Conservation Principles and Strategies
Protecting Biodiversity

What is Conservation?

- Management of human use of natural resources to provide maximum benefit to the present generation while maintaining its potential to meet the needs of future generations – *IUCN*

- Conservation embraces *preservation*, *maintenance*, *sustainable utilization*, *restoration*, and *enhancement of the natural environment*.

Conservation Principles

- Current usage recognizes the complex relationships among humans, animals, plants and the physical environment.

- Conservation is a process, applied cross-sectorally; not an activity sector in its own right.

Principles of Conservation

- Conservation is planned management to
  - Prevent overexploitation, pollution, destruction or neglect
  - Ensure future usability of natural resources.

- Recognizes limited knowledge and understanding of ecosystems
  - Allows natural processes to predominate wherever possible.

- It promotes
  - Less wasteful use of resources
  - More efficient extraction methods and recycling
  - Search for alternative natural resources

Objectives of Conservation?

- Three main objectives:
  1. ***Maintain essential ecological processes and life-supporting systems***. E.g., soil regeneration and protection, cleansing of water, nutrient recycling.
  2. ***Preserve genetic diversity***
     - Matter of both insurance and investment.
     - Basis of ecological processes and life-support systems
     - Basis of breeding programmes, scientific, technological and medicinal advances
     - Security of industries that use living resources
  3. Ensure ***sustainable utilization of species, ecosystems or natural resources***.

Types of Conservation

Soil conservation: soil is an important life-supporting system but threatened by human cultivation and climate change.

Water conservation: water is needed for food and industry.

Atmosphere conservation: we need clean air.

Wildlife conservation: preventing extinctions, maintaining biodiversity.

Energy conservation: energy is the driving force behind industry and civilization.

Urban conservation: deals with overcrowding, pollution, etc.

Marine conservation: different systems, rich in diversity.

Forest conservation: forests serve as home for many plants and animals.

Importance of Conservation

- Conservation is a response to a global environmental crisis that requires an immediate action.
  - Rapid human population expansion has led to unprecedented and unsustainable rates of natural resource consumption.
  - Humans activities continue to directly and indirectly deplete natural resource and threaten biodiversity, fast driving a number of them into extinction.
  - Human wellbeing and survival are directly linked to sustenance of biodiversity.
  - It is our responsibility to safeguard natural resources (biodiversity) for future generations.

Conservation and Development Aims

Development involves the use of natural resources.

Potential conflict between conservationists and developers.

Bui dam project

People whose primary concern is economic development	People whose primary concern is conservation
Place strong emphasis on quantitative production. E.g., Number of new acres brought under irrigation, increased yield of rice per acre.	Less emphasis on quantitative production. Inclined to ask: What desirable natural processes may be disrupted? What resources and values are sacrificed?
Interested in direct and readily measurable gains.	Look at direct and indirect socio-economic costs in the short-term, long-term, and the immediate benefits.

What are the Goals of Conservation?

- FAO and UNESCO defines conservation as the *rational use of the earth's resources to achieve the highest quality of living for mankind.*

- By this definition, such a conflict ought not emerge because both groups seek a common goal.

Kakum national park

Sources of the Conflicts between Conservation and Development Aims

- However, such conflicts may arise because:
  - the term **quality of living** is subjective and varies with cultur and economic status.
  - **Rational use** varies in interpretation.

Is it rational to mine a forested area?

Resolving the potential conflicts between conservation and development Aims

- Development provides the necessities of life and the material luxuries of civilizaton.
- Conservation assures that the environment is:
  - Satisfactory to the people involved.
  - Self-sustaining or capable of being sustained.
  - Heathful.
  - Challenging and offers opportunity for future change.

Role of ecological information in conservation and development

- Ecological knowledge essential to conservation as it is to development.
- Ignoring ecological facts may lead to failure of conservation efforts and waste of money.
- Range of conservation values to be considered in development planning ought to be related to ecological information. E.g., as obtained from EIA.

Role of ecological information in conservation and development

- Equally, the range of economic values must take into account the ecological information.
- Without these, sentiments and subjective evaluation or error of judgement will prevail.

Given a particular tract of land not yet opened to human use what options exist for its use?

Options for sustainable development of undisturbed lands

1. **Leave in completely natural state** to
   - maintain its biodiversity
   - reserve it for scientific study, educational use, watershed protection and for its contribution to landscape stability

Options for sustainable development of undisturbed lands

2. **Developed as a National Park or equivalent reserve** with the natural scene remaining largely undisturbed to serve as
   - a setting for outdoor recreation
   - an attraction for tourism

Options for sustainable development of undisturbed lands

3. **Limited harvest of its wild vegetation or animal life but maintained largely in the wild state**, serving to
   - Maintain landscape stability
   - Support certain kinds of scientific or educational uses
   - Provide for some recreation and tourism
   - Yield some commodities from its wild populations.

Options for sustainable development of undisturbed lands

4. **Intensive harvest of its wild products as forest production, pasture production or intensive wildlife production**.
   - value as a wild area for scientific studies and tourism diminishes but not necessarily lost.
   - Its role in landscape stability and watershed stability is changed but may be maintained at a high level.

Options for sustainable development of undisturbed lands

5. The wild vegetation and animal life having been almost completely removed, it can be **used for intensive urban, industrial and transportation purposes**.

Options for sustainable development of undisturbed lands

- So long as the first three choices are taken, the option remains open to change from one of these uses to any other, as well as any of the last two.

- If the fourth choice is picked, the option for restoring the land into any of the first three categories are reduced but not eliminated.

Options for sustainable development of undisturbed lands

- Selection of the last option largely prohibits any shifts to the other alternatives within a reasonable period of time.

- A rational and sensible choice from the options available must be based on ecological and economic considerations, etc.

How can we conserve biodiversity?

- Two broad strategies are used
  - ***In-situ*** methods
  - ***Ex-situ*** methods

Ex-Situ Conservation

- Conservation and maintenance of components of biodiversity **outside their natural habitats**.

- Involves conservation of genetic resources as well as wild and cultivated species, and draws on a diverse body of techniques and facilities.

Examples of *Ex-Situ* Conservation

1. Gene banks, e.g., seed banks, sperm and ova banks, field banks.
2. In vitro plant tissues and microbial culture collections.
3. Captive breeding of animals and artificial propagation of plants, with possible reintroduction into the wild.
4. Collecting living organisms for zoos, aquaria, and botanic gardens for research and public awareness.

Ex-Situ Conservation

- Ex-situ conservation measures can be complementary to *in-situ* methods as they provide an “insurance policy” against extinction.
- They can be conveniently classified according to the part of the plant conserved:
  - ✓ whole plant or living collection
  - ✓ seeds banks
  - ✓ tissue or genetic materials in culture

Whole Plant Conservation

- This is also called living collection. E.g., botanic gardens, plantations, etc.

Advantages:

- Useful for display and education or research.
- Species take time to reach reproductive maturity.

Whole Plant Conservation

Disadvantages:

- High maintenance cost and large spatial requirement in the case of trees.
- Frequent controlled pollination and re-establishment required for annuals, unless vegetative propagation methods are available.
- There is a possibility of taxa hybridizing, controlled pollination is obligatory among out breeders.
- Suceptibility to communicable diseases within monocultures.

Whole Plant Conservation

Challenges:

- Plants will, as a rule, prosper outside their natural range in the absence of co-evolved pathogens, eg. *Hevea brasiliensis* flourishes in plantations outside their region of origin.
- However, this confronts political problem; should governments allow plantation forestry? If so, how much of land should be converted into plantations?

Seed Banking

- This refers to conservation of species through the storage of seeds.
- It is the most preferred method of *ex-situ* conservation.

Seed Banking

Advantages:

- The principal advantage is the economy of space
- Its demand for labour is low

Seed Banking

Disadvantages:

- Relies on dependable power supply
- Requires meticulous monitoring of germinability over time
- Periodic regeneration under conditions which minimize selection among residual seed stock.
- Difficulty in application to tropical tree species most of which lack dormancy and are also recalcitrant to induction of dormancy using current methods.

Tissue Culture

Advantages:

- Tissue culture expecially meristems can maintain genotypes unaltered for long period of time.
- Thus, it provides an economic means of suspending at least temporarily changes in gene frequency.
- Provides an invaluable alternative for conservation of multiple lines of taxa not easily conserved *ex-situ* on this scale by other measures, e.g., rainforest trees with recalcitrant seeds.

Tissue Culture

Disadvantages:

- Requires a great deal of expertise; each taxon has its own requirements for successful establishment in tissue culture and regeneration.

- At present, basic mechanisms are poorly understood so that successful techniques must be arrived at through tedious trials and errors.

In-Situ Conservation

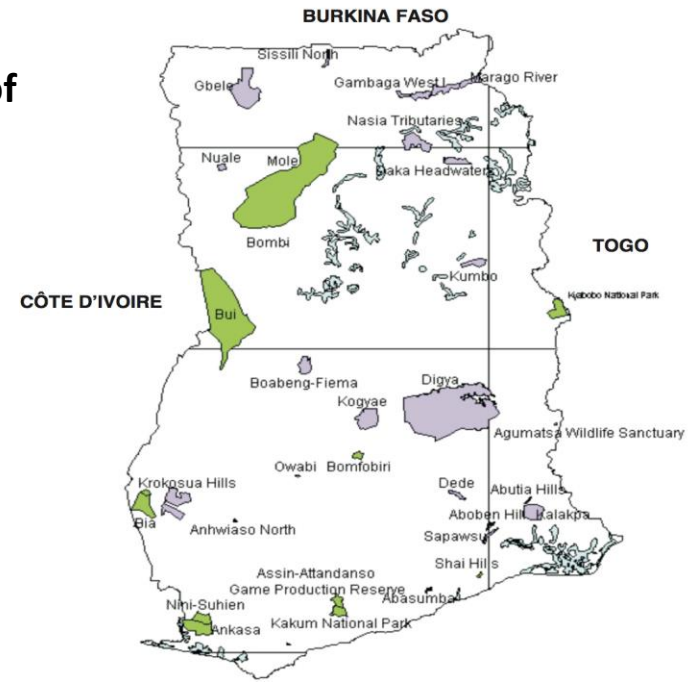
- Conservation of species in their natural habitats. i.e., protected areas including national parks, reserves, sanctuaries, sacred groves.

- These natural areas are used as “warehouses” of biological information.

In-Situ Conservation

- Considered the most appropriate way of conserving biodiversity.
  - As of 1993 nearly 7, 000 parks and protected areas covering over 650 million acres had been established worldwide.
  - Ghana has 21 protected areas including 7 NPs, 6 resource reserves, 2 wildlife santuaries, 1 Strict Nature Reserve and 5 Coastal Wetlands (IUCN, 2010)

Location of Protected areas in Ghana



Advantages of *In-Situ* Conservation

- Allows a population to maintain itself within the community of which if forms part and in the environment to which it is adapted.
- Allows indigenous species and systems to be protected, thus taking care of the unknowns until such time as methods are found for their investigation and utilization.
- Natural selection and community evolution continue and new communities, systems, and genetic material are produced.

Challenges of *In-Situ* Conservation

- Rigid preservation is virtually impossible to implement and even less likely to be maintained over time.
- There is a need to ensure that the genetic base of the population concerned is wide enough.
  - Demographic, environmental and natural uncertainties may cause significant reductions in the population of species.

Challenges of *In-Situ* Conservation

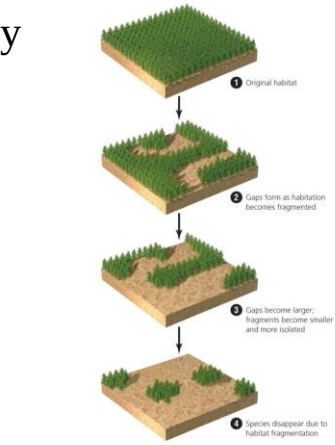
- Requires a greater knowledge of population structure, reproductive biology and gene flow than is normally available for most species.
- Needs international co-operation as in some cases a network of reserves within countries and sometimes spanning national boundaries becomes critical.
- *In-situ* conservation involves a series of planning and implementation requirement.

Practical Considerations

- Refuges, parks, preserves
  - How big should refuges be?
  - Where should they be?
  - McArthur & Wilson "Theory of Island Biogeography"
    - colonization rate
    - extinction rate (local)
    - predicts number of species

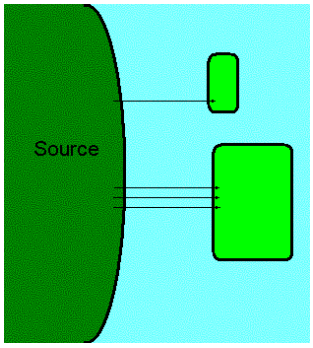
Practical Considerations

- Island Biogeography
  - Everyplace is an island
  - Habitat fragmentation
    - Smaller fragments hold fewer species

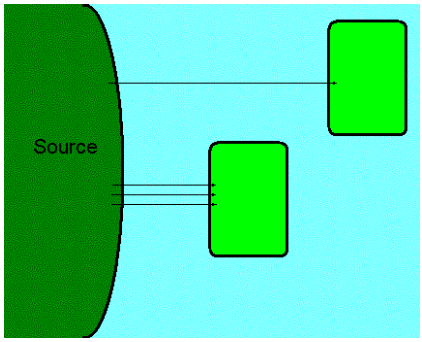


Practical Considerations

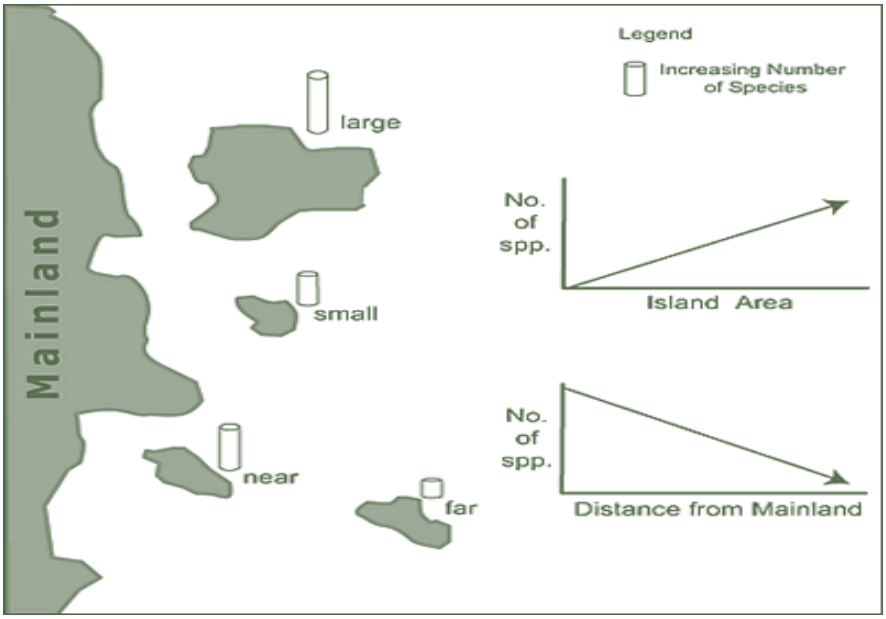
- Effect of island size



- Effect of island distance



Island Biogeography Theory

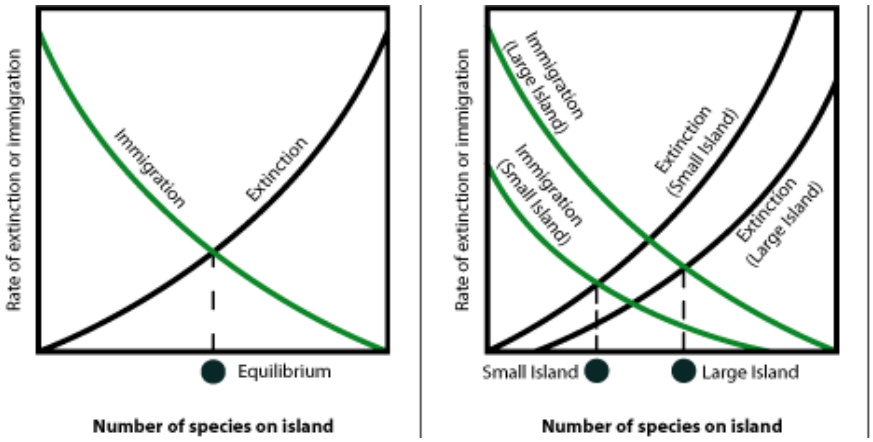


Island Biogeography Theory

- The number of species on an island is determined by the rate of immigration of new species and the rate of local extinction.
- Immigration is arrival of new species from mainland—larger patch.
- As the number of species on an island increases immigration rate declines
  - Niches are filled.
- As more species take up space, the population size of each species decreases.
  - Islands can hold a fixed number of species.
  - More likely go extinct
  - Extinction rate increases.

Island Biogeography Theory

- The number of species reaches a steady-state.
  - Immigration rate equals to extinction rate.

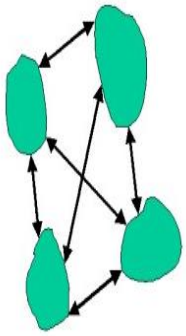


Metapopulation Theory

- Proposed by Levin (1970).
- Metapopulation (population of populations) is a group of several local populations that are linked by immigration and emigration.
- Theory similar to Island Biogeography
  - Populations instead of species
  - Think of a population as an island
- Population size is a result of
  - Immigration and emigration of genes.
- Smaller populations more prone to extinction.
- Local (sink) populations can go extinct but can be repopulated by source populations.

Metapopulation Theory

- Emphasizes the importance of connectivity between seemingly isolated populations.
  - Reducing migration potentially leads to local extinction of species over a wider area.
- Destruction of source populations might lead to extinction of many smaller populations.



- Habitat occurs in discrete patches
- All populations have a substantial risk of extinction
- Dispersal occurs among all patches
- Patch dynamics are asynchronous
- **Ignore population dynamics within a patch**

Conservation and Reserve Design

- Protect the greatest number of species, populations and ecosystems.
- Time and money are always limiting
  - Maximize benefits through ecological knowledge.
- Single large or several small reserves?
  - Which is better?

In a nutshell

(Anning's Take on the Need for Conservation)

- Conservation is a response to a global environmental crisis that requires an immediate action.
  - Rapid human population expansion has led to unprecedented and unsustainable rates of natural resource consumption.
  - Humans activities continue to directly and indirectly deplete natural resource and threaten biodiversity, fast driving a number of them into extinction.
  - Human wellbeing and survival are directly linked to the sustenance of biodiversity.
  - It is our responsibility to safeguard natural resources (biodiversity) for future generations.

End!!!