※ 以下題目請在「非選擇題作答區」作答

I. 中文翻譯：請將下文中十五個劃底線的粗體中文辭彙翻譯成英文，所有翻譯必須配合其原文文義，以小寫印刷體書寫，潦草者不予計分。所有的辭彙均以名詞回答，必須拼字正確才能得分。

氣候變遷，包括大氣中 CO_2 濃度的增加，氣溫升高，降雨模式的改變，及水患、乾旱及風災等事件發生的頻度與強度增加等環境因子的變化，對生物多樣性的衝擊，主要在於直接影響生物的生理調適，包括光合作用，呼吸作用，蒸散作用，分解作用，固氮作用等速率與效能的改變，進而影響生態系中養分循環、能量流動，植物的初級生產力、生長及開花結實等物候，連帶影響利用植物的動物及其他生物。由於不同物種對環境因子的耐受範圍不同，當環境因子發生改變時，有些物種可能因為更適合新的環境條件而得以取得生存優勢，甚至擴張分布範圍；有些物種則會逐漸調適演化適應新的環境因子而留在當地，或藉由播遷分布到環境較適合的地區繼續活存；但是更多的生物可能因為無法即時調適，或遷移到適當的地區而數量減少、分布縮小，甚至滅絕。因此氣候變遷可能導致一地區物種組成、數量、分布的變化，而這些變化有可能進一步影響各地生態系內原有的競爭、捕食、共生或寄生等互動關係，而導致更多物種的消失。

英譯詞彙 (每題 2 分)

1.氣候變遷	2.生物多樣性	3.光合作用	4.呼吸作用	5.蒸散作用
6.分解作用	7.固氮作用	8.養分循環	9.能量流動	10.初級生產力
11.物候	12.競爭	13.捕食	14.共生	15.寄生

II. 英文翻譯：請將下文中的十個劃底線的粗體英文辭彙翻譯成中文，所有的翻譯必須配合其原文文義。全部以正楷書寫，潦草者不予計分。

The National Ecological Observatory Network (NEON) is sponsored by the U.S. National Science Foundation (NSF) to gather long-term data on ecological responses to changes in land use and climate, and on **feedbacks** with the geosphere, **hydrosphere**, and atmosphere. NEON concentrates intensive data collection of a large suite of **variables** at a relatively small number of sites (60) to link forcings and responses in ecological systems. This design sets NEON apart from most existing biological **monitoring** networks. NEON will consist of distributed **sensor** networks and experiments, linked by advanced cyberinfrastructure to record and **archive** ecological data and samples of organisms and **substrates** (litter, soil, and water) for at least 30 years. Biological observations in NEON will cover a wide range of areas including sampling for selected taxa, population **dynamics** for those groups, infectious disease, biogeochemistry, etc. Using standardized **protocols** and an open data policy, NEON will gather essential data for developing scientific understanding and theory that address basic questions in biology and issues relevant to ecosystem management. Data collection and analysis will lead to data products that enable **forecasting** of the future states of ecosystems through open access community models.

中譯詞彙 (每題 2 分)

1.**feedbacks**	2.**hydrosphere**	3.**variables**	4.**monitoring**	5.**sensor**
6.**archive**	7.**substrates**	8.**dynamics**	9.**protocols**	10.**forecasting**

III. Multiple choice questions. Select only ONE best answer to each question (2% for each, 28% totally).

A. The zero-sum game for the limited surface of Earth has an overwhelming favorite – humans and their well-being, broadly writ. Biodiversity and habitat conservation to support the shrinking array of species may win minor battles in the competition for solar energy and physical space, but biodiversity will lose the war, as long as humanity continues to grow. This conclusion is not new, but recent sobering news about population trends, climate change, and mitigation proposals reinforces it.

Over the past decade, the United Nations has raised its medium population projection for 2050 from 8.9 to 9.2 billion (the current population is 6.8 billion). More disturbing is that those UN projections are based on the unfounded and unlikely core assumption that the "total fertility rates" of all countries will mathematically converge at 1.85 children per woman shortly after 2050 and then hold steady. In a world where national fertility rates range from 1 to 7 children, a spread similar to the norm in the 20th century, it boggles the mind to envision reproductive conformity within a few decades, let alone a long-term global below-replacement fertility level of 1.85. For decades, UN demographers used 2.1 as the "magic number" to which all societies would inevitably hew, but they lowered that by a quarter child last decade, after observing that many European and Asian countries had not actually towed the modelers' line and halted their fertility slide at 2.1, instead falling to 1.5 or below. The demographers' overreaction was to cut the global fertility projection to 1.85.

見背面

What does this have to do with biodiversity? A great deal. Almost every conservation plan outside of zoos depends on safeguarding sufficient habitat to support viable populations and ecosystems over the long run, through the calamities of an erratic planet. Biodiversity cannot become more space- and energy-efficient the way humans often have. Conservationists can sometimes overcome habitat loss and genetic bottlenecks and prevent extinctions by artificial techniques, such as captive breeding programs, invasives management, and ecosystem manipulations, but such solutions are expensive, risky, and temporary. In a crowded and climate-challenged world, conservation competes with both human food and solar/biofuel energy for surface area and sunlight.

Space is still the final frontier, and we are the champions of the world, growing by 79 million people per year, continuing that pace for at least another two decades, even under the rosy UN assumptions. The projected decline in growth later this century depends entirely on two unrealized dreams: universal access to and use of effective contraception and a global desire to average less than two children per family. We are far from achieving the former – roughly half of pregnancies, even in the US, are unintended. As to the latter, desired family size in many key developing countries is still 3 to 7 children and barely budging. Yet global interest and funding for slowing population growth are declining.

But won't human ingenuity overcome these demographic challenges, as we perpetually find ways to do more with less space and energy? Probably not. In the past 40 years, every global gain in energy efficiency has been accompanied by increases in affluence. Global and US per capita CO_2 emissions are almost exactly what they were in 1970. Emissions have grown with population, which has almost doubled. If we slow fossil-fuel use to protect the climate, we have to go back to the land (and water) for energy – and the zero-sum game.

1. The zero-sum game means
   A. a situation in which what is gained by one group is also gained by another group.
   B. a situation in which what is lost by one group is also lost by another group.
   C. a situation in which what is gained by one group is gained by another group.
   D. a situation in which what is gained by one group is lost by another group.

2. As long as human population continues to grow,
   A. the world gets smaller.
   B. the ecosystem provides much more services.
   C. the global change issue becomes less severe.
   D. the population requires many food, use higher energy, and potentially damage to ecosystems.

3. What is the main idea in the article?
   A. The space needed to preserve remaining biodiversity is more or less fixed.
   B. The major demands – food, fiber, wood, and fuel – must continuously become more space-efficient, as population grows.
   C. To give biodiversity a fighting chance, ecologists and everyone else must focus attention on managing the population of our own species
   D. When our own well-being is at stake, humanity will put people first.

B. If you're already worried about plastic – the fossil fuels used to make it, the toxins leaching from it, and the billions of fragments of it gathering in the ocean – 'tis the season to freak out. So, what with all those gifts flying between stores and homes, it seemed like a good time to check on progress with "green plastic", the innovation billed as a solution to some of the planet's most intractable crises.

Back in 2002, William McDonough and Michael Braungart, writing in the book, *Cradle to Cradle: Remaking the Way We Make Things*, envisioned a day when consumers could toss a plastic bottle from a car window without angst – knowing it would decompose on the side of the road, and possibly even sprout a (preferably native) plant from a seed contained within. The problem with plastic, they argued, was a matter of design and therefore easy enough to change. Or was it?

The bottom line is that we are still nowhere near the realization of that guilt-free vision, and there is dispute over how much "real" progress we've made. Seeking clarity, I spoke recently with a "bioplastic" booster, an industry critic, and an investigative journalist writing a book on plastic pollution. The booster was Greg Hoffman, CEO of Ecospan, a pioneering company based in the woodsy northern California town of Larkspur. Ecospan uses existing petrochemical plastic factories to produce various durable "green" products from clamshell containers to credit cards, with poly-lactic acid (PLA) derived from plants. The firm is engineering "closed-loop" deals with companies willing to recover and recycle the products –including a venture with Apple Inc to make packaging for shipping iPods in need of repair between stores and factories. "We've done a ton of R&D, and we're ready for primetime", Hoffman told me.

The raw material comes from NatureWorks, owned by the Cargill. It is produced in the world's largest biopolymer plant, in the cornlands of Blair, Nebraska, and is already being used to make "green" drinking cups and food packaging. NatureWorks claims its PLA production now uses one-third of the total fossil fuels required for manufacturing conventional plastic. The PLA bioplastic is also certified as compostable by the non-profit, Biodegradable Products Institute. Beyond that, Ecospan says no toxic additives are used in its products.

接次頁

I hung up the phone with a happy sigh. But then I called the critic: Tillman U Gerngross, a Dartmouth College engineering professor who worked in bioplastics for 7 years before publicly denouncing its "green" claims in a story published in 2000 in *Scientific American*. Gerngross remains skeptical about claims that the industry can reduce plastic's greenhouse-gas emissions. He is also concerned about the potential for overuse of agricultural land, as has been feared with ethanol production, if corn remains the main PLA source. And then there's the fact that the bulk of US corn is now genetically modified – meaning that support for "green" plastic means support for genetically modified monocultures. Finally, plant-based plastics emit methane – a major greenhouse gas – when they degrade in landfills.

At this point, I was both freaked out and confused. So my last call was to someone I hoped could set me straight: the author Susan Freinkel, who is writing a book about plastic. Freinkel gave me her own bottom line. "This stuff is being sold as 'green' plastic, but that word – 'green' – has ceased to have meaning", she said. The range of problems with plastic is too broad, and the touted substitutes too new, for anyone to assume we'll have guilt-free products any time soon. Freinkel wanted to know more about Ecospan's claim that it avoids harmful additives, since all plastic products require some chemicals for flexibility and ultraviolet radiation protection, among other things, and that toxics from these pose dangers as carcinogens and endocrine disruptors. When I called Ecospan back to ask more about its "natural" ingredients, however, its chief financial officer, Jeff Silver, said he couldn't describe or name them, for proprietary reasons.

Another big question mark, as Freinkel pointed out, is consumer behavior. Ecospan deserves praise for organizing closed-loop arrangements. But how far can these business-to-business deals be extended, as bioplastic production expands from what is now a tiny fraction of a $1 trillion global market? The material is technically "compostable", but only in commercial facilities. For now, a lot of it is getting inadvertently mixed up in plastic refuse destined for mainstream recycling – to the despair of the mainstream recyclers, who for now have no means of handling it. Can consumers really be trained to help return their bioplastic detritus to its source?

4. The 'green plastic' is
   A. products that made with green plants and clamshells.
   B. products that made with fossil fuels.
   C. products that made with green plants.
   D. products that made by McDonough.

5. The poly-lactic acid (PLA) is
   A. derived from fossil fuel raw materials.
   B. derived from plastics waste.
   C. used to make green products and derived from plants.
   D. derived from the company Ecospan.

6. According to the article, the PLA bioplastic
   A. uses more of the total fossil fuels required for manufacturing conventional plastic.
   B. is not the solution for current plastic overused problem.
   C. is free from toxic additives.
   D. is not qualified as compostable by the Biodegradable Products Institute.

7. According to the article, for the green plastic to be successful, it must
   A. reduce plastic's greenhouse-gas emissions.
   B. make more land available to corn production.
   C. announce its natural ingredients.
   D. change consumer behavior.

C. Near the scenic resort communities of Grand Lake and Winter Park (Grand County, CO), thousands of lodgepole pines (*Pinus contorta*) have been killed by a native bark beetle, the mountain pine beetle (*Dendroctonus ponderosae*). According to US Forest Service aerial surveys, more than 600,000 ha of Colorado's forests have been affected by this insect since 1996. Newspaper articles describe how vast acreages of forest have been "destroyed" or "lost". These accounts, state-wide mortality maps, and the mountain slopes covered with red, dying trees leave the casual observer with the impression that the beetles are killing every lodgepole pine in their path, and that these once green forests are gone, perhaps forever.

A closer look, however, reveals that the beetle-caused mortality and the changes in stand structure are extremely heterogeneous. Although some patches have almost no surviving canopy trees, such patches are actually fairly rare. Other patches contain only a few dead trees. The largest patch we could find with complete (100%) mortality of over-story trees was only about 0.4 ha; all areas larger than this had at least some surviving canopy trees. Survivors are present almost everywhere, which is important, because these will be the nucleus of the new forest that will emerge in the wake of the outbreak.

The beetles have selectively killed the larger trees, whereas most smaller trees and saplings have survived. Often obscured by the red crowns of the larger dead or dying trees, small trees usually are at least as abundant in a surviving understory as dead trees are in the overstory. All of these diverse stand structures are grouped together, however, in the reported acreages of "destroyed" forest.

見背面

Our intent is not to downplay the ecological importance of the bark beetle outbreaks that have exploded across western North America. The consequences – for some forest types, such as high-elevation whitebark pine (*P albicaulis*), for global carbon dynamics, and for future wildfires – could be substantial and, in many cases, negative. Rather, we suggest that researchers need to adequately and accurately document the actual patterns of forest change and the spatial heterogeneity of those patterns in a variety of forest types across western landscapes.

8. The word 'heterogeneous' is used to describe
A. the trees killed by the beetle.
B. the distribution pattern of the beetle.
C. the spatial pattern of the beetle outbreaks.
D. the distribution pattern of the trees before the outbreaks.

9. Why the beetles have selectively killed the larger trees?
A. Because most smaller trees and saplings have survived.
B. The article didn't provide the answer.
C. The bark beetle outbreaks have exploded across western North America.
D. The beetle-caused mortality and the changes in stand structure are extremely heterogeneous.

10. According to the article, which of the following statements is incorrect?
A. The Grand Lake and Winter Park are some scenic resorts.
B. More than 600,000 ha of Colorado's forests have been affected by the bark beetle since 1996
C. Researchers need to adequately and accurately document the actual patterns of forest change.
D. The beetle-caused mortality and the changes in stand structure are homogeneous.

11. What is the main idea in the article?
A. This information is key to evaluating whether current outbreaks.
B. Information about the variation in mortality is important for public understanding and scientific research.
C. Some of the beetle-induced changes will be undesirable for people who live, work, and play in the region.
D. With a richer dataset, we can begin to predict what kinds of forests we will have in the aftermath of the beetle outbreaks.

D. The Wenchuan earthquake (12 May 2008) disturbed a serene mountainous area of about 20,000 km^2 along the fault zone in the Longmen Mountains of Sichuan Province in southwest China. This catastrophe killed a large number of people and left many more homeless. The earthquake also damaged one of the world's most biodiverse temperate forests, in the Hengduan Mountain region, an important carbon sink in China. The potential therefore exists for substantial additional atmospheric CO_2 emissions in the future, as a result of decomposition.

After the earthquake, forest cover in Sichuan Province decreased by 0.5%, which means 330,000 ha (equivalent to about half the area of Singapore) of dense natural and planted forests were disturbed. As a result, the area above the epicenter of the earthquake will probably lose its ability to be a carbon (C) sink, which used to sequester 0.24 Tg of C per year, estimated from a mean C uptake of 0.72 Mg ha^{-1} yr^{-1} in Chinese forests. Moreover, based on a mean C stock of 41.36 Mg ha^{-1} in Chinese forests, we estimate that this earthquake damaged a forest C stock of approximately 13.6 Tg, an equivalent to 68% of the mean annual Chinese C sink (0.02 Pg yr^{-1}). After such a major disturbance event, most of the damaged C stock in coarse woody debris (CWD) from dead or damaged trees will eventually be released to the atmosphere. Over a short period of time, forest regeneration will probably not fully compensate for decomposition from CWD. Therefore, this event disturbed ~13.6 Tg of C.

Following this disturbance, forest renewal will likely allow for recovery of the C stock. However, such recovery usually requires decades or longer. Because attention and resources are currently being directed to rebuilding cities and related infrastructure, forest restoration in the disaster-stricken region will probably be further postponed.

However, this provides an important opportunity for ecologists to study the recovery of forest C stocks after a major disturbance event, which may provide insight into similar disturbances elsewhere.

12. According to the article, the Wenchuan earthquake not only killed many people, but also
A. destroyed wildlife habitat.
B. left people homeless and damaged tropical forests.
C. decreased subtropical forest cover in Sichuan Providence.
D. damaged temperature forests and released considerable CO_2.

13. If everything runs smoothly, how soon do you predict the forests to recover?
A. Less than 10 years.
B. In 5 years.
C. Many decades.
D. In a decade.

接次頁

14. According to the article, which of the following statements is incorrect?
A. The earthquake destroyed forests that were about 50% the size of Singapore.
B. The area damaged by the earthquake was covered by forests that are rich of biodiversity.
C. Any pause in forest recovery will result in a delay in C stock recovery in this region.
D. The earthquake may have transitioned this region from a net C source to a net C sink in the short term

IV. Write a summary essay in Chinese (>200, but <500 words) based on the following article (22%):

The phrase "water scarcity" now seems to roll off the tongues of corporate executives as often as it does those of environmental leaders. At the recent World Economic Forum in Davos, Switzerland, several captains of industry spoke fervently about the many challenges posed by water scarcity, while a Forum report warned of "water bankruptcy" and that "we simply cannot manage water in the future as we have in the past, or the economic web will collapse".

On the one hand, this is a good sign. Wider recognition that water constraints pose serious risks to food production, economic growth, and political stability the world over is the first step toward tackling these game-changing challenges. On the other hand, there is little evidence that decision makers have absorbed the most important lesson of 20th-century water management: water strategies that ignore the health of freshwater ecosystems offer short-term benefits at best, often end up costing more than they are worth, and severely compromise the prospects of future generations.

To date, the benefits of water development – dams, reservoirs, levees, river diversions, and groundwater wells – have largely been measured in metrics such as additional hectares irrigated, kilowatt-hours generated, cities safeguarded from floods, and populations supplied with drinking water. These gains have undoubtedly raised living standards and fueled economic prosperity for large segments of the human population. However, we have failed to measure the true costs of this infrastructure development – in particular, the lost goods and services due to the serious and steady decline in the health of freshwater ecosystems.

Consider these metrics. An estimated 25–55% of the world's wetlands have been drained, 35% of global river flows are now intercepted by large dams and reservoirs, and more than 100 billion tons of nutrient-rich sediment that would otherwise have replenished river channels, deltas, and coastal zones instead sit trapped in reservoirs. Some 60% of the 227 largest rivers in the world – and a much higher percentage of those in Europe, Japan, and the US – have been fragmented by dams, diversions, and levees. Rather than flowing to the natural rhythms of the hydrologic cycle, these rivers are turned on and off like plumbing works, eliminating the natural flow patterns and habitats upon which myriad life forms depend.

The economic costs of these lost ecological services, though untallied, are high and increasing. Scientists participating in the 2005 Millennium Ecosystem Assessment, estimated that wetlands alone provide water purification, flood mitigation, and other services worth US$200–940 billion per year. On a smaller scale, the water department in Kansas City, MO, has spent $4 million to improve its drinking water intake from the Missouri River. Why? The trapping of sediment by upstream dams, probably in combination with dredging for shipping purposes, has caused the river's channel to sink. Multiply that $4-million expenditure to compensate for the loss of this important ecosystem service – that is, sediment delivery and channel maintenance – many times over and we arrive at a serious chunk of change.

The name of the game in 21st-century water management must be the integration of ecological health and ecosystem services into water planning, policy, and management. In the book, *Rivers for life*, the authors recommend the setting of a "sustainability boundary" to cap the loss of services from watersheds, river systems, and other ecological infrastructure. The beauty of such a boundary is twofold. First, in economic terms, it maximizes the total value of freshwater ecosystems by taking into account both extractive and "instream" benefits. Second, it drives up water productivity – the value derived from each liter of water removed from its place in nature and put to use in agriculture, industry, or urban areas. We will need at least a doubling of water productivity over the next two decades to have a chance of adequately meeting human needs, while keeping a meaningful portion of ecological infrastructure intact.

This is not a pie-in-the-sky recommendation. In several nations and regions, including Australia, the European Union, South Africa Latin America, and the US, pioneering policies to safeguard freshwater ecosystem services are in place and are currently being implemented. The scientific underpinnings of these initiatives may not be perfect, but in this time of rapid ecological degradation, it seems critical not to let the "perfect" be the enemy of the "good", and to learn while doing.