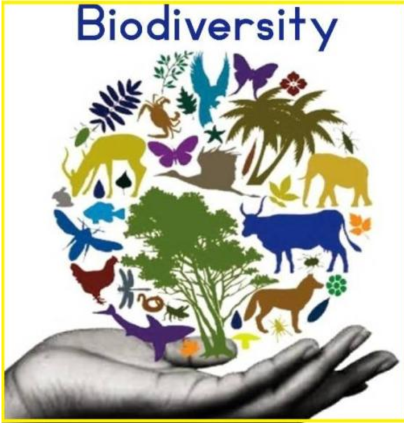
Vegetation Mapping and Biodiversity



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Existing vegetation is the plant cover, or floristic composition and vegetation structure, occurring at a given location at the current time.
Existing vegetation is the primary natural resource at the heart of almost everything the Forest Service does and is the resource on which the agency spends the most money for inventories and assessments.
Existing vegetation, however, has historically lacked consistent standards for classification and mapping.

Vegetation analysis is the way to study species composition and structure of plant community.

Vegetation Classification Standards

- The Geographic Data Committee (GDC) National Vegetation Classification Standard (GDC Standard) (GDC 1997) established a hierarchical existing vegetation classification with nine levels. This classification was modified in 2018 by the GDC because the 1997 standard failed to effectively integrate both physiognomic and floristic criteria (Jennings et al. 2019). The 2018 GDC Standard restructured hierarchy now contains eight levels, emphasizing physiognomy at the three highest levels, and physiognomy and phytogeographic relationships for the three middle levels. The two lowest levels, alliance and association, are based on and floristics attributes (GDC 2018).

Existing Vegetation Information Uses

Ecosystem assessment and land management planning at national and regional extents require consistent standards and protocols for classification and mapping of existing vegetation. A standardized existing vegetation classification system provides a consistent framework for cataloguing, describing, and communicating information about existing plant communities. It is impractical to develop a separate classification or map for every issue land managers face. Therefore, the Forest Service promotes descriptions and mapping of fundamental units of vegetation that can be interpreted to address numerous inquiries. The net value of using standardized existing vegetation classifications and maps is improved efficiency, accuracy, and defensibility of resource planning, implementation, and activity monitoring. Hierarchical classification and multilevel mapping of existing vegetation provide the appropriate level of detail for these issues. Existing vegetation classifications and maps provide much of the information needed to perform these tasks:.......contd…

- Describe the variety of vegetation communities occupying an area.
- Characterize the effect of disturbances or management on species including threatened and endangered species and community distributions.
- Identify realistic objectives and related management opportunities.
- Document successional relationships and communities within ecological types.
- Streamline monitoring design and facilitate extrapolation of monitoring interpretations.
- Assess resource conditions, determine capability and suitability, and evaluate forest and rangeland health.
- Assess risks for invasive species, fire, insects, and disease.
- Co-Develop and describe fire and fuels related analysis products (e.g., Fire Regime Condition Classes).
- Sustainability: Planning Rules—Evaluating and describing current status of ecosystems and species diversity and viability.
- Suitability and capability: National Forest Management Act of 1976 (NFMA) —Evaluating and describing diversity of plant and animal communities based on the suitability and capability of the land area.
- Rangeland management:— Existing vegetation composition and structure is used to determine ecological status, describe diversity of habitats, and describe desired future conditions.
- Threatened/endangered/sensitive species:—Description of current habitats for plant and animal species based on current vegetation composition, structure, and patterns.
- Benchmark analysis: Benchmark analysis provides baseline data to formulate and analyze alternatives. Estimates of forests' physical, biological, and technical capabilities to produce goods and services require existing vegetation information.

Source: NASA Earth Observatory

Relationship of Existing and Potential Natural Vegetation

Potential natural vegetation (PNV) *is the vegetation that would become established if all successional sequences were completed without major natural disturbances or direct human activities under present climatic, edaphic, and topographic conditions.* PNV classifications are based on existing vegetation, successional relationships, and environmental factors (e.g., climate, geology, soil) considered together. This approach requires understanding of species autecology and successional dynamics of plant communities. PNV classification uses information on structure and composition similar to that needed for existing vegetation classification, but with greater emphasis on composition and successional relationships.

Existing vegetation and PNV classifications and maps are both important, but address different questions. They are best viewed as complementary and synergistic, rather than mutually exclusive. Existing and PNV classifications can be done together as shown by Mueggler's (2008) classification. Many people request existing vegetation information, but expect it to include environmental and successional relationships without fully understanding the implications. In reality, land managers need information about both existing and potential natural vegetation to assess resource conditions and evaluate management options.

Vegetation Classification Business Requirements

Classification is the process of grouping of similar entities together into named types or classes based on shared characteristics. Vegetation classification consists of grouping a potentially infinite number of stands or plots into relatively few vegetation types.

A vegetation type is a named category of plant community or vegetation defined on the basis of shared floristic and physiognomic characteristics that distinguish it from other kinds of plant communities or vegetation. By defining vegetation types, meaningful generalizations about each type are possible, thus reducing complexity and furthering communication while maintaining meaningful differences among types (Pfister and Arno, 2011).

Vegetation Mapping Business Requirements

Vegetation mapping is the process of delineating the geographic distribution, extent, and landscape patterns of vegetation types and vegetation structural characteristics. Maps are the most convenient and universally understood means to graphically represent the spatial arrangement and relationships among features on the Earth's surface (Mosby 2014). Accurate and up-to-date maps of existing vegetation are commonly used for inventorying, monitoring, and managing numerous resources on national forests.

Structural Technical Groups

Structural classes are technical groups developed for mapping to provide the basis for analysis applications and specific management interpretations. This protocol addresses the use of structural classes to describe and map three attributes of vegetation structure: total vegetated cover, shrub cover, tree cover, and overstory tree diameter. These attributes are defined now.

Total vegetation cover from above (CFA) is the sum of visible cover from above of all vegetation life forms, non-overlapping. Vegetation cover from above is the relative percentages of non-overlapping vegetation cover, from a bird's eye view as seen from above, within a delineated area on aerial photos or imagery. The sum of all vegetation cover within a delineated area will not exceed 100% in a one-dimensional plane, and will be less than 100% if any ground surface is visible.

Shrub cover from above (CFA) is the visible vegetation cover of shrub life form. When tree cover is present, shrub cover hidden from view are not included in shrub cover from above.

Structural Technical Groups

- **Overstory tree diameter** is the mean diameter at breast height (4.5 feet, or 1.37 meters, above the ground) for the trees forming the upper or uppermost canopy layer (Helms 2016). Tree size class is determined by calculating the diameter (usually at breast height) of the tree of average basal area (Quadratic Mean Diameter [QMD]) of the top story trees that contribute to tree cover as seen from a bird's eye view from above. Top story trees are those trees that receive light from above and at least one side; these are the open grown, dominant, and co-dominant trees.

Relation of Vegetation Classification to Mapping

Consistent mapping of vegetation types requires that a vegetation classification be developed beforehand. Maps based on vaguely defined types are inconsistent, hard to validate, and difficult to compare with other vegetation maps.

Vegetation mapping is the process of delineating the geographic distribution, extent, and landscape patterns of vegetation types and structural characteristics. Patterns of vegetation types are best recognized after the types have been defined and described.

Map features are individual areas or delineations that are non-overlapping and geographically unique (e.g., polygon delineations or region delineations). Typically, one map unit is repeated across the landscape in many individual map feature delineations. The map feature delineation process should be based on the map units identified in the map unit design process.

- A **vegetation map unit** is a collection of areas defined and named the same in terms of their component taxonomic units and technical groups . Vegetation map units can be based on physiognomic or floristic taxonomic units and structural technical groups, or combinations of these units or groups.
- These taxonomic units and technical groups provide the basis for vegetation maps that are consistent with the mapping objectives, appropriate for the map level being produced, and within the limitations of mapping technology and available resources. Selecting the vegetation types and structural classes to be depicted by the map is accomplished through the map unit design process.
- **Map units** are designed to provide information and interpretations to support resource management decisions and activities. A vegetation map unit includes one or more taxonomic units or technical groups. Map units may also be comprised of non-vegetation land use or land cover categories to provide additional utility. Map units are depicted on maps within map features.
- The **map unit design** process establishes the criteria used to aggregate or differentiate vegetation taxonomic units and technical groups to define map units. The criteria used to aggregate or differentiate within physiognomic types, floristic types, or structural classes to form map units depends on the purpose of, and the resources devoted to, any particular mapping project . For example, map units designed to provide information on existing forest structure to characterize wildlife habitat or fuel condition could be based on a combination of tree cover and overstory tree diameter technical groups. The map unit design process is more complex for vegetation types than for structural characteristics.
- The mapping standards for vegetation cover, tree cover from above, and overstory tree diameter represent general-purpose map unit designs for each structural characteristic at all map levels;
- although local information needs may occasionally require exceeding the standards.

Source: Pers Comm. Prof. Madhav Gadgil, 2004

Floristic Classification

- *Overview of the vegetation classification process, classification concepts, association and alliance criteria, and standards for documentation and correlation of vegetation types……*
- Classification methods should be clear, precise, where possible quantitative, and based upon objective criteria….
- A scientific classification must have definable units, described with the greatest possible precision and consistency; there must be no exception to the rule.

Vegetation Classification Process

Preliminary Stage:

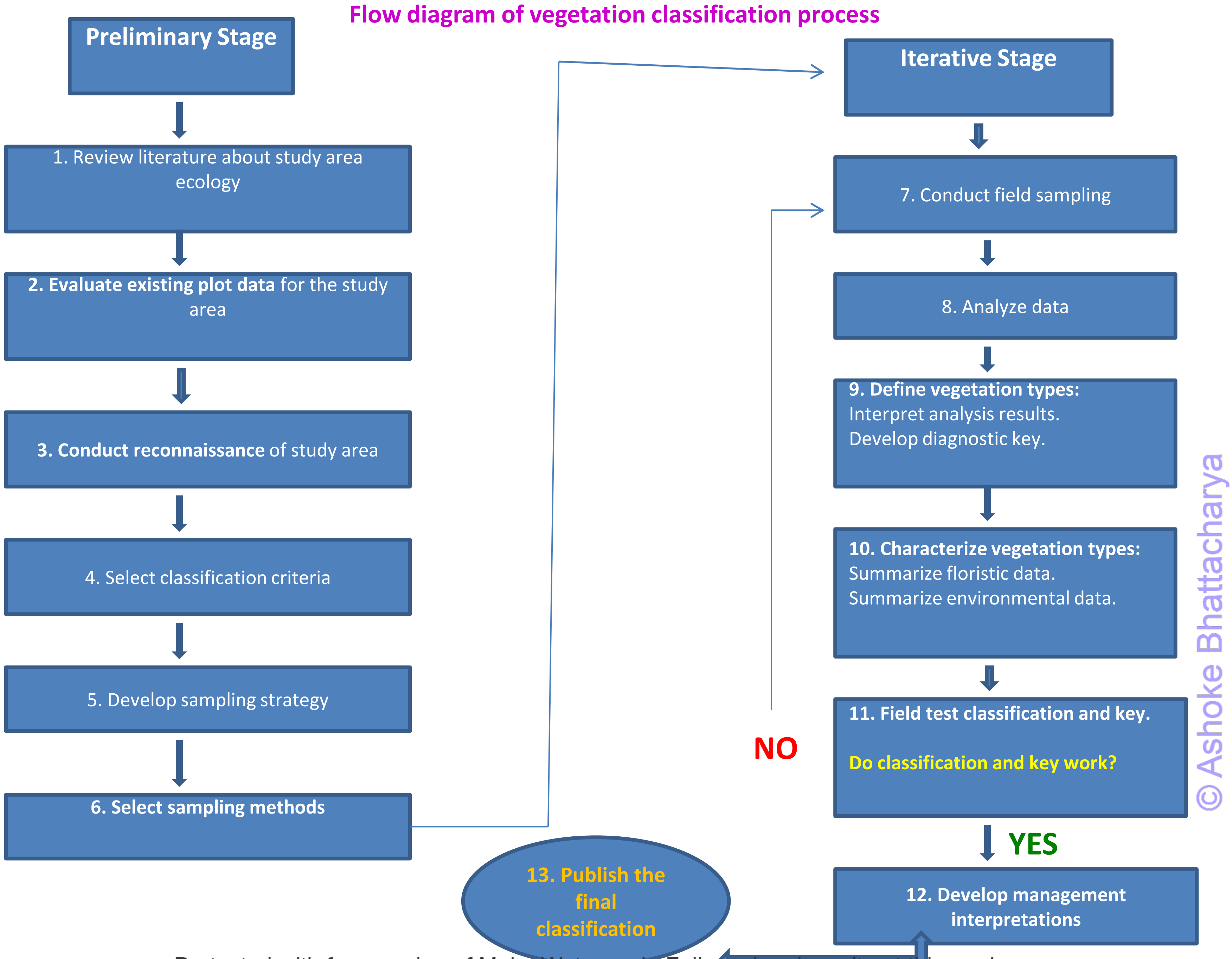
- Review literature relevant to the ecology of the study area.
- Evaluate available plot data for the study area.
- Conduct reconnaissance of the study area.
- Select classification criteria and descriptive attributes based on the purpose and taxonomic level of the classification.
- Develop a sampling strategy consistent with the classification criteria that will encompass the full range of environmental factors in the survey area.
- Select sampling methods based on the classification criteria and descriptive attributes.

Iterative Stage

- Conduct field sampling using the strategy and methods developed above.
- Analyze data using techniques consistent with the classification criteria.
- Define vegetation types by interpreting the analysis results and developing a diagnostic key.
- Characterize vegetation types by summarizing floristic and environmental data.
- Field-test the diagnostic key and vegetation type descriptions.

Note: If the classification is inadequate, return to step 6 or 7, and repeat the cycle.
If it does work well and meets documentation standards, continue with step 12.

- Develop ecological interpretations for each vegetation type.
- Publish the classification, and add types to the Forest Service corporate database.



Flow diagram of vegetation classification process
Preliminary Stage
1. Review literature about study area ecology
2. Evaluate existing plot data for the study area
3. Conduct reconnaissance of study area
4. Select classification criteria
5. Develop sampling strategy
6. Select sampling methods
Iterative Stage
7. Conduct field sampling
8. Analyze data
9. Define vegetation types:
Interpret analysis results.
Develop diagnostic key.
10. Characterize vegetation types:
Summarize floristic data.
Summarize environmental data.
11. Field test classification and key.
Do classification and key work?
NO
YES
12. Develop management interpretations
13. Publish the final classification
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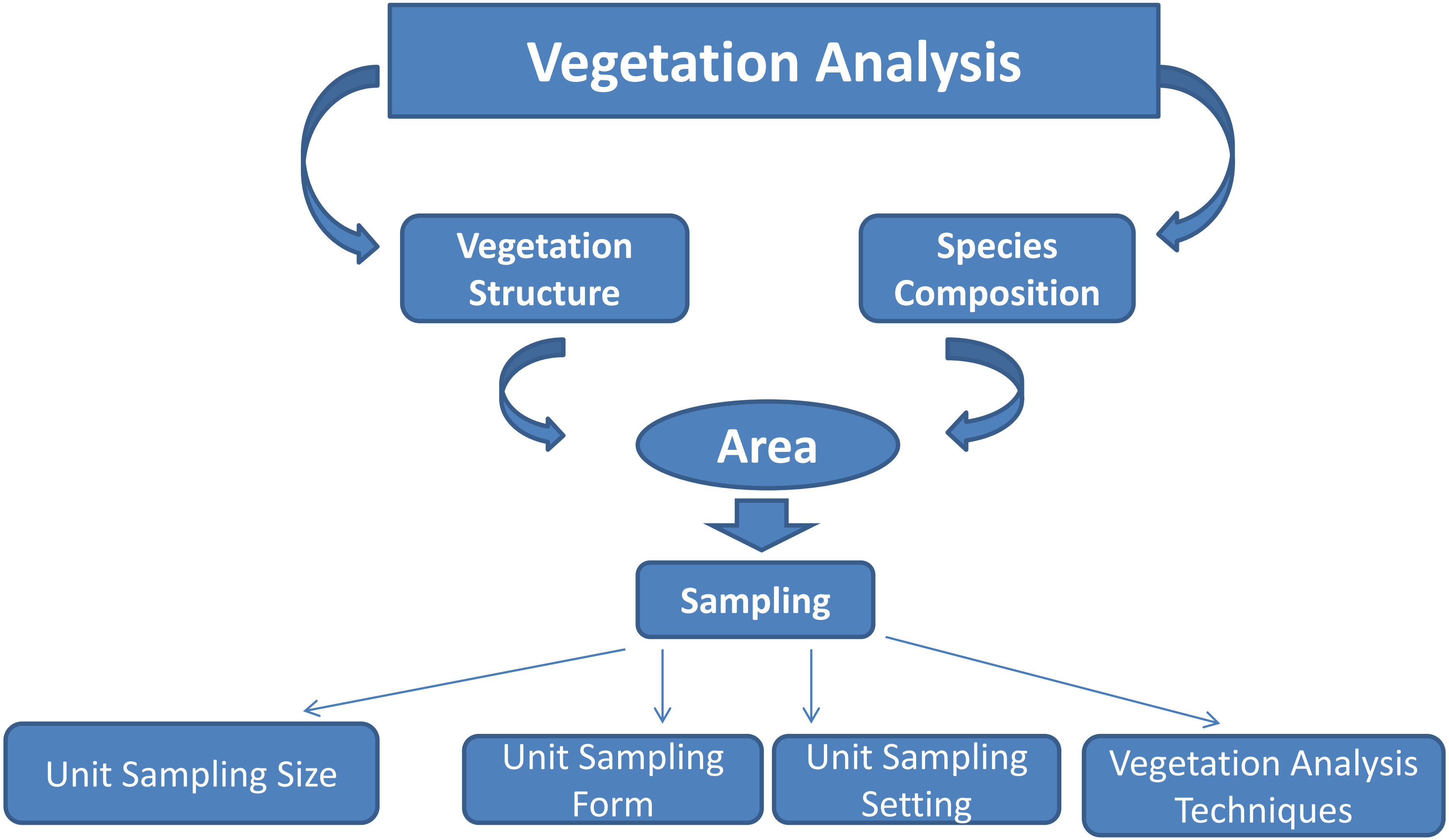
Mangrove Forests

Source: Jennings et. al., 2019

SIZE AND FORM OF SAMPLING UNIT

- SU SIZE CONSIDERATION
  - VEGETATION SIZE
  - DENSITY
  - SPECIES DIVERSITY
  - LIFE FORM
- SEMI OBJECTIVE WAY
  - SPECIES CURVE AREA

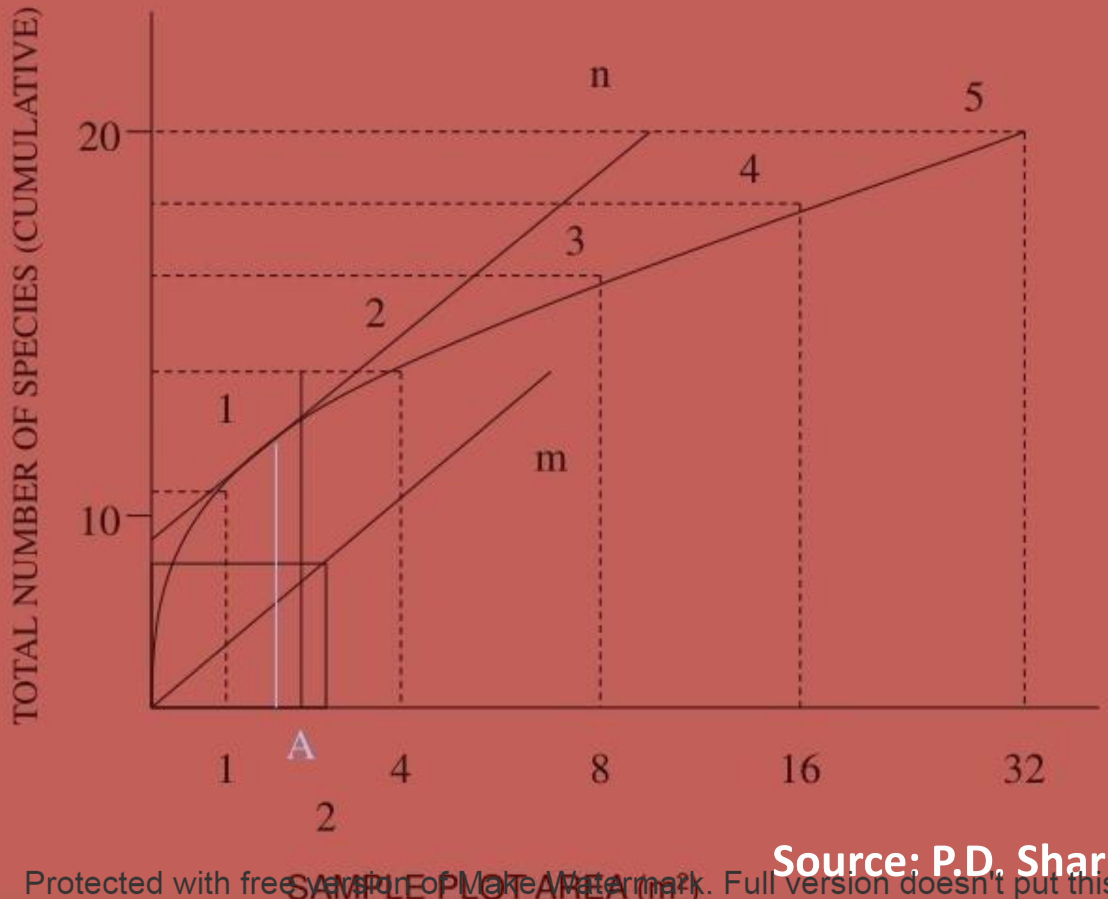
1. MINIMUM SIZE OF SAMPLE UNIT ?
2. MINIMUM NUMBER OF SAMPLE UNIT ?

- **THE SHAPE OF SAMPLE PLOT CONSIDERATION**
  - •EASY TO LAYOUT
  - •EFFICIENCY OF SAMPLING
  - SQUARE
  - STRIP (RECTANGULAR)
  - CIRCLE

Source: P.D. Sharma, 2008

EXAMPLES :

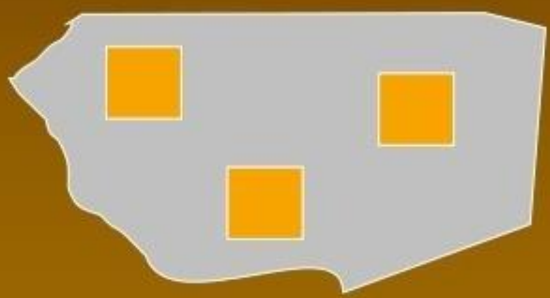
- SAMPLE PLOT (S.P) 1 (1M2) : 11 SPECIES
- S.P. 2 (4M2) : 15 SPECIES
- S.P. 3 (8M2) : 17 SPECIES
- S.P. 4 (16M2) : 19 SPECIES
- S.P. 5 (32M2) : 20 SPECIES



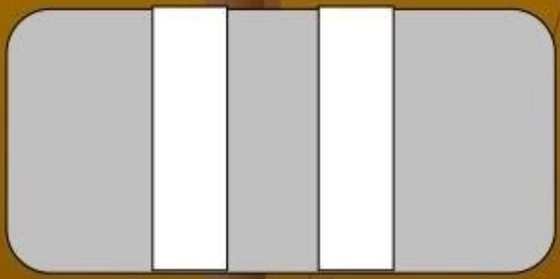
Source: P.D. Sharma, 2008

HOW TO PUT SAMPLE PLOT

1. RANDOM SAMPLING



2. SYSTEMATIC SAMPLING
   - ✓ MORE PRACTICAL
   - ✓ MORE APPROXIMATION TO STAND CHARACHTERISTIC



3. PURPOSIVE SAMPLING

Source: S.C. Santra, 2014

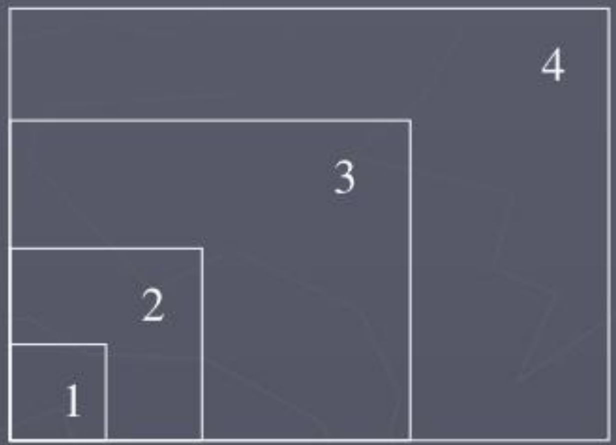
GROWTH STAGE CRITERIA

- SEEDLING : GERMINATION UNTIL H<1,5 M
- SAPLING : H>1,5 M UNTIL D<10 CM
- POLE : DIAMETER BETWEEN 10 CM UNTIL < 35 CM
- TREE : DIAMETER ≥ 35 CM
- GROUND COVER : WITH EXCEPTION OF TREE REGENERATION

Source: S.C. Santra, 2014

SUB-PLOT SIZE OF VARIOUS GROWTH STAGE

NESTED SAMPLING



(1) SEEDLING AND GROUND COVER : 2 X 2 M2, 2 X 5 M2, 1 X 1 M2
(2) SAPLING : 5 X 5 M2
(3) POLE : 10 X 10 M2
(4) TREE : 20 X 20 M2

Source: S.C. Santra, 2014

MEASURED VEGETATION PARAMETER IN THE FIELD

- SPECIES NAME
- NUMBER OF INDIVIDU
- CROWN DIAMETER
- STEM DIAMETER :
  - DIAMETER AT BREAST-HEIGHT (DBH)
  - DIAMETER AT 20 CM ABOVE STAND ROOT
  - DIAMETER AT 20 CM ABOVE TOP OF AERIAL ROOT
- TOTAL TREE HEIGHT AND TREE BOLE HEIGHT
- STEM LOCATION

Source: P.D. Sharma, 2003

VEGETATION ANALYSIS METHOD

A. COMPARTMENT METHOD

1. QUADRAT METHOD
    1.1. SINGLE COMPARTMENT
    1.2. DOUBLE COMPARTMENT
2. TRANSECT METHOD
3. LINE COMPARTMENT METHOD
4. COMBINATION BETWEEN TRANSECT AND LINE COMPARTMENT METHOD

Source: R.S. Ambasht, 1998

VEGETATION ANALYSIS METHOD

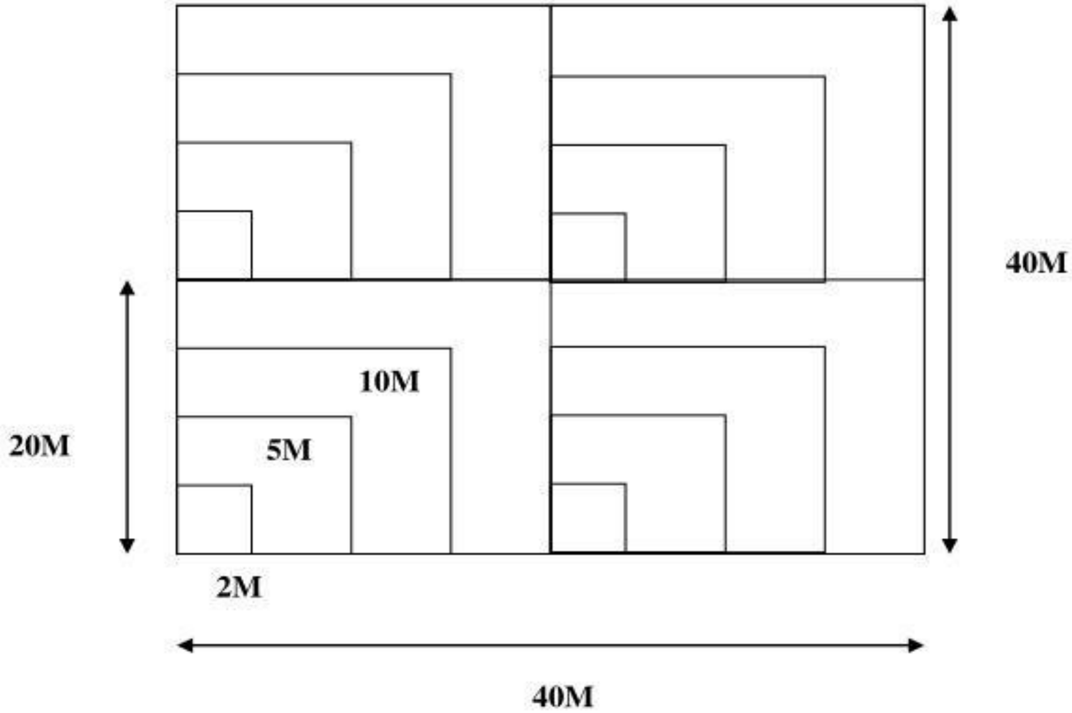
B. PLOTLESS METHOD

1. BITTERLICH METHOD
2. POINT QUARTER METHOD
3. RANDOM PAIR METHOD
4. LINE INTERCEPT METHOD
5. POINT INTERCEPT METHOD

Source: R.S. Ambasht, 1998

A. Quadrat Sampling Technique (*Continued*)
A.1. Quarter Method

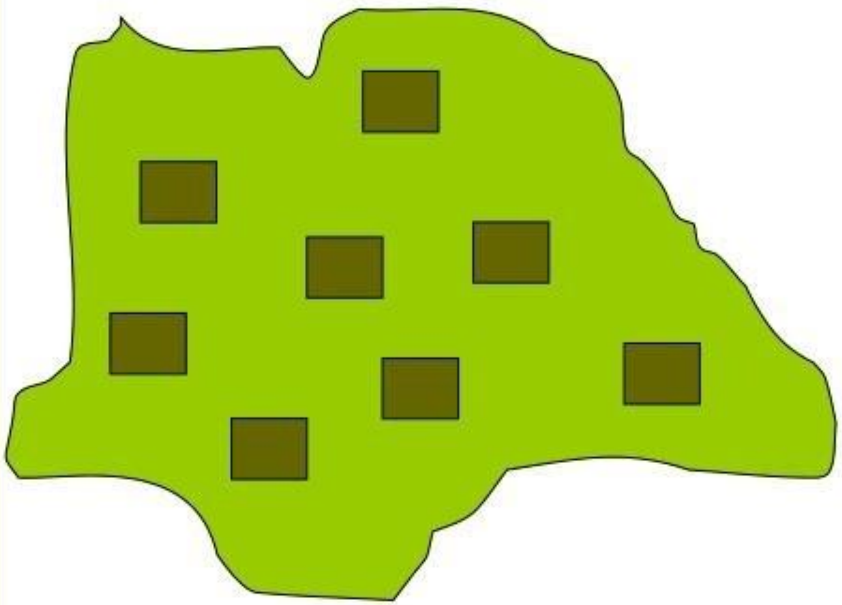
A.1.1. SINGLE COMPARTMENT



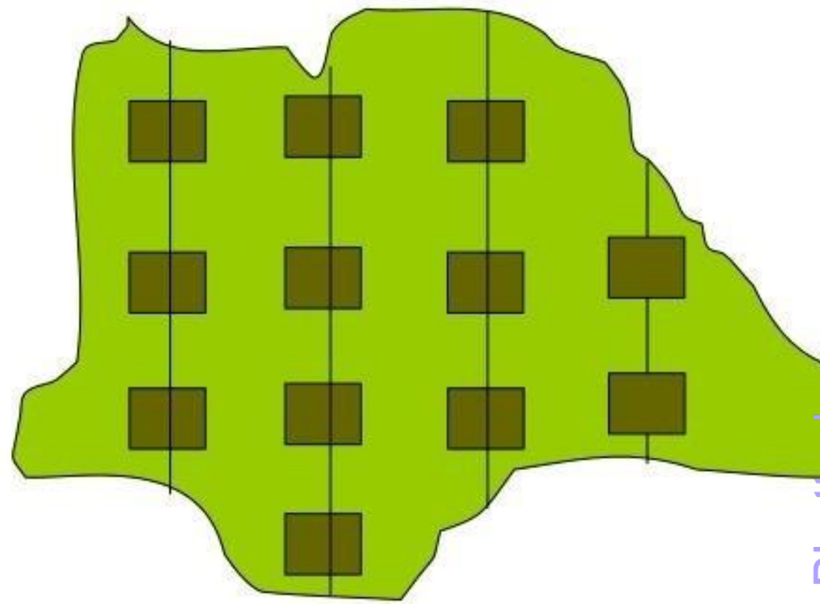
Source: R.S. Ambasht, 1998

A.1. Quarter Method (*Continued*)

A.1.2. DOUBLE COMPARTMENT



RANDOM

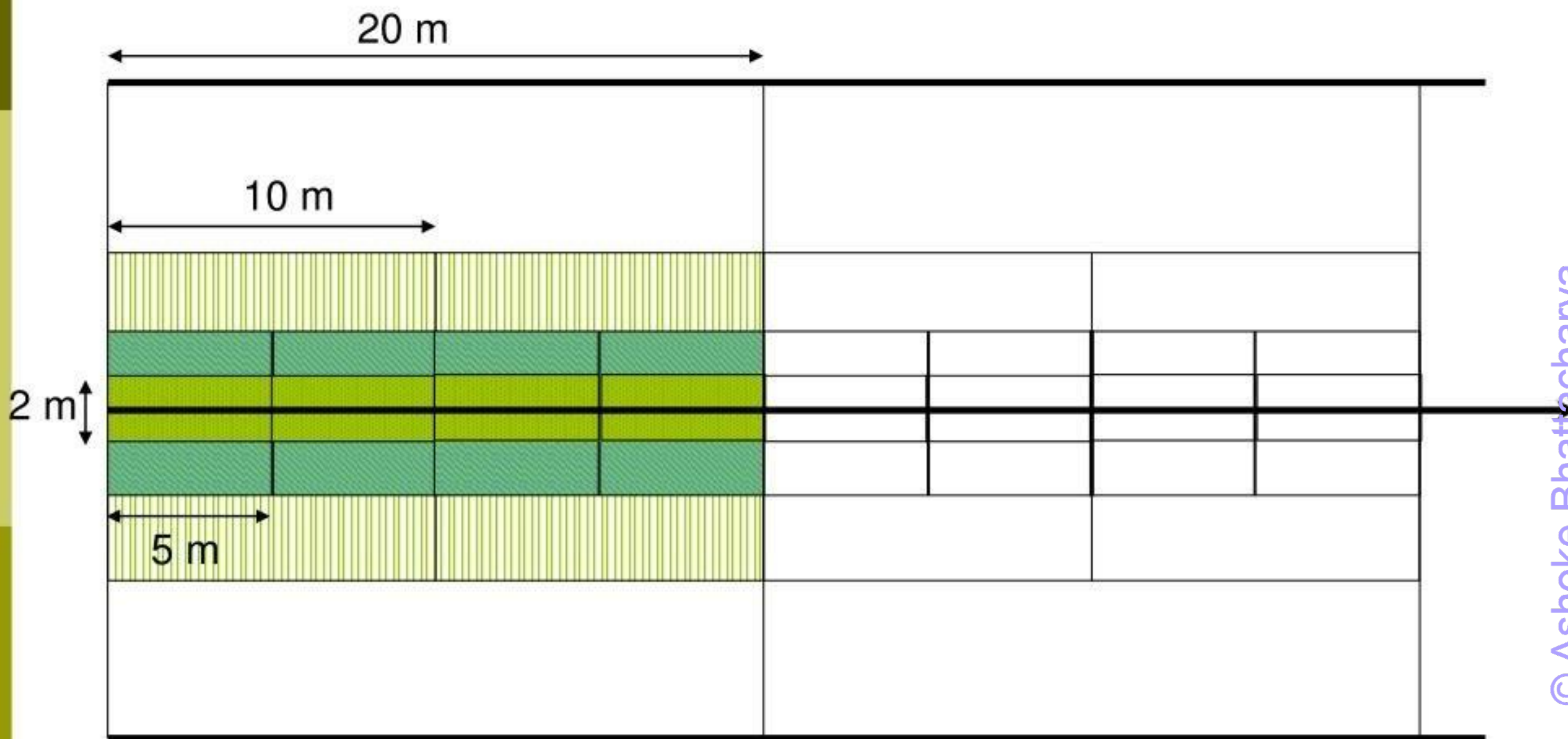


SISTEMATIC

VEG. ANALYSIS

Source: R.S. Ambasht, 1998

A.2. Transect Method



Source: R.S. Ambasht, 1998

A. Quadrat Sampling Technique (*Continued*)

TALLY SHEET FOR SEEDLINGS AND SAPLINGS

Quadrat	Species	N (ind)
1	…	…
	…	…
	…	…
2	…	…
	…	…
…	…	…
	…	…
n	…	…
	…	…

A. Quadrat Sampling Technique (*Continued*)

Summary of vegetation Analysis by the Quadrat Sampling Technique

Species	Density (ind/ha)	Relative Density	Frequ-ency (%)	Relative Frequ-ency (%)	Domi-nance (m^2/ha)	Relative Domi-nance (%)	Importance Valur
A							
B							
C							
D							
...							
...							
...							

DATA ANALYSIS FOR QUADRAT SAMPLING TECHNIQUE

$$DENSITY = \frac{NUMBER\ OF\ INDIVIDUALS}{AREA\ SAMPLED}$$

$$RELATIVE\ DENSITY = \frac{DENSITY\ FOR\ A\ SPECIES}{TOTAL\ DENSITY\ FOR\ ALL\ SPECIES} X100$$

$$DOMINANCE = \frac{TOTAL\ OF\ BASAL\ AREA\ OR\ AREAL\ COVERAGE\ VALUES}{AREA\ SAMPLED}$$

$$\text{RELATIVE DOMINANCE} = \frac{\text{DOMINANCE FOR A SPECIES}}{\text{TOTAL DOMINANCE FOR ALL SPECIES}} X100$$

Source: E.P. Odum, 1978

DATA ANALYSIS FOR QUADRAT SAMPLING TECHNIQUE (*Continued*)

$$FREQUENCY = \frac{NUMBER\ OF\ PLOTS\ IN\ WHICH\ SPECIES\ OCCURS}{TOTAL\ NUMBER\ OF\ PLOTS\ SAMPLED}$$

$$RELATIVE\ FREQUENCY = \frac{FREQUENCY\ VALUE\ FOR\ A\ SPECIES}{TOTAL\ OF\ FREQUENCY\ VALUES\ FOR\ ALL\ SPECIES} X100$$

$$IMPORTANCE\ VALUE = RELATIVE\ DENSITY + RELATIVE\ DOMINANCE + RELATIVE\ FREQUENCY$$

Source: E.P. Odum, 1978

Vegetation Mapping Project Plan, Schedule, and Budget

- Maintain and update the vegetation mapping project plan as a written document throughout the duration of the project. The plan should clearly define the project objectives, identify required resources, outline tasks to be accomplished, establish timeframes, and disclose budget constraints. At a minimum, the project plan should contain these four elements:
- It summarizes the project to facilitate communication to interested parties.

The technical design clearly and specifically fulfills these requirements:

- State project objectives and identify output products.
- State the methods and data sources to be used.
- Break the workload into identifiable tasks.
- Estimate effort, in hours, and type of personnel and skills by task.
- Estimate resource needs including costs, personnel, and equipment needed by task.
- Identify material and services needed by task.
- Assess risk of failure by task and provide contingency plans for high-risk tasks.
- State the data standards to be followed.
- Include a quality control process and accuracy requirements.

Vegetation Mapping Project Plan, Schedule, and Budget

- The breakdown of tasks in the technical design is particularly important. Tracking individual tasks is much easier than trying to manage the whole project as a whole. The task breakdown is also used to monitor progress and budget. Assessing risks and formulating contingency plans are also important to the technical design. Typical risks for vegetation mapping projects include the following:

- Problems related to using new or untried technology.
- Probability that primary data for certain geographic areas are not available.
- Probability of delay in acquiring imagery or other data.
- Budget and schedule overruns.
- Problems related to the logistical challenges of fieldwork.
- Training or hiring of skilled personnel.
- Failure to meet specified accuracy standards.

Vegetation Mapping Project Plan, Schedule, and Budget

- The project schedule is constructed from the technical design as follows:
  - Start with the time required for each task as listed in the technical design.
  - Determine which tasks are concurrent and which are sequential.
  - Consider the availability of personnel.
  - Consider constraints related to fieldwork, access to computers, and availability of data.
  - Include time for contingency plans.
  - Develop the final schedule.
- The project budget is calculated by assigning costs to each task identified in the technical design. Make sure to include salaries, travel and training costs, equipment and material needs, and required outside services, as well as personnel time.

Map Standards

- *Requirements for map unit keys*
- *Definition of standard map attributes*
- *Thematic map accuracy requirements*
- *Minimum map feature*
- *Spatial map accuracy requirements*
- *Map update cycles*

Biodiversity: What is it?

- Biodiversity: Why is it important?
- Biodiversity at its utmost: Tropical forest beetles
- Measuring global biodiversity and its decline
- Butterfly diversity and a comparison with bird and mammal diversity
- The global biodiversity of coral reefs: a comparison with rain forests
- Common measures for studies of biodiversity: Molecular phylogeny in the eukaryotic microbial world
- The rich diversity of biodiversity issues

- Global warming and plant species richness
- Plant response to multiple environmental stresses: implications for climatic change and biodiversity
- Names: The keys to Biodiversity
- Systematics: A keystone to understanding biodiversity
- Phylogeny and historical reconstruction: Host-parasite systems as keystones in biogeography and ecology
- Comparative behavioural and biochemical studies of plants
- Microbial biodiversity and biotechnology
- The impact of rapid gene discovery technology on studies of evolution and biodiversity
- Gap analysis for biodiversity survey and maintenance
- Ecological restoration and the conservation of biodiversity
- Taxonomic preparedness: Are we ready to meet the biodiversity challenge?

Biological Diversity:

- Immense diversity in biosphere not only at the species level but at all levels of biological organization ranging from macromolecules within cells to biomes.
- Biodiversity plays a crucial role in the life of man. Biodiversity fulfils the need of food, fodder, fuel, timber and medicines. Biodiversity provides stability to the ecosystem and maintains the ecological balance.
- Biodiversity is the term popularized by the sociobiology's Edward Wilson to describe the combined diversity at all the levels of biological organization. The most important of them are Genetic diversity, Species diversity, Ecological diversity.
- CBD defines Biological diversity as the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.
- Biological resources includes genetic resources, organisms or parts thereof, populations, or any other biotic component of ecosystems with actual or potential use or value for humanity.

Biodiversity in India:

- With 2.4 per cent of the world's land, India contributes 8 per cent to the world diversity. It has, therefore, been designated as one of the 12 mega diversity regions and one among the 194 signatories to the Convention on Biological Diversity (CBD) at Earth Summit in Rio de Janeiro in 1992.
- India has taken a number of policy initiatives towards conservation of nature, natural resources and biodiversity at international, national and regional levels. Some of the significant initiatives include:
    a. The World Heritage Convention (1972),
    b. The Convention on International Trade in Endangered Species of Flora and Fauna (CITES) 1975
    c. The Ramsar Convention on Wetlands (1975),
    d. The FAO's International Undertaking on Plant Genetic Resources (1983),
    e. The Convention on Biological Diversity (1992),
    f. The UN Convention to Combat Desertification (1994),
    g. The Trade Related Intellectual Property Rights (WTO-1994) 1994,
    h. The Cartagena Protocol for Biosafety to CBD (2000),
    i. The International Treaty on Plant Genetic Resources for Food and Agriculture (FAO 2001),
    j. The Global Strategy for Plant Conservation (2002),
    k. The Bonn Guidelines on Access to Genetic Resources and Fair and Equitable Sharing of the benefits arising out of their utilization (2002)

Biodiversity in India:

- The Government of India brought the CBD into force from 19th May 1994. This convention provides a framework for the sustainable management and conservation of India's natural resources.
- In order to regulate access to biological resources of the country with the purpose of securing equitable share in benefits arising out of the use of biological resources and associated knowledge, to conserve and sustainably use biological diversity a legislation was required.
- Legislation was also required in order to respect and protect traditional knowledge of local communities and to secure benefit sharing with local people who have conserved the biological resources.
- The Biological Diversity Act, 2002 (BD Act) was formulated after intensive consultation with various stakeholders.

The Biodiversity Act - 2002

It primarily addresses issues of conservation, sustainable use of biological resources in the country, issue related to access to genetic resources and associated knowledge and fair and equitable sharing of benefits arising from utilization of biological resources to the country and its people. A three tiered structure has been established under the Act at the national, state and local levels.

Meaning of Biological Diversity:

- Biodiversity has been defined under Section 2(b) of the Act as "the variability among living organisms from all sources and the ecological complexes of which they are part, and includes diversity within species or between species and of eco-systems".

- Biological resources is "plants, animals and micro-organisms or parts thereof, their genetic material and by-products (excluding value added products) with actual or potential use or value, but does not include human genetic material."

The Biological Diversity Act, 2002:

- Authorities which are responsible for its implementation:
  a) National Biodiversity Authority (NBA)
  b) State Biodiversity Boards (SBB)
  c) Biodiversity Management Committees (BMC)
  (Source: The Biological Diversity Act, 2002)
- Mechanism for access and benefit sharing:

It primarily addresses the issues concerning access to genetic resources and associated knowledge by foreign nationals, institutions or companies, and equitable sharing of benefits arising out of the use of these resources and associated knowledge by the country and its people.

(Source: http://www.nbaindia.org/act/act_english. htm)

a) The NBA deals with the requests for access to bio-resources and associated traditional knowledge and approval for seeking any form of Intellectual Property Rights (IPRs) in or outside India for an invention based on biological resource and associated traditional knowledge.
b) SBBs deal with matters relating to access to bio-resources by Indians for commercial purposes and restrict any activity which violates the objectives of conservation, sustainable use and equitable sharing of benefits.
c) The mandate of the BMCs is conservation, sustainable use, documentation of biodiversity and chronicling of knowledge relating to biodiversity

Access to biological resources and associated traditional knowledge:

- Access to biological resources and traditional knowledge to foreign citizens, companies and non-resident Indians (NRIs) based on ‘prior approval of NBA’ (Section 3, 4, 6 of the Act and Rule 14-20).
- Access permits to Indian citizens, companies, associations and other organizations registered in India on the basis of ‘prior intimation to the State Biodiversity Board’ concerned (Section 7 of the Act).
- Exemption of prior approval or intimation for local people and communities, including growers and cultivators of biodiversity, and Vaids and Haqims, practicing indigenous medicines (Section 7 of the Act).

Revocation of access or approval:

- Revocation will be done only on the basis of any complaint or *suo moto* under the following conditions:

    (i) violation of the provisions of the Act or conditions on which the approval was granted

    (ii) non-compliance of the terms of the agreement

    (iii) failure to comply with any of the condition of access granted

    (iv) on account of overriding public interest or for protection of environment and conservation of biodiversity (Rule 15, Sub rule 1)

(Source: K. Venkataraman, “India’s Biodiversity Act 2002 and its role in conservation”, Tropical Ecology 50(1): 23-30, 2009)

Restrictions for access to biological resources:

- The Act imposes certain restrictions on request related to access to biological resources and traditional knowledge if the request is on:

    (i) endangered taxa

    (ii) endemic and rare taxa

    (iii) likely adverse effects on the livelihood of the local people

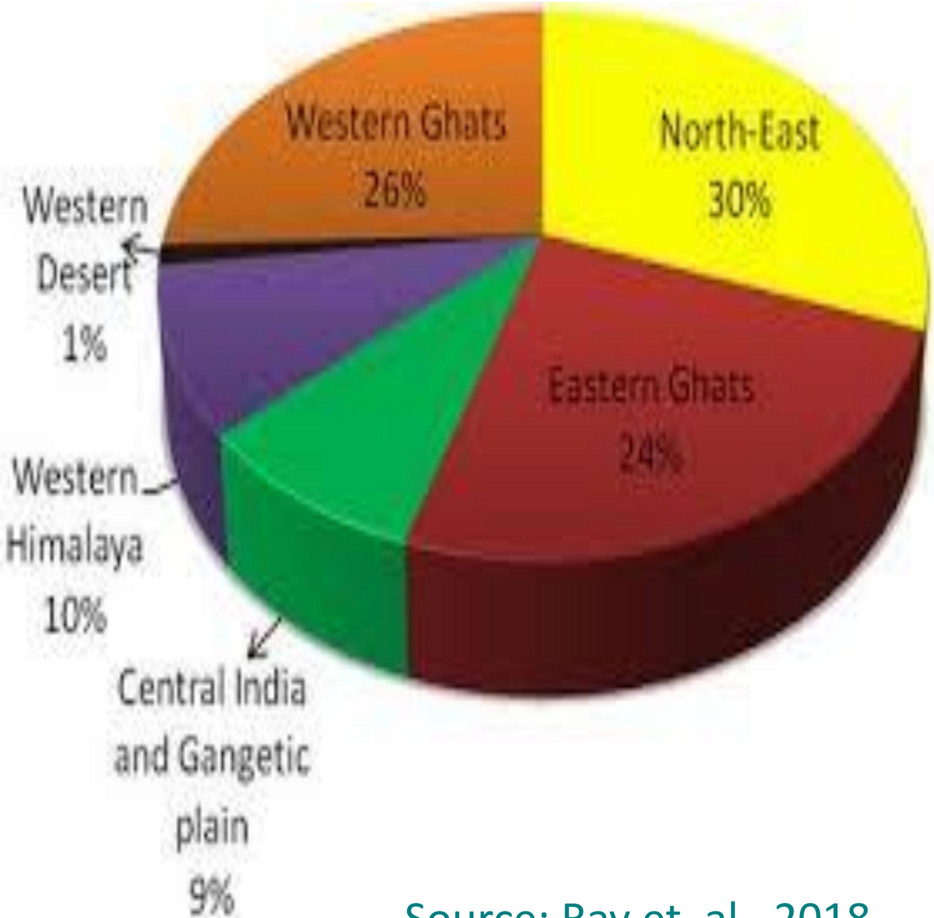
    (iv) adverse and irrecoverable environmental impact

    (v) cause genetic erosion or affect ecosystem function

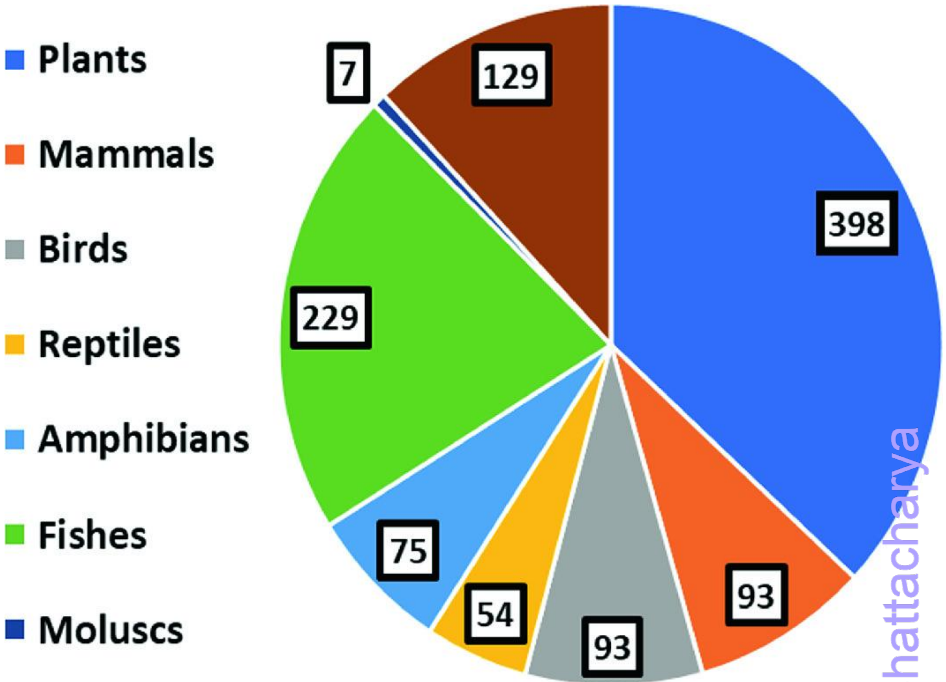
    (vi) purpose contrary to national interests and other related international agreements to which India is party (Rule 16, Sub rule 1)

    (Source: http://www.nbaindia.org/rules.htm)

LATEST SCENARIO OF INDIAN BIODIVERSITY

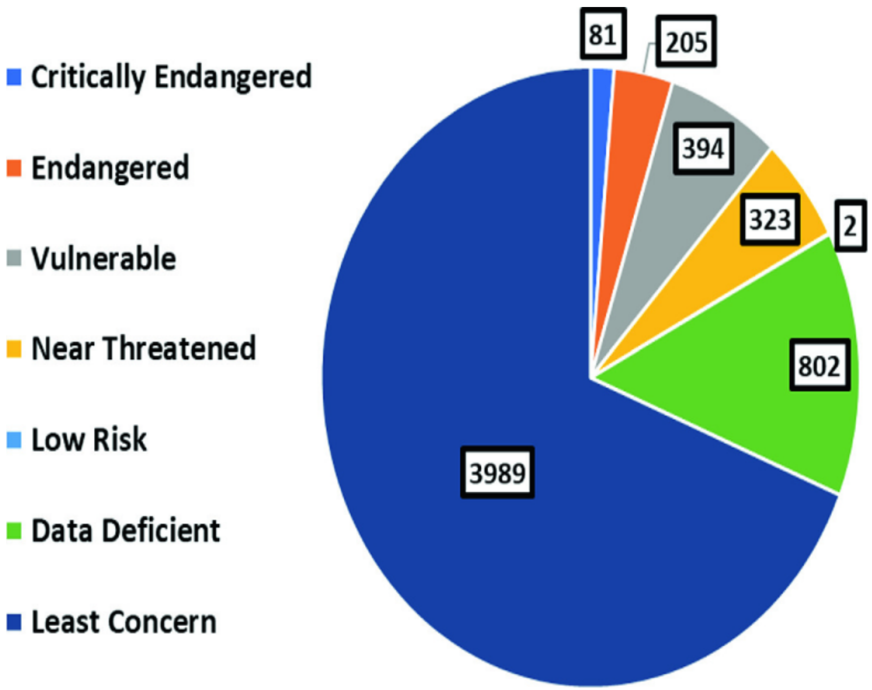


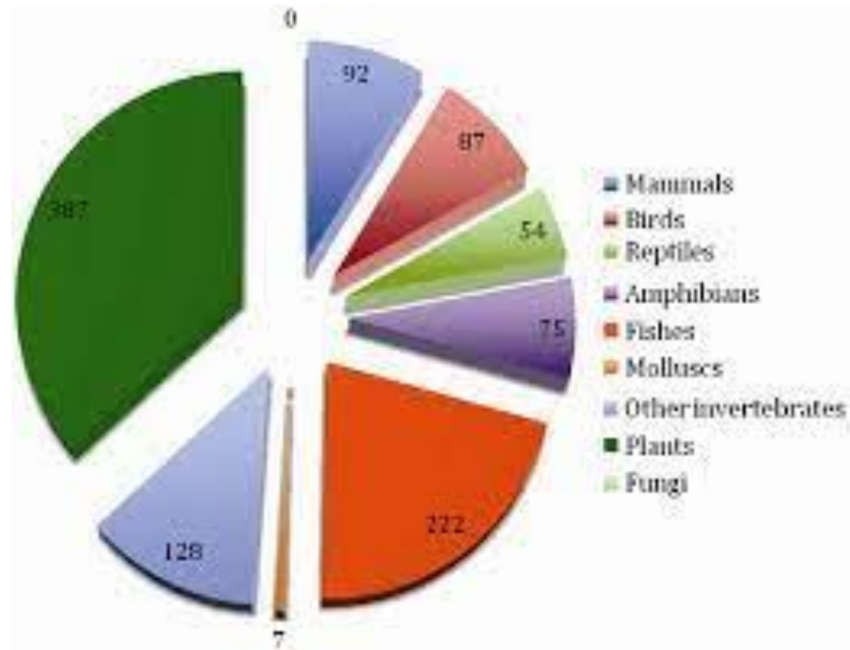
Source: Ray et. al., 2018



Source: Kapoor, 2020

LATEST PLANT SPECIES CONSERVATION STATUS





Source: Kapoor, 2020

LATEST PLANT SPECIES CONSERVATION STATUS

- The Red List of 2018 was released at the Rio+20 Earth Summit. It contains 132 species of plants and animals in India endangered.
- The number of plant species in India is estimated to be over 45,523 representing about 11.8 per cent of the world's flora. These include over 17,500 flowering plants of which 4,950 species are endemic to the country.
- As of 2020, 7,079 species are classified as critically endangered—the most threatened category of species listed by the IUCN are dependent on conservation efforts to protect them.
- As of 2021, of the 120,372 species currently tracked by the IUCN, there are 8,404 species that are considered to be Critically Endangered.

Source: Kapoor, 2020 & 2021


Critically Endangered
Syzygium travancoricum
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Critically Endangered

Are we ready now to meet the biodiversity challenge?

Thank you