

BSc Part 1 Notes Unit 5

ECOLOGICAL PYRAMID

What is Ecological Pyramid?

An ecological pyramid is a graphical representation of the relationship between the different living organisms at different trophic levels. It was given by G.Evlyen Hutchinson and Raymond Lindeman.

It can be observed that these pyramids are in the shape of actual pyramids with the base being the broadest, which is covered by the lowest trophic level, i.e., producers. The next level is occupied by the next trophic level, i.e., the primary consumers and so on.

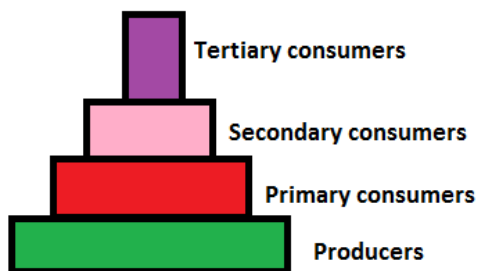
All the calculations for construction of these types of ecological pyramids must take into account all the organisms in a particular trophic level because a sample space of a few numbers or a few species will end up giving a huge level of errors.

Also Read: Ecology

Types of Ecological Pyramid

Three types of ecological pyramid exist. They are as follows:

Pyramid of Numbers

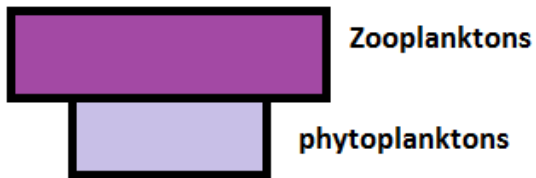


Pyramid of numbers

Pyramid of Numbers

In this type of ecological pyramid, the number of organisms in each trophic level is considered as a level in the pyramid. The pyramid of numbers is usually upright except for some situations like that of the detritus food chain, where many organisms feed on one dead plant or animal.

Pyramid of Biomass

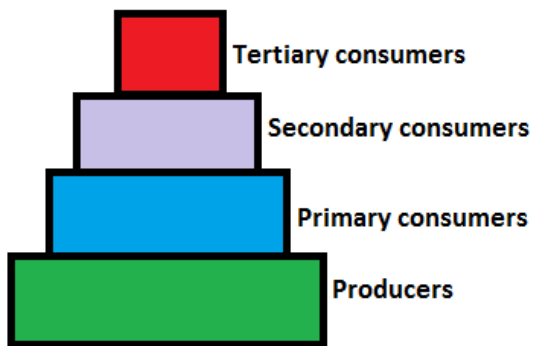


Pyramid of biomass in oceans

Pyramid of Biomass

In this particular type of ecological pyramid, each level takes into account the amount of biomass produced by each trophic level. The pyramid of biomass is also upright except for that observed in oceans where large numbers of zooplanktons depend on a relatively smaller number of phytoplanktons.

Pyramid of Energy



Pyramid of energy

Pyramid of Energy

Pyramid of energy is the only type of ecological pyramid, which is always upright as the energy flow in a food chain is always unidirectional. Also, with every increasing trophic level, some energy is lost into the environment.

Importance of Ecological Pyramid

The importance of ecological pyramid can be explained in the following points:

1. They show the feeding of different organisms in different ecosystems.
2. It shows the efficiency of energy transfer.
3. The condition of the ecosystem can be monitored, and any further damage can be prevented.

Limitations of the Ecological Pyramid

1. More than one species may occupy multiple trophic levels as in case of the food web. Thus, this system does not take into account food webs.
2. The saprophytes are not considered in any of the pyramids even though they form an important part of the various ecosystem.
3. These pyramids are applicable only to simple food chains, which usually do not occur naturally.
4. These pyramids do not deliver any concept in relation to variations in season and climate.
5. They do not consider the possibility of the existence of the same species at different levels.

To know more about what is an ecological pyramid and its types, keep visiting BYJU'S website or download BYJU'S app for further reference.

Frequently Asked Questions

What are the three types of ecological pyramids?

The three types of ecological pyramids include:

- Pyramid of Number
- Pyramid of Biomass
- Pyramid of Energy

What do you understand by an ecological pyramid?

An ecological pyramid is a graphical representation showing the relationship between different organisms in an ecosystem. It shows the flow of energy at different trophic levels in an ecosystem.

What is the 10% law?

The 10% law was given by Raymond Lindeman. This law states that when energy is transferred from one trophic level to the other, only 10% energy from the organic matter is passed on.

Why is the pyramid of energy always upright?

Pyramid of energy is a type of ecological pyramid that is always upright. This is due to the fact that during the flow of energy from one trophic level to the other, some energy is always lost as heat in each step.

Why are there less number of organisms at the top of the ecological pyramid?

There are less number of organisms at the top of the pyramid because there is very little food left for secondary consumers compared to the primary consumers. Similarly, there are fewer consumers than producers.

Types of Ecological Pyramids

Pyramid of numbers

This shows the number of organisms in each trophic level without any consideration for their size. This type of pyramid can be convenient, as counting is often a simple task and can be done over the years to observe the changes in a particular ecosystem. However, some types of organisms are difficult to count, especially when it comes to some juvenile forms. Unit: number of organisms.

Pyramid of biomass

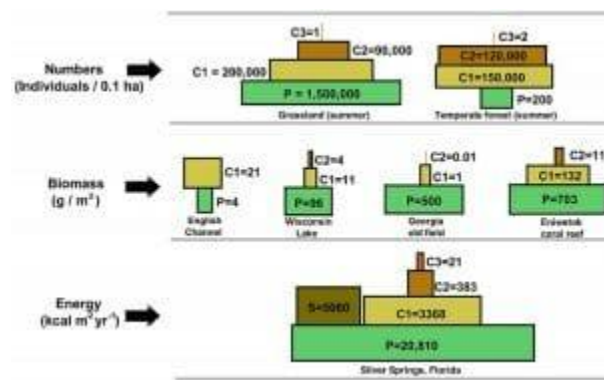
This indicates the total mass of organisms at each trophic level. Usually, this type of pyramid is largest at the bottom and gets smaller going up, but exceptions do exist. The biomass of one trophic level is calculated by multiplying the number of individuals in the trophic level by the average mass of one individual in a particular area. This type of ecological pyramid solves some problems of the pyramid of numbers, as it shows a more accurate representation of the amount of energy contained in each trophic level, but it has its own limitations. For example, the time of year when the data are gathered is very important, since different species have different breeding seasons. Also, since it's usually impossible to measure the mass of every single organism, only a sample is taken, possibly leading to inaccuracies. Unit: g m^{-2} or Kg m^{-2} .

Pyramid of productivity

The pyramid of productivity looks at the total amount of energy present at each trophic level, as well as the loss of energy between trophic levels. Since this type of representation takes into account the fact that the majority of the energy present at one trophic level will not be available for the next one, it is more accurate than the other two pyramids. This idea is based on Lindeman's Ten Percent Law, which states that only about 10% of the energy in a trophic level will go towards creating biomass. In other words, only about 10% of the energy will go into making tissue, such as stems, leaves, muscles, etc. in the next trophic level. The rest is used in respiration, hunting, and other activities, or is lost to the surroundings as heat. What's interesting, however, is that toxins are passed up the pyramid very efficiently, which means that as we go up the ecological pyramid, the amount of harmful chemicals is more and more concentrated in the organisms' bodies. This is what we call *biomagnification*.

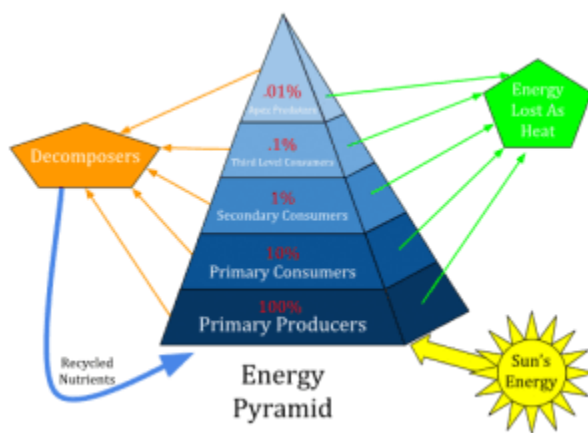
The pyramid of productivity is the most widely used type of ecological pyramid, and, unlike the two other types, can never be largest at the apex and smallest at the bottom. It's an important type of ecological pyramid because it examines the flow of energy in an ecosystem over time. Unit: $J\ m^{-2}\ yr^{-1}$, where Joule is the unit for energy, which can be interchanged by other units of energy such as Kilojoule, Kilocalorie, and calorie.

While a productivity pyramid always takes an upright pyramid shape, number pyramids are sometimes inverted, or don't take the shape of an actual pyramid at all. To demonstrate, let's take an oak tree, which can feed millions of oakworms. If we consider this ecosystem as our focus, then the producers' level (one tree) will end up much smaller than the primary consumers' level (millions of insects). This is less likely to occur in biomass pyramids, but is not impossible. The pyramids below show the different types of pyramids and the shapes they can have in different ecosystems.



Ecological Pyramid Examples

The diagram below is an example of a productivity pyramid, otherwise called an energy pyramid. The sun has been included in this diagram, as it's the main source of all energy, as well the *decomposers*, like *bacteria* and *fungi*, which can acquire nutrients and energy from all trophic levels by breaking down dead or decaying organisms. As shown, the nutrients then go back into the soil and are taken up by plants.



The loss of energy to the surroundings is also shown in this diagram, and the total energy transfer has been calculated. We start off with the total amount of energy that the primary producers contain, which

is indicated by 100%. As we go up one level, 90% of that energy is used in ways other than to create flesh. What the primary consumers end up with is just 10% of the starting energy, and, 10% of that 10% is lost in the transfer to the next level. That's 1%, and so on. The predators at the apex, then, will only receive 0.01% of the starting energy! This inefficiency in the system is the reason why productivity pyramids are always upright.

Function of Ecological Pyramid

An ecological pyramid not only shows us the feeding patterns of organisms in different ecosystems, but can also give us an insight into how inefficient energy transfer is, and show the influence that a change in numbers at one trophic level can have on the trophic levels above and below it. Also, when data are collected over the years, the effects of the changes that take place in the environment on the organisms can be studied by comparing the data. If an ecosystem's conditions are found to be worsening over the years because of pollution or overhunting by humans, action can be taken to prevent further damage and possibly reverse some of the present damage.

Related Biology Terms

- **Trophic level** – The position that an organism occupies within a food chain or an ecological pyramid, such as a producer, or a primary consumer. Many animals feed at several different trophic levels.
- **Species** – A group of organisms that exhibit common characteristics and can breed among themselves to produce fertile offspring.
- **Ecosystem** – A community of interdependent living organisms in association with the nonliving elements surrounding them. The way the living organisms and the physical environment interact is by exchange of nutrients and energy.
- **Food web** – A system of food chains that are interlocked with one another. Unlike in food chains, an organism in a food web can occupy several different trophic levels.

References :

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