(100%, 6.25% each, 6 pages total) ※ 注意：請於試卷內之「選擇題作答區」依序作答。
Please read the following articles and answer questions:

Article 1: Velocity of climatic change varies from mountain to marsh (Scientific America, 2009).
Article 2: Deporting plants and animals to protect them from climatic change (Scientific America, 2008).

1. What is/are a possible result of climatic change:
   a. A strong typhoon during summer in Taiwan;
   b. A tsunami hit Fukujima, Japan last year;
   c. A gradual trend of glacial meting on the Alps;
   d. A gradual rise of sea level;
   e. Maple tree growth line moving southward.
2. Please choose a best explanation for "dodge" in the first article?
   a. hide; b. run; c. a baseball team; d. a baseball position on field; e. climb.
3. What is the meaning of "plunk a tree frog down"?
   a. Cut the tree off;
   b. Take tree frog to other place;
   c. Insert the tree frog deep into the same tree;
   d. Playing tree frog as a kid's pet;
   e. Drop the tree frog from tree top to ground by accident.
4. What is biomes?
   a. An area with similar climatic condition where ecosystem reside;
   b. Speed of biological production;
   c. Weight of biological production;
   d. Mass of biological production;
   e. Primary productivity.
5. Following the articles, why do you think velocity of climate change matters as explained by the author?
   a. De-glaciation is too fast;
   b. Biomes may not be able to cope with;
   c. Butterfly can fly fast;
   d. Sea surface temperature change too fast;
   e. City interfere the relocation.
6. Following this article, if the average velocity of climate change is 0.4 km and 28.8% biomes are facing speed of 1 km/year of change, what type of life form(s) may NOT be able to survive?
   a. Plants;
   b. Some butterfly;
   c. Wolves;
   d. Birds;
   e. Whales.
7. What parameter(s) did Scott Loarie use to model velocity change?
   a. Temperature;
   b. Precipitation;
   c. Tornado;
   d. Typhoon;
   e. Earthquake.
8. What is the meaning of "run out of real estate" in the article 1?
   a. Land is too expensive for human to build houses;
   b. Too many housing project near large city;
   c. Plants and animals are running out of suitable places to move;
   d. Animals don't need house to move in;
   e. Too little house garden for butterfly to live in.

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9. Following article 1, which type(s) of the followings probably will not survive under current speed of climatic change?
   a. Desert snake;
   b. Mountain bears;
   c. Bamboo;
   d. Marsh fish;
   e. Butterfly.
10. A number of protected areas are set up in order to help biomes to survive the climatic change. What is the percentage cited in article 1 that has been set up worldwide?
   a. 4%;
   b. 8%;
   c. 10%;
   d. 15%;
   e. 18%.
11. What are the method(s) the authors try to suggest to better help the biomes facing the climatic change?
   a. Diverse stock portfolio;
   b. Expanding preservation area;
   c. Increasing connections between preservation area;
   d. Set up more ocean preservation area;
   e. Plant native plants in household garden.
12. What cases of assisted migration will be problematic?
   a. Moving endangered polar bear to Antarctic area;
   b. Moving endangered rhinoceros to Arizona;
   c. Moving Panda bear to Taiwan mountain area;
   d. Moving endangered Indonesia tiger to Siberia;
   e. Moving checkerspot butterfly to Alaska mountain area.
13. Why did authors recommend some measures of assisted colonization?
   a. Human occupied too large land area;
   b. Natural dispersal can not take place in some area;
   c. Fast global warming;
   d. City block suitable migration;
   e. Ocean become a problem.
14. Why some environmental advocates fight again such human assisted migration?
   a. Too expensive;
   b. Too much manpower;
   c. Bad experiences;
   d. Australia rabbit problem;
   e. Australia cane toad experience.
15. What is Florida panhandle?
   a. A type of cooking utensils;
   b. Frying pan made in Florida;
   c. A city in Florida making pan handle;
   d. An area in Florida;
   e. A Florida factory.
16. Why is Torreya Guardians taking action without waiting?
   a. Checkerspot butterfly can not wait any more;
   b. Human are cutting too many pine tree;
   c. Slow in Scientific research and policy maker;
   d. Disease and climatic change are endangering the Torreya;
   e. Staghorn coral need guardians.

---------- End of question ----------
---------- Please read the attached articles----------

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Velocity of Climate Change Varies from Mountain to Marsh
As global temperatures change, not all shifts will be equal. A new global analysis pinpoints the fast pace some species may have to move to remain in a suitable climate

By Katherine Harmon | Scientific America, December 23, 2009

Reports of maples on the march northward and butterflies flitting far afield are already flooding in, and climate scientists predict that with escalating temperature changes more species will need to either get out of dodge, or hope for emissions reductions that will help the planet dodge the climate bullet. Much of Earth's life forms are fine-tuned for specific ecosystems and their associated climates. Plunk a tree frog down in a harsh habitat it is not well adapted for, and it will fail to thrive—or even survive. Now, with regional climates shifting as a result of global warming, it is unclear just how far—and how fast—organisms will need to travel to keep up with moving climates. A new study, published online Wednesday in *Nature*, aims to paint a clearer picture by uncovering the variable velocity of climate shifts across the globe (*Scientific American* is part of Nature Publishing Group). "A lot of people talk about the rate of climate change—but how far do you have to go to reach a new climate?" asks study leader Scott Loarie, a post-doctoral fellow at the Carnegie Institution in Stanford, Calif. On average, given annual average temperature change models, local climates will move about 0.42 kilometers (or a quarter of a mile) each year, the study found. And 28.8 percent of the world's biomes (or ecosystems, areas with similar climatic conditions) are facing rates of change more than 1 kilometer per year. "What we're bringing attention to is the speed with which these things happen," Loarie says about the study, which analyzed these climate change velocities across the globe at the resolution of a single kilometer. Although these shifts might sound like small beans for mobile animals like birds, which can pick their environment with relative precision, for the very small, the very large and the very rooted, such a pace might be impossible. "Plants might be particularly vulnerable" in the case of rapid local climate changes, says Dov Sax, an assistant professor of ecology and evolutionary biology at Brown University in Providence, R.I. And even species that can travel more easily, like butterflies, can be dependent on specific plants or other biome system members that are slower to follow temperature changes. If a species can move to more comfortable climes, "the right ecosystem needs to be there" for them to thrive, Sax explains. Calculating climactic changes is a tricky business, and temperature is by no means the whole story. Loarie and his team chose temperature as a key marker, he says, because organisms are "bathed in temperature." His team also ran the models with predicted precipitation changes and arrived at similar conclusions, even though moisture levels can prompt more nuanced responses across species. Sax, who wasn't involved in the study, notes that predicting how species will respond to these changes can be even more difficult. "We're in a very early stage of figuring these things out," he says. One of the more quantifiable aspects of this analysis, the Earth's topography, turned out to play an important role in determining the velocity of these changes. "Slight differences in topography can have a big effect," Loarie says, noting that a species' success might rest on the "difference between the north and the south slope." There has been much hand wringing over mountainous plants and animals, which can only climb so high chasing cooler climes before they run out of real estate. In contrast, this study draws attention to the high velocity of change in flatland areas. Temperature and other climate changes in open expanses, such as the Amazon basin or Sahara Desert, will cover broader swaths of land than steep peaks, meaning that "large geographic displacements are required to change temperature appreciably,"

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wrote the researchers. Thus, flatlandspecies will have to travel much farther than mountain-dwelling species to maintain their present-day temperature conditions—and with even less likelihood that the rest of their familiar biome will follow. By contrast, with each kilometer up or down a mountain, climes can vary greatly. Thus, even some plant species may be able to keep pace with quick climate changes in the near future if they live in the right spot now. Loarie notes the importance of mountains to mitigate the effects of climate change, asserting that they "might provide real opportunities" for saving threatened species. Certainly, even in areas with high velocities of climate change, each local organism has a particular range of conditions it can tolerate. "Some are going to be just fine where they are," says Sax. But others, he notes, "are going to need to track their climate" more closely, moving along with changes as they occur.

Rapid shifts in climate, however, are nothing new. As recently as the last glacial period, local climates and whole biomes shifted substantially—and in short order, forcing many species to move, adapt or die out. But despite earlier pollen analysis that pegged the movement of some tree species (that is, average advancement via seed dispersal) at about a kilometer per year after the last ice age, genetic studies have reduced that estimate to a pace closer to a tenth of a kilometer per year, Loarie says. Even if many species were able to roll with these ancient changes, he notes, "these [current] changes are happening so much faster—and that's expressed in these velocities." Plants and animals are also contending with a much different landscape now than they were 12,500 years ago. "If we imagine plants and animals moving through a human-dominated area, it's likely to be much slower," he says. Those species that are capable of relocating at a brisk pace might indeed be thwarted by human development. Sax, who studies amphibian responses to climate change, says, "There are a lot of species you wouldn't normally be concerned about that might be in trouble in the future" because a barrier stands between their current habitat and one they might need to occupy in coming decades. Species that will likely need to move north along the West Coast to stay cool, for example, may run into insurmountable urban obstacles like Los Angeles or San Francisco. "If there's a city in the way, you're just not going to be able to do it," Sax says about such species. And even in more rural areas, he notes, large expanses of crop monocultures like corn or soy could pose problems for organisms dependent more diverse natural habitats. Even well-intended and successful protected areas might not be able to shelter all of their resident species indefinitely, note the study authors. Most of them are quite small and only some 8 percent of protected areas worldwide contain ample—and sufficiently variable—landscape to maintain their present climactic biomes 100 years from now. The best hope will be for areas with a range of lands to for species move onto. "If you have a preserve that currently features a bunch of different kinds of climates," says Loarie, "that preserve will be much more robust—kind of like a diverse stock portfolio."

Expanding preserves and creating more connections among them will be increasingly important, as "we'd expect species to have the most difficulty moving outside of protected areas," Loarie says. And for instances where plants or animals don't seem to be adjusting, "assisted migration might be an important component," he says, although he and Sax note that the implications of this practice are not well understood and can be quite risky. The best strategies, Loarie says, will be those with a two-pronged approach—those that slow climate change *and* expand viable habitats. He points to mitigation efforts discussed at Copenhagen, such as REDD

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(reduced emissions from forest deforestation and forest degradation), which would encourage forest preservation, thereby both helping to put the brakes on carbon dioxide levels and providing more room for many species to move—a plan he calls a "win-win situation." On a smaller scale, individuals can lend struggling species a hand by going native, Loarie says. Giving climate-challenged creatures a better toehold "could be as simple as people planting native plants in their garden because native plants attract native pollinators," he explains. The key, he says, "is keeping the landscape connected," so that when species need to hit the road, they have a throughway—or at least a possible path.

Deporting Plants and Animals to Protect Them from Climate Change
What if we relocated North African animals and plants to southern Europe to stop climate change-caused extinctions?

By David Biello | Scientific America, July 17, 2008 | 4

CLIMATE REFUGEE?: The Quino checkerspot butterfly might be the first species to be intentionally moved to avoid extinction as the climate changes.
Image: ©Laure Neish/iStockphoto

As San Diego and Los Angeles have grown, the scrub land of southern California has been paved and built over. That has squeezed out the Quino checkerspot butterfly's habitat, and with the climate changes coming as a result of human greenhouse gas emissions, its listing as an endangered species by the U.S. government may not be enough to save the pretty little butterfly from extinction. But a group of biologists suggest in this week's *Science* that simply moving the butterfly into similar habitat in nearby mountain ranges might solve the problem by overcoming the unnatural barriers humans have erected in the path of any potential shift in its natural range to follow such changing conditions. They call the idea "assisted colonization." "Humans have dominated the landscape to such an extent that natural dispersal cannot take place in many areas," says biologist Camille Parmesan of the University of Texas at Austin, who helped craft the proposal. "It is in those cases that assisted colonization makes the most sense—use it on species that would have been able to do it on their own, if not for humans." Specifically, Parmesan and an international group of biologists are proposing moving certain carefully selected species, such as the Quino checkerspot butterfly, as their historic habitats change rapidly because of global warming. They aren't calling for drastic moves, though. "We are not recommending placing rhino herds in Arizona or polar bears in Antarctica," the group writes, as, for example, the polar bear would then devastate Antarctic penguin and seal populations that have never encountered such a predator. "We are, however, advocating serious consideration of moving populations from areas where species are seriously threatened by climate change to other parts of the same broad biogeographic region," meaning in nearby locations sharing similar ecosystems. The cost of such an effort is unknown, but could range from nearly free for a small-scale effort such as shifting the Quino a few 100 miles (kilometers) north to multimillion dollar projects such as, for example, moving a monkey species from one cloud forest to another, according to marine biologist Ove Hoegh-Guldberg, of the University of Queensland in Brisbane, Australia, and lead author of the proposal.

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Not every potential project makes sense: The researchers offer a list of conditions under which such assisted colonization would be appropriate, including imminent extinction, feasibility and a favorable cost–benefit analysis. The idea still has some hurdles to overcome, not least the inherent horror of many conservation biologists at tampering with nature, no matter how human-dominated it is. After all, the human record with introduced species is not good, as the continent of Australia proves. European settlers there introduced rabbits, blackberries and cane toads, to name just a few. The latter of which was deliberately assisted in its colonization to control agricultural pests, but instead is displacing unique native animals, such as the northern quoll, a small carnivorous marsupial. There are similar examples of both intentional and unintentional introductions of so-called invasive species all over the world. That history leaves at least one environmental group devoted to preserving endangered species opposed to the idea. "We do not under most conceivable scenarios support or encourage introduction of species to habitats outside of their historical range," says Matt Lewis, a spokesman for the species program of the Washington, D.C.–based global environmental group, the World Wildlife Fund. "It is rare to find an example of such an introduction that hasn't led to dire consequences for one or more indigenous species of the area of introduction, and it is naive to think that such consequences would not also be a factor under the framework the authors propose." Conservation biologist Dov Sax of Brown University, who was not part of the group making the proposal, says these are reasonable concerns but that they can be overcome. "It can probably be done in a way that is responsible and will not lead to environmental catastrophes," says Sax, who is helping organize a group with funding from the U.S. National Science Foundation to assess the idea. But "no matter how we learn, we will always occasionally make mistakes. There will be unintended consequences on occasion." In fact, some people are not waiting for all of the scientific and policy issues to be worked out on this extreme conservation idea. A group of naturalists, botanists and ecologists known as the Torreya Guardians has begun to transplant a spindly pine from the Florida panhandle—where *Torreya taxifolia* has dwindled as a result of disease and, potentially, climate change—to receptive arborists in more northerly climes. And several marine biologists, including Hoegh-Guldberg, have suggested extending the range of heat-tolerating staghorn corals—and the algae they host—to replace their less tolerant brethren in formerly colder waters. "There is no place on this planet that humans have not interfered with and it is probably time for us to now become actively involved in engineering solutions," Hoegh-Guldberg says. "There are no other options except extinction at this point." The best, first example of this may just be the Quino in southern California, simply because it would be cheap and easy—a few days' labor by a few people to relocate an insect that is neither prolific nor aggressive—to help it find a safer clime. "This should be considered a last resort after other traditional conservation measures have been considered and/or tried," Parmesan says. "I think we need to try it on a very small scale as a small experiment on the most clear-cut case out there. I'm proposing this [to the U.S. Fish & Wildlife Service] for the Quino checkerspot butterfly."

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