Chapter 03: Biodiversity concepts

TD 01 : Ecological diversity indices

1-Diversity Indices

A **diversity index** is a quantitative measure that reflects how many different types there are in a dataset. When diversity indices are used in ecology, the types of interest in the community are usually species, but they can also be other categories. The entities of interest are usually individual plants or animals, and the measure of abundance can be number of individuals, biomass or energy. Principal diversity indices are:

1-1-Species richness (S)

It is often used as a measure of biodiversity. It is the number of species living in a specific area. A simple inventory can give an idea about all species categories present in a specific environment.

1-2-Simpson's Index (D)

The less diversity, the greater probability that two randomly selected individuals will belong to the same species. Simpson's Index is calculated as follows:

$$D = \Sigma\ ni\ (ni-1)\ /\ N(N-1)$$

Where;

ni is the number of individuals in species i.
N = total number of individuals of all species.

The value of Simpson's index **(D)** ranges from 0 to 1, with 0 representing infinite diversity and 1 representing no diversity, so the larger the value of D, the lower the diversity is.

1-3-Shannon-Weaver Index (H)

Also known as Shannon's diversity index**.** It participates to express the specific diversity of a population, to quantify the heterogeneity of the biodiversity of an environment, and therefore to observe the evolution of a population over time. The higher the value of the Shannon Weaver index (H'), the greater the diversity.

where;

$$H = -\sum_{i=1}^{S} p_i * \ln p_i$$

p = n /N: proportion of individuals of species i.
ln is the natural logarithm.
S = species richness.

1-4-Evenness Index (J)

Species evenness refers to how close in numbers each species in an environment is. It refers to the equal or different distribution of individuals within species. In other words, it provides information on the relative abundance of different species and their regularity in the community.

$$J = \frac{H}{H_{\max}}$$

$$\mathbf{H_{max} = Log2\ (S)}$$

Where;

H : Diversity index.
S: Species Richness
Log 2: binary logarithm

The value of J ranges from 0 to 1. Higher values indicate higher levels of evenness and equal distribution of species in a community, while low J indicates that one or few species dominate the community.

Example:

The following table shows the abundance values of different forest animal species. Calculate:

- The Simpson's Index (D)
- The Shannon-Weaver index (H)
- The Evenness Index (J) of this community.

Tab 01: Values of different forest animal species abundances

Species	Abundance
01	15
02	22
03	13
04	45
05	76
06	32
07	17
08	09
09	11
10	43

TD 02: Matter Recycling

1-Definition

Recycling is the process of converting waste materials into new reusable materials and objects. This concept often includes the recovery of energy from waste material. By recycling metals, glass and paper, less material needs to be mined and fewer trees are cut down. The use of recycled materials as raw materials rather than virgin materials results in significant energy savings, especially in the manufacturing sector. It also reduces air and water pollution.

Figure 01. Materiel categories used in recycling process

2-Benifits of recycling

Recycling is one of the most reliable solutions for biodiversity decline. It participates to:

- Reduce waste sent to landfills and incinerators.
- Conserve natural resources such as timber, water, and minerals.
- Prevent pollution by reducing the need to collect new raw materials.
- Reduce greenhouse gas emissions that contribute to global climate change.
- Sustain the environment for future generations.
- Enable job creation and aids to decrease unemployment

Figure 02. Waste selected in landfills to be recycled

3- Recycling steps

Recycling is a dynamic process that restores the life cycle of a material. The iconic recycling symbol has 4 principal steps:

a- Collection

Recycling is collected from curbsides, drop-off sites, deposit programs, or dumpster hauling.

b- Processing

Recycling is cleaned and sorted by material. Each material is prepared differently to be reused (Plastic is melted, glass is crushed, and paper is pulped).

c- Manufacturing.

The recyclables are sold to companies then converted into new products as consumer goods.

d- Purchase or use

Products made out of recycled material must be purchased. As long as consumer demand for recycled products, that will keep recycling services available.

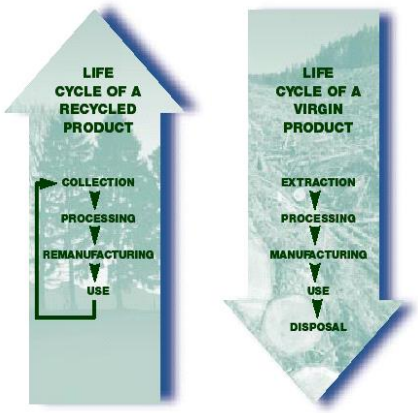

Figure 03. Recycling principal steps

4-Recycling Best Practices

A few social habits can help the authorities to accelerate the procedure of recycling materials:

- Clean, dry and sort recyclables: Remove food residue, liquids, and contaminants before tossing them in the bin.
- Flatten cardboard boxes: This saves space and improves sorting efficiency.
- Check labels and local guidelines: Not all plastics and other materials are recyclable everywhere.
- Separate recyclables from trash: Avoid contamination to ensure proper processing.
- Invest in reusable alternatives: Reduce your need for disposable items that end up in landfills or recycling facilities.