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**Self Study Report
SSR: CYCLE-II
(2017-2018 To 2021-2022)**

Research, Innovations and Extension

- 3.3.2 Number of Books and Chapters in edited volumes/books published and Papers published in national/ international conference proceedings per teacher during last five years



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Criterion No. – III

Research, Innovations and Extension

3.3.2 Number of Books and Chapters in edited volumes/books published and Papers published in national/ international conference proceedings per teacher during last five years

2021-2022	2020-2021	2019-2020	2018-2019	2017-2018
1	2	5	5	8



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SESSION
2017-2018



Synthesis of Supported Metal Nanoparticles: Future Scope

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ABSTRACT

Octahedral Molecular Sieves (OMS-2) material was prepared by redox method and was employed as catalyst support for the preparation of heterogeneous OMS-2 supported metal catalysts. All the materials were systematically characterized using various techniques such as X-ray diffraction (XRD), N₂ adsorption-desorption, Inductively Coupled Plasma-Optical Emission Spectrometry (ICP-OES), Transmission Electron Microscopy (TEM), etc. Highly dispersed supported metal nanoparticles were synthesized using ion-exchanged method. Characterization studies confirmed that metal particles are homogeneously distributed over OMS-2 support.

Keywords: Heterogeneous catalyst, metal nanoparticles, ion-exchange method, catalysis.

INTRODUCTION

Heterogeneous catalysts widely used in numerous catalytic transformations such as dehydrogenation, hydrogenation, hydrogenolysis, oxidation, dehydration, carbon-carbon bond formation, ammonia formation, Fischer-Tropsch Synthesis, etc (Suib *et al.*, 1997; Chen *et al.*, 2001; Amin *et al.*, 2000; Suib *et al.*, 2000). Manganese containing octahedral molecular sieves (OMS-2) materials was exploited as efficient heterogeneous catalysts support for synthesis of several supported metal catalysts. OMS-2 materials possess various important features such as highly porous nature, good adsorption-desorption property, ion-exchange capacity, moderate surface acidity-basicity, etc (Suib *et al.*, 1997). Moreover, doping of other metal predominantly divalent or trivalent cations in OMS-2 changes its electronic, structural as well as catalytic properties (O'Young *et al.*, 2002). The metal-doped OMS-2 material was found to be an excellent heterogeneous catalysts for oxidation of 2-propanol (O'Young *et al.*, 2002), oxidative dehydrogenation of ethanol (O'Young *et al.*, 2002), supercritical water oxidation of pyridine (Abraham *et al.*, 1999), phenol (Abraham *et al.*, 1995), ammonia (Gloyna *et al.*, 1998),





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fields to collect and share resources.

Each public library should prepare directories on different aspects such as health, education, transport, telephone etc and on different agencies, along with their activities and contact points of their locality to meet the general community information needs of the community.

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Suitable Facilities in Academic Library

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Abstract

Library is a unique place that strengthen the society, socially, educationally enlighten economic development of our country and with aim of spreading the knowledge enthusiastic, alert citizens, scientists, technicians, skilled professionals, students and provide the information today and for the future.

Keywords - Library services, Knowledge Centre, Academic Library, Library Collection

Introduction

India is a Country blessed with reading culture and tradition of great literature libraries are contributory important assistant in rich progress of country development Today libraries are enriching in educational, political, economical and scientific fields of the country and so today the development of human being is depends upon the curiosity of our country to achieve knowledge library has a capacity to produce information based economic system including library facilities and knowledge centre

Today with the help of modern technology, online reference of any subject is made available through the knowledge centers.

Facilities in Academic Library

Facility helps students, scientists, readers in the following way-

1. Classified E-learning material
2. E-learning material open to all
3. Museum and digital information





Angiospermic dicotyledonous seed from the Deccan intertrappean beds of Singhpur, Madhya Pradesh, India

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ABSTRACT


A well preserved dicotyledonous fossil seed was collected from Singhpur M.P. The seed is polygonal in shape, measuring about 5 mm in length and 2.5 mm in breadth, showing stalk like structure at the top with a slit which might be representing the micropyle. The seed coat is bitegmic having outer integument and inner integument. The embryo is very small and occupies the minimum space of the seed. The seed though shows some resemblances of the present day families like Apocynaceae, Alangiaceae, Bignoniaceae, Boraginaceae, Comanulaceae, Compositae, Loganiaceae, Martyniaceae, Pedaliaceae, Pittosporaceae, Sapotaceae, Solanaceae, Verbenaceae, and Convolvulaceae Polygalaceae, Simaroubaceae, Celastraceae, Rhamnaceae. It has close affinities with the members of the family Polygalaceae. It could not conclusively be traced to any particular genus but it broadly placed under Polygalaceae.

Key words- Dicot seed, Bitegmic, Polygalaceae, Deccan Intertrappean

INTRODUCTION

The present chapter deals with a study of fossil dicotyledonous Seed from the Deccan Intertrappean Beds of Jabalpur, Madhya Pradesh, India. So far few seeds have been reported from the different fossiliferous localities of Deccan Intertrappean beds of India. They are *Clusiocarpus arillatus* (Kumar, 1984), *Clusiocarpus indicum* (Kolhe and Wazalwar 1998), from Nawargaon, *Deccanosperma allirata*, *Ramakonospermus chitaleynsis*, *Mahabalespermum minutum* (Juneja, 1993) and *Ramakonospermus singhpurii* (Bhowal, 2003). Monocotyledonous phoenicoid seed is reported from Pisdura, Maharashtra by Ambawani and Dutta (2005). *Capparisocarpus nagpurii* (Konde 2012). So the present report of new dicot seed from Singhpur is noteworthy contribution to the knowledge of fossil seeds.




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Traditional medicinal plants used against various diseases in Nagbhid tahsil, Chandrapur (MS) India

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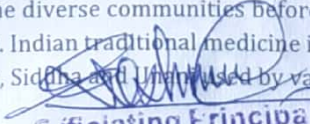
ABSTRACT

Nagbhid is surrounded by abundance of nature and forest. Local people of the area depend on the forest products for earning money as well as aware of the various medicinal properties of the plant. In present study survey of ethnomedicinal plants was carried out during January 2014 to December 2015 from Nagbhid Tahsil. Ninety botanically important medicinal plants belonging to forty nine families were identified with relevant information and are documented alphabetically with their botanical names followed by local name, family, parts used and modes of preparation of medicine. The local healers in this area use the medicinal plants in cure of various diseases. Documenting the indigenous knowledge is important for the conservation and utilization of biological resources of this area.

Key words: Medicinal plants, Local healers, Nagbhid Tahsil, Indigenous, conservation.

INTRODUCTION

According to the World Health Organization, most populations still rely on traditional medicines for their psychological and physical health requirements (Rabe and Van Stoden, 2000). Researchers have a special interest in the medicinal plants used in Ayurvedas and other traditional system of medicines. Most of the allopathic drugs have been invented but the plant-based medicines have its own unique status as it has no side effects on the human body. The knowledge of medicinal plants has been accumulated in the course of many centuries based on different Indian system of medicines such as Ayurveda, Unani and Siddha. Today there is an increasing desire to unravel the role of ethnobotanical studies in trapping the centuries old traditional folk knowledge as well as in searching new plant resources of food, drug etc. (Jain, 1991). There is an urgent need to document the ethno biological information presently existing among the diverse communities before the traditional knowledge is completely lost. Indian traditional medicine is based on different system such as Ayurveda, Siddha and Unani used by various communities (Gadgil,


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Bird diversity of agro- forest ecosystem in and around Nagbhid, Maharashtra, India

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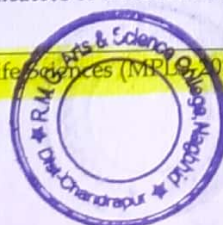
ABSTRACT

The present study was undertaken to explore species diversity of birds, seasonal abundance of birds and their migratory pattern in and around the study area. The study site (20°33'N to 20°35'N and longitude 79°39'2E to 79°39'4E) spreads over an area of 20 Km² located near Nagbhid, taluka level town in Eastern part of Vidarbha of Maharashtra State. It comprises numerous ponds and lakes apart from large Ghodazari Lake. It presents unique geographical site having mountaneous dry deciduous tropical forest, dominated by teak *Tectona grandis* and bamboo *Dendrocalamus strictus*, interspersed with meadows and paddy cultivations. A total of around 120 species belonging to 50 families 17 orders were recorded during Jan, 2015 to Dec. 2017. The species recorded included 6 Breeding Migrant (BM), 32 Passage Migrant (PM) and 82 Residents (R). Among the orders, Passeriformes is the richest order in terms of avian species diversity, represented by 56 species while family Muscipidae is found predominant. Wooly necked stork newly recorded during the present study is vulnerable (VU) species according to IUCN red data list. Present study will help in designing conservation strategy as this aquatic ecosystem adversely affected by fishing and agricultural activity which leads to bio-accumulation of pesticide in the pond posing serious threat and hence require immediate attention.

Key Words - Passeriformes, Migrant, Resident, Ghodazari, Muscipidae

INTRODUCTION

Birds are widespread in their occurrence, almost found everywhere in the world. Bird families and genera have broad geographical ranges, yet many individual species are specialized in their requirements and have narrow distributions. Birds are mobile and responsive to environmental changes. The variety of avian species in ecosystems reflects the well being of its habitat. Birds are likely to work better as biodiversity indicator taxa in terrestrial habitats than in either freshwater or marine habitats. Birds are the indicators of environment and are being used for conservation and



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Diversity of Zooplanktons in Janala Lake, Mul, Maharashtra (India)

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ABSTRACT

Zooplanktons play a very crucial role in the trophic dynamics and energy transfer in aquatic ecosystem. Their abundance increases in eutrophic water. They are also sensitive to pollution and many species are recognized as indicators of pollution. It is an integral component of an aquatic ecosystem. The study site Janala Lake is located near Mul, situated between 20°07'N and 79° 67' E. Water samples were collected once in month from the selected sampling sites of Janala lake to analyze the diversity of zooplanktons for the period of 24 months i.e. from January 2011 to December 2012. Zooplankton belonged to Rotifera, cladocera, copepod and ostracoda and both the lakes, the two years average showed the following sequence of their abundance. Janala Lake = Rotifera > Copepoda > Cladocera > Ostracoda. In the present investigation, total zooplankton was recorded maximum during summer and minimum during monsoon.

Key words: Zooplankton, Rotifera, Copepoda, Cladocera, Ostracoda

INTRODUCTION

Fresh water ecology emphasizes mainly the study of relationship between organisms and the fresh water environment. Study of all aspects (physical, chemical, geological and biological) of fresh water is termed as Limnology (George, 1997). Lakes are characterized by distinct biotic and abiotic environment. Lakes maintain ecological balance of flora and fauna and their interrelationship regulate surrounding climate and recharge ground water, but unfortunately, they are dying. The lakes are getting polluted due to inflow of domestic effluents, apart from pollution, resulting from washing of clothes, Vehicles, Cattle, immersion of Idols during certain festivals etc. All these activities are deteriorating the quality of the water in the lake resulting in the accumulation of the toxic chemicals and other sludge leading to ecological imbalance.



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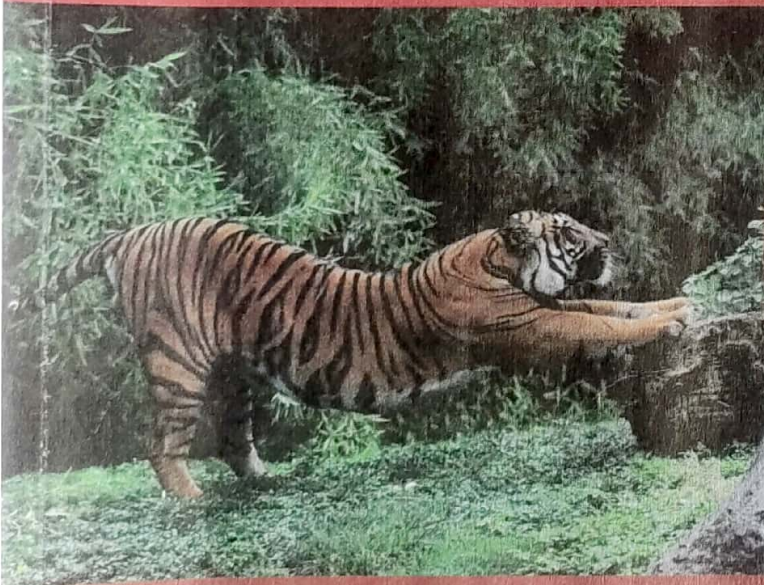
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Paper I - ANIMAL DIVERSITY (CHORDATES) AND COMPARATIVE ANATOMY
Paper - II: PHYSIOLOGY AND BIOCHEMISTRY - I

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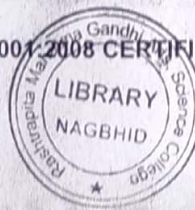
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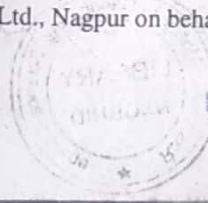
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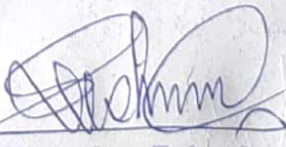
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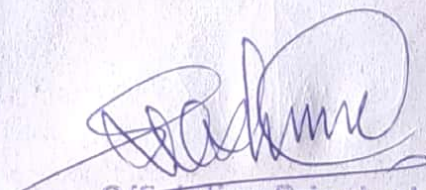
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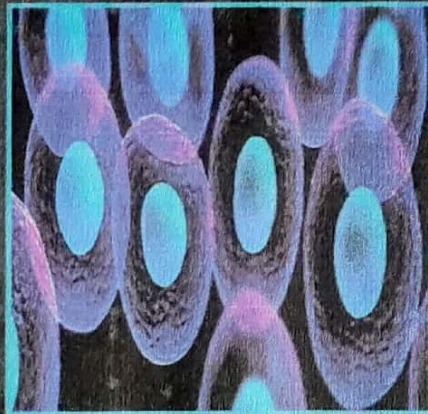
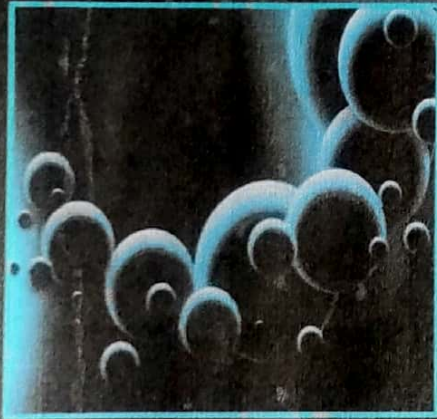

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**TEXT BOOK OF
CELL BIOLOGY**

Dr. G. D. Deshmukh

Dr. Amir A. Dhamani



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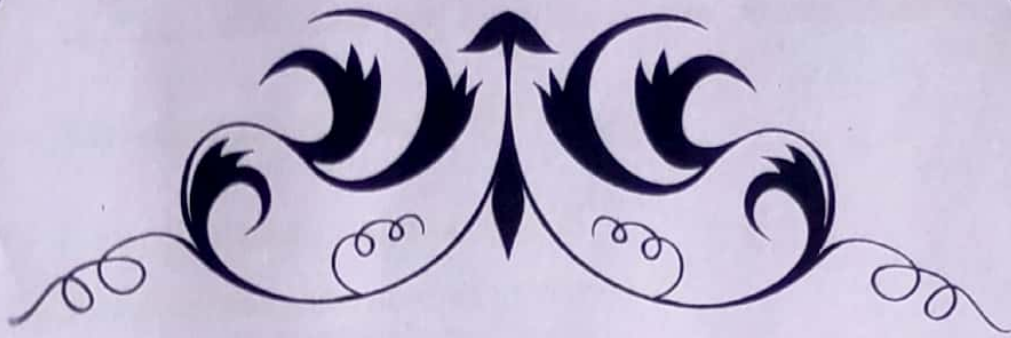
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SESSION

2018-2019



WADERS DIVERSITY IN THE KORAMBI TALAV OF GHODAZARI SANCTUARY, MAHARASHTRA, INDIA

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ABSTRACT

The present study was undertaken to explore species diversity of birds, seasonal abundance of birds and their migratory pattern in and around the study area. The study area, Korambi Talav (20°35'80"N and longitude 79°35'24"E) is located within the newly approved Ghodazari Sanctuary by Government of Maharashtra. Korambi village is remotely situated in the Nagbhid Taluka of Maharashtra and is in consideration for rehabilitation. It presents unique geographical site having mountainous dry deciduous tropical forest, dominated by teak *Tectona grandis* and bamboo *Dendrocalamus strictus*, and interspersed with meadows and paddy cultivations. A total of around 37 species belonging to 11 families 6 orders were recorded during Jan, 2015 to Dec. 2017. The species recorded included 3 Breeding Migrant (BM), 14 Passage Migrant (PM) and 20 Residents (R). Among the orders, Charadiformes is the richest order in terms of avian species diversity, represented by 12 species while families Scolopacidae and Anatidae are found predominant. Woolly necked stork newly recorded during the present study is vulnerable (VU) species according to IUCN red data list. Present study will help in designing conservation strategy as this aquatic ecosystem adversely affected by fishing and agricultural activity which leads to bio-accumulation of pesticide in the pond posing serious threat and hence require immediate attention.

Received: September 2018

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Keywords:

Charadiformes, Migrant, Resident, Ghodazari, Scolopacidae

INTRODUCTION

Wetlands occur extensively throughout the world in all climatic zones and are estimated to cover about 06% of earth's surface. They include a wide variety of habitats, which exhibit major differences in their characteristics and have supported the mankind since historical time. Wetlands attract a large number of migratory and resident bird species. (Tak, et al, 2003). Wetlands are defined as transitional zone between terrestrial and aquatic ecosystem where land is covered by shallow water (Mitsch & Gosselink, 1986). They are also known as biological supermarkets because they provide extensive food chain and rich in biodiversity. The insects constitute one of the major faunal component of wetland ecosystems. They play a very vital role in the trophic structure of freshwater wetlands in converting plant food into animal protein of insectivorous animals in the ecosystem. (Tak, et al, 2003). Waders are defined as a group of medium sized wading birds, which have a wide variety of bill structures and possess long legs and toes enabling them to live and feed in shallow water habitats. (Mishra, et al., 2016). Vijayan (1986) recorded 318 species of avian fauna from Indian wetlands which included 193 species of birds found to be completely dependent on wetlands. A lot of research has been done on wetland bird diversity of India (Urfi, 2002;

Kumar, et al., 2005; Alfred, et al., 2005; Mishra, et al, 2016). Waders diversity of Maharashtra reported by Chitampally and Bhatkhande, 1993; Wagh et al., (2015); Choudhari-Pachpande and Pejaver (2016); Bayani and Dandekar, (2017).

The study area had been in media during last decade due to man-wild conflict which resulted in the casualties inflicted by wild animals like tiger, leopard and wild boar on human life. In order to provide safe corridor to wild animals of protected forests like Tadoba-Andhari Tiger Reserve, Nagzira Wildlife Sanctuary and Umred Karhandla, the Maharashtra Government has approved Ghodazari in Chandrapur district as new wildlife sanctuary in the state. The sanctuary, is located in the North East of Tadoba, will include 159 sq km of Brahmapuri forest. The wildlife sanctuary located North East of Tadoba-Andhari Tiger Reserve (TATR). Hence this study has been undertaken to explore rich waders diversity of this unexplored habitat.

MATERIALS AND METHODS

Study area

Korambi Talav (20°35'80"N and longitude 79°35'24"E) is the man-made water reservoir, spreads over an area of 1000mts, situated near Nagbhid Taluka in Eastern part of



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THE PETRIFIED ANGIOSPERMIC FOSSIL FRUIT FROM A NEW LOCALITY
GHATPARASIA, M.P. INDIA

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Abstract

A well preserved dicot fruit was collected from sedimentary exposures of Ghatparaci in Chhindwara district, M.P.. The fruit is Triangular in shape, without stalk. It is unilocular, multiseeded with free central placentation and is characterized by presence of seven bitegmic seed. The fruit is dehiscent shows multilayered fruit wall differentiated into epicarp, mesocarp and endocarp. The fruit though shows some characters of the present day families like Amaranthaceae, Nyctaginaceae, Chenopodiaceae, Caryophyllaceae and Portulacaceae. It shows close affinities with the members of the family Portulacaceae because it represents characters like free central placentation, multiseeded fruit, multilayer fruit wall, and fruit triangular in shape without stalk. It could not conclusively be traced to any particular genus but it is broadly placed under the family Portulacaceae as *Portulacaceaeocarpon ghatparaciaii*.

Key-words- Dicot fruit, Indehiscent, Bitegmic, Portulacaceae, Deccan Intertrappean

Introduction

The fossil specimen studied and described below is an unilocular dicotyledonous fruit from the family **Portulacaceae** of the order **Centrospermae**. So far only a few unilocular dicotyledonous fruits have been described from the tertiary formation of India. *Sahnioocarpon harisii* (Chitale and Patil 1972), *Biloculocarpon mohgaonense* (Yawle, 1977). Fossil Centrospermous fruit described from the Deccan Intertrappean beds of Mohgaonkalan is *Centrospermocarpon chitaleyi* (Sheikh and Khubalkar 1982) and the fruits described so far are capsules or berries *Euphorbiocarpon drypeteoides* (Mehrotra 1983), *Euphorbiocarpon singhpurii* (Bhowal and Sheikh 2006), *Bicarpelocarpon singhpuri* (Bhowal and Sheikh 2008), *Portulacaceocarpon jamsavlii* (Meshram 2011), *Tiliaceaeocarpon jamsavlii* (Meshram 2013), *Legumenaceocarpon jamsavlii* (Meshram 2017).

The present fruit is being reported from a new fossiliferous locality of Ghatparacia, Madhya Pradesh India.

Material and Method

This petrified fruit was preserved in a black chert which was collected from Ghatparacia; dist. Chhindwara M.P. during excursion in 2016, the fossil specimen was exposed in an oblique



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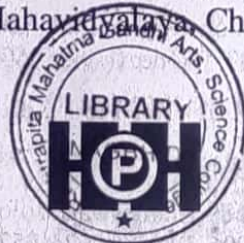
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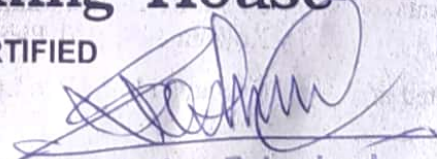


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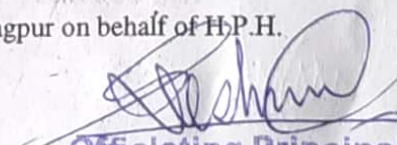
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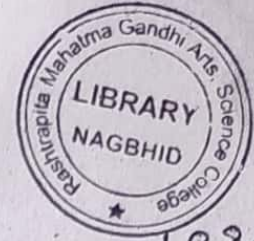
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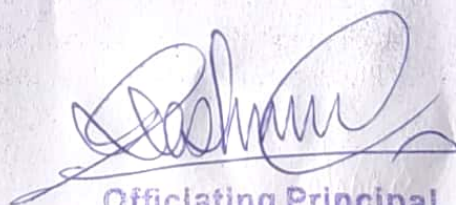
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Zoology

B.Sc. Semester V (CBCS)

With Practical
Manual Inside

Paper - III : INSECT VECTOR AND DISEASES
DISCIPLINE SPECIFIC ELECTIVES (DSE)
(Core Paper XI)



Dr. Pankaj R. Chavhan
Dr. Umesh S. Indurkar
Dr. Deepak S. Bansod
Jayesh W. Hajare
Dr. Ganpat D. Deshmukh

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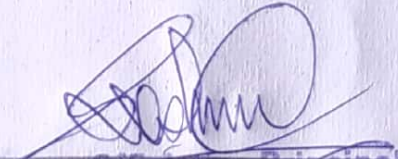
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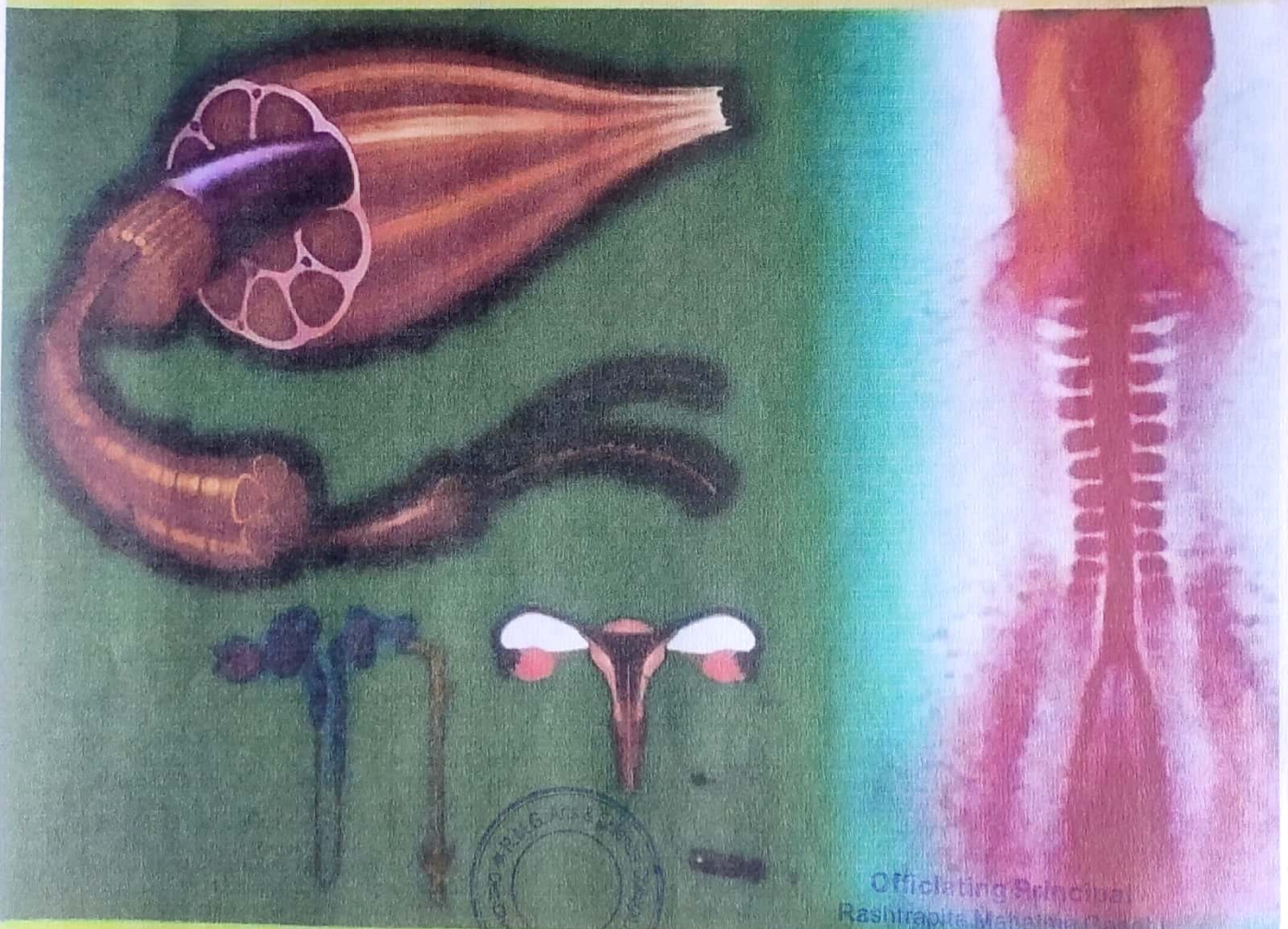
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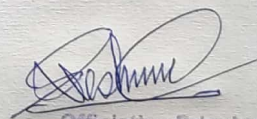
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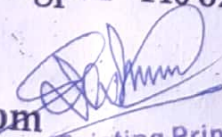
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Librarian, Rashtrapita Mahatma Gandhi Arts and Science College, Nagbhid

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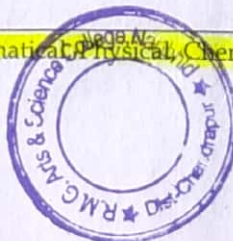
ABSTRACT

Knowledge about the users and their demands is necessary to make library and information services more effective and user oriented. The present study deals with users attitude towards information sources and information services in the library of Gondwana University Gadchiroli . Data is collected from the External observation of university library available facility to Users. The paper attempts to analyse use pattern, adequacy of library collection, user's opinion on information sources and services. Maximum users are found satisfied with the physical facilities and collection as well as arrangement of library reading material.

Keywords: Information resources, Library and information services, users, adequacy, University library

INTRODUCTION

On July 23, 2010 Maharashtra Legislative Assembly passed a unanimous resolution to constitute the Gondwana University, for the area comprising districts of Chandrapur and Gadchiroli.[1] The resolution was moved by then Higher and Technical Education Minister Rajesh Tope. The new university was constituted by issuing notification under sub-section (2) of section 3 of the *Maharashtra Universities Act, 1994*. [2][3] In 27 September 2011, Gondwana University was carved out of RTMNU, Nagpur. [4] The official inauguration date was delayed until August 2012 Library is not separate building in University . At present the library has over 11710 books related to different streams. Rapid accumulation and dissemination of information is the major concern of each academic library.



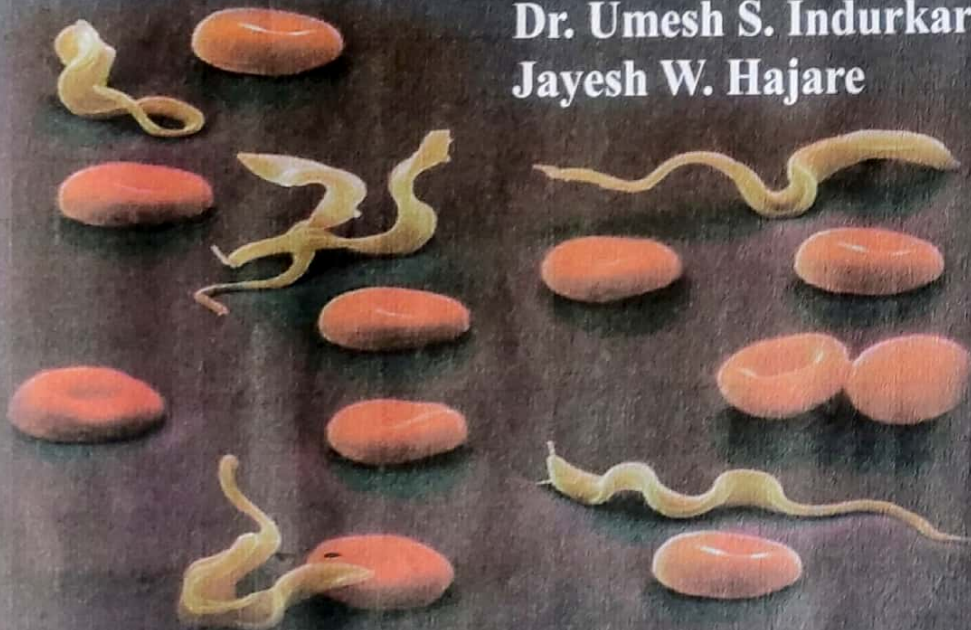
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Paper I - PARASITOLOGY

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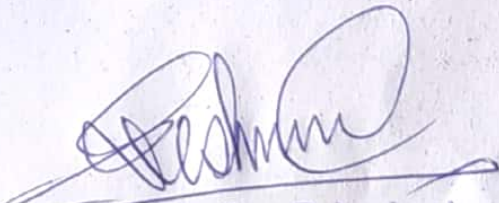
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UNIT - I

1. **Urochordata** - General characters, Ascidian tadpole and Retrogressive metamorphosis.
2. **Cephalochordates** - General characters, Amphioxus - external morphology and digestive system
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4. **Pisces**- General Characters and classification up to order. Osmoregulation in fishes and Accessory Respiratory organs.

UNIT - II

1. **Amphibia**- General Characters and classification up to order, Parental care and Neotony.
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UNIT - III

1. **Aves** - General characters and classification up to order, Flight adaptations (morphological, anatomical and physiological), birds migration and its significance.
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1. Comparative account of derivatives of integuments (scale and horn)
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CORE PAPER VI
USCZOT06

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4. Respiratory disorders and effects of smoking


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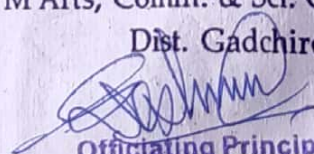
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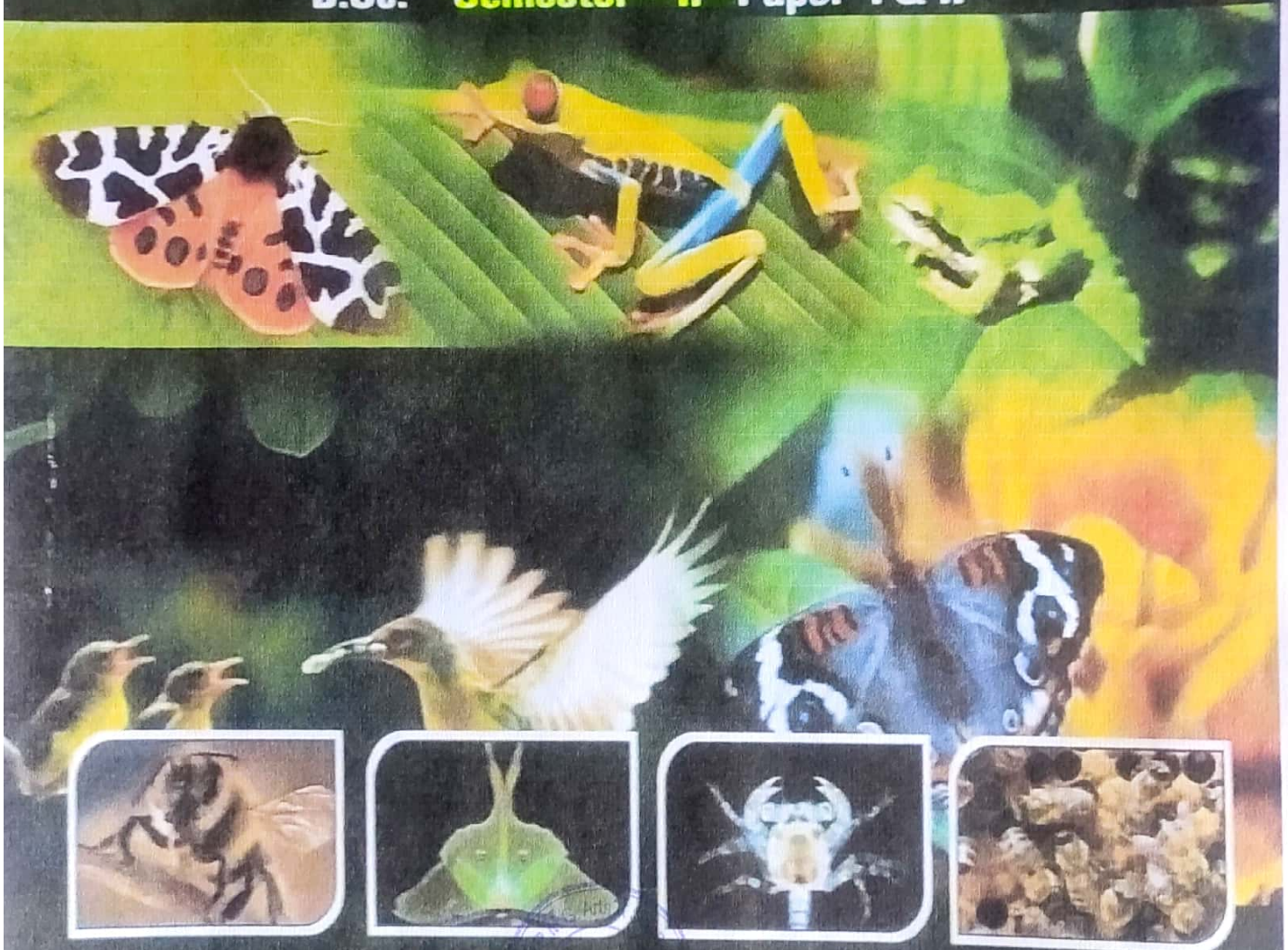
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Inside

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PROGRAMME - BACHELOR OF SCIENCE (B. Sc.), SEMESTER - II
CORE PAPER - III USCZOT03

Paper- I
ANIMAL DIVERSITY OF NON-CHORDATE
(ARTHROPODA TO HEMICHORDATA)

UNIT I

Phylum - Arthropoda

General Characters and classification up to Classes
Periplaneta- External morphology, Digestive system, Circulatory system, Nervous System, Reproductive system and sense organs.

UNIT II

Phylum - Mollusca

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UNIT III

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Paper- II
GENETICS AND EVOLUTION

UNIT I

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Interaction of genes - Incomplete dominance and Co- dominance, Multiple alleles, Lethal alleles, Epistasis, Sex linked inheritance, extra- chromosomal inheritance (Kappa particles)

UNIT II

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Chromosomal mutations - Deletion, Duplication, Inversion, Insertion, Translocation
Aneuploidy and Polyploidy
Gene Mutations - Induced and Spontaneous mutation

UNIT III

History of life

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Introduction to evolutionary theories - Lamarkism, Darwinism, Neo- Darwinism,
Direct Evidences of Evolution - Types of fossils, Incompleteness of fossil record, Dating of fossils, Evolution of Horse.

UNIT IV

Process of Evolutionary change

Isolating Mechanisms, Natural selection (example Industrial melanism)
Types of natural selection (directional, stabilizing, disruptive) Artificial selection,
Species concept - biological species concept, (advantages and limitations),
Modes of speciation (Allopatric, Sympatric and Peripatric)
Macro- evolution - Macro- evolutionary principles (Example: The Rock Finches)
Extinction - Mass extinction, causes and role of dinosaurs in evolution.

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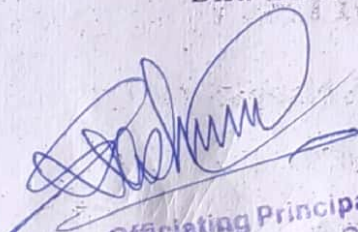
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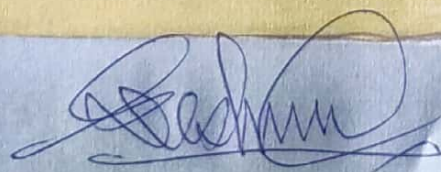
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Fourier's Theorem-statement, evaluation of Fourier coefficients, Its application to saw tooth wave and square wave, Limitations. Numericals.

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Ultrasonic waves and its properties, Production by piezoelectric effect, detection, applications (depth of sea, signaling & medical uses).

Noise and music, characteristics of musical sound, Intensity and loudness of sound, Bel and Decibels, musical notes, musical scale, Echo, Reverberation and time of reverberation, Absorption coefficient, Sabine's formula, Requirements of good auditorium. Numericals.

Unit- IV (Laser):

Coherence, spatial and temporal coherence, Einstein's coefficients (absorption, spontaneous and stimulated emission), population inversion, optical pumping, characteristics of laser beam, Ruby laser, Semiconductor laser, He-Ne Laser, applications of lasers. Numericals.



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Paper-II (Optical Physics)

USPHT08: OPTICAL PHYSICS

Aim: To make the students to understand the basic concepts of Light Waves and properties of light waves as core part of the subject.

Unit I (Interference of Light):

Definition and Properties of wave front, Huygens Principle of propagation of wave front, Principle of superposition and interference of light, Division of amplitude and division of wave front, Fresnel's Biprism, Phase change on Reflection- Stokes' treatment, Interference in Thin Films: due to reflected and transmitted light in parallel film, Fringes of equal inclination (Haidinger Fringes), Interference in wedge-shaped film, Fringes of equal thickness (Fizeau Fringes). Numericals.

Unit II (Newton's Rings & Michelson's Interferometer):

Newton's Rings: Experimental setup & theory, application of Newton's ring for measurement of wavelength and refractive index.

Michelson's Interferometer: construction and working, types of fringes (circular and localised), Determination of wavelength and Wavelength difference, Refractive index and Visibility of fringes. Numericals.

Unit III (Diffraction):

Basic concept of diffraction, types of diffraction, Fresnel's Diffraction: Definition, Half-period zones, Zone plate, Diffraction due to straight edge and narrow slit. Fraunhofer's diffraction: Definition, Single slit, Double Slit, Diffraction Grating- construction, theory, its application to determine wavelength. Numericals.

Unit IV (Polarization):

Concept of polarisation, Plane polarized light (PPL), production of PPL by reflection, double refraction, Brewster's law, Uniaxial and biaxial crystal, positive and negative crystal, Nicol's prism- construction and working, Nicol as a polariser and analyser, Circular and elliptical polarization, phase retardation (quarter and half wave plate). Numericals.



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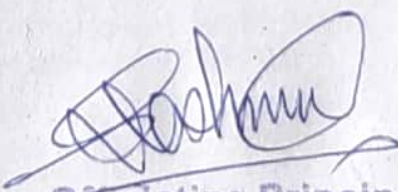
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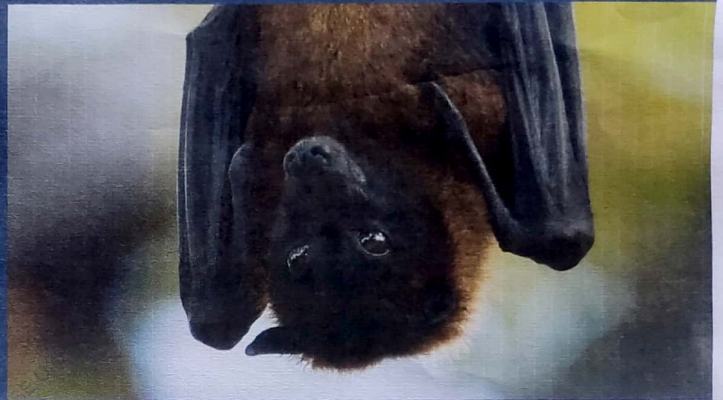



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SESSION

2020-2021

Reproduction is a high priority function of all mammalian species. Strategies used to perpetuate species vary greatly, but in general they evolved to improve the success of survival of the offspring. The reproductive state of an individual at any particular time reflects an integration and coordination of both external and internal signals and not just a simple response to a single environmental factor. Many mammals are seasonal breeders and respond to annual climatic changes by adaptive alterations in physiological as well as in histoarchitectural status in anticipation of the coming season. The switching on and off of reproductive functions during the annual breeding cycle of bats is the most striking example of such photoperiodically induced process. Although Chiropterans are the second largest order of mammals, detailed reproductive patterns and their associated changes in the Sertoli cell have been documented only in few species. Hence, present investigation was carried out on *Taphozous kachhensis* and *Pteropus giganteus giganteus* of Bramhapuri Forest Range (20060' 80.42"N and 79086 13.36" E) in Chandrapur district of Maharashtra, India Maharashtra, India.



Ganpat Deshmukh
Amir Dhamani



I am working as Assistant Professor at Rashtrapita Mahatma Gandhi College, Nagbhid, Maharashtra (India) and teaching Zoology to Undergraduate students since 18 years. I have till date published 15 research articles and 5 books. I have completed my Ph.D. on the role of Sertoli cell in the reproduction of bat.

FINE STRUCTURE OF SERTOLI CELL

FINE STRUCTURE OF SERTOLI CELL OF TWO SPECIES OF INDIAN BATS, *TAPHOZOUS KACHHENSIS* AND *PTEROPUS GIGANTEUS GIGANTEUS*

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FINE STRUCTURE OF SERTOLI CELL

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SPECIES OF INDIAN BATS, TAPHOZOUS
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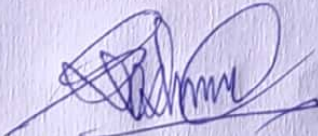
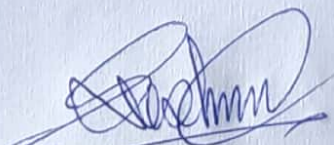

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**FINE STRUCTURE OF SERTOLI CELL OF TWO SPECIES OF
INDIAN BATS, *TAPHOZOUS KACHHENSIS* AND *PTEROPUS GIGANTEUS*
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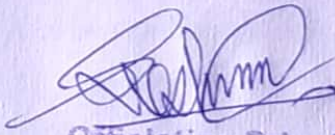
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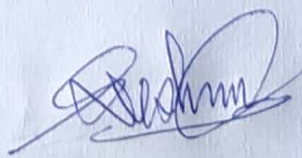

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Preface

Reproduction is a high priority function of all mammalian species. Strategies used to perpetuate species vary greatly, but in general they evolved to improve the success of survival of the offspring. The reproductive state of an individual at any particular time reflects an integration and coordination of both external and internal signals and not just a simple response to a single environmental factor. In order to maximize fitness in terms of an individual's genetic contribution to the next generation different life-history strategies have evolved for which the timing and frequency of reproduction are major determinants. Many mammals are seasonal breeders and respond to annual climatic changes by adaptive alterations in physiological as well as in histoarchitectural status in anticipation of the coming season. The switching on and off of reproductive functions during the annual breeding cycle of bats is the most striking example of such photoperiodically induced process.

Although Chiropterans are the second largest order of mammals, detailed reproductive patterns and their associated changes in the Sertoli cell have been documented only in few species. In the members of the family Emballonuridae, detailed reproductive patterns have been described in only two species, *Taphozous georgianus* from Australia and *Taphozous longimanus* from India. Bats play an important role in ecosystem balancing and human activities such as arthropod control, pollination and seed dispersing, providing fertilizer and food source etc. (Hill and Smith, 1984). It is therefore important to document and understand the reproductive biology of bats that may be crucial in conservation of this diverse group of mammals. Detailed analysis of reproductive patterns in mega-chiropterans will provide some useful comparisons with primate and micro-chiropteran reproduction. Hence, present investigation was carried out on *Taphozous kachhensis* and *Pteropus giganteus giganteus* of Bramhapuri Forest Range (20°60' 80.42"N and 79°86' 13.36" E) in Chandrapur district of Maharashtra, India Maharashtra, India.




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Chapter One

Reproduction in bats

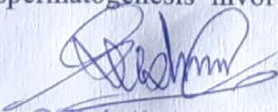
The reproductive state of an individual at any particular time reflects an integration and coordination of both external and internal signals and not just a simple response to a single environmental factor. Many mammals are seasonal breeders and respond to annual climatic changes by adaptive alterations in physiological as well as in histoarchitectural status in anticipation of the coming season. The switching on and off of reproductive functions during the annual breeding cycle of bats is the most striking example of such photoperiodically induced process. (Krutzsch and Crichton, 1990; Gopalkrishna and Badwaik., 1993; Entwistle et al., 1998; Beguellini et al., 2009).

Some well-known environmental factors influencing reproductive timing include food availability, ambient temperature and photoperiod. Although nearly 25% of all mammals are bats, we know very little about how environmental and internal factors interact to regulate annual patterns of reproduction in Chiroptera. (Heidemann, 2000) Bats are also varying greatly in terms of habitat, available foods and mating systems. Pettigrew (1986) and others have suggested that the Micro- and Megachiroptera evolved separately and that the megachiropterans are possibly prosimian primates.

Intra-specific variation has been reported, not just in the timing of reproduction, but also in the periodicity of reproduction in different environments and across the geographic range of the species (Vivier and van der Merwe, 1996). It is therefore often impossible to characterize a specific pattern of reproduction within species with a wide distribution (Bernard and Cumming, 1997). The occurrence of varied reproductive patterns appears to be generally related to major differences in latitude.; Bernard and Cumming, 1997). Bernard and Cumming (1997) identify a limit of 13 °N and 15°S between which most Microchiroptera are either bimodally polyoestrous or aseasonal breeders. The underlying factor determining latitudinal variation in reproductive patterns appears to be differences in the degree in seasonality of climate particularly in rainfall patterns, and corresponding food availability. Variations in reproduction also reflect local differences in patterns of rainfall. (Bernard and Cumming, 1997).

Spermatogenesis in bats, in common with other mammal groups, is highly seasonal at temperate latitudes. The timing of seasonal cycles of male reproduction is not simply a consequence of the timing of female cycles, but also appears to correspond directly to climatic seasonality and food availability (McWilliam, 1988). Seasonal variation in spermatogenesis involves profound




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Chapter Two

History of Sertoli cell research


Enrico Sertoli used the term mother cells on the 1st page of his publication (23) suggesting that this cell type served a unique function in its relationship to the developing germ cells. Indeed, Sertoli cell cytoplasm is indented by the germ cell in every stage of the cycle of the seminiferous epithelium, with certain stages showing tremendous indentation or deep crypts and often referred as type A Sertoli cells. Type B Sertoli cells are those that support the movement of elongate spermatids towards the lumen. Thus spermeation appears to separate these two basic structural features of the Sertoli cells. In their morphology, histochemistry and biochemistry as well as in their distribution, the nuclear and cytoplasmic components of Sertoli cells show variations not only with cyclic activity of spermatogenesis but also with the species and seasons as also revealed by recent morphometric analysis (Ueno and Mori, 1990; Russel et al., 1990, 1994; Ye et al., De Franca et al., 1993; Orsi et al., 1993; Bartke, 1994; Guraya, 1995; Saidapur and Shanbag, 1999; Kolkute and Dukelow, 1999). Russell et al. (1994) have made stereological and endocrine studies of hamster Sertoli cells in early testicular regression and early recrudescence. The general lack of Sertoli cell changes in response to a short exposure to inhibitory photoperiod in the seasonally breeding hamster.

Various cytoplasmic components showing species and cyclic or seasonal variations generally show a polarized distribution as evidenced from their abundance in the basal and trunk regions of Sertoli cells whose apical extensions usually show a paucity of organelles (Ueno et al., 1991). Lipid droplets generally surrounded by cisternae of smooth endoplasmic reticulum lie in the basal regions of Sertoli cells. Ye et al. (1993) observed that among the many parameters investigated, only the surface area of the cells, the volume of lipid, and the volume and surface area of the rough endoplasmic reticulum vary cyclically as demonstrated by statistical analysis. The parameters of rough endoplasmic reticulum generally showed a correlation with known patterns of protein secretion within the tubule and with the secretions of specific proteins as well as the factors important in regulating protein secretions.

2.1. Cytoskeleton components

Sertoli cell cytoskeleton not only plays some important roles in maintaining cell shape and facilitating intracellular transport but also influences neighboring spermatogenic cells (de-Miguel et




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Chapter Three

Materials and Method

Classification of *Taphozous kachhensis*

Class	-	Mammalia
Subclass	-	Theriformes
Order	-	Chiroptera
Suborder	-	Microchiroptera
Family	-	Emballunuridae
Subfamily	-	Taphozoinae
Genus	-	<i>Taphozous</i>
Species	-	<i>kachhensis</i>

Classification of *Pteropus giganteus giganteus*

Class	-	Mammalia
Subclass	-	Theriformes
Order	-	Chiroptera
Suborder	-	Megachiroptera
Family	-	Pteropodidae
Subfamily	-	Pteropinae
Genus	-	<i>Pteropus</i>
Species	-	<i>giganteus giganteus</i>

3.1. Collection

The specimens of *Taphozous kachhensis* were collected from the Ambai-Nimbai, caves about 45 km from Bramhapuri, District-Chandrapur, Maharashtra, India (20°38' 39.08"N and 79°35 30.99" E) while *Pteropus giganteus giganteus* from roosting site of Mango trees from Bramhapuri forest range District-Chandrapur, Maharashtra, India (20°60' 80.42"N and 79°86 13.36" E).



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Chapter Four

Morphology of testis

The germinal epithelium, is comprised of three distinct components: (1) the Sertoli cells which extends from the basement membrane towards the tubule lumen; (2) the different generations of spermatogenic or germ cells; and (3) the peritubular myoid cells, which envelope the Sertoli cells and germ cells and which are separated from the Sertoli cells by an extracellular matrix or basal lamina. With the evolution of amniotes, a new arrangement of the germinal epithelium emerged (Grier 1993). The cystic pattern of anamniotes is replaced by a new tubular organization in which permanent population of Sertoli cell is present. This restructuring has included profound changes in the cellular relationships that exist during spermatogenesis. Each Sertoli cell is associated with several, developmentally different cohorts of spermatogenic cells. Cohorts of spermatogenic cells are not enveloped by Sertoli cells, as occurs in anamniotes. Rather spermatogenic cells are located laterally between adjacent Sertoli cells with the most immature stages near the base of the epithelium. This produces a structurally complex epithelium consisting of Sertoli cells and multiple stages of developing spermatogenic cells. This tubular organization is present in all modern-day amniote species (Russell, 1993).

Interposed between and attached to the Sertoli cells are the smaller and more numerous germ cells. Because there is a continual production and upward migration of germ cells through the epithelium, each amniote Sertoli cell, at any given point in time, is in contact with many germ cells that are at different stages of differentiation (de Kretser, 1990)

During spermatogenesis, amniote germ cells proliferate and pass through the same series of events seen in anamniote classes. The most immature cells (spermatogonia) are located basally within the epithelium. As they begin the process of differentiation, they gradually become more apically positioned. During this upward migration, cells undergo complete meiosis and enter spermiogenesis. Incomplete cytokinesis during spermatogenesis results in germ cells remaining attached to one another forming isogeic clones that move through the epithelium as units. During spermiogenesis, spermatids become positioned in apical recesses (crypts) of Sertoli cells. It is within these crypts that the germ cells develop the morphological features characteristic of mature



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Chapter Five

Endocrinology of reproduction

Roy Greep (1954), demonstrated the existence of two anterior pituitary hormones, follicle stimulating hormone (FSH) and luteinizing hormone (LH), which when administered to hypophysectemized rats could reverse the atrophy of the testis. FSH acted on the seminiferous tubules and LH on the Leydig cells. Subsequent work with purer hormones has confirmed these early concepts, but more recent investigations suggest that the two compartments are not functionally independent and that there is in fact a close and complex interrelationship between them. (Gustafson and Damassa, 1987)

The testis secretes a variety of steroids which are synthesized from cholesterol. The principal secretory product is testosterone, a product of the Leydig cells, which are found in clumps in the intertubular tissue adjacent to the seminiferous tubules. (Payne and Hales, 2004) Testosterone is classified as an androgen since it stimulates male secondary sexual characteristics. The synthesis of testosterone proceeds through a biosynthetic pathway, part of which is common to all the major steroid-secreting endocrine glands, the final end product being determined by the enzymatic composition of the tissue. Testosterone secretion by the Leydig cells is stimulated by LH. Receptors for LH are found on the Leydig cells and in the majority of mammals a rise in LH secretion is followed by a rise in testosterone. (Bernard et al., 1991) In fact, the secretion of both LH and testosterone is episodic and hence quite large changes in the levels of these two hormones may be found over a 24-h period. (Haider et al., 2007) is mediated through the intracellular formation of 3'-5' adenosine monophosphate (cyclic AMP) which in turn stimulates, through a protein kinase mechanism, the activation of numerous cellular reactions, one of which is testosterone secretion. (McLachlan et al., 2002) The enzyme necessary for testosterone production are associated with the mitochondria and smooth endoplasmic reticulum of the Leydig cell. Consequently, long-term LH stimulation results in enlargement of the cell together with increases in mitochondria and smooth endoplasmic reticulum. (Matthiesson et al., 2006) Little is known of the in which testosterone leaves the Leydig cell but it is found in high concentration in spermatic vein, blood, testicular lymph and in the fluid within the seminiferous tubules.



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Chapter Six

Ultrastructure of Sertoli cell

6.1.1. Ultrastructure of the Sertoli cell in *Taphozous kachhensis* during sexually inactive period

The Sertoli cell known to change functionally and morphologically at ultrastructural level, during the annual reproductive cycle of mammals, Pudney and Fawcett, (1985) in ground squirrel; Kerr (1988) and Ueno and Mori (1990) in rat; Rune et al., (1992) in marmoset; Munoz et al., (2001) in Viscacha). The Sertoli cells play a major role in regulation of spermatogenesis and altering rates of spermatozoa produced. Sertoli cell functions include providing structural support and nutrition to developing germ cells, phagocytosis of degenerating germ cells and residual bodies, release of spermatids at spermiation and production of a host of proteins that regulate and respond to pituitary hormone release and that influence mitotic activity of spermatogonia (Johnson et al., 2008).

The results of the present study shows that, the Sertoli cells of the *Pteropus giganteus* and *Taphozous kachhensis* undergo marked nuclear and cytoplasmic changes which conform the change in the hormonal profile during the annual reproductive cycle. During spermatogenesis there are cyclic changes in the structure and cellular organization of germ cells in the seminiferous epithelium along its length. Accompanying these changes, Sertoli cells also show related changes in morphology and function. Electron microscope investigation have demonstrated, variations in the nuclear and cytoplasmic components of Sertoli cells not only with cyclic activity of spermatogenesis but also with the species and seasons as also revealed by recent morphometric analysis of different groups of mammals (Dym, (1973) in Monkey; Pudney and Fawcett., (1985) in ground Squirrel; Kerr (1988) and Ueno and Mori (1990) in rat; Rune et al., (1992) in marmoset; Munoz et al., (2001) in Viscacha).

The Sertoli cell extends radially from the basement membrane of the seminiferous tubule upto the lumen of the tubule and adjacent Sertoli cells are separated by the spermatogonia, which also lie in contact with the basement membrane. Fig.6.1 shows, bilobed nucleus which measures 6 μm in diameter. It is bounded by discontinuous nuclear membrane, continuity of which is interrupted by nuclear pore. The nucleoplasm is darkly stained with uniformly distributed heterochromatin. Nucleolus is not observed. The Sertoli cell is involuted to great extent, shows many signs of degeneration at ultrastructural level in the form of vacuoles and phagosomes



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Chapter Seven

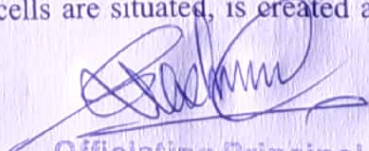
Role of Sertoli Cell in the reproduction of *Pteropus giganteus giganteus* and *Tapozous kachhensis*

7.1. Morphology of Sertoli cell

The changes in the organization of the germinal epithelium during the annual reproductive cycle are complimented by changes in the morphology of Sertoli cells. In general, Sertoli cells of amniote species are columnar in shape. In adult, they form a sessile and non-dividing population of cells that constitutes the major structural elements of the germinal epithelium. (Sinha-Hikim and Bartke, 2005) They are situated on a basement membrane that separates the epithelium from an underlying lumina propria. From this foundation, Sertoli cells extend towards the tubule lumen. Cytoplasmic processes extend from the lateral and apical surfaces of the cell bodies creating irregular contours. Each Sertoli cell varies in shape from its neighbours. The Sertoli cell which is columnar in shape and assumed to always extend from the basement membrane of the seminiferous epithelium to the lumen (Pudney and Fawcett, 1985; Hess and Franca, 2005), performs its nurse like cell function by extending its cytoplasm in the arm like processes in two dimensions and sheet-like or cylindrical processes in three dimensions around the developing germ cells and forming specialized junctional complexes that consist of gap and tight junctions, actin filaments and smooth endoplasmic reticulum (Dym, 1973; Grove and Vogl, 1989; Griswold, 1998; Guttman et al., 2000; Lee and Cheng, 2004; Hess and Franca, 2005). Approximately 40 % of the Sertoli cell contacts the surface of elongated spermatids (Mruk and Cheng, 2004; Lee and Cheng, 2004), illustrates the extent to which the Sertoli cell stretches its cytoplasm to communicate directly with the developing germ cells.

One significant structural feature that sets amniote Sertoli cells apart from anamiote Sertoli cells and from other epithelial cell types in general, is the position of the inter-Sertoli cell tight junctions. In contrast to other cell types, amniote Sertoli cell form tight junctions with one another close to the base of the epithelium (Skinner, 1991). Consequently, this partitions the germinal epithelium into two compartments (Morales and Clermont, 1993). A small basal compartment, in which most immature germ cells are housed, is formed below the junctions while a larger adluminal compartment, in which the more differentiated germ cells are situated, is created above




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Dr. Aparna S. Margonwar

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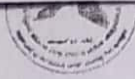
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B.Sc. Semester VI (CBCS)

Discipline Specific Elective-II (DSE-I)

Paper – I : Mycology and Plant Pathology – I

Paper – II : Mycology and Plant Pathology – II

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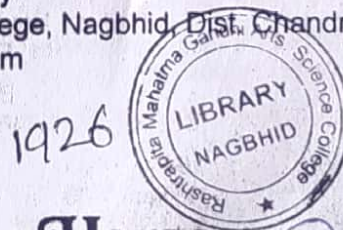
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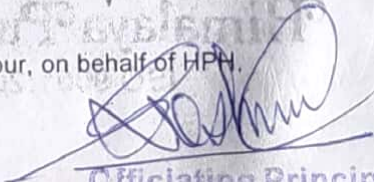
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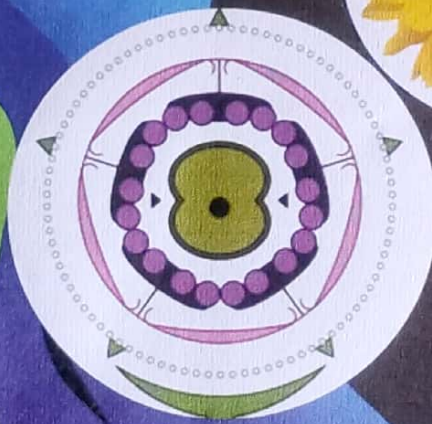
Botany

B. Sc. (Semester – III)

New Edition

Paper-I : Angiosperm Systematics & Indoor Gardening

Paper-II : Angiosperm Anatomy & Horticulture



Dr. S. M. Meshram

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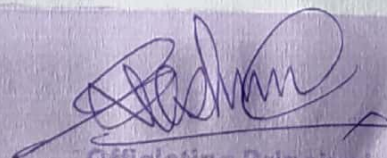
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B. Sc.

(Semester - III)

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Paper - II - Angiosperm Anatomy and Horticulture

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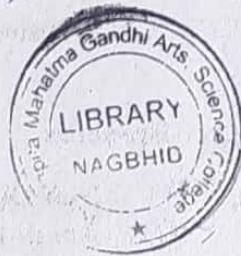
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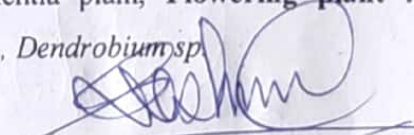
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Paper - II Angiosperm Anatomy and Horticulture

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