

NEXT IAS

**PHYSICAL & WORLD
GEOGRAPHY**

**CIVIL SERVICES
EXAMINATION 2025**

Published by





MADE EASY Publications Pvt. Ltd.

Corporate Office: 44-A/4, Kalu Sarai
(Near Hauz Khas Metro Station), New Delhi-110016

Contact: 011-45124660, 8860378007

E-mail: infomep@madeeasy.in

Visit us at: www.madeeasypublications.org



Physical & World Geography

© Copyright, by MADE EASY Publications Pvt. Ltd.

All rights are reserved. No part of this publication may be reproduced, stored in or introduced into a retrieval system, or transmitted in any form or by any means (electronic, mechanical, photo-copying, recording or otherwise), without the prior written permission of the above mentioned publisher of this book.

First Edition: 2017

Second Edition: 2018

Third Edition: 2019

Revised & Updated: 2020

Fourth Edition: 2021

Fifth Edition: 2022

Sixth Edition: 2023

Seventh Edition: 2023

Contents

Physical & World Geography

UNIT – I: GEOGRAPHY : AS A DISCIPLINE

Chapter – 1

Basics of Geography.....	2
Fundamentals of Geography	2
Introduction.....	2
Geography in Relation to Other Disciplines	2
Branches of Geography.....	2
The Latitudes and Longitudes	3
Latitudes	3
Longitudes.....	5
Time Zones	5
Leap Second	7

UNIT – II: GEOMORPHOLOGY

Chapter – 2

Origin and Evolution of Universe.....	9
Introduction.....	9
Earlier Theories	9
Modern Theories.....	10
Our Solar System	11
Structure of the Solar System.....	12
Rotation and Revolution	16
Rotation.....	16
Revolution	16

Chapter – 3

Our Earth	19
Introduction.....	19
Evolution of Earth.....	19
Evolution of Lithosphere.....	19
Evolution of Atmosphere	19
Evolution of Hydrosphere.....	19
Interior of Earth	21
Sources of Information	21
Layered Structure of Earth	21
Major Discontinuities of Earth's Interior	22

Chapter – 4

Distribution of Oceans and Continents.....	24
Introduction.....	24
Theory of Continental Drift	24
Sea Floor Spreading	25

Thermal Convection Current Theory	26
Mechanism of the Thermal Convection Current Theory	26
Criticism of the Theory	26
Plate Tectonics Theory.....	26
Plate Boundary Interaction.....	27
Geological Movement.....	29
Endogenetic Forces	29
Earth's Magnetic Field	30
Formation of Earth's Magnetic Field.....	30
Impact of Geomagnetic Field.....	31
Geo-Magnetic and Geographic Direction.....	31

Chapter – 5

Geophysical Phenomenon	33
Earthquake	33
Earthquake Waves	33
Shadow Zone.....	34
Measurement of Earthquake	34
Causes of Earthquake	35
Distribution of Earthquake Across the Globe	36
Seismic Zones of India.....	37
Impacts of Earthquake.....	38
Volcanism	38
Types of Volcanoes	38
Distribution of Volcanoes in World	39
Volcanic Landforms	40
Hazardous Impacts of Volcanoes	42
Economic Benefits of Volcanoes.....	42
Tsunami.....	42
Causes of Tsunami Waves	42
Generation and Propagation of Tsunami waves.....	43
Characteristics of Tsunami Waves	43

Chapter – 6

Rocks and Minerals.....	44
Introduction.....	44
Minerals	44
Classification of Rocks.....	44
Igneous Rocks	45
Characteristics of Igneous Rocks	45
Classification of Igneous Rocks	45

Sedimentary Rocks.....	47
Characteristics of Sedimentary Rocks.....	47
Classification of Sedimentary Rocks.....	48
Metamorphic Rocks.....	48
Agents of Metamorphism.....	48
Classification of Metamorphic Rocks.....	49
Rock Cycle.....	49

Chapter – 7

Geomorphic Processes.....	51
Introduction.....	51
Weathering.....	51
Physical Weathering Processes.....	51
Chemical Weathering Processes.....	52
Biological Weathering.....	53
Mass Movements.....	54
Slow Movements.....	54
Rapid Movements.....	54
Landslide.....	54
Erosion.....	55
Types of Erosion.....	56

Chapter – 8

Landforms.....	57
Introduction.....	57
Fluvial Landforms.....	57
Fluvial Process.....	57
Factors Influencing Fluvial Process.....	58
Upper Course.....	58
Middle Course.....	59
Lower Course.....	60
Landforms Formed by Underground Water.....	62
Erosional Landforms.....	62
Depositional Landforms.....	62
Glaciers.....	63
Erosional Landforms.....	63
Depositional Landforms.....	63
Coastal Landforms.....	64
Erosional Landforms.....	65
Depositional Landforms.....	65
Coasts of Submergence.....	66
Coasts of Emergence.....	67
Wind.....	67
Erosional Landforms.....	67
Depositional Features.....	68

Chapter – 9

Islands, Lakes and Coral Reefs.....	70
Islands.....	70
Types of Islands.....	70

Lakes.....	71
Types of Lakes.....	72
Important Lakes of the World.....	73
Coral Reefs.....	73
Types of Coral Reefs.....	74
Origin of Coral Reef.....	74
Geographical Distribution of Coral Reef.....	74
Coral Bleaching.....	75
Conservation of Coral Reef.....	75

UNIT – III: OCEANOGRAPHY

Chapter – 10

Oceans.....	78
Introduction.....	78
Relief of the Ocean Floor.....	79
Continental Margin.....	79
Minor Relief Features.....	81
Techniques and Technologies of Sea Floor Mapping.....	81
Classification.....	83

Chapter – 11

Distribution of Temperature and Salinity in Oceans.....	85
Introduction.....	85
Temperature.....	85
Factors Affecting the Distribution of Temperature.....	85
Horizontal and Vertical Distribution of Temperature.....	86
Salinity of Ocean Water.....	86
Factors Affecting Salinity of Ocean Water.....	87
Horizontal Distribution of Salinity Across The Globe.....	87
Vertical Distribution of Salinity.....	88
Halocline.....	89
Thermocline.....	89
Pycnocline.....	89

Chapter – 12

Movement of Ocean Water.....	90
Introduction.....	90
Ocean Currents.....	90
Factors Affecting the Ocean Currents.....	90
Types of Ocean Currents.....	91
Currents of the Pacific Ocean.....	91
Currents of the Atlantic Ocean.....	92
Currents of the Indian Ocean.....	92
Surface Currents Around the Globe.....	93
Major Ocean Gyres.....	93
Deep Ocean Currents Around the Globe.....	93
Great Ocean Conveyor Belt.....	93

Effects of Ocean Currents.....	94
Weather and Climate	94
Marine Life	94
Navigation.....	95
Marine Resources.....	95
Tides.....	95
Causes of Formation of Tides	96
Types of Tides.....	97
Characteristics of Tides	98
Inter-Tidal Zone.....	98
Flow Tide and Ebb Tide.....	98
Tidal Bore	99
Economic Significance of Tides.....	99

UNIT – IV: CLIMATOLOGY

Chapter – 13

Weather and Climate.....	104
Introduction.....	104
Composition of Atmosphere.....	104
Gases	104
Water Vapor	104
Dust Particles.....	104
Composition of Atmosphere.....	104
Homosphere	104
Heterosphere	105
Structure of Atmosphere on the Basis of Temperature.....	105
Elements of Weather and Climate.....	106
Temperature.....	106
Humidity.....	106
Clouds	107
Precipitation.....	107
Rainfall.....	107
Atmospheric Pressure.....	107
Wind.....	107
A Comparative Analysis of Weather and Climate..	108

Chapter – 14

Solar Radiation, Heat Balance and Temperature.....	110
Introduction.....	110
Incoming Shortwave Solar Radiation	110
Mechanism of Solar Radiation	110
Distribution of Solar Radiation.....	110
Zonal Distribution of Solar Radiation.....	110
Mechanism of Heating and Cooling of Atmosphere	111
Radiation.....	111
Conduction	111
Convection.....	111

Advection.....	111
Heat Budget of Earth	111
Latitudinal Heat Balance.....	112
Temperature.....	112
Factors Affecting Distribution of Temperature.....	112
Temperature Inversion	113
Ideal Conditions for Temperature Inversion	113
Types of Temperature Inversion	114
Upper Air Inversion.....	114
Frontal or Cyclonic Inversion	114
Valley Inversion.....	115
Climate Change.....	115
Causes of Climate Change	115
Impact of Climate Change	115
Control Strategy.....	116

Chapter – 15

Atmospheric Circulation and Weather System.....	118
Introduction.....	118
Distribution of Air Pressure	118
Vertical Distribution of Air Pressure.....	118
Horizontal Distribution of Air Pressure	118
Pressure Belts of Earth	119
Equatorial Low Pressure Belt	119
Sub-Tropical High Pressure Belt	119
Sub-Polar Low Pressure Belts.....	119
Polar High Pressure Belts	120
Seasonal Shifting of Wind Belts and their Climatic Significance	120
Factors Affecting Wind Motion.....	120
Pressure Gradient Force	120
Coriolis Force.....	120
Centripetal Acceleration	120
Frictional Force	120
Classification of Winds.....	121
Primary or Planetary Winds.....	121
Secondary Winds or Seasonal Winds or Periodic Winds.....	121
Monsoons	121
Winter Monsoons	121
Valley Breeze and Mountain Breeze	122
Katabatic and Anabatic Winds	122
Land and Sea Breezes	123
Tertiary or Local Winds	123
Loo.....	123
Foehn.....	123
Chinook.....	123
Mistral	123
Harmattan	123

Sirocco.....	123
Berg Winds	124
Bora	124
Air Mass.....	124
Properties of an Air Mass.....	125
Source Regions of an Air Mass.....	125
Essential Conditions Required for an Ideal Source Region	125
Major source regions of Air Masses.....	125
Classification of Air Masses	125
Geographical Classification of Air Masses	125
Thermodynamic Classification of Air Masses	126
Impact of Air Mass on Local Weather and Climate of A Region	126
Fronts.....	126
Formation of Fronts	127
Different Types of Fronts	127
Cyclones.....	128
Temperate Cyclones	128
Cyclogenesis	128
Tropical Cyclones	129
Naming of a Cyclone	132

Chapter – 16

Water in the Atmosphere.....	135
Introduction.....	135
Significance of Atmospheric Moisture	135
Distribution of Water Vapour	135
Evaporation.....	135
Factors Affecting Rate of Evaporation:	135
Condensation.....	136
Various Forms of Condensation	136
Cloud	136
Classification of Clouds	136
Classification of Clouds on The Basis of Appearance.....	136
Classification of Clouds on the Basis of Height.....	137
Precipitation.....	137
Mechanism Producing Precipitation	138
Forms of Precipitation	138
Types of Rainfall.....	138
Convictional Rainfall	138
Frontal Rainfall	139
Orographic Rainfall.....	139
Global Distribution of Precipitation	139
Factors Affecting the Distribution of Precipitation .	139
Distribution of Precipitation According to Amount of Precipitation Across the Globe	140
Seasonal Variation of Precipitation	140

Chapter – 17

World Climate	142
Introduction.....	142
Classification of World Climate	142
Various Types of Climate.....	142
Hot Wet Equatorial Climate	142
Tropical Monsoon and Tropical Marine Climate ...	144
Savannah or Sudan Climate.....	146
Hot Desert and Mid-latitude Desert Climate	147
Warm Temperate Western Margin (Mediterranean) Climate	149
Temperate Continental Climate	150
Warm Temperate Eastern Margin Climate (China Type)	152
Cool Temperate Western Margin Climate (British Type).....	154
Cool Temperate Continental Climate (Siberian) ...	155
Cool Temperate Eastern Margin.....	157
Arctic or Polar Climate	158

UNIT – V: ENVIRONMENTAL GEOGRAPHY

Chapter – 18

Basics of Ecology.....	161
Introduction.....	161
Biosphere	161
Elements of Biosphere.....	161
Lithosphere	161
Hydrosphere	161
Distribution of Water.....	162
Atmosphere	162
Ecosystem	162
Components of Ecosystem	162
Types of Ecosystems	164
Ecosystem Services.....	164
Ecozones	164
Biomes.....	164
Tundra.....	165
Taiga	166
Tropical and Temperate Rainforest	166
Tropical and Temperate Grassland.....	167
Mediterranean Climate.....	168
Desert Biome	168

UNIT – VI: WORLD GEOGRAPHY

Chapter – 19

Asia.....	171
Introduction.....	171
Physiography of Asia	172
Mountain Systems.....	173
Plateaus.....	173

Plains	173	Drainage of North America	214
Steppe	174	Lakes of North America	214
Deserts	174	Rivers of North America	215
Drainage of Asia	174	Climate of North America	216
Rivers of South East Asia	174	Canada	216
Rivers of South Asia	174	United States of America	216
Rivers of West Asia	175	Mexico	218
Rivers of East Asia	175	Agriculture of North America	218
Important Water Bodies of Asia	176	Agriculture in Tropical Zone	218
Climate of Asia	176	Agriculture in Sub-Tropical Zones	218
Agriculture of Asia	177	Agricultural Regions of Cool Temperate Zone	219
Principal Crops	177	Mineral Resources of North America	220
Mineral Resources of Asia	178	Natural Resources of North America	220
Energy Resources	178	Metallic Ores	220
Metallic Minerals	179	Iron Ore	220
Major Industries of Asia	180	Major Industrial Regions of Northern America	221
Major Industrial Countries of Asia	180	Southern New England	221
Product-wise Classification of Industries in Asia	182	Mid-Atlantic States	222
Iron and Steel Industry	182	Pittsburgh-Lake Erie Region	222
Aluminium Industries	182	Detroit Industrial Region	222
Textile Industry: Cotton and Silk Textile	182	Lake Michigan Region	222
Automobile Industry	183	Southern Appalachian Region	222
Pharmaceuticals Industry	184	Eastern Texas	222
		Pacific Coastal Region	223

Chapter – 20

Africa	196
Introduction	196
Physiography of Africa	197
Major Physical Regions of Africa	197
The Eastern and Western Rift Valley	200
Drainage of Africa	201
Climate of Africa	202
Agriculture of Africa	203
Principal Crops	203
Natural Resources of Africa	203
Energy Resources	204
Metallic Minerals	204
Non-Metallic Resources	205
Major Industrial regions of Africa	207

Chapter – 21

North America	211
Introduction	211
Physiography of North America	211
The Mountainous West	211
The Great Plains	212
Canadian Shield	213
Eastern Region	213
The Caribbean Region	213

Chapter – 22

South America	229
Introduction	229
Physiography of South America	230
Mountains & Plateaus of South America	231
Drainage of South America	231
The Amazon River	231
Orinoco River	231
Paraná River	232
Important Water Bodies Around South America	232
Climate of South America	233
Seasons in South America	233
Agriculture in South America	234
Major Crops of South America	235
Mineral Resources of South America	236
Energy Resources	236
Metallic Minerals	236
Non-ferrous Base Metals	237

Chapter – 23

Europe	242
Introduction	242
Key Facts about Europe	243



V

Unit

Environmental Geography

18. Basics of Ecology	161
-----------------------------	-----

CHAPTER 18

BASICS OF ECOLOGY

Introduction

Earth is the only planet in the Solar System that supports life. This is because of the three physical systems on it that is, soil, water and air which provide material essential for life. All the living beings differ from each other but they are all interdependent and interact with each other as also with, their environment directly or indirectly.

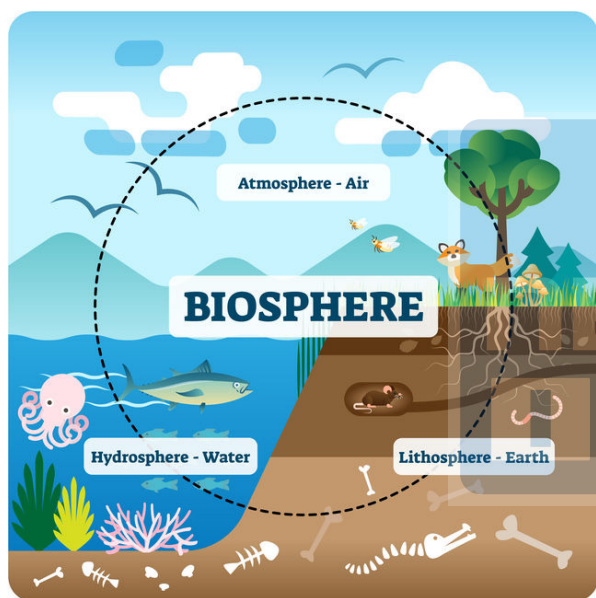


Fig. 18.1: Biosphere

Concept of Environment, Ecology and Ecosystem

- **Environment:** The term environment denotes all the physical, chemical and biotic conditions surrounding and influencing a living organism.
- **Ecology** is the scientific study of the relationship and interactions between organisms and their environment. The term ecology is derived from a Greek word *Oekologie* where “*oikos*” meaning “household” and “*logos*” means “*the study of*”.
- **Ecosystem** is a self sustaining unit of nature. It is defined as a functionally independent unit (of nature) where living organisms interact among themselves as well as with their physical environment. In nature two major categories of ecosystems exist: *Terrestrial* and *Aquatic*. Forests, deserts and grasslands are examples of terrestrial ecosystem.

- Ponds, lakes, wet lands and salt water are some example of aquatic ecosystem. Crop lands and aquarium are the example of man made ecosystems.
- **Biosphere:** A thin layer on and around the Earth which sustains life is called biosphere. Life exists in the diverse forms of living organisms. All these living organisms of the biosphere are directly or indirectly dependent on one another as well as on the physical components of the Earth. The three physical components of the Earth are *atmosphere*, *lithosphere* and *hydrosphere* (air, land and water).
- **Ecosphere:** It is used to denote biosphere (living components) along with its three abiotic components – atmosphere, hydrosphere and lithosphere of the Earth as one entity (unit).
- $\text{Ecosphere} = \text{Biosphere} + (\text{Lithosphere} + \text{Hydrosphere} + \text{Atmosphere})$

Biosphere

The biosphere is made up of the parts of Earth where life exists i.e. all ecosystems. The biosphere extends from the deepest root systems of trees, to the dark environments of ocean trenches, to lush rain forests, high mountaintops, and transition zones like this one, where ocean and terrestrial ecosystems meet. Overall, it is combination of lithosphere, hydrosphere and atmosphere.

Elements of Biosphere

Lithosphere

Lithosphere literally means rocksphere which represent the solid portion of the Earth's crust and upper mantle. It includes SIAL (Silica + Aluminium), SIMA (Silica + Magnesium) and upper mantle. Its thickness is about 100 km and average density of 3.5. It composed of silicate minerals.

Hydrosphere

The area of Earth's surface covered by water is called Hydrosphere. It comprises water in all its forms: ice (glaciers), water (rivers, lakes) and water vapour (atmosphere). A hydrosphere is the total amount of water

on a planet. The hydrosphere includes water that is on the surface of the planet, underground, and in the air. A planet's hydrosphere can be liquid, vapor, or ice. On Earth, liquid water exists on the surface in the form of oceans, lakes and rivers.

Distribution of Water

Water on the Earth's Surface	
Reservoir	Percentage of the total
1. Ocean	97.25
2. Ice caps and glaciers	2.05
3. Groundwater	0.68
4. Lakes	0.01
5. Soil moisture	0.005
6. Atmosphere	0.001
7. Streams and rivers	0.0001
8. Biosphere	0.00004

Oceans

Oceans are the major part of Hydrosphere. They are all interconnected. The ocean waters are always moving. The five major oceans are the Pacific Ocean, the Atlantic Ocean, the Indian Ocean, the Southern Ocean and the Arctic Ocean, in order of their size.

Cryosphere

- There are places on Earth that are so cold that water is frozen solid. These areas of snow or ice, which are subject to temperatures below 32°F for at least part of the year, compose the cryosphere. The term "cryosphere" comes from the Greek word, "krios," which means cold.
- Ice and snow on land are one part of the cryosphere. This includes the largest parts of the cryosphere, the continental ice sheets found in Greenland and Antarctica, as well as ice caps, glaciers, and areas of snow and permafrost. When continental ice flows out from land and to the sea surface, we get shelf ice.
- The other part of the cryosphere is ice that is found in water. This includes frozen parts of the ocean, such as waters surrounding Antarctica and the Arctic. It also includes frozen rivers and lakes, which mainly occur in polar areas.
- The components of the cryosphere play an important role in the Earth's climate. Snow and ice reflect heat from the Sun, helping to regulate our planet's temperature. Because polar regions are some of the most sensitive to climate shifts, the cryosphere may be one of the first places where scientists are able to identify global changes in climate.

Atmosphere

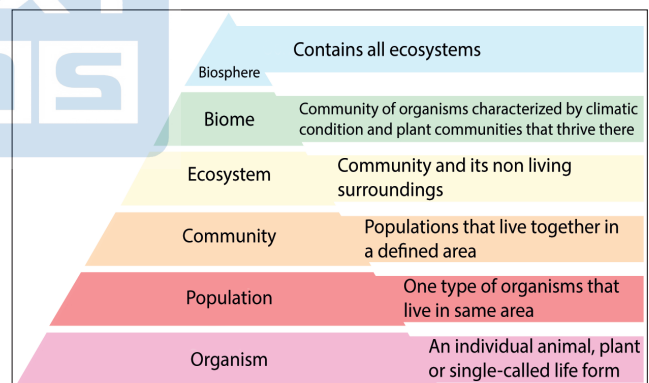
A layer of gas called the atmosphere surrounds the Earth. It provides us with the air we breathe and protects us from the harmful effects of Sun's rays. The atmosphere extends up to a height of about 1,600 kilometers. The atmosphere is divided into five layers based on composition, temperature and other properties. These layers starting from Earth's surface are called the troposphere, the stratosphere, the mesosphere, the thermosphere and the exosphere.

Composition of Atmosphere

Nitrogen is about 78 per cent, oxygen is about 21 per cent and other gases like carbon dioxide, argon and others comprise 1 per cent by volume. Oxygen is the breath of life while nitrogen helps in the growth of living organisms. Carbon dioxide absorbs heat radiated by the Earth, thereby keeping the planet warm. It is also essential for the growth of plants.

Importance of Biosphere

Human beings depend on biosphere to fulfill his needs such as food, housing, clothing, tourism etc. We are an integral part of the environment. Changes in the environment affect us and our activities change the environment around us. Here is a look at how biosphere is associated with ecosystems and communities:



Ecosystem

The term 'ecosystem' was coined by **A.G. Tansley** in 1935. An ecosystem is a functional unit of nature encompassing complex interaction between its biotic (living) and abiotic (non-living) components. For example, a pond is a good example of ecosystem.

Components of Ecosystem

Components that make up structural aspects of ecosystem include the non-living entities (abiotic components) and living organisms (biotic components). These components are linked together through nutrient cycles and energy flows.

Abiotic Components

The abiotic component can be grouped into following three categories:

- (i) **Physical Factors:** Sun light, temperature, rainfall, humidity and pressure. They sustain and limit the growth of organisms in an ecosystem.
- (ii) **Inorganic Substances:** Carbon dioxide, nitrogen, oxygen, phosphorus, sulphur, water, rock, soil and other minerals.
- (iii) **Organic Compounds:** Carbohydrates, proteins, lipids and humic substances. They are the building blocks of living systems and therefore, make a link between the biotic and abiotic components.

Biotic Components

It consists of the living parts of the environment, including the association of a lot of interrelated populations that belong to different species inhabiting a common environment. It includes producers, consumers and decomposers.

- (i) **Producers:** The green plants manufacture food for the entire ecosystem through the process of photosynthesis. Green plants are called *autotrophs*, as they absorb water and nutrients from the soil, carbon dioxide from the air, and capture solar energy for synthesizing their energy.
- (ii) **Consumers:** They are called *heterotrophs* and they consume food synthesized by the autotrophs. Based on food preferences they can be grouped into three broad categories. *Herbivores* (e.g. cow, deer and rabbit etc.) feed directly on plants, *carnivores* are

animals which eat other animals (eg. lion, cat, dog etc.) and *omnivores* organisms feeding upon both plants and animals e.g. human, pigs and sparrow.

Consumers are also referred to as *phagotrophs*. However, macro-consumers are normally herbivores and carnivores.

- **Herbivores/First Order/Primary Consumers:** They feed directly on green plants. For example, Terrestrial ecosystem consumers are cattle, deer, grass hopper, rabbit, etc. Aquatic ecosystem consumers are protozoans, crustaceans, etc.
- **Second Order Consumers/Primary Carnivores:** Include those animals that feed on herbivorous animals. For example, fox, frog, smaller fishes, predatory birds, snakes, etc.
- **Third Order Consumers/Secondary Carnivores:** The animals that feed on primary carnivores. For example, wolf, owl, peacock, etc. Some larger carnivores prey on Secondary carnivores.
- **Quaternary Consumers/Tertiary Carnivores:** Those animals which feed upon secondary carnivores. They are apex predators. For example, lion, tiger, etc.
- (iii) **Decomposers:** Also called *Saprotrophs*. These are mostly bacteria and fungi that feed on dead decomposed and the dead organic matter of plants and animals by secreting enzymes outside their body on the decaying matter. They play a very important role in recycling of nutrients. They are also called *detrivores* or *detritus feeders*.

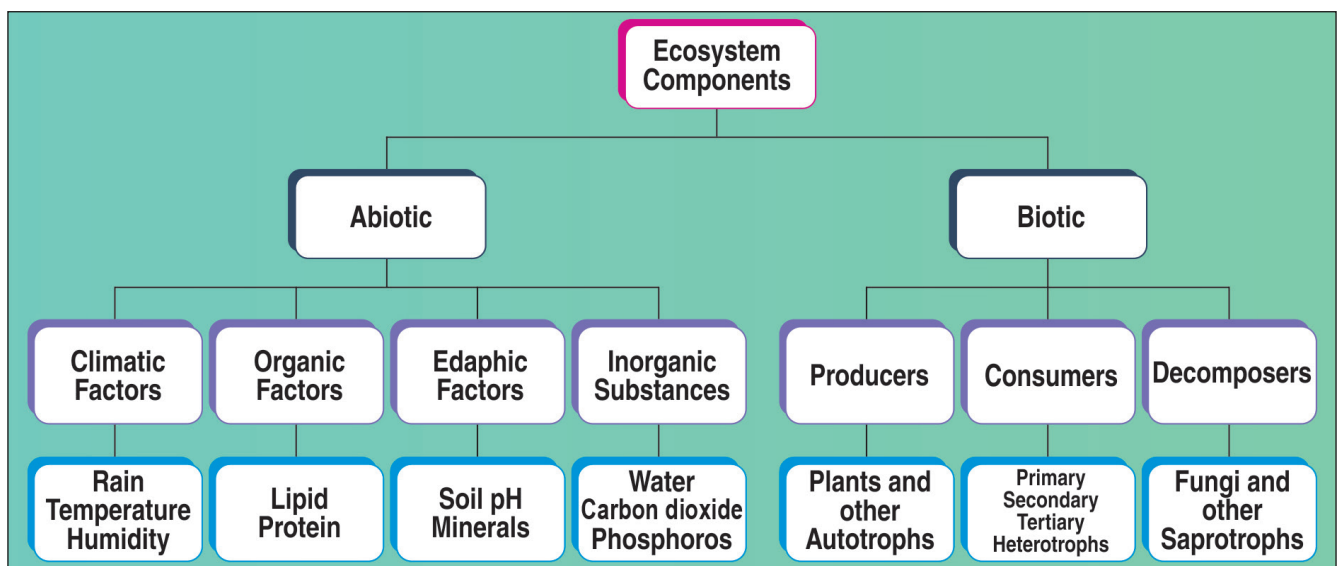


Fig. 18.2: Components of Ecosystem

Types of Ecosystems

Interaction of biotic and abiotic components results in a physical structure that is characteristic for each type of ecosystem. Plant and animal species are identified and enumerated to arrive at species composition.

Ecosystem Services

Ecosystem services are the processes and conceptions derived from ecosystem that sustain and enhance human well being. For example, healthy ecosystems provide:

- **The Stuff of Life** like food, fresh water, timber, and fiber for clothing.
- **Protection** from extreme weather, floods, fire, and disease.
- **Regulation** of the Earth's climate
- **Filtration** of wastes and pollutants.
- **Regeneration** of clean air, water, and soil.
- **Inspiration**, recreation and spiritual sustenance, and support for a way of life.

Ecosystem services were highlighted in the Conference on Biodiversity. It includes:

- **Provisioning Services:** Includes the supply of goods to direct benefit to human population which often have clear monetary value as wood, medicinal plants etc.

- **Regulating Services:** Includes range of vital services or functions that is carried on by the ecosystem which are rarely given the monetary value in the conventional market e.g. management of precipitation, removal of pollutants by filtering of air etc.
- **Cultural Services:** Includes the ecosystem contribution to the wider needs and aspirations of society. It includes spiritual value, aesthetics, and ecologically, scientifically significant sacred grooves.
- **Supporting Services:** Includes all the services which are essential to the functioning of the ecosystem. But lacks both in direct benefit to human population and thus direct monetary value e.g. the process of soil formation, process of plant growth etc.

Ecozones

Ecozones are also called *biogeographic regions* or *realms*. Each ecozone is a large area that contains a number of habitats, which are linked by the evolutionary history of the animals and plants within them. For instance Australasia is an ecozone, because its marsupials evolved in isolation to mammals in the rest of the world.

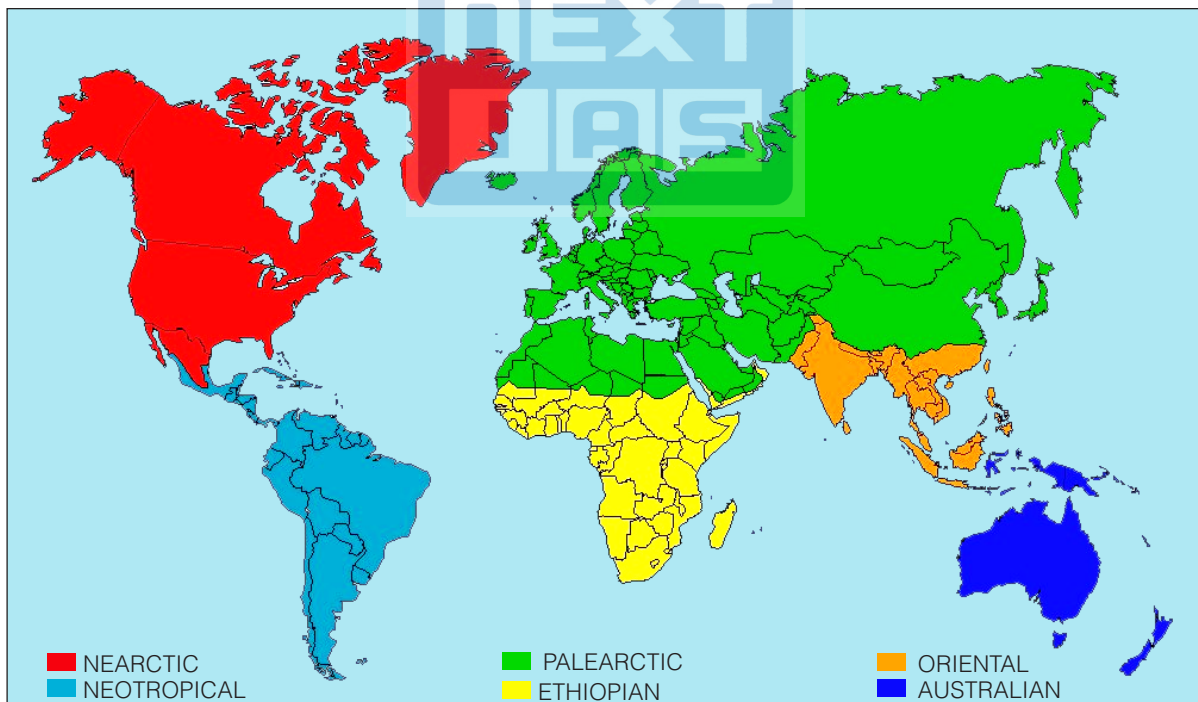


Fig. 18.3: Major Ecozones of The World

Biomes

A large community unit, characterized by a major vegetation type and associated fauna, found in a specific climatic region is a biome. Temperature, soil, and the

amount of light and water help determine what life exists in a biome. While an ecosystem is the interaction of living and non-living things in an environment. A biome is a specific geographic area notable for the species living there. A biome can be made up of many ecosystems. For

example, an aquatic biome can contain ecosystems such as coral reefs and kelp forests.

Ecotone can be described as the transition area between two biomes. Eg., the mangrove forests represent an ecotone between marine and terrestrial biomes. Other

examples are grassland, estuary etc. Species diversity is more in an ecotone than adjoining regions, by virtue of being a blending zone. This effect is called **Edge Effect**. Also, it can possess unique environmental conditions that are favorable to a species generally not found in adjacent communities.

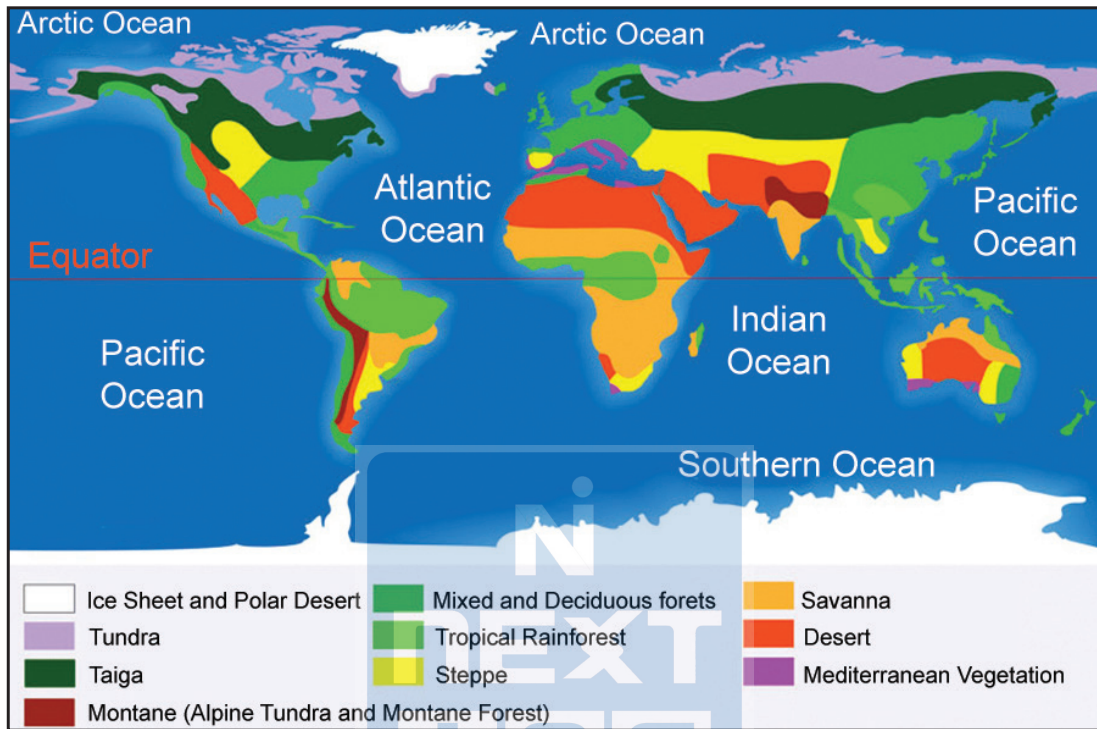


Fig. 18.4: Major Biomes of The World

Scientists have created several different systems of classification of biomes. They can be broadly classified into the following 6 categories on the basis of precipitation and temperature:

Tundra

It is transitional biome between the subarctic and ice cap. It has very cold temperature and generally dry conditions. Growth of natural vegetation in Polar Regions is limited to mosses, lichens and very small shrubs. It is called Tundra vegetation. It grows during the very short summer. Animals have thick fur and thick skin to protect themselves from cold climatic conditions.

There are 3 types of Tundra:

- 1. Arctic Tundra:** It is located in the Polar region of Northern Hemisphere. Due to a short growing season of 50 to 60 days, most plants reproduce by budding and division, rather than flowering. A layer of permanently frozen subsoil called **permafrost** exists. Permafrost is soil, rock, or peat that has been frozen for two or more years and has poor drainage.

Vegetation: The transition from Boreal forest to treeless Tundra is very gradual with tree species thinning out and becoming dwarfed. There are no deep root systems. Low shrubs, sedges, reindeer mosses, liverworts, grasses and lichens

Animals: Arctic foxes, wolves, polar bear, ravens, arctic hares, migratory birds.

- 2. Alpine Tundra:** It is located on mountains at high altitudes, where trees cannot grow. The average growing season is 180 days. Soil is well drained, unlike in Arctic Tundra. Therefore, it does not have permafrost.

Vegetation: Tussock grasses, dwarf trees, small-leaved shrubs, and heaths.

Animals: Pikas, Elk, mountain goats, butterflies, sheep.

- 3. Antarctic Tundra:** The isolation of Antarctica has led to quite different assemblage of species. Antarctica is mainly ice and very dry, so little land supports life.

Vegetation: Mosses and Aquatic Algae.

Animals: Penguins, Seals, Whales.

Impact of Climate Change on Tundra

Permafrost is a layer of frozen soil and dead plants that extends deep under the surface. Global warming is leading to deterioration of permafrost. Shrubs and spruce that previously couldn't take root on the permafrost (since it was frozen) now cover the landscape, potentially altering the habitat of the native animals.

Animals that are typically found further south, like the red fox, are moving onto the tundra. Also, melting of Tundra contributes to global warming as dead plant material exposed due to melting of permafrost decomposes and releases CO₂. Thus, Tundra has become a carbon contributor from a carbon sink.

Apart from this, ozone depletion at the North and South Poles means stronger ultraviolet rays that will harm the tundra.

Impact of Oil Drilling on Tundra

Arctic is home to world's largest untapped gas reserves and undeveloped oil reserves. **Arctic Council** consists of eight countries with sovereignty over the lands within the Arctic circle. These countries are: Canada, Denmark, Norway, Finland, Sweden, Iceland, Russia and the United States (Through Alaska). These nations can gain from the natural resources on, above and beneath the ocean floor. With the ice melting due to global warming, there is a race among littoral states to exploit the exposed oil and mineral resources. Despite the significant environmental concerns surrounding oil companies drilling offshore in the Arctic, demand for energy and the scarcity of similar

opportunities elsewhere oil companies are increasingly prepared to take the risk accessing the region. Oil spills can lead to devastating effects on the flora and fauna of the region. Oil trapped beneath the ice might migrate long distances. There would be virtually no way to clean up or contain the spill.

Oil drilling in the Arctic leaves harmful environmental and social effects, which may last for centuries, both because environmental damage does not heal easily in the area's harsh climate and because it is uneconomical to remove structures or restore damaged areas once drilling is over.

Taiga

Coniferous trees are also called **Taiga** or **Boreal forest**. They are found between Tundra in the north and temperate grasslands in the south. They are tall, softwood evergreen trees and are conifers. Trees are conical shaped to allow snow to fall off the branches. They have small leaves with thick cuticles. The canopy is closed and is low to the ground. There are few species of trees in the Taiga but there are extensive pure stands. The wood of these trees are very useful in making pulp, which is used for manufacturing paper.

- **Trees Found:** Chir, pine, cedar
- **Animals Found:** Silver fox, mink, polar bear
- **Areas of Occurrence:** Higher latitudes of Northern Hemisphere or higher altitudes. It is not found in Southern hemisphere because there is no large landmass at the same latitude.

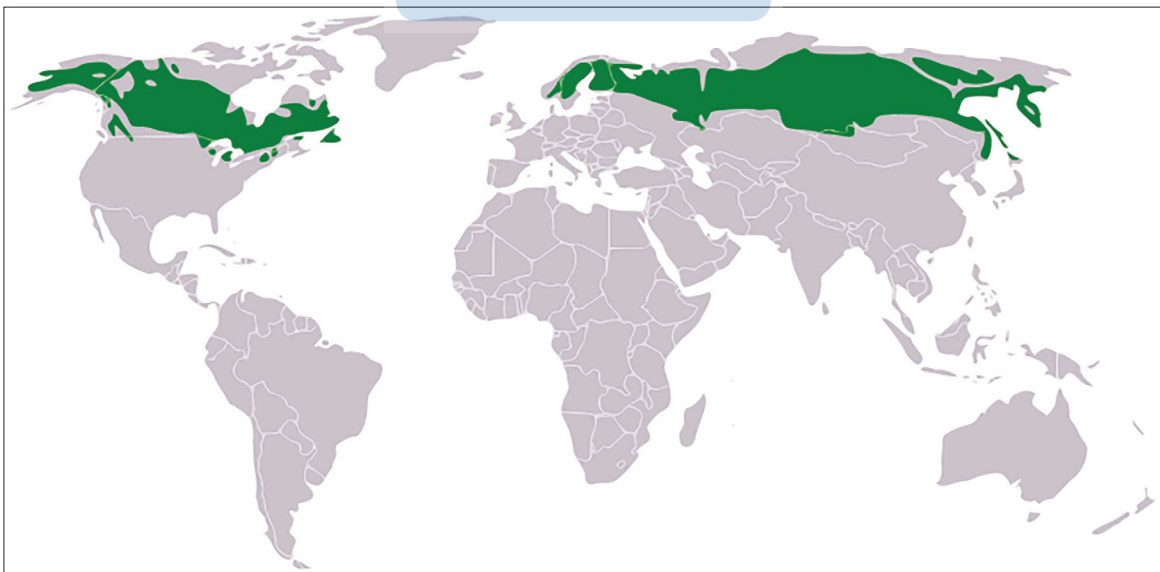


Fig. 18.5: Taiga Biome

Tropical and Temperate Rainforest

Tropical rainforest are also called Tropical Evergreen Forest, and are found in regions that are hot and receive heavy rainfall throughout the year.

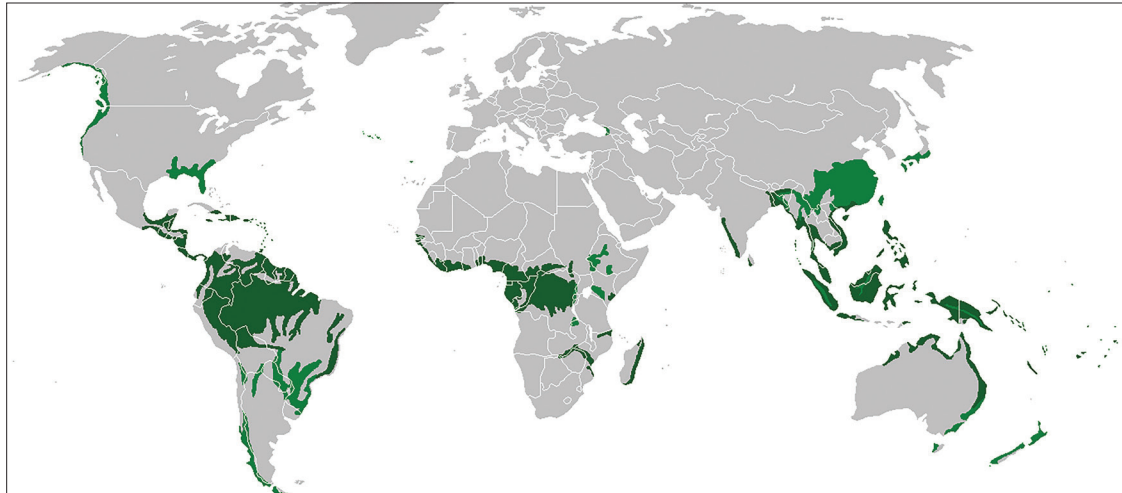


Fig. 18.6: Temperate and Tropical Rainforest

They are generally found along the equator, between 10-15 degrees North and South, and along tropical coasts that are backed by mountains and exposed to the trade winds but at low elevation (below 1000 m). Since there is no dry season, the trees do not shed their leaves altogether. The thick canopies of the closely spaced trees do not allow the sunlight to penetrate inside the forest. Therefore, tropical rainforest if cleared, does not regenerate quickly as compared to a tropical deciduous forest.

- **Trees Found:** Hardwood trees such as Rosewood, Ebony, Mahogany.
- **Areas of Occurrence:** Near equator-Amazon rainforests in Brazil, Congo forest, SE Asia etc.

Difference Between Tropical and Temperate Rain Forests		
Dimensions	Tropical	Temperate
Areas	Equatorial region	Mid-latitude coastal region
Vegetation	Hardwood trees such as Rosewood, Ebony, Mahogany Wide variety of Epiphytes is found.	Both hard and softwood trees like Oak, Pine, Eucalyptus etc. Mosses and ferns are common.
Leaves	Broadleaf	Needle
Commercial exploitation	Not suitable as trees are scattered over a wide area. Hot and humid conditions make commercial exploitation difficult.	Less number of tree species makes commercial exploitation easy.
Primary productivity	Very high	Comparatively low

Tropical and Temperate Grassland

These are areas where grass is the dominant vegetation. Grasslands occur naturally on all continents except Antarctica.

Grasslands: A Comparison Between Tropical and Temperate Grassland		
Dimensions	Tropical	Temperate
Areas	Either side of equator between 10° and 20° latitudes	Mid-latitudes and interior part of continents
Vegetation	Tall grass with long roots to facilitate absorption of water. Scattered trees or Parkland vegetation.	Grass is short, nutritious and perennial. No trees.
Famous	Animal Safaris (Big game country)	Extensive farming, animal ranching (Granaries of the world)
Common animals	Elephants, Zebra, Deer, Giraffe	Wild buffaloes, Bison, Antelopes
Soil	Soil is not fertile	Soil is fertile
Different names	East Africa: Savanna Brazil: Campos Venezuela: Llanos	Argentina: Pampas North America: Prairie South Africa: Veld Central Asia: Steppe Australia: Downs



Fig. 18.7: Tropical and Temperate Grasslands

Mediterranean Climate

While east and north-east margins of the continents are covered by Temperate Evergreen and deciduous trees, west and southwest margins have Mediterranean vegetation.

Areas of Occurrence

It is mostly found in the areas around the Mediterranean sea in Europe, Africa and Asia. It is also found in California in the USA, south west Africa, south western South America and South west Australia. These regions are marked for hot dry summers and mild rainy winters. The wet winter and dry summer seasonality of precipitation is the defining characteristic of this climate. They have evolved into a distinctive natural vegetation of hard leaved evergreen trees and shrubs, known as “**Sclerophyll forest**”.

It consists of small trees, with small hard leathery leaves, stems with thick bark. Citrus fruits such as oranges, figs, olives and grapes are commonly cultivated.

Mediterranean trees adapt themselves to dry summers with the help of their thick barks and wax coated leaves which help them reduce transpiration. Mediterranean

regions are known as “**Orchards of the world**” for their fruit cultivation.

Desert Biome

Desert biome constitutes of hot deserts and cold deserts. Deserts are regions where potential evapotranspiration is much higher than annual precipitation. Desert plants have to survive extreme dryness and drastic diurnal and annual temperature ranges. This biome is more productive than Tundra and has the maximum niche diversity because of more habitat and less biodiversity.

Almost all deserts are confined within 15-30° latitudes on either side of equator and between 30-45° in the continental interiors. They lie in the trade wind belt of the western part of continents where Trade Winds are offshore. Cold currents prevent moisture from getting precipitated, leading to aridity. Such deserts are tropical deserts. Annual rainfall is less than 25 cm. Temperate Deserts are those found in the continental interiors of mid-latitudes. E.g. Gobi, Turkestan.

Vegetation: Xerophytes (drought tolerant plants in which leaves are small and waxy) such as cactus. Succulents (which suck the sub surface moisture) and Phreatophytes (plants with deep seated roots).

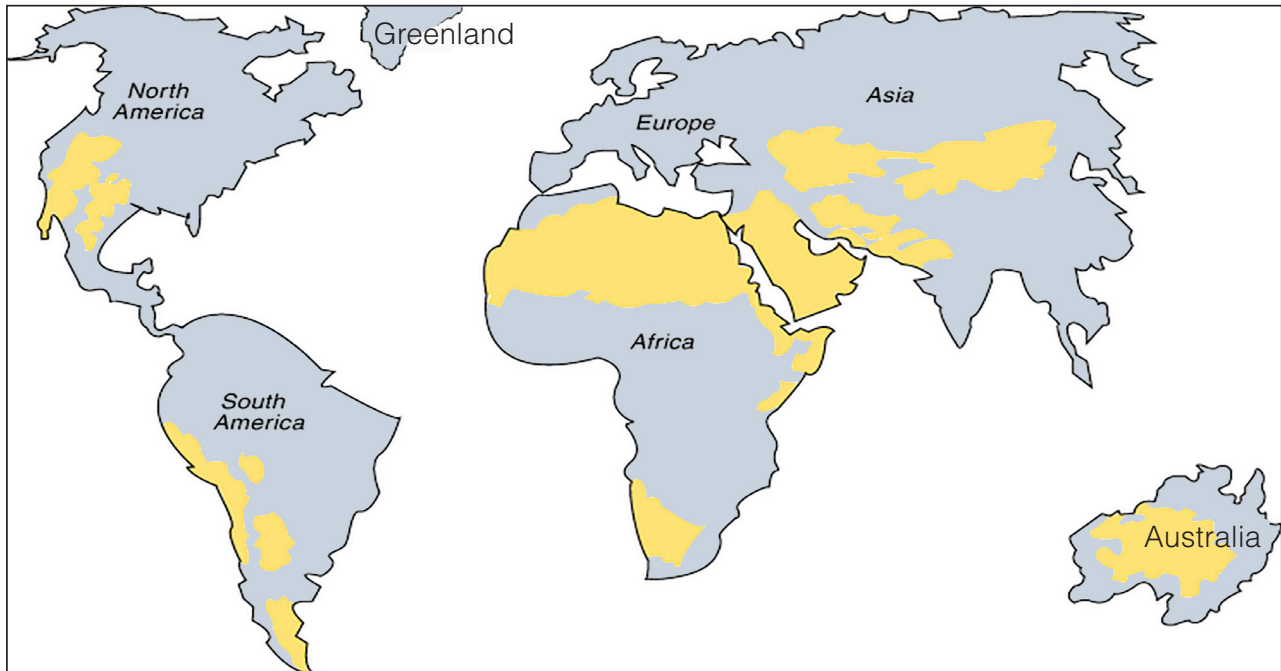


Fig. 18.8: Desert Biomes of the World

Benefits of Major Biomes of the World

