

### Deep Roots How trees sustain our planet NIKKLTATE



### Deep Roots how trees sustain our planet

#### NIKKI TATE

ORCA BOOK PUBLISHERS



All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying, recording or by any information storage and retrieval system now known or to be invented, without permission in writing from the publisher.

#### Library and Archives Canada Cataloguing in Publication

Tate, Nikki, 1962-, author Deep roots : how trees sustain our planet / Nikki Tate. (Orca footprints)

Includes bibliographical references and index. Issued in print and electronic formats. ISBN 978-1-4598-0582-8 (bound).—ISBN 978-1-4598-0583-5 (pdf).— ISBN 978-1-4598-0584-2 (epub)

1. Trees—Juvenile literature. 2. Trees—Ecology—Juvenile literature. I. Title. II. Series: Orca footprints

QK475.8.T38 2016

j582.16 c2015-904476-6 c2015-904477-4

First published in the United States, 2016 Library of Congress Control Number: 2015944487

**Summary**: In this work of nonfiction, the role of trees in maintaining a vibrant ecosystem, as well as providing food, fuel and shelter, is depicted through photographs, personal stories and facts.

Orca Book Publishers gratefully acknowledges the support for its publishing programs provided by the following agencies: the Government of Canada through the Canada Book Fund and the Canada Council for the Arts, and the Province of British Columbia through the BC Arts Council and the Book Publishing Tax Credit.

Cover images by Mahlia Amatina/mahliaamatina.com, and Hero Images/gettyimages.com Back cover images (top left to right): Claudiad/istock.com, Sugiyono83/dreamstime.com, Isabel Poulin/dreamstime.com (bottom left to right): Hafizismail/dreamstime.com, Max Earey/ dreamstime.com, jcamilobernal/dreamstime.com

Design and production by Teresa Bubela and Jenn Playford

ORCA BOOK PUBLISHERS www.orcabook.com

19 18 17 16 • 4 3 2 1

Trees are useful in many ways, but perhaps best of all they are beautiful to look at and good company on a sunny day. NADEZDA KOROBKOVA/DREAMSTIME.COM

For Dad and all the trees we planted together.

## Contents

Introduction .....

#### CHAPTER ONE: EARTH

Forests and Ecosystems	. 8
Forest or Farm?	10
Trees Feed the Soil	10
Hang On! Useful Roots	12
Greening Cityscapes	14
From Tiny Acorn to Mighty Oak	14
Corduroy Roads	16
Mycelium Highway	16

## CHAPTER TWO:

Green Lungs	18
What's a Carbon Sink?	20
Look Waaaay Up	21
Koalas Love Their Leaves	22
Epiphytes—Plants in the Air	22
Tree Houses	24
Trees with Roots in the Air	24
Stop that Wind!	24
Fog Drinkers	27
Go Play in the Woods	27

#### CHAPTER THREE: WATER

Trees and the Global Water Cycle	28
How Do Trees Drink?	28
Trees Create Rain	29
The Great Green Wall	30
Welcome to the Oasis	30
Ah, Cool!	32
Drink Up!	32
A Feast of Fish	32
Wooden Boats	34

#### CHAPTER FOUR: FIRE

Wood as Fuel	. 36
New Life after Fire	. 37
Ash Enhances Soil	. 39
Dirty Ash, Clean Soap	. 39
Let's Dance	. 39
Warming Up Winter	. 40
Great Ball of Fire	. 40
Slash-and-Burn Agriculture	. 41
Conclusion	. 42

Acknowledgments	43
Resources	43
Glossary	45
Index	46

## Introduction



When the flowering plum tree outside my window bursts into blossom, it's a sure sign spring has arrived. The tree also reminds me that the world is always changing. Good or bad, nothing lasts forever. ANA VODUSEK

o matter where you live, even if it's in a big city, chances are you won't be far from a tree or two. It's a good thing we find trees all over the place. Not only are they beautiful to look at, but they also provide shelter and food for all sorts of plants, insects and animals. We humans find them pretty useful too. Sometimes called the lungs of the planet, trees are critical for producing oxygen, cleansing both air and runoff water and feeding the soil. We build with their wood, burn them for fuel and enjoy the tasty fruit and nuts some produce.

I think about trees every day. My writing desk faces a big window, which looks out onto a flowering plum tree. In the winter, the tree's bare limbs are black against gray, rainy skies. If we get a big snowfall, I hustle outside to shake the branches to try and prevent them from snapping off under the weight of the snow. As the weather starts to warm in the spring, I watch for the first signs of buds. Before I know it, the tree is festooned with brilliant pink blossoms. During the warm days of summer, birds flit in and out of the leafy branches, and I sometimes take my cup of tea outside to sit in the shade cast by the tree. In the autumn the leaves change color, and when the winds begin to blow, the leaves flutter to the ground, leaving the branches bare once again.

Why should you care about trees? Why should we make it a priority to safeguard our forests, plant more trees and protect the many diverse plant species we call trees? In *Deep Roots*, we'll have a look at why trees just might be our best friends, *barometers* of how we are looking after our planet, and our partners as we move forward to create a healthier world.



There is nothing more delicious than fresh fruit picked from the tree. Cherries are my all-time favorite treat! BRETT JORGENSEN | DREAMSTIME.COM

I♥Trees

Our farm is small—less than a hectare (2 acres)—but since we moved here we have planted dozens of trees. Some (cherry, apple and pear trees) produce fruit each summer. Fast-growing Leyland cypress trees provide shade and act as both a windbreak and privacy screen. Other trees, like the Japanese maples and the blue spruce, we planted because we find them beautiful. Lots of birds, squirrels, insects, bats and other creatures appreciate our decision to plant trees. The tree branches are alive with activity at all times of the year as they provide food, protection and nesting places for many living things.



We use apples picked from trees in our orchard to make pies, applesauce, juice, jelly and fruit leather. NADEZDA KOROBKOVA | DREAMSTIME.COM

#### CHAPTER ONE

# Barth



Settlers in the western United States and Canada chopped down massive trees like these without considering how long it would take the ancient forests to recover. LEONARD FRANK, VANCOUVER PUBLIC LIBRARY 5628

#### FORESTS AND ECOSYSTEMS

Trees have adapted to all kinds of *ecosystems*. Where light, water and nutrients are readily available, trees can grow to incredible sizes. The tallest tree in the world is believed to be a coast redwood tree (*Sequoia sempervirens*) in Redwood National Park in California. At 115.72 meters (379.65 feet) tall, the tree known as Hyperion is about as tall as a forty-story building. The record for the tallest tree keeps changing. Trees grow each year and eventually fall, and a new tallest tree takes its place in the record books.

Where conditions are harsh, trees develop adaptations that help them survive. In most cases, trees like company and live in forests with many other kinds of plants, animals and insects. The particular type of forest changes depending on geography and climate.

The various lagers of a forest support different types of plants. Ferns and mosses grow well in the deep shade of the forest floor. RONNIE COMEAU/STOCKSY.COM



This grove of trembling aspens in Utah is actually a single tree with a massive root system and many stems. Known as Pando, this collection of trunks is believed to be the largest tree on the planet, covering more than 43 hectares (100 acres). J ZAPELL/WIKIMEDIA.ORG



#### TREES FEED THE SOIL

A living tree is a big, solid object with a long lifespan. There are many trees all over the world that are estimated to be at least a thousand years old. Eventually, though, even the longestlived trees die. Disease, insect infestation, windstorms, old age and lightning strikes are just some of the reasons why trees die, but even after a tree has fallen, it is still part of the ecosystem where it spent its life. In a forest, fallen trees soon become a source of nutrition for an army of *detritivores* and *decomposers*, the organisms responsible for the huge job of recycling trees. Tiny beetles, flies and fly larvae, earthworms and various kinds of bacteria and fungi all form part of the army of creatures who break a tree down. Eventually, the tree is no longer recognizable and becomes a part of the dirt of the forest floor.

Sometimes, young trees don't wait until the process of decomposition is complete before starting to grow. In the part

This nurse log provides the perfect place for young seedlings to start growing. WING-CHI POON/WIKIMEDIA.ORG



of British Columbia where I live, there are many examples of *nurse logs*—old trees that have fallen in the forest. It can take many years for a big tree to be completely broken down into *compost*, but while the process is going on, seeds from plants and trees fall on the rotting log. There is often enough soft material for small roots to take hold, and little trees can start to grow right out of the old stump or log.



The roots of this big old tree cling to the bank of a river. Sometimes tree roots extend a long way beyond the base of the tree, helping to anchor the tree even during windstorms. JAANA LUNNY

#### HANG ON! USEFUL ROOTS

Growing roots push into the soil and anchor trees so they don't fall over. Those spreading roots help loosen soil and allow water to penetrate the ground, where it can be stored for use during drier weather. They help stop soil from washing away in heavy rains or during floods. When forests are cleared to harvest timber for building, heavy rain hits exposed soil that's no longer protected by the cover of branches and leaves. Dead trees don't soak up water in the same way living trees do, and when the roots themselves die or are removed, rainfall is able to wash away precious topsoil. Not only does this make it harder for new plants to get established, but all that silt and sediment is carried downhill and flushes into streams, rivers and lakes. This silt can cause terrible problems for fish, who are unable to see prey when hunting in the murky water. Their ability to breathe and mate can also be affected.

*Phytoremediation* (**fy**-to-ruh-mee-dee-**ay**-shun) is the process of cleaning up soil or water runoff by using plants to remove (and sometimes break down) pollutants. Trees can be really good at phytoremediation, helping to keep the environment healthy. Even though you can't see them, tree roots play a critical role in keeping forest ecosystems in good shape. This is one reason why it's so important to replant trees after an area has been logged.



HJALMEIDA/ISTOCK.COM

- Try comparing leaves, needles, flowers or bark from several different types of trees.
- Notice both the similarities and differences between different species.
- Keep a notebook with your observations, diagrams and questions for future investigations.
- Next time you are in a forest, turn over a small patch of dirt with a spade. Using a magnifying glass, investigate how many living things you can find in a shovelful of soil.

Dead trees may feed the soil, but living trees draw nutrients up out of the ground so the tree can put them to good use. The right nutrients help trees grow tall and produce fruit, nuts, flowers, nectar and new leaves. CLAUDIAD/ISTOCK.COM

#### FOREST OR FARM?

Trees don't always die naturally and fall in place. Humans harvest them, sometimes cutting down an entire forest. Often, trees will then be replanted. Depending on the species of trees and the location of the new plantings, trees may be ready to harvest from these plantations in forty to fifty years. A fiftyyear-old collection of planted trees isn't quite like a natural forest. A mature forest that has developed on its own is made up of trees of many varieties, ages and sizes. A carefully planted and managed woodlot is made up of tree species selected for particular qualities like speed of growth or the type of wood produced. These man-made forests usually include only one or two types of trees, and those trees are planted over a relatively short period of time.

Intensively planted forests can help prevent additional destruction of *old-growth forests* by providing a source of wood products. All trees, whether growing in a closely controlled environment or in a natural forest, offer many of the same benefits: acting as a *carbon sink* (see page 20), moderating temperature and moisture, and limiting soil *erosion*.

Studying tree rings inside the trunk can tell scientists a lot about climate changes over time. The thickness of each ring will change based on how dry or wet or warm or cool a particular year was. Rings are generally wider during warm years with plenty of moisture.

> FOREST FACT: A tree planter in the Canadian bush can plant 1,600 to 5,000 new tree seedlings every day.

### Try This!



STEVE DEBENPORT/ISTOCK.COM

Next time you want to celebrate a special event, consider planting a tree. The impact of your gesture could well be felt hundreds of years from now!



Plantations like this one are more like farms than forests and are designed and cared for to maximize production rather than recreate a natural forest ecosystem. SUGAR0607/DREAMSTIME.COM



One of the most famous parks in the world is Central Park in New York City. Nature lovers Edward Barnard and Ken Chaya created a detailed map of the 341-hectare (843-acre) park, which includes more than 19,000 of the park's 25,000 trees. KCPHOTOS/ DREAMSTIME.COM



It doesn't matter how long your arms are, there's no way you (or even you and a few friends) would be able to hug a mature California redwood tree! The biggest can be nearly 31 meters (100 feet) in circumference. JCAMILOBERNAL/DREAMSTIME.COM

#### GREENING CITYSCAPES

The term *concrete jungle* refers to a city environment that's densely populated and characterized by a lot of concrete parking lots, roads, bridges and buildings. City planners all over the world have long recognized that trees can make a city more beautiful and less sterile. Even the very largest cities include parks and green spaces to give people a break from man-made structures.

#### FROM TINY ACORN TO MIGHTY OAK

Considering just how big trees can grow, it's amazing that many of them begin with a seed.

Giant sequoias are among the world's largest trees, but their cones are small—only 4 to 7 centimeters (1.6 to 2.8 inches) long. The cone itself is not a seed, but rather a home for more than 200 tiny seeds, each only about the width of a grain of salt! These trees measure their lifespans in hundreds of years, so it shouldn't be a surprise that the cones can be very patient. While a few seeds are released each year in hot weather, many wait until a fire passes through the forest. The heat from the fire triggers the cones to open, and out spill many seeds at one time. It can take thirty years before the cones open under exactly the right conditions. All that time, the seeds wait patiently for their chance to land on a patch of fertile soil, where they will begin to grow.

> FOREST FACT: Some studies suggest that people who can see trees from their hospital windows heal faster.



DANI TATE-STRATTON

Skog is a Canadian company that makes fancy engraved wooden items like postcards, writing journals and business cards. Every time a customer makes a purchase, the company makes a donation to The Nature Conservancy's Plant a Billion Trees campaign. Initiatives like this help ensure forests will remain healthy for generations to come.



Some enterprising furniture makers and cabinet builders use old wood from barns and other demolished structures to craft everything from kitchen counters to coffee tables, like this one made from an old wooden door.

QUASARPHOTO/DREAMSTIME.COM

I♥Trees

Planting a tree is a wonderful way to commemorate an important life event—like the birth of a child. When my mother was a baby, her family planted a lilac tree outside her grandmother's house in Germany. For her whole life, my mom loved lilac trees, and to this day I associate the smell of lilac blossoms in spring with warm memories of my mother.

Wood Works



Many family photos were taken in front of the lilac tree outside my greatgrandmother's house in Germany. COURTESY OF NIKKI TATE



Sections of ancient corduroy roads dating back 4,000 years have been found in Glastonbury in England, and there is evidence they were also used by the Romans. 3355M/DREAMSTIME.COM



Mushrooms sticking up from the forest floor are evidence of the hidden mycelium highway below. Though many mushrooms are delicious, some can be deadly. Don't pick and eat any mushrooms unless a knowledgeable adult is there to identify them! WALDRU/DREAMSTIME.COM

#### CORDUROY ROADS

Building a road might not be the first thing you think of when you consider how you might use tree trunks. Corduroy roads are built by placing logs side by side across the intended route and then covering the rough base with sand. Though roads like this might make a muddy or swampy area passable, they are not exactly known for being smooth. If the logs are used as a foundation and then covered by something longer-lasting (gravel or even paving), the resulting road can last a surprisingly long time. The Alaska Highway between Burwash Landing and Kaidern in Yukon Territory was built this way and lasted half a century!

#### MYCELIUM HIGHWAY

A highway of a very different kind lies just out of sight beneath the forest floor. The *mycelium* highway is a complex network of tiny interconnected fibers made up of individual threadlike filaments. The "fruit" of this massive net pops up out of the ground, where we see it and identify it as a mushroom. What travels on the highway? Bacteria migrate along the pathways and, as they go, perform functions as varied as breaking down toxic chemicals into harmless molecular components or extracting minerals from rock. Those minerals then travel to the finest hairs of plant roots, where they are absorbed. Nutrients carried along the fine tendrils of the mycelial mat help feed the massive trees living in the forest above. In some cases, the network carries diseases that can have a negative impact on the trees or other plants.

Scientists are only now beginning to understand the important role this underground transportation network plays in forest ecology, but as studies continue, mycelium may be used in oil-spill cleanups, water-filtration systems or even as a possible replacement for Styrofoam!







#### What makes Orca's nonfiction different?

Whether the topic is sustainability, cycling or bees, the Orca Footprints are **PASSION PROJECTS** written by enthusiastic authors who are keen to share their research and experience with young readers.

#### LOOKING FOR MORE FOOTPRINTS?











EVERY Last Drop









www.orcafootprints.com

#### NONFICTION FOR AGES 8-12

#### **TOPICS INCLUDE:**

- CYCLING
- FOOD PRODUCTION
- SUSTAINABLE ENERGY
- CLEAN WATER
- HOUSING
- WASTE AND RECYCLING
- BEES



