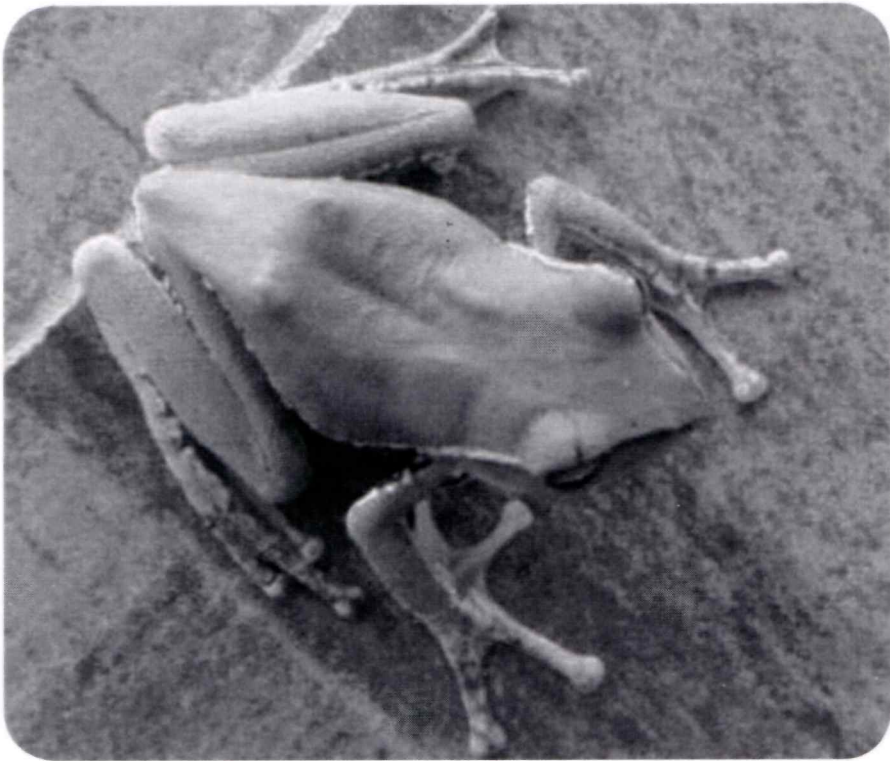


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**Cover**

**Variable Ghat tree frog (*Ghatixalus variabilis*):** A tree- frog endemic to upper Nilgiris, inhabiting Shola forests and grassland ecosystem.

**Photo: Kannan, P., Anushya, J. & J.Leona Princy**

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## AMPHIBIANS IN AND AROUND COONOOR, THE NILGIRIS, TAMILNADU

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**Abstract:** We studied the micro habitats, macro habitats and local distribution of amphibians, particularly the endemic taxa (*Raorchestes*) in and around Coonoor, a part of Nilgiri Biosphere Reserve. In each locality, visual encounter survey was done to collect basic data on amphibians. A total of 60 sightings consisting of *Duttaphrynus melanostictus* 39 (65%) followed by *Raorchestes tinniens* 8 (13%), *R. coonoorensis* 7 (12%) and *Ghatixalus variabilis*, 6 (10%) were obtained in Coonoor area.

### INTRODUCTION

Presence of a good population of amphibians in a region is an indication of a healthy environment (Gururaja *et al.*, 2008). Hence, amphibians are rightly called the 'indicator' species. Amphibians play major role in ecosystem functioning, as prey and predators, especially controlling agricultural insect pests starting from its eggs, larval, pupal and adult stages. They are also food for snakes, birds and smaller mammals (Erspamer, 1994). India has around 300 species of amphibians and new species are being discovered at a rapid pace every year. Amphibians are grouped into three broad groups – caecilians, newts, salamanders and the anurans (Inger & Dutta, 1986; Dutta, 1997; Ravichandran, 1996; Dutta *et al.*, 2001). The fascinating ecosystem of Nilgiris harbor many endemic, rare and endangered amphibians. Indian frogs are facing onslaught of challenges, including shrinking habitat caused by man, and because of this, more than 80% of the country's frogs are on the verge of extinction (Dutta, 1997; Inger & Dutta, 1986). The Western Ghats of India are very rich in amphibian species with 117 species of frogs, toads and caecilians. About 90 species are endemic to this region (Gururaja *et al.*, 2008).

## STUDY AREA

Coonoor (11.3502N 76.7961E; ca. 1800 m asl) is the second largest place in Nilgiri hills after Udthagamandalam, located in the Western part of Tamil Nadu, in the neighborhood of Mettupalayam. In certain tracts particularly in Coonoor range and west of Pykara, notably around Naduvattam, extensive stretches of hill country are occupied by a kind of evergreen scrub comprising along with the herbaceous complex of grasses and other species, varying proportions of shrubby vegetation. Wellington is near Coonoor, just en route to Ooty, apart from human-modified habitat, such as the oldest golf stadium in the country also has lush green valley nestled and hills covered with native vegetation and tea estates. At times you could also spot a black bison coming down on the course from the mountains surrounding it. Boys Company, also called Cruzpet is an area along the Ooty-Coonoor Road. The area is a small town located between Coonoor and Ooty on the NH 67, 6 km from Coonoor town and 12 km from Udthagamandalam, near the town of Hossatty / Ossatty.

## MATERIALS AND METHODS

In each locality, visual encounter surveys were done to collect data on amphibians from July 2018 to March 2019. This method involves searching for frogs in a locality or vegetation types recording all visible frogs on the surface (Campbell and Christman, 1982, Corn and Bury, 1990). While walking, we scanned the vegetation, path, and other possible places for frogs, recording the species observed within a 10 m distance from the path. Ecological information gathered included species, colour variations, microhabitat, defects, threats (presence of predators, habitat change etc.). The sampling duration in each locality was largely depending up on size of the area.

## RESULTS

In all, four species of amphibians namely the common toad (*Duttaphrynus melanostictus*), the tinkling bush frog (*Raorchestes tinniens*), the Coonoor bush frog (*Raorchestes coonoorensis*) and the variable Ghat tree frog (*Ghatixalus variabilis*) were recorded during the study. A total of 60 sightings representing four species of amphibians were recorded in and around Coonoor. The species which were recorded during the study were: *Duttaphrynus melanostictus* 39 (65%); *Raorchestes tinniens* 8 (13%), *R. coonoorensis* 7 (12%) and *Ghatixalus variabilis* 6 (10%). Various activities such as resting under stone, bush, jumping and moving

on the surface were noticed. The seasonal distribution pattern of *D. melanostictus* indicates that during winter 18 (30%) sightings were recorded followed by 14 (23%) during rainy season and 7 (12%) during spring. Three (5%) sightings of *R. tinniens* were recorded during winter, followed by 4 (7%) recorded during rainy season.

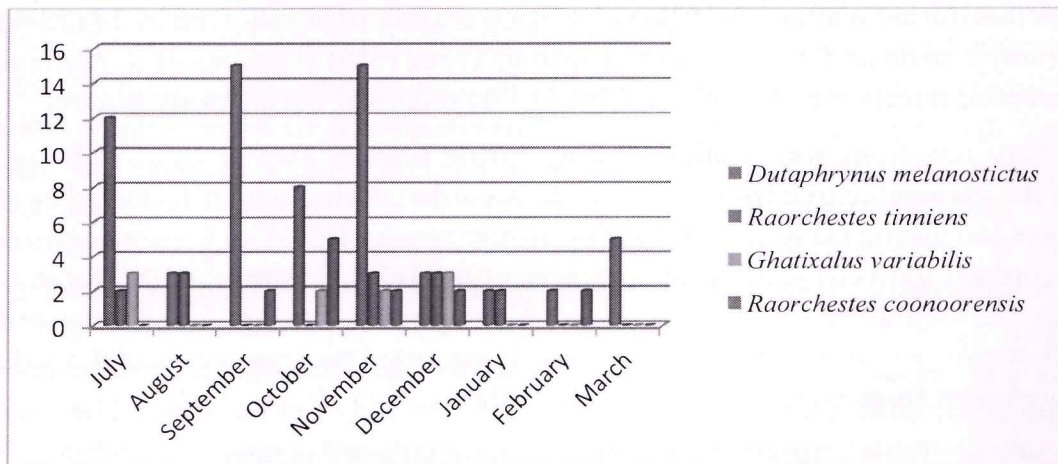
Very few frogs were noticed during spring season. Two (3%) of sightings were of the variegable tree frog *G. variabilis* recorded during winter followed by 4 (7%) recorded during rainy season. During winter season 1(2%) of *R. coonoorensis* were recorded followed by 5(8%) in rainy season and 1(2%) in spring. Microhabitats in which the amphibians were noticed were categorized into ground, shrubs and grass. *Duttaphrynus melanostictus* were mostly recorded on grass or ground, while the *Raorchestes* frogs were seen mostly on bushes.

**Table1. Species wise data on amphibians in Coonoor**

S.No	Species	No. of sightings	Percentage
1	<i>Duttaphrynus melanostictus</i>	39 (65%)	65%
2	<i>Raorchestes tinniens</i>	8 (13%)	13%
3	<i>Raorchestes coonoorensis</i>	7 (12%)	12%
4	<i>Ghatixalus variabilis</i>	6 (10%)	10%
	<b>Total</b>	60	100%

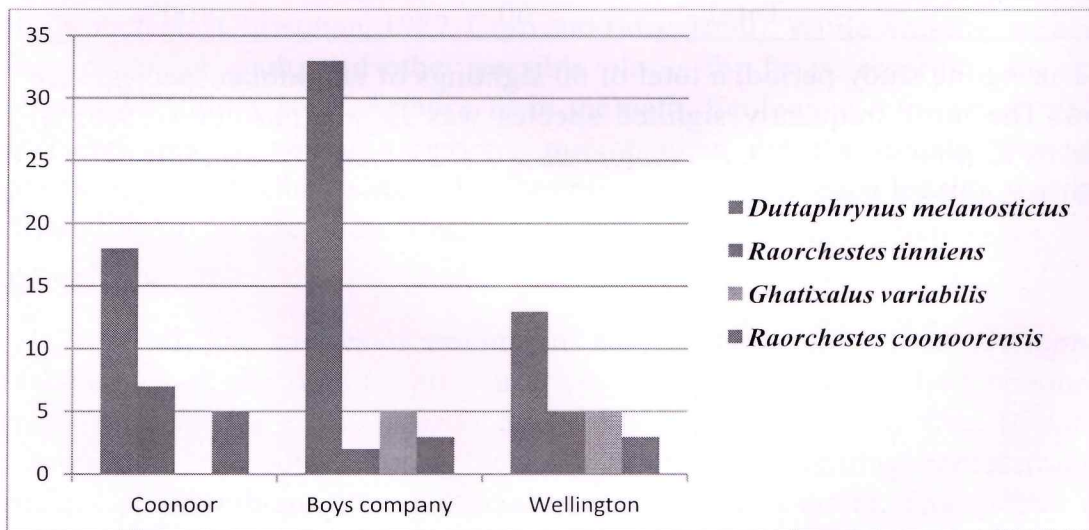
During the study period, a total of 60 sightings of amphibian species were recorded. The most frequently sighted species was *D. melanostictus* 39(65%) followed by *R. tinniens* 8(13%), *R. coonoorensis* 7 (12%) and *G. variabilis* 6(10%) (Table 1).

**Fig. 1. Month-Wise data on amphibians recorded in Coonoor**



During the study period between July 2018 to March 2019, a total of four species of frogs have been recorded in and around Coonoor. The month wise data shows that from July to September higher number of frogs were recorded. Low number of frogs was recorded during December to February (Fig1).

**Fig. 2. Area Wise Data on Amphibians in Coonoor**



A maximum of 20 (33%) individuals of *Duttaphrynus melanostictus* were recorded in Boys company, followed by *Ghatixalus variabilis* 3(5%), *Raorchestes*

*coonoorensis* 2(3%), *Raorchestes tinniens* 1 (2%). A total of 11(18%) individuals of *Duttaphrynus melanostictus* were recorded in Coonoor followed by *Raorchestes tinniens* 4 (7%) and *Raorchestes coonoorensis* 3 (5%). In Wellington 8 (13%) individuals of *Ghatixalus variabilis* were recorded followed by *Raorchestes tinniens* 3(5%), *Ghatixalus variabilis* 3(5%) and *Raorchestes coonoorensis* 2(3%) were observed (Fig. 2).

**Table 2. Macro Habitat Data of Amphibians Recorded in Coonoor**

S.No	Habitat	<i>Duttaphrynus melanostictus</i>	<i>Raorchestes tinniens</i>	<i>Raorchestes coonoorensis</i>	<i>Ghatixalus variabilis</i>	Total
1	Cultivation	2(3%)	2(3%)	0	0	4
2	Plantation	23(38%)	3(5%)	4(7%)	3(5%)	33
3	Human Habitation	10(17%)	3(5%)	3(5%)	2(3%)	18
4	Natural Vegetation	4(7%)	0	0	1(2%)	5
	<b>Total</b>	<b>39</b>	<b>8</b>	<b>7</b>	<b>6</b>	<b>60</b>

Plantation support a wide variety of amphibians followed by human habitation which support mostly *D. melanostictus* 23(38%) followed by human habitation 10 (17%) and natural vegetation 4 (7%). As regards *R. tinniens*, 3 (5%) each were recorded in plantation and human habitation. Cultivation supported comparatively less amphibian species. Natural vegetation supported more *D. melanostictus* and *G. variabilis* (Table 2).

**Table 3: Microhabitat wise Data of Amphibians in Coonoor**

S.No	Micro Habitat	<i>Duttaphrynus melanostictus</i>	<i>Raorchestes tinniens</i>	<i>Raorchestes coonoorensis</i>	<i>Ghatixalus variabilis</i>
1	Bush/Ground	25(42%)	3(5%)	6(10%)	4(7%)
2	On the grass	11(18%)	5(8%)	1(2%)	1(2%)
3	Under the Stone	3(5%)	0	0	1(2%)
	Total	39	8	7	6

Microhabitat wise data shows that *Duttaphrynus melanostictus* mostly prefer micro habitats such as bush and ground 25 (42%) followed by grass 11 (18%)

and under stone 3 (5%). *Raorchestes tinniens* mostly preferred grass 5 (8%) which was followed by bush 7 (5%). *Ghatixalus variabilis* and *R. coonoorensis* mostly prefer bush and ground (Table 3).

**Table 4: Activity Wise Data on Amphibians in Coonoor**

S.No	Activities Recorded	<i>Duttaphrynus melanostictus</i>	<i>Raorchestes tinniens</i>	<i>Raorchestes Coonoorensis</i>	<i>Ghatixalus variabilis</i>
1	Resting	8(13%)	2(3%)	1(2%)	1(2%)
2	Moving / Jumping	31(52%)	6(10%)	6(10%)	5(8%)
	Total	39	8	7	6

Among the various types of activities noticed on these four species of frogs moving and jumping was noticed in 48 (80%) individuals followed by resting 12 (20%) individuals (Table 4).

**Table 5: Season Wise Data on amphibians in Coonoor**

S.No	Species	Rainy season	Winter season	Spring season	Total
1	<i>Duttaphrynus melanostictus</i>	14(23%)	18(30%)	7(12%)	39
2	<i>Raorchestes tinniens</i>	4(7%)	3(5%)	1(2%)	8
3	<i>Raorchestes coonoorensis</i>	5(8%)	1(2%)	1(2%)	7
4	<i>Ghatixalus variabilis</i>	4(7%)	2(3%)	0	6
	Total	27(45%)	24(40%)	9(15%)	60

The season wise data shows that during rainy season starting from July to September maximum numbers of frogs were recorded. In winter season minimum numbers of frog species were present. In pre-summer very low number of were noticed (Table 5).

## DISCUSSION

Ecosystem functioning is dictated to a large extent by diversity and the community structure that results from factors such as richness and evenness of diversity. When compared to other amphibian species *Duttaphrynus melanostictus* had high abundance, followed by *Raorchestes tinniens* during the study period. The month wise data shows that the month of July to September had higher number of frogs recorded. January and February had minimum number of frogs in the study area. The amphibians of the Western Ghats are diverse and unique, with more than 80% of the 179 amphibians species being endemic to the rain forests of the mountains. Among the four species that were recorded in Coonoor area *Duttaphrynus melanostictus* 39(65%) had highest number of individuals followed by *Raorchestes tinniens* 8(13%), *Raorchestes coonoorensis* 7(12%) and *Ghatixalus variabilis* 6(10%). Toads can tolerate less moisture than after frogs, but they also seek refuge from the sun during the day and dry periods by hiding under vegetation, logs or other debris, or burrowing underground (Navas, 1996). During the present study it was very well noted that *Duttaphrynus melanostictus* used varieties of microhabitats because those habitat are mainly bog places, hence this a semi aquatic and bog places helps to moderate their body temperatures. *Duttaphrynus melanostictus* is most common species. It was a commonly encountered species and showed high relative abundance near human habitation. *Raorchestes coonoorensis* was rare and other species were found only in plantation. The data obtained from transects indicates that most of the frogs noticed mostly during nocturnal period. Among the four species *Raorchestes tinniens*, *R. coonoorensis* and *Ghatixalus variabilis* are endemic to the Western Ghats.

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## **ROLE OF ANIMAL PROTECTION LAWS AND REGULATIONS IN THE CONSERVATION OF AMPHIBIANS USED FOR DISSECTION, EXPERIMENTATION AND MUSEUMS IN EDUCATION**

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A number of countries have recognized animals in their Constitution and Animal Laws and Regulations are implemented in order to give protection to animals. In India, we have comprehensive sets of Animal Protection Laws in the world. Our Country recognizes animals in our constitution and it is the fundamental duty of every citizen of India to show compassion to all living beings. The codes of conduct govern our use and treatment of animals, both domestic and wild. However, the Zoology/Life Science / Biology/Pharmacy/Biotechnology/Medical Educationists, Learners, Scientists and Research scholars do not aware of Animal Protection Laws and Regulations.

The Pedagogy in Zoology, Animal Science, Life Science, Pharmacy and Medical Practical Curriculum involves killing of animals for dissections and experimentation. Dissection is the act or the art of cutting an animal into pieces in order to ascertain the structure of its parts. Dissect means to cut into parts for the purpose of minute examination. Dissection is the exploration of dead animals in the classroom to see what their internal parts look like and how they work. Vivisection is animal experimentation— cutting, burning, shocking, drugging, starving, irradiating, blinding and killing animals. Many science courses use dissection to give students a better understanding of frog anatomy and a specific look at internal organs and muscles.

Amphibians such as *Euphlyctis hexadactylus* (Indian Green frog), *Hoplobatrachus tigerinus* (Indian Bull frog), *Hoplobatrachus crassus* (Jerdon's Bullfrog), *Euphlyctis cyanophlyctis* (Indian Skipper frog), *Fejervarya agricola* (Indian Cricket frog/Rice field frog) and *Duttaphrynus melanostictus* (Common Toad) were collected and euthanised for dissections and experimentation in Education. Akbarsha (2015) reported that 100 million amphibians per year were captured from wild and killed for the purpose of education and experiments. He also stated that use in dissection and experiments added to the list of threats to amphibians. Researchers from the World Conservation Union reported in 2004 that a third of all amphibian species around the globe, including frogs, were threatened with extinction. Although habitat loss, pollution and climate changes are the primary causes, demand for dissection specimens increases pressure on threatened species. The dissection resulted in collection and killing of thousands of frogs which dwindled the population of aquatic amphibians such as *Euphlyctis hexadactylus*, and *Hoplobatrachus tigerinus*. Vasudevan and Supriya (2011) rightly pointed out that the ongoing use of animals for vivisection in education in India, is in violation of the legal provisions.

It is ironical that Zoologists, on the one hand, emphasize the role of every living organism in the delicate balance of nature, while on the other thousands of animals are killed and dissected in the laboratories to study the anatomy. Sathyanarayana (2009) says that the zoology teachers teach importance of biodiversity/wildlife and conservation in the class rooms and the same teachers kill animals and let the students dissect them in the laboratories ignoring the concept of biodiversity conservation. As zoologists every one of us should contemplate whether animal dissection is a process of learning or skill development? Most of the zoology teachers accept that from the skill development point of view also, dissection is no more relevant.

The Amphibians are also caught, killed and preserved for Research programmes on systematic studies. In order to find out the impact of pesticides number of amphibians are also sacrificed. Thousand of Amphibians were also preserved and exhibited in the Museums for the purpose of education, knowledge and training in the Curriculum which also resulted in the reduction of populations.

Dissections and Experiments in Education/Research and preservation in museums is one of the causative factors in the decline of amphibian populations.

The trapping, collection and killing of animals has a significant environmental impact. This will damage the ecosystem. Removal of frogs from the wild habitat results in increase in insect populations. Respect for life, mortality, death and dying are considered as ethical issues.

Zoology, Botany, Life science, Biology, Biochemistry, Biotechnology ,Pharmacy, Medical and Veterinary Teachers , Students, Scientists ,Research scholars , Animal Ethics Committee members ,Animal Welfare Activists, and Non Governmental Organizations must know the Animal Protection Laws which would include Constitutional Law, Central and State Acts, Rules, Regulations and bye-laws, Notification and Government orders. Ignorance of these laws and regulations is not an excuse by the persons who involved in killing the amphibians and other animals for dissection , experimentation , species identification and museums.

In view of the aforesaid facts, this article is published in order to prevent the further loss of Amphibians and other animals used for dissection and experimentation in education .Continuous education must be provided to all the aforesaid stakeholders regarding revisions and amendments of Laws.

### **The Constitution of India, Section 51A (g)**

The Constitution of India, Section 51A (g) requires from its citizens as a fundamental duty: “it shall be the duty of every citizen of India to protect and improve natural environment including forests, lakes, rivers and wildlife, and to have compassion for all living creatures’.

Constitution day also known as Samvidhan Divas is celebrated in India on 26 November every year to commemorate the adoption of Constitution of India. On this constitution day we reiterate our pledge to always uphold the Constitution of India.

### **The Prevention of Cruelty to Animals Act, 1960**

The Prevention of Cruelty to Animals Act, 1960 states in Section 17(2)d & (f): “that experiments on animals are avoided wherever it is possible to do so; as for example in medical schools, hospitals, colleges and the like, if other teaching devices such as books, models, films and the like may equally suffice’.

### **Indian Wildlife (Protection) Act, 1972**

The aquatic frogs (Dicroglossidae) are given legal protection under Schedule IV Indian Wildlife (Protection) Act, 1972. As per this Law collection,

killing and preservation of amphibians without permission from the Chief Wildlife Warden is punishable offence.

**Grant of permit for special purposes:-**

Notwithstanding anything contained elsewhere in this Act, it shall be lawful for the Chief Wildlife Warden, to grant a permit, by an order in writing stating the reasons therefore, to any person, on payment of such fee as may be prescribed, which shall entitle the holder of such permit to hunt, subject to such conditions as may be specified therein, any wild animal specified in such permit, for the purpose of, –

- (a) education; (b) scientific research; scientific management;

**Grant of permit for special purpose:–**

The Chief Wild Life Warden may with the previous permission of the State Government, grant to any person a permit to pick, uproot, acquire or collect from a forest land or the area specified under section 17A or transport, subject to such conditions as may be specified therein, any specified plant for the purpose of

- (a) education; (b) scientific research.,

**Prevention and Detection of Offences**

**50. Power of entry, search, arrest and detention.** - (1) Notwithstanding anything contained in any other law for the time being in force, the Director or any other authorised by him in this behalf or the Chief Wildlife Warden or the authorised officer or any forest officer or any police officer not below the rank of a sub-inspector may, if he has reasonable grounds for believing that any person has committed an offence against this Act, require any such person to produce for inspection any captive animal, **wild animal**, animal article, meat, [trophy, uncured trophy, or any specified plant or part or derivative thereof] in his control, custody or possession, or any license permit or any other document granted to him or required to be kept by him under the provisions of this Act;

It shall be lawful for any of the officers referred to in sub-section (1) to stop and detain any person, whom he sees doing any act for which a licence or permit is required under the provisions of this Act, for the purposes of requiring such person to produce the licence or permit and if such person fails to produce the licence or permit, as the case may be, he may be arrested without warrant, unless he furnishes

his name and address, and otherwise satisfies the officer arresting him that he will duly answer any summons or other proceedings which may be taken against him.

Any person detained, or things seized under the foregoing power, shall forthwith be taken before a Magistrate to be dealt with according to law.

Any person who, without reasonable cause, fails to produce anything which he is required to produce under this section, shall be guilty of an offence against the Act.

Notwithstanding anything contained in any other law for the time being in force, any officer not below the rank of an Assistant Director of Wildlife Preservation or Wildlife Warden shall have the powers, for the purpose of making investigation into any offence against any provision of this Act.

**51. Penalties.** - (1) Any person who [contravenes any provisions of this Act [except Chapter VA and section 38J]] or any rule or order made thereunder or who commits a breach of any of the conditions of any licence or permit granted under this Act, shall be guilty of an offence against this Act, and shall, on conviction, be punishable with imprisonment for a term which may extend to [three years] or with fine which may extend to [twenty five thousand rupees] or with both.

Provided that where the offence committed is in relation to any animal specified in Scheduled I or Part 11 of Sch. 11, or meat of any such animal, animal article, trophy, or uncurled trophy derived from such animal or where offence [relates to hunting in, or, altering the boundaries of] a sanctuary or a National Park, such offence shall be punishable with imprisonment for a term which shall not be less than [one year] but may extend to six years and also with fine which shall not be less than [five thousand rupees]<sup>11</sup>

[Provided further that in the case of a second or subsequent offence of the nature mentioned in this sub-section, the term or imprisonment may extend to six years and shall not be less than two years and the amount of fine shall not be less than ten thousand rupees.]

Such cancellation of licence or permit or such forfeiture shall be in addition to any other punishment that may be awarded for such offence.

The Wildlife (Protection) Act, 1972 Chapter V Trade or Commerce in Wild Animals

Animal articles and Trophies 39. Wild Animal etc., to be Government Property. 42. Certificate of ownership-The Chief Wildlife Warden may, for the purpose of Section 40, (Declaration) issue a certificate of ownership in such form, as may be prescribed, to any person who, in his opinion, is in lawful possession of any wild animal or any animal article, trophy or uncured trophy, and may, where possible, mark, in the prescribed manner, such animal article, trophy or uncured trophy for the purpose of Identification.

The University Grants Commission asked to surrender immediately to the Environment and Forest department in case University/College has procured any animal protected under the Wildlife (Protection) Act, 1972. Further it is also mentioned that no fresh purchase of preserved animals specimens be made. (Letter No.F14-4/2006(CPP-II))

Forest officials arrested three persons and detained one Tata Mobile vehicle for allegedly involved in catching frogs at Gaonkarwado-Usgao on June 7 at about 12.30 pm. According to reports, arrested ones were checked and the police recovered 70 frogs from them. They have been arrested under Wildlife (Protection) Act, 1972. Frogs are in demand in many restaurants and hunting is done specially during the monsoon (Down to Earth, 08/06/2008).

Following reports of dissection of frogs at Christian Medical College (CMC) without the permission of the chief wildlife warden, a team of officials from the district forest office raided the college premises. The District forest officer (DFO) said frogs were found on the premises and the college authorities did not have permission to dissect these. (*Tribune India*, 30 September 2009). *Euphlyctis hexadactylus* and *Hoplobatrachus tigerinus* are listed on Appendix II of CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora. This species is also included under the International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species.

In pursuance of the judgement of the Hon'ble High Court of Delhi in CWP NO.139/96 dated 19.5.1995 dissection of animals has been made optional to the students of Senior Secondary stage and the existing syllabus of biology for classes XI and XII to be modified to include alternate activities/experiments. Notification -PART -II SECTION 3 SUB SECTION (ii) OF THE GAZETTE OF INDIA). Government of India, Ministry of Human Resource Development (Department of Education) New Delhi, 20<sup>th</sup> January 1998. In view of this, the practical syllabus in



Biology of Classes XI and XII stands modified in so far as dissection of animals is concerned. The Central Board for School Education (CBSE) had decided to stop with immediate effect all dissection of animals in biology practicals in the senior school curriculum from March 2002.

In 2006 the University Grants Commission, New Delhi has requested all the Universities and Colleges to ensure the strict adherence to the provisions of the Wildlife(Protection) Act,1972 while procuring animals or their use in laboratories. The Ministry of Environment and Forest ,New Delhi has issued guidelines to stop experimentation on animals for training undergraduate and post-graduate students in colleges(April 18 2012 IANS). The guidelines were issued to the Medical Council of India (MCI), Pharmacy Council of India (PCI) and University Grants Commission(UGC).

The University Grants Commission has issued the Notification, No.F.14-6/2014 (CPP-II) dt 1<sup>st</sup> August 2014 under section 12(j) of UGC Act, 1956 urging all the Universities to stop dissection of animals at undergraduate and postgraduate levels.

The Additional Secretary, Ministry of Environment and Forests, New Delhi in the letter D.O.No.25/516/2010-AWD dt 21<sup>st</sup> February 2014 addressed to the Additional Secretary, Ministry of Human Resource Development, Department of School Education & Literacy, New Delhi informed “Since dissection of animals has been discontinued at the school level, there is no justification for using animals in the training of teachers in B.Ed., colleges. The use of animals in the syllabus of NTCE(National Council for Teacher Education ) affiliated colleges needs to be discontinued, if it has not been done already.”

THE GAZETTE OF INDIA : EXTRAORDINARY [PART III—SEC. 4]

**PHARMACY COUNCIL OF INDIA NOTIFICATION** New Delhi, the 25th August, 2014

**No.10-1/2012- PCI (Pt-I).**—In exercise of the powers conferred by Section 10 of the Pharmacy

Act, 1948 (8 of 1948), the Pharmacy Council of India, with the approval of the Central Government further amends the principal Regulations called the “Education Regulations, 1991” as under –

“ 1. **Short title and commencement**—

(1) These regulations may be called the Education (Amendment) Regulations, 2014.

(2) They shall come into force on the date of their publication in the Official Gazette.

2. In **Appendix-B** to the principal Regulations, under the heading (A) ACCOMMODATION, the

following two sentences shall be added at the end of last para –

“Wherever animal experimentations are prescribed in the curriculum, the required knowledge and skill should be imparted by using computer assisted modules. Animal hold area shall be as per the Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA) guidelines.”

**MEDICAL COUNCIL OF INDIA NOTIFICATION** New Delhi, the 18th March, 2014

**No. MCI-34(41)/2013-Med./64022.**—In exercise of the powers conferred by Section 33 of the Indian Medical Council Act, 1956 (102 of 1956), the Medical Council of India with the previous sanction of the Central Government hereby makes the following regulation.

In Clause A.1.9 the heading “Animal House” will be substituted as under:—

“For teaching Physiology and Pharmacology in UG curriculum, the required knowledge and skills should be imparted by using Computer Assisted modules. Only an animal hold area, as per CPCSEA Guidelines, is required.”

The aforesaid Animal Protection Laws played a significant role as an effective tool to conserve the Amphibians. In view of the existing laws and Notifications the Educators stopped dissecting the Amphibians in colleges and universities. Animal protection organizations and conservationists can make use of these animal protection legislation as a powerful tool in their efforts to safeguard the animals.

It is hoped that the present article will disseminate and enrich the knowledge on Legal Protection to Amphibians in India, to all the stakeholders.

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## SIGHTING RECORDS OF INDIAN MONITOR LIZARD (*VARANUS BENGALENSIS*) IN KANCHEEPURAM DISTRICT, TAMIL NADU

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### **Abstract**

A one year survey was conducted in Kancheepuram district of Tamil Nadu to record the presence of Indian monitor lizard (*Varanus bengalensis*). During the survey, a total of 10 direct live sightings of the target species were obtained. A range of microhabitats and habitat types were associated with the sightings of these lizards. The survey highlights the importance of frequent and active monitoring of large and predatory animals that suffers from poaching. The findings underscore the roles that such flagship species play in protecting a human-dominated peri-urban to rural landscape having a mix of protected and unprotected areas and habitats.

**Key Words** : Irulas, Indian Monitor lizard, Conservation, GPS Locations

### **Introduction**

Many species of animals are exploited for their flesh, skin and so on, due to their purported medicinal value or as an ingredient in food by the common hunter gatherer communities like tribals, around the world. Monitors are the world's largest lizards. They are found throughout Asia, Australasia and Africa, mainly in tropical and subtropical regions. Of the 35 species in the world four species are found in India. The Indian monitor (*Varanus bengalensis*) is the commonest and is found all over the country (Daniel, 2002; Das, 2002). These lizards are carnivores and feed by active hunting and scavenging, on a wide range of prey and carrion (Daniel, 2002). This species breeds mostly during the wet season from June to October. Eggs are laid in burrows, dead logs or even in termite mounds, to give the offspring

a greater chance of survival. Young monitors feed only on insects and normally find shelter in trees. The siblings are likely to stay in a group together for the first few months of life. Adult lizards sometimes take shelter in burrows or crevices in rocks and even in buildings (Daniel, 2002; Das, 2002).

In India, monitors are placed under Schedule I of the Wildlife Protection Act (1972) thus making them categorized in the endangered list. But the common monitor has been assessed as least concern by the IUCN Red list category. Native tribal communities believe it to have medicinal properties. In India, products derived from the Common Monitor are used to treat a variety of ailments that include hemorrhoids, rheumatism, body pain and burns, as well as spider and snake bites. They are also used as a cure for arthritis (Alves *et al.*, 2008; Padmanabhan and Sujana, 2008). Fat and meat of these lizards as well as their skins are all highly priced in the illegal animal trade (Norman 1987).

The establishment and management of protected areas such as reserve forests have provided refuge for these lizards in various parts of Tamil Nadu but still there is also a large population outside these areas that needs to be protected for long term conservation (Subramanean & Reddy, 2012). They can be conserved and protected by restoration of habitats, as in the case of Tholkappiar poonga in Chennai. Reserve forests are primarily associated with small hillocks like Nanmangalam and are important habitats for the monitor lizards. The general distribution and biology of Indian reptiles is well documented (Daniel, 2002; Das, 2002; Tikader & Sharma, 1992) but the recent trends in urbanization have influenced the herpetofauna assemblages including monitor lizards for which there is no base line information. Without Monitors there will be a major imbalance in the ecosystem leading to overpopulation in the prey species. The present survey of monitor lizards was done to find out the status of monitor lizards in Kancheepuram region.

### **Study Area**

Kancheepuram district is located in Northern Tamil Nadu with an area of 4,393 km<sup>2</sup> and lying between 11° 12' - 12° 00' N and 77° 28' to 78° 50' E is a fast-developing countryside just adjoining the Chennai city. The areas of Northern kancheepuram district that were surveyed include Tambaram taluk (Kottaimedu, Mambakam), Oragadam, Pallikaranai, Thirukazhukundram and Vadanemmeli, Sriperumbudur taluk (Karisangal, Malaipedu, Parandai, Sriperumbudur and Vadakkal) Madhuranthagam taluk (Kattukoodalur) Kancheepuram taluk

(Euthukadu, Ponneri, Punnavakkam, Thatchur and Wallajabad), Chengalpattu taluk (Kunrathur, Kuruvanmedu, Mettupalayam, Palur, Thatchumedu, Vadagupattu, Venkatapuram) (Table 2).

### **Materials and Methods**

Field surveys were conducted by the author along with Irula tribal field assistants. The team visited the various sites in the study area during April 2010 – March 2011, for one year. These lizards were sampled using visual encounter survey method involving searching of lizards in each of the habitat, recording all visible animals on the surface. Traditional ecological knowledge of the accompanying Irula tribal was extensively used for establishing the presence and locating the monitor lizards. Lizards were located only when they were active, during the daytime. Line transects of 1 Km length were marked in each of these habitats to document presence and absence of the study species that is monitor lizards.

### **Results and Discussions**

A total of 10 sightings of Indian monitor lizards were made. During the course of the survey in the Kancheepuram district, Indian monitor lizards were recorded in several places across a variety of habitats. The locations where the monitor lizards were sighted include Oragadum, Kattu koodalur, Thatchur, Palur, Kuruvan medu, Sriperumbudur and Kunnathur. Monitor lizard-recorded habitats comprise of rocky outcrops and hillocks surrounded by Reserve forests, Secondary degraded forests, coastal vegetation near the sea shore, Scrub jungles, tree plantations of both exotic and native species, abandoned building and paddy fields. All the study sites where the monitor lizard was recorded were rich in biodiversity, indicating its role as a flagship species of reptile for this region. These lizards were recorded in a variety of microhabitats such as burrows, rock boulders, under Eucalyptus trees in Reserve forests, Phoenix bushes, bushes on roadsides, sandy banks of Palar river bed, lake bund and its vegetations. Most of them were found to be active in the morning. On some of the occasions monitor lizards were found in pairs. A few females were found to be gravid.

But a large population of these lizards living even outside these hilly tracks also need to be protected from poaching. The establishment and management of new protected areas where this species can be protected from hunting is needed to provide refuge sites from persecution. Protection of these places could lead to long term conservation and protection of monitor lizards.

**Table 1.** Details of monitor lizard sightings in the study area

Sl.	Location & GPS points of sighting	Taluk	Sex	Size	Microhabitat	Activity when seen
1	Oragadam 12 ° 37' 31.1 " N 80 ° 03 ' 25.8 " E	Tambaram	M	Adult	Burrows of Rocks under a Eucalyptus tree base	Moving
2	Oragadam 12 ° 37' 31.1 " N 80 ° 03 ' 25.8 " E	Tambaram	F	Adult	Burrows of Rocks under a Eucalyptus tree base	Moving
3	Kattu koodalur 12 ° 26' 52.1 " N 79 ° 47 ' 46.4 " E	Maduranthakam	M	Adult	Phoenix bush	Foraging
4	Kattu koodalu 12 ° 26' 52.1 " N 79 ° 47 ' 46.4 " E	Maduranthakam	U	Adult	Phoenix bush	Foraging
5	Thatchur 12 ° 47' 54.92 " N 79° 49' 54.92" E	Kancheepuram	F	Adult	Bush on Road side	Basking
6	Palur 12° 45' 35.7 "N 79° 54' 34.5 " E	Chengalpattu	M	Adult	Track in the sand PalarRiver bed	Moving
7	Palur 12 ° 45' 23.3" N 79° 54' 56.7" E	Chengalpattu	F	Adult	Track in the sand, Palar River bed	Moving
8	Kuruvan medu 12° 47' 12.4" N 79° 57' 17.3 " E	Chengalpattu	F	Adult	Lake bund	Moving
9	Kunnathur 12 ° 47' 21.5 " N 79 ° 57 ' 41.8 " E	Chengalpattu	F	Adult	Vegetation in lake bund	Moving
10	Sriperumbudur 12° 54' 30.7" N 79° 55' 46.1 " E	Sriperumbudur	U	Adult	Vegetation	Moving

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## KARYOTYPIC ANALYSIS OF GREEN FROG (*EUPHLYCTIS HEXADACTYLUS*) AND COMMON TOAD (*DUTTAPHRYNUS MELANOSTICTUS*)

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**Abstract:** We studied the number, size, shape and bands of the chromosome i.e., karyotype of the toad *Duttaphrynus melanostictus* and the frog *Euphlyctis hexadactylus*. Slides showing the karyotype of the frog and toad were prepared using the flame dry method. Well spread metaphase plates were identified and photograph was taken and the length of the chromosomes were measured. Since the chromosomes of *D. melanostictus* were viewed in the metacentric stage both the long arm and short arm seems equal in length. The length of arms ranges from 0.4 to 0.65  $\mu\text{m}$ . The arm ratio was calculated as 1 for all the chromosomes followed by centromeric index 0.5 and morphological index ranged between 0.8 and 1.3. Like *D. melanostictus*, *E. hexadactylus* was also seen in metacentric stage. The length of the arms ranged from 0.45 to 0.55  $\mu\text{m}$ . The arm ratio was also 1 for all the chromosomes. Centromeric index was 0.5 in all pairs of chromosomes and the morphological index ranged between 0.9 and 1.1.

**Key words:** karyology, frog, toad, aquatic, terrestrial, India.

### INTRODUCTION

Amphibians of India have received a great deal of research and conservation attention in recent years (see Biju, 2001). The new resurgence of interest reveals a greater richness and diversity is yet undocumented in this fauna totaling to nearly 400 species in India (Dinesh et al., 2017). This great variation in the number of species is due to identification problems, which has mainly based on the morphological characters in the past (e.g. Dutta, 1997; Biju 2001). Recently a lot of molecular

and genetic techniques have been deployed to bring out additional, undocumented cryptic diversity in Indian amphibian fauna (Dinesh et al., 2009).

In the field of applied cytogenetics chromosome Karyotyping plays an important role as a clinical diagnostic tool. This technique is a combination of chromosome number and morphology. In cell biology, Karyotyping of chromosomes can serve as an index to monitor homogeneity and stability of cultured cells. This is an important technique in the detection of cancer, since most cancer cells show increased number of chromosomes, chromosomal deletions and rearrangements. Genetic malformalities can be predicted by Karyotype analysis of foetal cells collected amniocentesis. For Karyotype analysis, cells are incubated for 2-4 hours in the presence of mitotic inhibitors like colchicin or vinblastine sulfate to accumulate highly condensed chromosomes. The cells are then swollen in hypotonic solutions, dried over slide and stained.

**Karyotype:** The number, size, shape and bands of the chromosomes of a somatic cell may be termed a karyotype. A photomicrograph of the chromosomes if a cell arranged in a standard pattern intended to be the representative of the individual as a whole. A scientific group from the National Center for Human Genome Research in Bethesda, has published a modification to traditional Karyotyping that permits rapid identification of chromosomal alterations. These findings are of the ability to detect altered chromosomes is increasingly important for pre and postnatal diagnostics in cancer and other diseases. This recent tool is termed as “Spectral Karyotype”. The traditional process for Karyotyping involves adding a dye to metaphasic chromosomes. Different dyes that affect different areas of the chromosomes are used for a range of identification purposes. One common dye used is Giemsa, that process is known as G – banding. This dye is effective because it markedly stains the bands on a chromosome. Each chromosome can then be identified by its banding pattern, but the result is similar overall gray values for each chromosome.

The subsequent Karyotyping methods introduced by Schrock et al., (1996) use fluorescent dyes that bind to specific regions of chromosomes. By using a series of specific problems each with varying amounts of the dyes different pairs of chromosomes have unique spectral characteristics. The unique feature of the technology is the interferometer similar to ones used by astronomers for measuring light spectra emitted by stars. Slight variation in colour, undetectable by the human eye, are detected by a computer programme that then reassigns easily to distinguish colour to each pair of chromosomes. The result is a digital image rather than film



in full colour. Pairing of the chromosomes is simpler because homologous pairs are the same colour. Aberrations and cross-overs are more easily recognizable. In addition the spectral Karyotype has been used to detect translocations not recognizable by traditional banding analysis.

Recently, for Karyotyping, fluorescent dyes were added to the chromosomes. An interferometer filtered the emitted light, sending a signal to a camera that created a digital image. For fluorescent dyes that have overlapping spectra, such as the display colour can still be quite similar. Although to the human eye these appear to be the same colour, subtle differences in their wavelengths can be detected by the interferometer. As long as the spectral values for the display colours of the chromosomes differ by at least 6-15 nm, chromosomes can be distinguished from one another based on their spectra. With the spectral characteristics of each pair of chromosome characterized the computer assigns new colours to the different chromosomes. By recolouring the chromosomes, the problem of overlapping emission spectra is resolved. These new colours are referred to as classification colours because they enable classification of the chromosomes into a karyotype. On the other hand, Karyotypic analysis has provided little assistance in taxonomic resolution because of the well-known stability in diploid number, relative chromosomal lengths and morphology.

The development of cytogenetic studies on amphibians is mainly due to improved procedures for obtaining cytological preparations as well as to new techniques for differential chromosome staining. Squashing-or spreading-fixed cells two direct methods developed in early studies of amphibian cytogenetics, are commonly used in Brazil due to their easy and rapid execution and low cost. However, these methods have some limitations such as a low mitotic index and poor quality of metaphase chromosomes that are generally too condensed or overlapped. These characteristics present good resolution of banding patterns, which are indispensable in current cytogenetic studies.

Another important point is that contrary to warm-blooded mammals, birds and amphibian chromosomes as well as those of fishes and most reptiles generally do not display multiple achromatic bands when submitted to the usual G, Q or R banding procedures. A possible explanation is based on the high homogeneity of DNA base pair composition, which cannot be compartmentalized into AT-rich, GC-rich bands as in other vertebrates (Medrano, et al, 1988, Schmid, et al, 1990). Nevertheless, it has been shown that good longitudinal chromosome differentiation in cold-blooded

vertebrates including fish, amphibian and lizard groups, may be obtained with incorporation of 5-bromodeoxyuridine (Brdue) during DNA replication following in-vivo or in vitro treatments (Schempp and Schmid, 1981; Kuro-o, et al, 1986; Kasahara, et al (1987); Almeida-Toledo, et al, (1988); Yoneneaga- Yassuda et al, (1988). Although both procedures have been successfully used in vitro treatment during cell culture is advantageous for better control of BrdU treatment.

In order to improve the cytogenetic analysis of anuran specimens mainly regarding induction of BrdU replication banding, the lymphocyte culture has been standardized. Generally works in Karyotypic analysis of toads and frogs is meager.

Hence the present study aimed to

- Carry out karyotype analysis in one common Indian species of frog and toad
- Study the chromosome number and the length of long arm and short arm and to know the stage of chromosome viz., metacentric submetacentric, subtelocentric and telocentric.

## MATERIALS AND METHODS

**Collection of frogs and toads:** In the present study Green Frog (*Euphlyctis hexadactylus*) and the Common Indian Toad (*Duttaphrynus melanostictus*) were selected for chromosomal banding analysis. Young and healthy frogs and toads were collected from ponds and paddy fields in the surroundings of Mayiladuthurai and Mannampandal, in eastern Tamil Nadu. The animals were then maintained in the laboratory and acclimatized to lab conditions. The water was changed daily in order to remove the excretory materials and to provide a hygienic environment. Frogs and toads were fed with earthworms during the period of study.

### Preparation of Karyotype from Metaphase plates

Well spread metaphase plates was identified in the slides. A good photograph was taken at 100 X magnification. Occlumeter was used during photography. Karyometrical analysis was done in the following manner.

Each individual chromosome is numbered at random initially

Following measurements were done

- a. Length of the long arm (p)
- b. Length of the short arm (q)
- c. Arm Ratio  $\textcircled{R} = q/p$
- d. Centromeric index  $\textcircled{C} = p/p + q$
- e. Morphological index (M) =  $p(p+q) / q$
- f. The following table to determine the group organization of the chromosomes was interpreted as the arm ratio  $\textcircled{R}$  value.

'r' value	Type
- 1.7	(m) metacentric
- 3.0	(sm) sub-metacentric
- 3.7	(st) sub-telocentric
3.7 - $\alpha$	(t) telocentric

### Chemical preparation for chromosomes

Colchicin (0.05%), KCl (or) Sodium citrate (1%), Aceto-alcohol (1:3), Phosphate buffer (pH 7.2), Myers albumin, Acetic acid (45%), Ferrous aluminum sulfate (3%), Ethanol (50%), Heirs haemotoxyling Solution (1%), Picric acid (1%) and Giemsa Staining Solution were used for the chromosome preparation.

## RESULTS

### Chromosome description of the common toad *Duttaphrynus melanostictus*

In the present study karyotype of the toad *D. melanostictus* showed 11 pairs of chromosomes. The chromosomes were viewed in the metacentric stage and both the long arm and short arm were of equal length (Fig.3). The length of the long arm and short arm of the first four pairs of chromosomes were 0.55  $\mu\text{m}$ . The fifth and sixth pairs were little longer than the first four pairs and the length of the both

arms were 0.65  $\mu\text{m}$ . The long arm and short arm length of seventh, eight, ninth and tenth chromosome of chromosome was shorter than all the pairs having a length of 0.4  $\mu\text{m}$ . The arm ratio was 1 and same for all the eleven pairs of chromosomes. The centromeric index was calculated as 0.5 for all the 11 pairs of chromosomes. Morphological index was 1.1 for the first four pairs, 1.3 for fifth and sixth pair, 1, 0.9, 1.1, 1.3 and 0.8 for the seventh eighth, ninth, tenth and eleventh pair of chromosomes respectively (Table.1).

**Table:1 Karyometric analysis of *Duttaphrynus melanostictus* at 200 x Magnification**

Chromosomes measurements & indices	Chromosome pair										
	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>	6 <sup>th</sup>	7 <sup>th</sup>	8 <sup>th</sup>	9 <sup>th</sup>	10 <sup>th</sup>	11 <sup>th</sup>
Length of the long arm (p) ( $\mu\text{m}$ )	0.55	0.55	0.55	0.55	0.65	0.65	0.5	0.45	0.65	0.55	0.4
Length of the short arm (q) ( $\mu\text{m}$ )	0.55	0.55	0.55	0.55	0.65	0.65	0.5	0.45	0.65	0.55	0.4
Arm ratio (r) = q/p	1	1	1	1	1	1	1	1	1	1	1
Centromeric index (c) = p/q+q	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Morphological index (M) = P (P+q)/q	1.1	1.1	1.1	1.1	1.3	1.3	1	0.9	1.1	1.3	0.8

**Table:2 Karyometric analysis of *Euphlyctis hexadactylus* at 200 x Magnification**

Chromosomes measurements & indices	Chromosome pair												
	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>	6 <sup>th</sup>	7 <sup>th</sup>	8 <sup>th</sup>	9 <sup>th</sup>	10 <sup>th</sup>	11 <sup>th</sup>	12 <sup>th</sup>	13 <sup>th</sup>
Length of the long arm (p) (cms)	0.5	0.45	0.55	0.45	0.5	0.45	0.55	0.5	0.5	0.45	0.5	0.5	0.55
Length of the short arm (q) (cms)	0.5	0.45	0.55	0.45	0.5	0.45	0.55	0.5	0.5	0.45	0.5	0.5	0.55
Arm ratio (r) =q/p	1	1	1	1	1	1	1	1	1	1	1	1	1
Centromeric index (c) = p/q+q	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Morphological index (M) = P (P+q)/q	1	0.9	1.1	0.9	1	0.9	1.1	1	1	0.9	1	1	1.1

### Chromosome description of the pond frog *Euphlyctis hexadactylus*

In *E. hexadactylus* as against *D. melanostictus* 13 pairs of chromosomes were observed. Like *D. melanostictus* the chromosomes of *E. hexadactylus* were viewed in the metacentric stage (Fig.4). First, fifth, eighth, ninth, eleventh and twelfth chromosome pairs had the same length of 0.5  $\mu\text{m}$  followed by second fourth, sixth and tenth chromosome pairs with a length of 0.45  $\mu\text{m}$  and third, seventh and thirteenth chromosome pairs were of 0.55  $\mu\text{m}$  length. The arm ratio was same for all the 13 pairs of chromosomes. Centromeric index was calculated as 0.5 for all the chromosome pairs. Morphological index for first, fifth, eighth, ninth, eleventh and twelfth chromosome pairs were 1 followed by second, fourth, sixth and tenth chromosome pairs were 0.9 and third, seventh and thirteenth chromosome pairs were 1.1 respectively (Table : 2).

### DISCUSSION

Sexual dimorphism is widespread in the animal kingdom and the amphibians are no exception. It has been reported in amphibians as secondary sexual characters among anurans from China (Liu, 1936), hylid frogs in tropical America (Duellman, 1970) and among a few genera of Ranids from tropical evergreen forests of South India Inger, et al, (1984). Similarly, sexual dimorphism in size in *Rana temporalis*

[*Indosylvirana* spp.] has been reported by Boulenger (1920) but it poses a problem when individuals have to be sexed using just one or a few morphological criteria.

An important aspect of the chromosomal studies is to identify the six of chromosomal complements and in amphibians, this issue has been many interesting conflicts and remains unresolved. The earlier reports of morphologically identifiable heteromorphic sex chromosome pairs in some anurans are in need of reconfirmation. The paucity of genetic information in other amphibians makes the trends of amphibian evolution open to question.

Among the Apoda, the karyotype of only 4 species *Icthyophis beddomei*, *Uraeotyphlus narayani*, *U. menoni* and *Gegenophis carnosus*, have been recorded. This group exhibits the maximum number of chromosomal complements. The chromosome numbers of the sole species of Caudata, *Tylotriton verrucosus*, has been recorded. Although, the anurans have been widely utilized for experimental and educational studies, only three Bufonids, four Microhylids, one Rhacophorid and five Ranids have been karyotypically investigated. It is noteworthy that *Microhyla ornata* in India shows a higher chromosomal number ( $2n=26$ ) than in China ( $2n=24$ ), Prakesh (1998).

From the evolutionary point of view order Chiroptera occupies an important position among the eutherian mammals, because of their cosmopolitan distribution in wide variety of ecological conditions, Anderson and Jones (1967). Findley (1972) and Laval (1973) have given ample information on the ecology, natural history and behavior of bats, but their systematic and phylogeny are poorly understood. However, the neotropical species have been reviewed and their phonetic relationships, on a worldwide basis have been studied. More than 200 species of birds with the representatives of almost all the families of the order have been karyotyped. Much light could not have been shed on their intragenetic and intraspecific relationships due to the conservation exhibited by their karyotypes. Emphasis has been given on the G and C-banding study, which may permit a more insight analysis of the congeneric variations exhibited by the chiropteran karyotypes (Patton and Baker, 1978; Bickham, 1979). Choudhury and Patro (1985) reported using G banding technique in Indian microchiroptera that the autosomes in both the sexes were identical except for the pair of sex chromosomes XX female and XY male.



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## **FALLEN LOGS IN WATERBODIES AND THEIR IMPORTANCE FOR AQUATIC REPTILES – A PRELIMINARY STUDY FROM NORTHERN INDIA**

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Being cold-blooded animals, aquatic reptiles use shore line terrestrial proximity and islands for basking. If rocky outcrops are visible above water level, their part exposed above water is also used for basking. If fixed or floating wooden logs are present in a water body, their exposed parts are used for resting and basking. While surveying in various wild habitats, I had many opportunistic observations on wooden logs as such substrates, as presented below:

Table 1 : Use of fallen logs by the aquatic reptiles

S. No.	Location	*Type of habitat	Area surveyed	Date of observation	Species seen using the log for resting and basking	Details of the log and use pattern		
						Orientation of log	No. of sites used	Total no. of animals seen on the log
1	Diphu river, Kaziranga National Park, Assam	1	Appx. 500m stretch	13.12.2018	Assam roofed turtle ( <i>Panshura sylhetensis</i> )	Horizontal, fixed	4	12
2	Fateh Sagar, Udaipur, Rajasthan	2	Appx. 200m stretch of shore line	9.11.1998	Indian sawback ( <i>Kachuga tecta</i> )	Oblique, fixed	3	7
3	Karnakabas anicut, Tiger Project Sariska, Rajasthan	2	Whole anicut (Area appx. about 3ha)	14.8.2010	Checkered keelback ( <i>Xenochropis piscator</i> )	Oblique, fixed	1	2
4	Brahmnath Anicut, Tiger Project Sariska, Rajasthan	2	Whole anicut (Area appx. about 0.50 ha)	16.8.2010	Checkered keelback ( <i>Xenochropis piscator</i> )	Horizontal, floating	1	1
5	Pond of Hama village, Bhilwara, Rajasthan	2	Whole pond (Area appx. about 1ha)	9.3.2018	Indian mud turtle ( <i>Lissemys punctata</i> )	Oblique, fixed	1	3
6	Pond of Mukundgarh village, Bhilwara, Rajasthan	2	Whole pond (Area appx. about 1ha)	29.1.2016	Indian mud turtle ( <i>Lissemys punctata</i> )	Oblique, fixed	1	3

7	Jawai Dam (near Sena village), Pali district, Rajasthan	2	Appx. 500m shore line stretch	25.12.2016	Indian mud turtle ( <i>Lissemys punctata</i> )	Oblique, fixed	1	1
8	Beneshwar Dham (Confluence of Mahi, Jhakham and Som rivers)	1	Appx. 500m shore line stretch	20.11.2018	Checked keelback ( <i>Xenochropis piscator</i> )	Horizontal, fixed	1	2
9	Near Rajive Gandhi Gardian, Fateh Sager, Udaipur Rajasthan	2	Appx. 1000m shore line stretch	12.12.2016	Red eared turtle ( <i>Trachemys scripta</i> )	Horizontal, fixed	1	1
10	Baghdairrah pond, Udaipur District, Rajasthan	2	Appx. 50 ha area	28.12.2018	Checked keelback ( <i>Xenochropis piscator</i> )	Vertical, fixed	1	1
11	Braham Talab, Menar village, Udaipur district, Rajasthan	2	Appx. 50 ha area	27.12.2018	Indian mud turtle ( <i>Lissemys punctata</i> )	Oblique, fixed	1	2
12	Pangarh pond, Chittorgarh district, Rajasthan	2	Appx. 5 ha area	22.12.2018	Indian mud turtle ( <i>Lissemys punctata</i> )	Horizontal, floating	1	1

\*1= Fluvial water body, 2= Stagnated water body

Above table indicates that fallen wooden logs present in water bodies are important keystone resource for many reptiles, especially for turtles and checkered keelback snakes. This resource is very useful in both lotic and lentic ecosystems, which is used by the aquatic reptiles for resting and basking purposes. Besides reptiles, this resource is also shared as perching site by many bird species during daytime like Osprey (*Pandion haliaetus*), Darter (*Anhinga melanogaster*), Little cormorant (*Phalacrocorax niger*), Indian cormorant (*P. fuscicollis*), Great cormorant (*P. carbo*), Common kingfisher (*Alcedo atthis*), Stork-billed kingfisher (*Halcyon capensis*), White-throated kingfisher (*H. smyrnensis*), Pied kingfisher (*Ceryle rundis*) etc. Nymph of dragonflies also use this woods for their metamorphosis. Various types of moisture loving deciduous, semi evergreen and evergreen species are seen on the banks of perennial and semi-perennial streams, where they grow in the form of riparian strips. During flood condition, sometime trees of riparian strips uprooted owing to heavy bank erosion and starts drifting along with the water current. When water recedes, they stop flowing and entangled in some obstacle. Sometimes, heavy downpour in catchment area is also responsible for uprooting of trees and they also reach in downstream area with flowing water. Similarly, trees growing at shoreline of anicuts, dams, ponds and on their islands also uprooted due to effect of waves, flood and storms. Leaves and soft parts of the fallen tree face quick rotting but their hard woody part long last in the water in partially submerged fixed condition. The parts of fallen trees remain outside the water are used by the reptiles, birds and other life forms. Initially, bark of the stem and branches remains intact but in due course of time, it also lost due to decay and physical actions of the flood. Being bad conductor of heat, logs provide congenial sites to the aquatic reptiles for resting and basking..

Three orientations are seen in the aerial branches of the fallen logs, namely :

- (i) **Horizontal:** More or less parallel to the water surface, which are profusely used by the reptiles. The whole upper surface may be used for resting and basking (Fig.1).
- (ii) **Oblique:** Branches making an angle up to  $30^{\circ}$ - $40^{\circ}$  with upper surface of water are also used but their lower most part which is close to water, only is used. Distal part is avoided as climbing is not easy in this part of the branches (Fig.1).
- (iii) **Vertical:** Long vertical branches, emerging from water surface are of

no use as climbing is not possible on such branches, however, if a butt of a vertical branch is at water level or slightly emerging out of water surface, its tip may be used for resting and basking by the reptile (Fig.1).

If some wooden piece or plank is freely floating on the water surface, or entangled in some obstacle, may be used by the reptiles.

Many workers like Bhupathy et al. (1991), Bhatnagar and Mahur (2008), Yaseen et al. (2011), Sharma et al. (2014) and Shatma (2014) have studied aquatic reptiles of Rajasthan but importance of fallen logs in water have not described by them. To add the quality in aquatic habitats, logs present in water bodies should be retained at interval.

Assam is very rich state in biodiversity point of view. This state is rich in chelonian fauna also (Bhagabati et al. 2006). Assam has an extensive network of perennial rivers. Dotted logs should be retained in this network of streams to improve micro-habitat of the fluvial water bodies.

Scientific studies are needed to know the best locations, distance, orientation and other related aspects of logs to add quality to aquatic ecosystems for conservation of reptiles and other life forms.

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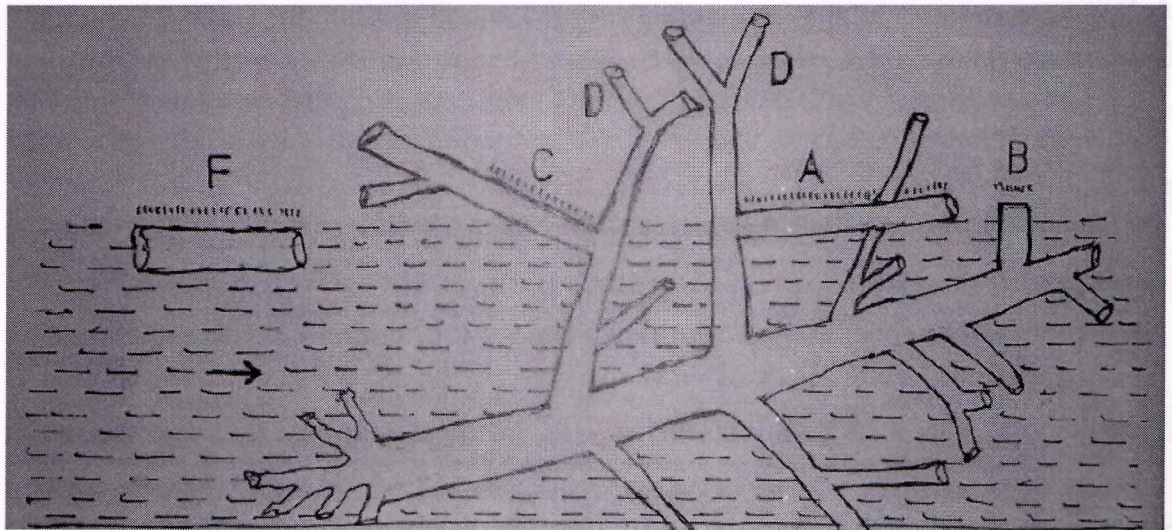


Fig.1: Fallen tree in the water touching the river bed making a “fixed log“. Towards left, a free floating log (F) is there which is not touching the bed of the stream.

A = Horizontal log,

B= Vertical log just emerging from the water level,

C= Oblique log,

D= Vertical log emerging from the water level but their end point is far away from the water

The barring area indicates the length of the log used by the aquatic reptiles for resting and basking

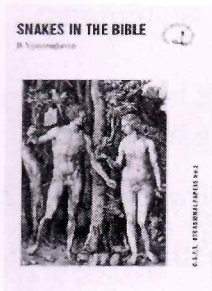
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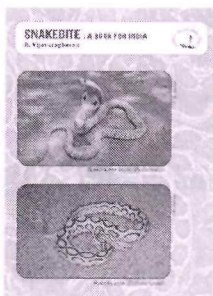
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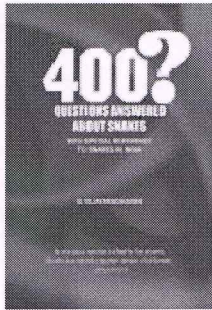
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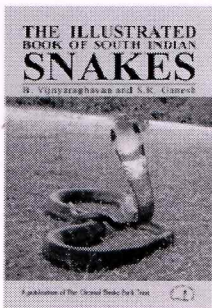


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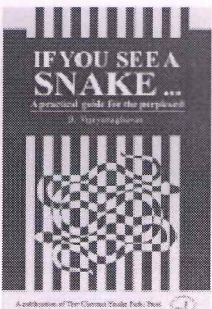


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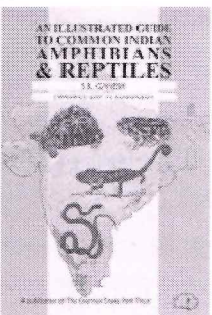


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