

The Next Communities: Evolution and Integration of Invasive Species

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On a global basis . . . the two great destroyers of biodiversity are, first, habitat destruction and, second, invasion by exotic species.

E. O. Wilson (1997) in *Strangers in Paradise*

Among the global perspectives gained by Darwin during his 5-year circumnavigation aboard the *Beagle*, those afforded by witnessing the prevalence and impact of introduced plants and animals were probably seminal to the transformation of his worldview. Exploring the continents of the southern hemisphere and the remote outposts of midoceanic islands, he saw biota replaced, natural economies disrupted, and species deeply altered from their original states. The first volume of Sir Charles Lyell's new *Principles of Geology* series (1830), an embarkation gift from Fitzroy, the *Beagle's* captain, had convinced Darwin that the natural forces he observed linked directly back to those that shaped the world prehistorically. And now he viewed landscapes that appeared as if painted over and repopulated with the familiar characters of the European countryside. Such cataclysms of biotic replacement, following closely on the modest actions of agrarian settlers, could be likened to the first colonizations of new lands, in which the fitting of life forms to the environment, and the assembly of living communities, could be closely inferred.

Since then, human-altered environments have yielded some of evolution's key lessons. The cases of industrial melanism in moths (Kettlewell, 1956), adaptations to toxic waste (Antonovics et al., 1971) and fertilization treatment (Snaydon, 1970; reviewed in Silvertown et al., 2006) in

plants, responses to resource extinctions in birds (Smith et al., 1995), the appearance of antibiotic and pesticide resistance (Palumbi, 2001a), and introduced pathogens, pests, and hosts in numerous systems have all helped biologists comprehend the environmental, economic, and social importance of contemporary evolution—evolution occurring on *ecological* timescales of days to years rather than on timescales of centuries to millennia (Carroll et al., 2007). We now realize that contemporary evolution is commonplace (see, for example, Palumbi, 2001a) and that it can have substantial ecological consequences and conservation implications (Carroll et al., 2007).

Among the human agents altering earth's habitats, species introductions offer particularly informative accidental experiments because they mimic natural events important in structuring natural communities (Vermeij, this volume). The movements of species and the peregrinations of continents have shaped the earth's terrestrial and marine biogeography throughout the history of life. During the past few centuries in particular, human transport has augmented rates of biotic exchange among the earth's realms far beyond preindustrial norms (Elton, 1958). As we similarly alter other planet-level processes, including climate and nutrient cycling, the resulting disruption of established patterns of community dynamics may create greater