



CHAPTER 55: ECOSYSTEMS

1

ECOSYSTEMS

- CONSIST OF THE LIVING ORGANISMS IN A COMMUNITY AS WELL AS THE ABIOTIC FACTORS

- MICROECOSYSTEM

- TWO IMPORTANT CONSIDERATIONS:

- ENERGY FLOW
- CHEMICAL CYCLING



FIG. 55.1

2

PHYSICAL LAWS

- LAW OF CONSERVATION OF ENERGY - ENERGY CAN NOT BE CREATED OR DESTROYED, ONLY TRANSFORMED
- 2ND LAW OF THERMODYNAMICS - ENERGY TRANSFERS CAUSE ENERGY TO BE TRANSFERRED TO A LESS USEFUL FORM (USUALLY HEAT)
- LAW OF CONSERVATION OF MASS - MATTER CANNOT BE CREATED OR DESTROYED

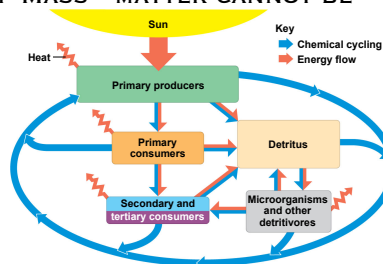


FIG. 55.4

3

TROPIC RELATIONSHIPS

- PRODUCERS - AUTOTROPHS
- PRIMARY CONSUMERS - EAT PRODUCERS
- SECONDARY CONSUMERS - EAT PRIMARY CONSUMERS
- TERTIARY CONSUMERS - EAT SECONDARY CONSUMERS
- DETRITIVORES - CONSUMERS THAT GET ENERGY FROM DETRITUS

4

IMPORTANCE OF DECOMPOSERS

- FOOD (BIRDS EAT EARTHWORMS)
- RECYCLING OF MATERIALS: MAKE VITAL CHEMICAL ELEMENTS AVAILABLE TO PRODUCERS
- TRANSFER CHEMICAL ELEMENTS IN INORGANIC FORMS TO ABIOTIC RESERVOIRS LIKE SOIL, WATER, AND AIR
- PRODUCERS TAKE THESE INORGANIC ELEMENTS AND RECYCLE THEM INTO ORGANIC COMPOUNDS

5

PHYSICAL AND CHEMICAL FACTORS

- PRIMARY PRODUCTION - AMOUNT OF LIGHT ENERGY CONVERTED TO CHEMICAL ENERGY BY AUTOTROPHS DURING A GIVEN TIME PERIOD
- GLOBAL ENERGY BUDGET
- ONLY A SMALL FRACTION OF THE SOLAR ENERGY THAT MAKES IT TO THE EARTH'S SURFACE COMES INTO CONTACT WITH PHOTOSYNTHESIZING ORGANISMS AND IS A USABLE WAVELENGTH (ABOUT 1%)

6

GROSS AND NET PRIMARY PRODUCTION

- **GROSS PRIMARY PRODUCTION (GPP)** - THE AMOUNT OF LIGHT ENERGY THAT IS CONVERTED TO CHEMICAL ENERGY BY PHOTOSYNTHESIS PER UNIT TIME
- **NET PRIMARY PRODUCTIVITY** - EQUALS GPP MINUS THE ENERGY USED BY THE PRIMARY PRODUCERS FOR RESPIRATION
 - $NPP = GPP - R$
 - CAN BE EXPRESSED IN TERMS OF ENERGY ($J/m^2/yr$) OR IN TERMS OF BIOMASS ($g/m^2/yr$)

7

LIMITATIONS TO PRODUCTIVITY IN AQUATIC ECOSYSTEMS

- **LIGHT**
 - PHOTIC VS. APHOTIC ZONE
- **NUTRIENTS**
 - LIMITING NUTRIENT - ELEMENT THAT MUST BE ADDED IN ORDER FOR PRODUCTION TO INCREASE (USUALLY NITROGEN OR PHOSPHORUS)

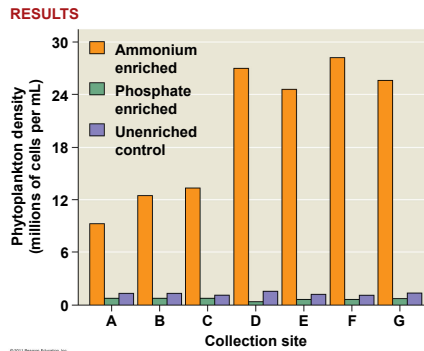


FIG. 55.8

8

EUTROPHICATION

- **PROCESS BY WHICH NUTRIENTS BECOME HIGHLY CONCENTRATED LEADING TO INCREASED GROWTH OF ORGANISMS (LIKE ALGAE)**
- **CULTURAL EUTROPHICATION** - ORIGIN FROM HUMAN SOURCES (USUALLY AGRICULTURAL RUNOFF AND SEWAGE)



FIG. 54.7

9

TEMPERATURE AND MOISTURE

■ MEASURED AS EVAPOTRANSPIRATION

■ ACTUAL EVAPOTRANSPIRATION - ANNUAL AMOUNT OF WATER TRANSPIRED BY PLANTS AND EVAPORATED FROM THE LANDSCAPE

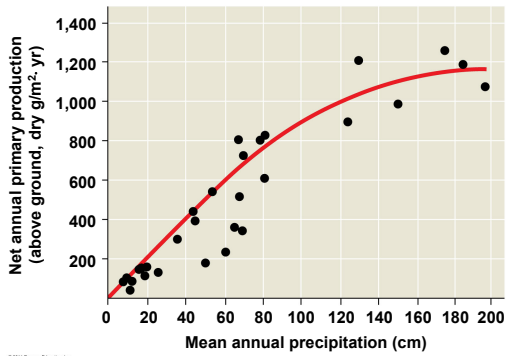


FIG. 55.9

10

TROPIC LEVELS AND ENERGY

■ SECONDARY PRODUCTION - AMOUNT OF CHEMICAL ENERGY IN CONSUMERS' FOOD THAT IS CONVERTED INTO THEIR OWN NEW BIOMASS DURING A GIVEN TIME PERIOD

■ PRODUCTION EFFICIENCY - THE FRACTION OF ENERGY STORED IN FOOD THAT IS NOT USED FOR RESPIRATION

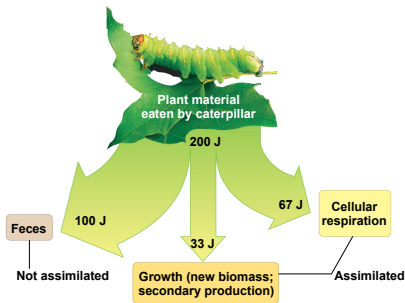


FIG. 55.10

11

TROPIC EFFICIENCY

■ PERCENTAGE OF PRODUCTION TRANSFERRED FROM ONE TROPHIC LEVEL TO THE NEXT

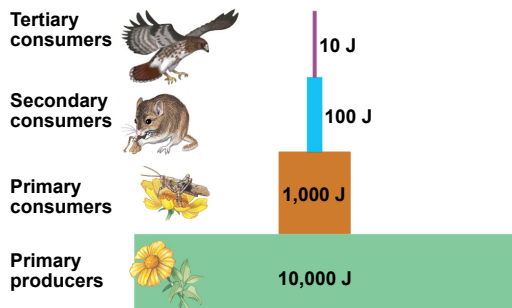


FIG. 55.11

12

GREEN WORLD HYPOTHESIS

- TERRESTRIAL HERBIVORES CONSUME RELATIVELY SMALL AMOUNTS OF PLANT BIOMASS BECAUSE THEY ARE KEPT IN CHECK BY VARIOUS FACTORS
- FACTORS:
 - PLANTS HAVE DEFENSES AGAINST HERBIVORES
 - NUTRIENTS
 - ABIOTIC FACTORS
 - INTRASPECIFIC COMPETITION
 - INTERSPECIFIC INTERACTIONS

13

BIOGEOCHEMICAL CYCLES

- NUTRIENT CIRCUITS THAT INVOLVE BOTH BIOTIC AND ABIOTIC COMPONENTS OF THE ECOSYSTEM
- GENERAL MODEL



FIG. 55.13

14

GENERAL SCHEME OF BIOGEOCHEMICAL CYCLES

- KEY ROLE OF DECOMPOSERS
- DECOMPOSITION INCREASES WITH INCREASES IN EVAPOTRANSPIRATION

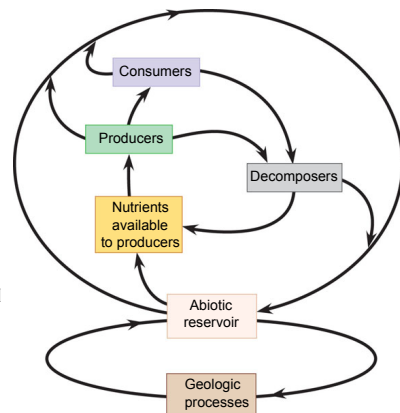


FIG. 54.18

15

AGRICULTURE AND NITROGEN CYCLING

- NUTRIENTS NOT RECYCLED IN AGRICULTURAL APPLICATIONS
- NUTRIENTS TAKEN AWAY AS CROP BIOMASS
- NATURAL STORE OF NUTRIENTS WILL EVENTUALLY BE EXHAUSTED

