



Research for Requiems: the Need for More Collaborative Action in Eradication of Invasive Species

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They [alien species] should be a high-priority for research and *action* by conservation biologists, but they are apparently not. Why? [emphasis added.]

Stanley Temple (1990)

Exotic organisms frequently cause environmental crisis. In such crisis, calls for more research are commonplace, but research results may be an unaffordable luxury, providing information only for the eulogy

Bruce Coblentz (1990)

Nowhere but on islands is extinction so rife. Historically and prehistorically, human commensals, such as rats and cats, have triggered a massive wave of insular extinctions across the globe. This is by far the single greatest cause of recorded historical extinctions (since A.D. 1600) and remains a significant threat today (Groombridge et al. 1992). Fortunately, this threat can be removed from many, if not most, of the world's islands by means of existing techniques. But while research on invasive species has exploded over the past decade, relatively little attention or conservation dollars have been spent on eradication, particularly in the Americas. Put simply, eradication of invasive mammals from islands is one of our most powerful conservation tools, yet it is woefully underutilized.

Over a decade ago, Coblentz (1990) called for more action and less lament from conservation biologists over the loss of biodiversity, urging them to go beyond their research and into the realm of action. That same year, Temple (1990) reminded us of the "nasty necessity" to eradicate invasive species, and Soulé (1990) foresaw the "onslaught of alien species" as being one of the "chal-

lenges of the decade." How have we progressed? Building on techniques pioneered by New Zealand conservation practitioners, some have taken on this challenge with success. The U.S. Fish and Wildlife Service and the Alaska Maritime National Wildlife Refuge are on the verge of completing an astonishing archipelago-wide eradication project that started over 50 years ago. In the Aleutian Islands, they have removed exotic fox populations from 40 islands (totaling over 500,000 acres), saving the Aleutian Canada Goose (*Branta canadensis leucopareia*) from extinction and protecting the most important seabird nesting area in the northern hemisphere (Ebbert & Byrd 2002; S. Ebbert & A. Sowls, personal communication). In northwestern Mexico, a regional island conservation program has made significant conservation gains. In 6 years, and for less than U.S. \$1 million, 29 exotic mammal populations have been removed from 23 islands, protecting over 70 endemic vertebrate and plant taxa and dozens of seabird colonies from extinction (Donlan et al. 2000; Tershy et al. 2002). Farther south in the Galapagos Islands, the Galapagos National Park Service and the Charles Darwin Foundation have eradicated 21 exotic mammal, 1 exotic invertebrate, and 4 exotic plant populations from 17 islands. These conservation actions have resulted in the protection of at least 198 endemic vertebrate and plant species, and the trend is set to continue, with 19 eradications currently in progress on 5 of the Galapagos Islands.

Larger and more biologically complex islands are now being tackled for eradication. Rat eradication has begun on Campbell Island (11,300 ha) in the New Zealand sub-Antarctic, raising the maximum size of an island on which rat eradication has been attempted by a factor of four. Off-shore of southern California, rat eradication is underway on Anacapa Island (365 ha), which will become the first

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rat eradication from an island where a native rodent is present (U. S. National Park Service 2000). Over 3000 feral cats were removed from Marion Island (29,000 ha), an unprecedented eradication (Bester et al. 2000). And in the Galapagos, goat eradication will soon begin on Isabela Island, the largest island conservation project of this type ever attempted (459,000 ha, the equivalent in size to Rhode Island, U.S.A.).

These are significant accomplishments demonstrating the value of conservation dollars invested in eradicating invasive species from islands. So yes, we have a powerful conservation tool at our disposal. Nevertheless, its use remains on the fringe of conservation circles (Simberloff 2001), and further development of this powerful tool is rarely supported by published research. For example, in a survey of *Conservation Biology* from 1991 to 2002, of the 100 publications dealing with exotic species (*Biosis* keywords: exotic, alien, or introduced), 86 were impact or population biology studies of exotic species, 8 discussed conservation strategies toward the management of exotic species, and only 6 evaluated the conservation benefits of the control or eradication of exotic species. No articles appeared dealing with research on eradication techniques. This mirrors the dearth of publications on removal efforts and techniques in other international journals (Simberloff 2001). This bias in the literature is certainly impeding conservation action against the effects of invasive species. How can we, as conservation biologists, redress this bias?

We believe that an explicit collaboration between conservation researchers and conservation practitioners is needed that (1) quantifies and publicizes the efficacy of eradication of invasive species from islands (e.g., Veitch & Clout 2002), (2) critically evaluates existing tools for invasive-species eradication (e.g., Nogales et al., 2004), (3) develops new eradication tools (e.g., Courchamp & Cornell 2000), and (4) exploits eradication programs as large-scale ecological experiments (e.g., Donlan et al. 2002). Without published analyses of the efficacy of invasive-species eradications, protected-area managers will continue to be reluctant to attempt eradications. In the absence of such collaboration, advances in eradication techniques will come slowly because conservation practitioners tend to be eager to move on to the next island rather than to publish, whereas researchers tend to work most comfortably at the plot scale and to be most attracted to the area of overlap between invasive species biology and community ecology.

Throughout the history of conservation biology, islands have taught us much. It is time for research to reciprocate the favor by directly facilitating invasive-species eradications. It is also time for conservation practitioners to think beyond their individual projects and work with researchers to facilitate the development of eradication techniques and subsequent ecosystem restoration as an

applied science. The coming decades will present hard conservation decisions for conservation biologists and society. Eradicating invasive species from islands is not one of them. Research that directly facilitates the improvement of eradication tools and projects that are specifically designed to incorporate research should be of high priority. Without such coordination, the science of conservation biology may find itself providing information solely for requiems.

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