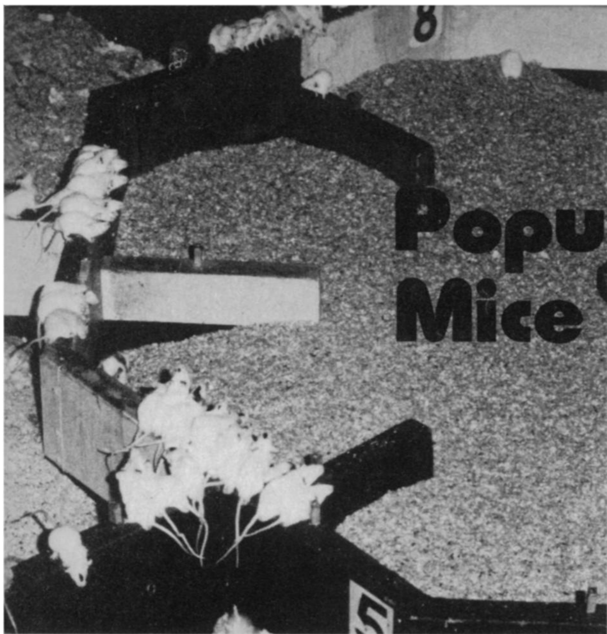


Adult male mice respond to an increasing population density by huddling together in small groups.

Population Overload: Mice Advice

Overcrowded laboratory mice eventually reach a point at which relationships cease and the colony becomes extinct. Is there a warning here for humans?

By BRUCE BOWER

In the story of the pied piper, a town is rescued from its ballooning rodent population by a young musician who leads the creatures away with his enchanting tunes. The burgeoning rodent populations of psychologist John B. Calhoun at the National Institute of Mental Health (NIMH), however, disappear on their own. As crowding intensifies in their experimental colonies, the animals reach a point of no return and self-destruct; behaviors necessary for survival, such as mating and parental care of infants, disappear.

What is more, Calhoun calculates that the human population is entering a 200-year period of rapid growth that, based on his animal model, may reach a similar point of no recovery in around 80 years. Since crowding effects strike at the most complex behaviors of a species, he says, escalating human population density is likely to progressively impair each person's ability to create and use ideas necessary for adaptive changes, rather than reproductive ability.

But in Calhoun's scenario, humanity is not expanding toward an inevitable oblivion. He sees a way for people, in contrast to experimental rodents, to reverse rapid population growth and bypass the point of no return. The "pied piper" in this instance is an increasingly sophisticated use of computer systems that will extend the human capacity to solve problems and adapt to the environment.

If such an "evolutionary" extension occurs, Calhoun predicts it will lead to intentional efforts to put a brake on fertility and set the stage for a rapid population drop beginning in the 21st century. He contends that unless this conceptual adaptation occurs, attempts to institute widespread contraceptive use will fail and the population will continue to increase.

"I try not to be a 'doomsdayer,'" says Calhoun, "but if there's a high probability of our entering a point of no return, then [my animal model] is worth considering."

Calhoun attracted considerable attention with his early crowding and cooperation experiments on rats and even inspired an animated movie about humanlike rats (SN: 8/7/82, p. 92). His willingness to assign human significance to animal data has been scoffed at by some scientists, but he remains undaunted. Calhoun described his latest and most elaborate crowding study — this one with mice — at a recent lecture in Washington, D.C., and used it to buttress his human population predictions.

The project took place in "universe 133," an 18-foot-wide, four-level mouse house at NIMH in Bethesda, Md. The structure contains eight cells of equal size, food and water dispensers, nest boxes and platforms on which mice can climb. Each cell has 120 numbered locations to aid in recording behavior. The entire unit was designed to house an optimum of up to 16 groups of about 12 adults, or around 192 mice.

Beginning with eight pairs of mice, the researchers allowed the population of universe 133 to expand. As it progressed through stages 1, 2, 4 and 8 times the optimum density, successive generations of mice became less and less able to reproduce or interact with others in normal ways. In late stages of crowding, around 200 weeks after the study began, mating ceased altogether. At that point, the population fell precipitously from what had been a peak of nearly 1,600 mice.

Childhood and juvenile behavior, says Calhoun, extended increasingly into adulthood (which begins at about 172 days of age for mice) as new generations crowded into the living space. Adult

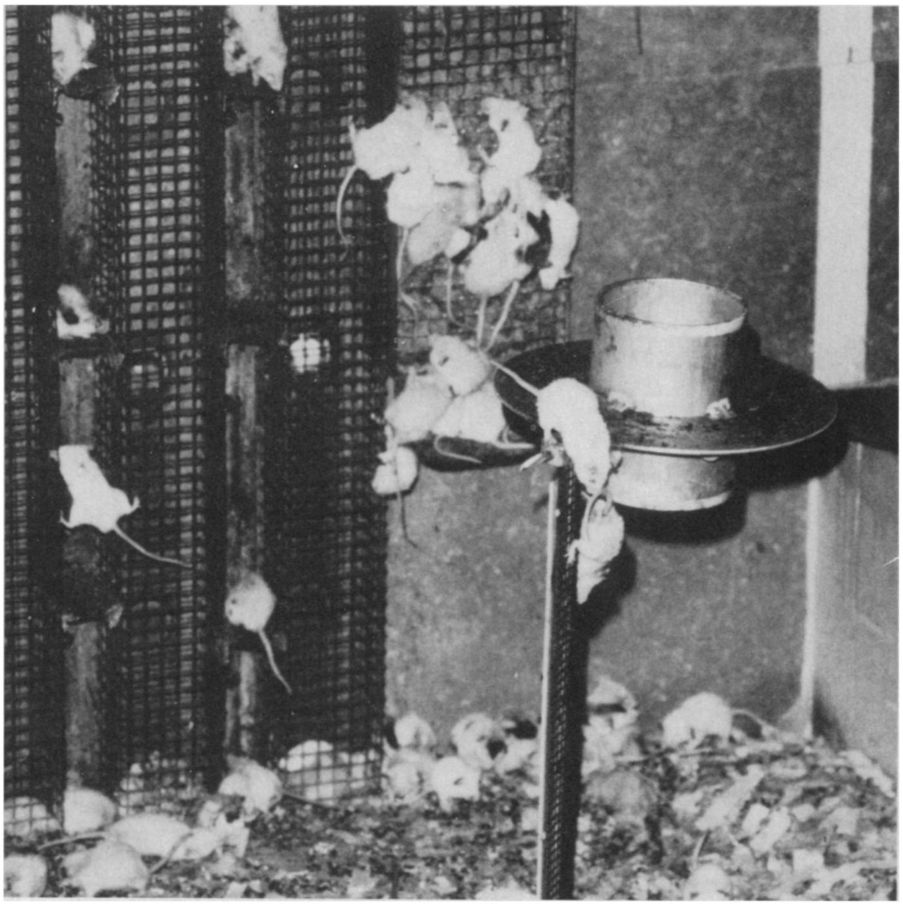
Photos: Calhoun/NIMH

Overcrowded female mice often wander about and trail behind novel objects, including Calhoun's feet when he enters their living structure.

females often persisted in the juvenile behaviors of wandering from cell to cell and following strange objects, such as the feet of an investigator when he entered the structure. Males often continued in an even earlier type of behavior, huddling together in small groups on cell barriers. Some became extremely aggressive, clamping onto other mice with their teeth and swinging them from platforms; an attacked mouse rarely fled, and if it did, the attacker rarely pursued.

In a previous experiment with rats, Calhoun had found that a group trained in two cooperative behaviors – gaining access to water only when two rats were present at a fountain and gaining access to food only when two members of an experimentally designated "clan" were present – was better able to adapt to increasing population density than a control group. The training, he says, allowed the rats to develop new social roles and maintain an optimum number of social contacts for each individual, even as crowding became worse.

But left to their own devices, the mice in universe 133 reached a point where all animals failed to develop relationships and reproduce. Crowding was reduced, of course, but the colony rapidly became extinct as older mice died. Calhoun estimates this point of no return to have fallen somewhere between 2.5 and 4.0 generations after the mice reached two times optimum density.



The mouse at center (on pole) became what Calhoun calls a "nipper," attacking another mouse and swinging him by his tail from a platform.

How does this apply to humans? The modern human population, which started out about 43,000 years ago, has grown rapidly only in the last two centuries, says Calhoun. According to a computer simulation he and a colleague developed, a 200-year-long world population transition period began around 1975, when density reached approximately two times optimum. Assuming a 27-year generational span for humans, the point of no return (2.5 to 4.0 generations after 1975) would fall between 2042 and 2083.

But the rapid extinction illustrated by the mice can be avoided, speculates Calhoun, if average "people in the street" acquire the knowledge necessary to create new social roles and adapt to changing circumstances. This can best be achieved, in his opinion, through the use of computers and networks of information-processing systems as thinking aids.

Calhoun has made an initial attempt to devise an electronic extension of the brain. He solicited essays on various aspects of population and mental health from 162 scientists and identified, through a computer analysis of 2,500 short excerpts from the contributions, the 13 most widely agreed-upon areas of concern. These "domains," including group organization and stress and the increasing size and complexity of social systems, are described in *Environment and Population: Problems of Adaptation* (Praeger, 1983), edited by Calhoun.

With further refinement, he believes, computer programs will be able to pinpoint important areas of concern from extensive literature reviews and serve as an "early warning system" for emerging problems in population, mental health and other areas.

However adaptation to increasing density occurs, his model predicts it will be accompanied by a population drop beginning around 2063, the middle of the time span assigned to the point of no return. At that point, according to projections by both Calhoun and the United Nations (UN), world population will be nearly 9 billion. About 200 years later, Calhoun suggests, the population will level off at its early-20th-century total of approximately 2 billion.

"There's been nothing like this [population and knowledge] transition period before," says Calhoun, "and there won't be anything like it again for a long time. We're entering a momentary, cacophonic blip of rapid change in the otherwise more leisurely course of history and evolution."

A 1981 UN report on world population growth contrasts with Calhoun's view. It predicts that by the end of the 21st century, the number of people on the planet will reach nearly 10.5 billion and remain stable thereafter. That amount, according to the UN, is the maximum number of human beings that can be adequately supported by the natural environment.

But Calhoun, armed with his rat and mice studies and mathematical equations derived from data on human fertility, mortality, age structure and historical population growth, stands by his model. Ironically, crowding research on rats and mice may have reached its own point of no return, he says, because it is expensive and takes years to complete. His four rodent studies, performed over the past two decades, cost about $3.5 million, a large sum in the behavioral sciences even when budgets were not being tightened.

Calhoun insists, however, that rats and mice can provide insight into the human condition. His friend Margaret Mead was familiar with his theories of population density and often referred to him as "my favorite wild man," a comment Calhoun recalls with pride.

"When you deal with complex issues such as population density changes, you have to think that way," he says. "If my animal model of extinction resulting from a failure to develop relationships has applicability to the human scene, it should be during the 200-year transition we've just entered." □