Worksheet 2.3: Biomes

In this worksheet, you will summarize information from the textbook that covers the following parts of the syllabus (subtopic 2.4):

* Biomes are collections of ecosystems sharing similar climatic conditions that can be grouped into five major classes: aquatic, forest, grassland, desert, and tundra. Each of these classes has characteristic limiting factors, productivity and biodiversity.
* Explain the distributions, structure, biodiversity and relative productivity of contrasting biomes.

Students should be encouraged to study at least four contrasting pairs of biomes of interest to them, such as temperate forests and tropical seasonal forests; or tundras and deserts; or tropical coral reefs and hydrothermal vents; or temperate bogs and tropical mangrove forests.

**Insolation:** levels of light intensity from the Sun

**Precipitation:** levels of rainfall

Activity

* The ESS course requires you to be able to explain biome distribution in terms of the following factors only:

– temperature

– precipitation

– insolation.

* Complete the tables on pages 3 and 4 using information from pages 102–12 of the textbook, or that you have found on the internet. Information on productivity can also be found on pages 90–91.
* In each case, indicate in the table whether or not each of these potential limiting factors plays a role. Quote figures where possible (e.g. average rainfall in rainforest is about 2500 mm per year).
* Look at the following exercise 4. Work through this question using the information provided. When referring to the productivity of biomes, the figures in the left-hand column are normally used (these figures relate to absolute levels of productivity and therefore correspond directly to levels of removal and fixation of carbon dioxide from the atmosphere). When comparing NPP to total biomass of producers in each ecosystem (figures in the right-hand column), the picture becomes more complex – why is this?

***Exercise***

*NPP, mean biomass, and NPP per kg biomass vary in different biomes, depending on levels of insolation, rainfall, and temperature. Mean NPP for tropical rainforest is greater than tundra because rainforest is hot and wet, so there is more opportunity to develop large biomass than in tundra.*

*However, NPP per kg biomass is far lower in rainforest than tundra because rainforest has a high rate of both photosynthesis and respiration, so NPP compared to total biomass is low. Tundra are cold and dry and have low rates of photosynthesis and respiration; plants are slow growing with a gradual accumulation of biomass but relatively large growth in biomass per year.*

*The table below shows values for these parameters for different biomes.*

|  |  |  |  |
| --- | --- | --- | --- |
| **Biome** | **Mean net primary productivity**  **(NPP) / kg m−2 yr−1** | **Mean biomass /**  **kg m−2** | **NPP per kg biomass per year** |
| Desert | 0.003 | 0.002 |  |
| Tundra | 0.14 | 0.60 | 0.233 |
| Temperate grassland | 0.60 | 1.60 | 0.375 |
| Savannah (tropical) grassland | 0.90 | 4.00 | 0.225 |
| Temperate forest | 1.20 | 32.50 | 0.037 |
| Tropical rainforest | 2.20 | 45.00 | 0.049 |

1. *Calculate the NPP per kg of biomass per year for the desert biome.*

Mean NPP / mean biomass = NPP per kg

0.003 / 0.002 = 1.5 NPP per kg

1. *How does this figure compare those for other biomes? Explain the figure you have calculated in terms of NPP, and NPP per kg biomass.*

It is much greater than the other biomes as the NPP in the desert biome is greater in relation to the others biomes. More NPP means more energy, which means more consumers in the biome.

1. *Compare the figures for NPP in temperate and tropical grassland. Explain the difference.*

Temperate grassland’s mean net primary productivity and mean biomass is less than than tropical grassland. The NPP per kg is more in the temperate however.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Biome | Tropical rainforest | Temperate deciduous woodland | Tundra | Hot desert | Temperate grassland |
| NPP? | High | Medium (2nd highest) | Low (only high for 1-2 months because sun is up for almost whole day) | Very low | Low |
| Insolation limiting? | High all the time | High in summer, low in Winter, moderate in fall and spring | Days are shorter | All water is evaporated or absorbed by the ground | Balanced like precipitation and evaporation rates |
| Insolation? | High | Varies (depending on 4 seasons) | Low | High | Balanced |
| Temperature limiting? | Rarely higher than 34°C or drops below 20°C | High in summer, low in winter, moderate in fall and spring | -12 to -6 ºC | Depends on time | Summer 37ºC, winter -40ºC |
| Temperature | High (26°C) | Varies (depending on 4 seasons) | Low | Hot days, cold nights | Hot summers, cold winters |
| Precipitation limiting? | Average of 125 to 660 cm of rain falls yearly | 500 to 1500 mm yr¹ | 50 mm yr¹ | Under 250 mm yr¹ | Enough to prevent deserts from forming, not enough to support forests |
| Precipitation | High (2500 mm yr¹) throughout the year | Highest | Lowest | Low | Enough |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Biome | Coral reef | Deep sea vents | Mangrove forest | Temperate bogs |
| NPP? | High | Low | Medium | High |
| Insolation limiting? | Strong sunlight all year round | Sunlight does not penetrate to depths of sea where vents are found | Mangrove trees blocking sunlight | Mainly shrubs, few trees from deposit of dead plant material |
| Insolation? | High | Low | Low | Low |
| Temperature limiting? | Near the equator so warm all year round | 45 - 122 ºC | Higher than 20ºC | Mostly in boreal ecosystems in the Northern Hemisphere |
| Temperature | Warm | High (around plates) | Warm (around 24 ºC) | Cool, temperate climes |
| Precipitation limiting? | Low rainfall during winter, high during summer | All over the world, around tectonic plates | Common: Tsunamis, heavy rain, droughts | Precipitation accumulates in many bogs forming bog pools |
| Precipitation | Low and high | Varies (does not affect biome) | 1000 – 1500 mm per yr | High |