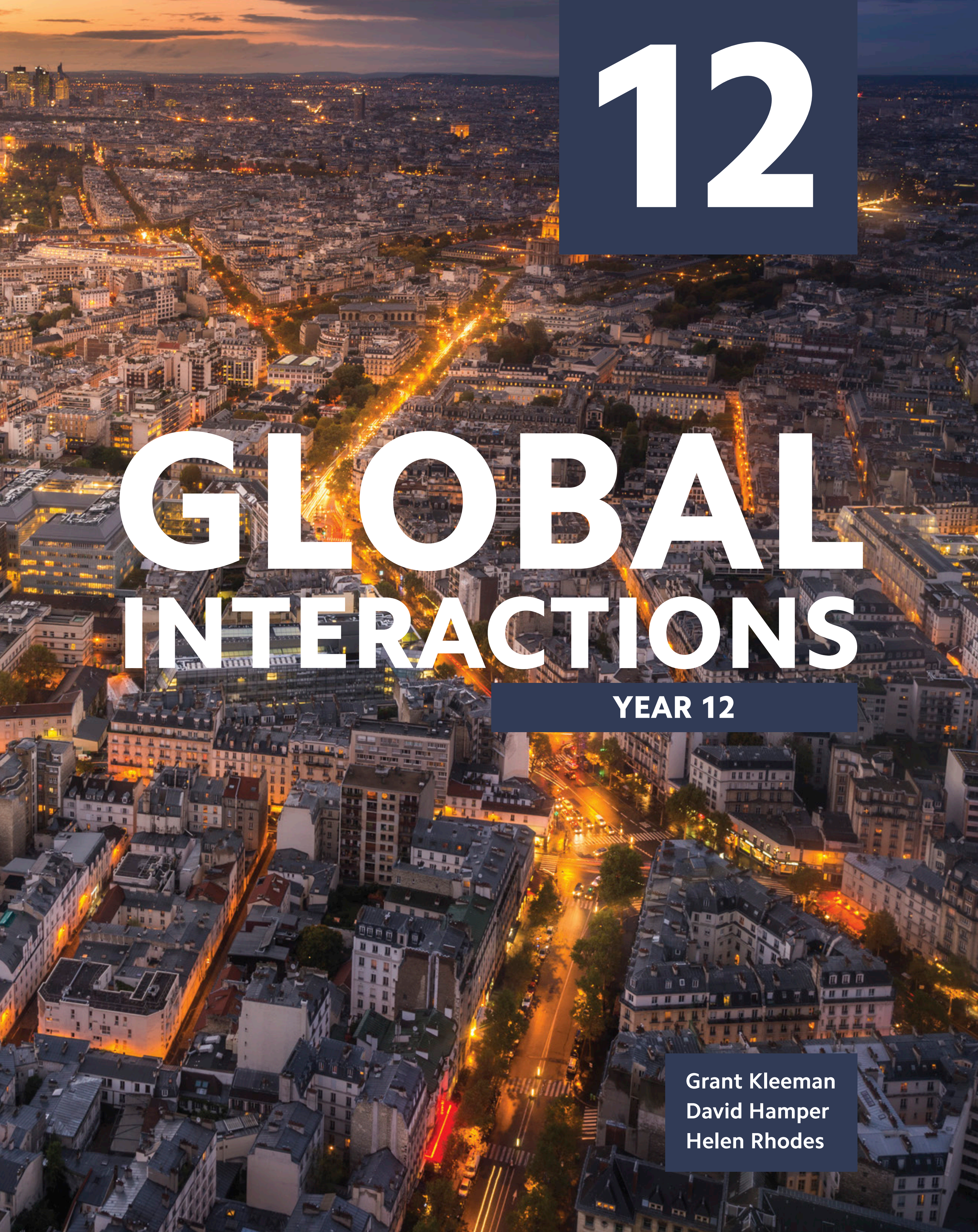

12

GLOBAL INTERACTIONS

YEAR 12

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David Hamper
Helen Rhodes

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Pearson

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Global Interactions Year 12

The fully revised and updated *Global Interactions Third Edition* series is written for the NSW Stage 6 Geography syllabus. The text aims to help develop students' knowledge, understanding, skills, attitudes and values in relation to the biophysical and human environments. Students using *Global Interactions* will be well placed to realise their full academic potential in Year 12 Geography.

Student book

- Chapter titles and units reflect the NSW Stage 6 Geography syllabus
- Full-colour text with engaging and highly visual design
- Dynamic and relevant images, textual examples, graphs and maps
- Topic-based units written in accessible language with clear and concise explanations of key terms and concepts
- A variety of learning activities for regular revision and consolidation
- Case studies that describe and encourage in-depth investigation
- End-of-chapter glossary for reference and exam-style questions
- Written by an experienced author team:
  - **Grant Kleeman** (lead author) is an experienced teacher educator, geography teacher, author, curriculum consultant and examiner. Grant has been closely involved in the development of the geography curriculum at the state and national level. He is the coordinating author of several texts, including the Pearson Geography NSW series.
  - **David Hamper** is an experienced geography educator and is currently Deputy Principal at International Grammar School, Sydney. David has also contributed to several geography texts including the Pearson Geography NSW series.
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The Publishers wish to thank James Forrest for his contribution to *Global Interactions 12 Second Edition*.

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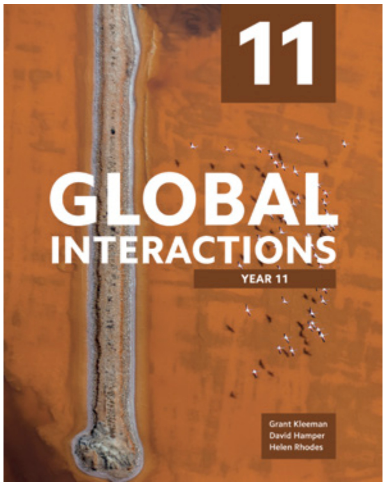
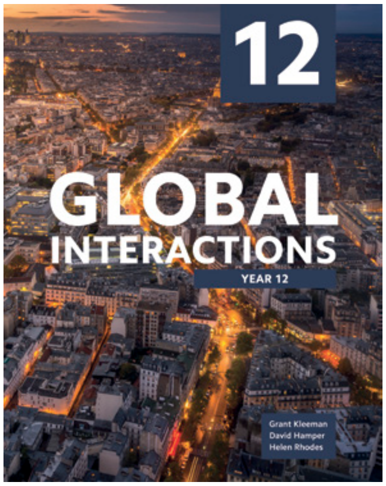




Contents

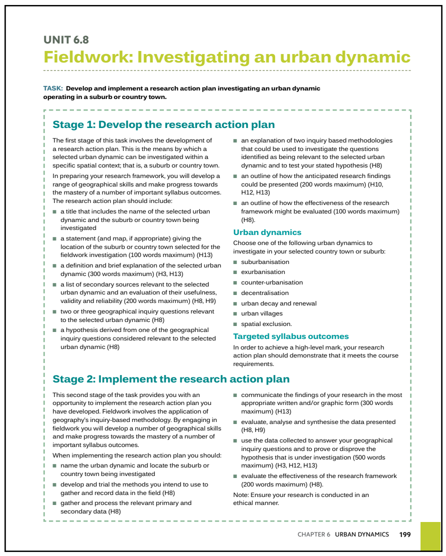
How to use

Case studies

Case study units relate to a specific event or location; and are written to extend students' knowledge and understanding.

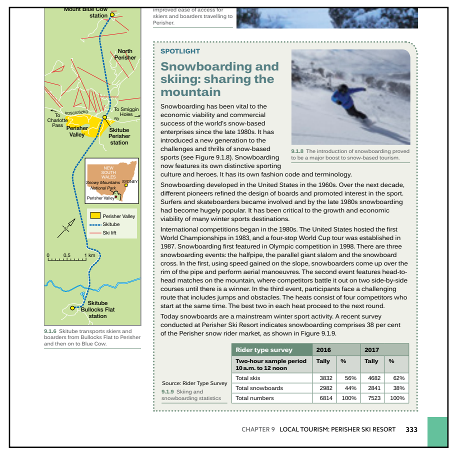
Fieldwork

The fieldwork section provides a step-by-step guide to undertaking and evaluating fieldwork.



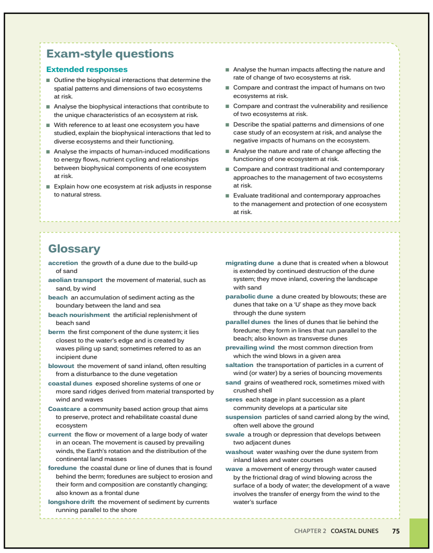
Spotlight

Spotlight boxes focus attention on a place, an issue or a concept relating to the unit. They are designed to develop students' knowledge and understanding of the concepts and processes that are central to the study of geography at this stage of learning.



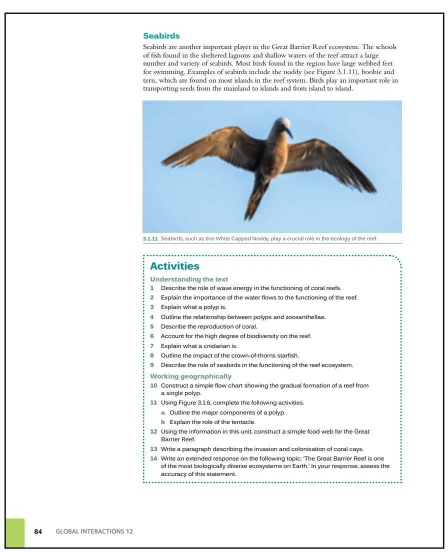
Exam-style questions

Exam-style questions are a variety of extended responses which enable students to practise and develop their exam skills.



Activities

Activities have been carefully selected to cater for the full range of student abilities. Many activities are based on the stimulus material presented and aim to facilitate the development of the skills used by geographers.



Understanding the text

These questions guide students towards an understanding of the content (knowledge and understanding) specified by the syllabus.

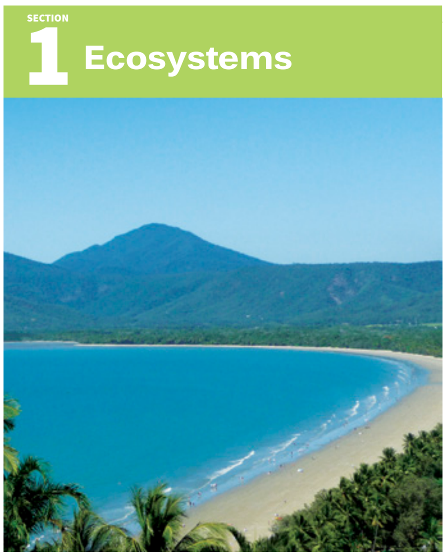
Working geographically

These tasks extend students beyond the text and involve them in a variety of learning experiences.

Using Global Interactions Year 12: Third Edition

Structure

This text is divided into three sections corresponding with the Stage 6 syllabus.



Section 1: Ecosystems

The focus of this section is a geographical investigation of the functioning of ecosystems at risk, and their management and protection. Students are provided with two case studies:

- coastal dunes
- the Great Barrier Reef.

Section 2: Urban places

The focus of this section is a geographical investigation of world cities, megacities and the urban dynamics of large cities and urban localities. Sydney is used as an example of a developed world city.

Section 3: People and economic activity

This section focuses on a geographical investigation of economic activity integrating local and global contexts. Students can choose from one of the following case studies:

- global tourism
- Perisher Ski Resort
- the global viticulture and winemaking industry
- First Creek Wines.

Year 12 Outcomes matrix

	Syllabus outcomes												
	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	H11	H12	H13
Section 1: Ecosystems	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓
Section 2: Urban places	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
Section 3: People and economic activity	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

SECTION 1

Ecosystems

All life on Earth depends on the functioning of ecosystems. As a species, humans are unique because they have the ability to destroy whole ecosystems. For the first time in human history we are on the brink of catastrophic environmental change in the form of climate change. If humans fail to act, there is the danger that the Earth's systems will collapse and bring about changes that will radically alter our planet.

However, we also have the capacity to protect and restore ecosystems. Now, more than ever, we need to understand the nature of the interactions taking place within the Earth's biophysical environment so that we can sustainably manage the Earth's ecosystems. To do this, we must better understand the way that ecosystems function and the way they are responding to environmental stress such as climate change.

In this section, we investigate biophysical interactions that lead to diverse ecosystems and their functioning, the vulnerability and resilience of ecosystems, the importance of ecosystem management and protection, as well as the traditional and contemporary strategies used to manage those ecosystems.

1.0.0 Port Douglas—coastal dunes and rainforests are both ecosystems that may be at risk.

Outcomes

Students:

H1 explain the changing nature, spatial patterns and interaction of ecosystems

H2 explain the factors that place ecosystems at risk and the reasons for their protection

H5 evaluate environmental management strategies in terms of ecological sustainability

H6 evaluate the impacts of, and responses of people to, environmental change

H7 justify geographical methods applicable and useful in the workplace, and relevant to a changing world

H8 plan geographical inquiries to analyse and synthesise information from a variety of sources

H9 evaluate geographical information and sources for usefulness, validity and reliability

H10 apply maps, graphs and statistics, photographs and fieldwork to analyse and integrate data in geographical contexts

H11 apply mathematical ideas and techniques to analyse geographical data

H12 explain geographical patterns, processes and future trends through appropriate case studies and illustrative examples

H13 communicate complex geographical information, ideas and issues effectively, using appropriate written and/or oral, cartographic and graphic forms

Overview

In Section 1, the focus is on ecosystems at risk: their functioning, management and protection.

Note: students are required to study two ecosystems at risk.

CHAPTER

1 Ecosystems at risk

At the beginning of the twentieth century there were 1.6 billion people on Earth and while pollution and environmental degradation were common, the problems were generally local. Today, the world's population has grown to more than 7.5 billion and the environmental problems resulting from this rapid growth affect the whole planet. Whole ecosystems are at risk and as habitats are destroyed, the species of plants and animals that depend on them become extinct.

The United Nations estimates that by 2050, the world's population will be 9.7 billion and the global economy will be at least five times its present size. To sustainably manage and protect the global environment, its habitats and biological diversity, solutions must be found that address the impacts of population and overuse of natural resources.

Human impact on the biophysical environment is not a recent event. Many indigenous peoples behaved in ways that transformed ecosystems in the past and led to the extinction of species. Such impacts were usually followed by long periods of environmental stability during which the biophysical environment adjusted to human impact. Some experts argue that the Earth's ecosystems are in fact 'human artefacts': ecosystems modified by thousands of years of human use.

> **But man is a part of nature, and his war against nature is inevitably a war against himself.**
>
> **Rachel Carson, *The Silent Spring*, 1962**

1.0.1 Rainforests are one of the most at risk ecosystems on Earth.

UNIT 1.1

Ecosystems and their functioning

Ecology is a science that examines the interactions between organisms and their living (biotic) and non-living (abiotic) environment. The key word in this definition is 'interactions'. Groups of organisms interact with each other and their biophysical environment. Collectively, they form an ecological system or ecosystem. Ecosystems are dynamic; this means that they are constantly changing and adapting.

By identifying characteristic patterns of interaction, it is possible to distinguish different types of ecosystems. An ecosystem is defined as an identifiable system of interdependent relationships between living organisms and their biophysical environment.

1.1.1 Fungi are an example of recyclers that ensure nutrients are returned to an ecosystem.

Ecosystems

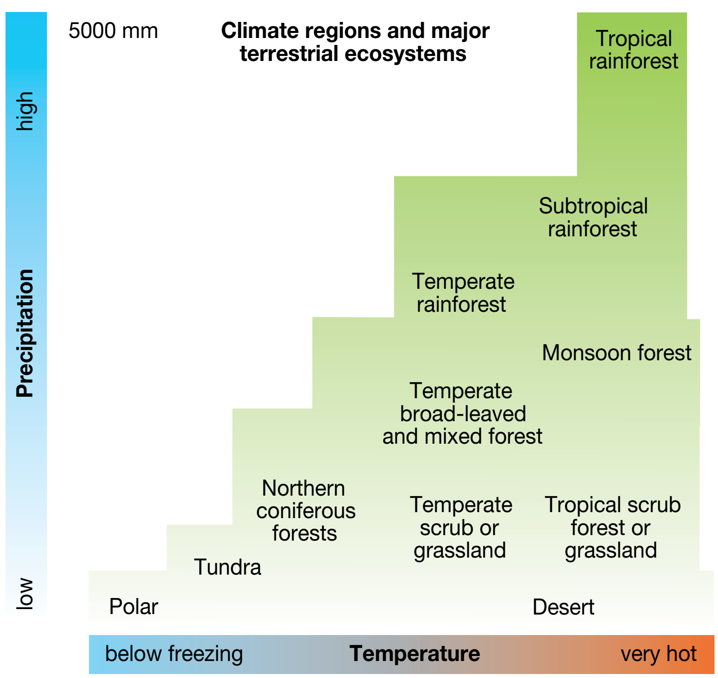
Ecosystems are systems through which incoming solar energy is captured and channelled through a hierarchy of life forms. Each ecosystem has its own characteristic plant and animal community. Plants, both on land and in the sea, convert sunlight (via photosynthesis) into storable—and edible—chemical energy. Animals feed on these plants and on other animals. The quest for food is the central organising principle within ecosystems.

An important feature of each ecosystem is the set of processes by which nutrients are retained and recycled. Living things do not create new matter. Instead, they recycle nutrients obtained from air, soil, water and other organisms, using solar energy to build and maintain themselves. The fungi shown in Figure 1.1.1 are just one example of the process of natural recycling.

Variations in ecosystems

Components of any ecosystem can vary naturally or as a result of human intervention. Each variation will in turn affect other components and processes within the ecosystem. Over time, a small variation or modification may be magnified (increased) throughout the system as a whole. This will make the ecosystem different from any other and/or will make it react in different ways to stimuli.

Environmental conditions vary and there have been substantial fluctuations in environmental conditions over the past 10 000–18 000 years. These changes include variations in the global climate and sea level; for example, until about 10 000 years ago sea levels were considerably lower. The conditions prevailing now have only existed for a relatively short period: 1500 years.



1.1.2 Precipitation and temperature interact to determine the characteristics of an ecosystem. This graph demonstrates the wide variety of ecosystems that result from the various combinations of this relationship.

Classifying ecosystems

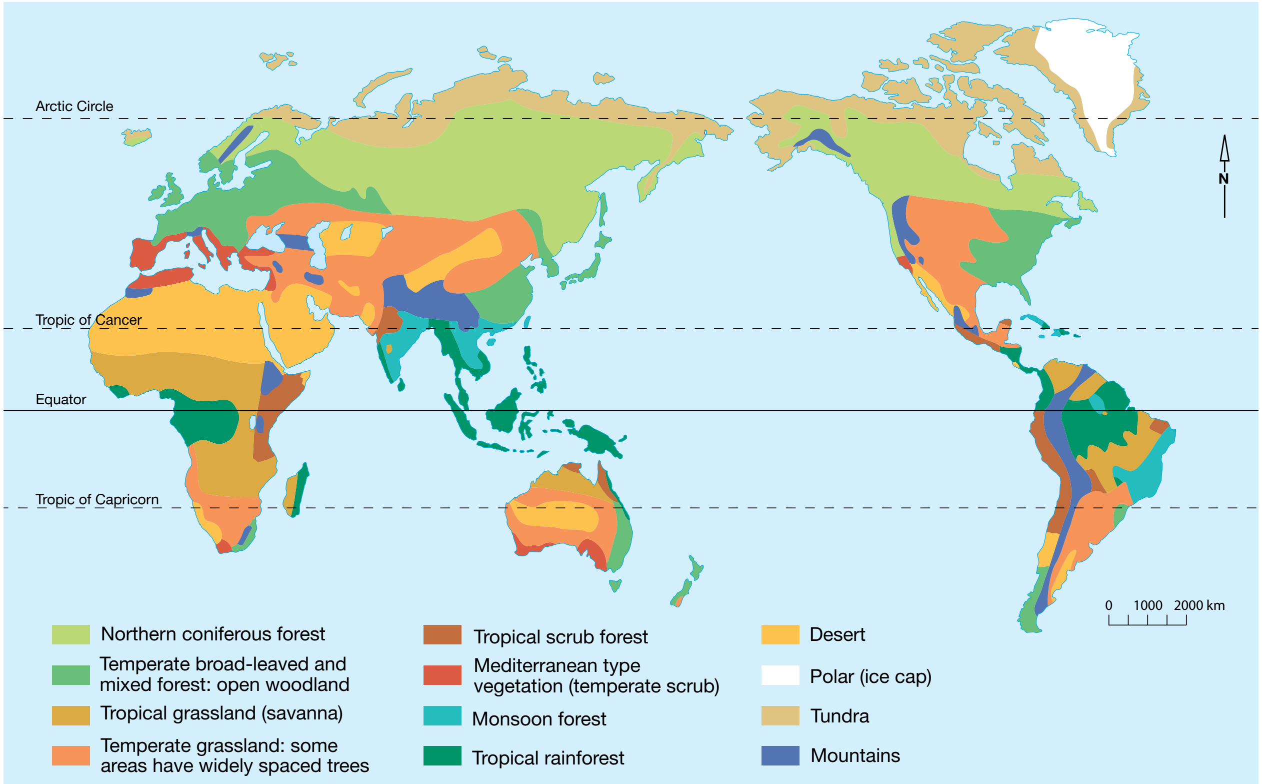
Ecosystems are usually classified according to their dominant feature and are named according to climate (for example, polar ecosystems), physical features (for example, mountain ecosystems) or vegetation (for example, rainforest ecosystems). The smaller the scale of an ecosystem, the more likely it will be named after a physical feature.

Terrestrial ecosystems

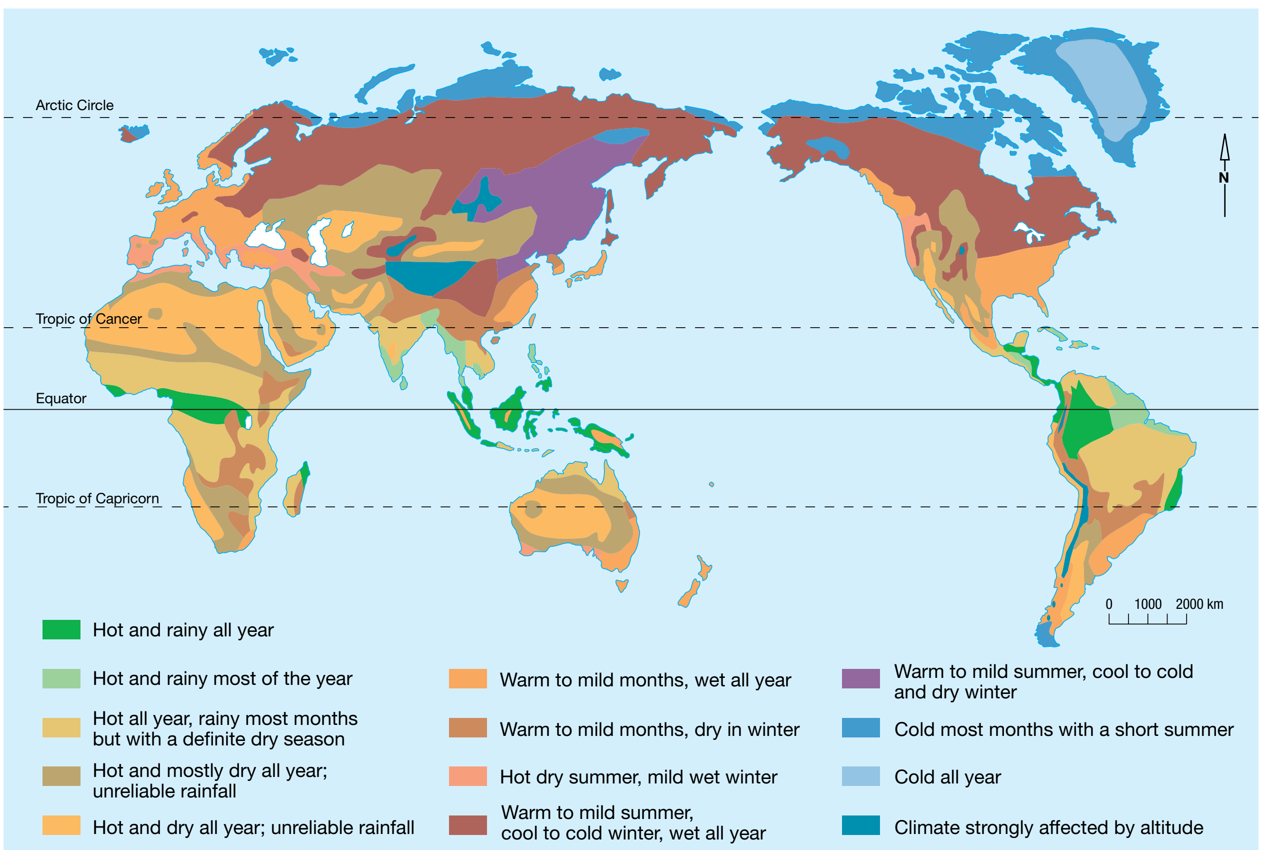
Land-based ecosystems (forests, grasslands and deserts) are called terrestrial ecosystems or biomes. The differences between terrestrial ecosystems arise from variations in average temperature and precipitation, as shown in Figure 1.1.2.

Location of terrestrial ecosystems

The location of terrestrial ecosystems is closely linked to world climate patters as shown in Figures 1.1.3 and 1.1.4.



1.1.3 The world's major terrestrial ecosystems



1.1.4 Worldwide climatic patterns

Characteristics of terrestrial ecosystems

The characteristics of the major terrestrial ecosystems are outlined in Figure 1.1.5.

Characteristics of major terrestrial ecosystems	
Ecosystem	**Characteristics**
Polar	■ Permanent ice cap, in places up to 5 km deep ■ No plant growth; no animal life away from coast
Tundra	■ Covered with ice and snow for much of the year; permanently frozen subsoil; 1–3 month growing season ■ Treeless; shrubby or mat-like vegetation ■ Most extensive in Northern Hemisphere
Northern coniferous forest (taiga)	■ Long winters with a thick cover of snow; short summers but with long, often warm days ■ 3–4 month growing season ■ Dominated by conifer trees; thick layer of needles on the ground ■ Occurs on large continental landmasses
Temperate grassland	■ Erratic rainfall; fires occur ■ Dominated by grasses and annuals (plants that complete their life cycle and set seed within a single growing season) ■ Often exploited for grazing sheep and cattle
Temperate broad-leaved and mixed forest	■ Warm, mild growing season that varies with latitude; moderate precipitation evenly distributed throughout year; large seasonal differences and changes in day length; rich topsoil ■ Some trees evergreen, some deciduous; well-developed understorey
Mediterranean-type vegetation	■ Long, hot, dry summers; mild winters with reliable rainfall; growth often stops in summer drought ■ Open forest with stunted tree growth; woodland and shrubland; many bushes and shrubs; tough evergreen leaves that are often spiny ■ Known as chaparral in North America, *matorral* in Chile and maquis in the Mediterranean area; also found in parts of southern Western Australia and parts of South Africa
Desert	■ Very little rain; true desert has less than 100 mm precipitation per year and arid areas less than 250 mm; high summer daytime temperatures (often >37°C); large temperature difference between day and night ■ Widely scattered shrubs; water-conserving plants and non-drought-adapted ephemerals (which grow and set seed quickly on rare occasions when water is available); some very dry, sandy deserts have almost no plant growth ■ Generally located between 20° and 35° north and south of the Equator
Tropical grassland (savanna)	■ Low rainfall but seasonal heavy storms can occur; frequent fires; thin soil ■ Grasses with scattered clumps of trees, grading into either open plain or woodland
Tropical scrub forest	■ Rainfall not abundant; high evaporation ■ Thorny shrubs and trees ■ Grades into tropical grassland and savanna
Monsoon forest	■ In the tropics but with distinct wet and dry seasons ■ Trees less closely spaced than in rainforest; many trees shed their leaves in the dry season
Tropical rainforest	■ Warm and humid; frequent rain; average temperature is 25°C all year; no true seasons; little change in day length; growth throughout the year; infertile clay soil ■ Closed canopy; little understorey; large number of plant species (great diversity) competing for available light; trees often have large trunks and buttressed roots; many epiphytes (plants that grow on other plants) and vines; little leaf litter
Mountain	■ Increasing altitude produces a decrease in temperature, similar to the effect of increasing latitude ■ Vegetation types vary with altitude; beyond a certain height, trees do not grow and the vegetation resembles tundra

1.1.5 Characteristics of major terrestrial ecosystems

Aquatic ecosystems

Ecosystems that are water based are called aquatic ecosystems. Examples include ponds, lakes, rivers, oceans, coral reefs, estuaries, and coastal and inland wetlands. The differences between aquatic ecosystems arise from variations in the amount of nutrients dissolved in the water, salinity, depth of sunlight penetration, and average temperature.

Size of ecosystems

An ecosystem may vary in size from a small pond to a vast area of rainforest or an entire ocean. Whether large or small, ecosystems rarely have distinct boundaries. This can complicate ecosystem management when there are definite boundaries, such as national parks or international borders. Individual ecosystems blend into adjacent ecosystems via a zone of transition or ecotone. An ecotone contains organisms common to both ecosystems, but may also have organisms unique to that area. As a result, the ecotone often has greater biodiversity than surrounding ecosystems.

The ecosphere

The ecosphere is the collection of living and dead organisms (the biosphere), interacting with one another and their non-living environment. The ecosphere represents the aggregate of the world's ecosystems.

The study of ecology

The study of ecology is concerned with interactions that occur at five levels of organisation: organisms, populations, communities, ecosystems and the ecosphere as shown in Figure 1.1.6.

1.1.6 The various components of the ecosphere are all interrelated. In order to manage these ecosystems sustainably we must first understand the way these components interact.

Organisms

An organism is simply any form of life. While there are a number of ways to classify organisms, the simplest distinction is between producers (plants), consumers (most animals) and decomposers (such as bacteria that feed on dead animal and plant matter). Plants range in size from microscopic, single-celled phytoplankton to the giant sequoia trees of North America. Animals range in size from microscopic zooplankton to the 30-metre-long blue whale. Decomposers range in size from microscopic bacteria to large fungi, such as mushrooms.

Species and populations

A group of organisms of the same species living together is known as a population. Populations are said to be dynamic: over time their size, distribution, age structure and genetic make-up adapt in response to changes in environmental conditions.

A species is a single type of organism that has the ability to reproduce its own kind. Estimates of the number of species on Earth vary from 5 million to 30 million and as high as 50 million. The majority of animal species are insects, mites and nematodes (worms). So far, only 1.4 million species have been identified and named.

Habitats

The area in which an organism or population lives is known as its habitat. The characteristics of a terrestrial (land-based) habitat are determined by the interaction between temperature and precipitation. Together with the soil, this interaction produces an environment that allows a particular combination of life forms to develop. An aquatic habitat is characterised by features such as temperature, nutrient levels, turbidity (light intensity), salinity and water currents.

Communities

Several populations interacting with each other within a particular habitat are called a community. Ecosystems are sometimes defined in terms of communities of plants and animals that live together in a common habitat. An ecosystem can be referred to as the combination of a community and its non-living environment: an ever-changing (dynamic) network of biological, chemical and physical interactions that sustains a community and allows it to respond to changes in environmental conditions.

Activities

Understanding the text

1 Define the term ecology.

2 Explain why ecosystems are described as 'systems through which incoming solar energy is captured and channelled through a hierarchy of life forms'.

3 Distinguish between terrestrial and aquatic ecosystems.

4 Describe the biosphere.

5 Describe the ecosphere. What are its components?

6 Define what is meant by these ecological terms: population, species, habitat and community.

7 Define the terms food chain, and food web.

Working geographically

8 Examine Figures 1.1.3 and 1.1.4. Write a report describing the relationship between the distribution of major terrestrial ecosystems and the world pattern of climate.

9 Study Figure 1.1.5 and select two of the ecosystems listed. Conduct research into these ecosystems and prepare a short report comparing the location, flora and fauna of each.

10 Using Figure 1.1.7 and the information contained in the text, outline the relative productivity of the ecosystems shown in the graph.

Productivity of ecosystems

The productivity of an ecosystem can be expressed in two ways:

- the amount of biomass produced in an area—the mass of new living matter produced per square metre of land (or within a volume of water) per unit of time
- energy flow—the amount of energy (in kilojoules) that is 'locked into' all the organisms in an area per unit of time.

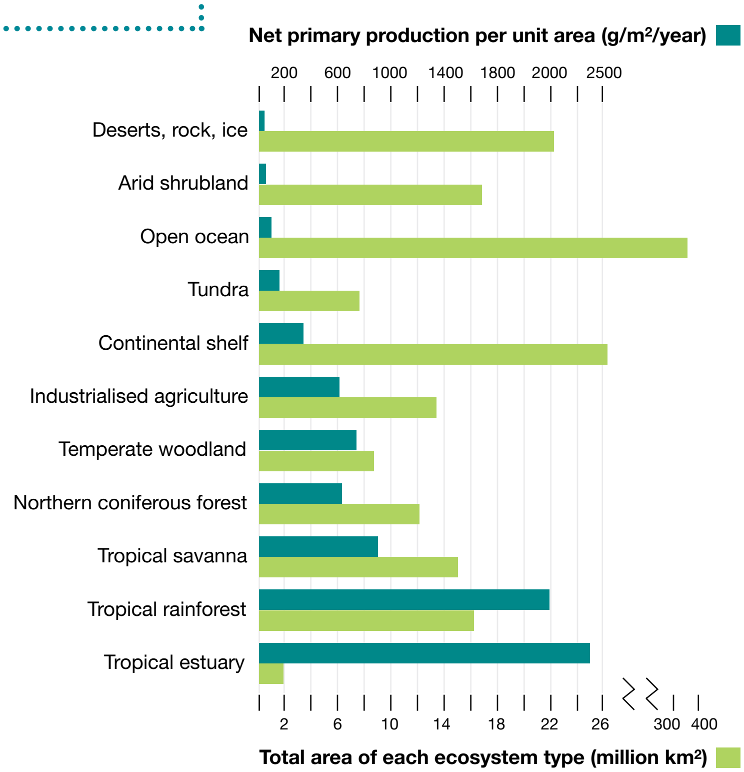
Both rates depend on the quantity of available energy and nutrients in the environment, and the efficiency with which energy and matter are incorporated into producers and passed up the food chain or food web. Figure 1.1.7 compares the productivity of some of the world's major ecosystems.

Energy flows and nutrient cycling

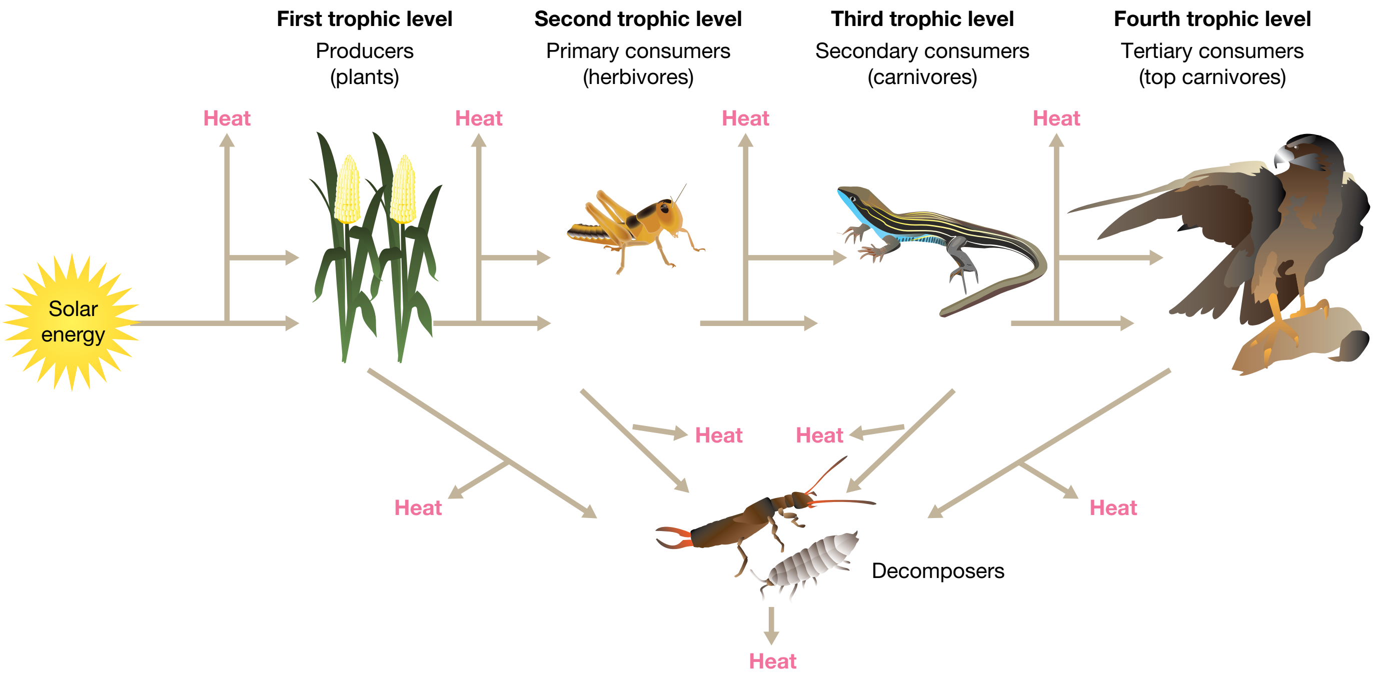
Producers, consumers and decomposers form a chain that facilitates the flow of energy from the Sun, through plants, to animals within the ecosystem. At each level of the food chain, energy (heat) is lost to the atmosphere. Food chains also facilitate the recycling of nutrients from producers, to consumers, to decomposers, then back to producers.

Organisms that share the same types of food in a food chain belong to the same trophic level. Producers belong to the first trophic level, primary consumers to the second, secondary consumers to the third, and so on. A simplified food chain, showing energy and nutrient transfers and the different trophic levels, is shown in Figure 1.1.8.

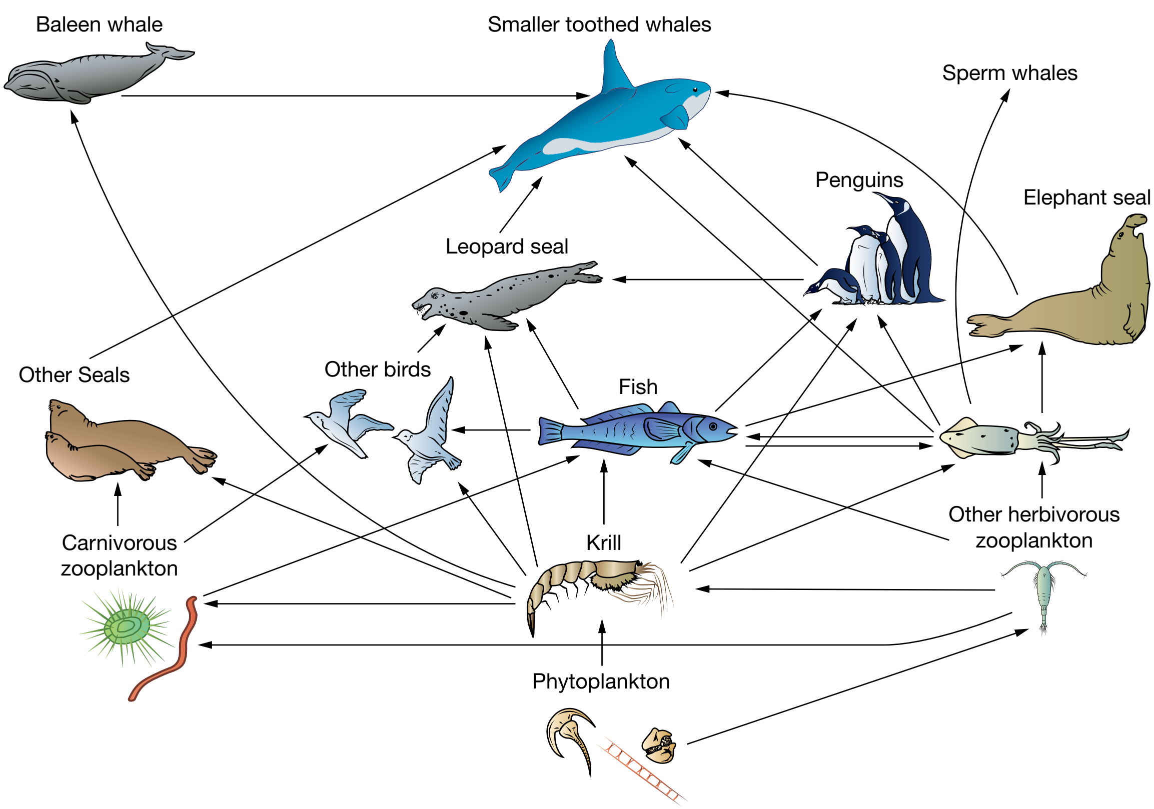
Simple food chains are rare. Organisms in a natural ecosystem are usually part of a complex network of interacting food chains, called a food web as shown in Figure 1.1.9. The various elements of the biome transfer energy by consuming each other: herbivores consume plants and are then, in turn, consumed by carnivores, with carnivores being consumed by larger carnivores.



1.1.7 This graph shows the relative productivity and size of key ecosystems. As the graph indicates, ecosystems of low productivity (such as deserts) require larger areas in order to be sustainable.



1.1.8 This ecosystem model demonstrates the role of solar energy and nutrient transfers within an ecosystem. The Sun is the source of energy in the ecosystem.



1.1.9 This is a simplified food web for Antarctica. In reality food webs are usually highly complex and involve numerous interactions of many smaller food chains.