December 13, 2022

Commissioner Christopher Herrick Christopher.Herrick@vermont.gov
Vermont Fish & Wildlife Department
1 National Life Drive
Montpelier, VT 05620

CC:

Wildlife Director Mark Scott (Mark.Scott@vermont.gov)
Program Manager David Sausville (David.Sausville@vermont.gov)
Governor Phil Scott (Sent via online contact form)

Re: Protecting Wild Canids in Vermont

Dear Commissioner Herrick,

We are writing on behalf of the Northeast Wolf Recovery Alliance, a newly created alliance of individuals and professional organizations who have been working for decades to facilitate the recovery of wolves throughout the Northeastern U.S. and eastern Canada. We recently received public records from your agency in response to a Public Records Act request regarding wolves in Vermont (see attached request dated August 28th, 2022 for reference). Thank you for the information.

We are now aware of at least two and likely three or more wolves killed in Vermont based on morphology and limited DNA data. They include 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 (see Endnotes 1, 2, and 3). In addition, a fourth possible wolf was reportedly killed by Vermont resident and hunter Steven Kimball. On August 16, 2022, John Glowa submitted a Public Records Act request regarding this animal (for details on this animal, please see this article in the footnote from VT Digger (Endnote 4). The alleged hunter acknowledged killing the animal and stated that a state biologist took samples of the animal for analysis. In her August 23rd, 2022 response to the Public Records Act request, Catherine Gjessing stated that the Department "…has no records responsive to the request."

Much of the information contained in the Department's Public Records Act in response to our request dated August 28th, 2022 has generated a number of questions and concerns. These include:

1) Does the U.S. Fish and Wildlife Service have a protocol for state agencies to respond to reports of possible live or dead wolves? If yes, what is this protocol and is Vermont following it?
2) Are there any federal standards for the DNA analysis of possible dead wolves? If yes, is Vermont adhering to these standards?

3) Did your agency report the 2013 North Hero canid to the U.S. Fish and Wildlife Service? If not, why?
4) Does the State of Vermont have a protocol for dealing with wolf sighting reports and possible dead wolves? If yes, what is that protocol?
5) Will Vermont consider resubmitting samples from the above named canids to another lab or labs capable of identifying these canids? A case in point is the 2013 North Hero canid, samples of which were sent to Northeastern Wildlife Genetics, Inc. Their report indicated that they analyzed only mitochondrial DNA and subsequently they were unable to identify the canid.
6) What is the status of implementation of Vermont's 2015 Wildlife Action Plan with regard to wolves?

At your earliest convenience, we request a meeting with your agency to discuss wolves and how Vermont can institute new policies relating to large wild canids in an effort to work towards wolf recovery in the Northeast United States. Multiple instances where hunters kill animals they claim they thought were very large coyotes, but which turn out to be wolves, suggest that one new policy should be to regulate coyote hunting with a limited season and required reporting.

The Northeast Wolf Recovery Alliance also recommends the following regulatory actions to ensure the future of wolf recovery in Vermont, including the full enforcement of legal protections for wolves provided by the federal Endangered Species Act and constructive participation in a national wolf recovery plan.

Regulatory Actions

In order to reach a middle ground between complete legal protection for all wild canids—which would provide the greatest protection for wolves—and current regulations allowing an open coyote season with no bag limit or reporting, we ask that Vermont Fish and Wildlife Department amend its regulations to institute the following protective procedures:

1. Regulate and limit the current open season on coyotes by establishing a limited hunting season from October 1st – December 31st.
2. All canids killed in Vermont should be checked-in, similar to the check-in requirement that currently exists for deer and bear. Canids taken by hunting or trapping should be tagged and possession of untagged canids should be prohibited and penalized. This requirement will provide better regulation and needed data on the numbers, sizes and characteristics of canids being taken in Vermont.
3. Checked-in canids that meet certain regulatory criteria (e.g., weight, size, canine spread, head and ear size) should be subjected to a DNA analysis to assess the genetic composition of the animal. This will provide critical data concerning the genetic makeup of large canids in Vermont and will identify wolves that are taken. The results of all DNA analyses performed on checked-in canids should be made available to the public annually

on the Department's website. The state should work with canid experts to use reputable labs that have prior experience genotyping hybridized canids in the eastern United States.

4. A two-year canid hunting moratorium should be imposed as soon as possible within the geographic area where a wolf kill has been documented. This measure is critical to protect other wolf pack members that may be present in the area. It may also deter hunters from taking large wolf-like canids in order to avoid the possibility that the take of a wolf will trigger a canid hunting moratorium.
5. Night hunting of "coyotes" should be prohibited due to the fact that hunting in nighttime conditions makes field identification of canid size exceptionally difficult. Additionally, the coyote hunting season should be shortened, and bag limits should be established. It should be recognized that eastern coyotes are already >25% wolf and this can confuse the general public in differentiating existing hybridized canids (aka eastern "coyotes") from wolves. Essentially, this similarity can create situations where people kill a small wolf (e.g., 60-65 pounds) thinking it was a large coyote.
6. Vermont's new wanton-waste law should be strictly enforced for all canids, similar to other animals, to ensure that their bodies are being used after being checked in (see #2). This requirement will ensure minimal waste of ecologically important predators, and will better adhere to the North American Model of Wildlife Management.

Wolves are federally protected under the Endangered Species Act throughout most of the lower 48 United States, including Vermont. Recently, the Center for Biological Diversity filed legal action against the U.S. Fish and Wildlife Service to seek a national wolf recovery plan; the lawsuit specifically notes the Northeastern U.S. as being one of several regions of the country where suitable wolf habitat exists and where wolves could thrive if protections are enforced and recovery measures undertaken. (See Endnote 5). In addition to the wolves we have described that were killed in Vermont in the past 25 years, there is growing evidence of wolf recolonization attempts in other states across the Northeast. Similar documented events have occurred in New York, Maine, Massachusetts, and south of the St. Lawrence River only 20 miles from the Maine/New Hampshire border. (See Endnote 6). Wolves are attempting to reestablish in the Northeast. But without state and federal actions to protect these dispersers, the killing of individual wolves will continue, and wolves will not be able to gain a toehold here, especially considering our existing canid is a coyote-wolf hybrid that can look very similar to full-bodied wolves. It is time to begin a collaborative effort to facilitate wolf recovery and its concomitant ecological and social benefits. We look forward to hearing from you in the very near future.

Sincerely,

Renee Seacor, JD
Northeast Wolf Recovery Alliance, Lead
Carnivore Conservation Advocate
Project Coyote & The Rewilding Institute

Sent on behalf of the Northeast Wolf Recovery Alliance Members:

Chris Amato
Conservation Director and Counsel
Protect the Adirondacks

Joseph S. Butera,
President & Co-founder
Northeast Ecological Recovery Society

Tom Butler,
Senior Fellow
Northeast Wilderness Trust

Jackie Bowen
Conservation Director
Adirondack Council

Brenna Galdenzi
President
Protect Our Wildlife, Vermont

Adam DeParolesa
President/Founder
Northeast Wolf Refuge

David Gibson
Managing Partner
Adirondack Wild: Friends of the Forest Preserve

John M. Glowa, Sr.,
President
The Maine Wolf Coalition, Inc.

Michelle Lute, PhD
Carnivore Conservation Director
Project Coyote

Jennifer Rosado, MS
Biological Field Technician
Maine Wolf Coalition

Christine Schadler, MS
Project Coyote Representative, Vermont & New Hampshire
Founder, New Hampshire Wildlife Coalition

Christopher Spatz
Coordinator, Wolf Species Conservation Report
2015 Vermont Wildlife Action Plan

Zee Soffron
Director
North American Wolf Foundation

Amaroq Weiss, MS, JD
Senior Wolf Advocate
Center for Biological Diversity

Jonathan Way, Ph.D.
Founder, Eastern Coyote/Coywolf Research
Author of *Coywolf: Eastern Coyote Genetics, Ecology, Management, and Politics*

ENDNOTES

Endnote 1 - In November 1998, Eric Potter shot and killed an apparent 72-pound male wolf in Glover, Vermont (Zimmerman 2005). This animal was killed approximately twenty miles southeast of where a possible wolf was killed in Vermont in October 2006 (see below, #8). An analysis of its mitochondrial DNA conducted at the University of California at Los Angeles (UCLA) as noted in an undated letter from Jennifer Leonard of UCLA to Thomas Decker of the Vermont Dept. of Fish and Wildlife concluded, "…the control region of the mitochondria was amplified and 6 sequenced…(and the)…sequence matches that of the wolf (Canis lupus lycaon) endemic to the north east of the United States, and the south east of Canada…." The DNA of this animal was later analyzed by the USFWS. In a letter dated January 16, 2002 from Dyan J. Straughan, Forensic Specialist at the National Fish and Wildlife Forensics Laboratory, to Thomas Decker, Ms. Straughan stated, "The mitochondrial DNA type of this canid is most similar to that of coyote standards, but has also been observed in grey wolves in Southeastern Canada and Northeastern United States." The actual examination results (Genetics Examination Report dated January 16, 2002) for mitochondrial DNA were as follows, " The mtDNA sequence of item LAB-2 differed significantly from reference mtDNAs of domestic dogs, red wolf (Canis rufus), grey wolf and fox, but was most similar to the mtDNA of coyote reference standards." The results for Nuclear DNA were as follows, "The STR genotype of LAB-2 was intermediate between the coyote and Alaskan malamute reference samples included in the analysis." We, the petitioners, respectfully disagree with and hereby challenge the USFWS' interpretation of its DNA data regarding this animal. We refer to a November 26, 2001 email from Dr. Paul Wilson of the Natural Resources DNA Profiling & Forensic Center at Trent University in Ontario, Canada to Walter Jakubas, wildlife biologist with the Maine Dept. of Inland Fisheries and Wildlife. In his email, Dr. Wilson wrote, "The interpretation of the data depends on what evolutionary model one uses as a framework. All of the laboratories may generate exactly the same DNA sequence (sic). A mtDNA from lycaon will be interpreted as a coyote if the facility does not consider the newly proposed evolution of the eastern timber wolf/red wolf. The USFWS may not have classified their DNA sequences with a second North American wolf species in mind. The UCLA and USFWS results are entirely consistent with each other. We can all have the

same databases and standardized approaches but the interpretation will always be laboratory-dependent." To our knowledge, the State of Vermont has never officially acknowledged that the subject canid was not a wolf and they continue to question the DNA assessment generated by the USFWS. We refer to an October 24, 2003 email from Kim Royar, wildlife biologist with the Vermont Department of Fish and Wildlife, to Michael Amaral, a USFWS biologist in Concord, New Hampshire. Ms. Royar writes, "As far as we are concerned the genetic background of this animal is still unclear. We did send samples to 3 labs: UCLA, Ashland (USFWS), and Ontario (Wilson). UCLA extracted mitochondrial DNA and determined that the sequence matched that of "Canis lupus lycaon". The mitochondrial results from Ashland suggested coyote but they only used 1 coyote reference and I'm not sure if any of their wolf references were from Canis lycaon (or from eastern Canada). Their nuclear DNA test suggested coyote and Alaskan malamute. I did review these results with a geneticist from UVM who felt their reference sizes were pretty low and suggested I ask for log likelihood scores…. They were not able to supply me with this information. I have yet to hear from Wilson." "Anyway, you can see why we are still holding off regarding the labeling of this animal." We, the petitioners, encourage additional DNA analyses of this animal and we maintain that the animal was a wolf, consistent with the aforementioned legal precedent for wolves in the Western Great Lakes DPS and known morphometric ranges for wolves.

Endnote 2 - On or about October 1, 2006, Charles L. Hammond of Newport Center, Vermont shot and killed a 91-pound male wolf in North Troy, Vermont. The animal was killed within twenty miles of a wolf pack that was being monitored by "wildlife workers" in Quebec, just north of the Vermont border (Harrigan 2005). We know of no evidence that the Vermont Fish & Wildlife Department, the USFWS, or the government of Quebec took actions to protect these animals. According to the Veterinary Medical Examination Report dated June 29, 2007, "The large canid carcass is a gray wolf according to both morphological and genetic studies." Furthermore, according to a September 18, 2007 email from Dr. Roland Kays of the New York State Museum, this animal had "…the exact same mtDNA sequence…" as the the wolf killed by Russell Lawrence in 2001. The fact that both animals had the same mtDNA sequence may be evidence of a breeding population of wolves south of the St. Lawrence River. On October 9, 2007, the Vermont Agency of Natural Resources issued a press release which falsely claimed that, "The lab concluded that this animal was of captive origin." In fact, the National Fish and Wildlife Forensics Laboratory concluded in its June 27, 2007, Genetics Examination Report that this "…male gray wolf is most likely of domestic origin." A cover letter from the laboratory dated June 29, 2007, stated that, "…the animal is a gray wolf but perhaps from a domesticated origin." The Vermont press release made no mention of the mtDNA match of the Vermont wolf with the 2001 New York wolf. It also made no mention of the October 5, 2006, email from Canadian Field Research Scientist Brent Patterson of Ontario's Trent University that the face of the animal had "clear features of eastern wolves (but the over-all size and mass more typical of gray wolves)." The June 27, 2007 Genetics Examination Report from the Service stated that the mtDNA sequence was "…identical to the mtDNA of gray wolf reference standards found…in the western Great Lakes States DPS…." It also stated that the "…STR genotype…is most similar to gray wolf reference standards from the northern Rocky Mountain DPS" and that the "…Y-STR haplotype…is similar to that observed among gray wolves from…the Western Great Lakes DPS…(h)owever, the…haplotype is unique and has not been observed in our database." We question and challenge any opinion/conclusion that this animal was "most likely of domestic

origin" given its morphology, DNA, and diet (whitetailed deer) and we disagree with this opinion, given the animal's matrilineal relationship to the wolf killed in New York in 2001. As noted in the Service's Report of Investigation, INV #: 2006505308 Report #3, "If the animal is determined to be a wolf it seems unlikely under the circumstances that federal prosecution would be sought pursuant to United States v. McKittrick. The subject indicated (he) believed the animal to be a coyote at the time (he) was pursuing it." This is precisely why the commerce or taking of coyotes and wolf/coyote hybrids needs to be regulated due to their similarity of appearance to wolves, especially given the documented large body size of eastern coyotes (Way and Proietto 2005, Way 2007). Simply saying that you "thought the animal was a coyote" serves as a blank check when it comes to killing wolves. Mr. Hammond was subsequently not prosecuted for killing the animal. The McKittrick Instruction itself needs to be re-visited. It mistakenly requires that the killer of an endangered species must have known its biological identity before prosecution can take place.

Endnote 3 – In the Fall of 2013, a 78-pound canid was killed in North Hero, Vermont by Ray Beavolin. The Vermont Fish and Wildlife Department sent tissue samples of this animal to Northeastern Wildlife Genetics, Inc. of Fairfax, Vermont. Only the animal's mitochondrial DNA was analyzed. Further analysis is required to determine the identity of the animal. Morphologically eastern coyotes weigh between 30-50lbs and 78-pound coyote is highly unlikely. (See attachment of report from Northeastern Wildlife Genetics, Inc.)

Endnote 4 - https://vtdigger.org/2022/07/26/dna-test-identifies-wolf-in-new-york-raises-questions-about-presence-of-population-in-northeast/

Endnote 5 - https://www.biologicaldiversity.org/campaigns/gray_wolves/pdfs/Wolf-National-Recovery-Plan-Status-Review-Complaint-11-28-2022.pdf

Endnote 6 - ESApetition2009final.pdf (easterncoyoteresearch.com)

Public Records Act Request - Sent by Renee Seacor on August 28th, 2022

We are seeking all agency records, from January 1, 2000, to the present date of this request, within the agency and with any party or entity external to the agency regarding and relating to:

(1) any sightings or killings of canid species including eastern coyotes, wolves, and hybrids that were reported to the Vermont Department of Fish and Wildlife (VT DFW) because of large size, wolf like appearance, or thought or believed to be a wolf;
(2) any canid genetic samples taken by VT DFW as a result of these reports or agency field surveys;
(3) VT DFW's assessment of canid genetics within the state of Vermont, including but not limited to the hybridization of eastern coyote populations with wolves
(4) any VT DFW scientific analyses, field studies, and modeling of potential population recovery regarding wolf species.

"Records" refers to, but is not limited to, documents, correspondence (including, but not limited to, inter and/or intra-agency correspondence as well as correspondence with entities or individuals outside the state government), emails, letters, notes, recordings, telephone records, voicemails, telephone notes, telephone logs, text messages, chat messages, minutes, memoranda, comments, files, presentations, consultations, biological opinions, assessments, species assessments, DNA analysis, genetic analysis, forensic analysis, evaluations, schedules, papers published and/or unpublished, reports, studies, photographs and other images, data (including raw data, GPS or GIS data, UTM, LiDAR, etc.), maps, and/or all other responsive records, in draft or final form.

Please provide all records in a readily accessible, electronic .pdf format. "Readily accessible" means text-searchable and OCR-formatted. We hereby request that you produce all records in an electronic format and in their native file formats. Additionally, please provide the records in a load-ready format with a CSV file index or Excel spreadsheet. If you produce files in .PDF format, then please omit any "portfolios" or "embedded files." Portfolios and embedded files within files are not readily accessible. Please do not provide the records in a single, or "batched," .PDF file. We appreciate the inclusion of an index.

To the extent any of the requests are deemed burdensome, vague, or ambiguous, please feel free to contact me, or have your attorney contact me, and I will be happy to discuss any such issues in hopes of facilitating these requests. Thank you for your prompt consideration and attention to this request. Please contact me if you need to discuss this request further.

Fee Waiver Requested. Project Coyote is a non-profit 501(c)(3) organization that disseminates and uses information to advance the interests of animals through science, education, and advocacy. Disclosure of the requested information is in the public interest and is not being sought for commercial purposes. In the event that the fee waiver request is denied, please inform me if the cost for searching or copying these records will exceed $50 before incurring such costs; otherwise please forward an invoice to me for payment of the actual costs and we will pay it promptly.

If you deny any or all of this request, please cite each specific exemption you rely upon to justify the refusal to release the information and notify me of the appeal procedures available to Project Coyote under the law.

To the extent any of the requests are deemed burdensome, vague, or ambiguous, please feel free to contact me, or have your attorney contact me, and I will be happy to discuss any such issues in hopes of facilitating these requests.

Thank you for your prompt consideration and attention to this request. Please contact me if you need to discuss this request further.

Northeastern Wildlife Genetics, Inc.

C. William Kilpatrick, Ph.D
763 Goose Pond Rd.
Fairfax, VT 05454

Genetic Analysis Report

Tissue (skin) from a large canid (78 lbs) shot in North Hero, Vermont by Ray Beavolin in the fall of 2013 was provided to the lab by Chris Bernier (VFWD) and was catalogued as sample NEWG-31. DNA (NEWG-31) was extracted from a small portion of the tissue sample using a Gentra DNA extraction kit and produced a yield of 44.98 ng/ul. The first part of the cytochrome *b* gene was amplified (78-F13) with primers L-14115 and H-14541 and sequenced with the forward primer (L-14115).

Comparison of the cytochrome *b* sequence (401 bases) amplified (78-F13) from DNA (NEWG-31) with sequences of several species of Canids, including the North Troy canid (NEWG-12) is shown below. Note: Blast search initially identified unknown (NEWG-31) as either a sequence from a coyote (*Canis latrans*) or a small Canadian wolf (*Canis lycaon*). The Blast search resulted in matches (100% identical) of the cytochrome *b* sequence from NEWG-31 with 5 sequences from coyotes available in GenBank (KF662096, DQ480509, DQ480510, DQ480511, & EU789789) provided by Bjornerfeldt et al. (2006), Pang et al. (2009) and Thalmann et al. (2013) and a single sequence reported to be from a small Canadian wolf (JF342907) from an unpublished submission. Aligned sequences below show mismatches highlighted in red and matches at those sites highlighted in blue:

Conclusion: The cytochrome b sequence amplified (78-F13) from the DNA (NEWG-31) extracted from the skin collected from a 78 pound canid shot in North Hero produced a 100% match with reference sequences from five coyotes (*C. latrans*) obtained from GenBank and four coyotes from Vermont (unpublished data). In addition, this sequence provided a 100% match with a sequence reported to be from a small Canadian wolf (C. lycaon) from GenBank (JF342097) from an unpublished submission. At present this is the

Cytochrome *b*

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                                                                      50
Dog             atgaccaaca ttcgaaaaac acacccacta gccaaaattg ttaataactc
Wolf-1          atgaccaaca ttcgaaaaac acacccacta gccaaaattg ttaataactc
Wolf-2          nngaccaaca ttcgaaaaac acacccacta gccaaaattg ttaataactc
NEWG-12         ATGACCAACA TTCGAAAAAC ACACCCACTA GCCAAAATTG TTAATAACTC
N_Hero                  A TTCGNAAAAC TCACCCACTA GCCAAAATTG TTAATAACTC
C rufus         atgaccaaca ttcgaaaaac acacccacta gccaaaattg ttaataactc
C rufus         atgaccaaca ttcgaaaaac tcacccacta gccaaaattg ttaataactc
C lycaon        atgaccaaca ttcgaaaaac tcacccacta gccaaaattg tcaataactc
C latrans 1     atgaccaaca ttcgaaaaac tcacccacta gccaaaattg tcaataactc
CanVT-5         atgaccaaca ttcgaaaaac tcacccacta gccaaaattg ttaataactc
CanVT-4         atgaccaaca ttcgaaaaac tcacccacta gccaaaattg tcaataactc
CanVT-3         atgaccatca ttcgaaaaac tcacccactn gccaaaattg tcaataactc
CanVT-2         atgaccaaca ttcgaaaaac tcacccacta gccaaaattg ttaataactc
C latrans 2     atgaccaaca ttcgaaaaac tcacccacta gccaaaattg ttaataactc

                                                                     100
Dog             attcattgac ctcccagcgc cttctaacat ctctgcttga tggaattcg
Wolf-1          attcattgac ctcccagcgc cttctaacat ctctgcttga tggaattcg
Wolf-2          attcattgac ctcccagcgc cttctaacat ctctgcttga tggaattcg
NEWG-12         ATTCATTGAC CTCCCAGCGC CTTCTAACAT CTCTGCTTGA TGGAATTCG
N_Hero          ATTCATTGAC CTCCCAGCGC CATCTAACAT CTCTGCTTGA TGGAATTTCG
C rufus         attcattgac ctcccagcgc cttctaacat ctctgcttga tggaattcg
C rufus         attcattgac ctcccagcgc catctaacat ctctgcttga tggaatttcg
C lycaon        attcattgac ctcccagcgc catctaacat ctctgcttga tggaatttcg
C latrans 1     attcattgac ctcccagcgc catctaacat ctctgcttga tggaatttcg
CanVT-5         attcattgac ctcccagcgc catctaacat ctctgcttga tggaatttcg
CanVT-4         attcattgac ctcccagcgc catctaacat ctctgcttga tggaatttcg
CanVT-3         attcattgac ctcccagcgc catctaacat ctctgcttga tggaatttcg
CanVT-2         attcattgac ctcccagcgc catctaacat ctctgcttga tggaatttcg
C latrans 2     attcattgac ctcccagcgc catctaacat ctctgcttga tggaatttcg

                                                                     150
Dog             gatccttact aggagtatgc ctgattctac agattctaac aggtttatt
Wolf-1          gatccttact aggagtatgc ctgattctac agattctaac aggtttatt
Wolf-2          gatccttact aggagtatgc ctgattctac agattctaac aggtttatt
NEWG-12         GATCCTTACT AGGAGTATGC CTGATTCTAC AGATTCTAAC AGGTTTATT
N_Hero          GATCCTTGCT AGGAGTATGC CTGATTCTAC AGATTCTAAC AGGTTTATTT
C rufus         gatccttact aggagtatgc ctgattctac agattctaac aggtttatt
C rufus         gatccttgct aggagtatgc ctgattctac agattctaac aggtttattt
C lycaon        gatccttgct aggagtatgc ctgattctac agattctaac aggtttattt
C latrans 1     gatccttgct aggagtatgc ctgattctac agattctaac aggtttattt
CanVT-5         gatccttgct aggagtatgc ctgattctac agattctaac aggtttattt
CanVT-4         gatccttgct aggagtatgc ctgattctac agattctaac aggtttattt
CanVT-3         gatccttgct aggagtatgc ctgattctac agattctaac aggtttattt
CanVT-2         gatccttgct aggagtatgc ctgattctac agattctaac aggtttattt
C latrans 2     gatccttact aggagtatgc ctgattctac agattctaac aggtttattt

                                                                     200
Dog             ttagctatgc actatacatc ggacacagcc acagcttttt catcagtcac
Wolf-1          ttagctatgc actatacatc ggacacagcc acagcttttt catcagtcac
Wolf-2          ttagctatgc actatacatc ggacacagcc acagcttttt catcagtcac
NEWG-12         TTAGCTATGC ACTATACATC GGACACAGCC ACAGCTTTTT CATCAGTCAC
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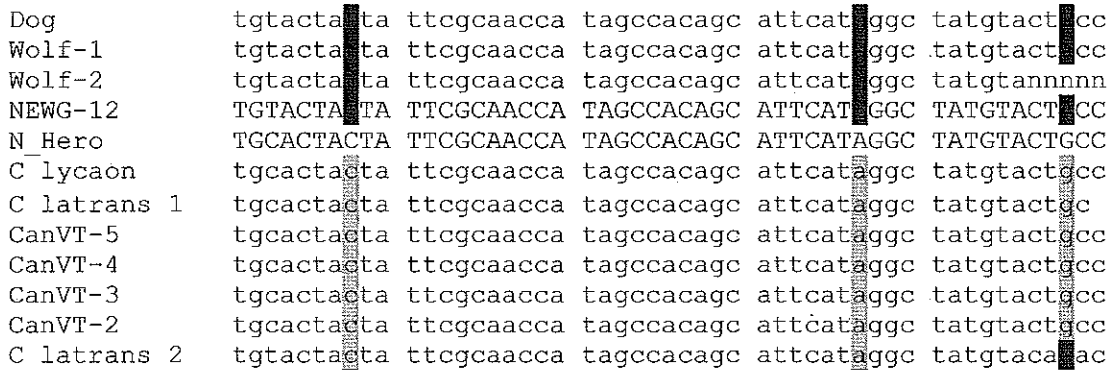
N_Hero          TTAGCTATAC ACTATACATC GGACACAGCC ACAGCTTTTT CATCAGTCAC
C rufus         ttagctatgc actatacatc ggacacagcc acagcttttt catcagtcac
C rufus         ttagctatac actatacatc ggacacagcc acagcttttt catcagtcac
C lycaon        ttagctatac actatacatc ggacacagcc acagcttttt catcagtcac
C latrans 1     ttagctatac actatacatc ggacacagcc acagcttttt catcagtcac
CanVT-5         ttagctatac actatacatc ggacacagcc acagcttttt catcagtcac
CanVT-4         ttagctatac actatacatc ggacacagcc acagcttttt catcagtcac
CanVT-3         ttagctatac actatacatc ggacacagcc acagcttttt catcagtcac
CanVT-2         ttagctatac actatacatc ggacacagcc acagcttttt catcagtcac
Coyote          ttagctatac actatacatc ggacacagcc acagcttttt catcagtcac

                                                                   250
Dog             ccacatctg  cgagacgtta actacggctg aattatccgc ta at ca g
Wolf-1          ccacatctg  cgagacgtta actacggctg aattatccgc ta at ca g
Wolf-2          ccacatctg  cgagacgtta actacggctg aattatccgc ta at ca g
NEWG-12         CCACATCTG  CGAGACGTTA ACTACGGCTG AATTATCCGC TA AT CA G
N_Hero          CCACATCTGT CGAGACGTTA ACTACGGCTG AATTATCCGC TACATACATG
C rufus         ccacatctg  cgagacgtta actacggctg aa
C rufus         ccacatctgt cgagacgtta actacggctg aa
C lycaon        ccacatctgt cgagacgtta actacggctg aattatccgc tacatacatg
C latrans 1     ccacatctgt cgagacgtta actacggctg aattatccgc tacatacatg
CanVT-5         ccacatctgt cgagacgtta actacggctg aattatccgc tacatacatg
CanVT-4         ccacatctgt cgagacgtta actacggctg aattatccgc tacatacatg
CanVT-3         ccacatctgt cgagacgtta actacggctg aattatccgc tacatacatg
CanVT-2         ccacatctgt cgagacgtta actacggctg aattatccgc tacatacatg
C latrans 2     ccacatctgt cgagacgtta actacggctg aattatccgc tacatacatg

                                                                   300
Dog             caaatggcgc ttccatattc tttat tg c tattc taca tgt ggacga
Wolf-1          caaatggcgc ttccatattc tttat tg c tattc taca tgt ggacga
Wolf-2          caaatggcgc ttccatattc tttat tg c tattcataca tgt ggacga
NEWG-12         CAAATGGCGC TTCCATATTC TTTAT TG C TATTC TACA TGT GGACGA
N_Hero          CAAATGGCGC TTCCATATTC TTTATTTGTC TGTTCATACA TGTGGGACGA
C lycaon        caaatggcgc ttccatattc tttattgttc tgttcataca tgtgggacga
C latrans 1     caaatggcgc ttccatattc tttatttgtc tgttcataca tgtgggacga
CanVT-5         caaatggcgc ttccatattc tttatttgtc tgttcataca tgtgggacga
CanVT-4         caaatggcgc ttccatattc tttatttgtc tgttcataca tgtgggacga
CanVT-3         caaatggcgc ttccatattc tttatttgtc tgttcataca tgtgggacga
CanVT-2         caaatggcgc ttccatattc tttatttgtc tgttcataca tgtgggacga
C latrans 2     caaatggcgc ttccatattc tttatttgtc tgttcataca tgtgggacga

                                                                   350
Dog             ggcctata t acggatccta tgtattcata gaaacatgaa acattggaat
Wolf-1          ggcctata t acggatccta tgtattcata gaaacatgaa acattggaat
Wolf-2          ggcctata t acggatccta tgtattcata gaaacatgaa acattggaat
NEWG-12         GGCCTATA T ACGGATCCTA TGTATTCATA GAAACATGAA ACATTGGAAT
N_Hero          GGCCTATACT ACGGATCCTA TGTATTCATA GAAACATGAA ACATTGGAAT
C lycaon        ggcctatact acggatccta tgtattcata gaaacatgaa acattggaat
C latrans 1     ggcctatact acggatccta tgtattcata gaaacatgaa acattggaat
CanVT-5         ggcctatact acggatccta tgtattcata gaaacatgaa acattggaat
CanVT-4         ggcctatact acggatccta tgtattcata gaaacatgaa acattggaat
CanVT-3         ggcctatact acggatccta tgtattcata gaaacatgaa acattggaat
CanVT-2         ggcctatact acggatccta tgtattcata gaaacatgaa acattggaat
C latrans 2     ggcttatact acggatccta tgtattcata gaaacatgaa acattggaat

                                                                   400
```



Reference Material (Cytochrome *b*):

Canis familiaris (Dog)	GenBank X94920
Canis lupus (Wolf-1)	GenBank DQ480505 (Old World)
Canis lupus (Wolf-2)	GenBank AF028141 (Canada)[1]
Canis rufus-1 (Red wolf)	GenBank U47042 (Pre-1940)[2]
Canis rufus-2 (Red wolf)	GenBank U47047
Canis lycaon (small Canadian Wolf)	GenBank JF342907 (unpub.)[3]
Canis latrans -1 (Coyote)	GenBank KF661096 (USA)[4]
Canis latrans -2 (Coyote)	GenBank AF028140 (396 bp)[1]
CanVT-2 through CanVT-5	Vermont Coyotes (unpub. data)

1. Wayne et al. (1997)
2. Roy et al. (1996) Cru-1 clusters with *C. lupus* & Cru-2 clusters with *C. latrans*
3. D. L. Imes and N. B. Sacks
4. Thalmann et al. (2013)

only sequence available from a small Canadian wolf and it is not clear that northeastern coyotes and small Canadian wolves can be differentiated on the basis of this genetic marker. It is clear, however, that the sequence of the large canid shot in North Hero is from a canid from the coyote-red wolf-small Canadian wolf lineage and not from the traditional wolf lineage. The cytochrome *b* sequence examined from this large canid shows about a 4% (16/401) sequence divergence from the taxa of the wolf lineage (*C. lupus* and *C. familiaris*) and only a 0% - 2.6% (6/232) from taxa of the coyote lineage (*C. latrans*, *C.rufus*, and *C. lycaon*). This cytochrome *b* sequence is the sequence commonly found in coyotes sampled from Vermont and at this point there is no evidence to indicate that this large canid represents anything other than a large northeastern coyote.

I have compared the entire mitochondrial genomes (16,500 bases) taken from GenBank among a couple of coyotes (*C. latrans*) and a small Canadian wolf (*C. lycaon*) and there appears to be several difference in a couple of mtDNA genes that might be useful in differentiating these two taxa. Future work could include comparison of sequences from one of these genes (ND2) to determine it utility in differentiating these two taxa.

C. William Kilpatrick, Director
Northeastern Wildlife Genetics, Inc.

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