

Ecology

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*Teaching service - Common Trunk Nature and Life
Sciences*

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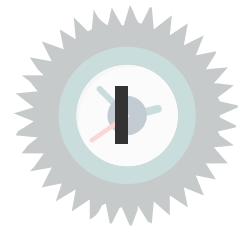
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Objectives



- To gain an understanding of the broad biological significance of ecological theory.
- To gain an understanding of the questions that ecologists study, the methods they use, and the questions that remain unanswered.
- To develop your ability to apply quantitative skills to analyze and interpret ecological data.

DS 03:Energy flow in the Ecosystem



1. Environmental Factors (Biotic Factors)

Transfert d'énergie et rendements Définitions ☒ Productivité brute (PB): Quantité de matière vivante produite pendant une unité de temps, par un niveau trophique donné. ☒ Productivité nette (PN): Productivité brute moins la quantité de matière vivante dégradée par la respiration. $PN = PB - R$. ☒ Productivité primaire : Productivité nette des autotrophes chlorophylliens. ☒ Productivité secondaire : Productivité nette des herbivores, des carnivores et des décomposeurs. Les rendements ☒ Rendement écologique : C'est le rapport de la production nette du niveau trophique de rang (n+1) à la production nette du niveau trophique de rang (n) : $(PS1/PN \times 100)$ ou $(PS2/PS1 \times 100)$. ☒ Rendement d'exploitation : C'est le rapport de l'énergie ingérée (I) à l'énergie disponible. C'est la production nette de la proie : $(I1/PN \times 100)$ ou $(I2/PS1 \times 100)$. ☒ Rendement d'assimilation : C'est le rapport de l'énergie assimilée (A) à l'énergie ingérée (I). Ce rendement exprime l'aptitude d'une espèce à utiliser l'énergie contenue dans les aliments : $(A1/I1 \times 100)$ ou $(A2/I2 \times 100)$ ☒ Rendement de production nette : Qui est le rapport de la production nette à l'énergie assimilée : $(PS1/A1 \times 100)$ ou $(PS2/A2 \times 100)$. TD écologie 2 ème Année LMD Biologie Solution d'exercice 1. $PB = LT \times 2,5 / 100 = 1000000 \times 2,5 / 100 = 2500000 / 100 = 25000$ => $PB = 25000 \text{ Kcal/m}^2/\text{j}$. 2. $PN = PB - R1 = PB - (90\% PB) = 25000 - (25000 \times 90 / 100) = 25000 - 22500 = 2500$ => $PN = 2500 \text{ Kcal/m}^2/\text{j}$. 3. Les rendements écologiques : a). Efficacité ou rendement photosynthétique = $PN/LT \times 100 = 2500/1000000 \times 100 = 0,25\%$ b). Chez les herbivores = $PS1/PN \times 100 = 25/2500 \times 100 = 1\%$ c). Chez les carnivores 1 = $PS2/PS1 \times 100 = 2,5/25 \times 100 = 10\%$ d). Chez les carnivores 2 = $PS3/PS2 \times 100 = 0,5/2,5 \times 100 = 20\%$ Solution d'exercice 2 : 1- La pyramide de nombre : $N1=P=\text{phytoplanctons}=880$, $N2=C1=\text{zooplanctons}=80$, $N3=C3=\text{poisson}=1$. 2- Les phytoplanctons sont des producteurs, les zooplanctons sont des herbivores et le poisson et un carnivore. 3- Autotrophe et hétérotrophe : Les producteurs sont dits autotrophes, puisqu'ils n'utilisent que le dioxyde de carbone atmosphérique, alors que les consommateurs sont appelés hétérotrophes car ils ne peuvent se nourrir que de matière organique complexe. 4- Il s'agit de chaîne de prédateurs : le nombre d'individus diminue d'un niveau trophique à l'autre, mais leurs tailles augmentent. 5- La productivité brute : $PB = 2.106 \times 1.5/100 = 30000 \text{ kcal/m}^2/\text{j}$ 6- La productivité nette : $PN = PB - R = PB - (80\% PB) = 30000 - (30000 \times 80/100) = 30000 - 24000 = 6000 \text{ kcal/m}^2/\text{j}$ 7- Les rendements écologiques : a/ Efficacité ou rendement photosynthétique = $PN/LT \times 100 = 6000/2.106 \times 100 = 0.3\%$ b/ Chez les herbivores = $PS1/PN \times 100 = 300/6000 \times 100 = 5\%$ c/ Chez les carnivores = $PS2/PS1 \times 100 = 100/300 \times 100 = 33.33\%$ 8- Chaîne trophique et réseau trophique Un réseau trophique est un ensemble de chaîne alimentaire (trophique) reliées entre elles au sein d'un écosystème et par lesquelles l'énergie et la matière circulent. Il se définit comme étant l'ensemble des relations trophiques existant à l'intérieur d'une biocénose entre les diverses catégories écologiques d'êtres vivants constituant cette dernière (producteurs, consommateurs et décomposeurs). can you translate to english ChatGPT

Energy Transfer and Efficiencies Definitions

- **Gross Productivity (GP):** The quantity of living matter produced per unit of time by a given trophic level.
- **Net Productivity (NP):** Gross productivity minus the quantity of living matter degraded by respiration. $NP = GP - R$.
- **Primary Productivity:** Net productivity of chlorophyll autotrophs.
- **Secondary Productivity:** Net productivity of herbivores, carnivores, and decomposers.

Efficiencies

- **Ecological Efficiency:** The ratio of the net production of the trophic level (n+1) to the net production of the trophic level (n): $(SP1/NP \times 100)$ or $(SP2/SP1 \times 100)$.
- **Exploitation Efficiency:** The ratio of ingested energy (I) to available energy. It is the net production of the prey: $(I1/NP \times 100)$ or $(I2/SP1 \times 100)$.
- **Assimilation Efficiency:** The ratio of assimilated energy (A) to ingested energy (I). This efficiency expresses the ability of a species to utilize the energy contained in food: $(A1/I1 \times 100)$ or $(A2/I2 \times 100)$.
- **Net Production Efficiency:** The ratio of net production to assimilated energy: $(SP1/A1 \times 100)$ or $(SP2/A2 \times 100)$.

Ecology Exercise Solution for 2nd Year LMD Biology.

Exercise 1 Solution

1. $GP = LT \times 2.5 / 100 = 1,000,000 \times 2.5 / 100 = 2,500,000 / 100 = 25,000 \Rightarrow GP = 25,000 \text{ Kcal/m}^2/\text{day}$.
2. $NP = GP - R1 = GP - (90\% GP) = 25,000 - (25,000 \times 90 / 100) = 25,000 - 22,500 = 2,500 \Rightarrow NP = 2,500 \text{ Kcal/m}^2/\text{day}$.
3. Ecological Efficiencies: a) Photosynthetic efficiency = $NP/LT \times 100 = 2,500/1,000,000 \times 100 = 0.25\%$
b) For herbivores = $SP1/NP \times 100 = 25/2,500 \times 100 = 1\%$ c) For carnivores 1 = $SP2/SP1 \times 100 = 2.5/25 \times 100 = 10\%$ d) For carnivores 2 = $SP3/SP2 \times 100 = 0.5/2.5 \times 100 = 20\%$

Exercise 2 Solution

1. Number Pyramid: $N1=P=\text{phytoplankton}=880$, $N2=C1=\text{zooplankton}=80$, $N3=C3=\text{fish}=1$.
2. Phytoplankton are producers, zooplankton are herbivores, and fish are carnivores.
3. Autotrophs and Heterotrophs:
 - Producers are called autotrophs. They only use atmospheric carbon dioxide, whereas consumers are called heterotrophs because they can only feed on complex organic matter.
4. This is a predator chain: the number of individuals decreases from one trophic level to another, but their sizes increase.
5. Gross Productivity: $GP = 2.10^6 \times 1.5/100 = 30,000 \text{ kcal/m}^2/\text{day}$.
6. Net Productivity: $NP = GP - R = GP - (80\% GP) = 30,000 - (30,000 \times 80 / 100) = 30,000 - 24,000 = 6,000 \text{ kcal/m}^2/\text{day}$.
7. Ecological Efficiencies: a) Photosynthetic efficiency = $NP/LT \times 100 = 6,000/2.10^6 \times 100 = 0.3\%$ b) For herbivores = $SP1/NP \times 100 = 300/6,000 \times 100 = 5\%$ c) For carnivores = $SP2/SP1 \times 100 = 100/300 \times 100 = 33.33\%$
8. Food Chain and Food Web:
 - A food web is a set of interconnected food chains within an ecosystem through which energy and matter circulate. It is defined as the set of trophic relationships within a biocenosis between the various ecological categories of living beings that constitute it (producers, consumers, and decomposers).

1.1. Exercise 01

- a- What are homotypic interactions and heterotypic interactions?
- b- List the different types.
- c- Complete the following table to show the effect of the trophic relationship on each organism. Use symbols: (+): favorable effect, (-): unfavorable effect, 0: no effect

	A	B
Predation (A: predator; B: prey)		
A: parasite; B: host		
Commensalism (A: commensal; B: host)		
Competition		
Phytophagy		

1.2. Exercise 02:

When the flour in which the *Tribolium confusum* beetles live contains a certain amount of toxic excreta, there is a reduction in female fertility, an elongation of the larval development period, and a phenomenon in which the adults (imagos) attack the eggs.

Eggs eaten (%)	adults/g of flour
7.7	1.25
98.4	40

- The environmental factor that induces females to reduce their fertility and prolong their larval stage is the presence of toxic excreta in the flour.
- Females prolong their larval development period due to the adverse conditions caused by the toxic excreta in the flour.
- This is an example of homotypic coaction.
- The phenomenon during which adults attack the eggs is called ovide.

1.3. Exercise 03

This study will help to identify the important aspects of ecology studies and make contact with a concrete example (Fig. 1).

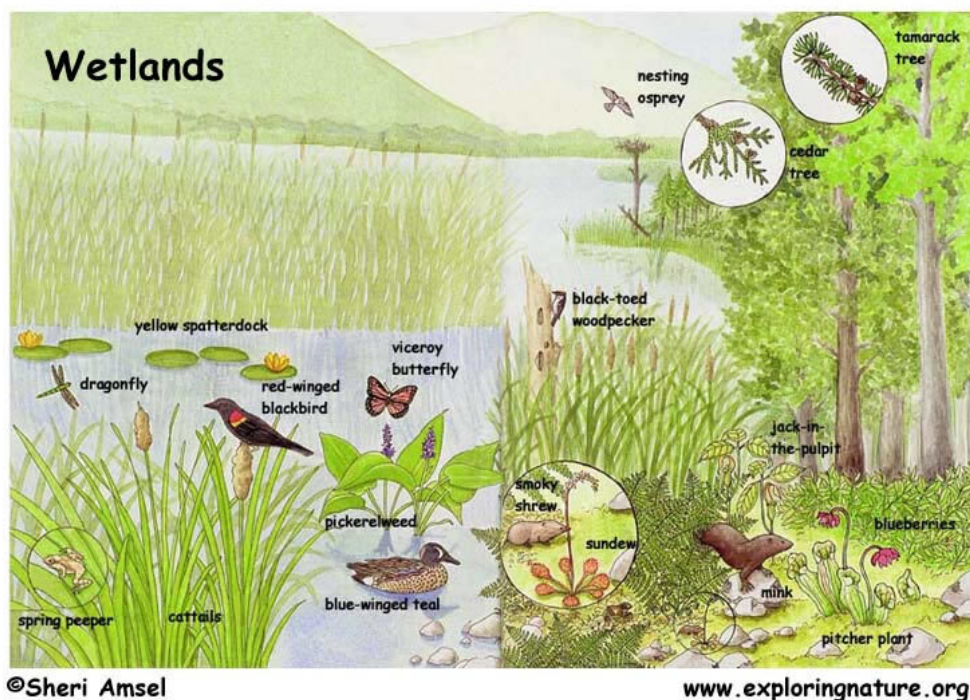


Figure 1: Pond Ecosystem: Solid arrows = is eaten by - many other possible arrows Dashed arrows = plant debris, corpses, excreta - many other possible arrows Proportions obviously not respected

a) Questions :

1. Provide the following definitions: ecosystem, biotope, biocenosis, abiotic factors, biotic factors
2. What are the abiotic factors of a pond?
3. List the biocenosis of the pond.
4. What types of interactions can exist between organisms in this ecosystem?

The ecological pyramids



1. Exercise 01:

Consider an ecosystem consisting of a 4-hectare alfalfa field (4 ha of alfalfa $\approx 2 \times 10^7$ plants), which feeds 4.5 calves, which in turn are consumed by a 12-year-old child.

- What type of pyramid can represent the trophic structure of this ecosystem?
- Represent the trophic structure of this ecosystem.

Exercise n°2: Consider an ecosystem consisting of vegetation at 809 g/m^2 , which serves to feed herbivorous animals weighing 37 g/m^2 , which in turn feed carnivorous animals weighing 11 g/m^2 , these are consumed by superpredators weighing 1.5 g/m^2 , and the plant debris and animal waste of this ecosystem are utilized by decomposers weighing 5 g/m^2 .

- What type of pyramid can represent the trophic structure of this ecosystem?
- Represent the trophic structure of this ecosystem.

Exercise n°3: Consider an ecosystem consisting of vegetation with an energy content of about $20810 \text{ Kcal/m}^2/\text{year}$, feeding herbivorous animals with $3368 \text{ Kcal/m}^2/\text{year}$, which in turn are consumed by carnivorous animals with $383 \text{ Kcal/m}^2/\text{year}$. The latter serve as food for predators with a productivity of about $21 \text{ Kcal/m}^2/\text{year}$, and the animal and plant waste and debris are used by a microfauna with a productivity of about $506 \text{ Kcal/m}^2/\text{year}$.

- What type of pyramid can represent the trophic structure of this ecosystem?
- Represent the trophic structure of this ecosystem

2. Exercise 02:

Consider an ecosystem consisting of vegetation at 809 g/m^2 , which serves as food for herbivorous animals weighing 37 g/m^2 , which in turn feed carnivorous animals weighing 11 g/m^2 . These carnivores are consumed by superpredators weighing 1.5 g/m^2 , and the plant debris and animal waste of this ecosystem are used by decomposers weighing 5 g/m^2 .

- What type of pyramid can represent the trophic structure of this ecosystem?
- Represent the trophic structure of this ecosystem.