

FEASIBILITY OF WOLF REINTRODUCTION TO NOVA SCOTIA: PUBLIC OPINIONS ON WOLVES AND THEIR MANAGEMENT IN LIGHT OF THE ECOLOGICAL POTENTIAL FOR WOLF RECOVERY

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ABSTRACT

This study investigated the ecological and social potential for wolf (*Canis* spp.) recovery in Nova Scotia, Canada. Reintroduction potential was considered through a GIS-based analysis of land cover, human population density, land ownership, prey density, and road density. Two disconnected areas of adequate habitat for wolves were identified. Qualitative interviews were conducted with seven identified groups on public attitudes towards the wolf and its potential recovery in the province. Opinions ranged from 'love' to a strong dislike of wolves, and many interviewees associated wolves with fear and expressed concern that they would come into contact with wolves on or near their properties. It would likely not be advisable to introduce an active wolf reintroduction program in NS at this time, due to the absence of effective habitat connectivity between the two identified areas of suitable habitat, and the public unease about wolf proximity. However, a proactive public education initiative is recommended in case of future reintroductions or natural immigrations of wolves and other top carnivores from nearby populations.

Key Words: *Canis* spp.; eastern wolf; rewilding; Maritime Provinces

INTRODUCTION

For the past few decades there has been growing interest in restoring wolves (*Canis* spp.) to portions of their historical range where sufficient habitat to maintain viable wolf populations exists (Fritts *et al.* 1995, Breitenmoser *et al.* 2001, Noss 2001, Nilsen *et al.* 2007, Licht *et al.* 2010). This has resulted in efforts in the United States which have allowed wolves to become re-established in some areas from which they were originally extirpated due to natural and human-induced loss (Boyd *et al.* 1995, Fritts *et al.* 1995, Mech 1995, Bangs

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and Fritts 1996, Bangs *et al.* 1998, Parsons 1998, Paquet *et al.* 2001, Phillips *et al.* 2003).

While Canada does not have plans for wolf restoration to any of its provinces, wolf repopulations occurring in the northeastern United States would likely result in dispersal to and subsequently colonization of New Brunswick (Harrison and Chapin 1997, Harrison and Chapin 1998, Wydeven *et al.* 1998, Larivière *et al.* 2000, Carroll 2003, Carroll 2005). There is also the potential for wolf dispersal into New Brunswick from source populations in Québec (Harrison and Chapin 1997, Harrison and Chapin 1998, Carroll 2003). A wolf was shot and killed in New Brunswick in 2012, the first wild-origin wolf recorded in the province since 1862 and the second wolf to be found south of the St. Lawrence River since wolves were extirpated from the region (McAlpine *et al.* 2015). If wolves were to re-establish in New Brunswick, it is probable that they would disperse into Nova Scotia, as was the case with the eastern coyote (*C. latrans*) (Moore and Parker 1992).

Wolves hold a powerful presence in the human psyche (Lopez 1978, Kellert 1986), resulting in strong and diverse public attitudes towards the animal (Nie 2001, Fritts *et al.* 2003, Nie 2003). Wolf management and reestablishment are contentious issues (Bath and Buchanan 1987, Kellert *et al.* 1996, Mech 2000, Boitani 2003), typically polarized by heightened emotions (Hoffos 1987, Nie 2003). Even in areas where there is ample wolf habitat, people's attitudes still become an important variable in recovery decisions (Bath and Buchanan 1987), as human-caused mortality is one of the leading causes of death in wolf populations (Ballard *et al.* 1987, Tucker and Pletscher 1989, Forbes and Theberge 1996, Larivière *et al.* 2000). While the attitudes of some Maritime residents towards wolves and wolf recovery have been explored (Lohr and Ballard 1996), and some public attitudes in Nova Scotia regarding predators have been examined (Marlin 2003, Weiss Reid 2003, Weiss Reid and Beazley 2004), no study specific to wolves in Nova Scotia has been undertaken. As the "success of [wolf] recovery efforts hinge, to a large degree, on the support and acceptance... by the public" (United States Fish and Wildlife Service 1987 p. 31), public attitudes are a crucial component of any reintroduction process (Thiel and Valen 1995).

Historically, the wolf species that inhabited eastern Canada and the northeastern United States was known as the eastern wolf (*Canis lycaon*), formerly the subspecies *C. lupus lycaon* (Nowak 1983, Nowak

1995, Environment Canada 2015). The current taxonomic designation for eastern wolves is controversial due to hybridization with gray wolves (*Canis lupus*) and coyotes (Way *et al.* 2010, Wheeldon *et al.* 2010). While there was also some debate over even the existence of a Nova Scotian wolf population (Ganong 1908, Dodds *et al.* no date), a recent paper demonstrated historical evidence for a persistent wolf population in Nova Scotia up until the early 20th century (Whitaker 2006, Whitaker and Beazley [in review]). In this study, we investigate the possibility of a future Nova Scotian wolf population from social and ecological standpoints. We first establish that there are ecological grounds for considering wolf reintroduction through a GIS habitat suitability model. As wolf populations in North America have been tied to public opinion for the last four centuries, our primary focus was qualitative research to explore attitudes and opinions that Nova Scotia residents have towards the wolf and its possible recovery in the province.

METHODS

Determining potential habitat for wolves

The development of a GIS habitat suitability model for wolves in Nova Scotia was based on five landscape criteria: land cover, human population density, land ownership, prey density (moose and deer), and road density (see Whitaker 2006 for model details). These variables characterize areas inhabited by viable wolf populations, and have been used to identify wolf habitat in northeastern United States (Harrison and Chapin 1997, Harrison and Chapin 1998, Mladenoff and Sickley 1998, Paquet *et al.* 2001). Two separate scenarios were considered, based on different thresholds of road density when determining suitable territory (<0.45 or <0.6 km/km²) and dispersal corridors (<0.7 km/km² or no road density parameter). The model was created using ArcGIS 8.3 Spatial Analysis software (Environmental Systems Research Institute 2003). As population dynamics were not considered in the evaluation of habitat, the resulting model provides a static portrait of potential wolf habitat in Nova Scotia.

Determining public perception of wolf reintroduction

Person-to-person semi-structured qualitative interviews were conducted with respondents who fell into one of seven identified groups: hunters, farmers, environmentalists, wildlife managers, students,

professionals, and retirees. Hunters, farmers, environmentalists, and wildlife managers were chosen as groups of individuals that may have strong preconceptions regarding wolves and their recovery/reintroduction. Students, professionals, and retirees were targeted to ensure inclusion of diverse views and different age classes. Four participants from each category were interviewed, with the exception of the farmer group, wherein five people were interviewed.

Individuals were recruited using a 'snowball' technique, where initial contacts helped identify other relevant participants (Patton 1990, Babbie 1998, Merriam 2001, Warren 2001). A total of 29 participants were interviewed for 25 to 60 minutes. Interviewees were 38% female and 62% male; 8 interviewees lived in rural areas, while 19 lived in the Halifax area and two lived in other towns in the province.

Data analysis followed Creswell (1994, 1998): (1) interview transcripts were read to obtain a sense of the data; ideas or reflections were noted; (2) each transcript was then carefully read and thoughts were recorded on the substance and themes of the interview; (3) themes were documented and clustered together, as transcripts were re-read; (4) themes were grouped into categories, and relationships between themes were explored; and, (5) narrative was written describing the themes and inter-relationships within and among them.

Limitations

The methods used in participant selection resulted in 65% of the interviewees being from the Halifax/Dartmouth area. Only 1/3 of the participants were from outside the province's major urban population and thus 'urban attitudes' could be overrepresented. The selection lacked gender equality, as male perspectives predominated, and cultural perspectives were not considered. In particular, the absence of First Nations people within this study was a strong limitation, as their cultural history provides evidence for the historical occurrence of wolves within the province and they would need to be consulted in any active reintroduction efforts.

RESULTS

Habitat suitability model

Only two areas of suitable habitat met the minimum size threshold required to support a viable population of wolves (Fig 1). In the

Potential wolf habitat in Nova Scotia

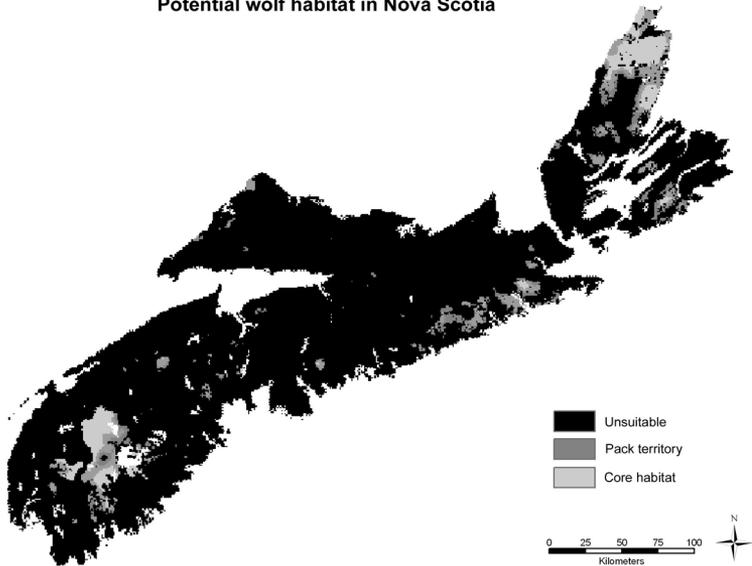


Fig 1 Map of potential wolf habitat (core and pack territory) in Nova Scotia. Both pack territory scenarios are shown in the darker grey.

northern end of the province, Cape Breton Highlands National Park and surrounding lands comprised 691 km² of core habitat; in the south-west region, Kejimikujik National Park and National Historic Site, the Tobeatic Wilderness Area, and surrounding lands provided 458 km² of core habitat. Supplementary habitat abutting these core habitat areas provided for a total of 1776 km² of potential wolf habitat in the Cape Breton Highlands area, and 1155 km² in the Kejimikujik region. Other areas of suitable quality of habitat were located across the province, but due to their small size and highly fragmented and isolated nature, they were not considered to be effective for wolf viability and thus not included.

With the two areas of suitable wolf habitat located at opposite ends of the province, the feasibility of habitat connectivity between them was considered in two scenarios. Following Harrison and Chapin (1997, 1998), two scenarios were run, modeling: (1) habitat suitability with a road density <math><0.7 \text{ km/km}^2</math>; and (2) habitat suitability with the road density parameter removed (Fig 2). The first scenario identified extensive connectivity in the southern part of the province, but high

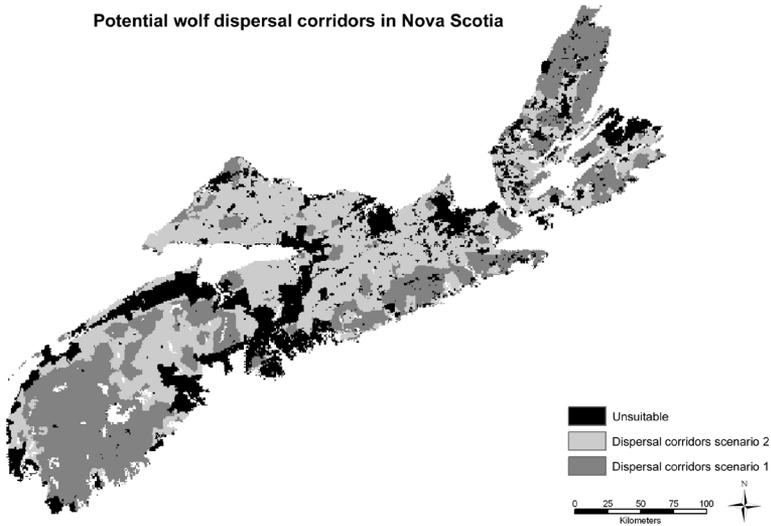


Fig 2 Map of potential wolf dispersal corridors in Nova Scotia. Darker grey dispersal corridor habitat includes road density restriction of $< 0.70\text{km}/\text{km}^2$. Lighter grey connectivity habitat has no limit on road density.

levels of fragmentation beyond. The second analysis found Cape Breton Island and the upper mainland of the province to be highly connected, but revealed a potentially restrictive belt across the middle of mainland Nova Scotia, severing any possible sustained connectivity between the northern and southern areas.

In other reintroduction studies (Harrison and Chapin 1997, Harrison and Chapin 1998, Paquet *et al.* 1999, Paquet *et al.* 2001), the average wolf population density was determined to be from 1.0 to 4.0 wolves/100 km² based on wolf densities documented across North America by Ballard *et al.* (1987). Following this density approximation, the possible wolf population supportable in the Cape Breton Highlands and surrounding areas would be from 18 to 72 animals, while in Kejimikujik and the adjacent Tobeatic Wilderness Area, the population could range between 12 and 46. Thus the total provincial wolf population would be 30 to 120 animals. This potential population size could be considered small; however, wolf populations are known to be self-sustaining with a total population size fluctuating between 40 to 120 individuals (Fritts and Carbyn 1995), and in the case of Isle Royale, fewer than 50 individuals (Boitani 2003).

Carroll (2003) also identified areas of potential habitat for large carnivores such as wolves. In Nova Scotia, these were concentrated in the southwest and northeast portions of the province. Additionally, spatially-explicit population models predicted a potential for wolf re-colonization into Nova Scotia via Maine, New Brunswick and the Chignecto Isthmus (Carroll 2005). Thus, the successful re-establishment of wolves in the province would be largely related to social tolerance rather than habitat availability.

Public perceptions of wolf recovery

Participants displayed a broad range of opinions and attitudes towards wolves and their recovery in Nova Scotia (Table 1). At one end of the spectrum, respondents liked wolves and approved of the idea of wolf recovery, while on the other end, participants were averse to both the animal and its potential reestablishment. Despite the differences in opinions, three major themes emerged from the interviews: fascination and fear of the wolf, as well as questions concerning the wolf's physical ability to inhabit the province. These themes suggest that though many of the participants find wolves captivating on some level, attitudes around actual reestablishment are hesitant at best due to concerns over fear and limited space.

DISCUSSION

While this study found two suitable habitat areas for wolves in Nova Scotia, these regions are located at opposite ends of the province. Connectivity between them would be compromised by human activity and infrastructure. The shortest straight-line distance between Kejimikujik and the Cape Breton Highlands is approximately 450 km, and during any dispersal wolves would have to contend with human barriers such as 4-lane highways and extensive farmlands. Wolves are capable of dispersing long distances, in some instances travelling over 800 km in a straight line from their original territory (Fritts 1983, Boyd *et al.* 1995). However, dispersing wolves characteristically suffer from higher mortality rates than do resident pack members (Peterson *et al.* 1984), and in non-forested or high road-density areas, dispersing wolves are extremely vulnerable to human presence (Licht and Fritts 1994). Because of the perceived limited amount of wilderness, participants noted that the wolf may come into contact with humans or their property. Overall, the recognition that wolves could actually

Table 1 Summary of themes from interviews with individuals from seven identified groups (hunters, farmers, environmentalists, wildlife managers, students, professionals, retirees) on wolves and their potential reintroduction to Nova Scotia. Quotes are distributed as evenly as possible among respondents (R) while still capturing the full range of themes.

Topic	Example quotes
Wolves	<p>“I think the wolf actually is pretty amazing” (R-4)</p> <p>“most of the people in the farming community... would be shocked to think that I like wolves” (R-23)</p> <p>“one of the most evocative creatures in all of nature” (R-25)</p>
Symbolism	<p>“a classic image of Canadian wilderness” (R-19)</p>
Negative associations	<p>“I look upon it as vermin from the farmer’s point of view... [and] from a personal point of view I don’t think I’d want to be out in the woods or in the country with them around” (R-15)</p>
Support for reintroduction	<p>“if it was natural, then it is just a part of the circle of life” (R-3)</p> <p>“[t]here’d be something healthy about [natural] restoration,... [it would] further reinforce that it’s part of the system here and it ought to be” (R-27)</p> <p>“if it will help our ecosystem... if it will help, then yes, they should be here. If we’re losing something by them not being here or maybe being overrun by something by them not being here, maybe that would be a good thing to bring them back” (R-5)</p>
Historical grounds	<p>“if it was something that was from here originally, I think it should be back” (R-16)</p> <p>“if it can be proven that it was part of the natural ecosystem prior to the arrival of Europeans or while the Europeans were here, I would be in favour of seeing the wolf reintroduced” (R-26)</p>
Prey and habitat availability	<p>“We could argue that we have a moral obligation to bring them back... but at the same time, it is just a matter of what do we really have to mess with nature” (R-19)</p> <p>“Nova Scotia doesn’t have a wildlife population big enough to sustain any large predator population, be it cougar, wildcat... wolf” (R-20)</p> <p>“it would [not] be fair to the wolves, to be honest with you... I don’t think there’s enough natural habitat for them” (R-21)</p>
Opposition to reintroduction	<p>“I would be quite happy to not have wolves in Nova Scotia... [and] I could not think of any reason why we would want to have wolves [here]” (R-7)</p> <p>“[any] government sanctioned or led venture like this is going to be hated doubly and the wolves would be annihilated even faster... [because] people need to be a part of the process in making these decisions” (R-6)</p>

Table 1 Cont'd

Topic	Example quotes
Wolf recovery (cont.)	
Urban vs. rural support	<p>“playing with the natural balance of things” (R-30)</p> <p>“all kinds of environmental issues and so on usually come out of cities. So this would be coming out of cities, too” (R-17)</p>
Hunting and land use restrictions	<p>“maybe [urbanites are] environmentally conscious from the educationally point of view... [but] they don't have the same understanding that the rural people would have if the wolves were introduced” (R-12)</p> <p>“[for] people in the country who farm... the wolf is a real pain in the ass” (R-14)</p> <p>“I eat deer, personally, that's my main source of meat but if I have to give it up for wolves, I am perfectly fine with that” (R-23)</p>
Perceived ecosystem impacts	<p>“if you have to regulate man out of the picture, then all you're going to do is turn the wolf into a bad guy” (R-21)</p> <p>“[I] would have to go against [any restrictions]” (R-10)</p> <p>“I think it would add a piece that we're missing. I wouldn't say beautify, but only enrich our diverse ecosystem” (R-22)</p>
Perceived economic impacts	<p>“could be another stress on an already endangered moose population” (R-19)</p> <p>“[could] prevent moose populations from altering habitat to its own detriment” (R-26)</p> <p>“maybe Nova Scotia has adjusted to not having them” (R-12)</p> <p>“improve ecotourism and that kind of stuff” (R-21)</p> <p>“decrease our game... [so] we wouldn't be able to go out and enjoy our hunting experiences” (R-2)</p>
Perceived threats to human safety	<p>“that puts sort of a price tag on the wolf, you know we're going to bring them in 'cause we're going to make more bucks. But what does that do to the wolf” (R-8)</p> <p>“this province is still quite rural when you get out and about.... So, you've got kids waiting for a bus at the end of a long lane on their own: that could be a threat” (R-15)</p> <p>“even if there was just one incident, to me, that would be one too many” (R-7)</p>
Perceived threats to wolf safety	<p>“very, very few recorded wolf attacks on human beings” (R-21)</p> <p>“I've got a neighbour... [and] he has a hate on for coyotes. And he would have a bigger hate on for wolves” (R-6)</p> <p>“as with the coyote: see'em, shoot'em” (R-20)</p>

Table 1 Cont'd

Topic	Example quotes
<p>Wolf recovery (cont.)</p> <p>Time and public education</p>	<p>“if I had a rural property... [and] wolves were constantly around, I think that I would probably purchase a gun and be willing to do that if necessary” (R-27)</p> <p>“you are afraid of what you don’t know, so if you knew more about... [wolves] you wouldn’t be so afraid of them or in general” (R-1)</p> <p>“over time... [people] would realize it’s like having bears around; there wouldn’t be any real concerns” (R-19)</p>

be near their homes made the participants cautious. “If they decided to take that part of land out there and put twenty wolves on it, I think I might not like that” (R-5), commented one respondent. Another participant observed that, “I would prefer to have them in an area not near my home... if that was a choice” (R-27).

In a study on public attitudes toward wildlife management, Reiter *et al.* (1999) found that one of the main concerns is a compromise of human safety by animals. This concern was echoed in a recent investigation into public attitudes towards wildlife in Nova Scotia, which found that many participants were fearful of the perceived threat to safety posed by the endemic predators of the province (Weiss Reid 2003, Weiss Reid and Beazley 2004). Fear is considered to be a significant factor in motivating people to oppose wolf restoration (Hutt and Grooms 2000) and in impairing willingness to introduce wolves to an area (Lohr *et al.* 1996). Fear greatly contributes to a ‘not in my backyard’ (NIMBY) attitude (Edelstein 1988 in La Vine 1995), the characteristics of which many participants of this study unconsciously expressed in their concerns over safety. This fear could be a strong negative factor if restoration in Nova Scotia became a reality and would perhaps override, or at the very least conflict with, any positive attitudes the respondents were feeling.

As wolves move through semi-agricultural areas, conflicts with human interests become inevitable (Mech 1995). All of the participants in this study believed that wolves would be shot if they wandered onto private property. This stance is comparable to the findings in Weiss Reid (2003), where some participants believed that the rights of wildlife in Nova Scotia “were limited to wild or protected areas and not in human communities” (p. 125). As restoration in the province is contingent on wolves successfully dispersing hundreds of kilometres over private property, these results suggest that the current social context in Nova Scotia may not be favourable to wolf recovery. However, if given a degree of protection from persecution, it is possible that wolves would be able to persist in and disperse through a human disturbed landscape like Nova Scotia (Licht and Fritts 1994, Haight *et al.* 1998, Merrill and Mech 2000). Awareness and educational programs (as suggested by some respondents) could play an important initial part in any restoration program to discourage attitudes of fear and hostility towards the wolf (Kellert 1986, Kellert 1991).

Conclusion

While wolves were undoubtedly once part of Nova Scotia's ecosystems (Whitaker 2006, Whitaker and Beazley [in review]), the landscape from which they were extirpated has changed. The once contiguous forested landscape has become a patchwork of civilization, and some of the formerly abundant prey species have disappeared or are in decline. Despite this environmental transformation, this study has shown that wolves could survive and possibly thrive in two core habitat areas that meet two fundamental requirements for a wolf population to exist: security cover/distance from humans and a sufficient prey base. These core habitat areas have the ability to support a small number of wolves, though without clear habitat connectivity between these core areas, the viability of these populations could be of concern.

As wolves were being extirpated in the early 1900s, coyotes were expanding into the eastern portion of North America. Eastern coyotes have been abundant in the Maritime provinces since the 1960s (Forbes *et al.* 2010). As they expanded their range, genetic introgression suggests there was interbreeding and hybridization between coyotes and eastern wolves (Rutledge *et al.* 2010, Way *et al.* 2010, Wheeldon *et al.* 2013). Some researchers have proposed renaming the current coyote in eastern North America a 'coywolf' to reflect its hybrid origin (Way *et al.* 2010, Way 2013). Despite this genetic introgression, eastern wolves and coyotes remain morphologically, genotypically, and ecologically distinct (Benson *et al.* 2012, Wheeldon and Patterson 2012).

Wolf reintroduction efforts would be complicated by the difficulty in jointly or separately managing canid populations (Wheeldon and Patterson 2012), and by the potential for hybridization between any reintroduced wolves and coyotes. For that reason, some researchers have proposed using gray wolves from the Great Lakes area in eastern reintroduction plans, as there are no recorded hybridizations between the two canid groups (Way *et al.* 2010, Wheeldon and Patterson 2012). Additionally, gray wolves are presumed to be sufficiently morphologically distinct to be almost always correctly differentiated by hunters in the field (Wheeldon and Patterson 2012).

While there are no existing plans to reintroduce the wolf to Nova Scotia, there is a small possibility that individuals could disperse from populations in Ontario and Québec, or from future reintroductions nearby (Carroll 2003, 2005, McAlpine *et al.* 2015). Nova Scotia could

be proactive in devising a wolf management plan for the province based on this possibility. Public attitudes and opinions on wolves and their recovery within the province should be further explored, particularly among residents surrounding the two potential wolf core areas. Additionally, this study did not engage with the Mi'kmaq First Nation, though wolves are part of their cultural history and traditions. First Nations have the right to help determine the management of entities of spiritual and cultural significance, and may have unique perspectives on wolves and their restoration to the province. If wolf recovery seems imminent, the province could implement a public education program. If educational measures are initiated to help people understand wolf/large carnivore behaviour and how to react in human/large carnivore interactions, potential fears and conflicts could be avoided (Reading and Clark 1996).

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