

The Sahyādri
**Freshwater Biodiversity
Conservation**

Teaching Guide



The Sahyādri

Freshwater Biodiversity

Conservation Teaching Guide

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The maps reproduced in this book are neither purported to be correct nor authentic.

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<http://data.iucn.org/dbtw-wpd/edocs/rl-540-001.pdf>



Preface

So far as I know, this Manual may be the first in India to guide teachers in teaching about freshwater biodiversity. Although it has come into being very late, when so much of freshwater biodiversity is declining or even extinct.

Teachers have few problems engaging students' attention when they teach about the large mammals such as tigers, rhinos, elephants, etc. or vast tropical rainforests or deserts. It is much more difficult to generate interest in freshwater fish, water plants, dragonflies, slugs and snails, etc. This manual provides a means of making those freshwater critters and systems interesting to youngsters through games, competitions, drawing, live debates, etc. Also – with the right approach – they can catch the attention of any age group by relating the negative results of ignoring freshwater habitats and the fascinating species that live (or try to live) in them.

There is something for almost any age groups, e.g., drawing and colouring, packet items for activities, games, dramas for youngsters and, for older kids, young adults and adults themselves there is IUCN information, assessments, projects, protection, and other tools.

In addition to the contents there is a very relevant Teaching Guide for the Teaching Guide, to wit, the pithy pages of Teaching Guide... how best you can use this following the contents and appendix.

I look forward to hearing about the result of teachers and ngo's who utilize this excellent Manual. While it will take time to improve the current situation it is a given that a large number of youngsters will grow up to be people who (at the very least) don't harm our freshwater environment and may indeed opt to improve it significantly.

Sally R. Walker, Managing Trustee/Chief Executive Director
Zoo Outreach Organization Trust

Critical Ecosystem Partnership Fund (CEPF)

Founded in 2000, Critical Ecosystem Partnership Fund (CEPF) is a global leader that encourages civil society to participate, conserve and thereby benefit from the conservation of some of the world's critical ecosystems. CEPF promotes protection of biodiversity hotspots through grants for non-governmental and private sector organizations ranging from small farming cooperatives and community associations to private sector partners and international organizations. CEPF supports civil society groups to conserve their environment, influence decisions that affect their lives, livelihoods and ultimately that of the global environment for the benefit of all. http://www.cepf.net/about_cepf/Pages/default.aspx



Wildlife Information Liaison Development (WILD)

Wildlife Information Liaison Development (WILD), as the name says is an organization established in 1999 to interface between the public and wildlife scenarios, conservation, research and education in India. Wildlife Information Liaison Development (WILD) Society is a sister organization of ZOO which was founded to support ZOO's increasing responsibilities and tasks in the area of field conservation. WILD and ZOO work together with other institutions and individuals throughout the world both *in situ* and *ex situ* for the purpose of promoting conservation education, conservation research, conservation (wildlife) welfare and conservation action.



Zoo Outreach Organization (ZOO)

Zoo Outreach Organization (ZOO) is a Positive, Constructive, Practical, Scientific, Sensible and Sensitive Conservation, Education, Research and Animal Welfare Society. ZOO reaches out to zoo personnel to give them things they need to improve their animal management. ZOO does many other things besides work with zoos. The organization hosts and runs five networks of field biologists for invertebrates, amphibians, reptiles, bats and rodents, a full fledged IUCN SSC South Asian Invertebrate Specialist Group, as well as a regional branch of the IUCN SSC Conservation Breeding Specialist Group and a regional network of zoo educators of South Asia. ZOO's specialty is zoo and conservation education. Over the years the organization has conducted many training courses in different states, countries and even continents and brought out many publications of packets, books, posters and other educational materials. www.zooreach.org



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Teaching guide – how best you can use this

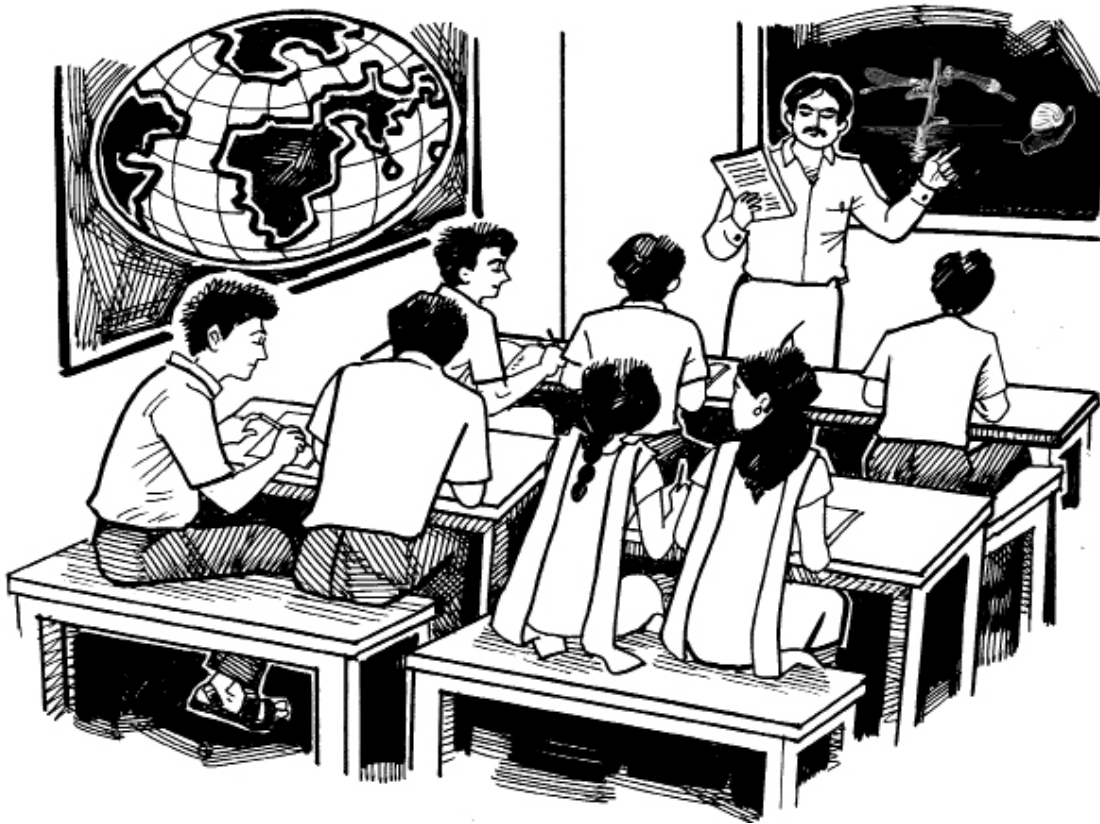
The *Sahyādri* Freshwater Biodiversity Teaching Guide consists of four units featuring freshwater animals and plants, which can be used as a medium for conveying a wide range of active learning techniques for both experienced and casual educators. The *Sahyādri* Freshwater Biodiversity Teaching Guide also provides education about freshwater animals and plants in general and creates interest among students and other target groups to contribute at the individual level to help protect them and their habitats.

Included in the materials are basic facts about the four freshwater groups viz., fishes, dragonflies, molluscs and water plants. It also includes value of FW biodiversity, basic taxonomy of select groups, Western Ghats maps, species diversity, threats, status, freshwater biodiversity uses and values, assessment methodology, conservation status and recommendations for conservation.

Specifically about selected FW species we have distribution, biology, role in human culture, conservation projects in Western Ghats and people contributing to conserve FW biodiversity. The last unit exercises are provided to help participants commit themselves to contribute for the conservation of FW biodiversity.

The approach in this guide is to teach and to attract non-traditional as well as traditional educators to adopt new teaching techniques and activities, which are more effective in influencing comprehension, retention and behavioural changes. In addition to the teaching guide, educational packets featuring Freshwater Biodiversity are used during the programme. Thus the methodology involves a combination of tools, a teaching guide, educational packets with booklet, masks, stickers, placard, posters, etc., which are useful in teaching different target audiences. The activities will be indoors and outdoors, informative, interactive and fun. Only a few basic supplies (other than the FW Biodiversity packet) are needed to supplement this teaching guide. Some activities are designed as handouts that can be removed from the guide and duplicated. In case there is no capacity to take photocopies, alternative group exercises are available in the guide. There is no need for a projector or any other 'technology' to use this material although presentations using projector can be included if one is available. The teaching guide is designed in such a way that only minimum expenditure is involved to plan an education programme.

The overall objective is to impart knowledge about the status of the *Sahyādri* Freshwater Biodiversity and to bring about attitudinal change among students and other target groups towards conservation of the species. To assess the attitudinal change, evaluation or assessment methods are included in the teaching guide. These evaluation techniques are suitable to use with a wide range of audience of different age groups, literate and illiterate. Read the unit "Introduction" before you go through the activities so that it will be easy to relate one unit with another.



How to use this teaching guide

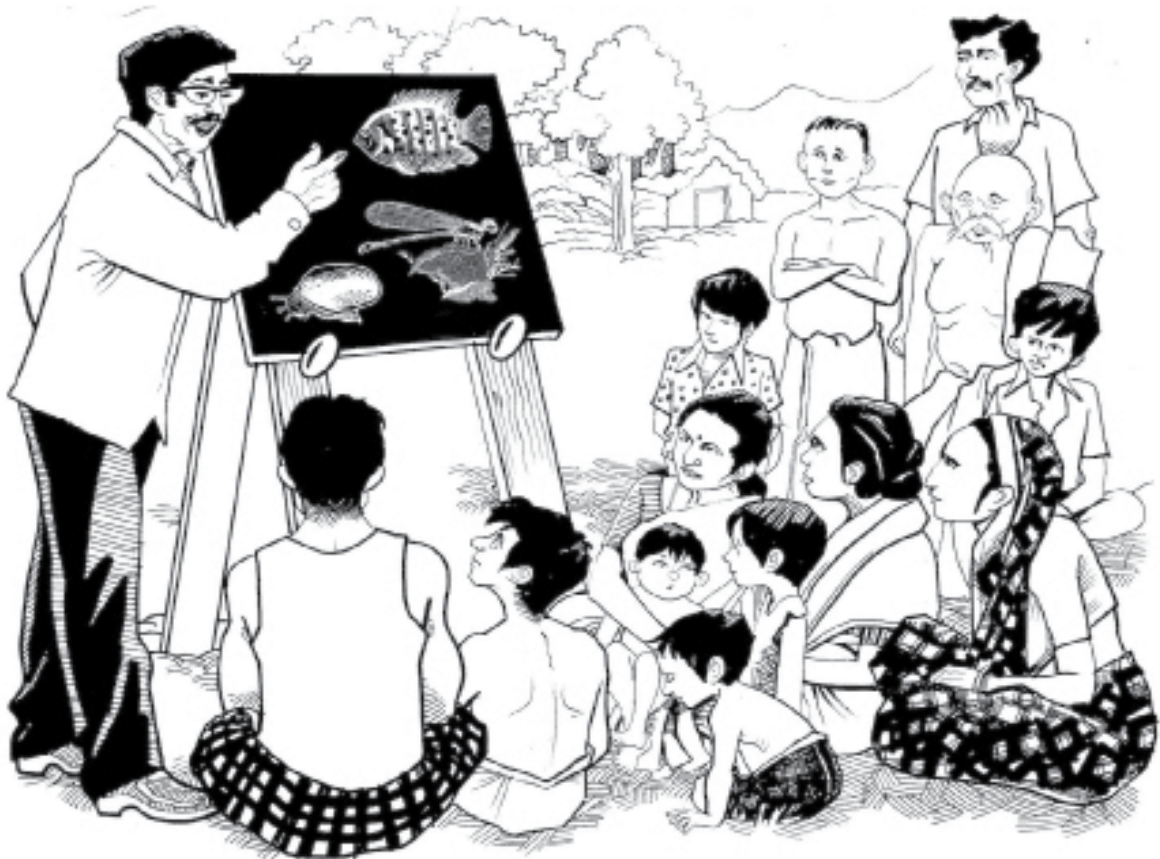
The aim of this manual is to translate scientific data from the report of 'The Status and Distribution of Freshwater Biodiversity in the Western Ghats, India' into stimulating concepts and messages that appeal to stakeholders and connect with their emotions and personal benefits.

These materials can be used as a comprehensive Freshwater Biodiversity "course" or as separate activities from this manual and the provided packet. Whether you have a long time or a short time, this programme is designed to help you teach about the *Sahyādri* Freshwater flora and fauna and their conservation.

In the end, we hope that your audience has a better understanding and appreciation of Freshwater Biodiversity of the *Sahyādri*, and decides to take steps to protect them.

Unit 1

ASSESSMENT TOOLS FOR EDUCATORS



**Assess Your Audience:
What Do They Know and What Did
They Learn? How To Find Out?**

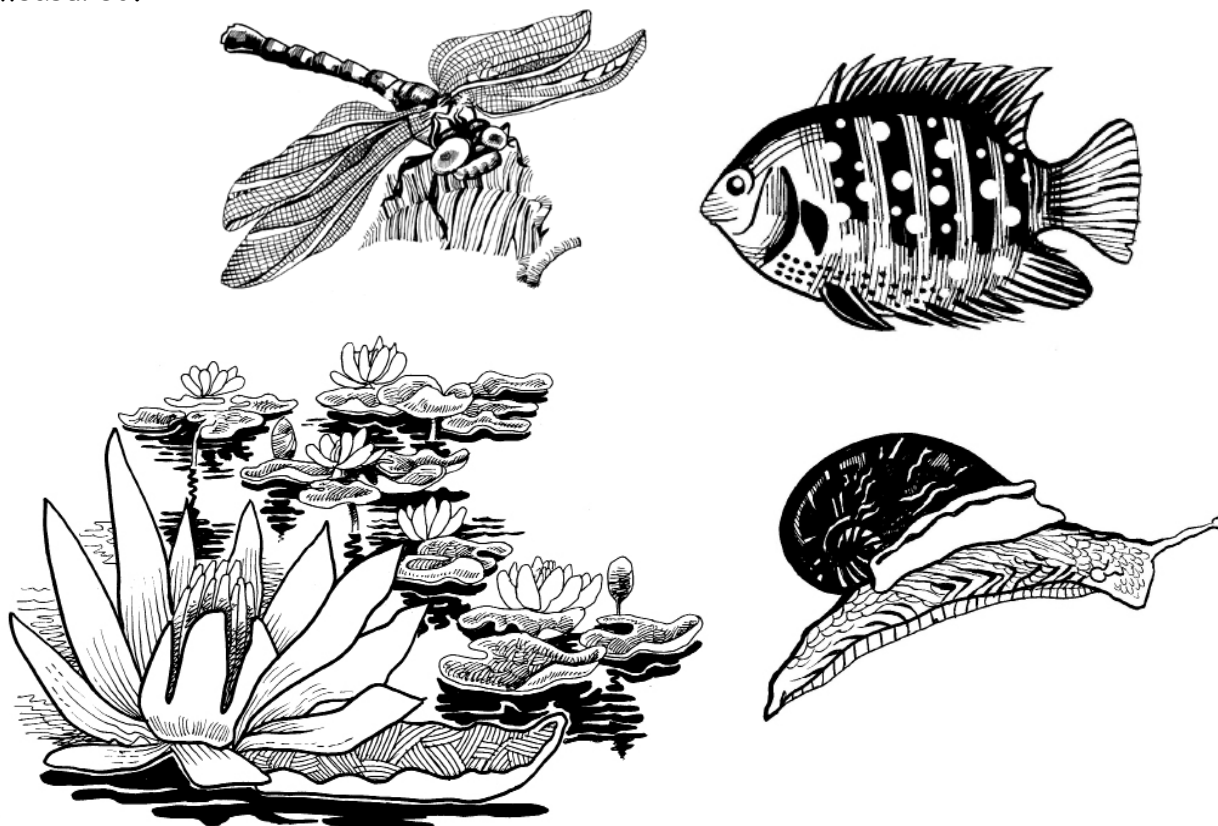
ASSESS YOUR AUDIENCE

WHAT DO THEY KNOW AND WHAT DID THEY LEARN? HOW TO FIND OUT?

Introduction

Before conducting a programme it is necessary for the educator to evaluate the knowledge base of the students about the subject. It will help the educator to teach effectively. To achieve this, the educator should have a method of measuring the audience's knowledge and also comprehension, feelings and behaviour. This unit introduces two evaluation methods. These methods are specific which can be used with students, adults, literate and illiterate audiences. Before conducting a programme go through the evaluation methods and choose the appropriate method suitable for your audience or both can be tried.

Each time when the educator conducts a programme this exercise should be carried out before and after the programme. By comparing the difference in the knowledge level, behavioural change and feelings, the attitudinal change can be measured.



Freshwater Biodiversity Conservation Teaching Guide

As educators, we need to know whether what we teach is effective or not. Depending on our goals, we should have a means of measuring not only acquisition of facts about the subject, but also attitudes, comprehension, feelings and impact on our behaviour.

Assessment tool 1: BRAIN MAPPING

Can be used with

Literate and illiterate audiences of any age group.

Timing

About 20 minutes for each session, one pre-programme and one post-programme.

Methodology

Brain maps test the ability of the brain to relate different words and concepts to a central theme. Brain mapping is a very effective evaluation tool, with an exercise both before and after the teaching session or programme. Brain mapping is efficient because it is quick and easy to administer. Brain mapping is also effective because it can be used with both literate and non-literate groups. Simply ask literate persons to use words and non-literate persons to use illustrations.



A brain map should demonstrate the associations people have with a specified theme (in this case Freshwater species) and the relationships between different associations. Although this is simple, it is not a familiar activity, so it is necessary to begin with a well-known and easy theme, such as "book" or "school" or "food". Demonstrate the activity by doing one as a group on the blackboard. If students do not respond immediately you can ask questions which elicit associated words for the demonstrator map.

If you are using 'School' as the theme, some questions that you can ask are ...

What are some examples of schools?

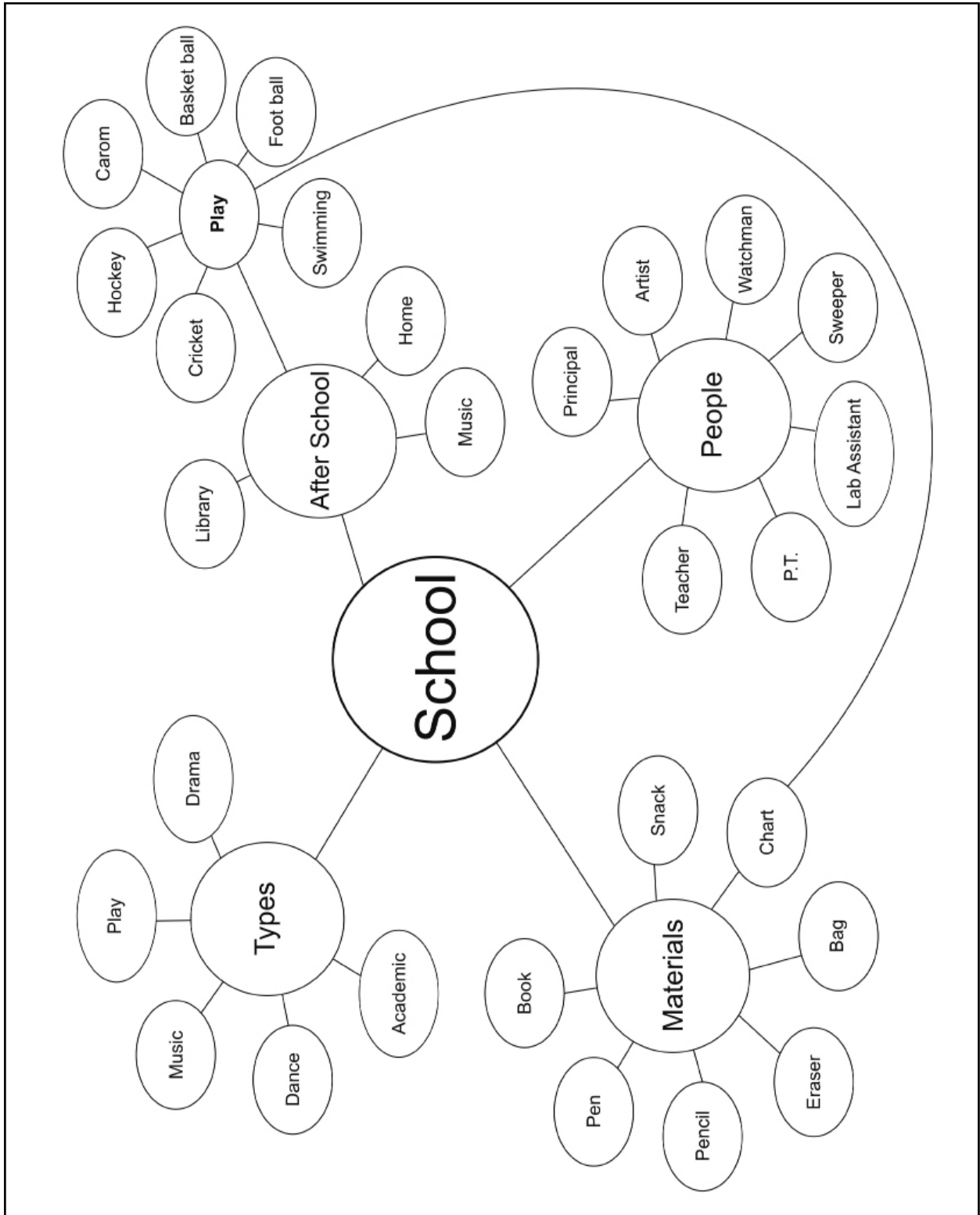
What kind of people do you find in a school?

What items do people take to school?

What do people do after they leave school?

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Sample brain map - subject: "School"

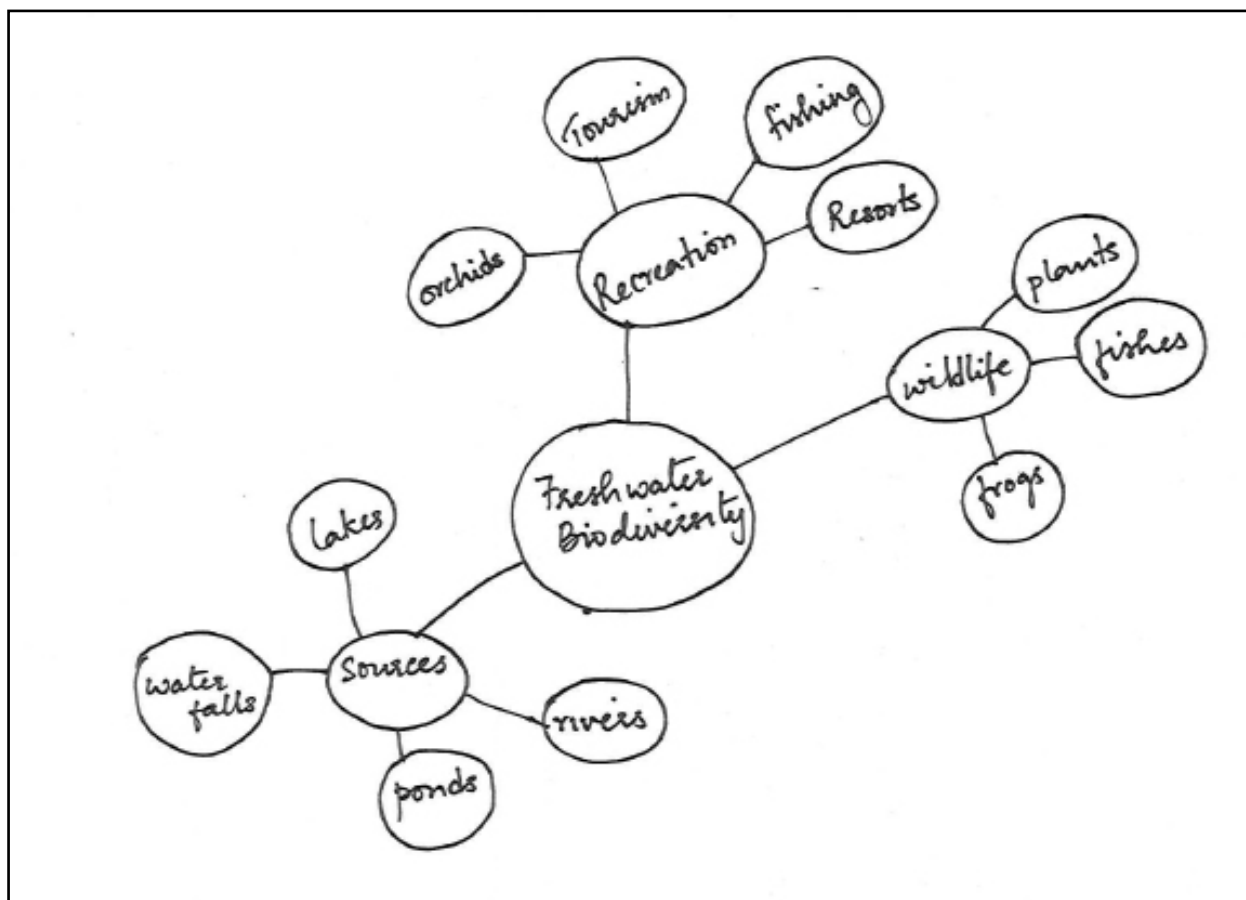


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Most members of your audience will understand how to make the brain map after the demonstration so you can give them the task of making a Brain Map for the theme 'Freshwater Biodiversity'. If you determine that some persons do not quite understand, you can ask the group to break into pairs and try to guide the pairing so that one of them understands the exercise. Retain these "maps". Ensure that they write their name and date on the Brain Map they prepared.

Since you are using this exercise as an evaluation you must conduct it first at the beginning before any information has been passed on about Freshwater Biodiversity and second time after the learning activities are over... just before the closing session. You should ensure for the second exercise that the same two persons work together both times if you have had to pair them.

Sample Brain Map "Freshwater Biodiversity" - Before the session



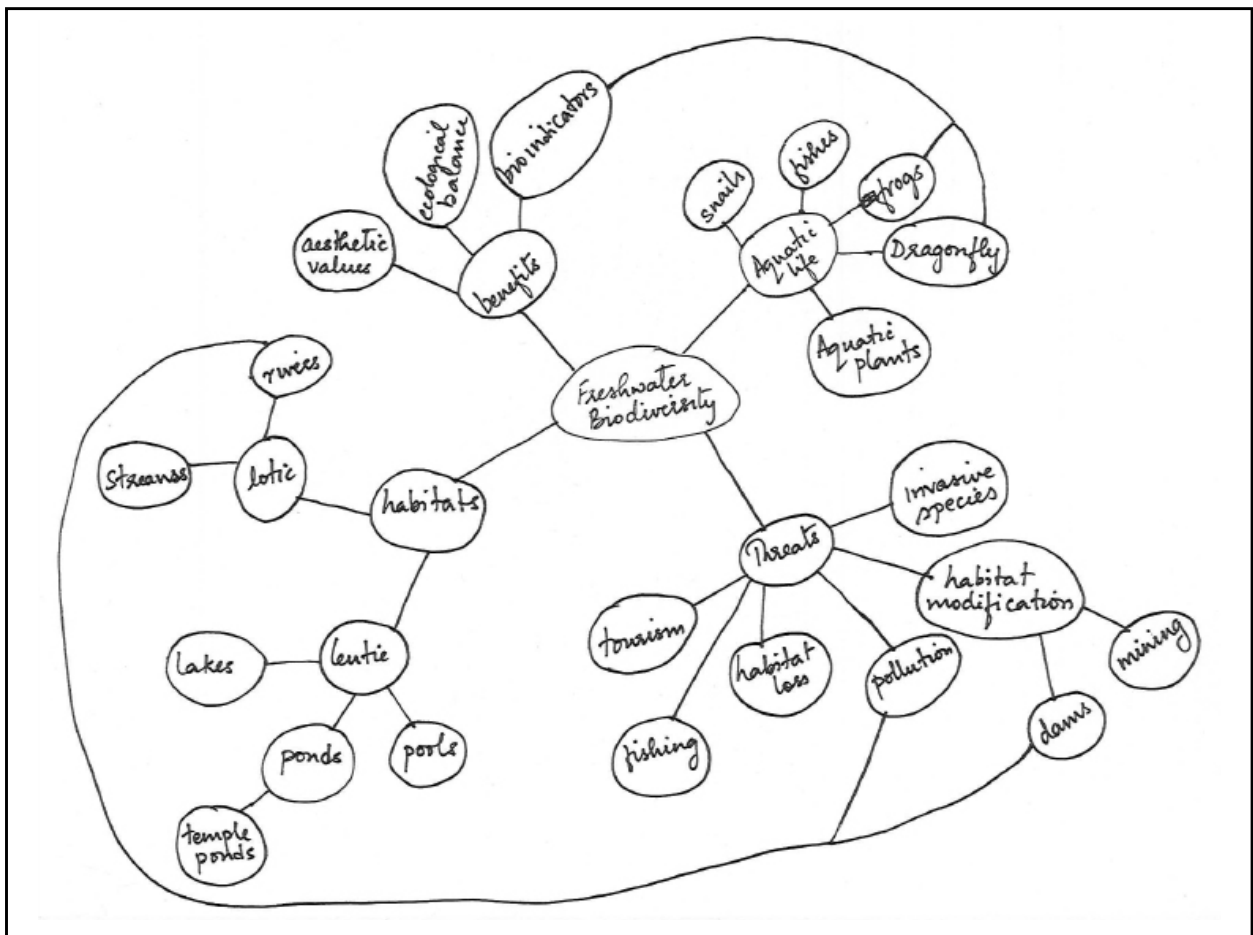
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After collecting the 2nd map, you can bring out the first one and show students the difference in how much they knew and how they felt before and after the course. The number and quality of items they listed and their associations distinctly illustrates that their knowledge base has expanded and their feelings have changed.

The participants will have the satisfaction of seeing how much they learned and you will have "evidence" that your teaching programme was a success. If you have Xerox or other copying facilities, you can give the participants a copy of their maps to take back to their place for personal or professional use.

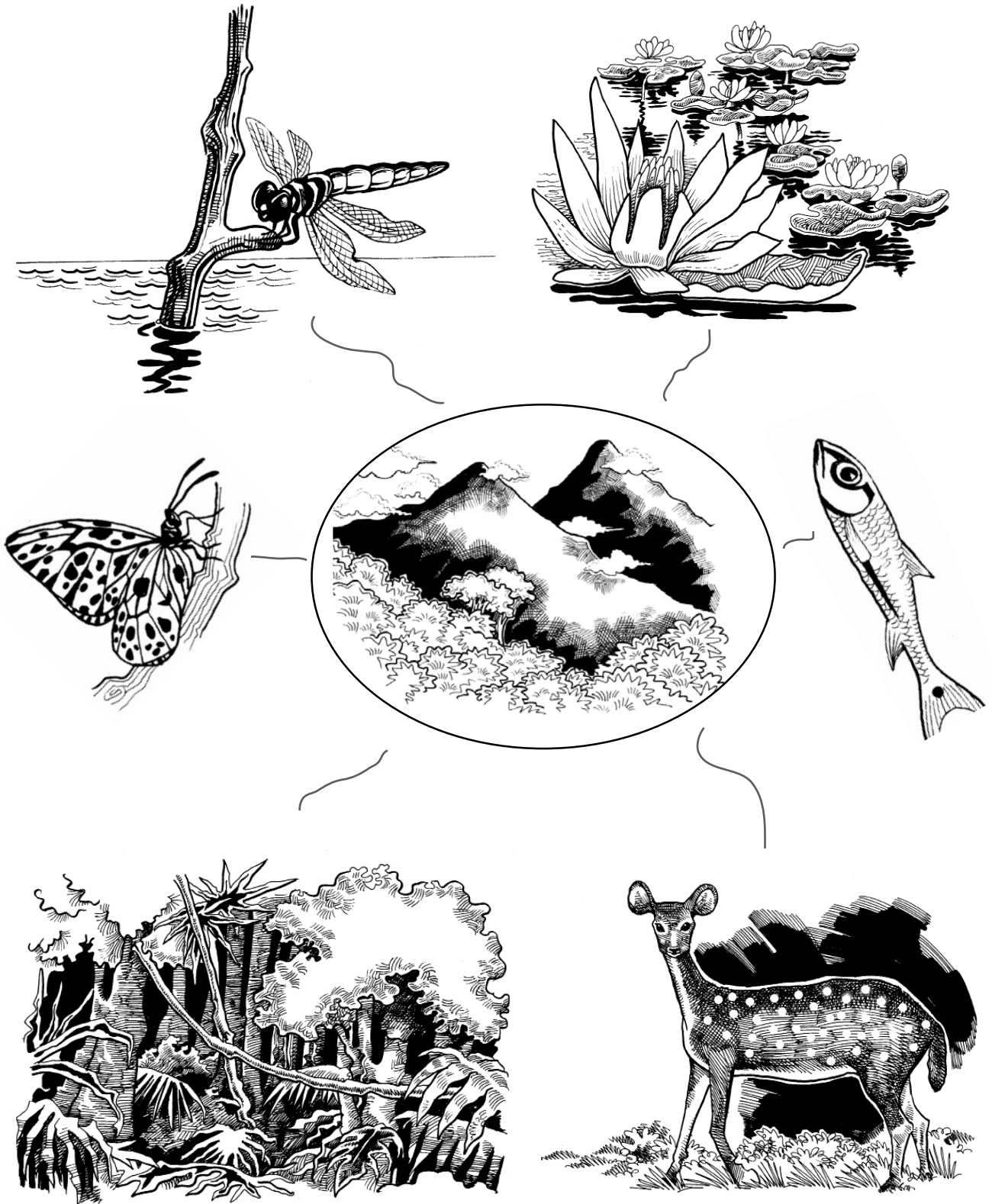
Rating the Brain Map: You can assign marks in the following way and evaluate: give 1 point for each concept and 2 points each for sub-concepts. Further addition of concepts under each sub-concept will get 3 points each. Add the total and evaluate. Marks should be assigned only if the data or the information listed is correct or relevant to the subject.

Sample Brain Map "Freshwater Biodiversity" - after the session



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Illustrated Concept Map: For Illiterate Audience



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Assessment tool 2: ATTITUDE ASSESSMENT

Can be used with

Literate and illiterate audiences of any age group.

Timing

About 30 minutes. Should be done pre and post workshop.

Methodology

"Happy face" illustrations are used to represent emotions of joy, impartial and sadness. Audience members are presented with answer sheets with twelve rows of three faces: one happy, one impartial and one sad.



Happy



Impartial



Sad

Ask your group to mark with a circle the face which reflects how they feel about each of the announcements which you read out. If they are glad to hear this news, they should circle the happy face. If they don't have any particular feeling, they can mark the impartial face which is the one with a straight line for a mouth. And if they are sad they should mark the sad face.

After the second session of this exercise, by comparing the two pre and post workshops questionnaires, you will have a good idea of how your workshop changed attitudes of people with quantifiable data.



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Attitudinal Survey Statements

1. Close your eyes and visualize you are in the Western Ghats. You feel the cool breeze and hear the running water, how does it make you feel?



2. You learn from a book that a variety of plants and animals live in the freshwaters of Western Ghats. What do you feel about it?



3. You hear from a scientific report that the Freshwater diversity of Western Ghats region is facing high level of threat. How does it make you feel?



4. Western Ghats is one of the Hotspots in the world rich in species diversity. How does it make you feel?



5. You learn from a learned source that freshwater plants and animals is a source of living for thousands of people. How does it make you feel?



6. It is specifically reported that overall species richness and number of species in the Western Ghats are decreasing. How do you react to this?



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7. Many communities are directly dependent upon the resources that wetlands provide in the Western Ghats region. How do you react to this?



8. IUCN SSC Freshwater Biodiversity Unit and ZOO found that 183 species out of 1146 Western Ghats species assessed are threatened with extinction. How do you feel about this situation?



9. Freshwater Biodiversity provide value to human society by direct services such as fish for food or water purification for drinking and indirect services such as nutrient cycling, flood control and water filtration. What is your feeling about this?



10. Freshwater ecosystems support various orders of animals, plants and fungi, contributing to a quarter of vertebrate diversity and almost as much of the invertebrate diversity that has been described to date. How does it make you feel?



11. Some major threats to Freshwater Biodiversity of Western Ghats are over-exploitation, water pollution, flow modification, habitat degradation and invasion by exotic species. How does it make you feel?



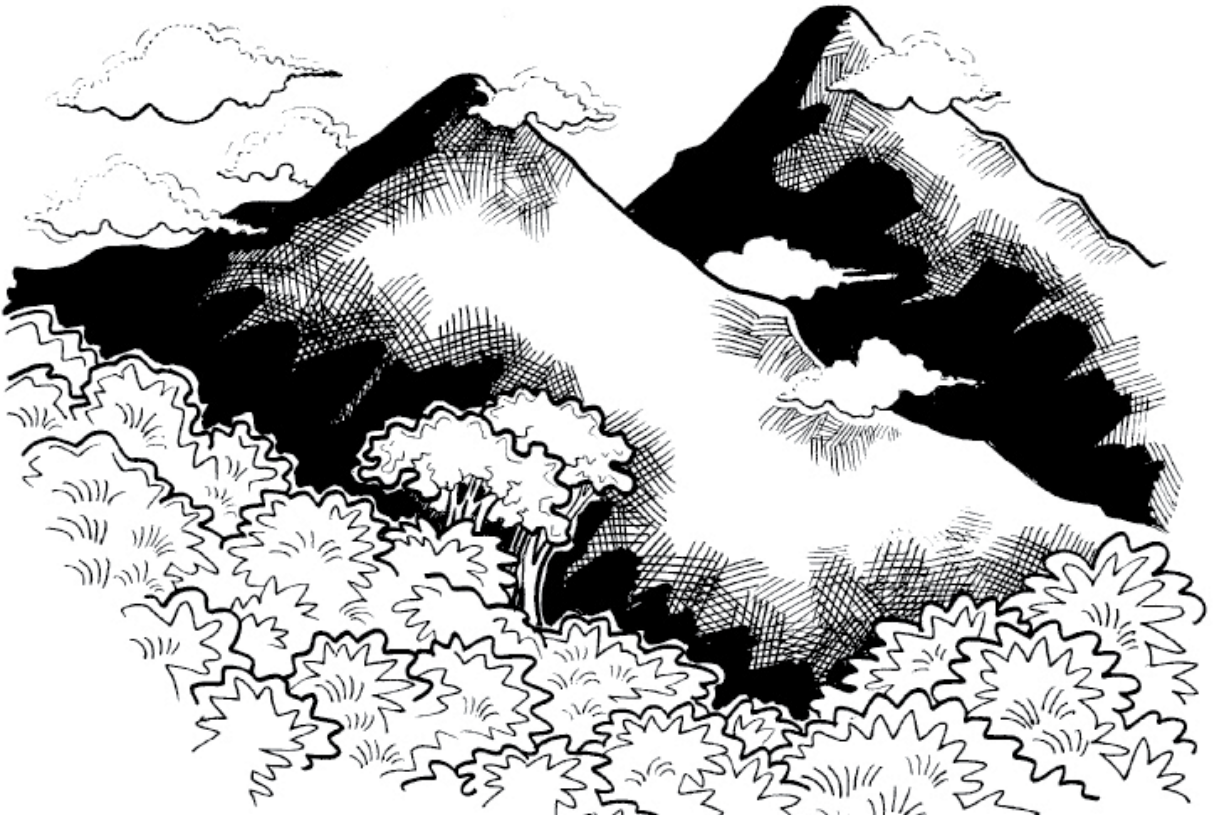
12. Assessing the status of species provides the means to monitor biodiversity trends and losses and helps in setting priorities for species conservation. How does it make you feel?





Unit 2

UNDERSTANDING WESTERN GHATS AND FRESHWATER BIODIVERSITY



Mini Drama

Facts about Western Ghats

Freshwater and Freshwater Types

Value of Freshwater - Water Footprint

Biodiversity: 5 Kingdoms of Life

Western Ghats: Region Delineation, Habitats and
Freshwater Systems

Western Ghats: River Systems

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MINI DRAMAS



Mini dramas are designed to introduce aspects of species biology and conservation issues in a way that is fun and memorable, and that allows the audience to know about plants and animals and the situations they face in the wild. These mini-dramas can be fun for all people from small children through adult, as long as the drama leader is able to motivate them to become involved. If you feel that the adults you are working with would not enjoy participating in these dramas, prepare a group of children to perform for the adult audience. Parents might get encouraged to participate if their children are involved.

The dramas are designed such that no special props or costumes are necessary. However, costumes and props will make the dramas more enjoyable and meaningful for the performers and their audience. You have been provided with education packets that has colourful masks. These masks can be reproduced and coloured so that many of the performers can wear them. Performers playing other roles can make their own masks.

Four drama scripts are included. Each drama should be performed by a minimum of six persons, so if you have 30 participants you may wish to use all four scripts. Break the group up into four smaller groups of equal size. Ask one person in each group to volunteer to be the director.

Explain that each group will rehearse its drama and must keep the subject a secret from the other groups and the audience. In each drama, all of the roles are in bold types the first time they are mentioned. For example, in the Habitat Loss drama participants will play the following parts: **trees, people, crops, freshwater**, etc. Depending on the number of people in the group, a performer may need to play more than one role. Make sure the participants understand that the dramas will be **performed without speaking**; only animal sounds, tools and natural sounds like wind are allowed. After the groups have rehearsed sufficiently, have each group perform for the audience. When each drama is finished, the audience must try to explain what event is being dramatized, and what roles are being played.

After all the dramas have been performed the following activities can be done:

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- Hold a discussion about the issues that have been presented.
- Ask participants and audience members to make a list of questions stimulated by the dramas. Use a flip chart or black board to list the questions.
- Ask them to propose other Freshwater Biodiversity issues that could be the subject of the dramas.
- If you will be working with participants over a sustained period of time, you may wish to ask participants to work together to write their own dramas.

Freshwater Biodiversity - Background information for drama

The Western Ghats is one of the world's most heavily populated Biodiversity Hotspots providing for and supporting 400 million people through water for drinking, transport, irrigation, and hydroelectric power, together with food and resources to sustain livelihoods. However, there is little appreciation for the value of freshwater ecosystems to the livelihoods of many highly dependent people, often the poorest in society. The Western Ghats region is experiencing high level of threat to freshwater species. Pollution, exploitation of biological resources, residential and commercial developments, dams and other natural system modifications, alien invasive species, agriculture and aquaculture, energy production and mining, etc., are some of the major threats to Western Ghats Biodiversity.



Drama 1

Freshwater resource (fish) and livelihood

For many years, a **community of fisher folk** had been living off of the bounty of **fish** that the rivers provided them with. Over time, the value of their commodity dropped forcing them had to catch more fish than in the past to make ends meet. This over-fishing on a continuous basis resulted in the depletion of fish resources in the **river** and finding good catch started to become scarcer by the day. They realized the gravity of the problem and decided to find a solution in order to save their livelihood and traditional way of life. Upon communicating with **experts** in the field, they were told that it was due to over-harvesting that they had incurred this problem. They learnt that they had to fish on a regulated basis such that the fish get the time to spawn and repopulate themselves, esp. during their spawning season. Also they chose not to kill juvenile fishes as much as possible. After taking such a resolution and applying it stringently, over time, the fisher folk found that the fish population bounced back to the old levels, and such a method of sustainable fishing was then wisely maintained.



Drama 2

Habitat restoration

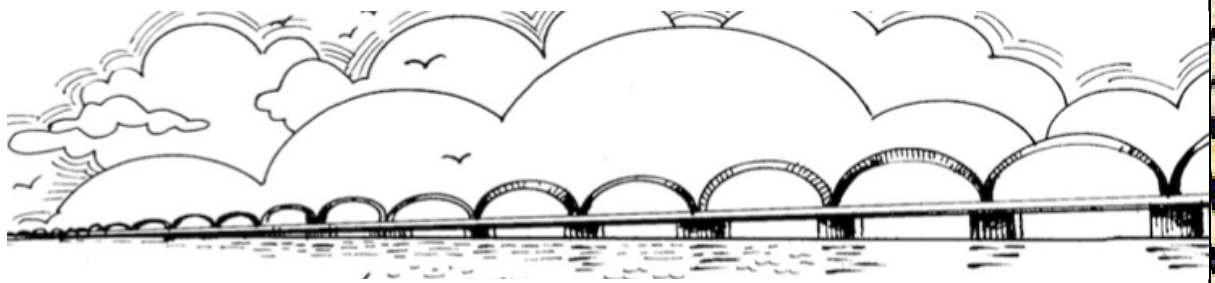
In 1900 a group of **people** left their homeland and settled in beautiful forest-land which they cleared of **trees** to make their home. They cleared more forest for farming in order to grow food. In 1925 they built new houses using old, large trees from the forest. They sold off more trees in nearby towns and began planting other **crops** like tea and coffee. In 1950 they laid roads and cleared more forest-land which provided more wood for sale. The people were happy and healthy those days. In 1975 they used modern tools and were able to clear even more forest. By 2000 there was nothing left in the forest. Where there was once clean, **freshwater**, the water was dirty, polluted. People began to suffer from diseases since much of the daily wastes were dumped in the forest. Water was not sufficient to water crops, so food had to be bought from outside and was very costly. Looking back over their history, people of the 21st century saw that the misuse of the forests and the water resources by their ancestors had spoiled the once bountiful land. They vowed to try and restore the forest and teach their children to care for it.



Drama 3

Threatened river

Two major cities in South India host a seasonal **river**, which has its peak flow during monsoon. Ignorance and indifference towards nature led to development activities resulting in the degradation of the river. The riverbed was filled with industrial wastes, acids and bleaching liquids. **People** of the region knew little about the different ecosystem services offered by the river. Apart from harbouring a variety of uniquely adapted **plants** and **animals**, the river helped maintain the groundwater levels. Water scarcity, which hitherto was unknown in the region started becoming a perennial problem making life difficult for the people by all means. There was acute scarcity of water for domestic use, drinking, as well as for agriculture purposes. Upon realization of the mistake made by the **authorities** and those involved in the developmental activities, the public held protests and asked for not only the restoration of the river but also the protection of other wetland areas around that region for the benefit of all. The **governing bodies** gave in to the requests and declared the wetlands as 'protected, no-development areas'. In due course water problem was solved.



Drama 4

Regulate water withdrawal

A beautiful rural countryside underwent rapid urbanization resulting in over extraction by industries leading to water scarcity along with inappropriate sanitation that led to a variety of problems ranging from degraded water quality, scarcity, spread of diseases and other health issues. The **people** of the region were made aware by an **NGO** about the situation and they were educated about the need to use resources in a proper manner and also develop in a sustainable way. Imbibing the ideas, the **locals** changed their lifestyle, reduced and regulated the process of their waste disposal as well as water usage among other eco-friendly practices. This mitigated the water-related issues to an extent thus ensuring that the resources are maintained at optimum health for prolonged use which also improved their living conditions.



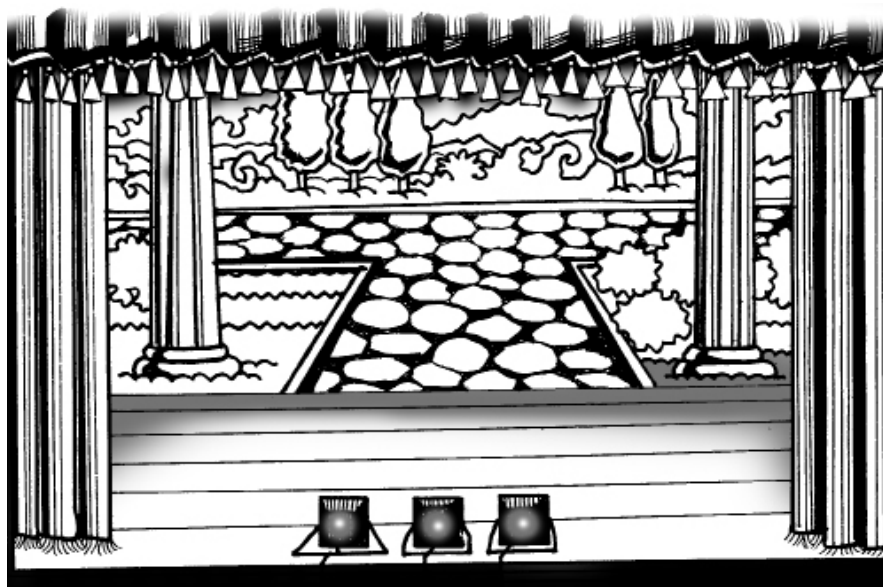
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Create your own Drama: Instructions

Using the guidelines below, work with your group to write and perform wildlife dramas.

Steps:

1. Choose a biodiversity/wildlife topic based on an issue that is important to your group. Try to pick a very specific issue, as you will have limited presentation time. What is your topic? (Facilitator may want to hold a brainstorming session first, and then write the chosen topics on a board).
2. Pick what events you want to act out - your story line - keeping it simple to be able to present within a five to ten minute time frame. What are the main events in your drama?
3. You do not need to write a script; rather think of the kinds of conversations your characters would have. What are the main topics of dialogue?
4. List the characters (people, plants, and animals) to be involved in this issue. Who are the characters in your drama?
5. Assign roles and rehearse. As you practice, keep in mind the message you are trying to convey.
6. What is the main message of your drama?
7. Decide where your drama will take place. What is the setting?
8. Make props and costumes - be creative! Using scrap materials and natural materials is a great idea. Make sure you have already practiced so that you do not take all the rehearsal time to make your props and costumes.
9. Present your drama! Define the stage area and audience area. Maintain the attention of your audience!
10. Discuss about the message with your audience.





Rajasthan
Ahmedabad
Gujarat
Bhopal
Madhya Pradesh
Nagpur
Maharashtra
Mumbai
Pune
Hyderabad
Andhra Pradesh
Karnataka
Bangalore
Chennai
Tamil Nadu
Kerala
Cochin
Madurai
Tiruvandrum

Palghat Gap →

Western Ghats Map

North
North West
North East
South
South West
South East
West
East

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FACTS ABOUT WESTERN GHATS

Length:	1490 km from Tapi Valley in Gujarat to Kanyakumari in south
Total area:	Approximately 1,60,000 km ² (leaving the Palghat gap)
Palghat Gap:	A 30 km break in northern Kerala
Width range:	48 km in Maharashtra to 210 km in Tamil Nadu
States covered:	6 (Gujarat, Maharashtra, Goa, Karnataka, Kerala and Tamil Nadu)
Annual precipitation:	2,000 to 8,000 mm
Area under Protection:	13,595 km ²

Number of Protected Areas within Western Ghats:	58
Number of National Parks within Western Ghats:	14
Number of Sanctuaries within Western Ghats:	44



Freshwater Biodiversity Conservation Teaching Guide

Freshwater systems

The freshwater ecosystem biodiversity within the Western Ghats region is highly diverse, unique and of immense importance to livelihoods and economies. Broadly, the freshwater rivers and streams in the Western Ghats fall under five main categories or eco-regions, viz.,

1. Narmada-Tapi
2. The Northern Deccan Plateau (Godavari River system)
3. The Southern Deccan Plateau (Krishna River system)
4. The Southern Eastern Ghats (Kaveri River system) and
5. The Western Ghats (west flowing rivers).

From the Western Ghats originate 46 east-flowing and 70 west-flowing major rivers. The west-flowing rivers originate in the Western Ghats and drain into the Arabian Sea while the east-flowing rivers merge into one of the three major river systems - Kaveri, Krishna or Godavari - before they drain into the Bay of Bengal.

Forest status:

There are four major forest types in the Western Ghats. They are

- Evergreen
- Semi-evergreen
- Moist deciduous &
- Dry deciduous.



Among the four broad vegetation types, moist deciduous forests occupy the largest area followed by semi-evergreen, dry deciduous, and finally evergreen.

Other vegetation types that occur in the Western Ghats include: Scrub jungles, Savannahs, Peat bogs, *Myristica* swamps.

The majority of the area under moist forest types falls within the southern states of Kerala and Karnataka. Together they account for 80 percent of the evergreen forests and 66 percent of the moist deciduous forests in the Western Ghats (IIRS 2002).

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Western Ghats is home to diverse social, religious, and linguistic groups. Approximately 245 (WGEEP report 2011) million people live in the peninsular Indian states that receive most of their water supply from rivers originating in the Western Ghats.

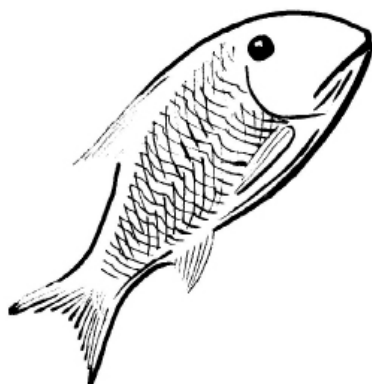


The Western Ghats supports a diverse fauna.

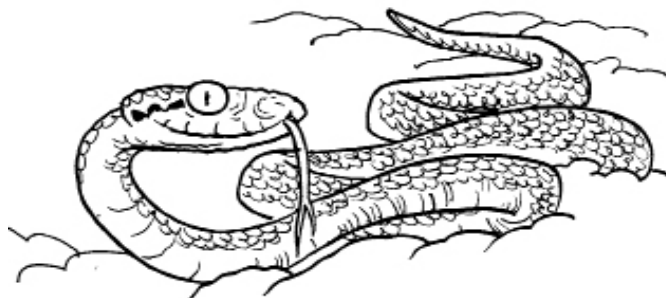
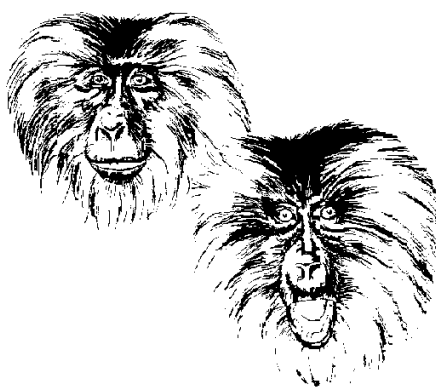
Among the vertebrates,

Birds	508 species
Fishes	218 species
Reptiles	157 species
Mammals	137 species and
Amphibians	126 species

are reported from Western Ghats.



Like other hotspots, the Western Ghats has a high proportion of endemic faunal species. If an animal or plant species' natural home (habitat) is restricted to one particular area or space on the globe, it is known as an endemic species, example: Lion-tailed macaque, Malabar grey hornbill. The greatest number of endemics in the Western Ghats is found among the amphibians (78%). Among other animal groups 62% are reptiles, 53% are fish, 12% are mammals and 4% Birds.



Freshwater Biodiversity Conservation Teaching Guide

FRESHWATER AND FRESHWATER TYPES

What is freshwater?

Freshwater is defined as water having a very low salt concentration - usually less than one percent.

Essentially there are two main types of freshwater bodies: Static water (lentic) and Flowing water (lotic).



Flowing water (lotic)



Static water (lentic)

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Types of water bodies



Stream

is shallow, narrow, natural body of flowing freshwater that can be safely crossed without the help of watercraft.



Brook

is a small, shallow stream with a more rapid current, often characterized by a rough or rocky bed.



Creek

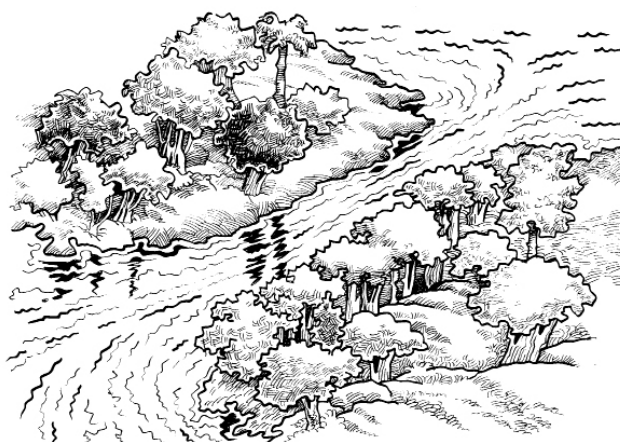
is a small, shallow stream of generally slow moving water.

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River

is a large body of water continuously flowing downhill over considerable distance from smaller upstream sources to a larger downstream reservoir, lake, sea or ocean.



Strait

is a narrow, shallow body of swiftly flowing water connecting two larger, deeper water bodies.



Marshes

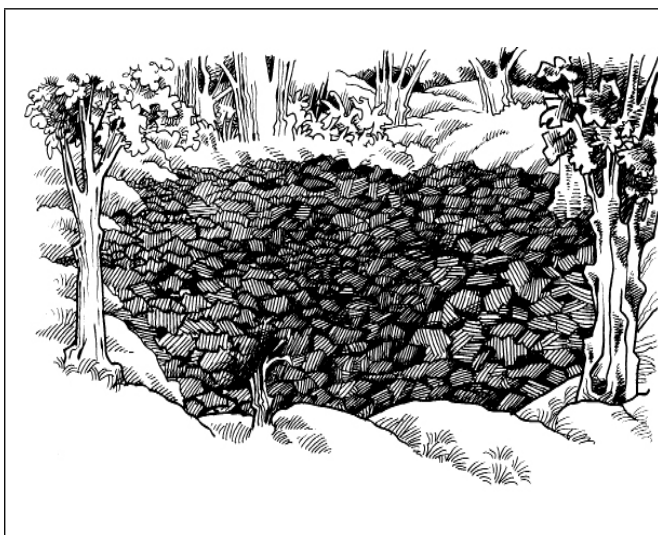
are characterized by large periodic fluctuations of water-table or water level.

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Swamps

are relatively high in nutrients supplied via surface runoff and groundwater from the surrounding land. The water table is usually above that of the ground surface, but there are large, seasonal fluctuations.



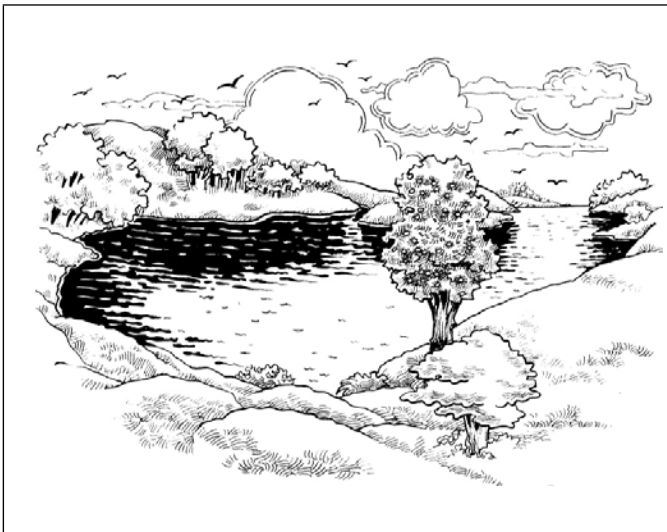
Peat Bogs: (Peat is partially decayed vegetable matter): are peat-accumulating systems fed only by rainwater and thus have very low nutrient levels. They are usually strongly acidic, and water flow is restricted. The water table is either at or just below the surface level and remains relatively constant.



Pond

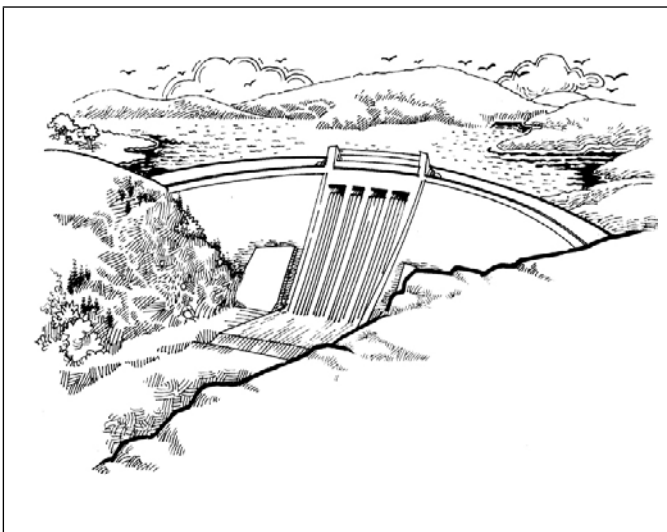
refers to a shallow basin of still water of less than ten surface acres. They may occur naturally, but are often man-made.

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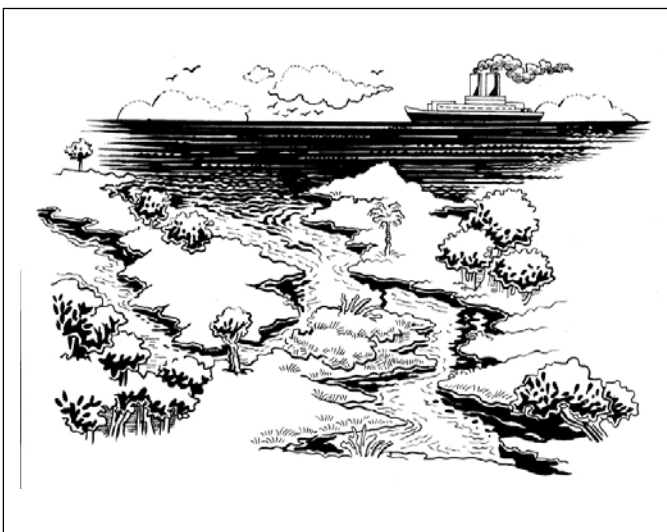
Lake

is a large body of relatively still (usually fresh) water which is nearly or completely surrounded by land. Lakes are characterized by broad basins and may vary in size from approximately ten surface acres to several hundred square miles of surface area.



Reservoir

is similar to a lake, but is the result of human engineering. Reservoirs may consist of a natural basin flooded by the deliberate damming or redirection of natural waterways, or they may be entirely manufactured by mechanically pumping water into large lined basins.



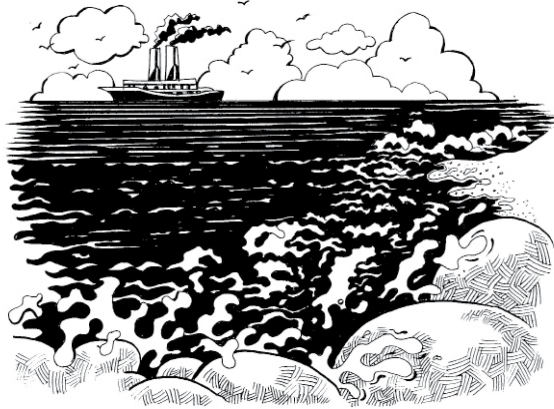
Estuary

is an example of a brackish water body. It is a semi-enclosed coastal body of water formed where a river meets the sea.

Brackish water

is a mixture of freshwater and salt water resulting from mixing of seawater with freshwater (as in estuaries).

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Sea

is smaller than ocean and are usually located where the land and ocean meet. Typically, seas are partially enclosed by land.

Ocean

is a vast body of salt water forming the interconnected waterway that surrounds the entire world.



VALUE OF FRESHWATER

Water

Water is hidden in all that we see around us: food, paper, plastic, clothing and everything else that we use. Water sustains life itself and we use water in our daily life for a variety of purposes like cooking, bathing, cleaning, washing, etc. Water is essential to produce all kinds of products e.g. cultivation of crops such as rice, wheat, etc., production of meat as well as dairy products to mention a few among the innumerable other commercial and consumable merchandise.



Freshwater is a finite resource that needs to be conserved and used carefully for our own future well-being as a species as well as for the well-being of our planet. Water from the Western Ghats supports about 40 crore people (400 million) living in 10 States of South and Central India (Kerala, Tamil Nadu, Karnataka, Goa, Andhra Pradesh, Maharashtra, Madhya Pradesh, Chhattisgarh, Gujarat and Orissa). They are benefited from the water originating in the Western Ghats for all their needs of daily life and development like drinking, transport, irrigation, and hydroelectric power generation, food production and other resource utilization to sustain livelihoods. Over the last few years, we have become aware of the need to account for the various ecosystem services we have been enjoying free of cost. This has resulted in our calculation of carbon footprints and water footprints at various levels (individual, community, business and industry, national and global levels). Such an understanding of the value of these free services from nature in economic terms helps us to be more conscious in our utilization of finite resources.

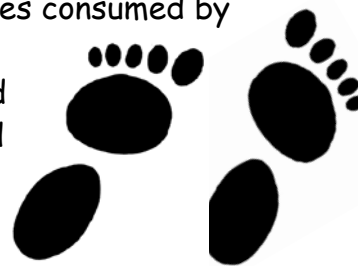


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What is water footprint?

The water footprint of an individual, community or business is defined as the total volume of freshwater used to produce the goods and services consumed by the individual or community or produced by the business.

Water use is measured in terms of water volumes consumed (evaporated or incorporated into a product) and/or polluted per unit of time (waterfootprint.org).



The indirect water footprint of a consumer or producer refers to the freshwater consumption and pollution 'behind' products being consumed or produced. The water footprint of a product (a commodity, good or service) is the total volume of freshwater used to produce the product, summed over the various steps of the production chain. The water footprint of a product refers not only to the total volume of water used; it also refers to where and when the water is used (waterfootprint.org).

For example, to produce One litre of milk, about 1000 litres of water is used, taking into consideration both direct usage and indirect use. A few more examples of everyday products and the amount of water that goes into their production are given below:

Product	Water used (litres)
Beef /300g	4650
Rice/kg	2497
Milk/litre	1000
Coffee/750ml	840
Banana/kg	790
Cane sugar/500g	750
Wheat /500g	650
Bread/500g	650
Potato/kg	287
Tea/750ml	90



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The average water use by an individual in India is estimated to be 147 litres/ person/day (www.data360.org). The lowest estimated cost of ground water in India is 2 Paise per litre. The following simple calculation explains the cost involved in the daily usage of water per day in each State in Peninsular India.

State	Human Population (crore)	Cost/day /Person (Rs.)*	Rs. (crore)
Tamil Nadu	7.21	2.94	21.19
Kerala	3.34	2.94	9.81
Goa	0.14	2.94	0.42
Karnataka	6.11	2.94	17.97
Andhra Pradesh	8.46	2.94	20.90
Maharashtra	11.23	2.94	33.03
Orissa	4.19	2.94	12.33
Chhattisgarh	2.55	2.94	7.49
Gujarat	6.03	2.94	17.75
Madhya Pradesh	7.25	2.94	21.34
Total	56.51		162.24

*147 × 0.02 = 2.94

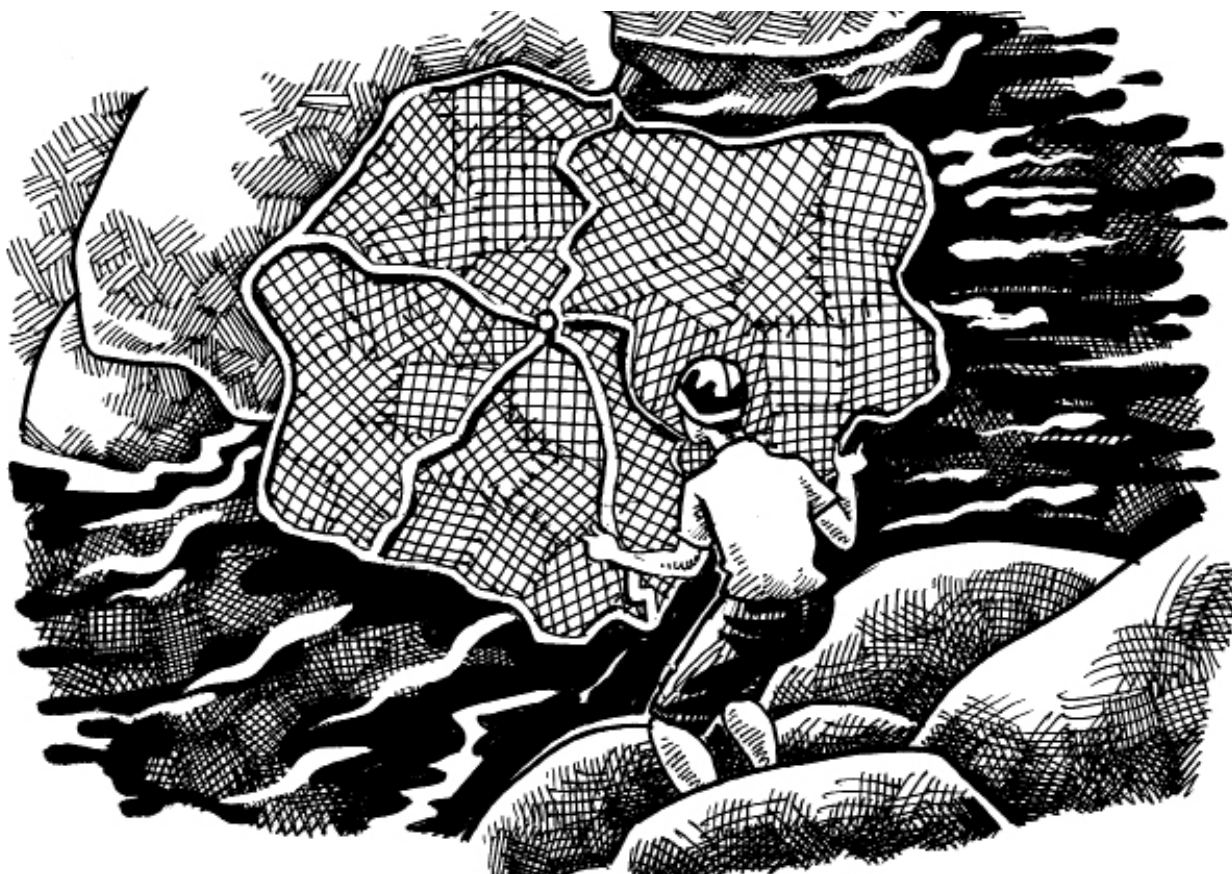


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The 56.5 crore people who live in all the above states use water worth of Rs. 162 crore everyday. Does that sound much to you? The above figure is just the average daily usage by the people. Now imagine the amount of water footprint (direct and indirect usage of water by the consumer and producer).

It has been estimated that daily water required for survival of an individual is 1000 lit/day. At global level, daily water usage ranges from 90-6500 lit/day/ person. This varies depending on a number of factors present in different regions. According to a 2004 calculation, water footprint of India is about 2685 lit/person/day from various water sources, which means each of us uses about Rs. 54 (2685×0.02) worth of freshwater every day. India's population as of 2011 is 121 crore (1.21 bn) and now you can calculate the cost involved in freshwater usage in India.

Water efficiency at all levels - home, city, nation, and planet - is crucial to ensure the security of our water supply. By eliminating water wastage today we can make certain that we will have enough water for tomorrow, and we can make sure that there will be enough to go around to all, including the natural environment in which we live. Thus we have to optimise the use of our water through sustainable practices.



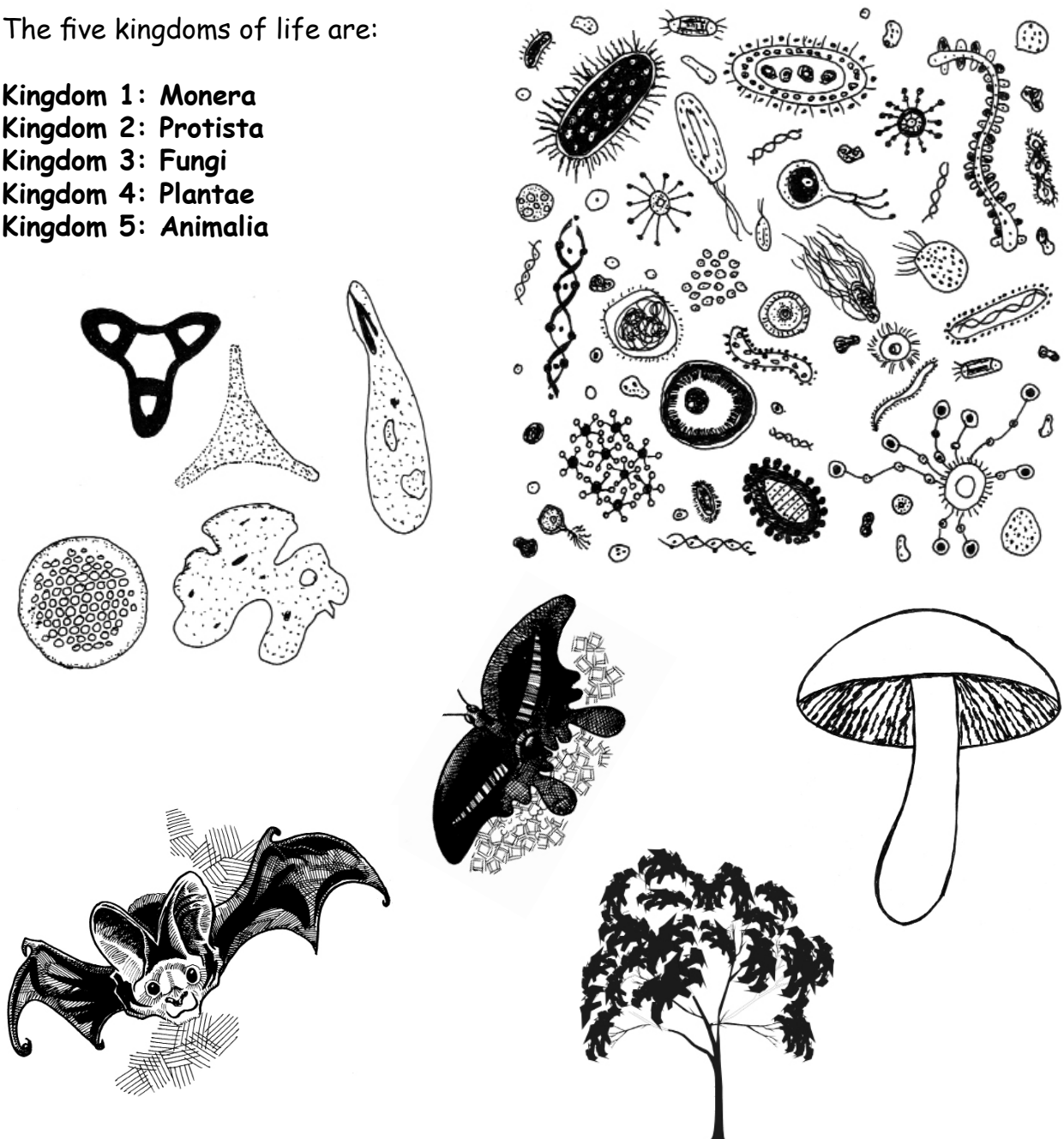
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BIODIVERSITY: 5 KINGDOMS OF LIFE

Scientists have classified all life forms into groups of species with similar characters. There are five major groups which are called Kingdoms.

The five kingdoms of life are:

- Kingdom 1: Monera
- Kingdom 2: Protista
- Kingdom 3: Fungi
- Kingdom 4: Plantae
- Kingdom 5: Animalia



All living organisms are assigned to a particular Kingdom according to certain characteristics. All species in a Kingdom are similar to one another in some way.

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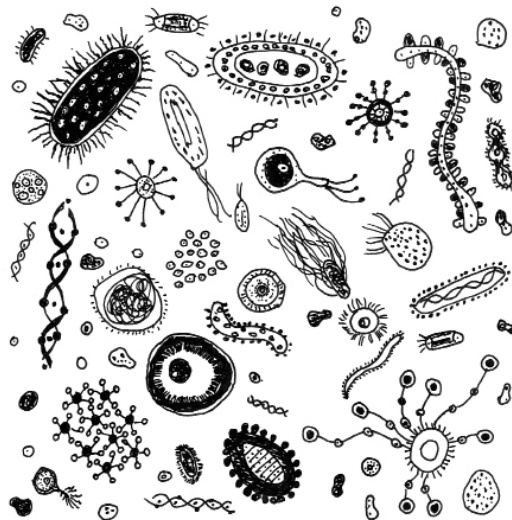
So far scientists, field biologists, and naturalists have discovered about 19 lakh (18,97,000) species on earth. Scientists estimate that the number of species yet to be discovered may be at least 40 lakh species.

Kingdom 1: Monera

(e.g. Bacteria)

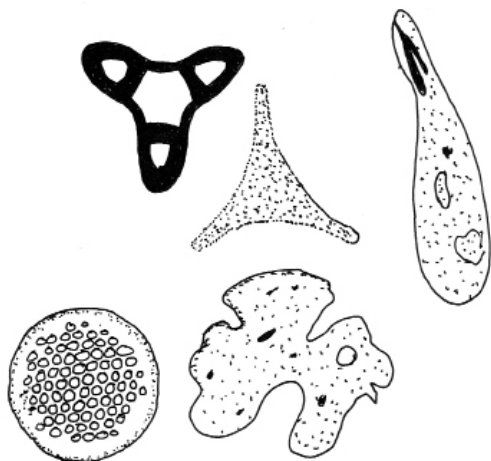
We wash our hands before eating. By doing so you wash the germs off your hands! Those germs are living things called Monerans. They are very, very tiny living things and there are many kinds. All these kinds are grouped under Kingdom Monera.

Monerans are single-celled organisms without even a membrane (sort of skin) around the nucleus (centre). Monerans cannot be seen with the naked eye because they are so small. More than a million of them can fit on the tip of your finger. They are in the air, on our skin, on the surface of plants and roots, in the deepest parts of the ocean and even inside our body. Millions of these bacteria fill the intestines of humans and other animals. In short, Monera (bacteria) can live anywhere. Some of these bacteria do good things like help in digestion, or turn milk into curd. Some of them do bad things, like infect organisms with diseases. Many of them are harmless. So far 9,000 types of Monera are known to science.



Kingdom 2: Protista

(e.g. amoeba, diatom, euglena, paramecium, some unicellular algae). Protists are also single-celled organisms with a nucleus (centre) and a nuclear membrane (skin) around it.



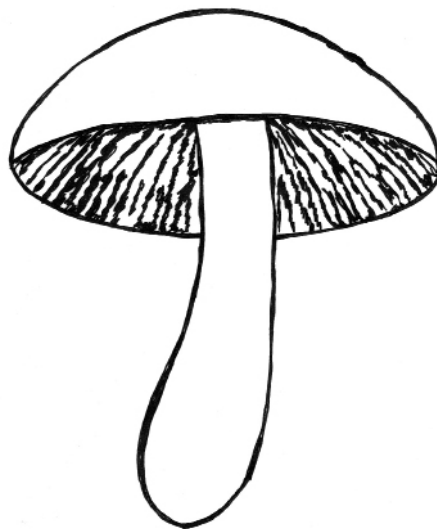
Some protists look like plants and others look like animals but they are all different. They live in moist and aquatic areas. There are about 70,000 kinds of protists reported so far. These are important in ecosystems as primary producers and primary consumers. Some protists are able to cause disease in humans and other animals but overall, protists are beneficial to the living world.

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Kingdom 3: Fungi

(e.g. mushroom, mold, shelf fungus, yeast)

Ask your audience if they have ever bought mushrooms from the market or collected under a bush a day or two after a heavy rain? If you leave bread on the shelf too long, then you can see fungi grown on it. Athlete's foot is a common fungus which feeds on a living host, you! Fungi occur in a wide variety of sizes and shapes. Amazingly, although fungi look like plants they are also closely related to animals. They get their food from other sources since they cannot convert the sun's rays into energy like plants do.



Edible mushrooms are well-known examples of fungi. We use fungi (yeasts) to make bread, in fermenting beverages and for producing medicines like penicillin. Fungi have long been used for production of antibiotics, vitamins, anti-cancer and cholesterol lowering drugs. So far 72,000 fungi are known to science.

Kingdom 4: Plantae

(e.g. trees, ferns)

A day for you and me will not pass without using plant or plant products. Plants include familiar organisms such as trees, herbs, bushes, grasses, climbers, ferns etc. All food required for most of the life on earth are obtained through plants by a process called photosynthesis. Plants use the energy of the Sun to convert water and carbon dioxide into sugar and oxygen, without which we cannot live.



Plants are responsible for most of the photosynthesis process though some Protists and Monerans can also perform photosynthesis. Plant products such as wood are used for buildings, furniture, paper, cardboard, musical instruments and sports equipment. They also provide cloth, fuel, medicine, natural products such as fibers, cooking oils, drugs, etc. Kingdom Plantae includes about 2.7 lakh species.

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Kingdom 5: Animalia

(e.g. bird, fish, insect, bat, man)

Animals are seen everywhere including our home. When you think of an animal you might think only of bigger animals like tigers, elephants and horses. Vertebrates such as mammals, birds, amphibians, reptiles and fish occupy only 2% of all animals reported so far. The rest are animals without backbones like insects, crabs, spiders, and millipedes. Animals are classified into vertebrates (animals with backbones) and invertebrates (animals without backbones).

There are 29 major groups among invertebrates and 5 groups among vertebrates.

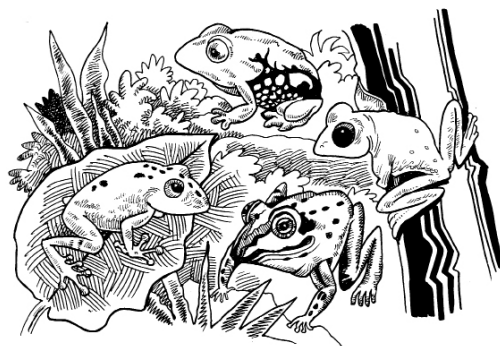
The vertebrate groups include fish, amphibians, reptiles, birds and mammals. Crabs, dragonflies, butterflies, beetles, earthworms and spiders are some examples of invertebrates. So far, about 14,76,000 kinds of animals are known to science and man is just one species among all living things.

Classifying living things

The living things on our planet evolved and adapted themselves to live according to the environment. During the process of evolution different species appeared. All living things are interconnected with other species and non-living things and they function well to run the ecosystem.

Scientists believed that there are about 5 million separate species living on the planet, but today, some scientists think there may be as many as 30 million species. We human are one of those millions of species. We are different from the rest of the species since we have the ability to change the planet in dramatic ways that affect many other living things.

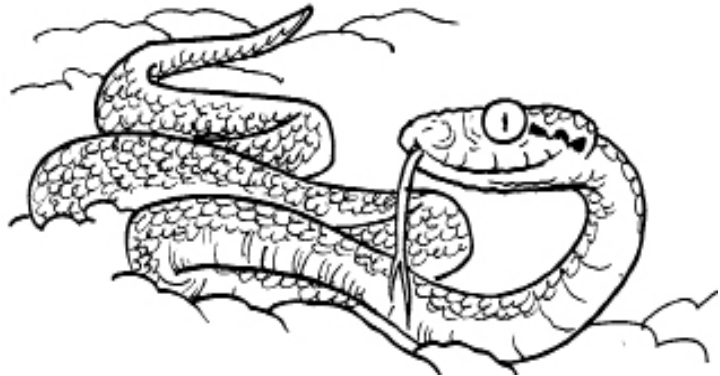
One may ask why we should understand how nature works and where we fit in? We need to know about nature in order to care for our world and we cannot do that without knowing about those other species and how they are linked with.



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What is the need to classify living things and how?

Carl von Linne in 1758 established a system to organize (classify) living things into groups based on their relationships. This system of uniform organisation is called taxonomy: the classification of living things. Taxonomy is a critical part of our understanding of life on Earth. It reveals the order and the diversity in the teeming life around us. Under this system, every living thing is given a unique classification. At one point of time there was no such system. A scientist studying a snake in Northeastern India would have referred to a snake as 'Naga sarpa', a scientist in Southern India would have referred to the same snake as a "Naagam" and a scientist in Bangladesh might have labeled it in a Bangla name. This type of confusion led to pressure to develop a universal language for scientists. Today, all scientists are using the universal system of giving a unique scientific name to each species e.g., The Indian cobra is named *Naja naja*.



How do taxonomists, the scientists who study classification of living things go about their work? They group similar kinds of creatures together based on their evolutionary relationships. It may sound simple; but it is not. The similarities and differences between species can be very difficult to detect, and taxonomists often disagree.

Seven Major Levels of Classification

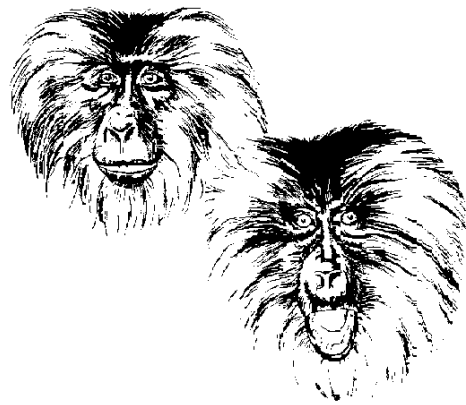
The seven major levels of classification from largest to smallest are: Kingdom, Phylum, Class, Order, Family, Genus, and Species. Each level can be divided into clusters of organisms that are most closely related. These clusters form the next level of classification. For example, each kingdom is divided into smaller phyla, each phylum into classes, each class into orders, and so on all the way to species.

Another way to describe the different classifications is in terms of shared genetic material. The creatures at each level share a greater proportion of genetic material than those at the level below them. It is for this reason that an understanding of species is so important: each species represents a unique and irreplaceable genetic resource. The concept of biodiversity cannot be properly understood without an appreciation of the species.

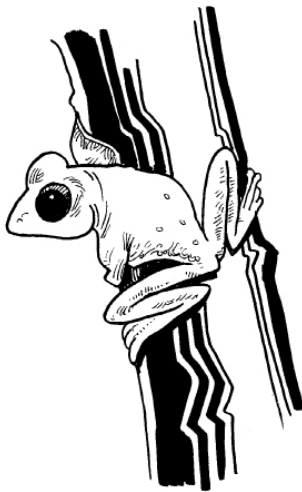
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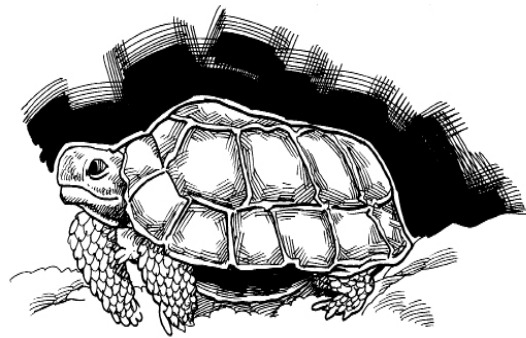
Squirrel



Lion-tailed macaque



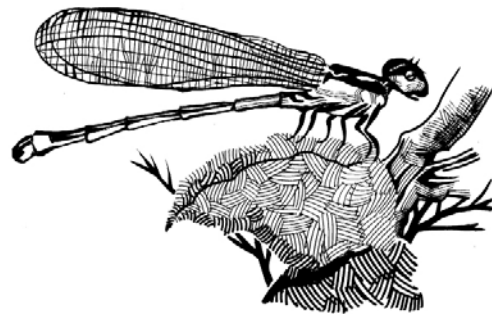
Frog



Turtle

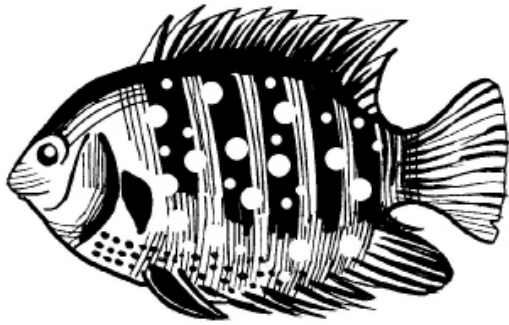


Snail



Damselfly

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Fish



Human



Lily



Water grass

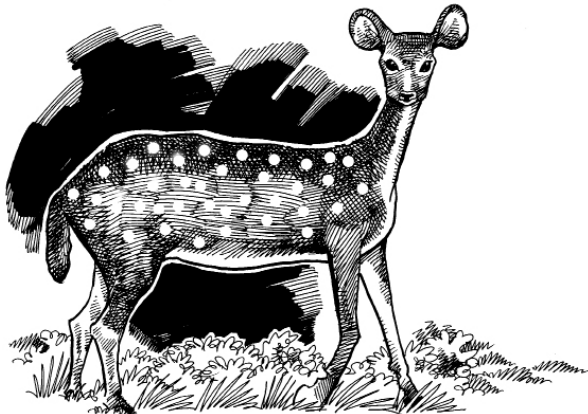


Bird



Bull

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Deer



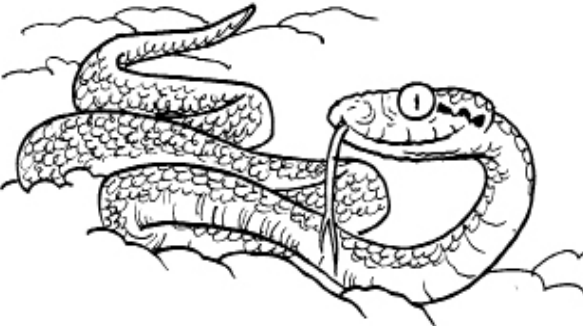
Otter



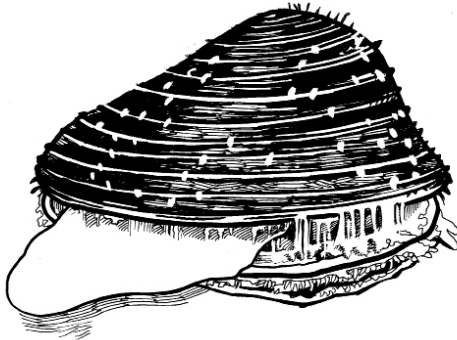
Dragonfly



Slug



Snake



Bivalve

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WESTERN GHATS: REGION DELINEATION, HABITATS AND FRESHWATER SYSTEMS

The Western Ghats may be divided into three major regions.

Surat to Goa

Goa to Nilgiri mountains

South of Palghat Gap

The Western Ghats region between Surat to Goa touches the coast for almost 600 kms and hence the name 'Ghats', meaning 'steps of a stair case'. Its elevation generally ranges between 700 and 1,000 m. However, some of the semi-evergreen forests namely Kalsubai and Mahabaleshwar have higher peaks of 1,646 m and 1,438 m respectively. The coastal zone between this region is called Konkan coast. It is a narrow region 50-60 km wide and made up of a series of more or less high hills.

The mountain heights from Goa to Nilgiri becomes more irregular. From Kudremukh upto the Palghat Gap the edge of the plateau is very often higher than 1,000 m and the peaks become more numerous and higher reaching up to 2,339 m at Vulva Mala at the edge of the Wayanad Plateau. The Nilgiri mountains reach a maximum height of 2,637 m at Dodda Betta.

The Western Ghats are interrupted by the Palghat Gap which is about 30 km wide. Anaimudi peak is the highest peak in south India that reaches a height of 2,695 m. Another popular peak namely Agasthyamalai (1,869 m) lies between Shencottah Pass and Kanayakumari.

The Western Ghats, based on their species and habitat values, have been identified as a potential forest World Heritage site and very recently in May 2011, IUCN has nominated Western Ghats in the list of World Heritage sites.

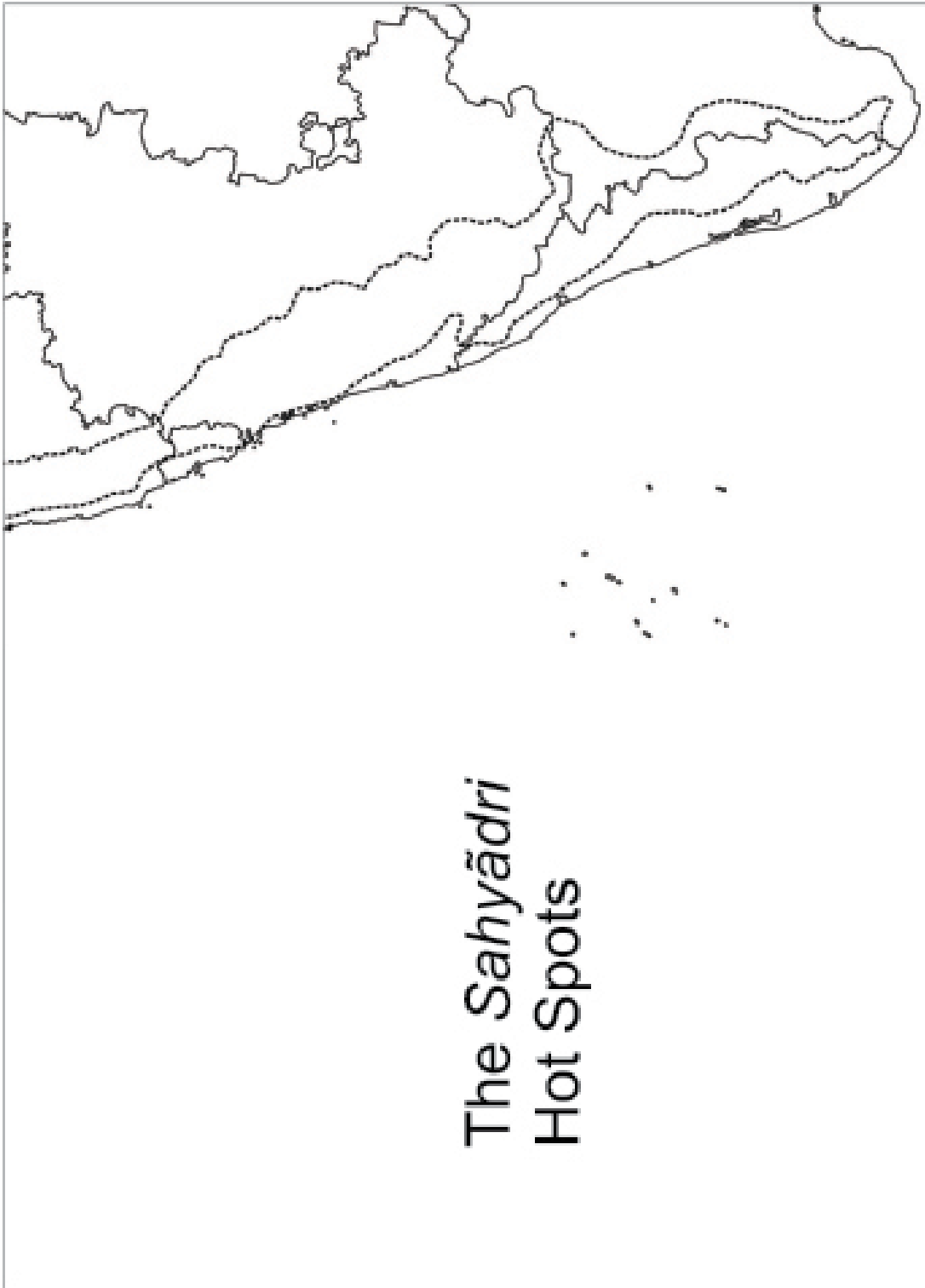


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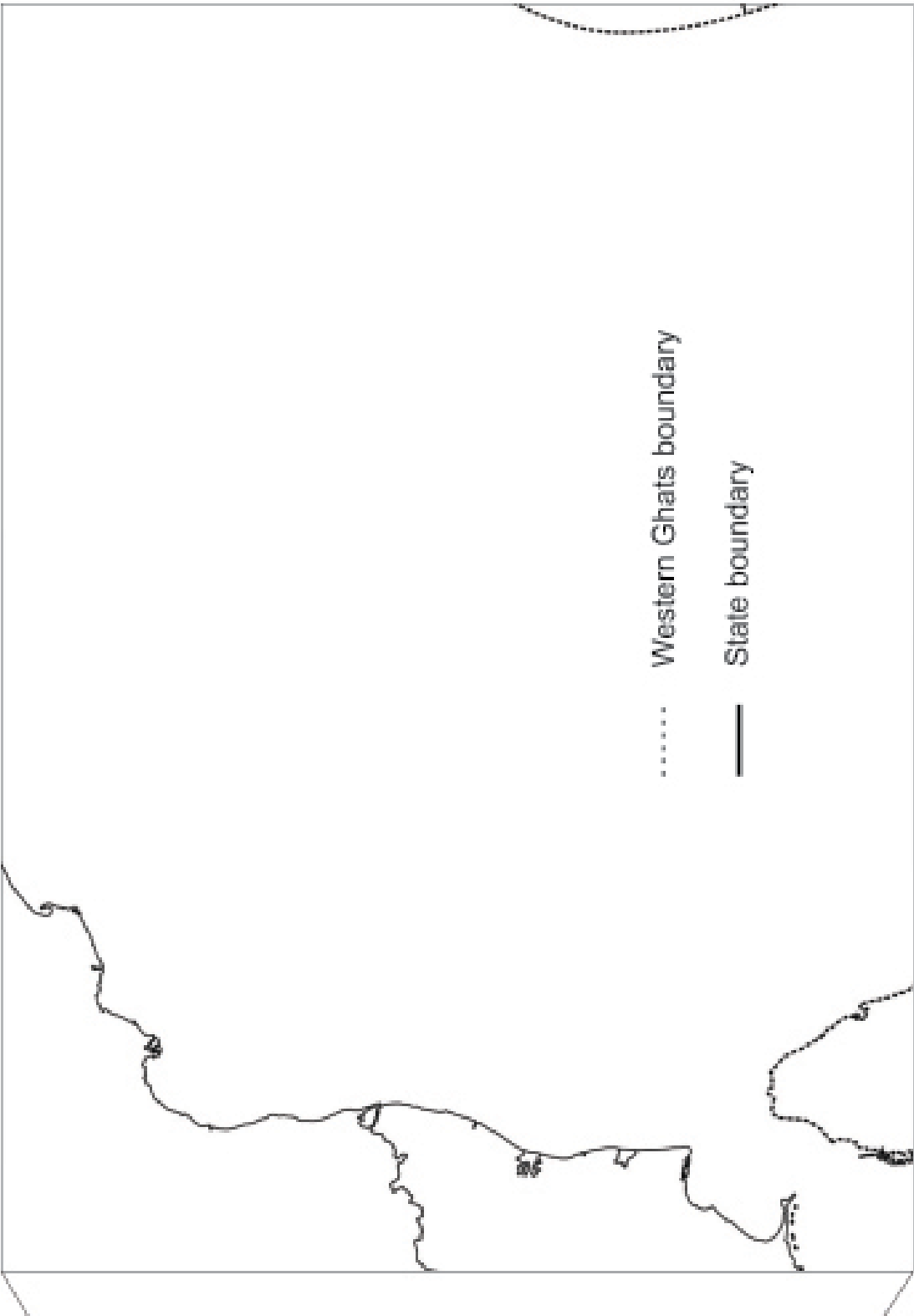
Instructions:

1. Take photocopies of the Western Ghats maps given on pages 51 to 58.
2. Take multiple copies as per the total number of groups formed.
3. Give the maps to be assembled of Western Ghats hotspots and Western Ghats river systems.
4. Give your audience ten minutes to read the map. Ask them to do the following in groups.
 - i) write down the list of States having Western Ghats hotspots.
 - ii) list and identify the regions of Western Ghats (central, southern and northern region).
 - iii) estimate the total area of the Western Ghats.
 - iv) list State wise rivers of Western Ghats.
5. Lead a discussion with the group. Ask them to think of the threats for the species of WG particularly to freshwater species.
6. The Western Ghats region is still reported to be dwindling. Why?
7. It has been estimated that nearly 40% of the forest cover in the Western Ghats was lost between 1920 and 1990. Discuss with them the impact of habitat loss on species and extinction. What could be the cause for this?





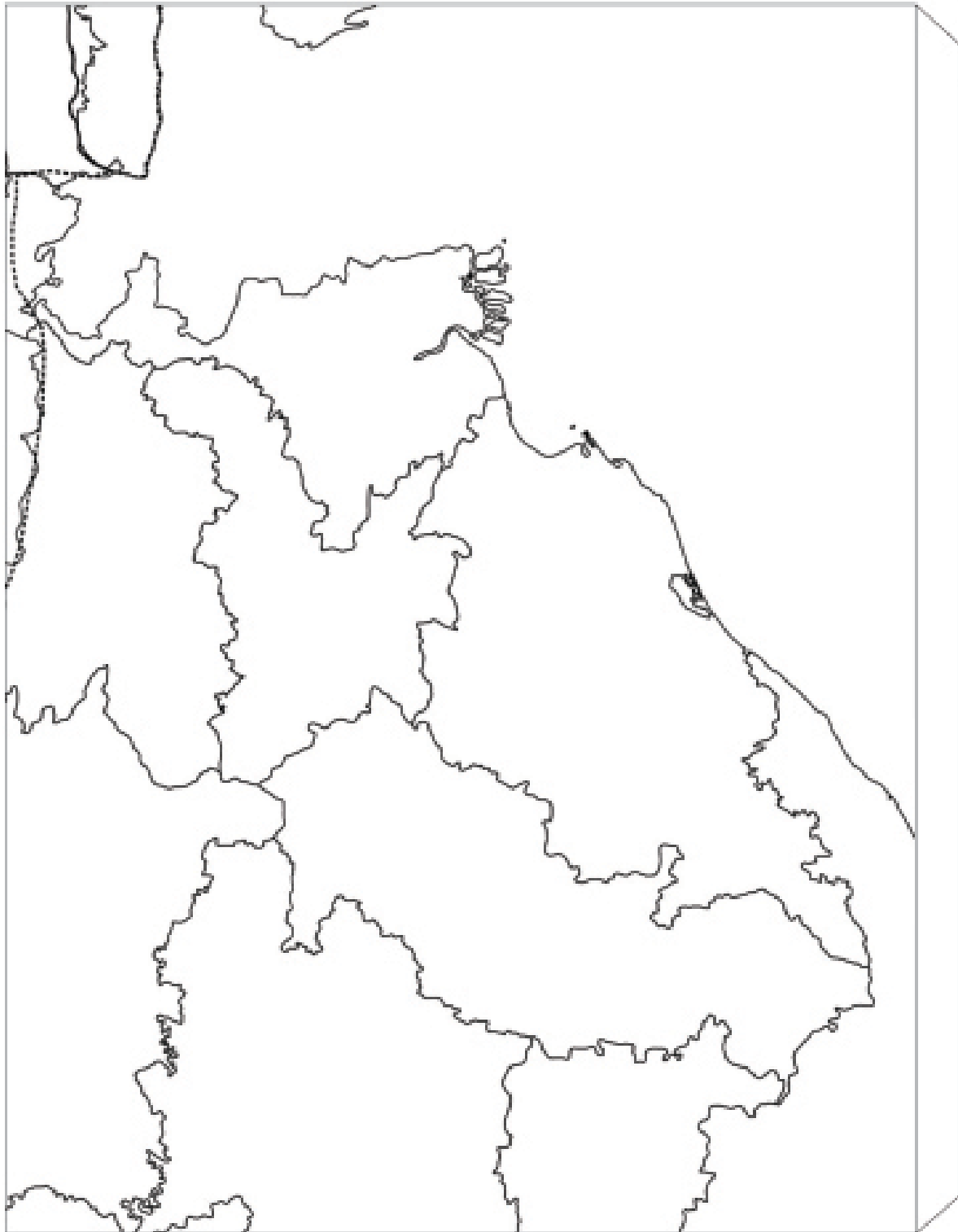
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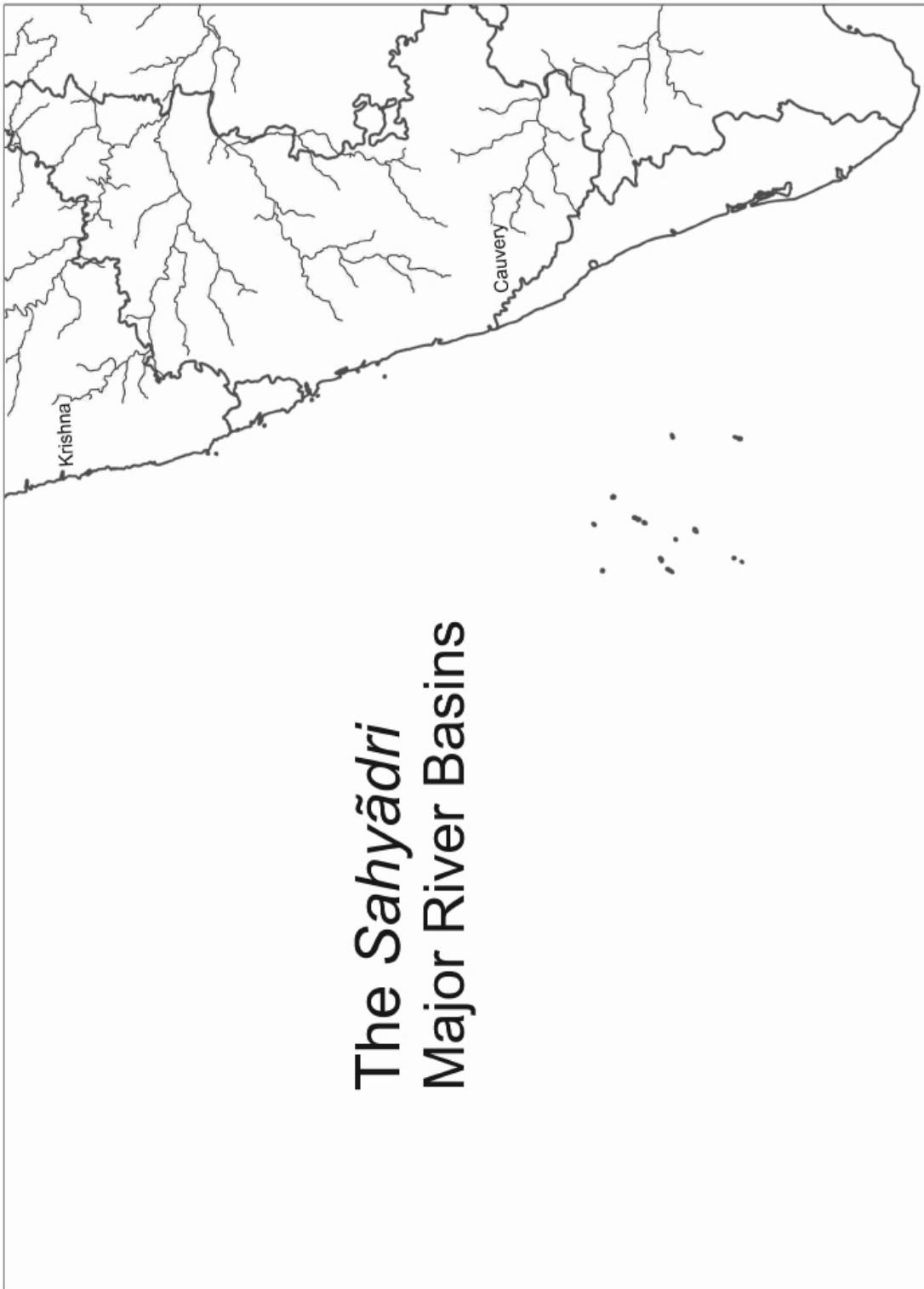


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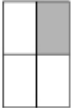
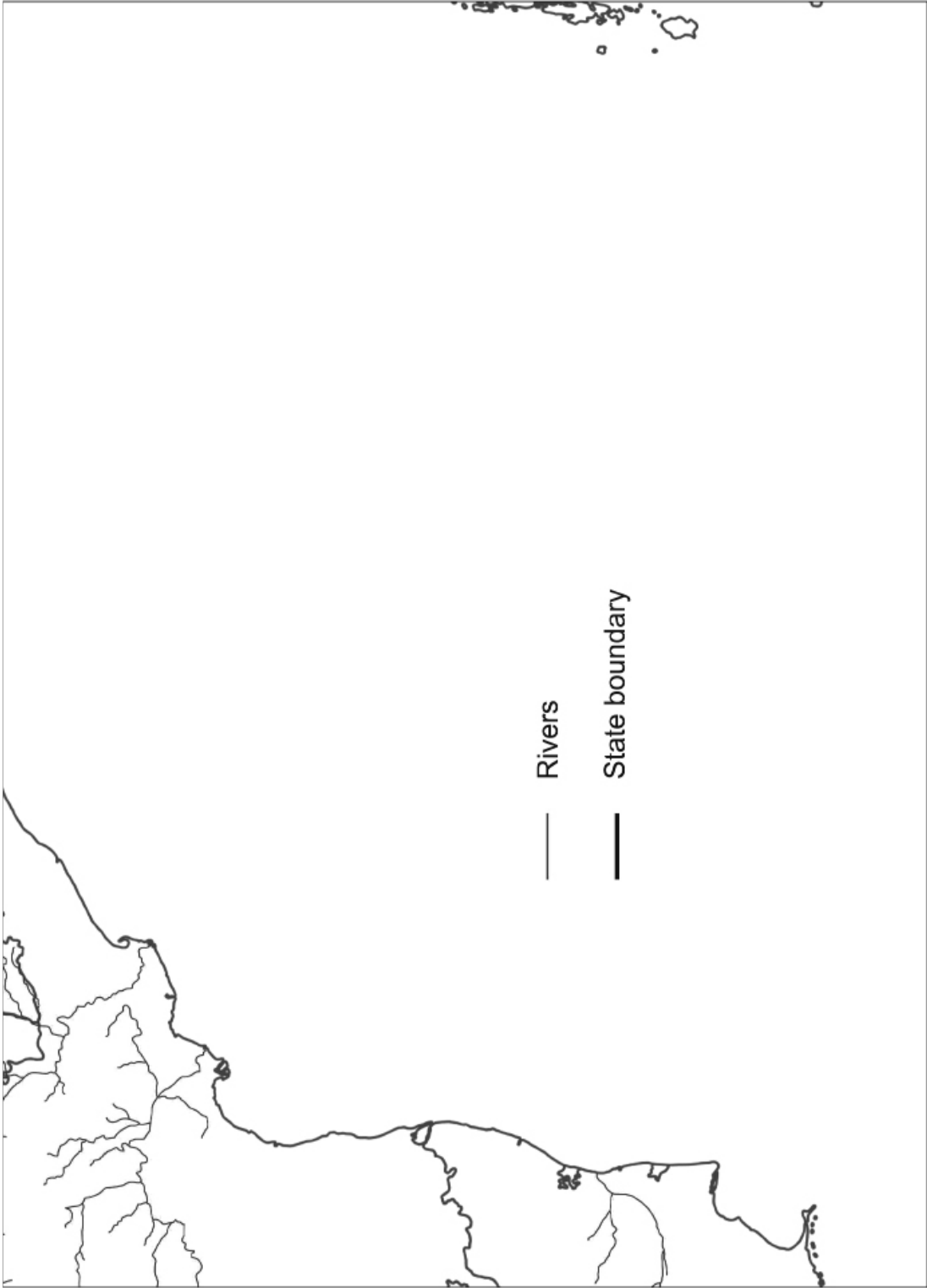


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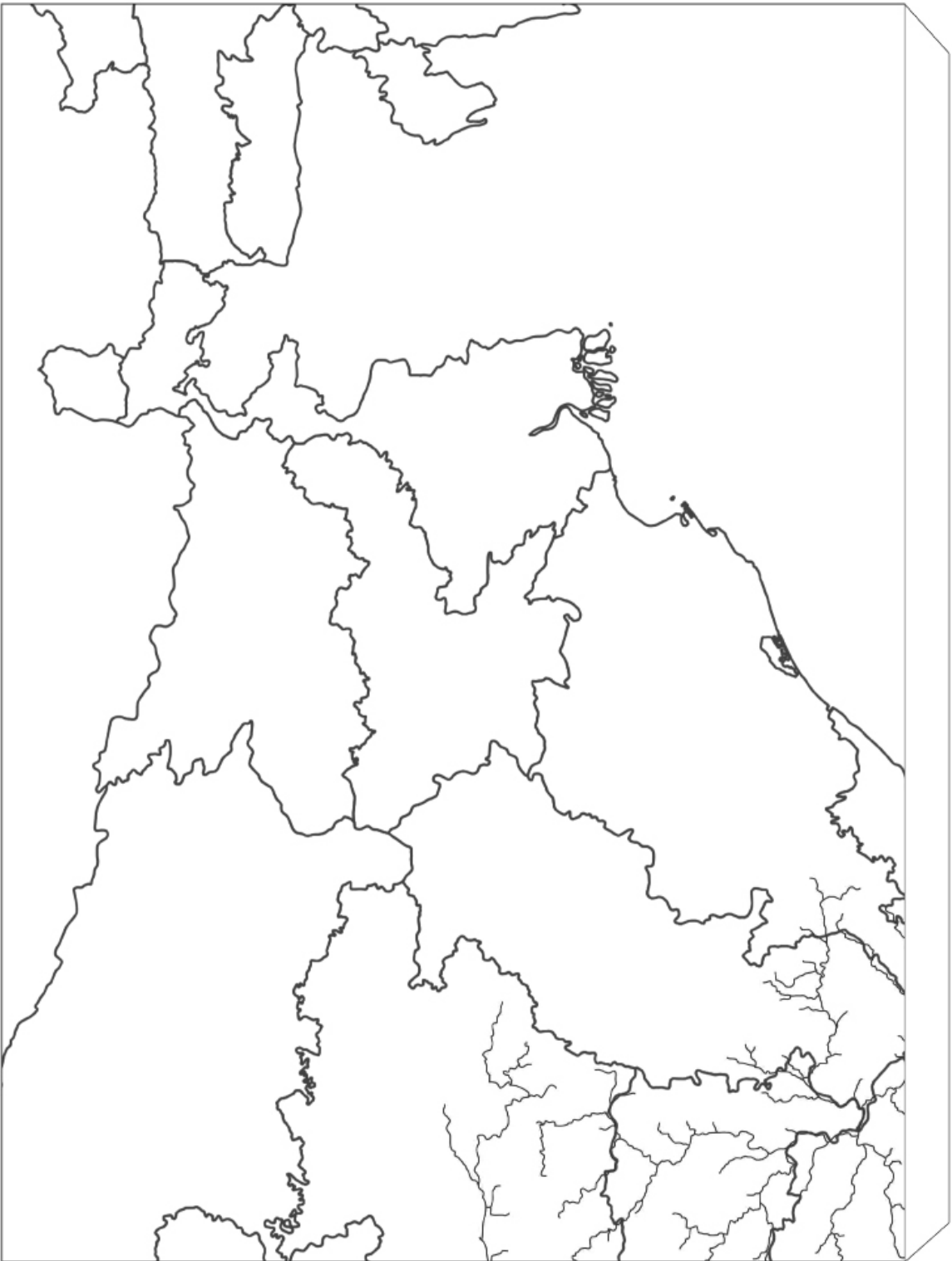
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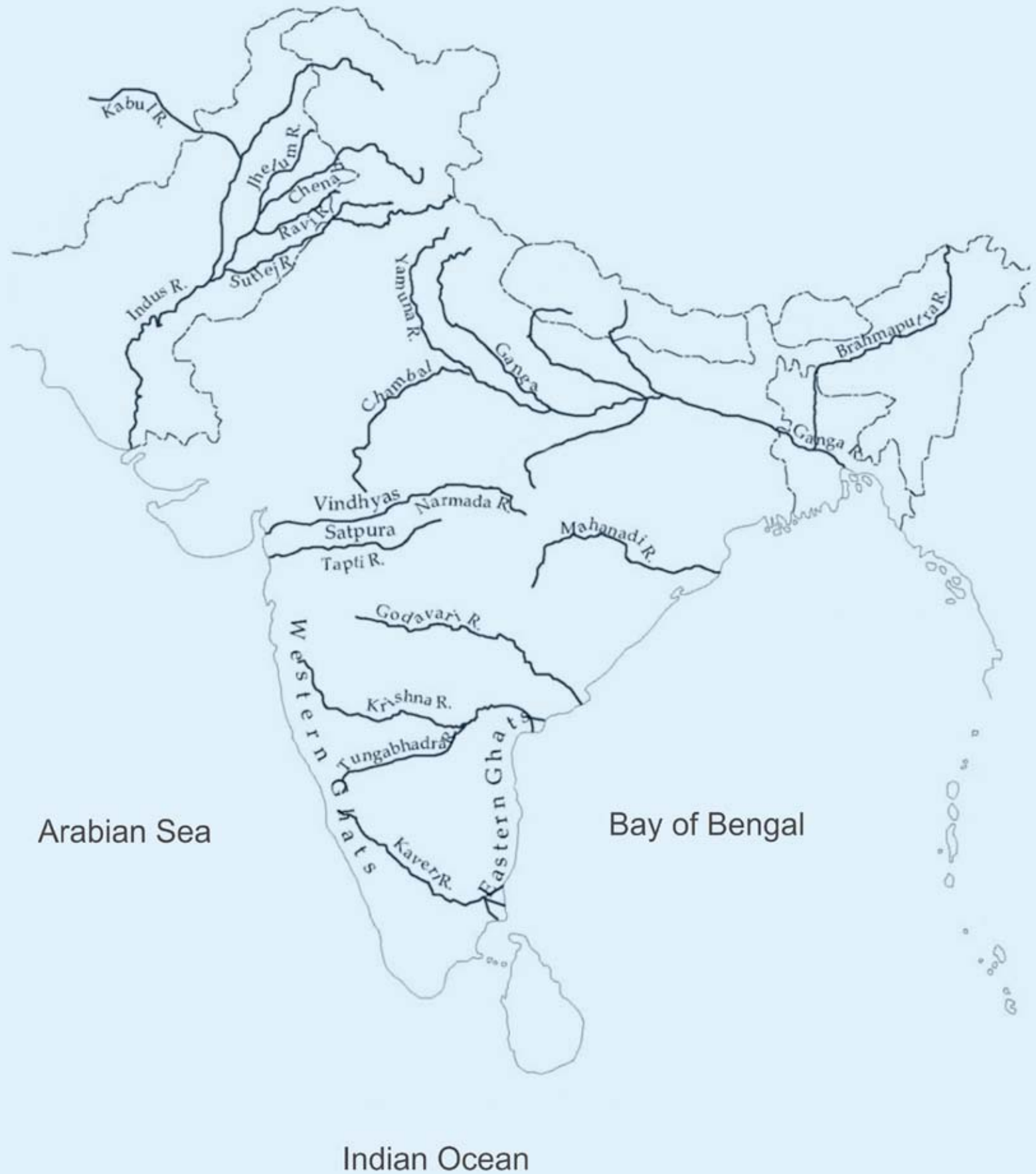
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Major River Systems of India



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WESTERN GHATS: RIVER SYSTEMS

We learned from the map activity that Western Ghats is the main source of water for Peninsular India. It is the place of origin of many rivers that together provide the bulk of utilizable surface water available in South India. Western Ghats is the place of origin for both east and west flowing rivers. These rivers traverse great distances in 10 Indian States.

East flowing rivers in Western Ghats

Three major rivers that originate in the Western Ghats and flow to the east are:

1. *The Godavari*
2. *The Krishna*
3. *The Kaveri*

The Godavari

The Godavari is second largest next to River Ganga in India and first largest in Southern India with a length of 1465 km. It starts in the Tryambak (Trimbak) plateau near Nasik, Maharashtra and flows eastwards through Andhra Pradesh before flowing into Bay of Bengal. River Godavari has many tributaries namely: Purna, Manjra, the Pranhita (Penganga - Wardha), Indravati, the Sabari, Darna, Kadwa, Mula, Karanji, Madhurnala, Devanala, Hebbala, etc. The entire river system has a drainage area of 312,812 sq. km. which is greater than the area of Madhya Pradesh or Germany.

The Krishna

The Krishna is the third largest river in India after Ganga and Godavari and second largest river in Southern India with a length of 1,400 km. It starts in Mahabaleshwar, Satara district, Maharashtra and flows eastwards through Karnataka and Andhra Pradesh before flowing into Bay of Bengal. River Krishna has many tributaries namely: Tungabhadra, Kudali, Veena, Koyna, Bhima, Malaprabha, Ghataprabha, Yerla, Warna, Dindi, Paleru, Musi, Urmudi, Tarli and Dudhganga river. The entire river system has a drainage area of 258,948 sq. km which is greater than that of Uttar Pradesh or United Kingdom.

The Kaveri

The Kaveri (Cauvery) is the third major river in Southern India with a length of 765 km. It starts near Talakaveri, Kodagu district in Karnataka and flows eastwards through Karnataka and Tamil Nadu before flowing into Bay of Bengal.

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Kaveri has many tributaries namely: the Shimsha, Hemavathi, Arkavati, Honnuhole, Harangi, Kabini, Lakshmantirtha, Lokapavani, Noyyal, Moyar, Amaravathi and Bhavani. The entire river system has a drainage area of 81,155 sq. km. which includes four states (Karnataka, Tamil Nadu, Kerala and Pondicherry) which amounts to an area lesser than that of Arunachal Pradesh or UAE.

Other east flowing smaller streams that originate in the Western Ghats are Thamiraparani and Vaigai River.

The Thamiraparani (Tambraparni)

The Tambraparni River rises on the eastern slopes of the Western Ghats near Agasthyamalai in Tirunelveli district, Tamil Nadu and has a length of 125 km. River Tambraparni enters the Gulf of Mannar near Palayakayal. This river has many tributaries which are: Peyar, Ullar, Karaiar, Pambar, Servalar, Manimuthar, Gadana, Pachaiyar and Chittar.

The Vaigai

The Vaigai River arises in the Varushanad Hills of the Western Ghats and initially flows north-east and then flows eastward then again it bends south east, passing Madurai town and empties into Bay of Bengal. It has a total length of 190 km.

The West-flowing rivers in Western Ghats

From Gujarat to Kerala a number of rivers arise and flow to the western side of the *Sahyādrī* and they are either perennial or non-perennial and torrential rivers. These swift west-flowing rivers flow into the Arabian Sea.

These rivers form estuaries, unlike the east flowing rivers which form deltas. Estuary is a channel where the freshwater of the rivers mix with the tidal seawaters. Delta is a triangular tract of sediment deposited at the mouth of a river, typically where it diverges into several outlets.

There are many west flowing rivers in the *Sahyādrī*. Kerala alone has 41 west flowing and 3 east flowing streams (See appendix).

The main west-flowing rivers in the WG are listed here.

Gujarat: Auranga, Par, Purna

Maharashtra: Surya, Vaitarna, Damanganga, Ulhas, Savitri, Vashisthi, Gad, Kajavi, Kodavali

Goa: Mandovi (Mahadayi), Zuari, Tiracol, Chapora, Talpona

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Karnataka: Kali, Gangavali (Bedthi), Aganashini, Sharavathy, Kollur-Chakra-Gangoli, Sita, Mulki, Gurupur, Netravathi

Kerala: Chaliar, Bharatpuzha, Periyar, Pamba.

Two other major rivers namely Tapti and Narmadha runs from east to west touching Madhya Pradesh, Maharashtra and south Gujarat emptying into the Arabian Sea.

The Tapti (Tapi)

The Western Ghats range originates from south of river Tapti in a place bordering Gujarat and Maharashtra. Tapti is one of the major rivers in Peninsular India passing through Maharashtra and south of Gujarat with a length of about 724 km.

The Narmada (Rewa)

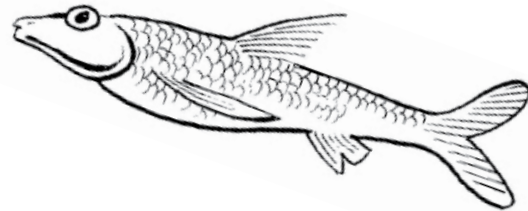
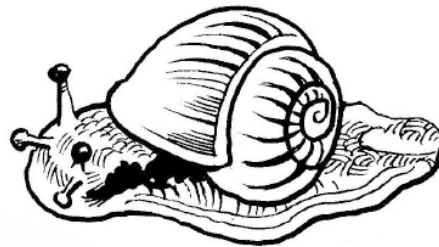
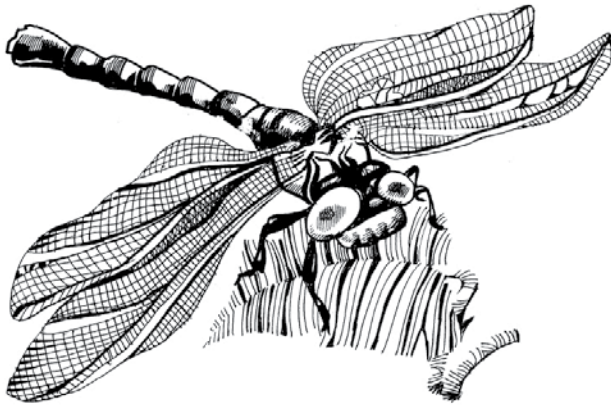
River Narmada forms the traditional boundary between northern and southern India. It originates from Amarkantak hill, in the Annupur district of Madhya Pradesh. This is the third longest river in peninsular India with a length of 1,312 km. The river system has a drainage area of 98,800 sq km. covering large areas in the states of Madhya Pradesh, Gujarat and Maharashtra.





Unit 3

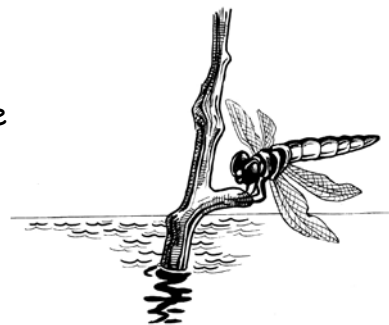
KNOW YOUR SPECIES



Dragonflies and Damselflies
Snails, Slugs and Mussels
Freshwater Fish
Water Plants
Illustrated History of *Sahyādrī*
and Freshwater Species

Dragonflies and Damselflies

Dragonflies and Damselflies are common insects seen around us flying over water bodies, forests and fields. Both the groups together are termed Odonates. The life history of Dragonflies and Damselflies are closely linked to freshwater habitats and the welfare of odonates is very important since they form an important link in freshwater ecosystems. To help them survive, it is essential that we learn more about them.



How they are locally called?

Gujarati: *Paniwalo bhamro*

Kannada: *Tumbi, tumbe, dumbi*

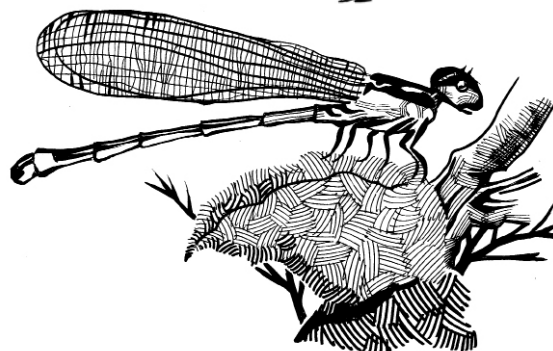
Konkani: -

Malayalam: *Thumbi*

Marathi: *Chathur, sui*

Tamil: *Thumbi, thataan, oosithattan*

English: Dragonflies and Damselflies



How to differentiate Dragonflies from Damselflies?

Dragonflies

Adult:

- Body long and stout
- Wings spread out at rest
- Fore wings and hind wings unequal in size
- Hind wing broad at base
- Strong fliers
- Eyes are large and usually touch each other

Nymphs (Aquatic larvae)

- Stout, robust body
- Respiratory gills not visible externally

Damselflies

Adult:

- Body long, slender and delicate
- Wings usually held together over abdomen
- Fore wings and hind wings approximately of the same size and shape
- Wings narrow at the base
- Weak fliers
- Eyes are smaller and separated, never touching

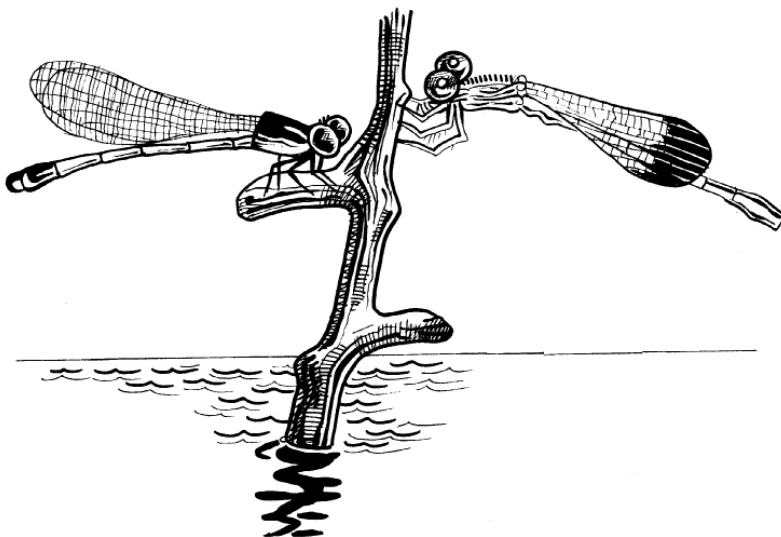
Nymphs (Aquatic larvae)

- Slender, fragile body
- 3 gills visible externally (at the end of the abdomen)

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Odonate facts:

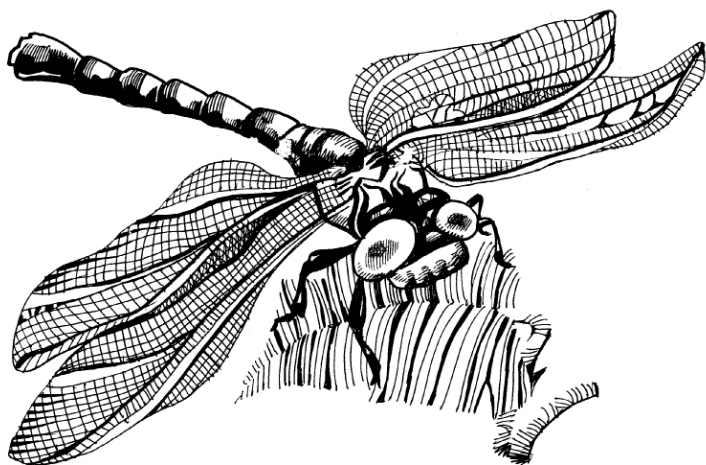
Globally there are about 5740 species of Odonates. (Dragonflies: 2941; Damselflies: 2739; Anisozygoptera: 2). In India about 500 species have been reported so far (Dragonflies: 267; Damselflies: 195; Anisozygoptera: 1). In Western Ghats there are 174 Odonates of which 69 are endemic.



Prehistoric dragonflies were much larger and the largest documented dragonfly had a wingspan of about 70-75 cm. The size of the present day odonates ranges from 2 cm to 20 cm.

Dragonflies are among the fastest flying insects in the world reaching speeds of over 48 km per hour. Their four wings allow them to move sideways, backwards and to hover in one place. And they can do all of these movements quickly and accurately, which makes them well suited to eat other insects right out of the air. Their flight abilities are the inspiration behind inventions such as the helicopter.

To aid their aerial lifestyle, odonates have large, compound eyes made up of thousands (up to 30,000) of smaller eyes (facets/lenses) that allow them to see in all directions.



Dragonflies and damselflies inhabit freshwater habitats like ponds, streams, marshes, swamps and wetlands. Adults are aerial predators while the young ones (nymphs) are predators in water. Males spend significant amounts of time defending their egg laying sites near ponds or streams. The eggs are laid in water or near water as the nymphs are aquatic in habit.

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Depending on the species the longevity of nymphs may last from a few weeks to a year. Adults survive for a few weeks.

Groups of dragonflies are called swarms and they are known to migrate.

Watching dragonflies, similar to bird watching, is called 'oding' (from the order classification Odonata).

They form an extremely important link in the ecosystem with their roles as predators and prey. As predators they feed on small flying insects and help in controlling pest insects such as mosquitoes and midges; as prey they form an important prey base to other animals such as fish, birds and spiders. Being very sensitive to changes in the environment, they are valuable as biological indicators, helping us monitor the health of our freshwater bodies.

Threats:

Construction of dams, pollution, soil erosion, deforestation, sand mining are among the major threats to the survival of dragonflies and damselflies as they are highly sensitive to changes in their environment.





Dragonflies

Damselflies



Anaxidae
Anax parthenocera



Dorsoniidae
Pantodonella aestiva



Gomphidae
fulvipes



Gomphidae
Paragomphus sikkim



Libellulidae
Erythrogastra erythrogastra ♀



Libellulidae
Erythrogastra erythrogastra ♂



Libellulidae
Erythrogastra erythrogastra ♀



Libellulidae
Erythrogastra erythrogastra ♂



Libellulidae
Neurobachia bella ♀



Libellulidae
Neurobachia bella ♂



Libellulidae
Cyathiger cyathiger



Libellulidae
Polyura cyathiger



Libellulidae
Parva parva



Libellulidae
Parva parva ♂



Libellulidae
Parva parva ♀



Libellulidae
Thalys thalys



Libellulidae
Thalys thalys



Libellulidae
Thalys thalys



Libellulidae
Thalys thalys



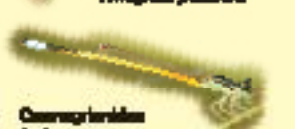
Calopterygidae
Maculata maculata



Calopterygidae
Libellula libellula



Calopterygidae
Libellula libellula



Calopterygidae
Libellula libellula



Calopterygidae
Libellula libellula



Calopterygidae
Libellula libellula



Calopterygidae
Libellula libellula



Calopterygidae
Libellula libellula



Calopterygidae
Libellula libellula



Calopterygidae
Libellula libellula



Calopterygidae
Libellula libellula



Calopterygidae
Libellula libellula



Calopterygidae
Libellula libellula

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Snails, Slugs and Mussels

Molluscs are a group of organisms that have soft bodies. They are found in a variety of habitats from terrestrial mountaintops to deep sea. The group includes snails, slugs, mussels, octopuses, squid, clams, scallops, oysters, and chitons. Two major groups of Mollusca are Gastropoda (snails, slugs) and Bivalvia (mussels, clams, scallops). A hard shell covers the bodies of most molluscs. Snails and slugs have distinct "head" and "foot" regions. Here our focus of interest is on freshwater snails, slugs and mussels.

How they are locally called?

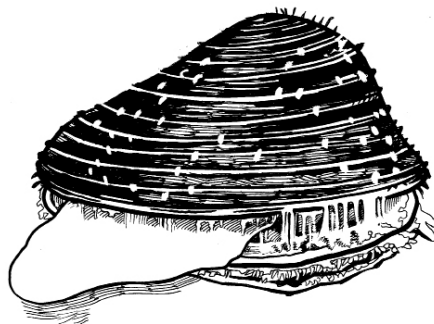
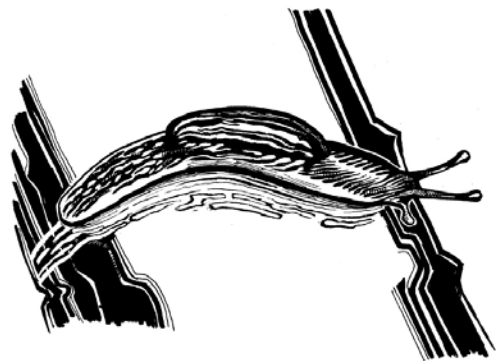
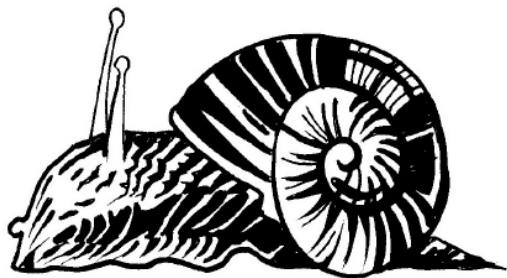
Gujarati:	<i>Gokalgoi</i>
Kannada:	<i>Basavana Hulu, Shankada hulu, Shambuka</i>
Konkani:	<i>Kongo</i>
Malayalam:	<i>Ochu (Snail)</i>
Marathi:	<i>Gogalgaay</i>
Tamil:	<i>Nathaai (Snail), Nanneer matti (Mussel)</i>
English:	Snails, slugs, oysters, mussels, scallops

Gastropoda

- One shell, spiraled (snail)
- Shell-less, soft slimy body (slug)
- Grazers, browsers

Bivalvia

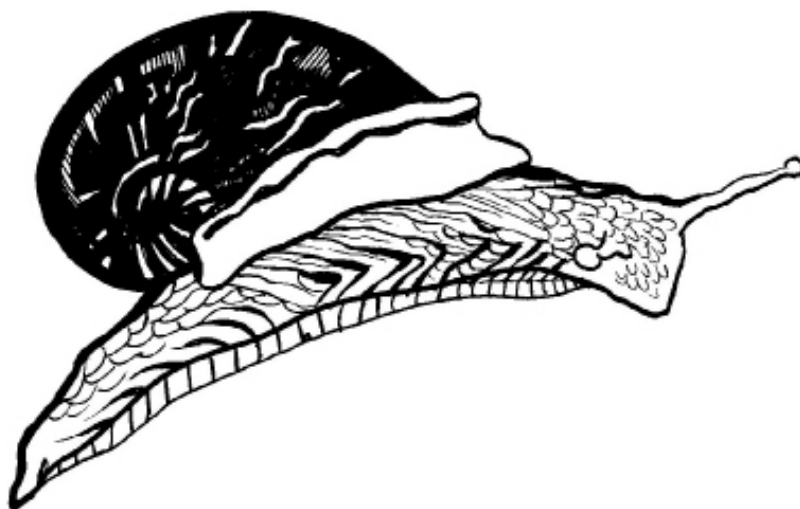
- Two shelled
- Filter feeders



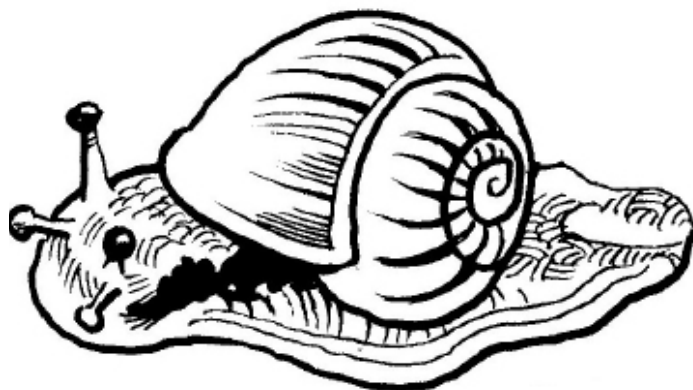
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Mollusc facts

Globally there are about 5000 species of freshwater molluscs. In India about 214 species have been reported so far. In Western Ghats there are about 60 freshwater molluscs.



Freshwater molluscs are seen in ponds, lakes, streams and rivers, wetlands and marshes. Molluscs are important as prey source for higher animal taxa, thus forming an important link in the ecosystem. They offer significant service by cleaning harmful bacteria and parasites from water.

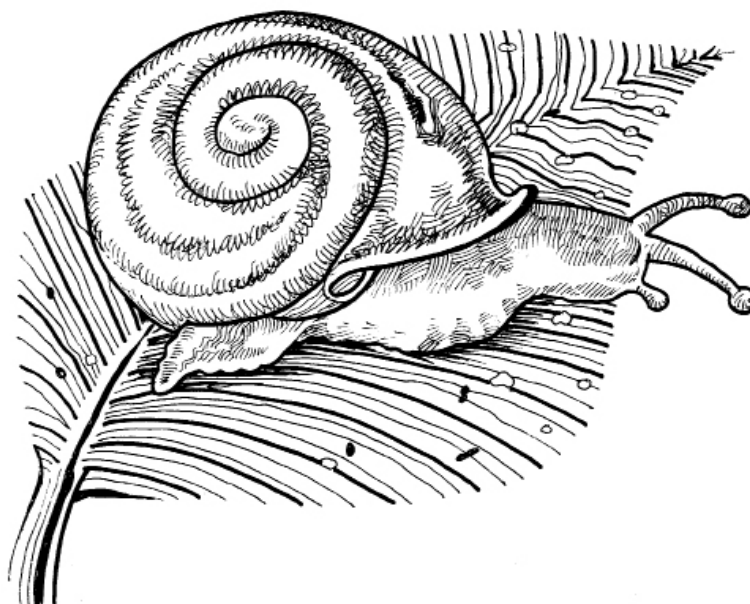


Snails and slugs may be grazers, browsers, suspension feeders, scavengers, detritivores or carnivores. Mussels are filter feeders - they feed on bacteria, algae, phytoplankton, and suspended organic matter in water.

Snails have a single, often coiled shell (absent in slugs), while snails, slugs and mussels possess a large muscular foot for locomotion.

Threats:

Pollution of freshwater habitats: Being filter feeders, mussels are at high risk from pollution.



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Flow modifications: Dams produce changes in the habitat - turning lotic habitat to lentic; shallow water to deep waters; increasing amount of siltation; forming barriers preventing fish migration which in turn, prevents dispersal of mussels.

Increased siltation: Siltation of water bodies due to agriculture practices.

Exploitation for food - harvesting

Invasive species.

Mining in aquatic habitats.

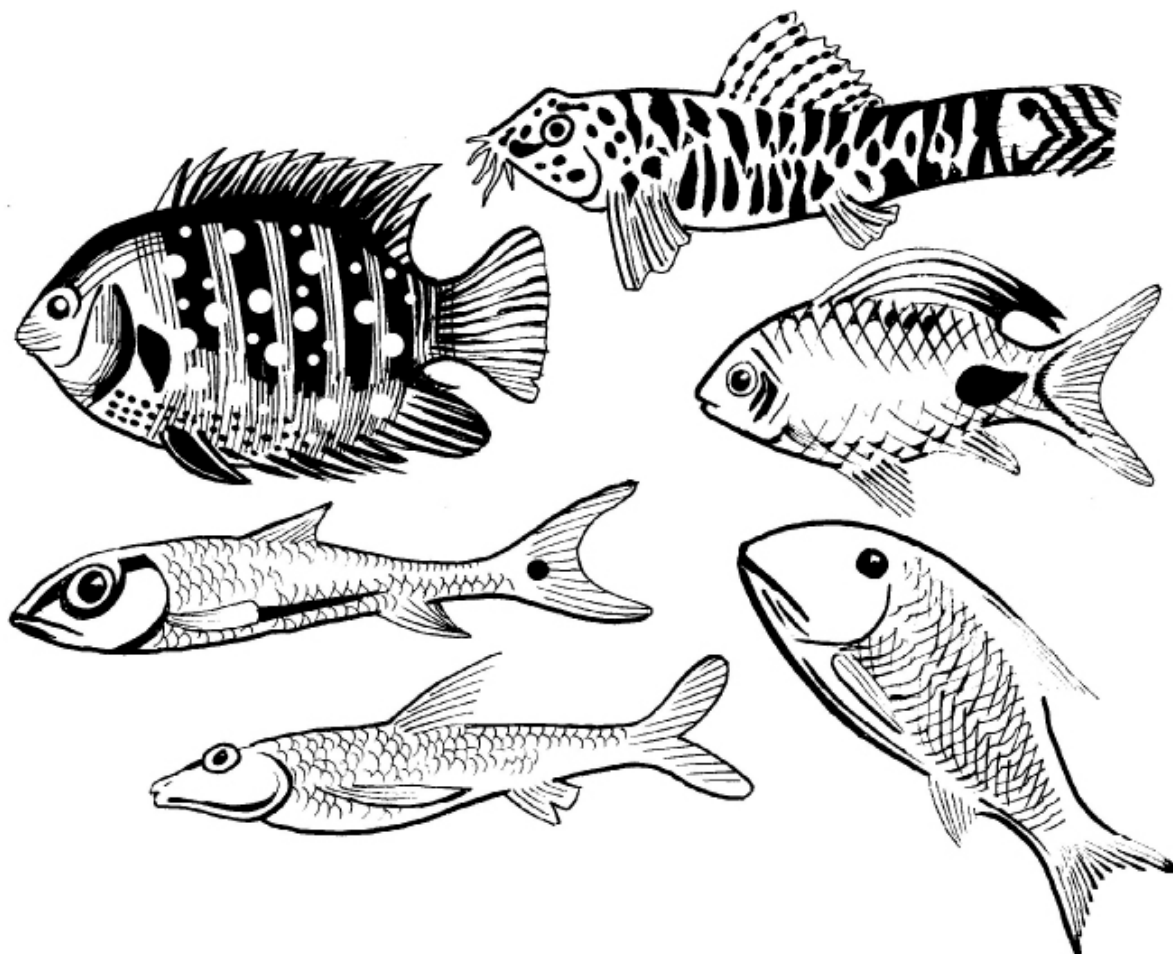


Freshwater Fish

Fish is a very familiar animal to most of us. They come in a variety of shapes, sizes and colours. Fish form a big share of the food consumed by man and also offer aesthetic pleasure as aquarium pets. Fish species have evolved differently for life adapted to different aquatic habitats ranging from marine to brackish to freshwater ecosystems and form a critical link in the food chain of these ecosystems.

How they are locally called?

Gujarati:	<i>Machali</i>
Kannada:	<i>Meenu</i>
Konkani:	<i>Nusthe</i>
Malayalam:	<i>Meen, matsyam</i>
Marathi:	<i>Matsya, Maasa (m), machli (f)</i>
Tamil:	<i>Meen</i>
English:	Fish



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Fish facts

Globally, about 15,000 freshwater fish species are recorded (including brackish water species). In India there are about 760 freshwater fish species of which 73 are in cold freshwaters, 544 are in warm freshwaters and 143 in brackish waters. Western Ghats harbours 290 fish species of which 189 are endemic.

They all live in a variety of habitats such as rivers, streams, ponds, lakes, wetlands, swamps and marshes.

Threats

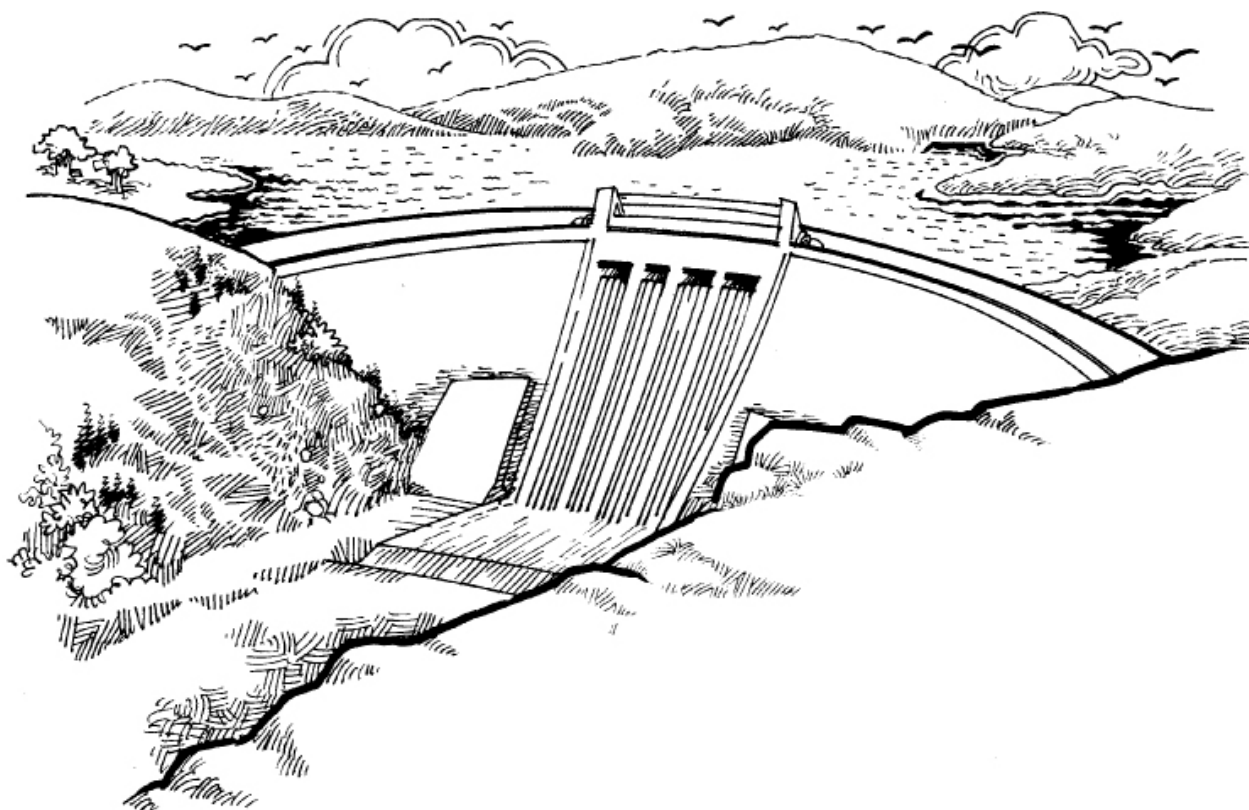
Some major threats for freshwater fishes are:

Pollution of freshwater habitats

Construction of dams and other structures alter the natural flow of the water body, thereby restricting migration of fishes (anadromous and catadromous fish migrations) for the purpose of breeding.

Over-exploitation for food.

Invasive species.



The Székelyi Freshwater Fish



Gádorhal / *Microlopholichthys* VU



Lepidostygis / *Lepidostygis* EM



Törkhal / *Carassius auratus* EM



Hévízbéka / *Desmopterus* EM



Méhmalac / *Mehmalac* VU



Balla / *Balla* EM



Pisces / *Pisces* CR



Ólom / *Ólom* VU



Ópala / *Ópala* VU



Balla / *Balla* VU



Tövis / *Tövis* EM



Méhmalac / *Méhmalac* VU



Hévízbéka / *Desmopterus* CR



Pisces / *Pisces* EM



Pisces / *Pisces* EM



Pisces / *Pisces* VU



Hévízbéka / *Desmopterus* EM



Ópala / *Ópala* EM



Pisces / *Pisces* EM



Ópala / *Ópala* EM



Törkhal / *Carassius auratus* EM



Hévízbéka / *Desmopterus* EM



Tövis / *Tövis* EM



Légy / *Légy* EM



Pisces / *Pisces* EM



Ópala / *Ópala* VU



Ópala / *Ópala* EM



Balla / *Balla* EM



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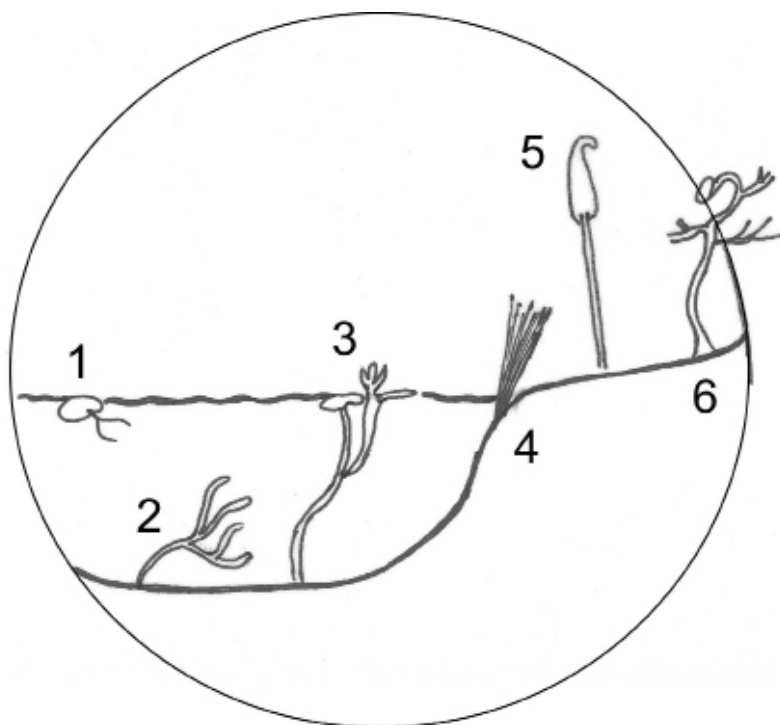
Water Plants

Water plants are referred to as Hydrophytes (Hydro = water; Phyte = plant). They grow in water or in soil that is permanently saturated with water. Water plants spend their entire life or at least a critical part of their lifecycle in water, either totally submerged or immersed or floating.

These plants, adapted to live in aquatic environments, are commonly found in wetlands. Water plants play a major role in providing aquatic fauna like fish a safe and nutrient rich habitat. Although various factors control the distribution of water plants, the principal factor is the depth and duration of flooding. Nutrients, disturbance from waves, and salinity are some other controlling factors. Most of the water plants reproduce by setting seeds but can also reproduce asexually by means of rhizomes and fragments.

Water plants can be classified into

1. Free floating
2. Totally submerged
3. Bottom rooted and floating
4. Emergent and rooted
5. Totally emergent
6. Stream bank and wet area plants.



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Water plants have special adaptations to survive in a wet environment. These include modifications in the leaf characteristics, reproduction strategies, etc.



Water plants readily respond to changes in water quality parameters like salinity, nutrient levels (either resulting in loss of water plant diversity or unusual increase in the same), pollution (metals, pesticides, herbicides) and therefore play a crucial role as bio-indicators in assessing the environment or habitat quality.

Threats:

- The major threats to freshwater water plants include runoff from agricultural and urban/industrial areas, the invasion of exotic species, the creation of dams and water diversion.
- Over exploitation and pollution.
- Land reclamation that threatens groundwater supplies.
- Grazing.



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Illustrated History of the Sahyādrī and Freshwater Species

Western Ghats has a very long history. About 400 million people in Peninsular India depend on the resources from the Western Ghats directly or indirectly. The relationship that human beings have had with Western Ghats habitats and its species since time immemorial and the status of the species now gives us a message that it is the responsibility of human beings to help ensure the survival of plants, animals and their habitats in the long term. Mankind has utilized the resources extensively. Even then they are closely associated with human cultural, religious and social activities. Scientists have reported that the fauna and flora of Western Ghats, particularly the freshwater species, are in danger and now the onus is on us to safeguard the future of the freshwater species.

If we want to safeguard the Western Ghats and the freshwater species, it is important to know the historical events related to them. Depicting history in words and pictures is a great way to learn also.

Here is an activity where your audience can trace the history of the Western Ghats and Freshwater Species. It provides portrayals of important historical events of the Hotspot. This can also serve as an art skills activity. This exercise has to be done in an orderly manner and so before you begin, take a photocopy of the event and dates given below and cut them according to date. You can then paste each event with dates on a piece of cardboard.

Depending on the size of your audience, hand out one or more of the provided Western Ghats history cards to each participant. Make sure you select dates starting from an early date back in time and go into the future, e.g. 2050. The history card can be given to an individual or to a pair of participants. Give the participants a blank piece of paper (preferably A3; otherwise A4) and also drawing or painting materials. Ask participants to illustrate the events in the history of Western Ghats and to write captions explaining how they feel about the events illustrated.

At the end of this exercise your audience will have created a fun and attractive exhibit on the history of the Western Ghats and freshwater species. Ask your participants to arrange their illustrations on the wall in chronological order. If you run this exercise in a classroom, it could stay up on the wall for a while or even be put in the hall or exhibited elsewhere for others to see. Give them a chance to explain their illustration to the group before putting it up on the wall.

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To personalize the historical timeline and put them in perspective you can also add:

- The date of your education programme about freshwater species
- The date of birth of the illustrator
- Any incidence related to Western Ghats and Freshwater Species that happened in and around the place where you conduct the education programme
- Date of creation and name of a protected area in the State or Province where you run the education programme
- Local newspaper incidents related to freshwater species and the Western Ghats

Discussion

After all the students or participants have put up their picture, take a break and let them go up and examine the illustrated history as a whole. This will help them to get the bigger picture of the history behind the topic discussed and participate more meaningfully in a discussion. You can ask them the following questions.

What happened during the history, which affected the Western Ghats/habitats/species? What were they?

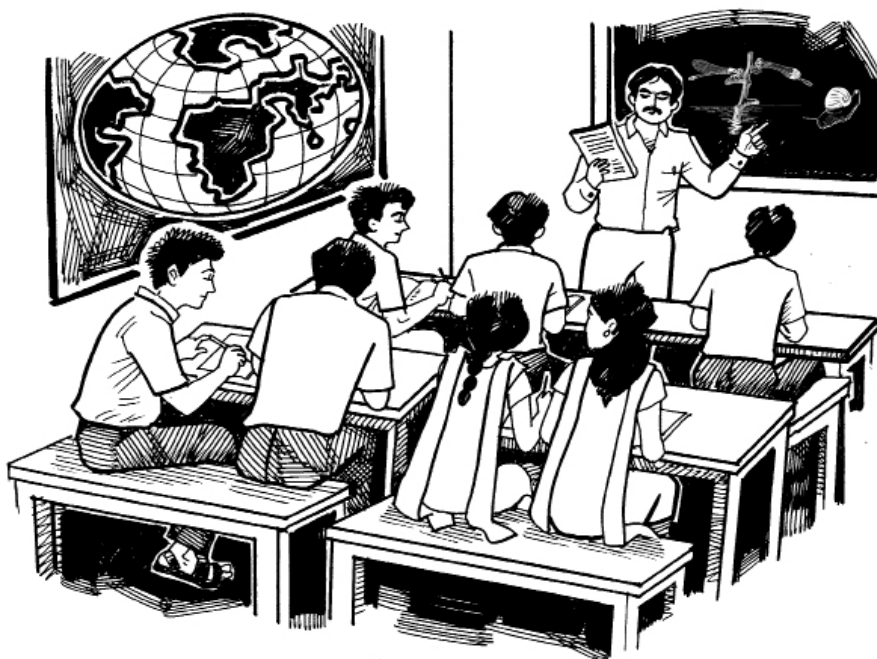
What are the causes of decline of pristine habitats in the Western Ghats?

Do the events in the history indicate any change in the way humans should perceive them?

What lessons do we learn from our mistakes across time with regard to our use of the services offered by the Western Ghats?

Do you have hope that threatened Freshwater Species can survive into the 21st Century? Why?

What are the major threats for the Freshwater Species of Western Ghats?



Illustrated history of the *Sahyādrī*

150 - 45 million years ago (m.y.a)

Peninsular India split from Gondwanaland about 150 m.y.a. and started moving north. The northward drift which lasted about 100 million years, finally ended with the peninsula colliding with mainland Asia 45 m.y.a.



12,000 years before present (ybp)

The Western Ghats first came under human influences during the palaeolithic or old-stone age some 12,000 years ago. Stone tools used by palaeolithic people have been excavated in the river valleys of Palakkad, Malapuram and Dakshina Kannada districts of the Western Ghats. Elsewhere, palaeolithic artifacts have been found in and around Mysore, Chickmangalur and Shimoga districts of western Karnataka.

12,000-5000 years before present (ybp)

Mesolithic (denoting the middle part of stone age) sites (12,000-5000 ybp) have been discovered around the river Mandovi in Goa.



12,000-5000 years before present (ybp)

Extended arid periods and human interference starting 12,000 years before present, leading to slow but extensive transformation of habitats in and around the Western Ghats. Unique landscape elements such as the *Myristica* swamps gave way to cultivation of rice.

5000 years before present (ybp)

Charcoal of 5000 years before present, got from trenches in Thenmalai (southern Western Ghats), indicates that the people could have burned forest.

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5000-3000 years before present (ybp)

During the new stone-age (5000-3000 ybp), there were domesticated cattle, sheep and goats in and around the Western Ghats. About 4300 years ago animals were domesticated in Lodekal, Karnataka.



3000 - 2300 years before present (300 BC)

In Western Ghats, agricultural communities in river valleys formed. River valley land diverted to agriculture.

2000 ybp

Todas settled in Nilgiri Plateau of Southern India.

2000 ybp

References to rice and millet cultivation in the South Indian hills are found in the 2013 year old Sangam Tamil literary works.

300 BC to 300 AD

Early chiefdoms engaged in overseas trade. Vigorous trade in pepper, cardamom and other natural forest produce.



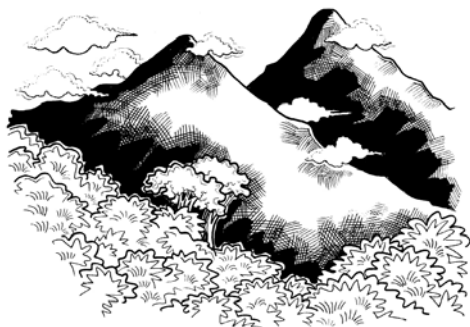
300 AD to 1500 AD

Gathering of spices in Western Ghats continued; spice gardens developed in narrow river valleys in Western Ghats.

1500 AD to 1800 AD

Influence of European colonial powers begin to be felt. Vigorous trade in spices; demand on timber for ship building.

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1700 AD

It was recorded in the history that Western Ghats is the origin of several big and small rivers—Godavari, Krishna, and Kaveri. All rivers provide 60% of utilizable surface water available in South India, and nearly 30% of the utilizable surface water in India.

1700 AD

The forests in India during the pre-colonial period were managed on a sustainable basis primarily because the ownership rested with the community.

1799-1810 AD

The British colonists spread over most of the Western Ghats in the late seventeen hundreds and early eighteen hundreds. They introduced commercially important plants and there have been invasions by a number of aggressive alien plant species.



1800-1820 AD

The British took control of the Western Ghats after annexing the territory of Tipu-Sultan and Marathas.

1800 - 1860 AD

Unregulated exploitation of natural teak, catechu, etc., happened in Western Ghats during this period. Sacred groves and sacred species, and traditions of restrained resource use continue to be maintained, but many destroyed.

1806 AD

All teak in the Malabar was reserved for commercial use by the British. This was the first show of interest in commercial forestry by the British.

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1813 AD

In the Western Ghats, the Nilgiris were colonized by British only in 1813 almost 2000 years after the Todas did.

1830-1880 AD

Massive deforestation by the British for ship building and for railway construction and operation.

1840 AD

Teak was first raised as monocultures in 1840. The first teak plantation in Kerala was established in Nilambur in 1844.

1865 AD

To reduce community control and to regulate the extraction of timber in India, forest laws were enacted in 1865 and revised in 1878, under which community rights were reduced to privileges, and free access to forests was replaced with restricted access.



1868 AD

Casuarina plantations first appeared in Uttara Kannada district between 1868 and 1869. Till then the forest plantations were of native species. Over the years, eucalyptus, cinchona, wattle, rubber, clove, etc., have displaced extensive patches of natural forests throughout the Western Ghats.



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1860 AD to 1947 AD

Continuance of British rule in India; landlords and bureaucrats dominate. Shifting cultivation banned in many tracts; State takeover of forestlands; large-scale teak plantations were begun in Western Ghats.

1878 AD

In spite of public opposition, the colonial rulers continued to take over forests and categorize them as reserve forests, protected forests and unclosed forests. State-controlled forests were classified legally in 1878 to derive benefits such as timber from these forests.



1900 AD

In British India in 1900, out of the total area of 202 million ha, 43% was under cultivation, 44% was kept for community use, and only 13% of the area (26 million ha) was notified as forest area. The notified area included reserved forest of 17 million ha (65%) and protected forest of 9 million ha (35%).

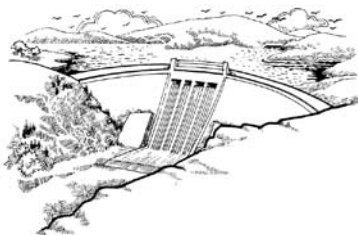
1904 AD

As early as 1904, Hooker had drawn attention to the distinct flora of the Western Ghats, which he called the "Malabar" floristic region.

1917-1918 AD

First World War. 228,076 tons of timber (excluding railway sleepers) were supplied by the specially created "Timber Branch" to help Allied military operations in Egypt and Iraq. Approximately 1.7 million cubic feet of timber (mostly teak) were exported annually during the war.

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1929 AD

Silent Valley identified by the British as a dam site.

1940 AD

Second World War. Timber Directorate set up in Delhi to channel supplies of forest produce from the provinces. Impact of the war on Indian forests was severe, especially in the Himalayas and Western Ghats.

1940 AD

Apart from the community and industrial demand, two world wars put additional stress on Indian forests. Demand for wood for cantonment and ship building activities during the Second World War, as well as post-war demands were met from forest working circles, resulting in the degradation of large forest areas.

1947 AD

After independence, forests were subjected to greater pressure as a result of several policy decisions, which included the "Grow More Food" campaign, industrialization, and developmental activities such as irrigation projects and hydroelectric projects. For meeting these requirements, forests were cleared and forestland was diverted for other purposes.



1947 AD to 1960 AD

Traditional social hierarchy breaks down in independent India; commerce and industry dominant. Diversion of land for agriculture and river valley projects; rapid rise of forest-based industry. Wildlife Sanctuaries and National Parks begin to be established.

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1952 AD

India's new National Forest Policy was formed this year. The policy emphasizes

- to prevent cutting of trees in hilly areas
- to replace destroyed forest by plantations
- to prevent soil erosion by planting trees
- to decrease pressure on forest by developing grazing land
- to grow economically important plants in forest
- to increase government revenue from forest.



1960 AD

The Western Ghats of Kerala region is thickly populated and famous for exotic food crops, spices, herbs and medicinal plants. Heavy migration took place to Western Ghats region from the plains of Kerala since 1960s and the forest flora and fauna are under severe threat of extinction.



1960 AD to 1980 AD

Pace of forest-based industrial development slows down. Beginning of shortages of forest produce; large-scale eucalyptus plantations; large-scale river valley projects. Many sacred groves felled to meet industrial requirements; many more Wildlife Sanctuaries and National Parks established.

1970 AD

During 1970-1980, there was an acute shortage of fuel wood and fodder for the rural poor, who depended on the forest to a great extent. This led to the over-exploitations of forests in rural India .

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1980 AD

The Forest Conservation Act of 1980 was passed, which banned forest clearing, forest conversion pressures were reduced.



1987-88 AD

Save the Western Ghats March of 1987-88 is a unique event that created history. It marked the beginning of involving the civil society to work for the cause of sustainable development. For the first time, it tried to bring about landscape level thinking across the political boundaries. It started mainstreaming Western Ghats.

1987-1998 AD

Tea plantations in south India increased by 17.7% from 74,765 ha to 87,993 ha. In addition to this, large areas of Eucalyptus plantations also occurred along with tea, which was used as fuel wood.

1988 AD

Dr. Norman Myers introduced the concept of global priority settings into the

international biodiversity conservation arena; Western Ghats and Sri Lanka was listed as a hotspot for biodiversity.

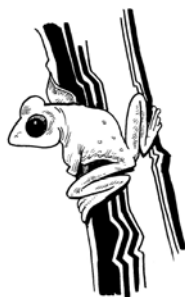
1990-1991 AD

Western Ghats of southern India had coffee plantations over an area of 270,821

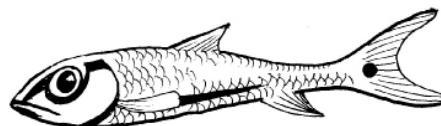
ha. grown under the shadow of native forest trees.

1990 AD

Western Ghats contains more than 30 percent of all plant, fish, reptile, amphibian,



bird, and mammal species found in India - and over 5,000 flowering plants.



1990 AD

The WG provides INR 5.5 Lakhs/hectare/year worth of ecosystem services—soil formation, recreation, nutrient recycling, water regulation and

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supply, climate regulation, flood and storm protection, food and raw materials, genetic resources, atmospheric gas balance, pollination, etc., (i.e) over a trillion US\$ per year, whereas India's GDP is about US\$ 500 billion.

1999 AD

The National Forest Policy of India (1952) stipulated that India as a whole should aim at maintaining one-third of its total land area under forest for securing eco-

logical stability, but forest cover at present is 63.7 million ha, or only 19.4% of the land area (Forest Survey of India 1999).

1999-2000 AD

The US\$ 447 million Indian coffee industry had plantations of about 340,346 ha. in the Western Ghats region of southern India.

2000 AD

According to Myers, among global biodiversity hotspots, Western Ghats and Sri Lanka rank third in terms of the number of endemic vertebrates /area ratio

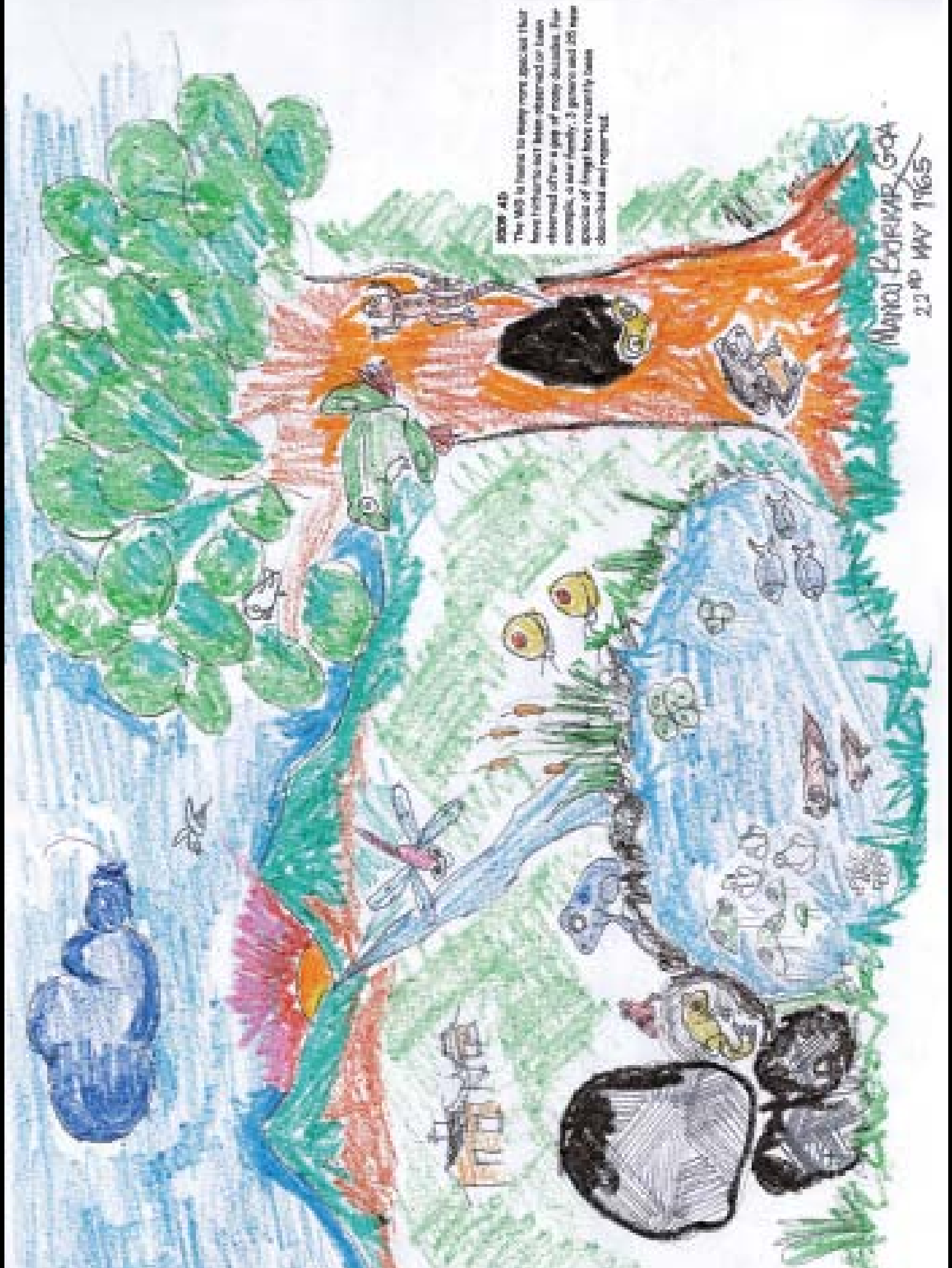
(species/100Km²).



2001 AD

India has 2.5% of the world's land area and 1.8% of the global forest area, but supports 15.6% of the world's human population and 14% of the world's livestock

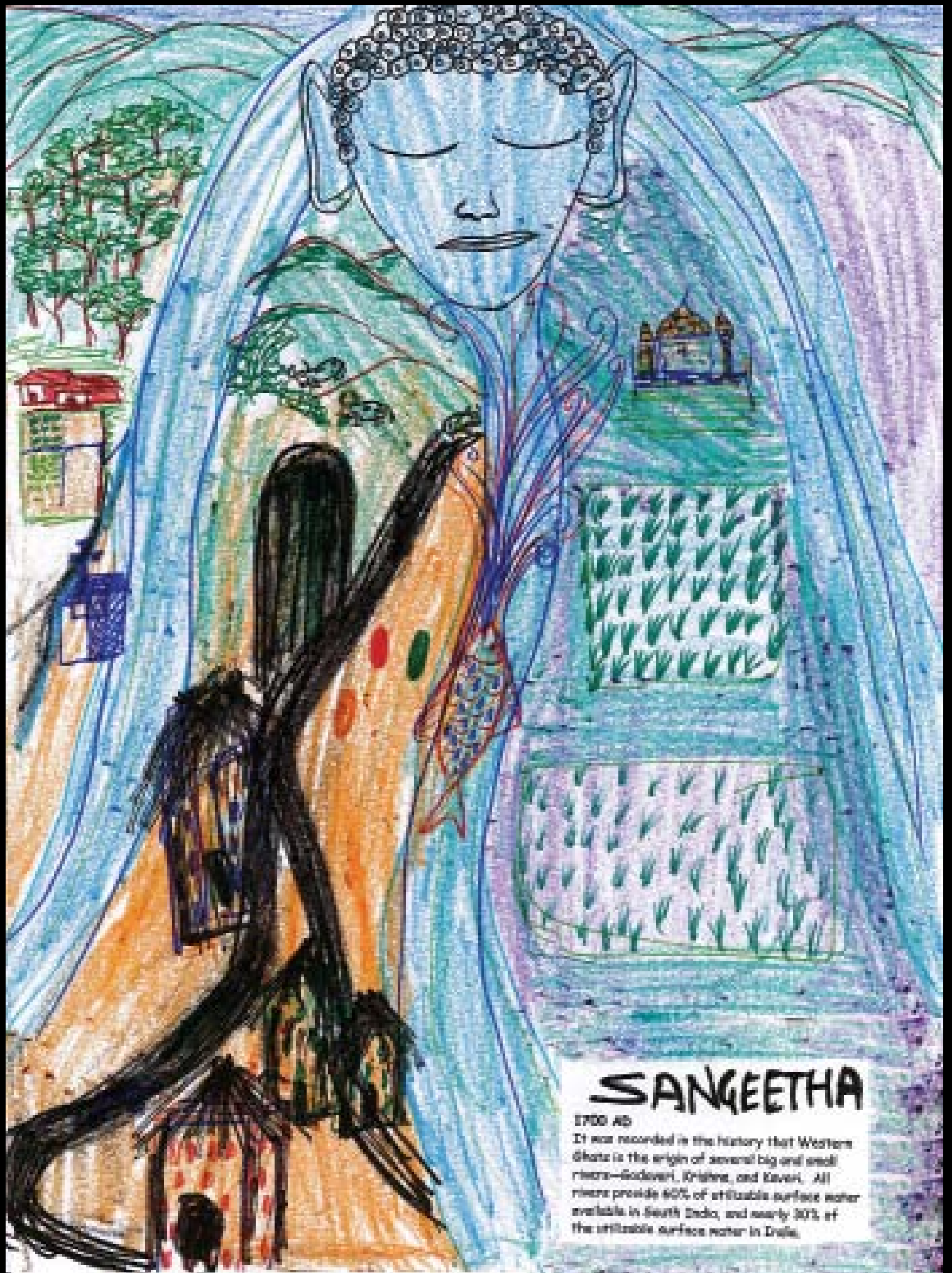
population. This large population depends on forests for meeting diverse biomass needs.



BOOK 45

The MS is found in many more species that have hitherto not been observed or taken abroad after a gap of many decades. For example, a new family, 3 genera and 25 new species of insects have recently been described and reported.

MARCOLO GORNER, GDA
22ND MAY 1965



SANGEETHA

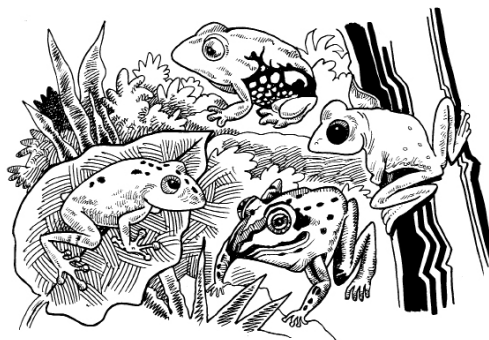
1700 AD

It was recorded in the history that Western Ghats is the origin of several big and small rivers—Godavari, Krishna, and Kaveri. All rivers provide 60% of utilisable surface water available in South India, and nearly 30% of the utilisable surface water in Drala.

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2009 AD

The WG is home to many rare species that have hitherto not been observed or been observed after a gap of many decades. For example, a new family, 3 genera and 25 new species of frogs have recently been described and reported.



2011 AD

Approximately 50 million people live in Western Ghats. High population density of 260 people/km² exert huge pressure on land and forests for agriculture, plantations and as well as forms of development, industrialization, mining and tourism.

2050 AD

What could be the status of Western Ghats, habitats and Freshwater Biodiversity ?



Unit 4

SPECIES PROBLEMS AND SOLUTIONS



**Citizen Debate: Conserving Freshwater Habitats with
Community Participation**
**Species Status, Patterns of Richness,
Threats, Conservation**
Methodology: Species Status Assessment
Protect Resources and Save Freshwater Biodiversity
**Conference: Protection and management of Freshwater
Species and Habitats**
Tips for Planning Education Programmes
How to use the Packets

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CITIZEN DEBATE: CONSERVING FRESHWATER HABITATS WITH COMMUNITY PARTICIPATION

Case study: The Athirapally Project

Project Background

The Kerala State Electricity Board (KSEB) proposed a 163 megawatt Athirapally Hydroelectric Project in 1994. The proposed project plan was to construct a dam (75 ft high and 1,020 ft wide) on the Chalakudy River in the Vazhachal Forest Division about 5 km upstream of Athirapally Falls and 1,312 ft upstream of Vazhachal Falls. However, environmental groups and people opposed the project. They claimed that it would damage the environment, violate on human rights, and threaten tourism. Critics also noted that if the entire course of the river were diverted to make electricity, the Athirapally-Vazhachal waterfalls could dry up. To avoid damaging the waterfalls, the KSEB proposed adjusting the water releases to maintain the waterflow.

In the mean time Ministry of Environment and Forests, Government of India, gave forest clearances in 1997 and environmental clearance in 1998 to carry out this project. Based on 3 Public Interest Litigations (PIL), the High Court of Kerala directed the central government to withdraw the sanction and conduct a public hearing and also asked the Electricity Board to re-examine the procedure. In 2002 Kerala State Pollution Control Board conducted a public hearing. The gathering questioned the reliability of the Environment Impact Assessment (EIA) and technical feasibility of the project based on the actual water availability. The Public Hearing Panel asked for a second EIA. The second EIA was questioned by the Chalakudy Puzha Samrakshna Samithi on various grounds. However, the electricity board went ahead and obtained the clearance from the MoEF in 2005. Following this, the Athirapally Gram Panchayat and the Kadar tribals-the actual potential sufferers of the proposed dam filed another PIL. In 2006 the High Court of Kerala quashed the Environmental clearance given by the MoEF and ordered for another Public Hearing. A Second Public Hearing on the proposed Athirapally hydroelectric dam was conducted in June 2006 in which no one spoke in favour of the project. A five member MoEF Environmental Appraisal Committee visited the site and assessed the situation. Based on the committee report, clearance was given on 2007. Representatives of Kadar tribe and environment friendly engineers filed a PIL again. Later the Kerala State Biodiversity Board analyzed and gave a report to the Kerala High Court. The Kerala High Court heard the case twice, in 2008 and in 2009, by two Division Benches. The judgment is awaited.

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Instructions for the activity

Share the project background with your audience. Divide your participants into equal groups as per the roles given below:

- Ecology Expert Panel (three members)
- Kadar Tribes / Villagers represented by both men and women
- Forest department officials and managers
- Officials from Kerala State Electricity Board
- Human rights activist
- Wildlife Conservation NGO's
- State Biodiversity Board Research team

The Ecology Expert Panel (EEP) must be made up of an odd number of people of three representing an ecologist, a forest official and an NGO representative. The other participants should be divided into equal numbers and assigned characters.

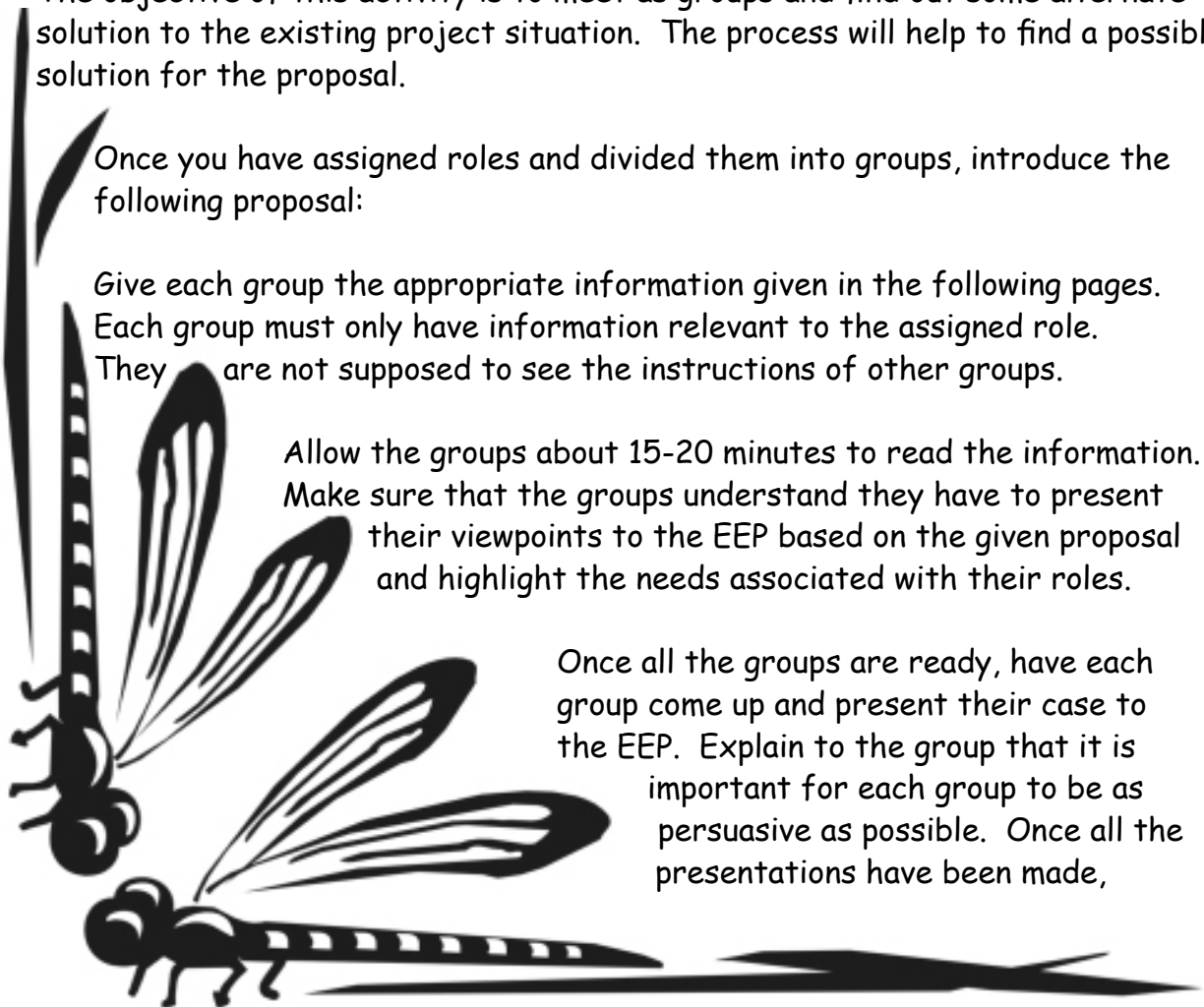
The objective of this activity is to meet as groups and find out some alternate solution to the existing project situation. The process will help to find a possible solution for the proposal.

Once you have assigned roles and divided them into groups, introduce the following proposal:

Give each group the appropriate information given in the following pages. Each group must only have information relevant to the assigned role. They are not supposed to see the instructions of other groups.

Allow the groups about 15-20 minutes to read the information. Make sure that the groups understand they have to present their viewpoints to the EEP based on the given proposal and highlight the needs associated with their roles.

Once all the groups are ready, have each group come up and present their case to the EEP. Explain to the group that it is important for each group to be as persuasive as possible. Once all the presentations have been made,



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the EEP will put all the points together and come up with a conclusion to submit to the deciding authority.

After the activity you can ask one of the participants to act as a media person and interview randomly about the role-play and the conclusion drawn.


1. Was the EEP's decisions sound practical and good?
2. Do you think the decision will help to solve the issue and protect the habitat and the species it supports?
3. Was the participation from all sectors equal?





Proposal

The Kerala State Electricity Board proposes a hydroelectric dam across the Chalakudy River in Trichur district, Kerala, to generate 163 MW of power to meet the deficit. The concrete gravity dam is envisaged to be 23 m in height and 311 m in length. The water-spread area would be 257 acre, whereas the total forest area required would be 341 acre. Water from the dam will be brought through a 4.69 km tunnel of 6.4 m diameter to the main power house situated north-west of the dam site and above Kannankuzhithodu into which the tail race water will be emptied. These discharges through the Kannankuzhithodu will join the Chalakudy River at a distance of 1.5 km. Two penstocks each of 3.4 m diameter and 50 m length will be provided to the power house with an installed capacity of 2 x 80 MW along with two dam-toe generators with which a total of 163 MW electricity can be generated to meet the peak hour demand.



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Ecology Expert Panel (three member)

You are a group of committee members representing the MoEF, State Biodiversity Board and an NGO respectively. Other groups will meet you and tell their concern about the proposal. Listen carefully as all are equally important. Make note of all the important points that will help you to take a decision. You must consider several issues such as: Is this in the best interest of people and biodiversity? Is the suggestion of long-term or short-term interest? Are the needs of the people taken into consideration? Where would the funds come from? Who would look after this project? After each group presents their case ask questions to find the weak or strong points of each argument. Once all presentations are made, you must hold a discussion within your group and announce your conclusion that will be submitted to the deciding authority.

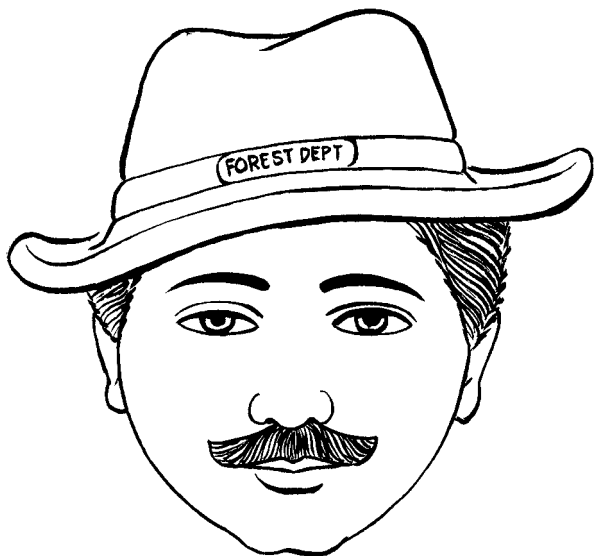


Kadar Tribes/Villagers represented by both men and women

As a villager/tribe you are the group who is directly affected if the project is implemented. You have almost lost your peace of mind because this project will affect the tribal dwelling habitats and some of the dwellings may fall within the submergence area when the dam is full. About 100 families are within the reach of the high impact area of the proposed Athirapally project. You are the most primitive of the South Indian forest tribes and your main occupation is hunting and food gathering restricted to the forests and hill tracts of Chalakudy river

basin. Your population is fewer than 1500. The Tribal Cooperative Society and Tribal Residential School are all within just 400 m downstream of the dam site. If you are forced to move out of this place you don't know what will happen.



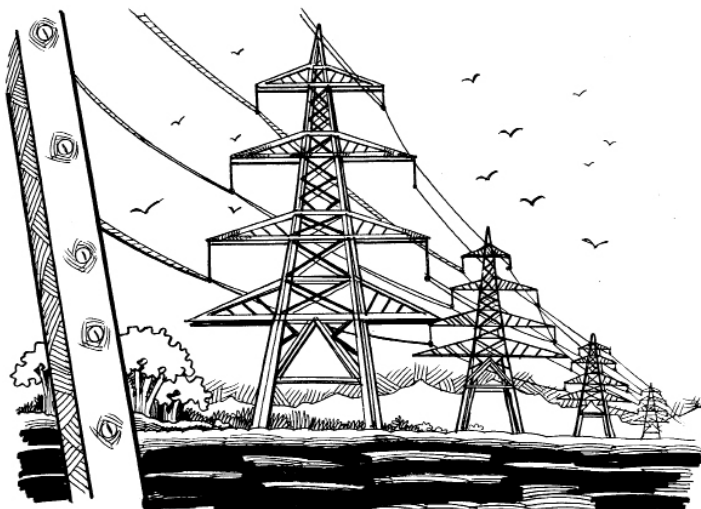


Forest department officials and managers

Your prime responsibility is to take care of the forest and the wildlife. While trying to fulfill this responsibility, your life is at high risk and to add to this you are poorly paid. We have the most powerful laws in the world but law enforcement is not possible due to lack of funds for conservation. You need enough staff and facilities to protect the species and its habitats.

Officials from Kerala State Electricity Board

As KSEB officials, you are intent on increasing the amount of power generated in the state by 163MW with the construction of this dam. Therefore, you seek clearance for this project citing the need for more



power to meet the ever-increasing demands. Unlike the scientists, you don't look at things from a long term perspective and thus feel that losing a patch of forest is not going to harm the biodiversity of the region and also that the tribes can start their lives afresh elsewhere.

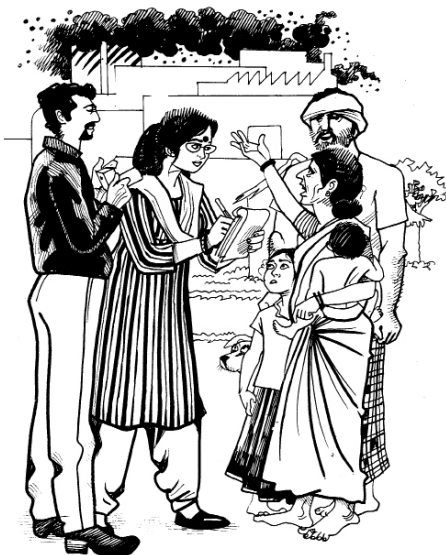
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Human rights activist

Your interest is to preserve the rights and well being of the Kadar tribes. Kadar tribes show more evidence of a Negrito ancestry with a predominant proto-Australoid element. They have been living for generations in this

region although at present their population is very small at around 1500 members.

They had been subjected to various resettlements on account of construction of various dams above the proposed dam in Athirapally. Your group claims that the proposal is not practical. You feel that your role is to make sure that the Kadar tribe gets the right to live in the forest where they have been living for generations.



Wildlife Conservation NGOs

Your group is an NGO involved in active wildlife conservation in the region, particularly Western Ghats. According to your observations, Chalakudy river system is a unique riverine forest ecosystem. The proposed dam site has a high number of endemic species. The riparian vegetation of the Vazhachal-Athirapally area serves as a link between the varied habitats

at lower and higher elevations.

The proposed site is classified as High Value Biodiversity Area and in a single study, out of the 99 species of fish recorded in the Chalakudy River, 68 were from the project area.



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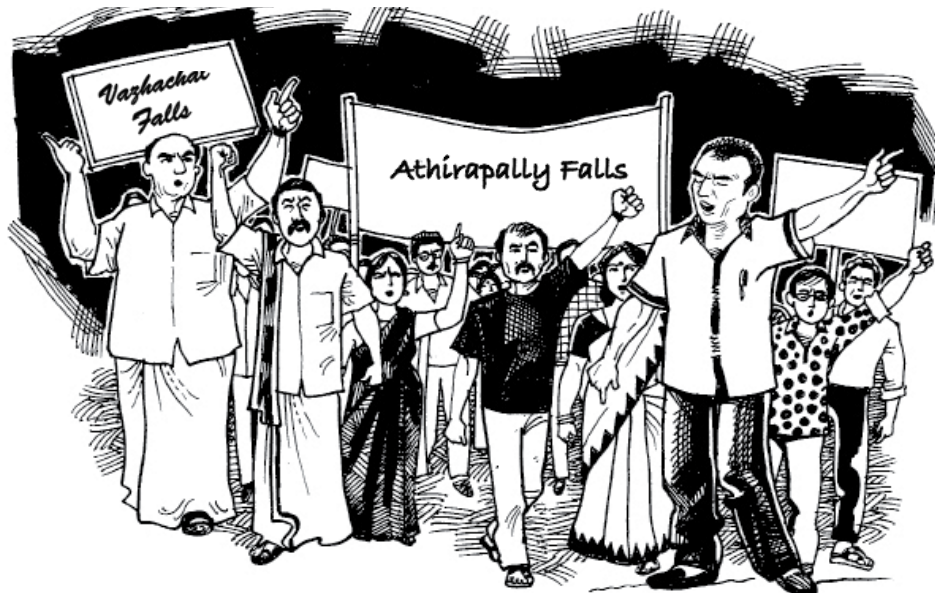
State Biodiversity Board Research team



As members of the SBB, you are more concerned about the long-term impacts of this project on the biodiversity of the region than the immediate benefits it may provide to the populace. You understand that the region is home to a number of endemic species found nowhere else in the world and construction of the dam would result in the submergence of this unique patch of riverine forest habitat and with it, all the unique plants and animals may be lost forever. You feel that loss of Biodiversity is too high a cost to pay for generating power when other possible alternative sources can be utilized for this purpose.

Note:

The Ecology Expert Panel WGEEP suggests that environmental clearance should not be given to any large-scale storage dams in Ecological Sensitive Zones in Western Ghats. The location of Athirapally dam falls within Ecological Sensitive Zones in Western Ghats of Kerala. Hence it has been recommended by the experts that the Ministry of Environment and Forests refuse Environmental Clearance to this project.



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SPECIES STATUS, PATTERNS OF RICHNESS, THREATS AND CONSERVATION

The Western Ghats is one of 34 biodiversity hotspots in the world. It supports about 400 million people mainly by its supply of water for drinking, transportation, irrigation, hydroelectric power, together with food and resources to sustain livelihoods apart from other direct as well as indirect services. Indian economy is growing very fast due to industrialization and urbanization. At the same time the conservation needs of its rich biodiversity areas are not being given the required attention and consideration. Also people who are dependent on the resources of the Western Ghats are ignorant and therefore do not have an appreciation for the benefits that they get such as freshwater and/or livelihood resources.

Globally many species are under threat and the status of the species that live in the Western Ghats was not known. In order to understand the species' status, an assessment of freshwater biodiversity of Western Ghats was conducted by the IUCN Global Species Programme's Freshwater Biodiversity Unit and Zoo Outreach Organization. It reviewed the conservation status and distributions of 1146 freshwater species belonging to four taxonomic groups.

Freshwater groups and number of species assessed

Freshwater Group	Total species assessed
Fish	290
Snail, slug and mussel	77
Dragonfly and Damselfly	171
Water plants	608
Total	1146

Why status assessment?

One of the major outputs of the conservation assessment workshops is recommendation for species conservation. Conservation recommendations are proposed to act in time and thus reduce the risk of future declines in species diversity. Survival of the species is important for the regular functioning of the ecosystem, which will benefit both the species as well as the people living across the Western Ghats region.

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Area covered for status assessment

The status assessment was done covering all water boundaries of the Western Ghats region. Freshwater species native to the Western Ghats states of Gujarat, Maharashtra, Goa, Karnataka, Kerala and Tamil Nadu were assessed. The states of Andhra Pradesh, western and southern portions of Madhya Pradesh, Odisha and Chhattisgarh were also included as the drainage of the rivers originating in the Western Ghats flow through these states. Species introduced to the region prior to 1500 AD were assessed, whilst species introduced after that date are considered non-native to the region and were not assessed. IUCN Red List Criteria, the world's most widely accepted system for measuring relative extinction risk, were employed to assess the status of all species.

Status report

Close to 16% of the 1,146 freshwater taxa assessed are threatened with extinction, with a further 1.9% assessed as Near Threatened. No taxa were assessed as Extinct or Extinct in the Wild. Approximately one-tenth of species were assessed as Data Deficient (10.5%), with the two invertebrate groups contributing more to data deficiency (25.8% on average).

The main threats impacting freshwater biodiversity in the Western Ghats include:

- a) **pollution**, with approximately 50% of fish, 20% of molluscs, and 21% of odonates threatened by it, and with urban and domestic pollution ranking as the worst threats followed by agricultural and industrial sources of pollution;
- b) **biological resource use** with 38% of fishes, 17% of molluscs, and 7% of odonates threatened by commercial fisheries and the aquarium trade;
- c) **residential and commercial development** with 14% of fishes, 11% odonates and aquatic plants, and 8% of molluscs threatened;
- d) **dams and other natural system modifications**, with 13% of fishes, 8% of molluscs, 4% of odonates and 3% of plants impacted;
- e) **alien invasive species** which, as understood currently, impact 22% of fishes;
- f) **agriculture and aquaculture** which impact 7% of odonates and 4% of plants; and
- g) **energy production and mining** which impact 6% of fishes, 5% of molluscs and 4% of plants overall.

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Freshwater *Fish* species of Western Ghats and IUCN Red List category.

Global Red List Category	Number of fish species		
	Endemic	Non-endemic	Total
Extinct (EX)	0	0	0
Extinct in the Wild (EW)	0	0	0
Critically Endangered (CR)	12	0	12
Endangered (EN)	53	1	54
Vulnerable (VU)	31	0	31
Near Threatened (NT)	3	3	6
Least concern (LC)	66	95	161
Data Deficient (DD)	24	2	26
Total species	189	101	290

Freshwater *Mollusc* species of Western Ghats and IUCN Red List category.

Global Red List Category	Number of mollusc species
Extinct (EX)	0
Extinct in the Wild (EW)	0
Critically Endangered (CR)	0
Endangered (EN)	4
Vulnerable (VU)	3
Near Threatened (NT)	0
Least concern (LC)	51
Data Deficient (DD)	19
Total species	77

Odonata species of Western Ghats and IUCN Red List category.

Global Red List Category	Number of Odonata species
Extinct (EX)	0
Extinct in the Wild (EW)	0
Critically Endangered (CR)	0
Endangered (EN)	4
Vulnerable (VU)	4
Near Threatened (NT)	6
Least concern (LC)	115
Data Deficient (DD)	46
Total species	171

Freshwater *Plant* species of Western Ghats and IUCN Red List category.

Global Red List Category	Number of Freshwater plant species
Extinct (EX)	0
Extinct in the Wild (EW)	0
Critically Endangered (CR)	12
Endangered (EN)	21
Vulnerable (VU)	21
Near Threatened (NT)	8
Least concern (LC)	517
Data Deficient (DD)	29
Total species	608

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Aquatic plants and fishes are the most heavily utilized freshwater groups in the Western Ghats. Twenty-eight percent of aquatic plants are harvested for medicinal purposes, and 14% and 13%, as food for people and animals, respectively. More than half (56%) of the fish species are harvested for human consumption, and a growing percentage (37%) of species are captured for the aquarium trade. Eighteen percent of mollusc species are used as food for humans.

The northern Western Ghats region within Maharashtra has a lower documented freshwater diversity than the southern region. Although this trend supports the expected relationship between species richness and rainfall, the lower diversity is probably due to inadequate surveys in the freshwater ecosystems of the west flowing rivers of the northern Western Ghats.



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METHODOLOGY: SPECIES STATUS ASSESSMENT

In this section, participants will become acquainted freshwater experts, field biologists, wildlife managers, conservation biologists and representatives of academic institutes working on freshwater species conservation. Tell participants that the methodology for this assessment is based on the collation and analysis of existing information, and application of IUCN Red List Categories and Criteria, and species mapping using GIS software. Tell them that the assemblage of experts in different freshwater groups is to provide the most current information about group in order to assign species to IUCN Red List Categories of Threat (See appendix for structure of Categories), formulate broad-based management recommendations and develop more comprehensive management and recovery programmes.



Introduction to assessment process:

In an assessment workshop participants will be divided into groups depending on the delegates, State or country representation (Example: Tamil Nadu, Kerala, Maharashtra, Goa, Karnataka) or their academic expertise (Example: odonates, fishes, molluscs, aquatic plants). Each group will work and develop the list of species (check-list) to be assessed. The group members will be trained in Species Information Service (SIS), an online centralized data storage programme fully compatible with IUCN Red List.

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IUCN status is deduced using species information available that is entered in SIS and by applying IUCN criteria. The rationale behind recommendations, of the criteria used for deriving a status for a species, as well as details of other information pertinent to the species will also be derived. After determining the status and using other information available in SIS database and participants' experience, the data will be analyzed to make recommendations. A report is compiled about what actions need to be taken to conserve the species (here, freshwater biodiversity).

After explaining the status assessment process, give them 10 minutes time to read the example species given in the appendix. Plan a discussion to make them understand how the status of a species is assessed.

Discussion

What information about the species might tell us if the species is in trouble? (Look at the information under Red List Status. If the population of the species is decreasing due to harvesting, and other threats like reduction in habitat quality and increased pollution, this is a sign of trouble. The species living area is disappearing... that's trouble.)

How an international pet trade can be a threat?

(Harvest is unregulated and collection of individuals yet to be mature (Juveniles) as well as brooders are major threats for the survival of the species.)

What about other threats? Read the threats and discuss with your group if they think these threats are serious and why?

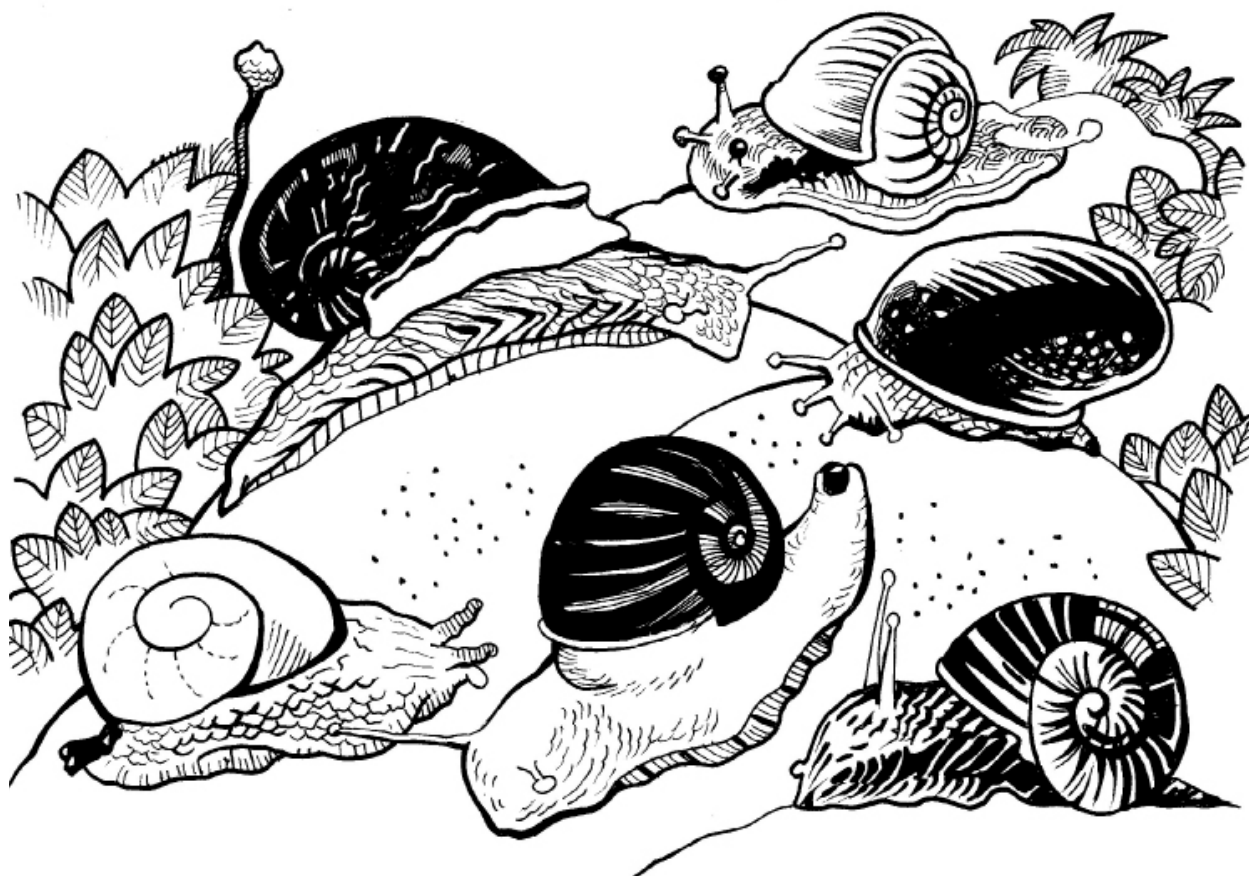
What about population trends? Do you think a population declining by more than 70% in important collection site is a good indication? This is another topic you can discuss with your group.

Read the assessment rationale for the status of *Miss Kerala* after you have discussed all these things. Now you can begin to understand how conservation biologists figure out these things. Although it is a high level subject, common sense also goes a long way in understanding species extinction.

Encourage your group to visit www.iucnredlist.org and search for the species of their interest. Refer appendix to see the list of Freshwater species assessed.

PROTECT RESOURCES AND SAVE FRESHWATER BIODIVERSITY

Western Ghats is one of the Biodiversity Hotspots and is home to an unimaginable numbers of unique plants and animals, big and small. Western Ghats is the origin of numerous rivers, which are the providers of life-giving waters to the millions living in Peninsular India. These waters, apart from supporting us, are also the lifelines for the many organisms, flora and fauna. These organisms, termed freshwater biodiversity, include water plants, dragonflies, damselfies, snails, and fish to name a few. But throughout history till date, the richness of the Western Ghats forests and rivers have been increasingly exploited mainly due to the explosion of human population in the region resulting in growing competition for resources between man and wildlife (here focus is on freshwater biodiversity).



The object of this game, is for individuals representing freshwater flora and fauna to avoid becoming Threatened, Endangered or Extinct. Remind the audience about the three major resources all wild animals need in their habitat for survival: food, water and space. These are the resources that need to be protected in order to

Freshwater Biodiversity Conservation Teaching Guide

protect them. Depending on its ecology and desirability to man, each group may need other sorts of protection also. For instance, a group such as freshwater fish, captured for food and also aquarium pet trade, need protection from poaching and over-fishing.

How to play:

A piece of blank paper is distributed to each member of your audience. Divide your audience into 4 equal groups by each counting out in sequence: 1, 2, 3, 4, 1, 2, 3, 4 and so on, thus forming 4 groups. Each group has to write a resource on their paper: group 1 write "FOOD", group 2 write "SPACE", group 3 write "WATER" and group 4 write "FW SPECIES". Let the audience take sometime to understand the concept of the game before being played.

Once all placards are prepared, bring the 4 groups together in an area with enough and clear floor space. Collect the placards and place them on the floors in a random manner. Now divide the group into 5 new teams of equal size. Teams 1-4 should



represent human population of Peninsular India, where each team will symbolically denote millions of people. Team 5 will represent the freshwater flora and fauna. Members of team 5 can be assigned to the following groups: water plants, dragonflies and damselflies, snails and slugs, fish. Each person is given a nametag designating the kind of animal or plant group he/she is and ask them to wear the nametag for easy identification.

Explain the rules of the game to the group. Each member of the team representing freshwater biodiversity should pick up one food placard, one water placard and one space placard to successfully complete round one. In addition to these three resources, FW GROUPS should also pick up one FW SPECIES placard. The flora/fauna will move from one resource to another and picking up that resource signifies that it has obtained the resource written on it. Each animal/plant (freshwater biodiversity) should remain in the place of the last resource it picks up. Placards

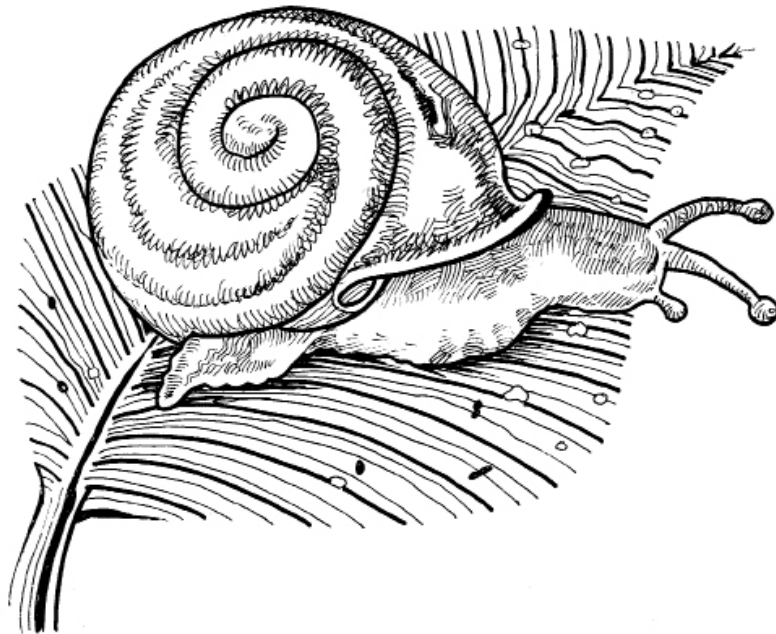
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cannot be shared. Explain to the participants that they may not always be able to find all the resources they need. If they cannot find all three, they will be given a mark on the chart designating them as threatened, and as the game continues more designations will be given marking them as endangered and finally as extinct.

Round 1

Explain that you are starting the game in year 1900. Ask members of team to step forward. Each of these individuals should find a resource placard, stand on it and call out what resource it is.

Ask the group why are people representing humans standing on the animals' resource cards? Help participants understand that man competes with all living things for all three natural resources. Man may compete for food, water and space directly or indirectly through activities like destroying habitats, polluting rivers and other water bodies, constructing dams over rivers, etc. In this regard, we can explain how we not only destroy habitats for plants and animals but also hunt and over-exploit them (e.g. Fish) for our food supply as well as for aesthetic purposes like the aquarium pet trade. Explain that teams 2-4 will enter the game in the later rounds representing the increase in human population growth over time.



Continue playing round one. Team 1 should occupy their resource placards and the animals/plants (freshwater biodiversity) should find and pick up three resource placards (as explained earlier) in order to survive. Participants who are FW GROUPS will need four placards: three resources as well as the one saying "FW SPECIES". Remind the plants/animals to freeze in place of the last resource they obtain. In

this round, all individuals should have been able to find all the necessary resources they needed. Now have all the animals/plants put back the resource placards on the ground in a random fashion.

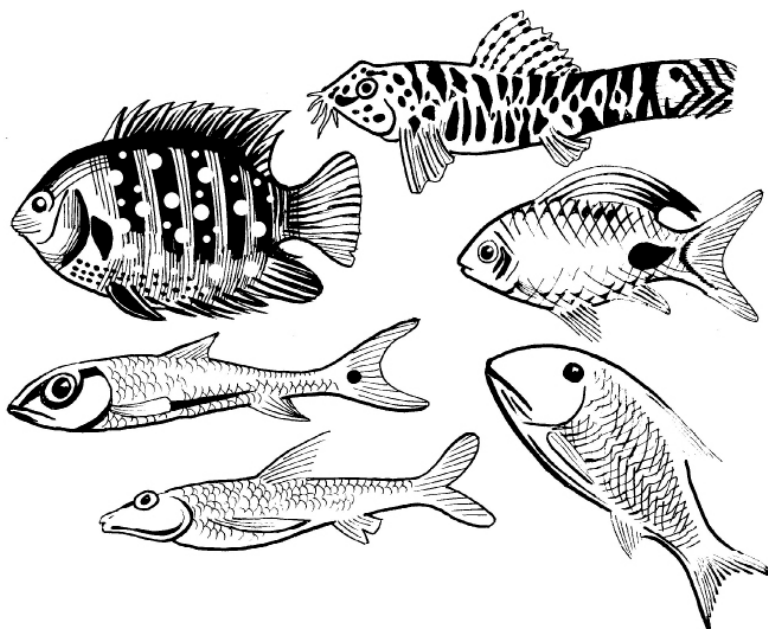
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Round 2

Tell the group that it is now year 1950. Explain that the population of peninsular India has grown by many millions. Send members of team 2 into the game to represent the growing population. Each individual should find a vacant placard, stand on it and call out its name. Have the animals/plants repeat the procedure from round 1 where they try to pick up the necessary resources for their survival. Ask each plant/animal if it was able to obtain every resource it needed. If an animal/plant was not able to obtain all three resources it becomes a threatened group (taxon). If this occurs, put an "X" mark on the chalkboard in the box named THREATENED next to the animal/plant's name. Then have all the animals/plants put the resource placards back on the floor.

Round 3

Now tell your audience that it is now year 2000. Send in team 3 to represent greater population growth. Once all members of teams 3 have occupied vacant placards, send in the freshwater biodiversity individuals (team 1) again to find their resource cards. In this round more animals may become threatened, some that were already threatened may become endangered depending on whether they were able to



collect the necessary resources or not. Again place "X"s in the appropriate boxes on the chart. Have the animals return their resources to the floor.

Round 4

Explain to your audience that it is now year 2025. Send in team 4 to represent another burst in population growth. Then have the animals again try to find and pick up resources for survival. On the chart, mark another "X" in the boxes for those animals/plants (freshwater biodiversity) that did not obtain all necessary resources. If an animal/plant has an "X" in all three boxes, it becomes extinct.

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Table

Freshwater species	VU / EN	CR	EX
Fishes			
Molluscs			
Odonates			
Aquatic plants			

VU - Vulnerable; EN - Endangered; CR- Critically Endangered; Ex - Extinct

Conclusion

Direct your participants' attention to the chart and note the status of each group of animal/plant. Discuss with them the meaning/objective of the game in terms of what is happening today around the world and here especially, in relation to freshwater biodiversity of the Western Ghats. Ask participants if they can remember animals/plants or habitats near their homes and in their regions that were once upon a time common and which they don't find today. Discuss with them if human population growth and accompanying activities of development were the reasons for the disappearances mentioned. Ask participants to speculate on the effects of humans on the freshwater biodiversity in the Western Ghats. Make sure the following topics are discussed: habitat destruction, pollution of rivers and other water bodies from industrial as well as agricultural run-off, construction of dams and flow-modifications in rivers, over-fishing for food and pet trade, etc., Ask people what alternative strategies or measures could be taken up for the various threats mentioned above so as to reduce the pressure on the freshwater biodiversity over the long run and thus ensure their survival.



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CONFERENCE: PROTECTION AND MANAGEMENT OF FRESHWATER SPECIES AND HABITATS

Ask your participants to assemble in groups. Give each group the following recommendations, or write in poster size in advance and place it in a place where the entire group can easily examine it.

Tell the groups that their job is to consider which of the eight actions are most important to give protection and to manage properly the habitats and biodiversity in the Western Ghats areas. Each group has 100 points and it must assign its points between the eight actions, to whatever extent it sees fit.

Depending on time and the level of your audience, you may wish to have them assign points only to the major actions, or divide points among all the secondary actions listed under the eight major ones. It is important to explain that one group may decide that all eight actions are important and therefore to assign an equal number of points to each. Alternatively, a group may decide that three actions are so important that sixty of the 100 points should be divided among those three. Stress that the goal is to consider the actions in accord with the information on the

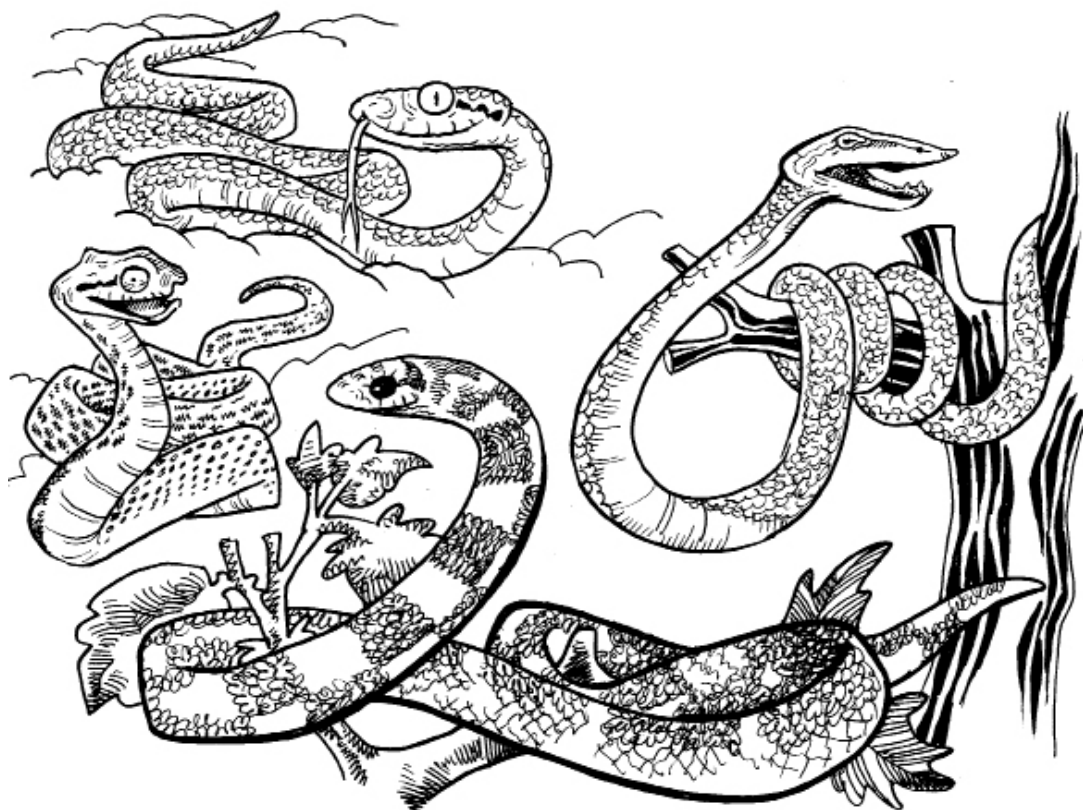


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existing conservation issues (here, Western Ghats Freshwater Biodiversity) and to make well-reasoned decisions about priorities. This sort of decision-making activity models how an action is prioritized in a conference with regard to protecting and managing biodiversity areas.

Pool all points and develop a National level plan based on the decisions made by the groups' choice about what efforts are needed to protect freshwater biodiversity. Have each group make a presentation in which it explains how its points were allocated. Keep a class tally on a black board as the groups make their presentations. After the last presentation, assess the number of points received by each action. Ask the group to assess the total points and discuss whether they feel those totals reflect the true priorities to freshwater biodiversity conservation. Make it clear to the audience that an action which may be very important in one location may get least priority in another location depending on the circumstances and factor involved. If any actions did not receive points, ask whether they should be dropped from the list.

The following are the recommendation outcomes reached at the Freshwater Biodiversity assessment workshop. The workshop recommendations suggest measures to protect the Freshwater Biodiversity of Western Ghats.



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Recommendations of the Freshwater Biodiversity Assessment of Western Ghats

1. Conduct taxonomic studies (classification), survey and monitoring

- 1.1. Promote studies on freshwater plants and animals of the Western Ghats
- 1.2. Understand their life history, ecology and populations
- 1.3. Revise taxonomy of Freshwater Biodiversity
- 1.4. Monitor all freshwater species of Western Ghats
- 1.5. Improve knowledge of subterranean (underground dwelling) species

2. Carry out habitat restoration

Endemic species, under threat of extinction, are narrowly distributed. These endemics can be saved by

- 2.1. Protecting their essential habitats like streams and rivers
- 2.2. Preventing man-made changes to the natural flow of streams and rivers
- 2.3. Protecting unique/special ecosystems such as Myristica swamps, high altitude peat bogs and laterite plateaus
- 2.4. Reducing the use of pesticides and other agrochemicals and their release into rivers and streams upstream
- 2.5. Controlling tourism in special habitats

3. Control Pollution

Pollution - a key threat to freshwater biodiversity can be controlled by

- 3.1. Implementing existing laws
- 3.2. Effective treatment of waste from industries located within river basins
- 3.3. Better management practices for crop and cattle production
- 3.4. Encouraging organic cultivation and proper solid waste disposal practices

4. Manage invasive alien species

- 4.1. Study invasive fish and plants in the Western Ghats
- 4.2. Understand their spread and harmful effects on the native species
- 4.3. Prevent releases of alien species into the natural environment through co-operation from stakeholders
- 4.4. Develop and implement national policy for the introduction and management of exotic species

5. Conduct environmental impact assessment of development activities

Conduct independent environment impact evaluation for all development activities

- 5.1. Dams

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- 5.2. Road construction
- 5.3. Urban and industrial expansion
- 5.4. In situations of undesirable impacts to the environment, measures should be taken to reduce such impacts

6. Raise awareness and do education outreach

Conduct education and awareness programmes to achieve the following:

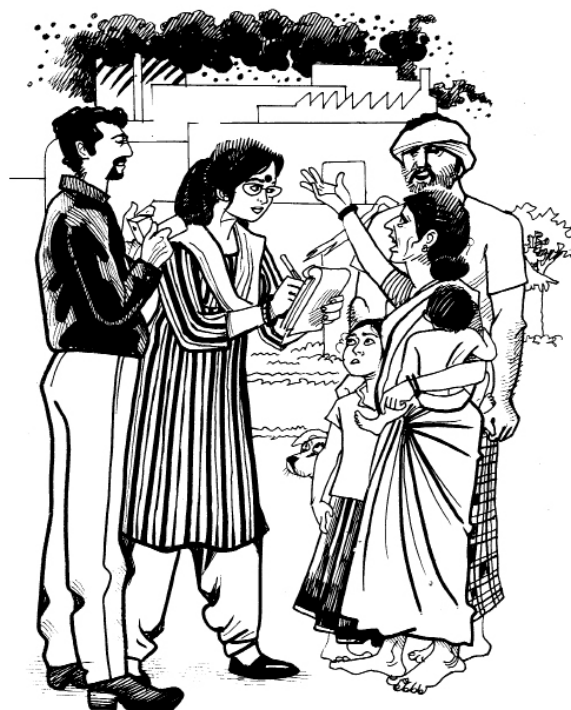
- 6.1. Change public attitude towards wetlands
- 6.2. Instill the urgent need to sustainably use, conserve and manage wetlands and rivers
- 6.3. Support and encourage participation of local communities in FW BD conservation
- 6.4. Effective conservation education for the public, especially children
- 6.5. Give easy access to Freshwater Biodiversity information to politicians, legislators and other stakeholders

7. Improve law enforcement

- 7.1. Implement and enforce existing laws
- 7.2. Develop and implement laws to curb illegal trade
- 7.3. Avoid constructing large dams where unacceptable impacts to freshwater species are predicted
- 7.4. Mining and quarrying should be regulated with strict laws
- 7.5. Include threatened and endemic species in the Wildlife (Protection) Act
- 7.6. Develop policies for the conservation of lesser-known invertebrate groups such as molluscs, dragonflies, damselflies, crustaceans and others

8. Improve collaboration

- 8.1. Support and encourage local and regional stakeholder participation in identifying Freshwater Key Biodiversity Areas (KBAs).
- 8.2. Management plans can then be put forth to benefit both the people and the biodiversity of the area.



TIPS FOR PLANNING EDUCATION PROGRAMMES

After the educators skills training programme you can plan education programmes at your place for your community and students. Combining the activities that you learned in the training programme with the 'Western Ghats' education packets that has stickers, masks, placard, rakhi and a booklet you can plan a half day, full day or three days education programme for groups of any age.

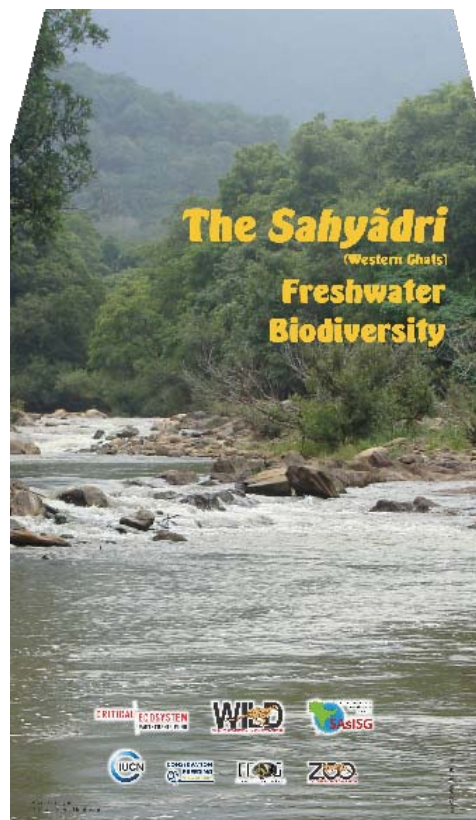
Western Ghats education packets are not effective if they are simply given out as souvenirs. It should be used as part of a systematically organized educational programme, featuring a variety of activities such as drama, debate, mime, games and any other activity that you learned during the training, focused on the drama theme. Used in such a way, the knowledge imparted will be more effective.

A full-fledged programme will be better organized if there is an educator or person with experience in facilitating an event with your audience, and a few other helpers. There are many things to do even in a simple programme.

You may need volunteers to help you prepare a short presentation from the information given in the kits and packets, and to help announce and coordinate the activities which are possible with the packet. All these activities are designed for maximum fun along with emotional and intellectual impact.

HOW TO USE THE PACKET

- Rakhi-tying ceremony with participants using the rakhi enclosed in their packet (the rakhi can be a symbol of the participants committing themselves to conservation)
- A marching demonstration and/or standing still chant where participants put on their masks and hold up their small placards in a public area (this is also a good photo opportunity which will please the press and also be more interesting for readers than a set of dignitaries on a dais or other photos typical of such events)
- Quiz programme to quiz participants on the information contained in the booklet

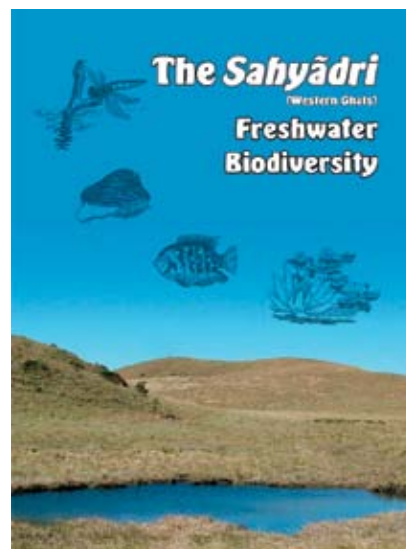


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- At least one or two games from the Western Ghats Freshwater Biodiversity teaching guide to be played with the participants
- A pledge card included in the Western Ghats Freshwater Biodiversity teaching guide; they should be given an opportunity to sign the pledge card and state their pledge
- If a painting or drawing competition is conducted or a debate, one or more of the themes should be concerned with Freshwater Biodiversity themes

Upon conducting your own education programme,

- After successful completion of the programme make a brief report to send to Zoo Outreach Organization either an email or hard copy.
- Photographs of the event are important in our programmes and are intended for publication and display on our website.
- Sometimes in our theme-based programmes sponsored by an international organization, these photos end up not only in our magazines and newsletters but also on many other websites with many hits or a yearly report.
- Photos of participants in action, which can be identified as part of the programme and associated with the theme, are preferable to the usual group photographs. Best is when participants are wearing their masks or carrying their placards or tying rakhi.
- Credits: be sure the host, organizers and sponsors, both local (ZOO) and international (CEPF) are included in your acknowledgements and in press.







Appendix

Freshwater Biodiversity Conservation Teaching Guide

Appendix 1

Datasheet on Fish *Puntius denisonii* (Day, 1865)

Scientific name: *Puntius denisonii*

Species Authority: (Day, 1865)

Common names: English - Denison Barb, Miss Kerala, Red Line Torpedo Barb

Taxonomy: ANIMALIA – CHORDATA – ACTINOPTERYGII – CYPRINIFORMES – CYPRINIDAE – *Puntius denisonii*

Assessment Information

Red List Category and Criteria: Endangered A2acde+3cde; B2ab(iii)

Year Assessed: 2011

Assessor(s): Ali, A., Raghavan, R. & Dahanukar, N.

Reviewer(s): Gopalakrishnan, A., Rema Devi, K.R., Shaji, C.P., Arunachalam, M., Johnson, J.A., Vidyadhar, A., Rahul, K., Krishna, K.K. & Molur, S.

Contributor(s): Molur, S., Bogutskaya, N. & Rema Devi, K.R.

Justification: *Puntius denisonii* has been assessed as Endangered as populations have declined by more than 50% in the recent past due to indiscriminate exploitation for the international aquarium pet trade. These declines are expected to continue in the foreseeable future unless local management plans, as well as national and international legislations are created and implemented. The species also has a restricted range with an area of occupancy of less than 300 km² with continuing decline in quality of key habitats.

History: 2009 – Vulnerable; 2007 – Vulnerable (IUCN 2009.2)

Geographic Range: Countries: Native: India (Karnataka, Kerala)

Population: The total population of *P. denisonii* is unknown. However the species is considered to be rare (Radhakrishnan and Kurup 2006, Kurup and Radhakrishnan 2006). Studies conducted at Cochin University of Science and Technology have indicated that populations of *P. denisonii* has declined at a rate of 70% at key collection sites (Kurup and Radhakrishnan 2006). A recent ongoing study by the Conservation Research Group, St. Albert's College, Kochi has observed that the species is overfished in Valapatanam River (exploitation rate $E = 0.596$) in Kerala (Raghavan 2010). In another completed study by MPEDA, based on the secondary data collected from the collectors, the catch by the collectors increased from 2003 to 2007 in Valapattanam, Kuttiyadi, Chalayar and Chandragiri rivers (Mercy and Malika 2010).

Population Trend: Decreasing

Habitat and Ecology: *P. denisonii* is a stream dwelling fish with an affinity towards rocky pools, edges with thick overhanging vegetation along its banks (Radhakrishnan 2006; Raghavan *et al.* 2009). However they have also been observed from a wide variety of riverine habitats including run, glide and riffles with sand, gravel, cobbles and boulders as substrates (Biju 2005). They are gregarious and often appear in shoals. The species is known to spawn during the North East Monsoon in the months of November-January (Manoj *et al.* 2010; R. Raghavan and A. Ali pers. obs.).

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Systems: Freshwater

Threats: Collection for the international aquarium pet trade is the single major threat to *P. denisonii* (Mittal 2009, Prasad *et al.* 2007). Harvest of 'yet to be mature' juveniles as well as brooders is a major concern as the fishery is unregulated and 'open access'. In addition, there is an on-going decline in habitat quality at prime habitats of *P. denisonii* due to pollution from plantations as well as domestic sources. Destructive fishing for larger food fish using dynamites and plant poisons also affect *P. denisonii* as they share habitats with the larger cyprinids.

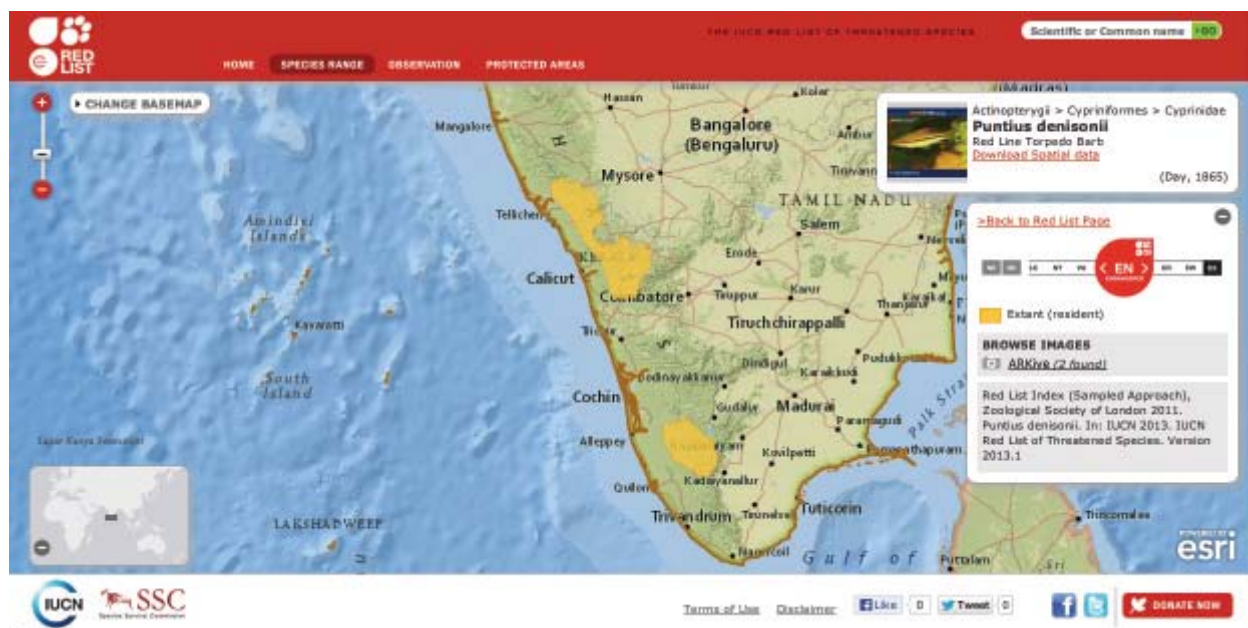
Conservation Actions: To regulate the harvest and trade of this cyprinid, the Government of Kerala (India) has initiated management plans including fixing total allowable catch (TAC), restrictions on gear size, closed seasons. There are also plans to demarcate certain key *P. denisonii* habitats as sanctuaries and no take zones (Mittal 2009). Although the captive breeding technology for this species has been developed by both researchers and hobbyists (Manoj *et al.* 2010; Mathew 2008; Mercy *et al.* 2010), commercial scale operations have not started. There are reports that *P. denisonii* is being captive bred in Indonesia and Singapore and exported (Mittal 2009), but the impacts of such operations on the collection and exports from India is yet to be understood.

Life history studies on the species have been conducted by Radhakrishnan and Kurup (2008) and Harikrishnan *et al.* (2008) studied the population dynamics in the rivers of Kerala. Distinct genetic stocks identified in Chandragiri, Valapattanam and Chaliyar rivers (Lijo unpublished PhD thesis, NBFGR).

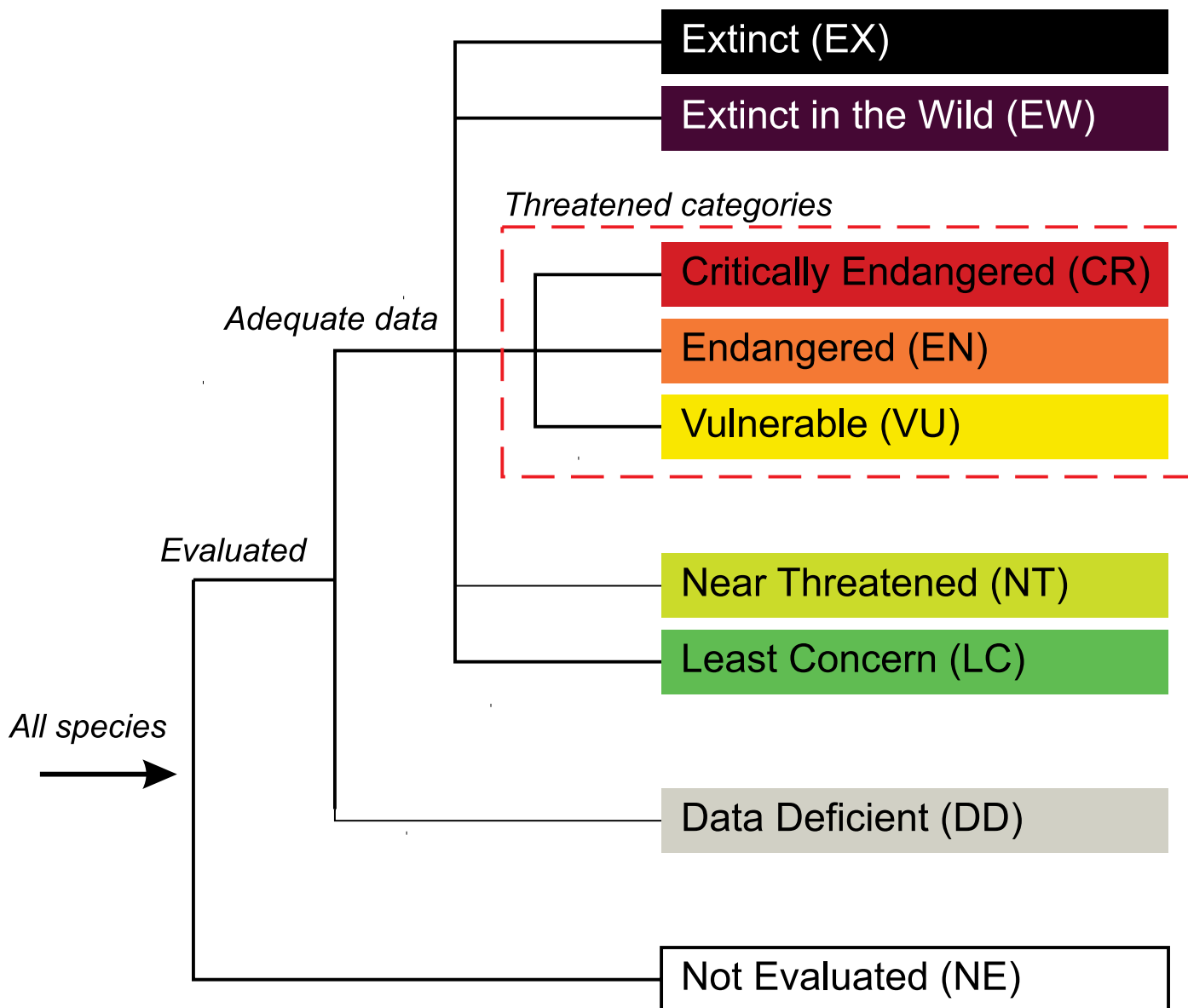
A species specific conservation plan requires urgent attention.

Citation: Ali, A., Raghavan, R. & Dahanukar, N. 2011. *Puntius denisonii*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Downloaded on **18 February 2013**.

Distribution map of *Puntius denisonii* (Day, 1865)



IUCN Red List Categories



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Appendix 3

Species List: Freshwater Biodiversity Assessments in the Western Ghats: Fish, Molluscs, Odonates, Plants, and Reptiles

*Endemic to the Western Ghats assessment region

Red List Categories: EX -Extinct; EW -Extinct in the Wild; CR -Critically Endangered; EN -Endangered; VU -Vulnerable; NT Near Threatened; LC -Least Concern; DD -Data Deficient; (PE): Possibly Extinct (draft) -Indicates a draft Red List assessment that still needs to be peer reviewed

FRESHWATER FISH

Order Anguilliformes	
Family Anguillidae	
<i>Anguilla bengalensis</i>	LC
<i>Anguilla bicolor</i>	LC
Family Ophichthidae	
<i>Pisodonophis boro</i>	LC
Order Beloniformes	
Family Adrianichthyidae	
<i>Oryzias carmaticus</i>	LC
<i>Oryzias dancena</i>	LC
<i>Oryzias melastigma</i>	LC
<i>Oryzias setnai</i> *	LC
Family Hemiramphidae	
<i>Hyporhamphus limbatus</i>	LC
<i>Hyporhamphus xanthopterus</i> *	VU - D2
<i>Zenarchopterus dispar</i>	DD
<i>Zenarchopterus striga</i>	LC (draft)
Family Belonidae	
<i>Xenentodon cancila</i>	LC
Order Clupeiformes	
Family Clupeidae	
<i>Dayella malabarica</i> *	LC
<i>Tenualosa ilisha</i>	LC (draft)
Order Cypriniformes	
Family Balitoridae	
<i>Acanthocobitis botia</i>	LC
<i>Balitora mysorensis</i> *	VU - B2ab(iii)
<i>Bhavana australis</i> *	LC
<i>Homaloptera menoni</i> *	LC
<i>Homaloptera montana</i> *	EN - B1ab(i,ii,iii) +2ab(i,ii,iii)
<i>Homaloptera pillaii</i> *	LC
<i>Homaloptera santhamparaiensis</i> *	EN - B1ab(iii) +2ab(iii)
<i>Indoreonectes evezardi</i> *	LC
<i>Longisichstura striatus</i> *	EN - B2ab(iii)
<i>Mesonoemacheilus herrei</i> *	CR - B1ab(iii) +2ab(iii)

<i>Mesonoemacheilus pambarensis</i> *	VU - D2
<i>Mesonoemacheilus remadevii</i> *	LC
<i>Nemacheilus anguilla</i> *	LC
<i>Nemacheilus denisoni</i>	LC
<i>Nemacheilus guentheri</i> *	LC
<i>Nemacheilus keralensis</i> *	VU - B1ab(iii) +2ab(iii)
<i>Nemacheilus kodaguensis</i> *	VU - D2
<i>Nemacheilus menoni</i> *	VU - D2
<i>Nemacheilus monilis</i> *	LC
<i>Nemacheilus mooreh</i> *	LC
<i>Nemacheilus nilgiriensis</i> *	LC
<i>Nemacheilus periyarensis</i> *	VU - D2
<i>Nemacheilus petrubanarescui</i> *	EN - B2ab(iii)
<i>Nemacheilus pulchellus</i> *	EN - B1ab(iii)
<i>Nemacheilus rueppelli</i> *	LC
<i>Nemacheilus semiarmatus</i> *	LC
<i>Nemacheilus stigmofasciatus</i> *	DD
<i>Nemacheilus triangularis</i> *	LC
<i>Nemachilichthys shimogensis</i> *	EN - B1ab(iii) +2ab(iii)
<i>Schistura dayi</i>	LC
<i>Schistura nagodiensis</i> *	EN - B1ab(iii) +2ab(iii)
<i>Schistura sharavathiensis</i> *	VU - D2
<i>Travancoria elongata</i> *	EN - B1ab(iii,v) +2ab(iii,v)
<i>Travancoria jonesi</i> *	EN - B1ab(iii) +2ab(iii)
Family Cobitidae	
<i>Botia striata</i> *	EN - B2ab(iii)
<i>Lepidocephalus coromandelensis</i> *	LC
<i>Lepidocephalus thermalis</i>	LC
<i>Pangio goaensis</i> *	LC
Family Cyprinidae	
<i>Amblypharyngodon melettinus</i>	LC
<i>Amblypharyngodon microlepis</i>	LC
<i>Amblypharyngodon mola</i>	LC
<i>Aspidoparia morar</i>	LC

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<i>Bangana ariza</i>	LC
<i>Barbodes bovanicus</i> *	CR (PE) - D
<i>Barbodes carnaticus</i> *	LC
<i>Barbodes wynaadensis</i> *	CR - A2ace
<i>Barilius bakeri</i> *	LC
<i>Barilius barna</i>	LC
<i>Barilius bendelisis</i>	LC
<i>Barilius canarensis</i> *	EN - B1ab(iii) +2ab(iii)
<i>Barilius evezardi</i> *	DD
<i>Barilius gatensis</i> *	LC
<i>Betadevario ramachandrani</i> *	DD
<i>Chela cachius</i>	LC
<i>Cirrhinus cirrhosus</i> *	VU - D2
<i>Cirrhinus fulungee</i> *	LC
<i>Cirrhinus reba</i>	LC
<i>Crossocheilus latius</i>	LC
<i>Crossocheilus periyarensis</i> *	EN - B2ab(iii)
<i>Danio rerio</i>	LC
<i>Devario aequipinnatus</i>	LC
<i>Devario devario</i>	LC
<i>Devario fraseri</i> *	VU - B1ab(iii)
<i>Devario malabaricus</i>	LC
<i>Devario neilgherriensis</i> *	EN - B1ab(ii,iii,v)
<i>Esomus barbatus</i> *	LC
<i>Esomus danrica</i>	LC
<i>Esomus thermoicos</i>	LC
<i>Garra bicornuta</i> *	NT
<i>Garra hughi</i> *	EN - B2ab(iii)
<i>Garra kalakadensis</i> *	EN - A2a;B1ab(ii,iii,v) +2ab(ii,iii,v)
<i>Garra mccllellandi</i> *	LC
<i>Garra menoni</i> *	VU - D2
<i>Garra mullya</i>	LC
<i>Garra periyarensis</i> *	VU - D2
<i>Garra stenorhynchus</i> *	LC
<i>Garra surendranathanii</i> *	EN - B2ab(iii)
<i>Horadandia atukorali</i>	LC
<i>Horalabiosa arunachalami</i> *	CR - A2ac;B1ab(iii,v) +2ab(iii,v)
<i>Horalabiosa joshuai</i> *	EN - B1ab(i,ii,iii,iv,v) +2ab(i,ii,iii,iv,v)
<i>Horalabiosa palaniensis</i> *	VU - D2
<i>Hypselobarbus curmuca</i> *	EN - A2acd
<i>Hypselobarbus dobsoni</i> *	DD
<i>Hypselobarbus dubius</i> *	EN - B2ab(iii)
<i>Hypselobarbus kolus</i> *	VU - A2acd
<i>Hypselobarbus kurali</i> *	LC

<i>Hypselobarbus lithopidos</i> *	DD
<i>Hypselobarbus micropogon</i> *	EN - A3cde; B1ab(ii,iii) +2ab(ii,iii)
<i>Hypselobarbus mussullah</i> *	EN - B2ab(iii,v)
<i>Hypselobarbus periyarensis</i> *	EN - B2ab(iii)
<i>Hypselobarbus pulchellus</i> *	CR (PE) - B1ab(iii) +2ab(iii)
<i>Hypselobarbus thomassi</i> *	CR - B2ab(iii)
<i>Labeo bata</i>	LC
<i>Labeo boga</i>	LC
<i>Labeo boggut</i>	LC
<i>Labeo dussumieri</i>	LC
<i>Labeo fimbriatus</i>	LC
<i>Labeo kawrus</i> *	LC
<i>Labeo kontius</i> *	LC
<i>Labeo porcellus</i> *	LC
<i>Labeo potail</i> *	EN - A2acde +3cde +4acde
<i>Laubuca dadiburjori</i> *	LC
<i>Laubuca fasciata</i> *	VU - B2ab(iii)
<i>Laubuca laubuca</i>	LC
<i>Lepidopygopsis typus</i> *	EN - B1ab(iii) +2ab(iii)
<i>Oreochthys cosuatis</i>	LC
<i>Osteobrama bakeri</i> *	LC
<i>Osteobrama bhimensis</i> *	EN - B1ab(iii) +2ab(iii)
<i>Osteobrama cotio</i>	LC
<i>Osteobrama cotio peninsularis</i> *	DD
<i>Osteobrama neilli</i> *	LC
<i>Osteobrama vigorsii</i>	LC
<i>Osteochilichthys brevidorsalis</i> *	LC
<i>Osteochilus longidorsalis</i> *	EN - B1ab(iii) +2ab(iii)
<i>Osteochilus nashii</i> *	LC
<i>Parapsilorhynchus discophorus</i> *	VU - B1ab(iii)
<i>Parapsilorhynchus elongatus</i> *	EN - B1ab(iii)
<i>Parapsilorhynchus prateri</i> *	CR (PE) - B2ab(i,ii,iii,iv,v)
<i>Parapsilorhynchus tentaculatus</i> *	LC
<i>Puntius ambassis</i> *	DD
<i>Puntius amphibius</i> *	DD
<i>Puntius arenatus</i> *	VU - B1ab(iii)
<i>Puntius arulius</i> *	EN - B2ab(iii)
<i>Puntius assimilis</i> *	VU - D2
<i>Puntius bimaculatus</i>	LC
<i>Puntius cauveriensis</i> *	EN - B1ab(iii) +2ab(iii)
<i>Puntius chalakkudiensis</i> *	EN - A2acde +4acde
<i>Puntius chola</i>	LC
<i>Puntius conchoniis</i>	LC

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<i>Puntius crescentus</i> *	EN - B1ab(iii)
<i>Puntius deccanensis</i> *	CR (PE) - B2ab(iii);D
<i>Puntius denisonii</i> *	EN - A2acde +3cde;B2ab(iii)
<i>Puntius dorsalis</i>	LC
<i>Puntius exclamatio</i> *	EN - B1ab(ii,iii) +2ab(ii,iii)
<i>Puntius fasciatus</i> *	LC
<i>Puntius filamentosus</i> *	LC
<i>Puntius fraseri</i> *	EN - B1ab(iii)
<i>Puntius jerdoni</i> *	LC
<i>Puntius kannikattiensis</i> *	LC
<i>Puntius mahecola</i> *	DD
<i>Puntius melanampyx</i> *	DD
<i>Puntius mudumalaiensis</i> *	VU - B1ab(iii)
<i>Puntius muvattupuzhaensis</i> *	DD
<i>Puntius narayani</i> *	LC
<i>Puntius ophicephalus</i> *	EN - B1ab(iii) +2ab(iii)
<i>Puntius parrah</i> *	LC
<i>Puntius pookodensis</i> *	CR - B1ab(iii) +2ab(iii)
<i>Puntius punctatus</i> *	LC
<i>Puntius rohani</i> *	VU - D2
<i>Puntius sahyadriensis</i> *	LC
<i>Puntius sarana</i>	LC
<i>Puntius sarana subnasutus</i> *	LC
<i>Puntius setnai</i> *	VU - B2ab(iii)
<i>Puntius sharmai</i> *	EN - B1ab(iii)
<i>Puntius sophore</i>	LC
<i>Puntius tamaraparniei</i> *	EN - B1ab(iii) +2ab(iii)
<i>Puntius thomassi</i> *	LC
<i>Puntius ticto</i>	LC
<i>Puntius vittatus</i>	LC
<i>Rasbora caverii</i> *	LC
<i>Rasbora daniconius</i>	LC
<i>Rasbora labiosa</i> *	LC
<i>Rohtee ogilbii</i> *	LC
<i>Salmophasia acinaces</i> *	LC
<i>Salmophasia bacaila</i>	LC
<i>Salmophasia balookee</i>	LC
<i>Salmophasia belachi</i> *	VU - D2
<i>Salmophasia boopis</i> *	LC
<i>Salmophasia horai</i> *	VU - D2
<i>Salmophasia novacula</i> *	LC
<i>Salmophasia phulo</i>	LC
<i>Salmophasia untrahi</i>	LC
<i>Schismatorhynchus nukta</i> *	EN - A2acd +3cd

<i>Thynnichthys sandkhol</i> *	EN - A2acde +3cde +4acde
<i>Tor khudree</i>	EN - A2acde
<i>Tor kulkarnii</i> *	EN - B1ab(iii) +2ab(iii)
<i>Tor malabaricus</i> *	EN - A2acde +3cde +4acde
Family Psilorhynchidae	
<i>Psilorhynchus tenura</i> *	CR - B2ab(iii)
Order Cyprinodontiformes	
Family Aplocheilidae	
<i>Aplocheilus blockii</i>	LC
<i>Aplocheilus lineatus</i>	LC
Order Osteoglossiformes	
Family Notopteridae	
<i>Notopterus notopterus</i>	LC
Order Perciformes	
Family Ambassidae	
<i>Ambassis ambassis</i>	LC
<i>Ambassis dussumieri</i>	LC
<i>Ambassis gymnocephalus</i>	LC
<i>Ambassis interrupta</i>	LC
<i>Ambassis nalua</i>	LC
<i>Chanda nama</i>	LC
<i>Parambassis dayi</i> *	LC
<i>Parambassis thomassi</i> *	LC
<i>Pseudambassis baculis</i>	LC
<i>Pseudambassis ranga</i>	LC
Family Anabantidae	
<i>Anabas testudineus</i>	DD
Family Channidae	
<i>Channa diplogramme</i> *	VU - B1ab(iii) +2ab(iii)
<i>Channa gachua</i>	LC
<i>Channa marulius</i>	LC
<i>Channa punctata</i>	LC
<i>Channa striata</i>	LC
Family Cichlidae	
<i>Eetroplus canarensis</i> *	EN - B1ab(iii) +2ab(iii)
<i>Eetroplus maculatus</i>	LC
<i>Eetroplus suratensis</i>	LC
Family Eleotridae	
<i>Bunaka gyrinoides</i>	LC
<i>Eleotris fusca</i>	LC
Family Gobiidae	
<i>Awaous grammepomus</i>	LC
<i>Bathygobius fuscus</i>	LC
<i>Glossogobius giuris</i>	LC (draft)
<i>Sicyopterus griseus</i> *	LC

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Family Nandidae	
<i>Nandus nandus</i>	LC
<i>Pristolepis fasciata</i>	LC
<i>Pristolepis marginata</i> *	LC
Family Osphronemidae	
<i>Pseudosphromenus cupanus</i>	LC
<i>Pseudosphromenus dayi</i> *	VU - B1ab(iii)
Family Terapontidae	
<i>Terapon jarbua</i>	LC
Order Siluriformes	
Family Bagridae	
<i>Batasio sharavatiensis</i> *	EN - B1ab(iii) +2ab(iii)
<i>Batasio travancoria</i> *	VU - B1ab(iii) +2ab(iii)
<i>Hemibagrus maydelli</i> *	LC
<i>Hemibagrus punctatus</i> *	CR (PE) - A2ac
<i>Horabagrus brachysoma</i> *	VU - A2bd
<i>Horabagrus nigricollaris</i> *	EN - B1ab(ii,iii,v) +2ab(ii,iii,v)
<i>Mystus armatus</i> *	LC
<i>Mystus cavasius</i>	LC
<i>Mystus gulio</i>	LC
<i>Mystus keletius</i> *	LC
<i>Mystus malabaricus</i> *	NT
<i>Mystus montanus</i> *	LC
<i>Mystus oculatus</i> *	LC
<i>Mystus seengtee</i> *	LC
<i>Mystus vittatus</i>	LC
<i>Rita gogra</i> *	LC
<i>Rita kuturnee</i> *	LC
<i>Sperata aor</i>	LC
<i>Sperata seenghala</i>	LC
Family Clariidae	
<i>Clarias dussumieri</i> *	NT
<i>Horaglanis alikunhii</i> *	DD
<i>Horaglanis krishnai</i> *	DD
Family Erethistidae	
<i>Pseudolaguvia austrina</i> *	DD
Family Heteropneustidae	
<i>Heteropneustes fossilis</i>	LC
<i>Heteropneustes longipectoralis</i> *	DD
Family Pangasiidae	
<i>Pangasius pangasius</i>	LC
Family Schilbeidae	
<i>Clupisoma bastari</i> *	DD
<i>Eutropiichthys goongwaree</i> *	DD

<i>Neotropius atherinoides</i>	LC
<i>Neotropius khavalchor</i> *	DD
<i>Proeutropiichthys taakree</i> *	LC
<i>Pseudeutropius mitchelli</i> *	EN - B1ab(iii) +2ab(iii)
<i>Silonia childreni</i> *	EN - A2ade +3de +4ade
Family Siluridae	
<i>Ompok bimaculatus</i>	NT
<i>Ompok goae</i> *	DD
<i>Ompok malabaricus</i> *	LC
<i>Pterocryptis wynaadensis</i> *	EN - A2ce
<i>Wallago attu</i>	NT
Family Sisoridae	
<i>Bagarius yarrelli</i>	NT
<i>Gagata itchkeea</i> *	VU - B2ab(iii)
<i>Glyptothorax anamalaiensis</i> *	EN - B1ab(iii) +2ab(iii)
<i>Glyptothorax annandalei</i>	LC
<i>Glyptothorax davissinghi</i> *	EN - B1ab(iii) +2ab(iii)
<i>Glyptothorax housei</i> *	EN - B1ab(iii) +2ab(iii)
<i>Glyptothorax kudremukhensis</i> *	CR - B2ab(iii)
<i>Glyptothorax lonah</i> *	LC
<i>Glyptothorax madraspatanus</i> *	EN - B2ab(iii)
<i>Glyptothorax malabarensis</i> *	DD
<i>Glyptothorax poonaensis</i> *	EN - B2ab(i,ii,iii,iv)
<i>Glyptothorax trewavasae</i> *	VU - B2ab(iii)
Order Synbranchiformes	
Family Mastacembelidae	
<i>Macrognathus aral</i>	LC
<i>Macrognathus guentheri</i> *	LC
<i>Mastacembelus armatus</i>	LC
Family Synbranchidae	
<i>Monopterus digressus</i> *	DD
<i>Monopterus eapeni</i> *	DD
<i>Monopterus fossorius</i> *	EN - B2ab(iii)
<i>Monopterus indicus</i> *	VU - B2ab(iii)
<i>Monopterus roseni</i> *	DD
<i>Ophisternon bengalense</i>	LC
Order Syngnathiformes	
Family Syngnathidae	
<i>Hippichthys penicillus</i>	LC
<i>Ichthyocampus carce</i>	LC
<i>Microphis cunocalus</i>	LC
Order Tetraodontiformes	
Family Tetraodontidae	
<i>Carinotetraodon imitator</i> *	DD
<i>Carinotetraodon travancoricus</i> *	VU - A2de +3de +4de

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FRESHWATER MOLLUSCS

Bivalves	
Order Arcoida	
Family Arcidae	
<i>Scaphula celox</i>	LC
<i>Scaphula nagarjunai</i> *	VU - D2
Order Unionoida	
Family Etheriidae	
<i>Pseudomulleria dalyi</i> *	EN (draft) - B1ab(iii,v) +2ab(iii,v)
Family Unionidae	
<i>Arcidopsis footei</i> *	EN (draft) - B2ab(iii,iv,v)
<i>Lamellidens consobrinus</i>	LC
<i>Lamellidens corrianus</i>	LC
<i>Lamellidens lamellatus</i>	LC
<i>Lamellidens marginalis</i>	LC
<i>Parreysia caerulea</i>	LC
<i>Parreysia corrugata</i>	LC
<i>Parreysia cylindrica</i> *	DD (draft)
<i>Parreysia favidens</i>	LC
<i>Parreysia khadakvaslaensis</i> *	VU (draft)
<i>Parreysia occata</i>	LC
<i>Parreysia rajahensis</i>	LC
<i>Parreysia shurtleffiana</i>	LC
Order Veneroida	
Family Corbiculidae	
<i>Corbicula annadaei</i> *	DD
<i>Corbicula krishnaea</i> *	DD
<i>Corbicula peninsularis</i> *	DD (draft)
<i>Corbicula regularis</i>	LC
<i>Corbicula striatella</i>	LC
<i>Villorita corbiculoides</i> *	DD
<i>Villorita cornucopia</i> *	LC
<i>Villorita cyprinoides</i> *	LC
Family Sphaeriidae	
<i>Pisidium clarkeanum</i>	LC

Gastropods	
Order Allogastropoda	
Family Bullinidae	
<i>Indoplanorbis exustus</i>	LC
Order Architaenioglossa	
Family Ampullariidae	
<i>Pila globosa</i>	LC
<i>Pila nevilleiana</i> *	DD
<i>Pila saxea</i> *	DD

<i>Pila virens</i>	LC
Family Viviparidae	
<i>Bellamya bengalensis</i>	LC
<i>Bellamya crassa</i>	LC
<i>Bellamya dissimilis</i>	LC
Order Cycloneritimorpha	
Family Neritidae	
<i>Neritina pulligera</i>	LC (draft)
<i>Neritina violacea</i>	LC
<i>Septaria lineata</i>	LC
Order Hygrophila	
Family Lymnaeidae	
<i>Lymnaea acuminata</i>	LC
<i>Lymnaea biacuminata</i>	DD
<i>Lymnaea luteola</i>	LC
<i>Stagnicola tungabhadraensis</i> *	DD
Family Planorbidae	
<i>Ferrissia baconi</i>	LC
<i>Ferrissia tenuis</i> *	LC (draft)
<i>Ferrissia verruca</i>	LC
<i>Gyraulus convexiusculus</i>	LC
<i>Gyraulus labiatus</i>	LC
<i>Gyraulus rotula</i>	LC
<i>Segmentina trochoidea</i>	LC
Order Littorinimorpha	
Family Bithyniidae	
<i>Bithynia pulchella</i>	LC
<i>Digoniostoma cerameopoma</i>	LC
<i>Gabbia orcula</i>	LC
<i>Gabbia stenothyroides</i>	LC
<i>Gabbia travancorica</i> *	LC
<i>Mysorella costigera</i>	LC (draft)
<i>Sataria everzardi</i> *	DD
Family Hydrobiidae	
<i>Stenothyra blanfordiana</i>	LC
<i>Stenothyra minima</i>	LC
Family Iravadiidae	
<i>Iravadia annadaei</i> *	DD
<i>Iravadia funerea</i> *	DD
<i>Iravadia ornata</i>	LC
Family Littorinidae	
<i>Cremnochonchus carinatus</i> *	EN - B1ab(iii) +2ab(iii)
<i>Cremnochonchus conicus</i> *	VU - D2
<i>Cremnochonchus syhadrensis</i> *	EN - B1ab(i,ii,iii,iv) +2ab(i,ii,iii,iv)

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Order Sorbeoconcha	
Family Pachychilidae	
<i>Paracrostoma martini</i> *	DD
<i>Paracrostoma tigrinus</i> *	DD
<i>Sulcospira huegeli</i>	LC
Family Thiariidae	
<i>Melanoides pyramis</i>	LC
<i>Paludomus annandalei</i> *	DD
<i>Paludomus inflatus</i>	DD (draft)

<i>Paludomus obesus</i> *	LC
<i>Paludomus rotunda</i> *	DD
<i>Paludomus stomatodon</i> *	DD
<i>Paludomus sulcatus</i>	DD
<i>Thiara granifera</i>	LC
<i>Thiara lineata</i>	LC
<i>Thiara riqueti</i>	LC
<i>Thiara rudis</i>	LC
<i>Thiara scabra</i>	LC

ODONATES

Order Odonata	
Family Aeshnidae	
<i>Anaciaeschna donaldi</i>	LC
<i>Anaciaeschna jaspidea</i>	LC
<i>Anax ephippiger</i>	LC
<i>Anax guttatus</i>	LC
<i>Anax immaculifrons</i>	LC
<i>Anax parthenope</i>	LC (draft)
<i>Gynacantha bayadera</i>	LC
<i>Gynacantha dravida</i>	DD
Family Calopterygidae	
<i>Neurobasis chinensis</i>	LC
<i>Vestalis apicalis</i>	LC
<i>Vestalis gracilis</i>	LC
Family Chlorocyphidae	
<i>Calocypha laidlawi</i>	DD
<i>Libellago lineata</i>	LC
<i>Rhinocypha bisignata</i>	LC
Family Chlorogomphidae	
<i>Chlorogomphus campioni</i> *	DD
<i>Chlorogomphus xanthoptera</i> *	VU - D2
Family Coenagrionidae	
<i>Aciagrion hisopa</i>	LC
<i>Aciagrion occidentale</i>	LC
<i>Aciagrion pallidum</i>	LC
<i>Agriocnemis keralensis</i> *	LC
<i>Agriocnemis lacteola</i>	LC
<i>Agriocnemis pieris</i>	LC
<i>Agriocnemis pygmaea</i>	LC
<i>Agriocnemis splendissima</i>	LC
<i>Amphialagma parvum</i>	LC
<i>Archibasis oscillans</i>	LC
<i>Ceriagrion cerinorubellum</i>	LC
<i>Ceriagrion coromandelianum</i>	LC

<i>Ceriagrion olivaceum</i>	LC
<i>Ceriagrion rubiae</i> *	DD (draft)
<i>Ischnura aurora</i>	LC
<i>Ischnura senegalensis</i>	LC
<i>Mortonagrion varralli</i>	DD
<i>Onychargia atrocyana</i>	LC
<i>Paracercion calamorum</i>	LC
<i>Pseudagrion decorum</i>	LC
<i>Pseudagrion hypermelas</i>	LC
<i>Pseudagrion indicum</i>	DD
<i>Pseudagrion malabaricum</i>	LC
<i>Pseudagrion microcephalum</i>	LC
<i>Pseudagrion rubriceps</i>	LC
Family Cordulidae	
<i>Hemicordulia asiatica</i>	LC
<i>Idionyx corona</i> *	DD
<i>Idionyx galeata</i> *	NT
<i>Idionyx minima</i>	DD
<i>Idionyx nadganiensis</i> *	DD
<i>Idionyx nilgiriensis</i> *	DD
<i>Idionyx periyashola</i> *	DD
<i>Idionyx rhinoceroides</i> *	LC
<i>Idionyx saffronata</i>	DD
<i>Idionyx travancorensis</i>	DD
<i>Macromidia donaldi</i> *	LC
Family Euphaeidae	
<i>Dysphaea ethela</i>	DD
<i>Euphaea cardinalis</i>	LC
<i>Euphaea dispar</i> *	LC
<i>Euphaea fraseri</i> *	LC
Family Gomphidae	
<i>Acrogomphus fraseri</i> *	DD
<i>Asiagomphus nilgircus</i> *	DD
<i>Burmagomphus cauvericus</i> *	DD

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<i>Burmagomphus laidlawi</i> *	DD
<i>Burmagomphus pyramidalis</i>	LC (draft)
<i>Cyclogomphus heterostylus</i>	DD
<i>Cyclogomphus wilkinsi</i>	DD
<i>Davidioides martini</i>	DD
<i>Gomphidia fletcheri</i> *	DD
<i>Gomphidia kodaguensis</i>	DD
<i>Gomphidia T-nigrum</i>	LC
<i>Heliogomphus kalarensis</i> *	DD
<i>Heliogomphus promelas</i> *	NT
<i>Ictinogomphus rapax</i>	LC
<i>Macrogomphus annulatus</i>	DD
<i>Macrogomphus wynaadicus</i> *	DD
<i>Megalogomphus hannyngtoni</i> *	NT
<i>Megalogomphus superbus</i>	DD
<i>Merogomphus longistigma</i> *	DD
<i>Microgomphus souteri</i> *	LC
<i>Microgomphus torquatus</i>	DD
<i>Onychogomphus acinaces</i>	DD
<i>Onychogomphus malabarensis</i> *	DD
<i>Onychogomphus nilgiriensis</i> *	LC
<i>Onychogomphus striatus</i>	DD
<i>Paragomphus lineatus</i>	LC
Family Lestidae	
<i>Indolestes gracilis</i>	LC
<i>Indolestes pulcherrimus</i> *	DD
<i>Lestes dorothea</i>	LC
<i>Lestes elatus</i>	LC (draft)
<i>Lestes malabaricus</i> *	NE
<i>Lestes patricia</i> *	NE
<i>Lestes praemorsus</i>	LC
<i>Lestes viridulus</i>	LC
Family Libellulidae	
<i>Acisoma panorpoides</i>	LC
<i>Aethriamanta brevipennis</i>	LC
<i>Brachydiplax sobrina</i>	LC
<i>Brachythemis contaminata</i>	LC
<i>Bradinyopyga geminata</i>	LC
<i>Cratilla lineata</i>	LC
<i>Crocothemis servilia</i>	LC
<i>Diplacodes lefebvrei</i>	LC
<i>Diplacodes nebulosa</i>	LC
<i>Diplacodes trivialis</i>	LC
<i>Epithemis mariae</i> *	LC
<i>Hydrobasileus croceus</i>	LC
<i>Hylaeothemis indica</i>	DD

<i>Indothemis carnatica</i>	NT
<i>Indothemis limbata</i>	LC
<i>Lathrecista asiatica</i>	LC
<i>Macrodiplax cora</i>	LC
<i>Neurothemis fulvia</i>	LC
<i>Neurothemis intermedia</i>	LC
<i>Neurothemis tullia</i>	LC
<i>Onychothemis testacea</i>	LC
<i>Orthetrum chrysis</i>	LC
<i>Orthetrum glaucum</i>	LC
<i>Orthetrum luzonicum</i>	LC
<i>Orthetrum pruinosum</i>	LC
<i>Orthetrum sabina</i>	LC
<i>Orthetrum testaceum</i>	LC
<i>Orthetrum triangulare</i>	LC
<i>Palpopleura sexmaculata</i>	LC
<i>Pantala flavescens</i>	LC
<i>Potamarcha congener</i>	LC
<i>Rhodothemis rufa</i>	LC
<i>Rhyothemis triangularis</i>	LC
<i>Rhyothemis variegata</i>	LC
<i>Sympetrum fonscolombii</i>	LC
<i>Tetrathemis platyptera</i>	LC
<i>Tholymis tillarga</i>	LC
<i>Tremea basilaris</i>	LC
<i>Tremea eurybia</i> *	NE
<i>Tremea limbata</i>	LC
<i>Tremea virginia</i>	LC
<i>Trithemis aurora</i>	LC
<i>Trithemis festiva</i>	LC
<i>Trithemis kirbyi</i>	LC
<i>Trithemis pallidinervis</i>	LC
<i>Urothemis signata</i>	LC
<i>Zygonyx iris</i>	LC
<i>Zygonyx torridus</i>	LC (draft)
<i>Zyxomma petiolatum</i>	LC
Family Macromiidae	
<i>Macromia annaimallaiensis</i> *	LC
<i>Macromia bellicosa</i> *	LC
<i>Macromia cingulata</i> *	LC
<i>Macromia ellisoni</i> *	LC
<i>Macromia ida</i> *	LC
<i>Macromia indica</i> *	DD
<i>Macromia irata</i> *	LC
<i>Epophthalmia frontalis</i>	LC
<i>Epophthalmia vittata</i>	LC

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<i>Macromia flavicincta</i>	DD
<i>Macromia flavocolorata</i>	LC
Family Platycnemididae	
<i>Copera marginipes</i>	LC
<i>Copera vittata</i>	LC
Family Platystictidae	
<i>Platysticta deccanensis</i> *	VU - B2ab(iii)
<i>Protosticta antelopoides</i> *	DD
<i>Protosticta davenporti</i> *	LC
<i>Protosticta gravelyi</i> *	LC
<i>Protosticta hearseyi</i> *	DD
<i>Protosticta rufostigma</i> *	LC
<i>Protosticta sanguinostigma</i> *	VU - B2ab(iii)
Family Protoneuridae	
<i>Caconeura gomphoides</i> *	DD

<i>Caconeura ramburi</i>	DD
<i>Caconeura risi</i>	DD
<i>Caconeura t-coerulea</i> *	DD
<i>Disparoneura apicalis</i> *	VU - D2
<i>Disparoneura quadrimaculata</i>	LC
<i>Elattoneura nigerrima</i> *	DD
<i>Elattoneura souteri</i> *	DD
<i>Elattoneura tetrica</i> *	LC
<i>Esme cyaneovittata</i> *	DD
<i>Esme longistyla</i> *	LC
<i>Esme mudiensis</i> *	DD
<i>Melanoneura bilineata</i> *	NT
<i>Phylloneura westermanni</i> *	NT
<i>Prodasineura verticalis</i>	LC

PLANTS

Algae	
Order Charales	
Family Characeae	
<i>Chara braunii</i>	LC (draft)
<i>Chara corallina</i>	LC (draft)
<i>Chara hydrophytis</i>	LC
<i>Chara nuda</i>	DD
<i>Chara setosa</i>	DD
<i>Chara zeylanica</i>	LC (draft)
<i>Nitella acuminata</i>	LC (draft)
<i>Nitella annamalaiensis</i> *	DD
<i>Nitella flexilis</i>	LC
<i>Nitella hyalina</i>	LC (draft)
<i>Nitella mucronata</i>	LC
<i>Nitella myriotracha</i>	LC
<i>Nitella oligospira</i>	LC
<i>Nitella pseudoflabellata</i>	LC
<i>Nitella tenuissima</i> *	LC
<i>Nitella terrestris</i> *	LC

Quillworts	
Order Isoetales	
Family Isoetaceae	
<i>Isoetes coromandelina</i>	LC
<i>Isoetes divyadarshanii</i> *	DD
<i>Isoetes indica</i> *	DD (draft)
<i>Isoetes panchganiensis</i> *	EN -B1ab(iii) +2ab(iii)
<i>Isoetes udupiensis</i> *	DD

Ferns	
Order Blechnales	
Family Lomariopsidaceae	
<i>Bolbitis appendiculata</i>	LC
<i>Bolbitis asplenifolia</i>	DD
<i>Bolbitis presliana</i> *	LC
<i>Bolbitis semicordata</i> *	LC
<i>Bolbitis subcrenata</i>	LC
<i>Elaphoglossum angulatum</i>	DD
<i>Elaphoglossum beddomei</i> *	LC
<i>Elaphoglossum nilgircum</i> *	LC
<i>Elaphoglossum stelligerum</i>	LC
Order Marsileales	
Family Marsileaceae	
<i>Marsilea minuta</i>	LC
<i>Marsilea quadrifolia</i>	LC
Order Pteridales	
Family Pteridaceae	
<i>Acrostichum aureum</i>	DD
Order Salviniiales	
Family Azollaceae	
<i>Azolla pinnata</i>	LC

Flowering Plants – Monocotyledons	
Order Alismatales	
Family Alismataceae	
<i>Alisma plantago-aquatica</i>	LC
<i>Caldesia oligococca</i>	LC

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<i>Caldesia parnassifolia</i>	LC
<i>Limnophyton obtusifolium</i>	LC
<i>Sagittaria guayanensis</i>	LC
<i>Sagittaria sagittifolia</i>	LC
<i>Sagittaria trifolia</i>	LC
<i>Wiesneria triandra</i> *	LC
Order Arales	
Family Araceae	
<i>Alocasia fornicate</i>	LC
<i>Colocasia esculenta</i>	LC
<i>Cryptocoryne ciliata</i>	LC
<i>Cryptocoryne cognata</i> *	EN -B2ab(ii,iii)
<i>Cryptocoryne consobrina</i> *	NT
<i>Cryptocoryne retrospiralis</i>	LC
<i>Cryptocoryne spiralis</i>	LC (draft)
<i>Lagenandra meeboldii</i> *	LC (draft)
<i>Lagenandra ovata</i>	LC
<i>Lagenandra toxicaria</i> *	LC
<i>Lasia spinosa</i>	LC
<i>Pistia stratiotes</i>	LC
Family Lemnaceae	
<i>Landoltia punctata</i>	LC
<i>Lemna aequinoctialis</i>	LC
<i>Lemna gibba</i>	LC
<i>Lemna minor</i>	LC
<i>Spirodela polyrhiza</i>	LC
<i>Wolffia arrhiza</i>	LC
<i>Wolffia globosa</i>	LC
<i>Wolffia microscopica</i>	DD (draft)
Order Commelinales	
Family Commelinaceae	
<i>Commelina benghalensis</i>	LC
<i>Commelina caroliniana</i>	LC
<i>Commelina clavata</i>	LC
<i>Commelina diffusa</i>	LC
<i>Commelina erecta</i>	LC
<i>Commelina imberbis</i>	LC
<i>Commelina subulata</i>	LC
<i>Cyanotis arcotensis</i> *	LC
<i>Cyanotis axillaris</i>	LC (draft)
<i>Cyanotis cristata</i>	LC
<i>Cyanotis cucullata</i>	LC
<i>Cyanotis fasciculata</i>	LC
<i>Cyanotis papilionacea</i> *	LC
<i>Floscopa scandens</i>	LC
<i>Murdannia esculenta</i>	LC

<i>Murdannia lanceolata</i> *	VU -D2
<i>Murdannia nudiflora</i>	LC (draft)
<i>Murdannia pauciflora</i>	LC
<i>Murdannia semiteres</i>	LC
<i>Murdannia spirata</i>	LC
<i>Murdannia vaginata</i>	LC
Order Cyperales	
Family Cyperaceae	
<i>Actinoscirpus grossus</i>	LC
<i>Bulbostylis densa</i>	LC
<i>Carex baccans</i>	LC
<i>Carex filicina</i>	LC
<i>Carex hebecarpa</i>	LC
<i>Carex lindleyana</i>	LC
<i>Carex longipes</i>	LC
<i>Carex maculata</i>	LC
<i>Carex myosurus</i>	LC
<i>Carex phacota</i>	LC
<i>Cyperus alopecuroides</i>	LC (draft)
<i>Cyperus alulatus</i>	LC
<i>Cyperus amabilis</i>	LC
<i>Cyperus arenarius</i>	LC
<i>Cyperus articulatus</i>	LC (draft)
<i>Cyperus castaneus</i>	LC
<i>Cyperus cephalotes</i>	LC
<i>Cyperus clarkei</i>	LC
<i>Cyperus compactus</i>	LC
<i>Cyperus compressus</i>	LC (draft)
<i>Cyperus corymbosus</i>	LC (draft)
<i>Cyperus cyperoides</i>	LC
<i>Cyperus difformis</i>	LC
<i>Cyperus diffusus</i>	LC
<i>Cyperus digitatus</i>	LC
<i>Cyperus distans</i>	LC
<i>Cyperus dubius</i>	LC
<i>Cyperus elatus</i>	LC
<i>Cyperus esculentus</i>	LC
<i>Cyperus exaltatus</i>	LC (draft)
<i>Cyperus haspan</i>	LC (draft)
<i>Cyperus imbricatus</i>	LC
<i>Cyperus iria</i>	LC (draft)
<i>Cyperus laevigatus</i>	LC (draft)
<i>Cyperus longus</i>	LC
<i>Cyperus maderaspatanus</i>	LC
<i>Cyperus malaccensis</i>	LC (draft)
<i>Cyperus meeboldii</i>	LC

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<i>Cyperus michelianus</i>	LC
<i>Cyperus mitis</i>	LC
<i>Cyperus nutans</i>	LC
<i>Cyperus pangorei</i>	LC
<i>Cyperus paniceus</i>	LC
<i>Cyperus papyrus</i>	LC
<i>Cyperus pilosus</i>	LC
<i>Cyperus platyphyllus</i>	LC
<i>Cyperus platystylis</i>	LC (draft)
<i>Cyperus procerus</i>	LC
<i>Cyperus pulchellus</i>	LC
<i>Cyperus rotundus</i>	LC
<i>Cyperus rubicundus</i>	LC
<i>Cyperus squarrosus</i>	LC
<i>Cyperus stoloniferus</i>	LC
<i>Cyperus tenuiculmis</i>	LC
<i>Cyperus tenuispica</i>	LC
<i>Cyperus tuberosus</i>	LC
<i>Cyperus zollingeri</i>	LC
<i>Diplacrum caricinum</i>	LC
<i>Eleocharis acutangula</i>	LC (draft)
<i>Eleocharis atropurpurea</i>	LC
<i>Eleocharis congesta</i>	LC
<i>Eleocharis dulcis</i>	LC (draft)
<i>Eleocharis geniculata</i>	LC
<i>Eleocharis lankana</i>	LC
<i>Eleocharis ochrostachys</i>	LC
<i>Eleocharis retroflexa</i>	LC
<i>Eleocharis spiralis</i>	LC
<i>Eleocharis swamyi</i> *	DD
<i>Eleocharis tetraquetra</i>	LC (draft)
<i>Eleocharis wadoodii</i> *	DD
<i>Fimbristylis acuminata</i>	LC
<i>Fimbristylis aestivalis</i>	LC (draft)
<i>Fimbristylis alboviridis</i>	LC
<i>Fimbristylis aphylla</i>	LC
<i>Fimbristylis argentea</i>	LC
<i>Fimbristylis bisumbellata</i>	LC
<i>Fimbristylis cinnamometorum</i>	LC
<i>Fimbristylis complanata</i>	LC
<i>Fimbristylis consanguinea</i>	LC
<i>Fimbristylis crystallina</i> *	EN -B2ab(iii)
<i>Fimbristylis dauciformis</i> *	EN -B2ab(i,ii,iii)
<i>Fimbristylis dichotoma</i>	LC (draft)
<i>Fimbristylis dipsacea</i>	LC
<i>Fimbristylis ferruginea</i>	LC

<i>Fimbristylis hirsutifolia</i> *	CR (PE) -B1ab(i,ii,iii) +2ab(i,ii,iii)
<i>Pycreus polystachyos</i>	LC
<i>Pycreus pumilus</i>	LC (draft)
<i>Pycreus puncticulatus</i>	LC
<i>Pycreus sanguinolentus</i>	LC
<i>Pycreus stramineus</i>	LC
<i>Pycreus unioloides</i>	LC (draft)
<i>Queenslandiella hyalina</i>	LC
<i>Rhynchospora corymbosa</i>	LC
<i>Rhynchospora rugosa</i>	LC (draft)
<i>Schoenoplectiella articulata</i>	LC (draft)
<i>Schoenoplectiella juncooides</i>	LC (draft)
<i>Schoenoplectiella lateriflora</i>	LC
<i>Schoenoplectiella roylei</i>	LC
<i>Schoenoplectiella senegalensis</i>	LC
<i>Schoenoplectiella supina</i>	DD (draft)
<i>Schoenoplectus corymbosus</i>	LC
<i>Schoenoplectus litoralis</i>	LC
<i>Schoenoplectus mucronatus</i>	LC (draft)
<i>Scirpus naikianus</i> *	DD
<i>Scleria foliosa</i>	LC
<i>Scleria mikawana</i>	LC
<i>Scleria poklei</i> *	DD
<i>Scleria terrestris</i>	LC
<i>Trichophorum subcapitatum</i>	LC
Family Gramineae	
<i>Anthoxanthum borii</i> *	NT
<i>Arthraxon hispidus</i>	LC (draft)
<i>Arundo donax</i>	LC (draft)
<i>Bothriochloa pseudischaemum</i>	LC
<i>Brachiaria eruciformis</i>	LC
<i>Brachiaria mutica</i>	LC (draft)
<i>Brachiaria ramosa</i>	LC
<i>Brachiaria reptans</i>	LC (draft)
<i>Chionachne gigantea</i>	LC
<i>Coelachne minuta</i> *	LC
<i>Coelachne perpusilla</i>	LC
<i>Coelachne simpliciuscula</i>	LC (draft)
<i>Coix aquatica</i>	LC (draft)
<i>Coix lacryma-jobi</i>	LC (draft)
<i>Dactyloctenium aegyptium</i>	LC (draft)
<i>Dimeria hohenackeri</i> *	EN -B2ab(ii,iii,iv,v)
<i>Dimeria ornithopoda</i> *	LC
<i>Echinochloa colona</i>	LC (draft)
<i>Echinochloa crusgalli</i>	LC (draft)

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<i>Echinochloa frumentacea</i>	LC
<i>Echinochloa oryzoides</i>	LC (draft)
<i>Echinochloa picta</i>	LC
<i>Eleusine indica</i>	LC
<i>Elytrophorus spicatus</i>	LC
<i>Eragrostis japonica</i>	LC
<i>Eragrostis subsecunda</i>	LC
<i>Eragrostis unioloides</i>	LC
<i>Eriochloa procera</i>	LC
<i>Glyceria spicata</i>	DD
<i>Hemarthria compressa</i>	LC
<i>Hubbardia heptaneuron</i> *	VU -D2
<i>Hygroryza aristata</i>	LC (draft)
<i>Hymenachne amplexicaulis</i>	LC (draft)
<i>Imperata cylindrica</i>	LC (draft)
<i>Isachne albens</i>	LC
<i>Isachne bicolor</i> *	VU -B1ab(ii,iii) +2ab(ii,iii)
<i>Isachne globosa</i>	LC (draft)
<i>Isachne meeboldii</i> *	CR -B2ab(i,ii,iii)
<i>Isachne pulchella</i>	LC
<i>Isachne swaminathanii</i> *	EN -B2ab(i,ii,iii)
<i>Isachne veldkampii</i> *	CR -B1ab(i,ii,iii) +2ab(i,ii,iii)
<i>Ischaemum jayachandranii</i> *	CR (PE) -B1ab(ii,iii) +2ab(ii,iii)
<i>Ischaemum molle</i>	LC
<i>Ischaemum muticum</i>	LC
<i>Ischaemum rugosum</i>	LC (draft)
<i>Ischaemum travancorense</i> *	LC
<i>Ischaemum vembnadense</i> *	EN -B1ab(iii) +2ab(iii)
<i>Leersia hexandra</i>	LC (draft)
<i>Leptochloa chinensis</i>	LC (draft)
<i>Leptochloa fusca</i>	LC
<i>Leptochloa neesii</i>	LC
<i>Leptochloa obtusiflora</i>	LC
<i>Leptochloa panicea</i>	LC
<i>Limnopoia meeboldii</i> *	EN -B2ab(iii)
<i>Oryza officinalis</i>	LC
<i>Oryza rufipogon</i>	LC
<i>Panicum paludosum</i>	LC (draft)
<i>Panicum repens</i> *	LC
<i>Panicum sumatrense</i>	LC
<i>Paspalidium flavidum</i>	LC (draft)
<i>Paspalidium geminatum</i>	LC (draft)
<i>Paspalidium punctatum</i>	LC
<i>Paspalum canarae</i> *	LC

<i>Paspalum conjugatum</i>	LC
<i>Paspalum distichum</i>	LC (draft)
<i>Paspalum longifolium</i>	LC
<i>Paspalum scrobiculatum</i>	LC (draft)
<i>Phragmites vallatorius</i>	LC
<i>Pogonatherum paniceum</i>	LC
<i>Polypogon fugax</i>	LC (draft)
<i>Polypogon monspeliensis</i>	LC (draft)
<i>Polypogon nilgiricus</i> *	LC
<i>Polytrias indica</i>	LC
<i>Pseudoraphis brunoniana</i>	LC (draft)
<i>Pseudoraphis spinescens</i>	LC (draft)
<i>Saccharum spontaneum</i>	LC
<i>Sacciolepis curvata</i>	LC
<i>Sacciolepis indica</i>	LC (draft)
<i>Sacciolepis interrupta</i>	LC (draft)
<i>Sacciolepis myosuroides</i>	LC
<i>Urochloa panicoides</i>	LC
Order Eriocaulales	
Family Eriocaulaceae	
<i>Eriocaulon achnon</i>	LC
<i>Eriocaulon anshiense</i> *	EN -B1ab(iii) +2ab(iii)
<i>Eriocaulon apetalum</i> *	LC
<i>Eriocaulon balakrishnanii</i> *	LC
<i>Eriocaulon baramaticum</i> *	DD
<i>Eriocaulon barbeyanum</i> *	NT
<i>Eriocaulon bolei</i> *	CR (PE) -B1ab(i,iii) +2ab(i,iii)
<i>Eriocaulon breviscapum</i> *	LC
<i>Eriocaulon brownianum</i>	LC
<i>Eriocaulon cinereum</i>	LC (draft)
<i>Eriocaulon conicum</i> *	LC
<i>Eriocaulon cookei</i> *	LC
<i>Eriocaulon cuspidatum</i> *	LC
<i>Eriocaulon dalzellii</i> *	EN -B1ab(ii,iii) +2ab(ii,iii)
<i>Eriocaulon duthiei</i> *	LC
<i>Eriocaulon elenora</i> *	LC
<i>Eriocaulon eurypeplon</i> *	LC
<i>Eriocaulon fluviale</i>	LC
<i>Eriocaulon fysonii</i> *	LC
<i>Eriocaulon hamiltonianum</i>	DD (draft)
<i>Eriocaulon heterolepis</i> *	LC
<i>Eriocaulon hookerianum</i>	LC
<i>Eriocaulon kanarense</i> *	LC
<i>Eriocaulon karnatakense</i> *	VU -D2
<i>Eriocaulon kolhapurense</i> *	VU -D2

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<i>Eriocaulon konkanense</i> *	VU -D2
<i>Eriocaulon koynense</i> *	DD
<i>Eriocaulon lanceolatum</i> *	LC
<i>Eriocaulon leucomelas</i> *	LC
<i>Eriocaulon longicuspe</i>	LC
<i>Eriocaulon maharashtrense</i> *	VU -D2
<i>Eriocaulon margaretae</i> *	LC
<i>Eriocaulon minimum</i>	LC
<i>Eriocaulon minutum</i> *	LC
<i>Eriocaulon nepalense</i>	LC
<i>Eriocaulon odoratum</i>	LC
<i>Eriocaulon parviflorum</i> *	LC
<i>Eriocaulon pectinatum</i> *	VU -B1ab(iii) +2ab(iii)
<i>Eriocaulon peninsulare</i> *	LC
<i>Eriocaulon quinquangulare</i>	LC (draft)
<i>Eriocaulon ratnagiricum</i> *	CR -B1ab(ii,iii,v) +2ab(ii,iii,v)
<i>Eriocaulon richardianum</i> *	EN -B2ab(ii,iii)
<i>Eriocaulon ritchieanum</i> *	LC
<i>Eriocaulon robustobrownianum</i> *	LC
<i>Eriocaulon robustum</i> *	LC
<i>Eriocaulon rouxianum</i> *	CR (PE) -B1ab(ii,iii) +2ab(ii,iii)
<i>Eriocaulon sahyadricum</i> *	LC
<i>Eriocaulon santapauli</i> *	CR (PE) -B1ab(iii) +2ab(iii)
<i>Eriocaulon sedgwickii</i> *	LC
<i>Eriocaulon setaceum</i>	LC (draft)
<i>Eriocaulon sexangulare</i>	LC (draft)
<i>Eriocaulon sharmae</i> *	CR -B1ab(iii) +2ab(iii)
<i>Eriocaulon sivarajanii</i> *	CR -B1ab(iii) +2ab(iii)
<i>Eriocaulon sollyanum</i>	LC (draft)
<i>Eriocaulon stellulatum</i> *	LC
<i>Eriocaulon talbotii</i> *	LC
<i>Eriocaulon thwaitesii</i>	LC
<i>Eriocaulon truncatum</i>	LC
<i>Eriocaulon tuberiferum</i> *	VU -B1ab(ii,iii) +2ab(ii,iii);D2
<i>Eriocaulon wightianum</i>	LC
<i>Eriocaulon xeranthemum</i>	LC
Order Hydrocharitales	
Family Hydrocharitaceae	
<i>Blyxa aubertii</i>	LC
<i>Blyxa japonica</i>	LC
<i>Blyxa octandra</i>	LC
<i>Hydrilla verticillata</i>	LC
<i>Najas graminea</i>	LC

<i>Najas indica</i>	LC
<i>Najas malesiana</i>	LC
<i>Najas marina</i>	LC
<i>Najas minor</i>	LC
<i>Nechamandra alternifolia</i>	LC
<i>Ottelia alismoides</i>	LC
<i>Vallisneria natans</i>	LC
<i>Vallisneria spiralis</i>	LC
Order Juncales	
Family Juncaceae	
<i>Juncus bufonius</i>	LC
<i>Juncus effusus</i>	LC
<i>Juncus inflexus</i>	LC
<i>Juncus prismatocarpus</i>	LC
Order Liliales	
Family Amaryllidaceae	
<i>Crinum lorifolium</i>	LC
<i>Crinum viviparum</i>	LC
Family Pontederiaceae	
<i>Monochoria hastata</i>	LC
<i>Monochoria vaginalis</i>	LC
Order Najadales	
Family Aponogetonaceae	
<i>Aponogeton appendiculatus</i> *	DD
<i>Aponogeton bruggenii</i> *	VU -D2
<i>Aponogeton crispus</i>	LC
<i>Aponogeton natans</i>	LC
<i>Aponogeton satarensis</i> *	EN -B1ab(ii,iii) +2ab(ii,iii)
<i>Aponogeton undulatus</i>	LC
Family Potamogetonaceae	
<i>Potamogeton crispus</i>	LC
<i>Potamogeton nodosus</i>	LC
<i>Potamogeton octandrus</i>	LC
<i>Potamogeton perfoliatus</i>	LC (draft)
<i>Potamogeton pusillus</i>	LC
<i>Stuckenia pectinata</i>	LC
Order Typhales	
Family Typhaceae	
<i>Typha angustifolia</i>	LC
<i>Typha domingensis</i>	LC
<i>Typha elephantina</i>	LC

Flowering Plants – Dicotyledons

Order Apiales	
Family Umbelliferae	
<i>Centella asiatica</i>	LC (draft)
<i>Hydrocotyle conferta</i> *	EN -B2ab(ii,iii)

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<i>Hydrocotyle javanica</i>	LC
<i>Hydrocotyle sibthorpioides</i>	LC
Order Asterales	
Family Compositae	
<i>Acmella paniculata</i>	LC
<i>Anaphalis beddomei</i> *	VU -B1ab(ii,iii)
<i>Anaphalis leptophylla</i> *	VU -B2ab(ii,iii)
<i>Anaphalis wightiana</i> *	VU -B2ab(ii,iii)
<i>Caesulia axillaris</i>	LC (draft)
<i>Centipeda minima</i>	LC
<i>Cyathocline lutea</i> *	LC
<i>Cyathocline purpurea</i>	LC
<i>Emilia zeylanica</i>	LC
<i>Enydra fluctuans</i>	LC (draft)
<i>Epaltes divaricata</i>	LC
<i>Grangea maderaspatana</i>	LC (draft)
<i>Gynura travancorica</i> *	NT
<i>Moonia heterophylla</i>	NT
<i>Notonia shevaroyensis</i> *	VU -B1ab(iii);D2
<i>Senecio wightii</i>	LC
<i>Sphaeranthus africanus</i>	LC
<i>Sphaeranthus amaranthoides</i>	LC
<i>Sphaeranthus indicus</i>	LC
<i>Wedelia chinensis</i>	LC (draft)
Order Campanulales	
Family Campanulaceae	
<i>Lobelia alsinoides</i>	LC
<i>Lobelia zeylanica</i>	LC
<i>Sphenoclea zeylanica</i>	LC
Order Capparales	
Family Cruciferae	
<i>Nasturtium officinale</i>	LC (draft)
<i>Rorippa indica</i>	LC (draft)
Order Caryophyllales	
Family Amaranthaceae	
<i>Alternanthera sessilis</i>	LC
Order Euphorbiales	
Family Euphorbiaceae	
<i>Homonoia retusa</i> *	LC
<i>Homonoia riparia</i>	LC
Order Fabales	
Family Leguminosae	
<i>Aeschynomene aspera</i>	LC (draft)
<i>Aeschynomene indica</i>	LC (draft)
<i>Crotalaria quinquefolia</i>	LC
<i>Geissaspis cristata</i>	LC
<i>Geissaspis tenella</i> *	LC

<i>Neptunia oleracea</i>	LC (draft)
<i>Neptunia plena</i>	LC
<i>Parochetus communis</i>	LC
<i>Sesbania bispinosa</i>	LC
<i>Sesbania javanica</i>	LC (draft)
<i>Sesbania procumbens</i> *	DD (draft)
<i>Smithia blanda</i>	LC
<i>Smithia hirsuta</i> *	LC
<i>Smithia sensitiva</i>	LC
Order Lamiales	
Family Labiatae	
<i>Clinopodium capitellatum</i> *	LC
<i>Pogostemon salicifolius</i> *	LC
<i>Pogostemon stellatus</i>	LC
<i>Pogostemon wightii</i> *	LC
<i>Scutellaria barbata</i>	LC (draft)
Order Myrtales	
Family Lythraceae	
<i>Ammannia auriculata</i>	LC
<i>Ammannia baccifera</i>	LC
<i>Ammannia multiflora</i>	LC
<i>Ammannia nagpurensis</i> *	EN -B1ab(ii,iii) +2ab(ii,iii)
<i>Ammannia octandra</i>	LC
<i>Ammannia senegalensis</i>	LC
<i>Nesaea brevipes</i>	LC
<i>Nesaea prostrata</i>	LC
<i>Rotala cookii</i> *	EN -B1ab(i,iii) +2ab(i,iii)
<i>Rotala densiflora</i>	LC
<i>Rotala fimbriata</i> *	LC
<i>Rotala floribunda</i> *	VU -B1ab(iii) +2ab(iii)
<i>Rotala illecebroides</i> *	LC
<i>Rotala indica</i>	LC
<i>Rotala macrandra</i> *	LC
<i>Rotala malabarica</i> *	CR -B1ab(i,ii,iii) +2ab(i,ii,iii)
<i>Rotala malampuzhensis</i> *	LC
<i>Rotala mexicana</i>	LC
<i>Rotala occultiflora</i>	LC
<i>Rotala ritchiei</i> *	EN -B1ab(ii,iii) +2ab(ii,iii)
<i>Rotala rosea</i>	LC
<i>Rotala rotundifolia</i>	LC
<i>Rotala serpyllifolia</i>	LC
<i>Rotala verticillaris</i>	LC
Family Onagraceae	
<i>Ludwigia adscendens</i>	LC (draft)
<i>Ludwigia hyssopifolia</i>	LC
<i>Ludwigia octovalvis</i>	LC (draft)

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<i>Ludwigia perennis</i>	LC
<i>Ludwigia prostrata</i>	LC (draft)
Family Trapaceae	
<i>Trapa natans</i>	LC
Order Nepenthales	
Family Droseraceae	
<i>Drosera burmanni</i>	LC
<i>Drosera indica</i>	LC
<i>Drosera peltata</i>	LC
Order Nymphaeales	
Family Ceratophyllaceae	
<i>Ceratophyllum demersum</i>	LC (draft)
<i>Ceratophyllum muricatum</i>	LC (draft)
Family Nymphaeaceae	
<i>Nymphaea nouchali</i>	LC
<i>Nymphaea pubescens</i>	LC
<i>Nymphaea rubra</i>	LC
Order Podostemales	
Family Podostemaceae	
<i>Cladopus hookeriana</i> *	LC
<i>Dalzellia zeylanica</i>	LC
<i>Dicraeia dichotoma</i> *	NT
<i>Farmeria indica</i> *	EN -B1ab(i,ii,iii) +2ab(i,ii,iii)
<i>Farmeria metzgerioides</i>	VU -B2ab(iii,v)
<i>Hydrobryopsis sessilis</i> *	LC
<i>Indotristicha ramosissima</i> *	LC
<i>Indotristicha tirunelveliana</i> *	NT
<i>Podostemum munnarensense</i> *	EN -B1ab(iii) +2ab(iii)
<i>Polypleurum dichotomum</i> *	LC
<i>Polypleurum filifolium</i> *	VU -B1ab(iii,v) +2b(i,iii,v)
<i>Polypleurum stylosum</i>	LC
<i>Polypleurum wallichii</i>	LC
<i>Willisia selaginoides</i> *	VU -B1ab(i,ii,iii)
<i>Zeylanidium barberi</i> *	LC
<i>Zeylanidium lichenoides</i>	LC
<i>Zeylanidium olivaceum</i>	LC
<i>Zeylanidium subulatum</i>	LC
Order Polygonales	
Family Polygonaceae	
<i>Persicaria attenuata</i> *	LC
<i>Persicaria barbatum</i>	LC (draft)
<i>Persicaria dichotoma</i>	LC
<i>Persicaria glabrum</i>	LC (draft)
<i>Persicaria hydropiper</i>	LC (draft)
<i>Persicaria lapathifolia</i>	LC (draft)
<i>Persicaria orientalis</i>	LC (draft)

<i>Persicaria strigosa</i>	LC
<i>Polygonum plebeium</i>	LC
<i>Polygonum pubescens</i>	LC
Order Ranunculales	
Family Ranunculaceae	
<i>Ranunculus sceleratus</i>	LC (draft)
Order Scrophulariales	
Family Acanthaceae	
<i>Acanthus ilicifolius</i>	LC
<i>Hygrophila balsamica</i>	LC
<i>Hygrophila difformis</i>	LC
<i>Hygrophila heinei</i> *	LC
<i>Hygrophila madurensis</i> *	CR -B1ab(ii,iii) +2ab(ii,iii);D
<i>Hygrophila pinnatifida</i>	LC
<i>Hygrophila polysperma</i>	LC
<i>Hygrophila quadrivalvis</i>	LC
<i>Hygrophila salicifolia</i>	LC
<i>Hygrophila schulli</i>	LC
<i>Hygrophila serpyllum</i> *	DD (draft)
<i>Justicia quinqueangularis</i>	LC
Family Lentibulariaceae	
<i>Utricularia albocaerulea</i> *	VU -B1ab(i,ii,iii) +2ab(i,ii,iii)
<i>Utricularia aurea</i>	LC
<i>Utricularia australis</i>	LC
<i>Utricularia bifida</i>	LC
<i>Utricularia caerulea</i>	LC (draft)
<i>Utricularia cecillii</i> *	EN -B1ab(i,ii,iii) +2ab(i,ii,iii)
<i>Utricularia exoleta</i>	LC (draft)
<i>Utricularia foveolata</i>	LC
<i>Utricularia gibba</i>	LC
<i>Utricularia graminifolia</i>	DD
<i>Utricularia hirta</i>	LC (draft)
<i>Utricularia lazulina</i> *	LC
<i>Utricularia minutissima</i>	LC (draft)
<i>Utricularia polygaloides</i>	LC (draft)
<i>Utricularia praeterita</i> *	NT
<i>Utricularia reticulata</i>	LC
<i>Utricularia scandens</i>	LC (draft)
<i>Utricularia smithiana</i> *	LC
<i>Utricularia stellaris</i>	LC (draft)
<i>Utricularia striatula</i>	LC (draft)
<i>Utricularia uliginosa</i>	LC (draft)
<i>Utricularia wightiana</i> *	VU -B1ab(iii)

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Family Scrophulariaceae	
<i>Bacopa floribunda</i>	LC
<i>Bacopa hamiltoniana</i>	LC
<i>Bacopa monnieri</i>	LC
<i>Bonnayodes limnophiloides</i> *	DD
<i>Centranthera indica</i>	LC
<i>Centranthera tranquebarica</i>	LC
<i>Dopatrium junceum</i>	LC (draft)
<i>Dopatrium lobelioides</i> *	DD (draft)
<i>Dopatrium nudicaule</i>	LC
<i>Glossostigma diandrum</i>	LC
<i>Ilysanthes rotundifolia</i>	LC
<i>Limnophila aromatica</i>	LC (draft)
<i>Limnophila chinensis</i>	LC
<i>Limnophila connata</i>	LC
<i>Limnophila glandulifera</i> *	DD
<i>Limnophila heterophylla</i>	LC (draft)
<i>Limnophila indica</i>	LC (draft)
<i>Limnophila polystachya</i>	LC
<i>Limnophila repens</i>	LC
<i>Limnophila rugosa</i>	LC (draft)
<i>Limnophila sessiliflora</i>	LC (draft)
<i>Lindernia anagallis</i>	LC
<i>Lindernia antipoda</i>	LC (draft)
<i>Lindernia ciliata</i>	LC
<i>Lindernia crustacea</i>	LC (draft)

<i>Lindernia estaminodiosa</i> *	LC
<i>Lindernia hyssopoides</i>	LC
<i>Lindernia manilaliana</i> *	EN -B1ab(ii,iii)
<i>Lindernia micrantha</i>	LC (draft)
<i>Lindernia minima</i> *	EN -B1ab(ii,iii,v) +2ab(ii,iii,v)
<i>Lindernia molluginoides</i>	LC
<i>Lindernia nummulariifolia</i>	LC
<i>Lindernia oppositifolia</i>	LC
<i>Lindernia parviflora</i>	LC
<i>Lindernia procumbens</i>	LC (draft)
<i>Lindernia pusilla</i>	LC
<i>Lindernia ruellioides</i>	LC
<i>Lindernia tenuifolia</i>	LC
<i>Lindernia viscosa</i>	LC
<i>Microcarpaea minima</i>	LC (draft)
<i>Torenia bicolor</i> *	LC
<i>Veronica anagallis-aquatica</i>	LC (draft)
Order Solanales	
Family Convolvulaceae	
<i>Aniseia martinicensis</i>	LC
<i>Ipomoea aquatica</i>	LC (draft)
<i>Ipomoea coptica</i>	LC
<i>Merremia gangetica</i>	LC
Family Hydrophyllaceae	
<i>Hydrolea zeylanica</i>	LC



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Reptiles

Reptiles are cold-blooded animals. They lay eggs and their skin is covered with hard, dry scales. Reptiles do not burn as much energy keeping their body warm and as a result they do not eat nearly as much food as a similar sized mammal or other warm-blooded animal.

Snakes, lizards, crocodiles, and turtles are some of the major examples of reptiles.

Snakes are legless, elongated, carnivorous reptiles. They lack eyelids and external ears. Only small percentage of these animals are poisonous. Snakes, if they eat large prey, can go weeks without needing to eat again.

Lizards are another example of reptile. They are most closely related to snakes, but like snakes, lizards have movable eyelids. Lizards have a small head, short neck, and long body and tail. They are similar to snakes but with legs. Some examples of lizards are Calotes, chameleons, geckos, monitor lizards and skinks.

Crocodiles are semi-aquatic reptiles. Gharial is another example of the same group. These reptiles are carnivores. They are very strong with bodies built for predation including powerful tapering jaws. They are good at hearing and they communicate with a wide range of vocalizations such as grunts, coughs and barks. They bask to regulate their internal temperatures. These are active during the day. They look slow but can move very quickly when attacking their prey.

Turtles and tortoises are another group of reptiles. A turtle lives in the water and a tortoise lives on land but both lay eggs on the ground. A tortoise has a dome shaped shell with short and sturdy feet. Its legs are bent, instead of being straight and directly under the body. A turtle has a flat streamlined shell with webbed feet with long claws. A turtle is estimated to live between 20-30 years while tortoises live more than 100 years and some individuals are known to have lived longer than 150 years.

About 265 species of reptiles have now been recorded from the Western Ghats of India with 66% of these species being completely restricted to this distinct mountain range.

The status of endemic reptiles of Western Ghats are listed here:



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Reptiles of Western Ghats (Endemics)

Family: Agamidae	
<i>Calotes aurantolabium</i>	DD
<i>Calotes ellioti</i>	LC
<i>Calotes grandisquamis</i>	LC
<i>Calotes nemoricola</i>	LC
<i>Calotes rouxii</i>	LC
<i>Draco dussumieri</i>	LC
<i>Otocryptis beddomii</i>	EN B1ab(iii)
<i>Psammophilus blanfordianus</i>	LC
<i>Psammophilus dorsalis</i>	LC
<i>Salea anamallayana</i>	LC
<i>Salea horsfeldi</i>	LC
Family: EUBLEPHARIDAE	
<i>Eublepharis fuscus</i>	LC
Family: GEKKONIDAE	
<i>Calodactylodes aureus</i>	LC
<i>Cnemaspis australis</i>	DD
<i>Cnemaspis beddomei</i>	DD
<i>Cnemaspis goaensis</i>	EN B1ab(iii)
<i>Cnemaspis gracilis</i>	LC
<i>Cnemaspis heteropholis</i>	NT
<i>Cnemaspis indica</i>	VU B1ab(iii)
<i>Cnemaspis indraneildasi</i>	VU B1ab(iii)
<i>Cnemaspis jerdonii</i>	VU B1ab(iii)
<i>Cnemaspis kolhapurensis</i>	DD
<i>Cnemaspis littoralis</i>	DD
<i>Cnemaspis monticola</i>	DD
<i>Cnemaspis mysoriensis</i>	LC
<i>Cnemaspis nairi</i>	NT
<i>Cnemaspis nilagrica</i>	DD
<i>Cnemaspis ornata</i>	NT
<i>Cnemaspis otai</i>	VU D2
<i>Cnemaspis sisparensis</i>	NT
<i>Cnemaspis wynadensis</i>	EN B1ab(iii)
<i>Cnemaspis yercaudensis</i>	LC
<i>Cyrtodactylus nebulosus</i>	LC
<i>Geckoella albofasciatus</i>	LC
<i>Geckoella collegalensis</i>	LC
<i>Geckoella deccanensis</i>	LC
<i>Geckoella jeyporensis</i>	CR B1ab(iii)
<i>Hemidactylus aaronbaueri</i>	LC
<i>Hemidactylus albofasciatus</i>	VU B1ab(iii)
<i>Hemidactylus anamallensis</i>	NT
<i>Hemidactylus giganteus</i>	LC

<i>Hemidactylus gracilis</i>	LC
<i>Hemidactylus graniticolus</i>	LC
<i>Hemidactylus gujuratensis</i>	VU D2
<i>Hemidactylus maculatus</i>	LC
<i>Hemidactylus porbadarenensis</i>	DD
<i>Hemidactylus prashadi</i>	LC
<i>Hemidactylus reticulatus</i>	LC
<i>Hemidactylus satarensis</i>	VU D2
<i>Hemidactylus treutleri</i>	LC
<i>Hemiphyllodactylus aurantiacus</i>	LC
Family: LACERTIDAE	
<i>Ophisops microlepis</i>	LC
Family: SCINCIDAE	
<i>Barkudia insularis</i>	DD
<i>Barkudia melanosticta</i>	DD
<i>Chalcides pentadactylus</i>	DD
<i>Eurylepis poonaensis</i>	EN B1ab(iii)
<i>Eutropis allapallensis</i>	LC
<i>Eutropis bibronii</i>	DD
<i>Eutropis gansi</i>	DD
<i>Eutropis innotata</i>	DD
<i>Eutropis nagarjuni</i>	NT
<i>Eutropis trivittata</i>	LC
<i>Kaestlea beddomei</i>	LC
<i>Kaestlea bilineata</i>	LC
<i>Kaestlea laterimaculata</i>	VU B1ab(iii)
<i>Kaestlea palnica</i>	DD
<i>Lygosoma ashwamedhi</i>	VU B1ab(iii)
<i>Lygosoma goaensis</i>	DD
<i>Lygosoma guentheri</i>	LC
<i>Lygosoma lineata</i>	LC
<i>Lygosoma pruthi</i>	DD
<i>Lygosoma vosmaeri</i>	DD
<i>Ristella beddomii</i>	LC
<i>Ristella guentheri</i>	DD
<i>Ristella rurkii</i>	DD
<i>Ristella travancorica</i>	DD
Family: COLUBRIDAE	
<i>Ahaetulla dispar</i>	NT
<i>Ahaetulla perroteti</i>	EN B1ab(iii)
<i>Boiga dightoni</i>	DD
<i>Coluber bholanathi</i>	DD
<i>Coluber gracilis</i>	DD
<i>Coronella brachyura</i>	LC

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<i>Dendrelaphis ashoki</i>	LC
<i>Dendrelaphis chairecacos</i>	DD
<i>Dendrelaphis giri</i>	LC
<i>Dendrelaphis grandoculis</i>	LC
<i>Dryocalamus gracilis</i>	DD
<i>Elachistodon westermanni</i>	LC
<i>Lycodon flavomaculatus</i>	LC
<i>Lycodon travancoricus</i>	LC
<i>Oligodon affinis</i>	LC
<i>Oligodon brevicauda</i>	VU B1ab(iii)
<i>Oligodon nikhili</i>	DD
<i>Oligodon travancoricus</i>	DD
<i>Oligodon venustus</i>	LC
<i>Rhabdops olivaceus</i>	LC
Family: ELAPIDAE	
<i>Bungarus fasciatus</i>	LC
<i>Calliophis beddomei</i>	DD
<i>Calliophis nigriscens</i>	LC
Family: GERRHOPILIDAE	
<i>Gerrhopilus beddomii</i>	DD
<i>Gerrhopilus tindali</i>	DD
Family: NATRICIDAE	
<i>Amphiesma beddomei</i>	LC
<i>Amphiesma monticola</i>	LC
Family: PSAMMOPHIIDAE	
<i>Psammophis longifrons</i>	LC
Family: TYPHLOPIDAE	
<i>Grypotyphlops acutus</i>	LC
<i>Typhlops exiguus</i>	DD
<i>Typhlops pammeceus</i>	LC
<i>Typhlops thurstonii</i>	DD
Family: UROPELTIDAE	
<i>Brachyophidium rhodogaster</i>	LC
<i>Melanophidium bilineatum</i>	VU B1ab(iii)
<i>Melanophidium punctatum</i>	LC
<i>Melanophidium wynaudense</i>	LC
<i>Platyplectrurus madurensis</i>	EN B1ab(iii)+2ab(iii)
<i>Platyplectrurus trilineatus</i>	DD
<i>Plectrurus aureus</i>	DD
<i>Plectrurus canaricus</i>	DD
<i>Plectrurus guentheri</i>	DD
<i>Plectrurus perroteti</i>	LC
<i>Rhinophis fergusonianus</i>	DD
<i>Rhinophis sanguineus</i>	LC
<i>Rhinophis travancoricus</i>	EN B1ab(iii)+2ab(iii)
<i>Teretrurus sanguineus</i>	LC

<i>Uropeltis arcticeps</i>	LC
<i>Uropeltis beddomii</i>	DD
<i>Uropeltis bicatenata</i>	NT
<i>Uropeltis broughami</i>	DD
<i>Uropeltis ceylanicus</i>	LC
<i>Uropeltis dindigalensis</i>	DD
<i>Uropeltis ellioti</i>	LC
<i>Uropeltis liura</i>	DD
<i>Uropeltis macrolepis</i>	LC
<i>Uropeltis macrorhynchus</i>	DD
<i>Uropeltis maculatus</i>	DD
<i>Uropeltis myhendrae</i>	DD
<i>Uropeltis nitidus</i>	DD
<i>Uropeltis ocellatus</i>	LC
<i>Uropeltis petersi</i>	DD
<i>Uropeltis phipsonii</i>	VU B1ab(iii)
<i>Uropeltis pulneyensis</i>	LC
<i>Uropeltis rubrolineatus</i>	LC
<i>Uropeltis rubromaculatus</i>	LC
<i>Uropeltis smithi</i>	NT
<i>Uropeltis woodmasoni</i>	LC
Family: VIPERIDAE	
<i>Peltopelor macrolepis</i>	NT
<i>Trimeresurus gramineus</i>	LC
<i>Trimeresurus malabaricus</i>	LC
<i>Trimeresurus strigatus</i>	LC
Family: XENODERMATIDAE	
<i>Xylophis captaini</i>	LC
<i>Xylophis perroteti</i>	LC
<i>Xylophis stenorhynchus</i>	DD

Major Rivers of Western Ghats

Rivers of Kerala

No.	Name of the river	Districts/ States in which river basin is located	Length (km)
1	Manjeswaram	Kasargod	15
2	Uppala	Kasargod	50
3	Shiriyá	Kasargod	67
4	Mogral	Kasargod	34
5	Chandragiri	Kasargod	105
6	Chittari	Kasargod	25
7	Nileswaram	Kasargod, Kannur	46
8	Kariangode	Kasargod, Kannur	64
9	Kavvayi	Kasargod, Kannur	31
10	Peruvamba	Kasargod, Kannur	51
11	Ramapuram	Kasargod, Kannur	19
12	Kuppam	Kannur	82
13	Valapattanam	Kannur	110
14	Anjarakandy	Kannur	40
15	Thalasseri	Kannur	28
16	Mahe	Kannur, Kozhikode	54
17	Kuttiyadi	Kozhikode	74
18	Korapuzha	Kozhikode	40
19	Kallayi	Kozhikode	40
20	Chaliyar	Kozhikode, Malappuram, Wayanad	169
21	Kadalundi	Malappuram, Palakkad	130
22	Tirur	Malappuram	48
23	Bharathapuzha	Palakkad, Malappuram, Thrissur	209
24	Keecheri	Thrissur	51
25	Puzhakkal	Thrissur	29
26	Karuvannur	Thrissur	40
27	Chalakkudy	Thrissur, Palakkad, Ernakulam	130
28	Periyar	Idukki, Ernakulam	244
29	Muvattupuzha	Ernakulam, Kottayam	121
30	Meenachil	Kottayam	78
31	Manimala	Kottayam, Pathanamthitta	90
32	Pamba	Pathanamthitta, Idukki, Alappuzha	176
33	Achenkoil	Pathanamthitta, Idukki, Alappuzha	128
34	Pallikal	Kollam, Pathanamthitta, Trivandrum	42

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35	Kallada	Kollam, Pathanamthitta, Trivandrum	121
36	Ithikkara	Kollam, Trivandrum	56
37	Ayroor	Kollam, Trivandrum	17
38	Vamanapuram	Kollam, Trivandrum	88
39	Mamom	Kollam, Trivandrum	27
40	Karamana	Trivandrum	68
41	Neyyar	Trivandrum	56
East Flowing Rivers			
42	Kabani	Kerala, Karnataka, Tamil Nadu	230
43	Bhavani	Kerala, Tamil Nadu	217
44	Pambar	Kerala, Tamil Nadu	-

Rivers of Tamil Nadu

No.	Name of the river	Districts/States in which river flows	Length (km)
1	Tamiraparani	Tirunelveli	125
2	Pachaiyar	Tirunelveli	32
3	Korayar	Tirunelveli	-
4	Chittar	Tirunelveli	80
5	Aluthakanniar	Tirunelveli	10
6	Aintharuviar	Tirunelveli	-
7	Jambunathi	Tirunelveli	-
8	Ramanathi	Tirunelveli	14
9	Gadananathi or Karunaiyar	Tirunelveli	18*
10	Hanumanathi	Tirunelveli	10*
11	Karuppanathi	Tirunelveli	27*
12	Gundar	Virudhunagar, Tirunelveli	28*
13	Mottaiyar	Tirunelveli	-
14	Manimuthar	Tirunelveli	9
15	Nambiyar	Tirunelveli	45
16	Karunaiyar or Karuvenniraiyar	Tirunelveli	30
17	Vadamalaiyar	Tirunelveli	-
18	Kottamalaiyar	Tirunelveli	-
19	Vaigai	Madurai, Ramanathapuram	190
20	Kaveri	Karnataka, Tamil Nadu	765
21	Paiaru (EG)	Thiruvannamalai, Vellore, Chengelpet	368
22	Thenpannai (EG)	Salem, Cuddalore, Villupuram	400
23	Vellaru (EG)	Salem, Trichy	215
24	Palar (348 km)	Karnataka, Andhra Pradesh, Tamil Nadu	222
25	Noyyal	Coimbatore, Tiruppur	180

* To ascertain the exact length of the river

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Rivers of Karnataka

No.	Name of the river	State(s) in which the river flows	Length (km)
East Flowing Rivers			
1	Kaveri (765 km)	Karnataka, Tamil Nadu, Puducherry	320
2	Krishna (1400 km)	Maharashtra, Karnataka, Andhra Pradesh	704
3	Tungabhadra	Karnataka	293
4	Hemavati	Karnataka	245
5	Palar (348 km)	Karnataka, Andhra Pradesh, Tamil Nadu	93
6	Ghataprabha	Maharashtra, Karnataka	283
7	Pennar	Karnataka, Andhra Pradesh	597
8	Malaprabha	Karnataka	304
9	Shimsha	Karnataka	221
10	Kabani	Kerala, Karnataka	230
11	Honnuhole	Karnataka	-
12	Manjira	Maharashtra, Karnataka, Andhra Pradesh	724
13	Bhima	Maharashtra, Karnataka, Andhra Pradesh	861
West Flowing Rivers			
14	Netravati	Karnataka	103
15	Sharavathi	Karnataka	128
16	Kali	Karnataka	184
17	Kubja	Karnataka	-
18	Chakra	Karnataka	52
19	Varahi	Karnataka	66
20	Kumaradhara	Karnataka	-

Rivers of Goa

No.	Name of the river	State(s) in which river flows	Length (km)
1	Baga	Goa	10
2	Chapora	Maharashtra, Goa	32
3	Galgibag	Goa	14
4	Mandovi	Goa, Karnataka	77
5	Sal	Goa	40
6	Talpona	Goa	32
7	Terekhol	Maharashtra, Goa	26
8	Zuari	Goa	145
9	Saleri	Goa	-

Freshwater Biodiversity Conservation Teaching Guide

Rivers of Maharashtra

No.	Name of the river	State(s) in which river flows	Length (km)
East-flowing Rivers			
1	Godavari (1465 km)	Maharashtra, Andhra Pradesh	545
2	Wainganga (Satpura range)	Madhya Pradesh, Maharashtra	609
3	Wardha (Satpura range)	Madhya Pradesh, Maharashtra	528*
4	Penganga	Maharashtra and border of Andhra Pradesh	676
5	Manjira	Maharashtra, Karnataka, Andhra Pradesh	724
6	Bhima	Maharashtra, Karnataka, Andhra Pradesh	861*
7	Nira	Maharashtra	203*
8	Sina	Maharashtra	313*
9	Krishna (1400 km)	Maharashtra, Karnataka, Andhra Pradesh	232
10	Koyna	Maharashtra	130*
11	Panchganga	Maharashtra	81*
12	Dudhganga	Maharashtra	103
West-flowing Rivers			
13	Tapi (Satpura range) (724 km)	Madhya Pradesh, Maharashtra, Gujarat	239
14	Purna (Satpura range) (334 km)	Madhya Pradesh, Maharashtra	142
15	Girna	Maharashtra	260
16	Vaitarna	Maharashtra	171
17	Ulhas	Maharashtra	145
18	Savitri	Maharashtra	99
19	Sastri	Maharashtra	90
20	Vashishthi	Maharashtra	48
21	Patalganga	Maharashtra	72*
22	Pili	Maharashtra	-
23	Nag	Maharashtra	-
24	Kundalika	Maharashtra	-
25	Daman Ganga	Maharashtra, Gujarat	-
26	Surya	Maharashtra	-
27	Karli	Maharashtra	-
28	Narmada (Satpura and Vindhya ranges) (1312 km)	Madhya Pradesh, Maharashtra, Gujarat	-

* To ascertain the exact length of the river

Some Wildlife and Water laws in India

India has many laws adhering to wildlife and water resources but not many laws concerning freshwater biodiversity conservation. It is very important to be aware of these laws. We have given a short write-up on five such laws.



Indian Fisheries Act, 1897

1. Prohibits destructive fishing practices such as dynamiting, poisoning.
2. Protection of fish in selected waters by rules of State Government.

Some states have a state level fisheries Act such as Kerala, Karnataka & Maharashtra.

Kerala: Inland fisheries Act, 2010

Karnataka: Karnataka Inland Fisheries (Conservation, Development and Regulation) Act, 1996

Maharashtra: Maharashtra Act of 1961

Wildlife Protection Act, 1972

1. Defines wildlife sanctuaries, National Parks, tiger reserves, community and conservation reserves.
2. Has six schedules listing animals that are protected.
3. Provides rights to local communities and tribals to access non-timber forest produce for non-commercial use.

Biological Diversity Act, 2002

1. Addresses all biodiversity found in India and states that appropriate management measure need to be taken for threatened species and collection should be prohibited or regulated.
2. All the state biodiversity boards which have the biodiversity register for local people follow this Act.



Wetland Rules 2009

1. Classifies wetlands into three categories based on size, habitat and climatic condition of the area and informs of the regulatory authority responsible for the wetlands belonging to each of the categories.
2. Explains specific activities that are permitted and not permitted within a wetland depending on which of the three categories it falls under.

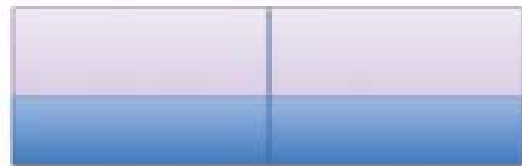
National Water Policy, 2012

1. A general act that states the importance of water for mankind to survive, present status of water & water use in India and the gaps in management of water resources.
2. Also, states what is needed to secure the future of our water resources.

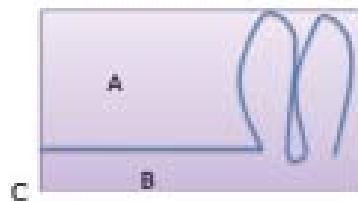
Freshwater animal origami: Make your animal



Make two small folds till the line.

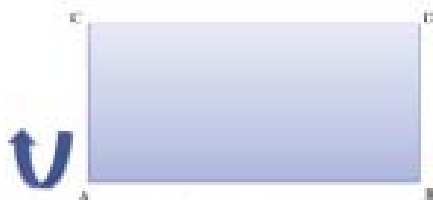


After folding, fold the complete paper in half along the vertical line



Dragonfly

Remove portion A by cutting it off. After tearing off portion A, twist the C end. Then Bend the wings of the dragonfly to form the shape.



Make small folds so that points A-B meet points C-D

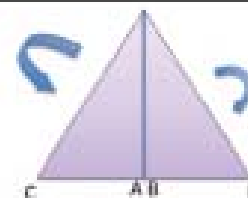


Snail

Start rolling the folded paper from point A to B



Fold and unfold



Fold in such a way that A & B touch forming triangles on either side



Fold



Fish

Contribution:
Priyanka Iyer

Energizer games

Body writing

Ask participants to write their name in the air with a part of their body. They may choose to use Index finger, for example, or toe. Continue in this way, until everyone has written his or her name with several body parts.

Threat Wink

Before the game starts, ask someone to be the 'the threat' and ask them to keep their identity a secret. Explain that one person among the group is the 'threat' or 'killer' and they can kill people (species) by winking at them. Everyone then walks around the room in different directions, keeping eye contact with everyone they pass. If the killer winks at you, you have to play dead. Everyone has to try and guess who the 'killer' (threat) is.

Lentic (static) and Lotic (Flowing)

Introduce the word Lentic and Lotic and explain the meaning. When you shout out the word 'Lotic' the group should move around the room, loosely swinging their arms and gently relaxing their heads and necks. After a short while, when you shout out the word 'Lentic', the group must stand still as a statue. All the participants have to instantly adopt, without talking, poses that show what 'Lentic' means. Repeat the exercise several times.

Draaa and dukutu

Ask everyone to imagine two dragonflies (freshwater animal). One calls '*draaa*' and the other calls '*dukutu*'. If you call out '*draaa*', all the participants need to stand on their toes and move their elbows out sideways, as if they were a dragonfly flying. If you call out '*dukutu*', everyone has to stay still and not move their wings.

Water and Land


Draw a line representing a waterbody and ask participants to stand behind the line. When you shout "water!", everyone jumps forwards over the line. When you shout "land", everyone jumps backwards from the line. If you shout "land" twice in a row, participants who move have to drop out of the game.

What has changed? (observation skill)


Participants break into pairs. Partners observe one another and try to memorize the appearance of each other. Then one turns their back while the other makes three changes to his/her appearance; for example, putting their watch on the other wrist, removing their glasses, and rolling up their sleeves. The other player then turns around and tries to spot the three changes. The players then switch roles.

Dancing bear


Participants form pairs and are given a sheet of newspaper (double sheet) each. They spread the sheet of newspaper and as music/claps or any other kind of start-stop mechanism is being played, the partners dance on the newspaper without stepping out of the newspaper. Whoever steps out of the paper during the dance is out of the game. When the music stops, the partners must fold the newspaper once and stand on it again. They should dance to the music or claps again when intimated. This should continue such that at every interval between the music/claps, the newspaper should be folded once. The game continues until only one pair of bears is left dancing on the smallest sheet of folded newspaper. Continue playing until they too step out of the paper. This will be an interactive fun-filled game to play.




CRITICAL ECOSYSTEM
PARTNERSHIP FUND




South Asian Invertebrate
Specialist Group
SAsISG



WILD
WILDLIFE RESEARCH LABORATORY



ZOO
ZOO OUTREACH ORGANIZATION



Threatened Taxa
Research | Education | Conservation

PLEDGE CARD

The Sahyadri Freshwater Biodiversity Conservation

I, _____ pledge to practice what I
learned in this training by committing myself to do the following two actions:

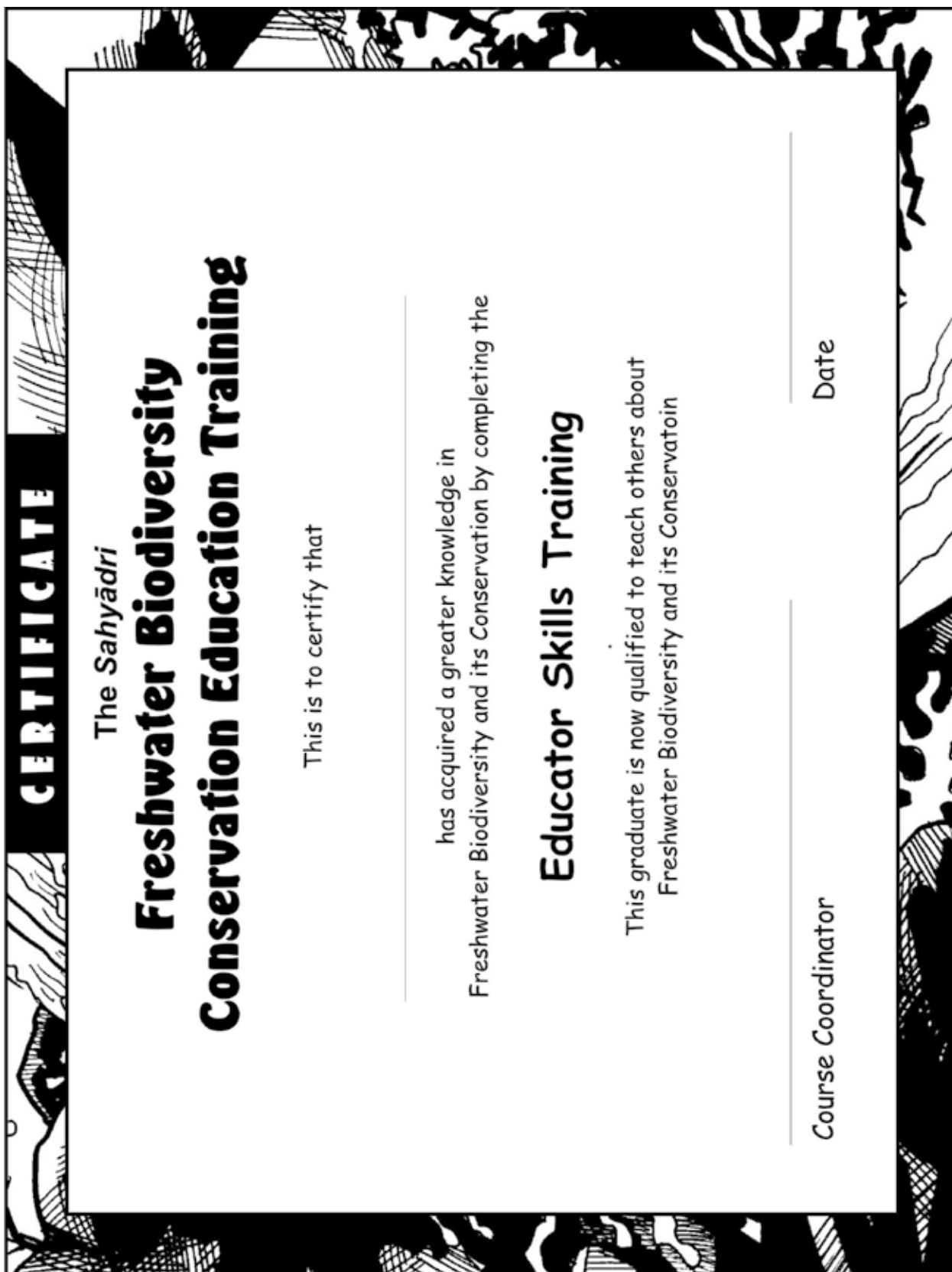
1. _____

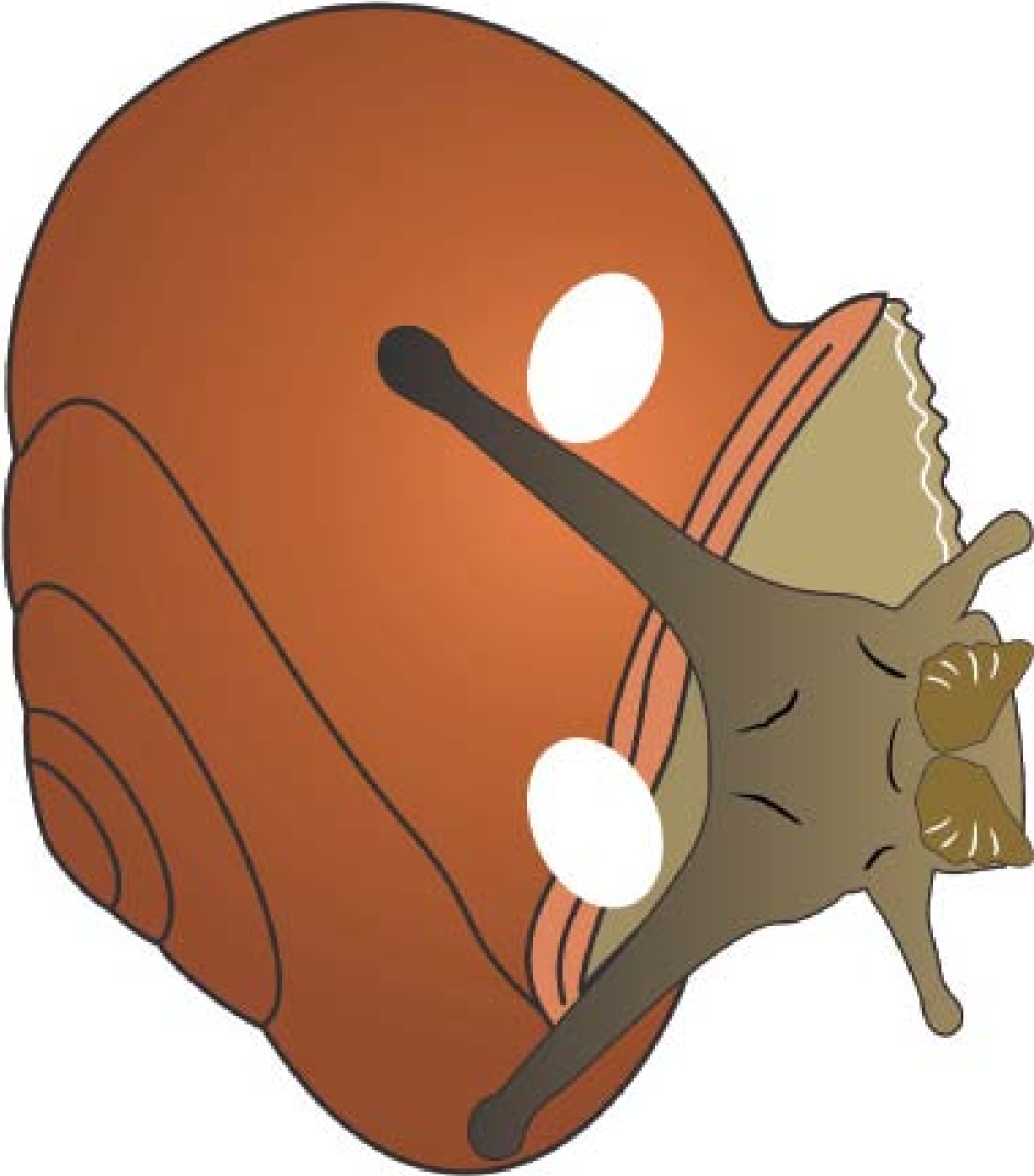
2. _____

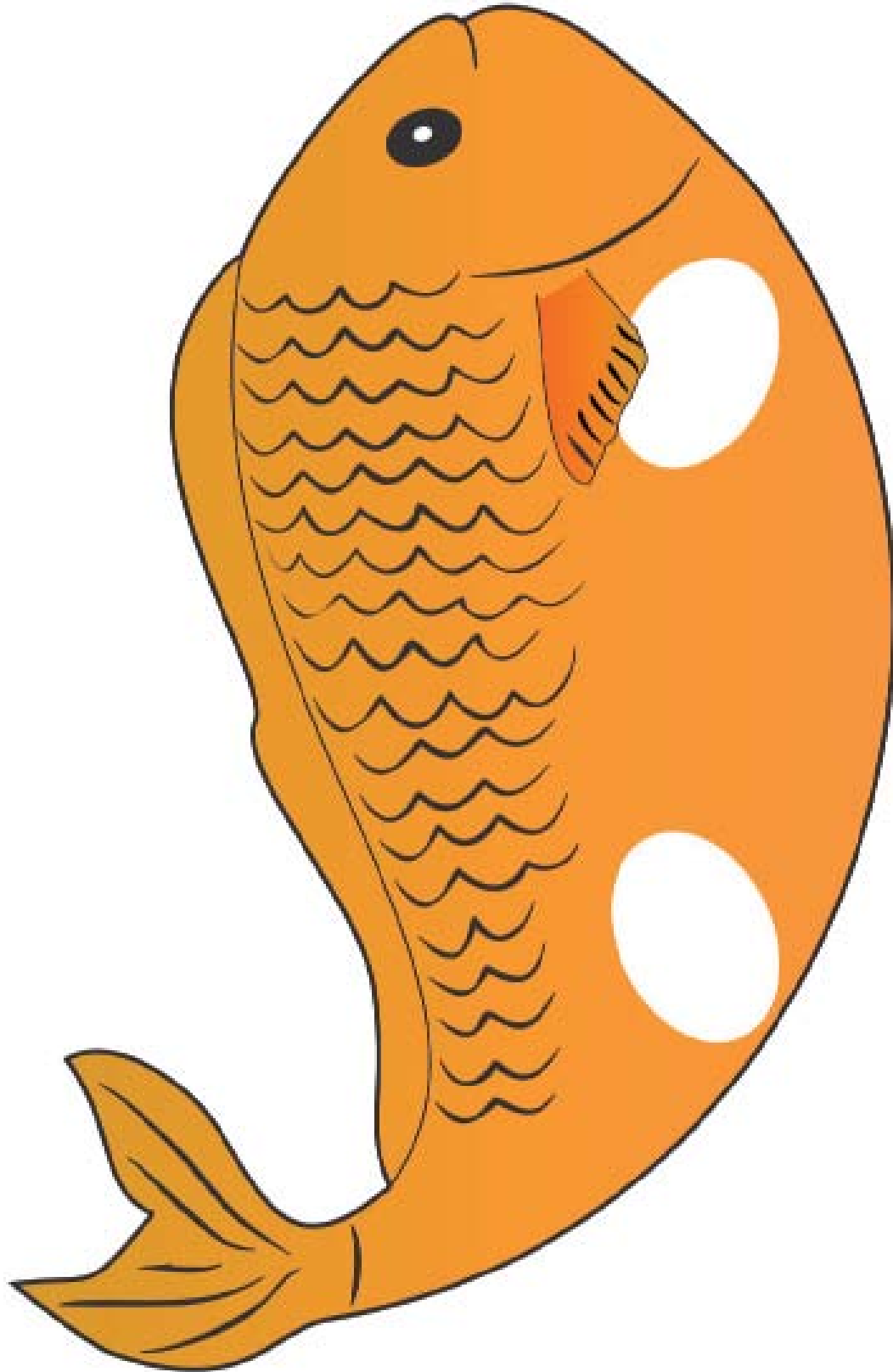
Date _____ My Signature _____

Name of witness _____ Signature of witness _____

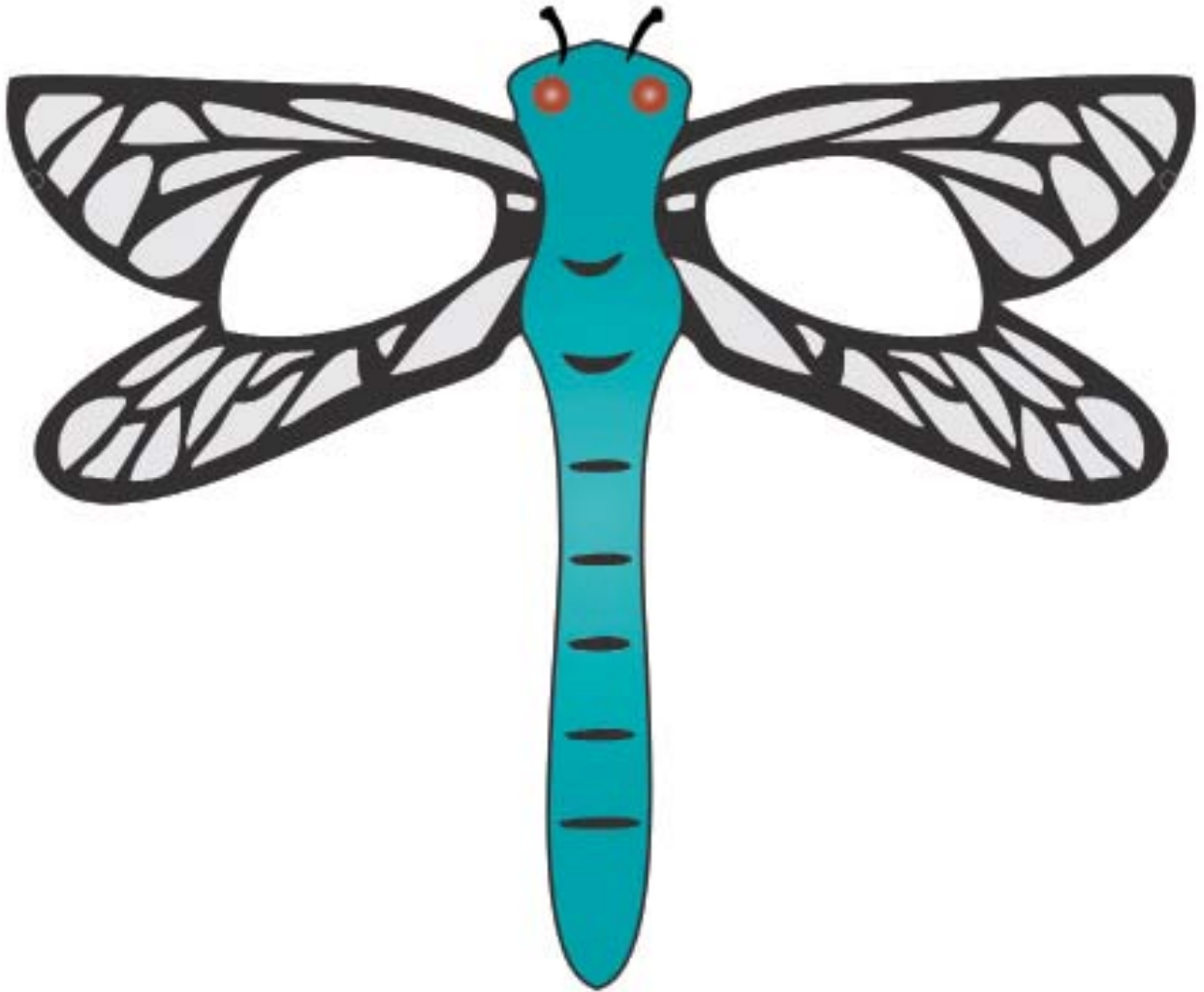
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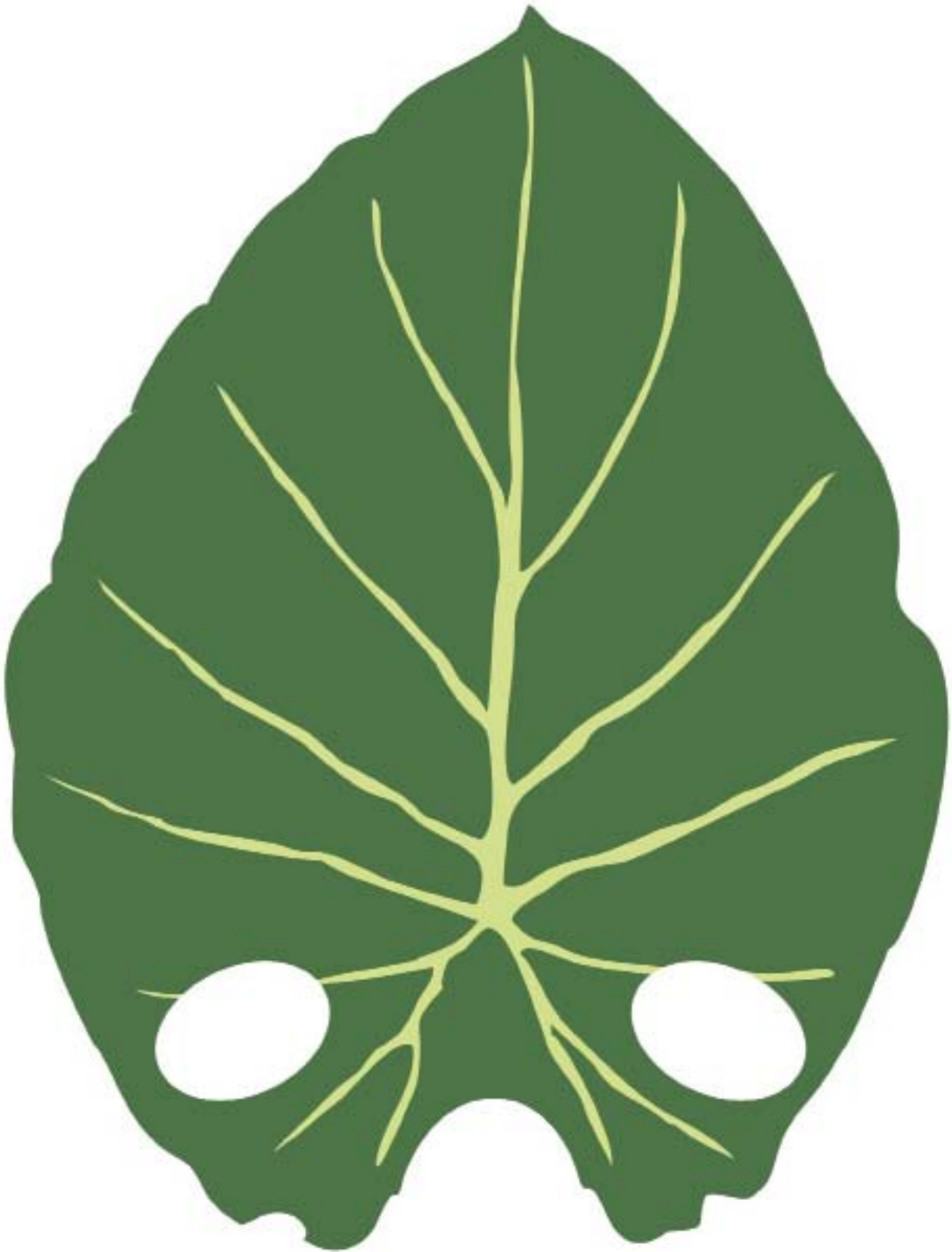




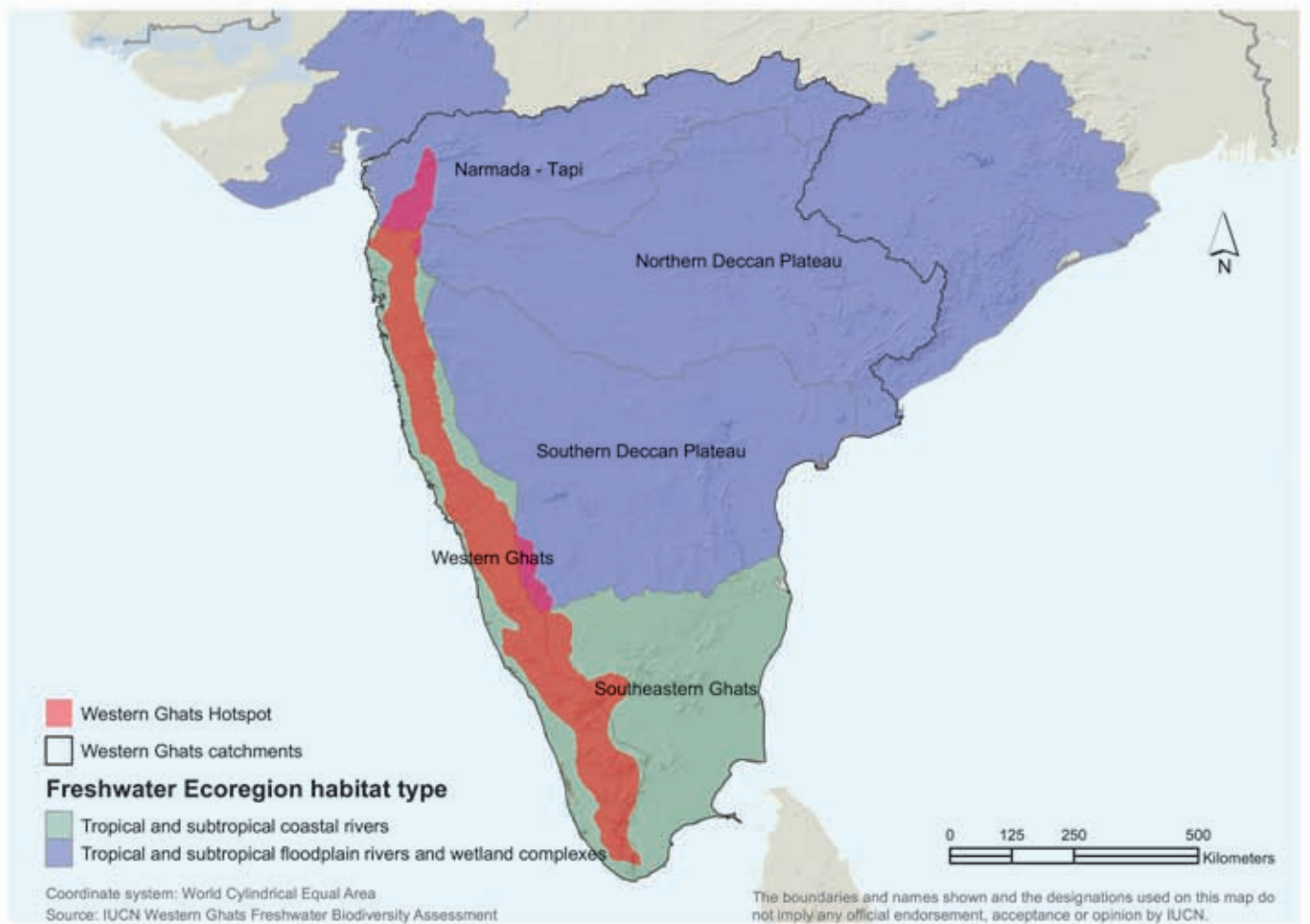


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Notes



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