*Editorial*

# The Nasty Necessity: Eradicating Exotics

In 1974, while working on conservation issues in the Indian Ocean's Mascarene Islands, I proposed to use poison to eradicate 2000 introduced rabbits from Round Island, the 151-ha home of 17 endemic organisms (1 bird, 6 reptiles, and 9 plants) severely endangered by habitat degradation caused by the rabbits. This action was opposed vociferously by animal welfare groups who were concerned about cruelty during the poisoning. As a young and idealistic conservationist I was shocked that such an important program could be halted by opponents who concluded they would rather allow the extinction of all 17 endangered endemics than condone the poisoning of rabbits. The island's condition deteriorated for 12 more years until 1986 when the rabbits were finally eradicated by a well-executed poisoning program.

Last year, while clearing invading trees from a remnant tall-grass prairie near my home that has been preserved by The Nature Conservancy, I had to confront irate neighbors who were outraged that conservationists would kill trees. There seemed no way to convince them that the trees were alien plants in a prairie, inconsistent with The Nature Conservancy's goals of preserving the biological diversity of the remnant ecosystem. In the eyes of my neighbors, I was a villain, not a hero, for killing those trees. These and other experiences with exotic species during my career as a conservation biologist have heightened my sensitivity to issues involving their eradication.

Looking back through the pages of *Conservation Biology,* I am amazed to find so few articles on exotic organisms, one of Jared Diamond's "Evil Quartet" of mechanisms responsible for contemporary extinctions. Alien species that have escaped the limits of their natural geographic ranges, as a result of intentional or inadvertent human activities, invade natural communities, with predictable consequences. Their predation, browsing and grazing, competition for limited resources, introduction of diseases and parasites, hybridization, and initiation of environmental chain reactions reduce natural diversity by causing extinctions and shifts in patterns of relative abundance. They should be a high-priority subject for research and action by conservation biologists, but they apparently aren't. Why? Conservation biologists should be as proficient at eradicating exotic species as they are at saving endangered species.

In spite of all that is known about the negative influence of exotics and the obvious conservation benefits of controlling them, their eradication

inspires little enthusiasm among most conservationists, the public, or governments. Reasons for this apathy include misconceptions about the nature and magnitude of the problem, fears of the negative public reactions that almost invariably accompany eradication efforts, especially for animals, and intimidation by the inefficient labor-intensive nature of current eradication technologies.

The threats posed by exotics are often understated, frequently being dismissed as a serious problem only for oceanic islands. Island ecosystems have, of course, been extensively affected, but they are actually microcosms of what can happen to remnant continental ecosystems that are naturally islandlike, such as lakes, or that have become insular through the process of fragmentation. Once embedded in a matrix of disturbance that facilitates range expansions of human commensals and provides opportunities for deliberate introductions, a remnant ecosystem resists invasion by exotics in proportion to its area. Small patches are easily invaded and disturbed, whereas large patches are more resistant. The magnitude of the threat to a variety of continental ecosystems is severely underestimated. The introduction of Nile perch into East Africa's Lake Victoria may, for example, result in as many extinctions as all the introductions of domestic cats onto the oceanic islands of the world.

No matter how well justified by conservationists, proposals to eradicate exotic species are rarely popular because they often involve activities that people find distasteful. Especially when an exotic vertebrate is involved, emotions typically override conservation science. Having experienced firsthand the heated controversies that resulted from efforts to eradicate such evocative exotics as rabbits, burros, and swans, I know that these are unpleasant obligations for conservationists, and aversive conditioning quickly saps enthusiasm after a few bad experiences. To reduce the likelihood of program-halting confrontations, conservationists must do a better job of educating the public about the threats of exotics and building support before a program begins, and they must devise more palatable methods of eradication that avoid issues of ethics or cruelty. Eradication techniques now on the horizon may soon meet conservationists' requirements for effectiveness and acceptability.

To realize the full potential of these new technologies, conservation biology should actively recruit to its ranks scientists whose research will produce new approaches for controlling or eradicating exotic species. Such scientists are now scarce in the disciplines that have so far been attracted to conservation biology, but they abound in the emerging fields of biotechnology, and they have already been recruited into the applied field of agricultural pest management. Combining the new discoveries from high technology sciences, such as molecular biology and immunology, with traditional approaches of epidemiology and population biology holds tremendous promise for eradicating exotics. Many techniques can be borrowed directly from new approaches to pest management. Genetic engineering, immunochemical applications, gene transfers, and recombinant DNA technologies have replaced toxic chemicals and other more primitive methods of population control. These new approaches permit the species-specific manipulation of fertility, induction of genetic load, repression of immunity, and production of host-specific pathogens. We should promptly incorporate these techniques, with care, into the conservation biologist's arsenal of weapons against exotics. Exotic species on remote oceanic islands present the ideal situation for releasing genetically altered organisms into the out of doors as part of an eradication program. The chances of altered individuals spreading beyond an island

are remote, and there are typically few proponents for keeping the exotics around.

New technologies, heightened public awareness and support, and a renewed commitment by conservation biologists may make it possible to begin winning a war against exotics that has so far produced few victories for conservationists. The most troublesome species, especially those that threaten endemic species on remote islands, should be the first to fall. Nonetheless, these possible remedial actions will be insufficient if the spread of exotics continues unabated. Prevention through effective international treaties and national legislation must also be pursued as part of a coordinated global strategy. The combination of eradication of established exotics and prevention of further introductions may take the teeth out of one-fourth of the "Evil Quartet." It's time for conservation biologists to begin taking the lead in this campaign. We are uniquely suited to mount the type of interdisciplinary scientific effort that is needed.

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