AAAS

Patrick Young reports from New Orleans at the annual meeting of the American Association for the Advancement of Science

Going to the goats

Human activities, not climate change, forced the widespread abandonment of Neolithic villages in the western Fertile Crescent around 6000 B.C., propose Gary O. Rollefson and Ilse Kohler-Rollefson of San Diego State University.

For years, anthropologists and archaeologists blamed the abandonments on reduced rainfall that made farming impossible in the region. But excavations at three sites in the north-south-trending hills of Jordan show these communities continued to flourish until around 5000 B.C. "So rainfall couldn't explain the abandonment, because these three sites and two discovered but not excavated continued to exist and thrive, and they share the same weather patterns" with the abandoned villages, Rollefson says. The San Diego researchers explored two of the sites, 'Ain Ghazal and Waei Shu'eib, with Alan H. Simmons of the University of Nevada-Reno and Zeidan Kafafi of Yarmouk University in Jordan. A German team from the Free University of Berlin excavated the third village, Basta.

In work completed last summer at 'Ain Ghazal, located near Amman, Rollefson and his co-workers found the village's population peaked at about 2,800 around 6000 B.C. and remained at that level for another 10 centuries. At its largest, 'Ain Ghazal's buildings covered 30 to 40 acres.

The researchers blame plaster floors and grazing goats for the widespread abandonments. The plaster floors, a common feature of buildings in the area, needed lime made by heating limestone with a wood fire. By their calculations, each house at 'Ain Ghazal required burning six oak trees for plaster and felling four oaks for beams. Over hundreds of years, "this is a drain of an awful lot of trees," Rollefson says. Villagers also kept large goat herds, which prevented natural reforestation by eating emerging seedlings.

"As the goats continued eating the seedlings and brush, the soil itself deteriorated and eroded," Rollefson says. By 6000 B.C., the land available for farming on the plains lay too far off for a comfortable daily walk, and the villagers abandoned their homes to establish hamlets of typically 10 families each, Rollefson says.

Their hilly locations saved 'Ain Ghazal and its Jordan neighbors for another 1,000 years, he adds. Between November and May, the plains below received enough water from seasonally flowing rivers for villagers to graze their goats there, thus slowing damage around the village. But in the end, these villagers, too, lost their land and had to disperse to new homes.

Fracturing rock's computer simulations

Rock fractures behave differently in the ground than predicted by laboratory experiments, a new study finds. The research suggests that computer simulations of the flow of gas and liquid through rock, based on laboratory data, provide unreliable answers to people planning disposal sites for hazardous chemicals and nuclear wastes, says Leslie Sour Gertsch of the U.S. Bureau of Mines in Spokane, Wash.

In a Colorado mine, Gertsch cut out a block of rock about 2 meters square by 2.3 meters deep, leaving it attached at the base. Jacks placed on its four sides allowed her to compress the rock and study the effects of the stress on a natural fracture. She found that compression failed to reduce nitrogen seepage through the fracture at the rates predicted, and that it actually increased the flow in the middle part of the fracture.

"I was forced to conclude that a lot more fractures [in the rock] connected to that fracture than I realized," Gertsch says. "These fractures affect both the conductivity of that simple fracture and how it reacts to that [compression] load." What happens to rock *in situ* "is much more [complicated] than we currently are able to measure," she adds, which means "we cannot supply the data that are important to these models."

Biology

Ron Cowen reports from Irvine, Calif., at a National Research Council conference on declining amphibian populations

Brooding over Australian frogs

In the last decade, about 20 of Australia's estimated 194 frog species have suffered serious local declines and at least two seem to have disappeared, reports zoologist Michael J. Tyler of the University of Adelaide in Australia. The declines echo unexplained losses of amphibian populations around the world (SN: 2/24/90, p. 116). One of the more bizarre species to become extinct anywhere is the Australian *Rheobatrachus silus,* or gastric brooder, which Tyler identified in 1973. Adult females of this stream-dwelling species swallow their eggs, hatching and developing the young in their stomachs. Soon after the offspring lose their tadpole-like tails, the mothers eject the baby frogs by mouth. Tyler's report of this unusual behavior made headlines in the mid-1970s, when the creatures were so abundant in the rain forest near Brisbane that researchers could observe 100 of them in a single night. But by 1981, the brooders had vanished.

One problem in tracing what happened, Tyler says, is that researchers did not immediately recognize the absence as an extinction because it occurred during winter, when observers would normally expect a temporary population decline.

"This phenomenon of apparently inexplicable decline or disappearance is [being] repeated time and again in eastern Australia," Tyler says. While he cannot offer an explanation for the trend, he suggests that important clues might emerge from an examination of several other Australian species, such as the small marsh frog *Limnodynastes tasmaniensis,* that have thrived or even increased their numbers and range during the same time span. Oddly enough, the marsh frog may owe its good fortune to human tampering with the environment — namely, road construction and excavation. During the rainy season, the pits created by workers quarrying for road materials make ideal breeding sites for the frogs, Tyler says. These temporary "water holes" cannot sustain fish and other predators of tadpoles, he adds. In more arid regions, excavation along the banks of streams has similarly boosted the population of other Australian frogs. "An appreciation of these success stories," Tyler says, "may contribute to an understanding of the modern failures."

More specific than species

Focusing on local population shifts rather than on the worldwide numbers of an entire species could give scientists more useful clues to the recent amphibian declines, asserts Alain Dubois of the French National Museum of Natural History in Paris. This notion runs counter to the approach of many conservationists, who tend to apply the "endangered" label to a whole species rather than singling out the local population in decline, Dubois says. For example, he says, the *Bombina variegata* or fire-bellied toad, named for its brightly colored abdomen, is one of the more thriving amphibians in Yugoslavia and Greece but is one of the more endangered in France and Italy.

Corpses and culprits

Among the many unknowns about amphibian loss is the question of when in their life cycle the animals are most vulnerable to environmental stress or disease. In some cases, extinction has struck swiftly and with little notice, leaving researchers with few corpses for postmortem studies.

"I don't know there's a crime until I see a dead body," says Richard Montali, a pathologist at the National Zoological Park in Washington, D.C. He and others say it's unlikely a virus or bacterium would play a primary role in the declines of so many species, but an infectious agent might devastate an amphibian already weakened by habitat loss or other environmental change during a vulnerable stage of life.