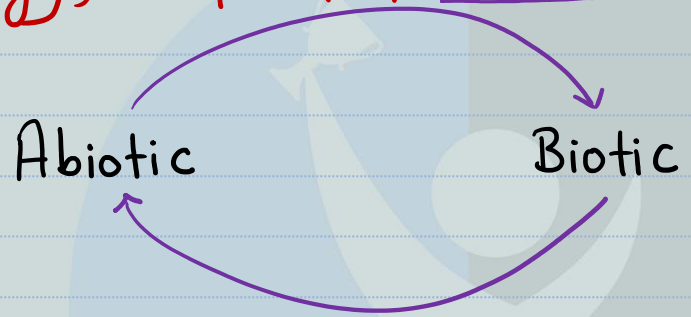
ECOSYSTEM

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ECOSYSTEM

Basic unit of Ecology, Composed of Abiotic and biotic components.



" Lake < Forest < Marine ecosystem "

TYPES OF ECOSYSTEM

I. Natural Ecosystem

a. Aquatic

- Marine
  - Ocean
  - esturies
  - Lagoon's.
- Fresh water
  - Lentic (standing water) (Lake)
  - Lotic (Running water)
    - Stream
    - River

b. Terrestrial

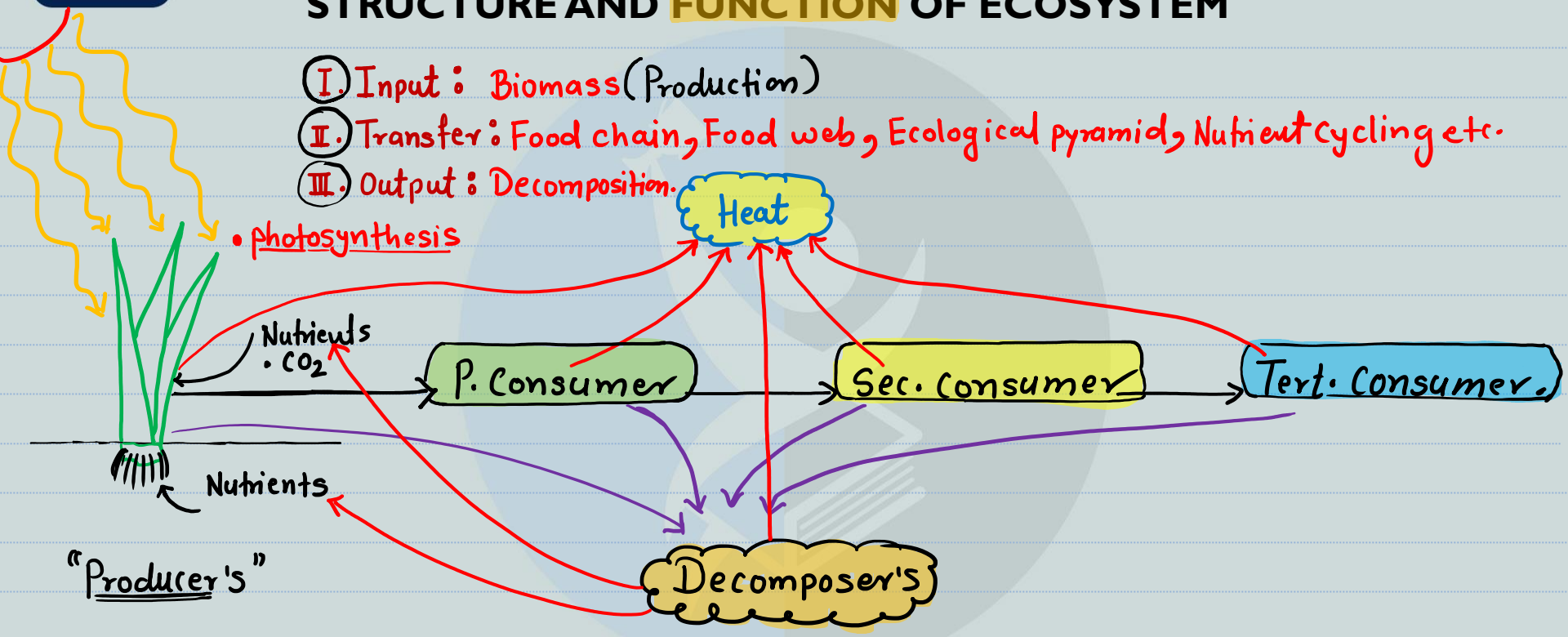
- Forest
- Grassland
- Desert
- etc.

II. Artificial Ecosystem.

- Agricultural land
- Botanical garden's
- Aquarium
- Garden

etc.

STRUCTURE AND FUNCTION OF ECOSYSTEM



I. Input: Production: Biomass produced by any troplic level.

a. Primary production

↳ Biomass produced by producers.
↳ by photosynthesis

↓

1. Gross primary production

GPP = NPP + R

"Total biomass produced by Producer"

b. Secondary production

↳ Biomass produced by Consumers.
↳ Consumption.

2. Net Primary production.

NPP = GPP − R (Respiration)

"Stored biomass"

VARIOUS METHODS TO CLACULATE PRIMARY PRODUCTION

I. Calorimetery Method. (Heat measure)

II. Harvesting method. (Fresh weight / dry weight)

III. (O_2 Uptake method.

IV. O_2 - production (light - Dark bottles)

V. Chlorophyll cont^{n}.

Dark Bottle

I_D O_2 cont^n. = 10ml/ltr

- Respiration

"24 Hrs"

"Incubation"

F_D = 6ml/ltr.

$R = I_D - F_D$

R = 4ml

Light Bottle.

I_L O_2 cont^n. = 10ml/ltr.

- Photosynthesis ✓✓
- Respiration.

F_L = 15ml/ltr.

$NPP = F_L - I_L$

$NPP = 15 - 10$

$= 5$

$$GPP = NPP + R$$

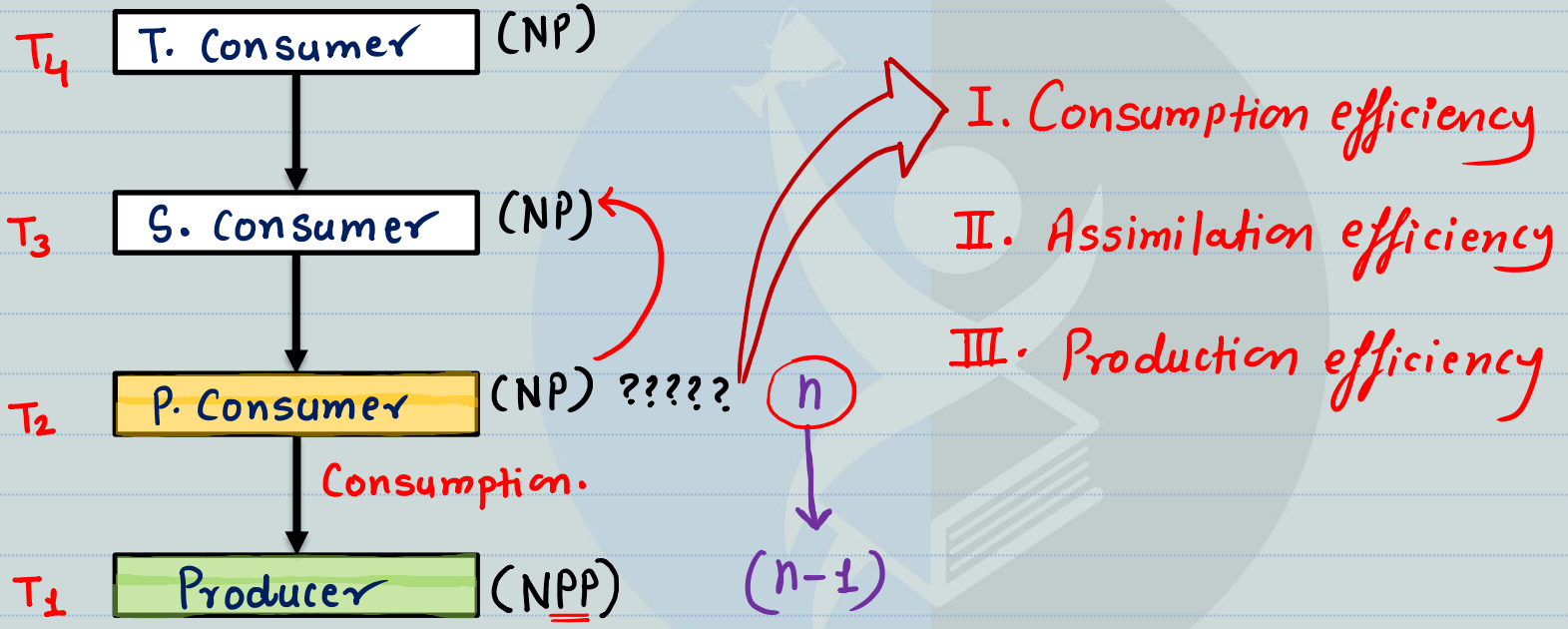
$$= F_L - \cancel{I_L} + \cancel{I_D} - F_D$$

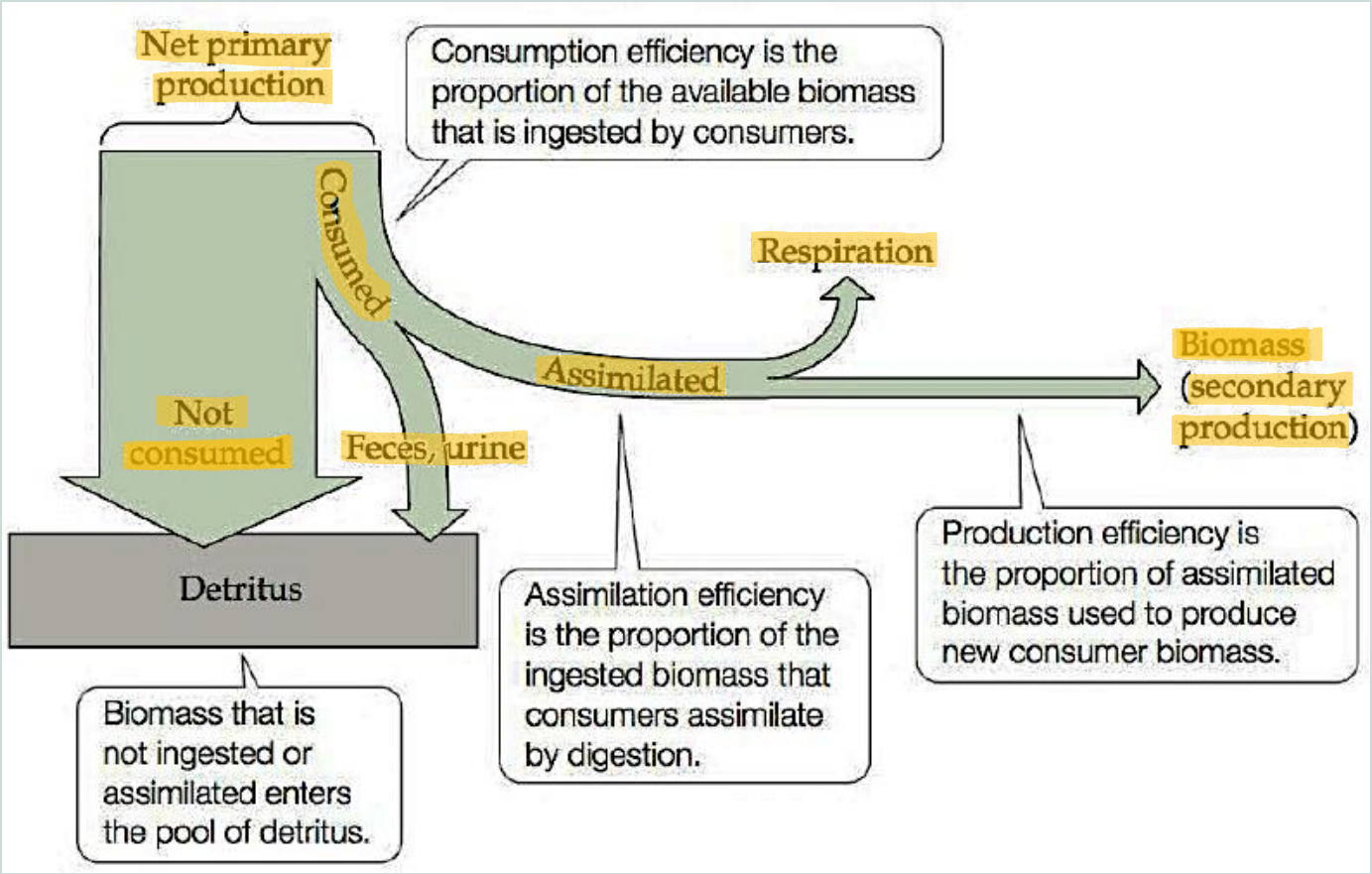
$$GPP = F_L - F_D$$

$$= 15 - 6$$

$$\boxed{GPP = 9\ ml}$$

SECONDARY PRODUCTION




Net primary production
Consumption efficiency is the proportion of the available biomass that is ingested by consumers.
Consumed
Respiration
Assimilated
Biomass (secondary production)
Not consumed
Feces, urine
Detritus
Assimilation efficiency is the proportion of the ingested biomass that consumers assimilate by digestion.
Production efficiency is the proportion of assimilated biomass used to produce new consumer biomass.
Biomass that is not ingested or assimilated enters the pool of detritus.

The proportion of the available biomass that is ingested is the consumption efficiency.

$$\text{Consumption efficiency} = \frac{I_n}{Prod_{n-1}} \times 100$$

- Consumption efficiencies in forests range from **1–2%.**
- In grasslands, consumption efficiencies range from **30–60%.**
- In aquatic ecosystems consumption efficiencies of **60–99%.**
- Consumption efficiencies for carnivores are typically higher than those of herbivores and vary from **5–100%.**

The proportion of the ingested food that is assimilated is the assimilation efficiency.

$$\text{Assimilation efficiency} = \frac{A_n}{I_n} \times 100$$

- Assimilation efficiency is determined by the quality of the food (its chemical composition) and the physiology of the consumer.
- Carnivore assimilation efficiencies are often about 80%
- Assimilation efficiencies for herbivores average only about 5–20%

Production efficiency

The proportion of the assimilated food that is used to produce new consumer biomass is **production efficiency.**

$$\text{Production efficiency} = \frac{Prod_n}{A_n} \times 100$$

- Invertebrates generally have fairly high production efficiencies that average about **10–50%.**
- Vertebrates tend to have lower production efficiencies than invertebrates.

The efficiency with which energy is transferred from one trophic level to the next.

$$\text{Trophic-level transfer efficiency} = \frac{Prod_n}{Prod_{n-1}} \times 100$$

$$\text{Lindeman's efficiency} = \frac{\text{'Assimilation at trophic level n'}}{\text{'Assimilation at trophic level n - 1'}} \times 100$$

" this concept is about energy transfer between trophic levels "

Lindemann's Law of 10% energy transfer states that approximately 10% of the energy available in one trophic level is transferred to the next trophic level in an ecological food chain.

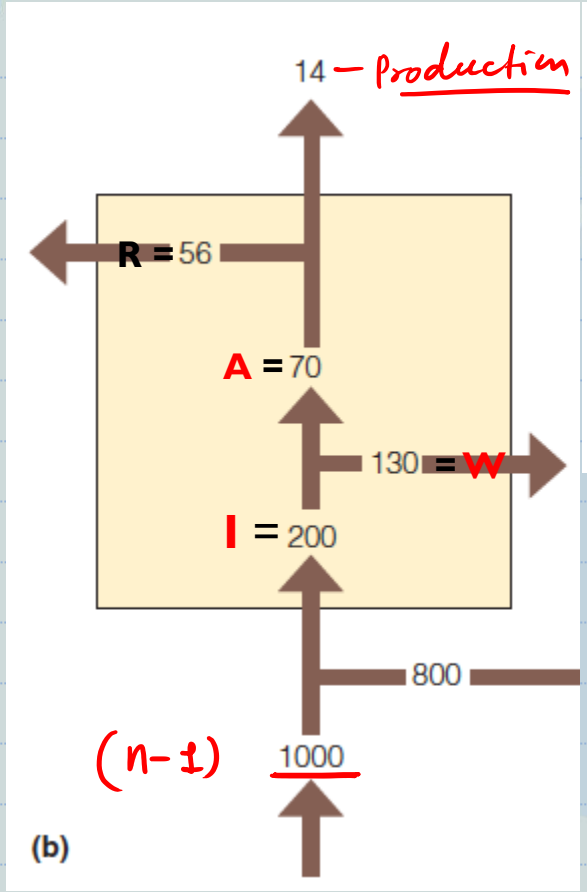
Chalo ab apna dimag lagao..

Energy	Terrestrial ecosystem	Lake ecosystem
Total available NPP (J)	1000	1000
Consumed energy (J)	250 = 25%	650 = 65%
Assimilated energy (J)	120 = 48%	450 = 69%
Net Production (J)	50 = 41%	190 =

$\frac{250}{1000} = 25\%$ $\frac{650}{1000} = 65\%$

$\frac{120}{250} = 48\%$ $\frac{450}{650} = 69\%$

$\frac{50}{120} = 41\%$ $\frac{190}{450} = 42\%$



Invertebrate herbivore efficiencies

$I/P_{n-1} = 20\%$

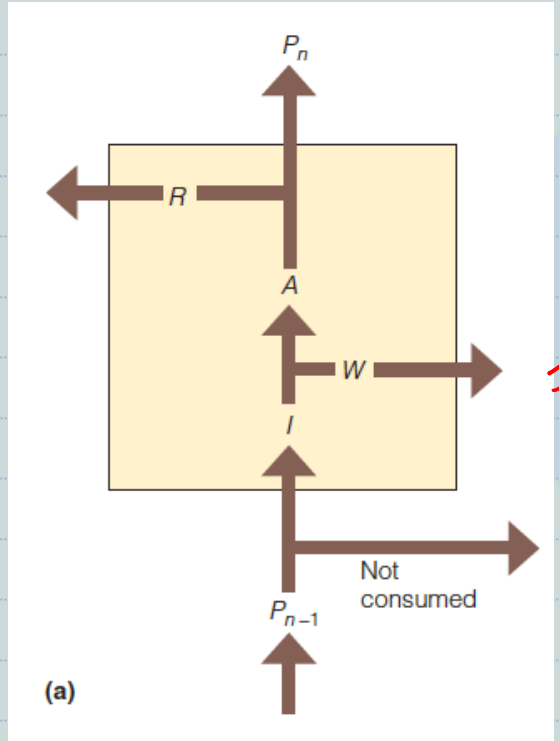
$A/I = 35\%$

$P_n/A = 20\%$

W = Waste

R = Respiration

The diagram below depicts energy flow within a single trophic level, where I-amount ingested, NA= amount not assimilated, R=respiration, and Pn= biomass production at trophic level.



Which one of the following options represents correct values for Pn, NA, R and I in kcal respectively, if Pn-1 = 1000 kcal, I/ Pn-1 = 20%, A/I = 35% and Pn/A= 20%?

(1) 56 14 130 200

(2) 14 130 56 200

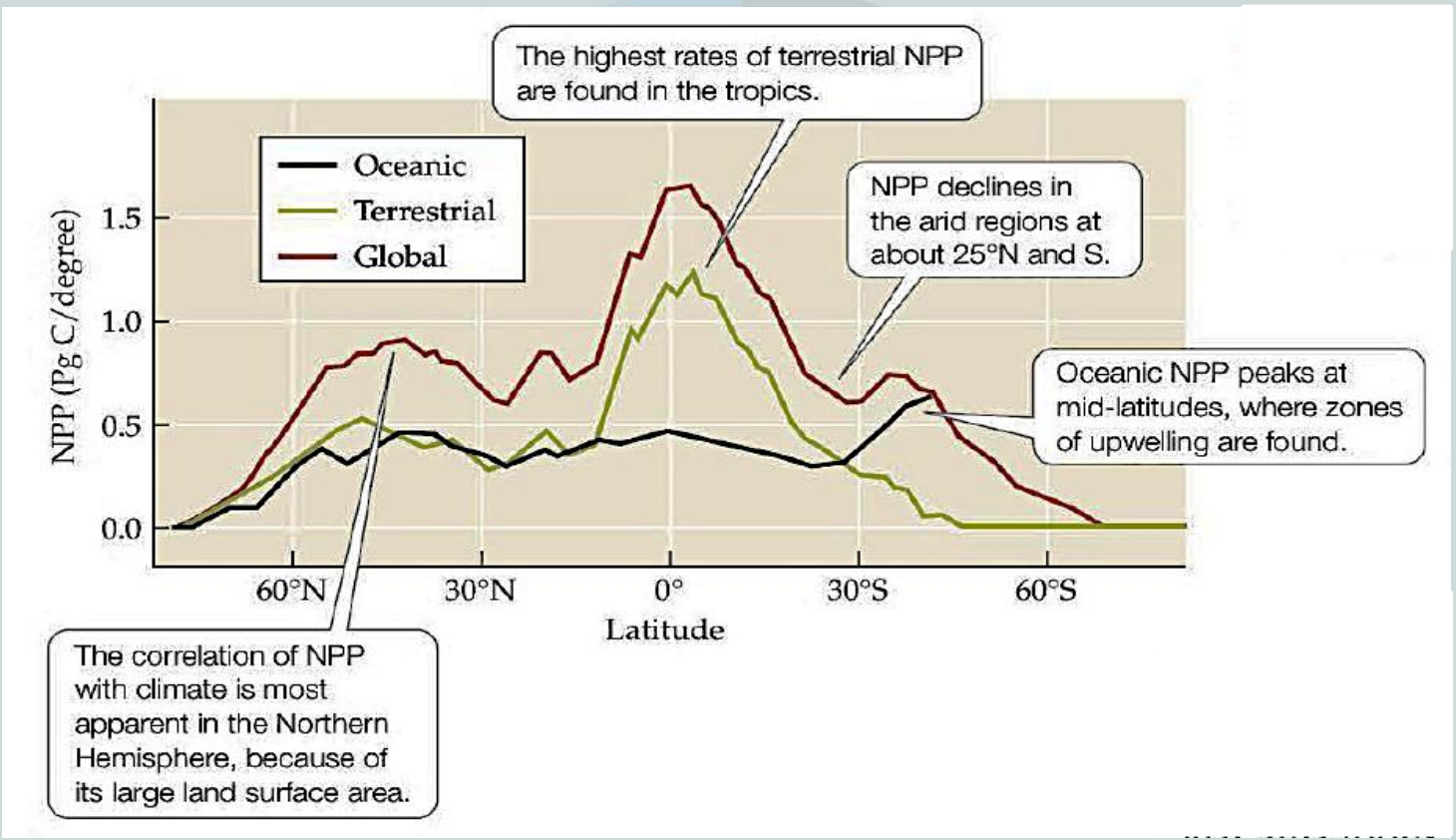
(3) 200 130 56 14

(4) 56 130 200 14

TABLE 21.1 Production Efficiencies of Consumers

CONSUMER GROUP	PRODUCTION EFFICIENCY (%)
Endotherms	
Birds	1.3
Small mammals	1.5
Large mammals	3.1
Ectotherms	
Fishes and social insects	9.8
Nonsocial insects	40.7
Herbivores	38.8
Detritivores	47.0
Carnivores	55.6
Non-insect invertebrates	25.0
Herbivores	20.9
Detritivores	36.2
Carnivores	27.6

Worldwide NPP Production Pattern



1. NPP in **terrestrial ecosystems** is limited mainly by water, temperature, and nutrient availability

2. NPP in **aquatic ecosystems** is limited mainly by light and nutrient availability

Table 20.1 Net Primary Productivity and Plant Biomass of World Ecosystems

Ecosystems (in order of productivity)	Area ($10^6 km^2$)	Mean Net Primary Productivity per Unit Area ($g/m^2/yr$)	World Net Primary Productivity (10^9 Mt/yr)	Mean Biomass per Unit Area (kg/m^2)	Relative Net Primary Productivity (Mean Net Primary Productivity/ Mean Biomass per Unit Area (g/g/yr)
Continental					
Tropical rain forest	17.0	2000.0	34.00	44.00	0.045
Tropical seasonal forest	7.5	1500.0	11.30	36.00	0.042
Temperate evergreen forest	5.0	1300.0	6.40	36.00	0.036
Temperate deciduous forest	7.0	1200.0	8.40	30.00	0.040
Boreal forest	12.0	800.0	9.50	20.00	0.040
Savanna	15.0	700.0	10.40	4.00	0.175
Cultivated land	14.0	644.0	9.10	1.10	0.585
Woodland and shrubland	8.0	600.0	4.90	6.80	0.088
Temperate grassland	9.0	500.0	4.40	1.60	0.313
Tundra and alpine meadow	8.0	144.0	1.10	0.67	0.215
Desert shrub	18.0	71.0	1.30	0.67	0.106
Rock, ice, sand	24.0	3.3	0.09	0.02	–
Swamp and marsh	2.0	2500.0	4.90	15.00	0.167
Lake and stream	2.5	500.0	1.30	0.02	25.0
Total continental	149.0	720.0	107.09	12.30	
Marine					
Algal beds and reefs	0.6	2000.0	1.10	2.00	1.0
Estuaries	1.4	1800.0	2.40	1.00	1.8
Upwelling zones	0.4	500.0	0.22	0.02	25.0
Continental shelf	26.6	360.0	9.60	0.01	36.0
Open ocean	332.0	127.0	42.00	0.003	42.3
Total marine	361.0	153.0	55.32	0.01	15.3
World total	**510.0**	**320.0**	**162.41**	**3.62**	

Imp.

TABLE 20.1 Variation in NPP among Terrestrial Biomes

BIOME	NPP (G C/M²/YR)	TOTAL NPP (PG C/YR)	PERCENTAGE OF TERRESTRIAL NPP
Tropical forest	2,500	21.9	35
Tropical savanna	1,080	14.9	24
Temperate forest	1,550	8.1	13
Temperate grassland	750	5.6	9
Boreal forest	390	2.6	4
Temperate shrubland	500	1.4	2
Tundra	180	0.5	1
Desert	250	3.5	5
Crops	610	4.1	6

Table 28: The ranking of ecosystems based on NPP: B ratios (kilograms of dry matter produced per year per kilogram of standing crop)

Rank	Ecosystem	P/B rato
1	Oceans	42
2	Continental shelf	36
3	Upwelling zones	25
4	Pond and lakes	8.2
5	Estuary	1.8
6	Algal beds and reefs	1.0
7	Cultivated land	0.59
8	Temperate grassland	0.31
9	Tundra and alpine	0.21
10	Tropical grassland	0.18
11	Desert shurb	0.10
12	Tropical rain forest	0.045
13	Tropical seasonal forest	0.042
14	Temperate decidous forest	0.040
15	Boreal forest	0.040
16	Temperate evergreen forest	0.036

HAPPY LEARNING

THANKS

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