adaptation to extreme environments. She has published research papers and chapters and has participated in many conferences.



OP 7

Diversity and distribution of ectoparasitic trichodinid ciliophorans (Protozoa: Ciliophora) in freshwater and estuarine fishes of West Bengal, India

Amlan Kumar Mitra

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Abstract

Trichodiniasis is one of the major diseases found in fish worldwide, caused by ciliated protozoans of the family Trichodinidae. Ichthyoparasitological surveys since 1998, in search of ciliated parasites in wild and cultured freshwater and estuarine fishes of West Bengal, India revealed a number of trichodinid ciliophorans of the genera *Trichodina* Ehrenberg, 1838, *Paratrichodina* Lom, 1963, *Dipartiella* Stein, 1961, *Trichodinella* (Raabe, 1950) Srámek-Husek, 1953, *Tripartiella* Lom, 1959 infesting gills, skins of the host fishes. Many new species of the genus *Trichodina* and *Paratrichodina* have been identified and reported in the last two decades. A large number of invasive trichodinid ciliates have also been reported from wild fishes as well as in exotic fishes. The purpose of this paper is to highlight the findings during the last two decades, which extend extant knowledge on diversity, distribution, host preferences, seasonal incidence and prevalence of this fascinating group parasitizing wild and cultured fishes.

Biosketch

Dr Amlan Kumar Mitra is serving as an assistant professor of Zoology in Ranaghat College (affiliated to University of Kalyani), India. His research interests include biodiversity, taxonomy and systematics of protozoan parasites of annelids and fishes with special emphasis on Trichodinid Ciliophorans. He has published more than 40 research papers in various national and international peer reviewed journals. He acted as Principal Investigator of research project funded by the University Grants Commission (India).

Notes



OP 8

Cypermethrin induced cytotoxicity effects on cell behaviour, morphology, cell physiology and cell organelles in freshwater ciliates *Paramecium caudatum* and *Blepharisma intermedium*

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Abstract

Experiments were designed to investigate the invitro cytogenotoxic effects of cypermethrin using selected freshwater ciliate models such as *Paramecium caudatum* and *Blepharisma intermedium*. *Paramecium* was highly sensitive and responsive to cypermethrin showing both morphological and physiological changes in its shape, size and structure at 5, 10 and 20ppm concentration whereas *Blepharisma* was relatively tolerant. In acute studies, cell motility was affected slightly at lower concentrations but at higher concentrations cells exhibited rocking movements, later on cells became motionless. LC50 for 3 h exposure was found to be 69.44 ± 03.94 ppm and 124.17 ± 02.33 ppm to *Paramecium* and *Blepharisma* respectively. In acute exposure cells showed deformities such as swelling, blebbing, oval shape, and at higher concentrations shortening of longitudinal axis with blackening of cytoplasm and Leaking of cytoplasmic contents were observed. A significant depletion of phagocytosis was observed for 30 minutes and 1 hour exposure. Changes in pulsatory vacuole activity were also observed on exposure to 18, 22 and 26ppm of cypermethrin for 20min duration. Macronuclear aberrations such as rod shaped, fragmentation, vacuolization and complete diffusion were observed and were dose dependent. Our findings in the present studies emphasize the possible potential of *Paramecium* and *Blepharisma* as useful models for basic ecotoxicology studies.

Biosketch

Dr Amanchi is an Assistant Professor of Zoology in the Osmania University, Nizam College, (Autonomous), and Hyderabad, Telangana State, India. He has Masters in Zoology and obtained his PhD in Zoology in the area of Protozoology and Environmental Toxicology from Osmania University in the year 2007 and joined as a teaching faculty. His research interests lie in the area of Freshwater protozoan ecology, Ecotoxicology of pesticides, heavy metals and environmental safety. He has collaborated with researchers in other disciplines of Life sciences, particularly environmental Sciences, biotechnology for bioremediation of pollutants, and Applied Toxicology. He is the instructor for both Undergraduate and Post-graduate programmes. He has 14 years of teaching and 10 years of research experience to his credit. The topics he teaches are Biology of Invertebrates and Vertebrates, Bio molecules, Chick Embryology and Development for UG Students, Molecular Genetics and Developmental



OP 9

Newly found endosymbionts in ciliates: have we met before?

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Abstract

Ciliates often host endosymbiotic microorganisms, which can be prokaryotic or eukaryotic, cytoplasmic or intranuclear, and can differ in their host and compartment specificity. The number of newly found endosymbiotic associations in Ciliates is constantly increasing and reflects the efforts put in sampling. Recently, we registered two new eukaryotic and two new prokaryotic endosymbionts in the cytoplasm of *Paramecium* (a microsporidium in *P. primaurelia*, a yeast in *P. bursaria* and two new endosymbiotic bacteria in *P. nephridiatum*) and a bacterium residing in the macronucleus of *Spirostomum minus*. The eukaryotic invaders are truly novel for paramecia. *Globosporidium paramecii* is the second microsporidian parasite in Ciliates, which has received full morphological and molecular characterization. Though experimental yeast infection has been carried out in *P. bursaria* previously, such populations rarely occur in nature. The status of the three bacterial endosymbionts is still equivocal. Morphology of the flagellated cytoplasmic endosymbiont of *P. nephridiatum*, residing in an individual vacuole and positive in FISH with *Lyticum*-specific probe, is identical to that of *Pseudolyticum minutus*, which was described previously only with TEM and thus lacks molecular characterization. The curved cytoplasmic endosymbiont of *P. nephridiatum* was revealed in FISH with probes specific for *Holospira* and *Goertzia*, both exclusively endonuclear symbionts. Though the fine structure of this bacterium did not show any resemblance to infectious forms of *Holospira* it demonstrated some infection capacity. At the same time, despite morphological differences, preliminary partial characterization of its SSU rRNA gene sequence brings this endosymbiont closer to *Paraholospira nucleivisitans*. Anyway, neither of these genera has ever been found in the cytoplasm of *P. nephridiatum*. According to preliminary FISH experiments, the macronuclear endosymbiont of *S. minus* belongs to Alpha-proteobacteria group, like previously described ones; a monoclonal laboratory culture was established and molecular and morphological characterization is underway.

Supported by RFBR grants #15-04-06410 and #18-04-00562.

Biosketch

Prof Sabaneyeva, PhD, is an Associate Professor at the Department of Cytology and Histology, Faculty of Biology, Saint Petersburg State University, Russian Federation. For



OP 10

A Study on tintinnids (loricate ciliates) from the mangrove proximal zone waters of Port Blair, South Andaman

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Abstract

We report here the interaction between the environment and tintinnids inhabiting in the mangrove proximal zone waters of south Andaman, in relation to certain physicochemical and biological parameters. As the proximal zone of mangrove waters is subjected to regular tidal effect, tintinnids community was studied for one year (September 2012-August 2013) during the northeast monsoon, intermonsoon, and the southwest monsoon periods. We recorded a total of 27 species belonging to 17 genera, and the abundance of tintinnids varied seasonally and spatially with higher abundance during the southwest monsoon (19-59 Cells L-1) followed by the intermonsoon (18-27 Cells L-1). Statistical analysis (CCA analysis) depicts that the influences of environmental variables were varied seasonally and the temperature, salinity, and pH are the major variables influencing on tintinnids assemblages in the mangrove proximal zone. As results, the northeast monsoon was dominated by *Codonellopsis ostenfeldi* and *Tintinnopsis beroidea*, the intermonsoon was dominated by *Tintinnopsis butschli*, *Tintinnopsis dadayi* and *Tintinnopsis karajacensis*, and the southwest monsoon was dominated by *Dictyocsta* sp, *Tintinnopsis uryguayensis*, and *Stenosemella* sp. These results suggest that species composition of tintinnids community is varied seasonally by changes in the influence of environmental variables occurring in this proximal zone.

Biosketch

Dr Sai Elangovan is a Postdoctoral Researcher at CSIR-National Institute of Oceanography in Goa, India. He has been working extensively on microzooplankton taxonomy, carbon production and grazing studies from Northern Indian Ocean (Bay of Bengal, Arabian Sea, and Andaman Sea). He actively took part in several cruises on various research vessels (~150 days) apart from local field trips to coastal, estuarine and freshwater systems. Interestingly, he found a new species (*Strombidium mansai*) while working on the associations of ciliates in Oxygen Minimum Zones of the Bay of Bengal and the Arabian Sea. This work got published in Indian Journal of Geo-Marine Sciences (IJMS, April 2017). Besides, he is working on microzooplankton functional response to the climate change warming in the Arabian Sea. To his credit, he has ten publications in national and international journals and active part in several scientific reputed journals as a review editor (Frontiers in Marine



OP 11

Description of four hypotrichous ciliated protists from Maharashtra, India; phylogenetic relationships with congeners

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Abstract

Varied climatic and physical conditions increases biodiversity in different regions of the state of Maharashtra, India. It is a Deccan trap region mostly formed from igneous rocks and black, medium black, shallow and calcareous types of soils. These soils have variable water holding capacity and permeability varying groundwater under water table conditions. Ciliated protists are ubiquitous and found in wide range of environmental conditions. Ciliate diversity from the soils of Maharashtra was analysed using classical and molecular methods and a comparative study was made. Three urostylids and one stichotrichid from Class Hypotrichea were isolated; *Anteholosticha antecirrata*, *Pseudourostyla cristata*, *Pseudourostyla nova* and *Pseudouroleptus caudatus caudatus*. Comparison of these populations with descriptions available in literature was done. Morphometric and molecular studies of isolated populations showed that these differed from described populations of the respective species and may be separated at the sub species level. Phylogenetic analyses using 18S rDNA gene sequences were done to study the relationships of the Maharashtra isolates from their respective congeners.

Biosketch

Dr Shashi has completed her MPhil and Doctoral from Department of Botany, University of Delhi where she optimized in vitro plant regeneration in millets crops such as *Pennisetum*, *Sorghum*, and apomictic grasses such as *Dichanthium*, *Pennisetum* and *Cenchrus*. Furthermore, she extended her research to standardized genetic transformation technique in apomictic taxa during her Doctoral research. In addition, she has successfully completed research projects on molecular characterization of genes through RNA in situ hybridization, heterologous protein expression and embryological approaches. Before her doctorate, she has participated in investigation of mega fossils with leaf impression to correlate with the past distribution and migration of vegetation since the tertiary period in Himalayan foot hills of Uttarakhand, India. After her doctoral research, she has also worked on ecological aspects, where she investigated the role of soil microbial communities in the invasion plants success. In this project she has identified microbial communities in rhizosphere and characterize phenolic compounds present in roots via TLC, GC-MS analysis. Currently she is associated with Dr Komal Kamra, where she is involve in identification and characterization of ciliates and their diversity analysis in fresh water bodies via morphological and physiochemical methods as well as phylogenetic analysis using molecular markers. She has published 7 Research articles in National and International Journals and contributed 3 Book Chapters in Springer Books. She has also presented her research findings in several National/ International Conferences/ Symposium and attended Workshops in all around India.



OP 12

Ciliated protists as indicators of ecosystem health: Opportunities, challenges, and case studies in Italy

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Abstract

This communication aims to provide an overview of the outcomes and the challenges encountered in using ciliated protists as indicator of ecosystem health in the framework of several projects conducted in Italy since 2009. Ciliates (and, in general, protistan microorganisms) in spite of the key roles they play in the microbial loop, still constitute a neglected component of the biodiversity, which is rarely included in ecological risk assessment plans. Ciliates are important bacterial and fungal feeders and thus, they significantly contribute to channel nutrients up to the food web. Furthermore, numerous ciliate species can be easily cultured with a short generation time, such as those selected for the setting up of our ecotoxicological experimentation (i.e., *Coleps hirtus*, *Euplotes aediculatus*, and *Rigidohymena tetracirrata*). Thus, in this context, the present communication aims to highlight the usefulness of ciliates as test organisms for the development of simple and cost-effective “prognostic” assays (i.e., able to detect sub-lethal toxicant effects of various environmental matrices) based on the exploitation of antioxidant responses as well as of “diagnostic” assays (i.e., able to detect overall ecosystem impairment) based on the analysis of the community structures of ciliates in arable soils to evaluate the potential impact of different agricultural managements.

Biosketch

Prof La Terza has earned her PhD in Protistology, University of Pisa in 1992. Her professional history and academic activities are: (1) Visiting scientist at the Fred Hutchison Cancer Research Center, Seattle (USA) in 1990-1992; (2) Postdoc fellowship, Department of Molecular, Cellular and Animal Biology, University of Camerino in 1992-1994; (3) Presently she is working as Lecturer in Ecology at the School of Biosciences and Veterinary Medicine, University of Camerino. Current research interests focus on Diversity and Ecology of Ciliates, Biomonitoring, Soil Biology and Ecology. Her consultancy activities/ participation at congresses include: (1) European Commission's expert in the field of “Bioindication and Biodiversity in the frame of the project, Biodiversity and Bioindication to evaluate soil health” in collaboration with the Joint Research Center, Ispra (VA), Italy (2004/2006); (2) Presently she is a member of the expert committee established for the launch of the “National Monitoring Network on Soil degradation and Soil Biodiversity” at the Institute for



OP 13

Transcriptomic analysis of heavy metal induced changes in gene expression in freshwater ciliates

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Abstract

Heavy metals like cadmium and copper are widely found in the environment and are the major toxic inorganic environmental pollutants present in both terrestrial and aquatic ecosystems. Heavy metal stress induces production of reactive oxygen species (ROS). Enhanced ROS generation can cause oxidative stress and result in tissue damage. Increase in their concentration due to anthropogenic activities is a matter of concern. To control the increasing pollution, it is necessary to assess the heavy metal toxicity. In this present study, ciliates are used as cellular tool to assess the metal toxicity and to study the various mechanisms to overcome the heavy metal stress. The effect of Cu and Cd on the population growth of freshwater ciliates was observed. The 24-hr LC50 was measured where heavy metals negatively affected the growth of ciliates. Also, the activities of various antioxidant enzymes viz. superoxide dismutase, catalase and glutathione peroxidase (involved in SOD-catalase-glutathione cycle) were studied in the presence of Cu and Cd. The levels of antioxidant enzymes were found to increase significantly with higher concentrations of heavy metals suggesting that these enzymes are involved in protecting the cells from oxidative damage induced by Cd and Cu. In addition, transcriptional expressions of stress genes like *hsp*.

70 and metallothionein have been evaluated by qPCR. Significant increase in the expressions of these genes were observed with increase in heavy metal concentration. The results suggest that antioxidant enzymes and these stress genes may act as effective molecular biomarkers to evaluate heavy metal toxicity in ciliates.

Biosketch

Dr Ravi Toteja, Associate Professor of Zoology in Acharya Narendra Dev College, University of Delhi, has done his graduation in Zoology (Honours) and Post-graduation with specialization in Cell Biology from University of Delhi. He did his MPhil in Tumor Immunology and PhD in Molecular Parasitology from University of Delhi. He has been teaching Cell and Molecular Biology and Immunology since 2000. He is working on biodiversity of ciliates and stress response in ciliates. He has a number of research papers published in peer reviewed journals. He has attended several National and International



OP 14

Morphology, ontogenetic, and molecular phylogenetic studies on species of the genera *Sterkiella* and *Fragmospina*

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Abstract

We investigated a poorly known species of the genus *Sterkiella* based on two populations collected from an agricultural field in Marche Region, Italy and from soil samples collected from the Silent Valley National Park, India. This study represents an example where data on the ontogenesis clarifies the polyphyletic behavior of the genus *Sterkiella*. Both populations showed a rather similar morphology and ontogenetic pattern and thus supported the polyphyletic behavior of the genus *Sterkiella* in molecular phylogenetic analyses. In addition, description of a species of the genus *Fragmospina* has been presented based on the detailed investigations on morphology, ontogenesis, and molecular phylogenetic methods.

Biosketch

Dr Santosh Kumar is senior scientist at the Zoological Survey of India, Kolkata. His research mainly focuses on the taxonomy and ecology of protozoan ciliates. He did his PhD from the University of Delhi, where he studied the diversity of ciliate from selected biotopes in India and the effects of heavy metals on certain ciliate species, especially the recombinant cell lines of *Tetrahymena thermophila*. Further, he studied community structure of ciliates from extreme habitats and their adaptation to high sulphur tolerance, photo-sensitivity, feeding behaviour, and cytotoxic compounds. He was the part of the Soil Mapping project, Italy, where he studied ciliated protozoa as bio-indicators of soil quality in agriculture fields under different farming practices. He was also part of the Korean Research Fellowship programme, where he studied ciliated protozoa as bio-indicators water quality in industrial polluted sites and extreme habitats. He has described more than 20 novel ciliates from India, Australia, Jamaica, South Korea, and Italy, based on the standard methods, i.e., morphology and molecular phylogeny employing ribosomal and mitochondrial genes. He has published articles in best journals of the field and contributed to over 25 presentations in national and international conferences/symposia/workshops.



OP 15

Studies on physico-chemical parameters and protozooplankton abundance in Konam reservoir, Visakhapatnam district, Andhrapradesh-India

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Abstract

A pioneer study on analysis of water quality characteristics and protozooplankton abundance was undertaken in KONAM Reservoir located in the foot hills of Eastern Ghats of Visakhapatnam district for a period of 12 months (July 2015-June 2016) at six GPS fixed locations (From dam gates to Catchment area). The mean dimensional scaling of water quality variables indicated that the reservoir waters influenced by rainfall, seasons and showed appreciable variations spatially and seasonally categorizing the damside and catchment area as two distinct regions. The biological observation of Protozooplankton composition included 17 species of flagellates and 35 species of ciliates distributed at all stations. Flagellates (mean abundance: 2,246 nos/ml) outnumbered ciliates (mean: 565 nos/ml) and the dominant genera are *Cryptomonas* sp. and *Peridinium* sp., among flagellates and *Halteria* sp., and *Strobilidium gyrans* among ciliates. Seasonally, the flagellate abundance is high during pre monsoon and hot month seasons and ciliate abundance followed the peaks of flagellates indicating ciliates are more of nutrient dependent rather than with the prevailing water quality conditions.

Biosketch

Dr V Ratna Bharathi earned her MPhil in 1993 and PhD in the year 1997. She has worked as Post Doctoral Fellow in Zoology department, Andhra University in the year 2000 and carried out studies on "Role of Protozooplankton in Productivity off Bay of Bengal, Visakhapatnam India". In the year 2015-2017, she has been working in a project on "The studies on Protozooplankton in relation to water quality in Konam Reservoir, Visakhapatnam, India". She has attended an International symposium on Protozoology during 1997 July Held at University of Sydney, Sydney, Australia and Presented Poster on Planktonic Ciliates of Visakhapatnam Harbour. She has a teaching experience of 21 years and worked as Junior Lecturer for Board of Intermediate education. Presently working as Assistant Professor in Zoology at Dr VS Krishna Govt Degree and PG college, Vishakhapatnam, Andhra Pradesh, India. She has attended 15 conferences and has 5 publications in reputed scientific journals.



OP 16

Morphology, ontogenesis and molecular phylogeny of a novel freshwater oxytrichid ciliate from river Yamuna, Delhi, India

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Abstract

A novel oxytrichid ciliate was isolated from water samples collected at three locations along the stretch of river Yamuna, Delhi, India. Morphological, morphometric and morphogenetic studies were done using live and protargol stained cells and phylogenetic studies were done using 18S rDNA gene and V4 region of 18S rDNA gene. The novel oxytrichid is most similar to *Gastrostyla* sps. but exhibits uniqueness in the combination of characters such as number of frontoventral cirri, type of cortical granules and arrangement of FVT cirri. Ontogenetic studies show variations regarding division of streak V-VI and dorsal kinety 3 fragmentation. Novel oxytrichid species was compared with species from genera *Gastrostyla* and other *Gastrostyla* like genera such as *Hemigastrostyla*, *Apogastrostyla* and *Protogastrostyla*. According to phylogenetic analysis, this species paired consistently with *Oxytricha granulifera* and *Architricha indica* as close neighbours.

Biosketch

Ms Harpreet Kaur is a PhD Research Student working as a Junior Research Fellow in Ciliate Biology Lab, SGTB Khalsa College, University of Delhi since 2015. She completed her BSc and MSc in Zoology from University of Delhi. Presently, she is working on characterization of free living ciliated protists as indicators of pollution and their impact on the micro-ecology of river Yamuna flowing through National Capital Region (NCR) of Delhi, India, along with exploration of biodiversity of ciliates from the extremophilic regions of India using morphological and molecular approaches. She has also worked in a University of Delhi Innovation Project where she contributed in development of a working community based model to create awareness and treatment of epilepsy. She is a member of International Society of Protistology (ISOP). She has presented her research finding in national and international conferences and participated in workshops nationwide.

Notes



OP 17

Phytochemical screening for identification of bioactive compounds and antiprotozoan activity of fresh garlic-bulb over trichodinid ciliates affecting ornamental goldfish

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Abstract

Ornamental fish culture is an economically important business of our country and contributes in the socioeconomic uplift of the backward community with a little investment. However, parasitic outbreaks cause increased mortality, which in turn results in high economic loss in this industry. Trichodinids are known to be a major problem in fish farms causing serious damage, particularly under cultured condition of gold fish. The wide variety of chemicals used for treating trichodiniasis not only makes the environment unfavorable for aquaculture but the pathogen also becomes resistant towards them over time. So, the chemicals should be used more rationally to prevent the protozoa from becoming resistant towards them and moreover there is an urgent requirement of alternative therapeutic strategies to control this protozoon mediated damage of the ornamental fishes. Hence, the present study has been designed to identify a non-chemotherapeutic agent for disease treatment in aquaculture which might be beneficial for the industry. Garlic is popularly known to be rich in a variety of secondary metabolites owing the ability to synthesize many different substances that has been widely exploited by the local community for its medicinal value, which led us to test it as a therapeutic agent for trichodiniasis in goldfish. After determining its toxicity level ethanolic extract of garlic was found to reduce the trichodinids burden of goldfish significantly ($P < 0.01$) within 4 days only which clearly demonstrates the antiprotozoan activity of fresh garlic bulb. Further the bioactive components of garlic responsible for its antitrichodinid activity were identified using GC-MS.

Biosketch

Dr Bandyopadhyay is Professor of Zoology in the University of Kalyani, West Bengal, India. His research interests include taxonomy and biodiversity of Protozoan, Helminth parasites of fishes, birds and mammals. Recently, he put emphasis on the control of protozoan as well as bacterial infection of edible and ornamental fish with the help of locally available plant bio-molecules. He has published more than 155 research papers in various national and international peer reviewed journals. He acted as Principal Investigators of several research projects funded by the University, ICAR, UGC, DST (West Bengal), DST (India). Currently he is leading three major research projects funded by the DST (India) and DBT (India). 30 students have been awarded PhD degree under his able guidance. He has visited many countries like, Australia, South Korea, China, Bangladesh and Spain. He was a visiting Professor of Department of Life Sciences, Manipur University, Manipur,



OP 18

Views and news: latest findings unravel hidden diversity of *Paramecium*

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Abstract

Paramecium is one of the top-model objects in ciliatology, and in last twenty years many *Paramecium* species have been redescribed (*P. duboscqui*, *P. nephridiatum*, *P. chlorelligerum*) or discovered (*P. schewiakoffi*, *P. buetschlii*). However, sampling in remote and also well-screened regions of the World continues to bring surprises. Descriptions of known species sometimes appear to be misleading, while molecular markers may prepare traps for researchers. We present a revision of two subgenera of *Paramecium*, namely *Paramecium* and *Cypriostomum*. Despite subgenus *Paramecium* comprises the best-studied species, we made several new findings in this group. New *Paramecium* species retrieved in Pakistan was first considered as *P. caudatum* subspecies by 18S rDNA sequence. However, morphologically this strain could be attributed to the *P. aurelia* complex, while mitochondrial markers and cell physiology data unequivocally support it as an independent species. Two divergent clusters in all molecular phylogenies assumed existence of two cryptic species within *P. multimicronucleatum*. Microscopic analysis of strains belonging to these clusters showed that they clearly differ morphologically. Two new strains belonging to the cryptic species “*Eucandidatus P. germanicum*” retrieved in Russia last year allowed us to prove that this species is also a valid *Paramecium* morphospecies. Subgenus *Cypriostomum* traditionally comprises four morphological species (*P. calkinsi*, *P. nephridiatum*, *P. polycaryum*, and *P. woodruffi*). We revised it by morphology and three-loci molecular phylogeny using about 60 strains sharing general distinctive features of this group. We observed numerous morphological peculiarities including novel for *Paramecium* type of the micronucleus, as a result reconsidered classical species descriptions and described at least two new *Paramecium* morphospecies. So hidden *Paramecium* diversity gives a perfect example that morphological differences may be overlooked, morphological similarity can be misleading, and molecular data are not always reliable, thus requiring comprehensive analysis for new species description.

Biosketch

Dr Potekhin was born in 1975, Leningrad, USSR. He graduated from St Petersburg State University, Russia in 1998, earned his PhD in Cell Biology in 2002 and Postdoc in St Petersburg State University (2002-2007). Presently working as Professor at Department of Microbiology, Faculty of Biology, St Petersburg State University, Saint Petersburg, Russia. His topics of lecture are on General Virology”, “Molecular Parasitology of Protists”,



OP 19

Biodiversity of ciliate fauna especially of hypotrichous ciliates of Sikkim, the western segment of Eastern Himalayas

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Abstract

Cataloguing and describing ciliate community structure of Sikkim is a first ever effort to investigate ciliate biodiversity of the region. The community of ciliated protists of the region is undoubtedly very rich and distinct. Over hundred hypotrichous and non-hypotrichous ciliate species were isolated from various collection sites including soil and aquatic habitats. Morphology and ontogenesis was investigated using live observation and protargol impregnation, and molecular phylogeny was studied using 18S rDNA sequences. The study has provided new knowledge on the occurrence and distribution of ciliate fauna across Sikkim. Members of the family Oxytrichidae were predominant among the hypotrichous ciliates of the region. Few species were strikingly similar to the earlier described species while others showed remarkable differences with respect to morphology, morphometry, morphogenesis and molecular characteristics. The study of some selected cases provided literary information of significance and helped in filling gaps and clear anomalies in the Hypotrich Systematics. Furthermore, this study throws light on the dispersal patterns of some ciliated protists.

Biosketch

Dr Jasbir Singh is presently working as Assistant Professor in Department of Zoology, Sri Guru Tegh Bahadur Khalsa College, University of Delhi. He completed his Doctoral from Department of Zoology, University of Delhi. The title of his thesis was 'Ciliated Protists from Sikkim, a Biodiversity Hotspot; descriptions of some ciliate taxa with phylogenetic notes using classical and molecular methods'. During his PhD tenure he has worked for three years under a project as Junior/Senior Research Fellow entitled "Extremophilic free living ciliated protozoa from different ecozones in the Eastern Himalayas" funded by Department of Biotechnology, Government of India. His area of Interest is-exploration of hypotrichous ciliate biodiversity, and study of their differentiation and regulation of cortical structures, developmental strategies and molecular phylogeny. He has published 5 Research articles in International Journals.



OP 20

Dominance of aloricate ciliates in the near shore waters off Kochi, southwest coast of India

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Abstract

Ciliates are the major protistan component of microzooplankton (20 - 200 μm in size) in estuaries, coastal waters and open ocean waters. They form an important component of the plankton food web, act as top predators within the microbial food webs. Planktonic ciliate studies from Indian waters are mostly focused on tintinnids, the loricate ciliates, leaving the aloricate ciliates unaccounted in sampling and identification due to their small size and delicate body structure. In the present study, ecological response of ciliate community to the hydrographical transformations in the near-shore waters of the South-west coast of India has been presented with special emphasis on aloricate ciliates. Monthly time-series sampling was carried out during January-December 2014 at four locations along a transect perpendicular to the Kochi coastline up to 30m depth. Seasonal hydrographical features in the study region were chiefly influenced by estuarine flux throughout the year and coastal upwelling during the Southwest Monsoon. A total of 49 species of ciliates were identified, of which 29 were loricate ciliates and 20 aloricate ciliates. Irrespective of seasons, ciliate abundance was higher at the inshore locations compared to the offshore ones. Maximum ciliate density was obtained during the SWM, which was associated with high estuarine influx and phytoplankton biomass. This study reveals the dominance of aloricates over loricates in the coastal waters off Kochi with a differential response to the estuarine influx.

Biosketch

Ms Anjusha is a Senior Research Fellow at CSIR-National Institute of Oceanography, Kochi, India. She has completed her MSc in Marine Biology from CUSAT, India. She has been working widely on microzooplankton taxonomy, ecology, feeding biology and plankton food web dynamics from Arabian Sea and Bay of Bengal. Lately, she has submitted her PhD thesis entitled "Studies on microzooplankton in some tropical aquatic environments" to Bharathidasan University, India. She actively took part in several field trips to open ocean, coastal and estuarine systems. During her tenure in NIO, she has worked on ecology and trophic interactions of various plankton components involved in the plankton food webs in the coastal and estuarine environments. To her credit, she has seven international publications in reputed scientific journals and active member of Society of Marine Biologist (SOMB-CUSAT, India). Besides, she has been awarded for CSIR- Senior Research Fellowship (Government of India).



OP 21

An overview of progression of ciliate biology research at University of Delhi

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Abstract

This paper presents a synopsis of the ciliate research conducted at the Ciliate biology laboratories at three constituent colleges of University of Delhi, Delhi, India. The research Laboratories at SGTB Khalsa College, Acharya Narendra Dev College and Maitreyi College have keen interest in unravelling the hidden diversity of fresh water and soil ciliates using combination of morphological characterization and molecular sequencing. The group is also dedicated in searching for alternative gene markers that will adequately reveal genetic diversity and provide better resolution for species identification. The research group is specifically interested in molecular phylogenetic analysis of Hypotrichous ciliates collected from this part of the world as data from India is still fragmentary. Continuous efforts of our work and joint collaborations in future with other groups in India may be fruitful for our future endeavours. Ciliates are also used as a eukaryotic model to analyze the stress response to different heavy metals. Our group is also studying the cellular adaptation to heavy metal stress by regulating the gene expression of heat shock protein, *hsp70* and other genes involved in glutathione metabolism under oxidative stress. Two of the stress induced genes, *hsp70* and superoxide dismutase (SOD) have been partly sequenced and characterized. Also in our laboratory, we are trying to correlate community structure of ciliates in relation to various physico-chemical characteristics of the soil samples. An understanding of soil ciliate diversity and physico-chemical parameters may help us to drive decisions in future about the best practices to apply for improving soil quality and conservation practices for water resources in future. Community structure of ciliates appears to be of major importance for soil formation and they could serve as sensitive indicators in future.

Biosketch

Dr Seema Makhija, an Associate Professor of Zoology at Acharya Narendra Dev College, University of Delhi, did her graduation with honours in Zoology, Post-graduation with specialization in Cell Biology and Doctorate in Molecular Ciliate Biology from the University of Delhi. She was recipient of research associate fellowship of CSIR. Area of her research includes biodiversity of ciliates of Delhi region and stress response in ciliates. She is the Principal Investigator of UGC (University Grants Commission) and DST sanctioned research projects. She has number of research publications peer reviewed journal to her credit. She has presented her work in various National and International conferences and has been



OP 22

Ciliates as bioindicators of marine water quality

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Abstract

Although protists, and especially ciliates, have long been used as indicators of freshwater quality, they are rarely used in this capacity in marine waters. Here I will summarize the results of a series of studies carried out in Jiaozhou Bay, on the Yellow Sea coast of NE China, in which we investigate the relationships between ciliate communities, both planktonic and periphytic, and certain physico-chemical parameters that varied at different sites within the Bay. In each study, ciliates were identified and enumerated by direct microscopy, and data were analyzed using various statistical packages mainly within the PRIMER package. A main aim of this investigation was to develop protocols that minimize sampling effort, the level of taxonomic expertise required, the number of taxa that need to be identified, and the necessity to enumerate taxa, without losing predictive capability. Our main findings were: (1) eight sampling events per year may be an optimal sampling strategy for determining seasonal patterns of community structure for planktonic ciliates; (2) 90% of the periphytic community could be recovered using 10 microscope slide replicates immersed at one depth for 3-21 days; (3) multivariate (step-best-matching) analysis allows a subset of the most reliable indicator species to be identified without losing accuracy of water quality prediction; (4) applying taxonomic efficiency, i.e., identifying to the highest rank without losing critical bioindicator information, revealed that genus-level identification allows for accurate prediction of water quality; (5) efficiencies of sample analyses can be achieved by omitting ubiquitous groups, and using presence/absence of others rather than abundance data.

Biosketch

Dr Warren is a research scientist at the Department of Life Sciences, Natural History Museum, London where he also curates the protozoa collections. He earned his PhD in 1983 at University of Surrey, UK and the title of the thesis: 'The ecology, morphology and taxonomy of freshwater peritrich ciliates'. Current and recent interests focus primarily on: (1) Biodiversity and systematics of ciliates; (2) Use of ciliates as bioindicators of water quality; (3) DNA barcoding for ciliate species identification. He has more than 250 research publications to his credit. He has been appointed as Vice President for International Society of Protistologists in the year 2013-14 and as President for British Society for Protist Biology in the year 2012-15. Presently, he is on the editorial board of several journals like *Protistology*, *Chinese Journal of Oceanology and Limnology* and *Boletín de la Real Sociedad Española de Historia Natural*. Also, he is a member of the board of reviewers of *European Journal of Protistology* and is a member of steering committee of International Research Co-ordination Network for Ciliate Biodiversity (IRCN-BC).



PP 1

Mesohaline tintinnid in the Pearl River Estuarine

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Abstract

Tintinnids are planktonic ciliates that mainly appear in marine pelagic habitats. According to their distribution in world oceans, tintinnids were divided into several biogeographical types in genera level. Neritic species inhabited in estuaries, bays and marginal seas. Although zooplankton had mesohaline assemblages, there was not report of mesohaline tintinnid assemblage. We hypothesized that tintinnid also had mesohaline assemblage as other zooplankton groups. To prove this hypothesis, tintinnid assemblage from upstream fresh waters (salinity 0) to polyhaline waters (salinity 32) in the Pearl River Estuary were investigate in six cruises. Most species belonged to neritic type, with a few cosmopolitan and oceanic species. Tintinnid abundances were high when salinity <13 or >28, but relatively low when salinity fell in the range of 13-28. *Tintinnid* species richness increased with the increase of salinity. *Tintinnopsis mayeri* and *T. compress* mainly occurred at low salinity (<2.5) waters. They were considered as oligohaline species. *T. parva*, *T. tubulosa*, *T. fimbriata* and *T. tentaculata* mainly occurred in salinity range of 2.5-15. They were considered as mesohaline species. *Amphorellopsis acuta*, *T. tubulosoides*, *T. radix* and *T. tocaninensis* were polyhaline species. They had high abundance in waters with salinity >25. Some species belonging to cosmopolitan genera including *Codonellopsis ostenfeldi*, *C. morchella*, *Amphorides minor* and *A. amphora* almost disappeared when salinity <25. Mesohaline species, together with some oligohaline, polyhaline, and occasional species with low abundance, constituted the mesohaline community. We proved our hypothesis that there was mesohaline tintinnid assemblage.



PP 2

Seasonal Incidence of *Tripartiella bulbosa* Lom, 1959, an Ecotoparasitic Ciliated Protozoan Parasites in the Mozambique tilapia *Oreochromis mossambicus* in West Bengal

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Abstract

There is a delicate balance between the host, pathogen and environment. Disease outbreaks in aquatic organisms by protozoan parasites are directly related to various climatic changes in their biological environment like temperature, salinity and oxygen levels and temperature possibly plays the most vital role among all. The present study showed that exotic fish *Oreochromis mossambicus* which is a popular food fish and cultured widely in West Bengal serve as a host for a ciliated protozoan parasite, *Tripartiella bulbosa* Lom, 1959. Infections with peritrichous ciliates, belonging to the species *Tripartiella bulbosa* were frequently recorded from the *Oreochromis mossambicus*. The infection rate reached its peak during winter when water temperature ranged from 14-26°C, below and above this temperature the infection rate decreased.



PP 3

Studies on identification, prevalence and intensity of infestation of Trichodinid Ciliophorans (Protozoa: Ciliophora) in the freshwater edible fishes of Purulia district, West Bengal

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Abstract

Trichodiniasis is a fish disease caused by ectoparasitic trichodinid ciliophorans and often causing a threat to the fishery sectors around the world. Infestation of fishes by this particular group of protozoan parasites is held responsible for low production caused by massive destruction of skin and gill epithelium of host fishes and further gets exposed to bacterial and viral diseases due to damaged tissue.

Ichthyoparasitological surveys in search of trichodinid ciliophorans were conducted in various wild and cultured edible fishes in various ponds, lakes, rivers of the Purulia district of West Bengal during July, 2013 to June, 2016. Out of 593 host fishes of thirteen genera 142 fishes of eight genera were found to be infested by various species of *Tripartiella* (Lom 1959). The study reveals that prevalence rates of the parasites vary with the seasons and hosts and interestingly it is evident that hybrid carps appear to be more susceptible than pure carps.



PP 4**Study of dorsal infraciliature of some of the oxytrichid hypotrichs (Ciliophora, Hypotricha, Oxytrichidae) collected from Sikkim, an Indian state****Jasbir Singh*** and Komal Kamra

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Abstract

In a first ever study to catalogue and describe ciliate community structure of Sikkim most of the dorsomarginalian hypotrichs belonged to the family Oxytrichidae. This provided an excellent opportunity to study them in detail because the family Oxytrichidae has always been a grey area for systematists for varied reasons. They were studied especially with respect to their dorsal infraciliature because according to the contemporary scheme of classification, the dorsal pattern which includes one or two dorsomarginal rows and simple fragmentation of kinety 3 (fragmentation sometimes secondarily lost or multiple) is very likely an autapomorphy of the family Oxytrichidae. Remarkably, oxytrichids with all four character states with respect to fragmentation of dorsal infraciliature- simple fragmentation, multiple fragmentation, no fragmentation and incomplete fragmentation, of dorsal kinety 3, were obtained from various sites across Sikkim. Study of oxytrichids from Sikkim not only led to the clarification of the systematic status of some taxa but has also further corroborated the idea of use of the dorsal kinety fragmentation pattern as its major morphological apomorphy.



PP 5

Environmental heterogeneity determines planktonic ciliate diversity: Some examples from the east coast of India

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Abstract

In the sea, ciliates form numerically significant populations in coastal waters, and environmental heterogeneity is widely recognized to be a determinant of key elements of ciliate communities. Efforts in recent years have begun to document ciliate diversity in marine systems, and to elucidate the processes that structure assemblages across space and time. The paper presents a detailed account of the ciliate communities and the controlling factors based on multiple datasets on water quality and taxa composition and abundance over a period of years from 4 ecologically differing marine environments namely Kakinada bay, a bar-built shallow water body affected by annual freshwater influx and mangrove outwelling; the Coringa mangrove channels of Godavari estuary; the backwaters of a highly polluted harbour in Visakhapatnam and, Chilka Lake, Asia's largest brackishwater lagoon on the east coast of India. On the basis of ciliate abundance data and through multivariate ecological approach it was possible to segregate these water bodies and evaluate the ciliate composition and abundance patterns in relation to the prevailing environmental conditions. Faunistically, while *Enchyles* sp.(18.7%), *Halteria ciriifera* (15.7%) and *Phacodinium* sp. constituted the most dominant species in Kakinada Bay, *Enchyles* sp. singularly contributed up to 49.3% of the population in the mangrove channels of the Godavari estuary followed by *Halteria ciriifera* (15.7%) and *Holophrya simplex* (15.3%). In the polluted Visakhapatnam harbour, *Nassula* sp. (16.4%), *Lagynophrya* sp. (16.4%) and *Furgosonia* sp. were the most predominant forms. In Chilka Lake the important species were *Lagynophrya* sp. (13.0%), *Uronema filificum* (9.8%) and *Strobilidium gyrans* (8.5%). The paper attempts to discuss on these issues.



PP 6

Morphology and morphogenetic description of a new soil ciliate species of *Notohymena* from Rithala Sewage Treatment Plant, Delhi, India

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Abstract

Ciliates inhabit wide variety of ecological niches; free living forms are found in both aquatic and terrestrial habitats. In the present study, a new ciliate species was isolated from the soil samples collected from Rithala sewage treatment plant, Delhi, India and is described based on its morphology and ontogenesis. Morphological features of *Notohymena* n. sp. are as follows: flexible body; anterior lanceolate and posterior rounded end; body size about 51 x 15 µm in protargol preparations with body length:width ratio of around 3.5:1; buccal cavity large and deep; undulating membranes in *Notohymena*-pattern; adoral zone with 19 (average) adoral membranelles; 18 frontal-ventral-transverse cirri; one right and one left marginal row with about 14 and 13 cirri respectively; 6 dorsal rows including two dorsomarginals, of which the fourth row is curved and occupies 2/3rd region of the cell; 3 caudal cirri; two macronuclear nodules; 1-4 micronuclei. A detailed morphogenetic study revealed de novo origin of oral primordium between left marginal cirral row and post oral ventral cirri and involvement of five parental cirri (three frontals and two ventrals) in formation of streaks I-VI for the proter and opisthe. The morphological and morphogenetic characterization confirm that the present species is a distinct species of the genus *Notohymena* belonging to the subfamily Oxytrichinae.



PP 7

Faunistic study on the freshwater ciliates of Delhi, India

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Abstract

Delhi region lies in the subtropical semi-arid zone wherein the temperatures are highest in May-June and lowest in January. It also receives its monsoonal rainfall during the month of July-August. Thus, the region offers ideal conditions for the growth and proliferation of the aquatic living beings. During the past two decades, a series of investigations have been carried out on the freshwater free-living ciliate fauna from multiple sites at the river Yamuna and different fresh water bodies viz., Sanjay Lake, ponds in Raj Ghat, Nehru Vihar, Wazirabad, Nandnagri, Kamla Nehru Ridge, Bhaleswa Lake and Okhla Bird Sanctuary. Basic ecological parameters were checked at the time of collection like pH, temperature, etc. Samples were brought to the laboratory; ciliates were identified using live cell observations and silver staining methods. A large number of Spirotrichean species and a lower proportion belonging to class Karyorelictea, Litostomatea, Prostomatea, Phyllopharyngea and Colpodea were identified. To name a few, species belonging to the genus *Tetmemena*, *Oxytricha*, *Gastrostyla*, *Paraurostyla*, *Aponotohymena*, *Amphiseilla*, *Pleurotricha*, *Histiculus*, *Architricha*, *Rubrioxxytricha* were characterized.



PP 8

Diversity and biogeography of suctorians (Ciliophora: Suctoria) epibionts of decapods (Crustacea: Decapoda)

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Abstract

Ciliates usually have an ecological relationship with decapod crustaceans known as epibiosis, due the calcified surface of the crustacean body functions as a suitable substrate for ciliates colonization, providing oxygen, nourishment and shelter. Among the most common epibiotic ciliate species of decapod crustaceans, some species of the subclass Suctoria Batisse, 1994 have been reported. The objective of this study was to provide some data about the species diversity of suctorians as epibionts of decapod crustaceans of the families Cambaridae and Pseudothelphusidae, showing its geographic distribution and their possible distributional patterns based on biogeographic analysis. We found 15 genera of suctorians which have been recorded as epibionts of these crustacean families, distributed in most of the biogeographical regions, except for the Antarctic region, where not data about suctorians on decapods crustaceans are available.



PP 9

Seasonal variation of loricate ciliates (tintinnids) in a tropical estuary: the Mandovi estuary, West coast of India

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Abstract

We report here the seasonal variation of loricate ciliates (LC: tintinnids) in the Mandovi estuary (West coast of India), a tropical estuary, in relation to certain physicochemical and biological parameters. As with other tropical estuaries, Mandovi estuary is also strongly influenced by seasonal changes in fresh water flow. LC community was studied for one year (January 2013 to December 2013) covering the premonsoon (February-May), monsoon (June-September) and the postmonsoon (October-January) periods. Their abundance in this estuary varied seasonally and on a spatial scale with higher abundance (290-320 cells L⁻¹) in the upstream (~11 kms from the mouth of the estuary) during the premonsoon. Whereas in the downstream (near mouth region opening into the Arabian Sea) their high densities were attained during the monsoon (70-110 cells L⁻¹) and postmonsoon (45 - 85 cells L⁻¹) period. Statistical analysis (CCA analysis) have shown salinity and dissolved oxygen are the major environmental variables influencing the LC assemblages in this estuarine systems. As results, the species composition and community structure may be strongly influenced. At downstream, *Codonellopsis ostenfeldi* and *Leprotintinnus nordquisti* that are dominant forms of loricates in monsoon are replaced by *Codonellopsis ostenfeldi*, *Codonellopsis tesselata*, and *Tintinnopsis beroidea* in premonsoon. Likewise, at upstream region dominant *Tintinnopsis* (*T.directa* and *T. uryguayensis*) of premonsoon are outnumbered by *Codonellopsis tesselata*, *Tintinnidium apertus* of monsoon period. These analyses suggest that species composition and community structure of LC is strongly influenced by their surrounding variables in this estuarine system.



PP 10

Diversity of protozoan ciliates from the Thane Creek, Mumbai, India

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Abstract

Protozoan ciliates are an important component of aquatic and terrestrial ecosystems, where they act as grazers of bacteria and protozoa, thereby providing nutrition for the benefit of plants and other life forms. Ciliate diversity has not been explored extensively from the Indian subcontinent, though some report exists and especially from the region, West Bengal, which has been given some attention. Recent, studies from the Indian subcontinent (Valley of Flowers, Uttarakhand and Silent Valley National Park, Kerala) have shown not only the diversity but also some level of endemism (Seven new species were recorded and published from the areas mentioned above). Thus, keeping the above in mind, a survey was conducted to investigate the diversity of protozoan ciliates from the Flamingo Bird Sanctuary, Thane Creek, Mumbai. The soil and water samples were collected from the mangrove forests, rock pools, and terrestrial soils. Interestingly, based on the observations from live and after protargol impregnation of the raw cultures, over 30 ciliate species were identified. The study briefs the observation of all the species recorded, including one species new to science and some being the first record to Indian fauna.



PP 11

Planktonic ciliate community structure vis-à-vis water quality in Chilka Lake, a brackish water lagoon on the east coast of India

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Abstract

Coastal lagoons around the world are subjected to considerable anthropogenic pressure and Chilka Lake, Asia's largest brackishwater lagoon and a Ramsar site on the east coast of India is no exception. A one year study (Jan-Dec 2009) on the planktonic ciliates over a spread of 36 hydrographically differing GPS fixed locations in the lagoon revealed altogether 77 species of ciliates the dominant among them being *Mesodinium* sp. (9.48%), *Holophrya nairi* (4.75%), *Oxytricha chilkensis* (4.41%), *Gruberia calkinsi* (3.74%), *Podophrya* sp. (2.96%), *Chlamydomon* sp. (2.93%), *Tokophrya* sp. (2.72%), *Stylonychia* sp. (2.47%), *Prorodon marinus* (2.44%), *Uronema filificum* (2.03%), *Frontonia* sp. (1.96%), *Didinium* sp. (1.83%), *Chilodonella* sp. (1.67%), *Sphaerophrya soliformis* (1.65%), *Lacrymaria coronata* (1.62%) and *Sphaerophrya magna* (1.58%). On the basis of water quality and ciliate abundance data and, using a multivariate approach implemented in PRIMER, it was possible to distinguish the 36 locations into 3 clusters/groups. Group-1 consisted of stations representing the south sector i.e. Rambha Bay (sts. 1-16); Group-2, the central and north sectors (sts.17-33) and Group-3 the outer channel nearer the sea (sts. 34-36). The findings revealed a great measure of difference in the composition, seasonal succession and numerical abundance of ciliate populations among the groups/regions examined (ANOSIM, Global R: 0.815 at 0.1%). Different measures of alpha (SRp, H', J', Δ^*) and beta diversity (MVDISP, β , β -dissimilarity) indices revealed structural characteristics of ciliate assemblages. BVSTEP, Redundancy analysis (RDA) and multiple linear regressions revealed that ciliate community structure in the Lake is governed to a great extent by spatio-temporal variability in salinity, water column transparency, nutrients and chlorophyll *a* concentration. Micro-zooplankton (70% being ciliate population) grazing experiments under low (0 to 10), and high salinity conditions (10-20) showed that a significant fraction of phytoplankton standing stock is consumed through grazing ($48.98 \pm 17.1\% \text{ d}^{-1}$ and $52.42 \pm 19.9\% \text{ d}^{-1}$ respectively and a mean of $51\% \text{ d}^{-1}$) which suggests the exceptional ecological role of ciliates in the microbial food-web dynamics within the lagoon.



PP 12

Morphology and morphogenesis of a novel stylonychid ciliate from India

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Abstract

The morphology and morphogenesis of a novel stylonychid ciliate isolated from a water sample collected from the Thane Creek, Mumbai, India, were investigated. The new species looked similar in morphology to the well known *Tetmemena pustulata*, however, on detailed investigation some non-overlapping differences in the ciliature were identified, i.e., fine differences in the number of cirri in marginal rows and the number of bristles in dorsal kineties of the Indian population in comparison with the population described by Wirnsberger et al. 1985, which justified the separation at the species level. A detailed description based on the examination of specimens in vivo and after protargol impregnation from raw culture is presented. Furthermore, the study also compares the resting cyst of the new species with related congeners. In this regard, the study extends the concept of cyst species to hypotrich ciliates, which thus far have been known only for spathidiids.



PP 13

Tank-less bromeliads as a suitable terrestrial habitat for ciliates in a dry tropical forest

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Abstract

With the exception of the soil, little is known about ciliate diversity in other terrestrial environments like bromeliads, which are a conspicuous component of the Neotropical forest, deserts and Andean paramos in the American Continent. However, it is still unknown if tank-less bromeliads are a suitable habitat for ciliates. This type of bromeliads are common in dry tropical forests where epiphyte species survive by the absorption of water from the atmosphere, and terrestrial forms have thick leaves. The objective of this work was to find the presence of ciliates in five species of terrestrial and epiphytic tank-less bromeliads. We conducted two samplings during the humid season of the years 2015 and 2016 to collect 19 samples in a portion of a dry tropical forest located in the Biosphere Reserve Chamela-Cuixmala, Jalisco, western Mexico. To identify ciliate species, we carried out in vivo observation with optical microscopy and silver impregnations. Nineteen ciliate species were recorded from all the five bromeliad species, almost the half of the ciliate species were observed as active feeders, and 95% were encysted. *Bresslauides terricola*, *Drepanomonas minuta*, *Leptopharynx brasiliensis*, *Phacodinium metchnikofii*, and *Spathidium spatula* were recorded in bromeliads for the first time worldwide. *Leptopharynx* was the genus with more species. Our results are an evidence that tank-less bromeliads are suitable habitats for ciliates acting as cyst reservoirs when water disappears from the plant.

We thank to Posgrado en Ciencias Biológicas, UNAM, and National Council of Science and Technology (CONACYT), for the grant number 224627 to CDR. We thank to JH Vega-Rivera for the permission to collect samples in the Reserve of the Biosphere Chamela-Cuixmala, IB-UNAM. Special thanks to Biól M Reyes-Santos for her technical assistance and Mag D Méndez-Sánchez for the elaboration of the map.



PP 14

Report of ciliate infection in ornamental fish during post monsoon period

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Abstract

Xiphophorus hellerii commonly known as “Swordtail fish” is a species of freshwater and brackish water ornamental fish belonging to the family Poeciliidae. Ornamental fish farming is one of the most economically important strategies all over the world and considered one of the most important means of home entertainment because of their body morphology and picturesque colors. The ornamental fishes are exposed to various disease problems which causing harm to ornamental fish industry, due to different parasitic invasion. The present paper deals with the prevalence of ciliate parasite in this ornamental fish collected from Nadia and Howrah districts of West Bengal, India. We conducted the survey during the pre- monsoon, monsoon and post-monsoon season of 2017. The study revealed that the highest ectoparasitic ciliates infection during the post-monsoon period in comparison to pre monsoon and monsoon period.



PP 15

Phylogenetic study of three spirotrich ciliates using modern biological techniques: an integrated approach

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Abstract

Spirotrich ciliates are one of the most complex group of ciliates comprising of subclass stichotrichia and order sporadotrichida. This group has always been debated to be most complex due to its polyphyletic relationship in the phylogenetic tree. In the present study, we attempt to compare one Indian representative each of the family Oxytrichinae (*Notohymena* sp.), Stylonichinae (*Tetmemena* sp.) and a sister group to 18 FVT cirri oxytrichids (*Gastrostyla* sp.) using detailed morphological and molecular methods. Cells were isolated and cultured from river Yamuna. Live cell observation and silver staining were performed to reveal the infraciliature. Ribosomal genes (SSU rRNA and ITS1-5.8S-ITS2) were sequenced and used to construct the phylogenetic tree. Phylogenetic relationship suggests that the *Notohymena* sp. clade together with other *Notohymena* sp. and *Paraurostyla weissei*; *Tetmemena* sp. clade with *T. pustulata* and *T. vorax* group. *Gastrostyla* sp. has a rather confused phylogeny as it clades with other Oxytrichids with strong bootstrap support. These phylogenetic traits have been discussed by superimposing specific morphological characters such as the relevance of cortical granules and pattern of the undulating membrane. Thus, morphology and molecules have been integrated to understand the exact relationship of these genera.



PP 16

Species divergence in *Paramecium* is accompanied by fast changes of micronucleus morphology

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Abstract

At the moment, *Paramecium* consists of 16 valid morphological species. Moreover, several cryptic species exist, which are difficult for morphological identification but recognizable by molecular approach. One of them is “*Eucandidatus Paramecium germanicum*” which was described as a cryptic species similar to *P. caudatum*. Recently two strains very similar in morphology to “*Eucandidatus P. germanicum*” were found in different locations in Leningrad region, Russia. These strains fit description of “*Eucandidatus P. germanicum*” but looked in general more similar to *P. multimicronucleatum*. They had up to three micronuclei (MIC's) of a peculiar endosomal type with a vesicular chromatin body in the center surrounded by achromatin rim. Type of MIC is considered as one of the key species discriminating features in *Paramecium*, and this species introduces a new type of MIC which can be called “endosomal-vesicular MIC”. Two-marker phylogenetic analysis (18S rDNA, COI gene) showed that these strains clustered with “*Eucandidatus P. germanicum*” in a separate branch closer to *P. caudatum* but not to *P. multimicronucleatum*. All together the data confirm that “*Eucandidatus P. germanicum*” should be accepted as a true morphological species. The other interesting paramecium was sampled in Western Siberia, Russia. Big paramecia had classical cigar shape, although singular endosomal MIC prevented attribution of this strain to any of the known species. Unexpectedly, molecular analysis revealed that the strain takes a position in one of two known clusters of *P. multimicronucleatum* branch, and molecular distance between these clusters allowed to suspect existence of two cryptic species within *P. multimicronucleatum*. Thus, we got the evidence that MIC morphology by itself is not very conservative feature in *Paramecium* species, and that recently diverged species are not necessarily very similar, as it is known in the *P. aurelia* complex of sibling species.



PP 17

Molecular characterization of heat-shock protein in ciliates

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Abstract

Heat-shock protein 70 (HSP70) plays a major role in protein homeostasis and in cytoprotection under various stress conditions. The ubiquitous HSP70 proteins are the most abundant, highly conserved and are more sensitive towards diverse kinds of stresses among all the heat shock proteins. In the present study, *hsp70* gene of two freshwater spirotrich ciliates, *Tetmemena* sp. and *Euplotes* sp. was isolated, sequenced and characterized. The three-dimensional protein structure was predicted ab-initio by using SWISS-model software. *Hsp70* gene of *Tetmemena* sp. contained 1,759 bp of coding region (CDS) encoding 586 aa. The N-terminal domain (5' leader) consists of ATP-binding domain (1-365 aa) followed by the substrate binding domain of about 157 aa (366-523 aa). The remaining 117 aa constitutes the C-terminal domain (3' leader). *Hsp70* gene of *Euplotes* sp. contained 896 bp with 298 aa coding region. The protein structure was again predicted and found that the sequenced region contains only ATP-binding domain. The ATP-binding site domain had the highly conserved sequences showing high amino-acid identity with *hsp70* of other eukaryotes. The conserved motifs from the 3D structure were determined and marked in both the ciliate species. On the basis of *hsp70* nucleotide sequences, phylogenetic tree was also constructed to find that this gene can act as a potential molecular marker for evaluating the genetic relationship in addition to ribosomal RNA.



PP 18

First report of ciliate parasites infecting edible ornamental fish *Botia rostrata*, collected from the river Subansiri of Arunachal Pradesh, India

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Abstract

Ornamental fish culture is a flourishing business in India. They have huge commercial value. But the lucrative business of ornamental fish culture are facing lot amount of problem due to parasitic infestation. During the survey we have isolated and identified some ciliate parasite namely *Trichodina* sp., *Tripertiella* sp. and *Ichthyophthirius multifilis*. The species have been identified following the guideline of Lom 1958. There are many records of ciliate parasites infesting fishes have been found throughout the World, but no such study has been conducted on the history of this parasitic group infecting ornamental fish *Botiarostrata* collected from the river Subansiri of Arunachal Pradesh, India.



PP 19

Heavy metal induced changes in the protein profile of fresh water ciliates

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Abstract

Ciliates are unicellular organisms; a single cell capable of performing all the functions that a multicellular organism can perform. Since ciliates are dwellers of water bodies and they have no cell wall so they can be used as model organisms for studying heavy metal pollution in fresh water. Being a single cell organism, it is relatively easy to study the changes induced in them due to pollutants. *Tetmemena* sp. was chosen for protein profiling. The cells were treated with various concentrations of heavy metals Cd and Cu. It was found that within 24 hours no cells survived when treatment was given with CuSO₄ at the concentration of 1.0 µg/ml but when treatment was given with CdCl₂ at same concentration (1.0 µg/ml) it only killed 50% of cells within 24 hours after treatment. This shows that CuSO₄ was more toxic than CdCl₂. Total protein profiling of these treated cells was done to find out whether expression of some high molecular weight proteins are induced due to heavy metal stress. Several protein bands were observed in heavy metal treated cells as compared to control. This clearly suggests that heavy metal stress can induce changes in the total protein profile of fresh water ciliates.



PP 20

Efficacy of culture media and food source on photosensory pigment of the eukaryotic microbe *Blepharisma*

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Abstract

Blepharisma is a heterotrich ciliate and a microphagous filter feeder belonging to the phylum Ciliophora. It has a distinct rose-color due to the presence of the subpellicular pigment Blepharismin (BP) and has a long macronucleus and several micronuclei. The species of this genus exhibit variability with regard to pigment colour and size. These pigments are known to have three functions: light perception, chemical defense against predators, and protection against UV radiation. In addition to chemical defense against predators, BPs exhibit toxicity against other ciliates. More than 30 species of the genus *Blepharisma* have been reported from fresh, brackish, sea water as well as from the soil in many parts of the world. The present preliminary study was aimed to observe morphological characteristics and ascertain the role of media and food source on pigmentation. *Blepharisma* sp. was isolated from fresh water sample from river Yamuna at Okhla Bird Sanctuary, Delhi and maintained under laboratory conditions. Various combinations of six different media viz., Pringshiem's Medium, Hay Medium, four samples of potable waters (A, B, C, D; from four different sources) and four different food sources (Wheat, Rice, Cabbage and Hay) were used for culturing and maintenance of *Blepharisma* cells. Feulgen and protargol staining were used for the morphological studies. Cell number, size and extent of pigmentation were taken into consideration for the comparative analysis. The pigmentation of the cells was maximum in the combination of one of the potable water (D) and rice as food source. The photosensitivity of *Blepharisma* is dependent on the photoreceptor system, composed of pigment granules containing the endogenous photoreceptor BP. Increase in the amount of the pigment can be of help to the cells in their self defense mechanism.



PP 21

First report of some known *Trichodinella epizootica* Šramek-Hušek, 1953, and *Tripartiella* Lom, 1959 from the cultured lionhead-ranchu goldfish in India

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Abstract

Trichodiniasis of fishes cause economic losses in the fish industry through mortality and decrease growth rate. Very few studies of these ectoparasites have been made in India. A comprehensive ichthyoparasitological survey in some ornamental fish farms of different parts of India has been done since March 2014-April 2015. During the study these trichodinid parasites have been identified from the gills of lionhead-ranchu goldfish. They are *Trichodinellae pizootica*, *Tripartiella* viz. *Tripartiella bulbosa*, *Tripartiella copiosa* and *Tripartiella obtusa*. All these parasites have been recorded for the first time from the gills of lionhead-ranchu goldfish in India i.e. the paper deals with the diversity and description of ciliophorans parasites of ornamental fish.



PP 22

Biodiversity of soil ciliates from in and around Delhi, India

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Abstract

Ciliates are one of the most diverse unicellular eukaryotic microorganisms present in almost all the habitats where eukaryotes have been found to exist and therefore one of the most successful groups of protists on the Earth. They have prominent ecological role as they form a major part of the microbial loop in the soil food web, as they prey upon the bacteria and the lower protozoan species and maintain the ecological balance. Changes in the soil ciliate community structure have been suggested as bioindicator markers of environmental stress. Present study aims to understand the soil ciliate community structure in different parts of the Delhi region. Random sampling was done from different sites in Delhi regions, such as the human inhabiting land, agricultural lands, sewages treatment plants etc. All samples were processed by the non-flooded Petri dish method and were analysed for ciliates by monitoring the run-off water after 24 hrs, 48 hrs and 72 hrs. Detailed morphological characterization was performed by live observations combined with the protargol impregnations. The majority of ciliates found belonged to the class spirotrichea mainly from three groups, oxytrichids, amphisiellides and stichotrichines. The identified species majorly belong to the genera *Oxytricha*, *Stylonychia*, *Anatoliocirrus*, *Sterkiella*, *Hemiamphiseilla*, *Anteholosticha*, *Gonostomum*, *Fragminospina*, *Parentocirrus*, *Cyrtohymena*, *Notohymena*, *Gastrostyla*, *Strongylidium*. There were also representatives from the other classes but with less abundance (genera *Colpoda*, *Uroleptus*, *Lacrymaria* and *Dileptus*). *Colpoda* was present in almost all the sites examined. Presence of Colpodids in all sites, especially in disturbed sites suggests its higher tolerance to stress and presence of more spirotrichs in a site indicated a good quality soil.



PP 23

Molecular phylogeny of *Blepharisma* sp. based on sequence analysis of 18S rDNA and ITS gene

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Abstract

Blepharisma sp. is a fresh water unicellular heterotrich ciliate that has been used as a model organism at undergraduate level for several cytochemical studies for the past few decades. The main characteristic feature of this genus is the presence of subpellicular pigment 'blepharismin' which renders it a pinkish appearance when observed in-vivo. The main purpose of this study was to characterize this species using morphological and molecular markers to elucidate its phylogenetic relationship with other members of the genus. Molecular analysis was done by amplifying and sequencing 18S rDNA gene and the internal transcribed spacers ITS1-5.8S-ITS2 gene. 18S rDNA is unique among ciliates for its anomalous length and high evolutionary rate. ITS gene is known to be the most variable part of ribosomal RNA stretch and thus helpful in species level identification. The phylogenetic status based on 18S rDNA and ITS gene showed that *Blepharisma* sp. isolated from river Yamuna is distinct from the other known species of the genus *Blepharisma*.

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PP 24

A study on the process of regeneration in ciliate, *Tetmemena* sp.

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Abstract

Ciliates, being unicellular organisms, are capable of performing all the functions that multi-cellular organisms can perform. Their simplicity allows to study the structure and functions of a eukaryotic cell in a more efficient manner. The ciliate protozoans with macro and micro nuclei have excellent potentiality to regenerate into a complete form from a tiny fragment provided each cut fragment has a macronuclei node. The indispensability of macronucleus in the process of regeneration has been documented in various ciliates like *Stentor* sp., *Epistylis articulate* and *Blepharisma* sp. Earlier studies on the fresh-water form *Stylonchia mytilus* have shown that regeneration is closely connected with a profound reorganization of the whole body of the protist. In the present investigation, regeneration studies were carried out in the fresh-water ciliate *Tetmemena* sp. The cells were damaged chemically using Urea. The damaged cells regenerated their organelles and other body parts completely within 24 hours. This shows that *Tetmemena* sp. has regeneration capabilities. When the same cells were treated again with Urea, it required comparatively high concentration of Urea to damage the cells suggesting that the cells have developed resistance against urea.

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PP 25

Ciliates in Sewage Treatment Plants: Role and community structure

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Abstract

Sewage Treatment Plants (STPs) play an important role in improving water quality of a running freshwater systems. Most of the STPs along river Yamuna as it passes through Delhi, India, use activated sludge treatment method for cleaning the raw sewage (industrial and domestic). Ciliated protists are key players in cleaning water in STPs as they feed on bacteria and can withstand harsh conditions with respective to high concentration of pollutants in raw sewage. Ciliate community varies at each step of the treatment along with the change in water quality. STP selected for the present study had two phases for cleaning the domestic raw sewage: the duration of aerating activated sludge varied in two phases. Physicochemical analysis was done to determine the water quality. In phase II, water was clearer than phase I due to more aeration of raw sewage. Ciliated protist species varied in both phases. The diversity of ciliate communities and their abundance was recorded in the two phases. Variation between ciliate communities will be presented.

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PP 26

Ultraviolet B (UVB) induced changes in eukaryotic microbe, ciliates

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Abstract

The effect of ultra violet radiation B (UVB) was studied on two ciliate species namely *Blepharisma* sp. (presence of pigment, absence of cytoplasmic granules) and *Notohymena* sp. (absence of pigment, presence of cytoplasmic granules). UVB radiation is an environmental stressor for many aquatic organisms. However, there has been relatively little information available on the impact of UVB radiation on ciliates. In the present study it was found that UVB can alter cell morphology, reduce the cell movements and retard the cell growth. Ciliates have diverse defence mechanisms to combat stress induced by UVB. Some of these defence mechanisms are formation of cysts, induction of stress proteins and apoptosis is also one of the strategy adopted by them have been studied.



PP 27

An updated review of microzooplankton studies in the Bay of Bengal

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Abstract

Microzooplanktons (MCZP; 20-200 μm) are one of the major functional groups of organisms that share an ecological function as a grazer and a contributor to the aquatic food chain. Marine microzooplanktons abound in the oceans of the world, mainly includes the major protozoan groups such as Ciliophora, Foraminifera, Radiozoa, Dinoflagellates and Crustacean nauplii. In this paper we have reviewed the occurrence and diversity of MCZP in the Bay of Bengal, a tropical basin situated in the eastern part of the northern Indian Ocean. The analysis of published data on Microzooplanktons from East Coast of India, Sunderban Coast, and the Andaman and Nicobar waters are collated in a list of about 230 species of micro zooplanktons. Analysis of the published data showed that ciliates dominate the microzooplankton community, accounting for about 47% of the total biomass, followed by heterotrophic dinoflagellates (23%), radiozoans (15%) and planktonic foraminiferans (15%). Among the ciliates, which form the most diverse group, includes loricate ciliates accounted for 87% while aloricates make up about 13% of the population. Among the ciliates the most abundant species recorded from the oceanic waters are *Amphorella gracilis*, *Codonella amphorella*, *Helicostomella subulata*, *Protorhabdonella simplex*, *Salpingella attenuata*, *Undella globosa* whereas *Codonella nationalis*, *Strombidium conicum*, *Tintinnidium primitivum*, *Tintinnopsis cylindrica*, *Lohmaniella spiralis* are recorded in the coastal waters of BoB. Species richness and diversity among microzooplanktons is changing according to the seasons and various environmental parameters.



PP 28

Marine ciliates of Indian waters - An updated assessment of the diversity

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Abstract

Ciliates constitute the most significant group in the eukaryotic microbial community inhabiting diverse habitats of both terrestrial and aquatic ecosystems. Free living ciliates form the most important intermediate link between producers and consumers in all estuarine and marine ecosystems and also play a key role in the herbivorous food web. Only about 182 species of ciliates have been recorded from the Indian waters which is only a small share (3.35%) of the total ciliate diversity from the world. In this context, study from the Indian coastal waters is meagre and the possibility of the unexplored diversity is more than the explored. Majority of the marine ciliate study is from the Bay of Bengal and Sunderban region, and restricted that too to the loricate ciliates, mainly Tintinnids. Aloricate or naked ciliates are least studied in the marine environment. Of the two groups of ciliates, viz., aloricate and loricate, 182 species recorded from Indian waters which are distributed among 91 genera, 64 families and 31 orders comprising 35% of the Order Choreotrichida followed by Heterotrichida (6%). The study on aloricate ciliates is only meagre compared to loricate. A lot of emphasis should be given to the study of such fragile microscopic groups which act as an important link between primary producers and consumers.



PP 29

Role of Ciliates to monitor the efficacy of Sewage Treatment Plant: A Review

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Abstract

An activated sludge process refers to a multi - chamber reactor unit that makes use of highly concentrated microorganisms to degrade organics and remove nutrients from wastewater to produce a high quality effluent. The wastewater sludge contains mixed culture of microorganisms. Microorganisms are capable of reducing the organic matter and other pollutants in the sewage. Ciliated protists play an important role as they maintain the density of bacterial populations by predation and being responsible for an improvement in the quality of the effluent. The good condition of activated sludge is indicated by the presence of high content of settled and free floating ciliates, high content of *Bacillus* sp., *Flavobacteria* sp., *Pseudomonas* sp., presence of rotifers and nematodes, presence of less amount of flagellates and amoebae, and lack of fungi and filamentous bacteria. Sludge loading affects the presence of total number of ciliates. It has been proposed that the presence of protozoa in activated sludge influence the removal of *E. coli* bacteria from sewage effluent. The half-life of *E. coli* in the plant was 16 hour in the absence of protozoa. With the presence of protozoa the half-life of *E. coli* was reduced to 1.8 hour. The quality of effluent varies with the presence and absence of ciliates. The effluent shows turbidity when it is treated without the presence of ciliates and turbidity in the effluent goes decreasing when presence of ciliates increases. This shows that ciliates play an important role in cleaning and enhancing the quality of effluent.



PP 30

***Tetrahymena thermophila* as model organism - A Review**

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Abstract

Tetrahymena, a fresh water inhabitant, small, single celled, has contributed to understand many fundamental principles of eukaryotic biology. It is well adapted to diverse environment and range of temperature. It was first cultured in 1923 by Nobel laureate Andre Lwoff. *Tetrahymena* possesses advantages of single cell models and yet shares with multicellular animals many genes and processes. Also, it nearly takes as many genes as human's do (~25000), and packs into one unlike multicellular organisms which divide complexity among different cells. *Tetrahymena* has nervous and digestive machineries as multicellular organisms have, which other single celled organisms lack. It is an important model organism for studying neurobiology. It maintains both germline and somatic genomes being single celled. UGA is the only stop codon for *T. thermophila* which is used in some genes to encode selenocysteine, thus making it the first organism with potential to translate all 64 codons into nuclear genes into amino acid. Combination of genome sequence, the functional diversity makes *T. thermophila* an ideal model for functional genomic studies. *Tetrahymena's* utility as genetic model organism is revealed by accessibility to both forward and reverse genetics, short life cycle, can undergo large scale and synchronous matings and it's 2 nuclear genomes have been sequenced and having powerful biochemical and cytological attributes. Also, *Tetrahymena's* evolutionary divergence from more commonly studied model organisms while retaining most of the cell biology inherited from last eukaryotic common ancestor, is major advantage as model system. Although, *Tetrahymena* was established as an advantageous model organism in early 1920s, it continues to be vehicle of ground breaking discoveries in structural, molecular and cellular biology because of its ability to be genetically manipulated, biochemically deconstructed and visually inspected.



PP 31

Ciliates as Bioindicator

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Abstract

Ciliates with their small life cycle show quick response to functional and spatial variations in community due to change in environmental conditions, and this has led to their usage as indicators of water quality. Spatial patterns of the ciliate, tintinnid are significantly correlated with environmental variables like dissolved inorganic nitrogen and soluble reactive phosphate and silicate. Spatial patterns clearly depict that more the tintinnids, worst is the quality of water, therefore tintinnids can be used to assess the water quality and serve as bioindicator. Ciliate species *Euplotes aediculatus* and *Halteria grandinella* show very high sensitivity towards presence of copper metal and show median lethal concentration (LC_{50}) of 0.01 - 0.17mg l^{-1} Cu. *H. grandinella* also shows sensitivity towards presence of Cadmium (LC_{50} =0.07mg l^{-1}) and Chromium (LC_{50} 0.1mg l^{-1}) while *Spirostomum teres* is the best bioindicator to detect the presence of nickel. *Tetrahymena thermophila*, are used as bioindicators to detect bioactive substances like Ginkgo biloba extract (GBE) which significantly inhibit their chemotaxis and PKG activity and thus can be used as bioindicator of GBE. Acrylamide, which is industrial and laboratory chemical, is carcinogenic and is found in starch containing food possibly leading to carcinomas in humans. Acrylamide concentration ≥ 1500 mg l^{-1} is lethal for *Paramecium bursaria* and concentration required to induce 50% decrease in the cell number (IC_{50}) is 7.8mg l^{-1} for algae endosymbiotic to *Paramecium bursaria*. Thus, *Paramecium bursaria* is a sensitive bioindicator for assessment of acrylamide toxicity. Sensitivity of the ciliate protozoans towards chemical and metallic pollutants make them very suitable bioindicators to judge the quality of water in sewage treatment or to judge the effect of environmental stress and anthropogenic impact on soil or marine water. The short time and simplicity of these tests make them suitable for general use.



PP 32

Telomeric G-Quadruplex DNA in ciliates

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Abstract

Telomeres are nucleoprotein complexes at the termini of linear eukaryotic chromosomes. Their main functions are to prevent chromosomal ends from being recognized as sites of DNA damage, to contribute to the overall nuclear architecture and to ensure correct replication of chromosomal ends. Telomeric DNA consists of a tandem arrangement of a short sequence repeat containing a guanine-rich strand. The protrusion of the guanine-rich strand (G-overhang) is a feature conserved from simple eukaryotes to vertebrates. Telomeric G-overhangs of ciliate *Stylonchya lemnae* fold into a G-Quadruplex DNA structure in vivo and is regulated by cell cycle-dependent phosphorylation. Their formation requires the presence of two telomeric end binding proteins (TEBP α , TEBP β) which bind to the guanine rich overhang (G-overhang) of telomeres. The formation or building blocks of G-Quadruplex are G-quartets that arise from hydrogen bonding between four guanines. The β -subunit of *Oxytricha* telomere-binding protein greatly accelerates G-quartets formation. G-Quadruplex provides a nucleic acid based mechanism for regulating telomere maintenance. Telomeric proteins act as molecular chaperone for G-quartets formation which provides the existence of DNA structure in vivo at chromosome telomeres. Telomerase, or a telomerase-associated protein, is involved in the dissociation of TEBP β from the telomeric complex. The TEBP α -TEBP β heterodimer has two apparently opposite functions: first, it provides a capping structure that inhibits telomerase activity; and second, the telomerase is somehow involved in the disassembly of the capping structure to permit telomere synthesis. These functions are mimicked by the human POT1-TPP1 telomeric capping complex, which has been shown to regulate telomerase activity in vivo both positively and negatively. Intermolecular parallel G-quadruplexes can serve as substrates for telomerase in vitro and have been extended by using purified telomerase isolated from *Euplotes aediculatus* and purified recombinant *Tetrahymena thermophila* telomerase, their extension being mediated through direct interactions between this higher-order structure and telomerase.



PP 33

Importance of symbiotic relationships of ciliates with different organisms

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Abstract

Mutualism is an ecologically important association between two different species in which they both benefit from one another. It explains how species which are different, formed to live differently, come together to function as a unit to sustain themselves in conditions that might have been inhabitable otherwise. We reviewed studies on ciliates as model organisms displaying mutualism with the purpose to understand the benefits of such associations and relate them to such beneficial symbiosis in higher organisms. Ciliates being unicellular and facultative symbionts are the archetypal organisms for laboratory studies. Some studies have reported that symbiosis with *Chlorella* imparts UV-protection to the ciliate (*Paramecium bursaria*), and imparts screening effect from UVR ranging from 59.2% to 93.2%, which can reach up to 100%. Other studies have shown the association of algae with ciliates, where the algae acquire a larger amount of nutrients, while the host ciliate is supplied with energy in the form of carbohydrates that the algal counterparts synthesize. Yet other studies enlist one of the major roles of symbiosis between *P. bursaria* and *Chlorella* species, where the symbiosis enables the green ciliate to uptake ammonia, which in other aposymbiotic ciliates is the excretory product. Thus, studying the symbiosis between *P. bursaria* and *Chlorella* can give us knowledge about how they are equipped against odds in the presence of each other to strengthen this beneficial interactions in nature. Additionally, such symbiotic associations of ciliates with different organisms are important for the sustainability of the aquatic ecosystems. Thus, the understanding of such mutualistic relationships of ciliates is required, which can be used to put together strategies for conservation, protection and maintenance of water bodies and aquatic ecosystems.



PP 34

Role of ciliate protozoa in nutrition of the ruminants

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Abstract

Role of ciliate protozoa in ruminal fermentation has been a subject of much debate, since they were shown to be non-essential for growth in lambs. The observation that the ciliate protozoa are sequestered in the rumen and thus do not contribute to their host's post-ruminal nutrient supply in the quantity suggested by their proportion in the rumen, has led to further speculation on their significance in the nutrition of ruminants. The effects of ciliate protozoa on the ruminal ecosystem, digestion in different parts of gut, nature of nutrients and productivity of their host was reviewed by comparing faunated and ciliate-free ruminants. It was found that pH of ruminal contents was lower in ciliate-free animals. Since both bacterial growth and enzymes are inhibited at lower pH, it has a major impact on ruminal digestion. Reduction in net microbial synthesis and increase in dietary protein degradation in rumen resulted in lower flow of protein to small intestine in faunated ruminants. It was found that faunated animals had lower protein and higher energy available. Ciliates did have a considerable effect of the proportion of volatile fatty acids or amino acids. Ciliate protozoal fraction of ruminal contents was identified as being more important than bacterial fraction in reducing nitrates and nitrites in the rumen and in degrading some mycotoxins. Such detoxification is an advantage to faunated animals. Methanogenic ruminal bacteria have been observed to be attached to ciliate protozoa and such protozoa have been reported to be major methane-producing fraction in ruminal contents. The extent to which the foregoing differences influence ruminal function is uncertain but they are a clear indication that the ruminal ecosystem of ciliate free and normal faunated animals can be quite different. It is clear that protozoa are not essential but can significantly affect the ruminal fermentation and their host's nutrition.



PP 35

Infection of *Balantidium coli* in humans

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Balantidium coli is a ciliated protist, cosmopolitan in nature. Its reservoir host is pig and it causes infection in humans. It is endemic in sub-tropical and tropical regions such as South America, Central America, South-east Asia, Western pacific islands and communities which have direct close contact with swine. It is the only ciliate protist that infects humans and causes dysentery with mucous and blood. Water is the most common source of transmission. It inhabits in cecum and colon and causes a disease called Balantidiasis (perforated colon). It is the largest ciliate protozoan infecting humans and non human primates. Contamination and infection depends on sanitary measurement and personal hygiene. Symptoms may appear or they may be asymptomatic in humans. It was also observed that it causes similar dysentery as caused by *E. histolytica*. Although balantidiasis is considered as rare, it is more common in immuno-competent persons (with AIDS, leukemia). They do not need to have direct contamination as they develop balantidiasis even through water supply. However, it is observed that people living in contact with domestic pigs are naturally resistant and mostly without any clinical manifestation or it may cause mild diarrhea. *B. coli* causes infection in intestine but not in liver however, a case was reported in India in a immune-compromised person. Symptoms started with mild fever and mild pain in upper abdomen. But after examining stool no cyst was found, then ultrasound was performed that revealed infection in liver with pus containing oval trophozoites. Its trophozoites also show parasitism after going into sub-mucosa and mucosa and causes ulceration of colon and facilitate invasion of pathogenic bacteria (*Salmonella*). It can also cause infection directly through anal passage but lung infection is serious in case of *B. coli*. Thus, the diagnosis of *Balantidium coli* infection is very important for its proper cure.



PP 36

Role of HSPs in ciliates: A review

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Abstract

A varied number of protein families are involved in proper functioning of a cell. One of them is the Heat Shock Protein (HSP) family, which is an important part of the cell's machinery for proper folding. This protein is not only limited to a specific organism but present in diverse organisms such as bivalves, ciliates, insects, and even humans. Among this family, HSP70 is well investigated, corresponding to a multigene family, characterised by its two isoforms: a constitutive HSP70, and an inducible HSP70 isoforms (transcribed under stress). A study on *Tetrahymena thermophila*, a freshwater ciliate protist having 13 different heat shock proteins, revealed a heat inducible HSP70 called Ssa5, abundantly expressed in the cytoplasm during conjugation and heat stress. Deficiency of Ssa5 did not affect the survival of the cell under stress, but resulted in fertilisation defects (Pronuclear fusion). A similar study carried out on *Euplotes crassus*, a marine ciliate having 48 different heat shock proteins has pointed the up-regulation of 3 heat shock proteins - HSP40, HSP70 and HSP90 after exposure to high copper and cadmium concentration resulting in a unique role beyond that of a molecular chaperone. Thus, these heat shock proteins can act as potential biomarkers for contamination assessment of heavy metal pollution in aquatic ecosystems. However, there may be various other HSPs in ciliates that also show different expression patterns under stress conditions as in contaminated waters. Therefore, further studies are needed to decipher the role of heat shock proteins in ciliates.



PP 37

Cilioprotists -Markers for aquatic sustainability

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Abstract

The demand for freshwater has grown ominously worldwide, but the degradation of its quality has further reduced its availability. Both rural and urban watersheds suffer from undue human activities, which alter the characteristics, the balance and the dynamics of natural water bodies making it difficult to supply good quality water. Interest has increased over the past few years in different methods for treating sewage and there is a growing need for sewage treatment solutions with low energy requirements and using indigenous materials and skills (like ciliates). These organisms have favourable characters, being a large group found in all aquatic environments, with short life cycle and high reproductive rate, allowing the detection of environmental impacts in a short time scale. To combat the aquatic sustainability, a technique named Gravel Bed Hydroponic System (GBH) was developed and has been proved effective for sewage treatment in several Egyptian villages. GBH engineered ecosystem consists of sloping channels lined with an impermeable membrane and filled with gravel or an equivalent aggregate to provide a matrix in which hydrophytes are then planted. Feed water is introduced at the top of the bed which flows through the aggregate to emerge downstream as a final effluent. Ciliates use the predation mechanism for pathogen removal from GBH. They are also used in restoration of peatbogs. Peatbogs are wetland ecosystems, which store a third of terrestrial carbon globally; they are the fastest disappearing and most endangered ecosystem in Europe. Based on the results of a long-term study, it is assumed that mowing down of reeds causes changes in the physicochemical properties of peatbog water. Studies indicate that ciliates are highly suitable as markers in assessing the effectiveness of restoration. An indicator species approach based on functional and ecological groups may be appropriate for biomonitoring, and future research should take into account the complicated trophic relationships within the microbial food web in aquatic ecosystems.



PP 38

Use of a variety of molecular markers particularly ribosomal RNA gene in Phylogenetics-A review

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Abstract

A pertinent and prompt assigning of taxonomic rank for a species is imperative once it is discovered. This can be achieved by using a suitable molecular marker. The suitability depends on a few characteristics viz. presence in all of the organisms, clock-like behaviour, no horizontal transfer, and a large existing data set. Out of many markers, the rRNA (the 18S rRNA in eukaryotes and the 16S rRNA in others) has been used extensively because of its presence in all cells. Not only it has exactly the same function in all cells, its sequence of functionally constraint region is also conserved enough. It includes slow as well as rapid evolving regions both. The fast evolving regions find their importance in determining closely related species, whereas the slow-evolving regions are suitable for determining distant relationships. The horizontal transfer of rRNA genes is a rare occurrence and is absent in most cases. The rRNA gene database of aligned sequences is large and easily accessible online. In general, the comparison of rRNA gene sequences allows demarcation between strains at species and subspecies level, besides classifying organisms at the genus level across all major phyla. However, in certain cases we cannot depend solely on rRNA gene sequences, in such cases, either of beta subunit of RNA polymerase (*rpoB* gene), mitochondrial DNA (mtDNA), nuclear ribosomal internal transcribed spacer (ITS), cytochrome oxidase I/II (Col Coll), cytochrome-b gene, ribulose 1, 5-bisphosphate carboxylase/oxygenase (*rbcL*) marker sequences have been used in various combinations or exclusively taking into consideration different data sets. Different methodologies like, distance matrix methods (neighbour-joining, UPGMA, Fitch-Margoliash), character based methods (maximum likelihood, parsimony, Baseian) and validation methods (bootstrapping, and Jack knifing) have been used to derive phylogeny based on these markers.



PP 39

***Balantidium coli*: review of the parasitic ciliate with case studies**

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Abstract

Balantidium coli, the only ciliate that is pathogenic to man, causes balantidiasis with many symptoms including acute appendicitis, peritonitis, hematuria. This is a rare diseases found in geographical pockets all over the world majorly in West Bengal (India), Bolivia, Papua, New Guinea and the Philippines. Infection generally occurs in unhygienic places near human inhabitations and is transmitted via the oral-faecal route. Infection caused by *B. coli* is normally asymptomatic and the symptoms are observed only under extreme conditions such as heavy infections. They are quite similar to symptoms of an infection of *Entamoeba histolytica*, due to which it is difficult to diagnose the disease. Its life cycle has two developmental stages: a trophozoite stage and cyst stage. In trophozoite stage, two nuclei are present that is, one macronucleus and one micronucleus; in the cyst stage only one macronuclei is visible. *Balantidium coli* infects humans in cyst stage as cyst wall prevents degradation of cyst in the acidic environment of the stomach and the basic environment of the small intestine until it reaches the large intestine. Excystation takes place in the large intestine where it excysts to the trophozoite stage. Present review explains morphology, life cycle, clinical presentation, treatment and epidemiology of the parasite. Case studies from different regions of the world will be presented.



PP 40

Quality assessment of potable water in Delhi for sustainable development

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Abstract

Water is one of the most important and precious natural resource essential for the survival of all living organisms. However, due to high population growth there is marked increase in waste discharge from various anthropogenic activities contaminating ground water bodies, the main source of water for domestic use in many parts of the city. Consumption of water with chemical impurities in long term causes serious health issues. The major chemical contaminants in supply water are increased level of hardness, alkalinity, acidity and chemical disinfectants used for water treatment. Along with that as the water flows through supply system chemical by-products are formed from the material used for pipeline construction. It is imperative to develop strategies and spread awareness regarding sustainable management of water as this crucial resource is a vehicle for many deadly diseases if remain untreated. The Environmental Protection Agency (EPA) has established standards for drinking water which fall into two categories: primary and secondary standards. In the present study the quality of drinking water (ground water-14 and supply water-17) was analyzed collected from various zones of Delhi (North, East, West, South & Central). The 31 water samples were tested for physical (Colour, Odour, pH and TDS) and chemical parameters (DO, COD, free CO₂, alkalinity, chloride ion concentration, total hardness and BOD) using standard titrimetric procedures. Most of the parameters were found to be within the permissible range but some levels crossed the desirable limits for human consumption. Some samples had high TDS levels indicating a decrease in primary and secondary standard of potable water and need to be treated prior to being used in any manner. Impure potable water poses adverse effect on human health, threatens ecosystems and limits economic productivity and development opportunities of a nation. Therefore, it is of prime importance to do quality assessment of potable water at regular intervals for sustainable and resource efficient water solutions.



PP 41

Awareness about harmful ingredients in lipstick: A cross sectional survey

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Abstract

Use of cosmetics dates back to beginning of civilization. It includes all preparations which are applied on external body parts, mucous membrane or oral cavity of human beings. Cosmetics include a range of products like face creams, lip balms, moisturizers, lipsticks, mascaras, eyeliners, toothpaste etc. Several recent reports highlight the presence of low-level concentrations of potential carcinogens, reproductive or developmental toxicants in personal care products. The continuous exposure of these chemicals and their bioaccumulation over a period of time can lead to development of various forms of cancer, reproductive and developmental ailments and hypersensitive skin reactions. Lipstick is one such cosmetic product which is used by females of all economic strata and all age groups. Presence of certain heavy metals in lipstick can be more detrimental as it has chances of getting ingested along with food we consume. Various studies from USA, Canada, have reported heavy metal Lead in their lipstick samples (61% and 81% respectively). Thus safety of such products should be regulated. In view of this, the present survey was conducted to assess usage, attitude, and awareness of women about lipstick use. Also an effort was made to understand the consumers' attitude towards lipstick use after informing them about the hazardous chemicals and heavy metals present in the same.



PP 42

Whole genome sequencing of *Thermus parvatiensis*, a thermophilic bacterium isolated from the Himalayan hot water spring at Manikaran, India

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Abstract

The area of thermophile research has presented interesting challenges and opportunities for the understanding and discovery of novel mechanisms and pathways. Along with biotechnological potential, it is intriguing to study the dynamics associated with thermophilic genomes. *Thermus parvatiensis*, a thermophile (optimum 70°C), was isolated from the hottest water spring of India (~96°C) at Manikaran, Himachal Pradesh, co-existing with ciliated protists. This study describes the complete genome sequencing of *T. parvatiensis*, leading to the construction of two replicons: a chromosome (1.87 Mbp) and a mega plasmid designated pTP143 (143 Kbp). Annotation of genes associated with DNA repair and stress response on the plasmid indicated the role of mega plasmid for thermophilic survival in *T. parvatiensis*. Viral signatures were mapped on the genome by detection of integrated phages and CRISPR elements indicating the role of phages in population dynamics as well as genome evolution. The plasmid pTP143 was found to harbor elements of the mobiliome and contributes mostly to the plasticity of the genome. Strain specific genomic regions were identified on the plasmid by mapping the plasmid pTP143 with plasmids of other *Thermus* genomes. Genome wide strain specific regions were highlighted by metagenomic recruitment of reads obtained from the same niche. The core genome (n=1177) for the *Thermus* group was identified and annotated. Besides this, the pan genome was also annotated and it revealed a diversity of functions within the variable repertoire. This study led to a robust understanding of the genomic construction of *T. parvatiensis* and the conserved genome of the *Thermus* group.



PP 43

Diversity and distribution of testate amoebae in the natural and polluted ecosystem of West Bengal

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Abstract

Testate amoebae are amoeboid protists play that an important role in the natural ecosystems as bio-indicators. No comprehensive study on this group is available in the country as regards to diversity and distribution of the natural and polluted ecosystems. The present paper deals with the comparison of community structure of testate amoeba in the different ecosystems in urbanised areas of Kolkata metropolitan, West Bengal. We have adopted a species level approach in selected sites representing the polluted and non-polluted environments of different ecosystem. All together 36 species of testate amoebae were identified from which 20 species of Lobosea and 16 species of Filosea. Strong variations in the composition and dominance of species of testate amoebae in the study sites depending on the environmental factors such as pH, temperature, moisture, and heavy metal accumulation. Species richness was significantly lower in the polluted zones than in the less polluted areas. Maximum diversity of species was found in the conserved and natural ecosystem dominated by *Centropyxis aerophila* followed by *Euglypha laevis* with an average abundance of 1040 nos/100g, whereas in the polluted zones and in wetland ecosystem, the abundance of species was reduced to 520 and 580 respectively. The results revealed that diversity, abundance and distribution of testate species may have a significant role in indicating the atmospheric pollution therefore it can be used as a monitoring tool for assessing the intensity of pollution.



PP 44

Thiazolidinediones analogues and their protective role in diabetic pancreas

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Abstract

Diabetes is a complex, heterogeneous metabolic disorder that is characterized with abnormally elevated levels of glucose. Type 1 diabetes occurs predominantly in young people and is due to autoimmune destruction of the beta cell of pancreas, leading to insulin deficiency. Type 2 diabetes is much more common and the vast majority of people with this disorder are overweight. India, alone has 69.2 million people afflicted with diabetes as per the 2015 data. Sedentary lifestyle and high calorie diet is generally considered responsible for development of this disease. Dramatic advances made in last decade have helped in better understanding of this complex disease. Reports are indicative that even though the tendency to develop diabetes may be inherited, environmental factors are also involved in its etiology and progression. Toxic substances in the environment have been considered possible diabetogenic agents like alloxan, a molecule produced by oxidation of uric acid with nitric acid. Thiazolidinediones (TZDs) are the class of antidiabetic agents that function primarily by increasing insulin sensitivity. The drug is also implicated in ameliorating oxidative stress. The present study was intended to elucidate the effects of alloxan on basic pancreatic structure and to determine whether treatment with synthetic TZD analogues can alleviate the effect of alloxan. TZD was also compared with standard drug. The results suggested that tested TZD analogue has ability to preserve the structure of pancreas. At the same time it is more effective than the standard TZD for diabetes.



PP 45

Influence of sodium fluoride on tail regeneration in *Hemidactylus flaviviridis*

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Abstract

Epimorphic regeneration is the ability to regenerate the lost appendage or organ after it is lost. Amphibians possess the highest regenerative ability followed by fishes, reptiles and mammals. The epimorphic regeneration involves healing of the wound, dedifferentiation of cells, proliferation and redifferentiation of cells. Several *in vivo* factors influence regeneration; however, many *ex vivo* factors too influence regeneration. One such common naturally occurring substance is sodium fluoride. At a concentration of 50 $\mu\text{g/ml}$, sodium fluoride enhances wound healing and tail regeneration in *Hemidactylus flaviviridis* and as the concentration is increased, sodium fluoride hampers tail regeneration while concentrations of 3000 and 5000 $\mu\text{g/ml}$ prove to be fatal. The control animals took 9 ± 0.4 days to heal the wound while those administered sodium fluoride (100 $\mu\text{g/ml}$) took 9.17 ± 0.439 days for wound healing. Also, the control animals produced early blastema in 10.2 ± 0.418 days while experimental animals took 11.33 ± 0.46 days for the same. This indicates that sodium fluoride is slowing the early phases of tail regeneration in *Hemidactylus flaviviridis*. When present in comparatively lower concentrations, fluoride causes oxidative stress which is manifested as increased lipid peroxidation and lowered levels of antioxidant enzymes but at higher concentrations, it causes apoptosis. However, the exposure to lower concentrations of sodium fluoride has been shown to have some positive effects too. The low fluoride concentration induces cell division, migration and matrix synthesis in epithelial cells *in vitro*. The hampering of tail regeneration in *Hemidactylus flaviviridis* due to sodium fluoride at high concentrations may be due to its direct adverse influence on the healing of the wound after amputation and on the proliferation of the cells during blastema formation. Sodium fluoride, thus, may be used as an exogenous factor that may assist tail regeneration but its higher levels are detrimental.



PP 46

Genomic features of *Luteimonas tolerans* UM1 isolated from the hexachlorocyclohexane dumpsite

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Abstract

Luteimonas tolerans UM1, a yellow pigmented, rod-shaped, Gram-stain-negative, non-pathogenic *Gamma proteobacterium*, isolated from hexachlorocyclohexane (HCH) contaminated soil was sequenced under Genomic Encyclopedia of Bacteria and Archaea (GEBA) project launched by Joint Genome Institute (JGI) using Illumina sequencing technique. Genome of strain UM1 was of size of 2.5Mbp having (G+C) content 61.1% and 2410 CDS. Genome sequencing of strain UM1 was performed to understand its unique existence in HCH contaminated soil. Functional annotation of the genome revealed enrichment of pathways for two component regulatory system and type II secretion systems. Island Viewer revealed the presence proteins for ribosome associated heat shock proteins implicated in recycling of 50S subunit, sulfate permease and cobalt-zinc-cadmium resistance proteins CzcD on the genomic island present in the genome. Phylogenetic analysis based on single gene (16S rRNA) and whole genome (Genome to genome distance calculator) showed that *Luteimonas* sp. ANTB3E is the closest neighbor of strain UM1 and both the strains clustered in single clade. Thus, genome analysis of strain UM1 shed light on genome organization of a bacterial strain tolerating HCH pressure.



PP 47

In-Silico identification of different endosymbiotic strains of the bacteria *Rickettsia* harboured by arthropods

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Abstract

Rickettsia is a genus of non-motile, gram-negative, non-spore forming, highly pleomorphic bacteria. It is an alpha proteobacteria. Though it is the causative agent of many diseases it is also reported from a large number of arthropod hosts such as whitefly, mealy bug etc which are important agricultural pests. *Rickettsia* is known to enhance the fitness of its arthropod hosts by supplying nutrients such as various vitamins and minerals. It is also known to increase the thermotolerance of its hosts. Since, it is mostly maternally transmitted it is known to induce feminization in its arthropod hosts. Being obligate intracellular parasite, its survival depends on entry, growth and replication within the cytoplasm of its eukaryotic host cells. It cannot be cultured in artificial nutrient environments. Hence, identification of various strains of this bacteria is difficult using traditional approaches. We have tried to identify different endosymbiotic strains of the bacteria *Rickettsia* harboured by arthropods. In-silico analysis was conducted using a multi-gene approach. Phylogenetic trees of 16S rRNA, *traA* and *gltA* gene sequences of *Rickettsia* were constructed using Bayesian Inference of Phylogeny. BEAST software package was used to construct these phylogenetic trees.



PP 48

Assessment of ground water from different locations of Delhi and its effect on growth of different plants

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Abstract

Underground water bodies are important source of water for irrigation purposes and is less vulnerable to contamination by pollutants compared to surface water bodies. Soils from different areas within same city may have different composition and thus, it may have varying effect on the native plants. Various inorganic substances present in the underground water were tested using plants as model system. The quality of ground water stored in water tanks from different localities of Delhi was assessed by determining the growth rate of certain flowering plants using that water. The different source of water i.e. from East, West and North Delhi was used for watering plants and the role of specific inorganic substances was observed on the growth of plants as *Jasminum sambac*, *Hibiscusrosa sinenses*, *Catharanthus roseus*, *Ocimum basilicum*, *Nerium*, *Murraya koenigi* and *Petunia*. The inorganic and components assessed for current analysis were carbonates, Nitrates, sulphates, chlorides along with the organic matter content. The levels of dissolved oxygen content and carbon dioxide content was also estimated for comparisons. The levels of these nutrients was re-measured at later stage of plant growth for assessment of the nutrients absorbed by the plants. There was simultaneous analysis of changes in soil texture and it was observed that in few cases, the soil minerals were utilized more and the soil texture changed from more loamy to sandy and conversely there was change from sandy to silt. The parameters utilized for assessment of plant growth was count of the number of leaves, branches, flowers and estimation of total protein content. Furthermore, such regular analyses of ground water from more locations can pave the way for environment impact assessment due to human intervention.



PP 49

Preliminary studies on estimating the composition and concentration levels of dangerous metals in fine dust at Dariba Kalan, Delhi: human health concerns

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Abstract

Worldwide heavy metals are identified to be hazardous to humans because of their toxicity, mobility, and long residence time in the environment. In the current investigation, fine dust samples were collected from the narrow by-lanes of Dariba Kalan in Delhi, India which is known to be a one of the largest wholesale market for gold. Dust samples from window ledges and shop shutters were carefully collected in sanitized containers for detailed single-comparator instrumental neutron activation analysis (kO-INAA). Instrumental neutron activation analysis (INAA) is used to determine the concentration of trace and major elements in a variety of matrices wherein samples are subjected to a neutron flux and radioactive nuclides are produced. This follow-up dust collection study and consequent analysis was necessitated by way of identification of hidden sources of heavy metals in the ambient that general public may not be aware of. Dust Samples collected from Dariba Kalan and Ravi market had very high concentrations of Chromium and Zinc compared to values stipulated by World Health Organization (WHO). While Zinc was 1.5 - 2 times more than the permissible value, Chromium was nearly ten times higher. Gali Khazanchi where most of gold jewellery is made exhibited enormous levels of Cadmium and Mercury, both being nearly 40 times the permissible limit. Knowledge of the existence of heavy metals even in trace-levels in the immediate ambient which humans encounter on a day-to-day basis is deemed important since these pose a great health risk. With enhanced concentrations of Cr, Zn, Hg and Cd in dust samples at Dariba Kalan it is but urgent to undertake mitigation aspects through proactive exposure-assessment initiatives.

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PP 50

Quantitative determination of vitamin P in different types of tea

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Abstract

Tea is the most consumed beverage in the world. It can be classified into three major types- non fermented green tea, semi-fermented oolong tea and fermented black and red tea. The chemical composition of tea consists of polyphenols, alkaloids, amino acids, proteins, minerals and others. Among all the components of tea, polyphenols are known to have antioxidant properties i.e. they scavenge the harmful free radicals that damage the cell. Flavonoids belong to the large group of beneficial plant components known as polyphenols. Bioflavonoids are found in plants and thus known as the plant pigments. Bioflavonoids or flavanoids are known as vitamin-P although they are not true vitamin but possess vitamin like properties. Tea has been used for centuries for treatment of ailments and is considered a healthful beverage. Role of tea is well established as a nutraceutical and many studies elucidate its pharmacological worth. The present study aimed to evaluate the amount of Vitamin-P in different types of tea: black tea, green tea and herbal tea and the sample most suitable for consumption was thus identified. The method is based on the ability of Vitamin-P to be oxidized by potassium permanganate. Thus we can determine the Vitamin-P content in tea by titrating with KMnO_4 in the presence of Indigocarmine as indicator. It reacts with potassium permanganate after the complete oxidation of vitamin P. The results of our study suggest that the content of vitamin P in each type of tea is different. Highest content of Vitamin P i.e. 24 mg% was recorded in green tea (diamond) followed by Dilmah green tea, different brands of black tea and herbal tea. Tetley tea has the lowest content of Vitamin P i.e. 4.8 mg%. The amount of green tea needed for daily requirement of Vitamin P will be lesser and can be considered best for human consumption.



PP 51

Role of bacterial endosymbionts in ciliates

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Abstract

Cilia bearing protists, free-living or symbionts, found in water-bodies and soil are known as ciliates. Ciliates host many endosymbionts which play many physiological roles in the body of hosts, for example *Ichthyophthirius multifiliis* hosts Alpha proteobacteria, Sphingobacteria and Flavobacteria as endosymbionts. However, the role of these bacterial endosymbionts is not clearly understood. It has been reported that the endosymbionts in other organisms like insects help in providing resistance against different insecticides and chemicals. So, it raises a question, whether, these endosymbionts present in ciliates provide them such physiological capabilities, which help them to survive in different microenvironments. For example, various studies have reported the presence of different types of ciliates in chemically polluted water in river Yamuna and Ganga. But none of the studies show whether these endosymbionts are involved in providing some benefits to ciliate hosts. Thus, studies are needed to decipher the role of endosymbionts in ciliates in polluted water. Moreover, the presence of these endosymbionts in ciliates can help us in understanding the strategies evolved by ciliates in adapting themselves to changing stressful environments like increasing temperatures and chemical discharge. These interactions of the ciliates with their endosymbionts can also help us in understanding the evolution of ciliates. This will also help in devising the strategies needed for the conservation of aquatic ecosystem by using ciliates.



PP 52

Potential health risks arising from Ambient Air Pollution (AAP) due to variation in PM₁₀, SO_x, NO_x and CO concentration levels in New Delhi, Bengaluru (India) and Ljubljana (Slovenia): A spatio-temporal study

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Abstract

Health effects associated with exposure to particulate matter (PM) besides NO_x (vehicular emissions), SO_x (industrial emissions) and CO (indoor ambient air pollution) are well known. It is a matter of grave concern that although ambient air pollution (AAP) resulting from the aforementioned pollutants affects people worldwide; low-and middle-income (read developing) countries disproportionately carry this burden to a great extent. World Health Organization (WHO) considers air quality of any particular country as the benchmark of sustainable development and most developing nations lose out on this aspect. In the current investigation a spatio-temporal study involving variation of PM₁₀, SO_x, NO_x and CO concentrations in three cities- two in India (New Delhi and Bengaluru) and one in Slovenia (Ljubljana) is carried out. Choice of the cities is intended to investigate variation in pollutant concentrations with Slovenia (Ljubljana) being a developed nation and India (Bengaluru, Delhi) a developing country. Comparing measured values of the pollutants in Slovenia and India indicate that there is a difference of about 10 times in concentrations amongst almost all of them. Readings indicate that concentration of SO_x is low compared to other pollutants both in Slovenia as well as India. However, during peak traffic hours concentrations of both SO_x and NO_x show enhancement in values in Bengaluru and Delhi. SO_x concentrations are noted to be more in Bengaluru compared to Delhi and which may be attributed to presence of CNG powered vehicles in Delhi. CO and PM₁₀ concentration levels are seen to depend majorly on wind patterns and direction in the ambient. Looking at the concentration of pollutants in India a need to proactively undertake mitigation measures on war-footing is felt.

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PP 53

***Moina* as a prospective invertebrate model organism for studying Parkinson's disease**

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Abstract

Model organisms are those with the wealth of biological data that make them attractive to study natural phenomena that are more difficult to study directly. More and more of them are being employed in investigating the pathophysiology, diagnosis and cure of the disease(s). *Moina*, also called water fleas, belonging to the family of crustaceans, have combine characteristics of any other vertebrate MO such as rodents, primates fishes, and that of invertebrates MO like *Drosophila melanogaster*, *C. elegans*. Additionally, it offers convenience with its easy culture conditions, small size, high reproductive capacity, and genetic similarity with humans. The proposal for a new model system can be seen in *Moina* for studying PD which is one of the progressive incurable neurodegenerative disorder/disease, and is caused due to degeneration of dopaminergic neurons and marked by deficits in movement and locomotion including hypokinesia (slowness in movement), bradykinesia (decrement in movement), akinesia (no movement). Besides being free from ethical issues, these water fleas not only have transparent body for easy viewing of internal organs, characteristic quantifiable movement patterns and similar human behaviour induced deficits, but most importantly the existence of dopaminergic neurons, making them preferable prospective animals for modelling in movement disorders.



PP 54

Estimation of Saponification value of edible oils and Ghee

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Abstract

Saponification (SAP) is the hydrolysis of fats and oil under alkaline conditions to produce glycerol and salt of corresponding fatty acids. Saponification value is expressed by potassium hydroxide in mg required to saponify 1g of fat. This value is inversely related to mean molecular mass. Knowledge of Saponification number is important to industrial user to know the amount of free fatty acid present as this determines large measure of refining losses. Additionally, Saponification value can be used to distinguish between short chain and long chain fatty acids which can be directly correlated with quality of oil in terms of its cholesterol lowering effect in bloodstream. High cholesterol level is a major risk for coronary artery diseases (CAD) and also for heart stroke. Low SAP value indicates high number of essential fatty acids in oil which plays major role in lowering the cholesterol and hence the chances of CAD. This study is intended for the evaluation of saponification value in different types of edible oil (mustard oil, olive oil, coconut oil, refined oil etc.) and ghee. The sample is first saponified and then titrated with 0.5N HCl until the end point is reached. End point is determined by the decolorization of pink color. These results demonstrate that mustard oil has lowest SAP value (148 mg/g) followed by olive oil (156.75mg/g), refined oil (165.2mg/g), Ghee (201.6 mg/g), and maximum SAP is found in coconut oil (250 mg/g). Therefore, mustard oil is more suitable for edible purposes and can lower the cholesterol level in blood stream.



PP 55

Detection of common adulterants in mustard oil from the samples collected from Delhi

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Abstract

Mustard oil is an important component in cooking in kitchens of majority of households in north India. It not only enhances the taste of the food but is also an essential component of a balanced diet. However, if mustard oil is adulterated with cheap oils or other toxic chemicals, it may pose a serious threat to the health and well-being of the family. Hence, the aim of our study was to find out the presence of selected common adulterants in mustard oil in the samples collected from Delhi. We selected 12 brands of mustard oils and tested them for common adulterants where 80% samples showed strong presence of mineral oil in them. Some mustard oil samples also showed presence of argemone oil (60%) and prohibited colors (83.3%). Further, 37.5% samples showed presence of cotton seed oil. Consumption of mustard oil which is contaminated with these adulterants puts our health at risk as they may cause cancer, paralysis, liver damage and cardiac arrest. Adulteration with argemone oil leads to epidemic dropsy and also causes oxidative stress and death of red blood cells, which may prove fatal. Mineral oil adulteration also causes increase in serum cholesterol. Consumption of cottonseed oil shows several side effects like higher risk of cancer and heart disease, skin inflammation and problems related to reproductive system. When all these adulterants are present in a single mustard oil sample, their effects amplify and put a huge risk of several diseases on the consumer. The government must take a suo motu cognizance of the widespread problem of adulteration in foods in India.



PP 56

Qualitative determination of nitrogen containing insecticides in different fruits

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Abstract

Insecticides are defined as the chemicals that are sprayed over crop to increase the yield and to protect them from harmful insects. Insecticides when sprayed in high concentration causes harm to yield and in turn causes harm to health. It leads to various diseases like asthma, autism and Parkinson's disease. Often, people are attracted to the word organic with respect to fruits and vegetables thinking that those fruits are healthy for them as compare to normal fruits. The aim of this study is to determine the presence of nitrogen containing insecticides in different organic and inorganic fruits procured from local market of Delhi. Fruits like apples, pomegranates, grapes, oranges, guavas etc. were analysed by lassaigne's method. Organic compound is fused with sodium metal to form sodium cyanide. Sodium cyanide when treated with ferrous sulphate solution forms sodium ferrocyanide. Further ferric chloride is added to the solution, a prussian blue complex ferric-ferrocyanide is formed. This indicates the presence of nitrogen containing insecticides in different samples of fruits. Results of this study showed the occurrence of nitrogen containing insecticides residues in commonly consumed organic and inorganic fruits like grapes, pomegranate, orange etc. People should be aware of the fact that organic is not truly organic and the insecticides that are used in organic or in inorganic farming are not 100% safe. Therefore, there is an urgent need to develop comprehensive intervention measures to reduce the potential health risk to consumers.



PP 57

Existence of different strains of the endosymbiotic bacteria *Cardinium*

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Abstract

Cardinium is a bacteria belonging to the group bacteroidetes. It has been reported from a number of arthropod hosts. It is an endosymbiont found in many insects. It is known to cause the expression of various reproductive alterations in its diverse host range. It has been associated to induce cytoplasmic incompatibility, parthenogenesis and feminization in its hosts. This bacteria is presently unculturable in the artificial media. Till now 4 different strains of *Cardinium* are known to be harboured in insect hosts. We have tried to identify different groups of *Cardinium* using bioinformatics approach. We constructed phylogenetic trees of 16SrRNA and *gyrB* gene sequences for *Cardinium* using Bayesian inference of phylogeny. The gene sequences for *Cardinium* were retrieved from NCBI database Bayesian phylogenetic trees were constructed using BEAST software package version 1.6.2. The nucleotide substitution model was decided using the J Model Test version 1.0 software. The Bayesian Phylogeny method uses a likelihood function to create a quantity called the posterior probability of trees using a model of evolution, based on some prior probabilities, producing the most likely phylogenetic tree for the given data. The Bayesian approach has become popular due to advances in computing speeds and the integration of Markov chain Monte Carlo (MCMC) algorithms.



Workshop Facilitators

Workshop Facilitators



Dr Renu Gupta



Dr Jasmine P



Dr Nageshwara Rao Amanchi



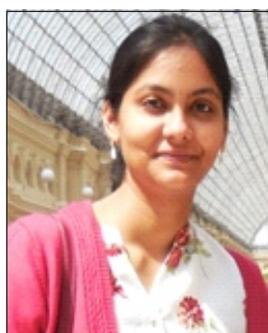
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Biosketch

Dr Renu Gupta is an Assistant Professor of Zoology at Maitreyi College, University of Delhi. She is also a Mentor for Students' Projects on ciliate biodiversity, molecular phylogeny and ecology under Star College Scheme, DBT, Government of India. Besides obtaining BEd in Biology from Annamalai University, she did her MPhil and PhD in Zoology from University of Delhi. As a Post-Doctoral Research Associate Fellow of CSIR (Council of Scientific and Industrial Research, Delhi) and also as DST (Department of Science and Technology) Women Scientist, she has handled research projects on biodiversity, morphology, cell biology and taxonomy of ciliates. She has been an awardee of North-South-Dialog Scholarship from Austrian Embassy, Delhi for working with Prof Wilhelm Foissner at University of Salzburg, Austria in 2001. She has published many research papers in International reputed journals and has presented a large number of research papers in various International and National Conferences. Her research has been applauded immensely by the scientific community at various conferences and she has received the best presentation award at the 9th Asian Conference on Ciliate Biology. Her keen interest in ciliate biodiversity has also resulted in description of novel ciliate species. She has been teaching Cell Biology, Molecular Biology and Ecology since 2001. Along with her routine teaching, she has also taught the undergraduate students from Indira Gandhi National Open University and PG diploma students in Nanotechnology at Maitreyi College. She has organized workshops, seminars and conferences at National and International levels. She has authored a practical manual for undergraduate course on Cell Biology and chapters in two books. She has been a reviewer for reviewing research manuscripts submitted for publication to some Zoological International Journals since 2009. She is a member of American Society for Microbiology and Indian Society of Cell Biology.



Dr Jasmine P

Protozoology Section, Zoological Survey of India, Kolkata, West Bengal, India

Biosketch

Dr Jasmine P is currently serving as Scientist D & Officer-in-Charge in the Protozoology section of Zoological Survey of India, Kolkata, under Ministry of Environment and Forests, Govt of India. Her research focuses on the spatiotemporal variations in the diversity of protozoan community in the various ecosystems, especially the moss inhabiting protozoans. She is involved in the project “Seasonal dynamics of microzooplankton (ciliates) and its role in the pelagic foodweb of the northern coastal waters of Bay of Bengal”. Her career started as a doctoral researcher at National Institute of Oceanography in 2002, and joined the academic ranks as a Research Scientist in Centre for Marine Living Resources (CMLRE) under Ministry of Earth sciences in 2007. During her research in NIO & CMLRE, she has been working on environment and productivity patterns of the Northern Indian Ocean and the seasonal diversity of mesozooplankton community especially planktonic ostracods in the Arabian Sea and Bay of Bengal. She has participated regularly in research cruises and has on-board research experience of more than 400 days. She was also selected as one of the zooplankton specialists during the Pilot Expedition of Southern Ocean by National Centre for Antarctic and Ocean Research (NCAOR) India during 2004. She served as an expert in Biological Oceanography in the Marine Fisheries Research Centre, Ministry of Fisheries, Sultanate of Oman in 2009 to 2011. As a researcher her contribution towards the Ocean sciences has been accepted and published in the international and national peer reviewed journals. During 2017, she participated in the Arctic Expedition of India, conducted by NCAOR, MoES. She is also involved in the supervision of curatorial, care and maintenance of the National zoological collections of Protozoa section, ZSI, Kolkata. Besides research and academics, she is serving as the chairman of Women’s committee of Zoological Survey of India and also a member of Women’s committee of Staff Selection Commission Eastern region.



Dr Nageshwara Rao Amanchi

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Biosketch

Dr Nageswara Rao Amanchi is an Assistant Professor of Zoology in the Osmania University, Nizam College, (Autonomous), and Hyderabad, Telangana State, India. He has Masters in Zoology and obtained his PhD in Zoology in the area of Protozoology and Environmental Toxicology from Osmania University in the year 2007 and joined as a teaching faculty. His research interests lie in the area of Freshwater protozoan ecology, Ecotoxicology of pesticides, heavy metals and environmental safety. He has collaborated with researchers in other disciplines of Life sciences, particularly environmental Sciences, biotechnology for bioremediation of pollutants, and Applied Toxicology. He is the instructor for both Undergraduate and Post-graduate programmes. He has 14 years of teaching and 10 years of research experience to his credit. The topics he teaches are Biology of Invertebrates and Vertebrates, Bio molecules, Chick Embryology and Development for UG Students, Molecular Genetics and Developmental Biology, Tools and Techniques, Principles of Toxicology, Environmental and Occupational Toxicology and Research Methodology for PG Students. He has associated actively in organizing several of national and international conferences, seminars and workshop programs for upcoming researchers and students in the University. He received grants from UGC and has published his research findings in national and International reputed journals. He is Life member in several academic bodies and assistant editor in International Journal of Zoology Studies.



Dr Santosh Kumar

Zoological Survey of India, Kolkata, West Bengal, India

Biosketch

Dr Santosh Kumar is senior scientist at the Zoological Survey of India, Kolkata. His research mainly focuses on the taxonomy and ecology of protozoan ciliates. He did his PhD from University of Delhi, where he studied the diversity of ciliate from selected biotopes in India and the effects of heavy metals on certain ciliate species, especially the recombinant cell lines of *Tetrahymena thermophila*. Further, he studied community structure of ciliates from extreme habitats and their adaptation to high sulphur tolerance, photo-sensitivity, feeding behaviour, and cytotoxic compounds. During his postdoctoral research, he was part of the Soil Mapping project in Italy, where he studied ciliated protozoa as bio-indicators of soil quality in agriculture fields under different farming practices. Dr Kumar worked on two Austrian Science Foundation projects studying the diversity of soil ciliate from Australia and Neotropic. Dr Kumar was Research Professor at the University of Ulsan, under the Korean Research Fellowship programme, where he studied ciliated protozoa as bio-indicators water quality in industrial polluted sites and extreme habitats. Dr Kumar is presently involved in cataloguing ciliate diversity from Indian subcontinent, i.e., from Thane Creek, Mumbai, Western Ghats, Protected areas of West Bengal (Mahananda Wildlife Sanctuary and Buxa Tiger Reserve). He has described more than 20 novel ciliates from India, Australia, Jamaica, South Korea, and Italy, based on the standard methods, i.e., morphology and molecular phylogeny employing ribosomal and mitochondrial genes. He has published about 18 articles in peer reviewed SCI-journals of the field and contributed to over 25 presentations in national and international conferences/symposia/workshops.

Dr Jasbir Singh

Department of Zoology, SGTB Khalsa College, University of Delhi, Delhi, India

Biosketch

Dr Jasbir Singh is presently working as Assistant Professor in Department of Zoology, Sri Guru Tegh Bahadur Khalsa College, University of Delhi. He completed his Doctoral from Department of Zoology, University of Delhi. The title of his thesis was 'Ciliated Protists from Sikkim, a Biodiversity Hotspot; descriptions of some ciliate taxa with phylogenetic notes using classical and molecular methods'. During his PhD tenure he has worked for three years under a project as Junior/Senior Research Fellow entitled "Extremophilic free living ciliated protozoa from different ecozones in the Eastern Himalayas" funded by Department of Biotechnology, Government of India. His area of Interest is exploration of hypotrichous ciliate biodiversity, and study of their differentiation and regulation of cortical structures, developmental strategies and molecular phylogeny. He has published 5 Research articles in International Journals.



Ms Jeeva Susan Abraham

Ciliate Biology Lab, Acharya Narendra Dev College, University of Delhi, Delhi, India

Biosketch

Ms Jeeva Susan Abraham has completed her MSc from Department of Zoology, University of Delhi. She has worked in a major research project entitled “Stress induced induction of metallothioneins (MTs) gene in ciliates and its use as biomarker to assess environmental pollution”. She is currently pursuing her PhD in Ciliate Biology Laboratory, Acharya Narendra Dev College, University of Delhi. Her major research area focuses on the biodiversity, taxonomy and phylogenetics of ciliates isolated from various freshwater and soil habitats from Delhi region. Her study attempts to understand the role of ciliates in different habitats by integrating morphological and modern molecular approaches. She has presented her work in various national and international conferences including 2nd Asian Congress of Protistology held at Kalyani University, West Bengal (2014), 4th workshop sponsored by IRCN-BC held at Qingdao, China (2015) and in Protist conference at Moscow (2016). She has published 7 research papers in peer-reviewed journals. She has sequenced many 18S rDNA and ITS genes and submitted in GenBank, NCBI.

Ms S Sripoorna

Ciliate Biology Lab, Acharya Narendra Dev College, University of Delhi, Delhi, India

Biosketch

Ms S Sripoorna has completed her MSc from Department of Zoology, University of Delhi. Presently pursuing her PhD in Ciliate Biology Laboratory, Acharya Narendra Dev College, University of Delhi. She has presented her research works in many national and international conferences and participated in workshops held in India. She has also attended and presented her work at 4th workshop sponsored by IRCN-BC held at Qingdao, China (2015) and in Protist conference at Moscow (2016). She has also underwent training on ciliate taxonomy at the laboratory of protozoology, Ocean University of China, Qingdao from 24th-31st October, 2015. Her research work is on studying the response of freshwater ciliates towards heavy metals at both cellular and molecular level. She has so far evaluated the heavy metal toxicity in ciliates by studying the cell survivability, morphological and physiological changes, generation of reactive oxygen species (ROS), activity of antioxidant enzymes and activity of stress genes. She has sequenced *hsp70* and superoxide dismutase genes from freshwater ciliates and submitted in Genbank, NCBI. To her credit, she has published 7 research papers in reputed journals.



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