BIOLOGY

Natural selection: The birdseed factor

A popular view of evolution is that its direction is largely determined by occasional bottlenecks of intense selection during a species' history. Observations of such a bottleneck have now been reported for a population of Darwin's finches on a Galapagos island. A severe drought in 1977 caused a food shortage, and the finch population suffered an 85 percent decline. Peter T. Boag of Trent University in Ontario and Peter R. Grant of the University of Michigan in Ann Arbor had banded birds and measured their morphological characteristics between 1975 and 1978. They report that finch survival of the drought was not random. Large birds, especially males with large beaks, survived best because they were able to crack large, hard seeds. Seeds are the staple diet of the finches during the dry season, but during the drought only large seeds were available. "It is reasonable to infer natural selection from the greater survival of large birds because about 76 percent of the variation [in body and beak size measurements] is heritable," the scientists say in the Oct. 2 SCIENCE. When they calculated selection intensity, they found values considerably greater than any published to date for other selection events.

Save the nuts (and fruits)

At the turn of the century Americans could munch on more than 8,000 varieties of apple. Today fewer than 1,000 types are grown in the United States, and just two account for more than half the market. Scientists at the Department of Agriculture are worried that the trend will not only limit gastronomic experiences, but that it will reduce the likelihood that future crop problems can be combatted with genetic techniques. Harold Fogle of the Northeastern Region Agricultural Research Service in Beltsville, Md., says that traits of commercial interest, such as appearance and long shelf-life, have been stressed, while plants have been lost that have other desirable traits such as disease- and insect-resistance, hardiness and efficient fertilizer uptake.

A national fruit and nut germplasm preservation plan has now been developed by the USDA. As the first step, Fogle and coworkers have compiled and computerized an inventory of nearly 25,000 types of fruits and nuts in North America and 14,000 in Europe. The listing includes the fruit and nut collections of private and institutional breeders, nurserymen, amateur pomologists and growers. If a collection is discontinued, the USDA will arrange to transfer rare plants to another nursery or to a national repository. The first national repository is in Corvallis, Ore., and a second is being planned for Davis, Calif. Because many fruits and nuts are cultivated through cutting and grafting, living specimens rather than seeds must be preserved.

Fogle laments the strawberry varieties developed years ago by the USDA. "If our computer capabilities were available thirty years ago, we could have those strawberry cultivars to help us develop new disease-resistant everbearing types. Now those old varieties are probably lost forever."

Gazelles model kidney disease

Polycystic kidney disease afflicts one in 500 people in the United States, but no known domestic or laboratory animal. University of Florida scientists have discovered that the disease does occur naturally among one group of animals — South African Springbok gazelles. In a herd of one male and thirteen female adults, housed in Gainesville, one in every four newborns dies from the disease. David Senior and Elliott Jacobson are searching for a marker to identify carriers of polycystic kidney disease among gazelles, and possibly among people. They also plan to look into prevention and treatment.

EARTH SCIENCES

Earth's orbits: Fuel for monsoons

About 9,000 years ago, a culture in the mid-Sahara sustained itself by fishing and living near the lakes then common in the now desertified region. Monsoon rains extended further inland then, whereas now, in Africa, they occur mostly near the western coasts. John Kutzbach, professor of meteorology at the University of Wisconsin in Madison and director of the university's Center for Climatic Research, reports in the Oct. 2 SCIENCE that the decrease in monsoon intensity is caused by changes in the earth's orbit that in turn affect solar heating of the earth and its atmosphere. His theory fits neatly with evidence that ice ages also were caused by changes in the earth's orbit and the position of the planet's axis, and by slight changes in the planet's elipticity — the deformation in the earth's shape caused by rotation.

"These orbital factors provide a beautiful example of a well-known force [for climatic change]," he says. The change in climate occurred, he says, because the perihelion — the point in the earth's orbit when the planet is closest to the sun — changes with time. The change in perihelion happens at a rate of about one day every 60 years. Now, the earth is closest to the sun in January and furthest in July, resulting in warmer winters and milder summers. Nine thousand years ago, however, the cycle was reversed and the perihelion was in July. Calculations performed with a computer at the National Center for Atmospheric Research in Boulder, Colo., show that the solar radiation received by the earth 9,000 years ago was seven percent greater in summer and seven percent less in winter than it is today. The extra heating in summer warmed the land, which in turn warmed the air. As the warmer air rose, moisture condensed, and cooler air from over the oceans moved in, bringing stronger monsoons inland to nourish the interiors of Africa and Asia. "It was an amplification of present processes," Kutzbach says.

Most work in this area has been done at high latitudes where ice forms, but the calculations of solar radiation in the Sahara show that the same factors affect climate in the tropics. Results of the research, which was funded by the National Science Foundation, may aid development of a theory of climate, Kutzbach says, which will be useful in predicting natural changes in climate as well as the effects of man-induced factors such as carbon dioxide.

Deep heat in Oregon

Prospects for tapping geothermal energy in the United States Northwest received a boost recently with the discovery by the United States Geological Survey (USGS) of the hottest geothermal temperatures in the country so far. Measurements at a test hole drilled 810 meters into the summit crater of Newberry Volcano in Oregon show that in the lower 450 feet of the hole temperature gradients were about 600°C per kilometer, compared to a worldwide continental average of about 30°C per kilometer.

The next step, says Robert Tilling, chief of the USGS office of Geophysics and Geochemistry, is to learn if there is enough flow at the site to produce hot geothermal fluids at the volume and rate that a power generation plant would require to convert the geothermal energy to electricity.

The high temperature gradient is encouraging, Tilling says, because if it continues at lower depths, the potential for development may increase. Also, the find tends to confirm a theory that the low temperatures previously found at shallow depths in the nearby Cascade Range reflect the effects of shallow lateral flow of cool groundwater rather than the real geothermal potential. Similar results were reported recently in the Canadian Cascades where geothermal temperatures of more than 200°C were measured in the Meagher Creek area of British Columbia.