

Hazardous wastes may be found in fields, abandoned buildings, along roads, or near wooded areas and wetlands. Warning signs include drums of 55-gallon drums, strong odors, oil or sludge spills on waterways, and dead or dying animals in fields and woodlands. "A single sign or combination of signs can be reported," said McGuire. "Wolves should not attempt to interact on their own, as toxic fumes, flammable chemicals, or explosive materials may be present."

Hazardous wastes are discarded in drums, usually stored in drums in 55-gallon steel drums, and are flammable, reactive, corrosive or toxic in nature. Improper disposal of hazardous wastes can cause contamination of drinking water supplies, fires, fires and air pollution, and harm to people and property through indirect contact.

The EPA estimates that of the 30-40 million tons of hazardous wastes generated annually in the U.S., only 10 percent are properly managed. Major hazards include the primary metals, organic and inorganic chemicals, electronics, textiles, petroleum refining, rubber and plastics industries. Ohio, Michigan, Illinois and Indiana are among the top ten states in the generation of hazardous wastes.

A free brochure on the "Seek and Destroy" program is available in single copies through the Office of Public Information, U.S. EPA, Region V, 230 Dearborn St., Chicago, Ill. 60604, by calling (312) 353-2072.

Wolves Howl at Minnesota Wolves

Wolves, much like loners in society, have little to howl about. Wolves do not belong to a pack rarely reply to howling from other wolves. An interesting aspect of wolf behavior and reasons why wolves howl or respond were investigated over a one-year period by research biologists in wolf howls in the Superior National Forest of northern Minnesota.

David Mech, a research biologist with the U.S. Fish and Wildlife Service, and H. Harrington, a biologist with the Division of Biological Sciences, State University of New York, conducted the study to determine what role howling plays in the maintenance of wolf territories. The biologists imitated wolf howls and recorded responses from radio-collared wolves that could be located.

At his office in St. Paul, Mech, recognized internationally as a wolf expert, recorded replies and behavior of radio-collared wolves—in response to human imitations—were analyzed from eight wolf packs and ten lone wolves. He said pre-

vious work by other researchers showed that free-ranging wolves respond to human imitations of howling as well as or better than playbacks of recorded howling by real wolves. Wolves apparently have the ability to distinguish individual voices. Agonistic responses from *Canis lupus* indicates, in the opinion of Mech, that wolves regard the human imitated call as howling from alien wolves.

During the experimental howling sessions, the biologists noted that wolves remained near their original site after howling, or retreated if they remained silent. The difference apparently was related to the problems of avoiding both accidental and deliberate encounters, and to "cost/benefit considerations" related to resources at the wolves' locations, according to Mech.

He said howling enables packs to avoid one another. The major benefit of replying to howling of alien wolves is the avoidance of an "accidental" encounter. The biologist reports that accidental encounters have been observed among wolf packs in Minnesota. Wolves are keenly defensive of and sensitive to territorial rights established by packs. Conflicts can arise when alien wolves enter a territory. "By howling," Mech said, "resident wolves advertise their position, allowing both resident and intruder to modify their movements to minimize the probability of an accidental meeting." The potential cost of replying, on the other hand, may be much greater than the energy required to howl because "advertisement announces the so-called advertisers' location and may subject them to attack, even by intruding wolves," he said.

Observations have been made in which intruding wolves located and attacked other wolves by following their adversaries' tracks in snow. Howling also could be used this way by wolves. Thus an important potential cost of replying to howling is the possibility of attack.

During the Minnesota study, the howling rate varied significantly throughout the year. A midwinter increase was correlated with the breeding season, especially for groups containing breeding animals. A second, larger increase in reply rate started in midsummer, peaked about August, and declined to a low in early winter. The decline in autumn howling response occurred sooner in a pack whose pups developed faster, Mech reports.

Study findings indicate the howling reply rate was significantly higher among all packs and lone wolves attending prey kills. The more food remaining at a kill, the higher the reply rate was.

Kills are valuable resources to wolves—resources not easily replaced, according to the biologists. Capturing and killing prey is a difficult and dangerous task. Most encounters between wolf

packs and prey are unsuccessful. In other words, wolves generally must work hard when hunting for their dinners. A decline in the deer population in the area where the study was conducted reduced the number of available prey, so most kills were fully utilized by wolves. (Defense of a kill would be expected, Mech said, for even subordinate captive wolves can successfully defend their food from other more dominant wolves.)

During the study, larger wolf packs replied more often than did smaller packs. Howling enables a strung-out pack to reassemble, the biologists said. For wolves separated from their pack, the howling rate was dependent on the age and social role of pack members. Specific behaviors noted during howling sessions—including movements away from the howler—indicated that howling was related to interpack agonism, Mech said. Moreover, three of the major factors influencing the reply rate also significantly affect the level of agonism toward strangers, namely: pack size, social role, and breeding season.

Two other factors, kills and pups, are both important pack resources necessitating exclusive occupancy of a site, Mech said. The high reply rates at sites containing kills—or pups—constitute strong circumstantial evidence that howling is important in the maintenance of a territory.

Howling was considered most effective in mediating avoidance in two situations: (1) when two packs approached a common area of overlap; (2) when a pack returned to an area that was little used for weeks in which scent posts (spoor) would have lost effectiveness in deterring strangers (alien wolves).

Both scent marking and howling apparently are important in spacing. However, scent marking and howling differ in their roles and are complementary; scent marking being long term and site-specific; howling being immediate and long range, in the words of Mech.

Lone wolves which do not possess territories rarely replied to human howling during the study, Mech said. Lone wolves shared the "low profile" behavior of surplus animals in a territorial population. Interpack howling sessions may continue for hours, he said. In Minnesota, three adjacent packs were heard howling, apparently to each other, each from within its own territory. After such sessions packs moved apart, suggesting their interpack howling occurs in an agonistic context, and thus may be involved in territorial maintenance.

The study answered questions about the role and importance of howling in territory maintenance. Radioed wolves replied to 494 of 1,783 trials during which biologists imitated wolf howls. Of the replies, 390 were recorded and 349 were of adequate quality for analysis.



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