RISING

DISPATCHES *from the* NEW AMERICAN SHORE

ELIZABETH RUSH

MILKWEED EDITIONS

Published 2018 by Milkweed Editions
Printed in Canada
Cover design by Mary Austin Speaker
Cover photo © Michael Christopher Brown/Magnum Photos
18 19 20 21 22 5 4 3 2 1
First Edition

Milkweed Editions, an independent nonprofit publisher, gratefully acknowledges sustaining support from the Jerome Foundation; the Lindquist & Vennum Foundation; the McKnight Foundation; the National Endowment for the Arts; the Target Foundation; and other generous contributions from foundations, corporations, and individuals. Also, this activity is made possible by the voters of Minnesota through a Minnesota State Arts Board Operating Support grant, thanks to a legislative appropriation from the arts and cultural heritage fund, and a grant from Wells Fargo. For a full listing of Milkweed Editions supporters, please visit milkweed.org.

Library of Congress Cataloging-in-Publication Data

Names: Rush, Elizabeth A., author.
Title: Rising : dispatches from the new American shore / Elizabeth Rush.
Description: First edition. | Minneapolis, Minnesota : Milkweed Editions, 2018. | Includes bibliographical references.
Identifiers: LCCN 2017059870 (print) | LCCN 2018016302 (ebook) | ISBN 9781571319708 (ebook) | ISBN 9781571313676 (cloth : alk. paper)
Subjects: LCSH: Coast changes--Climatic factors--United States. | Coasts--Climatic factors--United States. | Sea level--Climatic factors--United States. | Rush, Elizabeth A.--Travel--United States.
Classification: LCC GB459.4 (ebook) | LCC GB459.4 .R86 2018 (print) | DDC 551.45/70973--dc23
LC record available at https://lccn.loc.gov/2017059870

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Connecting the Dots

H. J. Andrews Experimental Forest, Oregon

THE RUFOUS HUMMINGBIRD IS NO LARGER THAN A SPOOL of thread. The mass of the average adult equals that of one and a half pennies. Females are bigger than males, and both eat three times their body weight most days to stay alive. Despite their size, these tiny rust-throated birds travel five thousand miles each year between their wintering grounds in Mexico and the Gulf Coast and their breeding grounds in the center of the Pacific Northwest. Measured in body lengths, their migration is the longest in the world. The oldest begin the journey in late January. The youngest follow shortly thereafter.

When I show up at the H. J. Andrews Experimental Forest in late May the rufous have already arrived, plunging their feathery tongues deep into the first alpine wildflowers. I too have traveled far to get to these fifteen thousand acres, nestled in the luxurious folds of Oregon's Central Cascades. But unlike the hummingbirds', my journey wasn't nectar fueled. I watched two movies and

ate a ham sandwich while my Boeing 737 burned through thousands of gallons of jet fuel. I do, however, walk the final twenty feet to a cabin in the woods on my own. This will be my home for the next two weeks while I serve as the forest's writer-in-residence.

On my third morning, it is a little after eight o'clock and I am outside; the clicking of red tree voles high up in the surrounding old growth rinses my mind clean. I have been awake and writing since before dawn, and I needed a break. I needed to feel the last of the morning mist latch on to my hair. I needed to stare dumbly at the deep rivulets and landscapes in miniature running up the trunks of the nearby Douglas fir trees, which have been thriving in this little grove for well over four hundred years. This easy proximity to a sliver of the natural world that resonates on a time scale so utterly different from my own: that is why I am here. I am hoping these weeks awaken something in me, something in the language that I use to describe events so large they resist my pinning them into the pages of this book.

I walk past the research scientists' bunkhouses. They are low slung and the color of mud. Hand-carved wooden signs hang above the entryways, labeling the buildings with names linked to local geographic features and species. First I pass Quartz Creek, then the Rainbow Building, named after the beloved endemic trout. When I reach the balcony of Roswell Ridge, where the bird crew sleeps, I stop. Someone has lined the railing with hummingbird feeders. There I spot my first rufous: pouring its slender beak into a glass spigot, sucking up the syrup below.

If these slight birds spun out silk as spiders do, each one would run through 8,849 spools a year in its migrations. When the rufous flies away, I imagine a single iridescent string trailing behind its feathered body. And then I imagine the many thousands of others in the Andrews just like it. If the continent is a quilt, then these hummingbirds—so much smaller than my own

hands—place the stitches that hold the fabric together. I squint and try to distinguish one wingbeat from the next as another rufous approaches. What extraordinary creatures, I think, weaving here and there—mountains and lowlands—together with their windblown little bodies.

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The H. J. Andrews Experimental Forest is one of twenty-eight Long-Term Ecological Research (LTER) centers scattered across the United States. In the early eighties, when the National Science Foundation realized that almost every project it funded was driven by individual researchers and limited in scope—often spanning no more than five years, thanks, in part, to the steady tick of the tenure clock—it began to invest in a series of outposts dedicated to the study of ecological processes that play out over much longer periods. While the idea seemed novel and perhaps indulgent thirty years ago, today these research centers are generating some of the most relevant climate change data in the country. At the Bonanza Creek station in Alaska, they track the impact of arctic ice loss on human and nonhuman travel across remote landscapes; scientists at W. K. Kellogg Biological in Michigan measure the rate of CO_2 respired by different agricultural crops; and just a couple hundred miles south, at Konza Prairie in Kansas, they are studying the impact of increased rainfall and warmer weather on the productivity of grassland ecosystems.

Along with the handful of climate studies that the Andrews hosts, it is one of the few LTER stations to devote funding to the arts. Its Long-Term Ecological Reflections program invites two writers annually to take up residence in the forest, to visit and record their responses to a predetermined set of study sites. Each writer reflects upon the exact same spots as those who

went before, and collectively they generate a creative record of the changing relationship between people and forests over time. When I accepted the invitation in 2016, the project was already in its thirteenth year out of a planned two hundred. I had, completely independent of the residency, read many of the essays produced during the first decade of the program, so I thought I knew what my time in the forest would yield.

I thought I would spend my mornings revising this book, then hike madly through the afternoons, making sure to visit each of the four reflection plots littered throughout the Andrews. At night, I imagined, I would cook myself coho salmon for dinner and fall asleep to the sound of Lookout Creek tumbling over the downed bodies of five-hundred-year-old trees.

But when I spot that first rufous, my expectations about what the residency will produce begin to shift. Not revision, but expansion. Even though I am 1,350 feet above sea level and a good hundred miles east of the nearest saltwater marsh, I cannot stop thinking about the changes taking place closer to the sea. When I look at the iridescent feathers twitching on the rufous's belly, I do not see the pump and flow of blood beneath the skin or the stitching of flesh atop its wind-shot bones. I do not see a bird exactly. Instead I see a map of its migratory route, and the many swamps and wooded lowlands that it passes through along the way.

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About a week in, I meet Sarah Frey, one of the few researchers at the Andrews devoted to studying the impact of climate change on the forest. She is wearing a green down parka and a headlamp. It is nine o'clock in the morning when I reach the open field behind the Rainbow Building, but Sarah has been sitting there

since dawn, capturing hummingbirds and implanting them with tiny tracking devices called Passive Integrated Transponder (PIT) tags. She is exactly what you might expect from an early-career female scientist: straight faced, sleep deprived, and curious.

In 2008 she and her husband, Adam Hadley, set up a new three-part long-term study at the Andrews. Step one: distribute strings of vertical temperature sensors throughout the forest. These generate a data set exhibiting, at an unprecedentedly fine scale, the range of undercanopy air temperatures across the mountainous terrain. Step two: track bird movement through the forest during breeding season. And step three: analyze how temperature is influencing bird distribution in the Andrews. In an age when climate change is expected to have pervasive negative effects on biodiversity, the husband-and-wife team wanted to know whether there were unexpected pockets of cooler temperatures scattered through the Andrews, and if birds had begun to seek them out.

"We've got one," Sarah calls to Adam, who is doing "surveillance" at the other capture net. He comes over to the folding table where Sarah is about to perform a minor surgery, pulls at his LTER baseball cap, and offers to narrate so his wife can concentrate.

She grabs the tiny bird the way a child grabs a thick marker, pressing all five fingers into its round torso so she can hold it up to my eye level. I am immediately impressed by the rufous's aliveness, the animal quality of its face. I see the features of my cat and also those of my lover reflected there—they are the only other beings I have recently inspected at such close range. And then there is the hummingbird's beak, which is far more menacing than I had expected. I see it and think: tusk on a narwhal, long and sharp and strangely disproportionate in size to the animal's body.

I pull closer, and Sarah reflexively loosens her grip. Sensing the possibility of freedom, the rufous darts into the dense

undergrowth. "I really wanted you to get a good look and I lost the thing," she says, turning from me, disappointed.

According to the Audubon Society, by 2080 this glittering hummingbird will lose 100 percent of its nonbreeding range in the United States, most of which rests in the forested lowlands around the Gulf of Mexico, the place where cypress stands meet marsh. I think back to the hundreds of dead trees that line the Isle de Jean Charles's drowning bayous and know that the loss of this bird's winter range has already begun.

It might seem like a stretch to say that *here* is connected to *there*, and that the bodies of these small birds do the connecting. However, just as the Neapolitan immigrant brings a bit of Italy to New York City, and just as Colombians from Medellín carry the central highlands to the northern corner of Providence, so the rufous transport some piece of all the places they pass through here, to what Sarah calls the belly button of the Willamette National Forest.

Another rufous wings by in a blur, and I begin to wonder what will happen when their wintering grounds disappear. If the rufous don't have a place to live come January, will they return to the Andrews in May? If not, they won't thrust their long slender bills deep into the scarlet gilias and western columbines for nectar. They won't withdraw faces and bodies dusted in pollen. I imagine that if they don't do this, perhaps fertilization will become less likely. Fewer seeds will form. And if fewer seeds form, fewer flowers will reproduce, their Technicolor slowly seeping from the high spine of Carpenter Mountain.

At least that is one version of what could happen. It's also possible that another pollinator could rush in to fill the space left by the rufous. Or that the rufous could change its wintering grounds and its migratory route and end up drinking the nectar of other flowers on other mountainsides. I don't know what bothers me

more, the possible loss of the rufous and all the biodiversity that partially depends on it, or that I have no idea how any of this will play out in the end.

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A couple of days later, when the first of three record-breaking heat waves that will descend upon the state this summer has finally broken, I drive to the top of the Andrews, where the Carpenter Mountain Trail begins. It is the highest in the reserve, and even the parking spot has a view. The edges of the narrow path are littered with trillium and Indian paintbrush, with globeflowers and Queen Anne's lace. Before I lived in Rhode Island, before Brooklyn and Southeast Asia, I lived here in the Pacific Northwest. Often I tell folks, "I miss Oregon like a person." And even though a decade has passed since I last relished the long and deliciously damp Cascadia winter—perfect for mornings at my writing desk, afternoons at Powell's, and weekends in the woods on raincoat-mandatory hikes—returning always feels a little like coming home. Every other year I make a pilgrimage to this moss-heavy range. It reminds me of the relationship many of those who left Jean Charles still maintain with the island. Though Walton doesn't live out on the bayou anymore, he returns at least once a month to throw the cast net and catch up with Chris.

Switchback after switchback, I work my way up. My mind empties as clouds begin to cluster around the mountains across the valley. Eventually the trail levels out, meandering through a stand of pistol-butted western hemlock encased in wisps of witch's hair, spectral green lichen, that sway in the thin air. One tree has fallen across the path. Up close the lichens covering its long body are unruly, each rubbery strand a neuron firing, each cluster an entire neural network. In winter deer and caribou feast on this stuff. Today the

ends of many of the strands sport tiny saucers. My field guide tells me that these are rare and signal reproduction.

The witch's hair is not the only living thing here in the midst of making more. The Andrews serves as a breeding ground for hundreds of different species of migratory birds: ospreys, Pacific-slope flycatchers, black-throated gray warblers, nighthawks, Swainson's thrushes, lark sparrows, golden-crowned kinglets, and many, many others. Like the rufous, they are hardwired to take advantage of the intense productivity of northern ecosystems during the long days surrounding the solstice. And like the rufous, these birds travel across a transcontinental web of marshes, estuaries, wetlands, and bogs, a patchwork of feeding grounds and places to pause when exhausted by so much motion. In the early 1920s, the federal ornithologist Frederick Lincoln introduced the concept of the flyway, a migratory bird superhighway. Like us human beings, these feathered fellows are creatures of habit. When they travel they often retrace their routes, making pit stops in the same exact locations year after year. Today there are hundreds of refuges strung, like beads on a necklace, along the United States' four primary flyways.

Earlier that morning, after spotting a pair of ospreys turning slow and weighty circles above my cabin, I read the *Audubon Climate Report*, a guide to the future of North American birds. I was not surprised to learn that 40 percent of all avian species are migratory. In North America, a third of these nomadic creatures are considered at risk of extinction, thanks in no small part to the threat sea level rise poses to coastal wetlands. As I hike I think back to those findings and wonder if in the future we will ask ourselves the chicken-or-the-egg question in reverse: which went first, the tidelands or the osprey? The columbine or the rufous?

Soon the switchbacks begin to steepen, the moss to wither, and the rufous tracking stations to multiply. But I don't see a

single hummingbird. Is it coincidence or a sign? The thought haunts the rest of my ascent. Species extinction, of course, means not individual deaths but the irreversible disappearance of an entire kind of animal. And yet in the uncanny way that even the most horrific events can become normal when encountered with some regularity, the word *extinction* no longer registers as astonishing. I realize on that mountainside that I have become deeply habituated to the thought of losing much.

Eventually the forest gives way to the summit, a fist of high alpine basalt that until just a few weeks ago was under snow. At its top sits a boarded-up fire lookout. It is too early in the season for the cabin's keeper to be here. I climb onto the wooden porch and the Three Sisters, with their volcanic, still-snowy peaks, swim into view. Cold air glides out of a nearby gully, making me pull my jacket from my pack. I eat three squares of chocolate wrapped in gold tinfoil. From far in the valley below comes the looping call of a solitary bird attempting to attract a mate. In my notebook I scribble, "I come to these mountains with my big questions, the way I imagine my grandparents went to god." Down in the valley, the bird repeats its call again and again. I crane my neck, turning my ear toward the wind-weighted Douglas firs, but hear no response.

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There are 183 black dots on the laminated map of the Andrews that Bryan Doyle lays on the hood of my rental car. Each of the dots represents one of the sites where, six times in each breeding season over the past eight years, members of Sarah Frey's field crew—including Bryan—have listened for ten minutes and recorded birdsong in the canopy. This data will be mapped onto the vertically integrated temperature readings she has been collecting.

When the study is complete Sarah will have an illustration of how heat, and therefore changes in climate, influence the movement of breeding birds throughout the Andrews.

Of the 183 dots, points 1 to 182 are numbered sequentially. Then there is point 400, the northeasternmost spot in the Andrews's long-term bird count. It sits well over a mile from the nearest trail or road. It is 3:45 in the morning, and Bryan and I are about to attempt to hike to it in the darkness before the dawn.

I drum my finger on the map one last time and flick off my headlamp before getting into the car. Bryan settles into the passenger seat, brushing aside his two-foot-long beard, which is the ochre color of decomposing Douglas firs. I drive us deep into the Andrews, gliding through long tunnels of trees and salmonberry vines, gravel thundering on the underside of the car. We skirt the edges of high mountain meadows, roll through fields of thick fog that few will see. After forty minutes Bryan flips on his GPS and coolly says, "Here." I park the car in the middle of the road. There is no shoulder and no one coming up behind us.

Bryan puts on a baseball cap and I do the same. He hands me a walkie-talkie the size of a brick. "Set it to channel three," he says. "Then hit 'Talk.'" The air fills with crackling static. "Just in case," he adds, a phrase that I repeat.

Then he turns, steps off the unpaved road, and slips out of sight into a dense thicket of vine maples. Vine maple is related to the bulkier and more common broad-leafed maple, but it has dozens of smaller trunks instead of a large main one. On steep slopes like this, the trunks bend sideways, creating an interconnected web of branches like outstretched, grasping fingers.

"It's a bit like going through baleen," Bryan says from ten feet in front of me. He lifts a foot waist high and kicks it forward, navigating up and over a tangle of trunks. He totters in a controlled fall and the branches close immediately behind him.

When I try to imitate Bryan, my thigh gets caught, though inertia wants me to keep moving. Eventually I wrest my leg free. I begin to let gravity do more of the work and soon I too am half falling down the hill, slipping into the whale's mouth. Our world becomes darker as the forest canopy closes, the hill always against our backs.

"If you think this is hard, try climbing out," Bryan calls.

Even with my headlamp on I can't really see him. Instead I navigate by ear and by touch, letting go of the idea that I need to follow a trail to move through the woods. Twigs bend and pop underfoot. Perhaps this is what the future will be like, I think, as the places we have long navigated by disappear beneath the surface of the sea. At first the disorientation is uncomfortable, but slowly my mind and body unclench, embracing the unknown.

After thirty minutes the vine maples open up into what was once a Douglas fir plantation. We flick off our headlamps as the sky turns the color of whale oil, smudged and gray. The forest floor is dry and bouncy beneath our feet, dropping away and then rising back up in one long undulation. By the time we reach point 400, over an hour has passed since we started walking. My skin sticks to my clothing, but I resist the urge to peel off my jacket. When crawling through thickets of devil's club I need the extra layer. The shrub is so prickly that the Salish people equate its diabolical spines with the power to protect, and mix its ashes with bear grease to make ceremonial face paint.

"I had no idea birders were so badass," I tell Bryan, panting and throwing my pack on the ground.

"We definitely see more of the Andrews than any other crew."

Bryan holds up his watch to signal that he is about to start the count, then cocks his head to one side, steadies his clipboard, and starts taking notes. He recently passed a series of tests devised by Sarah to measure competency in birdsong identification. His

colleagues, who have not yet done the same, must lug a recorder the size of a bread box through the backcountry. Bryan relies on his ear alone. A song cascades down from the canopy like water tumbling over polished stones. From a bit farther up the hill comes the steady trill of a miniature machine gun firing. Some calls are straight chirps and others seem to move back and forth, like a conversation between old friends.

When the ten minutes are up, I ask Bryan what he has heard. There are three Swainson's thrushes in from the Andes. A Pacific wren visiting from Nevada and other states east. A Steller's jay and a varied thrush, both locals. A Pacific-slope flycatcher up from the mountains of Mexico. And a golden-crowned kinglet who, like Bryan, came from the Midwest.

As he describes their many different points of origin, it occurs to me that most of the birds and both of the humans in this stand of Douglas firs are in from out of town. Summer visitors, vagrants, migrants, travelers all. Each of us will leave the Andrews and its old growth when the days get long and rainy. And each of us will likely return again. Perhaps in this way Bryan and I are not that different from the rufous and the other birds overhead. We too fly in an endless loop. We are snakes with our own tails in our mouths rolling downhill. There is no difference between the beginning and the end. No singular home, pulling harder than the rest.

In the winter, when the bird count season has closed, Bryan works the graveyard shift at a liquor store in Saint Paul, Minnesota. He also fronts a one-man band called Typewriter. His second EP, which he plans to release this summer, is going to be called *Songs from Space Station H*, meaning the H. J. Andrews Experimental Forest.

"This place is so removed from everything else. In this weird way, being out here, you feel sort of out of time. And yet, you know,

it is so keyed in as well . . . ," Bryan says, trailing off, his attention turning to the granola bar he has just pulled out of his pack.

As I listen to Bryan, I think about the places these birds pass through on their way here: of the disintegrating cypress swamps the rufous hummingbirds fly from; of the willow groves that Swainson's thrushes have long sought out in San Francisco's South Bay; of the drowning bayous the ospreys pause in before crossing the Gulf. The birds are all nomads, at home in movement. But what happens when points along their paths begin to disappear? What disorientation will settle upon all of us then? I'd like to think that we can become more and more ourselves through this vicissitude. That through our losses we will be made whole.

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Bryan and I tumble down a fern-covered gully. We are on our way to the next stop on the morning's count: point 59. This valley is so large, so verdant, and so seemingly unending that the only useful reference I have is the cartoon *The Land Before Time*. I tell Bryan this and our talk turns to dinosaurs. Back when the dinosaurs lived, the world was a lot warmer than it is today. Sea levels were 550 feet higher. If current sea levels rose 550 feet, they would drown not only the overwhelming majority of the refuges in our coastal flyways but also one-third of the planet's dry land.

"Maybe we secretly love dinosaur movies because they make us think that extinction is somehow reversible," I say.

At that moment Bryan's ankle buckles. He reaches back, his body lengthening, then bouncing against the forest floor. In seconds he is back on his feet. "Damn boots," he says, wiping the pine needles from his pants.

We walk out across a giant Douglas fir bridging two steep slopes, above a brook that connects with the Mack Creek below. The ferns are so thick that it is hard to know exactly how far we could fall. In this case the uncertainty is probably a good thing.

At point 59 Bryan hears two Pacific-slope flycatchers, a hermit warbler, a varied thrush, and a Swainson's thrush, its song spiraling upward. When I ask him how tough it was to learn the birdcalls, he says very. Most have, as you might expect, more than one song. The hermit warbler, for example, has six, a trait that Bryan lovingly describes as "bogus."

Any language learner will tell you that studying a new linguistic system is a humbling experience; with it comes the knowledge not only of different words and grammatical structures but also of worlds and cultures unlike your own. When you learn a language you learn to see your way of life as one of many, your place on this earth as fragile and shifting as any other. Sarah and her team cannot directly ask the birds how they are adapting to climate change. But they can learn a little of the language of the flycatchers and then head to point 400 to listen very carefully for a scrap of that song.

The Andrews is a place not only of long-term scientific inquiry but of deep reverence for the natural world. Each of the scientists working here has learned to see things from another perspective—through, for instance, the eyes of the rufous hummingbird or the groping roots of the Douglas fir. It reminds me of something Robin Wall Kimmerer—who, not coincidentally, served as the Andrews's second writer-in-residence—observes in *Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge, and the Teachings of Plants*. "Doing science with awe and humility is a powerful act of reciprocity with the more-than-human world. . . . Love of data . . . the wonder of a p-value . . . are just ways we have of crossing the species boundary, of slipping off our human skin

and wearing feathers or foliage, trying to know others as fully as we can."

Bryan has spent the past three summers slogging through this rough mountainous terrain in order to listen to the songs of his fellow migrants high overhead. It is a labor-intensive task, one that demands he pay attention in a world where we do not tend to "pay" anything without receiving something in exchange. But just as paying attention to another person fosters intimacy and makes us feel less alone, perhaps scientific observation allows us to enter into a similar relationship across species. By listening, by returning to the grove time and again, by tuning our ears to the sounds of beings unlike ourselves, we begin to reenter what Thomas Berry, the Catholic eco-theologian, calls "the great conversation" between humans and other forms of life. This too can have a grounding effect, can help stave off a different, larger, and more gaping loneliness. If anything is sacred, it is this, I think. And by *this* I mean all of it: the salmonberries beginning to ripen in the bramble; the scratchy, scolding caw of the Steller's jay that will nibble there; the long, straight trunks of the Pacific red cedars that rise into the sky's blue cathedral. The web of life that too often capitalism seems dead set on dismantling.

From up in the forest canopy I catch a filament of flutelike song. "Is that the Swainson's thrush?" I ask. Bryan nods.

The first step in learning to think of that olive-colored drifter as one of my own, as a member of my scattered tribe, as part of the constellation of people and places I most fiercely defend, is knowing the sound of its voice. The chirps and squeaks it makes to warn of outsiders in the grove, and those it casts into the air to draw another thrush in. Its song of protection, and the melody it sings to reproduce. Like so many of the other beings in the Andrews, it too passed through the marshes of coastal California on its journey north, compelled by a desire to write its name in the sky.

By the time we reach our final stop—point 40—at 10:28 a.m., Bryan has tied his beard up in a knot and the birds are growing quiet. He listens and notes four different species. I sit on a gigantic stump, the body of the ancient tree harvested nearly a hundred years prior. Bryan offers to take my photo, and as I hand down my camera a northern spotted owl swoops through the clearing and lands on a branch not twenty feet away.

The spotted owl's appearance pins me in place. Its eyes are as big and round as shooter marbles, as impenetrable as obsidian. For a full minute it does not blink. The intelligence flickering beneath its downy feathers is somehow wholly different from my own. It is an intelligence that belongs to the old growth in a way that I do not. Unlike all the migratory creatures just passing through the Andrews, the spotted owl will mate and breed and die in place, here. Only here. This forest is the one home this bird will ever know.

I had hoped to see a spotted owl when I accepted this position and have never admitted it, fearing disappointment. Today there are about two thousand pairs of spotted owls left in the Pacific Northwest, four of which are known to mate in the Andrews. During the "Forest Wars" of the late eighties and early nineties, a battle raged over the future of the region's old growth: the lumber industry predictably calling for harvesting and job creation, environmental groups for preservation. Back then it was common to see a "Save a lumberjack, eat a spotted owl" bumper sticker bumping along the forest service roads that run through the Cascades. The recession had put many out of work, and it was feared that the few remaining timber jobs would disappear if the owl was listed as endangered.

But members of the H. J. Andrews spotted owl research team

had been stalking the understory in search of these elusive creatures for over four decades. In the middle of the Forest Wars, they proved that these shy birds reproduce only in old growth, and that the felling of the Northwest's ancient forests was precipitating their decline. A judge used this small fact to create an injunction against harvesting nearly twenty-five million acres of spotted owl territory back in 1990. Today these large swaths of old-growth forest are part of Oregon's $16 billion outdoor recreation industry, which pumps revenue into rural communities that once depended upon timber.

A second bird swoops in and looks right at me. I scribble a string of nonsense in my notebook, a desperate attempt to translate my excitement at experiencing what feels like a moment of interspecies communication. Never before have I stared into the eyes of something so wild for so long. Soon I give up. Settle in to my awe and my ignorance. Transcription will come later, I tell myself, gazing at the birds' brilliant polka-dotted plumage instead. One owl flies toward the other, wings cleaving the air. It lands on the same branch and waits, shoulder to shoulder with its mate, for what I do not know. I watch them for nearly an hour. I want to be alone with these beings near extinction, whose lives are doubly meaningful by our perverse design.

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The next afternoon, back at headquarters, I check in with Steve Ackers, the current lead researcher on the spotted owl study. Steve is wearing an all-gray outfit: gray Carhartt baseball cap, gray KEEN clogs, gray T-shirt, and gray quick-dry pants. The day I was invited to be the writer-in-residence at the Andrews, I was teaching an essay in which Steve appeared. At the time the connection seemed serendipitous. But as I talk with him on my last

afternoon—recalling my own spotted owl encounter—coincidence is the furthest thing from my mind. I feel like part of the network of beings that make this place what it is and are shaped by it in turn.

"One owl looked at me, without blinking, for over a minute straight," I tell Steve eagerly. Its gaze had felt like such a tremendous gift.

"Do you want to know why they do that?" he asks. "Why they sometimes allow you to stare?"

"Yes," I whisper.

"We've been in contact with the owls for over a decade," he says. "Usually we bring mice."

"You mean when I reached into my bag, it didn't spook because—"

"It thought you were pulling out a box of bait mice. They've become completely habituated to humans. It's the one part of the study I don't like."

I look around Steve's office, which is plastered with photographs of spotted owls, wings outstretched and claws cranked open. Mice had been pulled from Steve's backpack, in part, for this explicit purpose: to capture an image of an enigmatic creature. An image that he would share widely to help keep the Andrews safe. He and the spotted owls have formed a bond, a kind of kinship founded on the reciprocity that comes with paying attention, forged in the fire of mutual exchange. *I'll give you a mouse if you let me take your photograph.* For fourteen years they have been, consciously or not, pursuing the preservation of these groves together. Preserving the rocks that lie under the surface of Lookout Creek, moving downstream with each big storm, remaking the river from beneath. Preserving the high spine of columbines for the hummingbirds that feast there in May. Preserving the pistol-butted hemlock and the tangles of witch's hair. Preserving the

branches from which the Swainson's thrushes cast their hopeful song. The loss of its wildness was a price the owl was forced to pay in order to save so much else.

In fact, the logging ban that protected the spotted owl's breeding habitat is—if you look at the results it produced as opposed to the intention behind the action; if you consider, for instance, the varied geography of the places the ban safeguarded and not just the specific species it was designed to save—an example of what biologists have begun to call "conserving the stage." Instead of focusing on the longevity of a single species or place, these scientists suggest setting aside areas rich in geophysical variation. To maintain our planet's diversity of life we need to pay special attention to topography, they say. That's because, as the earth warms, species are on the move, many relocating up in elevation or poleward at a respective rate of forty vertical feet and eleven miles every decade. These species are attempting, in part, to track their thermal niche, the temperature in which they are most likely to survive and thrive. Here in the Pacific Northwest, Douglas fir–dominated old-growth stands can occur anywhere between sea level and roughly six thousand feet. Setting large parcels aside inadvertently meant safeguarding areas across geologically diverse landscapes. And it meant presenting the flora and fauna that live here—at least the mobile kinds—with an opportunity to respond to rising temperatures by rising with them, up the mountainside.

When Steve asks me if I know where I was when I spotted the spotted owls, I say yes. It was 10:28 a.m., and I was standing at point 40 on the long-term bird count survey. Steve doesn't know where point 40 is, so I run over to the bird crew's apartment and ask Bryan if I can borrow his map.

As I walk past the Rainbow Building, my mind turns back to migratory birds and the marsh. Classifying landscape resiliency

as a function of topographical variety goes a long way toward explaining just how vulnerable tidal marshes—and the thousands of species dependent upon them—are. After all, most sit within three feet of the highest high tide. This also explains why roughly half of the over fourteen hundred plants and animals considered at risk of extinction in the United States pass through wetlands at some point in their lives. The question becomes, not how we can save the osprey or the rufous, but how we can preserve the various places where they pause during their transcontinental treks, many of which are, unlike the Andrews, painfully flat. The answer is as complex as it is simple. If we want the creatures that make their lives in tidal marshes to have the chance to rise up along with rising temperatures and rising seas, we need to relocate the human communities that restrict the possibility of the marshes' upland migration.

Back in Steve's office I unfold the map and tap my finger over the single black dot of point 40. For a few seconds he says nothing. Finally he asks, "Are you sure they were spotted owls and not barred?"

"I think so," I say, pulling out my camera to show him the proof.

He recognizes the birds immediately. "That's them. The male hatched in 2006. The female is older, almost fourteen now," he says. "We haven't seen them since March. Now we know why. They've moved."

For the first time in ten years, the owls had crossed Mack Creek, moving higher up the mountainside that has long been their home. Only a few months later would I realize what this might mean. I was having a discussion with a literature scholar about Alexander von Humboldt, the Prussian explorer and naturalist known for his observation that as altitude changes so too does the climate. For every two hundred feet up the Andes he

climbed, the temperature dropped by a single degree. And as the temperature changed, so did the species.

Later that day, I open a photo I took of the bird count map and compare it with the one the owl researchers use, counting the topographic lines between point 40 and the owls' old breeding tree. Four slender bands separate the two. That means that point 40 is eight hundred feet higher than the owls' former home and that it is also likely a degree or two cooler up there. Perhaps the owls moved because they were trying to track their thermal niche. Perhaps the temperature had slowly begun to rise in the Andrews, causing this bird, one of the most stationary and territorial in all the forest, to migrate uphill.

I write Steve an e-mail, floating my idea. His response is fast and professional: "I think your thermal niche hypothesis has a lot of merit, but it would be tricky to tease out the effects of stressors from a shift in elevation in response to climate change without better data."

At first I am disappointed. Then I open up the images of the owls I had snapped. I look at them looking at me from their perch and I sense that their fate and ours—and the hummingbird's and the osprey's and the columbine's and the cordgrass's and the scarlet gilia's—are all tied up in one another in ways that I can't quite explain. Though I have tried. Tried to make something durable out of language that flickers like the wing of a rufous in flight. Tried to make myself mindful, at least, of the role topography plays in determining a creature's chances for survival.

Often I have wished I were back at the Andrews, though not in that grove staring at those spotted owls, and not at the top of Carpenter Mountain. I have wished myself back into that first light when I learned to hold still and listen to my fellow traveler's flutelike song rising from its branch.

On Restoration

Richard Santos: Alviso, California

I WAS BORN IN ALVISO. MY DAD CAME HERE, LIKE MANY other Portuguese at the time, to work in the canneries and to turn fruit into wine. Eventually he got some underwater land, you know, in the marsh. He had a hard time selling it, so he decided to turn it into a dump. And that became our family business. He had regular contracts, took the waste for most of the town.

There was one thing all of us who lived in Alviso had in common: we were poor. Though we didn't really know it. We all worked in the orchards, and when the days were done we fished off the levees. It was a Huckleberry Finn kind of life.

When I was a kid we'd go down to the salt ponds with Tommy Lane. We'd tie a rope with a stick on the end to the bumper of Tommy's truck and call it waterskiing. That Tommy was a champion swimmer. He probably has about one hundred trophies back

in his house. When I was in high school, in 1959, the coach from the Santa Cruz swim club came down. He said to Tommy, "Son, I'm going to take you all the way to the Olympics." Tommy, being a bumpkin from Alviso with an IQ of about seven, said, "No thanks. I'm gonna marry Beverly and work at the power plant across the street." And that's exactly what he did, worked there for forty years.

Everything I know about fishing I learned from Tommy. Back in 1979 I caught the biggest sturgeon in the history of Alviso. Took an hour and ten minutes to reel it in. Seven-foot, 900-pound sturgeon. When I finally threw the fish in the boat it busted up the place. So I threw it back. Years later I caught a 207-pound sturgeon. We took that fish to the local Chinese restaurant. There were about thirty-seven of us. We had them sauté it with sweet-and-sour and onions. What a feast! We gave them the head and they cut open the gills and big chunks of meat fell out.

Back then it was mostly salt ponds and orchards. There was no Highway 237, only Route 9. People thought this was the outback. Judges, congressmen, governors, they all came out here to Vahl's Restaurant—which is still operational, by the way, her nephews run the place. Vahl's, and all of Alviso really, was so secluded, so far from everything else, that there was little in the way of law. People drank, they gambled, they whored. The trains all ran through town and the hobos would jump off, and my father—he eventually became the police chief—he would greet them right there and ask, "Are you working?" If you said no, he put you in a car, drove you to the outskirts of town, dropped you off, and told you never to come back. Back then this was all migrant camps—Portuguese, Armenians, Spaniards, blacks, okies. Everyone was generous. It's often folks with the least that share the most. I would sit by the

fire at the camps and listen to them singing and they would feed me tortillas.

And now everyone is trying to get a piece of Alviso, and I won't let them. I don't want high-density housing and tech campuses. I want my grandkids to be able to see the mountains and to run along the levees. Sure we've flooded in the past, but I have a sixth sense about flooding and I don't think we're going to flood again, mainly because that wetlands restoration project is providing a lot of additional protection that we never had before. And it's helping to bring back all the different kinds of fish we had out here when I was growing up.

The thing is, we the people of Alviso own this city, and nobody with big money owns it. A couple years ago a developer approached me and said, "Mr. Santos, you have four acres. I will give you one million for each of them." They wanted to put a couple hundred houses in there. I said, "What am I going to do with that four million bucks? I'm going to move to Beverly Hills. Get two German shepherds. Sip a beer and eat a sandwich. But who am I going to talk to? I can't go back home anymore because I sold out. And I can only buy so many sandwiches and beer, so how the hell do I find happiness?" He thought there was something wrong with me. Well, I thought there was something wrong with him.

There are a lot of people in San Jose, with money, who would like to see me disappear. Only because they would get their way with development. I fight so hard because I'm trying to preserve the history and the characteristics of Alviso. The stories we tell about this place are powerful. More powerful than money. More powerful than all the different fantastical futures the tech industry might offer. When you take a cubicle and you put fourteen mice in

there, they destroy each other. But if you put four in, they survive. Now that cubicle is Alviso. Alviso can exist. And you can bring business in. But you can't make it too tight. The City of San José doesn't care. They just want a slam dunk.

A couple of years ago the Alviso advisory board approved a development of office buildings on the southern end of town for Cisco. Now years go past and the dot-com bubble crashes and Cisco can't afford to build anymore. So they sell the land to another developer that wants to put in a big manufacturing and trucking distribution center. But we don't want that traffic rumbling through our streets at all hours of the night, right next to our school. That's not the kind of development we approved. Well, the City of San José told us that we had approved a project, and they gave the developer the go-ahead. They just steamroller us as they have so often in the past.

But I'll tell you what, the wetlands restoration project out there in the bay, they're keeping huge chunks of land out of developers' hands, and that keeps the area around Alviso open space. And when that area is open space, it can absorb the floodwaters that would otherwise run right through this town. They wanted to build a stadium out in those wetlands, but now that land is part of the project, so it is illegal to develop them. For me, that's the real slam dunk.

When I go out into the area around the Don Edwards Center I see plover, egrets, burrowing owls, harvest mice. I hear the grass shrimp are back too, though I don't get around to fishing much these days. They all seem to be more plentiful than they were a decade ago. And I tell you, lately there are a whole heck of a lot more jackrabbits running around than I've seen in a long time.

Those wetlands are going to save the community that I've fought so long to protect. I was skeptical at first, sure. I thought it was just a bunch of environmentalists mucking around in the weeds, but now I see it's the best chance we've got to keep Alviso *Alviso*. To save the community and the ducks and geese and sturgeon and all those other animals that have made this a wonderful place for me to live out all of my seventy-some-odd years.