June 17, 2024

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Comments submitted by email to **nyswap2025@dec.ny.gov**

Dear Ms. Denoncour and Division of Fish & Wildlife Staff:

On behalf of The Rewilding Institute and Project Coyote's members in New York, thank you for the opportunity to comment on the Species Status Assessments (SSAs) for the Department of Environmental Conservation's draft 2025 State Wildlife Action Plan (SWAP). We look forward to additional opportunities to comment on the DEC's overall text for the SWAP when it is drafted, since that document will convey the agency's approach to wildlife protection and conservation for the next decade.

Our comments focus on recommended changes to SSA for Wolf and the need for DEC to take concerted action to assess the presence of wolves and admixed canis in New York. In addition, our organizations strongly recommend that DEC classify Wolf as a Species of Greatest Conservation Need (SGCN) or Species of Potential Conservation Need (SPCN), the rationale for which is discussed below. We are also providing an extensive bibliography of scientific research in support of our comments, and for use as a reference by DEC as the agency finalizes the 2025 SWAP and considers measures to advance wolf recovery.

The Rewilding Institute (TRI) is a national non-profit organization that promotes scientific information on landscape-scale conservation and wilderness protection. We advocate for the restoration and protection of wide-ranging, large carnivores such as wolves and cougars, which when given room to roam, bolster ecological resilience.

Project Coyote, a national non-profit organization, is a North American coalition of scientists, educators, and citizen leaders promoting compassionate conservation and coexistence with North America's wild carnivores through education, science, advocacy, and coalition building.

Both The Rewilding Institute and Project Coyote are founding members of the Northeast Wolf Recovery Alliance (NEWRA), which aims to facilitate the recovery of wolves throughout the Northeast U.S. and eastern Canada. NEWRA members conduct research,

public education, and policy advocacy and are currently collaborating on projects to advance the genetic understanding of wild canids and state legislation and regulations to protect them.

In November 2022, NEWRA met with Katie Petronis, DEC's Deputy Commissioner for Natural Resources, Dan Rosenblatt, Wildlife Diversity Section Head, Jacqueline Lendrum, Director of the Division of Fish and Wildlife, and Sean Mahar, now DEC's Interim Commissioner. The goal of this meeting was to gain an understanding of the agency's position on wolf recovery and present recommendations for additional actions, some of which are discussed in these comments as well.

1. Strengthen the SSA on Wolf

We appreciate DEC's inclusion in the SSA for the draft 2025 SWAP of *Canis lycaon, C. lupus lycaon,* and *C. lupus x C. Lycaon*—a clear recognition of the complex and continually evolving science on the wolves that once inhabited the state and may be making their way back. We encourage DEC to include additional information in the SSA on recent research and trends on several topics, as follows.

Hunter misidentification

We support DEC's emphasis in the SSA that intentional killing of wolves and misidentification by coyote hunters are significant impediments to wolf recovery in New York. Misidentification is also a serious legal consideration because New York law prohibits the "taking," defined to include killing, of wolves because of their status as an endangered species in the state.[1] In addition, New York law on "incidental take" of endangered species states that, "The misidentification of a species will not be grounds for a claim that a take was accidental and unforeseeable."[2]

In this context, DEC should consider the findings of a recent study by Benson, J. F., Mahoney, P. J., Wheeldon, T. J., et. al (2024) on reducing human-induced mortality of wolves recommends restricting coyote killing to advance the protection of eastern wolves. A study by Newsome, T.M., Bruskotter, J.T., and Ripple, W.J. (2015) emphasizes that minimizing mistaken identity among wild canids is an essential regulatory strategy in support of wolf recolonization. This is an issue that has significantly affected other morphologically similar canids, even where the differences are more pronounced, including red wolves in North Carolina.[3]

The ecological role of wolves and admixed canis

We appreciate DEC's recognition in the SSA of studies indicating that sufficient habitat and prey base exist in New York and the Northeast to potentially support wolf populations. In

[1] Environmental Conservation Law §11-0535(2); 6 NY Code, Rules, and Regulations Part 182.5(a)(7)(ix).
[2] 6 NY Code, Rules, and Regulations, Part 182.13(2).
[3] Hinton, J., Brzeski, K., Rabon, D., & Chamberlain, M. (2017). Effects of anthropogenic mortality on Critically Endangered red wolf Canis rufus breeding pairs: Implications for red wolf recovery. Oryx, 51(1), 174-181. doi:10.1017/S0030605315000770

addition to van den Bosch, M., Beyer Jr, D. E., Erb, J.D., et al (2022), which concluded there are conservatively more than 17,000 square miles of potential wolf habitat throughout New England and New York, we encourage the DEC to review Yovovich et al (2023), which noted two habitat patches within New York of more than 10,000 km^2, and thereby viable to support long-term cougar populations. Sufficient habitat for cougars implies sufficient habitat for wolves, since both species are wide-ranging, generalist predators.

The SSA unfortunately lacks any discussion of the ecological value of eastern wolves and admixed canis, in particular their importance in maintaining healthy, balanced natural systems. Considerable science exists on how apex predators like wolves facilitate "trophic cascades," or effects throughout the food chain. Such information should be added to the "Habitat Discussion" section of the SSA.

In particular, Benson, J. F., Patterson, B. R., and Mahoney, P. J. (2014) summarized the issue of ecological contribution in the context of wolf reintroduction in Yellowstone Park.[4] Ripple, W.J, Estes, J.A., Beschta, R.L., et al. (2014) have reviewed global evidence of the importance of wolves in controlling cervid populations and a range of other direct and indirect ecological effects.

In addition, we encourage DEC to consider emerging science on the role of wolves that has been published since the last SWAP was adopted in 2015. In particular, DEC should take note of Otis, J. A., Thornton, D., Rutledge, L., & Murray, D. L. (2017), which indicates that in areas where eastern wolves and coyotes mix, the admixed canis exhibit flexibility in their prey base, with implications for a range of species and habitats. Similarly, Benson, J.F., Loveless, K.M., Rutledge, L.Y., and Patterson, B.R. (2017) have documented how eastern wolves prey on deer more than coyotes do, but that this trend varies depending on the specific genetic ancestry.

Previous studies have confirmed the varied morphology and ecological role of eastern coyotes with admixed wolf genetics, including coyotes serving a more wolf-like ecological role (i.e., increased use of forest habitats, larger body size, increased proportion of ungulates in their prey base).[5]

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[4] More recent studies suggest that the presence of wolves has played an important role, but an insufficient one, in reversing decades of damage caused by the overgrazing of elk and other ecological problems in Yellowstone. See a summary article by Jim Robbins, "Yellowstone Wolves: the Debate Over Their Role in the Park's Ecosystem," *New York Times,* April 23, 2024, https://www.nytimes.com/2024/04/23/science/yellowstone-wolves-elk-bison-climate-change.html

[5] Monzón, J., Kays, R., & Dykhuizen, D. E. (2014). Assessment of coyote–wolf–dog admixture using ancestry-informative diagnostic SNP s. Molecular ecology, 23(1), 182-197; Way, J.G. (2013). Taxonomic Implications of Morphological and Genetic Differences in Northeastern Coyotes (Coywolves) (*Canis latrans* × *C. lycaon*), Western Coyotes (*C. latrans*), and Eastern Wolves (*C. lycaon* or *C. lupus lycaon*). Canadian Field-Naturalist 127(1): 1–16; and Jensen, A. J., Marneweck, C. J., Kilgo, J. C., & Jachowski, D. S. (2022). Coyote diet in North America: geographic and ecological patterns during range expansion. Mammal Review, 52(4), 480-496.

Most recently, Pfeffer, E., Barth, K., Bitsko, L., et al. (2022) documented coyotes in areas of northeastern and north-central Pennsylvania that were found to have higher percentages of wolf ancestry, were larger in size, and documented in regions with higher deer densities. Additional studies on the varied ecological role and niche of eastern coyotes and admixed canids have been conducted on eastern wolves surrounding Algonquin Provincial Park, which could be applicable to New York; see Benson et al. (2017); Otis et al. (2017); and Oliveira et al. (2020).

Heppenheimer et al. (2018) notes the unique genetic markers of eastern wolves, indicating a separate evolutionary lineage, and warranting their recognition as a priority for conservation efforts. Heppenheimer also highlights conservation strategies for eastern wolves should support "managed introgression," which would conserve eastern wolf genetic material in any genome regardless of their potential mosaic ancestry composition and the habitats that promote them, suggesting prioritizing conserving genetic diversity across a gradient of admixed individuals. This perspective proposes that canis with varying degrees of wolf and coyote ancestry should be conserved to maintain unique eastern wolf genetic material and enhance evolutionary potential.

In addressing the pressing issue of climate change, studies by Wilmers, C.C. and Schmitz, O.J. (2016) and Schmitz, O.J., Wilmers, C.C., Leroux, S.J., et al. (2018) emphasize that carnivores play a key role in carbon sequestration through consumption of ungulates and cascading effects on other species and soil. DEC should consider the work of these and other authors on the potential benefits of wolves as the climate in the Northeast shifts and New York continues to pursue climate mitigation strategies.

Extirpated status

We recognize that since the first iteration of the state wildlife action plans in 2005, DEC has classified Wolf as an extirpated species. However, we ask DEC to amend the statement in the 2025 draft SSA for Wolf to reflect current conditions, to read, "Extirpation does not mean a species is extinct, but rather that it no longer occurs in a wild state within New York, *or that DEC currently lacks clear evidence of it doing so*" (emphasis added). This change would reflect the scientific adage that "absence of evidence is not evidence of absence."

The draft SSA cites only two cases of wild wolves identified in New York in about 30 years (2001 in Saratoga County and 2021 in Otsego County). However, because both instances involved wolves killed by coyote hunters based on "mistaken identity," it is possible that these are more representative than definitive when it comes to the number of wolves present in New York. As we detail below, DEC has considerable options available to gather more evidence on this possibility, as well as the degree to which eastern coyotes are admixed canis with a significant proportion of wolf genetics.

The "unknown" status of wolves

We ask DEC to revise the Abundance and Distribution Trends table in the draft SSA. Specifically, the answer to the "Present" column should be changed from "No" to "Unknown" for the Northeastern US and adjacent states; and all the state-by-state entries

for abundance and distribution should be "unknown." There is precedent for changing these categories as SWAPs are revised; for example, the distribution of wolves in the 2015 SSA was noted as "unknown" for North America, but "increasing" in the 2025 draft.

To date, regulatory agencies across the Northeast have not taken concerted action to assess whether wolves are present or how widespread the misidentification of large canis by coyote hunters actually is. In neighboring Vermont, for example, at least two and likely three or more wolves (based on morphology and limited DNA data) are known to have been killed since the 1990s, yet New York's 2015 and draft 2025 SSAs state that Wolf is "not present" in that state.[6]

Conservation Actions

We ask DEC to expand and strengthen the Conservation Actions included in the SSA, which as currently written are far too vague to convey intent by the agency, provide guidance to staff, and ensure accountability to the public over the next decade until the next SWAP revision. Specific suggestions are as follows:

- "Awareness and communications" could include educational materials about the protected status of wolves for hunters and trappers, outreach events to ensure that the information is widely received, and public messaging by DEC on the wolf's potential presence and endangered status in both federal and state law. Such actions would expand on and legitimize DEC's statement in the SSA that it is "seeking reports from trappers and hunters of large canis (more than 50 pounds) for evaluation, and is in the process of developing protocols to assess reports of suspect animals." (See below for recommended actions DEC could take regarding admixed canis in New York.)

- "Alliance and partnership building" is a critical part of the work of public agencies, but DEC has not indicated the partners with which it seeks to build relationships. The SSA mentions the Staying Connected Initiative but does not offer detail on what this partnership would entail. We and other members of NEWRA would welcome the opportunity to communicate regularly with DEC to promote greater understanding, acceptance, and coexistence with wild canis in New York and investigate the question of social tolerance for wolves. Negative attitudes and perceptions toward both wolves and coyotes will continue to negatively affect the survival and well-being of all canis. We encourage active partnerships with groups working on increasing coexistence with carnivores and actively working on public education and outreach on these topics.

- It is unclear what DEC means by "Sub-national level" with regard to compliance and enforcement. It is critical to clarify and expand this Action category, as it reflects the recommendation by the Association of Fish & Wildlife Agencies that state regulators pursue landscape-scale, cross-boundary conservation through coordination of SWAPs.[7]

[6] These included a 72-pound male killed in 1998 in Glover, a 91-pound male killed in 2006 in North Troy, and possibly a 78-pound large canid (sex unknown) killed in 2013 in North Hero.

[7] Association of Fish & Wildlife Agencies, State Wildlife Action Plan & Landscape Conservation Action Group, *Leading At-Risk Fish and Wildlife Conservation,* 2021.

DEC should consider the most recent study on habitat suitability for wolves in the Northeast, which emphasizes that cross-jurisdictional collaboration will be essential to recovery; see van den Bosch, M., Beyer Jr, D. E., Erb, et al (2022).

The SSA mentions the need to preserve and improve habitat linkages among existing wolf populations, but lacks detail on what this would entail. DEC should indicate how it will share information with agencies in Northeastern and Midwestern U.S. states and proximate Canadian provinces, including on such topics as the genetic make-up of large canis, coyote hunter education, and the potential need to change coyote hunting seasons and regulations.

2. Classify wolf as a SGCN or SPCN

As discussed above, we do not agree with DEC's unequivocal classification of Wolf as "extirpated" in the current day, which the agency has used as the rationale for not listing Wolf as a Species of Greatest Conservation Need (SGCN).

New York's 2005 Comprehensive Wildlife Conservation Strategy stated that three extirpated carnivores (wolf, lynx, and cougar) warranted conservation action and further research with regard to social acceptability and habitat suitability, and that classification as SGCN would in fact help "facilitate that evaluation."[8]

Nonetheless, in the 2015 SWAP, DEC removed SGCN status for all three carnivores because of a "focus of conservation resources on resident species that currently have a population at risk in New York."[9] We understand that DEC has limited resources and is challenged to address grave threats to the survival of many species and ecosystems across New York.

At the same time, some parts of the current definition of SGCN in the draft 2025 SWAP reflect current circumstances for wolves in New York, i.e., they have "identified threats that may put them in jeopardy" (in particular coyote hunter misidentification) and require conservation action to "sustain recovery," particularly in the next ten years.[10] We also recognize that other parts of the definition may not be applicable, including "The status of these species is known" and "these species are experiencing some level of population decline" and "need conservation actions to maintain stable population levels.")

<u>Should DEC decide that full SGCN listing is not appropriate for Wolf in the 2025 SWAP, we strongly request that the agency assign Wolf the status of Species of Potential Conservation Need (SPCN).</u> The definition of these species is clearly applicable to Wolf, i.e., a "*species whose status is poorly known*, but there is an identified threat to the species, or features of its life history that make it particularly vulnerable to threats. The species may be declining,

[8] New York State Comprehensive Wildlife Conservation Strategy, 2005, p. 33.
[9] New York State Wildlife Action Plan, 2015, p. 9.
[10] New York draft State Wildlife Action Plan, 2025, Species of Greatest Conservation Need List, 2024.

or begin to experience declines within the next ten years, and *studies are needed to determine their actual status*" (emphasis added).[11]

Additionally, we highlight the similarity between circumstances surrounding the wolf and other species on the SPCN list, such as the Least Weasel, which has been documented in New York on only five occasions in two locations and for which DEC has concluded that there are no known populations.[12]

There is far more scientific understanding now than a decade ago of the potential for wolves being present in New York State and the Northeast, including in the form of admixed wild canis. Further, in the coming years increased genetic research will provide a more comprehensive understanding of canis genetic ancestry in New York and broader region. Given this, we would like to see DEC return to its reasoning in 2005 that assigning a status of Conservation Need is necessary to advance research and actions that could show the way to wolf recovery—at minimum through a classification as SPCN in the 2025 SWAP.

3. Assess the status of admixed wild canis

As noted above, in late 2022, members of NEWRA met with DEC staff to discuss measures the agency could take to ensure that wolves in New York are adequately protected in accordance with their status as a listed endangered species under both federal and New York State law. At the time, we requested that DEC take regulatory action to assess admixed wild canis and to minimize the likelihood of misidentification of wolves by coyote hunters. We urge the DEC to reconsider the conservation actions that NEWRA presented to DEC staff in 2022.

Since the development of the last SSA published by the DEC for wolves, there has been a growing understanding in the scientific literature on the mortality risks of eastern wolves. In particular, the DEC should take note of Benson et al. (2024), which highlights the importance of a conservation strategy that reduces human-caused mortality to allow for an increase in dispersal rates by enacting a harvest ban for all canis. We appreciate the DEC's recognition of the threat of high levels of human-caused mortality from hunting and trapping pressure and the risk of illegal killings due to misidentification in the draft SSA.

However, in light of scientific literature on eastern wolves, we note that DEC regulations will have to go beyond simply "[e]nforcing compliance by coyote hunters," as stated in the draft 2025 SSA, due to the morphological similarities of species and will require regulations that prohibit coyote hunting in order to allow for eastern wolves to disperse, survive, and decrease the rates of hybridization.

In this regard, DEC should consider the findings of Benson et al. (2014) and Rutledge et al. (2010). Instituting restrictions on coyote hunting and trapping around Algonquin

[11] New York draft State Wildlife Action Plan, 2025, Species of Potential Conservation Need List, 2024.
[12] New York draft State Wildlife Action Plan, 2025, Least Weasel SSA, "Species of Potential Conservation Need List, 2024.

Provincial Park has been essential for the protection of eastern wolves in the Ontario region due to the inability of hunters to properly identify species in the field. As is required for eastern wolf conservation in Canada the same level of protection will be required of the DEC to properly and sufficiently protect dispersing wolves in New York.

In light of recent scientific research, we highlight the growing need for the DEC to focus on conservation actions across species to include all wild canis (i.e., wolves, eastern coyotes, and admixed individuals). Doing so would provide a multifold of benefits for wolf conservation including: (1) reducing the chance of misidentification; (2) reducing the tendency for introgression/hybridization due to anthropogenic mortality increasing rates of hybridization; (3) allowing for the restoration of the natural social structure of potentially dispersing eastern wolves; and (4) providing protection for eastern coyotes (admixed canids), which has demonstrated a more wolf-like ecological function than western coyotes.

We fully support DEC's management and conservation efforts stated in the draft 2025 SSA to advance "understanding attitudes of New York residents toward wolf recovery, providing education that could reduce illegal killing of wolves, and preserving and improving habitat linkages to existing wolf populations in Canada and suitable habitat in other Northeastern states." We now ask DEC to consider additional recommendations to propel conservation efforts in the context of the draft 2025 SWAP and integrate them into the SSA for Wolf, as part of the sections on "Conservation Actions" and "Monitoring in New York." Specifically, we strongly recommend that DEC:

- Implement a more active management program for canis in order to monitor for wolf presence and allow information gathering on population and biological data that will facilitate informed management decision-making. DEC should require that all wild canis killed in New York be tagged, reported, and sealed—as is required currently for other furbearer species such as fisher, marten, otter, and bobcat. In addition, canis that meet certain criteria that DEC will establish (e.g., over 50 pounds, pelage coloration, etc.) should be subject to DNA analysis.

- Conduct research on canis genetics across the state. We recommend the DEC consider adding a conservation action to the SSA stating that the agency will partner with research institutions to assess canis genetics and ecology within New York.

- Impose a two-year canis hunting moratorium in the geographic area where there has been documented presence of a wolf. As noted above, a hunting and trapping moratorium for coyotes is a deployed and necessary conservation strategy in Canada to protect eastern wolves from high rates of human-caused mortality due to misidentification. A moratorium on coyote hunting was also implemented in Wisconsin during gray wolf recovery during the 1980s to eliminate wolf killing due to misidentification. After the coyote hunting ban was implemented, local wolves

experienced unprecedented population growth.[13] As is implemented for other species such as bobcat in New York, the DEC should consider closing hunting and trapping in specified Wildlife Management Units in light of information showing the presence of wolves in the region.

- Prohibit coyote hunting at night, a time when the risk of misidentification is greatest. This action was taken in North Carolina in the red wolf recovery area due to the high risk of misidentification under nighttime conditions.[14]

- Implement a wanton-waste requirement for hunted wild canis. This would rein in the widespread killing of coyotes without any consideration of end-use and, in turn, reduce the chances of wolves being needlessly killed as well.

- Consider an adaptive management approach in light of the ongoing genetic research underway which will provide an increased understanding of the genetic makeup of canis within New York and throughout the Northeast. Different conservation approaches and actions may be required as new information emerges on the genetic makeup of canis already present in New York and the Northeast.

Finally, we note that the U.S. Fish and Wildlife Service recently launched the court-mandated development of a National Wolf Recovery Plan.[15] Our organizations and other members of NEWRA will be working to ensure that this process takes into consideration the Northeast as a potential recovery area. In this context, it will be all the more vital for DEC to collect information about wolves in New York; recognize the ecological value of admixed canis and the need for greater protection of those animals; and implement strategies to prevent the misidentification of wolves by hunters.

In closing, we emphasize again that the Association of Fish & Wildlife Agencies strongly recommends that state regulators leverage the SWAP process to pursue landscape-scale, cross-boundary efforts and, in turn, achieve effective conservation outcomes.[16] This approach dovetails with the need for greater protection of natural areas essential to facilitating the movement of wide-ranging wildlife such as wolves, in particular the "Algonquin to Adirondacks" region.

We encourage DEC to collaborate with agencies in Canada, including the Ministry of Natural Resources and Forestry in Ontario and Quebec to assess canis genetics in the

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[13] Thiel, R.P. *Keepers of the wolves: the early years of wolf recovery in Wisconsin.* The University of Wisconsin Press, Madison, 2001.
[14] North Carolina Wildlife Resources Commission. Hunting Regulations. North Carolina Wildlife Resources Commission, 2017. http://www.ncwildlife.org/Portals/0/Regs/Documents/Hunting-Regulations.pdf
[15] Stipulated Settlement Plan, Center for Biological Diversity (plaintiff) v. Deb Haaland, in her official capacity as Secretary of the U.S. Department of the Interior, et al. Case No. 1:22-cv-03588-DLF, December 13, 2023.
[16] Association of Fish & Wildlife Agencies, State Wildlife Action Plan & Landscape Conservation Action Group, *Leading At-Risk Fish and Wildlife Conservation,* 2021.

borderlands region, and to implement necessary conservation measures to facilitate the protection of natural areas that can serve as essential corridors for wildlife dispersal.

We believe that the achievement of DEC's mission to "conserve, improve, and protect New York's natural resources and environment" necessitates the presence of keystone species that play a critical role in maintaining healthy natural systems. The absence of top carnivore species such as wolves has left a functional void in the state's ecosystems and contributed to an overall decline in environmental quality.

It is incumbent upon the agency to focus resources not only on immediate problems, but also on the achievement of longer-term goals and nature-based solutions to the ongoing climate and biodiversity crises, including the recovery and protection of highly interactive apex predator species such as wolves.

Thank you for your time and consideration of our comments. We look forward to further discussions with DEC about the recovery of wolves in New York and across the Northeast.

Sincerely,

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Appendix. Annotated Bibliography

1. Genetics of Wild Canis in Eastern North America

Benson, J. F., Patterson, B. R., & Wheeldon, T. J. (2012). Spatial genetic and morphologic structure of wolves and coyotes in relation to environmental heterogeneity in a Canis hybrid zone. Molecular ecology, 21(24), 5934-5954.

Benson et al, analyzed wolves and coyotes in and around Algonquin Provincial Park (APP) to identify distinct Canis types, determine the range of the eastern wolf population outside the park, and examine the fine-scale spatial genetic structure and landscape-genotype associations within the hybrid zone. Researchers identified three genetically and morphologically distinct Canis types corresponding to gray wolves, eastern wolves, and coyotes in the APP region. Additionally, they found that 36% of the individuals were hybrids with genetic admixture from two or three Canis types. Eastern wolves were less frequently found outside APP but did exist in some unprotected areas, where they are sympatric with a diverse mix of coyotes, gray wolves, and admixed canids. The study also modeled genetic ancestry in response to prey availability and human disturbance and found that individuals with greater wolf ancestry occupied areas of higher moose density and fewer roads.

Takeaway: The study highlights the complex interplay between genetics, morphology, and environmental factors in hybrid zones, emphasizing the need for nuanced conservation approaches that consider these dynamics to preserve genetic diversity and ecological functions in hybridizing species.

Way, J.G. and J.L. Hirten. (2019). Wild Canis spp. of North America: a pictorial representation. Canadian Field-Naturalist 133: 295-296.

Way and Hirten et al. noted the strong morphological similarities between eastern coyotes (Canis latrans) and eastern wolves (Canis lycaon). They emphasized that body size and genetics are often the only way to tell one Canis type apart from another. Individual canids may be difficult to tell apart in the field, not only from a distance, but even when captured, especially where their ranges overlap (e.g., in and around Algonquin Provincial Park, Ontario).

Takeaway: This variability makes it very difficult to discern closely related canids properly and highlights the ongoing likelihood that small—to medium-sized wolves (e.g., 60-65 pounds) are hunted and trapped when assumed to be large ‘coyotes’.

Heppenheimer, E.; Harrigan, R.J.; Rutledge, L.Y.; Koepfli, K.-P.; DeCandia, A.L.; Brzeski, K.E.; Benson, J.F.; Wheeldon, T.; Patterson, B.R.; Kays, R.; Hohenlohe, P.A.; Von Holdt,

B.M. (2018) Population Genomic Analysis of North American Eastern Wolves (Canis lycaon) Supports Their Conservation Priority Status. Genes 9:606.

Heppenheimer et al., used a population genomics approach to uncover spatial patterns of variation in 281 canids in central Ontario and the Great Lakes region. They detected eastern wolf alleles in admixed coyotes along the northeastern regions of Lake Huron and Lake Ontario. They found eastern wolves are genetically distinct from both gray wolves and coyotes, possessing unique genetic markers indicating a separate evolutionary lineage, and warranting their recognition as a priority for conservation efforts.

Researchers encouraged an innovative discussion regarding a plan for targeted conservation strategies to preserve the unique genetic identity of Eastern wolves and their ecological role. A conservation approach could support “managed introgression”, which could conserve eastern wolf genetic material in any genome regardless of their potential mosaic ancestry composition and the habitats that promote them. Admixture can lead to beneficial genetic changes by creating new variations in fertile offspring, enabling adaptive selection. The hybridization in the current Eastern wolf population exemplifies a crucial but often overlooked mechanism for adaptation. Through genome and phenotype recombination, this process may underpin the Eastern wolves' ability to thrive in a rapidly changing environment. Conservation efforts should prioritize individuals with admixed genomes due to their greater genetic variation and adaptive potential. These efforts would benefit significantly from ongoing genomic and ecological monitoring of both source and admixed populations. Preserving even partial genomes highlights the importance of maintaining genetic diversity in conservation strategies.

Takeaway: *Heppenheimer et al.,* suggests prioritizing conserving genetic diversity across a gradient of admixed individuals. This perspective proposes canids with varying degrees of wolf and coyote ancestry should be conserved in Ontario to maintain unique Eastern wolf genetic material and enhance evolutionary potential. This strategy also emphasizes conserving ecological functions, noting that wolves, more than coyotes or hybrids, consistently prey on large ungulates like moose and deer, stabilizing predator-prey dynamics. From this ecological perspective, maintaining a population with high eastern wolf ancestry is essential to preserving their ecological role.

Rutledge, L.Y., S. Devillard, J.Q. Boone, P.A. Hohenlohe, and B.N. White. (2015). RAD sequencing and genomic simulations resolve hybrid origins within North American Canis. Biology Letters 11: 20150303. https://doi.org/10.1098/rsbl.2015.0303.

Rutledge et al, identified 127,235 SNPs (single-nucleotide polymorphisms, or genetic variations), revealing that eastern wolves are a distinct genomic cluster and not a result of hybridization of gray wolves and western coyotes. The findings clarified the hybrid origins of Great Lakes-boreal wolves and eastern coyotes, providing valuable insights for conservation efforts of these Canis populations. Results support the eastern wolf as a distinct genomic cluster in North America and help resolve hybrid origins of Great Lakes wolves and eastern coyotes.

Biological Correlates with Degree of Introgressive Hybridization between Coyotes Canis latrans and Wolves Canis sp. in Pennsylvania, USA. The American Midland Naturalist, 188(2), 199-211.

A total of 192 coyotes across Pennsylvania were genotyped at 63 ancestry informative SNPs (single-nucleotide polymorphisms, or genetic variations) to determine the percent of coyote genome attributable to wolf origin. Coyotes from Northeastern and Northcentral Pennsylvania had higher wolf ancestry and were larger in size. These regions also have higher deer densities, which may confer an adaptive advantage to larger individuals with more wolf genetics. Additionally, researchers noted that coyotes with higher percent wolf were larger, less red in some parts of their pelage, and had a different pelage patchiness composition, identifying that coat color may be a phenotypic marker for introgressive hybridization.

Takeaway: The findings suggest that canid size and wolf ancestry could be beneficial in areas with abundant deer populations, and that pelage coloration might serve as an indicator of genetic introgression levels. This information could help wildlife managers understand the shifting ecological roles of these hybrid animals. Furthermore, the degree of redness within coyotes may be used as an indicator for introgression levels for population managers, aiding in understanding the shifting ecological role of coyotes.

2. Ecological value of eastern wolves and admixed canis

Benson, J.F., Loveless, K.M., Rutledge, L.Y., and Patterson, B.R.. Ungulate predation and ecological roles of wolves and coyotes in eastern North America. Ecol Appl. (2017). Apr;27(3):718-733. doi: 10.1002/eap.1499. Epub 2017 Mar 15. PMID: 28064464.

Since the extirpation of wolves (Canis spp.) across much of eastern North America, Eastern coyotes (Canis latrans) have moved into the role of apex predator. Historically, Eastern wolves (C. lycaon) held this top predator role in the region's deciduous forests. This study found that packs with higher Eastern coyote ancestry showed lower per capita kill rates for ungulates (deer and moose) and moose specifically. Additionally, coyote-dominated packs consumed less ungulate biomass and more human-associated food compared to packs with higher wolf ancestry. Eastern wolves, similar to gray wolves in other studies, preyed on deer when available. In areas with fewer deer, Eastern wolves killed moose at rates akin to those of gray wolves at similar moose densities across North America.

Otis, J. A., Thornton, D., Rutledge, L., & Murray, D. L. (2017). Ecological niche differentiation across a wolf‐coyote hybrid zone in eastern North America. Diversity and Distributions, 23(5), 529-539.

Human-caused habitat alterations and habitat disturbance have resulted in widespread species range shifts leading to hybridization and attendant changes in the distribution, abundance and interaction of species, specifically wild canis. This research highlighted significant spatial genetic and morphological variations among the canid populations, which correlate with the

environmental gradients across the hybrid zone. This intermediate niche occupancy suggests that admixed canids can use a range of habitats as well as those with high human disturbance. Admixed canids in the eastern wolf and eastern coyote hybrid zone display niche characteristics that are intermediate between those of their parent species, providing high behavioral plasticity in their niche characteristics. Understanding the niche differentiation and adaptability of admixed canids is crucial for conservation strategies, as it informs how hybridization might impact native species and ecosystem processes.

Oliveira, T., Benson, J. F., Thompson, C., & Patterson, B. R. (2020). Resource selection at homesites by wolves and eastern coyotes in a Canis hybrid zone. Ecosphere, 11(12), e03320.

Oliveira et al., modeled canid resource selection using telemetry data and habitat characteristics at homesites within a largely unprotected landscape in Ontario, Canada, identified as a potential recovery zone for the threatened eastern wolf.They analyzed the selection patterns of wolves, coyotes, and hybrids during the critical pup-rearing period, considering both ecological and anthropogenic factors. They found that packs with greater wolf ancestry exhibited a stronger preference for wetlands and tertiary roads, while avoiding mixed conifer-hardwood forests.

A continuing goal of eastern wolf recovery within Canada is to increase both their numbers and geographical range beyond the core population in Algonquin Provincial Park. These findings offer essential insights for conservation efforts by detailing the resource preferences of wolves, coyotes, and hybrids during the pup-rearing period, and helps to disentangle ecological relationships between hybridizing canids increasing our understanding of variation in resource selection relative to human disturbance and natural habitat features.

Thornton, D. H., & Murray, D. L. (2014). Influence of hybridization on niche shifts in expanding coyote populations. Diversity and Distributions, 20(11), 1355-1364.

Thornton and Murray, examined the influence of hybridization on the niche shifts of expanding coyote populations. Hybridization of coyotes with wolves has allowed coyotes to exploit new habitats and resources, facilitating their range expansion. Coyote-wolf hybrids are found to have an increased use of forested habitats in comparison to pure coyote. The research underscores the importance of understanding genetic and ecological interactions in wildlife management and conservation, as hybridization can significantly affect species distributions and ecosystem dynamics.

Schmitz, O.J., Wilmers, C.C., Leroux, S.J., et al. (2018). Animals and the zoogeochemistry of the carbon cycle. *Science,* doi: 10.1126/science.aar3213

Research and remote-sensing technologies focusing on the carbon cycle tend to be characterized by contributions from plants, microbes, and abiotic systems. But the role of wild animals is considerable, particularly those that roam widely across landscapes. There is a need to consider the trophic interactions among carnivores and herbivores, which greatly influences

plants and soils, in order to achieve accurate carbon accounting. The net effects vary across ecosystems but can be significant.

Wilmers, C.C. and Schmitz, O.J. (2016). Effects of gray wolf-induced trophic cascades on ecosystem carbon. *Ecosphere,* doi: 10.1002/ecs2.1501

Predator impacts on carbon cycling have not been widely quantified for terrestrial ecosystems, including analyses of the potential for gray wolves to have cascading impacts on ecosystem carbon cycling. Consideration of gray wolf effects on boreal forests indicate an increase in net ecosystem productivity due to predation on ungulates, while decreases could occur in grassland ecosystems. It is worth examining in more detail the potential significance of the indirect effects of top predators on terrestrial ecosystem carbon using more systematic landscape-scale sampling in locations with and without wolves.

Ripple, W.J, Estes, J.A., Beschta, R.L., et al. Status and Ecological Effects of the World's Largest Carnivores (2014). Science, https://www.science.org/doi/10.1126/science.1241484

Large-bodied carnivores are wide-ranging and relatively rare because of the positions at the top of food webs and play essential roles in ecosystem structuring and stability through both indirect and direct trophic effects. This review of the status, threats, and ecological importance of 31 largest mammalian carnivores globally includes gray wolf. In North America and Eurasia, cervid densities have been found to be nearly six times higher in areas without wolves than in areas with wolves and have been identified as the most important predator of cervids in the Northern Hemisphere.

Ripple, W.J., Beschta, R.L., Fortin, J.K. & Robbins, C.T. (2014). Trophic cascades from wolves to grizzly bears in Yellowstone. Journal of Animal Ecology, 83, 223–233.

Ripple et al., studied ecological conditions before and after wolf reintroduction in Yellowstone National Park to assess the impacts of reintroducing this apex predator, on various trophic levels of the ecosystem. This study highlights how top predators can drive trophic cascades that benefit other species, such as grizzly bears, elk populations, and riparian vegetation and contribute to ecosystem recovery and stability. The research emphasizes the critical role of apex predators in ecosystem dynamics and supports the value of predator conservation.

3. Management strategies

Benson, J. F., Mahoney, P. J., Wheeldon, T. J., Thompson, C. A., Ward, M. E., McLaren, A. A., ... & Patterson, B. R. (2024). Humans drive spatial variation in mortality risk for a threatened wolf population in a Canis hybrid zone. Journal of Applied Ecology.

Telemetry data from 438 canids in 141 packs was collected from 2002 to 2020 to investigate the influence of human activities on the spatial variation in mortality risk for eastern wolf populations within the "hybrid zone" surrounding Algonquin Provincial Park. The hybrid zone refers to a

three-species hybrid zone area where eastern wolves interbreed with other canis species including eastern coyotes and Great Lakes grey wolves.

The risk of mortality varies significantly across different regions within the hybrid zone. Areas with higher human population density and activity exhibit increased mortality rates for wolves. Within APP annual human-caused mortality from harvest and vehicles was low w (0.06), whereas annual human-caused mortality was higher in adjacent areas (0.31).

Takeaway: The study offers evidence-based recommendations for policymakers and conservationists to develop strategies that reduce human-induced mortality, promoting the survival and recovery of threatened wolf populations. Notably, researchers highlight that protecting eastern wolves from human-caused mortality would require a harvest ban for all canids, including coyotes.

Benson, J. F., Patterson, B. R., & Mahoney, P. J. (2014). A protected area influences genotype-specific survival and the structure of a Canis hybrid zone. Ecology, 95, 254–264.

This study analyzed the survival rates and mortality risk of different genotypes within a Canis hybrid zone. Eastern wolves survive well inside APP but are 3.5 times more likely to be harvested by trapping and shooting outside APP relative to sympatric coyotes and admixed canids. For all canids, harvest was the leading cause of death outside APP, dispersing canids survived poorly, and mortality was greater in areas of higher road density. Thus, eastern wolves dispersing from APP are especially vulnerable to harvest mortality.

Newsome, T.M., J.T. Bruskotter, and W.J. Ripple. (2015). When shooting a coyote kills a wolf: Mistaken identity or misguided management? Biodiversity and Conservation 24: 3145-3149. https://doi.org/10.1007/s10531-015-0999-0

Stricter regulations of coyote hunting were found to be an effective regulatory strategy for addressing and minimizing cases of mistaken identity in areas where endangered wolves may exist or recolonize. These management actions should be adopted more widely, and especially in areas where wolves are at low densities or recolonizing new areas. The study notes that appropriate education and training is needed to ensure that the public is aware that (i) wolves and coyotes are difficult to distinguish from a distance and (ii) coyotes are far too resilient to be affected by most periodic eradication programs, let alone from derbies or recreational hunting. We conclude that the recreational hunting of coyotes could restrict wolf recolonization while providing little benefit to animal agriculture.

Rutledge, L. Y., Patterson, B. R., Mills, K. J., Loveless, K. M., Murray, D. L., & White, B. N. (2010). Protection from harvesting restores the natural social structure of eastern wolf packs. Biological Conservation, 143(2), 332-339.

Protection of canis from hunting and trapping across species, both eastern wolves and eastern coyotes, restored the natural social structure of eastern wolves, directly influencing introgression with coyotes. Reduced anthropogenic mortality can restore the natural social structure of kin-based eastern wolf groups. Since the implementation of a harvest ban on both eastern coyote and eastern wolves in the region around Algonquin Provincial Park, human-caused mortality decreased (P = 0.000006) but has been largely offset by natural mortality, such that wolf density has remained relatively constant at approximately three wolves/100 km2. However, the number of wolf packs with unrelated adopted animals has decreased from 80% to 6% (P = 0.00003). Despite the high kinship within packs, incestuous matings were rare. Results indicate that even in a relatively large protected area, human harvesting outside park boundaries can affect evolutionarily important social patterns within protected areas.

4. Large carnivore habitat suitability and modeling in the Northeast, U.S.

van den Bosch, M., Beyer Jr, D. E., Erb, J. D., Gantchoff, M. G., Kellner, K. F., MacFarland, D. M., ... & Belant, J. L. (2022). Identifying potential gray wolf habitat and connectivity in the eastern USA. Biological Conservation, 273, 109708.

Carroll, Carlos. (2003). Impacts of Landscape Change on Wolf Viability in the Northeastern U.S. and Southeastern Canada: Implications for Wolf Recovery. Wildlands Project Special Paper No. 5. Richmond, VT: Wildlands Project. 31 pp.

Both van den Bosch et al 2022 and Carroll et al. 2003, demonstrate suitable habitat has been identified throughout the eastern U.S., including New York as well as potential dispersal corridors and habitat priority linkages for wolves to recolonize populations in the region. *Van den Bosch et al,* highlights the need for inter-jurisdictional cooperation to enhance cross-boundary wolf conservation and recolonization of suitable habitats.

Yovovich, V., Robinson, N., Robinson, H., Manfredo, M. J., Perry, S., Bruskotter, J. T., ... & Elbroch, L. M. (2023). Determining puma habitat suitability in the Eastern USA. Biodiversity and Conservation, 32(3), 921-941.

Yovovich et al., provided a habitat suitability analysis for another large carnivore, cougar, in the Eastern United States. Authors used a habitat suitability index to identify areas where cougars could sustain populations. They identified 17 potential habitat patches in the Upper Midwest, Ozarks, Appalachia, and New England, notably two habitat patches in New York that we're larger than 10,000 km², thereby large enough to likely support long-term cougar populations (these habitat patches were in the Catskill and Adirondack mountain regions).