Ecology

(Scientific study of the structural and functional aspects of an ecosystem)

Components of an ecosystem:

A) Abiotic
B) Biotic

A) Abiotic: water, wind, solar radiation, gaseous components of the atmosphere, organic compounds, other contaminants
B) Biotic: aquatic organism, Terrestrial organisms

Garden

A) Abiotic: Soil, Solar radiation, gaseous components of the atmosphere, organic compounds, other contaminants

B) Biotic: Terrestrial organisms including Plants, trees, birds, insects, other animals; Microbes

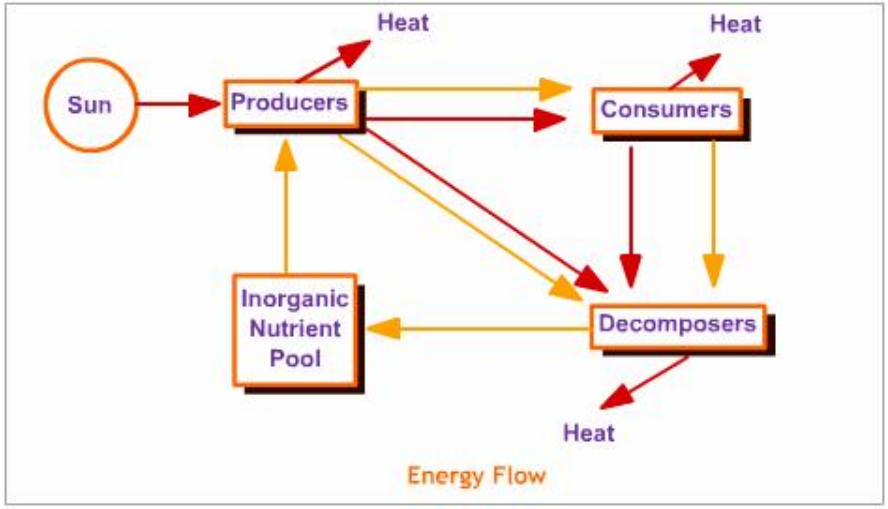
Properties of Ecosystem:

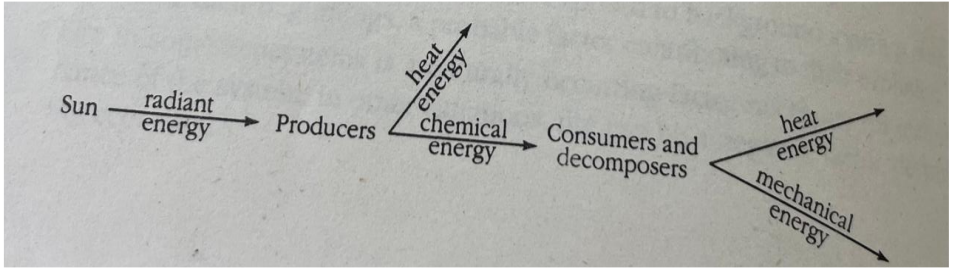
1. Ecosystems exist independently of specific components.
2. Its components are interdependent.
3. An ecosystem has a function
4. It is active, dynamic and thriving.
5. A sliding scale of organization exits.

Concurrent occurrence of

1) **Energy Flow**
2) **Mineral recycling**

- **Producers**
- **Consumers**
- **Decomposers**


Heat
Heat
Sun
Producers
Consumers
Inorganic Nutrient Pool
Decomposers
Heat
Energy Flow


Sun
radiant energy
Producers
heat energy
chemical energy
Consumers and decomposers
heat energy
mechanical energy

Measuring primary production

Harvest Methods: Dry weight of harvest.

Limitation: Roots are excluded, energy used for plant respiration cannot be calculated

Collection: Plant material is collected, typically by clipping it at ground level.

Dry the sample: The harvested plant material is dried in an oven until all moisture has evaporated and the weight is constant. This provides a reliable measurement of the dry biomass, free from fluctuations in water content.

Weigh the dry biomass: The dried sample is weighed to determine the biomass per unit area.

Calculate net primary production (NPP): The increase in biomass over a specific time period provides an estimate of net primary production (NPP), the organic matter remaining after plants have used some for respiration.

CO2 Assimilation: Limitation: Use of expensive instruments

O2 Production: Limitation: Use of expensive instruments

Radioisotope Method: High sensitivity allowing for the measurement of very low rates of production, especially in nutrient-poor (oligotrophic) waters where other methods are not effective.

Precision: Replicate incubations can yield good precision, and many samples can be processed at once.

Specific for carbon fixation: The method directly measures the rate of carbon fixation, which is the definition of primary production

Radioisotope method:

The method is based on the premise that photosynthetic organisms will take up the radioactive carbon-14.

The basic procedure, pioneered by E. Steemann Nielsen in 1952, involves:

- Sample collection: Water samples containing the autotrophs are collected from the desired depths.
- Tracer addition: A known quantity of radioactive carbon, in the form of sodium bicarbonate ($NaH^{14}CO_3$) is added to the water samples.
- Incubation: The samples are incubated for a set period (e.g., 6 to 24 hours) in clear (light) and opaque (dark) bottles. To simulate natural conditions, these bottles are often suspended at the same depths from which the water was collected.
- Assimilation: During incubation, the phytoplankton photosynthesize and incorporate both the stable carbon and the added radioactive carbon into their cells.

- Filtration and analysis: At the end of the incubation, the samples are filtered to capture the phytoplankton and other particulate organic matter. The filter is then dried, and its radioactivity is measured using a scintillation counter. The filters may also be acidified to purge any unincorporated inorganic matter.

- Calculation: The amount of carbon fixed is calculated based on the ratio of radioactive carbon taken up by the phytoplankton to the total radioactive carbon added.

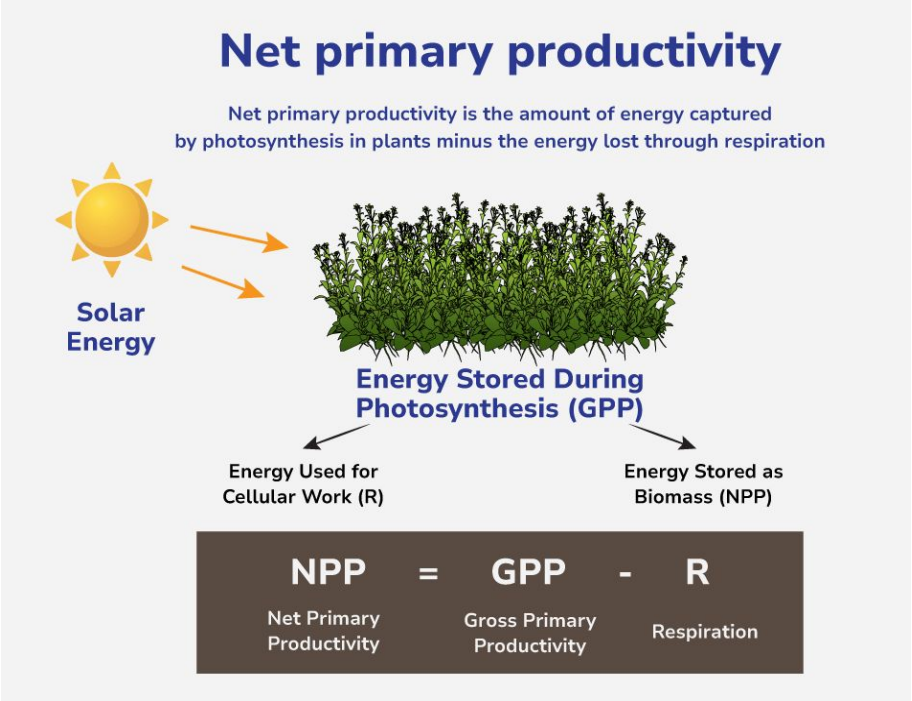
- Limitations: Apart from being expensive, it requires special handling procedures, safety precautions, and waste disposal protocols, which can complicate field operations

Gross Productivity: The carbon assimilation capacity of vegetation photosynthesis per unit area and time

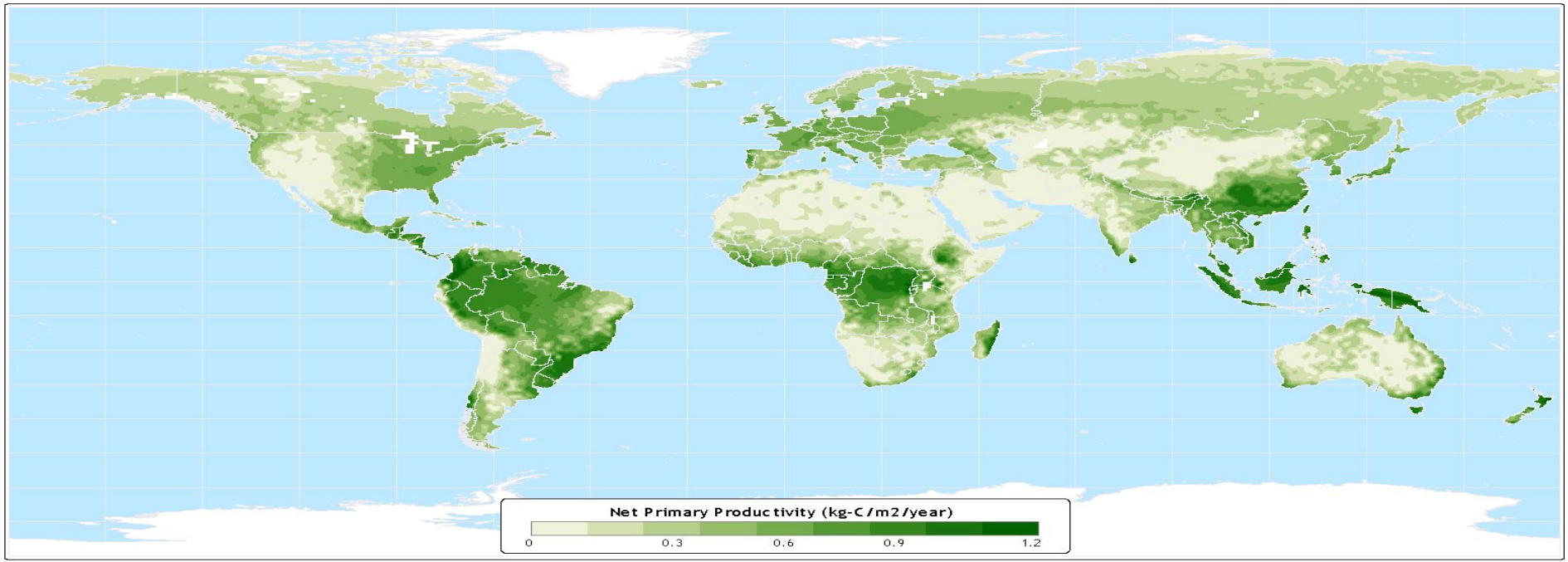
Net Productivity: Gross Productivity minus plant metabolism

Factors influencing Productivity:

1) Moisture
2) Soil
3) Nutrients
4) Temperature

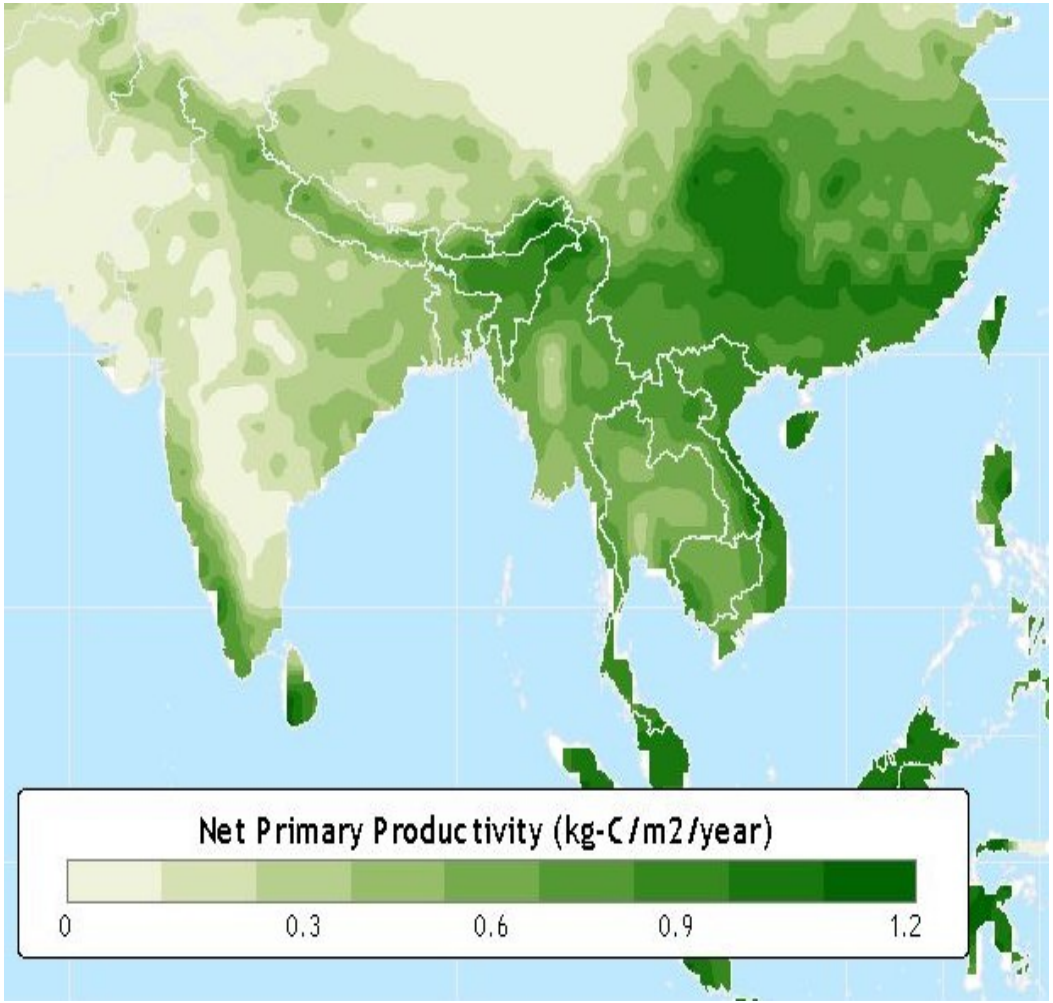


Net Primary Productivity



Data taken from: IBIS Simulation
(Kucharik, et al. 2000)
(Foley, et al. 1996)

Atlas of the Biosphere
Center for Sustainability and the Global Environment
University of Wisconsin - Madison



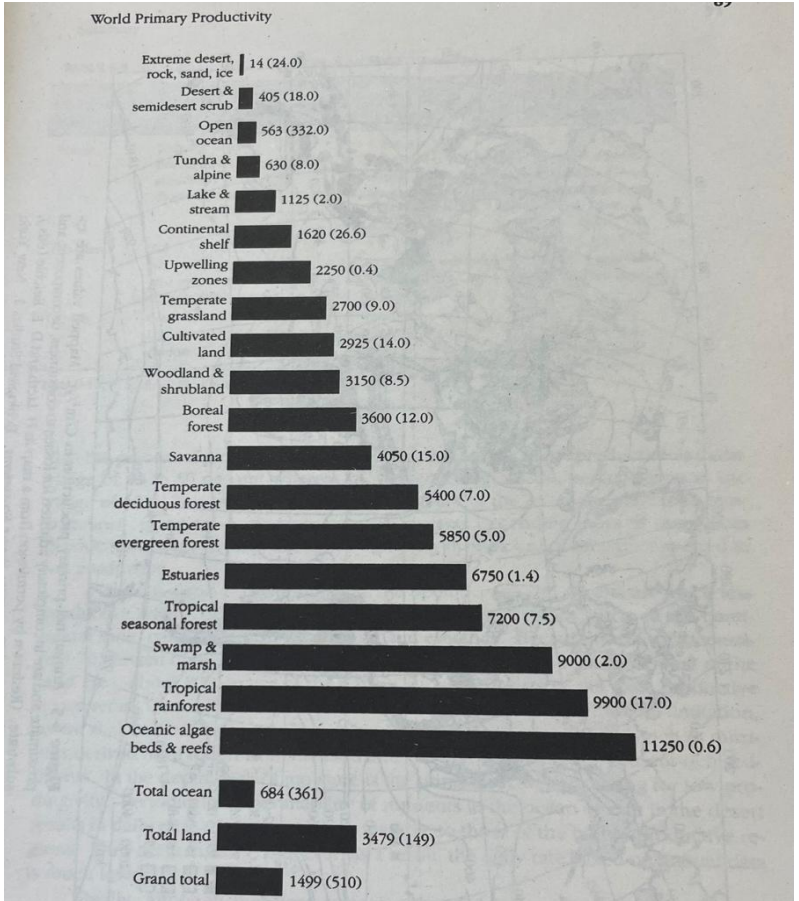


Figure 6-4 Annual average rate of net plant production. The number after the bar is C/m²/yr; the number within the parentheses is area in 10^6km². (Derived from data in R. J. Whittaker, 1975. *Communities and Ecosystems*, 2d ed. New York: Macmillan Co.