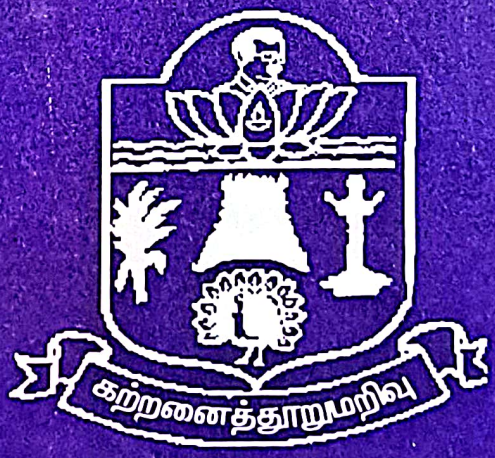
Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research

22-24 February 1995



P.G. and Research Department of
Wildlife Biology and Zoology
A.V.C. College (Autonomous)
Mannampandal, Mayiladuthurai - 609 305
Tamil Nadu, South India

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Printed by
Southern Printers Limited,
Mahadhana Street, Mayiladuthurai-1. ☎ 24060,23084,22920.

A.V.C. COLLEGE, MANNAMPANDAL - 609 305
MAYILADUTHURAI, TAMIL NADU

The A.V.C.College owes its birth and development to the magnificent role played by the Anbanathapuram Vahaira Charities (A.V.Charities), Thiruvilandur, Mayiladuthurai. Besides the purposes mentioned in the original endowment, other charitable purposes also received consideration at the hands of the trustees.

The College was inaugurated on 29th June 1955 by His Holiness the 25th Guru Maha Sannidhanam of Dharmapuram Adheenam.

A beautiful site consisting of 54 acres of dry land belonging to Arulmigu MayuranatharSwamy Temple and situated at Mannampandal was chosen for the permanent location of the College. His Holiness Guru Maha Sannidhanam of Thiruvaduthurai Adheenam gave the site in exchange for 17 acres of wet land belonging to the A.V.Charities. The College thus came to be located at this site, 5 Kms east of Mayiladuthurai town, which is a combination of urban,suburban and rural areas. This institution started serving many sectors of the society, throughout this agriculture based district-Nagai Quaid-e-.Millath District.

The college owes much to the late Prof.A.Ramanathan Pillai, the first Principal of the College for various steps taken by him under the guidance of the College Committee for getting the College started, with affiliation granted by the University of Madras at its Syndicate meeting held on the 20th May 1955.

The unstinted efforts of the second Principal, Prof. Muthu. Viswanathan helped this college to become a post graduate Institution in the year 1970. The sincere efforts of the third Principal Prof. R. Balasubramanian made the college to offer research facilities in some departments from 1982 and later under his leadership the college attained Autonomous status in 1985. A.V.C. College that was started with 120 students has grown to be an autonomous college with Post-graduate and Research facilities with a student strength of over 2500. There are about 130 faculty members and 60 non-teaching staff members. The Evening college for women started on 15th August 1984.

During these four decades (nearly) this College has under gone a rapid development. Many courses were started in several disciplines at the undergraduate and Post-graduate levels as indicated below:

U.G. P.G. & RESEARCH COURSES

B.A.(Eco)	- 1958	M.A. (Eco)	- 1970
B.Sc.(Maths)	- 1958	M.Sc. (Maths)	- 1970
B.Sc.(Chem)	- 1959	M.Com	- 1975
B.Sc.(Phy)	- 1964	M.Sc. (WLB)	- 1980
B.Sc.(Zoo)	- 1966	M.Phil (Zoo)	- 1982
B.Com.	- 1968	Ph.D. (Zoo)	- 1983
B.A.(His.)	- 1970	M.Phil (Maths)	- 1984
B.Sc.(Bot)	- 1975	M.Sc. (C.Sc)	- 1987
B.A.(Eng)	- 1979	M.Sc. (Ele)	- 1988
B.Sc.(C.Sc.)	- 1984	M.Phil.(Com.)	- 1990
		M.Sc.(Chem)	- 1991
		M.C.A.	- 1991
		M.Phil.(Eco)	- 1991
		M.A.(Eng)	- 1992
		M.Sc(Bot)	- 1994
		M.Sc(Zoo)	- 1994

DIPLOMA COURSES

PG Diplomo in Computer Application	- 1988
Dip. in Office Automation	- 1993
Dip. in Bio-Resourse Technology	- 1994

RESUME OF THE DEPARTMENT OF ZOOLOGY & DIVISION OF WILDLIFE BIOLOGY

The department was offering zoology at the Pre-university class and ancillary level from 1958 to 1966. Madras University granted affiliation to this college to start B.Sc. Zoology major in the academic year 1966-67. In 1980-81 the department had the proud privilege of starting the unique M.Sc. Wildlife Biology course for the first time in India and thereafter it was recognised as a research department with the starting of Part- time and Full-time M.Phil. courses in Zoology and Wildlife Biology in the year 1982. Part-time and Full-time Ph.D. programme was launched in 1983 and presently the department is full-fledged with UG, PG and Research courses like M.Phil., Ph.D., both Part-time and Full-time. Besides, in the evening college M.Sc., Zoology and a Diploma Course in Bioresources a parallel course for the students studying in second year U.G. and first year P.G. was started during the academic year 1994-95.

I. INFRASTRUCTURE OF THE DEPARTMENT

A. STAFF

The present position of this department is due to the unstinted, sincere and hard working of the faculty members. The present staff strength is 13. Dr. P. Govindan formerly Dean, Professor and Head of the Department of Zoology, Annamalai University worked as Professor Emeritus from 1980-'90. Prof. Thomas worked as P.G. Professor. Among the present faculty members, 4 have Ph.D. qualification and the rest have acquired M.Phil. One among them was also trained at Smithsonian Institution, USA on Wildlife Conservation and at The Paignton Zoo, UK. Three members had training on various aspects of Wildlife studies and Management at the Wildlife Institute of India, DehraDun. Nine of them are pursuing their Ph.D., programme on part-time basis. Prof.R.Natarajan has joined as CSIR Emeritus Scientist from 1st July,1993 and left the college on 1994.

The faculty members represented number of Professional bodies and societies such as Indian Society for Parasitologists, World Pheasant Association, Bombay Natural History Society, World Wide Fund for Nature-India, IUCN Species Survival Commission Veterinary Specialist Group, Pheasant Specialist group.

B. DEPARTMENT LIBRARY

The department has built up a library of its own and it harbours 3600 books, 7 International journals and 28 Indian journals, News letters pertaining to Forestry, Zoology and Wildlife Biology are subscribed.

C. MUSEUM

We have about 2500 specimens (formalin preserved and stuffed) in our museum. A new museum block was built for Rs. 3.5 lakhs and it was opened recently. The University Grants Commission gave financial assistance i.e., to the tune of 1.20 lakhs while the remaining amount was borne by the Management. There is a separate museum for the preservation of plants.

D. EQUIPMENTS

The department received Funds from the University Grants Commission and Management, for the purchase of important equipments necessary for carrying out research in zoology and Wildlife Biology including a DCM Turbo 100 plus XT 386 computer and AT 386 Computer with Printer.

E. AVIARY

There is a well established aviary in our College campus for the study of birds (60' x 12 ' x 10') with all facilities.

F. ANIMAL HOUSE

There is an animal house with different types of chambers for keeping the animals.

II. CURRICULAR ACTIVITIES

a. Results
b. Collaboration with Forest Department
c. Research activities
d. Research schemes
e. Publications.

A. RESULT

The department has got very good results from the beginning both in U.G. and P.G. The results for the past five years are listed below. The department has also won the Rolling shield from the college for 5 consecutive years.

PASS PERCENTAGES AT UG AND PG LEVELS FOR THE PAST 5 YEARS

ACADEMIC YEAR	UG	PG
1990 - 1991	70	100
1991 - 1992	54	100
1992 - 1993	63	100
1993 - 1994	48	80
1994 - 1995	59	87

C. COLLABORATION WITH FOREST DEPARTMENT

All our Final year P.G. students collaborate with the Forest Department or Wildlife Institute or Indian Institute of Science or Bombay Natural History Society or Salim Ali Centre for Ornithology and Natural History, Natural History societies and Zoo Outreach Organization to do their project work in the IV semester for a period of six months.

D. RESEARCH

Till date, Five candidates have been awarded Ph.D. degree and 20 Ph.D. scholars are actively engaged in their research programmes. Three Ph.D., scholars have submitted their doctoral dissertation. Within a span of ten years 93 scholars have completed M.Phil. in Zoology and Wildlife.

E. RESEARCH SCHEMES OF THE DEPARTMENT

1. Studies on the Helminth parasites of amphibians. UGC Minor Research Project. Rs.2,000/= (1983-85). Principal Investigator Dr. M.C. Sathyanarayana.

2. Studies on digenetic trematodes from marine fishes of Tharangambadi coast. UGC Minor Research Project (1986-88) Rs.9,000/= Principal Investigator Dr. M.C. Sathyanarayana.

3. A study on the occurrence, burrowing habits, food, feeding and breeding of field rats. UGC Minor Research Project. (1988). Rs.15,000/= Principal Investigator Dr. R. Kanakasabai.

4. Integrated Environmental Research Programme on River Cauvery, Department of Environment, Forests and Wildlife (1989-1992). Rs.5,68,640 Principal Investigator Dr. M.C. Sathyanarayana.

5. Epidemiological Studies, Dept. of Environment, Forests and Wildlife (1989-90). Rs.1,25,000/=. Principal Investigator Dr. M.C. Sathyanarayana.

6. Research work on Nilgiri tahr (1991) funded by M/s. Madras Cements Ltd., Rs.15,000/=. Research Advisor Dr. M.C. Sathyanarayana.

7. Biological control of rodents by Barn Owl. Rs.50,000/= funded by M/s.Pest Control (India) Ltd., Madras. Research Advisor Dr. R. Kanakasabai.

8. Ecology of barn owl (*Tyto alba*) and its predatory pressure on the rodents of agricultural importance, ICAR (from September 1992 onwards August 1995). Rs.3,74,400/=. Principal Investigator Dr. R. Kanakasabai.

9. Preservation of Ecosystem of Coastal areas, Ministry of Human Resources Development, Rs.48,000/= (1993-94) Principal Investigator Dr.M.C. Sathyanarayana.

10. Impacts of sea level changes on the estuarine ecosystems. CSIR Project (from June 1993 to August 1995). Amount Rs.3,48,960/=. Emeritus Scientist, Dr. R. Natarajan.

11. Helminth Diseases of Blackbuck, Department of Science and Technology. (1993-96) Rs.3,00,000/= Principal Investigator Dr. M.C. Sathyanarayana.

12. Project on species specific protein in the mosquito *Culex quinquifasciatus* and other species. Rs.14,500/ for 2 years UGC Minor Project Work. Dr. K. Manimozhi

13. Evaluation of few anticoagulant rodenticides against the rodents, UGC Major Project, Duration 3 years from March 1993, Rs.2,50,000/= Principal Investigator Dr. R. Kanakasabai.

14. Digenetic trematodes of important marine fishes of Poombuhar coast. Rs. 30,000/= (1994-96) Principal Investigator Dr: M.C. Sathyanarayana.

15. I.C.A.R Barn Owl Project has been extended upto August 1997 with an outlay of Rs.3,46,890/=. Principal Investigator Dr. R. Kanakasabai.

E. PUBLICATIONS

More than 150 Scientific papers have been published by the staff and research scholars of the Dept. both in National and International Journals and in Newsletters. A souvenier was released during the National symposium on Natural resources and their conservation.

The following Abstracts have been released during the time of the symposium.

1 Seminar on Wildlife Biology - Nov. 1981.

2 Evaluation of the Under Graduate project studies workshop - Nov. 1984.

3 National Symposium on Natural Resources and their Conservation - Feb 1989.

4 Environmental awareness and self employment - Dec. 1991.

5. Workshop on water quality assessment - Mar. 1993.

6. Workshop on Biostatistics for College Teachers and Research Scholars - Dec. 1993.

7. National Symposium on Recent Trends in Indian Wildlife Research - Feb. 1995.

MANUAL

A Manual on water quality assessment was prepared.

PROCEEDINGS

Proceedings of the National Symposium on Recent trends in Indian Wildlife research.

CO-CURRICULAR ACTIVITIES

A. SEMINARS/WORKSHOPS/SYMPOSIA CONDUCTED

As a part of co-curricular activity this department has ogranised the following Seminars, Symposiums and Workshops.

1. Seminar on Wildlife Biology was organised with the financial assistance of University Grants Commission during 26-28, November 1981.

2. On behalf of the Bharathidasan University a workshop on "Evaluation of the Under Graduate Project studies workshop was conducted during 17th and 18th November 1984.

3. Environment awareness workshop and a rally at Mayiladuthurai was conducted on 13th December 1986.

4. National Symposium on Natural Resources and their conservation was organised during 15-17 February 1989.

5. The department successfully conducted a Tamil Seminar on Environmental awareness and self employment from 19th to 21st December '91.

6. A workshop on water quality assessment was conducted between March 24 and 26 ,1993.

7. An inservice training for P.G. Teachers (Biology) was conducted during Sep.27 to Oct.1, 1993.

8. A Workshop on Biostatistics for College Teachers and Research Scholars was conducted between December 21 and 23, 1993.

9. A National Symposium on Recent Trends in Indian Wildlife Research was organised with the financial assistance of University Grants Commission, Dept. of Science and Technology, Dept. of Environment, Forest and Wildlife, council of Scientific and Industrial Research and Tamilnadu State Council for Science and Technology during February 19-21, 1995.

10. National Environmental awareness Campaign - 1994-95 of the Ministry of Environment and Forests Govt. of India was conducted for the school students of Mayiladuthurai Town from 1-3rd August 1995.

B. EXHIBITIONS CONDUCTED

1980 - A.V.C. College Silver Jubilee exhibition conducted for 3 days.

1986 - Wildlife Week Exhibition at Kodiakkarai in collaboration with the Forest Department of Thanjavur district was conducted.

1987 - One month Tamilnadu Government wildlife exhibition at Cuddalore - with the forest department of South Arcot District. Won the first prize for the best stall- Tamil Nadu Government exhibition.

1988 - 15 days Wildlife exhibition at Cuddalore.

1990 - 3 days Science exhibition at A.V.C. College, Mannampandal, funded by Tamilnadu State Council for Science & Technology, Madras.

1994 - IPM exhibition at Annamalai University and Karaikal (1995).

1995 - Science exhibition at ARC Matriculation School for 2 Days.

With a view to create an awareness about Wildlife in the minds of youth and the public the department started' Peacock Nature Club' in A.V.C. College in 1982 and it is now affiliated to Nature clubs of India supported by WWF.

Faculty members and Wildlife Biology students every year undertake the Asian Wetland Bird Census and also participate in the Black Buck census at Kodiakkarai sanctuary in collaboration with the Tamil Nadu Forest Department. This year they have also enumerated the wild animals in the Grizzled giant Squirrel Wildlife Sanctuary at Srivilliputhur during 1994. Black buck Census was carried out at Guindy National Park during 1995.

C. EXTENSION ACTIVITIES

As soon as the value of Barn Owl in checking the rodent pests of agricultural and medical importance was recognised, the Department of Agriculture, Government of Tamilnadu, Central Integrated Pest Management Centres, Government of India; Food and Agricultural Organisation, Rome; Tamilnadu Agricultural University, Coimbatore; Indian Bank, Kumbakonam arranged Scientists' - Farmers' meet at different places of Tamilnadu wherein the Principal Investigator and staff of ICAR Barn Owl Project explained the importance of conserving the Barn Owl population for effective control of rodent pests by Biological means.

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NATIONAL SYMPOSIUM ON RECENT TRENDS IN INDIAN WILDLIFE RESEARCH

OBJECTIVES

India is bestowed with rich diversity of Wildlife. The development of industrial society, population explosion and the concept of development which implies higher and higher levels of production, consumption and generation of waste has brought about a great change in the environment, some of them catastrophic causing great concern about the preservation of our wildlife diversity. No doubt various conservative measures taken by the Government of India on this aspect has resulted in tremendous improvements in our wildlife. However, a lot is yet to be done and any meaningful wildlife conservation strategy should have an input from researches on the wildlife habitats, physiology, behaviour, etc.,.

Recently, a large number of Governmental and non-governmental organisations, Universities and other similar bodies have concentrated on wildlife research and education in India. But a coordinated effort between different agencies engaged in this field is lacking or insufficient. So, it is thought a common forum is needed to discuss about the recent trends in wildlife researches that is going on in different parts of this continent, which would in turn greatly help in formulating a working plan for urgent needs concerned with the conservation of our wildlife. The symposium is aimed at providing such an opportunity to our wildlife researchers all over India.

Scientific Programme

The symposium provides a forum for critical review of the current methods used in wildlife research and new findings and concepts pertaining to the conservation of Indian Wildlife. Eminent scientists, dedicated research workers and academicians will present papers on the following aspects of Indian Wildlife and Forests:

1) Invertebrate diversity
2) Herpetofauna
3) Avifauna
4) Mammals
5) Forest and Forestry and
6) Wildlife Management and Conservation.

The Scientific programme will include six sessions in which papers and poster presentation will be given.

RESUME OF THE SYMPOSIUM

The Symposium began with the registration of participants even before a day ie. on 21st. The Inaugural function had a colourful start on 22nd February 1995 at 10-00 a.m. with an Invocation to the Almighty. Prof.J.Krishnamurthy read the messages received from several dignitaries wishing the function every success. Prof. A. Rajamohan, Principal, welcomed the gathering and introduced the luminaries on the dais. College Committee Chairman Thiru.E.S.Ganapathy gave his Presidential address. The Inaugural address of the Symposium was delivered by Dr. K. Dharmalingam, Member Secretary, Tamilnadu Science and Technology who blessed the Institution for hosting this National Symposium and stressed the importance of Studies in the field. Mr. B. Vijayaraghavan, Chairman, Madras Snake Park Trust critically evaluated the present day research which is mainly confined to laboratory. He elaborately discussed the importance of behavioural, taxonomical and ethnobotanical studies. Dr. R. Natarajan, Emeritus Scientist highlighted the importance of Conservation in his felicitation speech. The Inaugural function came to an end with a proposal of Vote of thanks by Dr. R. Kanakasabai, the Organising Secretary. The Inaugural function prolonged upto 12 noon without a tea break.

The Technical session I on Herpetology began at 12.30 p.m in which Mr. B. Vijayaraghavan acted as the Chairman, and Prof. C. Sankaravadivelu as the Co-Chairman. Three papers were presented by 2 researchers. The Chairman passed his frank and sharp criticism on the papers presented in this session.

The post lunch the techinical session II on ornithology commenced, in which Dr. B. Ramaswamy of Osmania University and Dr. P. Balasubramanian of SACON, Coimbatore performed the duties of the Chairman and Co-chairman. A total of eight papers were presented of which 6 belonged to ornithology and 2 papers on forestry.

The Second day of the symposium began with a special lecture by Mr. Mangalraj Johnson, Retd, Wildlife Warden, on Conservation and Wildlife administration. He clarified all the doubts regarding the limitations of the forest and Wildlife administration. He chaired the session assisted by Dr. Mathew John of Veterinary science. A total of seven papers were presented in this session.

The Technical session III on the second day was on mammalogy chaired by Dr. Mir Mansoor, Veterinary Officer of Kashmir, Co-chaired by Dr. N. Sivaganesan of SACON, Coimbatore. Including the Chairmans paper on "Hand rearing of the snow leopard" four papers were read in this session which are critically questioned and defended by the presenters.

The Technical session IV after lunch was on Invertebrate Diversity in which Dr. M.R. Chandran, Prof. of Animal ScienceBharathidasan University gave a special lecture on Immunomodulation of the toxic chemicals and chaired the session. Dr. Devi Swetharanyam, DGG Arts College, Mayiladuthurai acted as the Co-chairman.

The ultimate day of the symposium began with the Invertebrate diversity session in which Dr. Devi Swetharanyam coordinated the proceedings as chairman of the session. Five papers including that of the Chairperson were presented in this session.

Dr. N. Sivaganesan of SACON, Coimbatore presented his paper on Nilgiri biosphere reserve management with his lively projection.

Dr. A.N. Subramanian, Reader, CAS in Marine Biology gave a special lecture on Marine pollution and conservation of Marine Mammals.

The penultimate academic session was on Forestry chaired by Dr. R. Saravanamuthu and coordinated by Dr. K. Thiyagesan who acted as the Co-chairman. A total of five papers were presented in this session.

Of the 69 participants registered for this symposium, 44 papers were presented by scholars. All the papers were critically evaluated and a few of the papers received brick bats both from the Chairman and the participants. Except these, other papers were of excellent standard and are appreciable.

The valedictory function commenced after the plenary session in which participants gave suggestions to invite other discipline members. Prof. J. Krishnamoorthy welcomed the gathering and the Chief Guest. Prof. G. Ramaswamy presented the activities of the symposium as Resume of the symposium. The Secretary of the A.V.C. College Education Committee Thiru.S. Balasubramanian presided over the funtion. Dr. V. Ramaiyan, Director CAS in Marine Biology, Portonovo gave the valedictory address. Prof. A. Rajamohan, Principal distributed the certificates to the participants. Prof. G. Thirunavkkarasu, Vice Principal proposed a vote of thanks and the symposium came to a happy end with the singing of the National Anthem.

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WILDLIFE RESEARCH IN INDIA

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The degradation and depletion of our natural resources due to both processes of development and the lack of it are well documented in many tracts including the country report to UNCED in 1992. This has led to the formulation of the National conservation Strategy and Policy statement on environment and development which take note of actions already taken to conserve forests and wildlife including the National Wildlife Action Plan, establishment of National Parks and sanctuaries, surveys and research studies. It refers to the need for an agenda of action "to prevent further damage to and conserve natural and man-made heritage", "to conserve and nurture the biological diversity, genepool and other resources through environmentally sustainable development and management of ecosystems' and " to protect the ..... ecosystems and wildlife habitats..... ". To address this agenda among the instruments of action should be "to encourage research ..... and to promote application of modern tools of science and technology for conservation."

Thus... Wildlife habitat conservation, biodiversity conservation and research to help them are part of the firm agenda for action. It is significant that conservation of these natural wildlife resources is not linked at in isolation but in the context of the whole of the resources. Research too has to note these linkages and whole in certain areas, higher specialized studies related to species, populations, communities or habitats and area may be necessary, the research must get integrated with other streams of research whether on linked usages of natural resources or competitive uses of areas for industry, agriculture or/ and their impact on wildlife itself.

It is in the spirit of the totality of the exercise that research on wildlife has been taken up along with several other research projects like those on ecosystems, biospheres etc. Specific research on species like the tiger, lion, elephant etc. also has been done and some research on aspects of ex-situ conservation (including the veterinary aspects) has been carried out. Institutes like Wildlife Institute of India, Forest Departments, Universities, NGO's like BNHS, WWF etc have pioneered some projects.

But on survey and assessment of the research shows that wildlife research is too much a function of the particular interest of the researcher and rarely a function of the need to study a species or population in totality including its habitat and ecosystem. Inspite of taxonomic efforts having shown the steady endangerment of several species there has been no focus on research on all rare and endangered species. In areas like population and habitat viability analysis, a captive breeding of ecology of whole areas like grasslands (covering all species in them) or wetlands there have been yawning gaps. Yet partly because of the interest of the researchers or the accessibility of the subject or availability of earmarked funds from home, from abroad certain projects have been taken up eventhough there was duplication and overlap of objectives. Obviously all this needed correction in a country like ours where financial resources have to be put to optimal use based on clearly defined and discussed priorities.

It was in this context that the Ministry of Environment and Forests, Government of India have tried to bring together the institutions, experts, Universities, Departments etc. which are engaged in forestry research and tried to identify gaps in dealing with ecosystems, wildlife, habitats or rare and endangered species. with a view to ensure some kind of conservation and building up broad based expertise in the country in a situation where

biodiversity conservation is throwing up challenges here and abroad, institutions like Wildlife Institute of India, BNHS, SACON, WWF have been asked to bring together researchers in regional formation. It is in this context that this Symposium of AVC College on Recent Trends in Indian Wildlife research assumes significance and one hopes the conclusions of this symposium will be a valuable supplement to these regional efforts and be of guidence to policy makers, Forest and Wildlife authorities and fund giving agencies.

Pradesh and in 1986 to Royal Bardia National Park, Nepal. Recent reports indicate that 238 rhinos were poached in India between 1982 and 1985 but this rate of attrition has slowed down considerably due to successful protection programmes.

The great herds of gazelles and deer which once roamed the subcontinent have long since disappeared, although they could be seen in fair numbers until the 1940's. The dainty little Chinkara Gazelle is the most agile of the group and, although exterminated in most of its former range, still survives in the Indian deserts and the open plains of the Deccan, as well as in the foot hills of the Salt Range and in some other semi-desert areas of Pakistan.

Of the eight deer species, the most familier is the Chital, or spotted deer, which with its closely spotted rufous coat, is often regarded as the most beautiful of the world's many deers. For this reason it is a favourite in parks and zoos. In the wild it can be seen in most of the forests below the Indian and Nepalese Himalayas.

Monkeys are part of almost every Indian scene, crowding around villages and boldly entering cities, where they help themselves to feed at wayside stalls and mingle with the traffic. They are rarely molested, although a few species such as the Goldern Leaf monkey of the Sankoah River region on the Bhutan frontier have been known to be killed for their beautiful fur.

A paradise for birds

The Indian subcontinent is a positive paradise for both amateur bird-watchers and serious ornithologists. If Sri Lanka is iincluded, it has 2061 species and distinctive subspecies of birds, a figure surpassed only in South America. Europe has a mere 630 or so, including vagrants. It is possible to see 150 different species in a single day on a car journey around Delhi area including Sultanpur, where a sanctuary has been established. The great diversites of species is, of course, again a reflection of the many different climatic and vegetational zones available for their development.

The cold-blooded creatures

No attempt to describe the wildlife of the Indian subcontinent can ignore its crocodlies, snakes and other reptiles. Of the first mentioned there are three species - the bluntnosed mugger, or marsh crocodile, the thin snouted, fish eating gharial and the larger sea-going estuarine crocodile. The big saltwater estuarine Crocodile can occassionally be seen in the tidal creeks of the Ganges, Brahmaputra and Mahanadi rivers and some Indian coastal waters. A sanctuary has been established for them at Bihar and Kaniska in Orissa, while others have been reared successfully by the Madras Crocodile Bank.

The threatened environment

From the proceeding pages it will be obvious that throughout the Indian subcontinent wildlife has suffered a very serious decline, chiefly due to the enormous reduction of forests and the steep increase in the human and livestock populations. Nevertheless, the variety of species of mammals, birds, reptiles and plants which can still be enjoyed, is astonishingly great. Some substantial remnants of all the various forest types still remain and the scenic splendour of the subcontinent although much altered is till magnificent.

In India the amount of land subject to flooding has doubled in the last ten years.

It has been calculated that 53 percent of India's land is now subject to serious degradation from erosion, water logging, salinity, alkalinity or the ill-effects of shistiny cultivation. Of these, flooding and excessive salinity are the chief problems and both can be attributed to inadequate control of the major rivers. The fresh water sources in India are now polluted. The use of chemical fertilisers and pesticides is encouraged by the Government. But the factories discharge their untreated efluents into the rivers and the payment of subsidies encourages the overdosing of crops, so that run-off quickly pollutes the irrigation channel. Sulphur/dioxide and oxides of nitrogen as a fall-out from factory chimneys in the form of 'acid rain' is also damaging animal health and forest

Conclusion

The natural world of the Indian subcontinent stands at the crossroads. Indiscriminate hunting of the forests since the turn of the century have taken their toll, and many wonderful species of plants, animals and birds are seriously endangered if not already lost. Therefore it is absolutely required to reconcile the conservation and management of its wildlife with the overwhelming needs of more than eight hundered million human inhabitants, who depend on natural resources for survival.

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GLOBAL IMPACTS ON BIOSPHERE

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With major climate changes predicated in the near future, the need to maintain maximum biodiversity is emphasised, since that will be the raw material with which the human society must adopt to change. We can hierarchically build up from the local, to the national, to the regional, to the global by building up a network, standard methodology and nomenclature for information exchange.

But information about biodiversity alone is not sufficient to protect habitat. More often than not, it is a global truism that money speaks louder than words. Any form of development results in some environemtnal change, which need not be negative but still there is loss of species in the habitat. At least we must be certain about what we are losing and must ensure that the sustainable benefits of development out-wieghts the environement cost.

It is estimated that there are about 30 million species on this planet, of which only 1.5 million have been described. The habitat of this biodiversity include wet lands, mountains, deserts, coasts and seas, though of course the most important are the tropical forests which contain 1/3 of the world species. If a particular habitat is reduced by 10% of its size, nearly half the species it supports will be lost. If the present rate of habitat destruction continues in the tropics, then up to a third of world species now living could be destroyed in the next two decades.

Majority of speicies are insects (750,000) plants (250,000) and vertebrates (41,000). The remains are invertebrates and microorganisms. Most species are found close to the equator and few near the poles. Species diversity peaks in tropical forest and coral reefs For example 700 tree species occur in tropical forest of 15 hectares area whereas the whole of North America has only this number.

It has just become an absolute and urgent necessity at the global level to preserve the diversity containing the gene pool. Each and every species of plant or animal has unique characteristics: almost any of it may be of potential use in medcine or in the development of crops and other products. During the coming decade we must ensure the survival of as many species as possible either by in situ preservation or by breeding in captivity. The population levels of endangered of threatened species must also be carefully monitored. Each variety within a species contains unique general diversity of genes within a species helps in the adaptation to pollution and disease. In rural communities, people make useof earth's biodiversity directly.

The new approaches emerging in connection with national resources preservation are geographic information systems which make use of satelite images, microwave sensors and aerial photographs. In this way it must be possible to build up world-wide pictures of species diversity to assess the status of an important habitat and biologically critical areas, to provide early warning of reductions in populations of individual species and to carry out informed studies of general trends.

One-fourth of earth's species are at risk (nearing extinction) within next 30 years because of habitat destruction. Tropical deforestation would eliminate nearly 10% of the total species by 2020. Pollution of land and water will also lead to such losses of life.

Normal vegetation only protects and sustains land and water supplies. When rural people loss species, their welfare (also that of future generations) are threatened.

Life on land depends on the product of the photosynthesis, which are being diverted to support a single species, the mankind which is harvesting plant derived materials from over 35% of the total land surface, with agriculture crops accounting for around 10% of terrestrial primary production. During the development of civilization over the past 10,000 years, to-date we have ploughed 15 million km^2, used 32 million km^2, leaving only the most inaccessible, unproductive and inhospitable part of the remaining 90 million km^2 in a pristine state. Thus we have succeeded at a considerable environmental cost, in providing food, fuel and fibre to the evergrowing human population (currently increasing by 1 million every 5 days). From this process we have depleted vegetation cover, leading to destruction of many thousands of plant and animal species and a world wide reduction in Biodiversity. Further more, the fertility of the cultivating land is declining due to soil erosion, toxification and desertification. The global use of top soil is estimated to be around 75,000 million tonnes/year-an order of magnitude greater than its natural rate of replenishment. Additional changes likely in the near future in global climate due to CO_2 accumulation, or the greenhouse gases effect. Ozone holes and direct UV radiation, the rate of climate change could be of critical importance in determined bioshperic responses to global warming. Plants and soils are responsible for the rate of rainfall, the return of water to the atmosphere and the heat budget on the earth's land surface. In the event of global warming, regional alterations in rain fall patterns are likely to have a greater ecological and socio-economic impact.

Many animal and plant populations are maintained over periods of time by immigration. That the small populations of plants and animal may periodically become extirpated because of, for instance, a severe winter, drought and exploitation by man. These lost populations founded by individual emigrating from areas where the species fared better. Those kinds of movements are probably responsible for the longterm maintenance of many species. Habitat fragmentation and disruption of movement corriodors by over-human activity reduces the ease with which animals and plants may move about. This in turn increases the likelihood populations will not be reestablished.

Also decomposition process appear to be the most consitive indicators of changing climate conditions in temperate forests.

Animals and plants are not likely to respond as entire communities, but species will move with changing climatic conditions independently of one another. New mixtures of species may export prey to new predators and disease organisms to new hosts. The reserves established to protect communities may fail because plants and animals will move out of the reserve bounderies following the moving climate conditions. The current role played by reserves must be enlarged and reserve planners and managers must become prepared to deal with climate change.

Because most of the species becoming extinct are tropical plants and invertebrates about which we know almost nothing, their losses go unlamented by the public. This would mean annual rates of extinction measured in tens or even hundreds of thousands of species, resulting in an environmental, evolutionary, and socio economic crisis greater than any other in history. Even if human impact on the environment were halted today, species would continue to become extinct for decades because of the environmental damage that already has occured.

Monospecific conservation programmes are important and often enjoy popular appeal, especially for large reptiles, birds or mammals. Many species of turtles, snakes, crocodiles, parrots, primates, elephant, rhinoceroses, and whales, among others, have conservation problems related as much to specific human uses (hunting, pet trade, etc.) as to loss of habitat. Nevertheless, there is little hope in the near future that specific "recovery plans" can be formulated and implement for more than a small fraction of all endangered species.

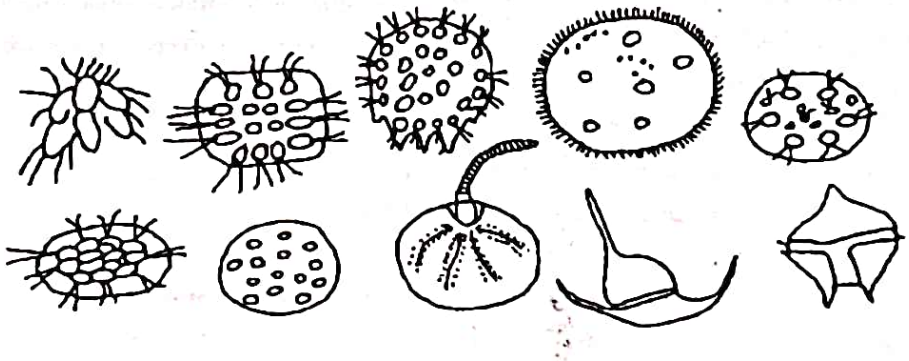
It is now widely recognized that protection of entire natural ecosystems, with their interdependent assemblages of plants and animals, is the only effective way to preserve a major portion of the remaining biodiversity. The office of endangered species is beginning to emphasize geographic areas or ecosystems rather than single species in its listing efforts. Captive breeding programmes are essential to preserve the remaining genetic stock of many highly endangered & contrasted with those of migratory shorebirds. Migrating animals depend on food sources availble enroute; however the timing of the migration may be triggered by different environmental dues than those that trigger bursts in food production. Climate change may desynchronize the timing of migration and food production, food that is needed in to complete the migration and for reproduction. Migratory animals present a challenge to conservation because they often cross national borders, thus requiring international co-operation. Climate change, acid deposition, and habitat fragmentation may interact synegistically to reduce or elminate communities.

Fragmentation of habitats by human activity shrinks population sizes and makes them more vulnerable to extinction. Loss of migratory corridors forecloses the opportunity for new individuals to reach empty habitats. Polluting aquatic and terrestrial habitats may make them fragmented to the plants and animals that live there. For example, acid deposition may accelerate soil acidification and fragment the habitats of sensitive amphibians. Roadways may be formidable obstacles to animals that migrate among habitat patches. Deforestation shrinks and fragments habitats and produces greenhouse and acidforming gases, which further fragments habitats.

The current estimation of deforestation is 16.8% million hectares/year. The world's live stockpide of wood amounts to 35 billion m^3, which generate a small growth of 6 million m^3 area, which occurs in thinly populated areas of Alaska, Canada and Siberia. Most of the tropical rain forests, near the equatorial region, located in developing countries, suffer from a huge loss, facing a shortage.

Although our environmental information remain inadequate in many instances, there is no longer and the overall picture regarding biological diversity is alarming and is getting worse.

Throughout the world, species are being lost at a higher rate than ever before. In destroying these products of billions of years of organic evolution, we threaten the existence of all natural communities including human communities. In spite of our attempts to live apart from nature, humans require supplies of air, water and food just like any other species.



Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research,
A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

THE STUDIES ON PLANKTON FLUCTUATION IN A RESERVOIR AT ANNAMALAINAGAR, TAMILNADU

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ABSTRACT : The present investigation deals with the qualitative and quantitative estimation of plankton. Some of the phytoplankton and zooplankton were identified in a reservoir at Annamalainagar, Tamilnadu, during April to September, 1993. The biology, total number and productivity during the study period were studied. The phytoplankton showed fluctuation and its productivity was higher (618 org/l) during June and lowest (402 org/l) in April 1993. The density of zooplankton population was maximum (496 org/l) during September and minimum (224 org/l) in June 1993. The significance and fluctuation in plankton productivity was discussed.

The total inland water spread is over 1.37 million hectare in India. Tamil Nadu holds only 49,887 hectare (Jhingran, 1975) Several studies have been made on the fresh water environment with reference to physico-chemical and biological characteristics (Daborn and Clifford, 1974; Sondergaard and Sand-Jensen,1979; Ramanibai and Ravichandran, 1987; Deckker and Williams, 1988; Saunders and Lewis, 1989 and Bahra *et al* 1993). Waters in the tropical region of India particularly small ponds, tanks and reservoirs have not been studied extensively. With this in view, the present work has been undertaken which deals with the planktonic community of a local reservoir at Annamalainagar.

STUDY AREA

The present study was undertaken in a reservoir at Annamalainagar (11°24 N; 79°44'E), Chidambaram, South Arcot Dt., This freshwater reservoir has two sub-units which are separated by the main road. Both the reservoirs have the same water spread area of 31354 m ^{2} each (228.60m x 137.16 m) and the depth of 2 m. The water pumped out from the southern reservoir is used for other domestic purposes and hence only raw water directly pumped to the students hostels.

MATERIALS AND METHODS

Limnological studies were carried out during April 1993 to September 1993. Samples were taken from the five different stations monthly. Plankton were collected by filtering the water through 0.3 mm mesh plankton net and counted under the microscope using plankton counting chamber. Identifications were made following Davis(1955), Prescott (1964), Edmondson (1965) and APHA (1989). The plankton population was expressed in org/l.

RESULTS AND DISCUSSION

The phytoplankton fluctuates monthly and its productivity was high (68 org/l) in June and low (402 org/l) during April 1993. Phytoplankton comprise major portion in the reservoir. The basic process of phytoplankton production is dependent upon temperature, light and nutrients (Davis, 1955, Sreenivasan, 1964, Sondergaard and Sand-Jensen 1979; and Spencer and King, 1989).

The maximum population (66/l) of *Navicula* sp was observed during June and minimum 22/l in April . *Nitzschia sp*. ranged from a minimum of 32/l in September to a maximum of 70/l in June. *Cymbella sp* ranged from a minimum of 36/1 in September to a maximum of 60/l in August. *Fragilaira sp*. showed a minimum of 20/l in August and a maximum of 62/l in July. *Hydrosera* sp was found to a minimum of 36/l in September and a maximum of 78/l in June. *Oscillatoria* sp. ranged from a minimum of 30/l in April to a maximum of 54/l in May and July. *Anabena* sp. was observed a maximum of 40/l in April and a maximum of 74/1 in June. *Coelosphaerium* sp. showed a minimum of 22/l in April to a maximum of

86/l in September. *Microcystis* sp. ranged from 32/l in April to of 76/l in June. *Volvox* sp. showed a minimum of 52/l in June and a maximum of 70/l in May and September due to the grazing effect by zooplankton and fishes. The low level of phytoplankton may be due to the density of population was maximum (496 org/l) during September and a minimum (224 org/l) during June.

Euglena sp. ranged from minimum of 16/l in June to a maximum of 40/l in September. *Cyclops* sp. was observed a minimum of 20/l in May and June to a maximum of 44 in April. *Daphnia* sp. was observed a minimum (16/l) in June and a maximum (48/l) during September. *Diaptomus* sp. showed a minimum (16/l) it June and July and a maximum (50/l) during April and September. *Keratella* sp. ranged from minimum (14/l) in July and to a maximum of 54/l in September. *Brachionus* sp. ranged from a minimum of 20/l in June to a maximum of 58/l was observed during September. *Monostyla* sp. showed a minimum of 14/l in May and a maximum of 50/l during September. *Trichocera* sp. was recorded a minimum (20/l) in Augsut and a maximum (66/l) in April. *Synchacta* sp. ranged from a minimum of 20/l in June to a maximum of 48/l in September. *Philodina* sp. ranged from 16/l in June to a maximum of 44/l was observed during April and September. The observed Rotifers and Crustaceans are the major groups of freshwater zooplankton than the others, as it was reported earlier by Davis (1955). Rotifers were noted as the most dominant group of zooplankton, as these constituted the major fraction of the zooplankton population for the most part of the study. Bahura *et al* (1993) and Sampath *et al* (1978) reported that rotifers were the most dominant species.

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Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research,
A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

COEFFICIENT OF INTERSPECIFIC ASSOCIATION OF THE AQUATIC FAUNA OF THE HIGH ALTITUDE LAKE OF THE NILGIRIS

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ABSTRACT : The relative density, abundance and species indices of the aquatic fauna of Ooty lake indicated that their distribution pattern was affected by several factors. The covariation of the phytoplankton, zooplankton and microorganism community was calculated. Out of 153 pairwise combinations of Pearson's product moment correlation in phytoplankton, 34 species showed significant correlation. However, Spearman's correlation analysis revealed that 41 species are significantly correlated. In the case of Zoo plankton 4 showed negative correlation. In microorganisms, 44 combinations showed positive and 34 showed negative correlation that the increase of one species tend to increase the number of other species.

The quality of water may be assessed using biological parameters like diversity evenness and richness (Wilhm and Dorris, 1968; Stromgren *et al.* 1873; Legendre, 1973). The phytoplankton and zooplankton are often used as indicator organisms to study aquatic pollution (Guafin and Tarzwell, 1956; Wilhm *et al.*, 1978; Krishnamoorthy and Sarkar, 1979; Sunny Augustine and Diwan, 1990; Ragupathi *et al.,* 1994). The present study is taken up to learn more about these indicator organisms which are more sensitive to environmental changes and there are indication of progressive deterioration of Ooty lake (Balasubramanian and Balachandran, 1990). Later in 1994 Geetha studied the relative density classes of the fauna of the Ooty lake was studied and their abundance, distribution and the species diversity indices were calculated and found that species distribution was affected by several biological factors (Geetha, 1994). Intrinsic factors sometimes affect the species distribution and abundance i.e., the abundance of two species (Y_1 and Y_2) tend to increase or decrease together, when they respond in the same way to the same environmental factors or the otherway. These features indicate the positive or negative interactions between the two species.

METHODS

The water samples in the lake were collected twice a month from April 1994 to October 1994. To maintain uniformity the collection was made always in a particular point around 12.00 hrs. The phytoplankton and zooplankton were identified and counted separately, microorganisms were studied after maintaining separate cultures for bacteria and fungi. The collected data were subjected to Pearson's Product Moment Correlation and Spearman's Rank Correlation to compute the species covariations. The normal method for calculating the above said correlations are based on the following assumptions:

H_o: The species Abundance are not correlated.

H_A: The species abundance are correlated.

The computation of the correlation coefficient is based on the statistical methods.

Spearman's correlation coefficient is computed as: This correlation coefficient was usually calculated using the ordinary correlation coefficient between ranked value of Y_1 and Y_2.

Program of Ludwig and Raynolds (1988) were used to calculate Spearman's and Pearson's.

RESULTS AND DISCUSSION

Out of 153 pairwise combinations of Pearson's product correlations, 26 species show highly significant correlation and 8 show significant correlations. The other

combinations are independent of one another.However, the Spearman's correlation shows 25 species are correlated and 16 species correlated significantly. From the results it is observed that there is no marked variation in species covariation among the two methods tested.

The available number of species in the zooplankton communities are very less. Eventhough correlation coefficient values were computed with the available data it was found that only one species is highly correlated and one species is correlated out of six pairwise combinations, both in the Pearson's an Spearman's correlation test (Table 2). Since there are S(S-1)/2 pairwise combination (Six) the interpretation is not upto the expectations (Legendre and Legendre, 1983).

Thirteen microorganisms were recorded in the water sample of the Ooty lake. It is assessed that 17 pairwise combinations are highly correlated and six are correlated while using the Spearman's correlation test. However, while applying Pearson's correlation test, it is found that 24 pairwise combinations are significantly correlated. Out of which 12 are highly correlated. The total number of pairwise correlation of species in both test methods are 78.

The positive and negative correlation also exist between the pairwise combinations of the specie according to both Pearson's and Spearman's correlation. In the phytoplankton community 77 pairwise combinations show negative correlation an equal number of positive correlations also exist. Whereas in the zooplankton community the positive correlation is 4 out of 6 pairwise combinations of the species and the negative correlation is 2. In the microorganism around 44 combinations show positive correlation and 34 show negative correlation, out of the total of 78 pairwise combinations. From the results, it is concluded that the increase of one species will increase the number of other species in the case of positive correlation whereas in the negative correlation, it is vice a versa. However, it does not mean that casuality of the species is considerable.

From these results it is concluded that the interspecific association plays a major role acting as an intrinsic factor controlling the species distribution and abundance in an aquatic environment.

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Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research,
A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

A STUDY OF THE ZOOPLANKTON DIVERSITY OF THE THIRUKKULAM POND IN RELATION TO THE NUTRIENTS (PHOSPHATE & NITRATE) FOR A PERIOD OF SIX MONTHS

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ABSTRACT : An attempt was made to study the phosphate and nitrate contents of Thirukkulam pond in Mayiladuthurai and their relationship with zooplankton diversity. the zooplankton of the pond consisted of copepods, cladocerans and rotifers respectively occupying the first, second and third positions in their abudance. An inverse relationship has been observed between the nutrient contents of the pond and zooplankton production. It is inferred that the phosphate nd nitrate contents of the pond have direct bearing on zooplankton diversity.

The biological productivity of a pond is dependent on nutrients such as phosphates, nitrates, silicates, etc, which act as condition factors for the productivity. Many of these factors are not static and the interactions of these dynamic factors result in variations in the fauna and flora from season to season and even day to day in a pond. An understanding of pond ecology with its basic properties will enlighten the different processes involved in this unique ecosystem.

It is a well known fact that nutrients govern the organic production and thereby influences the biological productivity in terms of zooplankton diversity in tropical waters. Phosphate is a sub-optimum element in fresh water bodies. The sources of phosphates content of a pond may be the incessant contamination by domestic sewage (Ganapathi, 1950) industrial wastes and agricultural drainage (Seenaya, 1971), release from bottom sediments (Indira,1964) and also from the use of detergents (Imboden, 1974). It may also be released into water from the decomposition of the algal cells by bacterial agencies. Similarly, the nitrate content in fresh water bodies might originate through the surface run off from catchment areas (Indira,1964 and Hussainy,1967) domestic sewage (Warwick, 1967) and rainfall (Rao, 1955). Qastel and Scholefield (1951) had stated that the particulate organic matter and suspended soil particles might influence the conversion of ammonia into nitrates with the utilization of oxygen and thereby, contributing to the nitrate content of the pond.

The present study is an attempt to study the diversity of zooplankton in the Thirukkulam pond and its relationship with the nutrients such as phosphate and nitrate contents during six month periods.

The objectives are,

(1) estimations of phosphate and nitrate contents of pond water, and

(2) numerical analysis of the zooplankton in the above medium.

MATERIAL AND METHODS

The present study was carried out in the Thirukkulam pond of Mannampandal, Mayiladuthurai, Tamil Nadu, Phosphate and Nitrate.

The estimation of phosphate was made by the colorimetric method of Murphy and Reley (1962). The dissolved inorganic nitrate was determined by the method adopted by Wood *et al.* (1967)

Zooplankton

Ten buckets each of 10 litres of water, were collected from ten different open areas of the pond and quantitative estimation of plankton was made. The water was passed through a fine mesh sieve of plankton net (no.32) and samples of plankton were collected. The samples were fixed in 5% formalin and stored in glass

specimen tubes. The preserved samples were made upto 50 ml from which 1 ml was pipetted out using a wide mouthed pipette. The various species of zooplankton were counted by means of Sedgwick - Rafter counting cell. The results obtained were subsequently computed to numbers per litre.

RESULTS AND DISCUSSION

Phosphate

The highest phosphate content was recorded in late July while it was minimum in early July and in late October.

Nitrate

Late July was characterised with maximum value of nitrate in the pond while the lowest value was recorded in early July.

Zooplankton

Three groups of zooplankton, viz., copepods, cladocera and rotifera were present in the pond during the study period (Table 1). The copepods were the most abundant type (84.3%) of zooplankton and were represented by *Mesocyclops sp., Heliodiaptomus sp., Rhinodiaptomus sp., Paradiatomus sp., Neodiaptomus sp., Phyllodiaptomus sp., Spiodiaptomus sp.,* and *Nauplius sp.* The *Mesocyclops sp.,* and *Heliodiaptomus sp.,* were dominant when compared to other types. Similar abundance of copepods has been recorded in tropical ponds (Krishnaveni, 1980 & Indira, 1982). The cladocerans occupied the second place in the order of abundance (27.2%) represented by *Moina sp., Ceriodaphnia sp., Alonella sp., Simocephalus sp.,* and *Macrothrix Moina sp.,* and *Ceriaodaphinia sp.,* outnumbered the other types. Similar observations were made in Errakuppam Reservoir, Madras (Ganapati, 1956) and Almati Reservoir of Gujarat (Ganapati, 1964). The rotifers were the least abundant group (21%) and occupy the third place in the present investigation. Among rotifers, *Brachionus sp., Keratella sp.,* and *Platyes sp.,* occupied the first, second and third positions, respectively in the abundance. But Moore (1950) has reported the predominance of rotifers in lake Providence, Louisiana. The predominance of rotifiers over the other groups of zooplankton has also been reported in various Reservoirs (Ganapati, 1956 & 1964).

Table 1. Distribution of zooplankton (in numbers) of Thirukkulam Pond during the period of study.

Zooplankton	20th May	3rd June	17th June	1st July	15th July	29th July	12th Aug	26th Aug	9th Sep	23rd Sep	7th Oct	21st Oct
COPEPODS												
Meso cyclops sp.	130	125	105	160	40	56	160	130	88	85	80	80
Nauplius sp.	80	25	-	72	60	56	40	65	24	20	32	21
Heliodiaptomus sp.	80	75	90	190	160	124	150	180	144	110	40	35
Rhinodiaptomus sp.	80	75	76	98	128	20	72	105	80	60	42	40
Paradiaptomus sp.	83	75	95	140	112	68	90	105	88	62	60	50
Neodiaptomus sp.	82	75	125	180	104	40	52	80	40	40	30	32
Phylodiaptomus sp.	75	70	70	72	55	-	24	55	-	50	35	35
Spicodiaptomus sp.	60	54	30	92	-	64	64	70	36	-	32	40
CLADOCERA												
Moina sp.	85	80	71	80	26	28	52	70	60	56	66	72
Ceriodaphnia sp.	30	25	-	-	10	12	68	72	92	30	24	20
Simocephalus sp.	55	45	30	32	-	-	24	-	12	10	10	10
Alonella sp.	65	60	45	42	-	-	12	-	32	10	4	-
Macrothrix sp.	40	32	15	-	-	-	-	-	-	-	-	-
ROTIFER												
Brachionus sp.	30	45	40	110	90	40	76	56	16	40	60	42
Keratella sp.	30	35	25	55	40	-	26	15	8	25	32	27
Platyes sp.	15	25	18	30	-	-	12	12	-	25	30	25
Total	1020	916	835	1353	865	508	922	1015	720	623	577	529

In the present investigation an inverse relationship has been observed between zooplankton diversity and the contents of nutrients in the pond. The number of Zooplankton (1353) was the highest in early July when the phosphate content was the lowest (Table 2) and

Table 2. Relative numerical abundance of animals/litre of the various groups of plankton in the Thirukkulum Pond during the period of study.

Period			Plankton groups			Total
			Copepods	Cladocerans	Rotifers	
Mid	May	20.05.84	670	275	75	1020
Earl	June	03.06.84	574	242	105	916
Late	June	17.06.84	541	161	83	835
Earl	July	01.07.84	1104	154	195	1353
Mid	July	15.07.84	659	36	130	825
Late	July	29.07.84	428	40	40	508
Earl	Aug	12.08.84	652	156	114	922
Late	Aug	26.08.84	790	142	83	1015
Earl	Sept	09.09.84	500	196	24	720
Late	Sept	23.09.84	427	106	90	623
Earl	Oct	07.10.84	351	104	122	577
Late	Oct	21.10.84	333	102	94	529

lower in late July when the phosphate level was the highest. Similarly the highest zooplankton number (1353) was found to coincide with the lowest nitrate value (early July) and vice versa. An inverse relationship between zooplankton and nutrients viz, phosphate and nitrate has also been indicated by Ganapati (1956) for Errakuppam Reservoir and by Sreenivasan *et al.* (1964) for the fish nurseries in Madras.

Thus, the influence of the nutrients of the pond water on the diversity of zooplankton has been well enunciated in the present investigation.

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Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research,
A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

BENTHIC BIOMASS OF PORTO NOVO WATERS IN RELATION TO ENVIRONMENTAL PARAMETERS

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ABSTRACT : An attempt was made to study the benthic biomass (dry weight) in relation to environmental parameters such as salinity, temperature, dissolved oxygen and pH. These studies were carried out in three stations of Porto Novo waters viz., marine zone, gradient zone and Killai back waters. The study indicated that the benthos of Porto Novo waters consisted of four major groups viz., polychaetes, crustacea, bivalves , gastropods and other miscellaneous forms such as coelenterates, amphipods, copepods and gobid fishes. 18 species of polychaetes, 6 species of bivalves , 3 species of gastropods and 2 species of crustacea were recorded. The biomass of benthos in terms of dry weight varied from 0.34 to 1.96 g/m^2. To know the relationship among the environmental parameters,benthos and stations, appropriate statistical analyses were made.

Benthos form an important link in the food chain of organisms at different trophic levels. The role of benthos between the primary production and fish production, acting first as feeder of detritus and plant material and inturn forming the food of some predators like crabs and fishes is well understood (Panikkar and Aiyar, 1937, Sanders *et al.* 1962, Desai and Krishnankutty 1967, Desai 1973 and Ansari *et al.* 1980).Further in shallow waters macrobenthos constitute an important part of the biomass and therefore the study of benthos becomes inevitable to obtain a detailed account of the fishery potential of these biotopes.

It is also evident that benthos play an important role in the food chain of marine ecosystem and any reduction in benthic productivity may ultimately affect the demersal fishery. Harkantra *et al.* (1980) and Harkantra (1981) have reported that the catastrophe made to benthic organisms, especially by mass removal of molluscs results in the poor prawn fishery because the prawns mainly depend upon bivalves for their food resources.

Muss (1967) and Fenchel (1969) by their studies on benthic fauna of Danish estuaries estimated the abundance ratio of bacteria, ciliates and macrofauna in terms of biomass as 10:1: 50 which stressed the significance of benthos in estuarine ecosystem. Though many studies indicated the role of benthic communities on studies indicated the roll of benthic communities on demersal fisheries in trophic levels and their role on benthic production from temperate waters, similar studies in tropical waters have not been studied in detail. Therefore the study of benthos with reference to biomass is unavoidable if one has to understand the benthic community structure, the natural resources and fishery potential of estuaries and hence the present investigation.

STUDY AREA

The river Vellar originates from the Servarayan hills of Salem District and after running over a distance of about 480 Kms, it debouchs into the Bay of Bengal at Porto Novo (11° 29" N, 79° 46" E). It is a bar built estuary and the sand bar is shifted depending upon the strength of the flow of freshwater due to monsoonal rains. The width of the estuary is about 300 meters at low side and the depth about 2-3 meters. Ramamoorthi (1954) classified the Vellar estuary into (i) marine zone (ii) gradient zone (iii) tidal zone and (iv) freshwater zone based on salinity characteristics.

For the present study three stations were selected, the station I (marine zone) extends up the estuary for about 1.5 Km from the mouth and the station II (gradient zone) extends upto 2.3 Km from the marine

zone and the station III situated behind the sand dunes and lying parallel to the estuary .

METHODS

The sampling was done from May 1982 to April 1983. Four random samplings were made in each station. Weekly collections were made covering not less than 4 collections in a month . All the collections were made at low tide.

Hydrography

The bottom water samples were collected by means of Mayer's water sampler and brought to the laboratory immediately for various analyses. Temperature was measured by a thermometer of ± 0.5° C accuracy. Salinity and dissolved oxygen were estimated as described by Strickland and Parsons (1972). Hydrogen ion concentration (p^H) was measured by using a Elico model E10 p^H meter in the laboratory.

Sediment sampling

Sediment samples were collected using a Peterson grab of 0.08 m^2. Hand sieving was employed for separating the animals from the sediment. The sediment samples were screened through 0.5 mm round mesh sieve. The animals retained in the sieve were preserved in 5% neutral formalin. In the laboratory all the organisms in each sample were identified as far as possible up to the species level.

The biomass (dry weight) was determined by drying them in an oven at about 80° C - 110°C until constant weights were obtained (6 to 10 hrs) (Kasinathan *et al.* 1973). After identification the number of animals and biomass in the sample were calculated for a sq. m area.

Hydrographical parameters of bottom water were correlated with biomass using Spearman rank correlation coefficient. To study the variations if any among the stations and between stations. Analysis of variance was applied to the data (Sokal and Rohlf 1969).

RESULTS

Hydrography

Monthly variations in salinity, temperature, dissolved O_2 and p^H were given in table 1. The monthly mean salinity values varied from 17.04% to 34.84%; 15.07% to 34.28% and 19.67% to 34.25% at stations I, II and III, respectively. In general, the highest salinity

Table 1 - Monthly variations in the physiographic factors and biomass (dry weight) of benthos in the 3 habitats from 1982 to 1983

	Habitat I					Habitat II					Habitat III				
Period	Sal	Temp	Do	pH	Bio	Sal	Temp	Do	pH	Bio	Sal	Temp	Do	pH	Bio
May	34.71	31.25	3.92	7.50	1.32	31.30	30.35	4.00	7.92	1.59	33.30	30.60	3.63	7.72	1.24
June	32.06	31.75	4.31	7.85	0.58	29.08	29.45	4.41	7.81	1.17	33.18	30.65	4.41	7.62	1.11
July	31.94	29.90	4.18	7.62	0.43	29.79	29.60	3.98	7.65	1.59	26.92	28.75	3.94	7.77	0.96
Aug	29.03	29.25	4.37	7.80	1.03	29.29	28.65	3.05	7.60	1.27	30 17	28.25	3.96	7.52	1.07
Sep	27.69	27.75	4.47	7.50	1.31	28.40	27.00	4.13	7.67	1.68	29.77	29.35	3.06	7.47	1.33
Oct	23.39	24.60	4.92	7.57	1.05	27.27	27.15	4.45	7.25	1.41	28.53	28.30	4.51	7.62	0.79
Nov	17.04	23.75	5.60	7.45	0.55	15.07	23.10	5.00	7.30	0.44	19.67	23.50	5.62	7.32	0.87
Dec	19.22	22.80	4.82	7.60	0.65	18.08	24.75	4.37	7.35	0.52	22.46	24.85	4.32	7.40.	1.03
Jan	32.54	30.50	4.10	7.55	1.03	31.99	28.25	3.78	7.80	1.06	30.56	29.10	4.15	7.75	0.79
Feb	34.84	31.00	3.70	7.70	1.01	34.28	30.25	3.71	7.75	1.10	33.02	30.75	4.89	7.70	0.61
Mar	33.98	31.80	3.42	8.00	1.22	33.71	32.00	3.54	8.05	1.55	33.95	30.85	3.85	7.75	0.68
Apr	34.35	30.30	3.36	8.00	1.66	34.17	32.40	3.41	7.80	1.24	34.25	31.25	3.74	7.90	1.10
$\bar{X}$ ±	29.23	28.64	4.26	7.65	0.99	28.53	28.58	3.98	7.67	1.22	29.65	28.85	4.17	7.63	0.94
S.D.	6.19	3.37	0.44	0.56	0.43	6.07	2.75	0.53	0.25	0.07	4.59	2.55	0.63	0.14	0.04

Sal = Salinity; Temp = Temperature; Do = Dissolved oxygen; Bio = Biomass.

was recorded during summer and the lowest during monsoon (Table 1). The temperature varied between 22.80° and 32.40 °C. Generally the temperature was found to be maximum during summer and minimum during monsoon

At station I, the mean level of dissolved oxygen was found to be 3.36 ml/lit to 5.60 ml/lit; 3.05 to 5.00 ml/ lit at station II and 3.06 to 5.62 ml/ lit at station III. Low values of O_2 content were recorded during the summer and higher values during the monsoon season. At stations I, II and III the p^H ranged from 7.45 to 8.0, 7.25 to 8.0 and 7.32 to 7.90, respectively.

Nephthys polybranchia, Nereis sp. Phyllodoce sp. Prionospio cirrobranchiata

P. polybranchia

Sternaspis sp.

Crustacea

Apseudes chilkensisA. gymnophobiaAlpheus malabaricusHermit crabSylla serrata

Bivalves

Anadara granosa, Katelysia opima, Meretrix casta, Paphia textile

Solen kempiTellina sp.

Gastropods

Cerethidia fluviatilis, Nassarius sp .Natica macroechinensis

Table 2 - Spearman rank correlation co-efficient analysis among environmental parameters and benthos

	Station I				Station II				Station III			
	Sal	Temp	Do	Ben	Sal	Temp	Do	Ben	Sal	Temp	Do	Ben
Sal	1.00	0.79 **	-0.93 **	0.43 *	1.00	0.87 **	-0.80 **	0.37	1.00	0.86 **	-0.85 **	0.43 *
Temp		1.00-	-0.81 *	0.64 *		1.00	-0.66 *	0.45		1.00	-0.79 **	0.59 *
Do2			1.00	-0.62			1.00	0.37			1.00	-0.68

* Significant level rs (0.05) = 0.506
** Significant level rs (0.01) = 0.712

Benthos

Species composition

Qualitative analysis of benthos revealed that the benthos of Vellar estuary consisted of five major groups viz., polychaetes, crustacea, bivalves, gastropods and others which included coelenterates, amphipods, copepods, gobid fishes etc. Totally, 18 species of polychaetes, 6 species of bivalves, 3 species of gastropods and 2 species of crustacea were obtained

List of Benthos

Polychaetes

Ancistrosyllis constricta, Ceratonereis costae
Cossura delta, Dendronereis estuarina
Diopatra neopolitana, Glycera alba
Heteromastus similis, Laonomeindica,
Lumbriconereis polydesma
Lumbriconereis simplex

Biomass

The dry weight values varied from 0.43 to 1.66 gm/m², 0.44 to 1.69 gm/m² and 0.61 to 1.33 gm/m² at stations I,II &III, respectively.. In general the biomass values were relatively higher during summer and pre-monsoon seasons when compared to other seasons (Table 1).

DISCUSSION

Hydrography

The magnitude of variation in the environment as quoted by Qasim (1980) depends to a large extent on the time of the year and the place of observation. During the study period the monsoon failed and so the influence of freshwater was not very high and thus no marked variations in salinity were observed except on few occasions (Oct & Nov). As reported earlier by Balasubrahmanyan (1960) the station I showed rela-

tively higher values of salinity than stations II & III. Correlation analysis revealed that salinity and dissolved oxygen content were inversely related to each other which may be attributed to the inflow of freshwater during rainy season, whereas salinity and temperature were positively correlated to each other (Table 2) which might be due to intrusion of cool neritic waters into the estuary and also the salinity was gradually built up after the monsoon which reached its maximum during summer.

High level of dissolved oxygen were recorded during pre-monsoon seasons which may be attributed to the higher oxygen solubility in low salinity and low temperature. Dehadrai and Bhargava (1972) had reported similar observations from the Mandovi and Zuari estuaries of Goa.

No marked variations in p^H were observed and similar results were reported by Sivakumar (1982) in Vellar estuary.

Biomass of benthos

The biomass values of benthos in terms of dry weight at stations I,II and III were almost similar to the observations made by Parulekar (1973) and Harkantra *et al.* (1980) who worked along the west coast of India. Kasinathan *et al.,* (1973) reported that biomass of polychaetes and molluscs varied from 0.23 to 14.09 gm/m^2 and that of total benthos between 9.95 and 18.25 gm/m^2. Varshney *et al.,* (1981) recorded an average biomass of 0.349 gm/m^2 (dry weight) in Narmada estuary which also confirmed the results of the present investigation. However, the station III showed relatively low values of biomass than stations I and II which may be attributed to the low production and shallowness of backwaters and sediment types. The analysis of variance indicated that no significant variations exist between stations I and II with respect to biomass production. However, station III showed significant variations with stations I in this respect (Table 3).

A significant negative correlation was obtained between the dissolved oxygen content and the biomass of benthos. This may be explained that when the total fauna was high, the dissolved oxygen content was low, because benthos were bottom dwellers where the O_2 content was low due to the utilization of O_2 by benthos as well as anaerobic nature of the muddy substratum. Similar findings were made by Parulekar and Dwivedi (1974) from the westcoast of India. A positive correlation was also obtained between salinity and biomass of benthos.

Table 3 - ANOVA table for dry weight of benthos from stations I, II & III

Station	Source of variation	DF	SS	MS	F
I,II & III	Between stations	2	0.92	0.460	8.360**
	Within stations	33	1.84	0.055	
I & II	Between stations	1	0.01	0.010	0.163
	Within station	22	1.36	0.061	
I & III	Between stations	1	0.78	0.780	35.000**
	Within stations	22	0.48	0.022	
II & III	Between stations	1	0.58	0.580	6.980*
	Within stations	22	1.54	0.084	

** Significant at 1% level
* Significant at 5% level

The non significant correlation between the above parameters may be due to the dependence of benthos size on biomass rather than their number.

ACKNOWLEDGEMENTS

We are much grateful to the authorities of the Annamalai University , in particular the Director, CAS in Marine Biology, Parangipettai for providing the necessary facilities to carry out this work.

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Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research,
A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

SYSTEMATICS OF INSECTS OF PITCHAVARAM MANGROVE FOREST, SOUTH ARCOT DISTRICT, TAMILNADU.

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ABSTRACT : Systematics of insects of Pitchavaram Mangrove forest, south Arcot district, Tamilnadu was studied from December 1993 to March 1994. A total of 101 species of insects belonging to 9 orders and 42 families were collected and identified upto species level except a few. A maximum number of 28 species of beetles and 25 species of scale wings were collected. They were followed by 14 species of ants, bees and wasps, 11 species of bugs, 7 species of orthopterans, 7 species of flies, 3 species of dragonflies and only one species of antlion. Totally 52 species of insects were collected from herbs, 23 species from trees, 17 species from soil and 8 species from grasses while only one species from aquatic habitat. Fifty percent of the insects collected were found to be pests of plants or parasites on useful trees, insects and other animals while the remaining were beneficial insects.

One of the important types of forests in India is mangroves. India is rich in mangrove resources. The total area of mangroves in India is estimated to be 67470 sq km. The multivarious uses of mangroves include protection of shorline, boosting aquaculture, providing cheap resources of medicine and widening chances of rural employment. Pitchavaram mangrove forest acts as a suitable habitat for 200 species of birds, a few mammals, reptiles and other fauna (Sampath and Krishnamoorthy, 1993). Though the insects occupy an important position in the trophic structure of an aquatic environment especialy in the mangrove, there is no detailed report on their systematics. Pandit (1965) has stated that it is not possible to influence the population of economicaly beneficial insects or reduce the population of insects that cause damage to food, fibre and forestry, without identifying them, their characteristics and life processes. Since the relationship between insects and forests is very close, the classification of them is considered as a prerequiste for understanding forest entomology. The systematics of the Indian insects are very well explaind in the series of fauna of British India. The stumptous work ever produced on indian forest beetles was by Beeson (1961) and Stebbing (1977). The systematics of the insects of Vedaranyam reserve forest and Anamalai Wildlife sanctuary have been thoroughly worked out by Sridharan, (1982) and Subramanian (1983) respectively. However, the insects of the Pitchavaram mangrove forests has not been studied earlier and hence the presnt study.

METHODS

The Pitchavaram mangrove forest (11° 25 ' N, 74° 47 ' E) is one of the richest and most interesting mangrove forest in India, at the mouths of Vellar, Coleroon and Upanar rivers in south Arcot district near Chidambaram, Tamilnadu. The total area of this forest is 11,000 ha in which 1,416 ha is under reserve forest. The forest consists of 51 islands and islets separated by a complex network of creeks and channels. Climate in the study area is tropical monsoon. The region is subjected to the the North-east monsoon, with most of the rain fall in between October and December.

Insects were collected from Pitchavaram mangrove forest from December 1993 to March 1994 for the present study. Field observation and collection of insects were made during early morning and early evening hours. The identified insects were named, labelled and arranged in a systematic manner in the insect box and the characters of each species were carefully studied by using hand lens. In order to ensure the scientific value of the collected specimen, a small label bearing information concerning their systematic position was attached to the pin of each specimen.

The colleted specimens were identified by using the standard reference such as Indian Insect Life (Lefroy, 1909); Some South Indian Insects (Flecther, 1914); Indian forest insects - Economic importance: Coleoptera (Stebbing, 1977); Useful and destructive insects (Metcalf and Flint 1975); The identification of Indian butterflies (Evans, 1932); The illustrated encyclopedia of the butterfly world in colour (Smart, 1977); Butterflies of Indian region (Wynter Blyth, 1952); and with the help from the Department of Entomology, Agricultural College, Annamalai University, Chidambaram.

RESULTS AND DISCUSSION

In the present study, 101 species of insects were collected . These insects were classified into nine orders and forty two families. seventy-eight insects were identified upto species level, and fifteen insects upto genus level while eight insects were identified upto order level. The check list of insects is given in the Table-1. A maximum of 52 insects were collected from herbs followed by 23 insects from trees, 17 insects from soil, 8 insects from grasses and only one insect from water. Among the collections of this study 52 insects were harmful while the remaining 49 insects were beneficial. The present study also indicated that among the insects collected 50% were harmful either as pests of plants as inferred from previous works (Fletcher, 1914; Lefroy, 1909; Stebbing, 1977; Metcalf and Flint, 1975) or parasites on useful insects and other animals There were, 5 pest species of cultivated crops also. The adjoining places of Pitchavaram mangrove forest is rich in cultivated crops like paddy and groundnut, which would have provided suitable foraging ground to the insects like Leptocorisa *varicornis*, *Dysdurus cingulatus*, *Manido histro*, *Aschishus brevicornis*. The mangrove vegetation of Pitchavaram might serve as an alternate host for these insects. Two species of migratory orthopterans such as *Acridium Sucinutum* and *Acridium peregidium* were collected. Both were considered to be a serious pests of bushes and all green vegetation. *Hieroglyphus farcifer* and *Acridium malanocorne* are serious pest of cultivated crops from adjoining area. Odonates require an aquatic environment for rearing their youngones. The naiads are aquatic and Pitchavaram mangrove provide a suitable habitat for breeding of Odonates and hence might have resulted in species richness. Species richness was the highest in the coleoptera with 28 species among these 18 species were found to be pests and 10 of them were serious pest of trees. The Lepidopteran insects are abundant in Pitchavaram since the habitat is very ideal for the scale winged insects. Among the Hymenopterens collected *Chalcis crule* has been reported to be a parastitic upon catterpiller of butterflies (Lefroy, 1909). Since the butterfly fauna of Pitchavaram is found to be also rich the *Chalcis crule* is able to survive. All formicides were collected from dry places. Pitchavaram mangrove forest also inhabit jackal, otter and also large number of domestic cattles, hence the blood sucker *Tabanas striats* was also collected. The collections are included equal number of beneficial insects serving as pollinators (butterflies, wasps and bees) while many of them were scavengers such as dung beetle *Heliocpris bucephalus*, *Onthophagus onitis*, *Onthophagus longicornis*, *Cresmongaster dohrni* and *Soleses ispgeminata*.

Thus, the Pitchavaram reserve forest rapports a large number of insect species, and further studies on their relationship with the fauna and flora of this delicate ecosystem is needed.

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TABLE - 1 : List of Insects Collected at Pitchavaram Mangrove Forest

S.No.	Order	Family	Species	
1.	Orthoptera	Acrididae	*Acridiua sucinutum*	Herb
2.			*Acridiuma peregidium*	Grass
3.			*Acridium calanacorne*	Grass
4.			*Hieroglyphus farcifer*	Grass
5.			*Gryllotalfa africana*	Soil
6.		Phasoidar	*Necroscia pholidotus*	Herb
7.		Mantidas	*Hierodula coarclata*	Herb
8.	Odonata	Anisopteridae	*Rhyotherns varigata*	Grass
9.			*Acisoma panorpoides*	Plains
10.			*Aeschinid sp.*	Plains
11.	Homoptera	Fulgoridae	*M.Luptescens*	Grass
12.			*Pyrops sp*	Herb
13.	Hemiptera	Pyrrcohoridae	*Dysderus cingulatus*	Plains
14.		Saldidae	*Salda dixoni*	Wet vegetation
15.		Pentatomidar	*Nezuura vurudula*	Plains
16.			*Eusarcoris ventralis*	Plains
17.			*Manido histero*	Plains
18.			*Chrysocoris stolli*	Plains
19.		Hebuciceogakududa	*Henicocephalis basalis*	Damp siol
20.		Coreidae	*Aschishus breviconis*	Plains
21.			*Leptocorisa varicornis*	Grass
22.	Coleoptera	Scarabaedae	*Oxytonisia versicolor*	Grass
23.			*Heliocopris bucephalus*	Surface soil
24.			*Onthophagus longicornis*	Surface soil
25.			*Onthophagus onitis*	Surface soil

Contd.

S.No.	Order	Family	Species	
26.		Carabidae	*Dicrononcus amabilis*	Herb
27.			*Phersophus lineiforms*	Soil
28.		Dynastidae	*Oryctes rhinoceros*	Tree
29.		Cerambicidae	*Batocera rufomaculata*	Tree
30.		Curculionidae	*Rhyncophorusferu - ginus*	Tree
31.			*Myllocerus viridanus-*	Tree
32.			*Calandra sculpturata*	Tree
33.		Tenebriodinae	*Tribolium castaneum*	Tree
34.			*Gonocephalum hfomanseggi*	Tree
35.			*Cossyphus depressus*	Tree
36.			*Tribolium confusum*	Tree
37.			*Mesomorpha villiger*	Tree
38.			*Alphitobius piceus*	Tree
39.			*Amarygmus cuparius*	Tree
40.		Coccinellidae	*Ileus cincta*	Herb
41.			*Coccinella septempunctata*	Herb
42.		Chrysomelidae	*Aspidomorpha sanctaecrussis*	Herb
43.			*Haltica sp*	Herb
44.		Lampyridae	*Lamprophorus sp*	Grass
45.		Malacodermidar	*Platerious sp*	Tree
46.		Buprestidae	*Sphnoptera arachid*	Herb
47.		Cicindellidae	*Cicindella octonata*	Soil
48.		Mylabridae	*Mylabris pustulata*	Herb
49.	Neuropotera	Hemerobiidae	*Myrmeleonid sp*	Herb
50.	Lepidoptera	Papilionidae	*Polidours hector*	Herb

Contd.

S.No.	Order	Family	Species	
51.			*Polidours arisotolchae*	Herb
52.			*Paplio polytes*	Herb
53.		Pieridae	*Delias eucharis*	Tree
54.			*Leptosia nina*	Herb
55.			*Terisas hecabe*	Herb
56.			*Catcopsilia florella*	Herb
57.			*Colotis etrida*	Herb
58.			*Appias albina*	Herb
59.		Nymphalidar	*Ergolis aradine*	Herb
60.			*Atella phalantha*	Herb
61.			*Precis iphita*	Plains
62.			*Precis almana*	Herb
63.			*Precis lemonias*	Herb
64.		Satyridae	*Melantis leda*	Herb
65.			*Yphtima baldus*	Herb
66.		Danaidae	*Danais meliss*	Herb
67.			*Danais chrysippus*	Herb
68.			*Danais pixippus*	Herb
69.			*Danais nilgiriensis*	Herb
70.			*Euploeca core*	Herb
71.		Acraeidae	*Telchinia violae*	Herb
72.		Noctuidae	*Otheries masterina*	Tree
73.		Sphingidae	*Herse sonluvuli*	Tree
74.			*Lethe europa*	Tree
75.	Hymenoptera	Sphegidae	*Ammophila levigata*	Tree
76.			*Bembex sulphurescens*	Soil
77.			*Scliphron madraspatunam*	Tree
78.			*Stizus prismaticus*	Tree
79.		Multillidae	*Mutilla sexmaculata*	Tree

Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research,
A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

SPIDERS OF SHOOLPANESHWAR WILDLIFE SANCTUARY

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ABSTRACT : This paper presents the checklist of spiders recorded from the Shoolpaneshwar Wildlife Sanctuary during the faunal studies conducted for a period of two years in the Narmada Valley in Gujarat. This sanctuary is part of old Rajpipla forest and situated on left bank of Narmada. 50 species of spiders belonging to 29 genera of 16 families were collected. The spiders form an important foodlink in the undisturbed ecosystems of the sanctuary. The sanctuary area as a whole cannot be termed as an undisturbed ecosystem as there are several areas within it that are strongly disturbed or are in the process of destruction due to human interference. If the present rate of disturbances, is continued, the species diversity in this sanctuary will be perished within a short period. Hence, there is a need to maintain the ecological continuity in a forest area like Shoolpaneshwar Wildlife Sanctuary as if is necessary for the conservation of a variety of spiders, insects and the entire ecosystem.

Shoolpaneshwar wildlife sanctuary is part of old Rajpipla forest and is situated on the left bank of Narmada river. The Sanctuary, which is located between 73°32' and 73°54'E and 21°34' and 21°32'N has hilly terrain and covers 675 sq km. Numerous small streams arise from the mountain tops as tributaries that ultimately run into Karjan and Narmada rivers. The Tarav river meauders through the core area and augment the vegetational cover there. Towards the periphery of the sanctuary, the forest is almost degraded with patches of open areas and grasslands.

METHODS

A study of faunal in the sanctuary area was conducted through field trips for a period of two years (1991-1993). The collection and preservation of spiders were done as described by Tikader (1987) and identified with the help of relevant literature (Patel,1975; Tikader, 1977,1982,1987; Tikader and Malhotra, 1980).

RESULTS AND DISCUSSION

Both active web weavers and hunting types of spiders were recorded. About 50 species belonged to 29 genera of 16 families were collected from the study area. The density of spiders in the sanctuary area was very high due to the availability of specific habitats for variety of species and good population of insects. The hunting spiders such as the members of the family Lycosidae preferred to feed on insects belonged to the orders diptera, hemiptera, collembola, dermaptera while small flies were the favorite food for the Thomsidian species (Tikader,1982). Insects of all the above orders were abundant in the sanctuary (Radhakrishnan, 1992). The habitat preference of spiders also varied with the family (Tikader, 1987). Nephila, the giant wood spiders is known to make huge webs nearly one metre or more in diameter in shaded woods. They were feeding on tadpoles and froglets from the water surface. The members of the families clubionidae and gnaphosedae preferred, the rolled up dry leaves for making nests. All such types of habitats for the spiders are available in the sanctuary area besides a high species density and diversity of insects. spiders form an important food link in the undisturbed ecosystems of the sanctuary. They help keeping the insect population in check as well as supporting a high population a good population of amphibians and birds and thus form the part of a viable ecosystem of the sanctuary (Pilo, 1992).

The sanctuary area as a whole cannot be termed as an undisturbed ecosystem as there are several areas within it that strongly disturbed or are in the process of destruction due to human interference, especially for agriculture using insecticides. If the present process if disturbance is continued the species meriting conservation in Shoolpaneshwar sanctuary will be perished within a short period. The "old forest spiders and insects" are incapable of colonizing newly established woodlands (Hawskworth,1974). Hence, there is a need to maintain the ecological continuity in a forest area like Shoolpaneshwar wildlife sanctuary as it is necessary for the conservation of a variety of spiders and insects species (Table 1).

TABLE - 1 List of spiders collected from Shoolpaneshwas wildlife sanctuary

Species	Place of Collection	Species	Place of Collection
FAMILY : OECOBIIDAE (II)		**FAMILY : OXYOPIDAE (II)**	
1. *Occobius putus* (Cambridge)	Dediapada	12. *Oxyptus wroughtoni* (Pocock)	Upper Sagai
FAMILY : ERESIDAE (W)		**FAMILY : TIIRIDHAE (W)**	
2. *Stegrodyphus sarasinorum* (Karsch)	Kokati, Moti	13. *Theridion tikaderi* (Patel)	Kokati
FAMILY : ULOBORIDAE (W)		14. *Cyllognatha surajbae* (Patel)	Kokati
3. *Uloborus krishnae* (Tikader)	Dediapada	15. *Aroyrodes projiciens* (Cambridge)	Kokati
4. *U. danolsus* (Tikader)	Kokati, Kokam	**FAMILY : LYCOSIDAE**	
5. *U. khasiensis* (Tikader)	Namgir	16. *Hippasa madhuae* (Tikader and Malhotra)	Patavali
FAMILY : HERSILIDAE (H)		17. *H.lycosina* (Pocock)	Kokati
6. *Hersilia savignyi* (Lucas)	Kokati	18. *H.pisaurina* (Cambridge)	Kakati
FAMILY : PHOLCIDAE (W)		19. *H.partita* (Cambridge)	Moti Daberi
7. *Crossopriza iyoni* (Blackwall)	Dediapada	20. *Lycosa nigrotibialis* (Simon)	Moti Daberi
FAMILY : SALTICIDAE		21. *L.Madani* (Pocock)	Moti Daberi
8. *Plexippus paykullii* (Autouin and Savigny)	Patavali	**FAMILY : ARANEIDAE (ARGIOPIDAE) (W)**	
FAMILY : HETEROPODIADAE (H)		22. *Nephila maculata* (F.)	Upper Sagai
9. *Heteropoda bhalkakai* (Patel and Patel)	Waghumar, Patavali, Kokati	23. *Argiope pulchella* (Thorell)	Upper Sagai
		24. *A.aemula* (Walckenaer)	Kokati, Namgir
FAMILY : CLUBIONIDAE (H)			Upper Sagai
10. *Clubiona pashabhaii* (Patel and Patel)	Waghumar	25. *Cyrtophora cicatrosa* (Stoliczka)	Upper Sagai
		26. *C.citricola* (Forskal)	Kokati
11. *Castieneira tinae* (Patel and Patel)	Kokam, Moti Daberi	27. *Cyclosa moonduensis* (Tikader)	Kokati
		28. *Larinia chloris* (Autouin and Savigny)	Upper Sagai
		29. *Neoscona pavida* (Simon)	Kokati

W - Web-weaver, H-Hunting

ACKNOWLEDGEMENT

The study was carried out under the project, "Ecoenvironmental and Wildlife Management Studies on Sardar Sarover Submergence area in Gujarat" sponsored by SSNNL, NPG, Govt. of Gujarat. The authors are thankful to Professor Bonny Pilo and Dr.Y.M. Naik for their help and suggestion during the field studies and Dr. B.H. Patel for his help in identification of spiders.

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Proceedings of the National Symposium on Recent Trends in Indian
A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

THE IMPORTANCE OF PRESERVATION OF BIODIVERSITY OF AMPHIBIANS IN SHOOLPANESHWAR SANCTUARY

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ABSTRACT: The Shoolpaneshwar Wildlife Sanctuary is part of old Rajpipla forest and situated on the left bank of Narmada river. The rich fauna of the sanctuary can be ascribed to the Satpura hypothesis and the microzoogeographical peculiarity of the area as well. Amphibians are the most striking group of animals recorded during the faunal studies in the area. The amphibian fauna of the sanctuary is a mixture of forms adapted for both arid and semi arid as well as moist and wet land habitats. The presence of seven Western Ghats species that have limited distribution all over India enhances the importance of this sanctuary as an ecosystem worth preserving. The biodiversity of amphibians in this area is an ecological feature that has to be preserved and if possible, enhanced at any cost. The rich biodiversity of amphibians can also be attributed to the presence of several microclimatic niches in the regions well protected from the biotic interference. Nevertheless, towards the periphery of the sanctuary, the forest is more or less degraded with patches of open areas and grass lands. The human encroachment and subsequent degradation as well as commercial exploitation are increasing at an alarming rate. The study emphasizes the perturbations in the ecosystems and also the management strategies and action plans for the protection and the preservation of the sanctuary.

The Shoolpaneshwar Wildlife Sanctuary (73° 32' and 73° 54'E and 21° 34' and 21° 32'N), is situated on the left bank of Narmada. The 675 sq km area is resplendent with hilly terrain and valleys. The rich blank soil of the Deccan trap support a luxurious and varied vegetation at the core of the sanctuary and a fairly thick vegetation in the rest of the region. Numerous small streams arise from the mountain tops as tributaries that ultimately run into Karjan and Narmada rivers. The vegetation of the sanctuary is composed of moist and dry deciduous as well as evergreen trees.

The sanctuary, located at the western end of the Satpura range has many tall mountain peaks. There are two rivers (Tarav and Sankli Kadi) that run through the sanctuary. On the western side the area is bordered by Karjan river and the southern side by Devganga river. Due to the high rising Satpura peaks, the north west monsoon clouds are trapped more in this region and the average rainfall is about 1200 mm. Pevond Devganga river, the eastern region falls on the shadow side of Western ghats that reach up to Dangs in Gujarat and Dhula district in Maharastra. Thus a good rainfall, adequate water retention capacity of the hilly terrain due to the vegetational cover and the presence of large number of ever green trees make the sanctuary practically a moist and cool region even in summer months.

On the northern side, especially in Zarvani area there are several streams that support a luxurious vegetation. A large number of amphibians have been reported from this area. The humid and moist soil conditions along the stream bank coupled with loose laval, grave and coarse sand provide ideal habitat to several fossoria amphibians. The major groups of animals that are dominant and characteristics of this sanctuary are insects, spiders, amphibians and raptors.

METHODS

The field trips were conducted twice a month from 1990 to 1993 to study the ecology and fauna of the sanctuary. The species collected were identified with the help of literature (Boulenger 1890,1920, Daniel, 1963,1975) or experts in this field (ZSI, Calcutta).

RESULTS AND DISCUSSION

Thirteen species of amphibians belonged to 7 genera and 4 families were recorded. The rare species *Rana keralensis.* (Naik and Vinod,1993), four microhylid

species, *Kaloula pulchra* (Naik *et al.* 1993) *Uperodon globuosum*, *Micromria rubra* and *Microhyla ornata* and *Polypedatus maculatus* were found distributed. Sarkar (1984) has reported 9 species of amphibians from Gujarat. Our studies on the distribution of amphibian faunna in Gujarat revealed the presence of 15 species of anurans belonged to seven genera and four families (Naik and Vinod 1994). Out of these 15 species, 13 species are present in the Shoolpaneshwar wildlife sanctuary that implies the species richness of the study area. The amphibians recorded in the sanctuary belonged to all four principal habitat types (aquatic, fossorial, terrestrial and arboreal).

There are many reasons for the rich density and diversity of amphibian fauna in the area . The Zoogeographical peculiarity of the area is the most significant among them. Floristically, South Gujarat be low Narmada belongs to Malabar region. The evergreen forests have the largest wild gene pools. Humidity, temperature and vegetation are the main factors that determine the ecological features of the two regions, North of Vindhya and south of Satpura. Many dominant South Indian amphibians are found in the forests of Dangs and Satpura ranges. The species such as the spade foot frog, *Uperodon globulosum*, abundant in the Satpura range is absent in the northern part of Vindhya range.

The uniqueness of the sanctuary can also be ascribed to the Satpura hypothesis (Hora, 1937). This hypothesis explains the presence of several common species in north east region and south west region as there existed a probable route by which several north east species could spread to south west India through Satpura mountain range. Several such species have been recorded from the study area (Naik and Vinod, 1992).

The degradation of forest and altered land use patterns can be directly proportional to the reduction in the density and biodiversity of amphibians. Majority of amphibians are depended on the forest canopy. The encroachment and subsequent degradation as well as commercial exploitation of the forest are even at a higher rate. Establishing a stable and viable ecosystem in the region is the first step to protect and preserve the amphibians. The remedial measures to protect and to develop a healthy biosphere in the sanctuary are:

1. Minimize human resident population's dependency on forest land of cultivation and livelihood.

2. Stop commercial exploitation of the forest.

3. Minimize cattle grazing by providing the villagers with better breeds encouraging them to go for stable feeding or to keep buffaloes instead of cattle (buffaloes have higher capacity to digest fodder than cattle and their productivity is higher).

4. Initiate long-term measures to protect the total ecosystem from human interference by promoting small scale industries, co operative farming, dairy and poultry farming etc. This will increase the in come of the native and they need not cut trees for additional income and the other measures to increase ecosystem.

ACKNOWLEDGEMENTS

The faunal survey of Narmada Valley was carried out under the project "Ecoenvironmental and Wildlife Management Studies on Sardar Sarovar Submergence Area in Gujarat" Sponsored by SSNNL. We would like to thank Dr. A.K. Sarkar (ZSI) for his help in identification of anurans.

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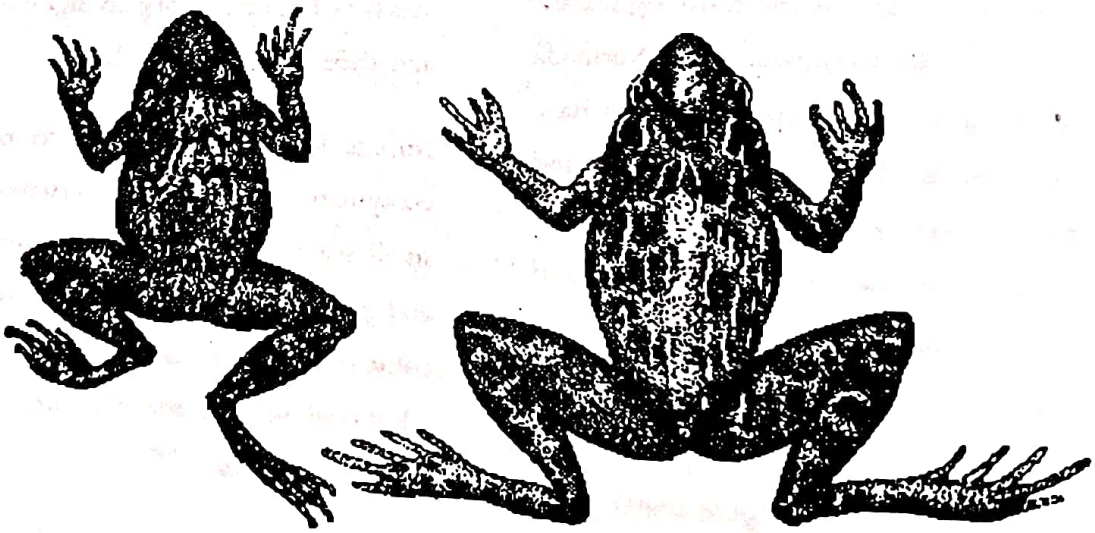

MORPHOMETRY OF MAJOR VISCERAL ORGANS OF FEMALE COMMON KRAIT (*Bungarus caerules*)

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ABSTRACT: A study on the morphometry of major visceral organs of a female common krait was undertaken. Total length, body length, tail length, number of ventral scales and length of oesophagus and stomach (thick walled narrow tube without dilation were 130.5 115.15cms, 207 an 71 an 19cms respectively. The length of intestine (43cms) terminal part, straight tube (13cms), cystic and pancreatic ducts (2.5cms) the right (29cms) and left lobes (23 cms), liver, heart (2.5 cms), trachea (29 cms) only right lung (17cms), right kidney (6 cms) was recorded. There were 10 -11 lobes in the left and right kidneys respectively. The right ovary (2.9 * 0.6 cms) was longer than the left ovary (2.5 * 0.7cms). The details of this study have been discussed.

The position of major visceral organs of the snakes have been documented by Bellairs and Attridge(1975); Bergmen (1961); Bragdon (1953); Davis (1981); Deoras (1978); Parsons and cameron (1977) an Swaminathan *et al* (1995). In literature of the anatomical descriptions of organs of snakes are mostly generalised and scanty. Knowledge of anatomy is necessary to understand pathology and immuno prophylaxis. Hence a preliminary study was envisaged to outline the anatomical disposition of the major visceral organs of female common krait.

MATERIALS AND METHODS

Four naturally died female common krait without any specific etiology at Arignar Anna Zoological Park, Madras were preserved in 10% formalin after taking the measurements of the body and tail. The number of ventral scales were counted. The number of ribs were counted after making a median incision and exposing the visceral organs. The morphology and position of major visceral organs were studied in relation to the ribs.

RESULTS AND DISCUSSION

The length of the snakes were measured as 130.5 cms, 131 cms and 132 cms respectively. Cloaca was situated at the junction of the body and tail. The number of scales on the ventral aspect counted were coinciding with the number of ribs. Like other species, the thoracic cavity was not demarcated from abdominal cavity due to the absence of diaphragm. The average size and relative position of the major visceral organs were summarised in Table 1.

Table 1. Morphometry of major visceral organs of female common krait

S.No	Organ	Size (cm)	Position (in relation to ribs)
1	Oesophagus	71	1-125
2	Stomach	19	125-157
3	Intestine	56	157-203
4	Liver		
	Left Lobe	23	64-111
	Right Lobe	29	72-120
5	Gall bladder	2.1	152-156
6	Pancreas	1.9	154-157
7	Spleen	0.6 x 0.5	156-158
8	Heart	2.5	50-54
9	Trachea	29	1-54
10	Lung-Right	17	54-80
11	Kidney		
	Left	6	181-194
	Right	6.2	177-190
12	Ovary		
	Left	2.5x0.7	171-176
	Right	2.9 x 0.6	163-169

Digestive System

The oesophagus was present as a long tube running on the left side of the thoracic and abdominal

cavity. Anteriorly the wall was thin and towards the stomach, there was gradual increase in thickness. Terminal part of the oesophagus blended with the stomach which was also tubular but the wall was thicker than that of oesophagus, unlike Russell's viper and rat snake, the stomach was tubular lacking dilation. The pyloric end of the stomach has a narrow constriction from where it continued as duodenum. The small intestine had several short transverse loops tightly enveloped by dorsal mesentery like that of rat snake. Cystic and pancreatic ducts opened into duodenum 2.5 cms distal to the pyloric end of stomach. The large intestine continued as a thick walled, straight tube without dilation and terminated into cloaca. Liver was bilobed. Left tube was placed little cranial to the right tube, Gall bladdor was a dilated sac, located on the right lateral aspect of the posterior extremity of stomach. Pancreas was pear shaped, lobulated and located on the ventral aspect of the gall bladder. A small depression was present on the dorsal surface of pancreas to accommodate a reddish nodular spleen. Unlike Russell's viper, heart was placed at the terminal part of the trachea and not related to the liver.

Respiratory System

Trachea appeared as a short cartilaginous tube placed dorsally on the medianline. Unlike Russell's viper, left lung was alone developed. The saccular part of the lung was observed but the vascular part was absent. Terminal part of the lung extended upto the level of cephalic end of right lobe of the liver.

Urogenital System

Kidneys were elongate, paired and shows segmental lobules. Anterior extremity of the right kidney was placed cranial to that of left kidney. Collecting tubule from each lobule of kidney joined together to form a single tubular ureter. Both the ureters ran posteriorly and opened into cloaca. Urinary bladder was absent like other species. Ovaries were paired elongated and asymmetrically placed. Right ovary was more anteriorly placed than left ovary. Unlike many species (Fowler, 1986) both the oviducts were developed and extended from each ovary as a tortous tube initially and became straight tube posteriorly and opened into the urodeum of cloaca.

ACKNOWLEDGMENTS

Authors are grateful to Mr. R. Sundararaju I.F.S., Director an Mr. M. Jaganatharao, I.F.S., Deputy Director, Arignar Anna Zoological Park, Madras-48 for their encouragement and facilities provided.

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Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research,
A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

MORPHOMETRY OF MAJOR VISCERAL ORGANS OF FEMALE RAT SNAKE (*Ptyas nycosus*)

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ABSTRACT : The morphometry of major visceral organs of female rat snake was carried out. The alimentary canal extended from pharynx to cloace. The oesophagus was 48 cms in length.

The position of major visceral organs of the snakes have been documented by Davis (1981); Deoras (1978); Bellairs and Attridge (1975); Bergdon (1953); Bergman (1961); Oarsibs and Cameron (1977) and Swaminathan *et al.* (1955). Description of visceral organs of rat snakes is lacking. Since rat snake is listed as endangered species, for the conservation of this species, a knowledge of anatomy and histology is essential for the diagnosis and treatment of different pathological conditions. With this view, the present study is aimed to describe the gross anatomical features of major visceral organs of female rat snake.

MATERIALS AND METHODS

Four female rat snakes naturally died without any specific etiology at Arignar Anna Zoological Park, Madras were preserved in 10% formalin after taking the measurements of the body and tail. After counting the ventral scales, a median incision was made to expose the visceral organs. The number of ribs were counted. The morphology and position of major visceral organs in relation to the ribs were studied.

RESULTS AND DISCUSSION

The total length of the snakes were measured as 170 cms, 172 cms, 174 cms and 168 cms respectively. Cloaca was situated at the junction of the body and tail. The number of ventral scales counted were coinciding with the number of ribs. As in other snakes, the thoracic cavity was not demarcated from abdominal cavity due to the absence of diaphragm. The average size and their relative position of the major visceral organs of rat snakes were recorded in Table-1.

Table 1. Morphometry of major visceral organs of a female rat snake.

Organ	Size (cms)	Position (in relation to ribs)
Oesophagus	48	1-78
Stomach		
Greater Curvature	14	78-106
Lesser Curvature	10	-
Intestine	83.5	106-193
Liver		
Left lobe	17.8	63-92
Right lobe	19.4	61-91
Gall bladder	1.65	126-130
Pancreas	1.7 x 1	132-135
Spleen	0.7 x 6	130-132
Heart	2.2 x 1.3	43-50
Trachea	25	1-52
Lung-Left	12.8	48-62
Kidney		
Left	9 x 0.6	163-186
Right	12 x 1	157-170
Ovary		
Left	5	143-148
Right	8.5	126-135

Digestive System

The alimentary canal extended from pharynx to cloaca. The oesophagus was a narrow, thin walled tube running on the left side of the trachea and its wall gradually become thicker towards the stomach. Like

Russell's Viper, stomach was thick walled, dilated sac with greater and lesser curvatures (Swaminathan *et al.* - cited). The pyloric end of the stomach was distinguished by a narrow constriction from where it continued as duodenum. The small intestine had several short transverse loops tightly enveloped by dorsal mesentery. The cystic and pancreatic ducts opened into the duodenum - 2.5 cms from the pyloric end. Caeca was absent as recorded by Swaminathan *et al.* (cited Wolf-Eberhard Engelmann and Fritz jurgen, 1984). The large intestine had no distinctive features except its dilatation which was comparable to the ampullated end of rectum of mammals. Liver was elongate and had 2 lobes. Right lobe was longer and the cranial end of right lobe was placed more anteriorly than that of left lobe. Gall bladder was a thin walled dilated sac placed caudal to liver on the ventrolateral aspect of the posterior extremeity of the stomach. Pancreas was bilobed and conical with broad end posteriorly placed. Spleen was present as a small nodule at the narrow anterior extremity of the pancreas. Heart was three chambered and located on the upper third of the body.

Respiratory System

The trachea was a cartilagenous tube with tracheal rings and opened into left lung which had well developed septa that formed shallow compartments called alveoli. The nonrespiratory vascular part was absent. Right lung was absent. The lung extended between the heart and cranial part of the left lobe of the liver.

Urogenital System

Kidneys were elongated, paired and a symmetrically placed with segmental lobules. Right kidney commenced anterior to the left kidney. The collecting tubules of each lobule joined together to form ureter which extended from each kidney to the urodeum of the cloaca. Urinary bladder was absent. Ovaries were elongated, paired and asymmetrically placed. Right ovary was placed cranial to the left ovary. Unlike many species (Fowler, 1986) both the oviducts were developed and extended as a tortuous tube initially and became straight tube posteriorly and opened into the urodeum of cloaca.

ACKNOWLEDGEMENTS

Authors are grateful to Mr. R. Sundararaju I.F.S., Director and Mr. M. Jaganatharao, I.F.S., Deputy Director, Arignar Anna Zoological Park, Madras-48 for their encouragement and facilities provided.

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Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research,
A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

DIVERSITY AND CONSERVATION OF THE AVIFAUNA OF KANNIYAKUMARI DISTRICT

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ABSTRACT : Kanyakumari District with a wide range of natural habitats include dense tropical wet ever green forests, rapid mountain streams, ponds, estuaries and some arid regions. Moreover, man made habitats such as reservoirs, plantation and agricultural crops are not uncommon. These habitats support a wide diversity of birds. Two hundred species of birds were recorded over these areas. Aviaunal diversity of this district, their threats and few suggestions for conservation have been discussed. Kaniyakumari District marks the lands end of India falling between 8°5' and 8°30' North latitude; 77°10' and 77°36' East longitude. It has a total area of 1,684 square kilometers of which 446 square kilometers are forest land. It has a long coastline of 68 kilometers, bordering the land on the east, west and south. This part of the country is the closest to the equator with a fairly widespread rainfall (about 2000 mm annually) and tropical climate. Topographically the district varies from sea level to hills over 1000 mts. Consequently, a wide range of natural habitats including dense tropical wet evergreen forest, rapid mountain streams, ponds, estuaries and some arid regions prevail. More over man made habitats such as reservoirs, plantation and agricultural crops are not uncommon. This varied terrain supports a wide diversity of birds. Atleast 150 species of birds have been recorded over these areas. This paper provides a fairly good account of the avifaunal diversity of this district, their threats and a few suggestions for conservation.

Kaniyakumari district is closest to the equator with a fairly widespread rainfall and tropical climate. Topographically the district varies from sea level to hills over 1000 metres. Consequently, a wide range of natural habitats typical of Western Ghats are met with as being part of it. Of the 507 known species of the Western Ghats, 175 species have been recorded by sightings alone, 158 of them are considered to be residents of which 5 of the 15 endemics have been recorded here. 17 are migrants visitings during winter.

METHODS

The various habitats were visited as frequently as possible for over a period of ten years and the birds were identified (Ali, 1969; Ali & Ripley, 1983; Ali, 1979 and Daniels, 1992)

OBSERVATIONS AND DISCUSSION

The Landscape of Kaniyakumari district can be broadly classified into two major elements. Viz.,Western Ghats and the Wetlands.

Habitat transformation

Converting natural forests into plantations has been a practice for at least two centuries in south India (Daniels *et al* 1990). The Western Ghats have been quite exploited this way and that part existing in Kaniyakumari district is no exception. Large patches of tea (*Camellia sinensis*), cloves (*Syzigium aromaticum*), and small patches of eucalyptus (*Eucalyptus spp.*) betelnut. (*Areca catechu*) coconuts (*Cocos nucifera*) coffee (*Coffea arabica*) cardamom (*Elattaria cardamomum*) and tapioca (*Mannihot utilissima*) have become permanent elements of the Western Ghat's landscape of this district today. Thus highly degraded forests with lush growth of *Eupatorium odoratum* and *Lantana camara* are met with along the foot hills near human habitation.

The important ever green forest species like the Great Indian hornbill, Imperial pigeon, Nilgiri wood pigeon, Blue-winged parakeet, Racket tail drongo, malabar trogon, white bellied treepie, velvet fronted nuthatch are frequently encountered in the wet evergreen forests of this district, but none of these species have been recorded in the monoculture plantations such as rubber, clove and tea. In these monoculture plantations the most frequently recorded species are sun birds and red whiskered bulbul, and honey bizzard in rubber. The reason for such a low

diversity in monoculture plantation may be due to the lack of plant species diversity and / or the use of pesticides and insecticides, that remove the majority of the arthropods (Daniels, 1994). Similar observations have been made elsewhere in the Western Ghats by Daniels *et al* (1990). However, observations show that the species diversity is more in degraded forests where there is a lush growth of the exotic weeds. It may be that these degraded patches serve as 'Corridors' for the evergreen species as well as the species near human habitation. Evergreen species like the trogon, blue winged parakeet, white bellied treepie and rackettail drongo are the most common ones found in degraded areas where house crow, red vented bulbul, red whiskered bulbul, white headed babbler, house sparrow, common myna, etc are seen. Grey jungle fowl is another, very commonly seen in degraded patches especially within Lantana invades areas. Thus the greater diversity of birds in the degraded forest can be felt.

Wetlands are areas which have sufficient waterlong enough to support the growth of hydrophytic vegetation (Vijayan 1986). Marshes, swamps, bogs, reed - beds, lagoons, mangroves, backwaters, estuaries, ponds, lakes are the terms used for wetlands in Ali and Ripley (1983). Wetlands are either natural or man made. man made may be reservoirs, lakes, paddy fields and channels. Whether natural or man made, these wetlands support a wide variety of birds that fall into 3 categories ie, (i) Completely dependent (ii) Partially dependent and (iii) opportunistic users. Cotton teal, whistling teal, dabchick, purple moor hen, white breasted water hen, pheasant tailed and bronze winged Jacanas may be considered, completely dependent species. These are found in stagnant waters where there is a lush growth of hydrophytes like, *Nelumbium* or *Nymphaea, Nympheoides, Typha* or *Eicchornia* where they nest. Partially dependent species may be egrets, herons, storks and darters which forage on wetlands but roost on coconut and / or any other grove adjacent to wetlands or even a few kilometers away from the wetlands. Egrets are seen on dry grass lands too. The black bittern is often seen in the ochlandra brakes along hill streams. The most common species along the coast are the waders and plovers, stilts, terns and reef herons are met with along estuaries. Most of the coastal species are migrants and can therefore be considered opportunistic users.

Similar to the habitat transformation taking place on the Western Ghats, Wetlands are being converted to bus stands, Cinema theatres, hospitals and housing lands. This is the present trend that continues without any check in this district. The main reason being population explosion.

The Threats : Loss of habitats

Continuous destruction of most evergreen forests may lead to total depletion of this habitat which ultimately will cause the loss of dependent birds.

Poaching

Killing certain birds for their edibility and medicinal values by weapons or trapping them by means of snares are two common practices of the local people of this district.

Use of Chemicals

Use of pesticides and insecticides indirectly affect the bird diversity by altering the insect and other small vertebrate invertebrate communities.

Reclamation of Wetlands

Considered as wastelands, wetlands are being drained for agriculture,industry, hospitals, housing and cinema theatres.

Construction of Dams

The large deep reservoirs are not attractive to many of the Wetland species.

Fishing

Although fishing is permissible, overfishing and the disturbances related to fishing are harmful.

Pollution

Discharge of domestic and factory sewages, agri-

cultural run off (chemicals) affect the wetlands.

Conservation

Birds contribute most significantly to the diversity of terrestrial vertebrates and also have a special role in conservation as they not only help identify areas most worth saving, but also have the capacity to make conservation an "affair of the heart". As with any other group of organism, the problem in conserving birds is the limited availability of habitats. This is particularly true in developing countries such as India where all available habitats have been and still are under constant human pressure. As a result some habitats have totally vanished while other remain as fragments.

Suggested conservatory measures

The only way by which birds can be protected is by protecting the prevailing habitats.

1. The pressure exerted on evergreen/semi - evergreen and moist deciduous habitats by planters must be controlled.

2. Use of pesticides/insecticides in monoculture plantations can be minimised.

3. Using wetlands for building purposes must be checked.

4. Discharge of domestic and factory sewages and agricultural run off must be avoided.

ACKNOWLEDGEMENTS

I wish to acknowledge the Department of Forest Government of Tamil Nadu, for readily permitting me to sample inside the Reserve Forest areas. Also I thank Dr. Morris for permitting me to sample in the monoculture plantations of his estate.

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Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research,
A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

ROOSTING HABITS OF THE SMALL GREEN BEE-EATER, *Merops orientalis* IN MAYILADUTHURAI, TAMILNADU.

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ABSTRACT : An attempt was made to study the roosting habits of the small green Bee-eater, *Merops orientalis* in Mayiladuthurai area during January 1993 to April 1993. Communal roosts of Bee-eater were located in five trees namely *Odina wodier*, *Jatropha glandulifera*, *Azadirachta indica*, *Ipomea carnea* and *Cassia tora* during the pre breeding season. The communal roosts of Bee-eater was small in size, ranging from six to ten individuals. Usually they started to roost 10 to 15 minutes before sunset and departed from the roost 5 to 15 minutes before sunrise one by one or in pairs. The height of roosting trees ranged from 1.5 to 4.0 meters. The birds were found to forage at a distance of 200 to 800 meters away from the roosting sites.

Many bird species roost together for atleast a part of the year. Sometimes such social roosting may be a simple consequence of the paucity of suitable roosting sites forcing the birds to crowd together. However in a majority of cases of communal roosting, they associate together through some social attractions and do not disperse even if alternative roosting sites are available (Gadgil and Ali, 1975). Different birds show great variations in the times at which they go to roost in the evening and leave in the morning. As regards Bee-eater, *Merops orientalis* communal roosting becomes very important because of its insectivorous behaviour, especially feeding on harmful crop pest species, viz., species of Coleoptera, Diptera and Hymenoptera (Hussain, *et al*, 1973). No such attempt has so far been made regarding roosting behaviour of Bee-eater except a few preliminary studies on the population dynamics of Bee-eater made by Sivakumar (1988) and Rethinakumar (1991) and hence the present investigation.

The objective of this work were

1. Location of roosting/nesting sites both during prebreeding and breeding months.
2. a. Whether the habit of communal roosting is constant throughout the study period viz., January 1993 April 1993 or seasonal.
   b. Whether they formed the communal roost of small size (2-5 individuals) or of medium size (10 - 100 individuals) or of enormous (several thousand individuals) (Gadgil and Ali, 1975).
   c. Whether the roost includes members of only one species or mixed roost.
3. Roost site characteristics viz., height of the roosting trees, distance to feeding ground, and so on.
4. Relating of temperature, sunrise and sunset to roosting and awakening of the Bee-eater.

METHODS

The data for the present study were collected from January 1993 to April 1993 in Mannampandal area. The study area is situated at a latitude of 11° 8'N and longitude of 80° 50'E. It has different ecological niches which provide suitable shelters and feeding sites for the Bee-eater. The data with reference to temperature and rainfall for the study period were obtained from the meteorological station, Mayiladuthurai. With the aid of 7 x 50 binocular observations were made for about 10 days each month. We searched the roosting site of Bee-eater along Cauvery bank and railway track o Mannampandal. The distance between roosting tree and feeding site were measured by using marked rope The birds were found to roost on nest holes from late part of February 1993. About ten such nest holes wer recorded along the Cauvery banks and puddles. Thei morphometric measurements were also recorded.

OBSERVATIONS

Physiographic factors

During the study period the minimum temperature ranged from 27.7° C to 34.9° C and the mean monthly temperature were 30.13° C and 33.25° C respectively. During the later part of February 1993 the study area recorded 42 mm rainfall (Table 1).

Table 1.Physiographic factors in Mayiladuthurai during January-March 1993.

Month	Temperature (°C)		Rainfall (mm)	
	Mini X	Maxi X	Mini	Maxi
January				
1-15	27.7	30.4	Nil	Nil
15-31	28.4	30.6	Nil	Nil
February				
15-28	29.5	31.7	Nil	Nil
	30.13	33.25		
15-28	30.8	35.5	4.2	Nil
March				
1-15	29.5	35.4	0.5	2.0
15-30	34.9	35.8	Nil	Nil

Roosting/nesting sites

During January 1993 a roosting tree *Odina wodier* was recorded near the railway track at Mannampandal. They were also found to occupy some temporary roosts in plants such as *Jatropha glandulifera, Azadirachta indica, Ipomea carnea* and *Cassia tora*. The height of roosting trees ranged from 1.5 to 4.0 meters. The permanent roost was occupied by the Bee-eater almost throughout the non breeding period while the temporary ones were occupied during both breeding and non breeding seasons. The number of birds in a permanent roosting tree (*Odina wodier*) were six to ten individuals. In general the flock size of Bee-eater arriving at the roost in the evening was recorded for 15 days in January 1993. It varied from six to ten. Moreover the birds tend to migrate to some localities for nest building in the later part of the study period.

Time of arrival and departure at roost

Daily activities of Bee-eater started a little before sunrise. All the Bee-eaters departed from the communal roost at 5 to 15 minutes before sunrise one by one or in pairs. They dispersed in different directions for feeding. After leaving the roost (without making any circular flight overhead) they fly straight in a particular direction very rapidly as if they were in hurry and during day time, they were found in the feeding area either solitarily or in pairs. Similar observations were made by Mahabal and Bestawade (1985). After spending the day time in the feeding ground for various activities, the Bee-eaters started their movements towards the communal roosts in the evening about 30 minutes before sunset but roosted at 10 - 15 minutes before sunset. Particularly in the later part of the study period, they arrived from different directions gathered above the roosts and manoeuvred in the sky for sometime before settling down. Data on the relationship between roosting time and sunrise and of sunset were given in Table 2.

Table 2. Relationship between the time of sunset, roosting, sunrise and awakening

Month	Sunset	Roosting	Sunrise	Awakening
January				
1-15	...	...	...	...
15-31	18.10	18.00	06.02	05.56
February				
1-15	18.10	18.01	05.53	05.47
15-28	18.14	18.08	05.48	05.42
March				
1-15	18.20	18.23	05.42	05.35
15-30	18.35	18.42	05.35	5.32

During the study period 10 nest holes were located. The Bee-eaters dug horizontal or oblique tunnels ending in individual egg chambers dug in the side of an

earth cutting, burrow-pit or in an uneven sandy ground. The horizontal length of the nest holes ranged form 51 - 148 cm, while the diameter of the nest holes ranged from 4.7 - 5,8 cm. The height of the nest holes from the ground varied from 6.2 - 20.2 cm. Mean values for the above three parameters were 92.45, 5.12, and 12.34 cm respectively (Table 3). Eventhough nest holes were observed till the end of the study period, eggs could not be recorded. In the present study, the distance between the roosting trees and feeding sites ranged from 200 - 800 m.

Table 3. Nest holes (10) record of small green Bee-eater during the study period.

Nest Dimension	Mini	Maxi	Mean	SE
Horizontal length (cm)	51	148	92.45	12.34
Diameter (cm)	4.7	5.8	5.12	0.13
Height from the ground (cm)	6.2	20.2	12.34	0.32

DISCUSSION

During the study period, the Bee-eater reached the roost before sunset and departed from the roost before sunrise. The flock size varied from 6 - 10 and they were found feeding either solitarily or in pairs. Recently a number of interesting suggestions have been made as to nature of the advantage conferred on birds participating in communals roosting. The four major hypotheses in this respect.

Whether communal roosting enables birds

a. to conserve heat,

b. to assess the population density which are then adjusted to the prevailing level of food supply through emigration and adjustment of reproduction rate,

c. to serve the function of the communication of information regarding location of food resources and

d. to reduce the risk of predation.

Although it is likely that more than one of these functions may be simultaneously served by communal roosting, the best method of testing the various alternative hypotheses is to try to genetate the functions on the suggestions that any one of them is the primary function. Keister *et al* (1985) have reported that selection of communal roosts with more favourable microclimate than surrounding areas aids in thermoregulation and energy conservation. Kelty and Lustaick (1977) have reported that European Starlings selected favourable microclimates provided by pine woods and thereby reduced daily existence metabolism by 12.88%. The information centre hypothesis (Ward and Zahave, 1973) predicts communal roosts and breeding colonies have a food information function, whereby unknowledgeable birds follow successful foragers to better feeding sites.

In our observation, the Bee-eaters were found to be concentrated in areas where food resources are plentiful. Gadgil and Ali (1975) have opined that the proportion of solitary feeders and even more strikingly the proportion of bird species feeding in pairs, is markedly greater amongst communal roosters. In their observations most of the species feeding in pairs are resident species and it is likely that the birds are pair banded and territorial on a year round basis. The most novel hypothesis namely that communal roost serves as centres for the exchanging of information regarding the location of food sources has been put forth by Ward (1965). If a flock that has discovered a good patch of food recently tends to fly to the patch in the morning with a characteristic flight, than other flocks at the roost which have failed to find a good patch of food on the previous day can join in and take advantages of the patch of food found by the first flock. However in our study the Bee-eaters are mainly solitary feeders. A more careful examination of the feeding habits of these would greatly help to clarify whether these birds also communicate information about the location of food sources inspite of the apparently solitary mode of feeding. Moreover an examination of the nature of food categories of Bee-eaters would help to strengthen the above hypothesis.

ACKNOWLEDGEMENTS

We would like to thank the Management and Principal of A.V.C College, Mannampandal, Mayiladuthurai, for providing necessary facilities to carry out this research. Our thanks are also due to Mr.R.Nagarajan, Research Associate and Mr.P.Neelanarayanan, Senior Research Fellow, ICAR-Barn Owl project for their critical reading of the manuscript. The comments of Mr. M. Varadharajan, Lecturer in Wildlife Biology, A.V.C. College were greatly appreciated.

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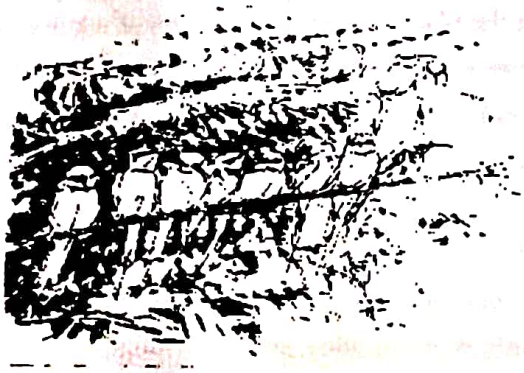

Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research,
A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

UTILIZATION OF NEST BOXES BY COMMON BARN OWL, *Tyto alba stertens*

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ABSTRACT : A wooden nest box (36"X18"X21") for barn owl was designed for the conservation and propagation strategy. Totally, forty nest boxes were installed in the months of July 1993, October 1993, and December 1993. Of the 40 nest boxes 65% were close to human habitation, 22.5% near to agriculture fields and 12.5% in groves. The nest boxes were utilized totally by the barn owls to the tune of 40.93% for nesting/roosting between September 1993 and January 1995. The results indicate that the installation of nest boxes in areas where nest sites are scarce is a feasible strategy, for the conservation and propagation of barn owl.

The barn owls are ubiquitous in distribution, primarily inhabit man-made structures, hunting over agricultural lands, human habitations and groves for rodent pests and shrews. Neelanarayanan *et al.* (1993) have reported that the nests of barn owls were located in the ground, in the gaps or crevices, present behind the statues of Gods and Godesses around the Sanctum Sanctorium and vehicles of different Gods, in the images of Parrot (Vehicle for the God of Love) and Peacock (Vehicle for Lord Muruga). These nests have been as refuge due to non-availability of safe places like innerside of the temple towers, unused rooms and barns (Neelanarayanan *et al.*, 1993). Further, the authors stated that the erection of artificial nest boxes could be useful for the conservation and propagation of the barn owls where nest sites are scarce or absent and of poor quality.

Southern (1959 and 1970), Korpimaki and Sulkava (1987) and Saurola (1989) have reported that the artificial nesting sites have been readily accepted by barn owls and have been widely used in long term studies of owls. The provision of nest boxes have increased the breeding density of barn owls in Malaysia (Lenton, 1978) and U.S.A. (Marti *et al.*, 1979). The objective of this study was to monitor and compare nest boxes utilization by barn owls in three different habitats viz., human habitations, trees in groves and near to agricultural lands and to suggest suitable habitats for the installation of nest boxes.

MATERIALS AND METHODS

The study area (35km^2), intensively engaged in agricultural operations, was in the tail end of Cauvery delta of Nagapattinam Quaid-e-Milleth district Tamilnadu. The cultivated crops include rice, pulses cotton, groundnut, sugarcane, coconut palm and oi palm.

Nest boxes for barn owls were prepared in the wooden planks of *Samanae samaon* as suggested by Kanakasabai *et al.*(1994). Forty nest boxes were installed in the months of July 1993, October 1993 and December 1993 in the places where poor quality of natural nesting sites were observed and all other possible man-made structures and trees (*Mangifera indica*, *Tamarindus indicus*, *Azadirachta indica* and *Samanae samaon*) near to human habitations (n = 25), in the trees (*Tamarindus indicus*) of groves (n = 5) and in the trees (*Tamarindus indicus* and *Delonix regia*) available near to agricultural lands (n = 10). The height of the installed nest boxes ranged from 3 to 10 m above ground level.

All the nest boxes were monitored once in a month for the period between September 1993 and January 1995 for inferring the utilization by barn owl

Nest boxes utilization was confirmed either by seeing the adult bird and eggs or chicks or by seeing the presence of indirect signs viz., pellets, droppings and prey remains. Two way ANOVA was performed to find the differences in the utilization of nest boxes by barn owl among the habitats (Sokal and Rohlf, 1981).

RESULTS AND DISCUSSION

The mean percentage of utilization of barn owl was found to be high in the boxes installed near to human habitations (45.2%) followed by agricultural lands (41.8%) and groves (16.3%) (Table 1). A significant difference was observed in the utilization of nest boxes by barn owls among the habitats (Two way ANOVA). The barn owls used maximum number of boxes during November 1994 (80%), October and November 1993 (66.7%) and November 1993 (61.5%) which were near to human habitations, groves and agricultural lands, respectively. The overall mean nest box utilization by barn owl for nesting and roosting was 40.9% during the study period (Table 1). From the results it is evident, that the barn owls are closely associated with man and agriculture. Marti *et al.* (1979) have also reported that the barn owl is tolerant of close human presence. They are closely related with man and agriculture (Colvin, 1986).

Out of forty boxes, five boxes were installed near to the nest sites of poor quality and they were occupied by barn owls immediately for nesting. The immediate of natural nest sites. Similar observations have been reported by Johnson (1994) whose action of placing a nest box has been successful where birds have moved out into neighbouring boxes.

According to Marti *et al.* (1979) and Johnson (1994) scarce and non-availability of safe and suitable nesting sites would apparently act as a limiting factor for

Table 1. Percentage of utilization of nest boxes by Barn owl in three different habitats between September 1993 and January '95.

MONTH & YEAR	Percentage of nest box utilization for nesting and roosting *							
	Habitat Types						Total	
	Human habitation		Groves		Agricultural Lands			
	Barn owl	Other Birds**	Barn owl	Other Birds**	Barn owl	Other Birds**	Barn owl	Other Birds**
September '93	30.8	0.0	0.0	0.0	0.0	0.0	20.0	0.0
October '93	28.5	0.0	66.7	0.0	38.5	0.0	36.7	0.0
November '93	50.0	0.0	66.7	0.0	61.5	0.0	56.7	0.0
December '93	30.7	0.0	33.3	0.0	50.0	0.0	35.0	0.0
January '94	28.0	0.0	20.0	0.0	30.0	0.0	27.5	0.0
February '94	60.0	0.0	40.0	0.0	50.0	0.0	55.0	0.0
March '94	44.0	8.0	0.0	0.0	30.0	30.0	35.0	12.5
April '94	36.0	20.0	0.0	20.0	30.0	20.0	30.0	20.0
May '94	40.0	20.0	0.0	0.0	40.0	20.0	35.0	17.5
June '94	36.0	20.0	0.0	0.0	40.0	20.0	32.5	17.5
July '94	32.0	4.0	0.0	0.0	50.0	10.0	32.5	5.0
August '94	36.0	8.0	0.0	0.0	60.0	0.0	37.5	5.0
September '94	60.0	12.0	0.0	0.0	30.0	10.0	45.0	10.0
October '94	52.0	0.0	20.0	0.0	40.0	0.0	45.0	0.0
November '94	48.0	0.0	10.0	0.0	40.0	10.0	42.5	2.5
December '94	80.0	8.0	0.0	0.0	60.0	10.0	65.0	7.5
January '95	76.0	12.0	20.0	0.0	60.0	10.0	65.0	10.0
Mean	45.2	6.6	16.3	1.2	41.8	8.2	40.9	6.3

* - The period between September '93 and December '93 there were 20 nest boxes (13 in human Habitation, 3 in Groves and 4 in Agricultural lands) for Barn owls and thereafter there were 40 nest boxes (25 in Human habitation, 5 in Groves and 10 near to Agricultural lands) in the study area.

** - Other birds included Spotted owlet, Bluerock pigeon and Common myna.

the breeding population of barn owls. Further, Johnson (1994) has emphasized the importance of provision of nest boxes for barn owls and this helped him to maintain the density of breeding pairs. Nest boxes may also be beneficial for the roosting barn owls during adverse climates since they provide a sheltered micro-environment (Marti *et al.*, 1979).

The acceptance of boxes installed in the man-made structures and trees by barn owls indicated that they use the boxes as substitutes against the losses of natural nest sites and showed equal reproductive output to that of other sites (Johnson, 1994) and this corraborates the results of the present study. By constructing owl doors in the barns, the European farmers encouraged the barn owls to nest in (Honer, 1963).

Besides barn owls, the Spotted owl (*Athene brama*), Blue rock pigeon (*Columbia livia*) and Common myna (*Acridotheres tristis*) occupied the nest boxes to the tune of 6.3% (overall mean) in all the three habitats. Of these, the boxes near to agricultural lands had higher rate of occupancy (8.2%) when compared to others. Shawyer (1987) has reported that the Tawny owl (*Strix aluco*) was found to be a nest site competitor of barn owl. Placement of small nest boxes for other birds could be an alternative for avoiding their occupancy in the boxes installed for barn owls. This action may also reduce the nest site competition among these birds.

Thus, it is suggested that the provision of nest boxes for barn owls in the man-made structures and trees near to agricultural lands, where the prey is abundant, would be a feasible strategy for the effective conservation and propagation of barn owls. By doing this, we can also encourage the barn owls to check the rodent pests of both agricultural and medical importance.

ACKNOWLEDGEMENTS

We are grateful to the Principal and Management for providing necessary facilities and encouragement. We are thankful to Messers. R. Balu, V. Elangovan, M. Agoram, P. Kambarajan and K. Ramesh for their help. Our thanks are also due to Dr. R.P. Mathur, Pest Control (India) Ltd., Madras for his encouragement. The financial assistance rendered by ICAR, New Delhi is gratefully acknowledged.

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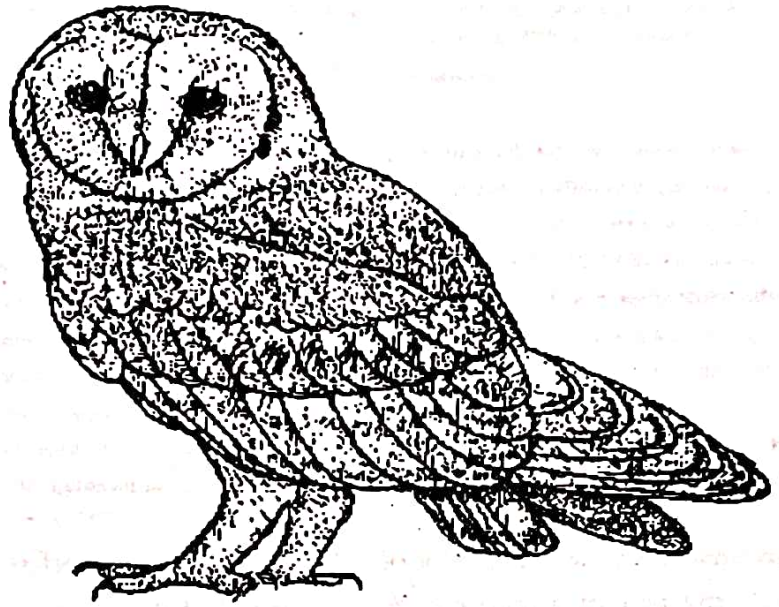

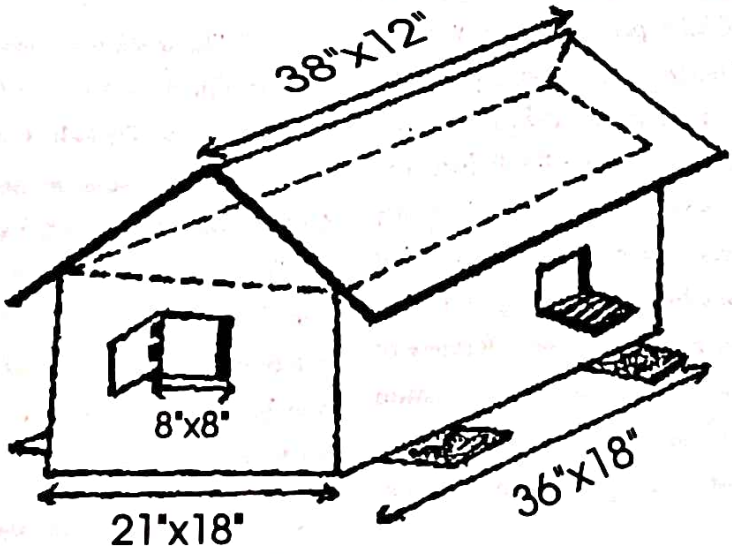

Nest Box for Common Barn owl

Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research,
A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

ARTIFICIAL PERCHES USE BY COMMON BARN OWL (*Tyto alba stertens*) IN RICE FIELDS

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ABSTRACT : The common barn owl, *Tyto alba* requires a perching place to sit and observe the prey. Thirty four "T" shaped perching poles were made with three different heights viz., 5 ft, 7 ft and 9 ft and implanted in (0.75 ha each) Kuruvai (June-August 1994) and Thaladi (October 1994 -January 1995) rice fields. They were implanted 10 m off from the bunds and the distance between two poles was of 10-15 m. The perching poles used by barn owls were studied by an indirect method i.e., by observing the milky white droppings of barn owl on the poles. The perching poles use by barn owl was observed once in a week and simultaneously the population of rodent pests and magnitude of their depradation were estimated. These informations from the data were analysed for four developmental stages of rice crop. Barn owls more frequently used the 9 ft poles than the poles of 5 and 7 ft. The population of rodent pests, and their damage to tillers was minimum in the fields with 9 ft poles. It is suggested that the perching pole of 9 ft height could be used for the management of rodent pests in the rice fields. The perching poles can be allowed to be in the fields until the inception of panicle maturation stage.

Rodent pests are undeniably the principal foe of our farmers. In general, any pest of a crop can be managed by five methods viz., cultural, physical, mechanical, biological and chemical. For the first time in India, the barn owl was reported as a potential biological agent against rodent pests by Santhanakrishnan (1987) and later Neelanarayanan *et al.* (1994). Hall *et al* . (1981) and Askham (1990) have opined that the use of artificial perches possibly could improve the predatory efficiency of some raptors on rodent pests. According to Hall *et al.* (1981) the use of perches could be valuable especially before the rodent's breeding activity and when many crops are either absent or provide little cover. The importance of artificial perches for raptor's hunting, resting and feeding has been emphasized by Reinert (1984). Review of literature indicate that there is no published information on the artificial perching pole use by barn owl in the crop fields and hence the present investigation with the following objectives:

1. To study the perching pole s of different heights use by resident barn owl during four different developmental stages of rice crop in Kuruvai and Thaladi seasons.
2. to determine the preferred height of perching pole barn owl and
3. to study, whether the barn owl's predation (by way utilizing the perches) in the rice fields could red the rodent numbers and tiller damage or not?

MATERIAL AND METHODS

The study was carried out in approximately 3 ha of rice fields of Kuruvai (June - August 1994 ; va - ASD-18) and Thaladi (October 1994 - January 19 variety - PY-4) seasons near Vilanagar, Nagapatti Quaid-e-Milleth district, Tamilnadu. The study area divided into four plots, of which three were of 0.7 size for planting 5 ft, 7 ft and 9 ft high "T" sh perching poles individually and the fourth one w one ha size was maintained as a control plot sim neously, for comparison.

The artificial perches were prepared as sugg by Kanakasabai *et al.* (1994). Thirty four "T" sh perches (consisting of 12 Nos. - 5 ft; 12 Nos. - 7 ft a Nos. - 9 ft perches) were planted in study plots wh crop was at the age of approximately 20 days transplantation. The distance between the two p

was of 10 - 15 m, and they were 10 m off from the bunds on all sides.

The perching poles used by barn owl was confirmed by an indirect mehtod i.e., by observing the mikly white droppings of barn owls, on the poles and around the crop. The perching poles used by barn owl was observed once in a week. For every observation, during evening hours the seldom observed markings (or) droppings of other birds were removed by using water and mud. In the next day morning the poles and crops around the poles were inspected for fresh white markings of barn owl and they were enumerated and recorded.

Simultaneously, in all the four study plots, the population of rodent pests was estimated by live burrow count method as suggested by Neelanarayanan *et al.* (1995) and their depradation to tillers was assessed by diagonal method as suggested by Neelanarayanan *et al.* (1993) on the inspection day of the perching poles used by barn owl. In the study plots an imaginal diagonal line was laid and in order to get more samples from a field, at every 3 m interval one sq ft (30 cm^2) quadrats were laid instead of 10 m intervals as suggested by Neelanarayanan *et al.* (1993). In each quadrat, the damaged and undamaged tillers were enumerated and the percentage of tiller damage was then calculated by using them. The data collected were pooled and analysed for four developmental stages of the rice crop. To find the differences among the perching poles use and their utilization among the developmental stages, Two way ANOVA was performed by following the method of Sokal and Rohlf (1981).

RESULTS AND DISCUSSION

Perching poles use

The 9 ft perching poles were more frequently used by the barn owls than the other two. The number of perching poles used, during Kuruvai season was higher than that of the Thaladi season (Tables 1 & 2) In Kuruvai season the planted perching poles of 9 ft high were readily accepted by the barn owls during the first week of plantation itself and they used the poles to the tune of 70% (Table 1). Few 7 ft high poles were used by barn owls during Kuruvai season and their utilization decreased further in Thaladi season. None of the perching poles of 5 ft high were utilized by barn owls, excepting one during milky stage of Kuruvai season. Significant difference was observed in the utilization of the different heights of perching poles by barn owls (Two Way ANOVA). Hall *et al.* (1981) have reported that the barn owls readily used the perches offered to them in the alfalfa fields and the authors have seen hunting from the perches. According to our personal observations of the activities of barn owls in the wild, the lowest perching height was 10 ft. The perching poles of 9 ft high, when available during vegetative phase of the crop were frequented by the target species and the frequency was observed to be minimum when the crops were at the panicle maturation stage during both seasons.

Utilization of perching poles by barn owls differed significantly among the developmental stages, in both seasons (Two way ANOVA). From the results it is obvious that the barn owl frequented the perches present during early developmental stages of the crop than the older stage. Hall *et al.* (1981) have opined that the perches planted in the fields where either the crops are absent or that provide little cover could be valuable in checking the rodents' activity. The poor use of perches by barn owls in the present study, during panicle maturation phase may be due to close canopy cover of the crop with which the predator cannot see through the moving prey inside the fields. Hence, the planted perches can be allowed to be inside the fields until the inception of panicle maturation stage and thereafter they can be removed from the rice fields. This timely action can also help the peasants to save their grains from bird depradators like parakeets and munias. However, in the present study we did not observe any depradation to grains by these birds.

Table 1. Population of rodent pests and the intensity of their tiller damage in the perching poles implanted (9 ft, 7 ft and 5 ft) and control plots of Kuruvai season rice fields.

Age of Crop (After transplantation)	9 ft Rice fields					7 ft Rice fields					5 ft Rice fields					Control plots			
	A	Rodents-live burrows/ha				A	Rodents-live burrows/ha				A	Rodents-live burrows/ha				Rodents-live burrows/ha			
		B.b.	*M.m.*	*M.b.*	% of Tiller damage		*B.b.*	*M.m.*	*M.b.*	% of Tiller damage		*B.b.*	*M.m.*	*M.b.*	% of Tiller dama	*B.b.*	*M.m.*	*M.b.*	% of Tiller damage
Vegetative (1-30 days)	7 (70)	4	1.33	0	0	5 (41.66)	4	2	0.66	0.5	0	5.33	4	2.66	0	6.4	4.0	3.0	0
Milky (31-45 days)	12 (40)	3.11	2.22	0	4.51	6 (25)	7.33	2.66	0	6.84	1 (4.16)	5.33	4	0	5.10	5.0	2.8	0	6.2
Panicle formation (46-60 days)	14 (46.6)	4.44	2.66	0.44	2.22	1 (4.16)	5.33	2.66	0.33	2.0	0	4	2.66	1.33	4.35	8.0	5.1	4	8.39
Panicle maturation (61-80 days)	5 (25)	4.0	1.33	0	0.9	0	6.66	0.33	0.66	1.1	0	4	1.33	1.33	5.9	9.3	3.0	2.9	8.51

Table 2. Population of rodent pests and the intensity of their tiller damage in the perching poles implanted (9 ft, 7 ft and 5 ft) and control plots of Thaladi season rice fields

Age of Crop (After transplantation)	9 ft Rice Fields					7 ft Rice Fields					5 ft Rice Fields					Control Plots			
	A	Rodents-live burrows/ha				A	Rodents-live burrows/ha				A	Rodents-live burrows/ha				Rodents-live burrows/ha			
		B.b.	*M.m.*	*M.b.*	% of Tiller damage		*B.b.*	*M.m.*	*M.b.*	% of Tiller damage		*B.b.*	*M.m.*	*M.b.*	% of Tiller damage	*B.b.*	*M.m.*	*M.b.*	% of Tiller damage
Vegetative (1-50 days)	6 (60)	2.66	0	1.33	3.27	2 (16.66)	3.11	2.66	1.33	5.33	0	4.0	2.66	0	6.33	6.5	2	1	8.89
Milky (51-65 days)	4 (40)	2.66	2.0	1.33	6.49	1 (8.33)	3.33	2.0	0	5.5	0	4.0	2.66	1.33	5.8	5.5	2.6	2.0	10.68
Panicle formation (66-85 days)	4 (40)	4.0	1.33	0.66	6.81	1 (8.33)	5.33	2.66	1.33	6.36	0	8.0	6.66	2.66	6.83	10.2	4	1	10.9
Panicle maturation (86-110 days)	2 (20)	4.0	2.66	1.33	5.5	0	6.66	4.0	2.66	7.52	0	8.0	4.0	4.0	7.3	11.0	2.6	3.2	11.3

B.b. - Bandicota bengalensis; M.m. - Millardia meltada; M.b. - Mus booduga.

A - No. of perching poles used

Values within the parenthesis indicate the percentage of perching poles used by Barn owl during the respective stages.

Black drongo (*Dicrurus adsimilis*), Small green bee-eater (*Merops orientalis*) White breasted king fisher (*Halcyon smyrnensis*) and Blue jay or Indian roller (*Coracias benghalensis*) were utilized the perching poles during day time. The black drongo utilized the poles more frequently than the others. The black drongos used almost all the poles irrespective of their height. According to Thirumurthi and Abraham (1975) the drongos feed voraciously on insect pests of crops. Thus, the plantation of 9 ft high perching poles in the rice fields would not only help the ryots to check the vertebrate pests during night hours, but also the insect pests during day time, to certain extent. It is also important to mention here that the crop fields of today do not have any perching sites, excepting telephone and electric lines, near to them. Hence, the plantation of perching poles of this kind is indispensable to harvest the service of avian predators to keep our pests under control.

Density of rodent pests

In both seasons, the predominant pest, *B.bengalensis* was found to be minimum in the 9 ft high perching poles rice fields (2.66-4.44 live burrows/ha) than the 5 ft (3.11-7.33 live burrows/ha), 7 ft (4.0-8.0 live burrows/ha) and control plots (5.0-11.0 live burrows/ha) (Tables 1 & 2). The 9 ft high perches fields had comparatively low population of *M.meltada* and *M.booduga* than the other study plots (Tables 1 &2). The observed differences in the population of rodent pests might be due to the predatory pressure exerted by the barn owls. Pearson (1966 and 1971), Pitelka(1973) and Baker and Brooks (1982) are of the opinion that the predation is an important factor in the regulation of rodent population cycles.

Tiller damage

In Kuruvai season, the rodent depradation to tillers was observed from milky stage to panicle maturation stage while in Thaladi season it was observed from vegetative phase to panicle maturation phase (Tables 1 & 2). The 9 ft high perching poles fields had less tiller damage than the other plots. The observed highest tiller damage in the 9 ft high perches fields was 4.51% during milky stage of Kuruvai season and 6.81% during panicle formation of Thaladi season while in the control plots it was 8.51% (Kuruvai) and 11.3% (Thaladi) during panicle maturation stage (Tables 1 & 2) . From the results it is evident that the tiller damage showed a decreasing trend in the 9 ft high perching poles fields, in both seasons.

The maximum utilization of the 9 ft high "T" shaped perching poles by barn owls in this study indicate that these perches could be suggested for the management of rodent pests in the rice fields, particularly until the inception of panicle maturation phase and fallow lands. Further, the efficacy of these perches need to be studied on other important crop fields of different agro-climatic zones, provided that area has got resident barn owl population.

ACKNOWLEDGEMENTS

The authors are thankful to Principal and Management of A.V.C. College (Autonomous) for having rendered necessary facilities. We are grateful to Mr.A.P. Kalyanam for his generous help during the period of investigation. Thanks are also due to Messers. R.Balu, P. Kambarajan and K.Ramesh for their assistance. We record our sincere thanks to Mr.K.S. Subiah, Madras; Dr.R.P.Mathur, Pest Control (India) Ltd., Madras and Dr. A.M.K.M. Rao, CPPTI, Hyderabad for their encouragement. The financial assistance rendered by the ICAR, New Delhi is gratefully acknowledged.

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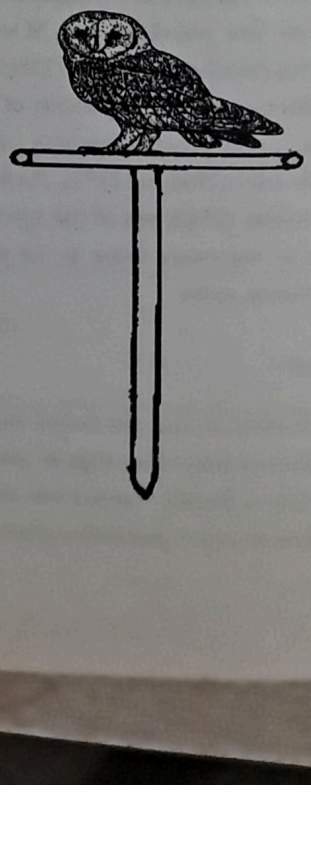
"T" Shape perching pole for Common Barn owl



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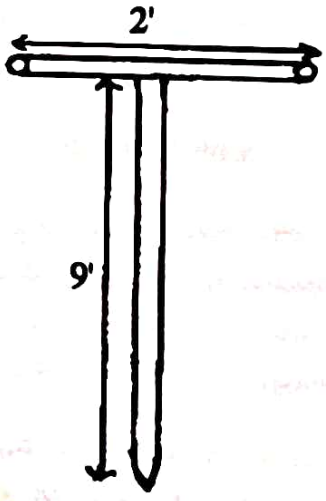

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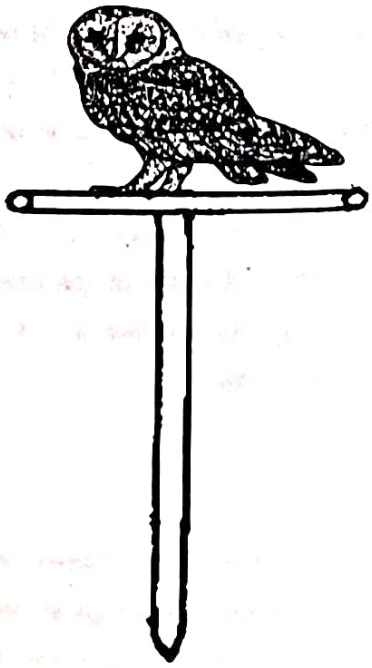

Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research,
A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

GROWTH CHANGES IN THE BODY WEIGHT, BILL LENGTH AND TALON LENGTH OF INDIAN BARN OWL, *Tyto alba stertens* Hartert, 1929, NESTLINGS

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ABSTRACT : Growth changes on the body weight, bill length and middle talon length in the nestlings of Indian Barn Owl (*Tyto alba stertens*) have been analysed. Immediately after hatching the mean body weight, bill length and talon length of the nestlings are 15.8±2.73g, 0.63±0.163cm and 0.23±0.082cm respectively. Maximum growth rate has been observed during the III week for body weight, II week for bill length and V week for talon length. The asymptotic weight of the nestlings has been 525±56.718g. The weight of the owls has significantly declined ($t=6.79$, $df=26$, $P<0.01$) prior to fledging. Bill length and talon length attain their full growth only after fledging. The growth patterns obtained with reference to the above three parameters have been compared with the earlier reports on various other subspecies of Barn Owls and the possible causes for the observed growth patterns have been discussed.

The nocturnal bird, Barn Owl (*Tyto alba stertens*) is a predator of various rodent pests. Barn Owl is characterized by having strong hooked bill and sharp powerful talons for grasping, killing and tearing their prey, which are usually rodents. Of late the economic importance of this bird, especially as a potential rodent controlling agent, has been increasingly realized (Lenton, 1984; Nagarajan *et al.*, 1993; Neelanarayanan *et al.*, 1994 a&b). However, many aspects of its biology with reference to Indian conditions are either inadequately investigated or little known, and the pattern of nestling growth is one of them.

Growth in birds has most frequently been described in terms of weight versus age curves for nestlings or chicks (O'Connor, 1985). Ricklefs (1969) documented the growth and development of over 75 altricial bird species. Haggerty (1994) stated that documentation of external changes in nestlings over time may be especially helpful in future studies where nestlings age estimates are required. Morphometeric measurements of nestlings have been found to be good indicators of age, in Mallard (*Anas platyrchynchos*) (Greenwood, 1974), Willson Grouse (*Lagopus lagopus*) (Myrberget, 1975), House Martin (*Delichon urbica*) (Bryant, 1975), Tengmalm's Owl (*Aegolius funereus*) (Korpimaki, 1981; Carlsson and Hornfeldt, 1994), Ural Owl (*Strix uralensis*) (Eriksson *et al.*, 1984), Red-tailed Hawk (*Buteo jamaicensis*) (Bechard *et al.*, 1985) Northern Harrier (*Circus cyaneus*) (Saunders and Hansen, 1989) Ring Ouzel (*Turdus torquatus*) (Janiga, 1992) and Dotterel (*Charadrius morinellus*) (Thomson, 1994).

Very few information are available on the growth of Barn Owls of various geographical locations. Ricklefs (1968a) has established some parameters of growth of North American subspecies (*Tyto alba pratincola*) by making use of the growth data of Summer (1929) and Pickwell (1948). Growth changes in terms of body weight have been studied in the smaller European subspecies (*Tyto alba alba*) by Radu (1973) in captivity, and by Schenreld and Cirbig (1975) in wild. Lenton (1984) has studied the Asian subspecies (*Tyto alba javanica*) to assess the pattern of weight gains in nestlings. Wilson *et al.*, (1987) recently analyzed growth characteristics of African subspecies (*Tyto alba affinis*) in central Mali. No information is available on the growth rate of Indian subspecies (*Tyto alba stertens*) during developmental stages and the present investigation is an attempt to fill up this lacuna. The objectives of the present study are to record periodic growth changes in the nestlings in term of body weight, bill length and talon length and to use the data so obtained to understand their growth pattern and to evaluate the possibility of using the results in the age determination of nestlings.

STUDY AREA

The study area includes, Mayiladuthurai, Mannampandal, Thilliyadi and Thiruvidaikazhi of

Nagapattinam Quaid-E-Milleth district of Tamilnadu, Southern India. This area is called as "Granary" because of its large scale agricultural operations involving cultivation of paddy, sugarcane, plantain, groundnut, pulses and other cereals. River Cauvery and its tributaries are the perennial water sources of this area. This area is also popularly known for its large number of holy temples and ancient monuments. Since the study area contains large number of suitable nesting and foraging habitats, Barn Owl breeding is high at the study area.

MATERIALS AND METHODS

Active nests, either natural or artificial nest boxes, were located by the signs given in the keys for Barn Owl nest site location by Nagarajan *et al.* (1993) and Nagarajan *et al.* (1995). All observations were carried out in the nests. Hatching order was recorded in the owlets and the day of hatching is regarded as day zero (0) (Janiga, 1992) for counting subsequent days of growth. Hatched siblings were individually identified by means of coloured leg rings for age determination. Handling stress to the nestlings were minimized by handling them very carefully. The nestlings were measured once in a week from hatching till fledging. Every week data on the body weight, bill length and middle talon length were taken from the nestlings. The data were collected either in the late evening (after 17 30 hours) or early morning (before 06 30 hours), of a day (because during the other day light hours, the bird, if get disturbed, may fall prey to its diurnal enemies like crows, kites, etc.).

Weight : The nestlings and adults were weighed with a spring balance or monopan balance and while being weighed, if necessary, the animals were placed in a pre-weighed polythene or cloth bag (Pettingill, 1985).

Morphometery

Bill length : A thread was placed from the tip to the upper mandible to the end of the horny culmen on the forehead and its length was later measured as bill length.

Middle talon length : The length of the middle claw was measured by using a thread and its rate of growth was taken as an index of talon growth.

Data analysis: Irrespective of nest, the data of similar aged nestlings were pooled to analyse the pattern of growth changes in body weight, bill length and middle talon length. Student's t test was used to compare the mean values of the above growth parameters between the fledglings and adult birds. Statistical inferences were by following Sokal and Rohlf (1981).

OBSERVATIONS AND RESULTS

Changes in the body weight, bill length and talon length during the growth stages of Barn Owl nestlings are given and compared with that of adults, in Table 1. Immediately after hatching, the body weight of a nestling has been 15.8 ± 2.73g. The growth rate is low during the I week as the mean body weight gain is 4% and is rapid during III week with the highest mean growth rate (20%). By the end of III week the mean body weight reaches 219.9±28.32g (range: 180.0 to 270.0g) *i.e.,* 40% of the body weight of a fully grown nestling. At the age of VII week, *i.e.,* prior to fledging the growth rate has been 17%. During that period the nestlings on an average weigh 525.6±56.71g (range: 460.0 to 640.0g) which is 25% greater than that of adult weight (Table 1). This shows that the weight of the owls should have significantly declined after fledging, and a student's t test between the weights of owlets in the prefledging stage and the body weight randomly caught wild adult bird also subscribes a significant difference ($t=6.79$, $df=26$, $P<0.01$).

Just-hatched nestlings has a mean bill length of 0.63±0.163cm (range: 0.4 to 0.8cm). The bill growth is highest (22%) during II week (1.48±0.463cm) and lowest (1%) during VII week (2.34±0.234cm). At fledging the mean bill length is 2.34±0.234cm and the mean bill length of an adult is 3.31±0.450cm (Table 1). This shows that 64% of the bill grows prior to fledging and the remaining 36% after fledging. Statistical analysis also shows that the bill length is significantly higher in

the adults than fledglings (t=6.83, df=26, P<0.01).

Mean talon length at the time of hatching was 0.23±0.082cm (range: 0.1 to 0.3cm). After I week, the growth of talon length has been rapid and almost similar from III to V week and the talon length at the end of V week is 2.26±0.360cm (range: 1.5 to 2.6cm) (Table 1).

Table 1. Age-related changes in the body weight (g), bill length (cm) and talon length (cm) of nestling Barn owl

	Growth rate															
	Body Weight (g)						Bill length (cm)					Talon length (cm)				
Age (Wk)	N	Mean	S.D.	I	CI	Range	Mean	S.D.	I	CI	Range	Mean	S.D.	I	CI	Range
Hatch (0)	6	15.8	2.73	0	0	11.0-19.0	0.63	0.163	0	0	0.4-0.8	0.23	0.082	0	0	0.1-0.3
I	42	37.6	13.61	4	4	20.0-65.0	0.89	0.311	10	10	0.5-1.5	0.41	0.181	7	7	0.3-0.7
II	29	121.4	36.84	16	20	67.0-180.0	1.48	0.463	22	32	0.6-2.0	0.91	0.355	18	25	0.6-1.6
III	22	219.9	28.32	20	40	180.0-270.0	1.68	0.403	7	39	1.0-2.2	1.27	0.423	13	38	0.7-2.2
IV	11	310.0	29.58	18	58	250.0-350.0	1.92	0.299	9	48	1.7-2.3	1.67	0.498	15	53	1.0-2.3
V	7	392.1	17.76	16	74	360.0-400.0	2.26	0.190	13	61	1.9-2.4	2.26	0.360	21	74	1.5-2.6
VI	17	438.2	11.72	9	83	420.0-450.0	2.33	0.211	2	63	2.0-2.8	2.44	0.294	7	81	1.9-3.0
VII	16	525.6	56.71	17	100	460.0-640.0	2.34	0.234	1	64	2.0-2.9	2.49	0.311	1	82	1.9-3.0
Adult	12	393.8	36.25	-	80	350.0-450.0	3.31	0.450	36	100	3.1-3.9	2.99	0.599	18	100	2.4-4.1

I - % Increase CI - Cumulative % Increase

The talon growth rate has been low (1%) during the VII week by which time it was 2.49±0.311cm. The mean talon length of a fledgling is significantly lower than that of an adult's (2.99±0.599cm) (t=2.64, df=26, P<0.05) indicating about 18% of the talon growth after fledging.

DISCUSSION

Mean growth rates (weight changes) are more or less similar to that are reported earlier for *T.a. javanica* (Lenton, 1984), and the *T. a. affinis* (Wilson *et al.*, 1987), as the peak in the body weight occurs during the VI to VII week in all the cases. Ricklefs (1968a) has also obtained a similar growth curve for *T. a. pratincola*. The above observations concur with the Lenton's (1984) statement that "growth proceeds at a rate, possibly a physiological maximum, that characteristic of the species and is not adjusted to some ecological optimum". The asymptotic weight of the nestlings is 525.6±56.71g. There appears to be considerable subspecies differences with reference to the mean asymptotic weight of the nestlings as Lenton (1984) reports it to be 606.4±16.2g S.D. for *T. a. javanica* and Wilson *et al.*, (1987) to be 340.5±29.0g S.D. for *T. a. affinis*. Contrasting report are available with reference to adult Barn Owl weight as Hardy *et al.*, (1982) found that in Britain for *T. a. alba* the mean adult weight is 281.6g for males and 297.4g for females, while Bunn *et al.*, (1982) quote an average 337g for the same subspecies and Colvin (1982) reports for the *T. a. pratincola* the mean adult weight is 485g for males and 570g for females and Marti (1973) quotes for captive *T. a. pratincola* from Colorado, U.S.A. a mean weight of 603.1±43.6g S.D.

There is a remarkable reduction in body weight just before fledging. Loss of weight prior to departure in nestlings has also been reported for the Malaysian sub-species *T.a.javanica* by Lenton (1984). This weight reduction has been regarded to have an advantage for moving out of the nest as it reduces the wing load and gives extra energy for flying activity (Kumar and Rao, 1984).

Structures used most by nestlings whilst in the nest develop rapidly and those not functional until the

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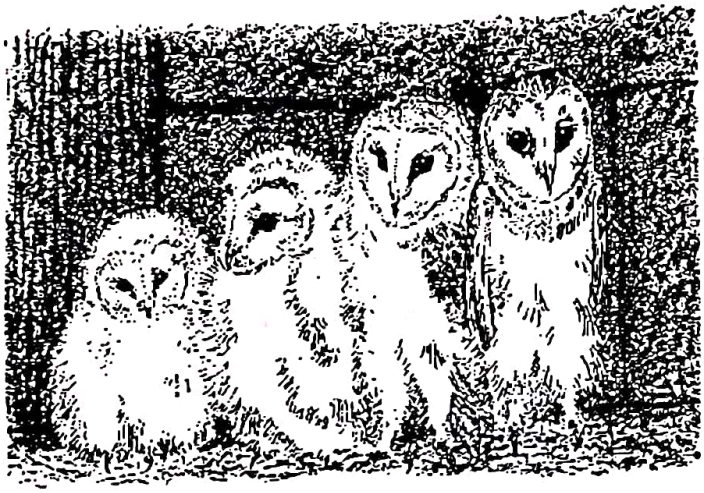

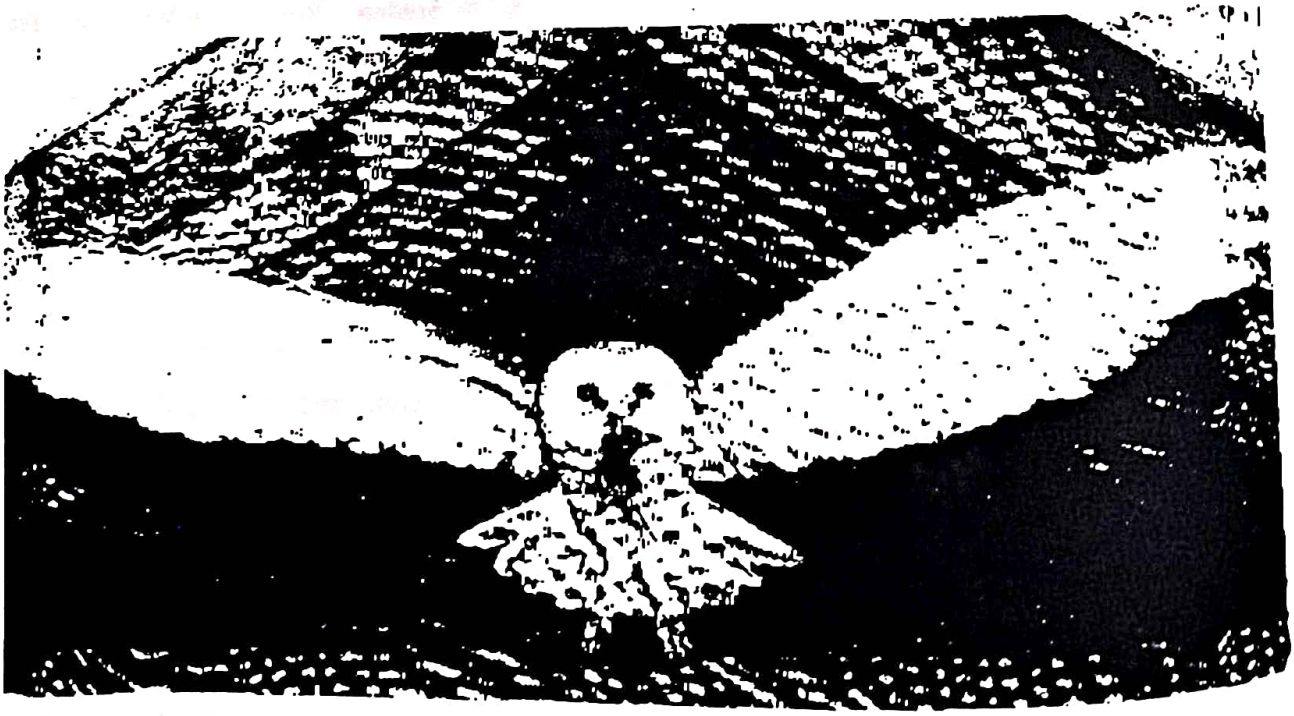

Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research,
A.V.C. College, Mayiladuthurai - 609 305, South India, 1995

DIURNAL TIME-BUDGET OF WHITE PEAFOWL (*Pavo cristatus*) IN CAPTIVITY

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ABSTRACT The study was carried out at Arignar Anna Zoological Park, Vandalur by using scan sampling method of observation. The peak hour and mean percentage of individual activities for male, female and juvenile were studied separately and the values showed that there was differences between male, female and juvenile in different activities. The activity of peafowl was mainly influenced by the day light. The major activities observed were locomotion, resting and autopreening.

Time activity budget reveals the different activities of a species during a period of time. Time sharing between activities determine breeding, growing and survival success of the species (Manning, 1979, Macfarland, 1985), the instinct behaviour, normal physiological psychology, stereotyped fixed action pattern or custommatory acts (Manning, 1979) of the species at any stage of its life. The present study on the diurnal time activity budget of white peafowl may help to determine the normal homeostatic behaviour for better maintenance of the species in captivity.

METHODS

The present study was carried out for 70 hours, 08.00 to 18.00 hrs in the month of November 1994 at Arignar Anna Zoological Park, Vandalur. Scan sampling method (Altmann,1974) was used. The behavioural observations were made on an adult male, an adult female and a juvenile. Feed was provided to the birds daily at 10.00 hrs with grains and at 12.00 noon with feed mixture consisting of greens, garlic and onion. The percentage of every activity in each hour was calculated by using the total observation and their significance by using the non-paired student 't' test.

RESULTS AND DISCUSSION

The present study showed that the day light was the major synchronizing agent in the activity of the white peafowl. The male, female and juvenile birds showed differences in proportion of time spent on each activity. Locomotion, auto - preening and resting were the major activities of white peafowl in captivity.

Locomotion

It includes walking, running, chasing and playing of which walking was the major activity. The mean percentage of time spent by male, female & juvenile for locomotion in a day were 47.3 ± 11.1, 33.9 ± 5.5, 58.5 ± 2.9 respectively., and the peak hours were observed during 12.00-13.00 (60.9%), 17.00-18.00 (46%) and 11.00 - 12.00 (72.9%) respectively. Locomotion was gradually increased till afternoon and decreased thereafter, which showed that the activity was well correlated with photoperiod of a day (Navaneethakanan, 1984).

Resting

It includes standing and lying without performing other activities. Standing was the major activity in which birds were found to be standing idly or observing its surroundings. The mean percentages of time spent in resting per day were 27.9± 11.0, 33.6 ± 6.0, 15.0 ± 3.1 for male, female and jurvenile respectively and peak hours were 8.00 - 9.00 (41.1%), 11.00 - 12.00(42%) and 14.00 - 15.00 (23.7%) resp. Female spent more time in resting, that too in standing (Rands *et al.* 1984) while standing.

Auto preening

It includes self grooming with bills and scratching with its feet and was observed during standing, lying and perching. The mean % of time for male, female &

juvenile were 14.0 ± 1.9, 22.3 ± 3.8, and 13.1 ± 2.2 respectively and peak hours were 16.00-17.00(21.4%), 8.00-9.00(32%) and 16.00-17.00 (20%), respectively.

Allopreening is thought to be important in the maintenance of social relationship and is mostly found in the monogamous bird (Mc Farland, 1981). Since peacock is the polygamous and the study was during post mating period, allopreening was very rarely observed, that too in juvenile - its mother & between females with the purpose of enhancing maternal support & co-operation (Mc Farland, 1981, Rands *et al.* 1984.).

Foraging

It includes feeding and feed searching & the later is very rarely observed. Feeding was mostly from the feed tray and rarely from services with worms and insects. The mean % of time spent per day were 6.6 ±1.6, 7.3±0.9, 9.5±1.9 for male, female and juvenile respectively and the peak hours for male were 11.00-12.00 and 17.00-18.00(10.30%); for male and jurvenile it was found at 17.00-18.00(13.7%) &17.00-18.00(19.7%) respectively.

As in natural condition peak foraging was found in evening hours (Jerdon, 1964, Salim Ali & Ripley, 1980). As juvenile is the growing one it spends more time in foraging than adults. Among adults female spent more time in foraging due to its high energy requirement for body maintenance, egg laying and for nesting (Dahlgran, 1990).

Drinking

The mean % of time spent per day were 1.8±0.4, 1.06±0.3, 1.3 ± 0.6 for male, female and juvenile respectively and the similar peak hours for male and female were 13.00-14.00 & 17.00-18.00 with the % of 3.2 & 2.0 respectively. For juvenile the peak hour was 17.00-18.00(2%). The peak drinking in afternoon may be due to increase in temperature and exhaustion due to locomotion.

Comfort movements

It includes very varied activities such as allopreening, calling, dropping and dust-bathing. the mean % for male, female and juvenile were 0.6, 0.9 & 0.9 respectively. Peafowls have a dust bath with the purpose of facilitating subsequent oiling & preening and to remove unwanted parasite (Clayton & Cotogreeve, 1994). Dust bath was rarely observed as in feral condition (Johnsingh & Murali, 1980) that too frequently in Juveniles. Alarm calls of ' KOK-KOK' and short gesping shrieks of 'Ka-aan' repeatedly six to eight times (Salim Ali & Ripley 1980) Johnsingh & Murali 1980) was observed in peafowls in response to like common mangoose, wild dogs and chital running around the cages.

Our study clearly showed that there was no difference between white peafowl and blue peafowl in the activity pattern (Bergmann, 1980) although the former is one of the mutant variety of the latter, (Baker 1915, Bergmann 1980) and not much difference was observed in activity pattern of peafowls in captivity in feral condition, since photoperiod was the chief synchronizing agent, and peafowls quickly adopt themselves to the captivity (Fitzimons, 1979). We found similarities in captivity and feral condition in the onset and end of activities and in the timings of foraging, drinking and roosting.

ACKNOWLEDGEMENTS

The authors are grateful to Mr. R. Sundaraju, Director, and Mr. M. Jaganatha Rao, Deputy Director, who have provided permission and help for our study in the zoo. We are grateful to the Dean, Madras Veterinary College, for his encouragement. We express our gratitude to Mr. T. Radakrishnan, Statistician M.V.C; Dr. V. Vasiah, Dr. R. Thiruthalinathn, Dr. N. Paneerselvam. Dr. D. Swaminadhan, and Mr. N. Baskar, for their immense encouragement and suggestions during our study. Special thanks to Mr. M. Shyam Shankar and Ms. S. Suchitra for their kind help and encouragement.

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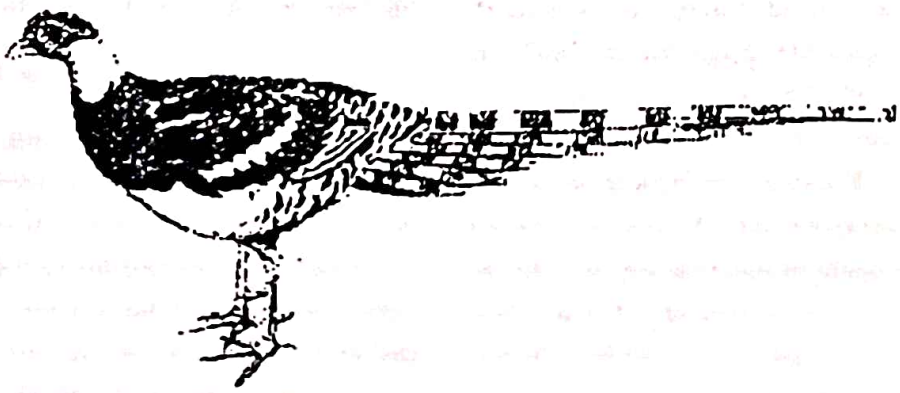

Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research,
A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

A STUDY OF WINTER WATERFOWL AT UDAYAMARTHANDAPURAM BIRDS SANCTUARY AND MUTHUPET LAGOON, TAMILNADU.

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ABSTRACT: Udhayamarthandapuram Birds Sanctuary and Muthupet lagoon are the two important refuges for the aquatic migratory birds in Nagai-Quaid-e-Milleth-district, Tamilnadu. During 1993-94 Bird census twenty eight species at Udhyamarthandapuram and forty three species at Muthupet lagoon were recorded and their total population was calculated. The reasons for the abundance of individual species were also discussed.

The Conservation and management of aquatic birds throughout their range have evolved considerable interest and concern. Their relatively high energy demands and locally large population make them important components of aquatic ecosystems. Interspcific difference in size, habitat use, distribution responses to seasonal environmental pressures and food habits provide the fabric for natural experiements in the elaboration of resource. The population of aquatic birds in 1993 - 94 was assessed at Udayamarthandapuram.

STUDY AREA

The study was conducted in a part of the Muthupet lagoon which is famous for the mangrove forest and Udayamarthandapuram bird sanctuary. Muthupet lagoon is situated in Nagai district, Tamilnadu (Lat 10 46N; Long 79° 51 E) on the east coast of India. Lagoons receive water every year during the monsoon from Pamaniyar and Koraiyar. The lagoons are densely vegetated with mangrove species such as *Avicenia officinalis, Exoecaria agallocha and Aegiceera carriculatum.* Udhayamarthandapuram is located 13 Kms from Thiruthuraipoondi in Nagai Quaid-e-Milleth district, Tamilnadu. This bird sanctuary covers an area of 111 acres and it is surrounded by the agricultural lands with paddy and sugarcane crops. This sanctuary receives water from Koraiyar river which is connected to River Cauvery every year during north-east mansoon. *Acadua rubitica and Ipomea* sp. were found to be predominant in the lake. The wetland area is fully covered with sub merged vegetation like *Hydrilla Vorticellata, Potomogaton crispns and Najarminas* free floating vegetation like *Lemna pancicostata and Spirodela polyrive.*

METHODS

In the present study population of aquatic birds was estimated by direct count as suggested by Vijayan (1985). Udayamarthandapuram Sanctuary is surrounded by earthern dykes and by using these dykes as transects birds were counted. In muthupet lagoon by boat, counts were carried out fortnightly between 7.00 AM to 11.00 AM. A pair of 8 X30 binoculars was used. Care was taken to avoid the double count by watching birds direction of flight and landing in case they are disturbed by predators.

RESULTS AND DISCUSSION

28 species of aquatic birds recorded from the Udayamarthandapuram birds Sacturay, 6 species of Anatidae viz., spot bill, cotton teal, common teal, pintail, blue winged teal and shoveller contributed 31-5% of the overall population. While 5 species of Ardidae contributed about 14%. The three species of Rallidae contributed 8% and five species of Charadridae contributed 3% respectively. Among all the aquatic birds, the higher number recorded was of the open bill stork (23% followed by pintail (14%) little cormorant (9%) little grebe (7%). night heron, pond heron, little egret, median egret, cotton teal, common teal, spot bill, blue

winged teal, shoveller white breasted water hen. Purple moorehen, coot, little ringed plover, common sandpiper, river tern had contributed morethan 5% of the population. 9 speicies namely viz., Cattle egret, white ibis, glony ibis, spoonbill, red shank, green shank, green sandpiper, wood sandpiper, and little terns were seen only in few numbers.

In Muthupet lagoons, totally 1539 birds belonging to 10 Families namely Podicipidae, Pelecanidae, Ardidae, Ciconidae, Threshkiarithidae, Anatidae, Rallidae, Charadidae, Laridae, Alcedidae were observed during the study period. Nine species of Family Ardidae contributed 14% while six species of order Anseriformes contributed 11.5%. Among all the aquatic birds in Muthupet lagoon the highest number recorded was of pond heron (20%) followed by pied kingfisher (10%) and little egret (9%) respectively. Median egret, black winged stiff Kentish plower, Caspian terns had contributed more than 5% of population. Night heron, large egret, painted stork, openbill stork, cotton teal, common teal, spot bill, pintail, blue winged teal, shoveller, common sandpiper were seen in only in few numbers.

The highest number of migratory ducks recorded at Udhayamarthandapuram Sanctuary may be due to availability of the food and suitable wintering ground. The fluctuation in the population size of the migratory species is generally attributed to habitat change, non-availability of food, human disturbance in a particular habitat Sayree and Rundle (1984) reported that the water depth is an important factor influencing habitat use by migratory birds which is similar to the present study. Trees mainly on the edge of the lake form the resting habitat for open bill stork. The entire aquatic area of the sanctuary is interested with a number of *Acacia nilotica* planted on dykes. The openbill stork breeding migrant which begins to arrive in the sanctuary when the molluscs are common. When the main wetlands are inundated they move to a small puddles in the terrestrial area inside as well as outside the sanctuary for feeding. Quality of feeding condition is probably important one for population fluctuation in many stork species (Kushlan, 1986, Frederick and Collopy, 1987).

The higher population of pond heron and pied kingfisher in Muthupet lagoon is mainly due to availability of trees and boughs hanging over the water on either side of the river which is connected to the brackish water area of the lagoon.

As a result of low tides in the edges of the lagoon and river rich in small fish, prawn and other aquatic inverteberates are plenty this factor is responsible for the high population of egrets. The little egrets have a feast picking the tiny fry from the shallow areas such foraging habitat of little egret was reported by Kushlan (1976) and Wiland (1977). This factor is responsible for the little egret have a feast picking high population of egrets.

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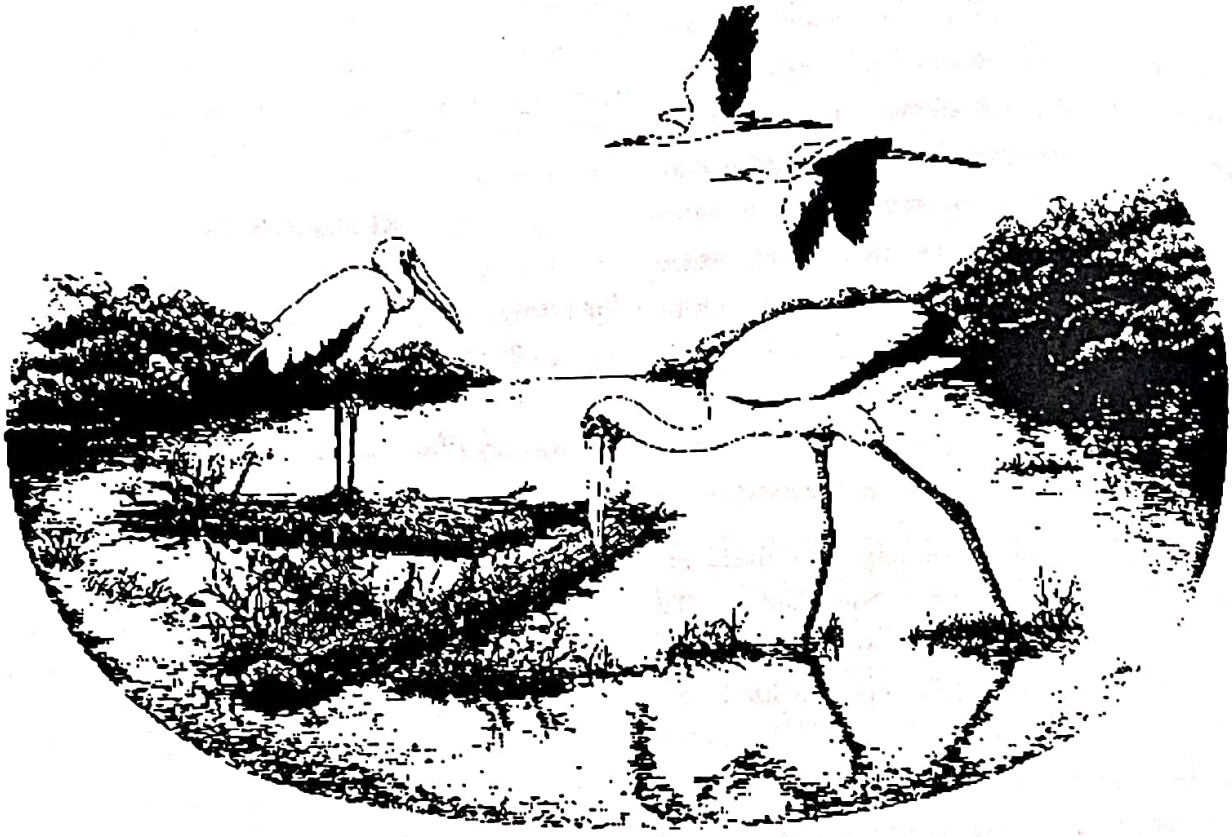

Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research,
A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

A STUDY ON THE FEEDING HABITS OF AVIFAUNA OF CERTAIN LAKES OF THANJAVUR DISTRICT

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ABSTRACT: A brief study was undertaken on the food and feeding habits of selected migratory avifauna in a few fresh water lakes of Thanjavur District. The studies on birds such as sandipipers, stilts, snipes, moorhens, jacana, ibises, cormorants, darters, spoonbills, ducks and teals, herons, egrets and storks and their food and feeding habits revealed that they occupy certain specific trophic niches in their environment. A decline in their natural feed affect their population.

A number of migratory birds regularly visit the southern part of the Indian Peninsula especially the rich fertile lakes of Thanjavur district (Sugathan, 1989). Each group of birds confine themselves to certain natural food and prey species in their respective trophic niches in the freshwater lake ecosystem.

MATERIALS AND METHODS

The gut contents of selected birds were analyzed and studied. The natural food or prey species, swallowed or digested or partly digested were recorded. The area of study includes freshwater lakes between Sengipatti and Sologampatti, about 24 km from Thanjavur.

RESULTS AND DISCUSSION

The results revealed that the members of heron family (pond heron, large heron, egrets) mainly feed on fishes and frogs. There is a seasonal variation in feeding due to availability of food.

Cormorants are mainly fish-eaters. Painted storks prefer small water-snakes and openbilled storks feed only on molluscs. White ibis, black ibis and spoonbills prefer freshwater crabs. Teal ducks and geese and waterhens are largely herbivorous. Sand pipers, stilts ingest small worms and small molluscs. Jacanas, moorhen, coot largely feed on aquatic weeds.

ACKNOWLEDGEMENTS

The author gratefully acknowledges the help and encouragement rendered to him by the Management and the Secretary and Correspondent, A.V.V.M. Sri Pushpam College (Autonomous) Poondi to Carryout this work.

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Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research,
A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

MEAN BURROW OCCUPANCY OF FIELD RODENT PESTS

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ABSTRACT : The population of rodent pests is estimated in the crop fields by adopting any one of these mathods viz., live burrow count, Lincoln index and Removal method. Burrows of rodent pests namely *Bandicota bengalensis, Millardia meltada* and *Mus booduga* were excavated in different crop fields of our area and fallow lands to determine the mean burrow occupants from February 1993 to January 1995. The observed average maximum number of rodents / burrow was 4.53 ± 4.53,3.21 ± 2.45 and 4.92 ± 3.66 during January 1994 for *B. bengalensis, M.meltada* and *M.booduga*, respectively . The mean burrow occupants of the predominant rodent pest, *B.bengalensis* was statistically insignificant between the years , excepting January 1994 and 1995. On the otherhand, the mean burrow occupants of the *M.meltada* and *M.booduga* differed significantly between the years for two and three months, respectively.

Rodents are the major vertebrate pests responsible for 10-15% loss to total national produce in India, for spreading many diseases of man and live -stock, for inflicting heavy losses in poultry by killing young chicks, breaking eggs, eating and contaminating feed and for destruction of household articles, property and even currency notes (Malhi and Chander Sheikher, 1989). For taking up a control campaign against them a knowledge on the density of field rodent pests is absolutely essential. In India, counting of live burrows of field rodents is one of the methods of population estimation. This method can only give an index i.e., the number of live burrows of rodents in an area but not the number of rodents in that area. However, this method has advantages over other methods. By this method, large area can be covered with less man power and energy and it is economic too. According to Srivastava (1968) the population of rodent pests fluctuated between the months in a year. By studying the burrow occupants of each rodent species one can find out the periods when the control campaigns can be started most economically against a particular species of rodents or all of them together (Srivastava, 1968). In general, if the control campaign is done during the period when the population of rodent pests are at their minimum, that would be effective and economic. Literature review indicates that there is no published information about the population dynamics of field rodents from cauvery delta, Tamilnadu and hence the present investigation with following objectives.

1. to study the number of rodents that occupy a single burrow and compute the mean burrow occupants of three species of rodent pests individually,
2. to understand the breeding period of each species,
3. to suggest a suitable period for effective and economic control campaign for all rodent species and
4. to study the possibility of utilizing the obtained average burrow occupants values for the calculation of rodent population (in numbers) in future.

METHODS

The study was carried out in the crop fields of Kanjanagaram, Natham, Vilanagar, Melapathy and Vadagarai villages of Nagapattinam Quaid-e-Milleth District, Tamilnadu.To get an equal representation in the data, the burrows of rodent pests (lesser bandicoot rat, *Bandicota bengalensis* ; soft furred field rat, *Millardia meltada*; and Indian field mouse, *Mus booduga*) in the bunds of rice, sugarcane, soybeans, cotton, pulses and fallow lands were excavated twice in a month between February 1993 and January 1995 with the help of local rodent trappers . The active burrows of rodent pests

were identified by following the descriptions given by Neelanarayanan *et al.* (1994). In the excavated burrows, the number of rodents occupied were enumerated and recorded. The calculated mean values of two years were analysed statistically (Between the months) by Student's "t" test (Sokal and Rohlf, 1981).

RESULTS AND DISCUSSION

The mean burrow occupancy of three species of field rodents from February 1993 through January 1995 is given in Tables 1 & 2. Maximum average number of *B. bengalensis, M. meltada* and *M. booduga* per burrow was found to be 4.53 ± 4.53, 3.21 ± 2.45 and 4.92 ± 3.66, respectively during January 1994 and this is due to the breeding activity of these rodent pests (Table 1). The maximum mean number of rodents per burrow observed by Srivastava (1968) in Uttar Pradesh was 5.0 for *B. bengalensis*, 3.5 for *M. meltada* and 3.9 for *M. booduga*. Sivaprakasam (1988) has reported that the mean number of occupants was highest during November, 1987 for *B. bengalensis* (4.8), during December 1987 for *M. meltada* (6.5), and during January 1988 for *M. booduga* (3.4). The results of the present study indicate that the burrows of *B. bengalensis*, *M. meltada* and *M. booduga* had one rodent per burrow in most of the months, especially during summer (March through June) and between September and December, excepting *M.meltada*. In contrast, Srivastava (1968) has reported that there were wide fluctuations throughout the year in the average number of burrow occupants of five species of rodent pests including *B. bengalensis*, *M.meltada* and *M.booduga* in Uttar Pradesh. The reasons for the fluctuations in the populations of rodents mainly depends upon the climatic conditions (Srivastava, 1968) and unfavourable climatic conditions and paucity of food availability (Prakash and Mathur, 1987) and these corroborates the results of the present study.

The breeding activity of the predominant rodent pest of our area *B.bengalensis* was observed, during January, February, July, August and October. Although, the breeding activity of *B. bengalensis* was observed in the months of July, August and October, most of the population bred only during January and February of the two years under study. Similarly, most of the *M.meltada* and *M.booduga* populations were found to breed during January and February of these two years. The high reproductive activity of rodent pests is due to the ripening and harvesting stages of the Samba and Thaladi seasons paddy crop during this period and when the climatic conditions are conducive and availability of food is abundant. Contrary to this, Sivaprakasam (1988) has reported that the peak reproductive activity occured during November 1987 for *B.bengalensis*, September 1987 for *M.meltada* and November 1987 for *M.booduga*. Further, he has stated that peaks of population density coincided with the maturity of Kuruvai and Samba seasons paddy crop in Cauvery delta. The

Table 1. Mean burrow occupancy of three species of field rodent pests (1993-1994).

Rodent Pests	Month and Year											
	02/93	03/93	04/93	05/93	06/93	07/93	08/93	09/93	10/93	11/93	12/93	01/94
Bandicota bengalensis	3.07± 3.92 (24)	1.0 (22)	1.0 (20)	1.0 (25)	1.0 (23)	1.0 (25)	2.08± 3.8 (23)	1.0 (25)	1.0 (20)	1.0 (20)	1.0 (23)	4.53± 4.53 (26)
Millardia meltada	2.1± 2.28 (10)	1.0 (11)	1.0 (8)	1.0 (12)	1.0 (10)	1.0 (12)	1.10± 0.3 (12)	1.0 (20)	1.0 (20)	1.8 0.38 (11)	1.8 0.4 (10)	3.21± 2.45 (14)
Mus booduga	1.77± 2.98 (9)	1.0 (7)	1.0 (8)	1.0 (11)	1.0 (9)	1.8 ± 0.4 (11)	2.8 ± 2.14 (9)	1.0 (6)	1.0 (8)	1.0 (10)	1.0 (11)	4.92± 3.66 (13)

Table 2. Mean burrow occupancy of three species of field rodent pests (1994-1995)

Rodent Pests	Month and Year										
	02/94	03/94	04/94	05/94	06/94	07/94	08/94	09/94	10/94	11/94	12/94
Bandicota bengalensis	3.41± 4.24 (24)	1.0 (32)	1.0 (22)	1.0 (30)	1.0 (20)	1.8± 2.4 (20)	2.66± 3.68 (25)	1.0 (23)	1.69± 2.25 (23)	1.0 (26)	1.0 (27)
Millardia meltada	2.61± 2.16 (13)	1.0 (10)	1.0 (11)	1.0 (12)	1.0 (12)	1.16± 0.37 (12)	1.07± 0.26 (13)	1.07± 0.26 (13)	1.15± 0.36 (13)	1.0* (13)	1.0* (13)
Mus booduga	3.71± 3.65 (14)	1.0 (7)	1.0 (10)	1.0 (9)	2.28± 1.57* (7)	1.13± 0.33* (8)	3.45 ± 2.74 (11)	1.0 (14)	1.0 (10)	1.0 (12)	1.0 (10)

* Values are statistically significant at 5% level (Student's "t" test) between the years.
Figures within the parenthesis indicate the number of burrows excavated.

observed differences between the results of the present study and Sivaprakasam (1988) might be due to the change in the paddy (all seasons) cultivation periods.

According to Prakash (1975) the rodents in most of the climatic zones, are found to breed all the year round but exhibit a peak reproductive activity during monsoon and winter. Although we did not observe the breeding activity of three species of rodents during ripening and harvesting stages of other crops, attention must be paid to study the relationship between the different developmental stages of each crop and breeding activity of rodent pests. Such studies would be immensely helpful for a researcher to suggest a suitable period (cropwise) for rodent control campaign for a particular species or all the inhabited species together. The observed litter size of rodent pests was 5 - 12 for *B. bengalensis*, 4 - 7 for *M.meltada* and 4 - 8 for *M. booduga*. It was observed during breeding season that the male rodents of all the three species were found to occupy solitarily in a burrow while the female animals were with their litters. During non-breeding season both sexes of all species of rodents were found to occupy the burrows individually.

According to Sridhara (1985) the knowledge of breeding periodicity and population dynamics is essential to time the control operation. From the resu it is evident that *B. bengalensis* was found to breed duri January, February, July, August and October. In t case of *M. meltada*, the reproductive activity w restricted to January and February, while *M. boodu* populations was found to breed during January, Febr ary, June and August. Thus, the rodent control oper tion (poison baiting) can be done between March a June for all the three species of rodents and during th time the availability of alternate food is also scarce a this would certainly enhance the efficacy of contr operation. However, this can be treated as a gener suggestion and development of cropwise rodent contr measures including the period (developmental stages the crop) and methods to be adopted would be mo useful in accomplishing greater control over roden pests. Baskaran *et al.* (1995) and Neelanarayanan *et a* (1995) have developed the technology of this kind fo the rice crop and the rodent researchers can extend th same to other crops as well.

The mean burrow occupants of *B. bengalensis* did not differ significantly ($P>0.05$) between the years, excepting January 1994 & 1995 ($P<0.05$). The mean burrow occupants differed significantly ($P<0.05$) in the months of November and December for *M.meltada*

and January, June and July for *M.booduga*. Since the results of the present study (Vide Tables 1 & 2) is not consistent with that of Sivaprakasam (1988) who has reported that the highest number of burrow occupants was observed during November 1987 and January 1988 for *B. bengalensis*, during December 1987 and January 1988 for *M.meltada* and during November 1987 for *M. booduga*, the mean burrow occupants values can not be used for the computation of rodent population (in numbers) in future. Futher, the results of these two studies revealed that reproductive periods of rodent pests have changed in 6 to 7 years of time as per the changes in the rice cultivation periods.

ACKNOWLEDGEMENTS

We express our deep sense of gratitude to the Principal and the Management of A.V.C. College (Autonomous) for having rendered necessary facilities and encouragement. Authors are thankful to Mr. R. Balu for his help. We also thank Mr. S. Marimuthu of Natham and his team for their help in excavating the burrows of rodents. Our thanks are also due to Mr. K.S.Subiah, Madras and Dr.R.P. Mathur, Pest Control (India) Ltd., Madras for their encouragements. The financial assistance rendered by ICAR, New Delhi is gratefully acknowledged.

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Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research,
A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

A STUDY ON DIURNAL ACTIVITY PATTERN OF SAMBAR DEER (*Cervus unicolor*)

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ABSTRACT : Observations were made on sambar (*Cervus unicolor*) in Aringnar Anna Zoological Park at Vandalur. The behavioural studies revealed that the deers were most active during 11.00 to 12.00h and at 15.00 to 16.00h which coincides with the feeding time. Resting time was pronounced in the morning and afternoon. Statistical analysis showed no significant differences in activities such as standing, walking and sleeping.

Sambar deer are not gregarious in behaviour, the deer has become common and diurnal in parks and sanctuaries (Israel, 1988). A thorough knowledge of activity pattern of any animal is necessary to understand its behaviour and any change in it due to biotic or abiotic factors. Huges (1988) has said that animals welfare will suffer when they are unable to perform the normal patterns of behaviour. In review of literature on sambar deer the information on activity pattern is scanty. Few workers like Brander (1927), Prater (1965), Schaller (1967), Krishnan(1972) and Semiadi (1994) have highlightened on morphology ecology and general behaviour. The studies on the diurnal activity patterns of sambar deer might help in the conservation of this animal.

STUDY AREA AND METHODS

All works were carried out at Arignar Anna Zoological Park, Vandalur located in Chengai M.G.R district, 32kms from south of Madras. The samber deers are exhibited in a large dry open moated peninsula type enclosure. The sambar herd consisted of 9 stags, 13 hinds and 5 fawns. The animals were fed twice at 11.00 with wheat bran, bengal gram and salt and at 15.30 hrs with grasses and twigs. The behavioural recordings activities of three selected animals stag, hind and fawn from 7.00 to 17.00 in November 1994 were made. Scan sampling method (Altman, 1974) with an interval of one minute was adopted.

RESULTS

Although most of the activities were spread out throughout the day the main activity period was at noon 11.00-12.00 and evening 15.00-16.00. Resting was pronounced in morning 10.00-11.00 and in afternoon 12.00-13.00. Feeding reached its peak at 11.00 - 12.00 and at 15.00-16.00. Rumination and sleeping showed peak at 9.00 - 10.00 and 13.00 - 14.00 respectively. Moving was observed more at 11.00 - 12.00. Maximum wallowing time was at 11.00-12.00 and 15.00 - 16.00. There was no consistent time for high or low grooming activity. The ocassional behaviours did not show any definite pattern.

The characters such as standing, moving and sleeping were not significant among individuals. Lying and grooming were not significant among adults but between fawn and adults it was highly significant. The other significant behaviours were eating concentrate and ruminating. Grazing was highly significant between stag and fawn but the other two combinations showed low significance. Fawn and stag differed significantly in wallowing but it was non significant between adults (Stag & Hind), hind and fawn.

Stags spend about 40.94% of the day light hours in lying, 23.06% in standing, 9.58% in feeding, 14.38% in runimation and 12.04% in others. Equivalent figures for Hind and Fawn are 41.58%, 20.31%, 17.04%, 9.73%, 11.34% and 57.81%, 17.52%, 12.19%, 2.23%, 10.25% respectively.

DISCUSSION

Observations show that sambar deer in captivity

spent about 67.69% of the day time in resting which was pronounced in mornings and afternoons after early morning grazing and concentrate feeding respectively (Schaller 1967, Krishnan 1972). Fawn spends more time in lying and varies significantly from the adults. Laying may be to reduce heat loss and to save energy (Mc Farland 1981) which was nonsignficant among adults. Standing too showed non significance among the three individuals.

The feeding periods were most intense periods of daily acitvity. Feeding is more conditioned reflex because concentrate feed is supplied in morning 11.00 and grasses and twigs are fed at 15.30. Sambar deer actively grazed and browzed in mornings and evenings and showed preference for grasses Schaller (1967) Hinds and Fawns spend more time in feeding (17.04% & 12.19% respectively) than adult males (9.58%) which may be that males have dominant access to areas of maximum feed availability (Clutton Brook 1977)or due to lactation infemales which doubles food choice (Cultton Brook *et al.* 1982). The significant variation in feeding behaviour may be attributable to sex difference (Selender 1966), age (Patridge & Green 1985) and to individual difference (Grant 1976) Rumination usually follows the early morning foraging and the distinct variation in rumination time was due to drymatter intake or due to different genotype of the animals (John Hancock 1953).

Though moving was consistently observed at all time a slight increase was found before and after peaks of feeding suggesting a good coordination among the two activities where moving is a function of feeding or vice versa. This type of movement from lair to feeding place was stereotyped (Darling 1937) and showed no significance among the three individuals.

Wallowing is a stereotyped activity (Darling 1937) and was mostly found after feeding. Drinking was found along with wallowing for which the feeding behaviour may be a direct stimulus for drinking (Mc Farland 1981). The significance difference in wallowing between stag and fawn and the nonsignificance between hind and fawn suggests that the fawn mostly remains near its mother.

Sleep in the deer was associated with the afternoon hours for a very short time. Balch (1955) has referred that ruminants rarely sleep because of the need to keep the thorax upright while ruminating and the apparent lack of sleep and the typical lying position are characters of ruminants.

Though no consistent time for high or low grooming activity was observed the significant variation in grooming between the hind and its fawn was due to the filial relationship between them which existed in the form of allogrooming usually by the hind by means of licking (Sridhar 1992). Stags indulged in autogrooming and differed significantly from the fawn. Grooming may be performed for ecotoparasite removal (Barton 1985) reducing social tension between animals (Schino *et al* 1988).

Though the deers exhibit various types of behaviours in real life an animal makes decision on whether to continue the current activitiy or change to some other form of behaviour (Mcfarland 1981). These decision criteria influence the order in which the animals go about their daily tasks (Mcfarland 1977).

As our study describes only the diurnal activity pattern of sambar deer in captivity in one season a further detailed study extending over the 24 hour period in different seasons might help in better understanding of the sambar deer and in conservation of this beautiful animal.

ACKNOWLEDGEMENT

We are grateful to Mr. R. Sundararaju, Director, AAZP for granting permission to conduct this work in the zoo. We acknowledge the help of Mr. M.Jaganatha Rao, Deputy Director, AAZP. We also thank the Dean of Madras Veterinary College for all the help rendered. We are deeply indebted to the Veterinarians, AAZP for their dedicated assistance in the field. We are especially greateful to Mr. T. Radhakrishnan, Statistitian, MVC for helping with data analysis. We thank Mr. N. Baskar, Biologist,

AAZP and our colleagues P.S.Venkatesan and D. Santhi for their kind assistance and encouragement.

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Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research,
A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

HISTOLOGICAL CHARACTERISTICS OF PREORBITAL GLAND OF BLACKBUCK (*Antilope cervicapra*)

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ABSTRACT: In antelopes chemical communication is established by the presence of certain dermal glands. Preorbital gland in blackbuck (*Antilope cervicapra*) of antelope family was studied. It was located in the bony fossa anterior to the lower margin of the orbit. There are variations in the size and colour between the territorial male and the rest of the adult males. In territorial black buck the gland was darker and larger than the other bucks. On microscopical examination, the characteristic and distinguishing features of the territorial buck were 1. epidemis was thick 2. hair follicle components namely hair follicle, sebaceous glands and arrectores pilorum were thick 3, Apocrine sweat glands were more in number with wider lumen distributed throughout the dermis. The alveolar type of glands were thrown into numerous folds, 4. The fat also as isolated mass. 5. Cytoplasmic blebs were observed in the cuboidal cells lining the sweat glands, and 6. the most distinguishing feature was the presence of melanin pigment as coarse granules in all the cell of epidermis except those of stratum corneum. Melanoblasts were also found in the superficial layer of dermis.

Resource defency polygyny is the most common mating strategy by male antelopes (Gosling , 1986) and most, perhaps all resource territories are scent marked using glandular secretions, faeces, urine (Gosling, 1985). Blackbuck (*Antilope cervicapra*) live in social groups. The males are territorial in nature and various territorial behaviours have been described (Schaller, 1967; Prasad, 1981 and Sinha, 1986). These territorial behaviours have also been reported in captive population (Mungall, 1979 and Manimozhi, 1988).

For establishing chemical communication and scent marking several skin glands are present in mammals (Johnson, 1973 and Ralls, 1971). The chemical signals are associated with occurrence of specialised dermal gland namely pre orbital gland (POG) in blackbuck (Manimozhi and Kanakasabai, 1990). The marking frequency is an indication of territoriality in captive blackbuck (Manimozhi & Kanakasabai, 1994). The preorbital gland and forehead glands have been identified in black-tailed deer (Muller Schwarze, 1971). The source of scent associated with rubs has never been identified (Atkeson & Marchindam, 1982). The olfactory organs play a significant role in the social behaviour of mammals. The literature on the histological structure of preorbital gland in blackbuck is one of the olfactory gland is scanty. The work has been aimed at the descrption of histological features of the adult and territorial bucks, which could lead to a better understanding of the behavioural patterns.

MATERIALS AND METHODS

3 territorial males, 6 adult males, and 5 sub-adult males were selected for the present study. The gross features and external morphology of the glands were recorded. The preorbital glands were collected from blackbuck immediately after death at Arignar Anna Zoological Park. The glands were fixed in 10% formalin. Fixed tissues were processed in paraffin wax 4-6μ sections were cut and stained with haemotoxilin and eosin. Comparisons were made between the territorial buck and rest of the adult bucks. Thickness of the epidermis, hair follicle size, diameter of sebaceous and sweat glands were measured. Morphometric measurements were tested with Student "T" test (Snedecor and Cochran, 1967). Micrometry of components of preorbital gland were tested with Mann-Whitney "U" test (Campbell, 1989).

RESULTS AND DISCUSSION

The blackbuck had a pair of preorbital gland (POG) which were packed in the bony fossa 20 mm anterior to the lower margin of the orbit. The POGs

were large, weighed 5 to 9 grams and the surface was covered by skin. The skin covering the gland invaginated to form a slit located on the upper side of the gland.

The slit measured 1.8 cm to 3.4 cm. When the glandular activity increased the slit opened up appearing as a bowl. The depth of the bowl during the active phase ranged from 0.5 to 1.7 cm. Glands opened into this depression. The morphometric measurements were tested statistically. The results showed significant differences among them ($P < 0.001$).

The preorbital gland appeared to be typical dermal gland with the epidermis on the surface and the dermis accomodating both sebaceous and sweat glands in addition to the hair follicle. The surface of the preorbital gland was sheathed by stratified squamous epithelium of kerotinising type. Over the indistinct basement membrane stratum cylindricum formed a single layer. Several layers of polyhydral cells constituted the stratum spinosum over which the stratum granulosum, stratum lucidium and stratum corneum were present. In the stratu germinativum melanoblasts and melanin granules wer seen in the cytoplasm of the epithelial cells. The loos connective tissue formed the dermis. The hair follicle sebaceous glands and sweat glands were present. Thic collagen fibers were main constituents of the connectiv tissue fibers. The cells of the connective tissue like mas cells, lymphocytes, fibroblasts etc were diffusely distrib uted in the dermis.

Sebaceous gland and arrectore pilorun which were associated with hair follicles were found towards the papillary layer of dermis. The root of hair follicle extended into the reticular layer of the dermis. The Sebaceous glands were seen on both sides of the hair follicles. The papillary layer of the dermis was highly vascular with numerous capillaries. Resting on the basement membrane of the sebaceous glands were the tall columnar cells and the rest of the secretory cells were squamous. The cytoplasm of squamous cells were filled with fat droplets.

Table 1. Morphometric measurements of preorbital gland in three age groups of Black buck

Age Groups	Weight of the gland g	POG length cm	POG width cm	Depth of slit cm
Sub-adult buck (n=12)	5.10±0.36	2.0±0.16	1.43±0.22	0.73±0.17
Adult buck (n=10)	6.72±0.30	2.8±0.15	2.42±0.24	1.36±0.11
Territorial buck (n=6)	8.32±0.68	3.2±0.78	2.87±0.14	1.6±0.11

Table 2. Micrometry of components of preorbital gland of adult bucks Vs Territorial buck

Age Groups	Thickness of the Follicular area (Epidermis)		Thickness of the Interfollicular area (Epidermis)		Diameter of Hair Follicle mμ	Diameter of Sebeceous gland mμ	Diameter of sweat gland mμ
	Cellular area mμ	Stratum corneum mμ	Cellular area mμ	Stratum corneum mμ			
Adult buck	108.59± 17.17	8.89± 1.19	41.28± 16.94	8.89± 1.97	125.09± 24.86	97.79± 26.47	308.87± 160.16
Territorial buck	146.69± 13.36	54.31± 7.41	114.30± 13.20	38.87± 8.43	605.95± 95.14	317.20± 117.27	536.63± 142.36

In the reticular layer of dermis the collagen fibers were thinner and formed a network. The sweat glands were distributed in the reticular layer of the dermis. The sweat glands were saccular, with wide lumen lined by single layer of cuboidal cells. Myoepithelial cells were also present within the basement membrane of the sweat glands. The duct arising from the sweat glands transversed the papillary layer of the dermis and opened into the neck of the hair follicles. In addition to this the blood vessels in the form of arterioles and venules were also found in the reticular layer.

In contrast to the general features already described the territorial buck had certain unique features which could be identified both morphologically and histologically.

In Territorial buck, the gland was larger,heavier, and darker. The slit was longer than the rest of the animals (Table-1). Histologically both epidesmis and dermis and all the components are associated with these two components revealed certain distinguishing characteristics (Table-2).

EPIDERMIS

The epidermis was thicker due to increased number of cells in the stratum spinosum and a thick stratum corneum.Melanoblasts were more in number and coarse granules distributed in the cytoplasm of epithelial cells. Desquamated cells mingled with homogeneous secretion accumulating on the surface of the skin could be easily identified in the territorial buck.

DERMIS

Hair follicles were comparitively thicker. Sebaceous glands were branched, better developed with more number of cells (Table-2) and occupying major part of the papillary layer of the dermis. Similarly, the sweat glands which are normally confined to the deeper layer of the dermis were found in abundance occuping both papillary and reticular layer of the dermis. The distinguishing feature of the sweat gland of the territorial buck was abundance of the secretory alveoli and were in the form of dilated sacs with wider lumen and the wall of the alveoil was thrown into numerous folds with shelf like epithelial projections into the lumen. The cuboidal cells were taller with darkly stained with acidophilic cytoplasm and were characterised by cytoplasmic blebs.

Another unique feature of the Territorial buck was the presence of fat cells among the epithelial cells lining the alveoli and in addition fat cells were also present as isolated groups but were always associated with basement membrane of the alveoli. Due to abundance of sweat and sebaceous glands the dermis appeared to be having lesser number of collagen fibers. The scanty connective tissue between the glandular mass was highly vascular.

The thickness and diameter of follicular area, interfollicular area, hair follicles, sweat glands and sebaceous glands were significantly greater in territorial buck than adult bucks ($P < 0.001$).

The observations which have been made on POG of the blackbuck revealed both morpholigical and histological differences that exists between territorial and adult bucks.

ACKNOWLEDGEMENT

One of the author (A.M.) is thankful to Thiru R. Sundararaju, I.F.S., Director and Thiru M.Jaganatha Rao, I.F.S., Deputy Director of Arignar Anna Zoological Park, for providing necessary facilities to collect samples and for their constant encourgement. My special thanks also are due to veterinary officers Arignar Anna Zoological Park.

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Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research,
A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

ACTIVITY PATTERNS AND FEEDING HABITS OF GAUR (*Bos gaurus*) IN BERIJAM RESERVE FOREST, PALNI HILLS, TAMILNADU.

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ABSTRACT: Daily activity pattern studies revealed that the gaur was most active between 0600 h and 0900 h to 1990 h. The different activities such as feeding, moving, resting, vocalization, drinking, figthing and comfort behaviour were observed. The result shows that the gaur spent most of the time on feeding. Gaur feeds selectively in grass dominated areas though they also feed on browse species. The diet of the gaur consists of the grass species such as *Themeda cymbarica, T. tremula, Eragrostis tenuifolia, Setaria sp. Heterepogon matrinii, Imperata cylindrica and Ishaemum sp.* The gaur actively feeds from 0600 h to 0900 h in the mornings and 1600 h to 1900 h in the evenings.

Reyonlds *et al* (1982) reported that the bison are found in varying habitats throughout their range. It is most useful to identify their diet by association with geographic. Gaur prefers to feed on browse species if the habitat type are usually associated with plant phenology (Reynolds *et al* 1982). By investigating their response to forage biomass, structure and quality, we may better understand their original trophic niche. Investigations on whether the animal is a selective feeder or whether it feeds in proportion to what is available have often failed because of difficulty in measuring availability.

The gaur has been important to the ecology, yet little is known about its ecology and especially its feeding habits in relation to natural vegetation. It is high time that we know more about the ecological needs of the gaur and the characteristics of the forest so that proper conservation needs can be implemented to prevent the extinction of this animal in India. The key to any successful application of any management policy is collection of an adequate basic information on which decisions can be made. It is hoped that this report will prompt local management personnel to evaluate the situation in greater details. Successful intensive management of gaur as a wildlife resource could lead to economic benefits for the region.

The objective of the present study is to provide the latest and most upto date information on our vulnerable species The present work is planned to collect data on the following ecological needs of gaur in Palni hills. To find out the activity patterns, and to know the food and feeding habits of gaur.

STUDY AREA

The present research work was conducted at Reserve forest in Palni hills (15 E to 57 N). It is an eastward offshoot of western ghats, south India. The elevation is 2100 M. The plateau of grasslands with sholas. The grass land habitat forms three quarters of the upper Palanis. The dominant species of grass are *Themeda cymberica, T.tremula, Heteropogan matrini, Ischaemum* sp, *Ergostis tennifolia* and *Settaria* sp. The commercial plantation includes wattle, eucalyptus, pine, alden and geranium.

MATERIALS AND METHODS

Group scan method (Altman, 1974) was used to collect data on age/sex, feeding, moving, resting, vocalization, drinking, fighting and comfort behaviour. The grass species preferred and parts of the plants eaten by the gaur were also recorded.

RESULTS

Activity Patterns

A daily activity pattern was observed for 12 h of the day time. The gaur is most active between 0600 h to 0900 h and 1600 h to 1900 h. The different activities such as feeding, moving, resting vocalization, drinking, fighting and comfort behaviour were observed. The result shows that the gaur spent most of the time on feeding. Gaur also spends much of the time in moving from place to place. The gaur took rest in the sholas between 1000 h to 1500 h.

Food and Feeding

Gaur feed selectively in grass dominated areas. The observation shows that the gaur are primarily grass eaters though they also feed on browse species. The diets of the gaur consist of the grass species such as *Themeda cymabrica, T. Tremula, Eragrostic tenuifolia, Settaria* sp, *Heteropogan matrini Imperata cylindracea* and *Ishaeum* sp. The animals prefers to feed on only the upper portions such as leaf blade, stem, seeds and flowers of the aforesaid grass species.

The observations on the plant composition of the diets of various age/sex classes of gaur revealed that the grass is preferred by all the age classes when compared to browse. Adult males preferred browse at a higher level when compared to others. The gaur actively feeds from 0600 h to 0900 h in the mornings and 1600 h to 1900 h in the evenings.

DISCUSSION

Activity pattern

The gaur spent their time mostly on feeding. Krishnan (1972) has reported that the gaur feed till late in the morning and also in the evening. It was also noticed in the present study that they took rest between 1000 h to 1500 h in sholas. Thus the temperature plays significant role in the daily activity pattern of the gaur. Krishnan (1972) informed that the gaur generally down during the hottest part of the day.

Food and Feeding

Pedent *et al* (1974), Reynolds and Hawley (198 and krishnan(1972) also reported that the bisons a primarily grass eaters. The plant composition of the die support Larson (1940), Langhurst (1961), Garreto (1938), Martin *et al* (1951), Scoper (1941) and Nelso (1965) that the bison are primarily grass eaters. The die of the gaur consists of the grass species such as *cymbarica, T. tremula, E. tenuifolia, H. matrini, I. cylindric Settaria* sp and *Ishaeum* sp. Of these, the tall grasses we used extensively. Krishnan (1972) reported that the gau feeds on various kinds of tall and short grasses. In th present study, the animals preferred to feed on only th upper portions such as leaf blade, stem, flowers and seed Reynolds and Hawley (1987) stated that the wild biso select the leafy tops of many plant species which are highe in nutritive quality than the lower parts of the same plant The gaur prefers both the finer and coarser grass. It i interesting to note that the finer grass species comprise the major food in the present study.

ACKNOWLEDGEMENTS

It is with great pleasure that we acknowledge th help, encouragement and facilities provided b Prof.R.Balasubramanian (Rtd Principal) and Dr. R Kanakasabai, Head of zoology department, A.V.C. Col lege, Mayiladuthurai. We experss our gratitude to th District Forest officer, Forest range officer, the field staf and the Tamilnadu Forest department for assistance. W express our gratitude to Mr. N. Sivaganesan for hi assistance in identifying the plant species. .pm1

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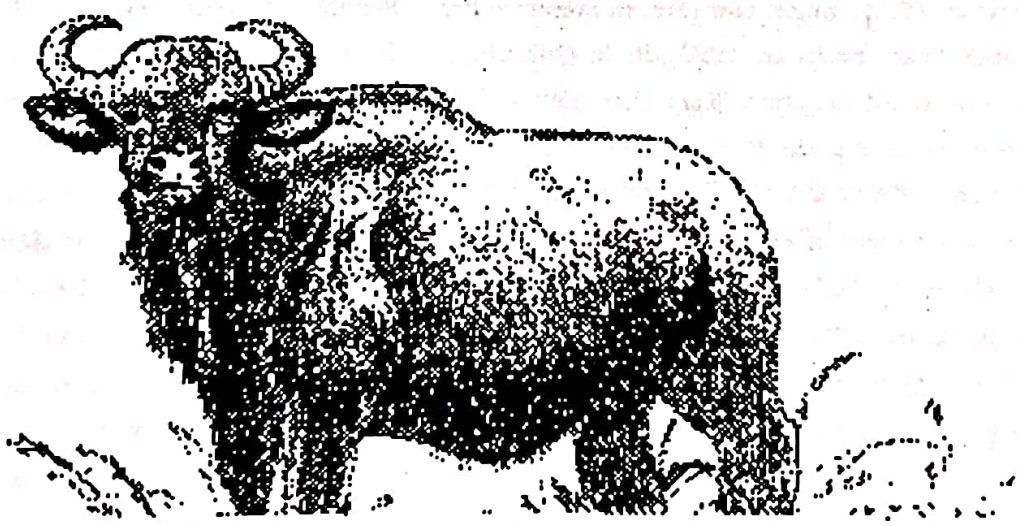

Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research,
A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

CONSERVATION PERSPECTIVES OF THE THREATENED WILDLIFE HABITATS AND SELECTED ENDANGERED MAMMALS OF THE NILGIRI BIOSPHERE RESERVE

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ABSTRACT : Significance of reserve forests, which form 59% of the Nilgiri Biosphere Reserve, in terms of endangered species and threatened habitats (5540 sq km) has been focussed. These reserve forests harbour various endangered species such as elephant (*Elephas maximus*), hyaena (*Hyaena hyaena*), sloth bear (*Melursus ursinus*) fourhorned antelope (*Tetracerus quadricornis*), blackbuck (*Antilope cervicapra*), Nilgiri marten (*Martes gwatkinsi*) and Nilgiri langur (*Presbytis johnii*) Abundance of these species in the reserve forest was greater than in some protected areas in the Nilgiri Biosphere reserve. Many endangered species heavily depend on endangered habitats such as gallery forests, valleys, and tropical thorn forests which are located in reserve forests. These forests are being subjected to heavy anthropogenic pressures. The ways and means to protect the endangered species and habitats throught species specific and habitat specific conservation programmes have been addressed. This approach would go a long way in benefitting not only specific endangered species and habitats but also in conserving the rich biodiversity of the Nilgiri Biosphere Reserve.

Several studies have been undertaken in the Nilgiri Biosphere Reserve on elephants (Nair *et al*, 1980, Prasad *et al*, 1980, Desai *et al*, 1987, Sivaganesan,1991), gaur (Krishnan, 1972), nilgiri tahr (Steven Sumitran Per comm), sloth bear (Baskaran 1990),dhole (Johnsingh 1978) and lion tailed macaque (Ramachandran, 1986), but mostly in national parks & sanctuaries. The reserve forests which form 59% of the NBR holding considerable population of a variety of endangered species but have been relatively less studied except for a long term study on elephants (Sukumar, 1985).Of late, the management of reserve forests has gained considerable importance for conservation of endangered species(Desai, 1993).

This paper assesses 1) proportion of reserve forests in the NBR and their conservation status and 2) conservation status of the threatened habitats and selected endangered mammals,focusing on reserve forests of Sigur-Singara Reserve Forests adjoining Mudumalai WLS (MWLS).

STUDY AREA

The Nilgiri Biosphere Reserve includes a complex of protected areas and reserve forests in Tamil Nadu, Karnataka and Kerala states. The study area Sigur-Singara reserve forest (S&S RF) and the Mudumalai Wildlife Sanctuary (MWLS) (11°30' & 11° 39' N and 76° 27 & 76°43' E) are situated in the south east of the Nilgiri Biosphere Reserve. These areas encompass a wide variety of forest types from scrub and deciduous forest to tropical semi evergreen forests, reflecting the gradients in rainfall and topography. The altitude ranges from 300 mt in the Moyar valley to over 1150 mt in the Morgan Betta. The terrain is mostly flat, except for steep hills, in the east of S&S RF area. The annualrainfall increases from 600 mm in the Sigur area to 900 mm in the western region of the MWLS. Perennial rivers such as Moyar, Kedarhalla and Singara drain the area.

METHODS

Information on mammalian diversity, abundance and conservation problems of each species and their habitats were collected. Abundance of each species was assessed base on limiting factors such as habitat quality, fire, grazing by livestock, and other forestry operations

RESULTS AND DISCUSSION

The NBR has more areas under reserve forest (59%) than protected areas. Although these forests are being subjected to severe biotic pressures it has good population of elephants, gaur, nilgiri tahr, fourhorned antelope, blackbuck, hyaena, tiger, leopard and wild dogs. An effective breeding population of mugger crocodile is found in the Moyar valley. These species require species specific research programme for better management.

Table 1. Percentage protected areas reserve forests in and core area of the Nilgiri Biosphere Reserve

States	Protected area		Reserve Forest		Core area	
	Sq km	%	Sq km	%	Sq km	%
Karnataka	1513.56	76.59	462.70	23.41	701.80	56.58
Kerala	433.92	33.56	858.80	66.44	264.50	21.32
Tamilnadu	399.56	17.60	1870.66	82.40	274.00	22.09

The vast tract of reserve forests (82%) in the NBR Tamil Nad need special attention for conserving the threatened wildlife and their habitats. Vegetation types such as shola-grassland patches, tropical thorn forests, dry mixed scrub forest and gallery forests are commonly found in the reserve forest. These forests are subjected to developmental activities sch as hydroelectric projects, tourism expansion, grazing pressure, illegal encroachments of forest lands and conversion of revenue land into pattaland. The same is also applicable for the reserve forests of the Kerala part of the NBR but the magnitude varies. Protected areas in Karnataka with over 76% of NBR in the state could well protect all "flagship" species and their habitats. In contrast, the protected area coverage is less in Tamil Nadu (17%) and Kerala(34%) which requires further expansion by including vital wildlife habitats. The proposed Sugalgottai WLS in Moyar valley is ideal for preserving species such as blackbuck and fourhorned antelope.

The Karnataka part of the NBR has more protected (Bandipur Tiger Reserve & Nagarahole National Part) and core areas of the NBR than other two states. Therefore, the conservation effort and resources need to be channalized towards states with more reserve forests. Such an approach would preserve the integrity of NBR along with its endangered flora and fauna.

Table 2. Major conservation problems for selected en dangered mammals in the NBR.

Species	Population status	Key conservation issues						
		LC	WI	GR	FR	PO	DIS	DEP
Elephant	3	+	+	+	+	+	-	+++
Gaur	3	+	+	+++	+	+	+++	+++
Nilgiri tahr	2	+	+	-	++	+	-	-
Tiger	2	+	-	-	-	-	-	+
Leopard	3	+	-	-	-	-	-	+
Wilddogs	3	+	-	-	-	-	+	+
Hyaena	2	+	-	+	-	-	-	+
Sloth bear	2	+	+	+	+	-	-	+
Fourhorned Antelope	2	-	+	+	-	-	-	+
Blackbuck	3	-	+	+	-	+	+	+

Population status; Subjective ratings; Lc = Loss of forest connectivity, WI = Weed invasion, GR = Grazing pressure, FR = Fire incidence, PO = Poaching, DIS = diseases, DEP = Developmental activities +++ = heavy; ++ = moderate pressure; + low.

Each species is subjjected to a single or a combination of factors (Table 2). It is necessary to draw a species specific management programme to safeguard these endangered species in the reserve forests. Management practices and research activities need to be oriented towads these specific problems. The expansion of developmental activities is a major threat for the survival of many endangered species.

Sukumar (1986) suggested that the priority in the management of the NBR largely lies in the assessment of its various boundaries and zonations. The key issues before the managers with regard to the existing zonation

of the NBR and its impact on various endangered species and their habitats are as follows:

a. Aspects of biosphere zonations to protect the habitats of highly endangered species such as fourhorned antelope, blackbuck, hyaene and a few species of small carnivores; brown mongoose, rusty spotted cat, nilgiri martens, fishing cat.

b. To develop any standard management approach to safe guard species which exist outside the protected areas; and

c. The necessities to modify the existing zonation of the NBR with regard to habitat and species specific conservation needs to preserve the rich biodiversity of the NBR.

ACKNOWLEDGEMENT

I wish to thank the Tamil Nadu Forest Department for permission to study in Mudumalai Wildlife Sanctuary and Nilgiri North Forest Division. Ajay A Desai is thanked for sharing his data source in Table 3. I sincerely thank Dr. V.S. Vijayan, Director SACON for providing necessary facilities to prepare the paper. Drs. Ajith Kumar & Justus Joshva gave comments on the manuscript. My sincere thanks to Shri. K. Chidambaram I.F.S., K.S.Neelakandan I.F.S and P.C. Thyagi I.F.S who rendered logistic support during this field study.

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Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research,
A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

PRELIMINARY SURVEY ON CROP DAMAGE BY WILD ANIMALS IN THE FORESTS OF KERALA

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ABSTRACT : A survey was conducted to determine the nature of crop damage by wild animals in Kerala. The data were collected from the office records of the Divisional 1 Forest Offices and by visiting the field. Major crops destroyed by wild animals in Kerala are paddy (*Oryza sativa*), coconut palm (*Cocos nucifera*), plantains (*Musa* sp.), arecanut (*Areca catechu*), coffee (*Coffee arabica*), tea (*Thea sinensis*), rubber (*Havea braziliensis*), cashew (*Anacardium occidentale*), Oil palm (*Elacis guineensis*), pepper (*Piper nigrum*), sugar cane (*Saccharum officinarum*), tap ioca (*Manihot utilissium*) etc. Maximum crop damage was recorded from the Wynaad Wildlife Sanctuary. Elephant (*Elephas maximus*), wild boar (*Sus scrofa*), porcupine (*Hystrix indica*), gaur (*Bos gaurus*), sambar (*Cervus unicolor*), bonnet macaque (*Macaca radiata*), common langur (*Presbytis entellus*) are the main animals involved in crop damage. Out of the total compensation claimed only 8.2% was disbursed by the Forest Department. It is found that high voltage electric fencing using energizer is very effective for stopping elephants from entering agricultural fields.

The forest area in Kerala is highly fragmented due to settlements and enclosures. Enquiries with forest officials and cultivators revealed that crop loss in agricultural fields, especially adjoining forest areas, is very high in Kerala. This is due to the straying of wild animals such as wild boar, elephant, porcupine and deer from the forest to the agriculture fields. Due to this situation, the hostility between animals and villagers in the fringe of the forest areas is increasing. Wild animals are guarded from poaching. Due to this population of many animals are increasing. Consequent to this, man-wildlife conflicts are also increasing in certain areas. Man-wildlife interactions in Karnataka and Nilgiris especially the conflict between elephants and man has been studied by Sukumar (1990). Appayya (1992), Balasubramanian *et al.* (1993) and Ramesh Kumar and Sathyanarayana (1993). Crop raiding and economic loss due to elephants were studied by Mishra (1971) and Datye (1993) in Bihar. According to Santiapillai and Jackson (1990) elephants kill about 100 to 200 people, each year in India. No information is available on this subject from Kerala. This survey was conducted from January 1994 to July 1994, to collect preliminary data on depredation of agricultural crops by wild animals.

METHODS

The data were collected from the office records of the Divisional Forest Offices. The details gathered include animals involved in crop damage, species of crop damaged, compensation claimed by farmers, and amount sanctioned by the Forest Department. Field data were also obtained from Wynaad, Neyyar, Peppara and Chinnar Wildlife sanctuaries to study the patterns of cultivation, animals involved in crop damage and the type of protection methods employed.

RESULTS

Pattern of crop damage

The major crops destroyed by wild animals in Kerala were paddy (*Oryza sativa*), coconut palm (*Cocos nucifera*), plantains (*Musa* sp.), arecanut (*Areca catechu*), coffee (*Coffee arabica*), tea (*Thea sinensis*), rubber (*Havea braziliensis*), cashew (*Anacardium occidentale*), oil palm (*Elacis guineensis*), pepper (*Piper nigrum*), mango tree (*Mangifera indica*), jack tree (*Artocarpus heterophyllus*), sugar-cane (*Succharum officinarum*), tapioca (*Manihot utilissimum*), mulberry (*Morus aba*), lemon (*Citrus* sp.) *Colocasia sp., Alocasia sp.,* ginger (*Zingiber officinalis*),

sweet potato (*Ipomaea batatus*), lemon grass (*Cymbopogon citratus*) and few medicinal plants.

Maximum damage of crop was recorded in Wynaad Wildlife Sanctuary followed by Wynaad north, Wynaad south, Kozhikode and Munnar Forest divisions. Only less incident was reported from Mankulam, Thenmala, Palakkad, Vazhachal, Chalakudi, Thrussur and Malayattur Forest divisions. There was no crop depredation in Silent Valley National Park, Periyar Tiger Reserve, Parambikulam Wildlife Sanctuary, Kothamangalam, Kottayam, Konni, Punalur and Trivandrum divisions.

Table 1. Compensation claimed by cultivators and sanctioned by the Kerala Forest Department during 1985-1993

S.No	Forest Divisions	Claimed (Rs.)	Sanctioned (Rs.)
1	Wynaad Wildlife	48,50,549	2,40,505
2	South Wynaad	22,30,824	1,23,828
3	Mannarkad	9,14,500	3,315
4	Nilambur South	5,42,225	43,040
5	Munnar	5,16,680	43,600
6	Kozhikode	5,09,101	21,630
7	Chalakudi	3,76,090	6,175
8	Kannur	2,21,320	15,990
9	Idukki	1,70,750	24,000
10	Palakkad	1,35,900	800
11	Malayattur	50,000	0
12	North Wynaad	47,500	3,30,492
13	Vazhachal	24,000	0
14	Mankulam	16,000	3,000
15	Nilambur North	11,250	1,500
16	Periyar Tiger Reserve	5,000	500
17	Thenmala	3,000	802
18	Kothamangalam	0	1,500
19	Ranni	0	3,550
20	Trivandrum Wildlife	0	5,000
	Total	1,06,24,689	8,69,227

Animals involved in crop damage

Elephant (*Elephas maximus*), wild boar (*Sus scrofa*), porcupine (*Hyareux indica*), gaur (*Bos gaurus*), sambar (*Cervus unicolor*), bonnet macaque (*macaca radiata*), common langur (*Presbytis entellus*), barking deer (*Muntiacus muntjak*), mouse deer (*Tragulus meminna*), blacknaped hare (*Lepus nigricollis*), malabar giant squirrel (*Ratufa indica*), and peafowl (*Pavo cristatus*) were causing damage to the agricultural crops in Kerala. Amoung these, elephant and wild boar caused maximum damage to the crops all over Kerala. Elephants were mainly involved in damaging crops like coconut palm, plantains, arecanut, rubber, coffee, pepper and paddy. Wild boar destroyed mainly tapioca, sweet potato and lemon grass. Gaur involved in the destruction of sugar-cane, mulberry, paddy and other cash crops in the Marayur Range of Munnar division. In Neyyar and Peppara Wildlife Sanctuaries, and Agasthyavanam Biological Park of Trivandrum Wildlife division, wild boar, elephant, mouse deer and barking deer were causing severe damage. Sambar was damaging crops in Mannarkad Range of Mannarkad division and elephants were destroying crops in Agali and Attappadi Ranges in Palghat District.

Compensation and control measures

The total compensation claimed by cultivators all over Kerala for the period starting from 1985 to 1993 was around Rs. 1,06,24,689. Kerala Forest Department had sanctioned an amount of Rs.8,69,227 as compensation (Table 1). In some places the cultivators have not claimed any compensation, but only reported the damage to the Forest Department based on which the forest officials assessed it and paid compensations.

In order to reduce the animosity towards wild animals and to prevent crop loss, electric fences using energizers were installed by the Forest Department in Peppara, Neyyar and Wynaad Wildlife Sanctuaries. They were effective in stopping elephants from entering the fields.

Traditional control measures based on mechanical and chemical methods were employed by cultivators and tribals and they were also effective in controlling the wild animals from entering the agriculture fields. Mechanical methods include erecting thorny bush barriers, stone walls, barbed wire fencing, displaying colour cloths, threatening with fire and keeping watch and ward on

watch towers. They also used crackers to frighten away the wild animals. Indigenous chemical methods such as placing bath soap in a coconut shell at night, spraying kerosene or waste oil on the path of wild boar or smaller mammals such as blacknaped hare, mouse deer were also practiced.

DISCUSSION

Elephants cause severe damage to crops in Kerala. This is because raiding elephants prefer cultivated crops. According to Balasubramanian *et al.* (1993) and Ramesh Kumar and Sathyanarayana (1993) ragi and paddy were the major crop items raided by the elephants in the forest of Karnataka and Nilgiris. But in Kerala, coconut palm, sugar cane, cocoa, arecanut and paddy were the main crops raided by elephants.

In most of the Forest divisions, wild boar is involved in causing heavy damage due to its high density of population. This can be compared to the problems created by over abundant populations of nilgai and black buck in Haryana and Madhya Pradesh (Chauhan and Sawarkar, 1989).

Out of the compensation claimed by people, only 8.2% was sanctioned by the Forest department. This is due to the lack of funds. According to Santiapillai and Jackson (1990) compensation and insurance for crop damage was sanctioned on a limited basis in Sri Lanka, due to numerous practical problems.

High voltage electric fencing, which gives a sharp non-lethal electric shock, is very effective and relatively the cheap method compared to others, for stopping elephants from entering the agriculture fields. The electric fences using energizers, can be installed where the man-wildlife conflict is a serious problem.

ACKNOWLEDGEMENTS

We are indebted to Dr. P.S.Easa, Scientist-in-Charge for all the help rendered during the study. The study was financed by the Wildlife Wing of Kerala Forest Department.

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Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research,
A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

HAND REARING OF A FEMALE SNOW LEOPARD NEONATE IN SALIM ALI NATIONAL PARK SRINAGAR (KASHMIR)

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Because of being efficient hunters and committed consumers of meat cats have distinguished themselves as most specialised living carnivores. Moreover 37 species of cats distributed throught the world, occupy a variety of ecological niches in different types of habitats ranging from deserts to tropical rain forests and temperate woodlands to rocky and mountain sides.

Among the cats snow leopard has a unique and dominative role in himalayan ecosystem, that is the reason for which it is considered as key species of the region.

In J&K State, snow leopard was treated as a vermin untill 1968 (Schaller, 1977) but subsequently animal was given official protection because of its highly endangered status. Inspite of the total protection which the animal continues to inspite of the total protection, which the animal continues to enjoy throughout its range, reports suggest that the results so achieved are not much encouraging most probably due to poaching, low fecundity rate and scarcity of natural prey. The low proliferation rate and distinct genetic make up of the animal, have jointly contributed in raising the conservation value of snow leopard to a higer value than it was earler value of snow leopard to a higer value than in was earlier thought. Till recently snow leopard was taxonomically named as *Panthra unica* in most of western references. But now the uniqueness of this animal has been acknowledged through its acceptancess as a single species genus, *Unica unica* (Wilson and Reeder, 1993).

The present paper is an attempt to make available first hand information gained while hand rearing of a wild born female snow leopard neonate in Salim Ali National Park Srinagar, Kashmir.

MATERIALS AND METHODS

An abandoned (Wild-born) female snow leopa neonate in its approx. 12th day of age, supplied Divisional Forest Officer Kargil (Ladakh region), w received for hand rearing on 22.7.1993. During t process of hand rearing, the neonate was intensively car and closely monitored for its first 14 weeks of age from t date of its arrival in Salim Ali National Park. Generall Weaning age in most of Carnivores is considered 1 weeks, but it seems that weaning age may vary in differe situations. In the present case, considering the physic health condition and prevailing climatic conditions th hand rearing was prolonged up to 15 weeks from it approx. date of birth.

RESULTS AND DISCUSSION

First physical examination of the neonate revelea that the young one was very week, dehydraded, wit sunken eyes (only 30% open). Blood stained mucous an watery faeces were frequently excreted. The rectal tem perature was 30°C. The symptoms, indicated that the young one was suffereing from Acute Gastro entritis.

First of all, the neonate was cleaned with cotton soaked in warm and week solution of savlon. The following treatment was given:

Dependal M Susp. 3 ml tid (Composition: Furazolidone 25 mg, Metronidazole 75 mg, pectin 50 mg, Light kaolin 1 gm. per 5 ml. susp). Dextrose 10% 20 ml (bottle fed) 2 hrly..

No other liquid feed was offered to the young one during the first 24 hours of its arrival in Salim Ali National Park Srinagar. There was a good response to the above treatment given.

After 24 hrs of treatment, the young one appeared comparatively active, diarrheal dysentry was also under check. The young cub was then offered fresh cow milk (50:50 concentration) with the addition of some lactase enzyme to come over apprehended reoccurance of gastro entritis. Side by side prophylactic treatment with Dependal M susp. was continued for about a week. During the first 9 days of hand rearing milk feed concentration was maintained at 50:50 and was fed 6 times a day from 7 am to 10 pm (Night feeding was avoided). Every day just before first and last feed the young one was orally given 2-3 drops of multi Vitamin syrup and after every alternate feeding (during the 1st month of age), the ano genital region of the young one was stimulated, with cotton soaked in warm water. Milk feed concentration was gradually changed with advancement of age.

At five weeks of age, the cub showed a strong tendency towards solid objects by biting on vegetation, shoes, clothes and nipples of the feeder. This was the indication that physiologically cub had developed appetite for solid food. In first instance, minced sheep liver was introduced as solid food to the cub. This was continued upto 9 th week of its age and then replaced by mutton with long bones. The solid food (mutton) was given in addition to routine bottle feeding, although frequency i.e. Number of bottle feedings, was decreased.

From 15 th week onwards, animal was offered only fresh mutton and was left, without keepers frequent interfereance, in an enclosure (20 ft. length x 10 ft. bredth x 8 ft. height) with attached den (7 ft. length z 5 ft. width x 4 ft. height) and other in built necessary enrichment items like bushs for shade, vertical & herizontal logs for climbing, water point etc. Only one time nominal bottle feeding was offered to the animal on every alternate day to keep the animal cooperative for administration of necessary medicines when required.

Body temperature of the cub remained almost static at 37° C 1°C throughout the hand rearing period. Other health monitoring data regarding body weight, body length and body height with regard to advancing age.

In addition some important physical and behavioral developments noted during hand rearing of this animal are also given below:

S.No	Physical & behavioral features	Age(days)
1.	Complete opening of eyes	14
2.	Auto-groming	18
3.	Complete opening of ears	20
4.	Standing & Walking freely	21
5.	Eruuption of 1st tooth (top middleincisor)	26
6.	Retraction of claws	29
7.	Defection without stimulation.	30
8.	Leaving nest box of its own.	38
9.	Eating of solid food voluntarily	40
10.	Sitting and playing with hard objects	42
11.	Holding of tail upwards	49
12.	Washing of face with paws	55
13.	Stalking & Chasing	56

Hand rearing has been and still is a relatively common procedure for raising both wild born orphan or

abandoned and captive born neglected or rejected neonates. But it is of utmost importance that the neonate under hand rearing programme should not become victim of inadequate socialization or imprinting. Because this could result in modification of its social behaviour and later can effect its sexual preferance. (Fox, 1968). To avoid this mal-effect it is necessary to arouse the natural instincts in the neonate by adding necessary environmental and behavioral enrichments to its abode ratherthan to keep the neonate in frequent and close association of a human keeper.

ACKNOWLEDGEMENTS

I am highly thankful to Ex. Chief Wildlife Warden, Mr. A. R. Wani (IFS) present Chief Wildlife Warden, S. Saran Singh (IFS) and Regional wildlife Warden Kashmir, Mr. M. Shafat (DCF) for their continued official support and interest in hand raising of this precious animal. Besides thanks are due to my staff working in Veterinary Clinic and at captive breeding centre Salim Ali National Park, Srinagar for their cooperation especially in the face of prevailing tough times.

Finally, I pay my special thanks to Mr. Jan Mohamed (SKICC Extension Counter TRC) who helped me a lot in typing, tabulation and graphic presentation of this paper.

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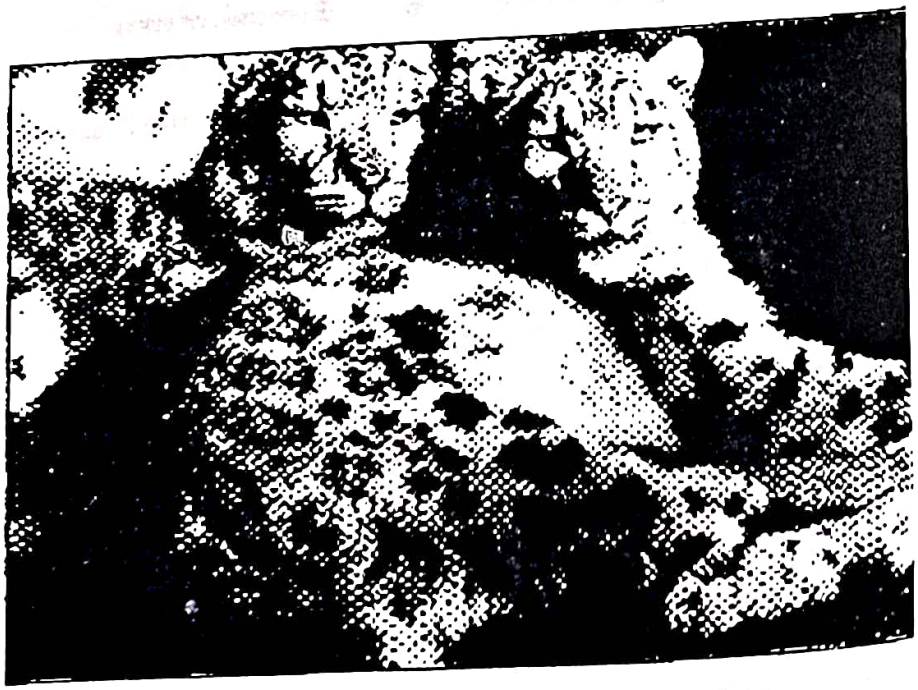

Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research,
A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

ESTIMATION OF POPULATION GROWTH OF HANUMAN LANGUR IN JAIPUR, INDIA

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ABSTRACT : The Hanuman langur lives in a wide variety of habitats. They have already joined list of threatned species published by CITIES. The population and ecology of Hanuman langur were studied from 1985 to 1988 at Jaipur. The percapita rate of increase in group size was estimated in four different habitats in 20 langur groups. The per capita rate of increase in group size was highest in forest habitat. But the average per capita rate of increase in population was 0.99 and the value of lamda is less than 1. It indicates that there was overall decrease in the population over a period of one year.

Hanuman langurs are commonly seen in most of the north Indian cities. There are very few longterm behavioural and demographic studies conducted systematically on any one population (Mohnot, 1968, 1971 ; Mohnot *et al*, 1981) Generally population structure of non-human primates is highly sensitive to ecological features. The present investigation therefore was taken up to study the population growth of twenty langur groups in different habitats of Jaipur (Rajasthan) in one year time.

METHODS

Jaipur, The study area is the capital city of the state of Rajasthan in India. It is situated amidst the Aravalli Hill ranges at an altitude of 430m above mean sea level and lies on lattitude 26°55N, and longitude 75°55E. The region is semi arid and moderately vegetated, with 600 mm average annual rainfall. Maximum temperature is 46°C during June and with a minimum of 6°C in January. Humidity is 80% during monsoon months.

The habitats of Jaipur was deivided into (1) Temple area (2) Tourist area (3) Residential area (4) Forest/Village area Twenty Hanuman langur groups were censused in 1986 and recounted in 1987 to know the population growth.

A simple measure of population growth is given by the per-capita rate or finite rate of increase - lambda (Eisenberg *et al*. 1972)

RESULTS

Temple Habitat

One unimale langur group, one all male group of Govindeo temple area and one unimale group of Galta temple was selected. These groups (GUM I, GAM III GV) were first censused in 1986 and then in 1987. The population growth rates were 1.1, 1.0, 0.7 respectively brining average growth rate of 0.9. In one group value of has decreased which indicate decrease in population size.

Tourist Area

Three unimale groups JAM, AUMI, and VUM from Jantar Mantar Amber Fort and Vidhyadhar garden and one multimale group (SMN) at Sidodia garden were selected for the estimation of population growth. Jantar Mantar group and Amber Groups grew with the rate of 1.1 and Vidhadhar garden group showed the growth rate of 1.0 in one year time. The multimale group Susidia garden had to be excluded from the list as it had undergone fission. Considering only unimale groups, the average growth rate of langur groups in Tourist Area was 1.13 which is slightly less than the growth rate of temple area.

Residential Area

Nine groups from different Residential areas like

Bapu Nagar, Tilak Nager, Durgapura, Jhotwara, Sanganer, Ghatgate, Brahmpuri, Banipark and 'C' Scheme were selected. Their growth rate in one year were observed as follows: 1.10, 1.36, 0.9, 1.0, 1.0, 0.8, 1.0, 0.7 and 0.8 respectively. Average growth rate was 0.9.

Forest/Village

Four groups from Jhalana, Sagar, Jagatpura and Khatipura were censused in 1986 and then in 1987. Their growth rates were 1.0, 1.0, 1.06, and 1.16 respectively Average growth rate was 1.0.

Per capita rate of increase was highest in Forest/ Village type of habitat. Out of 35 groups 19 groups (initially 20 groups were selected but one group underwent fission, therefore it had been eliminated) showed an average value of Lambda as 0.99. The value of lambada indicates that overall population has decreased in Jaipur in one year time.

DISCUSSION

Per capita rate of increase was highest in Forest/ Village habitat. It could be because, this particular habitat had large sized groups as compared to other habitats. The average percapita rate of increase in population of langurs of Jaipur is 0.99. The value of lambda is less than one, plus the adult female: juvenile ration is also on the lower side. Both these facts certainly point towards declining population.

ACKNOWLEDGEMENTS

We are very thankful for the financial assistanc from UGC, New Delhi to study the population o primates of Jaipur.

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Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research,
A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

STUDIES ON THE DISTRIBUTION, STATUS AND ECOLOGY OF THE LION-TAILED MACAQUE IN THE GRIZZLED GIANT SQUIRREL WILDLIFE SANCTUARY (WESTERN GHATS), SRIVILLIPUTHUR

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ABSTRACT: The endangered lion tailed macaque of India (LTM) is fighting its last battle in some small patches in the western ghats. It is distributed in small pockets of the shola forest of Karnataka, Tamilnadu, and Kerala in elevations ranging from 500-1600 mts. The PHVA symposium concluded that about 4000 animals are living in the wild. A survey of macaque at the Grizzled Giant Squirrel Sanctuary, Srivilliputtur revealed that there were 75 animals of 5 troops. There are many private estates in the western ghats and in this area these animals are scared away by the estate owners by firing crackers and shooting to guard their cash crops. The clearing of forest paves way to the fragmentation of the existing population and is the impending danger to these animals. No concrete steps so far have been taken to protect this species.

Among the macaques, the Lion-tailed macaque (*Macaca silenus*) is on the verge of exinction due to the destruction of their habitat-the rain forests of the Western Ghats and secondarily to hunting for some misguided belief and medical purposes. These monkeys still have a precarious existence in some remote regions of their native habitat by moving between patches of some remote regions of their native habitat by moving between patches of some remnant shola forests and protected forests (Mangalraj, 1985; Ajit, 1987). The LTM (Lion-tailed macaque) has one of the most restricted range of all primates of the Indian sub-continent and it has very low population which is restricted to the evergreen forests of the Western Ghats (Krishnan, 1971). There are now several small populations of LTM isolated from one another in portions of fragmented habitat (Green and Minkowski, 1977; Ramnath 1987, Ali, 1987). It seems to have become extinct in its northern range and is now probably conferred to Kerala and scattered in the hills of Southern Tamilnadu (Krishnan 1972). It is reported from North Kanara in Karnataka, South wards to Kerala and Tamilnadu (Prater, 1971; Kurup, 1978; Blanford, 1988).

Only very less amount of studies have been made so far about their status and biology in the field. No work has been done so for at the Grizzled Giant Squirrel Wildlife Sanctuary, a part of the Western Ghats, where this study was undertaken between Dec.93 to April'94.

MATERIALS AND METHODS

The study area is located between 9:5 and 9° 20'N latitude and 77°.21' and 77°.45' longitude in the Western Ghats. The Srivilliputhur Grizzled Giant Squirrel Wildlife Sanctuary is one of the growing sanctuaries in the Southern part of the peninsular India enclosing an area of 480 sq. km. and was declared as a Wildlife Sanctuary in December, 1989. Only the Sattur Hills and the adjacent boundaries are selected as the study area since the pilot survey revealed that the LTMs are restricted to these places alone. The thick woodlands of the study area are intercepted by Cardoman plantations and by the meandering rivers and their distributaries.

Direct Head Count' (Sale and Berk Muller, 1986) method and 'Canopy Juncture Count' using a binocular are the methods employed to study the population and its distribution. The tree composition of the study area was

calculated by laying 'stratified belt transacts' of 100 x 20 meters. (Dittus, 1977 and Soepadmo, 1987). The density of the food trees was calculated in the study area. Focal animal sampling technique of Altman (1974) was followed to record the activity pattern and also daily ranging pattern.

RESULTS AND DISCUSSION

The summary of the census of the different areas is given in Table-1. 73 individuals were observed in the four ranges of the sanctuary. Of the total 73 monkeys, 15 were adult males and 20 were adult females and the sex ratio works to 1:1.3. Out of the 20 adult females, only 8 adult females were having young ones. So mother infant ratio works to 1:2.5. All the groups observed were of mixed troops, no solitary male or all male group was observed during the study period.

Table : Population count and its identification marks, Group composition of the LTM in Grizzled Giant Squirrel Sanctuary.

Group	Place/ Transect	Identification mark	Total	Composition				
				A.M.	A.F.	S.M.	S.F.	Y
A	Kurathividuthi	A male with wounded left thigh	12	2	3	3	4	-
B	Kallimalai	A female with long Nipple	15	3	4	2	4	2
C	Kavu	An individual with hairless tail	14	4	2	3	2	3
D	Patchaiar	A female with torn nose	14	3	3	4	3	1
E	Mudaliar Oothu	Five males and three youngones	18	5	6	2	2	3
			73	17	18	14	15	9

A.M = Adult Male A.F = Adult Female S.M = Sub-Adult Male S.F = Sub-Adult Female Y = Young

The troop size was of the range 12 to 18 with an average of 14 which is less than that already reported by Ajit (1987) for LTMas 20. Activity pattern was defined as the percentage of day times spent by the LTM. The feeding (43.60%) and resting (48.20%) were the major activities while the other activities were negligible. No significant difference was observed between the activities of the adult male and adult female. The daily range varied from 1.52 km to 3.14 km. The variation is mainly due to local disturbance of the estate people and the food availability. Mangalraj Johnson (1978) has listed the food items of LTM as leaves and leaf buds from trees, barks of trees, tree moss, leaf galls, grasshopper and other insects but in the present study they were found to feed only on fruits, flowers and sprouting leaves only. A general preference for seeds by LTM was noticed by Ajit Kumar (1987) and a similar observation was made that LTM's feed on the seeds of *Aanqifera indica, Semi Carpus travancoria* etc. in the study area apart from their usual feeding on *Madhuca malabarica, Ficus, restusa, Garicinia cambosia*. These five trees were the most exploited trees for food by the LTM. The consumed seeds were expelled out through the excreta. The undamaged seeds germinate when the season is favourable and thus LTM plays a key role in the dispersal of fruits in this sanctuary.

The problems faced by LTM in this sanctuary are the fragmentation of the population, due to private estates and the loss of canopy bridge, scarcity of forests for plantations in the higher elevations apart from regular driving away from the vicinity of plantation area.

To conserve the species several steps were taken by the forest department apart from plantation of food tree species. Habitat restoration demands translocation of developmental activities, effective fire control, elimination of minor forest produce collection and modification and forestry management practices.

ACKNOWLEDGMENTS

We thank the Principal, and Head of the Dept. of Zoology for giving an opportunity to do this study, the Chief Wildlife Warden for granting permission to carryout this work in the sanctuary and one of us (Haridoss) is thankful to the Govt. of India, Ministry of Environment, Tamilnadu for the financial assistance during the study period. Our thanks are due to all the forest dept. staff members.

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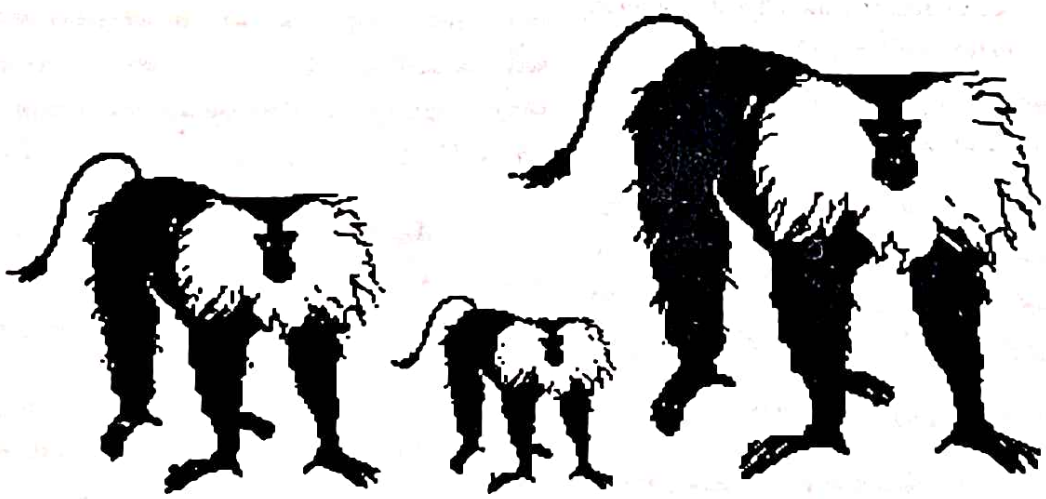

Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research,
A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

A STUDY OF VISITORS ATTITUDES TOWARDS WILD ANIMALS AND ZOOS

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ABSTRACT : A study of visitors attitudes towards wild animals and zoos was carried out at Arignar Anna Zoological Park at Vandalur. The survey covered a total of 1200 visitors at random. The questionnaire method was adopted. The questionnaire contained a total of 47 questions of which 19 questions were based on visitors social background, their nature and attitude towards wild animals and 28 questions were based on their opinion about the zoo in conserving the wild life. The data was analysed mainly based on age, sex, educational and economic status.

The increase in human population and the corresponding increase in need for space, food, water etc. results in deforestation and ultimately possesses a threat to wild animals. This results in disturbance in the ecological balance. Thus the survival of wild animals mainly depends on sanctuaries, zoological gardens and National parks. The sanctuaries, zoos and national parks attract many visitors. The attitude of the visitors is difficult to understand, as their attitudes are subtle because of the existence of age, sex and educational bias. Understanding the behaviour of visitors towards zoo animals plays a main role in their conservation and also in proper maintenance of zoos.

With the intention of studying the visitors attitude towards zoo animals and zoos and to make them aware or their part in conserving the wild life survey was carried out at Arignar Anna Zoological park.

MATERIALS AND METHODS

The study was carried out in November 1994 at Arignar Anna zoological park, Vandalur located in Chengai M.G.R. district, 32 kms from south of Madras and 22 kms from North of Chengleput, in November 1994. The questionaire method was adopted. The visitors were interviewed randomly at the exit of the zoo. The survey covered a total of 1200 visitors. The data were analysed using age, sex educational status economical status and dietary habits.

RESULTS

The study revealed that most of the visitors w in groups (48.3%) and some visited in families (41.3 few through educational institutions (6.5%) and v few came alone (3.9%).

Most of the visitors were in the age group of 35 years (73.4%) some below 15 years (10.3%) a others above 35 years. Males (74%) were found to v more than females (26%). Among the visitors, 89.4 were educated and the rest were uneducated. Mid income group (63.7%) visited more than low inco group (28.8%) or high income group (2.8%).

Majority visited the zoo for recreation (70 some in a casual way (18.6%), few for educative p poses (8.5%) and very few as they had nothing to (2.9%).

Majority felt relaxed after the visit (60.0 some felt entertained (28.1%) and a few felt bo (6.3%).

Non - vegetarians (66.8%) visited more th vegetarians (33.2%).

Majority visited the zoo for the first time (67.4% some for second time and others for the third or ma times (20%).

Almost all insisted in conservation of wildlife (99.8%) out of which 10.8% were illiterates.

Majority liked to see the animals in open enclosures (66.5%) and big cages (23.5%) but few opted small cages (10%) in order to see the animals closely.

Almost all said that the animals have feelings (99.0%) and that there is no good or bad animal (97.0%).

Suggestions of the visitors for Zoo improvement

There was equal response for and against cage comfortability of the animals.

Most of them felt that the hygienic condition was better (64.0%) and rest felt that it could be improved and also that the cage water was insufficient and unhygienic (67.2%).

Almost 50% of the visitors required more information about the animals (51.0%) and most preferred the method of writing on the boards (40.0%), many preferred guides (35% mainly illiterates), Majority felt that the informations on the display boards were clearly readable (79.0%). Inclusion of languages other than Tamil and English was suggested by a few visitors (3.6%).

Many insisted in environment/vegetation improvement (72.0%) and most of them opted for flowering trees.

Majority of the visitors insisted to add more animals (87.0%).

Though more than 75% of the visitors saw all the animals, they were unable to see them in order and insisted in some more arrow marks (37%) and direction boards/layouts (40.0%).

Although most felt that the visitors time was convenient (78.0%), some of them preferred extension of time in morning from 07.30 hrs onwards (21.8%). More than half of the mass were unaware of the zoo holiday (59%).

Majority suggested improvement in transport facilities inside the zoo (85%) and some outside the zoo (25%).

Educated, males and students showed interest in touching the animals. Almost all the visitors agreed in having children's park, elephant and camel riding.

Almost half of the mass felt that the entrance fees was nominal and a very few especially high class people suggested that it could be increased a bit.

About half felt that the visitors facilities inside the zoo were comfortable (65%), very few felt uncomfortable (5.7%) and others felt that it was not bad. (39.3%).

The favourite animals

for males tigers, lions, birds, snakes, jaguars, elephants and chimpanzee.

for females - birds, tigers, snakes, lion, deers, elephants, hippopotamus, squirrels.

for students - tigers, jaguars, panthers, leopards

for children - lion, tigers, elephants, leopards, snakes.

Recommendations

As majority visited for recreation the recreation facilities like children's park, elephant riding and camel riding must be improved.

As the public prefer to see the animals in open enclosures or big cages this system can be adopted with increase in number of animals

Improvement in hygienic condition of cage water.Addition of more information on the boards can be made and the system of using guides can also be adopted.

Improvement in vegetation / environment preferably by means of flowering trees.

As many of them cannot see the animals in order, the arrow marks, layouts and direction boards must be increased.

Though the present visiting time is convenient, extenssion in time can be done in morning from 07.30 hr as preferred by the visitors.

Improvement in transport facilities inside the zoo by means of small unit vehicles, provision of bicycles etc.

Provision of animals for the public to touch them can be thought of.

As more than half of the visitors were unaware of the holiday of the zoo extensive advertisement is necessary.

Some more improvements in the existing fa ties such as light refreshment stall, rest areas and provi of some extra-facilities like telecommunication, first can be thought of.

ACKNOWLEDGEMENTS

We are grateful to Mr. R. Sundararaju, I.I Director, Arignar Anna Zoological Park for gran permission to conduct this work in the zoo. We ackn edge the help of Mr. M. Jaganatharao, I.F.S., De Director, A.A.Z.P. We also thank the Dean of Ma Veterinary College for all the help rendered. We thankful to Dr. V. Vasaviah, Dr. R. Thiruthalinat Dr. N. Paneersellvam and Dr. D. Swaminathan, Ve narians, A.A.Z.P. for timely help and valuable sug tions.

Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research,
A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

FOREST GRAZING AND DISEASE SPREAD TO THE WILDLIFE

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ABSTRACT : Foot and Mouth, Rinderpest and other diseases are interesting models for the study of the inter-relationship between disease in wild animals and domestic stock. The virus types, substypes, variability of virulence in different species leads to a complex epizoological developments.

Practically no medical or veterinary interest had been taken in the Wildlife diseases, except few major health problems affecting man or his domesticated stock. Human plague, rinderpest, leptospirosis, foot and mouth disease and rabies are the good examples. Recently few wild life species have been adopted for the experimental studies such as voles, armadelloes, red foxes, raccoons, mink and ferrets etc.

Over the years, the views steadily developed that Wildlife disease can not be separated for consideration of their effect in man and / or his domesticated stock and now-a-days it is widely acccepted that the problems must be looked at as a whole and not merely from one particular angle.

In general, interest in the subject has increased in the last decade. In the past, awareness of wildlife disease was brought to the notice only when crisis occured, such as wide spread out break of Foot and Mouth or Rinderpest in the wild games. We are aware that the spectrum of disease in wild animals is of great importance both to human and Veterinary medicine. There are clear cut evidence of the spread of disease from wild animals in both directions.

We have had the recent and unfortunate example of serious human disease coming from the handling of green monkeys from Africa affected with the then unrecognized virus infection (AIDS). Abroad, the Myxomatosis is wide spread disease of rabbits. The vampire bats population in certain parts of south America is a considerable danger because they act as a nocturnal reservoir of the rabies virus.

In our country the system of grazing of the indigenous herd of cattle (Called as Patti mädu) from the village are taken by the village cattle herd boys to the adjoining forest area for grazing and returned in the evening to the village. During the process of grazing some of the animals which are clinical cases or convalacing carrier animals, healthy carriers contaminate the forest pasture and due to the heavy shading in the forest area the contagion are likely to survive for long duration than in the grazing plots in the village, and it forms the focus of infection to the susceptible animals in the forest.

The most vital disease in the order of importance is the Foot and Mouth and Rinderpest. The disease is an interesting model for the study of the inter-relationship between disease in wild animals and domestic stock. The virus types, sub-types, variability of virulence in different species lead to a complex Epizootological development. The modification of such strains to take in a wider range of species leading to the perpatuation of the virus in domestic animal population.

It has sometime been suggested that the transfer from one species to another does result in the exaltation of virulence of the strain. The common wild species susceptible to Foot and Mouth are the buffaloe group such as bisons, deer, elephants, camels and doubtful observation in hippopotamus, hedge hogs, porcupine, wild rats is marginally susceptible but play a role in dissimination of the disease more likely through the mechanical carrying than as on actual infected animals. Ingested rats seems to excrete the virus for at least 3 days. In Grey Kangaroos, wallabies and wild rabbits in the wild nature the virus seems to be present in the pharingeal region. It is the

possibilities of the existance of the disease in two populations, wild and domestic existance side by side and may be perpatuating the disease independently and occassional cross-over from one to the other, where the two population intermingle extensively.

Indian elephants records are that they are susceptible under un-natural conditions of close contact with the diseased cattle. But no evidence of Foot and Mouth disease has been found in African elephants.

ARBOVIRUSES

Almost all arboviral diseases are Zoonotic and the natural hosts being the wild animals. Maintained in vertebrate host the haemophagous arthropods feeding on the hosts during the viremic stage becomes infected and multiplies in the tissue of arthropods. The virus can then be passed on by the bite to another susceptible vertebrate host, which bite be arboreal and terrestrial mammals, birds and even reptiles. Thus the arthropods act as an "Infected Pins" i.e their mouth parts. Examples are Kyasnur Forest Disease in Indian monkeys, Yellow fever in primates, Ricketsial infection of other type, louping ill, tick bone encephalitis virus, Russian spring summer encephalitis, complex vesicular stomatitis virus.

SALMONELLA IN WILD ANIMALS

A survey suggests that Salmonella have been isolated from practically from all living animals. Where there is no isolation in a particular species shows that these animals have not been investigated.

LEPTOSPIROSIS

The reservoir of leptospirosis in wildlife is probably of considerable importance to the health and performance of domesticated animals. Small mammals, especially rodents are the chief carriers of leptospirosis. The bacteria forms colonies in the kidney tubules of the hosts and are shed in the urine which may contaminate streams and pools on the working environment of certain human occupation.

BRUCELLOSIS IN WILDLIFE

A wide variety of animal species are capable o being infected with Brucella organisms. The foxes an rabbits also play a role in the dissemination of the disea *Brucella abortus*, *Brucella melitensis* and *Brucella suis* a the biotypes involved.

Most of the animals are capable of transmittin the Brucella organisms by contaminating the food an water or by the urine discharges and there are also th possibilities of transmission by common ecto parasite The major importance of our wild animals would appe to be their activities as SCAVENGERS, physically ca rying contaminated materials from infected premises t a previously uninfected area.

ANIMAL PASTEURELLOSIS

Pasteurella multicide affects various classes o animals and birds. This disease is common in the winte months when animals, particularly free living species ar exposed to cold and starvation.

TUBERCULOSIS

This has been reported in a wide variety of of wil animals. Some of these infections were typical mamma lian or avain tuberculosis and many are atypical and so fa not able to type it.

Virtually, erradication of tuberculosis from th cattle herds and poultry flocks will automatically reduc the incidence in wildlife population. Among the large mammals tuberculosis has been encountered most fre quently in various species of deer.

The incidence is only common where birds hav a close association with man and his poultry. Number of reports refer to crows, starlings, sparrows, wood pigeons and pheasents all of which have some contact with farms and to the domestic poultry.

While it is unlikely that mycobacterial infections in free living wild animals will be a major threat to our

agricultural industry it is necessary that we should take due caution against it.

PROTOZOAN PARASITES

Another important group of infection spread is the protozoan parasites and some of them are of zoonotic significance to a greater or lesser extent. As wild and domestic mammals co-exist in the same area, the adult wild animals are regarded as typically non-pathogenic carriers. The situation is not fully understood as to say it causes abortion on neonatal or juvenile mortality.

Under the category of Trypanosomes in India, *Trypanosoma evansi* is the major trypanosome affecting the domestic and wild animals and to less extent by *Trypanosoma theileri*. The other species are not reported in India among our wildlife. The humid climate with the increase in fly population after the monsoon is the period of crisis for the infection. Coming to the prioplasams of wild mammals-it is extremely common-but not much is known about it. Theileriaian intra-erythrocytic prioplasam is frequently found in the African antelopes.

A prioplasam was responsible for the death of the famous lioness "ELSA" which featured in the series of books by *Mrs. Joy Adamson*. When realeased into the wild, it died shortly afterwards. The blood smear was positive for the piroplasams.

WILD RUMINANTS AS RESERVOIR HOST OF HELMINTHIC INFECTIONS

Examination of the helminth parasite fauna of a number of wild ruminants indicates a high degree of cross-transmissibility to domesticated hosts. The extent of transmission in nature is influenced by a number of factors. Few helminth parasites of ruminants are highly host-specific. The majority of those recorded from wild species have domesticated ruminants as their prime hosts.

There are possibilities of the emergence of strains and species of differing infectivity which hinders the acceptance of equal transmissibility of certain parasites to both groups of hosts.

The majority of helminth infections of wild species to which domesticated stock are exposed are of low pathogenicity and the wild animals appear more likely to suffer in any encounter in the common grazing areas.

Of the helminthic zoonoses the ruminants play a major role for Hydatidosis, both domestic ruminants to large extent and wild ruminants to some extent.

Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research,
A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

PLANTS IN MODERN MEDICINE

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ABSTRACT : The medicinal and pharmaceutical resources of India is very high since the ancient years. Medicinal plants were known to the early civilizations. Most diseases caused by infectious organisms can be controlled by drugs. The history of the drug plants is as early as 5000 to 4000 BC. Drug yielding plants can be used as raw materials for pharmaceutical, perfumery, cosmetics and flavour industries. Some of these plants produce valuable drugs which have high export potential. Plants form a dominant part of ayurvedic pharmacopoeia. Emetine, papaverine, quinidine, berberine, khellin, morphine, atropine, cocaine, noscapine resperpine, serpentinine and vincamine are some of the important plant drugs. More than 200 plants are exploited from wild sources for production of formulation of traditional systems of medicine. Plants not only give food and shelter and also takes care about our health.

Medicinal plants were known to the early civilization. The history of the drug plants is as old as the history of these civilizations. The chinese are reported to have used drug plants as early as 5000 to 4000 B.C. The medicine and pharmeceutical resources plans can be used as raw material for pharamaceutical, perfumery, cosmetics and flavour industries. The medicine system can be classified into ancient and modern time systems. Earliest references to medicinal plants are found in the Rigveda and Atharveda. Drugs have been classified on the basis of their physilogical action and on the basis of the morphology of the drug yielding parts of the plants. The usual history of plant drug is in ancient times, the people first used the plant substance in crude form. In the middle time, scientist isolated one or more compounds, studied the effects of these compounds and their use as drugs. In modern times, scientist learned to synthesize the useful compounds or related compounds. In the present time medical science has paid great attention to the study of drug plants. The branch of medicinal science which deals with the drug plants is called pharmacognosy, whereas the study of the action of drugs is called pharmacology. Central Drug Research Institute, Lucknow has been involved in the development of new drugs form plants for several years.

PLANTS IN ANCIENT MEDICINE

Ayurveda

The Indian system known as Ayurveda originated as far back as 2000 B.C. Ayurveda means "Science of life", it implies two connected ideas-the science of life and the art of living.

Plants form a dominant part of Ayurvedic pharamacopoeia Charak Samhita (900 BC) is the first recorded treatise on Ayurveda. It describes 341 plants and palnt products for use in medicine. It has divided plant drugs into fifty groups according to their decoctions.

The next land mark in Ayurveda is Sushruta Samhita (600 BC) with special emphasis on surgery, and describes 395 medicinal plants. Later Sarangathara (14th century) the author of Sarangadhara Samhita systematised Ayurvedic Materia medica. Ayurveda was thus a well organized science of its times.

The literature of Siddha Medicine by Siddha's is the basic for the Research on "Traditional systems of Medicine". Siddha worth 4448 divisions of diseases. All new diseases about which we are fearing today is already included by Siddhas. For example, the 'Vettai Megha' described by Agathiar on 'Vallathi' is entirely same as that of the disease now we called AIDS.

The Egyptan system

The ancient Egyptian possessed a sound knowledge of human anatomy as well as of the medicinal uses of many plants. They knew about drug plants in about 1600 B.C. Pain killing drugs and sedatives were well known to

them. Hanbena a herb which is known to us as a sedative and hypnotic source extracted from *Hyoscyamus niger* (solanaceae) was first used by them. Oinoa as a cure for scurvy and also as a cure for intestinal disorders is an old Egyptian prescription.

The Chinese System

The first great medical treatise appeared in China around 450 B.C. Chinese medicine has been practiced in China and had spread to korea and Japan and much of South East Asia, since more than 2000 years ago. Ancient China has developled many cures, some of which soothes coughs, was known to the chinese 4000 years ago. Pumpkin seeds, another chinese contribution is a well-known wormridder. It is now found of be effective against snail fever also. The antimalarial drug gingha (aerial part of *Artemisia annua*) is effective when given orally or intramuscularly. Roots of *Panax ginseng known* as *'Ginseng'* is highly valued as an extender of memory and as a general tonic.

PLANTS IN MODERN MEDICINE

Most diseases caused by infectious organisms can be controlled by drugs. The plants that are still in common use came from many parts of the worth and involve substances derived from the roots, stems, leaves, flowers, fruits and seeds of various species. As in the past, some of the products serve both as condiments and as drugs. Some of the important plants drugs which are used in modern medicine are as follows:

Emitine is extraced from the roots of Ipecacuanha. It is highly active against *Entamoeba histolytica*. It is emetic on oral doses of 10-20 mg at higher dosage it depresses the heart and produce dilation of the coronary vessels. The toxicdose for man is between 1.1g and1.8 g.

Atropine (C_{17} H_{22} O_3 N) is extracted from the leaves of *Atropa belladonna* L. (Solanaceae). It is used as a stimulant to the sympathetic nervous system, dilate the pupil of the eye. Belladonna is used externally to relieve pain and internally to check excessive perspiration. This plant is perennial herb, grow wild in kashmir, Himalayas at altitude of 200-4000 M.

Cocaine ($C_{17}H_{21}O_4N$) is extracted from the leaves with high boiling petroleum of *Erythroxylon coca* (Erythroxylaceae). It is used as an excellent local anesthetic also as a tonic for the digestive and nervous symptoms. This plant is a small much branched shrub or tree. The leaves are chewed by the natives of South America for stimulating physical and mental activities. The coca is de-alkaloidized in USA to be used as 'Cola' flavouring.

Papaveine is extracted from immature capsules of opium poppy - *Papaver somniferum* (papaveraceae). It is eaten and smoked by billions of people for deriving pleasant feelings of exhilarations and peace. The drug exhibits a distinct local anesthetic activity. Its side effects are drowsiness, constipation, increased reflex excitability and gastric distress. It is used to relieve pain, induce sleep and relax. Addiction to opium leads to physical and mental degradation, debility, delirium and even death. This plant is an annual herb.

Berberin is an well-known alkaloid extracted from Berberis species. This alkaloid has anit-ametic activity.

Quinidine was prepared and named by Louis Pasteur in 1853. It is extracted from the bark of several species of Cinchona (Rubiaceae). It is a very bitter, white granular anti-malarial drug. It is also useful as a tonic and antiseptic. Many potential anti-arstrhthmic drugs have been prepared since then none has displaced quinidine. It is the most widely used agent in the treatment of cardiac arrhthmias. The tree is a fairy large tree. The medicinal property of the bark of the tree were discovered in 1638.

Khellin is isolated from the fruits of *Ammi vishaga*. It acts as a catalyst in the heart respiratory cycle.

Morphine and Noscapine (Narcotine) are another alkaloids extracted from opium seeds. Morphine is used as an sedatives to relive pain and cause sleep. It is usually taken orally, reactally or by injections to cause local insensitiveness and also used as for the treatment of caugh. Noscapine present in opium to an extend of 3-

10%. It is used in the treatment of asthmatic paraxysmal cough.

Resperpine is extracted from the roots of *Rauwolfia serpentina* (Apocyanaceae). It is used in the treatment of violent kinds of insanity and high blood pressure. It acts as a sedative and depressant in hypertension and chronic psychoses. It is also used for treatment of insect bites, fevers and dysentery, anxiety, tension, insomnia and infant hyperactivity. The most common side effets are nausea, vomiting and serious depression. The plant is an errect perennial shrub. Serpentin is an another extract separated from the roots of *Rauwolfia* plant.

Vincamine is extracted from the plant *Vinca minor* L. It is used as an antihypertensive drug in East European countries. It is extracted on a commercial scale in Hungary and has been introduced under several trae names for increasing cerebral and coronary circulation.

Some Important Alkaloids and its uses

Colchicine is an alkaloid extracted from the roots of *Colchicum autumnale* (Liliaceae). It is used in the treatment of gout and rheumatism and also used in genetics to bring chromosome doubling.

Ephedrin is an alkaloid extracted from the stem and roots of *Ephedra* species (Ephedraceae). It is used for rheumatism, mold astringent, alternative, diuretic, stomachic and tonic.

Podyphyllin is extracted from the rhizome of *Podophyllum hexandrum* Royle (Berbeidaceae). It is also curing cancerous tissue. It is an herbaceous plant.

Strychnine ($C_{12}H_{22}n_2O_2$) is extracted from the seeds of *Strychnos nuxvomica* L. (Loganiaceae). It is used in the treatment of nervous disorders and paralysis. The plant is woody wine.

Digitalin is extracted from the leaves of *Digitalis purpurea* L. (Scrophularceae). It is used as a heart stimulant.

Santonin is extracted from unopened buds of *Hyoscyamus nigher* (Solanaceae). It is used as a sedative and hyphotic.

Aristolochin is extracted from the dried stems of *Aristolochia indica* (L) (Aristolochiaceae). It is used to promote digestion and for the regulation of menstrual in small doses; large doses cause dangerous irritation in the digestive system and in kidney; and lead to even abortion in pregnant women.

Role of Medicinal Plant Research in India

The list of drug yielding plant are long. Drugs from natural source have great advantage over synthetic drugs. A large number of medicinal plants grwo wild are being exploited by pharmaceutical industries. Therefore, ther is need to develop agro-technology for cultivating medicinal plants of commercial value. Central Institute of Medical and Aromatic Plants (CIMAP) Lucknow has been involved in developing the agrotechnology of medicinal plants since its establishment in 1959.

More than 200 plants are exploited from wild source for production of formulation of traditional systems of medicine, viz., Ayurveda, Siddha and Unani. Some of these plants are also used in modern system of medicine. The most important plants which are exploited for production of active constitutents are Nuxvomica for production of strychinine and Brucine. Berberis species for the production of berberine. *Adhatoda vasica* for adhatoda edxtract and *Gloriosa superba* for production of colchicine.

India has a rich wealth of medicinal plants. Eighty five medicinal plants, whose ingradients are used in different pharmacdeutical preparations are recognized by Indian pharmacopoeia (1966) Central Drug Research Institute (CDRI) Lucknow, also play an aimortant role in the development of new drug yielding plants in India. The modern medicine system is partially related with ancient system. It is possible to extend new drugs from the plants in future. Plants not only give food and shelter and also takes care about our health.

ACKNOWLEDGEMENTS

Author thanks Dr. R. Selvaraj, Reader in Botony, Annamalai University for encouraging and fulfil the paper. He also thanks Dr. T. Govindarajulu (Late) Professor and Head, of the Department of Botany, Annamalai University and authorities of Annamalai Univesity.

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Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research.
A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

BIRD ATTRACTING TREES FOR REFORESTATION OF DRY EVERGREEN FOREST

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ABSTRACT : Birds play a vital role in seed dispersal of plants, because of their fruit-eating habits and the long distances they travel. They aid in the natural regeneration of several wild plants by dispersing their seeds away from the parent plant as well as by placing them in suitable sites for germination. A study on plant-bird interactions carried out in Point Calimere Wildlife and Birds Sanctuary, South India. The vegetation of the forest in this Sanctuary is tropical dry evergreen type. Our of 317 flowering plants recorded 91 species produced fleshy fruits. Twenty fruit-eating birds, of which 14 are legitimate seed dispersers, are recorded from this locality. Those plants whose fruits were eaten by birds are considered as bird attracting plants. The list of these plants was prepared by making extended observations on fruit bearing trees. At Point Calimere, 27 wild trees belonged to 17 families are recorded as bird attracting species. Moraceae and Rubiaceae are the dominant families having five and three bird attracting species respectively. However, only 10 tree species were found to attract more than six species of legitimate seed dispersers. Maximum number of bird species were attracted by *Salvadore persica* (15) followed by *Manilkara hexandra* (12) and *Ficus infectoria* (11). In additin to these ten species, other trees such as *Walsura trifolia, Lannea coromandelica, Azadirachta indica* and *Crataeva adansonii* which fruit during dry season and whose fruits form food for birds during lean period are also considered important from the birds point of view. Therefore, it is suggested that the above-mentioned bird attracting indigenous trees should be selected.

The survival of a plant species is best ensured by the dispersal of fruits and seeds to as many different and far off localities as possible (Venkateswarlu,1982). The dispersal of plants prsents an opportunity to the seeds to escape themselves from predation (Janzen, 1970). Among the regular methods of seed dispersal, birds play a vital role, because of their fruit eating habits and the long distances they travel (Ridley, 1936). Birds are actively engaged in external and internal transport of seeds. while the external transport is largely accomplished by the accessory structures in the seeds, internal carriage is generally associated with edible and small fruits which may be pulpy and arillate seeds, which are brightly coloured. In most cases, birds defecate the seeds after digesting off the pulp. It has also been proved (Ridley, 1936; Fleming & Heithaus, 1981). Thus by dispersing the seeds, and enhancing the rate of germination, birds play a vital role in rebuilding the disturbed ecosystems. Very few studies have been conducted on this aspect (Gandhi Tara, 1995). Hence, a study was conducted in the dry evergreen forest at Point Calimere to identify the potential bird attracting trees.

STUDY AREA AND METHODS

The study was conducted at Point Calimere Wildlife and Bird Sanctuary (10°18' N, 79°51' E), Tamil Nadu. The vegetation of the sanctuary is classified as tropical dry evergreen forest type (Champion & Seth, 1968). Littoral vegetation is prominent along the seashore. A total of 317 flowering plants have been reported from this Sanctuary (Balasubramanian, 1991). The forest is discontinuous and is being intersected by numerous open grazing lands. There are two distinct seasons in a year. One is long dry season (April - August) and a short rainy season (October - December).

The sanctuary has got a rich biological wealth. A total of 18 mammal species are reported from Point Calimere. Sugathan (1983) reported 137 passerine bird species from this Sanctuary. Insect life is also rich here. Major fruit-eating birds in this Sanctuary are Whitebrowed Bulbul (*Pycnonotus luteolus*), Redvented Bulbul (*Pycnonotus cafer*), Koel (*Eudynamys scolopaca*), and Common Myna (*Acridotheres tristis*). Jungle Crow (*Corvus macrorhynchos*), Rosy pastor (*Sturnus roseus*) Greyheaded Myna (*Sturnus malabaricus*), Brahminy Myna (*Sturnus pagodarum*) and Tree Pie (*Dendrocitta vagabunda*) Orange-breasted Green pigeon (Treron bicincta) are the other fruit-eating birds in this Sanctuary.

Trees yielding fleshy fruits were identified and marked. Ten individuals of each species were tagged.

Fruiting phenology data were collected once a fortnight. Three categories, namely, 'none', 'few', and 'many' were employed to indicate abundance of fruiting (Frankie *et al.*, 1974). Extended observations were carried out on fruit bearing trees to record the avian visitors and their fruit-feeding behaviour. Data on number of visits made by each species, mode of fruit handling, quantity of fruits consumed per visit were gathered (Howe, 1977 and Howe & Vande Kerckhove, 1981). Birds which ingest the whole fruit (pulp as well as seeds) are considered as legitimate seed dispersers. Birds which eat only the pulp or seed are considered as pulp and seed predators respectively (Snow, 1971).

RESULTS AND DISCUSSION

At point calimere, 27 fleshy-fruited trees were found to attract birds (Table 1). Moraceae with five species is the dominant family attracting avifauna. Balasubramanian and Bole (1993) observed three seasonal fruiting patterns of fleshy-fruited plants in this sanctuary. Eleven tree species fruited during rainy season, nine species in dry season and seven species during both seasons.

During dry season, resident frugivorous birds such as Whitebrowed Bulbul and Redvented Bulbul made local migrations to neighbouring villages, six kilometres away from the sanctuary in search of food. Thus, bird attracting trees such as *Azadirachta indica, Lannea coromandelica* and *Crataeva adansonii* that fruited during the lean period become pivotal for birds in this ecosystem. Species such as *Ficus benghalensis, Ficus microcarpa and Ficus infectoria* which had a staggered fruiting attracted a variety of frugivorous birds. Another group of trees viz., *Manilkara hexandra, Salvadora persica, Ehretia ovalifolia* and *Zizyphus oenoplia* whose fruiting is associated with the rainy season also support diverse group of frugivorous birds including the migrants.

All the above mentioned species were visited by two or more legitimate seed dispersers. Therefore, the changes of getting their seeds dispersed by birds are high for these trees. Hence, while undertaking reforestation programmes, preference should be given to these species which are dispersed by birds. However, it is suggested here that care should be taken to plant them in suitable habitats. Species such as *Manilkara hexandra, Salvadora persica* and *Zizyphus oenoplia* could be planted in lowlying areas of the sanctuary. The remaining seven species are mostly seen on ridges and hence, they should be planted on dunes.

ACKNOWLEDGEMENTS

I am thankful to **Mr. L. Nathan,** Wildlife Warden and other forest officials, Point Calimere Wildlife Sanctuary for their co-operation and help. My sincere thanks are due to **Dr. V.S.Vijayan,** Director, Salim Ali Centre for Ornithology and Natural History for the encouragement and support. I owe my gratitude to **Mr. G. Kumaravelu,** Conservator of forests (WL), Coimbatore for the suggestions. I thank the Bombay Natural History Society for financial support.

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Table 1. Bird attracting trees and their fruiting periods in Point Calimere

Family & Scientific name	Local Name	Fruiting period	No. of Frugivorous birds visited
CAPPARIDACEAE			
Crateava adansonii DC.	Marvilingam	6-8	1(1)
FLACOURTIACEAE			
Flacourtia indica (Burm.f.) Merr.	Karukka	1-3	4(4)
OCHNACEAE			
Ochna obtusata DC.	Chilanti	5,6	1(1)
MELIACEAE			
Azadirachta indica Juss.	Vembu	6-8	2(2)
Walsura trifolia (Juss.) Harms.	Walsura	6-8	3(2)
HIPPOCRATEACEAE			
Pleurostylia opposita (Wallich) Alston	Manikkasa	1-12	3(3)
RHAMNACEAE			
Zizyphus mauritiana Lam.	Elanthai	1,2,12	
Zizyphus oenoplia (L.) Miller	Soorai	1-4	6(6)
SAPINDACEAE			
Lepisanthes tetraphylla (Vahl.) Radlk.	Kattuma	4,5	6(0)
ANACARDIACEAE			
Lannea coromandelica (Houtt.) Merr.	Othiyan	6-9	6(6)
MYRTAACEAE			
Syzygium cumini (L.) Skeels	Naval	9-11	5(2)
MELASTOMACEAE			
Memecylon umbellatum Burm. f.	Kasa	10-1	2(2)
RUBIACEAE			
Canthium dicoccum Gaert.Teijsm & Binn.	–	9-12	6(6)
Catunaregam parviflorum Lam.	Mullu Karai	9-2	4(4)
Ixora Pavetta Andrews	–	3,4	4(4)
SAPOTACEAE			
Manilkara hexandra (Roxb.) Dubard.	Palai	12-4	12(7)
Mimusops elengi L.	Mahizham	11-3	2(0)
EBENACEAE			
Diospyros ferrea (Willd.) Bakh.	Thovarai	9-11	3(3)
SALVADORACEAE			
Salvadora persica L.	Vasamaram	1-5	15(7)
CORDIACEAE			
Cordia obliqua Willd.	Naruvili	5-6	3(3)
Ehretia ovalifolia Wight	–	2,8-11	6(6)
EUPHORBIACEAE			
Drypetes sepiaria (Wt. & Arn.) Pax. & Hoffm.	Veeramaram	3-5	4(4)
MORACEAE			
Ficus benghalensis L.	Aalamaram	1-12	9(9)
Ficus microcarpa L.f.	Kall-ichchi	1-12	8(8)
Ficus religiosa L.	Arasamaram	10-12	8(8)
Ficus infectoria	Kal-aal	1-7,9,10	11(11)
Plecospermum spinosum Trecul	Ekki mullu	6,7,10-1	5(2)

Note : Numbers given in parantheses indicate the number of legitimate seed dispersers for that particular tree.

Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research, A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

ETHNOBOTANICAL STUDIES IN MELAGIRI HILLS, HOSUR FOREST DIVISION, DHARMAPURI DISTRICT, TAMILNADU.

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ABSTRACT : In the present paper 42 species of medicinal plants belonged to 20 families and 32 general, responsible for curing human diseases were recorded, (which are mainly used by the local people) from Melagiri Hills. The herbal species have been listed alphabetically with correct nomenclature and the corresponding diseases, they cure.

Ethnobotany is "The study of the relationship which exits between people of primitive societies and their plant environment" (Schultes 1962). Ethnobotanical studies have very often resulted into the discovery of important drug plants. India with its wide variety of vegetational types and secluded tribal populations, affords ample scope for studies concerning various aspects of folk-lore medicines. The system of allopathy is still unknown to the interior tribals, most being dependent upon Ayurvedic and folk medicines to various ailments. The important ethnobotanical works in India have been enumerated by Agarwal and Saha (1968), Das and Misra (1987) and Sabnis and Bedi (1983). By considering the above said points in mind, an attempt has been made in the present study on available medicinal plants in Melagiri Hills of Estern Ghats.

METHODS

The present study was carried out in Melagiri Hills of Eastern Ghats which is a part of the Hosur Division of Vellore Circle. This tract of forest is a block of 950 km² lies between the latitudes 12°7" and 12° 44" N and the longitudes 77° 30" and 78° 27" E. After an initial visit in three parts of Melagiri hills, namely Melur, Gullatty and Tholupetta, Plant collection trips were undertaken everyday for 3 months, with the help of three men who practice medicine with these herbal to the local people of this study area. The data were also obtained from the benefited individuals after interview and frequent visits. The collected plants were identified with the help of Botanists of forest division and Department of Botany A.V.C.College

OBSERVATIONS AND DISCUSSION

Totally, 42 species of herbal remedies were collected in the present study wherein there were 1 Gymnosperm, 1 monocotyledon, 11 Herbs, 6 Shrubs and 23 trees. They were coming under 20 families and 32 genera.

Hemidesmus indicus Local name: Nannari (ASCLEPIADACEAE)

The root of this plant is used to improve the vitality, energy and loss of appetite. It is an important ingredient for many other drugs especilly medicine for snake poison. Root decoction of this remedy is given internally to cure stomach pain and to stop frequent motions (Sabnis and Bedi, 1983).

Bambusa valgaris Local name: Moongle (POACEAE)

This species is used by man for family planning. Tender shoots and leaf juice are used to cause abortion during two to three months pregnancy.

HERBS

*1. **Abutilon indicum*** Local Name: Thuthi (MALVACEAE)

The leaves are ground into a paste, and applied for skin deseases. The leaves are also used to cure piles.

Bakhru (1993) has explained that it is useful in the treatment of fever and bronchitis.

2. ***Acalypha indica*** Local Name: Kuppaimeni (EUPHORBIACEAE)

Leaves are given for killing intestinal worms. The root ash is given to children for cough. Bakhru (1993) stated that the herb is special value in treating caugh (Cough and difficulty in breathing is caused by obstration in the larynx), laxative and cure skin diseases.

3.***Achyranthus aspera*** Local Name: Naiyuruvi (AMARANTHACEAE)

The leaves are used to cure asthma and the leaf juice is used to cure diarrhoea. Bakhru (1993) has stated that it is used to cure asthma, diarrhoea and menorrhagea. Munusamy (1910) has explained that the seeds are used to easiest and painless delivery.

4.***Euphorbia hirta*** Local name: Ammmanpacharisi (EUPHORBIACEA)

Leaves are given for women to reduce excess bleeding during menstrual period and it is also used to increase the strength of our teeth. Lac of this remedy is for antiseptic and to remove glass from affected parts.

5. ***Hiptage madablata*** Local name: Adumutta

This remedy is used as an ingredient for many drugs. The roots are given to the children for muscle convulsion.

6. ***Leucas aspera*** Local name: Thumbai (LABIATAE)

The leaf of this herbal remedy mixed with pepper and garlic is used to cure migrine and leaf juice externally applied for skin diseases. Flowers are used as a first aid for snake bite and cure head-ache.

7. ***Ocimum canum*** Local name: Nai tulsi (LABIATAE)

Leaf juice to produce vomiting and to remove musilage from lungs, and free from severe cold.

8. ***Ocimum sanctum*** local name: Tulsi (LABIATAE)

The leaf juice is used for catarrh and bronchitis. It is also dropped in the ear to stop ear pain. Bakhru (1993) stated that it is a good nerve tonic and sharpen memory.

9. ***Phyllanthus amarus***: Local name: Kilanelly (EUPHORBIACEAE)

The leaf is ground and mixed with milk to cure jaundice and it is also an important ingredient for drug of fever.

10. ***Pumbago zylanica*** Local name: Kodivel (PLUMBAGINACEAE)

Root bark is given for arthentic pain. Root juice is a good remedy for curing boils (Sabnis and Bedi 1983).

11. ***Ptrerolobium Indicum*** Local name: Ciru Kodi

Leaf mixed with milks given to the women after child birth for expulsion of placenta and prevent excess bleeding.

SHRUBS

1.***Atlantia Monophyla*** : Local name: Kattu Yelumichai (RUTACEA)

This herbal remedy is an important ingredient for drug of malarial fever.

2. ***Caesallpina bonducella***: Local name: Kegic Cedi (CAESALPINAE)

Leaves are boiled with water to apply on the affected part of scorpion stinging. The fruits are used to cure the hydro coel, juice of tender leaves are used to cure menstrual pain.

3. ***Citrus limonium*** : Local name: Yelumichai (RUTACEAE)

The bark is an important ingredient for drug of Malarial fever. The fruit juice is given in dysentery and

diarrhoea treatment. The juice extracted from fruit is used to cure severe haed-ache (Debashis, et al 1987).

4. ***Vitex negundo:*** Local name:Nochi (VERBINACEAE)

The leaves are used to cure fever, cough, cold, and stomach-ache, Debasihis et. al. (1989) stated that leaves are used to cure scabies and dermatitis. Leaf juice placed on caries from toothache (Dass and Misra : 1987). Satyamurthy (1994) stated that it is an anti rheumatic drug.

5. ***Zyzyphus oenopila*** : Local name: Porpli (RHAMNACEAE)

This herbal species is an important ingredient for the medicine of insect bite.

6. ***Todalia asiatica*** : local name: Kattumilakarani (SAPIADACEAE)

The leaf of this species is used as an ingredient for drug of insect poison. It is also used to cure asthma. The root and leaf are used to cure inflammation of stomach.

TREES

1. ***Acacia lucofloea :*** Local name: Saraya Velan (MIMOSOIDAE)

The leaves are used to cure severe wound due to iron materials

2. ***Aegle marmelos :*** Local name : Bilpetharai (RUTACAE)

The leaves are main part for the medicine of leucoderma. The leaves with neam leaf reduce blood sugar (Bhagwan dash 1993). Negi (1992) stated that the leaves cure diarrhoea, dysentery and irritation of alimentary canal.

3. ***Albizzia amara :*** Local name:Cigaramaram (MIMOSAE)

The leaves and barks are used to cure epilepsy for adult and the leaf juice is used to cure eye disorders.

4. ***Butea monosperma*** Local name: Porasu (FABACEAE)

The gum is useful in the treatment of diarrhoea and dysentery for children. The seeds are especially useful in the treatment for round worms and tape worms and it is also applied with lime juice for dhobis itch. Bhawan Dash (1993) reported that the drug is used to prevent conception, where the drug is prepared as a paste with seed, honey and ghee, and applied inside of the vagina in sufficient quantity. According to yoga chintamani the seeds have to be powdered and taken with water for three days during the time of fertilisation to produce sterility.

5. ***Casia fistula:*** Local name: Sarakonnai (CAESALPINOIDAE)

It is an important ingredient of drug for snake poison. The pulps are used to cure constipation. Bakhru (1993) reported that is is well known laxative treatment for constipation.

6. ***Chlorozylon Swietenia:*** Local name: Urukli (RUTACEAE)

Sap or bark is used to cure the eye disorders.

7. ***Derris indica :*** Local name: Pungam (FABACEAE)

The leaves and bark of this remedy are used to cure diarrhoea and vomitting. The flowers are used to cure chronic diabetes, root decoction to cure septic wounds, dyspepsia, skin diseases and eye disorders. It has reported that leaf and bark pastes applied on as muscle relaxation (sabnis and Bedi 1983).

8. ***Ficus benghalensis :*** Local name: Aalan (MORACEAE)

Lac mixed with milk, is used to cure bleeding piles. The aerial roots are used to prevent dental disorders. This remedy is used to cure diseases like chronic diarrhoea, bleeding piles, female sterility, leucorrhoea and rheumatism (Bakhru, 1993). Ajay Kumar mohoptera

(1991) stated that fruits used to increase vitality and vigour. Juice from the young shoots and mixed with sugar scandy which prevent loss of vital fluid and buds are used to cure scabies (Debashis, et. al., 1989).

9. ***Ficus recemosa***: Local name : Athy (MORACEA)

The leaves are used to cure the haematemesis (blood vomitting) and excessive bleeding during menstrual cycle.

10. ***Ficus religiosa*** : Local name : Arasu (MORACEAE)

The leaves are used to cure chronic dysentery. The dried fruits are mixed with honey and this mixture is used to prevent spermatorrhoea and nocturnal emmisssion. Bhagwan Dash (1993) stated that it is used to cure gout. Bakhru (1993) stated that the leaves are used as a tonic and cure cardiac weakness.

11. ***Holoptelea integrifolia*** Local name : Thabasu (HERNANDIACEAE)

The fresh decoction of the bark is used to cure heavy stomach-ache.

12. ***Limonia acidissima*** Local name: Naivelan (LILIACEAE)

The leaves of this herbal remedy is used to cure the stomach-ache and vomitting. The bark is used to stimulate milk secretion of lactacting women.

13. ***Phyllanthus emblica:*** Local name: Nellly (EUPHORBIACEAE)

It is one of the most important ingredient for many drugs. It is valued chiefly for its high vitamin C content and it is always used for Vitamin C deficient diseases.

14. ***Phythacalobiuym indicum*** Local name: Kodukkaipule (ILICIACEAE)

This herbal fruits contains high quantity of Vitamin C. It cures the diseases like scurvy.

15. ***Pluctromia dedimum:*** Local name: Nekkiny (CANNABINACEAE)

This herbal remedy is used for insect poison.

16. ***Pterocarpus marsupium*** Local name : Vengai (FABACEAE)

The leaves are important ingredient of the drug for leucoderma (Sabnis and Bedi, 1983) has pointed out that the gum with water gives antiemetic and antidysenteric effect.

17. ***Santalum album*** Local name: Santhannam (SANTALACEAE)

Santalwood paste is a good medicine for prickly heat. It prevents excessive sweating. Bhagwan Dash (1993) stated that the tree used to make steritliy in women and burning sensation of urinary bladder.

18. ***Strychnos nux-vomica*** Local name: Etty (LOGANIACEAE)

Root bark and wood barks are used as main ingredients for snake poison. The decoction of the bark is used to cure cholera and fever. Seeds are used to cure mad and leprosy.

19. ***Strychnos pottotorum*** Local name: Ciru Etty (LOGANIACEAE)

Seeds are used to curve eye disorders. Fruits are used to cure cough and cold. The seeds contain 0.17% alkaloids and hence that it is also used as water purifier in water tanks.

20. ***Terminalia bellerica*** Local name : Thani (COMBRETACEAE)

The fruits of this species is to cure constipation and dental pain and infection. Bhagwan Dash (1993) and Munusamy (1910) explained the Triphala which includes three myrobalance namely, E. *officinalis, T. bellerica, and T. chebula,* which is frequently given by ayurvedic physicians for the treatment of chronic consti-

pation.

21. ***Terminalis chebula*** Local name: Kadukkai (COMBRETACEAE)

The seeds are used to cure cough and dyspepsia and the fine powder of bark is used to cure elephantiasis. Bakhru, (1993) stated that the physicians in ancient india used it in the treatment of diarrhoea, dysentery, heart-burn, flatulence, dyspepsia and liver disorders.

22. ***Wrigthia tinctoria*** Local name: Veppalai (APOCYNACEAE)

The lac of this species is used to cure the inflammation of skin.

23. ***Zizyphus jujuba*** Local name: Elandai (RHAMNACEAE)

The leaves are used to cure piles and diarrhoea. Bakhru (1993) stated that it is beneficial in mental retardation; it increases functioning of brain by releasing more glutamic acid into the blood stream. Dabadhis, et. al (1989) are of the opinion that the leaves are used to cure boils and skin inflamation.

From the present study it is evident that these plants are highly medicinal value and the cost of treatment is cheap and safe. It is also felt from this study that preservation and propagation of these rare flora is must. Further ethnobotanical studies should be profitably utilised for interaction between organised traditional medicine and folk medicine. Moreover, information on all such knowlege should be recorded at the earliest, and scientifically tested for blending into other tradational Indian system of medicine. As a concluding remark of this present study it is suggested that ethnobotanical research provides new vistas for application, improvement and popularisation of traditonal medicines.

ACKNOWLEDGEMENTS

We are greatly indebted to the Principal and Head of the Dept. of Zoology of A.V.C. College for providing the necessary facilities. Our sincere expression of gratitude goes to Dr. R. Saravanamuthu, Prof. K. Ambalavanan, Dept of Botany and Mr. Ramnathsekar, Botanist for the identification of plants. The authors are thankful to Mr. Jaganatha Rao, DFO, Hosur forest division for his kind cooperation and hospitality.

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Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research
A.V.C. College, Mayiladuthurai 609 305, South India, 1995

STUDIES ON THE ENERGY CONTENT OF THE DECOMPOSING LEAF LITTER IN THE MANGROVE ECOSYSTEM.

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ABSTRACT: The mangrove ecosystem at Pichavaram is dominated by *Avicennia* spp. and *Rhizophora* spp. The leaf litter decomposition of the plants in the mangrove habitat was studied by adopting nylon mesh bag technique. The changes in the energy content and the absolute energy of the decomposing leaf litter was studied by using Oxygen Bomb Calorimeter. The energy content was ranged between 2875 and 4161, and 3182 and 4688 g cals g^{-1} dry weight of the litter; the absolute energy content declined from 77.2 to 25.2 and 117.2 to 26.6 k.cals; and the energy release from the litter during the period of one year was 67.2 and 77.3% in the decomposing leaf litter of *A. marina* and *R. apiculata* respectively.

Detrital system in mangroves is important and it is the basic energy source in the foodweb in estuarine environment (Odum, 1970). Considerable amount of biomass in the tropical and subtropical environment is provided by leaves which is an important contributor to the foodweb. Dead plant materials are not only the reservoir of minerals but also it contains most widely distributed sources of energy which is a source of heterotrophic organisms (Satchell, 1974, Alexander, 1977). These leaf litter is acted upon by the diverse array of micro organisms like fungi, bacteria arthropods etc., and release minerals as well as energy. The studies on energy content of decomposing leaf litter was carried out by Ovington and Heitcamp, 1960, Ovington, 1961, Olson, 1963, Bocock, 1964 Odum and Heald, 1975, Sumitra Vijayaraghavan et al., 1980. Owing to the paucity of information on the mangrove detrital system the present work was carried out.

MATERIALS AND METHODS

Study Site

The present investigation was carried out in the Pichavaram Mangroves (PORTO NOVO) at South Arcot district, Tamilnadu. It consists of 40% waterways, 50% forest and the rest constitute mudflats sandlflats and salty soils. The climatic nature is monsoonic.

Study Material

The leaf litter of *Avicennia marina* and *Rhizophora apiculata* was selected as the study material. Generally *A. marina* is present in the central part of the islet and *R. apiculata* is around the periphery.

Methods

Decomposition of the leaflitter of *A. marina* and *R. apiculata* was studied by nylon mesh bag technique (Bocock and Gilbert, 1957). The naturally fallen leaflitter was collected from the studysite and they were washed and surface sterilized with 0.1% mercuric chloride. Then they were air dried and packed in nylon mesh bag (20x15 cm and pore size 1 mm) with 30 gm leaf litter each. Sixty such bags were prepared and buried in the study site with in the depth of 10 cm.

The nylon mesh bags were recovered at fortnightly intervals for first two months and on the first day of every subsequent months.

Determination of energy content

The calorific value of the decomposing leaf litter was determined by oxygen bomb calorimeter (Golley,1961). Known amount of dried and powdered leaf litter sample, not exceeding 1 gm each were made in to pellets with the help of mechanical compressor. The pellet was then tied to the ignition wire and connected to the terminals. Then these were burnt by passing electric current with oxygen (15 lb/inch^2). The rise in temperature of surrounding distilled water was noted. Blank estimation using benzoic acid was done to determine the

water equivalent of bomb calorimeter. Rise in temperature of distilled water was determined using Beckman thermometer and the energy content per gram dry weight of the leaf litter was calculated using the following formulae.

$$E = 570 \times t + 1350 \times t \; w$$

Where E = energy content in calories per gram; 570 = water equivalent of bomb calorimeter; 1350 = volume of distilled water in calorimeter;

W = Weight of pellets; and t = rise in temperature of distilled water.

RESULTS

The results of the present study were present in the Table *A.marina*: the energy content varied between 2875 to 4161 cal/g dry weight of leaf litter. There is no uniform trend during the period of study. But absolute energy content declined from 77.2 k. Calories to 25.3 k. Calories. Thus thereby a loss of energy of 67.2% during one year.

Table 1. Variation in the energy content* of the leaf litter at different stages of decomposition in the mangrove habitat.

Months 1991 -1992	No.of Samp.	R. apiculata			A. marina		
		Ec. (Ca/g)	AE (K.Ca)	EL %	Ec. (Ca/g)	AE (K.Ca)	EL %
Ini.	0	4688	117.2	0.0	3642	77.2	0.0
Feb1	1	4271	106.0	9.6	3701	74.0	4.2
Feb2	2	4112	93.3	20.4	3790	70.7	8.4
Mar1	3	4055	89.2	23.9	3776	69.7	9.7
Mar2	4	4030	88.0	24.9	3764	68.7	11.0
Apr	5	3979	84.7	27.7	3744	67.0	13.2
May	6	3707	77.2	34.1	3712	65.7	14.9
Jun	7	3435	69.9	40.4	3924	59.6	22.8
Jul	8	3182	61.4	47.6	3824	57.6	25.4
Aug	9	3310	55.6	52.6	3921	51.4	33.4
Sep	10	3399	51.8	55.8	4044	47.5	38.5
Oct	11	3466	47.1	59.8	4161	42.9	44.4
Nov	12	3617	41.2	64.9	3347	31.8	58.8
Dec	13	3428	33.6	71.3	3115	28.5	63.1
Jan	14	3239	26.6	77.3	2875	25.3	67.2

R. apiculata

The energy content varied from 3182 to 4688 Calories/g dry weight of leaf litter. Here also there was no uniform trend in the energy content. But the absolute energy declined from 117.2 k. Colories to 26.6. k. Calories, indicating a loss of energy of 77.3% during the period of one year.

DISCUSSION

Materials in the F and H layers of the wood land forest soil had lower calorific value than freshly fallen leaf litter (Ovington and Heitkamp, 1960; Ovington, 1961). According to Bocock, 1964 calorific values of decomposed materials were more than freshly fallen leaf litter. Odum and Heald, 1975 found an increase in the calorific values in the decomposing leaf litter of *R. mangle* in six months. Sumitra Vijayaraghavan et al., 1980, studied the energy content of *R. mucronata* (both in laboratory and field aquatic conditions) and reported an increase of energy content from initial level up to 13 months. The study of Bocock (1964) and present study were conducted for a period of one year. Whereas Ovington and Heitkamp (1960) and Ovington (1961) studied for several years. The energy content was determined from the residue remaining in the bag in the present study where as in the other studies, energy content was determined from the materials present in a particular layer. The differential trend in *A. marina* and *R. apiculata* might be attributed to the variations in the histology and biochemistry of the leaf litter of the two plant species.

ACKNOWLEDGMENTS

The authors are thankful to the Management and Principal, A.V.C. College for the Laboratory facilities.

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Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research,
A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

LEAF SURFACE MYCOFLORA OF TEAK PLANTATION OF SALIYAMANGALAM (THANJAVUR DT.) SOCIAL FORESTRY.

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ABSTRACT: The leaf surface mycoflora of green, senescent and brown fallen leaves of teak (*Tectona grandis*) was studied by plating of leaf surface washings and washed leaf bits. The observations were made over a period of 9 months at an interval of three months. Thirty eight species of fungi were isolated during the period of three samplings. Among thirty eight species isolated 3 belonged to phycomycetes, one belonged to ascomycetes and the remaining 34 belonged to fungi imperfecti. The population of the fungi was comparatively more on the surface of senescent leaves than the green and brown fallen leaves. The species of *Aspergillus* was more in the first sampling (November) than the other samplings *Humicola* sp *Melanospora* sp *Nigrospora* sp and *Petalotia* sq were also recorded.

The leaf surface constitutes a distinct micro habitat, phylloplane, which is inhabited by diverse array of micro- organisms including fungi, bacteria and actinomycetes. Some follicolous parasitic fungi spend a critical time until they are able to infect the leaf. Similarly saprophytes and weak parasite which participate in decomposition of leaves, wait until the host's resistance is decreased or the onset of senescence allows initial penetration into the tissue. The saprophytic microflora of leaf surface is of much interest for various reasons like antagonistic action against fungal parasites, its importance in decomposition of plant materials, after leaf fall, its role in toxicity to cattle its role in nitrogen fixation and its function as a source of allergenic air borne spores.

Teak (*Tectona grandis*) is one of the important timber yielding plants of very great commercial value. It belongs to the family Verbenaceae. Its timber is valuable for strength and durability. The population of teak is declining day by day and the attention of the Government is brigtly focussed this aspect, and efforts have been taken to develop teak plantation under social forestry scheme in selected areas.

Saliyamangalam, a small town situated on the banks of Vadavar river, in Ammapet panchayat union of Thanjavur Dt. (MSL 37 M) harbours a teak plantation. The plantation is 20 years old and includes about 500 trees. Since the information available on the leaf surface microorganisms of plantation crops is very limited in the present investigation an attempt has been made to study the mycoflora associated with the leaf surfaces of teak plants.

MATERIALS AND METHODS

The green, senescent and brown leaves of teak were collected from the study site and brought to the laboratory in separate sterilized polythene bags. The observations were made over a period of 9 months at an interval of three months.

Plating the leaf surface washings (Dilution plate Technique)

About 100 discs of 1 cm diameter were cut with the help of cork borer and taken in Erlenmayer flasks (250ml) containing 100ml sterile distilled water. The leaf bits of green, senescent and brown leaves thus prepared were taken separately in conical flasks with sterile distilled water. The flasks were then shaken for 30 minutes. The aliquot was seriously diluted to get 10^{-3} dilution. Then 1 ml of the final aliquot was plated onto the potato dextrose agar medium. The plate was gently rotated to get uniform distribution of the suspension. Three replicates were maintained for each leaf sample. The plates were incubated at ambient temperature (25° C) for about a week. The fungal colonies appearing on the nutrient agar medium were recorded from 5th day onwards. The fungi were mounted on clean slides and

stained with cotton blue and lactophenol. Identification of the fungi were done with the help of standard manuals. (Gilman, 1957, Ellis, 1971,1976; Subramanian, 1971).

The total number of species and fungal colonies observed were recorded.

Plating of washed leaf bits

This method was used to record the fungi growing in a vegetative form when leaf bits are plated. The surface washed leaves were used for plating. From each washed leaf, 5 bits, each measuring 5mm were further cut with sterile scissors. The resulting bits of the respective leaf bits were shaken in 50ml sterile water for 2 minutes and then transferred to a second flask with sterile water. This process was continued. After the tenth washing, the bits were blotted with sterile filter paper and placed on PDA medium. Three replicates were maintained for each sampling. ASfter 5 days of incubation the fungi were recorded and identified.

RESULTS AND DISCUSSION

The term phyllosphere was proposed analogus to rhizosphere and rhizoplane, but unlike the rhizolphere, the phyllosphere and phylloplane can not be demarkated. The fungi developed on the nutrient aagar medium from the plating of leaf surface washings and fungi developed on the washed and plated leaf bits were grouped into phyllosphere and phylloplane fungi respectively (Mishra and Srivastgava, 1971); similar distinction was also advocated by Diem(1973). But this can not be accpetable as it is difficult to distunguish the micro environment of the phyllosphere and hence the term 'phylloplane' has been used throught this study.

Totally 38 species of fungi were isolated during the period of three samplings. Among them *Absidia*, *Cunninghamella sp* and *Rhizopus sp* belonged to phycomycetes, and *Melanospora* belonged to ascomycetes and all other species belonged to fungi imperfecti. Among the different groups of fungi isolated, *Cladosporium sp*, *Curvularia sp* and a species of *Aspergillus sp* showed variations in their distribution during the period of samplings. the population of *Cladosporium sp* and *Curvularia sp* were more during the second sampling (Feb - April) and *Aspergillus* was more during the first sampling (NOv - Jan). Such seasonal variations in the distribution of *Aspergillus* during winter and *Cladosporium*, *Curvularia* during summer have been reported on the leaves of *Psidium guajava* (Pandey and Dwivedi, 1984). The population of as pergilli was more than other species recorded in the investigation and this may be due to heavy sporing nature of those species.

Table 1. Population of fungi isolated from the green leaf of by plating the green leaf washings.

Fungi	Samplings		
	I Nov.	II Feb.	III May
Alternaria alternata	3.0	0.7	8.3
Aspergillus candidus	4.0	8.3	9.0
A. flavus	6.3	8.7	8.0
A. fumigatus	3.0	6.3	8.3
A. ochraceus	4.3	9.3	9.0
A. sidulans	5.3	1.7	6.7
A. niger	2.7	4.0	9.3
A. oryzae	3.3	5.7	6.3
A. sulphureus	0.7	4.3	5.7
A. sydowi	3.0	9.0	11.7
A. terreus	5.7	9.3	11.7
Cladosporium sp.	11.7	5.7	5.0
Cephalosporium sp.	8.3	9.7	9.0
Curvularia lunata	15.0	4.0	2.0
Fusarium sp.	5.7	3.0	2.3
Penicillium citrinum	3.3	2.3	4.3
P. funiculosum	3.0	4.7	7.7
Pestalotia sp.	2.7	2.0	3.3
Rhizopus sp.	2.0	1.7	2.7
Trichoderma harzianum	9.0	11.7	10.0
Total no. of colonies	91.0	112.1	120.3
Total no. of species	20	20	20

The different stages of leaves namely green, brown and senescent were used. It was found that about, 16,12,20 species of fungi were isolated from the green, brown and senescent leaves respectively. The total number of colonies was comparatively more in the senescent leaves (Table I, to VI) than the green and brown leaves. The increased number of population on the surface of the senescent leaves might be due to loss of resistance, which permit the initial proliferation and

multiplication on the phylloplane. The casual spores and propagules on the surface of the young leaves may wait until hosts resistance is lost due to senescence. This may be an important reason for more number of fungi on the surface of senescent leaves compared to green and brown leaves. These fungi along with leaves may reach the soil and involve in the process of decomposition.

Table 2. Population of fungi from green leaf of by plating the washed leaf bits.

Fungi	Samplings		
	I Nov.	II Feb.	III May
Aspergillus sulphureus	1.7	5.7	6.3
A. sydowi	4.3	6.0	14.0
A. terreus	5.0	6.3	10.0
Cladosporium sp.	16.0	14.3	12.0
Curvularia sp.	17.0	11.0	10.3
Cunninghamella sp.	1.7	2.0	4.3
Fusarium oxysporum	3.0	2.0	3.3
Melanspora sp.	2.7	5.0	8.3
Penicillium sp.	5.7	8.0	9.0
Rhizopus sp.	1.3	2.7	4.0
Total No.of colonies	58.4	63.0	82.5
Total No.of species	10.0	10.0	10.0

Table 3. Population of fungi from the senescent leaf of by plating the leaf washings.

Fungi	Samplings		
	I Nov.	II Feb.	III May
Acrophialophora fusispora	3.0	7.3	11.3
Alternaria alternata	4.3	6.6	7.0
Aspergillus candidus	5.0	8.6	11.0
A. flavus	2.0	6.3	9.6
A. fumigatus	5.7	8.6	9.3
A. luchuensis	3.3	10.0	12.3
A. niger	5.0	8.3	11.0
A. sulphureus	4.3	6.6	9.0
A. sydowi	3.6	4.3	6.3
A.variecolor	3.7	6.3	9.6
Cladosporium sp.	19.3	17.3	15.0
Cunninghamella sp.	4.0	6.3	9.6
Curvularia lunata	21.0	20.0	-
Fusarium moniliforme	3.0	5.3	6.9
Gliocladium sp.	5.7	5.0	8.3
Helminthosporium sp.	3.6	8.0	9.3
Humicola sp.	3.0	2.3	4.0
Mucor sp.	0.7	1.7	3.0
Nigrospora sphaerica	8.3	9.0	10.0
Penicillium sp.	6.0	8.3	9.0
P.purpurogenum	2.0	4.3	11.7
Rhizopus sp.	1.3	2.6	4.0
Trichoderma sp.	4.0	6.0	9.3
Verticillium sp.	3.6	4.7	3.0
Total No.of colonies	125.4	163.7	199.5
Total No. of Species	24	24	24

Table 4. Population of fungi from the senescent leaf by plating the washed leaf bits.

Fungi	Samplings		
	I Nov.	II Feb.	III May
Absidia glauca	2.3	3.6	5.6
Altermaria alternata	0.7	1.7	4.0
Aspergilles niger	11.0	14.3	16.6
A. sulphureus	6.3	9.0	12.3
A. sydowi	4.0	6.6	9.0
Cladosporium sp.	16.3	13.0	10.6
Curvularia lunata	18.6	14.3	11.0
Fusarium oxysporum	2.3	4.0	8.3
Myrothecium sp.	3.0	4.3	11.7
Nigrospora sphaerica	2.0	4.6	5.9
Pencillium citrinum	5.7	8.0	9.3
Rhizopus sp.	8.3	11.0	13.6
Total no.of colonies	80.5	134.4	117.9
Total no.of species	12	12	12

Table 5. Population of fungi from the senescent leaf of plating the leaf washings.

Fungi	Samplings		
	I Nov.	II Feb.	III May.
Aspergillus fumigatus	1.7	5.0	6.3
A. niger	2.3	4.6	6.6
A. sulphureus	5.0	9.9	12.6
A. sydowi	4.0	6.3	9.3
Black sterile mycelium	2.0	3.3	5.7
Cladosporium sp.	22.3	16.0	11.3
Cunninghamella sp.	3.0	4.6	6.6
Curvularia lunata	19.0	13.0	9.3
Curvularia senegalensis	10.3	12.7	9.0
Fusarium sp.	5.3	9.3	11.0
Penicillium citrinum	2.6	5.9	9.0
Pestalotia sp.	3.0	6.3	4.0
Rhizopus sp.	8.0	3.0	1.3
Trichoderma harzianum	6.3	5.3	8.6
Total no. of colonies	74.8	105.2	110.6
Total no.of species	14	14	14

Table 6. Population of fungi from the brown leaf of by plating the washed leaf bits.

Fungi	Samplings		
	I Nov.	II Feb.	III May
Aspergillus candidus	1.7	4.3	5.7
A. sulphureus	2.7	4.0	9.3
A. sydowi	3.0	5.3	7.0
A. terreus	5.7	8.0	11.7
Cladosporium sp.	11.0	4.3	3.6
Curvularia lunata	13.3	9.0	6.3
Fusarium oxysporum	0.7	1.7	2.3
Pestalotia sp.	1.0	3.0	4.7
Penicillium citrinum	2.3	0.7	4.0
Total no. of colonies	41.4	40.3	54.6
Total no.of species	9	9	9

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Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research,
A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

COMPREHENSIVE APPROACH FOR THE REHABILITATION AND REGENERATION OF FORESTS, COMMUNITY LANDS AND PRIVATE LANDS

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ABSTRACT : Andhra Pradesh is the fifth largest State in geographical area and the thrid largest in forest area in the country. The notified forest area is 63,814 sq.km. which forms 22 per cent of the land. The per capita forest area is 0.10 hectares. Like most other States, forests in Andhra Pradesh are in various stages of degradation, primarily because of "biotic pressure", which includes the effects of human population _ in the form of cutting for cultivation, harvesting, wood for sale, indiscriminate grazing and burning of forest floor-adversely affecting the productivity of forests in quality and content.

As per the Forest Survey of India, 25 per cent of notified area is without forest cover and less than half of the area has crown density of 40 per cent or more. Nearly 28,000 sq.km. is categorised as degraded forest, requiring rehabilitation and regeneration.

Rejuvenation and rehabilitation of degraded forests is the aim of the six-year Andhra Pradesh Forest Project which is to be implemented from this year at a cost of Rs. 353 crores. The project, approved by the World Bank, is being an eco-friendly project described as a **"comprehensive approach for the rehabilitation and regeneration of forests, community lands and private lands".**

The main objective is to increase productivity and quality, alleviate rural poverty and protect the environment, to bring out an eco-friendly project in the state, Andhra Pradesh. Andhra Pradesh is the fifth largest State in geographical area and the largest in forest area in the country. The notified forest area is 63,814 sq.km. which forms 22 per cent of the land. The per capita forest area is 0.10 hectares.

Like most other States, forests in Andhra Pradesh are in various stages of degradation, primarily because of intense "biotic pressure", which includes the effects, of humen population -- in the form of cutting for cultivation, harvesting, wood for sale, indiscriminate grazing and burning of forest floor-adversely affecting the productivity of forests in quality and content.

According to the Forest Survey of India, 25 per cent of notified area is without forest cover and less than half of the area has crown density of 40 per cent or more. Nearly 28,000 sq.km. is categorised as degraded forest, requiring rehabilitation and regeneration.

In view of this background, the State felt the need for a comprehensive programme to improve the forest productivity and sustainability. Accordingly proposals were made to the World Bank in 1992 to include most of the related activities of the forest sector.

The project would benefit about 7 lakh households of fringe forest dwellers and small farmers, including about 1,50,000 tribal households. The beneficiaries belong to the poorest sections of society of society and consist of over 50 per cent of SCs and STs.

Specific measures under the project include statutory safeguards for the participation of women and tribals in the village forest protection committees, employment and training, targeting women of fringe forests.

The six-year project component includes regeneration or afforestation of degraded forest areas through joint forestry management (1,73,100 hectares), regeneration of bamboo forests, plantattions, high-yielding plantation by the Andhra Pradesh Forest Development Corporation, silvicultural operations in viable teak plantations (104,000), community forestry (12,500), farm forestry (34,500) and private waste lands (30,000). These plantation works would generate about 80 million man days of employment to the rural poor.

A special action programme for improvement of forestry research and plant propagation, establishment of research laboratories, nurseries, research and seed-processing at an estimated cost of Rs. 28.13 lakhs.

Starting of the joint forest management process through training/study tours, research, community infrastructure and NGOs' services at a cost of Rs.16.25 lakhs.

Improvement of bio-diversity conservation and protected areas management at a cost of Rs.20.31 lakhs. Eco-development programmes would be implemented in 100 villages and 225 forest officers working in various capacities would be transferred to the wildlife sector to ensure better management of protected areas.

Undertaking collaborative fodder development with the Department of Animal Husbandry at a Rs.1.25 lakhs.

The regeneration and rehabilitation of degraded forests account for 56.6 per cent of the project cost. It includes the participatory forest management, which account for 22.1 per cent of the total cost. The action programmes account for 32.3 per cent of the project cost, while the balance amount goes for sevice support, which includes consultancies, construction of buildings and purchase of equipment.

During the current financial year, which is the first year of implementation of the project, Rs.22.14 crores has been released by the State Government.

As a part of the efforts to regenerate forestry initiated by the Department a year ago, 58 'Jana Rakshana Societies' have been set up so far. Their number is expected to touch the 1,000 mark in 1995-96. The department is undertaking a study on the number of people who depend on forests to meet their daily needs. 'Once the demands are assessed we can supply the manpower to meet the demands in a sustainable manner', an expected observation.

Following the formation of societies, people seem to be realising the need for protecting forests and to look for alternate sources of fuel, like in the case of the backward Adilabad district, which has eight societies. In Utnoor the tribals run the societies.

They are learning that cutting forest is not the answer to their firewood needs. We are persuading them to use the forest in a sustainable manner and not in a destructive manner', the present project as an eco-friendly way says.

The Government, which wanted to start forest stations to prevent destruction of green cover in the State, seems to have given up the plan after studying the Kerala experiment. "Forest stations are not the remedy for our problems. They are not feasible. We have to evolve a solution to solve our problems", it observes.

Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research,
A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

ETHNOBOTANICAL STUDIES ON KURUMBAS OF KOTAGIRI (NILGIRIS) AND PHARMOCOGNOSY OF *Moringa concanensis nimo* (STEM BARK)

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ABSTRACT : The present paper highlights the role of Ethonobotany in the study and conservation of forest Ecosystem in Kotagiri regions of Nilgiris district by the tribals of kurumbas. It is emphasized that, traditional culture and social restrains developed by kurumbas on utilization can greatly help the conservation of Bio-diversity. There are abour seven subtribes dwelling in the above district of Tamilnadu. The interesting features of their anthropology are enlightened. The paper enumerates sixty plant species (54-genera, 45 families).which are used in their customs, food, medicines etc. in alphabetical order with notes on their local name, uses, method of collection, drug preparation, dosage and mode of administration etc, apart from their role in forest conservation. Among these *Moringa concanensis nimo* (stem bark) is used for birth control by the tribe. Pharma-cognosical informations are scanty and hence it is studied with the following parameters: macro and micro morphology of bark, organoleptic, flcurescence and phyto-chemical evaluation biochemical and geochemical estimation and physical constant, 'ash) determination from stem bark powder.

One of the aspects of ethnobiological contributions towards the Ecosystem is the study of the traditional knowledge base of tribals in protecting the forests. They possess accurate knowledge of the enviroment, including the plant species and ecological relations that exist among them (Rao, 1950).

The present day scientific discoveries are not able to uproot some of the diseases. We are purely depending upon western medicines to cure the disease. Tribal life is mostly associated with nature, they are familiarised with 'signature' and miraculars and perilous power of the plants. Hence an attempt is made to bring out the traditional use of the folk lore medicine of kurumbas of Nilgiris which has not been explored so far.

Among the plants used by them *Moringa concanensis* is most repeatedly used by the tribals for the antifertility action. Since the pharmacognosical informations is scanty and an attempt is made to evaluate its pharmacognosical characters with the following parameters:- taxonomy, histology, flower study. flourescence, phytochemical screening and physical constant.

MATERIALS AND METHODS

Field work in Ethnobotany is entirely different from that of routine taxonomic field work. The present investigation was undertaken with a view to study the Ethonobotany of Kurumbas of Nilgiris district especially distributed in Kotagiri taluk.

The data regarding the total population and area distribution of kurumbas were collected from district Aadi Dravida welfare office Udhagamandalam. Periodic field trips were under taken to Kunjapani, Mamaram, Sundapatti, Vellari-kombai, Kozillarai, Mullur sudukattu Nattum, kozithorai, Semmanarai Manaliada, Banagudisolai and Sarijini nagar.

With the help of highly experienced old knowledgeable local persons the plants in and around the hamlets were thoroughly studied. The specimens which were medicinally used and the parts used such as leaves, fruits, roots, bark etc., were noted in the field itself, prepared herbarium specimen and deposited in the Botany department, Kongunadu Arts and Science College, Coimbatore.

One of the important medicinal plants *M. concanensis*, was under taken for pharmaco-phytochemical studies.

The procedures of different parameters were followed as described by Subramanian (1990, 1993).

RESULTS AND DISCUSSION

ANTHROPOLOGICAL INVESTIGATIONS OF KURUMBAS

The Nilgiris is inhabited by six distinct tribes, kurumbas, Irulas, Paniyas, Kothas, Todas and Kattu Nagulas (Francis, 1908).

Taxonomy

M. concanensis stem bark longitudinal section reveals that it has parenchymatous tissues with essential starch grains. Organoleptic evaluation of the bark reveals yellowish brown colour and pungant odour, the charecteristic fluoresent properties have shown themselves to be out valuable aid in identification of drug.

Phytochemical screening of bark powder reveals the presence of cellulose, oils, fats, flavinoid, protein, suberin, sugar, starch, and tannin. Extractive value is high in alcohol. The powder may have similar properties to that of antifertility agent.

In the present work it has been given as to how the tribals are closely associated with plants and their ecosystem. This study can open new vistas to find an alternative remedy to uproot the diseases which has not been cured sofar and without side effect. The author has screened 60 plants enthobotanically for food, fruits, medicine and customs which are repeatedly used by kurumbas of Nilgiris district.

ACKNOWLEDGEMENT

The authors are grateful to Dr. M. Aruchami, Secretary and Dr. K. Kumaraswami Principal, KASC, Coimbatore.

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Proceedings of the National Symposium on Recent Trends in Indian Wildlife Research, A.V.C. College, Mayiladuthurai - 609 305, South India, 1995.

STUDIES ON THE INTERFUNGAL INTERACTIONS BETWEEN SOME SOIL FUNGI AND *Rhizoctonia solani*

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ABSTRACT: Interfungal interactions of soil fungi namely *Cunninghamella elegans, Gliocladium virens, Trichoderma koningi, T. harzianum* and *Trichoderma sp.* with *Rhizoctonia solani* were studied *invitro* in dual culture experiments. *G. virens, Trichoderma sp T. harzianum* and *T. koningii* grew over *R. solani*. Mycoparasitic interactions viz. coiling, penetration, rami-fication, hyphal bursting and lysis were observed. It has been assigned to necrotrophic mycoparasitism. Screening of fungi in the forest ecosystem for such antagonistic interactions could provide wild strains as tools for biological control.

Microorganisms, particularly fungi, for most part of their life remain as dormant propagules. Their activites is usually confined to the vicinity of the organic nutrients (Alexander 1971). Once when they become active they are subjected to interactions. The inter-fungal interactions, in which the activity of one organism is interferred by the other, involving hyphal interference, antibiosis and mycoparasitism as mechanisms of biolocal control have been highlighted (Boosalis, 1964. Boosalis and Mankau, 1965, Barnett and Binder, 1973; Ayers and Adams 1981, Baker, 1987 Turhan 1990). In the present investigation an attempt has been made to study the interfungal interactions between some individual species of fungi and *Rhizoctonia solani,* a broad spectrum pathogen, *invitro.*

MATERIALS AND METHODS

Colony Interactions : Dual Culture Experiments

The colony interactions between the test pathogen, *R.solani* and some of the soil fungi, *C. elegans, G. virens, T. harzianum and T. koningii* were studied *invitro* in dual culture experiments. Individual species of fungi and the test pathogen were grown in pure cultures on czapek-Dox agar medium. Agar blocks (5mm) cut from the actively growing margin of the individual species of fungi and test pathogen were inoculated juxtoposed to each other 3cm apart on czapek-Dox agar medium in peteriplates. Atleast three replicates were maintained. Controls were set in single and dual inoculated culture of the fungus. The position of the colony margins on the back of the disc was recorded daily. Assessments were made when the fungi had achieved an equilibrium after which there was no further alteration in the growth pattern. The assessment was made for the type of interaction between the two organisms in the petri-plates. The percentage inhibition of growth was calculated as follows.

$$\% \text{ inhibition growth} = \frac{r - r1}{r} \times 100$$

Where r = growth of the fungi measured from the centre of the colony towards the centre of the plate in the absence of antagonistic fungus.

r1 = growth of the fungus measured from the centre of the colony towards the antagonistic fungus.

MYCOPARASITIC INTERACTION BETWEEN *R. Solani* and ANTAGONISTIC FUNGI

The mycoparasitic interactions between the antagonistic fungi namely *C. elegans, G. virens, T. harzianum and T. koningii* and the test pathogen *R. solani* were studied in dual culture experiments following the method of Ikediugwu and Webster (1970), modified by Skidmore and Dickinson (1976). The antagonistic fungi and the test pathogen were grown individually on Czapek-Dox agar medium. Agar blocks (5mm) cut from the actively growing margin of the individual species of the antagonistic fungi and *R. solani* were inoculated on to the

Czapek-Dox agar medium juxtaposed to each other approximately 3cm apart. A deplasticized and sterilized cellophane paper of the size of the inner circumference of the plate was placed in each plate before inoculation. The plates were then incubated at 27 ± 2° C. After 5 days small squares of cellophane from the intermingling growth region of the colonies were cut, stained with cotton blue in lactophenol and observed under light microscope.

RESULTS AND DISCUSSION

There are five different types of interfungal interactions recognized between different groups of fungi (Porter, 1924, Dickinson and Broadman, 1971; Skidmore and Dickinson, 1976). They include (a) mutual intermingling growth without macroscopic sights of interaction (grade-1); (b) mutual intermingling growth where the fungus grow over the test fungus (grade -2); (c) mutual intermingling growth where the test fungus grow over the fungus; (d) mutual inhibition of both the interacting fungi with a narrow zone of inhibition (grade-4); and (e) mutual inhibition of growth at a distance (grade-5).

The type of interactions between the individual species of fungi namely *C.elegans, G.virens, T.harzianum and T.koningii* and *R. solani* was of grade-2. All the fungi tested grew over *R. solani*. However, there was no zone of inhibition formed which is an indication of the absence of the production of antibiotic substances by both the species of interacting fungi. But the growth of *R. solani* was inhibited towards the region of intermingling growth. The per cent inhibition of growth of *R.solani* was 53,64,58 and 76 due to the interaction of individual species of fungi viz., *C.elegans, G.virens, T.harzianum and T.koningii* respectively (Table 1).

Species of *Gliocladium and Trichoderma* coiled, penetrated, ramified and ultimately killed the hyphae of the host fungus at the region of intermingling growth. Granulation and vacuolazation of the host hyphae were also recorded which indicate the type of interactions as necrotrophic mycoparasitism. However *C. elegans* did not show coiling and peneration. Nevertheless the hyphae of *R.solani* were lysed which could possibly be due to the production of lytic enzymes. The results suggest that the fungi which are not pathogenic, could be used to control the pathogens. Hence search for wild strains of fungi as biocontrol agents from the forest ecosystem could throw new light on this line of research.

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Table 1. Colony interactions between some Antagonistic fungi and Rhizoctonia solani in dual culture experiments

INTERACTIONS	*C.e.*	*G.v.*	*T.h.*	*T.k.*
Growth of the pathogen towards antagonistic fungi (mm)	4.75 ± 0.25	4.08 ± 0.381	4.33 ± 0.577	3.3 ± 0.00
Growth of the pathogen away from the antagonistic fungi (mm)	10.0 ± 0.50	10.83 ± 0.721	10.00 ± 0.00	10.58 ± 0.629
Per cent inhibition of the pathogen in the zone of interaction	53	64	58	76
Growth of the antagonists towards the pathogen (mm)	7.5 ± 0.00	7.91 ± 0.721	12.5 ± 0.00	10.40 ± 0.721
Growth of the antagonist away from the pathogen (mm)	10.5 ± 0.00	9.16 ± 0.721	12.5 ± 0.00	10.4 ± 0.721
Per cent inhibition of the antagonists in the zone of interaction	28	11	0	0

C.e. – *Cunninghamella elegans* *G.v.* – *Gliocladium virens*
T.h. – *Trichoderma harzianum* *T.k.* – *Trichoderma koningii*

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