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POINTS IN QUESTION
ENDANGERED PARASITE SPECIES

SAVING endangered vertebrate species from extinction is self-evidently important in all nature conservation programmes. Given the fact that some host-specific parasite species are more endangered than their hosts themselves, it would be logical to make efforts to save parasite species too. Since parasites are not simply pathogenic agents, but species with their own evolutionary value, "equal rights for parasites!" (Windsor, 1990, *Nature* **348**: 104) is a brave new idea and prompts the question—do parasite species have the same biological value as that of free-living species?

The first exact descriptions on the positive correlation of area size and species richness of 'islands' (MacArthur & Wilson, 1967, *The Theory of Island Biogeography*, p. 203, Princeton University Press, Princeton, NJ) inspired numerous studies on the most diverse taxa of organisms suggesting that this correlation is probably valid for all communities of species. Publications on phytophagous insects give strong evidence for such correlation between host plant area (an 'island' for these insects) size and the number of insect species parasitizing them (see Cornell & Washburn, 1979, *Evolution* **33**: 257–274; Lawton, 1982, *Journal of Animal Ecology* **51**: 573–595 as examples and for more citations).

However, there is only one relevant study available on the host area size and animal parasite species richness correlation (Dritschilo, Cornell, Nafus & O'Connor, 1975, *Science* **190**: 467–469). These data on the number of ectoparasitic and phoretic mite species reported from North American cricetid rodents and the area size of the hosts resulted in a species–area curve which fitted the equation

$$S = k * A^z$$

found for island species (S = number of parasite species, A = host area size, k and z = constants).

Although this is the only study concerned in the island biogeography of animal parasites, there is no doubt that the correlation between host population size (regarding the area size, the abundance or both) and number of ectoparasite species is a general phenomenon.

Larger populations of host tend to harbour more parasite species than smaller ones. Thus, a major decrease in numbers within a host population—even without the danger of host extinction—will jeopardize the survival of some, perhaps even as yet undescribed, parasite species. The area fragmentation of the host species is supposed to have a similar result. After a decline, host populations may increase again, producing vacant niches for parasites. In an evolutionary time scale, these may be occupied by new parasite species emerging due to host-shifting. This is a rapid mode of parasite speciation, resulting from a random switch of host species by one or a few individuals of a host-specific parasite species. Since parasite extinctions and speciations take place relatively faster and are relatively more common than those of, for example vertebrates, the survival or extinction of any parasite species may be argued to have less biological significance than those of vertebrate species.

However, the extinction of parasite species can have a negative effect on the conservation of its host species. Parasites exert considerable selective pressure upon their host population, even if they are not pathogenic in a veterinary sense. Frequency-dependent selection exerted by parasites offers a possible explanation for the surprisingly high levels of genetic diversity of host populations (Dawkins, 1990, *Parasitology* **100**: S63–S73). Saving host species in relatively small areas can result in the extinction of several parasite species and consequently the loss of a part of selective pressure. These conservation areas will therefore resemble a zoo: animals kept together lacking their original potential to evolve. Host species can thus be saved without their parasites, but the level of their intraspecific genetic diversity cannot be maintained without them.

Population geneticists build their mathematical models of the minimum viable population size to help conservationists to design nature reserves. The underestimation of the role of parasite species in maintaining the genetic diversity of host populations may have an impact on the reliability of these models.

In spite of conservation efforts many vertebrate species are becoming represented by less and less numerous populations, therefore many parasite species are becoming extinct. How do we conserve endangered parasite species? The oocysts, eggs or other infective forms of many parasitic protozoan and helminth species can be readily stored for long periods. There is an urgent need for the collection and storage of the infective (frozen, lyophilized, etc.) forms of parasites of endangered host species. If conservation efforts will result in host population growth, then these parasite species should be reintroduced to nature.

It is not sufficient to save exclusively the vertebrate species. A more sophisticated nature conservation policy will tend to save the endangered species of pathogenic organisms as well.

L. Rózsa
Department of Parasitology & Zoology,
University of Veterinary Science,
H-1400 Budapest, Pf. 2, Hungary.

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