Pyramids

Feeding relationships and energy transfer in an ecosystem may be quantified and shown as ecological pyramids.

# Pyramid of numbers

|  |  |  |  |
| --- | --- | --- | --- |
|  | secondary consumer | | |
|  | | | primary consumer | | |
|  | | | | | producer | | |

Organisms are counted in a given area and grouped into trophic levels. Typically there are decreasing numbers as you go through the trophic levels but there are exceptions.

For example if the producer is a tree there is only one organism supporting the rest of the trophic levels.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | | | secondary consumer | |
|  | | | | | primary consumer | |
|  | producer | | | | |

If a consumer is a parasite the pyramid of numbers will often be top heavy as parasites are usually smaller than their host and occupy it in large numbers.

The number of organisms is represented as a rectangle whose length or area is proportional to the number of organisms in the unit area or volume.

Problems with pyramids of numbers:

* Deciding which trophic level an organism belongs to. Many feed at more than one level.
* The size of the producer varies and yet one grass plant is given the same status as one tree.
* The range of numbers from the producers to the top carnivores may be so great that it is impossible to represent the pyramid to scale even using a log scale.

To overcome these problems a pyramid of biomass may be used.

# Pyramid of biomass

This represents the total mass of the organisms at each trophic level. It involves weighing representative individuals as well as counting numbers. The dry mass is the true biomass but this involves death of the sample of organisms, which is not always acceptable.

Each rectangle represents the mass of the organisms per unit area or volume.

|  |  |  |  |
| --- | --- | --- | --- |
|  | secondary consumer | | |
|  | | | primary consumer | | |
|  | | | | | producer | | |

They usually have decreasing numbers as you move through trophic levels but again there are exceptions:

The biomass at the time of sampling is called the standing crop biomass. A small producer like algae has a high turnover rate and therefore the standing crop biomass is small, but can support a large number of animals, creating an inverted pyramid of biomass.

The standing crop biomass gives no indication of productivity over time – for example a fertile, intensively grazed pasture may have a smaller standing crop biomass of grass, but a higher productivity, than a less fertile and ungrazed pasture. This would result in an inverted pyramid of biomass.

|  |  |  |  |
| --- | --- | --- | --- |
|  | secondary consumer | | |
|  | | | | | primary consumer | |
|  | | | producer | | | |

Parasites have no effect on pyramids of biomass, because they are usually small if they occur in large numbers e.g. fleas.

The problems created by pyramids of biomass can be avoided by using a pyramid of energy.

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# Pyramid of energy

|  |  |  |  |
| --- | --- | --- | --- |
|  | secondary consumer | | |
|  | | | primary consumer | | |
|  | | | | | producer | | |

The advantages are

* It takes account of the rate of production over a period of time because each rectangle represents energy per unit area / vol per unit time. An example of units might be kJ/m2/yr
* Two species weight for weight may not have the same energy content therefore the biomass is misleading but energy is directly comparable.
* The relative energy flow within an ecosystem can be compared using pyramids of energy, also different ecosystems can be compared.
* There are no inverted pyramids.
* The input of solar energy can be added.

The disadvantages are

* The energy value for a given mass of organism is required, which involves complete combustion of a sample.
* There is still the difficulty of assigning the organisms to a specific trophic level. As well as the organism in the food chains there is the problem of assigning the decomposers and detritivores to a particular trophic level.