SMELL SIGNALS IN FOX SCAVENGING

Urine marking among scavenging foxes may constitute an elaborate message system — indicating complex social interactions among foxes

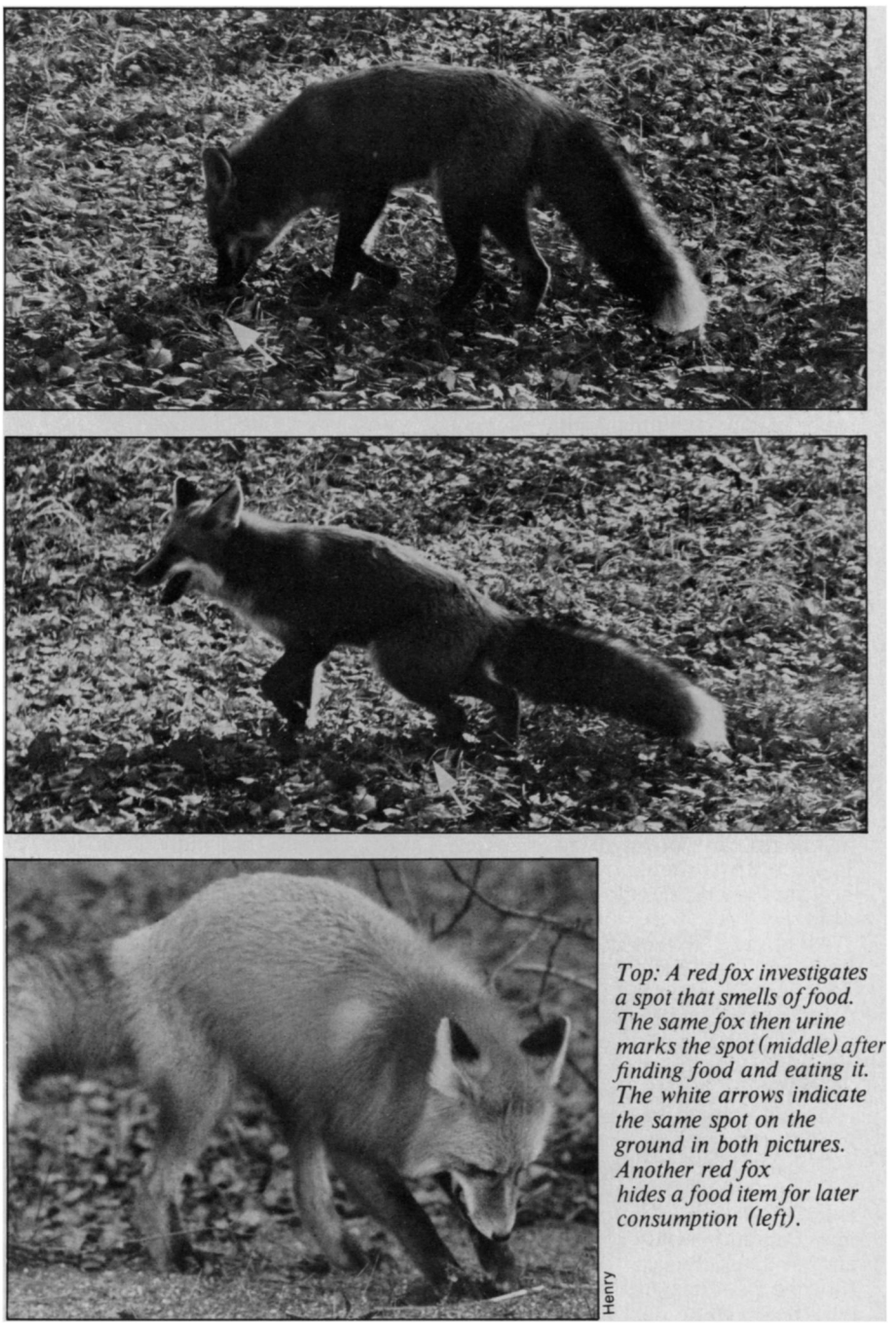
BY JOAN AREHART—TREICHEL

Dogs and fireplugs go together like bacon and eggs, but is there any logical reason why our pets would want to water our hydrants? Apparently there is. Urine marking, a highly sensitive form of olfactory communication among mammals, is known to serve a variety of behaviors.

For example, urine marks are used as a dominance display in many species, for following trails, as an alarm to warn members of the same species, to locate one's mate or a female in heat and probably to mark territories. Field observations have also suggested that urine marking is used as an aid in food scavenging by red foxes. J. David Henry, a biologist at the University of Calgary, Alberta, Canada, has attempted to learn more about this behavior by studying red foxes in their natural environment.

As Henry reports in the British journal BEHAVIOUR (61: 82-103, 1977), urine marking constitutes an elaborate message system among scavenging red foxes. Specifically, a urine mark left by one fox tells another fox that little or no food is left at a site where the odor of food may remain. Having received this message, the scavenging fox will not waste its time looking for food at that spot. On the other hand, if the fox smells food but not the odor of urine at a particular location, it can be quite sure that food is still there and will make a concerted effort to find the food. However, if both the odor of urine *and* a strong food odor come from the same area, the fox will most likely ignore the urine message of no food and check out the area in hopes of finding food.

In Prince Albert National Park, Saskatchewan, Canada, Henry studied free-ranging red foxes for long periods of time in a natural forest setting. His research ran from April to December during three consecutive years (1971 to 1973) and also during October 1974. Such scrutiny was possible because certain foxes scavenge for food around the human settlements in the park. These foxes soon habituate to humans and can be watched for long stretches of time both around the settlements and in their natural environment.



Top: A red fox investigates a spot that smells of food. The same fox then urine marks the spot (middle) after finding food and eating it. The white arrows indicate the same spot on the ground in both pictures. Another red fox hides a food item for later consumption (left).

Henry

First Henry observed the scavenging behavior of red foxes. Such behavior, he noted, could be identified from the following characteristics: The fox walks back and forth a number of times within the same area of woods, with its nose lowered, apparently scanning the ground. It often stops and investigates many spots on the forest floor. During scavenging, the fox appears to be searching for certain edible items, such as slow-mov-

ing invertebrates, bird eggs, carcasses or food caches made by it or another fox. Interestingly, the foxes were observed to urine mark up to 70 times an hour.

Henry hypothesized, on the basis of his general observations, that urine marking functions as a type of bookkeeping system during scavenging—that is, a fox marks those places where food has already been eaten, but where food odor remains. When the same, or a different, fox reinvestigates this spot, the scent of urine signals no food, and the fox will explore this spot for only a short time. In other words, urine marking might increase the efficiency of the red fox's scavenging behavior so that more food items are found per hour of scavenging. Such efficiency would be particularly valuable during periods of severe food shortage, to which red foxes are regularly subjected. Henry tested this hypothesis with two separate experiments.

The first experiment was designed to learn whether odoriferous food remnants triggered urine marking among red foxes. Henry placed one of seven different substances on the ground. The substances included soft dog food, dry dog food, water, synthetic urea, oil, gasoline and trimethylamine. The last four substances provided strong nonfood odors. Water was included in the experiment as a control. Whenever Henry placed one of these items on the ground, a fox approached, investigated and ate any food that was present. Henry then recorded whether the fox urine marked the substance. He continued the experiment until each substance had been set out 30 different times.

Although there were some individual variations, foxes tended to act the same. Only one substance, the soft dog food, consistently triggered urine-marking behavior. The foxes did not usually mark the dry dog food or any of the other substances. Because soft dog food, even after eaten, left some odoriferous remnants and dry dog food did not, Henry concluded that odoriferous food remnants sparked urine marking by the foxes.

The second experiment was designed to learn whether urine marking of food influenced foxes' scavenging behavior. Henry created five different types of stimuli: the odor of food; the odor of food and an open hole; the odor of food, an open hole and the odor of a fox; the odor of food, an open hole, the odor of a fox and the odor of a fox's urine; and a spot not manipulated in any way. He found that the foxes thoroughly investigated sites with the odor of food (types 1 through 3) and they investigated only briefly those spots with no food stimuli (type 5) and those spots with food and the scent of urine (type 4). Urine marking apparently did influence the foxes' scavenging behavior.

These results, along with those from the first experiment, tend to support Henry's hypothesis that urine marking constitutes a bookkeeping system among scavenging red foxes. In other words, a urine mark left by one fox tells another fox that little or no food is left at the site of food odor. That way, the latter will not waste its time looking for food at that spot.

Henry conducted a third experiment to determine whether the intensity of food odor at a urine-marked food spot influences foxes' scavenging behavior. He followed a young red fox for long periods of time as it scavenged its environment. During scavenging, the fox marked many places in the forest. Henry then put painted stones on both sides of each urine mark so that the marks could be relocated at a later date. When the fox left the area, Henry returned to these marks and buried three grams of soft dog food at half of them and 30 grams of soft dog food at the others, for a total of 60 bait spots. During the next two days, Henry recorded how long the fox investigated the various spots and whether it dug out the baits and ate them.

In the case of the 30-gram baits, the fox sniffed at them anywhere from 0.6 to 26.3 seconds and then began to dig. It dug out 24 of the 30 baits, ate them, carried them off or hid them in a new place. As for the 3-gram baits, the fox sniffed the area only 0.4 to 12.8 seconds, dug out only 2 of the 30 baits and occasionally urine marked the spots again and walked on.

These results suggest that scavenging foxes' reactions to urine marks strongly depend on the amount of food odor present. If there are both urine odor and a strong food odor, the fox will usually ignore the urine message of no food and try to locate the food. But if the urine is accompanied by only a faint food odor, the urine message of no food takes precedence, and the fox rarely bothers to look for food. To further assist other foxes in avoiding such meager caches, the fox may also urinate on the spot that has already been urinated on. That way, the spot carries a double message of no food for any other foxes that come along.

All these observations and experiments, Henry points out (as does research by other investigators), suggest that the use of urine marking in scavenging behavior may be a widespread behavior among red foxes. In fact, it may also occur among other closely related species. Henry's research also suggests that social interactions among solitary mammals such as the red fox may be far more frequent and complex than biologists have realized.

"Clearly the social evolution and ecological advantages of solitary species deserve to be studied in greater detail," Henry concludes. "It may emerge that a solitary organization does not always represent a primitive state, but rather in many cases may represent a highly evolved strategy that is ingeniously adapted either to utilize dispersed food resources or to occupy certain niches where a highly social species could not be maintained." □