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Peer Reviewed

Prediction Failure of a Wolf Landscape Model

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Abstract

*I compared 101 wolf (*Canis lupus*) pack territories formed in Wisconsin during 1993–2004 to the logistic regression predictive model of Mladenoff et al. (1995, 1997, 1999). Of these, 60% were located in putative habitat suitabilities <50%, including 22% in suitabilities of 0–9%. About a third of the area with putative suitabilities >50% remained unoccupied by known packs after 24 years of recolonization. This model was a poor predictor of wolf re-colonizing locations in Wisconsin, apparently because it failed to consider the adaptability of wolves. Such models should be used cautiously in wolf-management or restoration plans.* (WILDLIFE SOCIETY BULLETIN 34(3):874–877; 2006)

Key words

Canis lupus*, landscape, model, recolonization, Wisconsin, wolf.*

Predicting areas large carnivores might colonize upon natural recovery or reintroduction would be useful to resource managers. There have been 4 attempts to develop spatial models to predict such areas for gray wolves (*Canis lupus*; Mladenoff et al. 1995, 1997, 1999, Harrison and Chapin 1997, Corsi et al. 1999, Glenz et al. 2001).

Mladenoff et al. (1995, 1997, 1999) developed a logistic regression model based on landscape data and previous findings early during the wolf recovery (1979–1992) in Wisconsin, USA. The model suggested wolves tended to colonize and survive in areas with road densities $\leq$0.6 km/km^2 (Thiel 1985). The model derived putative wolf-habitat-suitability probabilities ranging from 0–100%. This model was used to predict where wolves might colonize Wisconsin, Michigan, and Minnesota, USA (Mladenoff et al. 1995, 1997, 1999), and was applied similarly to the northeastern United States (Mladenoff and Sickley 1998).

Sufficient time has now elapsed to evaluate the Mladenoff et al. (1995, 1997, 1999) model with the current distribution of wolf territories in Wisconsin. Herein, I make such a comparison.

Methods

I used data on wolf-pack-territory locations gathered by the Wisconsin Department of Natural Resources from 1993–2004 (Fig. 1) to compare their map locations to the wolf habitat-suitability-probability map of Mladenoff et al. (1999:39; Fig. 2).

I enlarged the habitat-suitability map to the same size and scale as the pack-territory map. I then overlaid a transparent acetate copy of the pack-territory map on the habitat-probability map and directly read the probability for each territory. Where a territory boundary enclosed areas of more than one probability, I scored the probability encompassing the greatest portion of the territory for that territory. If a territory enclosed areas of several probabilities, I used an integrated probability. Because some of the territory boundaries were based on estimates rather than on radiotracking locations (Wydeven and Wiedenhoeft 2004) and, thus, might not have been accurate, I independently used only the 54 territories based on radiotelemetry data.

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Results

I compared 101 wolf-pack territories discovered in Wisconsin between 1993–2004 (Fig. 1) with the Mladenoff et al. (1999) habitat-suitability map. Of these, 60% were located in areas of putative suitabilities <50%, including 22% which were in areas of 0–9% suitability (Table 1). When I compared only the 54 territories based on radiotracking, I obtained similar results (Table 1). Additionally, more than a third of the Wisconsin area with putative suitability >50% (Mladenoff et al. 1999:39) remained unoccupied by known packs of wolves during the 24 years of recolonization (cf. Mladenoff et al. 1999 and Fig. 1), even though the areas were well within dispersal distances for wolves (Wydeven et al. 1995) and wolves repopulated many areas of putative low probability (Table 1).

Discussion

The Mladenoff et al. (1995) model was derived to predict areas wolves had the greatest chance of re-colonizing. It was based on characteristics of areas inhabited by 14 wolf packs in Wisconsin between 1979–1992 and tested on 13 packs that colonized Wisconsin between 1993–1996 (Mladenoff et al. 1999). The model was then applied to both the northeastern United States to assess potential wolf habitat there (Mladenoff and Sickley 1998) and in the Wisconsin Wolf Management Plan (Wisconsin Department of Natural Resources 1999) to assess potential wolf habitat.

My results, based on 101 packs colonizing Wisconsin between 1993–2004, indicate the logistic regression model (Mladenoff et al. 1995, 1997, 1999) failed to predict extensive areas, both where wolf packs would colonize and where they would not. Because the model is supposed to be predictive, it was anticipated most wolves would colonize the areas of highest probability. Instead 60% of the packs colonized areas of <50% probability, including 22% in areas of the lowest probability. In addition, about a third of the available area of high probability was not known to be colonized. Wisconsin provides an ideal area in which to assess the model because it was originally derived from the Wisconsin wolf population. If it does not work there, there might be little reason to believe it would work elsewhere.

How could the model have failed to predict where Wisconsin wolves would re-colonize just a few years after it was devised? The

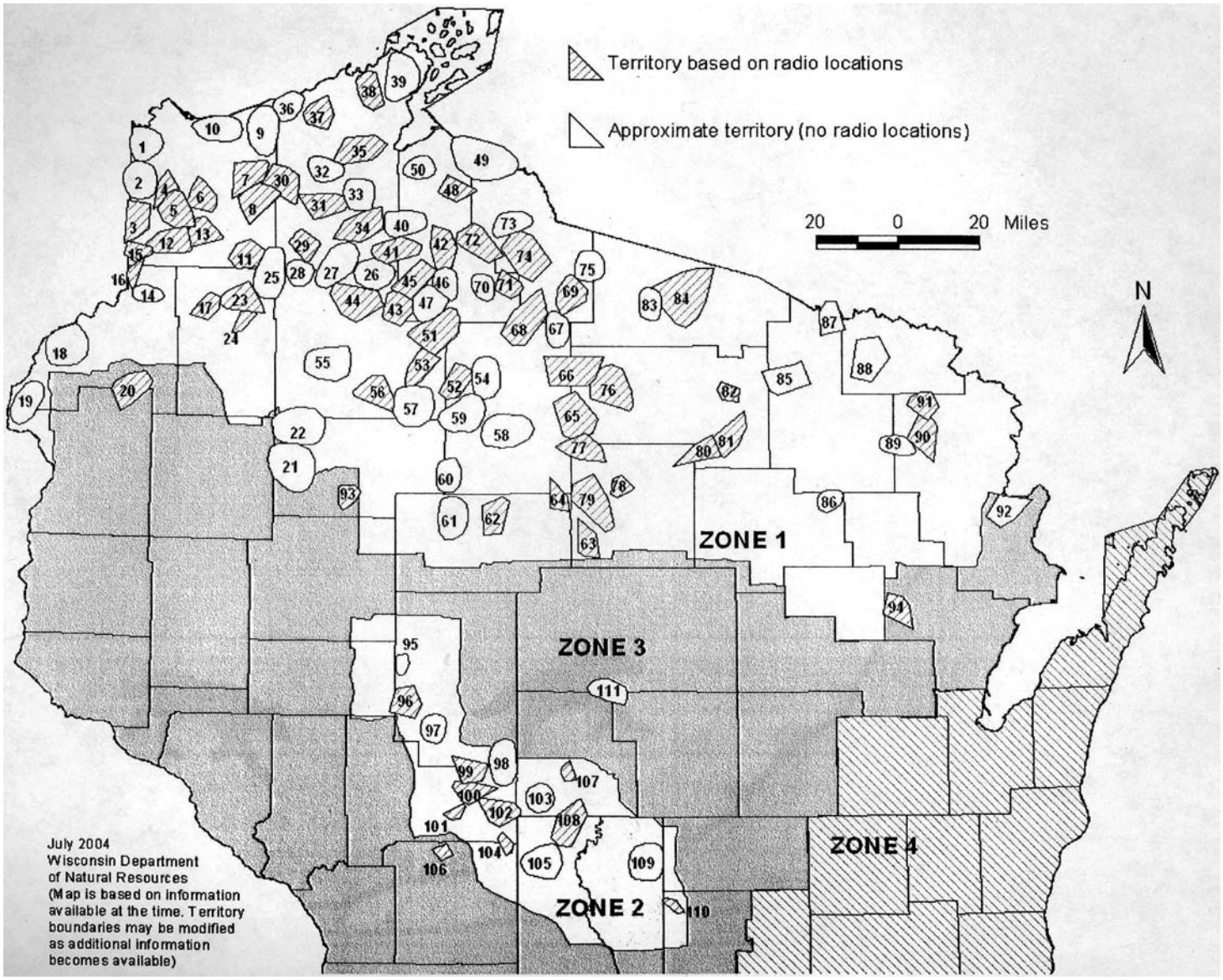

Figure 1. Wolf-pack territories formed in Wisconsin, USA, 1997–2004 (Wydeven and Wiedenhoeft 2004).

model clearly was descriptive, rather than predictive, merely characterizing areas where wolves were living during 1979–1992, not necessarily where they would live. The areas first colonized tended to be wild areas with low road densities (Thiel 1985) because 1) wolves living elsewhere were killed by humans, both illegally and accidentally (Wydeven et al. 1995), 2) the original colonizers came from Minnesota (Mech et al. 1995) where they had lived primarily in wild lands, and 3) wolves tend to colonize areas by proliferation from core areas (Fritts and Mech 1981, Ream et al. 1991, Wydeven et al. 1995). Since core recolonization areas tended to be wild lands, then early proliferation from those core areas tended to be in similar areas.

It is clear that wolves do not require wilderness (Boitani 1982, Mech 1995). Originally they inhabited almost every kind of habitat in the northern hemisphere (Young and Goldman 1944). The reason wolves remaining in the contiguous 48 states after a major extermination campaign inhabited only wild lands is because that is the only place where they avoided human persecution. In effect, humans relegated wolves to wild lands (Mech 1995).

In many parts of Europe, however, wolves frequent villages at night (Boitani 1982), roam through cities to scavenge at garbage landfills (Promberger et al. 1997) and den in wheat fields (Vila et al. 1993). Signs of similar behavior have long been noted in the United States as well (Mech 1995). In Minnesota wolves have been colonizing areas where road densities exceed the 0.6 km/km^2 that Thiel (1985) found characterized areas inhabited by remnant wolf populations and early colonizers (Mech 1989, Fritts et al. 1992, Berg and Benson 1999, Merrill 2000). They have even denned and raised pups in areas of high human disturbance (Thiel et al. 1998).

Thus, wolf recolonization of areas of putative low suitability in Wisconsin (Mladenoff et al. 1995, 1997, 1999) is not surprising. That recolonization does, however, reinforce the concerns of the Eastern Timber Wolf Recovery Plan (U.S. Fish and Wildlife Service 1992) and of Mech (1995, 1998, 2001) that re-colonizing

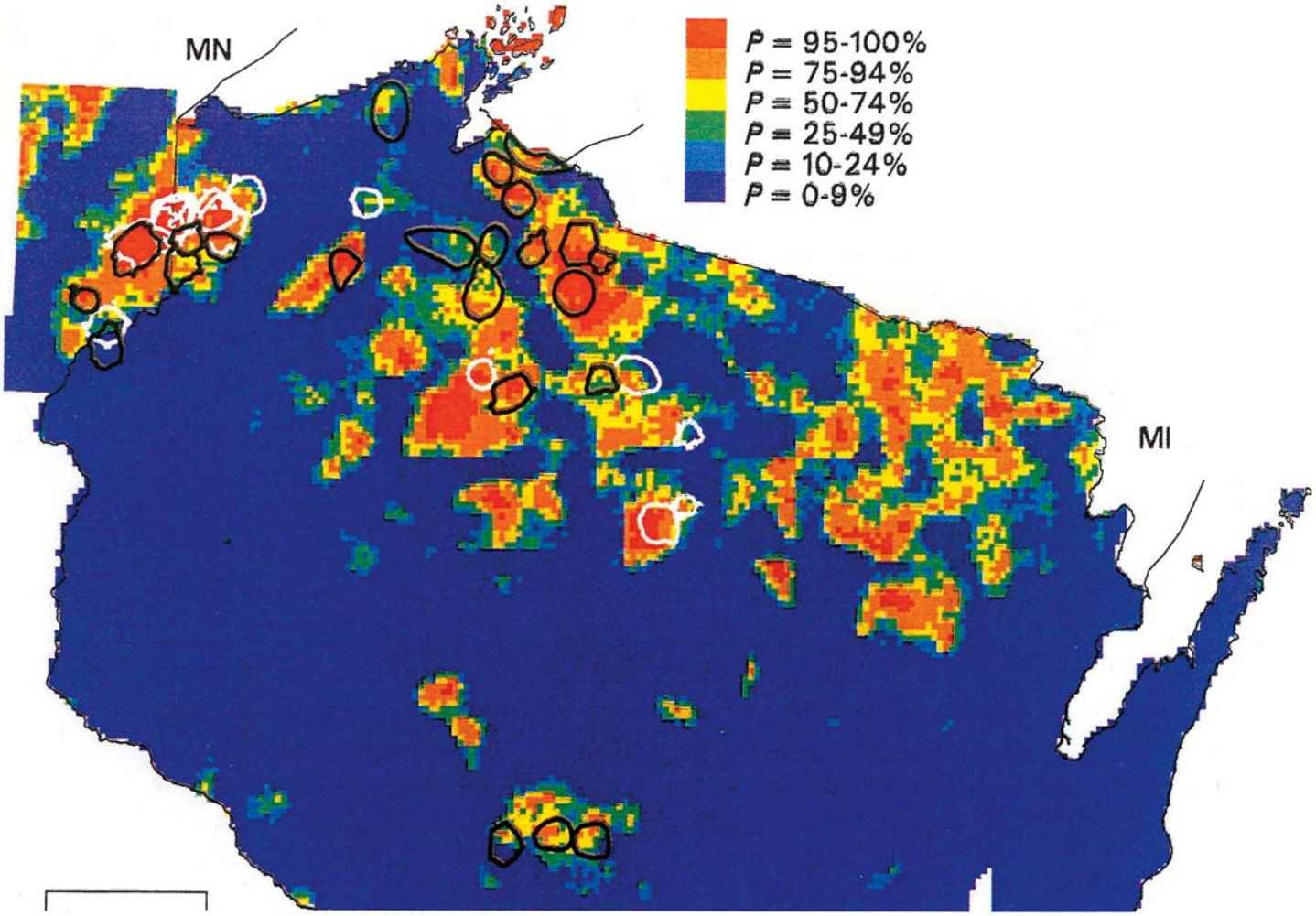

Figure 2. Map of putative wolf-favorability classes in northern Wisconsin, USA, including wolf-pack territories used in creating the model (white boundaries) and territories originating from 1993 to 1996 (Mladenoff et al. 1999).

wolves could result in considerable conflict with humans if not restricted by management to wild lands.

These findings also caution that 1) other models of putative wolf habitat suitability that fail to consider the adaptability of wolves and attempt to draw inferences from areas of artificially induced wolf-range restrictions may also be similarly flawed, and 2) wolf-range projections in wolf management plans, such as those in Michigan (Michigan Department of Natural Resources 1997) and Wisconsin (Wisconsin Department of Natural Resources 1999) that are based on unrealistic assumptions of the Mladenoff et al. (1995, 1997, 1999) model, should be reconsidered.

Table 1. Distribution of 101 new Wisconsin, USA, wolf-pack territories, 1997–2004 (Wydeven and Wiedenhoeft 2004), in relation to putative habitat-suitability classes as modeled by Mladenoff et al. (1995, 1997, 1999).

Putative suitability probability (%)	New territories			
	All		Radiotelemetry-based only	
	No.	%	No.	%
95–100	9	9	7	13
75–94	18	18	9	17
50–74	14	14	9	17
25–49	20	20	6	11
10–24	18	18	9	17
0–9	22	22	14	26

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ERRATUM

Mech, L. D. 2006. Prediction Failure of a Wolf Landscape Model. Wildlife Society Bulletin 34:874–877.

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Figure 1 in this article was incorrectly labeled. The title in Mech (2006) was

Figure 1. Wolf-pack territories formed in Wisconsin, USA, 1997–2004 (Wydeven and Wiedenhoeft 2004).

The correct title should have been

Figure 1. Wolf territories known to be present in Wisconsin, USA, in winter 2003–2004 (Wydeven and Wiedenhoeft 2004).

The map includes some territories that have been present since the 1970s, and some of the territories that appeared since 1997 had disappeared by winter 2003–2004. The full report where the figure originated is available at <http://dnr.wi.gov/org/land/er/publications/reports/WERR%20Timber%20Wolf/WERR_Status_of_Timber_Wolf_03-04.htm>.

WSB apologizes to the authors for this error.