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FROGS FIND DIVERSITY IN ADVERSITY

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Human development is supposed to wreak havoc with biodiversity as it chews up natural habitats into ever smaller fragments. But frogs living in the central Amazon rainforest have not got the message. More species of frogs live in isolated wooded fragments than in the nearby pristine forest, ecologists have found.

Mandy Tocher of the University of Canterbury in Christchurch, New Zealand, and her colleagues at the National Institute for Amazon Research in Manaus, Brazil, and Conservation International in Toronto studied frog populations in an area 70 kilometres north of Manaus between 1992 and 1994. They counted the numbers of species in 10 forest reserve-zones of primary forest that were left isolated after the surrounding forest land was razed for farming or ranching 7 to 10 years ago.

Four of the reserves covered only one hectare, four were 10 hectares in area, and two extended over some 100 hectares. For four of the reserves, the researchers had data on frog populations from before the arrival of the chainsaws. For the other, the post-fragmentation figures were compared to frog species counts made between 1983 and 1990 in equivalent areas within a nearby 2000-hectare region of undisturbed primary forest.

As expected, the larger reserves contained more species than the smaller fragments. But the real surprise was that all of the reserves were home to a more diverse collection of frog species than the pristine forest. On average, the fragments held 10 more species than an equivalent undisturbed area. One 100-hectare reserve contained 15 species before the surrounding forest was cut down, but boasted 32 afterwards.

At first sight, these results reflect well on the ability of isolated reserves to conserve wildlife in the face of deforestation. Because they need highly specific habitats to live and breed, frogs are often considered to be sensitive biological indicators of the health of ecosystems. If they are in decline, many scientists argue, other species are likely to be in trouble too. Conversely, if frogs are thriving, then an ecosystem must be in reasonable shape.

Tocher believes this view is too simplistic. "I wouldn't automatically say that the frogs are doing OK," she says. The fact that fragments have more species than the original forest is not necessarily an advantage, Tocher points out. "It may not be good if your goal is for the fragments to contain the exact community that was there before".

It is not yet clear why the number of species is so high in the fragmented areas. But it is possible that the effect is only temporary, caused by an influx of refugees forced from their former homes when the surrounding forest was razed. Tocher says that only further studies will show whether so many species can continue to live together under such cramped conditions. "We don't know what impact the new arrivals may be having on the older species."

There is already evidence that the population densities of some species are changing. Tocher and her colleagues studied four species in detail. One, *Eleutherodactylus*

fenestratus, was more abundant in the forest remnants than in equivalent pristine areas. This species lays its eggs on the forest floor, and the fragments had thicker layers of dead leaves than the undisturbed forest, Tocher notes, which would have prevented the frogs' eggs drying out. Two more species were equally abundant in fragmented and pristine areas, while the fourth - *Colostethus spepheni* - was less common in the remnants than in the undisturbed forest.

Tocher also cautions against assuming that frogs elsewhere in the world will fare so well if their habitats are fractured. What has a positive effect on species diversity in Brazil may hurt frog communities elsewhere, she says.