

SARCOPTIC MANGE FOUND IN WOLVES IN THE ROCKY MOUNTAINS IN WESTERN UNITED STATES

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ABSTRACT: We documented sarcoptic mange caused by mites (*Sarcoptes scabiei*) in 22 gray wolves (*Canis lupus*) in the northern Rocky Mountain states of Montana ($n=16$) and Wyoming ($n=6$), from 2002 through 2008. To our knowledge, this is the first report of sarcoptic mange in wolves in Montana or Wyoming in recent times. In addition to confirming sarcoptic mange, we recorded field observations of 40 wolves in Montana and 30 wolves in Wyoming displaying clinical signs of mange (i.e., alopecia, hyperkeratosis, and seborrhea). Therefore, we suspect sarcoptic mange may be more prevalent than we were able to confirm.

Key words: *Canis lupus*, ectoparasites, gray wolf, *Sarcoptes scabiei*, sarcoptic mange, wildlife disease.

INTRODUCTION

Sarcoptic mange is a highly contagious skin disease caused by mites (*Sarcoptes scabiei*) that burrow into the epidermis of the host animal and create tunnels where females lay eggs. Larvae hatch from eggs, which molt through two nymph stages and continue to burrow new tunnels in the epidermis. The 2-wk life cycle is completed after the second nymph stage molts to the adult (Sweatman, 1971). Each stage can add to the tunnel system, but most tunneling is done by adult females (Kreeger, 2003). Burrowing in the epidermis and allergic responses by the host to excretions from the mites cause pruritis, which leads to progressive skin damage as the host animal bites, scratches, and rubs the affected area. Infested animals generally suffer from alopecia, hyperkeratosis, seborrhea, scabs, ulcerations, and lesions. Severe cases can affect the animal's entire body and can lead to emaciation, poor body condition, and death from secondary infections or hypothermia in winter due to hair loss (Sweatman, 1971; Olsen, 2003; Kreeger, 2003). Sarcoptic mange is spread from infested animals to new hosts by direct contact, contact with areas

contaminated with mites (e.g., bedding sites or dens), or contact with common rubs used by infested animals (Kreeger, 2003).

Sarcoptic mange has been reported in wolves from Alberta (Todd et al., 1981; Alberta Fish and Wildlife, 2004), British Columbia (Miller et al., 2003), and Saskatchewan (Wobeser, 1992), Canada, India (Singh, 2003), Sweden (Morner et al., 2005), and other parts of Scandinavia (Olsen, 2003). In the United States, sarcoptic mange has been documented in wolves in Wisconsin (Wydeven et al., 1996, 2003), Michigan (Michigan Department of Natural Resources, 1997), Minnesota (U.S. Fish and Wildlife Service [USFWS], 2004a), and Alaska (Mech et al., 1998). Mange has also been reported in red wolves (*Canis rufus*) in North Carolina (USFWS, 2004b) and Mexican wolves (*Canis lupus baileyi*) in Arizona (M. Dwire, unpubl. data). Sarcoptic mange has not been documented in wolves in the northern Rocky Mountains (NRM). We report *S. scabiei* infesting wolves in Montana (MT) and Wyoming (WY) from 2002 through 2008.

Ironically, sarcoptic mange was deliberately introduced in Montana in 1905 when a state law required the state veterinarian

to inoculate wolves and coyotes with *S. scabiei* to help exterminate them. Anecdotal reports suggested the experiment partially succeeded, as many wolves were seen and wolf mortality occurred (Knowles, 1914). The “experiment” ended in 1916, but *S. scabiei* proved to be quite adaptable and persisted in sympatric coyote and fox populations. This intentional introduction may have contributed to the spread of sarcoptic mange in the western US and western Canada, but records are incomplete (Green, 1951; Alberta Fish and Wildlife, 2004). Others suggest that sarcoptic mange would likely be present in the Rocky Mountains today regardless of the intentional inoculation of wolves and coyotes in Montana, given the history of sarcoptic mange epizootics in other regions of North America.

After being extirpated from most of their range in the contiguous US by 1930, wolves began to recover in Montana in the mid-1980s, when wolves from southern Canada naturally recolonized Glacier National Park (Ream et al., 1989). In 1995 and 1996, the USFWS reintroduced 31 wolves from Canada into Yellowstone National Park (YNP) and 35 wolves into central Idaho. Sarcoptic mange has been documented in the Canadian wolf population; however, captured wolves showing signs of sarcoptic mange or evidence of disease were not selected for reintroduction (Fritts et al., 1997), and, as a precaution, Canadian wolves relocated to the US were examined for external parasites and given two injections (0.4 mg/kg) of ivermectin at 1–5-day intervals. By the end of 2008, we estimate that there were $\geq 1,645$ wolves in ≥ 217 packs living in the NRM (Sime and Bangs, 2009).

METHODS

From 1984 to 2008, >1,000 wolves were captured and handled during radio-collaring efforts in Montana, Idaho, and Wyoming. Additionally, ~1,000 wolves were killed in livestock depredation controls. During capture

operations and necropsies, skin scrapings were taken from affected areas on the hides of live and dead wolves displaying alopecia, hyperkeratosis, and seborrhea in Montana, Wyoming, and YNP. A scalpel was used to scrape and abrade the pelt where skin lesions were seen. Scrapings were frozen or preserved in 95% ethyl alcohol until further examination. Suspended material from the scraped site was transferred to a petri dish using a glass Pasteur pipette filled with 95% ethyl alcohol and examined under a microscope at 50 \times magnification. Mites were transferred to Clear-rite (Richard Allen, Richland, Michigan, USA), mounted in Acryloyd toluene on a microslide, and viewed at 400 \times magnification for specific identification (Furman and Catts, 1970; McDaniel, 1979; Bowman, 1999). Specimens were identified as *S. scabiei* by the Montana Fish, Wildlife and Parks (MFWP) Laboratory, Bozeman, Montana, and the Washington Disease Diagnostic Laboratory, Pullman, Washington.

RESULTS

Sarcoptes scabiei confirmed in Montana

From 2003 through 2007, 16 of the 168 dead wolves examined by the MFWP Laboratory were confirmed to be infested with *S. scabiei* (MFWP, 2007, unpubl. data). Representative specimens were deposited in the US Department of Agriculture, Agricultural Research Service (ARS), US National Parasite Collection, Beltsville, Maryland, accession number USNPC 101621.

Mange was first confirmed in one pack in 2003. By 2005, mange had spread to 11 of the 46 packs in Montana; however, mange declined in 2007 and was identified in only three of 71 packs in the state.

Sarcoptes scabiei suspected in Montana

Sarcoptic mange was first suspected in wolves that naturally recolonized Montana from Canada when two wolves were captured and radio-collared near Choteau in 1995 (USFWS, 1995). One wolf had significant alopecia, but samples were not collected, and *S. scabiei* was never confirmed. This wolf later migrated from the area and was not located again. Between 2003 and 2007, MFWP recorded field

observations of alopecia on 40 wolves and suspected sarcoptic mange as a cause. Three packs in Montana that were suspected of being infested with *S. scabiei* failed to persist due to low pup survival and unknown causes of mortality. Two pups were found dead at a rendezvous site in 2005, and the adult female exhibited alopecia over 85% of its body. Another pack that was thought to be previously infested in 2005 had healthy pups and did not show signs of mange in 2007.

***Sarcoptes scabiei* confirmed in Wyoming**

From 2002 through 2008, five specimens of mites collected from wolves in Wyoming and one specimen from a wolf in YNP were identified as *S. scabiei* by the MFWP Laboratory and the Washington Disease Diagnostic Laboratory. Representative specimens were deposited in the US Department of Agriculture ARS, US National Parasite Collection, accession number USNPC 101621.

The behaviors of some wolves changed once they became infested with *S. scabiei*. In 2002, an adult male wolf infested with *S. scabiei* displaying >70% alopecia over its body was captured and radio-collared east of YNP. The wolf was previously the breeding male in the pack. Subsequent monitoring indicated the wolf lived alone, apart from its former pack, at lower elevations in the surrounding foothills. The wolf survived another year before dying of possible mange related causes.

***Sarcoptes scabiei* suspected in Wyoming**

In Wyoming, 30 wolves from four packs east of YNP were observed displaying varying degrees of alopecia, hyperkeratosis, and seborrhea between 2002 and 2008. From 2006 through 2008, eight additional wolves from four packs in YNP displayed similar signs of sarcoptic mange.

Sarcoptes scabiei persisted in some geographic areas within Wyoming. Wolves from a suspected mange-infested pack east of YNP died in late winter/early

spring 2004. A new pack formed in 2005 and took over the home range used by the previous pack. No signs of sarcoptic mange were observed in this new pack during 2005, but by summer 2006, adults and pups from this pack all displayed alopecia.

Not all wolves died from the effects of sarcoptic mange. An adult female wolf captured in January 2007 had no hair on its tail and >50% alopecia and hyperkeratosis on its belly and flanks. Other pack members exhibited similar signs of sarcoptic mange. The wolf was recaptured in summer 2007, but its skin condition appeared normal with light-gray hair growing back over infected areas on its body and tail.

DISCUSSION

Assessments of the extent and scale of sarcoptic mange infestations are difficult. Sarcoptic mange in coyotes has been confirmed in wolf-occupied habitat in Montana and Wyoming; therefore, coyotes and other sympatric canids may have contributed to repeated infestations among wolves by direct or indirect contact. Wolves infected with sarcoptic mange often become weak, no longer travel with their pack, use areas of lower elevation and less snow cover, subsist by scavenging carcasses, and seek shelter from the elements in dense cover or haystacks in rural areas (Todd et al., 1981; Shelly and Gehring, 2002). Mortality data are biased because wolves infested with *S. scabiei* often die in winter from hypothermia and are never located (Shelly and Gehring, 2002). One suspected mangy wolf in Wyoming remained near a rural housing development in the late fall, but was removed after local residents complained of the wolf's presence. One wolf in Montana was removed from the population after it frequented haystacks, presumably for shelter from winter weather.

Our data support the conclusions of other biologists that sarcoptic mange can

impact wolves on a local scale (Cowan, 1951; Todd et al., 1981; Kreeger, 2003) and negatively affect pup survival (Brand et al., 1995; Wydeven and Wiedenhoeft, 2004a).

The progression of sarcoptic mange in wolves in the Midwestern US (Wisconsin, Michigan, and Minnesota) may be a valid predictor of the way in which sarcoptic mange will impact the wolf population in the NRM. Sarcoptic mange has been prevalent in Midwest wolf populations since the early 1990s. From 1991 to 1996, sarcoptic mange was detected on 27% of the wolves handled in Wisconsin. Mortality caused by sarcoptic mange averaged 27% of all known mortalities of radio-collared wolves in Wisconsin from 2002 to 2003 (Wydeven and Wiedenhoeft, 2004b), 31% in Michigan from 1999 to 2001 (Michigan DNR, unpubl. data), and 11% in Minnesota from 1994 to 2005 (USFWS, 2004a). Biologists suspect that sarcoptic mange has reduced the rate of population growth in Wisconsin (Wydeven et al., 1996), in Michigan (Michigan Department of Natural Resources, 1997), and in Minnesota (B. Paul, USDA Wildlife Services, Minnesota, unpubl. data).

Not all affected coyotes and wolves succumb to sarcoptic mange or associated health complications. Pence and Windberg (1994) documented coyotes surviving sarcoptic mange in Texas. Chronert et al. (2007) reported that 20% of coyotes displaying signs of sarcoptic mange recovered from the infection in Wind Cave National Park, South Dakota. Our data suggest that wolves can survive for extended periods, depending on infestation severity. Fewer wolves in Wisconsin died from sarcoptic mange during milder winters; however, increased survival of mange-infested wolves in winter also may have contributed to the spread of sarcoptic mange to other wolves in the same pack or beyond the pack if mangy wolves dispersed and joined other packs (Wydeven and Wiedenhoeft, 2000; Wydeven et al., 2001).

Our assessment of the prevalence of mange in the NRM wolf population is a minimum estimate. We confirmed 22 wolves in Montana ($n=16$) and Wyoming ($n=6$) infested with *S. scabiei*; however, based on field observations of wolves with clinical signs of mange in Montana ($n=40$) and Wyoming ($n=30$), we know that sarcoptic mange is more prevalent than we were able to confirm.

The severity of mange and the ways in which it will impact the NRM wolf population are yet to be determined. However, since 1987, >1,000 wolves in Montana, Idaho, and Wyoming have been monitored with radio telemetry and their fates determined. All causes of natural mortality, including mange, only comprised 11.8% of the total mortality for NRM wolves >6 mo of age from 1984 to 2004 (Smith et al., 2010). Based on examination of >1,000 wolves killed in livestock depredation control, we conclude that although sarcoptic mange has killed numerous individual wolves in the NRM, it has only affected wolf packs in a few specific areas in Montana and Wyoming and has not been confirmed in Idaho. Currently, the NRM wolf population continues to increase annually.

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LITERATURE CITED

- ALBERTA FISH AND WILDLIFE. 2004. Sarcoptic mange in Alberta. Publication I/168. Alberta Fish and Wildlife, Edmonton, Alberta, Canada, 2 pp.
- BOWMAN, D. D. 1999. Parasitology for veterinarians. 7th Edition. W. B. Saunders Co., Philadelphia, Pennsylvania, 414 pp.

- BRAND, C. J., M. J. PYBUS, W. B. BALLARD, AND R. O. PETERSON. 1995. Infectious and parasitic diseases of the gray wolf and their potential effects on wolf populations in North America. *In* Ecology and conservation of wolves in a changing world, L. N. Carbyn, S. H. Fritts and D. R. Seip (eds.). Occasional Publication No. 35. Canadian Circumpolar Institute, Edmonton, Alberta, Canada. pp. 419–429.
- CHRONERT, J. M., J. A. JENKS, D. E. RODDY, M. A. WILD, AND J. G. POWERS. 2007. Effects of sarcoptic mange on coyotes at Wind Cave National Park. *Journal of Wildlife Management* 71: 1987–1992.
- COWAN, I. M. 1951. The diseases and parasites of big game mammals of western Canada. *Proceedings Annual Game Convention* 5: 37–64.
- FRITTS, S. H., E. E. BANGS, J. A. FONTAINE, M. R. JOHNSON, M. K. PHILLIPS, E. D. KOCH, AND J. R. GUNSON. 1997. Planning and implementing a reintroduction of wolves to Yellowstone National Park and central Idaho. *Restoration Ecology* 5: 7–27.
- FURMAN, D. P., AND E. P. CATTS. 1970. *Manual of medical entomology*. 3rd Edition. National Press Books, Palo Alto, California, 163 pp.
- GREEN, H. U. 1951. The wolves of Banff National Park. Canadian Department of Resources and Development, National Parks Branch, Ottawa, Ontario, Canada, 47 pp.
- KNOWLES, M. E. 1914. Fighting coyotes with mange inoculation. *Breeder's Gazette* 66: 229–230.
- KREEGER, T. J. 2003. The internal wolf: Physiology, pathology, and pharmacology. *In* Wolves: Behavior, ecology, and conservation, L. D. Mech and L. Boitnai (eds.). University of Chicago Press, Chicago, Illinois, pp. 193–217.
- MCDANIEL, B. 1979. Mites and ticks. M. McBrown Co., Dubuque, Iowa, 335 pp.
- MECH, L. D., L. G. ADAMS, T. J. MEIERS, J. W. BURCH, AND B. W. DALE. 1998. *The wolves of Denali*. University of Minnesota Press, Minneapolis, Minnesota, 240 pp.
- MICHIGAN DEPARTMENT OF NATURAL RESOURCES. 1997. Michigan gray wolf recovery plan. Michigan Department of Natural Resources, Wildlife Division, Lansing, Michigan, 59 pp.
- MILLER, M. J., R. D. DAWSON, AND H. SCHWANTJE. 2003. *Manual of common diseases and parasites of wildlife in northern British Columbia*. University of Northern British Columbia, Prince George, British Columbia, Canada, 162 pp.
- MORNER, T., H. ERIKSSON, C. BROJER, K. NILSSON, H. UHLHORN, E. AGREN, M. P. RYSER-DEGIORGIS, C. HARD, A. F. SERERSTAD, D. S. JANSSON, AND D. GAVIER-WIDEN. 2005. Diseases and mortality in free-ranging lynx (*Lynx lynx*), brown bear (*Ursus arctos*), wolf (*Canis lupus*) and wolverine (*Gulo gulo*) in Sweden. *Journal of Wildlife Diseases* 41: 298–303.
- OLSEN, M. L. 2003. Causes of mortality of free-ranging Scandinavian gray wolves 1997–2003. The Norwegian School of Veterinary Medicine, Department of Arctic Veterinary Medicine, Tromsø, Norway, 31 pp.
- PENCE, D. B., AND L. A. WINDBERG. 1994. Impacts of sarcoptic mange epizootic on a coyote population. *Journal of Wildlife Management* 58: 624–633.
- REAM, R. R., M. W. FAIRCHILD, D. K. BOYD, AND A. J. BLAKESLEY. 1989. First wolf den in western United States in recent history. *Northwest Naturalist* 70: 39–40.
- SHELLY, D. P., AND T. M. GEHRING. 2002. Behavior modification of gray wolves, *Canis lupus*, suffering from sarcoptic mange: Importance of sequential monitoring. *Canadian Field-Naturalist* 116: 648–650.
- SIME, C. A., AND E. E. BANGS (eds.). 2009. *Rocky Mountain Wolf Recovery 2008 Annual Report*. US Fish and Wildlife Services, Ecological Services, Helena, Montana, 350 pp.
- SINGH, A. K. 2003. Sarcoptes mange (*Sarcoptes scabiei*) in a wolf of Satpuda forests of Betul, India. *In* World wolf congress 2003: Bridging science and community, Central Rockies Wolf Council, Banff, Alberta, Canada, 25–28 September 2003, p. 43 [Abstract].
- SMITH, D. W., E. E. BANGS, J. K. OAKLEAF, C. MACK, J. FONTAINE, D. K. BOYD, M. D. JIMENEZ, D. H. PLETSCHER, AND C. C. NIEMEYER. 2010. Survival of colonizing wolves in the northern Rocky Mountains of the United States, 1982–2004. *Journal of Wildlife Management* 74: 620–634.
- SWEATMAN, G. K. 1971. Mites and pentastomes. *In* Parasitic diseases of wild animals, J. W. Davis and R. C. Anderson (eds.). Iowa State University Press, Ames, Iowa, pp. 3–64.
- TODD, A. W., J. R. GUNSON, AND W. M. SAMUEL. 1981. Sarcoptic mange: An important disease of coyotes and wolves of Alberta, Canada. *In* Proceedings of the World Wide Furbearer Conference, Worldwide Furbearer Conf. Inc., Frostburg, Maryland, 3–11 August 1980, Volume 1, pp. 706–729.
- US FISH AND WILDLIFE SERVICE. 1995. Annual report of the Rocky Mountain interagency wolf recovery program. USFWS, Ecological Services, Helena, Montana, 23 pp.
- . 2004a. Proposed Delisting Rule. 50 CFR Part 17. RIN 1018-AJ03. Federal Register, Volume 69, No. 139: 43664–43692.
- . 2004b. Red Wolf Recovery. USFWS Quarterly Report, 4.1.04-6.30.04. US Fish and Wildlife Service, <http://wolfology1.tripod.com/id204.htm>.
- WOBESER, G. 1992. Traumatic, degenerative, and developmental lesions in wolves and coyotes from Saskatchewan. *Journal of Wildlife Diseases* 28: 268–275.

- WYDEVEN, A. P., AND J. E. WIEDENHOEFT. 2000. Gray wolf population 1999–2000. Wisconsin Department of Natural Resources, Park Falls, Wisconsin, 9 pp.
- , AND ———. 2004a. Progress report of wolf population monitoring in Wisconsin for the period October–December 2003. Wisconsin Department of Natural Resources, Park Falls, Wisconsin, 16 pp.
- , AND ———. 2004b. Status of the timber wolf in Wisconsin, performance report 1 July 2003 through 30 June 2004. Bureau of Endangered Resources, Wisconsin Department of Natural Resources, Park Falls, Wisconsin, 33 pp.
- , K. BEHELER-AMASS, N. J. THOMAS, R. N. SCHULTZ, S. M. SCHMITT, D. P. SHELLY, AND T. M. GEHRING. 1996. Occurrence of sarcoptic mange in Great Lake states gray wolves (*Canis lupus*): 1991–1994. In 14th Midwest Furbearer Workshop, Midwest Association of Fish and Wildlife Agencies, Wakefield, Michigan, 2–4 April 1996, p. 53 [Abstract].
- , J. E. WIEDENHOEFT, R. P. THIEL, R. N. SCHULTZ, B. E. KOHN, AND S. R. BOLES. 2001. Progress report of wolf population monitoring in Wisconsin for the period October 2000–March 2001. Unpubl. report, Wisconsin Department of Natural Resources, Park Falls, Wisconsin, 36 pp.
- , ———, R. N. SCHULTZ, R. P. THIEL, S. R. BOLES, W. H. HALL, AND E. HEILHECKER. 2003. Progress report of wolf population monitoring in Wisconsin for the period October 2002–March 2003. Wisconsin Department of Natural Resources, Park Falls, Wisconsin, 51 pp.

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