Workshop on "Ecological status of Dandeli Anshi Tiger Reserve"

(13^{th} - 15^{th} February, 2009)

Kulgi Nature Camp

Dandeli Anshi Tiger Reserve

Department of forest

Government of Karnataka.

AND

Energy and Wetlands Research Group

Center for Ecological Sciences,

Indian Institute of Science, Bangalore.

PREFACE

A three day workshop on “Ecological status of Anshi Dandeli Tiger Reserve” for capacity building of the forest department staff and young researchers was organized at Kulgi Nature Camp from 13th to 15th February 2009. The aim of the workshop was to provide hands on training in ecological field techniques to forest department staff from Dandeli Anshi Tiger Reserve and researchers from Energy and Wetland Research Group, Center for Ecological Sciences, IISc, Bangalore.

The workshop included training in field sampling for i) quantifying and characterizing trees, herbs and grasses (through transect based quadrats), ii) birds (through time constrained sampling), iii) amphibians (through time constrained sampling). In addition to these, techniques for physico-chemical characterization of water and usage of Geographical Position systems were demonstrated near Kulgi Nature Camp.

This report includes the protocol with data format for sampling vegetation, birds, amphibians, diatoms (Unicellular algae) and fishes from the freshwaters and also water quality analysis. Checklist of amphibians, birds and vegetation sampled during the workshop is also provided.

Mr. Vijay Mohan Raj (Deputy Conservator of Forest, Sirsi Division) and Mr. Manoj Kumar (Deputy Conservator of forest, Dandeli Anshi Tiger Reserve) highlighted the possible research opportunities for the better management of Dandeli Anshi Tiger Reserve. Annexure includes the list of tentative speakers for the proposed workshop to discuss the Action plan of Dandeli Anshi Tiger Reserve and also the list of possible research activities which can be taken up in the area.

INTRODUCTION

With 7% of world's flora and 6.5 % of the world's fauna spread across the 10 biogeographic zones of the nation, India constitutes one of the 10 mega biodiversity countries. The nation also boasts of two of the 34 biodiversity hotspots namely Western Ghats and Himalaya. The Western Ghats record the presence of 45 endemic plants and 73 endemic plants shared only with Sri Lanka. The Ghats form the catchment for 37 west flowing and three major east flowing rivers. With 60(%) of one of the two biodiversity hotspots of India namely the Western Ghats, Karnataka is one of the richest states of India in terms of total forest cover and has 21 wild life sanctuaries and 5 National Parks to its credit.

The District of Uttara Kannada (North Canara) - the greenest district of the state has three sanctuaries namely Dandeli Wild Life Sanctuary, Attiveri Bird Sanctuary, and Sharavathi Wild life Sanctuary and a national park (Anshi National Park). Out of the eight new tiger reserves approved by the Government of India in November 2008*, Karnataka received its fourth after Nagerhole, Bandipur and Bhadra. The Dandeli Anshi Tiger Reserve (875 sq.km) is constituted by Anshi National Park (250 sq.km, established 1987) and Dandeli Wild life Sanctuary (475 sq.km, established in the year 1956). The sanctuary includes small settlements like Kulgi, Kumbarwada, Gund, Ambikanagar,etc

*http://pib.nic.in/release/release.asp?relid=44799 accessed on 31-01-09.

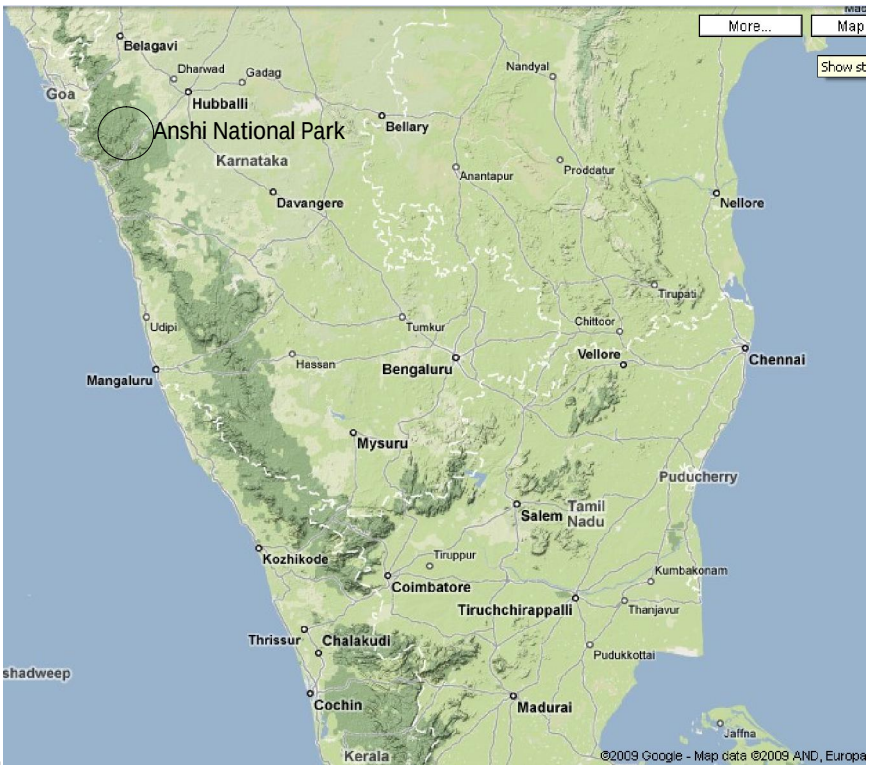


Fig 1: Geographical location of Anshi Dandeli Tiger Reserve. (Source: Google map)

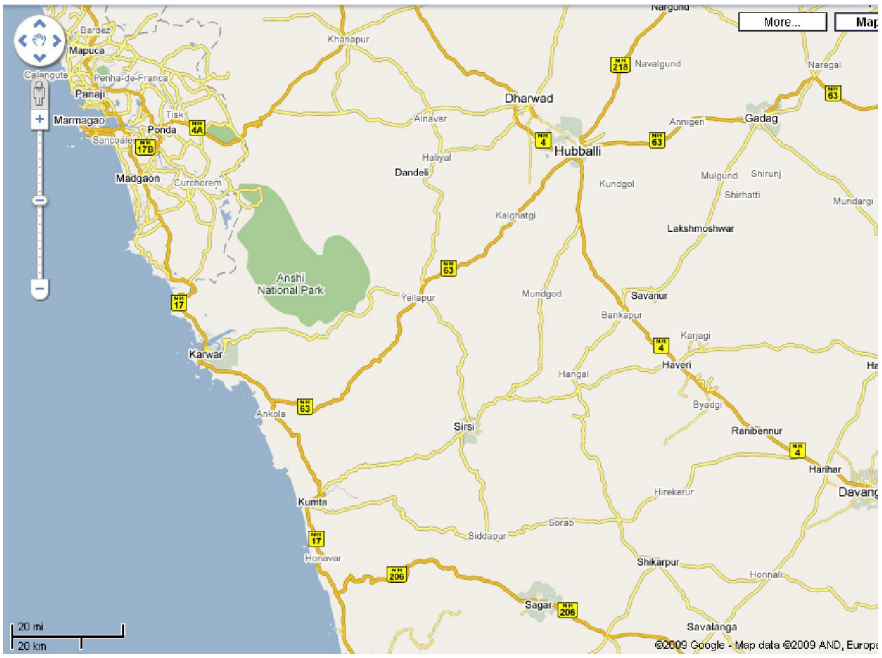


Fig 2. A: Location of Anshi National Park (Source: Google map)

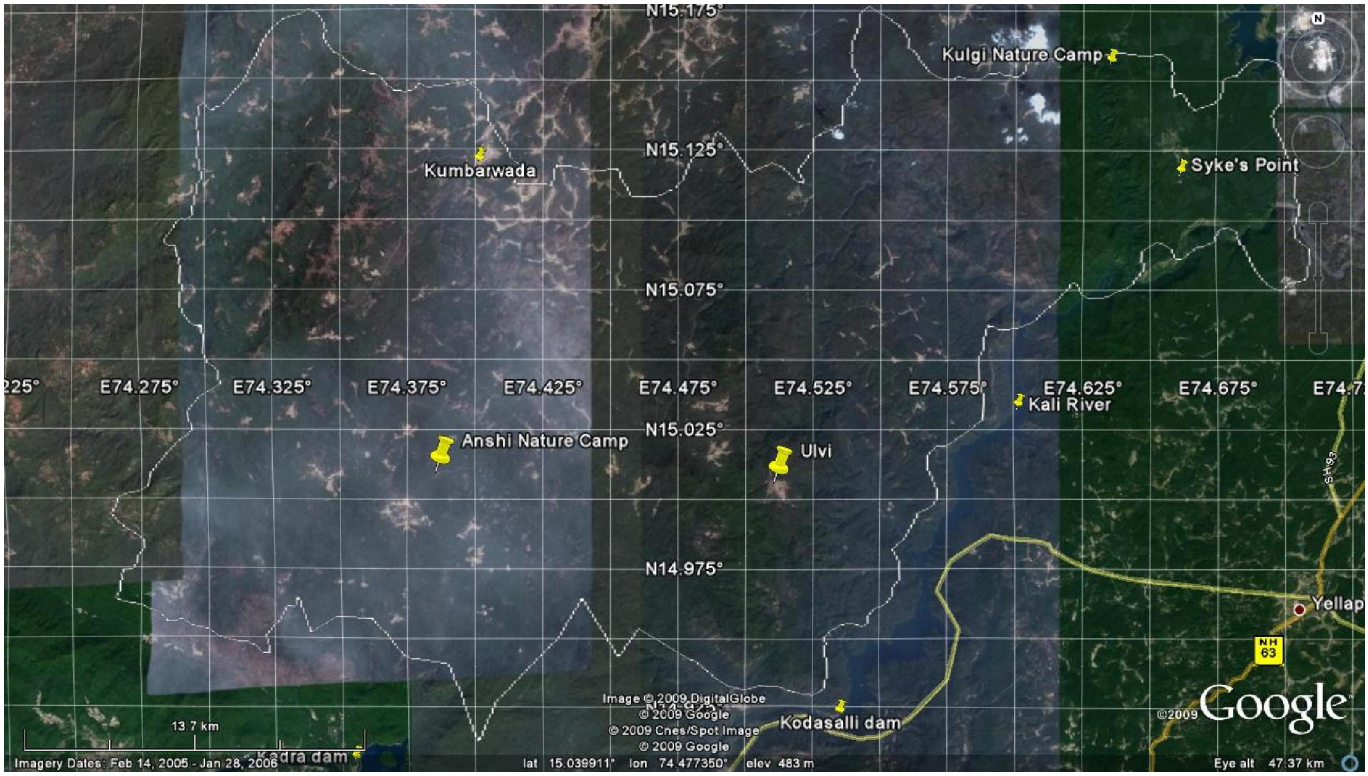


Fig. 2.B. Google Earth Image of Dandeli Anshi Tiger Reserve with prominent land marks

Protocols for assessing the ecological status

Ecological status assessment involves the investigations of both terrestrial and aquatic ecosystems. Table 1 lists the major components and methods for assessing ecological status.

Table 1. Components of Ecological status assessment

Terrestrial Ecosystem	***Methods followed***
i. Land-cover and Land-use Analysis	Slope based Vegetation indices (such as NDVI) depending on the extent of vegetation cover in the region could be used for the land-cover analysis using remote sensing data. Land-use analysis is to be done using supervised classification technique (maximum likelihood classifier).
ii. Vegetation Composition	Transect cum quadrats method for sampling and the computation of the diversity indices, tree basal area, IVI, % evergreen, and % endemics and regeneration status of trees (based on girth classes)
iii. Faunal component	Sampling methods differs with organism of interest, such as birds, reptiles, butterflies, tiger, leopard, etc.
Aquatic Ecosystem	
i. Phytoplankton	Sampling using phytoplankton net of mesh size 63 µm (bolting silk net No.25).
ii. Zooplankton	Sampling using plankton net with mesh size 50 µm and 75 µm.

iii. Ichthyofauna	Sampling using devices such as gill nets, and hooks and lines. The nets of varying mesh sizes (2 cm ×2 no., 5 cm ×2 no., and 12 cm ×1 no.) could be used in an approximate area of 200×200 sq.m. The lengths of the nets were maintained to 100 meters. The total duration of netting is 12 – 14 hours, complying with the routine practices of the fishermen. The nets are to be laid in the evenings and they are to be removed early in the morning. Shallow streams can be sampled using cast net and dragnets.
iv. Amphibians	Time constrained samplings (2x2 person-hours). Amphibians will be searched using torchlight and also based on their vocal calls.
Humans	
i. Socio-Economic-Energy Studies	Questionnaire based sampling to assess the energy consumption, dependency on forest resources, livelihood aspects

The protocols for estimating the vegetation, birds, amphibian (frogs), fish and diatoms are discussed in detail.

VEGETATION

The forest is classified as evergreen, semi-evergreen and moist deciduous based on the percentage of evergreen trees present in the sampled localities. Table 2 details the vegetation classification.

Table 2. Vegetation classification

Vegetation type	**Evergreen trees (%)**
Evergreen	90 to 100
Semi-evergreen	50 to 90
Moist deciduous	Less than 50

A preliminary examination or reconnaissance of the study area is required to get a general picture of the landscape and its vegetation. Regional and topographic maps and

survey maps assist in determining access routes, topographic obstacles, study of onsite features, and for spatial analysis (GIS - Geographic Information System). The reconnaissance survey would provide:

- Major vegetation patterns and plants communities, including their growth forms and dominant species.
- Correlation between plant communities and features such as topography, geology, soil and water.
- Past and present human influence on the vegetation.
- Identification of unknown plants - the plant materials need to be collected for later determination.
- Herbarium is to be prepared in needy cases.

Dandeli wild life sanctuary has been used for timber (teak) production for quite a long period of time. The area is mostly dry deciduous forest with some intermittent patches of semi evergreen forest. The monocultures of teak are not advisable for the long term benefit of the forest. It becomes important to study spatial pattern of vegetation in the sanctuary for better management.

Data Collection

Primary data collection in representative sample plots has to be done based on both qualitative and quantitative assessments. The frequency and number of the species present in different quadrat samples assess species abundance and diversity. Secondary data collection, which includes the preparation of species list occurring in the study area, is to be done by site visits and by consulting published literature.

Sampling Methods: A transect based quadrat method is used for vegetation sampling. The transect length may range between 100 to 200 m depending on the terrain and vegetation. However, in extreme cases, as in small islands and very large homogenous patches, transect length can deviate from the general range. Quadrats of 20 X 20 m

area are laid along transect, alternating on either side at intervals of 20 m, as shown in Figure 3.

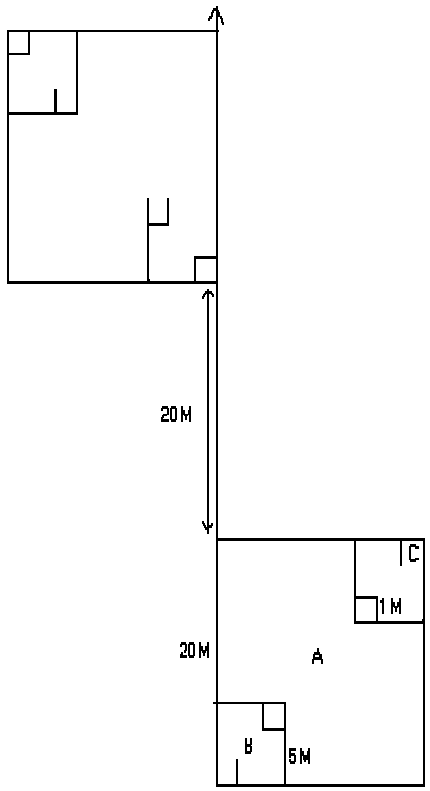


Fig. 3: Schematic representation of transect based sampling method for vegetation study.

The area of transects should be chosen without any bias to the terrain or the type of vegetation in the area. All the trees falling within the quadrates and having a girth of more than 30 cm (or 10 cm diameter) are to be recorded. The girth at breast height, height of the tree (ideally through clenometer) and the name of the plant are to be recorded (Table 3). It is difficult to identify all the plant species till species level based on the vegetation structure alone. Collect a small twig of unidentified plants for later identification.

Ground Vegetation Sampling:

Shrub Sampling: As can be seen in Figure 3, 5m X 5m opposite quadrates within the 20m X 20m tree quadrate are taken for shrub sampling. The ground layer of plants

(>1m height and higher but GBH < 30cm) should be sampled. Tree sapling, shrubs as well as tall herbs are enumerated in these $25m^2$ sub samples.

Herb Sampling: As seen in the opposite corners of 1m X 1m in each of the 5m X 5m are taken for herb diversity studies. Plants less than 1m in height are included in this quadrat. The plants may include lower plants like pteriodphytes as well as tree seedling.

Measurement of Canopy Cover: Multi-layered canopy structure as in the tropical rain forests is greatly significant in stopping the force of the torrential seasonal rains, in preventing soil erosion as well as in inducing greater percolation of water into the soil. The ideal way to measure the canopy of the vegetation is through the densitometer but rough estimates can be given by visual estimates. Within each tree quadrat of 20m x 20m, the nature of canopy cover is observed at 5 points and ranked as 0, 1, 2 and 3 as shown in Figure 4. Mean value of the 5 points was taken as the canopy for respective quadrat.

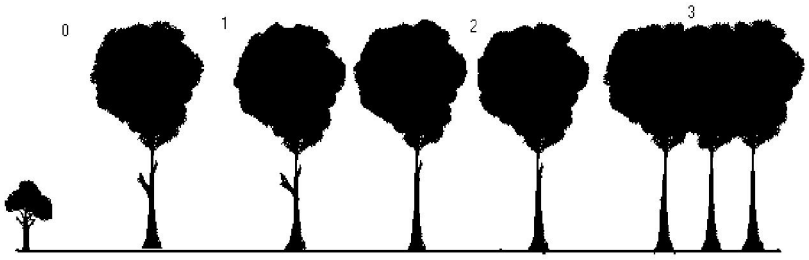


Fig. 4. Visual Estimate of Canopy Cover

Regeneration status of tree species: The regeneration status of various tree species are calculated in the sampled localities based on the representation of any given species of tree in different girth classes. The tree species distributed in all girth classes are considered as having good regeneration, whereas the ones with representation only in the higher girth classes might indicate the prevalence of different ecological conditions in the past.

Data Sheet for vegetation sampling

Date: Time:

Lat. Long. Altitude:

Hamlet: Village: Beet:
Range:

Name of the observer:

§ Transect no. Quadrat no.
§ Transect length.
Canopy Cover:

Table 3: Data Table

Name of the plant	Height	GBH	Phenology	Climbers	Remark	Specimen number if collected.

Any unusual sighting like epiphytes, parasites or unusual branching pattern will be recorded in remarks column.

Note: The following additional details are to be recorded from each sampled locality.

§ Patch type: Evergreen, semi-evergreen, moist-deciduous, scrub, etc.
§ Legal status.
§ Nature of the terrain: steep slope/moderate/low to flat/undulating.
§ The occurrence of a stream associated with the site.
§ Rock outcrops or rockiness: high/moderate/poor to nil.
§ Nature of rocks: lateritic/non-lateritic.
§ Soil erosion on the site: high/moderate/least.
§ Nearest human habitation (approximate distance).
§ Notes on human interference *viz.,* lopping, tree cutting, burning, fuel extraction, litter collection, cattle grazing and any other activities.
§ Sacred value.
§ Non-Timber Forest Produce (NTFP) collection.

Ecological Measurements:

A number of basic measurements are used in describing population and communities. Among these are density, frequency, coverage and biomass. Other important ecological measurements such as population distribution, species diversity and productivity are made from these.

Diversity is an indicator of status of an ecosystem. It consists of two components, the variety and the relative abundance of species. The higher value indicates higher diversity. Diversity is estimated using the Shannon-Weiner and Simpson methods. Various indices that are used in the biodiversity studies, which include both flora and fauna, are listed in Table 4.

Table 4*. Diversity parameters and indices used in the study.

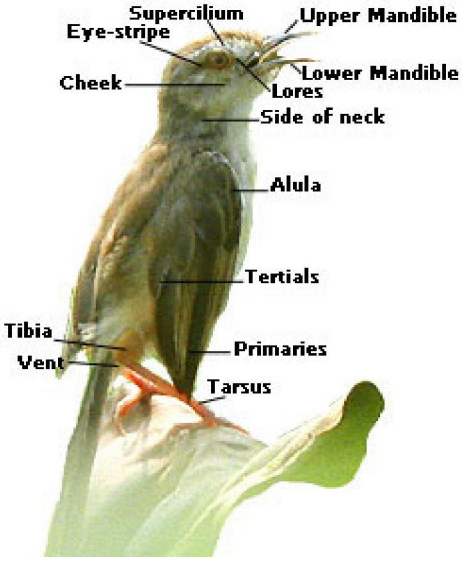
Index	Equation	Remarks	References
Density	Number of species A / Area sampled (m^2)	Compactness with which a species exists in an area.	Elzinga et al, (2001)
Relative Density	Density of species A x 100 / Total density of all species		
Dominance	Basal area of species A / Area sampled (m^2)	The occupancy of a species over an area	
Relative dominance	Dominance of species A x 100 / Total dominance of all species		
Frequency	Number of quadrats with species A / Total number of quadrats sampled	The repeated occurrence of a species	Elzinga et al, (2001)
Relative Frequency	Frequency of species A x 100 / Total frequency of all species		
Important Value Index	R. density + R. frequency + R. basal area		
Abundance	Number of individuals of a species x 100 / Number of sampling units		
Numerical Species richness	$(S-1)/(\log N)$	It is the numerical estimation of species richness dependent on sample size. But it completely ignores the composition and misses information of rare and commonness of a species.	Margalef (1958), Ludwig and Reynolds (1988)

Shannon Weiner's	$H' = -\sum_{i=1}^{s} p_i \ln p_i$	The value ranges between 1.5 and 3.5 and rarely surpasses 4.5.	Ludwig and Reynolds (1988); Legendre and Legendre 1998
Simpson's	$D = \frac{\sum n_i(n_i - 1)}{N(N-1)}$ or $D = 1 - \sum_{i=1}^{s} p_i^2$ Or $D = 1 / \sum_{i=1}^{s} p_i^2$	The value varies from 0 to 1. A value of 0 indicates the presence of only one species, while 1 means that all species are equally represented.	Ludwig and Reynolds (1988)

Ref: Ramachandra T.V., Subash Chandran M D., Gururaja K V and Sreekantha, 2007. Cumulative Environmental Impact .Assessment, Nova Science Publishers, New York

BIRDS

Birds are one of the most widely studied and the best biological indicators because they are easy to indentify, compared to many of the other class of organisms and virtually inhabit all the kinds of habitat. Because of their omnipresence, the attractive colour and the characteristic vocal calls, they have attracted many of the scientist and amateurs in field of ornithology and today the best of the field guides are available for identifying birds.



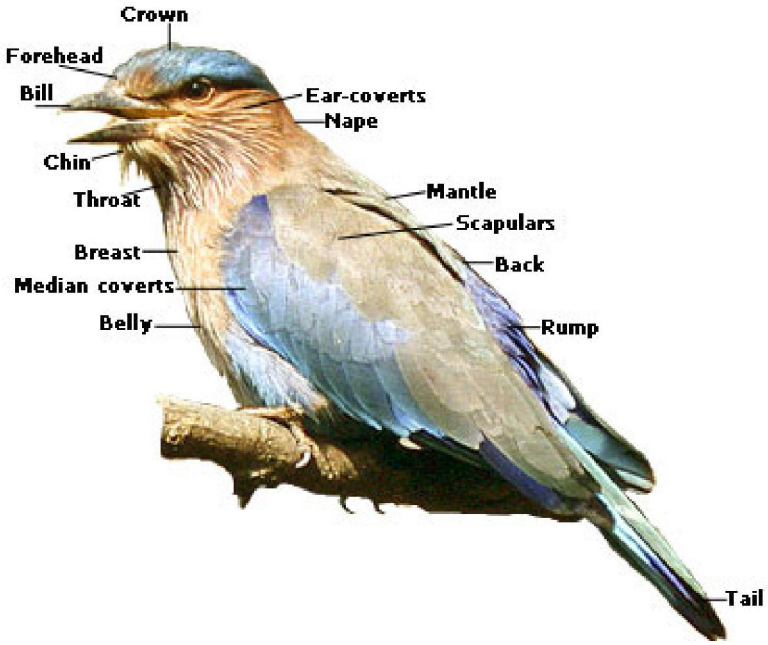


Fig.5 : Body parts of Birds

Image Source: http://www.kolkatabirds.com/topography.htm

Anshi Dandeli Tiger Reserve is known for its rich bird diversity 197 species of birds have been recorded from the Anshi National Park (Uttangi, year 1994). The reserve has good population of four types of Hornbills- Common Grey Hornbill, Malabar Grey Hornbill, Great pied hornbill (NT*) and Malabar Pied hornbill (NT*).

The sampling protocol for bird involves walking along a transect route for a fixed time (1 hr) keeping the pace of walking as uniform as possible. The survey must begin in early morning as soon as sufficient light is available for identification of birds. The observer should record all the species encountered on the way seen or heard. The transect should not be biased towards easily approachable routes and must cover different habitats available (open land, farm land, deciduous forest, semi evergreen patch, riparian vegetation etc. It is important to make a rough sketch of the unidentified birds for later identification.

The list of birds observed during the workshop is given in table 6.

*According to IUCN red data list.

Table 5: Data sheet for bird survey

Data Sheet No:			
Name of the Observers:			
Date Start time: End time: Start Lat. Long. Alt. End Lat. Long. Alt. Beet : Range: Nearest village: Habitat: Deciduous forest/Plantation/ Farm land/ Grass land/ Barren land/ Water body			
Sr. no.	Name of the bird	Frequency	Special remarks (if any)

Table 6: Birds in and round Kulgi Nature camp and Nagazari valley

Sr.No.	Name	Scientific name
1	Ashy Drongo	*Dicrurus leucophaeus*
2	Asian brown Flycatcher	Muscicapa dauurica
3	Asian Paradise Flycatcher	*Terpsiphone paradisi*
4	Bar-winged Flycatcher-Shrike	Hemipus picatus
5	Black Drongo	*Dicrurus macrocercus*
6	Black headed Oriole	*Oriolus xanthornus*
7	Black lored Tit	*Parus xanthogenys*
8	Black Throated Munia	*Lonchura kelaarti*
9	Black-naped Monarch	*Hypothymis azurea*
10	Blyth's reed Warbler	Acrocephalus dumetorum
11	Brahminy Kite	Haliastur indus
12	Brown headed Barbet	Megalaima zeylanica
13	Brown Shrike	*Lanius cristatus*
14	Chestnut tailed starling	*Sturnus malabaricus*
15	Common Flameback	*Dinopium javanense*
16	Common Iora	*Aegithina tiphia*
17	Common Rosefinch	Carpodacus erythrinus
18	Common Sandpiper	Actitis hypoleucos
19	Common Wood shrike	Tephrodornis pondicerianus
20	Crested Serpent Eagle	*Spilornis cheela*
21	Crested tree Swift	*Hemiprocne coronata*
22	Crimson Fronted Barbet	*Megalaima rubricapilla*
23	Emerald Dove	Chalcophaps indica
24	Golden- fronted Chloropsis	*Chloropsis aurifrons*
25	Great Tit	*Parus major*
26	Greater Coucal	*Centropus sinensis*
27	Greater Racket Tailed Drongo	*Dicrurus paradiseus*
28	Greenish Warbler	*Phylloscopus trochiloides*
29	Grey-headed Fish-Eagle	*Ichthyophaga ichthyaetus*
30	House Crow	Corvus splendens
31	House Swift	*Apus affinis*
32	Indian Magpie Robin	*Copsychus saularis*
33	Indian Pond heron	*Ardeola grayii*
34	Jungle Crow	*Corvus macrorhynchos*
35	Jungle Fowl	*Gallus sonneratii*
36	Jungle Myna	*Acridotheres fuscus*
37	Lesser Adjutant	*Leptoptilos javanicus*
38	Lesser Flameback	*Dinopium benghalense*
39	Little Egret	*Egretta garzetta*
40	Malabar Grey Hornbill	*Ocyceros griseus*

41	Malabar Parakeet	*Psittacula columboides*
42	Malabar pied Hornbill	*Anthracoceros coronatus*
43	Malabar Whistling Thrush	*Myophonus horsfieldii*
44	Orange headed Thrush	*Zoothera citrina*
45	Oriental Magpie Robin	*Copsychus saularis*
46	plum-headed Parakeet	*Psittacula cyanocephala*
47	Pompadour Green Pigeon	Treron pompadora
48	Purple rumped Sunbird	*Leptocoma zeylonica*
49	Purple Sunbird	*Cinnyris asiaticus*
50	Brown Cheeked Fulvetta	*Alcippe poioicephala*
51	Red backed Shrike	Lanius collurio
52	Red throated Flycatcher	*Ficedula parva*
53	Red vented Bulbul	*Pycnonotus cafer*
54	Red whiskered Bulbul	*Pycnonotus jocosus*
55	Rufous Treepie	*Dendrocitta vagabunda*
56	Scarlet Minivet	*Pericrocotus flammeus*
57	Small Minivet	*Pericrocotus cinnamomeus*
58	Spotted Dove	*Streptopelia chinensis*
59	Stork billed Kingfisher	*Halcyon capensis*
60	Tailorbird	*Orthotomus sutorius*
61	Tickell's blue Flycatcher	*Cyornis tickelliae*
62	Tickell's Flowerpecker	*Dicaeum erythrorynchos*
63	Velvet fronted Nuthatches	*Sitta frontalis*
64	Verditer Flycatcher	*Eumyias thalassinus*
65	Vernal Hanging Parrot (lorikeet)	*Loriculus vernalis*
66	White breasted Waterhen	*Amaurornis phoenicurus*
67	White cheeked Barbet	*Megalaima viridis*
68	White rumped Munia	*Lonchura striata*
69	White rumped Shama	*Copsychus malabaricus*
70	White throated Kingfisher	*Halcyon smyrnensis*
71	Wire-tailed Swallow	*Hirundo smithii*
72	Yellow-footed Green Pigeon	*Treron phoenicopterus*

AMPHIBIANS

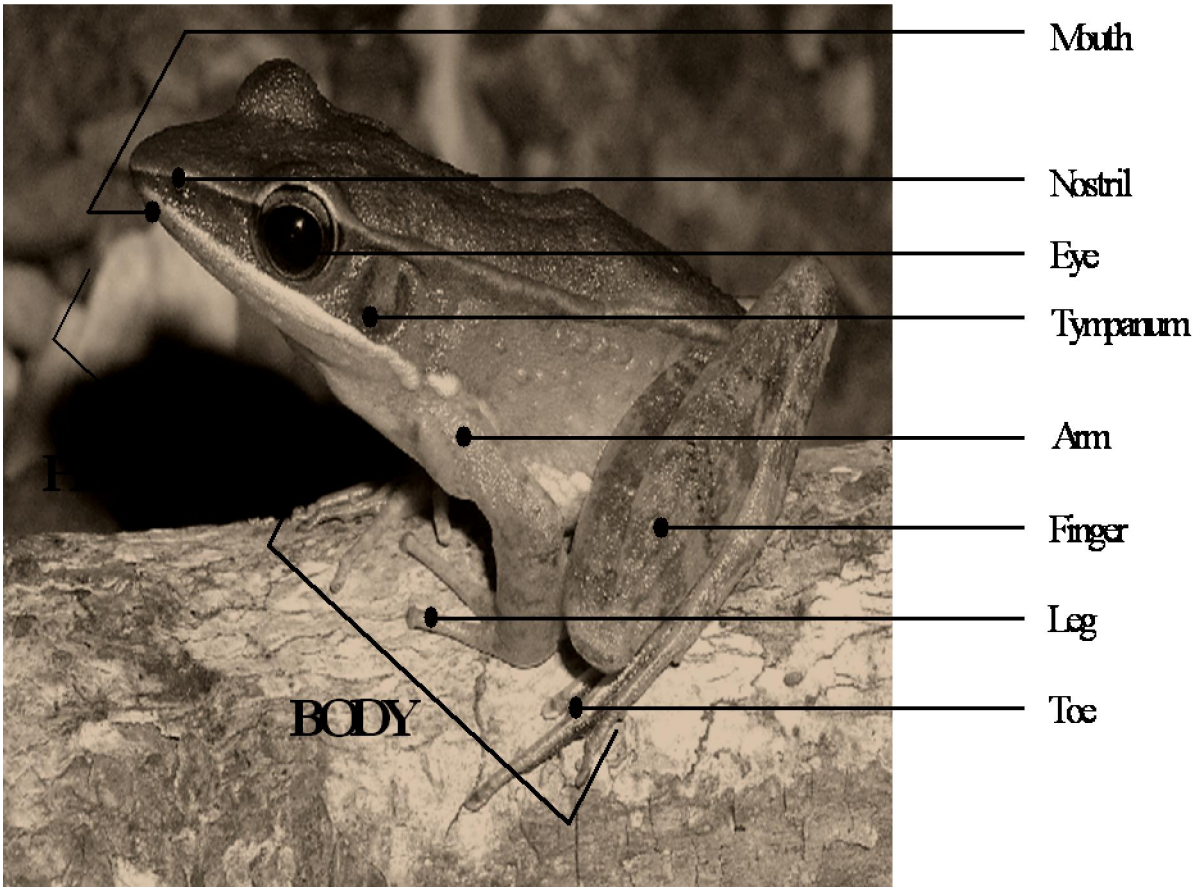
Amphibians are tetrapod vertebrates first appeared on the earth nearly 360 million years ago. Amphibians are one of the best bioindicators as they respond to the minute disturbances in their habitat or in the environment. Their relatively wide distribution, bimodal life style (aquatic tadpole and terrestrial adults), ectothermic conditions with stable environmental temperature of 20-30°C and moist permeable skin have made them highly sensitive and susceptible to the external changes. Amphibians are pivotal organisms both as prey and predator in many food chains and constitute a vital component of the ecosystem. In ecosystem management, they are the best biological pest controllers.

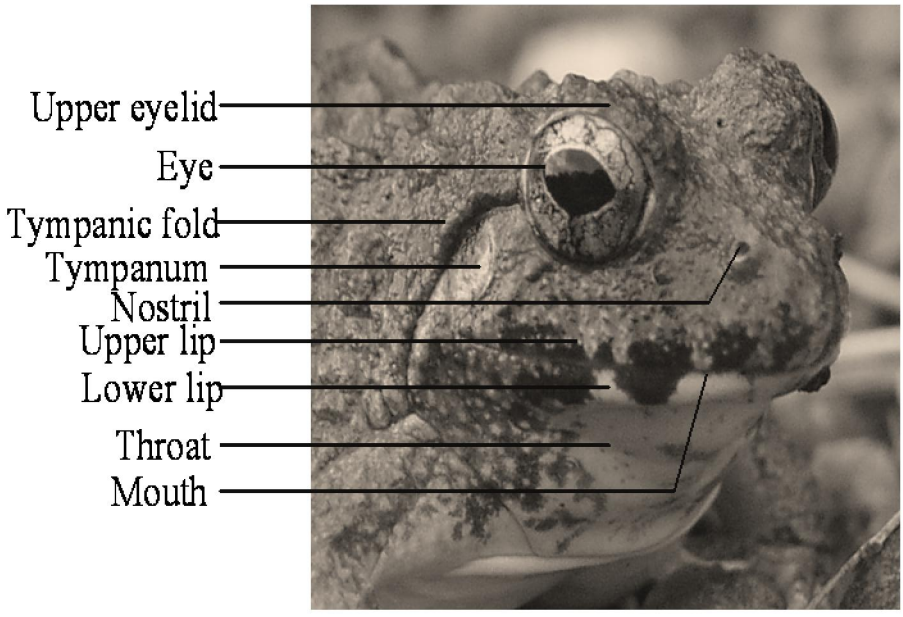
Amphibians are present in many habitats and microhabitats. They can be found inside the water, muddy and rock crevices, burrowing deep in the soil, or bushes, high canopy trees etc. Amphibians are a plenty during rainy season, as they require water to breed and to lay eggs. Majority of the amphibians are active during night (nocturnal). Amphibians are well known for their croaking noises (vocal calls), which they generally do to attract the partner. One can easily locate and identify the amphibian species based on their calls.

(http://wgbis.ces.iisc.ernet.in/biodiversity/sahyadri_enews/newsletter/issue6/index.htm)

General outlook

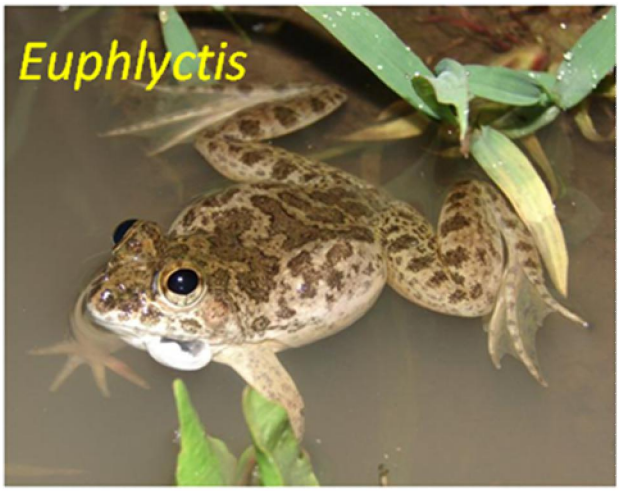
Fig. 6. Body parts of a Frog

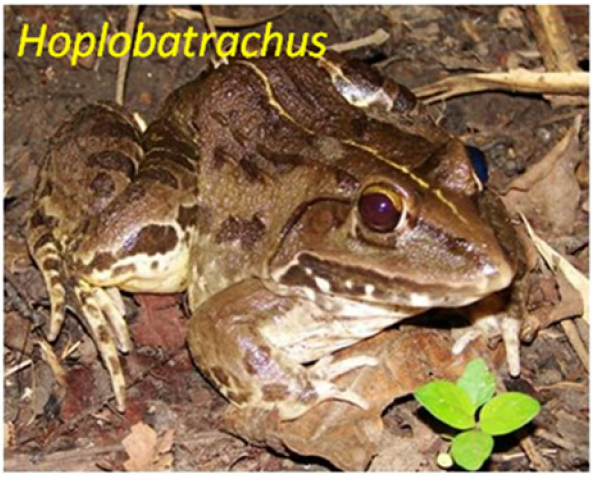


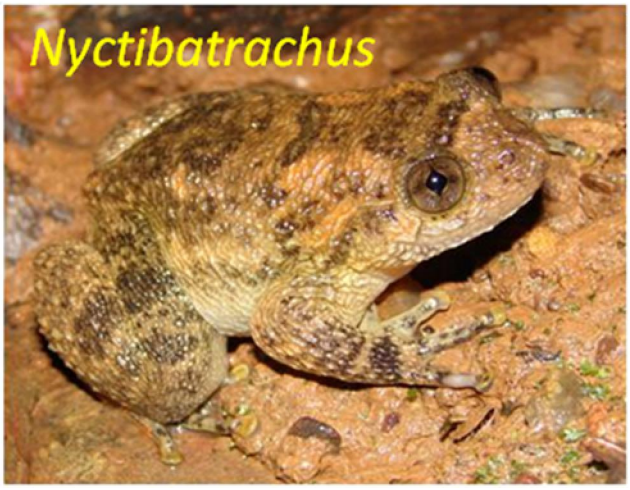


Some common Genera


Fejervarya


Euphlyctis


Hoplobatrachus


Nyctibatrachus

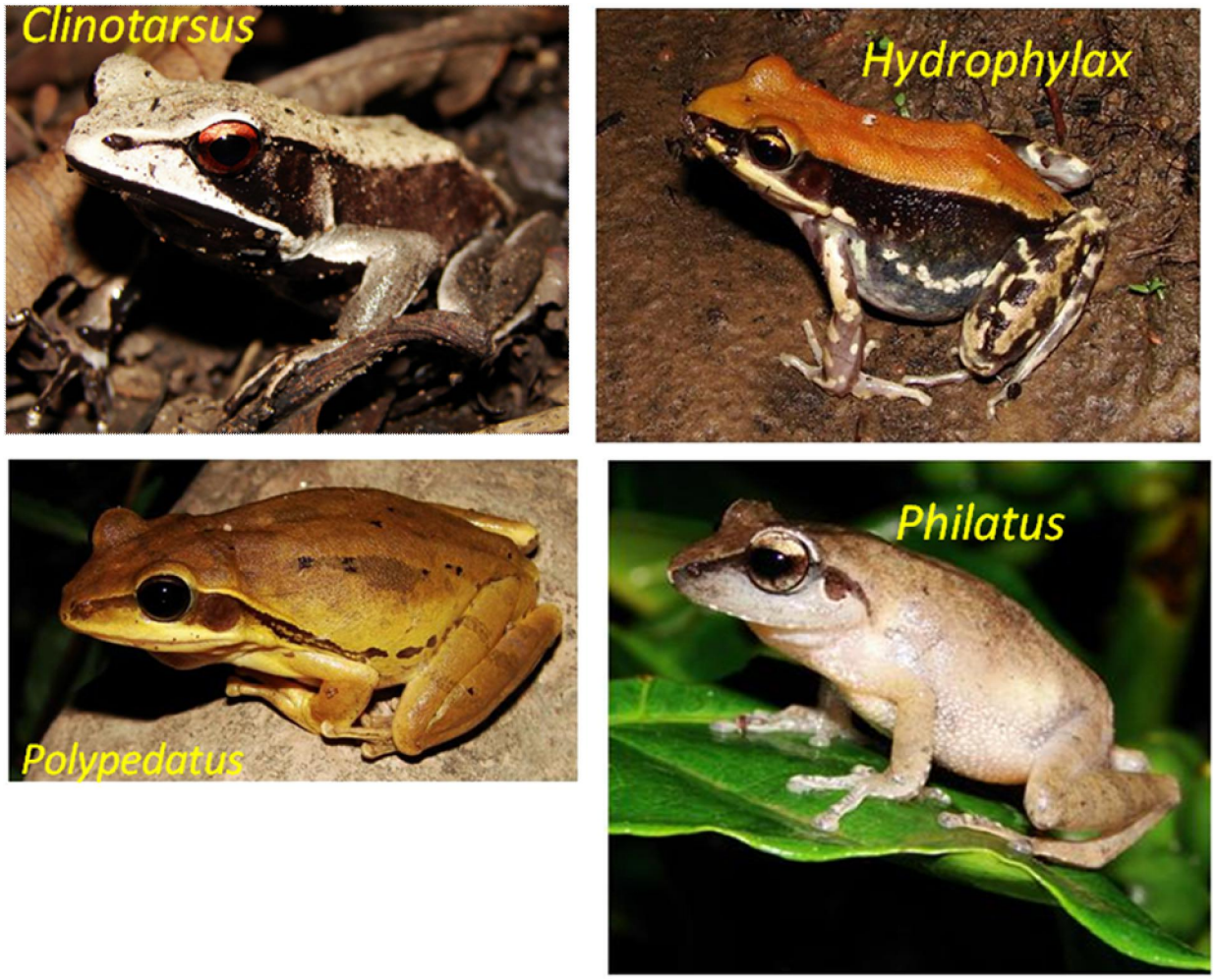


Fig. 7. Some commonly observed genera of frogs in the Western Ghats

The forest official at the forester and guard level were trained in amphibian sampling in streams of Nagazari valley. Table 8 lists the observed anuran species during the past three years of study in the area.

Method

Time constrained sampling: # of man hour search in all-most-all micro habitats. The sampling is done in torch light preferably in late evenings. Usually a search for half an hour by two individuals that is a total of one man hour is sufficient for sampling.

Data Sheet for Amphibian survey

Date:

Time (start):

Time (End):

Latitude: Longitude: Altitude:

Land-use (major): Agriculture/ Pond/ stream/ Evergreen/ Deciduous/ Grassland/

Air temperature: Water temperature:

Relative humidity Canopy cover:

Asphalted road nearby

Table 7: Data table for Amphibian Sampling.

Species encountered	Microhabitat/ activity	# individuals

Table 8: List of amphibians found in DATR during 2006-2009

Species	Common Name	IUCN status
Family: Bufonidae		
Duttaphrynus melanostictus	Common Indian toad	Least concerned
"Bufo" scaber	Fergusson's toad	Least concerned
Family: Microhylidae		
Microhyla ornata	Ornate narrow-mouthed frog	Least concerned
Microhyla rubra	Red narrow-mouthed frog	Least concerned
Kaloula taprobanica	Indian Painted frog	Least concerned
Family: Dicroglossidae		
Euphlyctis cyanophlyctis	Skitter frog	Least concerned
Euphlyctis hexadactylus	Indian Pond frog	Least concerned
Hoplobatrachus tigerinus	Indian Bull frog	Least concerned
Fejervarya caperata	Wrinkled cricket frog	Data deficient
Fejervarya syhadris	Sahyadri mini-cricket frog	Data deficient
Fejervarya sahyadrensis	Sahyadri cricket frog	Data deficient
Fejervarya sp.		
Family: Ranixalidae		
Indirana beddomii	Beddom's leaping frog	Least concern
Indirana semipalmata	Brown leaping frog	Least concern
Family: Ranidae		
Clinotarsus curtipes	Bicoloured Frog	Near threatened
Hylarana temporalis	Bronzed frog	Near threatened
Hylarana malabarica	Fungoid frog	Least concern
Family: Rhacophoridae		
Polypedates maculates	Common tree frog	Least concern
Philautus wynaadensis	Wynaad bush frog	Endangered
Philautus bombayensis	Bombay bush frog	Vulnerable
Philautus tuberohumerus	Knobbed hand bush frog	Data deficient
Family: Nyctibatrachidae		
Nyctibatrachus petraeus	Castle rock wrinkled frog	Least concern

- IUCN 2008. 2008 IUCN Red List of Threatened Species. <www.iucnredlist.org>. Downloaded on **18 February 2009**.

- Note: the list includes the species encountered during monthly surveys carried out earlier and during 13-15th February 2009.

FISH

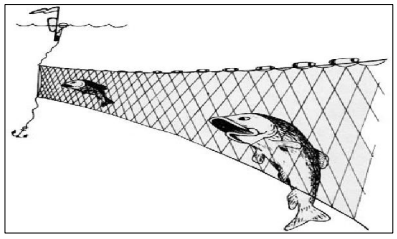
Parameters to be considered:

- Stream orders – first order, second order, 3rd order, etc.,
- Nature of Catchment area -
- Terrain of the surrounding region – plain, hilly, coastal, etc.,
- Micro-habitat conditions – Riparian forest, canopy cover, substrate type, dimensions of the water body, flow,
- Perennial, intermittent streams
- Effluent discharge

Seasonal Sampling: Seasonal variation in species occurrence and composition can be seen. Hence, sampling across the seasons is necessary to get the complete picture. Moreover, in each sampling event repeated daily sampling will yield the best results.

Sampling Time: Early morning or late evening is the ideal time for fish sampling

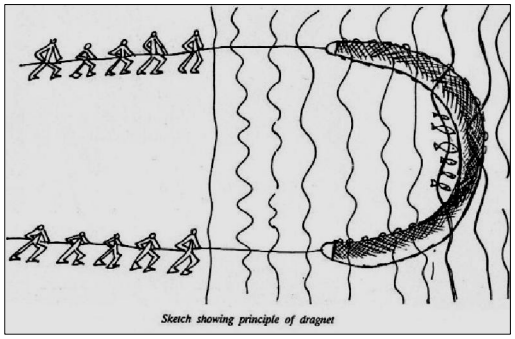
Sampling Types:



a). Gill net sampling: This is the appropriate sampling method for moderately deep pools. Fishes are trapped through their gills in the net. One has to use sufficient reasoning to choose the mesh size of the net to trap appropriate fishes. This reasoning has to come from size of the water body. On the other hand, gill nets with varying mesh sizes can also be effective.

b). Cast net sampling: This is the appropriate sampling method for shallow water bodies. However, art of using cast net is essential to use the net effectively.

c). Drag net sampling: One of the most effective sampling techniques in shallow and small pools, wherein, the net is dragged to sweep out the fishes of the water body. Although this technique is effective, this results in massive destruction of the fish communities and hence should be carefully used.



Sketch showing principle of dragnet

d). Hooks and lines:

For large carnivorous fishes, hooks and lines should be used for sampling. Especially in deep and rocky pools this method is effective to capture such fishes.

e). Opportunistic sampling in streams and rivers using unconventional methods: Several methods are available for opportunistic sampling that ranges from observation using naked eye till using cloths for sweeping the water bodies. However, one should avoid using destructive fishing methods such as poisoning, use of explosives, etc.

Some tips to locate the fishes in water:

- Swampy pools are known for air-breathing fishes
- Deep pools with clear water and rocky substrate are known for Mahaseers/huge carnivorous fishes, etc.,
- Perennial streams amidst the forests are known for some pristine and rare fishes that are known for Western Ghats only (endemic fishes)
- Torrential streams/step falls can be targeted for free flowing active fishes which have flat and wide pectoral fins. Ex: Garra, Parapsilorhynchus, Homaloptera fishes etc.

DIATOMS

Diatoms constitute a fundamental link between primary (autotrophic) and secondary (heterotrophic) production and form a vital component of aquatic ecosystems. Features such as siliceous cell wall (frustules), possession of unique photosynthetic pigments and specific storage products make them unique amongst the algae. The use of diatom tolerance values in water quality monitoring traces its history to Europe, where it has been used for a century and considered important for biomonitoring across the globe. Diatoms are frequently used as bio-indicators, and if they are not investigated live, they may be perceived simply as “glass boxes” used to give information about water quality. Diatoms have been shown to be reliable indicators of specific water quality problems such as organic pollution, eutrophication, acidification and metal pollution.

COLLECTION METHODS:

EPILITHIC DIATOMS: At least five cobbles (> 64, 256 mm) or small boulders (> 256 mm) should be collected without bias to one side of the river or the other from areas which have an obvious diatom film (detected by either its brown colour or slimy texture). Stones should be selected, as far as possible, from unshaded areas within the main flow and free from obvious filamentous algae or siltation. Any loosely attached surface contamination on the biofilm should be removed by gentle agitation in the stream water. The stones should be placed in a tray, along with approximately 50 ml of river water. Wash a stiff toothbrush in clean river water and rub it on waders or a similar surface in order to remove any diatom contamination from previous samples. Brush the upper surface of the stone vigorously to remove the diatom film, rinsing the toothbrush periodically in the water in order to transfer the diatoms. Replace the stone in the stream, and repeat the process for the other replicate stones. Transfer the water (which should now be brown and turbid due to the presence of diatoms) from the tray into the sample bottle. All sample containers must be labeled. Preserve the sample with Ethanol.

EPIPHYTIC DIATOMS: Replicate samples from five different plants of the same species should be taken. Samples of plants growing in the main flow of the river should be placed into a plastic bag along with about 50 ml of stream water. Each replicate

should consist of a single stem plus associated branches of the plant from the lowest healthy leaves to the tip. Diatom epiphytes should be present as a brown floc or film associated with the macrophytes. The plants should be shaken vigorously in the plastic bag in order to dislodge attached diatoms. The result should be a brown suspension that can then be poured into a bottle. All sample containers must be labeled. Preserve the sample with Ethanol.

DATA SHEET FOR DIATOM SAMPLING

SITE DETAILS

River: _____ Site: _____Date & Time:

_____

Lab Code: _____Habitat: _____Sample collected by:

_____

Co-ordinates_____ Elevation:

_____

PHYSICAL RECORDS

Width_____Depth:_____velocity:_____

____

SUBSTRATE & COVER (record estimated percentage)

Bedrock_____ Boulders/cobbles_____ Pebbles/gravel_____ Sand

silt/clay_____ Peat _____

Filamentous Algae

_____Macrophytes_____

SHADING (record estimated percentage)

LEFT BANK NONE | BROKEN | DENSE **RIGHT BANK** NONE | BROKEN | DENSE

HABITAT POOL | RUN | RIFFLE | SLACK

WATER CLARITY CLEAR | CLOUDY | TURBID | COMMENTS:

WATER QUALITY | | | | | |

pH **EC** **TDS** **W. Temp.** **DO**

NB It is important to include an immovable structure in a photograph as a reference for future comparison e.g. a bridge

WATER QUALITY

Water is the most vital resource for all kinds of life on this planet and is affected both qualitatively and quantitatively by varieties of activities on land, water & air. Water quality has a vital role in assessing the impacts in an around the streams & lakes. Basic physico-chemical studies reveal the status of water and the nature of the catchment responsible for the flow. Polluted state of water resources can lead to a steady decline in wildlife & fishes and often has miscellaneous effects on the environment. Some of the basic Physico-chemical parameters are:

pH: This indicates the extent and nature of the water, how acidic or basic the water is? Natural water usually has pH values between 5.0 and 8.5. These values are typical with slight seasonal variations; a sudden change would indicate industrial pollution. Many chemical reactions are controlled by pH and biological activity is usually restricted to a fairly narrow pH range of 6.0 to 8.0. Highly acidic or highly alkaline waters are undesirable because of corrosion hazards and possible difficulties in treatment.

Temperature: It is expressed in ^{0}C or ^{0}F. Many of the industries use the natural water for cooling the boilers and release the water in the streams again but at an elevated temperature. The abnormal increase in temperature can cause decline in the dissolved oxygen concentration and in turn affect the survival of aquatic organisms

Salinity: Expressed in mg/l or ppm it represents the total concentration of salt present in the water body.

Electrical Conductivity: Conductivity of solution depends upon the quantity of dissolved salts present. It is related to TDS content. Its value becomes greater with the increase of the degree of pollution.

Turbidity: The presence of colloidal solid gives liquid a cloudy appearance, which is aesthetically unattractive and may be harmful. Turbidity in water may occur due to clay and silt particles, discharge of sewage or industrial waste or to the presence of large number of microorganisms.

Total Dissolved Solids (TDS): The total dissolved solids in the water are measured in mg/liter or ppm. The value of TDS is higher in rainy season because of the mud dissolved in the water. Run off generally increases the TDS in streams.

Total Hardness as $CaCO_3$ This is the property of water, which prevents lather formation with soap and produces scales in boilers. It is mainly due to the dissolved calcium and magnesium salts. There is no health hazard but economic disadvantages of hard water include increased soap consumption and higher fuel costs.

Chloride: It enters into the surface water due to the weathering of some sedimentary rocks, from sewerage, industrial or agricultural runoff. It is responsible for the brackish taste in water and is an indicator of sewage pollution because of the chloride content in urine.

Nitrogen - Nitrate (NO_3 - N): Nitrogen - Nitrate is the final oxidation product of nitrogen. Natural sources of nitrate to surface waters include igneous rocks, land drainage and plant and animal debris. Natural levels, which seldom exceed 0.1mg/L NO_3 - N, may be enhanced by municipal and industrial wastewater, including lechates from waste disposal sites and sanitary landfills. In rural and suburban areas the use of inorganic nitrate fertilizers can be a significant source.

Phosphate: Phosphate is essential for the growth of organisms and can be nutrient that limits the primary productivity of a body of water. In instances where phosphate is a growth - limiting nutrient, the discharge of raw or treated wastewater, agricultural drainage, or certain industrial wastes to that water may stimulate the growth of photosynthetic aquatic micro- and macro- organisms in nuisance quantities.

Biochemical Oxygen Demand (BOD): BOD is a measurement of the Oxygen required for microorganisms whilst breaking down organic matter to stable inorganic forms such as CO_2, NO_3, and H_2O. So the water with high BOD indicates the organic pollution.

Chemical Oxygen Demand (COD): COD is used as a measurement of the Oxygen equivalent of the organic matter content of a sample that is susceptible to oxidation by a

strong chemical oxidant. Usually the concentrations of COD in surface water ranges from 20mg/L or less in unpolluted water to greater than 20 mg/L in water receiving effluents.

Table 7 lists the parameters, which shows that the parameters are well below the permissible limits for surface water given by Bureau of Indian Standards. The Nagzari Valley having the most suitable & pristine water followed by the stream near the Syke's point followed by reservoir near the Kulgi Camp.

Table 7: Analysis of some Basic Water Quality Parameters:

Parameters	**Water Reservoir near Kulgi Camp**	**Syke's Point**	**Nagzari Valley**	**Limits for Surface Water**
pH	8.67	8.72	8.5	6.5 – 8.5 (BIS)
Salinity	209	190	37.8	--
Conductivity	430	389	82.2	
TDS	280	270	54.9	<1500 mg/l
Air temp	24°C	20°C	26°C	
Water Temp	22°C	18°C	23°C	<40 °C
DO	9.82	8.21	8.65	> 4 mg/l
BOD	1.6	2	0.8	< 3mg/l
Alkalinity	302	380	20	<100 mg/l
Acidity	0	0	72	
Chlorides	26.98	19.88	11.36	<170 mg/L best for fish
Total Hardness	288	178	32	0- 60 Soft Water 61 -120 Mod. Hard Water 121 - 180 Hard Water 181+ Very hard Water
Ca Hardness	120.09	96.08	10.007	--
Mg Hardness	40.97	19.98	5.366	--
Nitrates	0.036	0.024	0.037	<0.1 mg/l (BIS)
Phosphates	0.041	0.052	0.095	<0.1 mg/l (BIS)
Na	3.2	3.3	1.5	<200 mg/l
K	2.6	17	5.8	--

Water Sampling Protocol:

1. Shore samples are to be collected from the surface of water, by gently putting the thoroughly washed container into the water which is free flowing (for the river samples) or from a clear place (in lake samples) taking into account that no other substances enter the container.

2. The on-site parameters which should be measured at the sampling point are the water temperature which can be either done by the help of a thermometer or with the help of a probe.

3. pH can be determined either through pH paper or by pH probes (for better accuracy).

4. Total dissolved solids can be measured with the help of probes which will give the idea of the total dissolved ions in the water sample.

5. The salinity & conductivity can also be done using the probe.

6. Dissolved oxygen estimation:

   I. DO is analyzed at the spot by Winkler's method in which the BOD (Niskin bottle sampler or van Dorn sampler) bottle has to be gently put into the water & should be slightly tilted so that water slowly enters the bottle as soon as the bottle is filled put the cap & close the bottle when it is still inside the water. Be careful not to allow any air bubbles to be entrapped, as it will significantly change the results. If bubbles are there after inserting the cap, remove and start the process again.

   II. Add 1 ml of the manganese reagent (Winkler's A) and 1 ml of the alkali-iodide solution (Winkler's B) making sure no air is entrained into the bottles. It is important to just immerse the tips of the dispensers without immersing them completely. This avoids contamination while eliminating air entrainment at the same time. Shake the contents well by inverting the bottle repeatedly. Keep the bottle for some time to settle down the precipitate.

   III. Add 1 ml of Conc. H_2SO_4 and shake well to dissolve the precipitate.

IV. Remove a part of the content into a conical flask for titration and Titrate against Sodium Thiosulphate solution using starch as an indicator.

Dissolved oxygen (ppm) = (Normality of $Na_2S_2O_3$ (0.025N)* Burette Reading* 8000)/ ml of sample taken for titration

Prerequisites & Precautions while sampling & analysis of Water samples

1. The sampling bottles or containers should be washed with non-phosphate detergent, rinsed thoroughly with running water, and finally rinsed with demonized water. (Traces of chemicals or detergent can interfere with the analysis.)
2. The inner portion of the sample bottle & caps should not be touched with bare hands.
3. Sample should be never permitted to stand in the sun; they should be stored in cool place.
4. The glasswares should be properly washed & rinsed with distilled water.

Data Sheet for Water Quality

Place of Collection:

Date: **Time:**

Latitude: **Longitude:** **Altitude:**

Site Details: **Sample Label:**

Basic quality Parameters:

pH: (Acidic/Alkaline) **Water Temperature:** **Air Temperature:**

Colour of water: **Clarity: Transparent/ Turbid/ Dark**

TDS (ppm): **Salinity (ppm):** **Conductivity (µS):**

Dissolved Oxygen (ppm):

THE TWENTY COMMONEST CENSUS SINS IN ECOLOGY

(Source: William J Sutherland – School of biological sciences, University of East Anglia, Norwich NR4 7TJ, UK).

1. Not Sampling Randomly: It is very satisfying to sample rarities or rich patches but it ruins the exercise. One common error is just to visit the best sites and use the data to estimate the population size.
2. Collecting far more samples than can possibly be analysed.
3. Changing the methodology in monitoring unless there is a careful comparison of the different methods, changing the methodology prevents comparison between the years.
4. Counting the same individuals in two locations and counting it as two individuals.
5. Not knowing your species: knowing your species is essential for considering biases and understanding the data.
6. Not having controls in management experiments. This is the greatest problem in interpreting the consequences in management.
7. Not storing information from where it can be retrieved in the future.
8. Not giving precise information as to where sampling occurred:- Give date and precise location. Site ‘A’, behind the tree’ of ‘near to the road’ may be sufficient now but mean nothing later.
9. Counting in one or more or a few large areas rather than a large number of small ones:- A single count gives no measure of the natural variation and it is then hard to see how significant any changes are. This also applies to quadrats.
10. Not being honest about the methods used:- If you only survey butterflies on warm still days or place small mammal traps in the location most like to be successful then this is fine but say so. Someone else surveying on all days or randomly locating traps, may otherwise conclude that the species has declined.
11. Believing the results: - Practically every census has biases and inaccuracies. The secrete is to evaluate how much these matter.
12. Believing that the density of trapped individuals is the same as the absolute density.

13. Not thinking about how your will analyse your data before collecting it.
14. Assuming you know where you are: - This can be one problem when marking individuals on maps or even when censusing areas, e.g. a one-kilometer square kilometer marked on a map. Population overestimates can result from incorrectly marking the same individuals as occupying very different locations or by surveying a larger block than intended.
15. Assuming sample efficiency is similar in different habitats:- Difference in physical structure or vegetation structure will influence almost every censusing technique and thus confound comparisons.
16. Thinking that someone else will identify all your samples for you.
17. Not knowing why you are censusing: - Think exactly what the question is and that what data you need to answer it. It is nice to collect additional data but will this slow down the project so that the objectives are not accomplished?
18. Deviating from transect routes:- On one reserve the numbers of green Hairstreaks Callophyrus rubi seen on the butterfly-monitoring transect increased markedly one year. It turned out that this was because the temporary warden that year climbed through the hedge to visit the colony on the far side.
19. Not having a large enough area for the numbers to be meaningful; If it is impossible to have a large enough area then question whether the effort might not be better spent on another project.
20. Assuming others will collect data exactly in the same manner and with the same enthusiasm. The international Biological Programme gave very specific instructions, yet it was hard to make such sense of data because the slight differences in interpretation led to a very different results.

Acknowledgements:

We thank Mr. Manoj Kumar, DCF, Dandeli Division and Mr. Vijay Mohan Raj, DCF, SIRSI Division, for supporting the workshop. Travel expenses of the participants were met out by research grant given by the Ministry of Environment and Forests, Govt. of India for ecological research in central Western Ghats.

Annexure I: Proposed research in DATR and probable institutions/persons

Sr. No.	Topic	Long term/Short term*	Institution/person
1.	Vegetation type and composition study	Long term (3years)	EWRG
2.	Habitat preference of tigers	Long term	WII/WCS/NCF
3.	Source Sink dynamics of tiger in DATR landscape	Long term	WII/WCS/NCF
4.	The causes of low density of herbivores and the measures to boost the population	Long term	WII/WCS/NCF
5.	a)The impact of teak on the habitat quality of the reserve b)Measures to upgrade/improve habitat conditions	a) Short term b) Long term	a) EWRG/KFD b) EWRG/KFD/UAS
6.	Impact of village relocation on the animal density of the reserve	Long term	COF, Sirsi/ WII
7.	Management of grasslands within the DATR	Long term	EWRG, KFD, UAS
8.	Conversion of abandoned/fallow paddy fields into swamps	Long term	EWRG, KFD,
9.	Incidence of foot and mouth disease/ Reinderpest in the past and possible recurrence in future	Short term	IAH and VB,
10	Epidemiological studies on carnivores and ungulates	Long term	IAH and VB,
11	Impact of livestock grazing, firewood and NTFP collection on the ecosystem of DATR	Long term	EWRG, Local colleges
12	A study on traditional, indigenous knowledge in DATR	Short term	Local NGO's, Biodiversity Board of Karnataka
13	a) Socio-economic profile of DATR and alternative livelihood options b) Studies on indigenous forest dwelling communities like Kunbi, Gowli, etc.	Long term	University of Mysore, ISEC, KUD,
14	Ecotourism potential and possible impact on the reserve	Long term	WII, ATREE, KUD
15	Socio-economic and cultural impact on the relocated people	Long term	KUD
16	Studies on reptiles, amphibians, arboreal mammals, butterflies, insects etc.	Long term	Amphibians – EWRG, Reptiles – CES, Arboreal mammals – CES,
17	Impact on wildlife of traditional hunting practices	Long term	KUD, KFD
18	The *modus operandi* in wildlife	Long term	KFD

	poaching		
19	Reclamation of mining areas with natural vegetation replacing *Acacia auriculiformis* gradually	Long term	COF
20	Man-animal conflicts and mitigation measures	Long term	ANCF
21	Inventory and conservation status of major plant taxa	Long term	EWRG
22	Assessment of waterquality in major streams in river Kali - Ground water recharge in the reserve, siltation rate in the reservoir	Long term	EWRG
23	Impact of management practices on vegetation dynamics in DATR	Long term	COF, EWRG
24	Weed infestation problems and weed management practices for DATR	Long term	NCBS, EWRG
25	Fire ecology and fire control measures	Long term	KFD, COF,
26	Design of spatial decision support system	Long term	EWRG
27	Impact of vehicular movement on wildlife in and around DATR	Long term	COF, KUD, local NGO's
28	Impact of Ulvi and Kavla fairs on the ecosystem on DATR and mitigation measures	Long term	KUD, Local colleges, NGO's
29	Scat analysis and genetic mapping of tigers of DATR	Long term	WII, WCS, NCBS, CCMB
30	Carrying capacity of the reserve with respect to important mammal species	Long term	WII/WCS/ANCF/NCF
31	Designing awareness programmes for different categories of people and developing course curricula and study material	Long term	CEE, KUD, Local colleges, NGO's, KSOU
32	Assessing the impact of awareness programme on conservation in DATR	Long term	CEE, KUD, Local colleges, NGO's, KSOU
33	Locating sources of water and creation of artificial sources of water in DATR	Long term	EWRG, KFD
34	Soil studies	Long term	UAS, NBSSLUP
35	Plant-animal interactions	Long term	WII, CES,
36	Staff training programmes in wildlife management and forest ecology	Long term	In collaboration with the institutes mentioned above
37	Phenological studies and mapping of key stone resources	Long term	
38	Training local people in fire and tourism management	Long term	

39	Preparation of field manuals for use by forest ground staff	Long term	

* long term indicates more than a year; short term indicates less than a year

Abbreviations:

EWRG – Energy and Wetlands Research Group, Centre for Ecological Sciences, Indian Institute of Science

WII – Wildlife Institute of India, Dehra Dun

WCS – Wildlife conservation society, Bangalore

KFD – Karnataka Forest Department

COF – College of Forestry,

UAS – University of Agricultural Sciences, Dharwar

IAH – Institute of Animal Husbandry and Veterinary Biologicals

NCF – Nature Conservation Foundation, Mysore

ISEC – Institute for Social and economic change, Nagarbhavi, Bangalore.

ATREE – Asoka Trust for Research in Environment and Ecology

KUD – Karnatak University, Dharwar

ANCF – Asian Nature Conservation Foundation

NCBS – National Centre for Biological Sciences

CCMB – Centre for Cellular and Molecular Biology, Hyderabad

CEE – Centre for Environmental Education

KSOU – Karnataka State Open University

NBSSLUP – National Bureau of Soil Sample Land Use Planning, Bellary road, Bangalore

Annexure II: List of tentative invitees for deciding on the action plan for better management of Dandeli Anshi Tiger Reserve.

Theme	Name	Field of specialization	Email ID/contact No.
Vegetation	1. MD Subash Chandran 2. GR Rao 3. Vasudev 4. GR Hegde	1. Relic forest, Myristica Swamps, Vegetation dynamics 2. Grasslands/orchids 3. Vegetation 4. Medicinal Plants	1. mdschandra@yahoo.com 2. grao1@rediffmail.com
Fauna	1. PD Sudharshan 2. Sneha Menon 3. Vijay Mohan Raj 4. Sreekantha 5. Surendra Varma 6. Ajay Desai 7. Vijay Kumar 8. Varad Giri 9. Gururaja KV 10. Gowri Shankar 11. Subramanian KA 12. Aravind NA 13. Sunil Kumar 14. Kavitha Ishwaran 15. Ullas Karanth 16. Kumara HN 17. Hari Sridhar 18. Geetha Nayak 19. Priyadarshanan 20. Sridhar Bhat 21. Karthikeyan S	1. Birds 2. Hornbills 3. Birds 4. Freshwater fishes 5. Elephants 6. Elephants 7. Amphibians - Philautus 8. Amphibians – Caecilians 9. amphibians – Anurans 10. Snakes – King Cobra 11. Odonates and aquatic insects 12. Butterflies/Mollusca 13. Ants 14. Ungulates 15. Tiger 16. Primates 17. Birds – Mixed hunting 18. Birds 19. Beetles 20. Large mammals 21. Butterflies	1. 2.sneha@ces.iisc.ernet.in 3. 4.sreekantha.dev@wipro.com 5. varma@ces.iisc.ernet.in 6. Belgaum 7. vj@ces.iisc.ernet.in 8. varad@gmail.com 9. gururajakv@gmail.com 10. 94481 56804/08181 223081 11. 094229 07805 12. 94481 24570 13. 98867 90640 14. kiswaran@ces.iisc.ernet.in 15. 16. 94489 97510 17. 18. 19. 20. College of Forestry, Sirsi 21.
Soil/Water	1. Dhaval Joshi 2. Karthick B	1. Soils of UK 2. Water quality at Kali River	1. dhavalgy@gmail.com 2. diatomist@gmail.com
Fire	1. Nandita Mondal	1. Fire ecology	1. nandita@ces.iisc.ernet.in
Ecotourism	1. Karthikeyan S.	1. Ecotourism	1. 94495 99777
Socio-economic	1. Indira 2. Jayanand Derekar 3. Gladwyn Joseph		1. Mysore University 2. 94806 03675 3. ATREE, Bangalore
Management			Karnataka Forest Department
RS and GIS, PSS	1. TV Ramachandra 2. HS Sudhira 3. Balachandra Hegde	1. RS_GIS 2. PSS, Virtual Maps, GIS Training 3. RS_GIS: Maps	1. cestvr@ces.iisc.ernet.in 2. hs.sudhira@gmail.com 3. 94487 74778/08389 296212
Wildlife Health and Rescue	1. Jacob V. Cherian 2. Saleem Hameed 3. Nanjappa 4. Khadri	1. Health care 2. Rescue 3. Health and rescue 4. Health and rescue	1. 2. 3. 94486 16522/ 4. 98863 74186/0821 2498045
Nature education and awareness	1. Santhosh Suthar 2. Pramod P	1. Nature education 2. Nature education	1. 94488 16200/94810 24946 2. 094431 67773: pramodpalakkad@gmail.com
Legal aspects	1. MK Ramesh	1. Environmental Law	1. NLSIU, Bangalore
Research			
Protection Strategy	1. Narayanan S	1. Wildlife Crime	1. 094440 72770 Wildlife Crime Bureau, Chennai

Participants of the workshop:

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