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FOREWORD

Science and the conservation of biodiversity

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Abstract: Humans are most likely to conserve biodiversity when they derive direct utilitarian benefit by doing so. High biodiversity, for example, may often reduce the frequency of disease and pestilence. Scientists are morally and professional obliged to (*i*) make society aware of such benefits and (*ii*) promulgate the value and practice of science.

Résumé : Les humains sont plus enclins à préserver la biodiversité lorsqu'ils peuvent en tirer un bénéfice pratique direct. Par exemple, lorsqu'elle est élevée, la biodiversité peut souvent réduire la fréquence des maladies ou des infections. Les scientifiques ont une obligation morale et professionnelle (*i*) d'informer la société de l'existence de tels bénéfices et (*ii*) de promulguer l'intérêt de la science et de la profession scientifique.

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Homo sapiens evolved and has flourished during an incredible time in Earth history. Biodiversity, at its zenith, was ripe for exploitation by a species possessing technology and an ability to share information. In a juxtaposition of ecological traits, specialization on technology and culture allowed our ancestors to become the ultimate generalist species. We inhabit all of our planet's terrestrial biomes and dominate all other life forms. We are the keystone species in every environment on Earth.

But there is a sinister side that distinguishes our niche. We are experts in liquidation, biocide, and intraspecific competition. We demand that our economies grow more rapidly than the exponential increase in our numbers. And we seem oblivious to the consequences of destroying, within a few decades, much of the biodiversity responsible for our evolution and subsequent success.

How should scientists respond to the crisis? As humans, we share the blame for the problem, but we are among the few of our species who seem to recognize the magnitude of the issue and the urgent need for action. Some suggest, and demonstrate by example, that we should be advocates of change: in policy, in attitude, perhaps even in the conduct of science. Others argue that our role must be less flamboyant, that we must adhere, dispassionately if necessary, to the objective rigours of science.

Regardless of how fine or fuzzy the line, and regardless of which side we favour, decisions affecting biodiversity must be based on high-quality science. With science as its touchstone, the Canadian Society of Zoologists established a standing committee on biodiversity in 1998. The committee approached the Editors of the *Canadian Journal of Zoology* shortly thereafter with a proposal for occasional reviews on biodiversity. The shared vision is that the reviews should address stimulating ideas, synthesize what we know and what we should know, and, when appropriate, highlight our ignorance. Hopefully, the process will yield new insights to guide future science and improve our efforts at conservation.

Sadly, many of our species, and even some of our colleagues, remain unconvinced about the necessity to conserve biodiversity. Thus, one of our tasks must be to assess, scientifically, the benefits and costs of biodiversity to the human condition. Ostfeld and Keesing (2000) set us on the right track. They ask how the incidence of zoonotic diseases varies with the diversity of hosts. Using their ground-breaking research on Lyme disease as a model, they suggest that multiple species of hosts may often act to dilute the incidence of disease. Disease is most prevalent when dominant host species fed on by generalist vectors are also competent reservoirs of the disease organism. Increased richness and abundance of other host species that are incompetent reservoirs can reduce infection by the zoonosis. In other scenarios, particularly those where all hosts are similarly competent as reservoirs, high biodiversity may act to increase the incidence of disease. Ostfeld and Keesing's detailed review of several zoonotic diseases worldwide reveals that many are likely to possess the traits that are necessary for the dilution effect to operate. High biodiversity is a good thing.

As habitats become increasingly fragmented, however, specialized and less abundant host species are often most at risk of extinction. Habitat destruction reduces the dilution effect. A reliable rule of thumb is that preserving biodiversity through habitat protection can often reduce the incidence of zoonotic diseases.

There are other evolutionary and ecological reasons why preserving habitat has utilitarian benefits to human self-interest. Converting natural environments to human use often creates

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sharp boundaries between habitats that differ dramatically in quality for native species. Imagine that such an altered landscape is occupied by a generalized pest species, and by its more specialized competitors. The specialists, though locally abundant in preferred habitats, are in triple jeopardy. Local densities are reduced by habitat degradation, metapopulation stability is altered through landscape modification, and converted habitats are likely to act as sinks that further reduce local and regional densities. Generalists, on the other hand, reap at least three kinds of benefits. (1) The densities of generalists increase in native habitat as their specialized competitors disappear. (2) The generalists are likely to occupy the converted habitats where they can begin to evolve adaptations that improve fitness in the altered landscape. (3) Improved fitness in the new habitat is likely to accelerate as generalist populations become freed from maintaining costly adaptations to their former competitors, predators, pests, and pathogens. The generalist evolves at lightning speed and becomes ever more specialized at exploiting humans. Humanity's short-term gains in a reduced biosphere will be quickly attenuated by other species whose life histories allow them to play a winning evolutionary hand that trumps our cultural ace.

Do scientists lose credibility by alerting society to these possibilities? I think not. Indeed, one might argue the converse. Knowing the potential effects, we are obliged professionally, and ethically, to ensure that policy makers understand the human costs of continued erosion of biodiversity. We must also explore, as Ostfeld and Keesing do here, the potential human benefits of living in "degraded" landscapes. Regardless of what we find, we will be able to influence policies most convincingly when our theories are backed by objective observation and peer review. We will be able to justify our observations most effectively when they are linked to explicit causal mechanisms. Even as we expand our focus, we must remain true to the principles of science. But we will be able to influence policy only if we work harder than we have in the past to ensure that our audience is literate in the practice of science.

Reference

Ostfeld, R.S., and Keesing, F. 2000. The function of biodiversity in the ecology of vector-borne zoonotic diseases. Can. J. Zool **78**: 2061–2078.