Science Policy Initiative at UVA
Direct Advocacy Committee
Olsson Hall, Room 286
151 Engineers Way
PO Box 400336
Charlottesville, VA 22904
spiatuva@gmail.com

Cindy Schulz, Field Supervisor
Virginia Field Office
U.S. Fish and Wildlife Service (USFWS)
6669 Short Lane
Gloucester, VA 23061

July 4, 2020
SPI-DAC comments on ACP impacts on at-risk species

Dear Ms. Schulz:

This letter outlines our concerns about impacts of the Atlantic Coast Pipeline and Supply Header Project (ACP) on at-risk species in West Virginia, Virginia, and North Carolina. These concerns are the result of analysis completed by the Science Policy Initiative - Direct Advocacy Committee (SPI-DAC). SPI-DAC is a graduate student organization dedicated to reviewing and synthesizing science relevant to environmental issues. Analysts on this project are science and engineering PhD students with expertise in ecology, evolution, and hydrology.

SPI-DAC has spent the past five months developing an independent scientific review of potential impacts of the ACP on at-risk species. We identified all Endangered Species Act (ESA) listed species with habitat ranges crossed by the ACP proposed route, reviewed scientific literature regarding the sensitivity and life cycle of these species, and examined the ACP strategies for mitigating impacts to those species.

We highlight conclusions which we consider to be insufficiently supported in the mitigation strategies presented in the ACP Final Environmental Impact Statement (FEIS). We also identify species which are omitted from the FEIS and the 10/16/2017 and 9/11/2018 Biological Opinions (BOs) despite credible risks of impacts. We do not consider this an exhaustive analysis of all potential species impacts but we do hope these issues will be considered in your ESA Section 7 review.

We acknowledge the immense effort by federal agencies to ensure that ACP impacts to at-risk species are mitigated. We hope that our comments are helpful in your effort

towards accomplishing this. We are happy to discuss our findings in more detail if we can be of greater service.

Sincerely,

SPI-DAC members:

Linnea Saby, ls3en@virginia.edu
University of Virginia,
Engineering Systems & Environment
Corresponding Author

Alyssa Bangerter, ab5dr@virginia.edu
University of Virginia,
Biology

Kerry Gendreau, kerryg@vt.edu
Virginia Tech,
Biological Sciences

Daniel Smith, dsmith36@vt.edu
Virginia Tech,
Biological Systems Engineering

Isaac VanDiest, ivandiest@vt.edu
Virginia Tech,
Biological Sciences

Joshua M. Rady, jmrady@vt.edu
Virginia Tech,
Forest Resources & Environmental Conservation

PART 1: Species impacted by increased sedimentation from ACP

Expected increases in baseline sedimentation rates were documented in the ACP Final Environmental Impact Statement (FEIS). In the Monongahela National Forest and George Washington National Forest, sedimentation modeling of subwatersheds crossed by the ACP indicate annual soil loss to be 200 to 800 percent above baseline erosion during the first year of construction (FERC, 2017). This substantial increase in sedimentation was determined even though model results accounted for "the implementation of soil erosion devices, such as water diversion bars and standard silt fencing, [which were assumed to] reduce erosion by 96 percent" (FERC, 2017, pp. 4-240). The 96 percent erosion control efficiency rate has been criticized by the Forest Service as inappropriate for steep slope pipeline construction (4th Circuit, 2018). We share the concerns that have been raised about sedimentation control efficiency rates. If modeled results are modified with a more conservative erosion control efficiency rate, expected sedimentation would increase further in National Forest lands and across the entire ACP route.

Increased sedimentation, even at anticipated rates, would put vulnerable species at further risk of harm. Sedimentation has been known to cause a myriad of ecological issues in freshwater streams for years (Henley et al., 2000). The impact of sedimentation on reducing primary production is significant, and it therefore impacts multiple trophic levels (Couceiro, et al., 2010). However, for the purposes of this analysis we primarily focus on the direct and immediate effects of sedimentation on aquatic species viability. In the mid-1990s the EPA declared that siltation is the greatest contributor to water quality degradation, and that it can drastically reduce the number of invertebrates that can persist in a given stream (EPA, 1994). Additionally, once the particulate is deposited on the stream bed, further direct effects on the reproduction of aquatic organisms occur. This is in conjunction with altered behavior and physiology that can increase the likelihood of extirpation (Kjelland, et al., 2015). Areas with existing sediment-based impairments may have these problems compounded by additional sedimentation caused by ACP. We have identified multiple endangered species in our analysis that are particularly at risk to the increased sedimentation levels that could result from the ACP construction.

1.1 Candy Darter (Endangered)

Candy darters (*Etheostoma osburni*) are short-lived small bodied freshwater fish that were declared federally endangered in 2018. They occupy streams in VA, WV, and NC. This species is currently facing two major threats. First is hybridization with the introduced variegated darter (*Etheostoma variatum*) that can outcompete candy darters

over both food resources and mating opportunities. The second threat is habitat degradation. Darters in general are not able to tolerate dramatic increases in turbidity or sedimentation, as they are visual predators that also need porous streambeds to lay their eggs. If sedimentation is high enough, that section of stream can see a sharp decrease in vital rates due to lack of prey items, particularly benthic invertebrates, in addition to losing nest sites (Berkman and Rabeni, 1987). It is important to note that historically the greatest factor for their sharp decline was not hybridization, but habitat destruction, degradation, and fragmentation (USFWS, 2018).

This species was not included in the 2017 or 2018 BO, but was mentioned in the 2017 FEIS (before ESA listing), where a population was found 1.5 miles from an ACP access road. Additionally, the FEIS specifically mentions that in the case of the candy darter being listed as federally endangered the USFWS enhanced conservation measures would need to be applied to Knapp Creek, Clover Creek, Glade Run, Thomas Creek, and the Greenbrier River. The high potential for increased sedimentation load entering these water bodies has the ability to negatively affect individual behavior and fitness as well as population vital rates. The Fish and Wildlife Service also mentioned in their 2018 listing decision of the candy darter that degrading habitat, especially in ways that reduce reproduction, could violate section 9 of the Endangered Species Act.

1.2 Clubshell (Endangered)

The clubshell (*Pleurobema clava*) is a freshwater mussel that requires low sedimentation to eat, breath, and reproduce. While it was declared as endangered in 1993, as of today there are only 13 known populations of this species. One of these populations, known as the Hackers Creek population, is likely to be impacted by increased sedimentation from ACP construction upstream. In the 2018 Biological Opinion, there was no estimate of how long it would take to reduce sedimentation load to a level that will return the location of the Hackers Creek population back in to suitable habitat for clubshell; and there is admittance that it may never return to suitable levels of sedimentation. Extended periods of low fitness because of shifts in habitat quality could lead to extirpation of the population.

In addition, many of the mitigation measures to ensure further survival of the Hackers Creek clubshell population are salvage missions where clubshells are removed from their natural habitat into captivity. The initial salvage missions have instead resulted in the death of individuals in captivity (USFWS, 2019a). With the loss of these salvaged individuals, any survivors that remain become even more important for the potential survival of this population. Given the precarious position of the Hackers Creek population, any further reduction in water quality should be avoided.

1.3 Diamond Darter (Endangered)

Diamond darters (*Crystallaria cincotta*) have a similar life history to the candy darter, but are more imperiled. They have been federally listed as endangered since 2013 and are currently only known to occupy a section of the Elk River near Charleston, WV. Previously, they occupied waterways in OH, KY, WV, TN, and IN. Historic habitat destruction is the main reason for their decline, but currently water quality issues caused by chemical runoff and sedimentation are the most pressing risks (USFWS, 2013a).

The diamond darter was not present in the 2017 FEIS or the 2017 or 2018 BO. We feel the risks to this species should be closely considered. While they have not been detected near the proposed ACP route, they have been found downstream of multiple stream crossings along the proposed ACP route in Randolph and Pocahontas counties, both in WV. The ACP does cross their USFWS-identified habitat area, as shown in Figure 1. Increased sedimentation in these streams, as well as potential fertilizer runoff, are credible risks to this species that need to be assessed and mitigated by ACP. The 2013 USFWS diamond darter listing decision notes that water quality in Elk River tributaries is already poor due to sedimentation among other factors, and furthermore asserts that the tributaries directly affect water quality in the Elk River itself, including diamond darter critical habitat (USFWS, 2013a).

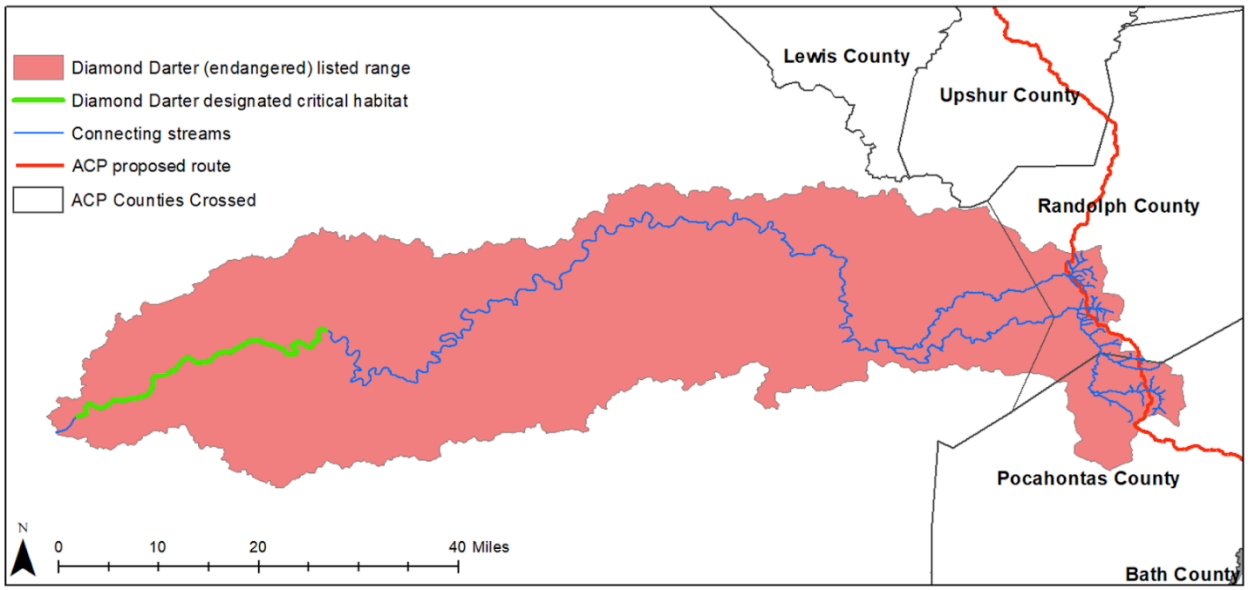

***Figure 1**. Selected National Hydrography Dataset (NHD) streams showing hydrologic connectivity between proposed Atlantic Coast Pipeline (ACP) route and diamond darter critical habitat. Six NHD stream crossings occur within the USFWS-identified habitat area for the Diamond darter, and other nearby waters may also be subject to increased sedimentation. This and all subsequent range shapefiles are sourced from the U.S. Fish and Wildlife Service Environmental Conservation Online System (ECOS).*

1.4 Madison Cave Isopod (Threatened)

The Madison Cave Isopod (*Antrolana lira*; MCI) was listed as Threatened in 1982 because of its limited distribution. MCI live in underground lakes and karst aquifers, and are sensitive to physical disturbance, groundwater contamination, and groundwater withdrawal. In their FEIS, FERC arbitrarily assumes that this species can redistribute into previously impacted areas, whereas a MCI population genetics study concluded that distinct, genetically isolated populations occur within a small geographical range (Hutchins et al., 2010).

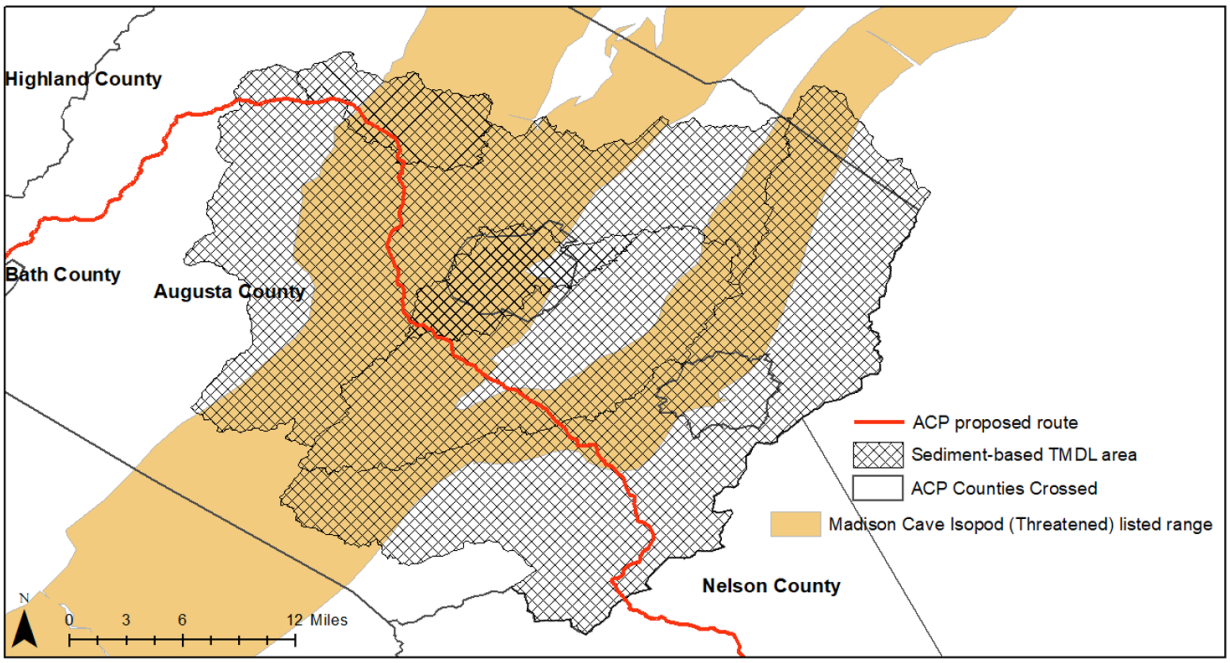

Figure 2. *Madison Cave Isopod USFWS-identified current habitat range is crossed by proposed ACP route. This area is already sediment-impaired, and subject to Total Maximum Daily Load (TMDL) limitations as a part of the Middle and South River TMDL projects.*

We also have concerns regarding the following assumption made in the FEIS in regards to Madison Cave Isopod (MCI) protection:

> "Construction of pipelines and aboveground facilities would generally be confined to depths of 10 feet or less, which is generally above bedrock aquifer depths and the water table of surficial aquifers" (FERC, 2017, pg 4-94).

It is a flawed assumption that groundwater is unlikely to be present within 10 feet of the surface. Indeed, many areas in the landscape may feature surficial aquifers less than 10 feet below the surface. These shallow aquifers are generally connected to deeper

aquifers, so even if only a small portion of a shallow aquifer is disturbed by ACP, larger areas may be contaminated through hydrologic connections. Similarly, impacts to surface water can also cause groundwater quality degradation. The impact on groundwater is especially challenging to foresee in karst terrain, where surface water or shallow groundwater may be hydrologically connected to a subterranean cave system where the MCI is assumed to be present. It is critical that ACP more thoroughly account for the expected impact on groundwater, including through better characterization of hydrologic connectivity, to ensure MCI protection.

1.5 Neuse River Waterdog (Proposed Threatened):

The Neuse River waterdog (*Necturus lewisi*) is a permanently aquatic, lungless salamander that requires clean water with a high dissolved oxygen content. As such, this species is highly susceptible to sedimentation and water pollution. This species is being considered for listing as Threatened due to its limited distribution, habitat fragmentation, and impairment of water quality. Figure 3 shows the decline in range of this species.

According to the FEIS, there are 19 water crossings through suitable Neuse River waterdog habitat along the proposed ACP route (FERC, 2017). The presence of waterdogs in four of these stream crossings were detected and therefore it was proposed to take special precautions (e.g. using the Horizontal Directional Drilling [HDD] technique and avoiding cutting vegetation) to mitigate negative impacts to the populations in these four crossings and one additional crossing (FERC, 2017). However, they propose using open-cut methods for 12 of the 19 stream crossings. Due to the difficulty of detecting this species using traditional surveying techniques, it is highly likely that individuals occur in some and possibly all of these 19 crossings despite their lack of detection. Therefore, we propose that ACP should include additional mitigation strategies to minimize impacts on the Neuse River waterdog within these stream crossings.

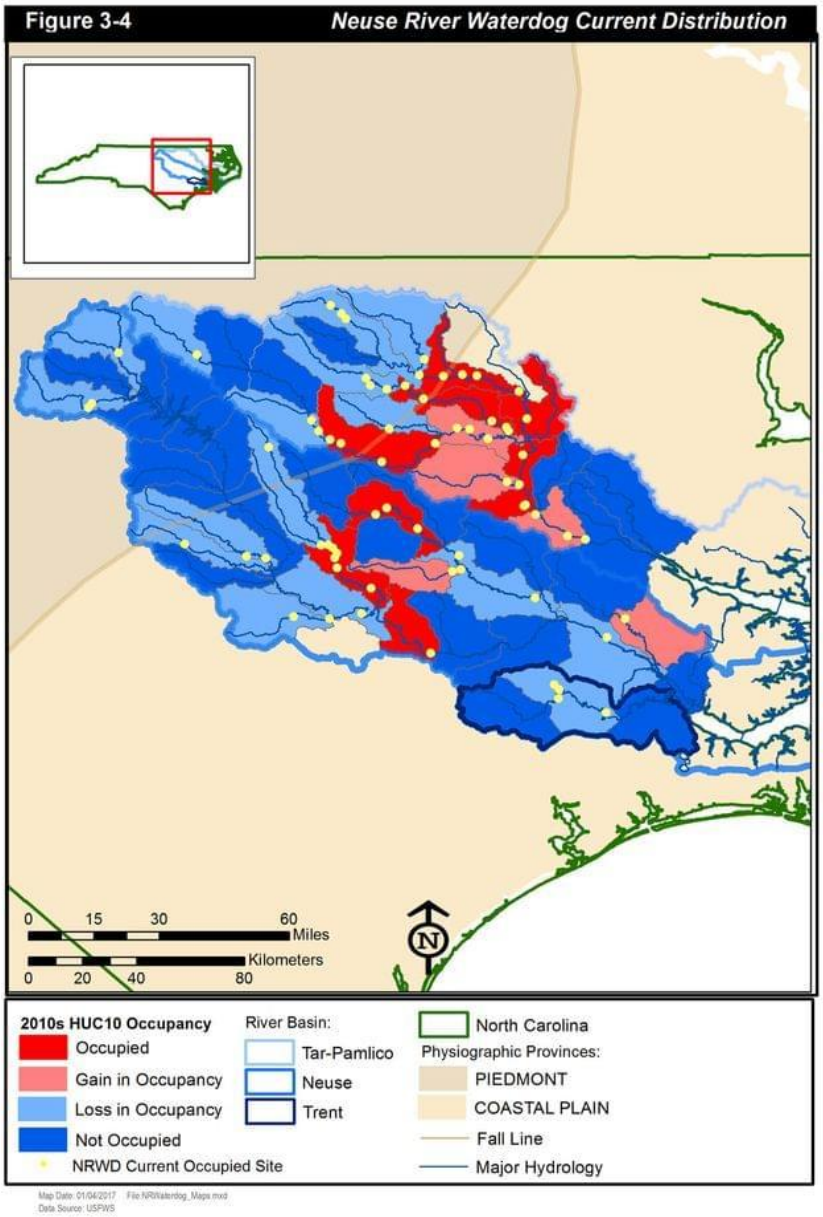

Figure 3. *USFWS figure demonstrating the current and historical range of Neuse River waterdog (Necturus lewisi), which coincides with the proposed ACP route. Reproduced from: (https://www.fws.gov/southeast/wildlife/amphibians/neuse-river-waterdog/)*

1.6 Roanoke Logperch (Endangered)

The Roanoke logperch (*Percina rex*) is another darter that is endangered and facing threats from sedimentation and habitat degradation, which are critical to consider during ACP construction. While there are multiple *Percina rex* populations, they are isolated

and won't be replenished via immigration, putting them at risk for extirpation. Far more thorough analyses have been released on this species compared with candy and diamond darters analyses, including the 2017 FEIS, 2018 BO, and USGS reports.

Many groups have critiqued expected sedimentation rates by ACP. For this reason, we feel it is important to assess how much damage will be caused to current habitats by higher than predicted sedimentation loads during ACP construction, as well as the streams that serve as relocation destinations outlined in the 2017 EIS. This includes reassessing impacts on the sixty-four National Hydrography Dataset (NHD) (Figure 4) stream crossings that occur in Roanoke logperch habitat, in addition to relocation streams, with more realistic sedimentation figures.

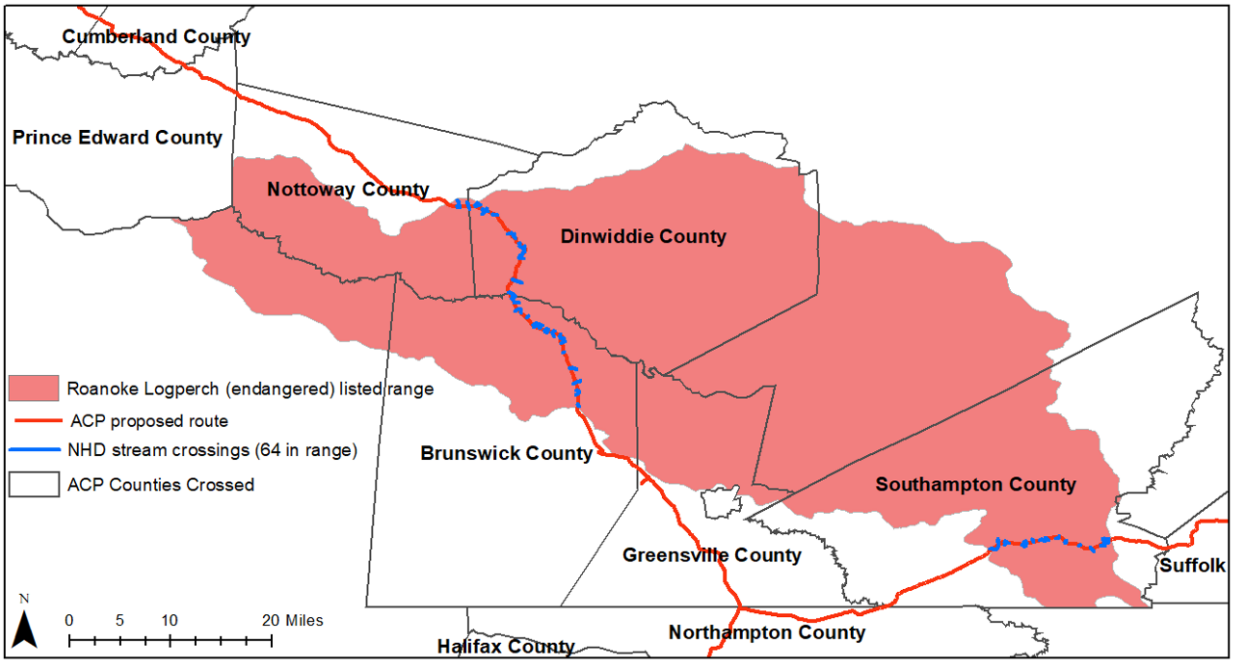

***Figure 4**. Proposed ACP crossings of NHD streams in Roanoke Logperch USFWS-identified habitat range, southeastern Virginia.*

PART 2: Species impacted by ACP corridor clearing

In this section, we describe our concerns regarding six terrestrial plant and animal species with habitat ranges crossed by the proposed ACP route. In some cases, we feel that the FEIS and BOs underestimate the long-term impact of habitat destruction and fragmentation on the fitness of these vulnerable species. In other instances, the surveying techniques, monitoring plans, and/or mitigation strategies proposed are not sufficient or aligned with best practices. We considered both short-term impacts of construction and long-term impacts of ACP corridor presence and maintenance. We feel that omissions discussed here, if ignored, could lead to long-term reduced fitness and violations of federal species protection rules.

2.1 Indiana Bat (Endangered):

Indiana bats (*Myotis sodalis*) were initially listed as endangered in 1967 because of their decreasing numbers due to human disturbance of their hibernaculum. Additional threats to the species noted in the USFWS 2007 Draft Recovery Plan include white-nose syndrome, summer habitat loss, forest fragmentation, and climate change. Some of the most important features of their summer habitats are the density of roost trees and the connectivity of roosting and migratory corridors (USFWS, 2007). Indiana bat populations have decreased dramatically over the past decade, particularly in Appalachia and the northeastern United States (USFWS, 2007). In their study on climate change and its effects on Indiana bat population ranges, Loeb and Winters (2013) projected that the Appalachian Mountains will provide critical summer habitat for the species over the next 40 years, while their western ranges may become uninhabitable.

Accordingly, destruction of suitable, unoccupied summer habitat was acknowledged as a major factor negatively impacting Indiana bats in the 2017 BO (Schulz, 2017):

> "We expect the majority of effects to Ibats [Indiana bats] from tree clearing will occur in suitable unoccupied summer habitat that Ibats use as a travel corridor between hibernacula and roost trees."

However, the 2018 BO (Phifer, 2018) contradicts this earlier claim and only focuses on occupied habitat for its individual bat take limits. These take limits fail to consider the long-term negative effects that tree clearing in all suitable summer habitat will potentially have on the Indiana bat species, particularly in combination with climate change, which may force bat populations to shift their ranges eastward as projected by Loeb and Winters (2013).

2.2 Red-Cockaded Woodpecker (Endangered)

Red-Cockaded Woodpeckers (*Dryobates borealis*; RCWOs) are an endangered species that occupy multiple Southeastern states. They are famous for their communal breeding and reciprocal altruism. These life history traits culminate with their nest trees, where cavities are created over 10 months to many years (Jackson et al., 1979). This is an exceptionally long time, and puts them at great risk to habitat destruction.

Aerial surveying for RCWOs was completed by ACP in 2015 and 2016, though the FEIS does not specify what kind of aerial survey was used. Fixed wing aerial surveys (as opposed to drone surveys) are able to detect RCWO cavities in trees reasonably well in open stands (Jackson, 1985). Their weakness however is in failing to detect individuals. Ground surveys for woodpeckers like those done by the U.S. Forest Service are able to find not only nest sites, but also estimate abundance and occupancy (Dudley & Saab 2003). These methods have been used to estimate nesting success and abundance of woodpeckers post disturbance (Latif et al., 2020). This is due to observers being able to detect calls and drums of RCWOs in addition to visual confirmation of birds, making this survey technique superior in its ability to find birds in a given habitat. While most RCWOs have remarkably high site fidelity tied to their natal habitat, juvenile females do frequently disperse (Walters et al., 1992) and would very likely be missed by fixed wing surveys, resulting in RCWO presence being under-represented by ACP.

ACP's plan to re-plant the area with longleaf pine will eventually restore some of the nesting and foraging habitat for the RCWOs. However, the trees will need to reach 75-95 years old before they can be suitable nest sites (Jackson et al., 1979), a fact that greatly increases the potential impact of construction. An additional mitigation effort with a high chance for increased population growth and resilience would be to construct cavities in nearby pine stands following the methodology of Copeyon et al. (1991), which resulted in an occupancy rate of 90%.

2.3 Running Buffalo Clover (Endangered)

The Running Buffalo Clover (*Trifolium stoloniferum*) is an endangered species with about 160 known populations. Six of these known populations will be directly impacted by ground disturbance and the burning and clearing of vegetation for construction. According to the 2018 Biological Opinion, the clearing and burning of vegetation will kill individuals in these populations, and the ground disturbance will likely reduce germination rates in these populations (Phifer, 2018). One population will be extirpated and the other five populations will experience a loss of many individuals and reduced germination rates for the duration of construction.

As an endangered species, populations of this species are protected under federal law. In the 2018 BO, the proposed mitigation measure is to protect an already existing population in perpetuity that should already be protected by the ESA. The current plan for the population that will be protected in perpetuity focuses on maintaining the right levels of tree cover and rooting out invasive species, but does not provide details of how that will be achieved, and therefore it cannot be rigorously reviewed. The plan contains no mentions of the time and labor this will take and assessments of whether the plan is realistic to conduct in perpetuity. Even if the protected population strategies are re-reviewed and approved, we consider this approach insufficient. All endangered species populations are protected, so proposing to maintain one population in order to justify the extirpation of another is not a satisfactory protection strategy.

2.4 Rusty Patched Bumblebee (Endangered)

The Rusty Patched Bumblebee (*Bombus affinis*; RPBB) was added to the endangered species list in 2017 largely due to habitat loss and degradation, pesticide poisoning, and intensive farming practices that both destroy nests with machinery and reduce diversity in pollen sources. The proposed ACP route coincides with a section of the species range that is likely to be difficult to repopulate with RPBB given its current and historical low frequencies in the region (Jepson et al., 2013). Using a modelling approach that was critiqued in the 4th Circuit opinion (4th Circuit, 2019) in conjunction with RPBB observations, the 2018 BO identifies one High Potential Zone (HPZ) that overlaps with ROW and access road construction, modelled suitable habitat, and observations of the RPBB.

The 2018 BO notes that the RPBB population in the HPZ will experience up to seven years of reduced fitness following ACP construction due to the reduction of diverse pollen sources. The assumption that the RPBB population will recover from this impact is not well-supported by scientific evidence, nor has ACP completed sufficient surveys to support this claim. Several years of reduced fitness in an already unstable population could lead to the extirpation of this HPZ population, especially as the permanent ACP corridor is unlikely to support the diversity of pollen sources currently present for an extended period of time. If the population does not recover as assumed it represents a violation of the recovery plan for the RPBB, which requires populations to expand and remain stable (USFWS, 2019b). Further analysis should be completed to address whether or not extirpation is likely following several years of reduced fitness, including more comprehensive *in situ* surveying.

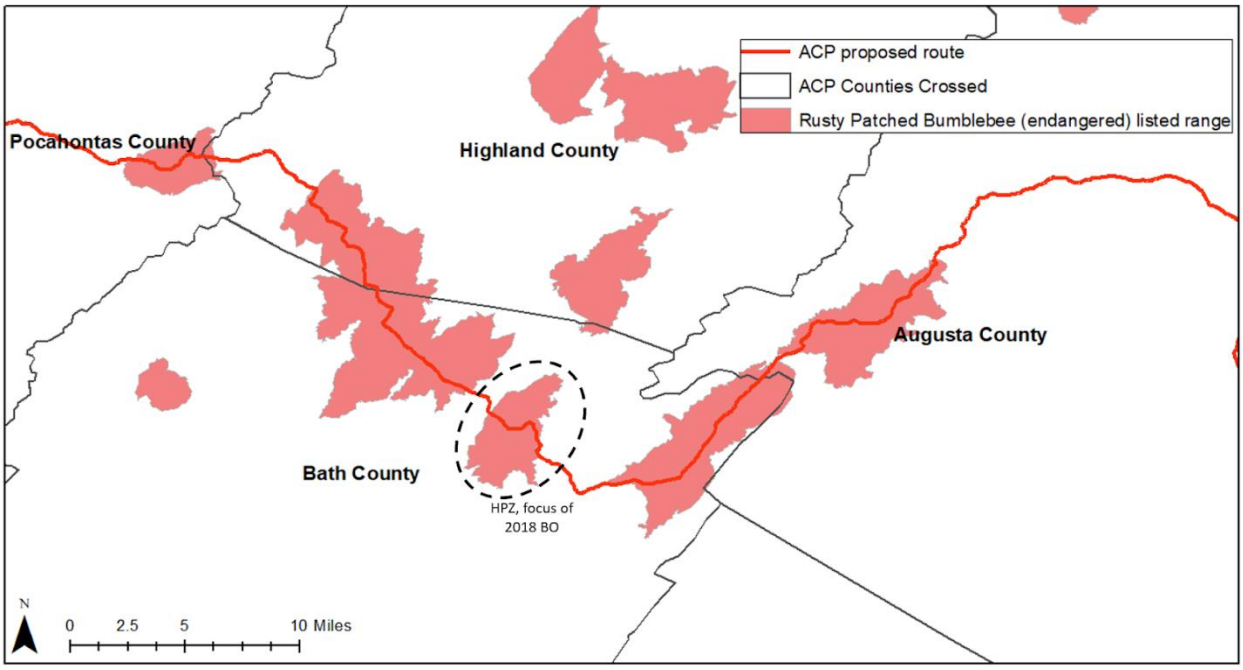

***Figure 5**. Rusty Patched Bumblebee USFWS-identified current habitat range. The High Potential Zone (HPZ) that was the focus of 2018 BO is emphasized.*

2.5 Small-whorled pogonia (Threatened)

The Small-whorled pogonia (*Isotria medeoloides*; SWP) is a threatened species which grows in small light breaks from the forest canopy and has poor tolerance for competition, especially from invasive species. According to the 2018 BO, there are four colonies of this species along the proposed ACP route. These colonies will experience increased ambient light due to tree clearing. Additionally, construction will likely lead to changes in drainage and erosion patterns, which will subsequently alter soil quality. This change in habitat quality could further imperil these colonies by increasing opportunities for invasive species to enter their habitat.

Trees that will be replanted after construction will take 20-30 years to grow to the stage where they will provide adequate shading for SWP populations. The monitoring process discussed in the 2018 BO only covers 10 years, and only promises action on reducing the threat of invasives for one year after the completion of construction. This leaves decades without protection for these colonies, during which invasive species could enter their habitat and outcompete SWP colonies. Although the 2018 BO mentions the potential increased competition from invasive species, increased ambient light, and likely changes in soil quality, they fail to address if all of those factors combined could lead to the extirpation of these colonies or not (Phifer, 2018).

2.6 Virginia Northern Flying Squirrel (Delisted 2013)

The Virginia Northern Flying Squirrel (*Glaucomys sabrinus fuscus*; VNFS), also known as the West Virginia Northern Flying Squirrel, is a subspecies of the Northern Flying Squirrel that subsists in clusters in a swath of the Appalachian Mountains in West Virginia and Highland County, Virginia (Menzel, 2006a). The VNFS is found at high elevations in mature Red Spruce and mixed spruce-northern hardwood forest, where it's diet of fungi and lichen is supported (Menzel, 2006b; Weigl, 2007).

The VNFS was removed from the endangered species list in 2013 due to recovery (USFWS, 2013b). Though the population is thought to be stable, the VNFS has been described as red spruce obligate, and fragmentation between inhabitable stands represents a persistent threat that is likely changing behavioral patterns (Trapp et al., 2016). Short- and mid-term prospects for the VNFS are good, however climate change is likely to have major impacts on high-elevation forests including red spruce (Butler et al., 2015), which could again imperil this subspecies (USFWS, 2019c).

A 10-year post-delisting monitoring (PDM) period was recommended, and in 2019 the interim PDM report was released (USFWS, 2019c). This report outlines the expected impact of the proposed ACP route on VNFS, in particular that the original proposed ACP route was moved to avoid major impacts to red spruce restoration areas.

The VNFS is only briefly mentioned in the FEIS and is not included in the 2017 and 2018 BOs. We feel the near-total exclusion of this subspecies from ACP mitigation planning documents is problematic. The proposed ACP route bisects the USFWS-identified habitat range (Figure 6). While the route has been modified to avoid crossing prime habitat, typified by the presence of spruce and fir, its path will still add an additional barrier to connectivity between southern and northern segments of the population. The ACP construction right of way for the relevant section is 125 feet (38 m) for low grades and 150 ft (46 m) for high grades common in the mountainous terrain of the flying squirrel's range (FERC, 2017). This width is at or beyond the upper limit of the VNFS's gliding distance (Vernes, 2001). Northern flying squirrels are not known to cross wide expanses of open terrain on the ground and would be exposed to high predation risk if they did (Weigl, 2007). It has been shown for the related Carolina Northern Flying Squirrel (*Glaucomys sabrinus coloratus*) that construction of a roadway averaging 125 feet (38 m) in width completely stopped their movement across its route (Kelly, Diggins, and Lawrence, 2013). It is reasonable to expect that the ACP construction will have a similar effect on the VNFS's movements across its path. While the ACP right of way will be reduced to 50 feet (15 m) following completion (FERC, 2017) it will take years for tree regrowth to effectively close this gap and restore connectivity. For a species with a

small population, maintaining genetic diversity through connectivity is important. Stopping gene flow, even if relatively rare, between two halves of the population for several generations raises concerns for us.

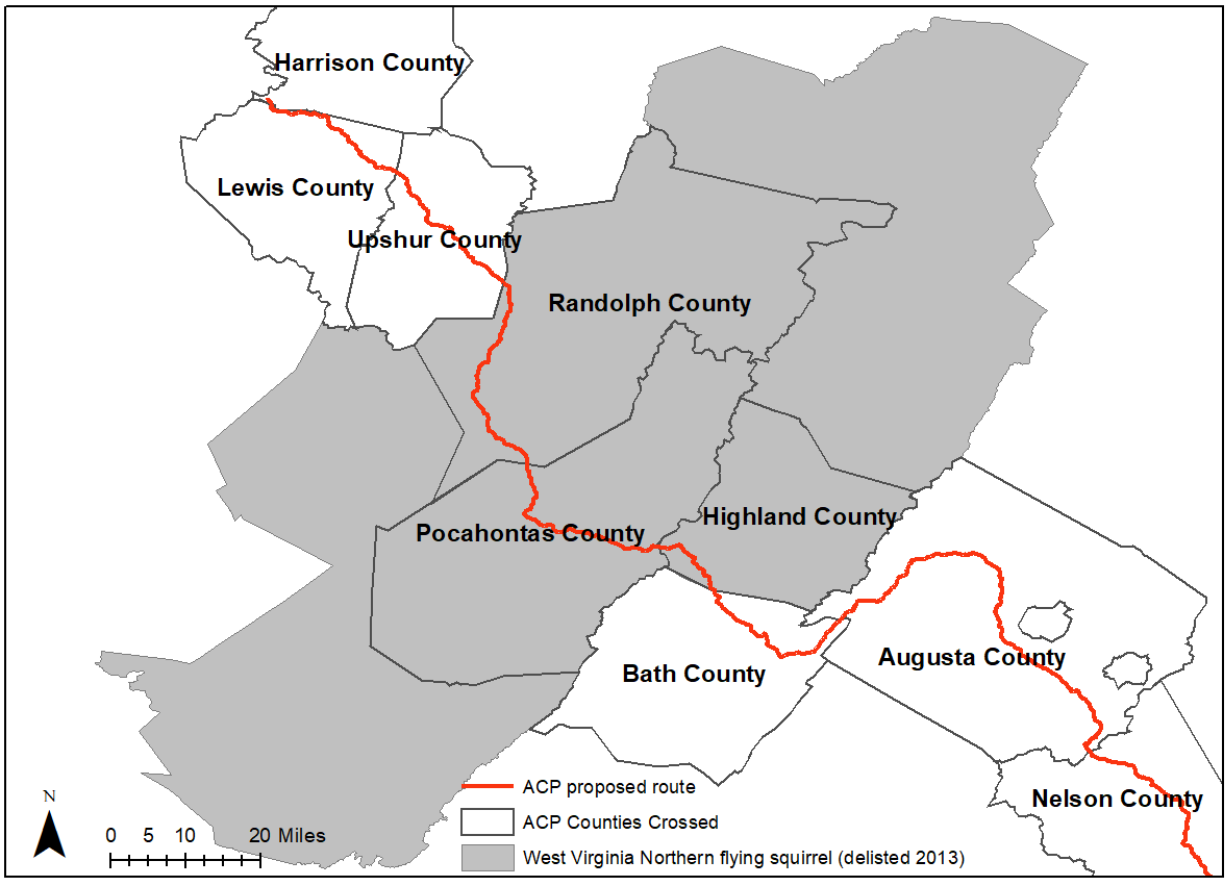

Figure 6. *ACP proposed route bisects USFWS-identified habitat range for the Virginia Northern Flying Squirrel. This subspecies remains in the Post-Delisting Monitoring period until 2023. This species is unlikely to be able to cross the ACP corridor during and following construction.*

Given that the proposed ACP route bisects the species' range, and that long-term risks to this species exist due to climate change, we think the impact of the ACP on this species is likely greater than has been considered. Since the VNFS is still in the PDM period until 2023 we recommend that ACP should monitor and survey for VNFS along the corridor and develop a plan to mitigate impact if individuals are encountered. Even if individuals are not identified along the route, we recommend that further consideration is given to the issue of VNFS ability to cross the ACP corridor.

CONCLUSION

In preparing this analysis we came to understand the enormity of the task set for the USFWS in its Section 7 review of the ACP Project. The work of the USFWS so far has been immensely helpful to us in our research. We respectfully submit our comments in the hope that they may be helpful and with a recognition of the fact that the USFWS shares our desire to have decisions be guided by the best possible science.

With the exception of the diamond darter, our species of concern have been the subject of much discussion in the ACP planning, permitting, and review process. In each case our concerns arise because of one or more problematic assumptions or missing perspectives. Our conclusions regarding aquatic species are based on the ACP and FERC assessments of anticipated sediment loads. If higher than anticipated sedimentation rates occur, as many critics have predicted, then our conclusions about aquatic species become even more pertinent. The Mountain Valley Pipeline, an infrastructure project with many similarities to the ACP, has experienced many erosion problems (VA DEQ, 2020; Hammack, 2020), a fact that reinforces our concern.

It is also the case that there has been a focus by planners and regulators on acute impacts to at-risk species. While it is sensible to carefully assess direct impacts of construction on protected species, we feel that risks to species that occur at greater distance and over the longer term have been underestimated. This is the case for the Madison Cave Isopod where connections between surface waters and ground waters are underestimated. While the diamond darter does not occupy sections of streams in the construction footprint it is still nonetheless fully connected to the ACP hydrologically. Direct impacts from ACP construction on the Virginia Northern Flying Squirrel may be far smaller than its long-term effects on population connectivity. Proposed mitigation activities for the Red-Cockaded Woodpecker and Small-whorled pogonia fail to recognize that tree planting will take many years to restore impacted habitat.

Certain issues presented here have not been addressed in any prior ACP planning documents to our knowledge. We hope you will give them your attention as you perform your review.

CONFLICTS OF INTEREST

SPI-DAC members completed this work on a volunteer basis. The analysis presented is entirely our own. We did not receive compensation for this work and have no conflicts of interest to declare.

REFERENCES

Berkman, H. E., & Rabeni, C. F. (1987). Effect of siltation on stream fish communities. *Environmental Biology of Fishes*, *18*(4), 285–294. doi:10.1007/BF00004881

Butler, P. R., Iverson, L., Thompson, F. R., Brandt, L., Handler, S., Janowiak, M., ... & Connolly, S. (2015). Central Appalachians forest ecosystem vulnerability assessment and synthesis: a report from the Central Appalachians Climate Change Response Framework project. *Gen. Tech. Rep. NRS-146. Newtown Square, PA: US Department of Agriculture, Forest Service, Northern Research Station. 310 p.*, *146*, 1-310. doi:10.2737/NRS-GTR-146

Copeyon, C. K., Walters, R. J., & Carter III, J. H. (1991). Induction of Red-Cockaded Woodpecker Group Formation by Artificial Cavity Construction. *The Journal of Wildlife Management*, 55(4), 549–556.

Couceiro, S. R. M., Hamada, N., Forsberg, B. R., & Padovesi-Fonseca, C. (2011). Trophic structure of macroinvertebrates in Amazonian streams impacted by anthropogenic siltation. *Austral Ecology*, *36*(6), 628–637. doi:10.1111/j.1442-9993.2010.02198.x

Dudley, J., & Saab, V. (2003). A field protocol to monitor cavity-nesting birds. USDA Forest Service - Research Paper RMRS-RP, (44 RMRS-RP), 1–19. doi:10.2737/RMRS-RP-44

Federal Energy Regulatory Commission (FERC) (2017). Atlantic Coast Pipeline and Supply Header Project Final Environmental Impact Statement Volume I.

Hammack, L. (2020). DEQ notes problems with erosion control during lull in work on Mountain Valley Pipeline. The Roanoke Times, 3/10/2020.

Henley, W. F., Patterson, M. A., Neves, R. J., & D.A. Lemly (2000). Effects of Sedimentation and Turbidity on Lotic Food Webs: A Concise Review for Natural Resource Managers. *Reviews in Fisheries Science*, *8*(2), 125–139. doi:10.1080/10641260091129198

Hutchins, B., Fong, D. W., & D.B. Carlini (2010). Genetic Population Structure of the Madison Cave Isopod, *Antrolana Lira* (Cymothoida: Cirolanidae) in the Shenandoah Valley of the Eastern United States. *Journal of Crustacean Biology*, 30(2), 312-322.

Jackson, J. A., Lennartz, M. R., & Hooper, R. G. (1979). Tree Age and Cavity Initiation By Red-cockaded Woodpeckers. *Journal of Forestry*, 77(2), 102–103. doi:10.1093/jof/77.2.102

Jackson, J. A. (1985). An Evaluation of Aerial Survey Techniques for Red-Cockaded Woodpeckers. *The Journal of Wildlife Management*, 49(4), 1083–1088.

Jepsen, S., E. Evans, R. Thorp, R. Hatfield and S. H. Black (2013). Petition to list the rusty patched bumble bee *Bombus affinis* (Cresson), 1863 as an endangered species under the US Endangered Species Act. The Xerces Society for Invertebrate Conservation.

Kelly, C. A., C. A. Diggins and A. J. Lawrence (2013). Crossing structures reconnect federally endangered flying squirrel populations divided for 20 years by road barrier. *Wildlife Society Bulletin*, 37(2): 375-379. doi:10.1002/wsb.249

Kjelland, M. E., Woodley, C. M., Swannack, T. M., & D.L. Smith (2015). A review of the potential effects of suspended sediment on fishes: potential dredging-related physiological, behavioral, and transgenerational implications. *Environment Systems and Decisions*, 35(3), 334–350. doi:10.1007/s10669-015-9557-2

Latif, Q. S., Saab, V. A., Dudley, J. G., Markus, A., & Mellen-McLean, K. (2020). Development and evaluation of habitat suitability models for nesting white-headed woodpecker (*Dryobates albolarvatus*) in burned forest. PLoS ONE, 15(5), 1–22. doi:10.1371/journal.pone.0233043

Loeb, S.C. and E.A. Winters (2013). Indiana bat summer maternity distribution: effects of current and future climates. *Ecology and Evolution*, 3, 103-114.

Menzel, J. M., W. M. Ford, J. W. Edwards and L. J. Ceperley (2006a). "A habitat model for the Virginia northern flying squirrel (*Glaucomys sabrinus fuscus*) in the central Appalachian Mountains." Res. Pap. NE-729. Newtown Square, PA: US Department of Agriculture, Forest Service, Northeastern Research Station. 10 p. 729.

Menzel, J. M., W. M. Ford, J. W. Edwards and T. M. Terry (2006b). Home range and habitat use of the Vulnerable Virginia northern flying squirrel *Glaucomys sabrinus fuscus* in the Central Appalachian Mountains, USA. *Oryx*, 40(2): 204-210. doi:10.1017/S0030605306000494

Phifer, P. R. (2018). Biological Opinion 05E2VA00-2018-E-13089. U.S. Fish and Wildlife Service. Hadley, MA.

Schulz, C. (2017). Biological Opinion 05E2WV00-2018-E-03616. U.S. Fish and Wildlife Service. Virginia Field Office, Gloucester, VA.

Trapp, S. E., Smith, W. P., & Flaherty, E. A. (2017). Diet and food availability of the Virginia northern flying squirrel (*Glaucomys sabrinus fuscus*): implications for

dispersal in a fragmented forest. *Journal of Mammalogy*, *98*(6), 1688-1696. doi:10.1093/jmammal/gyx115

U.S. Environmental Protection Agency. The quality of our Nation's water: 1992. (1994) Report No. EPA 841-S-94-002, EPA Office of Water, Washington, DC.

U.S. Fish and Wildlife Service (2007). Indiana Bat (*Myotis sodalis*) Draft Recovery Plan: First Revision. U.S. Fish and Wildlife Service, Fort Snelling, MN. 91 pp.

U.S. Fish and Wildlife Service (2013a). Endangered and Threatened Wildlife and Plants; Endangered Species Status for Diamond Darter. U.S. Fish and Wildlife Service. West Virginia Field Office, Elkins, VA.

U.S. Fish and Wildlife Service (2013b). Endangered and Threatened Wildlife and Plants; Reinstatement of Removal of the Virginia Northern Flying Squirrel From the List of Endangered and Threatened Wildlife. Federal Register, 78(42), 14022-14023.

U.S. Fish and Wildlife Service (2018). Endangered and Threatened Wildlife and Plants; Endangered Species Status for the Candy Darter. U.S. Fish and Wildlife Service. West Virginia Field Office, Elkins, WV.

U.S. Fish and Wildlife Service (2019a). Clubshell (*Pleurobema clava*) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Pennsylvania Field Office, State College, Pennsylvania.

U.S. Fish and Wildlife Service (2019b). Draft Recovery Plan for Rusty Patched Bumble Bee (*Bombus affinis*). U.S. Fish and Wildlife Service. Midwest Regional Office, Bloomington, MN.

U. S. Fish and Wildlife Service (2019c). Interim Report Evaluating Implementation of Post-Delisting Monitoring Plan for the West Virginia Flying Squirrel (*Glaucomys sabrinus fuscu*s). West Virginia Field Office, Elkins, West Virginia.

U.S. Fourth Circuit Court of Appeals (2018). Cowpasture River Preservation Association, et al v. United States Forest Service, et al. U.S. Fourth Circuit Court of Appeals, Docket: 18-1144, 12/13/2018.

U.S. Fourth Circuit Court of Appeals (2019). Defenders of Wildlife v. United States Department of the Interior. U.S. Fourth Circuit Court of Appeals, Docket: 18-2090, 7/26/2019.

Vernes, K. (2001). Gliding Performance of the Northern Flying Squirrel (*Glaucomys Sabrinus*) in Mature Mixed Forest of Eastern Canada. *Journal of Mammalog*y, 82(4): 1026-1033. doi:10.1644/1545-1542(2001)082<1026:GPOTNF>2.0.CO;2

Virginia Department of Environmental Quality (VADEQ) (2020). Mountain Valley Pipeline. Retrieved 7/4/2020, from https://www.deq.virginia.gov/MVP.aspx.

Walters, J. R., Doerr, P. D., & Carter, J. H. (1992). Delayed dispersal and reproduction as a life-history tactic in cooperative breeders: fitness calculations from red-cockaded woodpeckers. *American Naturalist*, 139(3), 623–643. doi: 10.1086/285347

Weigl, P. D. (2007). The Northern Flying Squirrel (Glaucomys sabrinus): a Conservation Challenge. *Journal of Mammalogy*, 88(4): 897-907. doi:10.1644/06-MAMM-S-333RR.1