A PLAGUE of RATS and RUBBER-VINES

THE GROWING THREAT OF SPECIES INVASIONS

YVONNE BASKIN

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A SCOPE–GISP Project

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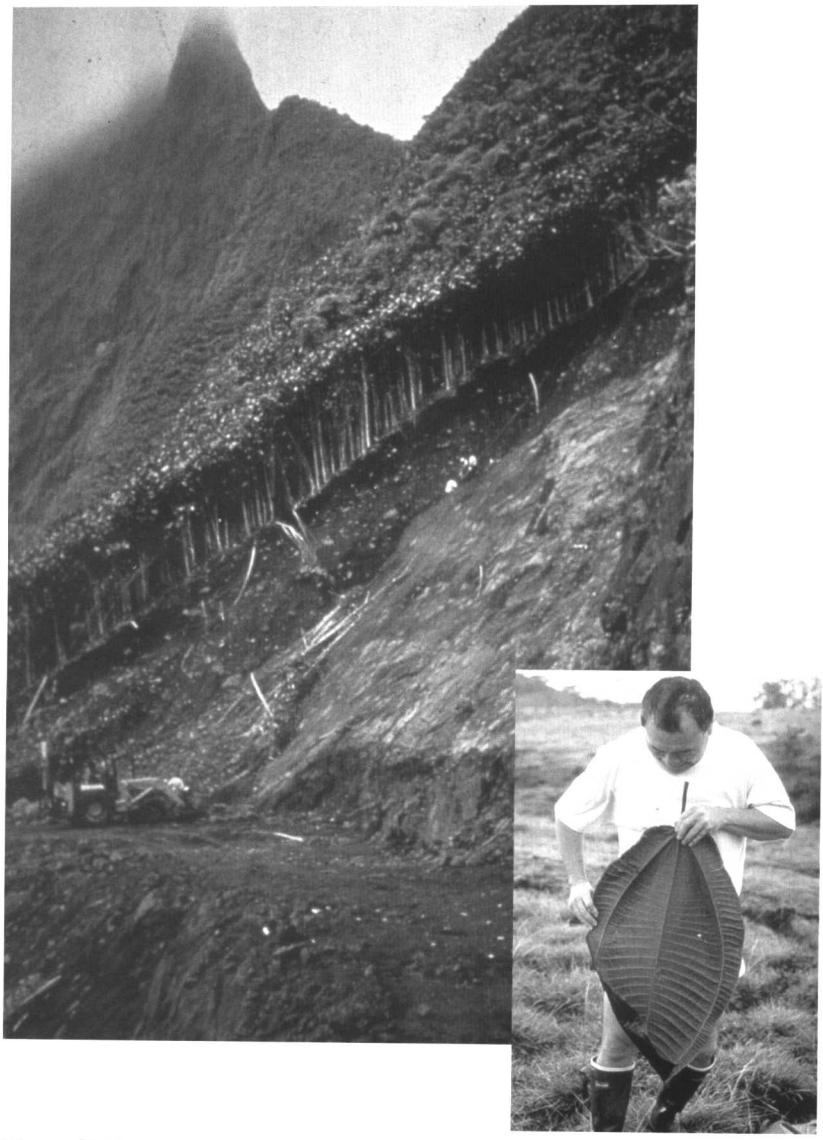
Asian kudzu vines blanket trees along a Florida highway. Kudzu invades another 50,000 hectares in the southeastern United States each year, overtopping and obliterating trees, telephone lines, barns, derelict vehicles, farmland, and stream banks. (Photograph by Ann Murray/University of Florida)

Rubbervine, imported to Australia from Madagascar in the 1860s as a garden plant, smothers vegetation along the Gilbert River in North Queensland. The exotic vine now infests 350,000 square kilometers of Queensland, an area more than half the size of Texas. (Photograph by Mike Nicholas)

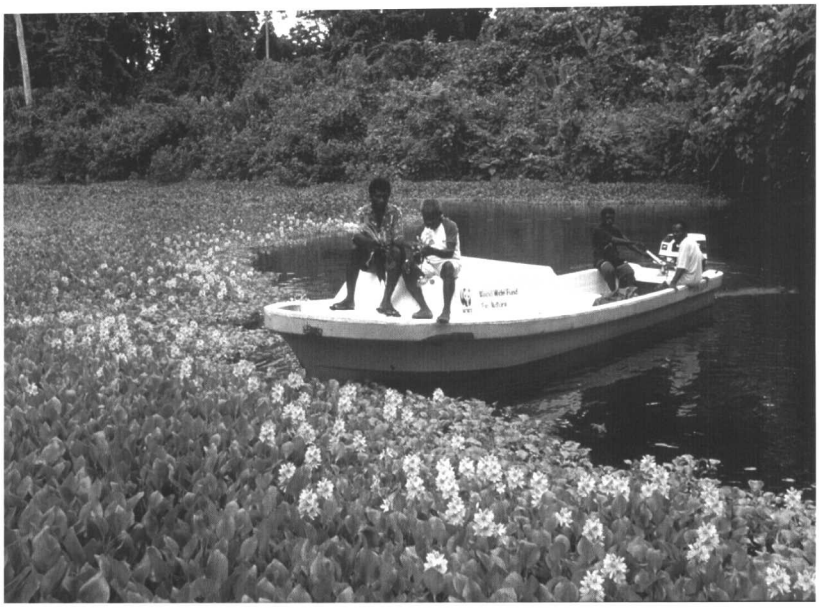


Many of Tahiti's mountain forests have been replaced by dense stands like this one of invading miconia trees. The shallow-rooted miconia increase the risk of landslides. The size of a single miconia leaf suggests how the invading trees are able to shade out native vegetation. Miconia infestations now blanket two-thirds of Tahiti, directly endangering forty to fifty endemic plants by overtopping, shading, and crowding them from forested slopes. (Mountainside photograph by Paul Holthus; leaf photograph by Robert Hobdy)

Before

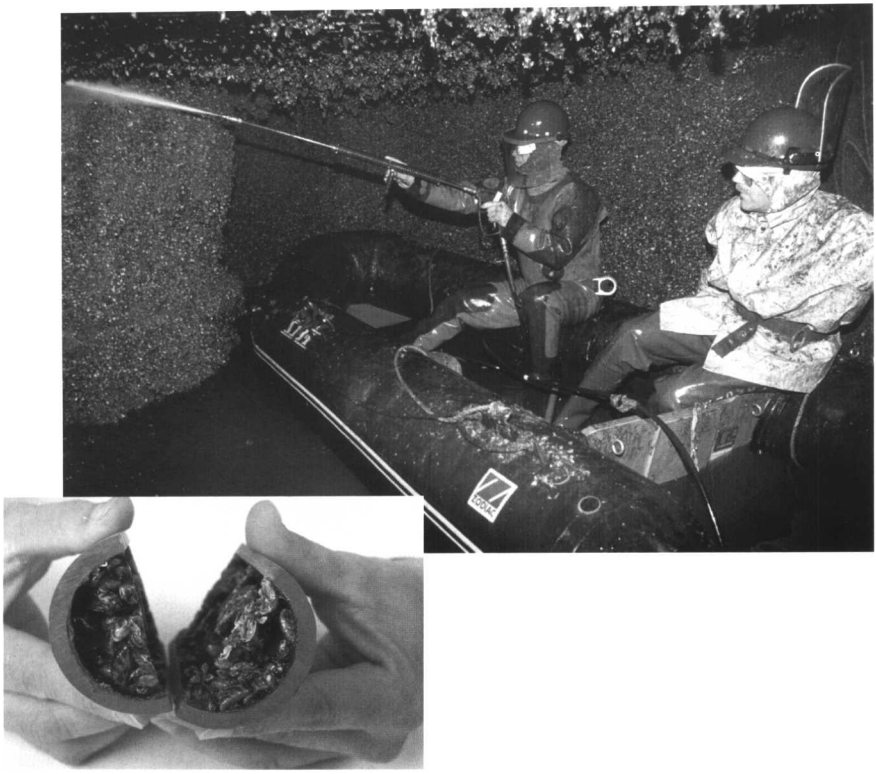
After

A swimming area at Wakulla Springs, Florida before and after an invasion by the Asian waterweed hydrilla. First introduced as an ornamental pond plant, hydrilla now causes severe problems by blocking recreational swimming and boating, impeding commercial navigation, clogging irrigation canals, shading out native plants, degrading water quality, slowing water flow, and interfering with water supply systems. (Photographs by Victor Ramey/University of Florida)



Large mats of invading water hyacinth choke an important wetland in the Solomon Islands. A wayward ornamental from South America, water hyacinth has become a scourge of waterways worldwide. In Africa, for instance, the weed has exploded across the continent since the 1950s, threatening rice cultivation, fisheries, navigation, hydroelectric power generation, tourism, and even human health (by providing habitat for snails and mosquitoes that vector schistosomiasis, malaria, and other diseases). (Photograph by Peter Solness)

A diver looks down on a cascade of the invasive seaweed *Caulerpa taxifolia* on the Mediterranean seabed. The lush, fern-like tropical seaweed was dumped into the sea from a public aquarium in Monaco in the mid-1980s and within fifteen years had carpeted vast areas of the shallow seabed off France, Spain, Italy, and Croatia, replacing much of the native life of the ocean floor. (Photograph by Alexandre Meinesz)

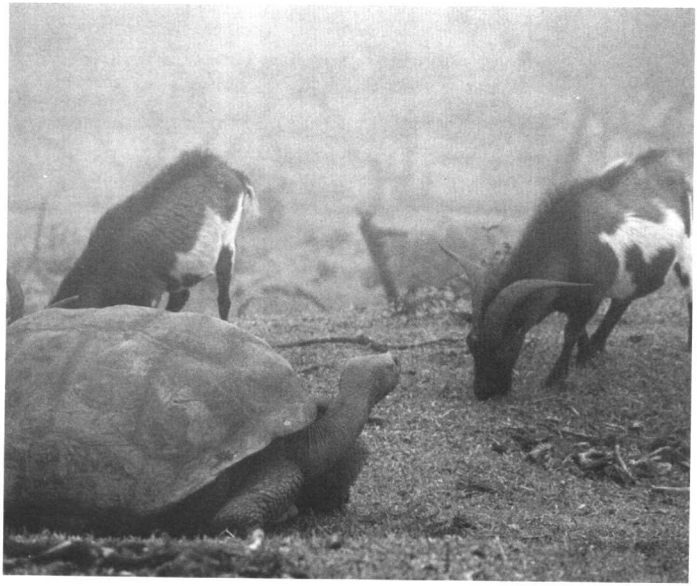


Workers use a high-pressure hose to blast away zebra mussels encrusting the walls of a Detroit Edison power plant in Monroe, Michigan. These mollusks, native to the seas of Eastern Europe and Western Asia, showed up in the North American Great Lakes in 1988, apparently discharged from the ballast tanks of a freighter. They spread quickly and aggressively, invading twenty states and reaching the mouth of the Mississippi within a decade. Zebra mussels encrust and foul anything solid in the water, from rocks, boat hulls, and pilings to water-intake pipes and filtration equipment. A cross-section shows a water pipe completely blocked by a dense infestation of mussels. (Photographs by Peter Yates)

The Nile perch, introduced several decades ago into Africa's Lake Victoria, has dramatically expanded the tonnage of fish caught from the lake even as it helped eliminate hundreds of species of small native cichlid fish that supported traditional village economies. Perch are shown here being unloaded at an export processing plant at Jinja, Uganda. (Photograph by Yvonne Baskin)

Village women who used to dry and sell small cichlid fish caught by local fishermen now fry and sell perch scraps from the processing plants along the road outside the city of Kisumu, Kenya. (Photograph by Yvonne Baskin)

A feral dog kills a Galápagos land iguana. Dogs, pigs, and human predators had exterminated so many of the unique reptiles by the late 1970s that a captive breeding program was launched at Charles Darwin Research Station to rescue the species. (Photograph by Tui De Roy)



Invading goats compete with giant tortoises for food on Isabela Island in the Galápagos. Goats also strip bare the water-capturing trees and other vegetation, creating drier conditions and eliminating vital waterholes and wallows that sustain tortoises and other native wildlife. (Photograph by Godfrey Merlen)

The exotic southern house mosquito shown on the eye of an apapane, or Hawaiian honeycreeper, transmits an avian malaria parasite brought to Hawaii by imported birds. (Photograph by Jack Jeffrey)

North American bullfrogs weighing up to nearly half a kilogram have escaped from frog-leg "ranches" worldwide to become major predators of other frogs as well as fish, salamanders, and even mice and birds. (Photograph by W. Stephen Price)

A feral cat kills a bird in Western Australia. In the United States, feral cats and outdoor pet cats kill half a billion birds each year. (Photograph by Evan Collis/ Dept. of Conservation and Land Management, Western Australia)

CONTENTS

ONE
Introduction: Confronting a Shrinking World 1

TWO
Reuniting Pangaea 19

THREE
Wheat and Trout, Weeds and Pestilence 43

FOUR
Elbowing Out the Natives 71

FIVE
The Good, the Bad, the Fuzzy 99

SIX
The Making of a Pest 125

SEVEN
Taking Risks with Strangers 147

EIGHT
Stemming the Tide 173

NINE
Beachheads and Sleepers 199

TEN
Taking Control 225

ELEVEN
Islands No Longer 259

TWELVE
Can We Preserve Integrity of Place? 285

APPENDIX A
100 of the World's Worst Invasive Alien Species 305

APPENDIX B
Index to Scientific Names of Cited Invasive Species 310

Notes 321

Acknowledgments 355

Index 359

ONE

Introduction: Confronting a Shrinking World

"We must make no mistake: we are seeing one of the great historical convulsions in the world's fauna and flora. We might say, with Professor Challenger, standing on Conan Doyle's 'Lost World,' with his black beard jutting out: 'We have been privileged to be present at one of the typical decisive battles of history—the battles which have determined the fate of the world.' But how will it be decisive? Will it be a Lost World?"

—Charles Elton, *The Ecology of Invasions by Animals and Plants*, 1958

"In contrast with the aftermath of prehistoric mass extinctions, human-dominated landscapes will encourage the generalist species to proliferate—all the more so as natural controls (predators, parasites) are preferentially eliminated. The upshot could well be a 'pest and weed' ecology, with all that implies for evolutionary history."

—Norman Myers, in the journal *Science*, 1997

Just a twenty-minute drive from downtown Auckland, on a steep slope behind Mick Clout's home, a lush remnant of primeval New Zealand forest remains. Spared from fire, ax, and plow because of its rugged aspect, the site still shelters two hectares of towering tree ferns, nikau palms, and the native evergreen trees the Maori, New Zealand's Polynesian settlers, call kahikatea. One fall day, as a light rain dripped soundlessly through the dense canopy and onto the rust-colored duff of the forest floor, several of us ventured into those woods hoping to see a pair of New

Zealand pigeons that had taken up residence. The legendary chorus of native birdsong that greeted the first European colonists has all but vanished, and what's left of New Zealand's forests are now disquietingly silent. As we listened for the cooing of pigeons, we suddenly heard instead a high-pitched call, eerily familiar to me yet startlingly out of place on this Southern Hemisphere island: the bugling of a North American elk.

Fortunately, the elk stag was confined on a neighboring game farm, along with the European red deer hinds imported to breed with him. Only a few times each year does a hind jump the fence and invade the forest to strip the bark from Clout's palms or damage the understory. Elsewhere in New Zealand, however, invading alien deer and elk cause severe damage to forests, rivaling the destructiveness of the invasive brushtail possums brought here long ago from Australia, which strip some 18,000 metric tons of leaves each night from forests like these. Clout, a professor of ecology at the University of Auckland and chair of the Invasive Species Specialist Group of the World Conservation Union (IUCN), maintains poison bait stations throughout this forest patch to kill the possums, which threaten not only the trees but also nesting pigeons and other native birds. It is possums, European ferrets, rats, and other furry alien invaders that have helped to silence the birdsong in New Zealand's forests. Along a creek at the foot of the slope, Clout pointed out other, more benign-looking invaders that nevertheless menace his remnant forest: recent garden fugitives such as wandering jew, willow, pampas grass, and privet now advancing along the streambed or upslope into the forest, threatening to choke out the native plant life that provides shelter and sustenance for the pigeons and other surviving birds.

As we walked back out of the woods and toward the house, we could see North American mallards dabbling about in rain puddles on the road below. The lush hills beyond were forested with California Monterey pines and Australian eucalyptus. It could have been a scene in San Diego but for the elk. An American or European visitor can easily feel at home amid the biota of Auckland and, indeed, much of the rest of New Zealand. That's because half the plant species and all the mammals (except for two native bat species) came from somewhere else. And New Zealand is not the only place to which many of these same plants and animals have been moved.

You will see many of the same beasts and much of the greenery in Cape Town or Sydney, Kuala Lumpur or Paris, San Francisco or Santiago.

The biological déjá vu of travelers today is the result of a massive game of musical chairs we have played with life on the earth, especially during the past 500 years. The extent and thoroughness of this rearrangement of plants, animals, and microbes is stunning, yet far from finished. We can find American beavers in Tierra del Fuego, African antelopes in New Mexico, Madagascar rubbervines in Queensland, and European pines in South Africa. On our increasingly connected planet, global trade and travel are accelerating the movement of organisms to places they could not have reached without our help. Their arrival is not always a cause for lament. We have transformed the living world in many ways that greatly enrich and sustain us, filling fields the world over with apples and wheat and gardens with geraniums and roses. But much of the transformation has been clumsy and careless at best, and we have created a growing litany of self-inflicted wounds. Among the freshest are the intercontinental movements of tree-killing Asian long-horned beetles, crop-devastating citrus canker, unstoppable zebra mussels, and deadly West Nile encephalitis and foot-and-mouth pathogens. These high-impact newcomers are called invasive alien species. It is the urgent need to reduce the ecological and economic fallout from the ongoing tide of invaders that is the subject of this book.

On the ecological side, the unique natural heritage that each region enjoys is increasingly besieged, not only by direct human activities but also by the overwhelming tide of new life we are introducing, deliberately or accidentally. Most alien creatures that escape or are loosed into the wild either perish or settle into new communities with little disruption. But a significant number—including the possums and privet shrubs, deer and willows, and myriad other species introduced into New Zealand—spread aggressively and invade in their new environments. These invaders dominate, disrupt, outcompete, prey on, hybridize with, or spread disease among native species or alter the terms of life in the community by changing the soil, the available light or water, the frequency of fire, or even the structure of the landscape.

Ecologists now rank biological invasions second only to habitat loss as

a threat to native biodiversity in much of the world. (*Biodiversity* is a shorthand term ecologists use for biological diversity, the rich web of life in a community or region.) The threats come from an unlikely array of misplaced creatures, from rust fungus and avian malaria parasites to rubbervines, melaleuca trees, blackberry bushes, goats, snails, and tiny scale insects that can suck the life from trees and shrubs. Few places on the earth remain untouched by such invaders. Even in the Antarctic, seals have been exposed to cattle diseases and penguins to poultry virus. On a tiny scale, the crowd of strangers that threatens to overrun Clout's bit of forest exemplifies the beleaguered status of natural areas worldwide, from Yellowstone National Park to the Everglades, from Hawaii to the Galápagos Islands, from the mountains of the South African Cape provinces to the Italian Apennines.

On the economic and social side, the organisms ecologists call invaders are called weeds, pests, or emerging diseases when they threaten human enterprise and well-being. Invasive alien species create hardships across a spectrum of human activities, altering the character and economic potential of our lands and waters; threatening our health and that of our crops, forests, and livestock; diminishing recreational values and even our sense of place. In the United States alone, ecologist David Pimentel estimates, invasive species cause $137 billion per year in losses, damage, and control expenses.

Most of us have heard *something* about biological invasions. The topic is hitting the headlines and television news reports with increasing frequency. News, by nature, focuses on the striking, the singular, and the menacing new arrivals: West Nile encephalitis virus striking down people and birds in the Northeast, Asian long-horned beetles denuding parks and boulevards of beloved old shade trees, zebra mussels choking off water pipes along the Great Lakes, Formosan termites attacking the historic French Quarter of New Orleans, Africanized bees advancing across the Southwest, and Asian gypsy moths and Mediterranean fruit flies (Medflies) breaching the border.

Even as I listened to the elk bugling through the tree ferns near Auckland, the *New Zealand Herald* was trumpeting an alarm about the third