English Reading for Ecological Environment

生态环境英语阅读

田　耀 ◎主编

天津大学出版社
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前　言

中共十八大以来，习近平总书记从中国特色社会主义事业“五位一体”的总体布局的战略高度，对生态文明建设提出了一系列新思想、新观点、新论断。这些重要论述为实现中华民族永续发展和中华民族伟大复兴的中国梦规划了蓝图，也为建设美丽中国提供了根本原则。2018年4月，习总书记在参加首都义务植树活动时指出，要“像对待生命一样对待生态环境，让祖国大地不断绿起来、美起来”。本着保护生态环境的责任和义务，笔者编写了本书。笔者从众多高质量英文书籍中认真仔细地筛选了30篇生态环保文章。其内容包括生态学的基本定义、生态系统的范围、政治生态学、环境保护运动、雾霾给环境所带来的影响、国际气候正义运动、建设可持续的经济社会、环境与社会的联系、成功的法律法规、文学生态、保护水土资源的重大意义等。其目的是让读者在学习生态英语的同时，可以通过国外学者对生态环境保护的精辟论著，体会生态保护的重大意义，从中吸取西方环保的成功经验，做到洋为中用。

为了帮助读者阅读，笔者将每篇文章的难点句子都做了中文翻译，重要的内容也都做了注释。同时，还在每篇文章末尾设置了思考题，以供读者回顾与掌握。

该书可作为英语专业的专业教材使用，也适用于非英语专业的本科生、研究生作为阅读教材使用，对于提高英语等级考试的阅读能力也有一定的帮助。

编者

2019年5月

Contents

Chapter One

Essential Concepts of Ecology

The science of ecology is the study of ways in which **organisms** interact with each other and with their non-living surroundings. This is a broad field of study that deals with the ways in which organisms are adapted to their surroundings, how they make use of these surroundings, and how an area is altered by the presence and activities of organisms. These interactions involve the flow of energy and matter among organisms. If the flow of energy and matter ceases, the organism will die.

All organisms are dependent on other organisms in some way. One organism may eat another and use it for energy and raw materials. One organism may temporarily use another without harming it. One organism may provide a service for another, such as when animals distribute plant seeds or **bacteria** break down dead **organic matter** for reuse. The study of ecology can be divided into many specialities and be looked at from several levels of organisation. Before we can explore the field of ecology in greater depth, we must become familiar with some of the standard vocabulary of this field.

Everything that affects an organism during its lifetime is collectively known as its **environment**. Environment is a very broad concept. For example, during its lifetime, an animal such as a raccoon (浣熊) is likely to interact with millions of other organisms (bacteria (细菌), food organisms (食物有机体), **parasites**, mates, predator (捕食者)), drink copious amounts of water, breathe huge quantities of air, and respond to daily changes in temperature and humidity. This list only begins to describe the various components that make up the raccoon's environment. Because of this complexity, it is useful to subdivide the concept of environment into abiotic (non-living) and biotic (living) factors.

Abiotic factors are non-living things that influence an organism. They can be organised into several broad categories: energy, non-living matter, and the physical characteristics of the place an organism lives.

Energy is required by all organisms to maintain themselves. The ultimate source of energy for almost all organisms is the sun; in the case of plants, the sun directly supplies the energy necessary for them to maintain themselves. Animals obtain their energy by eating plants or other animals that eat plants. Ultimately, the amount of living material that can exist in an area is determined by the amount of energy plants, **algae**, and bacteria it can trap.

Non-living matter in the form of atoms such as carbon, nitrogen, and phosphorus and molecules such as water provides the structural framework of organisms. Organisms constantly obtain

these materials from their environment. The atoms become part of an organism's body structure for a short time, and eventually all of them are returned to the environment through respiration, excretion, or death and decay.

Physical characteristics of the space organisms inhabit vary greatly. Each space has a structure and location that is also an important abiotic aspect of an organism's environment. Some organisms live in the ocean; others live on land at sea level; still others live on mountaintops or fly. Some spaces are homogeneous and flat; others are a jumble of rocks of different sizes. Some are close to the equator; others are near the poles.

The weather and climate (average weather patterns over a number of years) of an area present several kinds of abiotic factors. These include the amount of **solar radiation**, proximity to the equator, **prevailing wind patterns** and closeness to water. The intensity and duration of sunlight in an area cause daily and seasonal changes in temperature. Differences in temperature generate wind. Solar radiation is also responsible for the evaporation of water into the atmosphere that subsequently falls are precipitation. Depending on the climate, precipitation may be of several forms: rain, snow, hail, or fog. Furthermore, there may be seasonal precipitation patterns.

The kind of soil is determined by prevailing weather patterns, local **topography**, and the geologic history of the region. These factors interact to produce a variety of soils that range from those that are coarse, sandy, dry, and infertile to fertile soils composed of fine particles that hold moisture.

The biotic factors of an organism's environment include all forms of life with which it interacts. Some broad categories are: plants that carry on **photosynthesis**; animals that eat other organisms; bacteria and **fungi** that cause decay; bacteria, **viruses**, and other parasitic organisms that cause disease; and other individuals of the same species.

Although organisms interact with their surroundings in many ways, certain factors may be critical to a species' success. A shortage or absence of a specific factor restricts the success of the species; thus, it is known as a limiting factor. Limiting factors may be either abiotic or biotic and can be quite different from one species to another. Many plants are limited by scarcity of water, light, or specific soil nutrients such as nitrogen or phosphorus. Monarch butterflies are limited by the number of available milkweed plants, since their developing caterpillars use this plant as their only food source.

Climatic factors such as temperature range, humidity, periods of drought, or length of winter are often limiting factors. For example, many species of snakes and lizards are limited to the warmer parts of the world because they have difficulty maintaining their body temperature in cold climates and cannot survive long period of cold. If we look at the number of species of snakes and lizards, we see that the number of species declines as one moves from warmer to colder climates.

While this is general trend, there is much variation among species. The range of tolerance of a species is the degree to which it is able to withstand environmental variation. Some species have a broad range to tolerance, whereas others have a narrow range of tolerance.

It is important to understand an organism apart from its environment. The environment influences organisms, and organisms affect the environment. To focus attention on specific elements of this interaction, ecologists have developed two concepts that need to be clearly understood: habitat and niche.

The habitat of an organism is the space that the organism inhabits, the place where it lives (its address). We tend to characterise an organism's habitat by highlighting some prominent physical or biological feature of its environment such as soil type, availability of water, climatic conditions, or predominant plant species that exist in the area. For example, mosses (苔藓) are small plants that must be covered by a thin film of water in order to reproduce. In addition, many kinds dry out and die if they are exposed to sunlight, wind, and drought. Therefore, the typical habitat of moss is likely to be cool, moist, and shady. Likewise, a rapidly flowing, cool, well-oxygenated stream with many bottom-dwelling insects (底栖昆虫) is good trout habitat (鳟鱼息地), while open prairie (广阔的大草原) with lots of grass is preferred by bison (野牛), prairie dogs (土拨鼠), and many kinds of hawks (老鹰) and falcons (隼). The particular biological requirements of an organism determine the kind of habitat in which it is likely to be found.

The niche of an organism is the functional role it has in its surroundings (its position). A description of an organism's niche includes all the ways it affects the organisms with which it interacts as well as how it modifies its physical surroundings. In addition, the description of a niche includes all of the things that happen to the organism. For example, beavers (河狸) frequently flood areas by building dams of mud and sticks across streams. The flooding has several effects:it provides beavers with a larger area of deep water, which they need for protection; it provides a pond habitat for many other species of animals such as ducks and fish; and it kills trees that cannot live with their roots under water. The animals that are attracted to the pond and the beavers often become food for predators. After the beavers have eaten all suitable food, such as aspen (白杨木), they abandon the pond, migrate to other areas along the stream, and begin the whole process over again.

Notes

1. The science of ecology 生态科学：指的是研究生命系统与环境相互作用规律的学科。在生态学系统中，生命系统通常包括生物个体、种群、群落和生态系统等几个层次，而环境变化和污染会对生命系统造成严重的影响。当前，生态科学研究的重点包括生物多样性的保护和作用、受害生态系统的恢复和重建、全球变暖对陆地生态系统的影响以及生态系统的管理等。1987 年，联合国世界环境与发展委员会发表了题为《我们共同的未来》的研究报告。报告深刻检讨了“唯经济发展”理念的弊端，全面论述了 20 世纪人类面临的和平、发展、环境三大主题之间的内在联系，并提出将它们作为可持续发展的内在目标来追求，这是人类建构生态文明的第一个国际文献，也是这一学科在世界发展史上的一个辉煌成就。

2. Organism 生物体：生物体的物质基础是在其基本组成物质中都含有蛋白质和核酸。生物体的结构基础是除病毒等少数种类以外，生物体都是由细胞构成的。病毒不具备细胞

结构，需要依赖于寄主细胞才能进行繁殖，所以生命都需要细胞来表现，病毒等也不例外。生物体的基本特征如下：生物体都有新陈代谢作用、生长现象、应激性；生物体都能生殖发育；生物体都有遗传和变异的特性；生物体都能适应一定的环境，也能影响环境；生物体需要从外界摄取营养物质；生物体都有可塑性；生物体都能呼吸。这些基本特征是判断、区别生物与非生物的重要标志。生物体分为动物、植物、细菌、真菌、病毒五大类，每一类又可以细分，依次是界、门、纲、目、科、属、种等。

3. Bacteria 细菌：是生物的主要类群之一，属于细菌域；也是所有生物中数量最多的一类。细菌的结构分为基本结构和特殊结构：基本结构是各种细菌都具有的结构，包括细菌的细胞壁、细胞膜、细胞质、核质；某些细菌特有的结构称为特殊结构，包括细菌的荚膜、鞭毛、菌毛、芽孢。细菌的形状相当多样，主要有球状、杆状以及螺旋状。细菌主要以无性二分裂方式繁殖（裂殖），即细菌生长到一定时期，在细胞中间逐渐形成横隔，由一个母细胞分裂为两个大小相等的子细胞。细胞分裂是连续的过程，有些细菌分裂后的子细胞分开形成单个的菌体，有的则不分开，形成一定的排列方式。细菌也对人类活动有很大的影响：一方面，细菌是许多疾病的病原体，包括肺结核、淋病、梅毒、鼠疫等都是由细菌所引发的；另一方面，人类也时常利用细菌，例如乳酪及酸奶和酒酿的制作、部分抗生素的制造、废水的处理等。在生物科技领域中，细菌也有着广泛的运用。

4. Organic matter 有机物：是生命产生的物质基础。狭义的有机化合物主要是由碳元素、氢元素组成，是一定含碳的化合物，但是不包括碳的氧化物（一氧化碳、二氧化碳）、碳酸、碳酸盐、氰化物、硫氰化物、氰酸盐、金属碳化物、部分简单含碳化合物等物质。有机化合物都是含碳化合物，但是含碳化合物不一定是有机化合物。所有的生命体都含有机化合物，例如脂肪、氨基酸、蛋白质、糖、血红素、叶绿素、酶、激素等。生物体内的新陈代谢和生物的遗传现象都涉及有机化合物的转变。此外，许多与人类生活密切相关的物质，如石油、天然气、棉花、染料、化纤、塑料、有机玻璃、天然和合成药物等都离不开有机化合物。最简单的有机化合物是甲烷（CH_4），在自然界的分布很广，是天然气、沼气、煤矿坑道气等的主要成分，俗称“瓦斯”。有机化合物对人类具有重要意义，地球上所有的生命形式主要是由有机物组成的，有机物对人类的生命、生活、生产有极其重要的意义。

5. Environment 生态环境：就是“由生态关系组成的环境”的简称，是与人类密切相关的、影响人类生活和生产活动的各种自然（包括人工干预下形成的第二自然）力量（物质和能量）或作用的总和，也是影响人类生存与发展的水资源、土地资源、生物资源以及气候资源数量与质量的总称，是关系到社会和经济持续发展的复合生态系统。生态是指生物（包括原核生物、原生生物、真菌、动物、植物五大类）之间和生物与周围环境之间的相互联系、相互作用。常见的生态环境有热带雨林、热带季雨林、亚热带常绿阔叶林、亚热带常绿硬叶林（地中海沿岸）、温带落叶阔叶林、温带针阔混交林（欧洲西部）、亚寒带常绿针叶林、苔原带以及冰原带。由于人类利用自然的不合理，对环境造成的污染和破坏日趋严重。因此，环境问题已成为世界普遍关心的问题，也是人类社会为了生存和持续发展必须解决的问题。全球气候变暖、臭氧层的耗损与破坏、生物多样性减少、酸雨蔓延、森林锐减、危险性废物越境转移以及各种污染还有待人类去研究与补救。

6. Parasites 寄生虫：是指具有致病性的低等真核生物，可作为病原体，也可作为媒介传

播疾病。其特征为在宿主或寄主体内或附着于体外以获取维持其生存、发育或者繁殖所需的营养或者庇护的一切生物。许多小动物以寄生的方式生存，依附在比它们更大的动物身上。寄生虫可以改变寄主的行为，以达到自身更好地繁殖、生存的目的，例如人类若有一些寄生在脑部的寄生虫，反应能力就会降低。寄生生命链主要有三种生存方式：共栖（两种生物在一起生活，其中一方受益，另一方既不受益也不受害）、互利共生（两种生物在一起生活，在营养上互相依赖，长期共生，双方受益）、寄生（两种生物在一起生活，其中一方受益，另一方受害，后者给前者提供营养物质和居住场所）。在寄生关系中，受益的一方称为“寄生物”，受损害的一方称为“宿主”。在日常生活中，人类应该经常通过定期清洁身体、定期流通人体所在环境的空气、定期清洁人体所接触到的物品以及避免食用无保障或过保质期的食品来预防寄生虫可能带来的危害。

7. Algae 藻类：是指原生生物界一类真核生物（有些也为原核生物，如蓝藻门的藻类），主要水生，无维管束，能进行光合作用。体型大小各异，小至长 1 微米的单细胞鞭毛藻，大至长达 60 米的大型褐藻。一些权威专家将藻类归入植物或植物样生物，但藻类没有真正的根、茎、叶，也没有维管束。藻类的概念古今不同，中国古代所说的藻类是对水生植物的总称；而在中国现代的植物学中，仍然将一些水生高等植物的名称中贯以“藻”字，如金鱼藻、黑藻、茨藻、狐尾藻等。与此相反，人们往往将一些水中或潮湿的地面和墙壁上个体较小、黏滑的绿色植物统称为青苔，实际上这也不是现在所说的苔类，而主要是藻类。藻类植物并不是一个纯一的类群，各分类系统对它的分门也不尽一致，一般分为蓝藻门、眼虫藻门、金藻门、甲藻门、绿藻门、褐藻门、红藻门等。原核生物界中的藻类有蓝绿藻和一些生活在无机动物中的原核绿藻。属于原生生物界中的藻类有甲藻门（或称涡鞭毛藻）、隐藻门、金黄藻门（包括硅藻等浮游藻）、红藻门、绿藻门和褐藻门。而生殖构造复杂的轮藻门则属于植物界。属于大型藻者一般仅有红藻门、绿藻门和褐藻门等，为肉眼可见固着性藻类，此类大型藻类几乎栖息于海水环境中，故多以海藻称之。

8. Solar radiation 太阳辐射：是指太阳以电磁波的形式向外传递能量，即太阳向宇宙空间发射的电磁波和粒子流。太阳辐射所传递的能量，称太阳辐射能。地球所接收到的太阳辐射能量虽然仅为太阳向宇宙空间放射的总辐射能量的二十二亿分之一，但却是地球大气运动的主要能量源泉，也是地球光热能的主要来源。太阳辐射在大气上界的分布是由地球的天文位置决定的，故称此为天文辐射；到达地球大气上界的太阳辐射能量称为天文太阳辐射量。由天文辐射决定的气候称为天文气候。天文气候反映了全球气候的空间分布和时间变化的基本轮廓。太阳辐射能作为地球最主要的能量来源和基本动力，推动了地表的几乎全部自然地理过程，使地理环境得以形成和有序发展，同时也是动植物生长活动的最主要动力；太阳紫外辐射还在大气中形成臭氧，从而维护了地球生物圈的安全；太阳辐射在大气中形成的电离层，使世界的现代通信成为可能；人类社会最重要的能源——水能、风能、煤和石油，也都是由太阳能直接转化或经过有机体长期积累和化石化过程转化而成。

9. Prevailing wind patterns 地区常见的风模式：是指一个特定区域中通常的风力等级（0 级无风—17 级超强台风）、风向（北、东北、东、东南、南、西南、西、西北）、风类型（阵风、旋风、台风、龙卷风、季风等）。中国位于亚洲大陆东部，濒临太平洋，季风强盛，内陆还有许多山系，地形复杂，加之青藏高原耸立在西部，改变了海陆影响所引起的气压分布和大气环

流，增加了中国季风的复杂性。冬季风来自西伯利亚和蒙古等中高纬度的内陆，那里空气十分严寒干燥，冷空气积累到一定程度，在有利高空环流引导下，就会爆发南下，俗称寒潮，在此频频南下的强冷空气控制和影响下，寒冷干燥的西北风侵袭中国北方各省（自治区、直辖市）。每年冬季总有多次大幅降温的强冷空气南下，主要影响中国西北、东北和华北，直到次年春夏之交才消失。夏季风是来自太平洋的东南风、印度洋和南海的西南风，东南季风影响遍及中国东部，西南季风则影响西南各省和南部沿海，但风速远不及东南季风快。热带风暴是太平洋西部和南海热带海洋上形成的空气涡漩，是破坏力极大的海洋风暴，每年夏秋两季频繁侵袭中国，登陆中国南海之滨和东南沿海，热带风暴也能在上海以北登陆，但次数很少。

10. Topography 地形学：也叫地貌学，是自然地理学与地质学之间的学科，是研究地表形态特征及其发生、发展和分布规律，以便在人类的经济活动中利用自然、改造自然，并与其所造成的灾害进行斗争的学科。其研究内容包括地球表面形态和形成动力的分析，地球表面形态的发生、发育规律和组成地貌的沉积物的研究。地形学对矿产普查与勘探、建筑道路、各种工程、土壤改良、水土保持、地形测量、地质调查、区域规划、农业、地图编制以及国防建设等，具有重要的实际意义。按研究内容的不同，地形学可分为普通地貌学、区域地貌学、部门地貌学、应用地貌学和地貌制图学等。随着人类社会经济的发展，对地球表面地貌的影响也日益增强，比如地面沉降、土壤侵蚀、滑坡泥石流灾害、大坝地震等。这些负面效应已引起地形学研究者的广泛关注。

11. Photosynthesis 光合作用：即光能合成作用，是指含有叶绿体的绿色植物和某些细菌，在可见光的照射下，经过光反应和碳反应，利用光合色素，将二氧化碳（或硫化氢）和水转化为有机物，并释放出氧气（或氢气）的生化过程，同时也是将光能转变为有机物中化学能的能量转化过程。光合作用是一系列复杂的代谢反应的总和，是生物界赖以生存的基础，也是地球碳—氧平衡（即二氧化碳与氧气的平衡）的重要媒介。光合作用可分为产氧光合作用和不产氧光合作用。对于生物界的几乎所有生物来说，这个过程是它们赖以生存的关键。

12. Fungus 真菌：在拉丁文中原意是蘑菇，是一种真核生物。最常见的真菌是各类蕈类，另外真菌也包括霉菌和酵母。现在已经发现了 7 万多种真菌，估计只是现存的一小部分。大多真菌原先被分入动物或植物，现在真菌自成一门，与植物、动物和细菌相区别。真菌和其他三种生物最大的不同之处在于，真菌的细胞有以甲壳素为主要成分的细胞壁，而植物的细胞壁主要由纤维素组成。真菌是生物界中很大的一个类群，世界上已被描述的真菌约有 1 万属 12 万余种（属与种都是单位，且属大于种）。真菌的细胞既不含叶绿体，也没有质体，是典型异养生物。它们从动物、植物的活体、死体和它们的排泄物以及断枝、落叶和土壤腐殖质中吸收和分解其中的有机物，作为自己的营养。真菌的异养方式有寄生和腐生。真菌常为丝状和多细胞的有机体，其营养体除大型菌外，分化很小。高等大型菌有定型的子实体。除少数例外，真菌都有明显的细胞壁，通常不能运动，以孢子的方式进行繁殖。常见的真菌感染多为白色念珠菌、阴道纤毛菌、放线菌等。盐水涂片中注意寻找真菌孢子、菌丝或纤毛菌丛。

13. Viruses 病毒：是由一个核酸分子（DNA 或 RNA）与蛋白质构成的非细胞形态，靠寄

生生活的介于生命体及非生命体之间的有机物种。它是没有细胞结构的特殊生物体，是由一个保护性外壳包裹的一段 DNA 或者 RNA。借由感染的机制，这些简单的有机体可以利用宿主的细胞系统进行自我复制，但无法独立生长和复制。病毒可以感染几乎所有具有细胞结构的生命体。第一个已知的病毒是烟草花叶病毒，由马丁乌斯·贝杰林克于 1899 年发现并命名，迄今已有超过 5 000 种类型的病毒得到鉴定。病毒大约是细菌大小的百分之一。有一些病毒能诱发良性肿瘤，如痘病毒科的兔纤维瘤病毒、人传染性软疣病毒和乳多泡病毒科的乳头瘤病毒；另有一些能诱发恶性肿瘤，按其核酸种类可分为 DNA 肿瘤病毒和 RNA 肿瘤病毒。但是，病毒大概不是唯一的病因，环境和遗传因素可能起协同作用。病毒感染常发生在感冒等上呼吸道感染后，病毒可由血循环直接进入内耳血循环中，破坏耳蜗毛细胞、神经节细胞及微血管等结构。病毒亦可经圆窗侵入内耳，引起迷路炎等病损，进而引起耳聋。

Translations of Selected Sentences

1. Environment is a very broad concept. For example, during its lifetime, an animal such as a raccoon is likely to interact with millions of other organisms (bacteria, food organisms, parasites, mates, predators), drink copious amounts of water, breathe huge quantities of air, and respond to daily changes in temperature and humidity.

生态环境是一个非常宽泛的概念。例如，像浣熊这样的动物在其一生中可能会与其他千万种生物（细菌、食物有机体、寄生虫、同伴、捕食者）相互影响，会饮用大量的水，会呼吸大量的空气，会应对每日温度和湿度的变化。

2. The atoms become part of an organism's body structure for a short time, and eventually all of them are returned to the environment through respiration, excretion, or death and decay.

原子会在短时间内成为生物体身体结构中的一部分，并且最终会通过呼吸、排泄，或者死亡与腐烂回归到生态环境中去。

3. The biotic factors of an organism's environment include all forms of life with which it interacts. Some broad categories are: plants that carry on photosynthesis; animals that eat other organisms; bacteria and fungi that cause decay; bacteria, viruses, and other parasitic organisms that cause disease; and other individuals of the same species.

一个生物体所在生态环境中的生物因素包括与其相互作用的各种生命形式。其中一些大类包括：进行光合作用的植物；捕食其他生物体的动物；导致腐烂的细菌和真菌；引起疾病的细菌、病毒和其他寄生生物以及同一物种的其他个体。

4. Therefore, the typical habitat of moss is likely to be cool, moist, and shady. Likewise, a rapidly flowing, cool, well-oxygenated stream with many bottom-dwelling insects is good trout habitat, while open prairie with lots of grass is preferred by bison, prairie dogs, and many kinds of hawks and falcons.

因此，典型的苔藓栖息地大概就是凉爽的、潮湿的和阴暗的。同理，一条流速快、冰凉、富氧并伴有许多底栖昆虫的溪流，就是一块儿很好的鳟鱼栖息地；而广阔且牧草茂盛的大草原则更适合野牛、土拨鼠以及各种鹰和隼。

Questions

1. Describe what the science of ecology studies.

2. What does the ecological term "environment" include?

3. How does a habitat of trouts differ from that of bison?

Chapter Two

The Scope of Ecology

The field of ecology can be considered as the study of the interactions between organisms and their environment. Strictly speaking, the word ecology refers to the study of these interactions, but in common usage it may refer to the interactions themselves, as in the phrase "an organism's ecology".Ecologists may focus on the environmental interactions of an entire species, of populations of the species, or of individual organisms. Note that the environment consists of both biotic (living) and abiotic (non-living) components.

If we consider the interactions we might observe in other, very different systems—a tropical rain forest, a desert, **the Galápagos Islands**, or a meadow near timberline in **the Rocky Mountains**—we see that each system has its own complex web of interactions. To some extent, ecology is a tremendously diverse field that encompasses a wonderful variety of questions about biological phenomena.

Ecology and Levels of Biological Organization

Biologists tend to organize biological principles and phenomena into a hierarchy. Each level is more inclusive than the one below; cells are made of organelles(细胞器官), tissues are composed of cells, and so forth. Ecologists are primarily interested in the levels of this hierarchy from the organism through the ecosystem. Thus, ecology is a science that examines the most complex levels of biological organization. This accounts for the tremendous diversity of interactions included in the field of ecology.

Subdisciplines in Ecology

Ecology can be subdivided according to the levels of the biological hierarchy. Thus, the word organism might refer to any of the higher levels of the hierarchy—from the individual to the ecosystem. The interactions between the individual organism and its environment are termed auto ecology. Often the focus of auto ecology is the physiological response of the individual to the abiotic environment.

Population ecology examines interactions that occur between a population and its environment. A population is a group of individuals that belong to the same species and inhabit a particular locale. We define a species as a group of actually or potentially interbreeding individuals. Thus, the population of ecologist is concerned with a portion of a species and the interactions in

which it participates. A population of ecologist studying our prairie（大草原）stand，for example，might ask how the size of the vole population is regulated and controlled，or might wonder why some populations of prairie plants reproduce primarily by seed，whereas others reproduce vegetatively. These are ecological questions framed at the population level of organization.

Community ecology studies interactions among the populations of all species living in an area at a particular time，which together constitute the community. If a prairie stand does not burn frequently，forest eventually encroaches into the grassland. The progression of species replacement leading to forest is called succession. This web of interactions leading to forest is a community-level phenomenon. The number of plant species in the prairie is determined in part by the competitive interactions among the species of grass. Like succession，competition represents a community-level interaction.

Ecosystem ecology is the study of the most inclusive interactions，those among all the biotic（living）and abiotic（non-living）components of the system. An ecosystem thus includes both the community and its physical environment. The exchange of carbon dioxide among the atmosphere，the oceans，plants，and animals are an example of a global ecosystem-level interaction. Moreover，ecosystem interactions also occur on a smaller spatial scale. For example，the cycling of **phosphorus**—its release from grasses by the prairie fire and deposition into the soil，its incorporation into new grasses，its consumption by voles，and its return to the soil in faces—is also an ecosystem interaction.

Modern ecology has also developed a number of subdisciplines that focus on highly specialized facets of the science. For example，**physiological ecology** examines the ways that the bodily processes of organisms are adapted to the physical environment. **Genetic ecology** is the study of the ways in which an organism's ecology shapes its heredity（遗传）and the ways in which genes influence ecological processes. Another approach to ecological interactions，**systems ecology**，emphasises **mathematical modelling** of the interactions among the components of an ecological system，particularly the movement of energy and materials among the biotic and abiotic components of an ecosystem. A relatively new field，**landscape ecology**，focuses on the spatial patterns of ecological processes.

Sciences Allied to Ecology

Three fields of scientific study are closely related to ecology：natural history，environmental science，and resource management science.

Natural history is the study of the habits，behaviours，and interactions of organisms in their natural environments. Although natural history and ecology are intimately related，they differ in that modern ecologists generally attempt to test an explicit hypothesis，whereas natural historians tend to focus on the descriptive study of natural phenomena. Thus，in natural history，the description itself is the goal. Often that description raises ecological questions or provides the background information needed for further ecological research.