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Habituation threatening the reintroduction of wolves

Key words: Wolf, Lynx, Bear, *Canis lupus*, habituation

Abstract

Wolf recovery is widely considered one of the most successful wildlife restoration efforts of the last century. The shy and cautious wolf proved to be more adaptable than previously expected, and a strong comeback has been seen all over Europe. However, the success story is challenged by wolves' habituation to humans. Today, wolves often live in densely populated areas in close proximity to humans; this, in turn, has resulted in a strong habituation to humans and a growing number of attacks against not only livestock but especially hunting dogs under cover of darkness as well as during dawn, dusk, and night. The appearance of wolves in settled areas in broad daylight seems to be the rule rather than the exception, and there is no evidence supporting a change in wolves' behavior.

In this paper, we evaluate the situation in Finland and suggest that wolves' behavior is a question of habituation rather than an issue of classical conditioning. We also show that habituation is far from what can be called "normal behavior." To revert the ongoing habituation, we suggest allowing the euthanizing of wolves approaching human settlements as an alternative to random culling.

Introduction

When wolves are not hunted, they become bold and enter villages – even towns – searching for food. The phenomenon of wolves dwelling in settled landscapes has been known since ancient times.

In July 1421, wolves came into Paris. They were starving and discovered an easy source of food: the bodies of recently buried people in villages and fields. When Louis XI came to the throne in 1461, wolves still posed a threat to humans in the region of Paris. In 1461, 227 wolves were officially killed in Paris in barely six months: 157 healthy adults, a rabid female, 64 male cubs, and 5 female cubs (Moriceau 2007).

In the 1870s, they roamed the streets of large cities in the regions of Kazan, Voronezh, and Tver, grabbing dogs on the streets and attacking people (Granlund & Graves 2019).

Wolves were also in Moscow and St. Petersburg, and at the beginning of the nineteenth century, wolf packs even inhabited the outskirts of Petersburg, the capital of the Russian Empire (Graves 2007). Oriani and Comincini also report wolf attacks in Milan during the 1800s (2002).

Similar observations from the 21st century are reported in Canada, where wolves attack in

Northern Saskatchewan as they lose their fear of humans (nationalpost.com 2016).
The wolf is cautious, but this caution is not reasonable self-preservation as with the fox, which is never lost in moments of danger. Instead, the wolf's cautiousness is cowardice (Sabaneev 1876). The cowardice can be explained, and especially in summer, this fear is purely instinctive. At this time of year, the wolf does not attack dogs, foxes, or other animals that can wound it. Due to the inflexibility of its cervical and spinal vertebrae, it is unable to lick wounds on its back and sides, and in the summer, the slightest scratch in these parts of its body bleeds for a long time, easily becoming infected (Granlund & Graves 2019).
However, strong hunger supersedes the wolf's cowardice, and in such situations, wolves lose their instinctive fear of humans and kill dogs, cats, geese, sheep, goats, and large livestock right under the noses of humans.
In late autumn and early winter, wolves live a nomadic and more active lifestyle, and they lie down at daybreak wherever they are. At this time of year, the pack hunts together and may be observed close to human settlements (Sabaneev 1876; Heptner & Naumov 1967).
Later in the winter, before the beginning of the rut, the wolf pack dissolves. Adults disperse first, then yearlings, and finally juvenile wolves. They reunite later, but the young do not approach the adults and lie separately. During this time, the pack is scattered in small groups around its territory (Heptner & Naumov 1967). The wolves do not rejoin the pack until the end of the summer, when the whole family starts its nomad life (Granlund & Graves 2019).
After the dispersal, some yearlings may appear in human settlements simply because they lack their parents' guidance. As long as the pups are in the den, the parents do not hunt in the immediate neighborhood, but they go out to the farthest parts of their hunting region. This may also cause confrontations between lonely adult wolves and humans.
In August, the circle closes as the pack joins together and juveniles start hunting with the rest of the pack. From this time on until the first snow appears, the proximity of a wolf pack is manifested by its attacks on livestock and village dogs (Khudyakov 1937).
We will later show that the wolves' annual life cycle correlates with visual observations close to and within human settlements.

Habituation vs. conditioning

Traditional learning can be divided into associative learning (conditioning), and non-associative learning (habituation).
In animal behavior, associative learning is any process in which a response becomes associated with a particular stimulus. A famous example was Ivan Pavlov's use of dogs in which he demonstrated that the ringing of a bell signifies that a reward is coming.
Non-associative learning (habituation) is not paired with another stimulus; instead, it is a change in response to a stimulus that does not involve being associated with another stimulus such as a reward or punishment. Habituation is a case where an innate response to a stimulus decreases after repeated presentations of that stimulus, which is no longer biologically relevant. An example of habituation is when wild animals habituate to repeated noises from cars and forest harvesters, and therefore, they learn that the proximity of these things has no consequences.

Material and methods

The Finnish Wildlife Agency (http://riista.fi/) maintains a database, which, among other things, holds observations of large carnivores per municipality. Its information includes observation ID, date, time, age, pawprint size, house yard observations, distance to human settlements, and the observed number of carnivores. Data are collected and verified by a countrywide organization of well-trained hunters and trackers.
The sizes of the Finnish wolf, lynx, and bear populations are based upon annual population reports released by the Natural Resources Institute Finland (Luke 2018). Further information about the Institute is found at its website, https://www.luke.fi/en/.
We use information collected about wolves, lynxes, and bears and concentrate this study on

visual observations in the proximity of human settlements (< 150 meters). The statistics used in this report cover the period from January 1, 2012, to December 31, 2018.
Our study is limited to visual observations and game camera photos because the use of all observations including tracks would distort the result due to the difficulty of tracking in summer.

Wolves are habituating to humans

All observations between January 1, 2012, and December 31, 2018, show a grand total of 73,982 adult wolves and 5,102 young wolves. This number includes visually observed wolves, wolf tracks, and wolves at all distances from human settlements.
By limiting this study to visual observations, the observations are reduced to what is shown in Figure 1.
This chart presents the number of observations as well as the size of the Finnish wolf population. From 2014 to 2016, there is a significant increase in observations close to human settlements, and they remain at a constant level. If the visual observations of wolves are extended to 500 meters from human settlements, the increasing trend continues without any significant changes in the wolf population.
In 2015, the Finnish Ministry of Agriculture and Forestry allowed the culling of 17 wolves. The number was increased to 43 wolves in 2016 (MAF Finland 2017). In 2017, the ministry allowed the further culling of 40 wolves. This permit differed from earlier permits as it included all culled wolves without limiting hunting to the winter hunting season, but it also included wolves to be killed for other legal reasons, such as those mentioned in the EU Council Directive 92/43/EEC, article 16 (EU 1992).
The smoothing curve in Figure 1 suggests that the wolf culling in 2015, 2016, and 2017 had an impact on wolves' behavior as far as human proximity is concerned. This may indicate that wolves' habituation to humans may be reverted with changes in wolves' protection. This issue will be discussed later.
"We know that if humans can be linked to something that predators fear innately and that they cannot habituate to, then predators will avoid humans and their habitations" (Geist 2016).

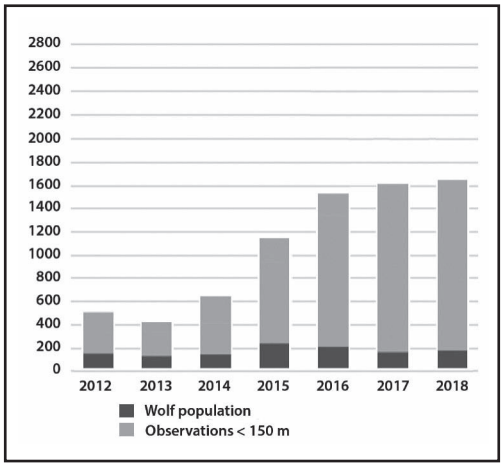

Figure 1 Wolf observations, 2012–2018.

The Contradiction

Both lynx (*Lynx lynx*) and brown bear (*Ursus arctos*) populations are greater than the Finnish wolf population in order of magnitude, and they inhabit the same areas as wolves. The size of the current Finnish wolf population is estimated by the Natural Resources Institute Finland to be between 165 and 190 wolves (Luke 2019). The institute estimates the lynx population to be between 1865 and 1990 animals and the brown bear population to be between 1710 and 1840.
The behaviors of the lynx and brown bear, as far as human settlements are concerned, differs significantly from wolves' behavior. Figure 2 is collected from lynxes' statistics, and this chart

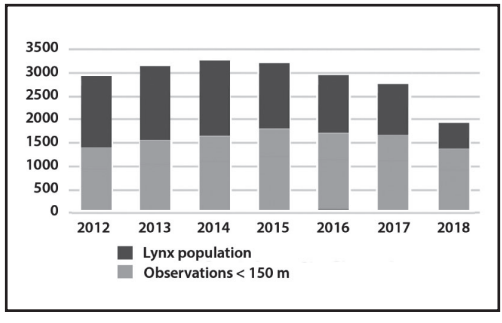

Figure 2 Lynx observations, 2012–2018.

gives a different view from what we observed in Figure 1.

Figure 2 shows the lynx population compared to visual observations within a 150 m range from human settlements. On average, a lynx visits house yards every second year.

However, as the population declines toward 2018, the number of observations tends to remain slightly higher compared to the population. In 2018, three of four animals visited house yards, which suggests that some habituation may happen within the lynx population.

We know that lynxes only extend their territories, thus differing from wolves, which may abandon their territory and conquer a new one in a totally different region (EuroNatur 2019). If a lynx has established its territory in the proximity of human settlements, it is less dependent on wild prey and may appear in house yards looking for cats and dogs (Prof. Ilpo Kojola in Metsälehti 2015).

As far as habituation is concerned, the brown bear exhibits a similar pattern of behavior to the lynx. Figure 3 shows the relationship between the brown bear population and house yard visits. From this chart, we notice that an average of one-third of brown bears enters areas inhabited by humans. One exception is in 2015, when the visual observations were slightly more than half of the declining brown bear population.

There is, however, one difference between the brown bear and the wolf as well as the lynx. Its winter sleep lasts from November to March, and thus, there are no observations found during this interval.

Although the brown bear senses human odor over long distances, it also senses the odor of carcass and remnant food from trash bins. Its fear may therefore be superseded by the possibility of enjoying an easy and tasty dinner. This phenomenon is known worldwide. Yellowstone National Park instructs its visitors with the following (YNP 2019):

"Never feed bears. Bears that become de-pendent on human food may become aggressive toward people and have to be killed."

Similar instructions are issued by the Finnish authorities (Riistakeskus 2016).

House yard visits

Our statistics reveal details about wolves' visits close to human settlements. As a crepuscular animal, the wolf's behavior is characterized as active during dusk and dawn and sleeping during the day. The observations of 405 wolves from November 1968 through March 1989 in Minnesota, US showed the following percentages of daytime activity: sleeping, 34%; resting, 31%; traveling, 28%, feeding, 6%; other, 2% (Mech 1992).

Our study supports David Mech's studies to some extent, as shown in Figure 4. However, it seems that Finnish wolves exhibit more activity throughout the day, although there are two peaks, one from 6:00 to 11:00 and the other from 17:00 to midnight.

The statistics in Figure 4 are broken down into monthly averages in Appendix B. The charts in Appendix B suggest that wolves' activity starts

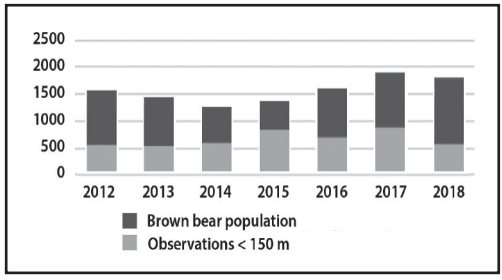

Figure 3 Brown bear observations, 2012–2018.

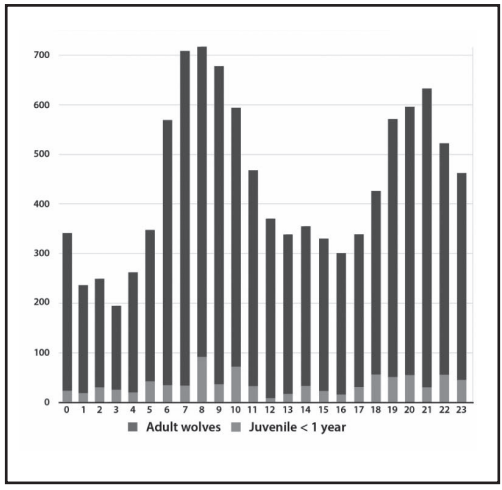

Figure 4 House yard visits: the diurnal cycle.

at dawn and continues for three to four hours, after which the majority of wolves rest until dusk. After sunset, their activity accelerates.

Theuerkauf et al. (2003) studied wolves' activity throughout the day in Poland, and their research supports our observations to some extent: wolves' activity peaked at dawn and dusk; they are crepuscular animals by definition. However, there is a significant difference between wolves in Poland and wolves in Finland. It seems as if the Finnish wolves start their activity after sunrise and not before as they do in Poland. Sabaneev (1876) suggests that wolves start their activity before sunrise, not after.

Wolves' activity close to human settlements follows their annual life cycle. This is observed in Figure 5, which shows that the wolves' visits are distributed over the calendar year. The wolf pack's nomad life starts in August and continues until December, and this is the period during which the observations reach their peak (Granlund & Graves 2019).

Observations put into perspective

To visualize the impact of wolves' habituation, we have normalized the observations with respect to the arithmetic mean of our lynx population. The use of the Finnish lynx population is motivated by the fact that this population in Finland is nearly twice as large as the bear population and more than ten times the wolf population.

The normalized graphs shown in Figure 6 do not leave any doubts. The graphs are based on the arithmetic mean of the lynx population from 2012 to 2018, which gives us 2,913 animals.

Wolf and brown bear observations are calculated using the equation:

normalized observations = $lm / a \times o_i$ where

i = year, from 2012 to 2018;

a = arithmetic mean value of population being calculated;

o_i = observations at year i;

lm = arithmetic mean value of lynx population.

After the wolf observations have been normalized in Figure 6, there are few doubts about the fact that wolves' behavior diverges from what can be considered as normal for wild animals.

As shown in Appendix A, Table 3, the wolf population has not changed significantly from 2012 to 2018, but the observations close to human settlements have experienced a dramatic change.

Normally, the wolf is cautious and only strong hunger can supersede its cowardice, but then it becomes bold and reckless (Sabaneev 1876).

Figure 6 debunks the old myth about the cautious wolf that avoids humans, and we suggest that the habituation is what separates wolves from brown bears and lynxes.

Wolves' habituation not only differs in the number of observations compared to the population but also in the continuously increasing trend. Figure 6 shows wolf observations < 500 meters

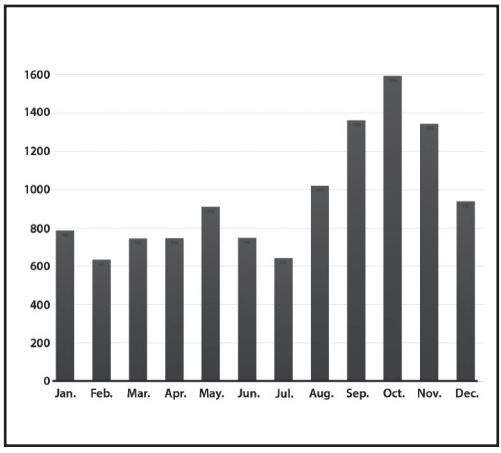

Figure 5 House yard visits: the annual cycle.

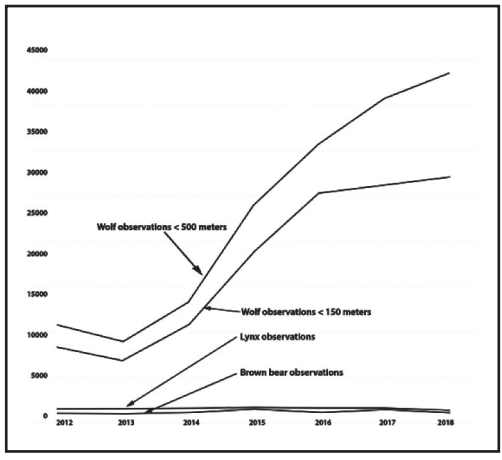

Figure 6 Normalized observations, 2012–2018.

from human settlements and house yards. This curve is not affected by the annual wolf culling between 2015 and 2017.
The type of behavior shown in Figure 6 can only be explained by wolves' accelerating habituation to humans.

Conclusion

Based on this research, we suggest that the accelerating habituation of the Finnish wolves is evidence of abnormal animal behavior.
Data from earlier centuries claim that wolves approach human settlements only as a result of starving and extreme hunger (Oriani and Comincini 2002; Moriceau 2007; Sabanneev 1876). This has not been observed throughout Finland. Instead in municipalities such as Pöytyä, the total number of wolf observations in house yards was 754 despite the fact that Pöytyä resides in the middle of Finland's highest white-tailed deer (*Odocoileus virginianus*) population. Thus, there is no reason to believe that hunger is the factor pulling wolves toward humans.
Also, the observations show a slight difference in the diurnal cycle, which supports our theory of wolves' behavior.
Our research reveals that wolves' behavior is only steps away from full domestication. Wolves dwelling within human settlements are more a rule than an exception. Although the wolf is a crepuscular animal and is supposed to be active before sunrise and after sunset, it appears in human settlements any time during the day.
The important issue is how to revert the ongoing habituation. We know that when dogs adopt a bad habit, it is extremely difficult to undo this habit.
Results from the wolf culling in Finland from 2015 to 2017 suggest that the wolves started to avoid contact with humans. They still dwell within the 500-meter limit, but the number of visits closer than 150 meters from human settlements has changed significantly.
We suggest that the European Union and member states experiencing wolves' habituation as a threat against human welfare and safety should evaluate the following proposal.
The interpretation of the Habitats Directive, Article 16.1, should be revised from what it is now (European Union 1992):
"Provided that there is no satisfactory alternative and the derogation is not detrimental to the maintenance of the populations of the species concerned at a favorable conservation status in ***their natural range****…"*
The EU defines the term "*favorable conservation status*" as (EU Commission 2016)
"*Population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component* ***of its natural habitats****…*."
This definition has a direct impact on wolf protection and is the keystone guiding the member states' interpretation of the Habitats Directive, Article 16.
We suggest that house yards and human settlements not be considered wolves' "***natural habitat,***" but the wolves should be considered outlaw animals when entering these areas.
This amendment to Article 16 would allow EU citizens to euthanize wolves without prior permission as soon as they enter human settlements or house yards.
The amendment would most probably return the shy and cautious wolf we want to see in the European wilderness while giving the rural population a fair possibility to legally protect their livelihood and livestock and allow children to play in the woods without fear of being harassed by wolves.
Whether the proximity of wolves imposes a threat to human safety is studied in other papers (Graves 2007; Granlund 2016; Granlund & Graves 2019).

Discussion

We may ask if this is the type of wildlife Europe wants to restore? Feral dogs are banned in most European countries due to the risks they impose on humans. It is known that the abundance of feral dogs is closely related to some of the diseases they spread in their environment.
As earlier mentioned, the observed behavior is far from what we could expect from a wild animal. It is difficult to find any historical evidence supporting this type of behavior among wolves.

Hunger and declining prey populations are known reasons, but there is no evidence showing a lack of prey animals in Finland.

Another reason may be the introgression of dog genes. Genetic research (Granlund & Graves 2019) revealed polymorphism in the agouti locus A among Finnish wolves, suggesting hybridization (Schmutz et al. 2007). The agouti a^y-allele is found among wolves in North Karelia, which may be descendants of feral dogs from Russia.

Empirical observations suggest that there is a larger introgression of dog genes. For instance, traits like white tail tips, white claws, pointed ears, and doggish posture all support hybridization. Unfortunately, morphological traits and behavior are superseded by genetic research and thus cannot be used as evidence.

However, introgression of dogs' genes may explain the wolves' behavior as far as their diurnal rhythm and frequent house yard visits are concerned.

Our proposal allowing the euthanization of wolves approaching human settlements could eliminate genetic traits supporting behavior atypical to wolves in the long run. We would expect some type of adaption, eventually forcing wolves to avoid human proximity.

If the ongoing habituation of European wolves is allowed to continue, it will probably end disastrously, with a partial or full eradication of the European wolf population once again.

"Those who cannot remember the past are condemned to repeat it" (George Santayana).

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Appendix A

Table 1 The Finnish lynx population and observations.

Year	Observations		Population, adults			Population, pups		
	Visual	Cam.	Min	Max	Average	Min	Max	Average
2012	1371	66	2340	2610	2475	449	536	493
2013	1474	119	2490	2770	2630	496	546	521
2014	1403	202	2740	2890	2815	487	541	514
2015	1510	227	2700	2795	2748	487	541	514
2016	1386	277	2490	2560	2525	433	469	451
2017	1274	362	2355	2495	2425	332	375	354
2018	1016	387	1865	1990	1928	N/A	N/A	N/A

Table 2 The Finnish brown bear population and observations.

Year	Observations		Population, adults			Population, pups		
	Visual	Cam.	Min	Max	Average	Min	Max	Average
2012	496	59	1330	1445	1388	143	168	156
2013	492	50	1255	1380	1318	132	156	144
2014	504	75	1140	1270	1205	134	160	147
2015	640	129	1155	1290	1223	163	187	175
2016	508	94	1380	1500	1440	187	216	202
2017	608	205	1600	1730	1665	201	232	217
2018	434	138	1710	1840	1775	N/A	N/A	N/A

Table 3 The Finnish wolf population and observations.

Year	Observations		Population, adults			Population, pups		
	Visual	Cam.	Min	Max	Average	Min	Max	Average
2012	743	512	150	160	155	N/A	N/A	N/A
2013	621	422	120	135	128	N/A	N/A	N/A
2014	914	666	140	155	148	N/A	N/A	N/A
2015	1668	1164	220	245	233	N/A	N/A	N/A
2016	2142	1565	200	235	218	N/A	N/A	N/A
2017	2487	1618	150	180	165	N/A	N/A	N/A
2018	2681	1675	165	190	178	N/A	N/A	N/A

Appendix B
Table 4 Diurnal wolf observations per month. The time from dusk to dawn is shadowed.