ECOLOGY

Bison Prime Prairie Biodiversity

Nostalgia may be one good reason for restoring bison to the North American plains, but now there's a scientific incentive as well: Bison appear to help keep grassland ecosystems healthy. Findings from a 10-year study in Kansas linking bison grazing to plant diversity in tallgrass prairie offer hope to land managers trying to preserve the last remnants of native U.S. grasslands. "Potentially there are ecological solutions to some of these biodiversity problems," says study leader Scott Collins of the National Science Foundation.

The study, described on page 745, may also put cattle grazing in a slightly better light. That's a hot-button issue in the U.S. heartland, where environmentalists contend that cattle are driving to extinction native plants on public lands. But some scientists worry that the message might be carried too far. "The danger is that people will manipulate these results into advocating more [cattle] grazing," says Stephen Torbit, a senior scientist with the National Wildlife Federation in Boulder, Colorado.

ALAN K. KNAPP

Home on the range. Study suggests that bison grazing helps maintain plant biodiversity in tallgrass prairie.

About 10% of North America's original tallgrass prairie remains in scattered patches from Illinois west to Nebraska and from Texas up to southern Canada. Ecologists know that fires—whether set by lightning or by people—kept the bison-filled prairies from turning into forests for millennia. Land managers now try to mimic those conditions by burning prairies in the spring to check woody growth and exotic species. But civilization poses a new, grave threat to tallgrass ecosystems worldwide: Atmospheric nitrogen from car tailpipes and fertilizers deposited onto prairies is helping some species flourish at the expense of others, on balance lowering the prairies' biological diversity (*Science*, 13 February, p. 988).

Hoping to better tease out the delicate relationship between burning, nitrogen, and grazing, scientists at Kansas State University in 1986 launched an experiment on 20 144-square-meter plots of grassland at the Konza Prairie Long-Term Ecological Research site in northeastern Kansas. They plied some of the plots with heavy doses of nitrogen, torched others once a year, did both to a third set of plots, and left the rest alone. They also mowed two sets of plots each June to simulate grazing by bison, which tend to nibble at a patch for a while then move on.

The team found that by 1994, the burning and added nitrogen had taken a heavy toll. Tallgrass prairie is a mixture of so-called C4 grasses, which grow better in warm, dry conditions, and C3 species, which prefer cooler, wetter digs. Although C4 grasses thrived on the burnt, nitrogen-rich plots, C3 plants were decimated, leaving these plots with roughly 5.6 species per 10 square meters—66% fewer than the control plot.

The story was much different in plots that had also been mowed, however: The number of species didn't fall off at all. The researchers got similar results when they compared burned and unburned Konza Prairie watersheds where bison had been reintroduced in 1987. The reason, Collins says, seems to be that the taller C4 grasses "form this big, thick canopy in which a lot of the less common species can't survive. Mowing or grazing shaves open that canopy and allows more light to get through, so a lot more species can coexist." That finding "is a significant advance in our understanding of what controls prairie composition," says ecologist David Tilman of the University of Minnesota, St. Paul.

The implications for cattle grazing are unclear, however. Rangeland ecologist William Lauenroth of Colorado State University in Fort Collins says the new findings represent "the first time a group of ecologists with no clear connection to the livestock grazing community" agree with range scientists that grazing can benefit prairie grasslands. But other experts say prairie-reserve managers shouldn't move too quickly to adopt mowing or grazing as a tool to manage biodiversity. For one thing, the impact may differ depending on which big galumph—a bison or a steer—is chewing up your prairie. Bison tend to range more widely than cattle, which if left in a field long enough are more likely to chomp it down to the roots.

Indeed, no one wants to see a stampede to open up protected grasslands to cattle grazing. The problem is that grazing—even by bison—"can be very bad for grasslands" that are already degraded, Collins says. The best approach, he and others say, is to allow moderate bison or cattle grazing on healthy prairies and track how the ecosystems respond.

–Jocelyn Kaiser

PRIMATOLOGY

'Monogamous' Gibbons Really Swing

SALT LAKE CITY—The sex and social lives of gibbons were long thought to be about as exciting as those of June and Ward Cleaver. Like a 1950s-style nuclear family, gibbons were thought to live in stable groups of five or six, in which a mom and pop mate for life and raise their offspring. Family comes first, and the only excitement comes when the group spars with the neighbors. "The impression was they were monogamous and not very social with other groups—therefore, that they were fairly boring," says Thad Bartlett, an anthropologist at Dickinson College in Carlisle, Pennsylvania.

But in a report here last month at the annual meeting of the American Association of Physical Anthropologists, Bartlett showed that gibbons are anything but boring. He and others have found that although many gibbon pairs mate for years on end, like human families of the '90s they have plenty of drama—infidelity, divorce, abandonment, and step-children from other unions, as well as much socializing and kinship among members of different groups. The findings show how important it is to explore what "monogamy" means for primates, and underscore the social complexity of these intelligent animals. "Gibbons really have been the prototype for monogamous primates," says Phyllis Dolhinow, a biological anthropologist at the University of California, Berkeley. "It turns out things just aren't as tightly structured as had been assumed."

T. BARTLETT

Nuclear family? Gibbon family life is more complicated than it looks.

The new view of gibbon family life is emerging from a fresh crop of long-term studies. For example, Bartlett, who presented his findings at the meeting, tracked two groups of white-handed gibbons (*Hylobates lar*) intensively for a year in the Khao Yai National Park in a seasonal tropical forest north of Bangkok, Thailand. These apes have been studied off and on for 15 years by ecologist Warren Brockelman at Mahidol University in Bangkok and his colleagues, so they are accustomed to humans; Bartlett thinks that this allowed the animals to relax and exhibit social behaviors not seen before.

Researchers had thought that gibbon families, although stable, were always territorial and hostile to neighbors, but the Thai gibbon families socialized with one another. In fact, one group spent 25% of its encounters with three other groups in "affiliative," or friendly, encounters, where the juveniles played and groomed each other. Most surprising, one adult male groomed and played with juveniles from another group. When Bartlett checked the long-term records on the groups, he realized that the friendly adult was an uncle of the neighboring juveniles, implying that the male had switched groups. "Their social relationships are a lot more complex than we'd assumed," says Bartlett. "They are migrating into groups that are not very far away, and there's a complex awareness of who is in the neighborhood."

This sociability also extended to mating habits. One young male left his group to move in with neighbors, where he began singing the characteristic mating duet with the adult female; he eventually supplanted her older male companion. This backs up work by primatologist Ryne Palombit of the University of Pennsylvania, Philadelphia, who recently studied gibbons at the Ketambe Research Station in Sumatra, Indonesia, for 6 years. He saw one female leave her group to join a newly widowed male, where she stayed for several months, mating with him and several other males before returning to her original mate. "All the textbooks say you have a male and female who are monogamous," says Palombit. "What we saw is that there may be a male and female, his brother, her sister, her daughter, his son. It's just very complicated, and the rigid nuclear family model is insufficient."

Instead, a new model is emerging of a "non-nuclear" family, where mates sometimes come and go, and the offspring from different unions grow up together. At least for gibbons, it seems that monogamy can be a lot more interesting than humans ever imagined.

–Ann Gibbons

ASTRONOMY

Last Hurrah for an Infrared Satellite

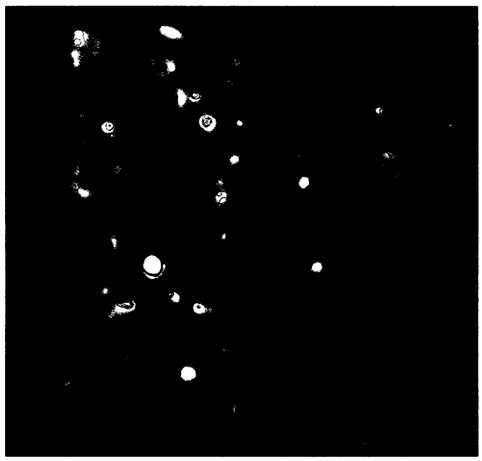
When the temperature climbs beyond 2 degrees above absolute zero, it gets uncomfortably warm for an infrared satellite. The European Infrared Space Observatory (ISO) reached that point early last month after it finally ran out of coolant and had to quit its measurements of the feeble heat radiation from the rest of the universe. Sometime about mid-May, engineers at the European Space Agency's (ESA's) ground station in Villafranca, near Madrid, will shut it down for good.

"This is a time for celebration, not sorrow," says ESA science director Roger Bonnet. ISO lived for 10 months beyond its expected 18-month lifetime, collected more than 26,000 observations from Earth's astronomical backyard to the far reaches of the universe, and made several important findings during its final days. "It's been a spectacular success," says Reinhard Genzel of the Max Planck Institute for Extraterrestrial Physics in Garching, Germany, who chairs ESA's astronomy working group.

Cooled by over 2000 liters of superfluid helium, ISO's sensitive detectors were able to study the infrared glow of "the icy, dusty, rocky, and molecular universe," as Bonnet puts it, as opposed to the hot, gaseous universe that emits visible light. In just a few of its research highlights, ISO studied colliding galaxies, discovered crystalline silicate grains in protoplanetary dust disks, and found huge quantities of interstellar water vapor in the Orion Nebula (*Science*, 17 April, p. 378).

As one of its last feats, ISO picked up the infrared signature of water in the chilly atmosphere of Titan, the largest moon of Saturn. Although it's a minor constituent of the nitrogen-rich atmosphere, water vapor "makes the already complex story of the atmosphere of Titan ... a little more enticing," says Carolyn Porco of the Lunar and Planetary Laboratory of the University of Arizona, Tucson. The finding, by a team headed by Athena Coustenis of the Paris Observatory and Alberto Salama of the ISO Science Operations Center at Villafranca, implies that water is being delivered into Titan's atmosphere from some outside source, Genzel said at a press meeting in London last month.

"The chances are next to nil for the ISO-observed water vapor to be derived from the [extremely cold] surface of Titan," agrees Porco. "A good candidate is cometary impact. But it may not be the whole story." Porco, who is principal investigator for the camera on board the Cassini spacecraft bound for Saturn and Titan, thinks the icy rings of Saturn might also be shedding water into Titan's atmosphere, "though I don't think anyone has given this serious consideration."



ESA

Distant fires. ISO reveals infrared-bright galaxies at two different wavelengths in a site to be probed by the Hubble Space Telescope; arrow indicates a previously unknown galaxy.

Farther afield, ISO also took a long look at a small patch of sky called the Hubble Deep Field South. In late October, the Hubble Space Telescope will observe this tiny region continuously for many days to spy on faint galaxies in the distant universe, repeating an observation it made more than 2 years ago in the northern sky. ISO's detailed image gives a preview of what Hubble may see. The image swarms with galaxies that are surprisingly bright in the infrared, just as an earlier ISO image of Hubble Deep Field North had shown. The galaxies must be ablaze with newborn stars, which are hidden from optical detectors behind shrouds of dust. What's more, says team member Sebastian Oliver of Imperial College London, "we've detected at least one galaxy with no known visible counterpart."

Even after the temperature of ISO's detectors became too high for most of its instruments to operate, the Short Wave Spectrometer, built by the Groningen laboratory of the Space Research Organization Netherlands, soldiered on into the second half of April, collecting data on "standard stars" to extend an existing star classification scheme into the infrared. And ISO's death will mean only a pause for space-based infrared astronomy. Future orbiting observatories, like NASA's Space Infrared Telescope Facility and ESA's Far Infrared Space Telescope, scheduled for launch in 2001 and 2005 respectively, will extend ISO's harvest of observations, which now fill nearly 1000 CD-ROMs.

–Govert Schilling

Govert Schilling is an astronomy writer in Utrecht, the Netherlands.