NATURAL SCIENCES

John H. Douglas reports from the University of California at San Diego at the Conservation Biology Conference

"The ark is sinking"

As their natural habitats diminish to a few scattered preserves, most vertebrate species will stop evolving and eventually become extinct, two University of California at San Diego biologists warn. Conference organizers Michael Soulé and Bruce Wilcox draw these conclusions from their surveys of animal populations confined to islands of various sizes in different parts of the world.

For new species to evolve, large groups of animals from an original common stock must develop in isolation from each other in areas large enough to prevent inbreeding. Game preserves will act as islands in isolating members of a species, Soulé says, but none of the preserves now planned would be nearly large enough for speciation to occur. No large mammals have been known to evolve into new species on islands smaller than 600,000 square kilometers — an order of magnitude larger than any of the world's national parks.

"Evolution is in trouble," Soulé concludes, and the effect on the world's ecosystem will be a "biological holocaust without precedent."

Unable to evolve, and forced by inbreeding to perpetuate undesirable genetic traits, many species of both plants and animals will soon become extinct, the researchers conclude. Wilcox presented estimates of "the rate at which the ark is sinking" for 19 East African national parks: About 11 percent of the parks' large mammal species will disappear because of inbreeding within 50 years, 44 percent in 500 years and 77 percent in 5,000 years.

As a rule of thumb, Wilcox says, dividing a natural habitat to a tenth its original size dooms half its animal species. By the turn of the century, only about 1.5 percent of the earth's surface will be designated as game preserves, so that "we stand to eventually lose over 3.5 million terrestrial species."

Death of the jungle

An onslaught has developed on the great tropical forests that will "reduce them to scattered fragments by A.D. 2000," says Oxford University botanist Timothy C. Whitmore. By then, the "world's richest and most complex ecocystems [will be reduced] to about one-third of their potential area."

Not only are large trees being cut, he says, but some forests are being leveled entirely, with smaller trees simply ground into chips for pulp. In Malaysia, bulldozers are compacting as much as 70 percent of the clear-cut land, hindering regeneration, and another proposed cut in 20 years will knock out what few seed trees are left.

In many countries, "the reality of bribery" must be taken into account, Whitmore says. He charges that on the Indonesian island of Sumatra, a whole national park has illegally been opened for logging as a result of bribes.

Some valuable tree species may become extinct, again as a result of too few individuals left on too little land. Whitmore estimates that the preservation of sufficient genetic diversity to perpetuate a species requires at least 5,000 trees, occupying a minimum area of between 17 and 135 square kilometers, depending on the species. The researcher concludes: "The prospect is frightening."

Patterns of extinction

Aside from the general problem of habitat loss and genetic inbreeding, surprisingly little has been known about just what makes a particular species go extinct. In an unusual move, Princeton biologist John Terborgh used most of the time given for his invited paper to present new data from Edwin O. Willis, an American zoologist working in Brazil, that may offer substantial new insights into the process of extinction, especially where several species interact.

At first, many researchers had hypothesized that sheer size of an animal might be the key — certainly many of the species now most endangered are rather large, like the tiger. But Willis's conclusion, drawn from a study of bird populations in areas left after logging in Brazil, points to two more important factors: scarcity and specialization.

Willis found that the smaller a group of birds originally was in an area, the more likely they were to disappear from that area entirely. This conclusion might seem like simple common sense until one considers the profound reasons *why* a species might be intrinsically rare. For birds at the top of the food chain, like falcons, the number is limited by a scarcity of food. For highly specialized birds, such as those that live off of the fruit of particular trees, population distribution will be extremely spotty — limited by the presence or absence of the fruiting trees.

Extinction then proceeds as follows: As habitat area is diminished, demise of highly specialized species can follow suddenly as a matter of chance. For example, the cutting down of a single fruit tree might kill off all members of a small community of birds. Higher carnivores suddenly may be left with too little prey in their territory, although the prey may exist in abundance elsewhere. Finally, the whole web of species interaction may break down, as when the death of a pollinating insect causes the demise of a plant that, in turn, provides food for higher animals.

Minimum population requirements

Once one recognizes the critical importance of population size in preserving a species, perhaps the most difficult question of all naturally arises: How small is too small? Geneticist Ian R. Franklin of the Commonwealth Scientific and Industrial Research Organization in Sydney, Australia, has tried to calculate a rough answer, but the actual number will vary from species to species for the reasons Terborgh discussed.

In a population too small, some desirable inherited characteristics will slowly be lost, a process called "genetic drift." To establish genetic equilibrium, the loss of traits through genetic drift should be less than the random production of new traits through mutation. Franklin estimates that this equilibrium will be established under the *best* circumstance for a population no smaller than 500,000 individuals existing in their natural environment.

How humans can help

Although 500 members of a species might be required to perpetuate a species in the wild, smaller numbers may be acceptable if humans manage their breeding to save maximum genetic diversity. Several speakers at the meeting addressed this problem.

William G. Conway of the New York Zoological Society says that a group as small as 50 to 100 individuals may be adequate if the animals are kept in captivity. But, he goes on to warn, even if half of all the zoo capacity in the United States were used for this purpose, only about 100 species could thus be saved. A better idea is to make natural parks profitable, as in Kenya, where a maned lion is worth nearly 450 times as much as a tourist attraction than as a trophy skin.

Most speakers agreed that some sort of genetic management will be needed in future game preserves if the disadvantage of limited size is to be overcome. One or two animals from one park might be introduced to another park each year, for example, to increase the genetic diversity of the species.