



Wolf attacks predict far-right voting

Bernhard Clemm von Hohenberg^{a,1} and Anselm Hager^b

Edited by Ruth DeFries, Columbia University, New York, NY; received February 8, 2022; accepted May 3, 2022

Does the return of large carnivores affect voting behavior? We study this question through the lens of wolf attacks on livestock. Sustained environmental conservation has allowed the wolf (*Canis lupus*) to make an impressive and unforeseen comeback across Central Europe in recent years. While lauded by conservationists, local residents often see the wolf as a threat to economic livelihoods, particularly those of farmers. As populists appear to exploit such sentiments, the wolf's reemergence is a plausible source for far-right voting behavior. To test this hypothesis, we collect fine-grained spatial data on wolf attacks and construct a municipality-level panel in Germany. Using difference-in-differences models, we find that wolf attacks are accompanied by a significant rise in far-right voting behavior, while the Green party, if anything, suffers electoral losses. We buttress this finding using local-level survey data, which confirms a link between wolf attacks and negative sentiment toward environmental protection. To explore potential mechanisms, we analyze Twitter posts, election manifestos, and Facebook ads to show that far-right politicians frame the wolf as a threat to economic livelihoods.

environmental conservation | human-wildlife relations | *Canis lupus* | political behavior | radical-right voting

To fight global warming and biodiversity loss, governments around the globe are implementing far-reaching conservation programs including the restoration of habitats and large-scale reforestation. While effective and necessary, such efforts also have redistributive consequences and may therefore generate political backlash. Although the complexities of human-wildlife conflicts are increasingly recognized (1), evidence on the political repercussions is still scarce. The growing success of radical far-right parties across Europe, which have an ambivalent or outright negative stance toward conservation, makes this a particularly pressing issue.

To explore the connection between wildlife conservation and voting behavior, we study the reemergence of the wolf in Germany. After the species had become extinct in much of Western Europe before or during the 20th century, conservation efforts have recently allowed the wolf to make an impressive comeback (2). While applauded by conservationists and the general public, this development is met with skepticism by those in proximity to emerging wolf populations (3). As wolves prey on livestock (see Fig. 1, *Left* for an over-time trend in Germany), one—debated—explanation for negative attitudes toward the wolf is economic threat (4, 5). Others interpret opposition to wolves as cultural resentment toward urban elites by those who identify with traditional ways of resource extraction (6).

How antiwolf sentiments play out electorally remains an open question. One recent study finds that support for a conservation ballot in the United States was lower in areas with wolf populations (7). Survey data suggest that US Republicans are more likely to hold antiwolf attitudes (8). In several European countries, right-wing populist parties cater to rural concerns about the wolf (9)—although scholars also note an increasing concern for biodiversity as well as a positive fascination with the wolf on the populist right (10, 11). To move this literature ahead, we assess whether wolf attacks predict voting for the far-right *Alternative für Deutschland* (AfD).

To explore the link between wolf attacks and far-right voting behavior, we assembled fine-grained data on wolf attacks across Germany at the municipality level since the 1990s. Our dataset comprises 14 of the 16 federal states (the remaining 2 did not provide data) and contains the time, place, and number of killed animals. As Fig. 1, *Right* illustrates, nearly 12% of municipalities have recorded attacks on livestock. We further collected data on municipality-level voting behavior in all federal, state, and municipal elections since 1990. Our primary outcome of interest is the vote share of the far-right AfD, but we also analyze votes for the proenvironmental Green party. Our empirical strategy is to compare communities with and without wolf attacks (i.e., the treatment) across time. We use two difference-in-differences-like estimators (*Materials and Methods*), both of which control for time-invariant confounders across municipalities as well as confounders that are constant across municipalities, but vary over time. Doing so allows us to control for a host of variables that may confound the relationship between wolf attacks

Author affiliations: ^aAmsterdam School of Communication Research, University of Amsterdam, 1012 WX Amsterdam, The Netherlands; and ^bInstitute of Social Sciences, Humboldt University, 10117 Berlin, Germany

Author contributions: B.C.v.H. and A.H. designed research, performed research, analyzed data, and wrote the paper.

The authors declare no competing interest.

Copyright © 2022 the Author(s). Published by PNAS. This open access article is distributed under [Creative Commons Attribution-NonCommercial-NoDerivatives License 4.0 \(CC BY-NC-ND\)](https://creativecommons.org/licenses/by-nc-nd/4.0/).

¹To whom correspondence may be addressed. Email: b.f.d.clemm@uva.nl.

Published July 18, 2022.

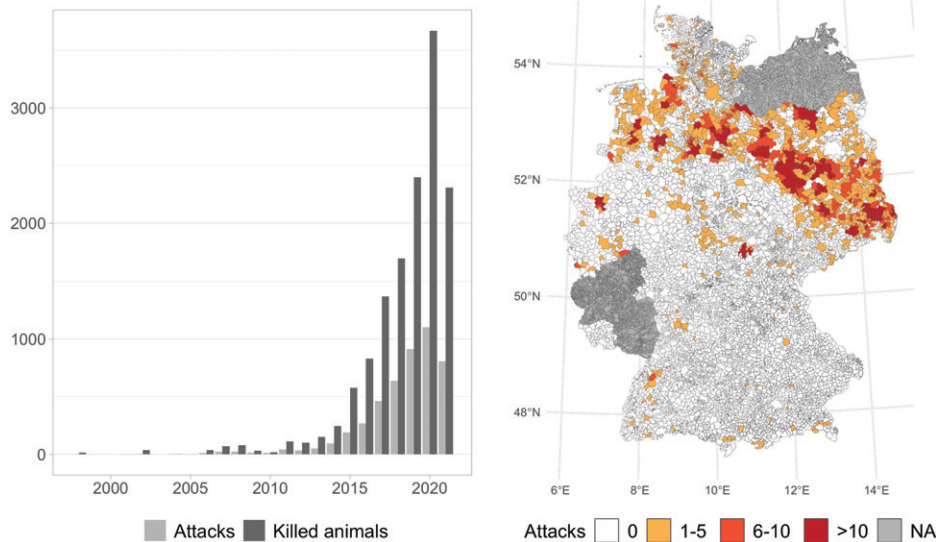


Fig. 1. Wolf attacks on livestock over time and space. (Left) Yearly aggregates of wolf attacks and killed livestock animals since 1998 in Germany. (Right) Map of wolf attacks since 1998 at the municipality level (harmonized at the 2021 borders, $n = 10,976$; two states did not provide data).

and far-right voting behavior. In addition, we collected three variables that vary across both space and time and may confound the relationship: the number of migrants, employment, and land use. Finally, we also control for lagged wolf attacks.

Results

Municipalities exposed to wolf attacks on livestock witness significantly rising vote shares of the far-right AfD (which first ran in 2013), as hypothesized in our preanalysis plan. To illustrate, Fig. 2 plots the estimated coefficient of a wolf attack dummy (binary) on vote shares (percent). In federal elections—our preferred outcome given that they take place in all municipalities at the same time—the AfD gains between 1 and 2 percentage points once a wolf has attacked. In state-level elections, the coefficient is significantly larger, suggesting that the far-right AfD gains over 5 percentage points after a wolf attack. In local elections, the coefficients are of similar size, although not consistently statistically significant. These effect sizes compare to absolute vote shares of 9.2% on average on the federal level and 11.6% on average on the state level since 2013. Reassuringly, the positive effects are robust to controlling for time-varying confounders, the coefficients are comparable across estimators, and they further hold when we analyze only rural municipalities.

At the same time, we find inconsistent evidence on whether wolf attacks are associated with a drop in voting for the Green party. In federal elections, the coefficient is close to zero and not statistically significant. The same holds for local elections, where we detect no clear positive or negative association. By contrast, in state elections, we do find consistent evidence that voters become less likely to vote for the Green party after wolves attack—however, the pretrends for this outcome (see replication material Section 2.1.1) warrant caution. Overall, the analysis provides limited evidence that wolf attacks shift votes from the Green party to the far-right AfD, and we cannot say whether Greens might be rewarded for their stance on wolf conservation in unaffected areas such as big cities.

Why may wolf attacks spark far-right voting behavior? We explore mechanisms in two ways, suggesting that economic concerns play a key role. First, we collected 29,045 survey responses from an online panel by Civey to a question whether “economic growth and environmental protection are compatible.” We geocoded these responses, constructed a weekly panel, and estimated a consistent negative coefficient: Wolf attacks make people less likely to support environmental protection compared to economic

growth, which plausibly leads them to support the anti-environmental AfD. Second, we studied the AfD’s communication regarding the wolf, drawing on three data sources: 1) We obtained the entire universe of AfD Facebook ads between 2018 and 2022, amounting to 10,475 unique ads with 94,578,526 impressions. The data show that the AfD, indeed, uses the wolf as a way to garner votes and largely relies on a frame whereby the wolf hurts the economy. As one ad stated, “More biodiversity? Sure, if it makes sense. But, our farmers are also part of the environment and farmers need space to live and work” (our own translation). 2) We qualitatively analyzed the AfD’s election manifestos since 2013. Here, too, we observe that the wolf is framed as an economic threat to locals: “The wolf is a predator, which leads to livestock loss among farmers” (our own translation). 3) We analyzed the entirety of Twitter posts of all German members of parliaments since 2008 (over 3.5 million tweets). After a keyword-based search

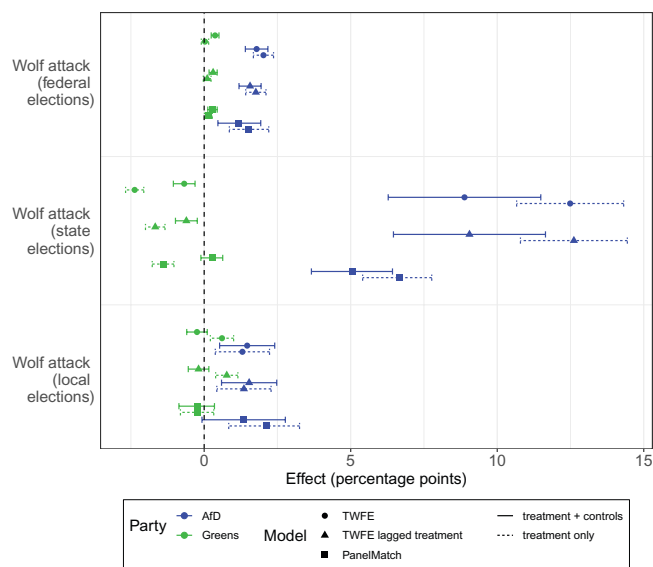


Fig. 2. Link between wolf attacks and far-right/Green voting behavior. Shown are point estimates and their 95% CIs from models regressing the AfD’s (blue)/the Green party’s (green) vote share on a dummy indicating that a municipality experienced a wolf attack, for federal elections (9 since 1990), state elections (120 since 1990), and municipal elections (147 since 1990). We use two estimators: PanelMatch (12) (square) and the traditional two-way fixed-effect estimator (TWFE) without (circle) and with treatment lag (triangle). We estimate all models with (solid line) and without (dashed line) controls. There are $n = 10,976$ municipalities in each election period.

of tweets about the wolf, we applied a dictionary-based sentiment analysis and estimated that the AfD tweets about the wolf most negatively (the mean AfD sentiment is 0.15 units more negative on a standardized scale than that of others; t test $t = 2.40$, $P = 0.02$). What is more, when geocoding AfD tweets based on the MP's constituency, we find that wolf attacks predict a more negative sentiment.

Discussion

We have provided evidence that the reemergence of the wolf has been accompanied by electoral gains for far-right parties: Using a municipality-level panel of voting behavior, we find that communities that witnessed wolf attacks are significantly more likely to vote for the radical right AfD, which espouses climate-skeptic and anticonservationist positions. The coefficients range between 1 and 10 percentage points, showcasing that wolf attacks are an important (although by no means the only) predictor of the far right's recent electoral gains. By contrast, the proenvironment Green party, if anything, suffers electoral losses when wolves attack, although this relationship is detectable only in state elections. In sum, the evidence points to wolf attacks as one potential driver of electoral radicalization.

Our evidence extends the scientific literature on environmental change and voting behavior in a number of important ways. Prior research has found that severe weather events can lead citizens to vote for more proenvironmental platforms (13). The common interpretation of such findings is that witnessing environmental issues first hand leads to attitude change. However, this coin may have a flip side: Experiencing wolves killing livestock in one's vicinity increases the likelihood of voting for far-right, conservation-skeptical parties. Since these parties often oppose measures against climate change, this may lead to a perplexing backlash effect of policies intended to help the environment. Given that many more wolf packs are expected to find territories in Europe—models estimate an increase to up to 1,400 packs in Germany from 150 today (14)—mitigating wolf predation on livestock as effectively as possible and generally finding balanced coexistence policies are key to future conservation and climate protection efforts.

In concluding, we lay out two caveats: First, our finding that wolf attacks predict far-right voting behavior does not mean that other factors do not also help the far right. Specifically, even though municipalities that witnessed wolf attacks swing right, we do not know how this compares to other factors explaining the vote for the radical right, such as antiimmigrant sentiment. That said, in our models we controlled for common determinants of far-right voting, including migration and employment. Second, we must caution that our analysis—although it absorbs a variety of likely confounders—still risks missing some sources of confounding, and one should be cautious in interpreting the findings in a causal manner.

1. N. H. Carter, J. D. C. Linnell, Co-adaptation is key to coexisting with large carnivores. *Trends Ecol. Evol.* **31**, 575–578 (2016).
2. G. Chapron *et al.*, Recovery of large carnivores in Europe's modern human-dominated landscapes. *Science* **346**, 1517–1519 (2014).
3. J. Karlsson, M. Sjöström, Human attitudes towards wolves, a matter of distance. *Biol. Conserv.* **137**, 610–616 (2007).
4. S. Dressel, C. Sandström, G. Ericsson, A meta-analysis of studies on attitudes toward bears and wolves across Europe 1976–2012. *Conserv. Biol.* **29**, 565–574 (2015).
5. A. Treves, L. Naughton-Treves, V. Shelley, Longitudinal analysis of attitudes toward wolves. *Conserv. Biol.* **27**, 315–323 (2013).
6. K. Skogen, O. Kränge, H. Figari, *Wolf Conflicts: A Sociological Study* (Berghahn Books, 2017).
7. M. A. Dittmer, R. M. Niemiec, G. Wittemyer, K. R. Crooks, Socio-ecological drivers of public conservation voting: Restoring gray wolves to Colorado, USA. *Ecol. Appl.* **32**, e2532 (2022).
8. L. M. van Eeden *et al.*, Political affiliation predicts public attitudes toward gray wolf (*Canis lupus*) conservation and management. *Conserv. Sci. Pract.* **3**, 1–11 (2021).
9. J. Leser, R. Pates, "The framing of right-wing populism: Intricacies of 'populist' narratives, emotions, and resonance" in *The Palgrave Handbook of Populism*, M. Oswald, Ed. (Springer International Publishing, 2022), pp. 437–450.

Materials and Methods

This study was preregistered at https://aspredicted.org/blind.php?x=JNB_4Y3. We did not treat human subjects and exclusively analyze administrative data aggregated at the municipality level or reuse existing survey or text data. Replication materials and additional analyses are available at the Harvard Dataverse: <https://doi.org/10.7910/DVN/OOHLX>.

Measurement. The municipality-level data on wolf attacks were provided by the respective agencies of the German federal states. Two states, Mecklenburg-Vorpommern and Rhineland-Palatinate, refused to provide data at the municipality level and are excluded from the main statistical models. For 12 of 16 states, the municipality-level data include the complete time period since attacks began. For Brandenburg, data were available only starting in 2015; for Schleswig-Holstein, data have not been made available on the municipality level since May 2020. We include all incidences for which the state agency's judgment was that the wolf was at least potentially the perpetrator, which amounts to 4,022 attacks until the last election analyzed. We exclude attacks that cannot be unambiguously attributed to a municipality (115 attacks).

The municipality-level data on voting behavior were provided by federal and state-level election officials. For each election, we collected all available municipality-level results from archives and websites. Since municipalities are regularly reshaped—leading to both mergers and splits—we harmonized all data at 2021 geometries. In the case of mergers and splits, votes were apportioned proportional to the geometric shapes. We have data on all federal elections since 1990, all state elections since 1990, and all municipal elections since 1990 (except for the municipal election of 1990 in Schleswig-Holstein). Control variables were assembled from the office for regional statistics (<https://www.regionalstatistik.de>).

Details on the survey data, election manifestos, Facebook ads, and Twitter data can be found in the online repository.

Statistical Modeling. Our preregistered model gauging the relation between wolf attacks and voting is the two-way fixed-effects model,

$$\text{Party}_{it} = \alpha_i + \alpha_t + \beta \text{Wolf}_{it} + \epsilon_{it}, \quad [1]$$

where Party_{it} is the vote share (in percent) of the AfD or the Green party in municipality i at election t ; and α_i and α_t are municipality and election fixed effects, respectively. Wolf_{it} takes the value 1 if a municipality witnessed a wolf attack in period t before the election (remaining at 1 thereafter) and 0 otherwise. ϵ is the error term. This is the base for our models including control variables and lagged treatments. As the two-way fixed-effects estimator can be problematic in the case of staggered treatments, we also estimate effects using the PanelMatch estimator proposed by ref. 12, which also accounts for treatment reversals.

Data Availability. Data on wolf attacks, elections, surveys and tweets (csv) have been deposited in Harvard Dataverse (<https://doi.org/10.7910/DVN/OOHLX>) (15).

Some study data are available. Due to restrictions by the data-providing state agencies, data on wolves were aggregated.

ACKNOWLEDGMENTS. We are very grateful to Paul C. Bauer for providing Twitter data, to Heike Klüver for providing Facebook ad data, and to Till Tietz for superb research assistance.

10. B. Forchtner, Ö. Özvatan, "Beyond the 'German Forest'. Environmental communication by the far right in Germany" in *The Far Right and the Environment: Politics, Discourse and Communication* (Routledge, 2019), pp. 216–236.
11. C. Kolvråa, "Wolves in sheep's clothing? The Danish far right and 'wild nature'" in *The Far Right and the Environment: Politics, Discourse and Communication*, B. Forchtner, Ed. (Routledge, 2019), pp. 107–120.
12. K. Imai, I. S. Kim, E. H. Wang, Matching methods for causal inference with time-series cross-sectional data. *Am. J. Pol. Sci.* **10**, 1111/ajps.12685 (2021).
13. C. Zanocco *et al.*, Place, proximity, and perceived harm: Extreme weather events and views about climate change. *Clim. Change* **149**, 349–365 (2018).
14. S. Kramer-Schadt, M. Wenzler, P. Gras, F. Knauer, *Habitatmodellierung und Abschätzung der potenziellen Anzahl von Wolfsterritorien in Deutschland*, volume 556 (Bundesamt für Naturschutz, 2020), pp. 1–30.
15. B. Clemm von Hohenberg, "Replication Data for: Wolf Attacks Predict Far-Right Voting." Harvard Dataverse. <https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/OOHLX>. Deposited 15 June 2022.