Trophic structure and ecosystem stability:………………………………….Week 6

Ecosystems with simple trophic structures are usually less resistant to drastic ecological change than are ecosystems with complex trophic structures . For example , in polar regions, if the production of lichens in the arctic ecosystems was dropped , the entire system would fall down , since all life depends upon lichens . Similarly , in the antarctic seas , if Krill (zooplankton) were eliminated by an ecological accident , there would be a catastrophic decline of all marine organisms which depend upon Krill for food .

On the other hand , in temperate and tropical regions were alternate food supplies are available , the temporary loss of any one species does not necessarily cause danger to the entire ecosystem . **Thus , instability of ecosystems increases as a direct function of trophic simplicity ,**

Ecological pyramids:

Analyzing trophic structures in terms of ecological pyramids is an important aspect of ecology , **since ecological pyramids offer an important way to evaluation of data and management . "Ecological pyramids" are diagrams of data representing the standing crops at each trophic level . They may be expressed in terms of numbers of organisms , total biomass , or total energy flow at each trophic level .** Figure 11 , shows all three types of pyramids for a hypothetical food chain ; grass ⟶ cat ⟶ man based on 10 acres per year .

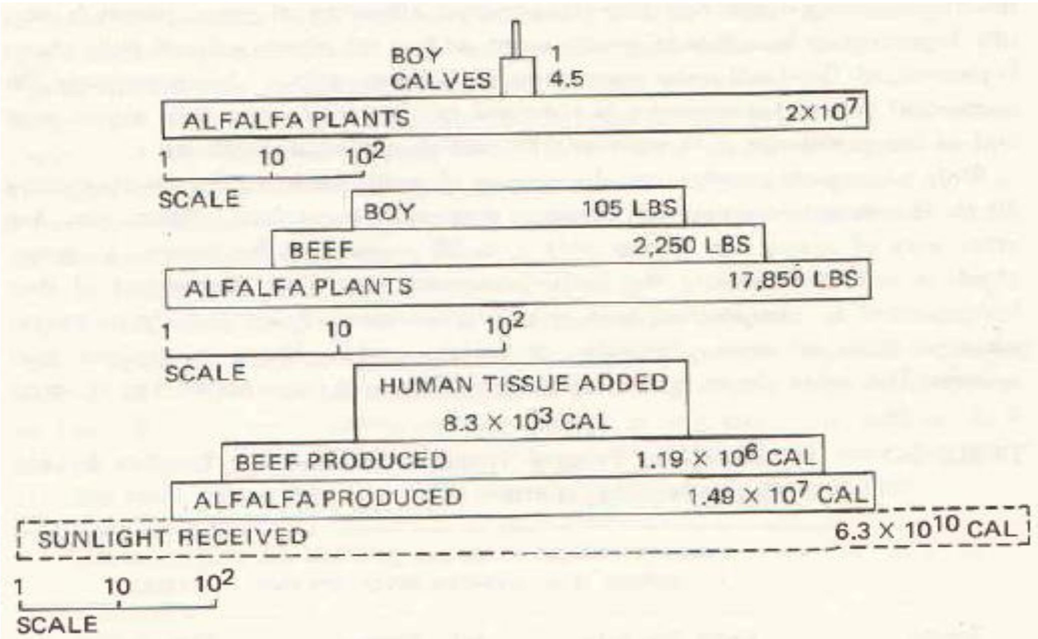


Fig .11 : The three types of ecological pyramids for a hypothetical food chain based on 10 acres per year

Ecological efficiencies:

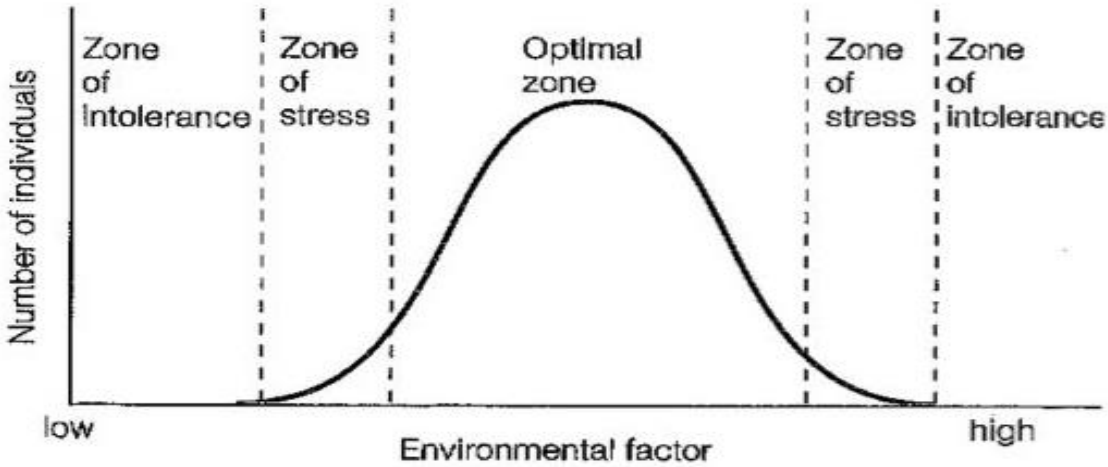
<u>Ecological efficiency of terrestrial green plants is usually 1% or less</u> , that is green plants utilize for synthesis only about 1% of the total energy striking their surface . However , **<u>ecological efficiency for aquatic plants is only 0.18% (about 0.2%)</u>** , because higher percentage of light is reflected or scattered . With subsequent energy transformations through each trophic level , usually 80 -95% is again lost through dispersion , heat loss , motion …etc . , **<u>Hence , ecological efficiencies of consumers from herbivores to large carnivores fall within the range 5 – 20%</u>** , meaning that each trophic level incorporates only this much of the energy it consumes into its own organic structure .

1-5: Limiting factors and tolerance levels:

A central problem of ecology is to understand the abundance and distribution of organisms . There are a countless questions concerning the abundance and distribution of plants and animals , which represent some of the core questions of ecology .

Shelford's and Liebig's laws:

The American ecologist Victor Shelford recognized the statement (1911) , which we call it today as **<u>Shelford's law of tolerance</u>** . This states that **<u>" the abundance or distribution of an organism can be controlled by factors exceeding the maximum or minimum levels of tolerance for that organism " .</u>** Thus , an organism might be limited by numerous physical , chemical and biological factors which exist at levels above or below that which organism requires or tolerates (See the fig below).



Shelford's law of tolerance

Before Shelford(1828) , the German botanist and physiologist , Justin Liebig , expressed a similar but more limited concept that we now call as **<u>Liebig's law of minimum</u>** . He noted that **<u>" the essential materials available in amounts most closely approaching the critical minimum would tend to be limiting " .</u>** Since , Liebig was a botanist, he thought primarily in some of plant physical and chemical requirements .

The principles elaborated from Liebig and Shelford are valuable in analyzing factors which limit abundance and distribution of an organism . **The practical search for limiting factors becomes one of the most important aspects of applied ecology .It may take two major directions . One in which the management objective is to increase the abundance or distribution of a desirable organism , and a second one in which the objective is to find some limiting factors which can reduce the abundance or distribution of a pest .**

Indicator organisms:

The term " Indicator organisms " refers to plants , animals or microbes which are indicators of ecological conditions . That is , by their presence or absence or specific appearance they give an indication to various ecological conditions . For example ,
the plants belong to the genus *Astragalus* grow in association with selenium a soil mineral commonly found in or near uranium depositions . Thus , these plants are practical indicators to the possible presence of uranium depositions . Similarly , in public health practice , the presence of coliform bacteria , especially *Escherichia coli* , a common commensal inhabitant of the intestinal tract of man and animals , is taken as an indicator of fecal pollution .