

BIOL 258 PRINCIPLES OF ECOLOGY I

3 CREDIT HOURS

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Course outline

- Basic definitions and concepts
- Introduction to ecosystems
- Ecological concepts
- Dynamic interrelationships of plant and animal communities with their environments
- Primary and secondary production in plants and animals.
- Ecological energetics

Course outline Cont'd.

- Introduction to population ecology
- Man and his habitat
- Habitat fragmentation and edge effects
- Biogeochemical cycles

Recommended text books and websites

- Cunningham Saigo. 1997. Environmental Science: a global concern. Fourth Edition.
- Fred Van Dyke. 2003. Conservation Biology: foundations, concepts, application. McGraw-Hill Company Inc.
- Manuel C. Molles Jr. 1999. Ecology: concepts and applications. McGraw-Hill Company Inc.
- Gutierrez, Kenneth, Marlon Amador, Eli Gonzalez, and Stephanie M. Tropical dry forest biome." *tropical dry forest biome*. N.p., n.d. Web. 15 oct. 2013.
<http://www.slideshare.net/mdonohue/tropical-dry-forest-biome>.
- Leo Robert Smith. 1990. Ecology and field biology.
- Bush Mark B. 2003. Ecology of a changing planet. Third Edition.

BASIC DEFINITIONS AND CONCEPTS

What is Ecology?

- Ecology is the study of the relationships and interactions among living organisms as well as the relationships and interactions between them and their environment.
- The interactions and relationships revolve around individuals, species, populations, communities, ecosystems, and even the planet.
- The study of ecological relationships can be achieved using two main approaches; autecology and synecology.

Basic Definitions and Concepts Cont'd.

- ☛ Ecology is a multidisciplinary course.
- ☛ The study of these ecological relationships from the point of view of a single species or individual is called autecology.
- ☛ If all the species living together are studied as a community, then this study is called synecology.

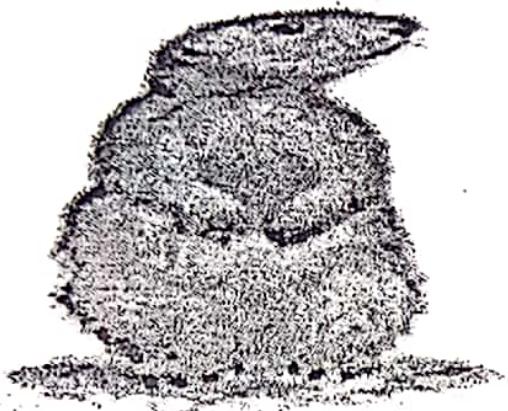
Concepts of ecology

- ◆ All living organisms affect their environment and vice versa.
- ◆ Environment plays an important role in the critical stages of the life cycle of species.
- ◆ Species react to changes in the environment, and they may adjust structurally and physiologically to the changes.
- ◆ The activities of species also cause changes in the environment e.g. growth, dispersal, reproduction, death, decay, etc.

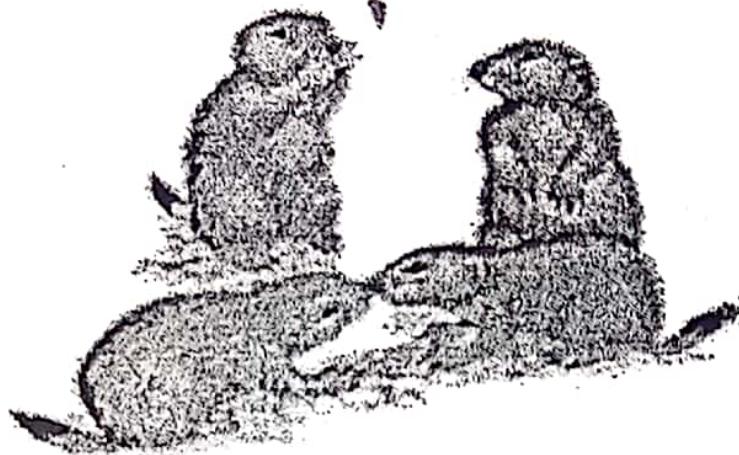
Basic Definitions and Concepts Cont'd.

- Under similar climatic conditions, two or more communities can develop simultaneously; some may reach climax stage, and others under different stages of succession.

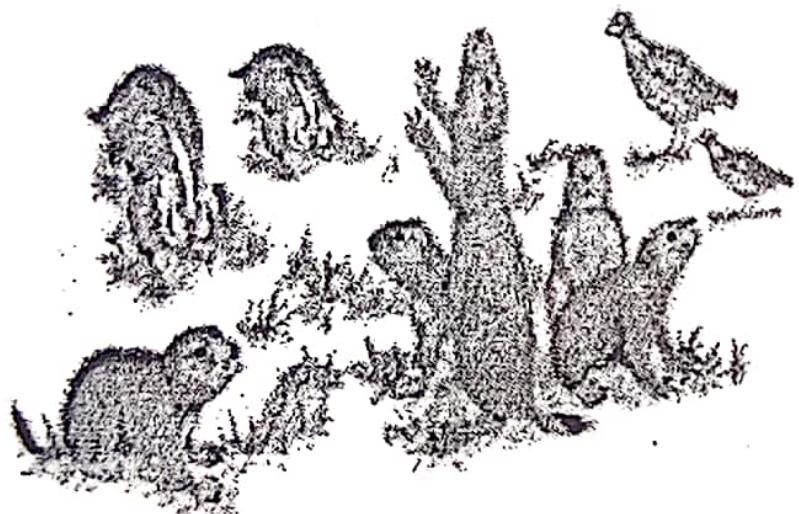
Ecological levels of organisation



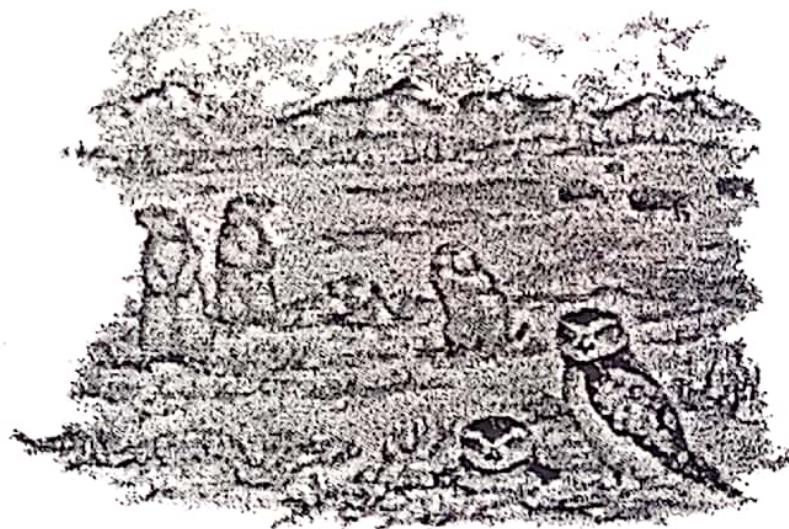
Individual



Population/species



Community



Ecosystem

INTRODUCTION TO ECOSYSTEMS

- ☛ An ecosystem is a community of living organisms in conjunction with their non-living environment, which interact as a system or ecological unit.
- ☛ Therefore, an ecosystem is made up of biotic and abiotic components which are interrelated and interact with each other.
- ☛ Energy flow and nutrient cycling occur within ecosystems.

Introduction To Ecosystems Cont'd.

Concepts of an ecosystem

- There is the presence of positive, negative and neutral interactions among organisms at both inter- and intra-specific levels.
- The chemical components of an ecosystem move in a defined path called biogeochemical cycles.
- There are some limiting factors that control survival and growth of organisms. The minimum and maximum levels of tolerance for all species vary seasonally, geographically and according to the population.

Introduction To Ecosystems Cont'd.

Concepts of an ecosystem

- ◆ Different kinds of populations undergo succession.
- ◆ Two main groups of organisms exist in ecosystems: native and non-native (exotic/alien) species.
- ◆ There exist certain important species referred to as keystone species.
- ◆ They are species that have strong effects on biological communities, with the effects being disproportionately large compared to their abundance and biomass.

Introduction To Ecosystems Cont'd.

Concepts of ecosystems

- ◆ Many populations exhibit viability despite the presence of ecological processes such as disturbance.
- ◆ Ecosystems may exhibit ecological resilience.
- ◆ Disturbance forms an integral part of many ecosystems in the world.

Introduction To Ecosystems Cont'd.

Components of ecosystems

(1) Biotic component

◆ This is made up of two groups of organisms namely, autotrophs and heterotrophs.

(a) Autotrophs

◆ They comprise of organisms which are capable of using simple inorganic materials from the abiotic environment and with the energy from the sun, build up complex organic substances.

◆ Autotrophs are known as producers and form the base of food chains.

Introduction To Ecosystems Cont'd.

(b) Heterotrophs

↳ Heterotrophs utilise, re-arrange and decompose the complex organic substances produced by the autotrophic organisms.

↳ Two types of heterotrophs exist within ecosystems:

(i) Consumers

↳ These are organisms that feed on other organisms. E.g. Animals and parasitic plants (*Dionaea*, Venus fly trap & *Nepenthes*, Pitcher plant)

Introduction To Ecosystems Cont'd.

(ii) Decomposers

- Decomposers break down non-living organic matter and convert them to simpler substances.
- Decomposers are referred to as saprotrophs. E.g. fungi, some bacteria.

Introduction To Ecosystems Cont'd.

(2) Abiotic component

- ◆ This is made up of the non-living physical and chemical factors of the ecosystem that influence living organisms and ecosystem functioning.

Examples

- | | |
|-----------------------|------------------|
| ◆ Rainfall | ◆ Altitude |
| ◆ Sunlight | ◆ Slope angle |
| ◆ Temperature | ◆ Oxygen |
| ◆ Soil water/moisture | ◆ Carbon dioxide |

Ecological principles

- ◆ Protection of species and species' subdivisions will conserve genetic diversity.
- ◆ Protecting habitat is fundamental to conserving species.
- ◆ Large areas usually contain more species than smaller areas with similar habitats.
- ◆ All species interact but the nature and strength differ.
- ◆ Climate influences terrestrial, freshwater and marine ecosystems.

Types of Ecosystems

Two main types of ecosystems namely, aquatic and terrestrial ecosystems exist.

Aquatic ecosystem

- ◆ This is the type of ecosystem in which water serves as the habitat for living organisms.
- ◆ Aquatic ecosystem comprises of fresh water and marine (salt) water types.

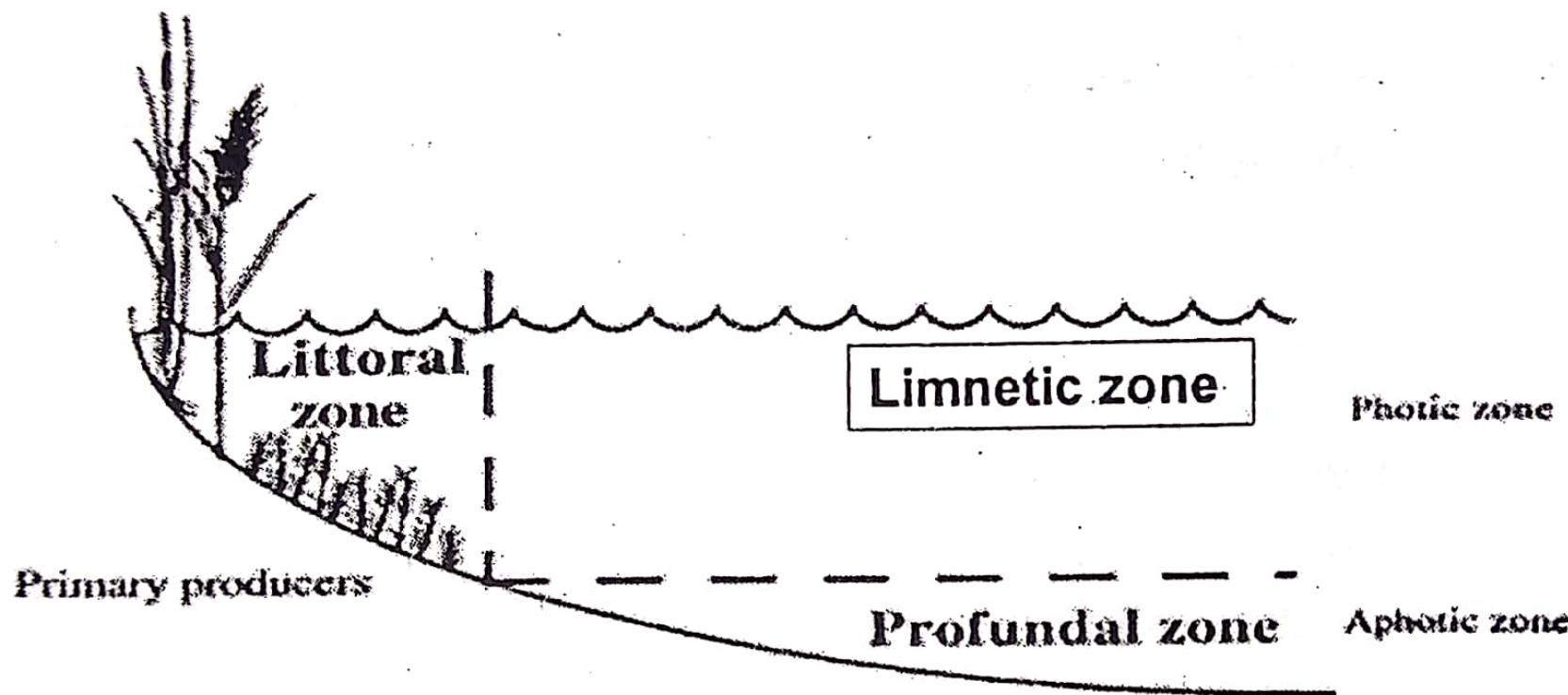
Fresh water ecosystem

- Fresh water ecosystem is subdivided into standing- and flowing-water ecosystems on the basis of water movement.

Standing-water ecosystem

- In this ecosystem water tends to remain in the same general area for a longer period of time.
- Examples include lakes, ponds.

Zones of Standing-water ecosystem



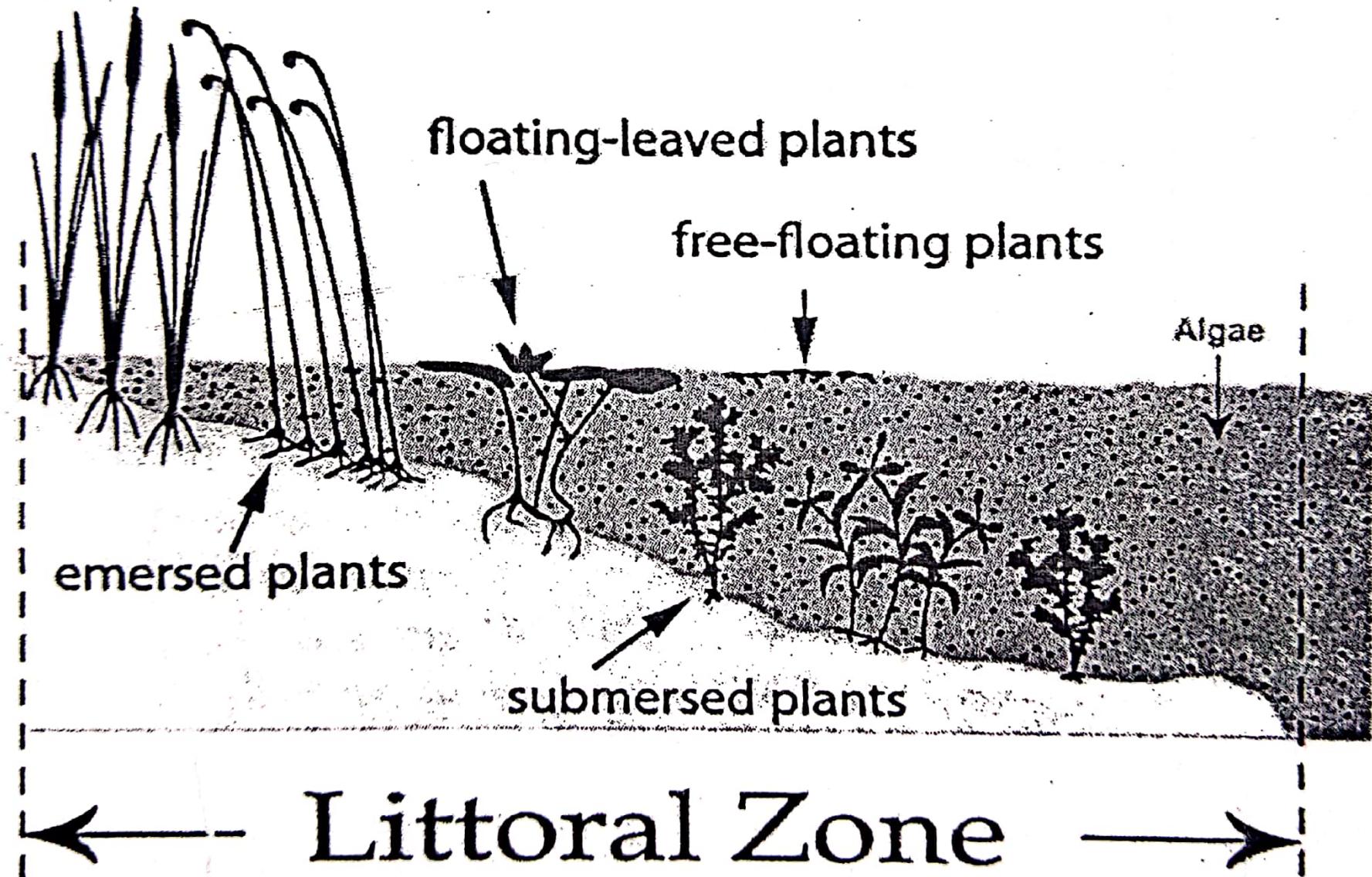
Different zones of lakes and ponds, including the 'open water' (pelagic) zone and the nearshore littoral zone, where the primary production at the sediment surface is high. Water and sediment below the compensation depth (i.e. where the amount of oxygen produced by photosynthesis equals that consumed by respiration) is called the profundal zone.

Zones of Standing-water ecosystem

Littoral zone

- ☛ This is the shallow water portions along the edge of a pond or lake.
- ☛ Light penetrates to the bottom of the littoral zone and hence photosynthetic organisms are abundant there.

Plants of littoral zone



Animals of littoral zone

- 1 The littoral zone supports different kinds of fauna.
- 2 It provides food and shelter for animals such as crabs, water birds, fishes etc.

Limnetic (pelagic) zone

- ◆ This is the open water area where light penetrates.

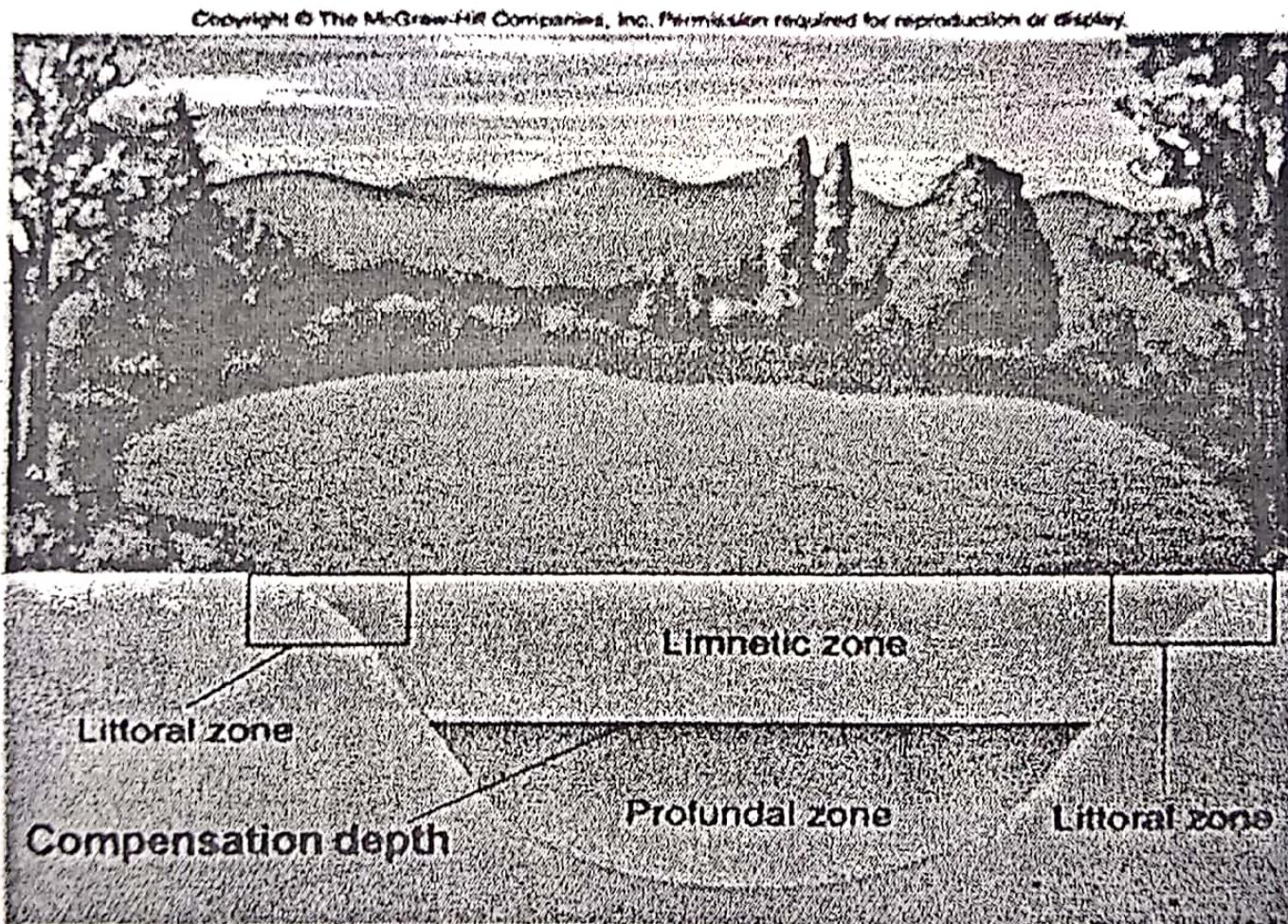
Plants of limnetic zone

- ◆ Plants in this zone are floating algae known as phytoplankton.
- ◆ The phytoplankton occupy upper parts of the limnetic zone so that they can receive enough sunlight for photosynthesis.
- ◆ Rooted plants (macrophytes) are absent in this zone.

Animals of limnetic zone

- ◆ Primary consumers such as microscopic crustaceans and rotifers occur in this zone.
- ◆ Secondary consumers include swimming insects and fish. These animals usually swim between the littoral and limnetic zones. Thus, they are able to feed on plants in the littoral zone as well.
- ◆ some animals in the limnetic zone camouflage themselves so that they become difficult to see from above and below.

Profundal zone



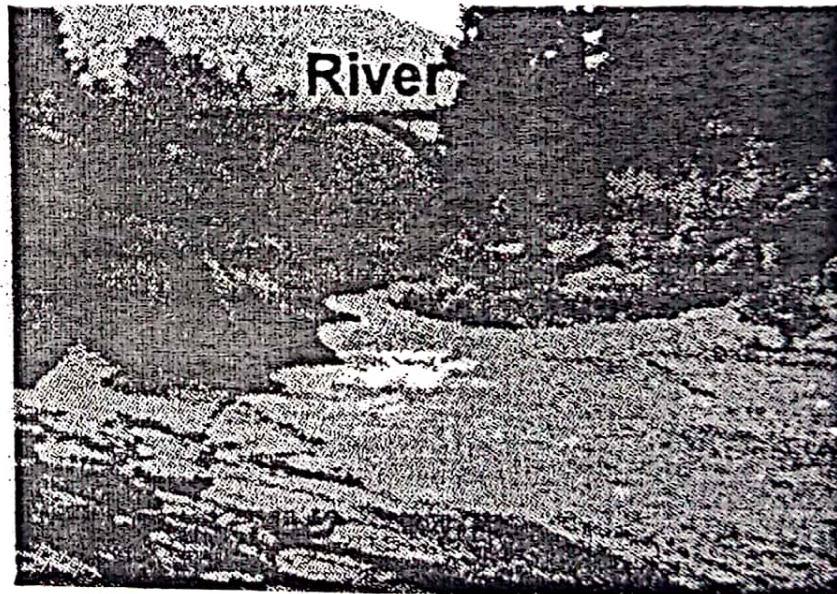
- This is a zone located beyond the depth of effective light.

- ◆ Diversity and abundance of life are limited by oxygen and temperature.
- ◆ Animals in this zone are therefore adapted to low oxygen concentration.
- ◆ Animals here depend on organic materials from littoral and limnetic zones.
- ◆ Some animals may occupy this zone during some part of the day, but migrate upward to the surface to feed.
- ◆ The profundal zone supports large population of bacteria and fungi which break down organic matter and release inorganic nutrients for recycling.

Flowing-water ecosystem

↳ A flowing-water ecosystem is any type of water body that flows constantly over land surface.

E.g. streams, rivers, creeks, waterfall etc.



↳ Velocity of water determines the type of ecological community in the water.

Plants of flowing-water ecosystem

- ◆ Producers of fast-flowing water ecosystem are mainly algae and grasses.
- ◆ Algae form an important component of the diet of fast-flowing water animals.

Animals of flowing-water ecosystem

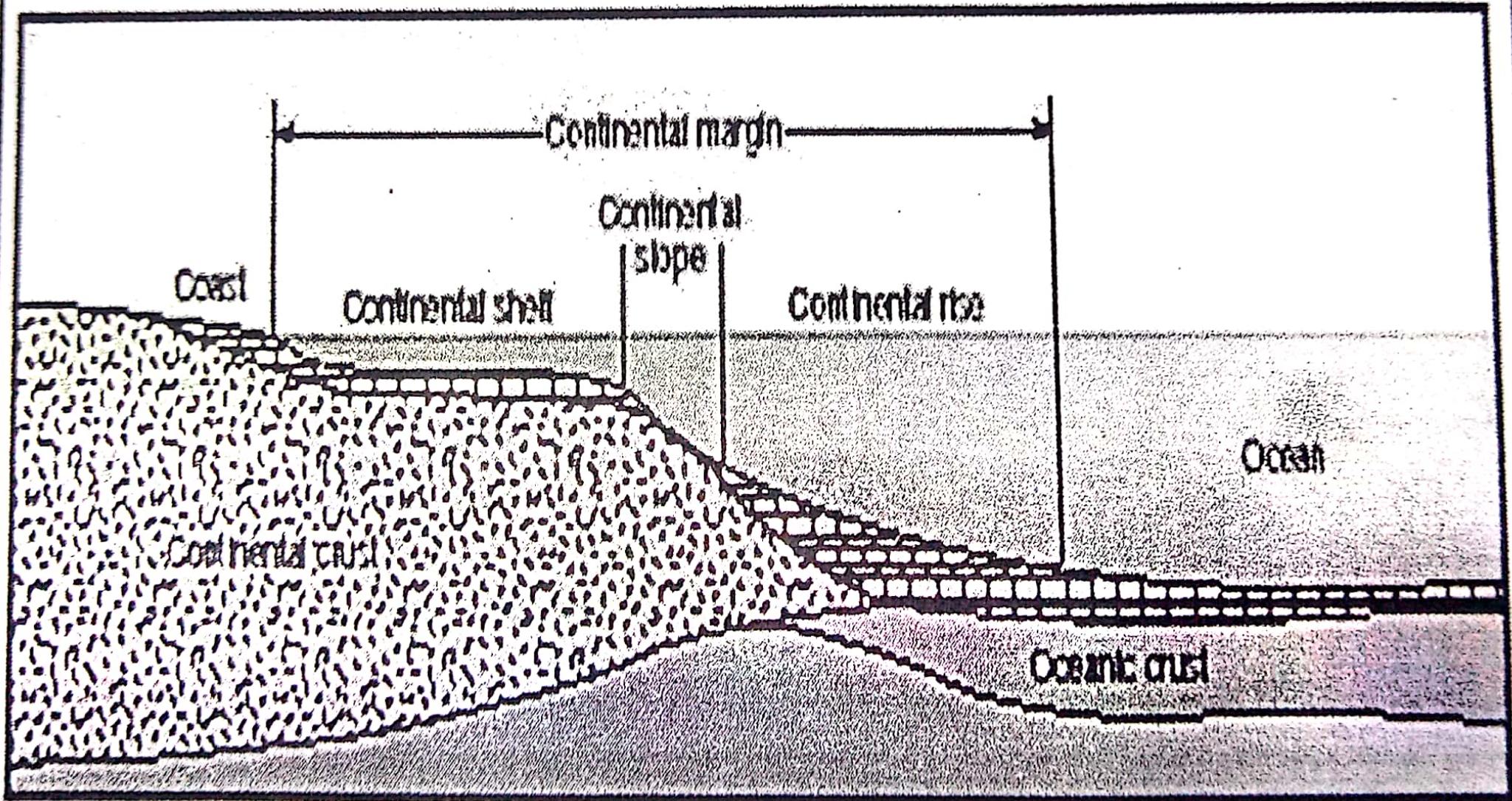
- ↳ As a result of strong water movement in flowing-water ecosystem, fauna communities are limited to animals that are able to withstand water movement.
- ↳ Examples: fish, insects, amphibians, reptiles etc.
- ↳ Fish will generally hide beneath or beside rock to avoid being moved down stream.
- ↳ Some insects attach themselves to aquatic plants so as to avoid being washed away by water.

- ◆ Carnivorous animals such as crocodiles, alligators, birds also live in some fast-flowing waters.
- ◆ Omnivorous animals include bears.

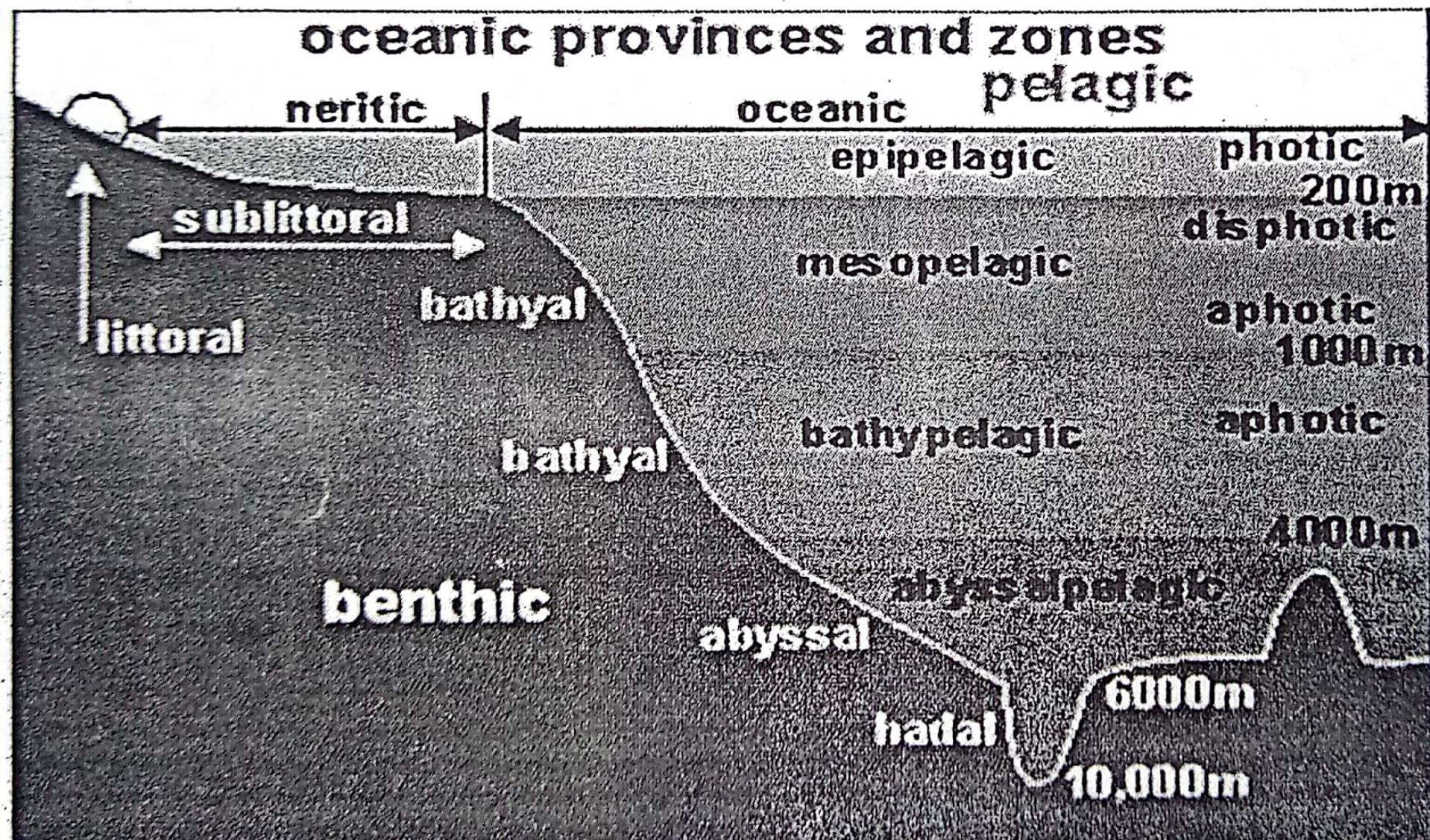
Characteristics of flowing-water ecosystem

- ◆ Existence of water currents.
- ◆ Close association of water with surrounding land area.
- ◆ Constant high oxygen concentration.
- ◆ Negligible thermal and chemical stratification.

Marine water ecosystem (Oceans)



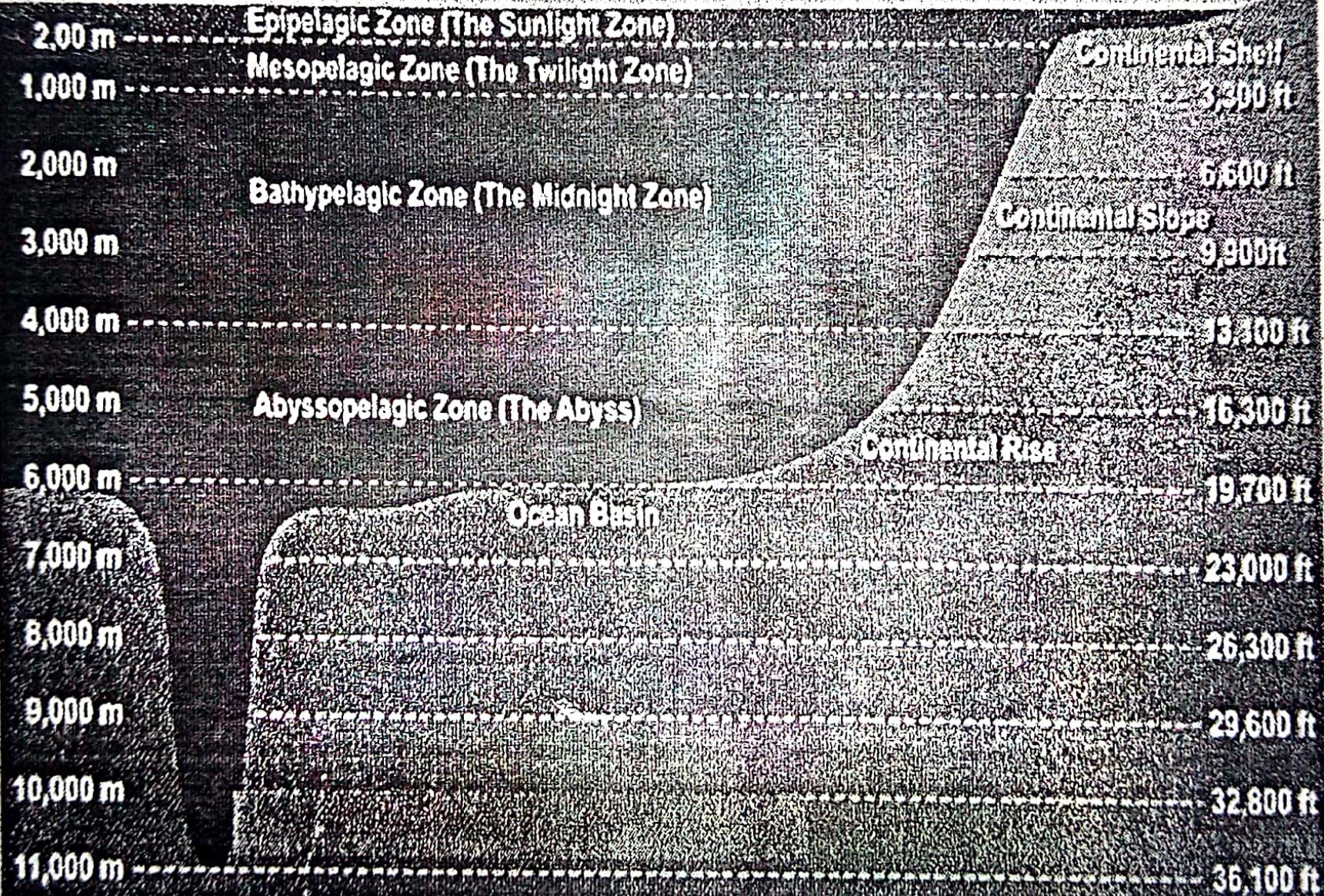
Divisions of the ocean



Provinces of the ocean

- (1) Benthic province – includes all of the ocean bottoms**
- (2) Pelagic province – includes the entire volume of ocean water**
 - **The pelagic province in turn consists of two zones; neritic and oceanic zones**
 - (a) Neritic zone – the relatively shallow water overlying the continental shelves.**
 - (b) Oceanic zone – the water over the ocean basins; photosynthesis is restricted to the surface.**

Zones of the ocean



Epipelagic Zone (surface/sunlight zone)

- ❖ The illuminated surface zone where there is enough sunlight for photosynthesis. Due to this, plants and animals are largely concentrated in this zone.

Mesopelagic Zone (twilight zone)

- ❖ This zone occurs just beneath the epipelagic zone. Light penetrates to this zone but it is very faint.
- ❖ Many animals spend daylight hours within the mesopelagic zone and then move towards the surface during evening hours.
- ❖ In this way, they can feed on the phytoplankton and zooplankton available near the surface of the water while avoiding predators during the day.

Bathypelagic Zone (midnight/dark zone)

- ❖ This zone is found beneath the mesopelagic zone.
- ❖ Sunlight does not reach this zone. The only light present at this zone is the light produced by some organisms living in this zone.
- ❖ Because sunlight does not get to this zone, many organisms that live at this point are either black or red in colour.
- ❖ Pressure at this zone is very high but many organisms are able to live there. E.g. Sperm whales move to this zone in search of food.

Abyssopelagic Zone

- ❖ The water temperature is near freezing, and there is no light at all.
- ❖ Only a few organisms with adaptations to the harsh conditions of this zone are able to live there. E.g. many invertebrates including basket stars and tiny squids.