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Wolf, *Canis lupus*, Behavior in Areas of Frequent Human Activity

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We report incidental observations of Wolves (*Canis lupus*) tolerating human activity in central Wisconsin. Three monitored packs raised pups in close proximity to varying levels of human activity. Wolf pups were raised <350m from rearing pens of the endangered Whooping Crane (*Grus americana*), which saw daily human activity. One pack used cornfields as rendezvous sites within 175 m of a maintenance shed visited regularly by workers. Another pack centered their activities along a well-traveled state highway using both the verge and the road center for activity. Aerial locations of 10 yearling and adult dispersing Wolves were plotted to evaluate human densities in natal territories relative to dispersal and post-dispersal territories. Township densities (\bar{x} = 9.02 humans/km², SE = 4.015) and residential densities (\bar{x} = 5.59 housing units/km², SE = 2.12) in natal pack territories were significantly greater ($P < .01$) for dispersal and post-dispersal township densities (\bar{x} = 43.98 humans/km², SE = 7.37) and residence densities (\bar{x} = 23.12 housing units/km², SE = 3.49). Furthermore, a pup negotiated the densely populated region of northern Illinois and dispersed from central Wisconsin to east-central Indiana, a distance of at least 690 km. As Wolves live in closer proximity to humans, living in areas of higher township and residential densities, they can be expected to be more habituated to people, increasing the probability of human/Wolf conflicts.

Key Words: Wolf, *Canis lupus*, pups, humans, habituation, behavior, Wisconsin.

Historically, Gray Wolves (*Canis lupus*) were one of the most widely distributed land mammals in North America inhabiting all regions except arid deserts (Young 1944; Mech 1970; Mech and Boitani 2003). However, human settlement and persecution restricted Wolves to northern forested regions and eventually the only substantial population within the lower 48 states occurred in northern Minnesota (Mech 1970).

Under the protection of the federal Endangered Species Act of 1973, Wolves have returned to some areas within their historical range (Mech 1995). They began recolonizing Wisconsin in the mid-1970s (Mech and Nowak 1981; Thiel and Welch 1981; Wydeven et al. 1995). Wolves have since repopulated much of northern Wisconsin and an isolated area in the central part of the state referred to as the Central Forest Region (CFR). In 1999, the Wisconsin Department of Natural Resources (WDNR) downlisted the Wolf from an endangered to a threatened species (WDNR 1999*). Wolves continued to surpass target recovery levels. In April 2003, the U.S. Fish and Wildlife Service proposed to delist the Eastern Distinct Population Segment of Gray Wolf, which includes Wisconsin (Federal Register 2003*).

Wolves initially recolonized areas in Wisconsin with significantly lower road densities (\bar{x} = 0.23 km/km²) and human densities (\bar{x} = 1.52 people/km²) (Mladenoff et al. 1995). As recovery progresses, Wolves are demonstrating an increasing tolerance to human activity throughout the upper Great Lakes region, including Wisconsin (Thiel et al. 1998). In recent years, Wolves have denned near active sphagnum moss drying sites, occupying homesites inside artillery impact zones on

military bases, crossed four lane highways and large expanses of non-forested areas, and bypassed major U.S. cities (Licht and Fritts 1994; Mech et al. 1995; Thiel et al. 1998). While such behavior is not unique to the species, it is unique to Wolves living in the continental United States (McNay 2002; Mech and Boitani 2003). Observations of Wolves displaying increased tolerance towards humans are of value insofar as it affects management of Wolf recovery. This paper reports on the success of Wolves attempting to colonize areas of higher human densities than previously reported in the continental United States.

Study Area and Methods

Wisconsin's Central Forest Region (CFR) encompasses 7767 km² of deciduous forest (*Acer saccharum*, *Tilia americana*, *Quercus alba*, *Q. borealis*, *Q. velutina*), coniferous swamps (*Picea mariana*, *Larix laricina*), aspen stands (*Populus tremuloides*, *P. grandidentata*), pine barrens (*Pinus banksiana*, *P. resinosa*, *P. strobus*), sphagnum bogs, and marshes (Curtis 1959; Finley 1976*). A 12 141-hectare swamp, the largest in Wisconsin, lies within the CFR (Martin 1965). The CFR includes portions of Eau Claire, Chippewa, Clark, Jackson, Wood, Monroe, Juneau, Adams, and Marquette counties. The majority of the CFR consists of private industrial, county, state and federal forestland. Major economic industries include logging and cranberry agriculture as well as dairy operations (WDNR 2003*). Road density within the CFR is 1.23 km/km² (U. S. Census Bureau 2000*; WDNR 2003*).

Wolves were captured on or near rendezvous sites, located by howling and track surveys, using offset,

modified #14 Newhouse traps during summers 2002 and 2003, following guidelines established by Animal Care and Use committees within the Wisconsin Department of Natural Resources and University of Wisconsin-Stevens Point. With the exception of setting traps, researchers minimized time spent in pack rendezvous sites to avoid Wolf-human interactions with study animals. Wolves were sedated with a 5:1 mL mixture of ketamine hydrochloride and xylazine and were weighed, sexed, and examined to assess general condition (Wydeven et al. 1995).

Radio collars were placed on adults. Pups received ear tag transmitters developed for a Wolf pup mortality study (Advanced Telemetry Systems, Isanti, Minnesota) programmed to transmit from 0700 – 1900. Pups and adults were located from the ground using a receiver with either a 5-element hand held Yagi antenna or a 9-element vehicle mounted antenna once daily from time of capture to 15 January each study season. All Wolves were located from fixed-wing aircraft 1-2 times/week.

Human activity observed near pack homesites was documented. Additionally, we interviewed people and collected reports from people who encountered study pack Wolves to assess the relative level of tolerant behavior of study packs towards humans.

Aerial locations of 10 dispersing Wolves were plotted in Universal Transverse Mercator (UTM) coordinates utilizing ArcView 3.X (ESRI, Inc., Redlands, California). Township (human) and residential (structural) densities for each county in which Wolf locations were plotted were queried (U. S. Census Bureau 2005*). Measurements obtained included township densities and residential densities in the county for (1) natal territories from which Wolves dispersed, (2) locations while Wolves were dispersing, and (3) after dispersers settled and either became territorial or became breeders.

Results

We monitored 17 Wolves from three study packs in 2002 and nine Wolves in five study packs in 2003. Seven Wolves and three packs were new in 2003. In three of the six study packs we were able to detail repeated interactions with humans.

Suk Cerney pack: Three male pups, one female pup, a yearling female, and an adult male Wolf were radioed near their den site between 3-6 July 2002 on Necedah National Wildlife Refuge (NNWR) in Juneau County (44°04.957'N, 90°10.399'W). The den site was located approximately 350 m from an observation bunker and several rearing pens used as part of a Whooping Crane (*Grus americana*) reintroduction program located on the NNWR. Between July and October employees and volunteers of the crane project, NNWR staff, along with visiting news media and guests, visited the cranes at least twice per day. Crane staff and Wolf researchers routinely observed pups before and during



FIGURE 1. Capture site of Wolf 409 in central Wisconsin on 10 August 2002 and death site in eastcentral Indiana, June 2003.

our study period. One pup watched Wolf researchers from the den, located in oak savannah dominated by Hill's oak (*Quercus ellipsoidalis*) for approximately 10 minutes as traps were set on 3 July 2002, approximately 10.5 m away. Adult Wolves were rarely seen. However, radio signals confirmed they were often in the immediate vicinity. The 4 radioed pups stayed in the area despite daily human activity, until their deaths between July 15 and 5 September 2002 (Heilhecker 2003*).

Bear Bluff pack: Six Wolves were captured in and adjacent to cornfields on private land in Jackson County between 20 July and 3 August 2002 (44°15.355'N, 90°20.582'W). Two male pups and two female pups, a yearling female, and a yearling male were radio-tagged. A partially planted, sandy soil cornfield with stunted corn stalks < 0.9 m tall, used as a daily rendezvous site from July to early November in 2002 and 2003, was approximately 175 m from the maintenance building used by employees of the cranberry farm at least twice a week. Distance from the rendezvous site to the maintenance building and cranberry beds were approximately 450 m and 1300 m, respectively. White-tailed Deer (*Odocoileus virginianus*), the Wolves' primary prey in the region, were abundant and cause \$35000/year damage to local commercial cranberry beds (K. Rice, Flying Dollar Cranberry Company, personal communication). Deer flies (*Chrysops* sp.) and mosquitoes (Culicidae) were generally less abundant in the corn-

fields compared to the surrounding forested land. In both years, and for years prior to our study, employees of the cranberry company regularly observed Wolves. Once during our study they witnessed a Wolf in their parking lot sniffing vehicle tires. The property manager also reported his dog interacting with Wolves in what looked like play behavior.

Noch Hanai pack: Wolf 429, a yearling female, was radio-collared on 3 June 2002. In summer 2002, she was observed multiple times acting indifferently to vehicles along State Highway 54 on the northern border of her natal pack territory (44°20.15'N, 90°35.51'W). In the autumn she dispersed and created a new pack that occupied a 102-km² territory centered along the same state highway. The pack's den site was discovered approximately 230 m from State Highway 54 in a Red Pine (*Pinus resinosa*) plantation with no under-story. Vehicles passing on the state highway were visible from the den. The wolves' rendezvous sites, as determined by matted grass, trails, human garbage with teeth marks, and deer legs, were on embankments along the shoulder of this moderately traveled state highway, adjacent side roads, and recently logged forests spanning a distance of 7.7 km by 60 m along the state highway.

In summer 2003, over 60 citizen phone calls and e-mails reported a radio-collared Wolf with pups walking, playing, and lying in the middle of the state highway. Initially four pups and a radio-collared adult were observed. On 19 July 2003, a dead male pup was collected from the shoulder of the highway. The necropsy revealed injuries consistent with a vehicle collision.

None of the Wolves appeared to be afraid of vehicles. On 20 July 2003, a citizen reported watching three pups and a collared female in the middle of the state highway. They moved off to the shoulder of the road to let vehicles pass and then returned to the middle of the road. E. Heilhecker and W. Hall, Jr., observed Wolf 429 looking both directions before stepping onto the highway. Pups were observed sitting on the side of the road chewing on deer legs as vehicles passed. Pups once walked next to Heilhecker and Hall's vehicle parked on the shoulder of the road. In all instances the pups appeared oblivious to the presence of vehicles. It was later learned that the Wolves had been fed by loggers working in this area during the late spring/early summer.

On 13 January 2004, WDNR received a report of an uncollared Wolf on State Highway 54 jumping into the bed of a truck containing deer hides and carcasses after its occupant had stopped to take pictures of the Wolf (M. Windsor and T. Babros, WDNR, personal communication). On 29 March 2004, an uncollared Wolf was observed walking back and forth across State Highway 54 stopping traffic. At one point the Wolf picked up a yellow plastic oil container, crossed the road, and lay down within 3 m of a vehicle. Several vehicles slowed down to watch the Wolf. While no one exited their vehicles, people rolled down their win-

dows and continued to talk within hearing range of the Wolf. The Wolf did not appear to be affected by the commotion. On 27 April 2004, the radio-collared female, Wolf 429, was humanely dispatched along Hwy 54 because she was unable to ambulate on her hind legs. A preliminary necropsy was inconclusive, but her paralysis was not caused by a vehicle collision. This Wolf did have a healed injury to the pelvic girdle that was caused by blunt trauma suggestive of an earlier collision with a vehicle (A. Dassow, University of Wisconsin, Madison, personal communication).

Dispersal: We compared aerial locations for 10 Wolves, as yearlings and adults, dispersing between 1998 and 2004. Seven Wolves (W002, W269, W309, W338, W341, W426, W429) established new territories; five of which (W309, W338, W341, W426, W429) were known to have successfully bred. Three Wolves (W337, W427, W480) continued to disperse until their deaths and never set up known territories. Township densities (\bar{x} = 9.02 humans/km², SE = 4.015) and residential densities (\bar{x} = 5.59 housing units/km², SE = 2.12) in natal pack territories were significantly lower ($P < 0.01$) than township densities (\bar{x} = 43.98 humans/km², SE = 7.37) and residential densities (\bar{x} = 23.12 housing units/km², SE = 3.49) in dispersal and post-dispersal territories (U. S. Census Bureau 2005*).

A male pup, W409, dispersed to eastern Indiana in less than 156 days. The pup was last monitored on 15 January 2003 and found dead on 20 June 2003. If the pup dispersed in a straight line, it would have passed through relatively densely settled areas of northern Illinois and the greater metropolitan Chicago area to reach eastern Indiana (40°06.4'N, 85°04.3'W) (Figure 1). The human density of Jackson County, its birthplace, was 7.8 people/km². The least populated counties along the Wisconsin/Illinois state border had 22.9 people/km² (Green County, Wisconsin) and 14.5 people/km² (Jo Daviess County, Illinois). The human density in Randolph County, Indiana, where the Wolf was found shot was 22.84 people/km² (U. S. Census Bureau 2005*). This was the first documented Wolf in Indiana since their extirpation in 1908 (Mumford and Whitaker 1982), and the southern-most movement of a radio-collared Wisconsin Wolf to date (A. Wydeven, WDNR, personal communication).

Discussion

Wolves' reactions to humans are a reflection of their experiences with people and the relative tolerance of humans to Wolves (McNay 2002; Fritts et al. 2003). By the mid-1900s Wolves were largely restricted to wilderness areas in North America due to intense human persecution (Young 1944; Mech 1995). With legal protection from the Endangered Species Act of 1973, a gradual increase in acceptance of Wolves (Fritts et al. 2003), and an expanding population, Wolves have inevitably come in closer contact with humans (Mech 1995; Thiel et al. 1998; Mech and

Boitani 2003). By the 1990s an increasing number of Wolves began dispersing into and colonizing more settled regions and agricultural areas in the northern United States (Licht and Fritts 1994; Mech 1995; Mech and Boitani 2003). Thiel et al. (1998) and Merrill and Mech (2000) reported tolerance of humans close to den and rendezvous sites in Minnesota and Wisconsin.

As Wolves colonize more fragmented habitat dominated by humans they will come into more frequent contact with humans, as our findings demonstrate. Dispersing Wolves from the numerous packs presently inhabiting the forest-farmland zones in Wisconsin and Minnesota are capable of penetrating great distances into landscapes highly dominated by humans (Licht and Fritts 1994; Merrill and Mech 2000; Fritts et al. 2003; Mech and Boitani 2003).

The male Wolf pup, 409, provides an example of this progression of tolerance to humans, a behavior that can be expected to be exhibited by Wolves in succeeding generations. Although movements of ≥ 670 km from their homesites have been well documented in Wolves (Van Camp and Gluckie 1979; Ballard et al. 1983; Fritts 1983; Ream et al. 1991; Licht and Fritts 1994; Merrill and Mech 2000; Mech and Boitani 2003), this is the first documentation of a wild North American Wolf moving through areas of such high human densities. While Wolf 409 was not known to have any contact with nor was known to have been conditioned to humans as a pup, it was subjected to increasing levels of human activity as it dispersed south and east of Lake Michigan. Interestingly, Wolf 429, the founder of what became the human-habituated Noch Hanai pack, came from the very same pack in which Wolf pup 409 was born.

We observed two forms of habituation of Wolves in our study: (1) pups that became accustomed to the presence of humans through repeated, benign association, and (2) association of humans with a food reward. In the two cases where litters were raised in close proximity to human activity and were frequently seen, the pups fled at the close presence or approach of a human(s). These Wolves created no known threats to public safety or caused any damage to personal property. Wolves displaying avoidance or fear behavior during direct encounters with humans are considered to be showing "normal" behavior (Smith and Stahler 2003*).

In the remaining case in our study, pups received food awards from humans. Wolves are not known to attack people during their first human encounter but require repeated exposure to humans before attacking (McNay 2002; Smith and Stahler 2003*). A prerequisite for aggressive Wolf behavior towards humans is habituation, with food being the most influential factor (McNay 2002; Smith and Stahler 2003*). Our human-habituated Wolves' whose bold behavior rapidly evolved into a public nuisance issue.

We expect more Wolf-human encounters and human-habituated Wolves due to the recovering Wolf popula-

tion in the Great Lakes area. Wisconsin's Wolf population has increased from 83 Wolves in 1995 to 425 Wolves in 2005 (Wydeven and Wiedenhoef 2005*). The growing Wolf population and increased number of Wolf sightings have raised safety concerns from the general public. A continuous educational program that focuses on how human actions affect Wolf behavior may minimize the establishing of human-habituated Wolves. Periodic news releases and public education programs at the federal and state forests, posters at road side kiosks emphasizing the reasons why feeding of Wolves is improper, writing stipulation in public contracts on public land prohibiting feeding of Wolves especially in areas where Wolf habituation is occurring, or fining individuals who feed Wolves may be useful approaches. When habituation occurs, attempts should be made to deter Wolves displaying bold behavior with aversion techniques such as rubber bullets and cracker shells before Wolf aggression develops. If aversion conditioning is unsuccessful, for public safety reasons, aggressively bold Wolves should be humanely euthanized.

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