Biology

Where have all the red grouse gone?

Researchers have solved a long-standing problem in ecology—and grouse hunting.

Most red grouse populations in northern England crash every 4 to 8 years, then stagger back to high numbers only to crash again. For decades, ecologists have been spinning explanations ranging from behavioral or genetic quirks to outside menaces. Many vertebrate species undergo a boom-and-bust cycle like the grouse does, but proving causes has been difficult.

The strongest test is to remove the proposed cause and see if the cycle stops, observes Peter. J. Hudson of the University of Stirling in Scotland. That's impossible in most wild populations, but Hudson and colleagues found a way to do it for grouse.

A single factor, a parasitic worm, can make bird numbers rise and fall, the researchers report in the Dec. 18, 1998 SCIENCE. They stopped the cycle in three populations by medicating some 3,000 birds in each group. The treated populations thrived while others crashed in 1989 and then rebounded. Next, researchers left two of the groups untreated and saw the cycle return: Numbers plummeted in 1993 and then rose.

"This is the first time we've demonstrated what causes a population cycle," Hudson says. *—S.M.*

Lobsters remember winners and losers

Male lobsters swaggering around tanks may preserve their pecking order by remembering who has already trounced them.

New evidence for this feat—pretty smart for an invertebrate—comes from Christa Karavanich of Richland College in Dallas and Jelle Atema of the Boston University Marine Program in Woods Hole, Mass.

Animals don't have to recall fights for a dominance hierarchy to stabilize. Individuals just need to pick up some status cue. A habitual loser might gush stress hormones, or frequent winners might flex a lot.

Lobsters seem more sophisticated, the researchers report in the December 1998 ANIMAL BEHAVIOUR. Working with 120 males, researchers staged duels between closely matched opponents. In the second round, males who had tangled before did not fight. The loser backed away immediately. However, strangers did fight, regardless of outcomes of earlier clashes with other opponents.

Earlier work suggests that lobsters identify each other by cues in urine released during fights. Such a feat is not beyond invertebrates. Previous work found signs of individual recognition in sweat bees and banded shrimp. *—S.M.*

Old West has fastest tree border yet

With old aerial photographs of New Mexico, researchers have documented the swiftest climate-caused forest shift on record.

A drought during the 1950s pushed a ponderosa pine forest back 2 kilometers in less than 5 years, report Craig D. Allen of the U.S. Geological Survey in Los Alamos, N.M., and David D. Breshears of Los Alamos National Laboratory.

As the more drought-sensitive ponderosas died back at the edges of the forest, a mix of piñon and junipers took their place. The drought ended decades ago. Yet the ponderosa pines have not grown back to their former limits. These research results appear in the Dec. 8, 1998 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES.

Previous studies of such sweeping forest changes made do with less precise methods, like analyzing pollen, tree rings, or pack rat debris. This work has documented shifts over the course of decades or even millennia, the researchers explain.

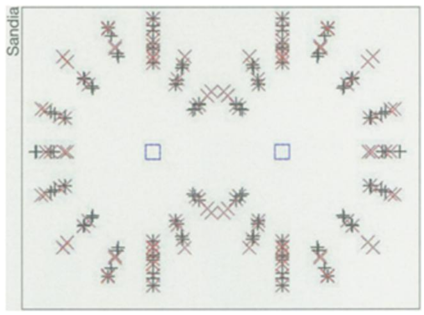
The faster shift confirms predictions from researchers studying how climate change might affect vegetation, Breshears says. "The modelers are out there saying that this [rapid change] is going to happen." *—S.M.*

Computers

Data sorting for electronic noses

When a chemical spill releases an unknown mixture of environmental contaminants, quick and accurate identification of toxic components is an essential part of any response to such an emergency. One promising approach to identifying troublesome vapors is the combination of a hand-held chemical-sensor system—an electronic nose—and a novel classification scheme modeled on the way people visually group nearby objects into clusters.

Physicist Gordon Osbourn and his coworkers at the Sandia National Laboratories in Albuquerque, N.M., studied how people decide whether various patterns of points drawn on a sheet of paper or displayed on a computer screen belong together in clusters. The researchers discovered that study participants acted as if they were superimposing an imaginary two-lobed, or dumbbell-shaped, template over each pair of points. If other points intruded into any part of this region, a person would conclude that the original two points do not belong together.



Cluster-perception experiments reveal a dumbbell-shaped boundary that people subconsciously used to decide whether two points (blue squares) belong to the same group.

Why that particular strategy works in people remains a mystery, Osbourn remarks. Nonetheless, a computer program applying the same strategy allows researchers to identify clusters in data sets and to determine whether a new data point belongs to any of the clusters already in a database. The Sandia team calls the resulting data classification scheme VERI, for visual-empirical regions of influence, and have applied for a patent.

Using a dumbbell template modeled on the shape discovered in experiments with people, the VERI computer program applies appropriately sized templates to all pairs of points and then links any two points that meet the criterion for belonging to a cluster. In two and three dimensions, the resulting patterns closely resemble the clusters that people would identify by eye among the data points. The computer program has the advantage that it also works with more complicated, higher-dimensional data—something the human eye can't do.

A chemical-detection system, for example, may have six sensors, each of which gives a reading for a given concentration of a particular substance. Those six pieces of data can be thought of as the coordinates of a point in six-dimensional space. Changing the chemical's concentration changes the sensor readings. Hence, each set of sensor readings for a different concentration defines a new point in six-dimensional space. Together, those points form a pattern, which can be detected using the VERI technique. Other chemicals produce different patterns.

One can apply the dumbbell test to a new point, representing freshly collected sensor readings at a chemical spill site, along with all points already in the database. It's then possible to identify the substance as one detected earlier or show there is no match. The latter capability is important for avoiding false alarms under unusual conditions out in the field, Osbourn says.

The researchers are incorporating the VERI data classification scheme into a lab-on-a-chip chemical-sensor system designed by Sandia for battlefield use. The same technique may also prove useful for identifying atoms in scanning tunneling microscopy, interpreting remote-sensing data from satellites, and differentiating tissues of the body in magnetic resonance images. *—I.P.*