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Prairie Paths, Mouse Highways and Night time Traffic

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Colored flags in a Sandhills valley mark trails of nocturnal mammals traced using a technique developed by University of Nebraska State Museum researchers

WE WALK OUT across the prairie carrying bulky flashlights. It is well past midnight, the sky is cloudy, the night is pitch black. Conditions are perfect tonight for a test of our new method for tracking small mammals. The special flashlights, set to use their small auxiliary incandescent bulbs, are producing a feeble light. It is just enough illumination for us to navigate to the center of our study area. I glance back at my partner, and he nods in agreement: it seems a good place to start our test.

I lift the flashlight over my head and throw the switch to its second position. The yellow light of the incandescent bulb is gone instantly as the contact clicks into position. There is a second of blackness and then the main fluorescent bulbs wink on. These bulbs are special, designed to produce long wave ultraviolet (often called “black”) light. All around us the black light illuminates tiny trails winding through the grass.

The trails are the garish colors typical of black-light posters; there are greens, oranges, reds and blues. The mice we dusted with fluorescent pigments hours earlier have left trails we can easily follow. We walk around like a couple of kids in a candy store, excitedly calling to one another as we find where a trail ends at the mouth of a burrow, where an animal has climbed into a bush, or where it has paused to eat a still partially intact fruit. To a mammalogist studying nocturnal rodents, these are valuable clues to the ecology and behavior of these small, secretive animals.

Most mammals are nocturnal. They forage for food, fight for territories, and find their mates in the dark. We humans have eyes adapted to use in the day; this means very acute, color vision. But as is often the case in biology, there are trade-offs, and the tradeoff for our excellent day vision is poor night vision. This compromise represents a serious handicap for mammalogists studying the ecology of nocturnal mammals, a handicap which is particularly keen in the study of small mammals where surveillance would be difficult under the best of lighting situations.

It is not surprising then that much of what we know about small nighttime mammals comes from trapping them. By knowing when and where an animal is caught, we gain insight into its behavior. A single capture represents little information, but after hundreds of captures, mammalogists can put together a composite picture of the animal’s travels and behavior.

It is still a rough picture, and fraught with problems. One such problem is how the trap with its bait might affect the animal’s behavior. If live traps are used, repeated captures of the same animal might produce the behavior known as “trap happiness” when animals become addicted to traps and the free handout of bait. Even with its shortcomings, trapping has much to recommend it. Trapping is easy, inexpensive, and because it is so widely used in the study of mammals, information gained in one study can be compared with that collected in other studies.

Mammalogists chafing under the limitations of trapping have experimented with other methods of studying small mammals. One such method is radio tracking. Many of us are familiar with the radio transmitters available to...
fit all but the smallest of mammals. However, radio tracking can only place an animal within a few meters—accurate enough if working with large animals or for certain purposes. But sometimes we want to know exactly where our study animals are and what they are doing. For these cases radio tracking will not work. There are image enhancers, such as night vision scopes (sniper scopes) that are very good for deer-sized mammals but much less effective for mice. Another method is to use low intensity artificial lights, but this method may change the behavior of an animal or it may increase predation.

Not long ago we developed a convenient, inexpensive, non-harmful way to learn about the secret lives of small nocturnal mammals. The technique allows us to follow trails made by rodents and to find where they have foraged, what they have eaten, and where they have their burrows. This
method involves the use of a fine, non-toxic powder that fluoresces under black light. After setting traps and capturing the animals alive, we gently dust them in the fluorescent powder. The powder, used to make fluorescent paint, comes in different colors. It is especially important that the powder is non-toxic because killing the animals or hurting them in any way would be detrimental to any community, populational or behavioral study. These pigments have been used in feeding experiments and our experience has been that the animals that are dusted suffer no ill effects either from the powder or from predation because of a change in visibility of them as prey items.

Once the powder is applied and the rodent goes on its way, we can follow its trail with a black light. The powder is very fine and rubs off a little at a time as the animal brushes past grass stems or other parts of plants. When the powder is illuminated with ultraviolet light a brightly fluorescing trail is left to reveal where the animal has traveled.

The trail is surprisingly revealing. If the animal climbs a tree, a trail is made on the bark; if it goes into its hole there is a brightly colored ring at the entrance; if it climbs to the top of a sunflower plant to eat the fruiting head, the fluorescent husks and leavings are found near the fluorescing stalk. If the animal does a little sand-bathing, it leaves a fluorescent sandy patch that is easily spotted. If an animal of one color follows an animal of a different color down the same path, the order of which came first is easily determined.

The idea for using fluorescent powder to track mammals was stimulated by a conversation overheard by Cliff Lemen at Cedar Point Biological Station, the University of Nebraska's field station near Ogallala. As he recalls:

One afternoon I was sitting in the main lodge waiting for dinner. It was hot and I was tired. I was more-or-less oblivious to the students and conversations around me. Gradually I became aware of two young women discussing a class project about ants. Incredibly, they seemed to be talking about a research project for class that involved tracking ants with a special powder. Track ants! I swiveled around to face the students and asked 'You mean you can track an ant with this powder?' Not really, they said, but because many ants often followed the same path when foraging you could put a ring of powder around the ant mound and as hundreds of ants tramped through the powder as they left the mound, the areas of most activity got marked. I was already thinking about rodents; if their idea worked for ants it just had to be adaptable to rodents. I asked if they had much of this fluorescent powder. 'Oh, sure,' was their reply. 'cans of it.' I strolled over and phoned my spouse and fellow mammalogist Patricia Freeman, who was in Lincoln: 'Hey, Trish, I just got an idea. . . .'

We were trapping the following night.

When we were first developing this new method we needed a place to test its potential. We chose Arapaho Prairie near Arthur for our initial study. Arapaho Prairie is two sections of land owned by the Nature Conservancy and often used for biological research by scientists from the University of Nebraska. We looked about Arapaho.
In daylight, trails show little evidence of the previous night’s activity (below left). But at night, a dusted animal’s trail glows dramatically under long-wave ultraviolet light (below right). Trails are then flagged, and later mapped. Right, author Lemen with mapping instruments, plane table and alidade, stands amid flags marking the routes of several animals.

Prairie for a site to use in our study. We wanted a place with high numbers of both individuals and species of rodents. At that time there had been no grazing and mowing at Arapaho for several years. To a biologist, grazing and mowing are disturbances. Without these disturbances the valley floors at Arapaho become fairly homogeneous stands of grass. With time, the standing dead grass accumulates and shades living plants, slowing their growth. Such a situation favors some species, but strictly from the point of view of studying rodents, such areas are boring. As the area becomes more homogeneous and plant productivity falls there are fewer and fewer rodents.

What turns our heads are areas of disturbance. At Arapaho the action of cattle from decades earlier had opened several blowouts, areas of open and blowing sand. Aerial photographs indicate that these same blowouts have been present for at least 60 years. In the Sandhills excessive disturbance (for example, too many cattle in an area or plowed and abandoned land) yields bare areas of blowing sand: total devastation with little plant or animal life.

However, at intermediate levels of disturbance there can be a crazy patchwork quilt of different habitats all side by side, dense grass, sage, sunflowers, sweet clover, open sand. It is in these areas of intermediate disturbance that the diversity and abundance of rodents are at their highest, and that interactions are common and rich: these areas act as magnets to students of small nocturnal mammals.

We set our traps just before sunset and checked them about two hours later, just at the beginning of nightly foraging activities. Once caught, the captives were dusted with the fluorescent powder and released. Instead of tracking them the same night we decided to wait until the next night so that we would have a complete night of foraging to study. The animal will leave a trail only the first night because the powder rubs off in the burrow during the day. We trailed one mouse—one with especially thick fur that held a lot of powder—almost a kilometer before the trail became so faint that we could no longer follow it.

We had initially tried to track the animals the same night they were
dusted, but not only did we have a hard
time staying awake, we also kept run-
ning into the fluorescing animal and
disturbing it. Usually waiting until the
next night or for several following
ights is not a problem unless it rains.
Then the trails become very dim or
wash away completely. Of course these
activities, as with most mammal trap-
ping activities, have to be coordinated
with the moon. On bright nights not
only is it more difficult to catch rats and
mice, but it is also difficult to trail them.
The best nights for tracking are the
darkest nights—especially cloud- cov-
ered, moonless nights.
On one such night in the winter,
when we held the UV light above our
heads it looked as though we were
standing among several superhighways
of different colors crossing and inter-
secting for about 20 feet around us, and
trailing off into the distance. They were
clear, very bright, and easy to see. On
brighter nights the lamp has to be held
close to the ground and tracking be-
comes difficult.
Biologists often view the study of hab-
itat preferences by animals as some-
thing akin to the economic problems
faced by people. A wide variety of
occupations exist; and, based on a per-
son's inclinations, abilities, and other
complex factors, an individual could be
successful in some jobs but not others.
Similarly, as a rodent forages in a cer-
tain way it must safely gather enough
food, gather the right mix of food for
nutrition, and have enough time left for
other essential activities if the species is
to flourish. To make the problem more
interesting yet, different species of
rodents have different body shapes and
internal physiologies so that the solu-
tion to the foraging problems for one
species might be useless for another.
Indeed, it is often the comparison of the
foraging strategy of different species
living in one area that produces the
most interesting insights. Therefore, we
decided to study how the different
rodents each solved their foraging problems in the complex jumble of vegetation types found in moderately disturbed habitats in the Sandhills.

In order to catch the rodents we set out live traps in a grid pattern in three different areas: one near a large, active blowout; the second in an older blowout where vegetation had stabilized the sand; and the third in the climax valley vegetation of dense grass. We carefully mapped the amount and location of land occupied by grass, sage, grass-forb, and open sand.

Following the trails was exciting and often meant tracking paths until the wee hours of the night. A few times we were so absorbed that dawn would creep up on us before we realized what time it was. Ideally, we wanted to follow each trail to its conclusion; that is, to the burrow of the animal. Normally, burrows are difficult to locate and impossible to identify as to occupant, but burrows of mice dusted in fluorescent powder are quite obvious because the hole is outlined in the fluorescent color, or plugged with nonfluorescing sand.

We marked the trails by placing flags at 3-meter intervals. During the day (mammalogists never sleep) we mapped the positions of the flags using a plane table and alidade, equipment typically used to map geological and archaeological sites. After several days of trailing different animals and using red flags for a red trail, yellow flags for a yellow trail and so on, we accumulated so many trails marked with different colored flags that the prairie looked like a field of flowers. In daylight, only the flags mark the trail which is otherwise invisible.

Our results indicate that the two largest species of rodents in our study have specialized on opposite ends of the vegetational spectrum of available habitats. The prairie

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