Every 30 seconds, 13 hectares—about 18 football fields—of forest disappears. Trees are cut down and harvested to meet our needs, such as for shelter and fuel. We also use trees to meet our material wants, such as for furniture and musical instruments. Deforestation is the removal of most or all trees in one area. Forests can be a renewable resource if they are left alone to regrow after being cut down. New trees can be planted and then harvested in 20 to 50 years. However, not all forests can be considered renewable. For example, trees in old-growth forests, such as rainforests, are very old. These forests took thousands of years to grow and develop ecosystems. Harvesting trees from old-growth forests is not sustainable because it would take hundreds of years for these trees to regrow, if they are able to grow again at all. Even so, this has not stopped some people from harvesting trees from old-growth forests (Figure 6.15).
Forests around the world are being cut down for different reasons. In countries such as Canada, trees are cut down to produce lumber and products such as paper and cardboard. Forests are also cut down to clear land for other human activities such as farming, mining, creating roads, and building human settlements.

**HOW TREES ARE HARVESTED**

Trees used to be harvested by hand. People had to cut down trees using saws and axes. On a good day, a single person could harvest one or two big trees. The development of large and specialized machinery has allowed people to harvest many more trees in a shorter period of time.

Many forests are cleared using a process called clear-cutting, which involves cutting down all the trees in a large area. This has led to public protests over the loss of important forest habitat. This method not only destroys forest habitat for plants and animals, it also exposes soil to erosion. Natural waterways are also changed or destroyed, sometimes permanently.

Today, forestry is largely regulated in developed countries. Laws limit the number of trees that are allowed to be cut, the ways they are cut, and how new trees are planted. Another forestry practice is to only harvest certain sizes or types of trees. These regulations all aim to promote sustainable forest use. Some countries have few or no laws to control the harvesting of trees. Figure 6.16 shows the average area of forests lost or gained per country per year from 2005 to 2010.

**Average Annual Change in Forest Area, 2005–2010**

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<table>
<thead>
<tr>
<th>Change in Forest Area (hectares)</th>
<th>small change (gain or loss)</th>
<th>area gained</th>
</tr>
</thead>
<tbody>
<tr>
<td>area lost</td>
<td></td>
<td></td>
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<tr>
<td>&gt;500 000</td>
<td></td>
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<tr>
<td>250 000–500 000</td>
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<tr>
<td>50 000–250 000</td>
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<td></td>
</tr>
<tr>
<td>&lt;50 000</td>
<td>no forest area</td>
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<tr>
<td>50 000–250 000</td>
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<tr>
<td>250 000–500 000</td>
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<td></td>
</tr>
<tr>
<td>&gt;500 000</td>
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</tr>
</tbody>
</table>
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**FIGURE 6.16** This map shows the average annual change in forest area (measured in hectares) for each country from 2005 to 2010.
ENVIRONMENTAL IMPACTS OF DEFORESTATION

Deforestation has many environmental impacts (Figure 6.17). It causes soil erosion and flooding, contributes to climate change, and results in the loss of plant and animal habitat. Roads are often created to allow for the removal of trees in the interior of a forest. Once the roads are created, the forest becomes accessible to more and more people. This creates further opportunities for deforestation.

SOIL HEALTH AND FLOODING

Deforestation has a huge impact on soil health. Tree roots anchor soil to the ground. Forests also naturally hold water in the ground and release it slowly into local waterways. When trees are removed, the soil is exposed to wind and water erosion. In extreme cases, landslides and flooding can occur. Without trees, rainwater moves quickly from bare land into waterways. Heavy rains can cause floods as rivers fill too quickly and overflow. Heavy rains and floods also wash away a lot of soil. Without soil, the land cannot grow new plants and the deforested area can become a wasteland.

CLIMATE CHANGE

Widespread removal of trees can have an impact on the local and even the global climate. Forests help regulate rainfall and help prevent soil erosion. Forests also absorb carbon dioxide (CO$_2$) from the atmosphere. Absorbing this greenhouse gas helps to reduce global warming. A tree in the temperate regions can absorb 13 kg of CO$_2$ per year, whereas a tree in the tropical regions can absorb 50 kg of CO$_2$ per year. It is estimated that forests can absorb up to 40 percent of the CO$_2$ released by human activity. This is another reason why removing trees, especially in tropical regions, is of concern.
PLANT AND ANIMAL HABITATS

Trees provide food and shelter for animals. Deforestation upsets the life balance of animals, similar to how removing sharks upsets the balance of life in the oceans. Tropical forests are home to millions of species, all living in a balanced ecosystem. When trees are removed, the habitat for these plants and animals is lost. Many animals die. Others try to move to different habitats. Sometimes they enter human settlements, and then conflicts can occur. Many plant and animal species are endangered and some have even become extinct, lost to our planet forever, due to deforestation. In Indonesia, for example, the Sumatran orangutan is listed as a critically endangered species due to habitat loss. The United Nations says it’s a conservation emergency. The Sumatran tiger is the last species of tiger in the area. There are fewer than 400 left in the wild. Their habitat is being destroyed by the pulp-and-paper industry.

Why do people have different opinions about the value of forests?

GEOGRAPHY AT WORK

ZOOLEGIST

Dr. Iain Douglas-Hamilton (Figure 6.18) grew up in England. His studies led him to develop a passion for elephants. He alerted the world to the severe plight of African elephants that are being killed for their ivory tusks. In 1993, he founded the nonprofit organization Save the Elephants. The organization helps to conserve elephant populations, protect their habitats, and reduce human–elephant conflicts. How do some of these conflicts arise? Many elephants are losing their habitats to deforestation. Forests are being cut down to increase agricultural land. Because of the loss of natural habitat, some elephants encounter human settlements and roam into agricultural crops to look for food. This creates conflict with the farmers.

Douglas-Hamilton’s main research interest is in understanding elephant behaviour by studying their movements. Save the Elephants created GPS-tracking collars for elephants using cellphone technology. This new technology obtains highly detailed data about an elephant’s location. ArcGIS software analyzes the data and creates detailed maps that identify migratory routes and land used by elephants. This information can then assist in planning landscape, conservation, and farming areas.

Douglas-Hamilton also travels the world giving lectures, and he works with the media, such as National Geographic, to promote education and awareness of elephants. He has won several awards for his life-saving efforts, including one of conservation’s highest awards the Order of the Golden Ark in 1988. His greatest achievement, however, has been to reduce the risk of human–elephant conflicts and safeguard the future of elephants.

MAKING CONNECTIONS

1. What skills do you think are needed in this type of career?

2. What interests you about zoology? What else would you like to know about this career?
SOCIAL IMPACTS OF DEFORESTATION

For many countries, forestry is an important industry. Forestry generates hundreds of billions of dollars in revenue worldwide. It also provides jobs for many people, especially in rural and remote communities. However, deforestation also has negative social impacts. It affects people who depend on the forest or land near the forest for survival. Historical sites can also be affected by deforestation.

SMALL-SCALE FARMERS

Deforestation affects people who live near the forest. They lose access to forest resources, such as fuel and food sources. The livelihood of farmers is particularly at risk as soil becomes degraded due to erosion. In some areas, so much soil has been lost that the land can no longer produce. Many farmers must relocate.

INDIGENOUS PEOPLES

Many Indigenous peoples around the world have been severely affected by deforestation and resource development. One example is the Penan people of Sarawak, Malaysia (Figure 6.19). These people have lived in the rainforest for generations. They depend on the plants and animals in the forest for food, shelter, and medicine. The sago palm, which is a traditional food source for the Penan, is endangered due to deforestation. The Malaysian government says the forests are being managed sustainably, but the Penan people and many researchers disagree. As deforestation continues, the Penan people may be forced to relocate to another part of the country. Their traditional ways of living will be lost forever.

HISTORICAL SITES

Deforestation can also affect areas of historical significance that are located within forests. For example, in Sweden, the economy relies heavily on forestry. Because of this, the government supports the sustainable use of forests. However, ruins of ancient settlements have been discovered in the forests. Many Swedish people want to protect the ruins. In 2004, an archaeologist was hired to locate all the historical sites in Sweden’s forests. The sites were then plotted on a map using GPS coordinates. Now all people who use the forests, from tourists to forestry companies, can access the information and make sure that these sites stay protected.
PROTECTING OUR FORESTS

Many local, national, and international organizations are working to protect forests around the world. Individuals can also take action to help protect forests.

ORGANIZATIONS THAT CARE

Many environmental organizations take action against deforestation. For example, the Forest Stewardship Council® (FSC) is similar to the Marine Stewardship Council (MSC), but for forests rather than oceans. The FSC certifies wood and paper products that meet their standards of environmental and social protection (Figure 6.20). The standards seek to ensure that trees are properly harvested and replanted. It also asks that forestry processes respect the rights of Indigenous peoples. Buying products that are certified by the FSC encourages forestry companies to manage forests sustainably.

Global Forest Watch (GFW) aims to preserve forests for future generations. It uses satellite imaging and other technologies to monitor the world’s forests. The satellite images provide information, such as changes in forest area. Information is compiled into a GIS. The data can help governments manage forests more sustainably. The data is available in near real time. This means that some illegal and harmful activities, such as burning forests, can be detected quickly, which may help stop further damage.

INDIVIDUAL ACTION

There are many ways each of us can help reduce deforestation and its negative impacts. We can plant trees. We can reduce, reuse, and recycle our paper products. Many old-growth forests are cut down to produce paper products such as books, writing paper, toilet paper, and paper towels. Recycling paper and using recycled paper means that fewer trees need to be cut down to make new paper. When buying paper products, look for labels that show whether they contain any recycled paper content. We can also choose to go paperless. Refusing delivery of flyers and catalogues, reading newspapers online, and using reusable gift bags instead of paper gift wrapping are all ways we can reduce our use of paper.

CHECK-IN

1. **Patterns and Trends** Look at the map of global annual forest change, in Figure 6.16 on page 185. What patterns do you see? Overall, are we gaining or losing forests?

2. **Evaluate and Draw Conclusions** Some people argue that deforestation can continue with no negative environmental effects as long as trees are replanted. Do you agree or disagree with this argument? Explain your thinking.