International Symposium on Ciliate Biology
biodiversity, ultrastructure, development, genome, parasitism
Delhi, India

06-07 February 2007

www.iscb2007.com

Venue: Sri Guru Tegh Bahadur Khalsa College
University of Delhi, Delhi, India

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TECHNICAL PROGRAM- ISCB 2007

06-07 FEBRUARY, 2007

Day: 1	**06 February 2007**	**Tuesday**
8.00	**Registration**	
9.00 – 10.30	**Inaugural session**	
10.30	**Tea**	
11.00-13.00	**Session 1**	
11.00	**Prof D Montagnes** (UK): Ciliates are key players in pelagic food webs; how should we incorporate them into ecosystem models?	
11.40	**Prof P Luporini** (Italy): Antarctic ciliates and their adaptation to cold	
12.20	**Prof W Song** (China): Marine ciliate research in China, biodiversity, cell development and systematics	
13.00 – 13.30	**Lunch**	
13.30 -15.05	**Session 2**	
13.30	**Dr YA Mazei** (Russia): Changes of psammophilous ciliate community structure during 16-th year period in the White Sea estuary	
13.45	**Prof J Kloetzel** (USA): The *Euplotes* cortex: Toward a molecular description of a morphogenetic model	
14.25	**Prof C Miceli** (Italy): Cytoskeletal proteins and functional genomics	
15.05-15.20	**Tea**	
15.20-16.55	**Session 3**	
15.20	**Prof A Warren** (UK): Morphology and diversity of marine free-living peritrich ciliates	
15.35	**Prof A Vallesi** (Italy): Ciliate pheromones: structure and activity	
16.15	**Prof K Hausmann** (Germany): Cell biological aspects of food acquisition and food digestion by ciliates	
16.55-17.30	**Cultural Programme – Flavour of Punjab**	

Page 3- Program Day 2

Day: 2	**07 February 2007**	**Wednesday**
9.00-10.00	**Poster Session***	**Photograph Session**
10.00-11.30	**Session 4**	
10.00	**Prof DH Lynn** (Canada): "The Ciliated Protozoa": An Introduction to the 3rd Edition and Rationale for the New Systematics	
10.40	**Prof A Warren** (UK): Ciliated protozoa in aerobic wastewater-treatment processes: an interactive guide to their identification and use as bioindicators	
11.30-11.45	**Tea**	
11.45-13.05	**Session 5**	
11.45	**Prof D Ammermann** (Germany): The special genome of ciliates	
12.25	**Prof E Orias** (USA): The *Tetrahymena thermophila* genome	
13.05-13.35	**Lunch**	
13.35-15.50	**Session 6**	
13.35	**Prof PK Bandyopadhyay** (India): Ectoparasitic Trichodinid Ciliophorans (Ciliophora: Peritrichia): An Overview	
14.15	**Prof SI Fokin** (Russia): Bacterial endocytobionts' biodiversity in Ciliophora	
14.55	**Prof C Kalawati** (India): Endo-commensal ciliates in amphibians	
15.35	**Dr A Mitra** (India): Biodiversity of Ectoparasitic Trichodinids (Ciliophora: Peritrichia) from Fishes in West Bengal, India	
15.50-16.50	**Valedictory Session**	
16.50-17.15	**Tea**	
17.15	**Round Table Discussion**	

*Posters will be displayed throughout the two days

MESSAGES

SCIENTIFIC ADVISORS

GR Sapra
Retired Professor, Department of Zoology, University of Delhi, Delhi-7, India.
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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 M Phil 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 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 about 60 research articles in reputed National and International journals.

A Warren
[1]Department of Zoology, Natural History Museum, Cromwell Road, London SW7 5BD, UK.

Dr Warren is a research scientist at the Natural History Museum, London where he also curates the protozoa collections. His research focuses on the taxonomy, biodiversity and ecology of ciliated protozoa. Current and recent interests focus primarily on: (1) the biodiversity of marine ciliates and their use as bioindicators of water quality in coastal regions of China; (2) predator-induced defense responses in ciliates; (3) the development of an interactive guide to the identification of sewage ciliates. He has more than 100 research publications to his credit. He has been on the editorial board of several journals. Presently he is the editor-in-chief of the Systematics Association and a member of the board of reviewers of the *European Journal of Protistology*. He has guided several research projects and currently he is the co-ordinator of a Darwin Initiative project.

ABSTRACTS
PLENARY / SYMPOSIUM SESSIONS

Keynote Address

The Amazing and Fascinating World of Ciliates: Introductory Remarks to the International Symposium on Ciliate Biology, 06-07 February 2007

K Hausmann
Free University of Berlin, Institute of Biology / Zoology, Research Group Protozoology, Koenigin-Luise-Str. 1-3, D-14195 Berlin, Germany. hausmann@zedat.fu-berlin.de

Abstract
Already the first microscopists, like the discoverer of unicellular organisms, and hence the father of protozoology, the Dutch-man Antoni van Leeuwenhoek (1632–1723), were fascinated by the ciliates due to their activities, interesting structures and beauty. Since then a tremendous amount of knowledge about the biology of ciliates has been accumulated. Nowadays ciliates are still – and will be in future – in the focus of ongoing basic research.

During this symposium we will deal with the following topics:
Anatomy / Ultrastructure
Biodiversity
Cell biology
Ecology
Genetics / Genomics
Molecular biology
Morphogenesis / Stomatogenesis
Physiology
Symbiosis
Systematics / Phylogeny
A wide variety of specialists in the diverse disciplines of ciliate research from all over the world gather together here in this meeting and will present the actual knowledge of numerous aspects of the surprising ciliates.

Biosketch
Dr Hausmann is a professor in the Department of Protozoology, Free University of Berlin. He is a member of several professional bodies – Berliner Mikroskopische Gesellschaft, Gesellschaft für Protozoologie, Haeckel-Haus-Förderverein, International Society for Evolutionary Protistology, International Society of Protozoologists. Presently, he is the President of Berliner Mikroskopische Gesellschaft. He has been a member of the board of reviewers of Biologie in unserer Zeit, Journal of Protozoology, PhotoMe, Protoplasma. He is the Book Review Editor of the European Journal of Protistology and Managing Editor of Mikrokosmos. He has 263 articles in scientific journals, 11 Chapters in books, 10 Books (translated into Czech, Dutch, English, Japanese, Russian, and

Spanish), 12 scientific films (commentary in German, English, and French) and 3 Video-discs (commentary in German and English).

Plenary/ Symposium Lectures

PL-1 Ciliates are key players in pelagic food webs; how should we incorporate them into ecosystem models?

D Montagnes
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Abstract
Evidence for the importance of ciliates in pelagic food webs is unequivocal. Freshwater and marine sampling over the last four decades has revealed their abundance and ubiquity, and through field and laboratory work there is compelling evidence that they are often the main grazers of primary production and contribute significantly to higher trophic level production. Furthermore, ciliates have been implicated in having a key role in biogeochemical cycling, including the sequestering of carbon and the release of biogenic gasses such as dimethylsulphide. Therefore, ciliates are now routinely incorporated into ecological models, ranging from those that are relatively simple and exploratory to those that are predictive on global scales. Much of our efforts to date have sensibly been spent collecting field data and establishing response data for ciliates, such as functional, numerical, and a variety of temperature responses. These responses are typically assembled from measurements conducted under steady-state conditions in the laboratory, which are then incorporated into models. One of the clear outcomes from both interpreting lab and field data alone and performing model simulations is that microzooplankton exhibit pronounced boom-bust dynamics, over periods of days, and not surprisingly these dynamics are predicted to be significantly altered by abiotic factors such as ambient temperature. This presentation will briefly examine the potential role of ciliates as exploiters of patches and the implications of these dynamics, explore how abiotic factors (e.g. temperature) may alter the dynamics, and finally address if our present approach of paramaterising models with steady-state lab-based measurements is appropriate. In the spirit of the symposium, through examples, the presentation will also: offer mechanisms for scientists to interact with students to generate interest ciliate biology; propose uses of ciliates as substitutes to higher animals in classroom exercises; and raise awareness that ciliates should be considered in graduate and undergraduate teaching.

Biosketch
Dr Montagnes is a senior lecturer in the School of Biological Sciences, University of Liverpool, UK. He did his PhD from the Department of Oceanography, University of British Columbia. His interests are in the ecology, eco-physiology and biodiversity of ciliates, specifically examining their roles in aquatic food webs. He is a member of several professional bodies, British Ecological Society, Fellow of the Linnaean Society, Society of Protozoologists (North American and British Sections). He has been a member

on the board of reviewers of several journals including Journal of Eukaryotic Microbiology, Acta Protozoologica, and European Journal of Protistology. He has more than 50 publications to his credit. He has written the chapter “A quantitative protargol stain (QPS) for ciliates and other protists in Handbook of methods in aquatic microbial ecology. Eds. Kemp, PF, Sherr, BF Sherr, EB, and Cole, JJ, Lewis Publishers

PL-2 Antarctic ciliates and their cold-adaptation

C Alimenti, A Vallesi and **P Luporini**
Dipartimento di Biologia Molecolare Cellulare e Animale, University of Camerino, Italy.

Abstract
Antarctic coastal waters host a huge variety of ciliates, among which *Euplotes* species are the most represented and easy to collect and domesticate to reproduce true-to-type under laboratory conditions. Most interest in understanding their evolutionary pathways and molecular strategies for adapting to the stably freezing temperatures of their environment was initially focused on *E. focardii*. Its strictly psychrophilic behaviour, denoting an ancient colonization of Antarctica, was shown to involve unique features of the "heat-shock" gene structure and expression, as well as of the organization and dynamics of the overall tubulin/microtubule system. Another species, *E. nobilii*, has now been found to provide unique opportunities to seek into structural and functional modifications that water-borne signal molecules have adaptively evolved to work at freezing temperatures. This species is phylogenetically closely allied to *E. raikovi*, and like *E. raikovi* (and other ancient *Euplotes* species), constitutively synthesizes and secretes a numerous family of protein pheromones that are utilized as autocrine growth (mitogenic) and paracrine mating (sexual) signals. Three of these molecules have been isolated and their 3-D conformations have been determined (in collaboration with the laboratory of Prof. K. Wuthrich) by NMR spectroscopy), and compared with those previously determined for a number of *E. raikovi* pheromones isolated from temperate waters. It nicely appears that they have retained, in common with the *E. raikovi* pheromones, a molecular core based on a compact three-helix bundle, and that on this core they have adaptively imposed unique non-structured regions to increase, locally and globally, their backbone flexibility and, thus, cope with the thermally constraints of their environment.

Biosketch
Dr Luporini is a Professor in Zoology at the Department of Zoology, University of Camerino, Italy. His major research interest is in the molecular and cellular biology of ciliates (*Euplotus* in particular) and adaptive biology of Antarctic Protozoa. He is a visiting researcher at the Institute of Animal Genetics (University of Edimburgh), Institut fur Thierphysiologie (Universitat Giessen) and Department of Biology at UCSB (Santa Barbara, USA). He was a co-recipient (with R Nobili) of an award by Accademia Nazionale dei Lincei and Ministro Beni Culturali e Ambientali in Botany and Zoology (for studies on ciliated Protozoa), 1987. The advisory positions held by him are as follows: Editor-in-Chief Ital J Zool., 1989-1999; Board of Reviewers Europ J Protistol, 1989-present; Scientific Committee Acta Protozool, 1990-present; Board of Reviewers J Euk Microbiol, 1994-1997, 2000-2005; chairman Scientific Committee National Program

for Antarctic Research, Section Biology and Medicine, 1998-present. He is the author of over 200 publications.

PL-3 On the biodiversity, cell development and phylogeny of marine free-living ciliates: researches carried out in China

W Song[1], A Warren[2], X Hu[1], Z Chen[1], M Wang[1], M Zhu[1], H Ma[1], J. Gong, X. Lin, D. Ji
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Abstract
With support by the NSFC, the Royal Society, DFG/DAAD and the on-going Darwin Initiative Programme, researches on the morphology, taxonomy, morphogenesis and phylogeny of free-living ciliates found in the Yellow and Bohai Sea in north China have been carried out in the last two decades by the protozoological group in OUC as well as collaborators from abroad. These include: (1) about 400 ciliates have been identified/ studied and morphologically described using different "modern" methods (silver staining, molecular biological techniques etc.). Numerous confusions, insufficient descriptions, misidentification of the "known" forms have been clarified, redefined, newly diagnosed, neo-typed, or critically revised; (2) about 150 new taxa (including nearly 100 new species, one new suborder, Protohypotrichina, four new families, Pseudoamphisiellidae, Gastrostylidae, Pseudotrachelocercidae, Onychodromidae, 29 new genera, and "numerous" new typification and new combinations) have been established and described; (3) the 18S-like, 5.8S rDNA and ITS genes of over 90 species have been sequenced, including 8 prominent groups: euplotids, stichotrichs, scuticociliates, heterotrichs, hymenostomatids, oligotrichs, peritrichs and cyrtostomatids, of which the systematic positions/ between/ among them are analyzed and several phylogenetic trees concerning some critical taxa are re-constructed; (4) about 60 species have been morphogenetically investigated, which concerns 8 significant groups (hymenostomatids, hypotrichs, heterotrichs, scuticociliates, cyrtophorids, oligotrichids, peritrichs and euplotids) presenting several developing patterns. Totally, the results of above-mentioned work appeared in over 200 research papers and 2 monographs, of which ca. 130 have been published in peer-reviewed international journals.
Keywords: Ciliophora; Phylogeny; Morphogenesis; Taxonomy and morphology

Biosketch
Dr Song is a professor in Ocean University of China. He is also Vice President of the Chinese Society of Protozoologists. His research interests span cell development, morphology, taxonomy, phylogeny and molecular biology of ciliated protozoa, and ecology and pathology of marine protozoa. He is a board reviewer of several international journals such as Journal of Eukaryotic Microbiology, European Journal of Protistology and Protozoological Monographs. He has been awarded the "Ciliate Cravat Award" in the year 2005 by the International Society of Protozoologists and "Ilse-Wilhelm Foissner Research Award" in the year 1992 by the Ilse-Wilhelm Forschungstiftugn. He is a

principal investigator of several on-line research projects - Cell developing pattern, taxonomy and the phylogeny of some critical groups of ciliated protozoa (by NSFC; 2005-2008), Ecology and biodiversity of planktonic ciliates in marine biotopes (by NSFC; 2004-2006), Conservation of Jiaozhou Bay: biodiversity assessment and biomonitoring using ciliates (Darwin Initiative Programme, UK; 2006-2008). He has more than 270 publications including more than 150 in peer-reviewed international journals and 4 books.

SL-1 Changes of psammophilous ciliate community structure during 16-th year period in the White Sea estuary

IV Burkovsky[1] and **YA Mazei**[2]
[1]Dept of Hydrobiology, Moscow State University, Moscow 119899, Russia.
[2]Dept of Zoology and Ecology, Penza State Pedagogical University, Penza 440026, Russia.

Abstract
During the period of sixteen years (1991–2006) psammophilous ciliate community structure in the White Sea estuary was studied. This period is corresponding to about 3000 generations of ciliates' populations, thus we can analyze "historical" (on the ciliates' "point of view") processes. Within constrained location (50x50 cm square) altogether 125 species was recorded. The mean number of species per year is 78 (52–92 species in different years). Inter year variability of species composition is characterized by both stochastic and trended changes. Stochastic component is affected by recombination of dominant species *Remanella margaritifera* and *Trachelocerca incaudata*. Trended component is connected with changes of the abundance of some dominant species (*Coleps tesselatus* decrease its abundance, whereas *Trachelocerca saggita* – increase) as well as in complex of subdominants (decreasing of *Histiobalantium majus, Pleuronema marina, Gastrostyla pulchra, Discocephalus rotatorius, Pleuronema coronata, Mesodinium pulex, Kentrophoros fasciolatum, Geleia fossata, Paradiophrys histrix* and increasing of *Tracheloraphis kahli, Tracheloraphis oligostriata, Tracheloraphis phoenicopterus, Histiobalantium marinum, Uronema marina*). There is clear stability of species richness and evenness during period studied. This indicates that general pattern of organization of community niche structure is rather constant. On this stable background abundance and biomass as well as trophic and size structure are more variable. There are evident increasing of abundance of raptorial-feeders and large-sized ciliates from the family Trachelocercidae during period studied. All trended changes of ciliate community structure, probably, reflect changes of littoral ecosystem: silt accumulation and redox-potential decreasing.

Biosketch
Dr Mazei is an assistant professor of Penza VG Belinsky State Pedagogical University, Russia. He received his PhD on the study of organization of microbenthos community in the zone of mixing of sea and river waters. His research interests include ecology of protists with special attention to ciliates, heterotrophic flagellates and testate amoebae in sandy sediments, in marine and freshwater shores as well and in other biotopes, such as sphagnum bogs. He has published about 25 research papers in reputed journals.

PL-4 The *Euplotes* cortex: Toward a molecular description of a morphogenetic model

JA Kloetzel
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Abstract
Cortical structure and ultrastructure have been studied extensively in several model ciliates such as *Paramecium, Tetrahymena and Euplotes*. However, unveiling the protein composition of the cytoskeletal structures described is a slower process. Using *Euplotes* as an example, a cortical framework of microtubules and their constituent tubulin isoforms are the best understood. Above the microtubules, and just beneath the plasma membrane, each of the membranous alveoli contains an alveolar plate (AP), which jointly forms a rigid, presumably protective, monolayer. The major AP proteins have been revealed, via gene sequencing, to comprise a novel set termed plateins, related to the articulins previously described in *Euglena* and *Pseudomicrothorax*. Adjoining alveolus/AP units are integrated by a protein meshwork (silver-staining, hence referred to as the 'argyrome') whose proteins ('argyrins?') have been imaged by immunofluorescence, but not yet identified on gels. Polykinetids (cirri and oral membranelles) interrupt the mosaic of alveolar plates at characteristic locations. The many basal bodies producing these compound ciliary organelles are tightly clustered in regular arrays by fibrous scaffolds or 'basal-body cages'. The gene encoding the major cage protein, termed cagein, has been sequenced. The derived protein, rich in coiled-coil regions, is predicted to be highly insoluble, unless covalently modified (perhaps by phosphorylation, permitting assembly/disassembly dynamics during cortical reproduction). The contractile calcium-binding protein centrin has been immunolocalized to basal-body cages as well, forming a 'sheath' structure enveloping each kinetosome. Additionally, a striated layer of anti-centrin-reactive material is localized to the back wall of the buccal cavity.
In addition to plateins and cagein, electrophoretic gels of *Euplotes* cortexes isolated by the Triton-high salt procedure reveal a relatively small number of strong protein bands, yet to be characterized. Each of these presumptive cytoskeletal proteins needs to be investigated as to its location within the cortex and, ultimately, its peptide sequence. As these additional pieces fall into place, the complex yet precise process of cortical assembly should begin to yield some of its secrets.

Biosketch
Dr Kloetzel earned his PhD from the Johns Hopkins University. He is the principal investigator of several research projects including cell membrane turnover during feeding in the ciliated protozoan *Euplotes*, and nuclear roles in post-conjugant development in *Euplotus*. More recently he has been concerned with cortical structure and morphogenesis in ciliates. He has more than 60 publications to his credit.

He has received several honours – Johns Hopkins Departmental Fellowship, National Institutes of Health Pre- and Post-doctoral Fellowships, Alexander von Humboldt Research Fellowship and a CNRS Fellowship for research in France. He is a reviewer of several journals; e.g., Acta Protozoologica, J Cell Biology, J Cell Science, J Eukaryotic Microbiology, J Morphology, J Protozoology, Cell Differentiation, Developmental Biology, Gene, Micron, and Environmental Health Perspectives. His current research focuses on the identification of novel cytoskeletal proteins in *Euplotes* and isolating the genes encoding these proteins.

PL-5 The tubulin superfamily: functional genomics and molecular adaptation

S Pucciarelli, F Marziale, P Ballarini, S Barchetta, E Joachimiak and **C Miceli**
Dipartimento di Biologia Molecolare Cellulare Animale, University of Camerino, 62032 Camerino (MC), Italy. cristina.miceli@unicam.it

Abstract
In eukaryotic cells, heterodimers of alpha- and beta-tubulins form microtubules which are the main components of cytoskeleton. The cytoskeleton is needed for several fundamentally important processes during the cell cycle, like separation of chromosomes in mitosis and meiosis, regulation of cell shape, positioning of cellular organelles and directing of vesicle traffic along the tubules. These processes are dependent on two key features of microtubules: the polarity, which originates from the oriented assembly of the alpha/beta subunits, and the dynamic growth where GTP-binding and hydrolysis in beta-tubulins plays a central role. A very large number of different proteins which are involved in these processes interact with microtubules. Therefore, there is a very high selective pressure to maintain the structure and functionality of tubulins and the members of tubulin superfamilies are highly conserved.
Tubulin superfamily has acquired over the last few years a remarkable importance within the molecular evolution field for the two following reasons: a- an increasing number of members has been characterized and named from delta to kappa (besides the well known alpha, beta and gamma-tubulin), which are proposed to be involved in the maturation of centrioles/basal bodies; b- potential prokaryotic ancestors have been identified: the FtsZ nearly ubiquitous in prokaryotes, and the newly discovered BtubA and BtubB which have only been characterized so far in Verrucomicrobial bacteria. The efficient biogenesis of tubulins depends on the eukaryotic chaperonin referred to as CCT (cytosolic chaperonin containing TCP-1), TCP-1 complex, TRiC or Ct-cpn60. Once released from CCT, alpha- and beta-tubulin chains interact with additional cofactors to constitute the native tubulin heterodimer, i.e., the functional component of microtubules. Ciliated protozoa are excellent experimental models for the characterization of all the above reported tubulin features.
Divergent tubulins are also involved in the molecular mechanisms of microtubule cold adaptation. The divergent beta-tubulin isotypes of the Antarctic ciliate Euplotes focardii are good examples of this implication. Of fundamental importance for the identification of tubulin amino acid substitutions correlated to cold adaptation is the possibility to compare the cold adapted tubulin sequences from E. focardii with homologs from organisms evolutionarily related but not cold adapted. The availability in our laboratory of mesophilic strains of Euplotes, collected from the coasts of East Africa and determined as a sibling species, morphologically very similar to E.focardii, can provide an optimal reference system. Phylogenetic analysis based on the small subunit of rRNA showed a very short distance between E. focardii and the African sibling species. On the basis of the mutation rate value for rRNA of ciliated protozoa, the separation time between the

two species was dated 80 millions of years ago, i.e. after Pangea fragmentation and during the separation of Antarctica from the Gondwana. This result suggests that E. focardii is a descendant of the Gondwana microfauna, separated from the African species with the separation of Antarctica. The cold temperature later gradually acquired by the Antarctic Ocean may have determined a selective pressure on genes for which the products were temperature sensitive, like the tubulins during microtubule dynamics.

Biosketch

Dr Miceli is a professor of Cell Biology at the, University of Camerino, Italy. She was also visiting researcher at the University of California, Santa Barbara and Irvine. She has served as Vice-President of the International Society of Protozoology and as member of the Editorial Board of the Journal of Eukaryotic Microbiology. Research activities are mainly focused on molecular and cellular biology using eukaryotic microorganisms, in particular ciliated protozoa, as models. The main research fields are the following: study of the genome organization and of the control of gene expression; study of molecular and cellular adaptation mechanisms in organisms living in extreme environments; molecular evolution and identification of molecular markers for phylogenesis and adaptation, particularly cytoskeletal proteins; characterization of bioindicators in environmental monitoring by classical and biotechnological approaches. She is the principal investigator of several research projects. She has more than 40 publications in reputed journals

SL-2 Morphology and diversity of marine free-living peritrich ciliates

Alan Warren[1], Daode Ji[2,3], Ping Sun[2] and Weibo Song[2]
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[2]Laboratory of Protozoology, Ocean University of China, 266003 Qingdao, P.R. China.
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Peritrichs are among the oldest-known groups of ciliates having first been observed by Antony van Leeuwenhoek in 1676. Some are free-swimming while others are sessile, being attached to a substrate via a stalk, scopula or lorica. They have colonised a wide range of habitats, marine, freshwater and terrestrial, and may either be free-living or ectocommensal. They form one of the most specious groups of ciliates with around 1,000 species representing 12 families and over 50 genera. Although genus identification among peritrichs is relatively straightforward, species identification is often difficult mainly due to inadequate species descriptions and morphological variation. Historically, species descriptions were based only on *in vivo* observations. In recent years, however, modern methods such a silverstaining have been routinely applied revealing taxonomically informative characters such as the pellicular silverlines and oral infraciliature. Using such techniques, extensive surveys of peritrichs have been carried out in NE coastal regions of China. These have revealed over 100 species which represents more than10% of the global peritrich species diversity. This talk provides a brief overview of the morphology and diversity of marine free-living peritrichs based on studies carried out in coastal waters near Qingdao, China.
This study was supported by the Darwin Initiative Programme (project no. 14-015) which is funded by the UK Department for Environment, Food and Rural Affairs.

Biosketch
Dr Warren is a research scientist at the Natural History Museum, London where he also curates the protozoa collections. His research focuses on the taxonomy, biodiversity and ecology of ciliated protozoa. Current and recent interests focus primarily on: (1) the biodiversity of marine ciliates and their use as bioindicators of water quality in coastal regions of China; (2) predator-induced defense responses in ciliates; (3) the development of an interactive guide to the identification of sewage ciliates. He has more than 100 research publications to his credit. He has been on the editorial board of several journals. Presently he is the editor-in-chief of the Systematics Association and a member of the board of reviewers of the *European Journal of Protistology*. He has guided several research projects and currently he is the co-ordinator of a Darwin Initiative project.

PL-6 Biology and evolution of the *Euplotes* pheromone systems

A Vallesi
Dipartimento di Biologia Molecolare Cellulare Animale, University of Camerino, Italy.
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Abstract
Ciliate pheromones (earlier denoted as mating type factors and/or gamones) have for long been exclusively associated with a mating (sexual) inducing activity. Their study in *Euplotes* has eventually lead to modify this concept, and to appreciate how their primary role is more likely played to promote (by acting like autocrine growth factors) the vegetative (mitotic) growth of the same cells from which they are constitutively secreted from the very beginning of their life cycle (regardless of the stage of cell "immaturity" to mate). A decisive contribution to this new knowledge was mostly derived from the experimental availability of two species, *E. raikovi* and *E. nobilii*, which secrete their pheromones in relative abundance and have thus greatly facilitated functional and structural analyses of these signal proteins. It's now clear that *Euplotes* pheromones form intra-specific families of structurally homologous proteins, whose basic architecture is provided by a common core of three alpha-helices with an up-down-up orientation, held together by three strictly conserved disulfide bridges. As such, these molecules can compete with one another to bind their cell-surface receptors and, hence, elicit different (growth or mating) cell responses.

Biosketch
Dr Vallesi is an associate professor at the Department of MCA Biology, University of Camerino, Italy. She graduated cum laude in Biological sciences from the University of Camerino in 1985. Her research interests are particularly in signalling and transduction mechanisms underlying the mitogenic and mating activities of soluble protein pheromones. She is affiliated to several scientific societies such as International Society of Protozoologists and is Adviser, Società Italiana di Protozoologia, Unione Zoologica Italiana. She is a co-author of several chapters in various books. She has published more than 20 papers in reputed journals.

PL-7 Cell biological aspects of food acquisition and food digestion by ciliates

K Hausmann
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Abstract
After presenting general types of food acquisition the use of extrusomes in immobilizing and eventually killing prey organisms is demonstrated. The predator *Homalozoon vermiculare* is chosen as an example of a raptorial ciliate killing its prey (other ciliates) by toxicysts. Ultrastructure and mode of function of the so far known four different types of toxicysts are demonstrated and explained.
A two step type of food digestion is realized in *Pseudomicrothorax dubius*. This gulper feeds on filamentous cyanobacteria like *Oscillatoria* using its cytopharyngeal basket constructed by thousands of microtubules. The first step of digestion is the very rapid destruction of the cell walls of the blue-green algae within a matter of seconds. By this the ciliate is enabled to ingest large quantities of cyanobacterial filaments in a short time. The initially single, very voluminous food vacuole becomes reduced to numerous small vesicles of 1–2µm in diameter. The following digestion of the cyanobacterial protoplasts needs several hours.
Vesiculation of a very large food vacuole into smaller vesicles is also observed in the predatory *Homalozoon vermiculare*. In this ciliate the process of digestion is in so far exceptional as the ingesta are segregated, i. e., food vacuoles are filled almost exclusively with certain cell constituent of the prey, e.g., miochondria, cilia, lipid droplets, extrusomes. Eventually indigestible matter is defecated via a cytoproct.
The studies were supported by the German Research Foundation (DFG).

Biosketch
Refer the page with the keynote address abstract.

PL-8 "The Ciliated Protozoa": An introduction to the 3rd edition and rationale for the new systematics.

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Abstract
It has been almost 30 years since John Corliss published the 2nd edition of "The Ciliated Protozoa". Several years ago, John and I jointly began the revisions for the 3rd edition, which I am now undertaking to complete. This latest edition, modeled on previous editions, has 17 chapters organized as follows: Ch.1 - Introduction; Ch.2 - a revised and expanded Glossary; Ch.3 - Characters and the Rationale behind the New Classification; Ch.4-15 - Characterizations of the Phylum and its 11 classes; Ch.16 - Deep Phylogeny, Gene Sequences, and Character State Evolution; Ch.17 - The Ciliate Taxa Including Families and Genera; and finally References. Each of Ch.4-15, modeled on the Traité edited by P. de Puytorac, is subdivided into 8 sections as follows: Introduction as an overview of the taxon; Taxonomic Structure; Life History and Ecology; Somatic Structures; Oral Structures; Division and Morphogenesis; Nuclei, Sexuality and Life Cycle; and Other Features.
The new systematics will be as current as possible, but likely date from 31 December 2006. It varies in some minor details from systems of classification that I have published in 1997 with Gene Small and in 2004 as sole author. I will present an overview of this classification and demonstrate how it is anchored in considerations of the ultrastructure of the somatic cortex and its structural conservatism, the importance of developmental patterns of the infraciliature as revealed by both light and electron microscopy, and the sequences of genes, particularly the small subunit rRNA gene. I will conclude by briefly characterizing the phylum, its two subphyla – Postciliodesmatophora and Intramacronucleata, and its 11 classes. The classes now recognized are the KARYORELICTEA, HETEROTRICHEA, SPIROTRICHEA, ARMOPHOREA, LITOSTOMATEA, PHYLLOPHARYNGEA, NASSOPHOREA, COLPODEA, PLAGIOPYLEA, PROSTOMATEA, and OLIGOHYMENOPHOREA.

Biosketch
Dr Lynn is a professor in the Department of Integrative Biology, University of Guelph, Guelph, Ontario, Canada. His area of research interest is systematics and ecology of ciliated protists. He has published over 100 research papers and several chapters in books relating to the systematics and ecology of ciliated protozoa. Two seminal contributions to the field of ciliate systematics are a review in Biological Reviews of the Cambridge Philosophical Society on "The organization and evolution of microtubular organelles in ciliated protozoa" and his collaborative work with Dr EB Small on an illustrated guide to over 600 genera of ciliates, classified by the macrosystem of Lynn & Small (Lynn & Small, 2002). He is a member of several biological societies at both

national and international levels. He has served as a Councilor for the Canadian Society of Zoologists and the International Society of Evolutionary Protistology. He has been President of the International Society of Protistologists and a member of its Executive Committee for over a decade. He has been the Editor-in-Chief of *The Journal of Eukaryotic Microbiology*, published by the International Society of Protistologists, since 1998. He has served on the editorial board or board of reviewers for Aquatic Microbial Ecology and Journal of Morphology. He has been honoured by colleagues who have named three species of ciliates after him, *Frontonia lynni*, *Pleuronema lynni* and *Strombidium lynni.*

PL-9 Ciliated protozoa in aerobic wastewater-treatment processes: an interactive guide to their identification and use as bioindicators

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Abstract
Ciliates are an important component of the microbial community in aerobic biological wastewater-treatment processes. In activated-sludge plants, for example, it is common to find 50,000 to 100,000 ciliate cells per millilitre in the mixed liquor. The major role of ciliates in the treatment process is the removal of dispersed bacterial growths by their predatory activities.
Over three decades ago the senior author demonstrated that there is a correlation between mixed-liquor ciliate community structure and effluent quality and in that plant performance can be quickly and accurately deduced by analyzing the ciliate populations in the mixed liquor of an activated-sludge plant. Furthermore, such analyses can be completed within a matter of minutes or hours, rather than days as is the case with the widely used BOD_5 test thus giving the opportunity for remedial action to be taken at a far earlier stage than would otherwise be possible. However, despite the advantages of speed and low cost, protozoan-based monitoring techniques are rarely used on site, mainly because of the difficulty non-specialists have in identifying ciliates.
The main aim of this work is to produce a multimedia, user-friendly guide to the identification of ciliates that can be used by specialists and non-specialists alike in order to quickly and accurately identify their living organisms and interpret their results in terms of plant performance and effluent quality. Brief diagnoses, detailed descriptions and line diagrams of the ca. 175 ciliate species that have been reported in aerobic biological wastewater-treatment processes are provided. Video clips of cells *in vivo* are also included for those species which are most commonly encountered and/or which are of greatest indicator value. A pictorial key has been developed that allows comparisons to be made with several taxa on the same screen. The identity of each species can be recorded, along with estimates of their relative abundances, for the sample in question. Once these data have been collected, an automated function can be activated that will give a prediction of effluent quality within a BOD range. We anticipate that the guide will be applicable world-wide since the wastewater-treatment ciliate fauna does not show significant biogeographical variation. The guide will be produced on CD-ROM to run on a low-cost computer system, either Windows or Macintosh. Further details of the guide are available at:
http://www.nhm.ac.uk/research-curation/projects/wastewater-ciliate/

Biosketch

Refer the page with the S-2 abstract.

PL-10 The special genome of ciliates

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Abstract
Ciliates are unicellular eukaryotes which have three characters in common:
1. Their surface is completely or partially covered with cilia.
2. They have two different kinds of nuclei: A macronucleus (Ma), responsible for the cellular metabolism and for its nearly entire transcription. Without Ma the cells do not survive. Besides, each cell has one or more micronuclei (Mi) which are necessary for the sexual reproduction, but otherwise are not required for the cell survival.
Their mode of sexual reproduction (conjugation) is unique: Two cells unite partially, after meiosis progenies of the Mi are exchanged, syncarya are formed, and then the cells separate.
Each exconjugant develops a new Ma from progenies of its syncaryon while the old one is degraded.
From over 8000 recorded species of ciliates only three species groups have been thoroughly investigated. These are the *Tetrahymena* species group, the *Paramecium* group and species of the genera *Euplotes*, *Oxytricha* and *Stylonychia*, known as the "Spirotrichs".
To give an example of how ciliates have provided unique findings in genome research I will concentrate on the *Spirotrichs*. These cells range from small to very large (up to 0.4mm.) and can be cultivated conveniently in large amounts. They have an especially interesting nuclear apparatus. Their Mi is a typical eukaryotic nucleus (diploid, with long chromosomes exhibiting mitosis and meiosis). The Ma is very different from the Mi. It contains all necessary genes for the life of the cells (about 30,000 different genes, complexity 50 mill bp), together with the sequences necessary for their regulation and replication, but not much else. Most DNA sequences (up to 98 %) of the Mi are eliminated during the development of a new Ma after conjugation.
The Ma genes, in contrast to the Mi-genes, are arranged in gene – sized DNA sequences ("mini-chromosomes"). Each of them harbours typically a single, central coding region, two non-transcribed, flanking, rather short (usually less than 400 bp) non-coding regions, and a telomere at each end. Each gene is present in thousands of copies per Ma.
More and more Ma gene sequences (and in the future the Mi DNA sequences, too) are becoming available and can be accessed on the Internet. New methods allow us to add (microbombardment, microinjection), to silence (RNAi) and to mutate genes. These tools make possible investigations of phenomena which today are the centre of interest of cell biologists. As an example I will report some recent results obtained from *Stylonychia.*
On the basis of the alpha-1-tubulin gene of this species, a "tagged" version (with a 19 bp sequence in the coding region) was constructed. Thousands of copies of this gene can be injected into the Ma. The endogenous and the tagged genes are maintained, transcribed and replicated together in the Ma. However, the tagged version can be mutated in all regions before injection. With this method it is possible to investigate which regions of the mini-chromosomes are essential for the "normal" transcription and replication

processes. These results together with other data would form the subject matter of the presentation.

Biosketch

Dr Ammermann did his PhD work on the development of a new macronucleus in the ciliate *Stylonychia* sps after their sexual reproduction. Significantly, he found that the long known "DNA-poor stage", which occurs after a DNA-synthesis-stage, is not caused by insensitivity of DNA against stains or “DNA camouflage", as was believed. It is caused by a dramatic breakdown and removal of over 90% of the DNA. Similar phenomena (much less dramatic) were described in some multicellular animals. He also found giant chromosomes in *Stylonychia*. These findings determined his research during his career. Over the years his research topics changed from cytology (e.g. chromosome morphology) to biochemistry (structure, function and maintenance of genes). Besides these, he has published papers about species definition, species descriptions, species concepts, DNA repair in ciliates. Ornithology is his hobby.

PL-11 The *Tetrahymena thermophila* genome

EP Hamilton[1], PH Dear[2], JA Eisen[3], RA Barbeau[1], C del Toro[1], T Rowland[1], HF Ryder[1], K Saks[1], SC Williamson[1] and **E Orias**[1]
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Abstract
Tetrahymena thermophila is an oligohymenophorean ciliate with many favorable attributes that have made it an excellent eukaryotic unicellular model organism. The Tetrahymena macronuclear genome has been sequenced to 9-fold redundancy by TIGR (The Institute for Genomic Research) using the whole-genome shotgun (WGS) sequencing method. The MAC was sequenced because it contains all the genes required for the vegetative life of the organism, while containing an exceptionally low amount of repeated sequence, which would hinder the assembly of WGS sequence. The article that describes the genome sequence and assembly and relevant analyses is published in the Sept. 2006 issue of journal Public Library of Science (PLoS) – Biology (http://biology.plosjournals.org/archive/1545-7885/4/9/pdf/10.1371_journal.pbio.0040286-L.pdf).
The assembled genome contains ~104 Mb, distributed among ~225 chromosomes (the best post-genomic estimates). Sequence reads, assemblies and gene predictions are publicly available without restriction for searching or downloading at TIGR, at the Tetrahymena Genome Database (TGD) and at the National Center for Biotechnology Information (NCBI).
In the talk the following points will be described:
- Evidence that the assemblies are highly accurate and complete.
- The existence of more than 27,000 predicted genes and evidence for high coding density in the genome.
- Lineage-specific gene family expansions that likely reflect the complexity and functional diversity of important biological processes in this free-living unicell.
- Post-genomic resources planned or under current development.
The combination of the genome sequence, the functional diversity encoded within it and advanced genetic tools make *T. thermophila* an ideal model protist for advanced functional genomic studies.

Biosketch
Dr. Orias did his PhD in 1960 at the University of Michigan, where he studied mating type differentiation in Tetrahymena. He joined the UCSB faculty in 1959. He has served as Guest Professor at the Biological Institute of the Carlsberg Foundation in Copenhagen, Denmark; Visiting Professor in the Anatomy Department at the Albert Einstein College of Medicine; Visiting Professor in the Graduate Program in Protistology, Universities of Camerino, Pisa and Padova, Italy; Guest Investigator in the Department of Molecular Biology of the University of California at Berkeley, CA, and as Invited Foreign Investigator in the Department of Developmental Biology of the Mitsubishi Kasei Institute of Life Sciences, Machida, Tokyo, Japan. He has served as President of the

international Society of Protozoologists, member of the Genetics Study Section of NIH, and of the Editorial Boards of the Journal of Protozoology, International Microbiology and Acta Protozoologica. Dr. Orias was a co-organizer of the 2nd International Ciliate Molecular Genetics meeting held here at UCSB in July 1986 and has recently organized international sessions and meetings on Tetrahymena Genomics. He currently serves as Coordinator of the International Tetrahymena Genome Project. He has more than 60 research articles in reputed Journals.

PL-12 Ectoparasitic trichodinid ciliophorans (Ciliophora: Peritrichia): an overview

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Abstract
The mobile peritrichs belong to the subclass Peritrichia Stein, 1859 and family Trichodinidae Claus, 1874, which is characterized as being motile and without stalk. The organisms are often found as ecto- or endo-parasites, on a variety of aquatic hosts, e.g., fishes, amphibians, cnidiarians, ctenophores, platyhelminthes, molluscs and echinoderms. The family Trichodinidae includes ciliophorans with complex denticles in the adhesive disc. These are commonly known as trichodinid ciliophorans. At present, nine genera are grouped within the family Trichodinidae. These are as follows: *Trichodinella* Sramek-Husek, 1953; *Dipartiella* Stein, 1961; *Tripartiella* Lom, 1959; *Semitrichodina* Kazubski, 1958; *Hemitrichodina* Basson and Van As, 1989; *Paratrichodina* Lom, 1963, *Trichodina* Ehrenberg, 1835; *Trichodoxa* Sirgel, 1983 and *Vauchomia* Mueller, 1938. The trichodinid ciliophorans are distributed in all corners of the world and the secret of the worldwide distribution of the trichodinid ciliophorans is that it does not need any intermediate host for the completion of its life cycle. As a rule, like other representatives of the phylum Ciliophora, the members belonging to the family Trichodinidae reproduce by binary fission. trichodinid ciliophorans frequently act as parasites to the hosts, mainly in fishes, causing a disease known as Trichodiniasis. Trichodiniasis is a frequent phenomenon in young fry, in the spring in fresh water fish stressed by harsh winter conditions, in fish cultured in aquaria and freshwater or marine forms.

Biosketch
Dr Bandyopadhyay did his Ph. D. in Zoology from University of Kalyani, West Bengal, India and is currently working in Kalyani University. His research interest includes Taxonomy and Biodiversity of protozoans as well as control of protozoan diseases related to fishes and birds. He has published more than 60 research publications in National and International journals. He acted as a Principal Investigator of several research projects funded by the University, ICAR, UGC and DST (West Bengal). Presently he is leading a research project funded by DST (Govt of India). He has guided 8 research scholars. He is the life member of Indian Society of Parasitologists, and member, editorial board, Acta Parasitologica Turcica

PL-13 Bacterial endocytobionts' biodiversity in Ciliophora

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Abstract
Different bacteria, which could be considered as facultative or, sometimes, permanents endocytobionts (Eb) can occupy ciliate's cell. Till now over 230 ciliate species are recorded as hosts of different intracellular bacteria. However, estimation of the number of species of free-living ciliated protists vary from 3000 to 30000. Thus the number of Eb recorded is, apparently, a small part of real diversity for such largely undiscovered world – ciliate-bacteria. In the presentation some new material concerning Eb variety, its categories and interaction with a host cell are presented. Special attention is paid for endocytobiosis between some ciliates and highly infectious bacteria *Holospora* or other alpha-proteobacteria, as well as to a life cycles and strategies of Eb of different ciliates. From ecological point of view we can assume that association with Eb sometimes is useful strategy for the host cell, especially in unstable environment like a littoral marine zone or river' estuary. However, quite low percentage of bacteria infection in most ciliate' populations, revealed so far, appears to indicate that majority of Eb are either parasites or commensals, not true symbionts. Dynamic of some bacterial infections, first of all infectious ones, in natural ciliate' populations looks epidemic. In some years and places the number of infected populations increases and then infected cells become rare for a long time. The need is great for far more extensive field-based research in this key sub-discipline of symbiosis.

Biosketch
Dr Fokin is an invited professor in the Department of Biology at Pisa University, Italy. He is also a leading scientific fellow in Biological Research Institute, St Petersburg State University, Russia and a member of the Zoology Invertebrate Department at the same university. He got his PhD on functional ciliate morphology from Leningrad State University and Dr Sc degree on ciliate taxonomy at the St Petersburg State University. Presently he is member of several international societies: International Society of Protozoologists, International Symbiosis Society, National Protozoologists Society and St Petersburg's Society of Naturalists. He is author of more than 200 publications in reputed national and international Journals and books about endocytobiosis, taxonomy and functional morphology in Ciliophora as well as in the history of Zoology.

PL-14 Declining amphibian populations and effect on endocommensal protistans

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Abstract
Amphibians, particularly anurans have the capacity to hold extremely high parasite loads ranging from Protozoa to Acanthocephala without any apparent deleterious effects; each one of them exhibiting varied grades of host – parasite interactions. It is often considered that the association between a 'parasite' and its 'host' is probably long established and must have evolved to a state of natural tolerance or apathogenicity resulting in a simple symbiotic association. An obvious experience in this case relates to a plethora of enteric protozoans inhabiting the amphibian gut where they often form an appealing group since they are a heterogeneous assemblage of two taxonomically divergent phyla of Protista namely, Chromista and Ciliophora. These parasites are unique in that they are not only different morphologically, dissimilar in requirements, coexist peacefully in the same environment but also remained together over the years as exclusive parasites of amphibians. The interaction among themselves and between them and the host, even though positive, remains poorly understood. Over the last 50 years or so, several species of amphibians have either disappeared or declined markedly in many countries such as Brazil, Mexico, Costa Rica, U.S.A, Australia, Bangladesh, India, Taiwan and Norway. While some species have become extinct due to natural reasons, in many cases the decline and malformations were attributed to human intervention. Factors responsible for amphibian decline are habitat destruction and degradation, introduction of invasive species, pollution and increased ultraviolet radiation, infectious disease and parasites. More recently, the latter hypothesis that parasites may be responsible for some amphibian declines has received considerable attention. In this context, the decline of their hosts will certainly have a greater impact on the existence and diversity of endocommensal protistans since many of them remained as exclusive parasites of frogs with a high degree of host specificity. Observations made on the heterotrich ciliates of the common Skipper frog, *Euphlyctis cyanophlyctis* (=*Rana cyanophlyctis*) and *Tomopterna breviceps* during the years 1989 and 2000 showed a significant change in parasite mix attributable to changes in the host populations. The present paper aims at understanding the ecological significance of the relationship between the anuran hosts and their ciliate associates.

Biosketch
Dr Kalavati has done Ph,D in Zoology from Andhra University. Presently, she is investigator of three projects funded by DOD; Ecology of marine microbenthos: physico-chemical processes and microfaunal communities with special reference to ciliated protozoa and flagellates ; An assessment for the potential of snail toxins along Visakhapatnam coast and Kakinada mangroves; Ecosystem modelling for Chilka Lake, a brackish water lagoon on the east coast of India. She is a receipient of BP Pandey oration award for research and teaching in Parasitology Awarded by Indian Society of Parasitology in 2003. Her research interests are Protistan Biology, Marine planktonic flagellates and ciliates and their role in marine food web and Myxozoa. She has guided

16 research scholars for their MPhil and PhD degrees and published more than 100 research papers.

SL-3 Biodiversity of Ectoparasitic Trichodinids (Ciliophora: Peritrichia) from Fishes in West Bengal, India.

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Abstract
In India, researches on the morphology, taxonomy and phylogeny of ectoparasitic trichodinid ciliophorans have been carried out in the last 20-25 years by the protozoological groups in the University of Kalyani, West Bengal. As a result, more than twenty new species of trichodinid ciliophorans representing the genera *Trichodina* Ehrenberg, 1838; *Paratrichodina* Lom, 1963; *Tripartiella* Lom, 1959; *Trichodinella* Šramek- Hušek, 1953 were identified, studied and morphologically described from different freshwater, estuarine and freshwater fishes from various districts of West Bengal. Biodiversity studies revealed occurrence of various European, African and Asian species and as well as a few Indian species in various species of exotic as well as wild fishes.

Biosketch
Dr Mitra did his Ph.D from the University of Kalyani, West Bengal, India. His research interests are in the biodiversity, taxonomy, and systematics of ciliate protozoans of fishes and birds. He has more than 20 publications to his credit.

ABSTRACTS

POSTER SESSION

P-1 On the occurrence of a new species of Trichodinid Ectoparasites (Ciliophora: Peritrichia) from an edible fish of West Bengal, India

A Chakraborty
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Abstract
An icthyoparasitological survey in search of trichodinid ciliophorans in estuarine fishes in South 24 Parganas of West Bengal revealed one new species of the genus *Trichodina* Ehrenberg, 1835. The new species was obtained from an estuarine fish *Mystus gulio* (Hamilton) and falls within the upper sized ciliophoran group. Concave shaped adhesive disc contains a central area, sub divided by more than one clear area. The adhesive disc is surrounded by a wide border membrane. The blades are broad with conical central part. The rays are directed towards the y-1 axis with prominent ray apophysis.

P-2 Differntial sensitivity of micronucleus towards cis-dichlorodiammine platinum (ii) during various life cycle stages in *Stylonychia lemnae* (Ciliophora, Hypotrichida)

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*Retired Professor, Department of Zoology, Delhi University, Delhi –110007, India

Abstract
Cis-Dichlorodiammine platinum (II) (cis.platin) is used extensively as an anti-cancer compound because of it's ability to cross-link DNA strands. It produces DNA lesions in several prokaryotic and eukaryotic cells. The present study was conducted to analyze micronuclear sensitivity towards cisplatin during meiosis and macronuclear development and compare it with vegetative state of cells in *Stylonychia lemnae*.
Treatment with cisplatin at a concentration of 150 µg/ml for 30 min causes severe DNA damage to micronuclei in vegetative cells leading to micronuclear pycnosis and their elimination.These amicronucleate cells also show impairment of macronuclear activity. However, following a short treatment (150 µg/ml; 10 min) micronuclei appear unaffected as they show normal mitosis and propagate in descendant vegetative population. However, during conjugation in most of such cells (97%), the micronuclear genome fails to transform into a new macronucleus. This failure is either due to an irreversible arrest of micronuclear meiotic process, generally at the pachytene stage or blockage of further development at polytene- post polytene stages. In polytene stage arrested cells initially normal polytene chromosomes are formed which later get disorganized and break into dense chromatin masses. In post-polytene stages of arrest, chromosomes dissolute normally but without accompanying reduction in size of macronuclear anlage.
Similar mild cisplatin treatment given directly to conjugants at meiotic prophase I stages results in instant irreversible blokage of meiosis. In the exconjugants the success rate for completion of macronuclear development progressively increases when the treatment starts at sequentially advancing macronuclear development stages.
Thus it appears that the micronuclear genome in the course of transformation into macronucleus, gradually acquires the capacity to offset cisplatin induced damage.

P-3 A new trichodinid ciliophoran (Ciliophora: Peritrichia) from an edible freshwater fish *Mystus vittatus* (Bloch) in West Bengal, India

P Mallik
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Abstract
Biodiversity survey of trichodinid ciliophorans in freshwater food fishes of West Bengal revealed one new *Trichodina* Ehrenber, 1835 species from an edible wild fish *Mystus vittatus* (Bloch). The new species falls within the bottom range of dimension as large sized ciliophoran. The adhesive disc is surrounded by distinct border membrane and the consisting of dark central area without any clear area. Blade of the ciliophoran is broad, truncated. Blade apophysis is present. Central part of the blade is broad and tapers to a rounded end. The ray apophysis is small. Rays are straight and directed towards to the geometrical centre of the adhesive disc

P-4 Germinal and somatic manifestations of ageing in *Stylonychia lemnae*

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Abstract
The ciliate *Stylonychia lemnae* shows age dependant pattern of decline in sexual and asexual reproduction potential. The magnitude of such a decline is related to the advancing clonal age. Our observations show that the onset of germinal aging (deterioration in micronuclear capacity to form a new macronucleus) and somatic aging (atypical macronuclear and cytoplasmic structure and behaviour) seem to be clearly demarcated and non-overlapping in terms of clonal age.
Clones raised from exconjugants with reorganized macronucleus (zero fission age) show distinct phases of immaturity and maturity when cells are ready to conjugate (around 200 fissions), phase of germinal aging (after 1200 fissions) followed by phase of somatic ageing (after 3000 fissions) culminating in clonal death.
Failure to develop a new macronucleus in a germinaly aged clone may set in soon after mating or at any of the later conjugational events. Conjugating partners may fail to separate and lyse thereafter; they may become abnormal on separation and undergo cytolysis. Meiotic failure, non formation of synkaryon, abnormal polytene chromosomes, developemental arrest at DNA poor and post reorganisational stages are other manifestations of germinal ageing.
The onset of somatic aging is exhibited in retarded growth of cells, appearance of abnormal cells and marked intraclonal variability in size and morphology of cells and prolonged generation time.
Ultrastructure of aged cells show abnormal mitochondria, thickened pellicle, many lipoidal bodies, large autophagosomes, myelinated bodies and condensed macronuclear chromatin.

P-5 Five new species of *Sicuophora* (Spirotrichea;Ciliophora) from Frogs of Andhra Pradesh, India

BN Rao
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Abstract
A three year study (1999-2002) on the endocommensal ciliates of 4 species of frogs namely, *Euphlyctis cyanophlyctis*, *Rana crassa*, *Tompterna brevipes* and *Limnonectis limnocharis* occurring in the north coastal districts of Andhra Pradesh (Vizianagaram and Visakhapatnam) revealed the presence of 17 species of ciliates comprising of 5 genera, *Balantidium, Sicuophora, Prosicuophora, Nyctotheroides* and *Trichodina.* Among them, genus *Sicuophora* is represented by as many as 8 species. They are *S. waltairensis, S. malabarica, S.linmnochari* and 5 hitherto undescribed species referred to as sp.I –V. *Sicuophora* sp.I and Sp II n.sp are from *Rana crassa*. Sicuophora sp.III n.sp, is from *Limnonectes limnocharis* and *Sicuophora* sp IV and Sp. V n.sp, are from *Limnonectes limnocharis* and *Euphlyictis cyanophlyctis*. The paper deals with the detailed descriptions of the new species, their prevalence, seasonal variations and host specificity.

P-6 *Prodiscocephalus*: a euplotid or stichotrichous ciliate? With phylogenetic analysis based on data referred from both ontogenetic and 18S rRNA gene information (Ciliophora: Spirotrichea)

C Shao, L Li, **M Wang**, Z Chen and W Song
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Abstract
The *Prodiscocephalus*-like ciliates, or the Discocephalina-species, belong to a unique and distinct group which is highly confused considering their phylogenetic position among traditional “hypotrichs” (*s. l.*). The main reasons thereby are because these organisms exhibit many intermediate morphological features and most of them are lacking the ontogenetic as well as molecular investigations. As the first one in this highly specialized group, the complete small subunit rRNA gene of a poorly-known species, *Prodiscocephalus borrori* was sequenced and analyzed, which belongs to the research project supported by the Darwin Initiative Programme and NSFC (2005-2008). Meanwhile, the process of its binary division was also observed and compared with other related taxa for the first time. Based on the data obtained from both researches, its evolutionary relationship among stichotrichs is determined. The results indicate uniformly that this taxon should be an out-most group to the typical euplotids while being similar to other stichotrichs might represent a convergent evolution. This conclusion generally supports hence the up-to-date, yet tentative arrangement given recently by Lynn and Small (2002), who suggested that the suborder Discocephalina might be, as a sister group to other typical euplotids, assigned in the order Euplotida Small & Lynn, 1985.
Keywords: Discocephalina; *Prodiscocephalus borrori*; Ontogenesis; Phylogeny; SS rRNA gene sequences.

P-7 Involvement of anaerobic ciliates in the anaerobic degradation of particulate organic matter

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Abstract
The influence of protozoa in anaerobic degradation processes was investigated by monitoring protozoan population in bioreactors fed with carbon sources in suspended (sodium oleate) as well as dissolved (sodium acetate) forms. The study showed direct influence of anaerobic ciliates on the performance of anaerobic reactors irrespective of loading rates and retention time. This includes high sludge activity, increased removal of COD (chemical oxygen demand) and MLSS (mixed liquor suspended solids) and higher biogas production with the presence of anaerobic ciliates. In the batch experiments overall biodegradation efficiency was more than 90% with anaerobic ciliates compared to 60% without ciliates.
Specifically, the enhanced methane production had positive correlation with the increased number of ciliates present in the bioreactor. The removal of particulates by ciliates in bacteria free cultures confirms that they are not purely dependent on grazing of bacteria, as it could also consume organic matter. The present study shows the direct involvement of anaerobic protozoa in effective conversion of particulate matter and bacterial biomass to methane.

P-8 Growth of anaerobic *Metopus* sp. in laboratory cultures

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Abstract
The study includes isolation of anaerobic ciliate, *Metopus* sp. from an anaerobic reactor and development of its monoculture under laboratory conditions. The isolated *Metopus* sp. had the mean dimensions of 32x 123µm with the generation time of 53 h. The ciliate mineral medium (CMV) with 1% wheat powder suspension was found suitable for the growth of *Metopus* sp. The temperature and pH ranges, for the best growth of *Metopus*, were 30-35^{0}C and 6-7 respectively. Incorporation of antibiotics, Penicillin G potassium and streptomycin sulfate at the optimum dose of 6000 and 200 U per mL respectively, could reduce the bacterial count (<30 cfu/mL) without affecting the *Metopus* growth. *Metopus* growth was affected by varying concentration of inorganic constituents in the medium such as ammonia nitrogen and sulfate. Maintaining an initial concentration of 500-600 mg/L ammonia nitrogen in the medium found to increase the growth rate of *Metopus* sp. The volatile fatty acids (VFA) such as acetate, butyrate and propionate in higher concentrations had adverse effect on *Metopus* growth and prevented its growth beyond 0.05M concentration. Increased COD removal by the growth of anaerobic *Metopus* sp., indicates its possible involvement in biodegradation.

P-9 Morphology and morphogenesis of a new species of *Parentocirrus* n.sp. (Ciliophora: Hypotrichida)

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Abstract

Parentocirrus n. sp. was isolated from a fresh water body in New Delhi, India. The cells are slightly flexible, dorsoventrally flattened, tapering anteriorly and broad posteriorly. The average size of a protargol impregnated non-dividing cell is 93×50 µm. The nuclear apparatus consists of 3-8 unconnected, roughly spherical nodules arranged in a slightly curved row. The micronuclear numbers varies from 1-3 and are generally present between the macronuclear nodules. Three contractile vacuoles are placed in the cells. Undulating membranes are arranged in the typical *Oxytricha* pattern. Adoral zone of membranelles is question mark shaped. The ventral ciliature consists of 44 Frontal-Ventral-Transverse cirri arranged as eight frontals, two postorals, four transverse and two ventral cirral rows (F_{1-8}, PO_{1-2}, T_{1-4}, VR_1 & VR_2) and one row each of right and left marginal cirri. The second ventral row (VR_2) is inactive during division morphogenesis. Dorsally there are four kineties (DK_{1-4}) and two dorsomarginals ($DM_{1, 2}$) and three caudal cirri placed at the posterior ends of $DK_{1, 2 \&4}$. During morphogenesis the third dorsal primordium splits to form an extra row of 2-6 bristles.

P-10 Occurrence of a new oxytrichid genus (Ciliophora, Hypotrichida) from Moradabad, UP, India.

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Abstract: Cells of a new oxytrichid genus were isolated from a water sample collected from Moradabad, UP, India. The cells are rigid, oval in shape, measure about 50 x 20 µm after protargol impregnation, possess 18 frontal-ventral-transverse cirri, one row each of right and left marginal cirri, two undulating membranes (UMs) in *Stylonychia* pattern (Berger and Foissner 1997), question mark shaped adoral zone of membranelles, four dorsal kineties, one dorsomarginal row and three caudal cirri. The morphogenetic process follows a pattern similar to that of the genus *Oxytricha* involving six parental cirri. The genus is characterized by a combination of generic features of *Stylonychia* and *Oxytricha* both. While morphologically it resembles genus *Stylonychia*, it is closer to genus *Oxytricha* in its morphogenetic pattern. This new combination of morphological and morphogenetic features justifies a new generic status.

P-11 Morphology and morphogenesis of a new species of the genus *Sterkiella* (Ciliophora: Hypotrichida) from Delhi, India

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Abstract
Sterkiella n. sp. was isolated from the river Yamuna, Delhi, India. The cells are slightly flexible, dorsoventrally flattened, ovoid with rounded ends. The average size of a protargol impregnated non-dividing cell is 70×30 μm. The nuclear apparatus consists of 4 unconnected oval macronuclei positioned characteristically slightly left of the median. The micronuclear number varies from 4-6. Adoral zone of membranelles (AZM) is question mark shaped. Undulating membranes are arranged in the typical *Oxytricha* pattern. A single contractile vacuole is present on the left margin just below the AZM. The ventral ciliature consists of 17 Frontal-Ventral-Transverse cirri arranged as eight frontals, 5 ventrals and 4 transverse cirri (F_{1-8}, V_{1-5}, T_{1-4}) and one row each of right and left marginal cirri. Dorsally there are four kineties (DK_{1-4}) and two dorsomarginals ($DM_{1, 2}$) and three caudal cirri placed at the posterior ends of $DK_{1, 2 \&4}$. Morphogenetic pattern is similar to that of genus *T. pustulata*. The six primordia differentiate into 17 FVT cirri in the pattern 1, 2, 3, 3, 4, and 4. Encystment and excystment is frequent even in proliferating cultures.

P-12 Taxonomic characterization of a new soil ciliate (Ciliophora: Hypotrichida) and its systematic implications

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Abstract
Shape and arrangement of undulating membranes (UM) have been used as important characters for distinguishing oxytrichid genera. Among the well established six different patterns of undulating membranes (Berger and Foissner 1997), *Cyrtohymena* and *Steinia* patterns are very prominent with a very deep and wide buccal cavity. The genus *Cyrtohymena* was erected by Foissner (1989) for the species, which showed endoral intersecting with the long and curved paroral. According to Berger (1999), some of the species assigned to the genus *Cyrtohymena* deviate from the majority in that the body is rather inflexible, adoral zone is 40-50% of the body length and the postoral ventral cirrus V_3 is distinctly displaced posteriad. The aforementioned features are generally not considered to be typical of oxytrichines but shared by stylonychines suggesting that *Cyrtohymena* is not monophyletic and the distinctive pattern of UM's has evolved twice.
We have isolated a cell from the lawn soil of zoology department, university of Delhi which has UM's of *Cyrtohymena* pattern but several of its other features do not conform to those of subfamily oxytrichinae. The slightly flexible cells measure about 95 x 50 μm, possess 18 frontal-ventral-transverse cirri, one row each of right and left marginal cirri, question mark shaped adoral zone of membranelles, four dorsal kineties, two

dorsomarginal rows and three caudal cirri. Detailed morphogenetic investigations revealed that the postoral ventral cirrus V_3 does not participate in primordia formation justifying a new generic status. Data from this study and considering that mentioned by Berger (1999) necessitates a review of the genus *Cyrtohymena* and the subfamily oxytrichinae.

P-13 Inhibition of membrane associated cellular functions by cadmium in unicellular ciliates

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Abstract
Fusion and repair of cellular membranes is an essential step for the accomplishment of several processes during sexual and asexual reproduction cycles of ciliates. Some of such processes are: (i) pair formation between the mating competent cells for initiating conjugation (ii) separation of the conjugating cells by membrane dissolution in the midcourse of sexual cycle and (iii) enclosing the ingested food particles inside a unit membrane during feeding.
The aforementioned processes are strongly inhibited by the presence of cadmium ions in the medium. Complementary mating types of the ciliate *Stylonychia* fail to form pairs as their juxtaposing membranes do not fuse. Conversely, conjugating pairs when transferred to cadmium containing medium are unable to disengage as singletes.
In another ciliate *Tetrahymena* the rate of endocytotic vacuole formation is significantly inhibited by cadmium. It is postulated that the binding of cadmium with cell membrane disturbs its functional properties.

P-12 Distribution and abundance of marine benthic ciliates in a bay-mangrove complex in the Godavari delta, east coast of India

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A three-season (monsoon, post-monsoon and pre-monsoon) based study (1998-'99) on microbenthos over a spread of 24 hydrographically differing GPS fixed locations in Kakianda Bay and adjacent mangrove waterways (Coringa and Gaderu) in the Godavari delta on the east coast of India revealed altogether 81 species of free-living ciliates represented by 69 genera and 55 families. The predominant taxa were *Euplotes aediculatus* (7.0%), *Stylonychia* sp. (6.2%), *Vorticella* sp. (6.2%), *Folliculina* sp. (6.1%) *Oxytricha* sp. (5.3%), *Colpoda* sp (4.9%), *Enchelys* sp. (4.6%), *Helicoprorodon* (3.6%), *Chlamydodon* sp. (3.5%) and *Kentrophorus* sp. (3.4%), which constituted numerically up to 50% of the total ciliate population. In general the ciliate community consisted of marine stenohaline components such as *Sonederia, Enchyls, Kentrophorus* and *Remanella* in the northern part of the bay near the open sea (mean salinity between 27.3 ±0.8 and 30.1 ±1.4 PSU); marine euryhaline species such as *Trachelocerca*, *Holophrya, Prorodon and Vorticella* in the south bay (mean salinity 21.6 ±1.6 PSU) subjected to considerable dilution. *Peritromus, Euplotes aediculatus, Lacrymaria* and *Frontonia* were typical of mangrove creeks (mean salinity between 7.8 ±2.3 and 14.3 ±1.9 PSU). There were 20 Biologically Important Species forming the community nucleus and 28 accidental or rare species that occurred only sporadically depending on the season and locality. Based on hierarchical clustering and Bray Curtis (abundance) similarity implemented in PRIMER, the ciliate populations could be distinguished into 4 assemblages namely, *Sonedaria – Enchelys* Assemblage, bacterivorus and noticed in the north bay predominantly nearer sea; *Prordon* - *Vorticella* Assemblage characteristic of silty-clay sediments rich in bacterial flora within the estuarine biocoenosis in the south bay and Gaderu; *Folliculina – Peritromus* - *Stylonychia* Assemblage of sand-silt-clay sediments of mangrove creeks, and *Flavella – Tintinnopsis* Assemblage in clayey sands, characteristic of Coringa region evidently influenced by differing sediment textural classes and other environmental criteria (e.g. sediment organic matter).