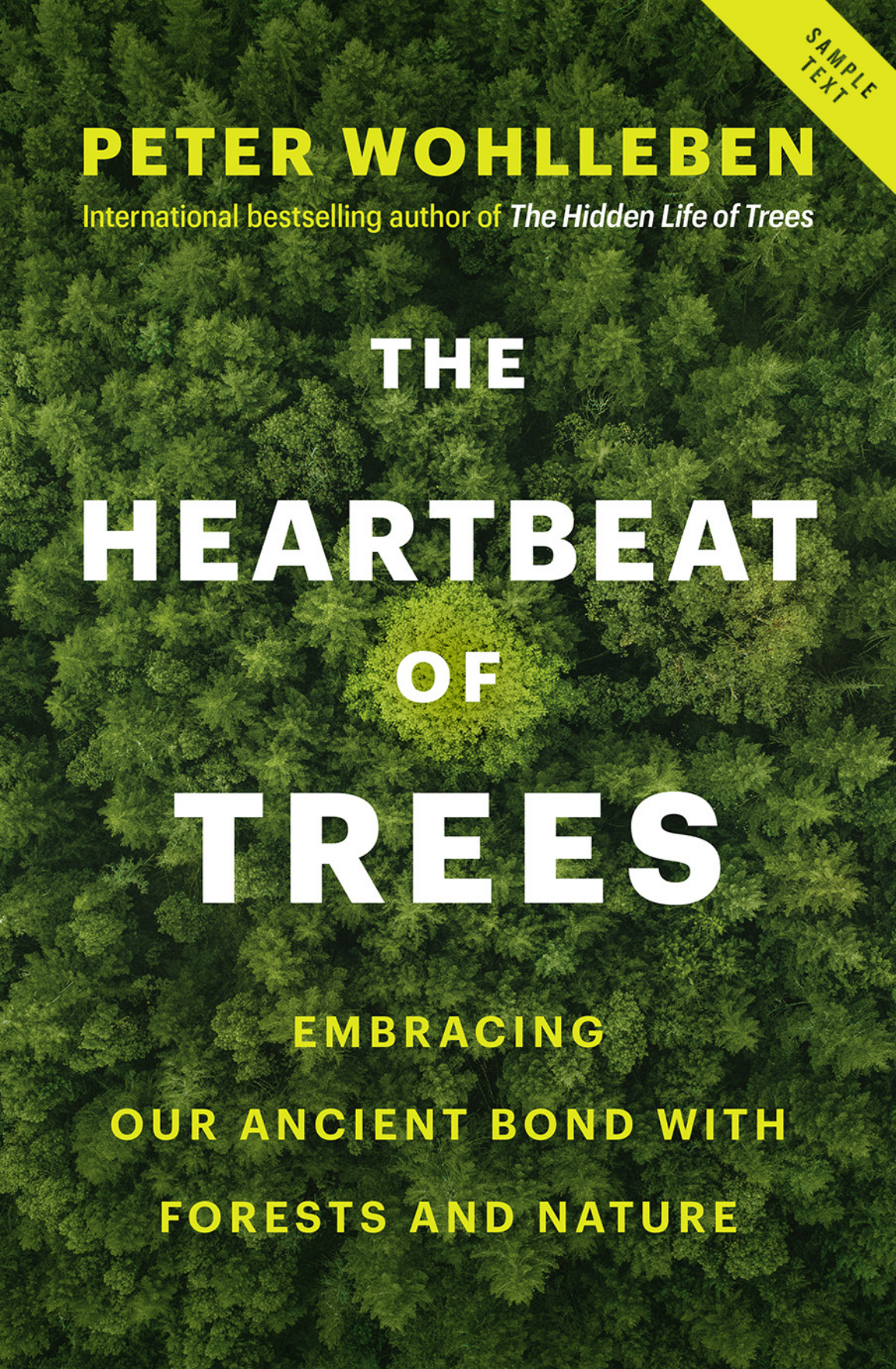
SAMPLE TEXT
PETER WOHLLEBEN
International bestselling author of *The Hidden Life of Trees*
THE HEARTBEAT OF TREES
EMBRACING OUR ANCIENT BOND WITH FORESTS AND NATURE

INTRODUCTION

In recent years, all over the world, there has been renewed interest in ways to immerse ourselves in nature. Forest bathing, for instance, has emerged as a therapeutic practice—in Japan, you can even get a prescription for it. At the same time, forests continue to be clear-cut with no thought given to the consequences. This reckless removal of trees fuels climate change. Faced with these contradictions, it can be hard for us to reclaim our place in the natural world. None of us deliberately sets out to destroy the environment, and yet we are all caught up in our consumer-oriented lives.

Assigning blame or giving in to despair, however, are far from helpful. Pointing an accusing finger at an apocalypse just waiting to happen, at a tipping point beyond which there appears to be no return to a stable climate, conjures up images of medieval inquisitions and couldn't be further from the positive encouragement we so desperately need right now.

And so, I invite you to join me in the forest instead, where we will discover that the ancient tie that binds humans and nature exists to this day and is as strong as ever.

Don't worry, our connection with nature is not so diminished that our only hope of long-term survival lies with modern technology. On this journey into the forest, you'll be amazed at how well your senses function. You are, for example, better at detecting some smells than dogs are. We'll discover that electrical activity in trees gives spiders goosebumps and explore a well-stocked natural pharmacy available not only to animals but also to you. And while you're exploring, you'll be surrounded by a cocktail of chemical communication that will strengthen your circulatory and immune systems.

Many people no longer notice these wonders. Not because our senses have atrophied—they all still work just fine, as the many different examples in this book will show you—but rather because of a strange philosophical and scientific worldview that erects unnecessary barriers between us and our fellow life-forms. Over here we have people, and over there we have nature. Over here reason runs the show, while over there a sophisticated, mindless, and apparently almost mechanical system runs its course.

The realization that we are still a part of this wonderful system and that we function according to the same rules as all other species is, thank goodness, gradually making headway. And it's only when it comes to the fore that conservation can be effective—that is to say, when we realize that what we are conserving is not just other forms of life but, first and foremost, ourselves.

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WHY IS THE FOREST GREEN?

More and more people are taking delight in nature and not only want to see the forest but also to experience it as intensely as they can—and I am one of them. We often envy animals for the immediate, clear feedback their senses give them, but how aware are we of our own senses? After living for centuries in a human-oriented world that robs us of the daily necessity of keeping a wary eye on nature, what skills do we still possess?

If we are to believe the multitude of reports that compare the amazing skills of animals with our own, as a species we don't have much to offer other than brain power. In matters of the senses, we fall short when measured against almost all of our fellow creatures. Sometimes we even seem to relish our role as evolutionary losers. And so, the bond between people and nature appears to be ruptured beyond repair, and all there is left for us to do is to peer enviously at the amazing abilities animals possess.

We couldn't be more wrong. We are completely capable of engaging effectively with the world in which we live. It wasn't so long ago that our ancestors had to fight their way through forests, registering the presence of every possible danger or potential prey quickly enough to act. And because the blueprint for making humans has not changed since then, we can console ourselves with the thought that all our senses are still intact. The only thing missing is a bit of practice—and here we can catch up.

Let's first consider vision and ask a seemingly simple question: Why do we see trees in color?

We know we feel relaxed when we look at green trees. A shady green view even improves our health. But why do we see the color green in the first place? After all, this is not a skill most other mammals share with us. Their world is restricted to a narrow range of colors. Take the highly intelligent dolphin. Like many marine mammals, dolphins see the world in black and white, because their retinas contain just one type of cone (cones are cells that make it possible to see color). To distinguish between two colors, you need at least two different types of cones. Paradoxically, the one cone dolphins and other similar animals have is for the color green. This one cone allows them to distinguish between various levels of brightness, but that is all. Dolphins can't even process blue light, which not only colors the surface of the ocean but also reaches way down into the depths.

OUR FOUR-LEGGED DOMESTIC companions, such as dogs and cats, and wild forest animals, such as deer or wild pigs, do considerably better than dolphins in the color department. In these mammals, the green cones are joined by blue cones,

and this combination allows them to see a limited range of colors—although the various shades of red, yellow, and green all run together and look the same to them. Having both green and blue cones is still not enough, however, to be able to see the color green. To do that, you also need to have cones that are sensitive to red light—as humans and many other primates do. And so, even though the color green calms our minds and promotes healing processes in us, it plays no role in the lives of most mammals.

But why do you need cones that are sensitive to green light and cones that are sensitive to red light in order to see the color green? This has to do with the wavelengths of light. Shades of blue have short wavelengths, and shades of green and red have longer wavelengths. If you are an animal that has only blue cones and green cones, whether the light entering your eye is green, yellow, or red, these "longer wave" shades stimulate only the green cones when they hit your retina, and all these colors look the same to you. Light with short wavelengths stimulates your blue cones, and light with longer wavelengths doesn't affect blue cones at all. That is why an animal that has cones for only blue and green can, strictly speaking, only distinguish between "blue" and "not blue."

It is only when another type of cone is added, one that is sensitive to another range of long-wave light, that a forest can be seen as green. And, wonder of wonders, we humans possess just such a cone in our retina.[1] It is sensitive to red light, and only when these three cones are functioning can we clearly distinguish whether the tree is green, yellow, or red. There's a reason the little LED lights in your computer or television screen are composed of minuscule blue, green,

and red dots. If you have these colors, you can create any color you want.

Seeing forests as green, therefore, is a special skill if you are a mammal. But why, among mammals, have we humans developed this ability? Researchers suspect it has less to do with the color green and more to do with the color red. For example, many fruits found among the leaves of trees and bushes are red when ripe. We are not the only ones with our sights set on these. Many birds also have their eyes on them, and birds see red even better than we do. Plants have reacted to the situation: fruit that is eaten by mammals tends to be greenish-red when ripe, whereas fruit favored by birds is bright red.[2]

It makes sense, then, that we can see red, but why is it that we find green so beautiful? In fact, why do we notice it at all? You might think this is an odd question. We have the cones for green, and so it seems hardly surprising that we notice this color everywhere in the forest all the time. But that doesn't necessarily have to be the case. Consider the color blue. Our ancestors probably didn't notice blue at all or, if they did, they considered it unimportant. Lazarus Geiger, an nineteenth-century German linguist, discovered that in many ancient languages there is no word for blue. Homer, an ancient Greek writer about whom we know very little, probably lived about eight hundred years before the birth of Christ. He described the color of the ocean as "wine-dark," and texts from later centuries categorized blue as a shade of green. It was only with the development of and trade in blue fabric that the concept of "blue" was born. Since then, we have separated it out as a color in its own right and been consciously aware of it.

so, do we see some colors only because there is a cultural reason to do so? Or, to put it another way, can we see blue only because we have a word to describe it? Jules Davidoff, professor of psychology at Goldsmiths, University of London, published the results of an impressive experiment on this subject. He and his team traveled to visit the Himba, a Namibian tribe that has no word for blue. On a computer monitor, he showed his test subjects twelve squares arranged in a circle. Eleven of the squares were green and the twelfth was very clearly blue. The Himba had great difficulty finding the blue square. Then he reversed the experiment. Davidoff showed people whose mother tongue was English another circle of twelve squares, this time all green. One of the squares had a tiny tinge of yellow in it that even I could not see. (You can take the test for yourself on the internet. The link is in the notes at the end of this book.[3]) English speakers had considerable difficulty finding the square in question. Not the Himba, however. They might not have a word for blue, but they have many more words for green than we do. This means they can describe even the smallest variations of color in green, and this is clearly what makes it easier for them to immediately identify the slightly differently colored square in the experiment.

Clues that the ability to see color is closely tied to culture also exist in countries where European languages are spoken. People whose mother tongue is Russian recognize different shades of blue far more quickly than non-Russian speakers, because Russian makes a clearer distinction between light blue and dark blue than other languages. A research team headed by New York psychologist Jonathan Winawer discovered that coworkers who spoke Russian were better at

distinguishing shades of blue than their English-speaking colleagues.[4]

UNFORTUNATELY, I KNOW only of studies into the color blue. As a forester, I am, of course, interested in what's going on with the color green. When I look out my office window at the clearing around the forest lodge where my wife, Miriam, and I live, I see infinite variations on the color green. The blue-gray green of the lichens on the old birch tree; the yellowish green of the wintery grasses; the vibrant blue-green of the needles on the branches of the tall Douglas-firs; the warm, yellow-gray green film of algae growing on the bark of young beech trees—all of that is green to me. I certainly notice the differences between the various plants and their component parts, and there are descriptive terms in English such as pine green, shamrock green, and sage green, but these combinations are rarely used in everyday speech. Today, we tend to use less precise descriptors, such as light green or dark green.

A strong argument can be made that long ago our ancestors *were* able to distinguish between many different shades of green and red. If, as I explained earlier, recognizing red was important for our survival (because it meant we could find ripe fruit), then the same could be said for all the various gradations in color from green to yellow. How else could our forebears pick out ripe yellow corn cobs when the lush greens of plots they had so laboriously tended all year faded in the fall as the plants began to dry out and wither away? Or find fruits that changed from green (unripe) to yellow or red to indicate that they were ready to be picked?

A look back even further into the past shows how important it was to be able to make these distinctions. If an animal

was wounded on the hunt, hunters could follow its trail only if they could clearly see drops of red blood on green grass. This ability to spot blood, incidentally, explains why one of the prerequisites when I applied for a job with the forest service—a job that, at the time, automatically included hunting animals—was full color vision.

TODAY, WE KNOW that red–green color blindness is genetically determined, just like the ability to see the color green. And yet, if the culture you are from affects how you see blue even though you have blue-sensitive cones in your eyes, it seems to me that the ability to see green is not something we should take for granted, either.

Writing is a good example of how much culture influences people's sensory perception. When you see the characters on this page, they form words with meaning, but Japanese characters would probably elicit a very different response—you might wonder how these symbols could ever give rise to mental images. Something similar happens with our sense of taste. Depending on the culture, the same food can be experienced as either disgusting or delicious, and you don't have to travel very far to see what I mean. In Sweden, for example, *surströmming,* fermented fish, is considered a delicacy. To me, however, it smells like fresh dog feces, and most tourists have an overwhelming urge to vomit as soon as the bulging can is opened.

Even if the ability to see green is determined by genetics rather than culture, that does not necessarily mean seeing green triggers a similar reaction in all of us. There is a lot of research that shows green, especially when we look at trees, affects our state of mind (I will look at this in more detail

later). But might our reaction be determined by the historical era and culture in which we live? To answer this question, we would need more comparative studies, for instance, with people such as the Inuit, who rarely see green, or the Tuareg, who live in the Sahara, where the color you are most likely to encounter is some shade of brown. I am not currently aware of any such studies.

As fascinating as the subject of color is, the clarity with which we see things is much more important. And here, both genetics and the nature that surrounds us play a significant role. Sometimes, as I mentioned before, all we need to do is train our senses a bit to bring them up to speed.

DO YOU DISLIKE the idea of wearing glasses or perhaps just want to stop your eyesight from deteriorating? Then there is something you can do about it—at least when it comes to near-sightedness. I used to think that the tendency to near-sightedness was hereditary and that at some time in the future everyone on the planet would be wearing glasses. After all, these days almost no one's life still depends on whether they've spotted lions on the horizon in time to run away. In the absence of this kind of danger, it makes sense that the ability to see long distances deteriorates as evolutionary filters eliminate what is no longer necessary. Especially since we can overcome most limitations with appropriate aids.

Given this, are we all going to end up wearing glasses? Absolutely not, because science has recently discovered that near-sightedness is simply a case of our eyes adjusting well to seeing objects up close—think books and computers. The good news is that each of us can reverse, or at least put a stop to, this progression to near-sightedness. There is just one

thing we need to do: go out into nature. As soon as our gaze drifts off into the distance, we are training our eyes to be far-sighted. If, however, we spend long hours at a desk, in low light and with our reading materials a short distance away, the advance of near-sightedness will continue.

These findings are the result of university studies that focused on children in East Asia. The change was particularly well documented in Taiwan during its rapid transformation into a more urban society. These days, 80 to 90 percent of Taiwanese high-school graduates need glasses, and 10 to 20 percent are struggling with visual impairments. What researchers first suspected might be genetic changes that would be passed down to the next generation were traced back to increased educational pressures and the accompanying loss of outdoor activities. Or, to put it another way, the benefits that came with modern society were turning young people into coach potatoes, and their sedentary lifestyles were the reason they needed to wear glasses.[5]

Near-sightedness caught up with me, too. When I was sixteen, my prescription was -2.5. That meant that the world more than 12 feet (3 meters) away from me was a complete blur. But my eyes did not stay that way. Unlike most of my fellow sufferers, my readings constantly improved and, after a few years, they hovered between -1 and a reading just above the level at which you no longer need to wear glasses. Even back then, I made the connection between the change in my eyesight and what I did for a living. For my work, I spent a lot of the day out in the forest evaluating trunks and crowns in stands of trees that were to be thinned, and I did all of this from a distance. I also spent a lot of my free time outside, repairing pasture fences or sawing logs for firewood.

Near-sightedness, therefore, is not an evolutionary adaptation as I feared, but simply our eyes adapting to seeing things up close, as they need to do for reading. Spending time out in nature and looking up or far away, at least when you are young, can improve or even prevent the problem.

THERE IS ANOTHER, completely different, way you can train your eyes. Maybe you've heard that dogs notice wild animals before we do? Contrary to what you might think, this often has nothing to do with scent, because the wind would have to be blowing directly at the dog. Rather, it's mostly because of movement, which our four-legged companions pick up with their peripheral vision. Our Münsterländer, Maxi, did this amazingly well from the window of a moving car.

Although I didn't know I was doing it, I've also trained myself in this skill over the course of my career. Wild animals are usually well camouflaged. The fur on deer is the same brown as the forest floor for a reason. But if a deer moves, I pick up on that out of the corner of my eye, even if the animal is some distance away. And I'm not alone in this, because, as it turns out, the human eye has an intriguing ability.

Our peripheral vision is actually very poor, and the resolution is so low that anything we see at the edge of our field of vision is blurry. And, as Dr. Laura Fademrecht and her research team at the Max Planck Institute for Biological Cybernetics in Tübingen, Germany, discovered, we can't even tell whether what we're looking at is a circle, a square, or one of the various other objects they used in their experiment. On its own, that discovery would not be particularly amazing were it not for the fact that when it comes to people, our peripheral vision can pick out many more details.

The researchers introduced life-sized stick action figures at the edge of the subjects' field of vision and had the figures make different movements. They made the figures wave, for example. Participants not only recognized these simplified shapes as people but were also able to judge immediately, based on their movements, whether they were being friendly or aggressive. From an evolutionary point of view, it is a distinct advantage to be able to immediately evaluate the intentions of approaching people. Peripheral vision, therefore, is hugely important to us as we interact with the outside world.[6]

You can try out this important skill even if you are in a city—supposedly as far from nature as you can possibly get. All those busy people moving about are great test subjects for your peripheral vision.

I GUESS IT'S not particularly surprising that our eyes still work extremely well, even if a closer investigation by scientists reveals a hidden skill. But what about our ears? Our sense of hearing is commonly thought of as weak compared with that of other members of the animal world, some might even say it has deteriorated from what it once was. But is that really true?

I invite you to join me in the forest, where we will discover that the ancient tie that binds humans and nature exists to this day and is as strong as ever.

PETER WOHLLEBEN

From the *New York Times* bestselling author of *The Hidden Life of Trees* comes a powerful return to the forest, where trees have heartbeats and roots are like brains that extend underground. Where the color green calms us, and the forest sharpens our senses.

In *The Heartbeat of Trees*, renowned forester Peter Wohlleben draws on new scientific discoveries to show how humans are deeply connected to the natural world. In an era of mobile phone addiction, climate change, and urban life, many of us fear we've lost our connection to nature, but Wohlleben is convinced that age-old ties linking humans to the forest remain alive and intact.

Drawing on science and cutting-edge research, *The Heartbeat of Trees* reveals the profound interactions humans can have with nature, exploring the language of the forest, the consciousness of plants, and the eroding boundary between flora and fauna.

A perfect book to take with you into the woods, *The Heartbeat of Trees* shares how to see, feel, smell, hear, and even taste the forest.

"Peter Wohlleben knows the battle that lies before us: forging a closer relationship with nature before we destroy it. In *The Heartbeat of Trees* he takes us deep into the global forest to show us how."

—**JIM ROBBINS**, author of *The Man Who Planted Trees* and *The Wonder of Birds*

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