

Quadrant II – Transcript and Related Materials

Programme: Bachelor of Science (Third Year)

Subject: Botany

Course Code: BOC 110

Course Title: Plant Ecology and Phytogeography

Unit: 8

Module Name: Ecological Efficiencies

Name of the Presenter: Arati K. Talauliker

Ecological Efficiencies

Energy flows from the primary producers through the various trophic levels of consumers and decomposers. Organisms use food energy that they assimilate to fulfil metabolic requirements, performance of work, growth and reproduction.

Large amounts of energy are lost from the ecosystem during energy flow. Some assimilated energy is lost through non-predatory death, egestion, and respiration. When energy passes from one level of production to the next, there is always energy loss.

The energy flow through the community depends on the efficiency with which organisms consume their food resources and convert them into biomass. Ecological efficiency describes the efficiency with which energy is transferred from one trophic level to the next.

Ecological efficiency is the percentage of energy in the biomass produced by one trophic level that is incorporated into the biomass produced by the next higher trophic level.

Quantifying ecological efficiency

Ecological efficiency is a combination of several related efficiencies

- Exploitation efficiency
- Assimilation efficiency
- Net production efficiency

Exploitation Efficiency

The percentage expressing the proportion of prey production (production at one trophic level) that is ingested by the next trophic level.

$$\text{Exploitation efficiency} = \frac{\text{Ingestion}}{\text{Prey production}} \times 100$$

Exploitation efficiency vary between different ecosystems

- Terrestrial forest – 1 to 2%
- Grassland – 30 to 60%
- Aquatic ecosystem – 60 to 99%

Assimilation Efficiency

The percentage expressing the proportion of ingested energy that is assimilated into the bloodstream.

$$\text{Assimilation efficiency} = \frac{\text{Assimilation}}{\text{Ingestion}} \times 100$$

Carnivore assimilation efficiencies are about 80% as they consume soft tissue, which is easily assimilated. Herbivores assimilation efficiencies are about 5 – 20% as plant leaves have many indigestible cell walls.

Net Production Efficiency (NPE)

The efficiency with which assimilated energy is incorporated into reproduction, growth and storage is called the net production efficiency.

$$\text{NPE} = \frac{\text{Consumers production}}{\text{Assimilation}} \times 100$$

Plants in temperate zones have NPE of about 75 to 85 % and plants in tropics have NPE of 40 to 60 %. Vertebrates have lower NPE than invertebrates as they use more energy to sustain their metabolism than new biomass production.

Ecological efficiency is the product of exploitation efficiency, assimilation efficiency and net production efficiency.

Ecological efficiency is equivalent to the amount of consumer production divided by the amount of prey production.

$$\text{Ecological efficiency} = \frac{\text{Consumer production}}{\text{Prey production}} \times 100$$

Ecological Efficiencies vary in different food chains

- Marine food chain – 30%
- Desert food chain – 2%