E-vole-ution: Spring is in the grass

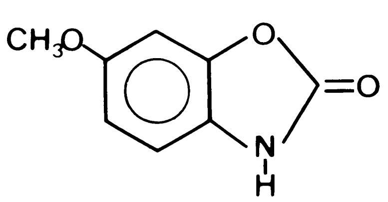
The longer length of spring days is the cue to most mammals that winter has passed and it is time to reproduce. But in unpredictable environments, the photo period may not be adequately linked to the onset of the growing season. In the mountain meadows of western North America, for example, the plant seedlings may first appear from April to late June in different years. In the Oct. 2 SCIENCE, University of Utah researchers report how the montane vole, and perhaps other animals, use a chemical abundant in young seedlings to provide a reliable cue that days of abundant food are close at hand.

"The montane vole is an opportunistic breeder," explains Patricia J. Berger, one of the researchers. The mouse-like animal lives less than a year, so it must time its reproductive efforts carefully. It begins to breed in the spring and continues throughout the summer, producing three or four litters of about six young during the season. Young voles survive the winter, not hibernating but eating grasses buried beneath the snow. With the onset of vegetative growth in the spring, the animals begin reproductive activity.

A specific chemical is the basis for the link between vole reproduction and the new growth of its food resource. Edward H. Sanders, working with Berger, Pete D. Gardner and Norman C. Negus, identified the chemical by fractionating and testing samples of winter wheat. Sanders says the chemical has been detected also in sprouts of corn, sunflower and a variety of grasses. It is present in the highest concentration in the first two or three weeks after the new sprouts come up through the ground. "Towards the end of the growing season or during a drought the concentration starts to rise again, but along with an increase in another compound that counteracts it by inhibiting the reproductive system," Sanders says.

The reproduction-triggering chemical is a cyclic compound called 6-methoxybenzoxazolinone (6-MBOA). It is active only when fed to voles within a narrow range of doses—0.02 to 0.1 milligrams per gram of laboratory diet. When injected into female animals, a dose of 5 micrograms per day gave the greatest stimulation to uterine growth. The scientists find that the chemical also triggers development of reproductive organs in female laboratory mice.

6-MBOA



Field experiments provide the best demonstration that 6-MBOA triggers vole reproduction. In Utah salt grass meadows during two winters, the scientists supplemented the natural food supply of the reproductively inactive vole populations. The food supplement was rolled oats, in some cases coated with 6-MBOA. In both tests, one before the winter solstice and the other after it, a large proportion of the females in the plots receiving 6-MBOA became pregnant. No females were pregnant before the test and no female receiving rolled oats without 6-MBOA became pregnant. In addition, the weight of the testicles of male voles eating 6-MBOA was considerably greater than that of the control group.

Preliminary investigations into the physiological effect of 6-MBOA indicate it acts "high in the neuroendocrine circuitry," in the brain. The scientists suggest that such a chemical cuing mechanism may prove common among herbivorous mammals inhabiting unpredictable environments. Some observations already indicate that rabbits, kangaroos, desert rodents and other rodents closely related to the vole respond to cues from their food resources.

Future observations on the population consequences of the chemical cuing mechanism may help describe a puzzling phenomenon — the extreme multiannual fluctuations of voles and other microtine rodents. Berger says that there is evidence that for hundreds, and probably thousands, of years the vole population has fluctuated in a reasonably regular pattern. Some years there will be hundreds or even a thousand voles per acre and in other years there will only be one or two. Perhaps the role of 6-MBOA, along with weather, age at first reproduction and fitness of the vole population may explain the dramatic and perplexing population pattern. □

Volcano beneath the sea

A team of scientists from the United States Geological Survey (USGS) has discovered the first evidence of submarine volcanic hot springs off the nation's coast. The vent is about 270 miles off the Oregon coast along the Juan de Fuca ridge that marks the junction of the Pacific and Juan de Fuca plates. Dave Clague, a submarine volcanologist with the USGS, describes the site as a long, linear ridge of volcanic activity rather than a single volcano. "It doesn't erupt out of a cone but along a fissure on the crest," he said. "We assume there has been recent activity because some of the rocks recovered are very fresh and glassy — less than 100 years old."

Other submarine hot springs such as those in the Galapagos spreading center and on the East Pacific Rise (SN: 1/12/80, p. 28) have been discovered but this is the first to be found far north of the equator. Clague said the volcano is almost exactly where the scientists expected to find it based on observations made at other locations where continental plates are spreading. The location, at the shallowest point along the section of ridge studied, suggested uplift caused by heat from recent volcanic activity.

No photographs were taken of the hot springs, nor were temperature measurements made. The historic evidence of the springs can be inferred from high concentrations of mineral ores, while a rich biological community indicates present activity.

Based on observations at other submarine hot springs, the ores are created when mineral-rich water hotter than 300°C wells up from the vent. When hot waters encounter the water on the sea floor, which is about 0°C, the minerals precipitate and form ores. The most abundant ore dredged up from the ridge is sphalerite, which comprised about 90 percent of the samples and is composed of about 55 percent zinc. The samples also contain about 300 parts per million silver, about 3,200 ppm copper, and 2,500 ppm lead.

"If these ores were on land, they would be imminently mineable," Clague said. At the present time, the technology does not exist to mine ores from waters 2,200 meters deep. But the legal obstacles to exploiting the resources may be even more formidable: The vent is in international waters. The United Nations Conference on the Law of the Sea, currently in session, is working to negotiate a treaty governing deep sea mining.

The objective of the research, which was conducted aboard the USGS research vessel *S. P. Lee,* is to increase understanding of how mineral ores are formed so that the knowledge can be applied in tapping mineral reserves on land. However, a more interesting outcome of the expedition may be the discovery of a biological community similar to those found at other submarine vents. Creatures there rely on heat from the hot springs and on sulfur, which is oxidized by bacteria in the stomachs of some of the animals. No samples of the deep sea animals were retrieved, but photos taken with a camera system designed by John Delaney of the University of Washington reveal that they are different from species found previously. No specimens were found of the giant clams or red-tipped tube worms that populate other known deep sea vents. The reasons for the differences will be explored in subsequent expeditions, possibly in summer 1982.

William Normark, chief scientist aboard the research vessel, is out of the country and could not be reached for comment. □