Expert Review of *FINAL ENVIRONMENTAL ASSESSMENT: Beaver Damage Management to Protect Coldwater Ecosystems, Forest Resources, Roads and Bridges, Sensitive Habitats, and Property in Wisconsin* (January 2013), prepared by United States Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services.

prepared by

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"A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise."

- Aldo Leopold, The Land Ethic, *A Sand County Almanac.*

"The Club should never lose sight of the fact that as an owner of otter range, it is the custodian of a rare and irreplaceable natural resource… The otters of the of the Salmon Trout River are unique, and in one sense more valuable than any amount of trout."

- Aldo Leopold's 1938 Report to the Huron Mountain Club

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I. INTRODUCTION

1. This expert report reviews the science, data, and assumptions contained in the January 2013 Final Environmental Assessment (2013 EA) prepared by the U.S. Department of Agriculture Animal and Plant Health Inspection Service (USDA-APHIS) division of Wildlife Services (Wildlife Services) regarding its activities in Wisconsin to kill beaver, destroy beaver dams, and drain wetlands (Wisconsin Beaver Elimination Program).[1] Because the management approach adopted pursuant to the 2013 EA consists of eliminating beaver in response to normal beaver behavior that it defines as damaging, the program is referred to throughout this document as the *Wisconsin Beaver Elimination Program*. In its Decision and Finding of No Significant Impact (FONSI),[2] Wildlife Services accepted the alternative recommended by the 2013 EA and chose to continue to provide "operational damage management services" in Wisconsin, to "reduce beaver damage to property, roads, bridges, railroads, agricultural and natural resources, and risks to public health and safety," on "public, private, and tribal property in Wisconsin where a need exists and when landowners/managers request WS assistance."[3]

2. The 2013 EA indicated Wildlife Services would use an "Integrated Wildlife Damage Management" approach, which "would encompass the use of practical and effective non-lethal and lethal methods of preventing or reducing damage while minimizing harmful effects of damage management measures on humans, target and non-target species, and the environment."[4] The 2013 EA committed to annual reviews of the Wisconsin Beaver Elimination Program,[5] while the FONSI indicated Wildlife Services would "continue to monitor the impacts of its activities on the issues analyzed in detail in the EA including impacts on the state beaver population and non-target species that could be affected by beaver damage management activities."[6]

3. In reality, however, Wildlife Services has killed Wisconsin beaver, destroyed their dams and drained wetland ponds on a massive scale, with little to no oversight, accountability, or evaluation of the environmental impacts of its actions. From 2013 through 2021, Wildlife Services shot, trapped, and drowned 24,649 Wisconsin beaver,[7] as well as thousands of other species as "bycatch," and destroyed 14,796 beaver dams.[8] In every year of operations under the 2013 EA, Wildlife Services has killed substantially more beaver than the 1,066 a year contemplated by the

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[1] USDA-APHIS Wildlife Services (January 2013). Final Environmental Assessment Beaver Damage Management to Protect Coldwater Ecosystems, Forest Resources, Roads and Bridges, Sensitive Habitats and Property in Wisconsin ("2013 EA") https://www.aphis.usda.gov/wildlife_damage/nepa/states/WI/wi-2013-beaver-ea.pdf.

[2] USDA-APHIS Wildlife Services (January 2013). Decision and Finding of No Significant Impact for Environmental Assessment: Beaver Damage Management to Protect Coldwater Ecosystems, Forest Resources, Roads and Bridges, Sensitive Habitats and Property in Wisconsin ("2013 FONSI"), 2; https://www.aphis.usda.gov/wildlife_damage/nepa/states/WI/wi-2013-beaver-fonsi.pdf.

[3] USDA-APHIS Wildlife Services, 2013 EA at 7.

[4] *Id.*

[5] *Id.* at 18.

[6] USDA-APHIS Wildlife Services, 2013 FONSI at 6.

[7] USDA-APHIS, Program Data Reports, Program Data Report G - Animals Dispersed / Killed or Euthanized / # Burrows/Dens Removed or Destroyed / Freed or Relocated (2013-2022); https://www.aphis.usda .gov/aphis/ourfocus/wildlifedamage/SA_Reports/SA_PDRs.

[8] APHIS-USDA Wildlife Services, Wisconsin Beaver Activity (Raw Data) (2013-2021). Annual data reports, retrieved from USDA-APHIS through FOIA Request No. 2023-APHIS-00294-F (Jan. 10, 2023).

2013 EA, and those numbers have continued to rise, hitting a record 3,492 beaver killed in 2022.

4. Meanwhile, Wildlife Services failed to perform any of the promised annual reviews of the Wisconsin Beaver Elimination Program until 2020, when it finally completed a monitoring report reviewing operations for the prior six years.[9] The 2020 review concluded that a revision to the EA was necessary because Wildlife Services had been killing more than three times the number of beaver each year than it had anticipated under the 2013 EA.[10] Subsequent monitoring reports in 2021 and 2022 reached the same conclusion.[11]

5. While the 2020, 2021, and 2022 monitoring reports acknowledge the need for a new environmental review, they nevertheless conclude that the Wisconsin Beaver Elimination Program has not had a "significant adverse effect on the state's beaver population" because there continue to be "stable or increasing beaver populations."[12] This assurance is meaningless, however, given the admission in the same reports that the Wisconsin Department of Natural Resources (WDNR) *stopped preparing estimates of the state beaver population in 2014*.[13]

6. For the last decade, Wildlife Services thus has not had any beaver population estimates on which to base any assessment of the impact the Wisconsin Beaver Elimination Program is having on the state beaver population. However, it has known, and ignored, the fact that it was killing more than three times the number of beaver each year than it had projected under the 2013 EA.

7. Perhaps more troubling, the decade-old 2013 EA relies on incorrect information, false assumptions, and outdated scientific studies going back to 1935. It thus fails to reflect what we have come to understand about beaver and the crucial role they play as keystone species and ecosystem engineers—restoring watershed health, improving water quality, reducing flooding, creating essential habitat, mitigating climate change, and helping other species to survive a warming planet.

8. It is a tragic irony that at the same time we are beginning to understand the critical role beaver play in efforts to mitigate climate change, Wildlife Services is killing more Wisconsin beaver than ever before, based on inaccurate assumptions and discredited science that in many

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[9] Hirchert & Harris (2020). Monitoring Status FY 2013-2019: Beaver Damage Management to Protect Coldwater Ecosystems, Forest Resources, Roads, Bridges, Sensitive Habitats and Property in Wisconsin ("Monitoring Status FY 2013-2019"). USDA-APHIS. Unsigned document released by USDA-APHIS in response to FOIA Request No. 2023-APHIS-00294-F (Jan. 10, 2023).

[10] Hirchert & Harris (2020), at 1-2. Report shows the increase in number of beaver killed each year from 2013 to 2019, with Wildlife Services killing 3,464 in 2019. *Compare* 2013 EA at 57, Table 4.1, and 59. Wildlife Services killed an average of 1,066 beaver a year from 2007-2011 and expected future take to be similar. Unsigned document released by USDA-APHIS in response to FOIA Request No. 2023-APHIS-00294-F (Jan. 10, 2023).

[11] Hirchert & Harris (2021). Monitoring Status CY 2020-2021: Environmental Assessment: Beaver Damage Management to Protect Coldwater Ecosystems, Forest Resources, Roads, Bridges, Sensitive Habitats, and Property in Wisconsin. USDA-APHIS, at 1; Hirchert & Harris (2022). Monitoring Status FY 2020-2021: Environmental Assessment: Beaver Damage Management to Protect Coldwater Ecosystems, Forest Resources, Roads, Bridges, Sensitive Habitats, and Property in Wisconsin. USDA-APHIS, at 1. Unsigned document released by USDA-APHIS in response to FOIA Request No. 2023-APHIS-00294-F (Jan. 10, 2023).

[12] Hirchert & Harris (2020), at 2; Hirchert & Harris (2021), at 2; Hirchert & Harris (2022), at 2.

[13] Hirchert & Harris (2020), at 1; Hirchert & Harris (2021), at 1; Hirchert & Harris (2022), at 1.

cases is decades old. This is nothing short of a tragedy.

9. In my opinion, Wildlife Services should halt the Wisconsin Beaver Elimination Program pending completion of an environmental assessment analyzing the impact of the program based on updated data and recent science. I believe this assessment will show that the continuation of the program poses significant threats to Wisconsin ecosystems, and that a new Environmental Impact Statement is required if Wildlife Services wishes to continue with this destructive program.

10. This new assessment is long overdue and urgently needed. Had Wildlife Services been performing the promised annual assessments since 2013, it would have almost immediately realized that the Wisconsin Beaver Elimination Program was killing more beaver than it anticipated in the 2013 EA. It would also have noted that there was no meaningful way to monitor the impact of the program on the state beaver population, because WDNR had halted its beaver population surveys. These circumstances would have merited an immediate revision to the EA. Instead, Wildlife Services has sat on these facts for a decade, even in the face of three consecutive monitoring reports calling for a supplemental analysis. Having evaded its responsibilities for several years, Wildlife Services now owes it to the wildlife and people of Wisconsin to immediately reevaluate the Wisconsin Beaver Elimination Program. Further, there should be a moratorium on Wisconsin's Beaver Elimination Program until a new Environmental Impact Statement is completed.

II. EXPERT BACKGROUND

11. I am an adult resident of Wisconsin, with extensive knowledge of beaver activity and hydrological systems across the state. My full resume can be found at Appendix A to this report.

12. I have worked as a professional wilderness guide and fishing/naturalist guide in Wyoming, Montana, Alaska, Michigan, and Wisconsin. I have held a hunting and fishing license in Wisconsin for over 50 years, and I am a lifetime member of both Trout Unlimited and Pheasants Forever.

13. I hold an B.A. in Social Philosophy from St. Norbert College and an M.S. in Water Resource Management from the University of Wisconsin-Madison, with an emphasis in ecosystem management of watersheds.

14. I serve as an advisor to the Beaver Institute, a national nonprofit based in Southampton, MA, whose goal is to use science to resolve beaver-human conflicts and maximize the benefits that beaver bring to the environment.

15. I am the former executive director of the Cedar Lakes Conservation Foundation (CLCF), the oldest land trust in Wisconsin. As a licensed real estate broker, I negotiated acquisitions and wrote conservation easements on properties. In addition, I managed 58 conservation properties for CLCF with the goal of protecting the watershed and hydrology of the five-lake district.

16. In 1994, I founded and served for 8 years as the executive director of Milwaukee Riverkeeper, an environmental advocacy non-profit for the Milwaukee, Menomonee and

Kinnickinnic Rivers, a watershed that encompasses 900 square miles.

17. In 2020, I designed a study titled "Hydrological Impact of Beaver Habitat Restoration in the Milwaukee River Watershed" in partnership with the University of Wisconsin, Milwaukee, Milwaukee RiverKeeper, and the Milwaukee Metropolitan Sewage District. This study found significant flood mitigation benefits could be achieved from beaver reintroduction for communities within the Milwaukee Watershed. This includes an average of 37% peak flood reduction, with over 1.7 billion gallons of stormwater storage through beaver created wetlands. Further, this could also remove over 500 homes from the floodplain, benefit biodiversity through the creation of wetland habitat, and increase stormwater storage capacity. In sum, the Milwaukee Metropolitan Sewage District estimated that this beaver reintroduction could provide $3.34 billion of stormwater storage in ecological services to the watershed.

18. I am the founder and president of Superior Bio-Conservancy, a 501(c)3 non-profit located in Milwaukee, Wisconsin, dedicated to protecting and restoring the biological integrity and hydrology of the Great Lakes Region and the Laurentian Forest Province throughout Minnesota, Wisconsin, and Michigan. Our team comprises scientists, sociologists, and members of regional Tribes, who work together to ensure a holistic approach to ecological practices from a scientific, cultural, and sovereignty standpoint. We seek to alter negative perceptions towards beaver within WDNR and the public, to increase access to and use of non-lethal beaver damage mitigation access, and to promote the best science available in wildlife management practices.

19. This review is informed by the publications listed in Appendix D, as well as my background knowledge, expertise, and experience; numerous meetings, conversations, emails, and other correspondence with Wisconsin Department of Natural Resources (WDNR) staff and Tribal representatives, including the Dec. 16, 2022 meeting of Wisconsin Beaver Management Task Force and the Feb. 2, 2023 meeting with the Voigt Intertribal Taskforce and The Great Lakes Indian Fish and Wildlife Commission; and extensive interactions with other experts in this field. My report is supplemented by an independent review by Dr. Ben Dittbrenner, attached as Appendix B.

III. ANALYSIS

A. Healthy Beaver Populations are Essential to Healthy Ecosystems

20. The North American beaver (*Castor canadensis*) is a unique aquatic mammal commonly called an "ecosystem engineer" because it transforms the landscape, creating healthier, more resilient watersheds, improving water quality, increasing the availability of fresh water, forming essential wetlands, reducing peak flood levels, limiting damage from forest fires, mitigating climate change, and helping other fish and wildlife species to survive a warming planet. Beaver are considered a keystone species because of the disproportionately large impact they have on the entire surrounding ecosystem, establishing critical habitat for a large variety of fish, amphibians, birds, and mammals.[14]

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[14] *See* Appendix D: Additional Resources, sections 2 and 4.

21. Beaver populations in North America were once in in the hundreds of millions, with hundreds of thousands in Wisconsin alone.[15] As a result of the fur trade, beaver were trapped nearly to extinction, dramatically altering the landscape across the country and destroying habitat for countless other species. Scientists have estimated that by 1900, fewer than 500 beaver remained in Wisconsin.[16] Beaver populations rebounded in subsequent decades, as the state closed or severely restricted trapping seasons, but then began another precipitous decline as a result of liberalized trapping regulations and WDNR's increased focus on killing beaver due to complaints about property damage and a misconceived desire to protect trout streams.[17] As a result, Wisconsin beaver have never fully recovered.

22. Beaver populations are sensitive to exploitation, and it may take decades to recover from declines. As WDNR has noted, "[b]eaver have relatively slow population growth rates which leaves them vulnerable to overharvest."[18] Beaver reach sexual maturity by 21 months, although the age at which they begin to breed is affected by population density and habitat quality.[19] Beaver are monogamous and each colony only produces a single litter per year.[20] Litter size is also affected by habitat quality, with the average litter containing 3-4 beaver.[21] Since beaver only have one small litter a year, "their populations are relatively low compared to other typical rodent species" and can take decades to achieve typical population densities.[22] Further, adult beaver, especially pregnant females, are more susceptible to being killed during open seasons, reducing the reproducing population significantly.[23] As a result, when the beaver population is damaged, it is slow to recover, and can take a long time to achieve population densities sufficient to provide ecosystem services.

23. The hydrology of a river with a matured series of beaver structures (ponds, canals, dams, food caches and lodges) is very different than a river with no or few beaver. Principles of healthy riverscapes require the river channel to be connected to the floodplain. Beaver create structures that add complexity to channels and force reconnection to the floodplain. Beaver structures slow the flow of water and spread it out, lengthening the flow residence time and decreasing its energy. The reduced energy of the flow causes less disturbance and makes the riverscape more stable. Ultimately, beaver fundamentally support the biological integrity of waterways by restoring the natal geomorphology, facilitating natural evolutionary processes.[24]

24. Once established, beaver dams and the pond wetland complexes that they create

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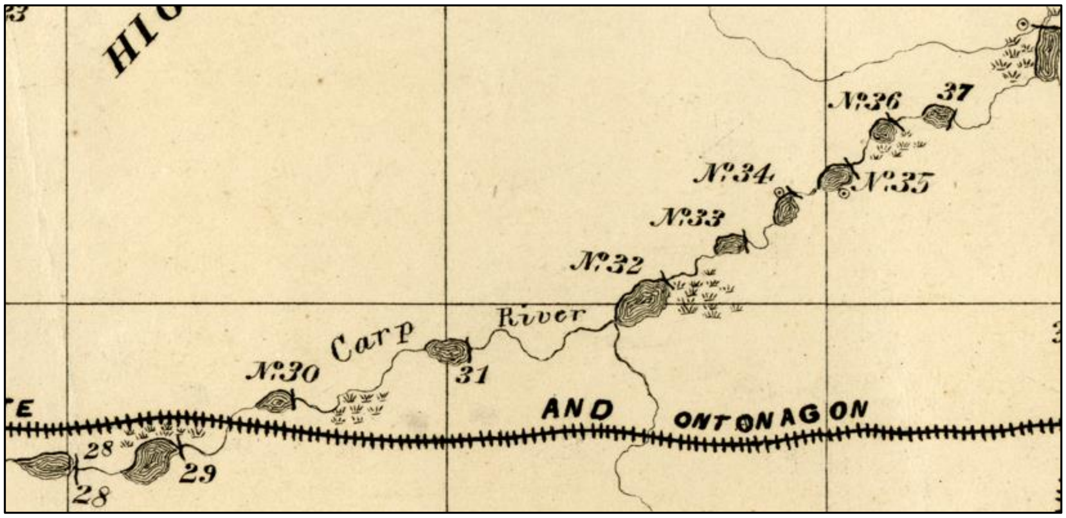
[15] WDNR (2015), Wisconsin Beaver Management Plan 2015–2025 ("2015 Beaver Plan"), at 36-39; https://www.wistatedocuments.org/digital/collection/p267601coll4/search/searchterm/ 931697415/field/dmoclcno.
[16] WDNR (1990). Beaver Management Plan ("1990 Beaver Plan"), at 1; https://fyi.extension.wisc.edu/beaver/files/2011/10/WI-Beaver-Mgmt-Plan-1990.pdf.
[17] WDNR, 2015 Beaver Plan at 38-39.
[18] *Id.* at 44.
[19] *Id.* at 23.
[20] *Id.*
[21] *Id.* at 24.
[22] Rosell, F. N., & Campbell-Palmer, R. (2022). *Beavers: Ecology, Behaviour, Conservation, and Management*. Oxford University Press at 247.
[23] *Id*. at 278.
[24] *See generally*, Brazier, R. E., Puttock, A., Graham, H. A., Auster, R. E., Davies, K. H., & Brown, C. M. (2020). Beaver: Nature's ecosystem engineers. *WIREs Water*, *8*(1). https://doi.org/10.1002/wat2.1494.

can exist for a long time. The map below, created in 1868, shows beaver ponds on the Carp River that still persist today.[25]



Beaver ponds in series. Henry Morgan 1868, Ishpeming Mich.

25. When beaver are undisturbed and unexploited, they restructure many first- and second-order streams and often build a string of ponds. These ponds function in a series as combination of stormwater detention ponds and sewage treatment plants. Each beaver dam creates a ponded wetland which stores and slows down water and reduces downstream flooding. These ponds work like speeds bumps to lower peak flows during high water events.[26]

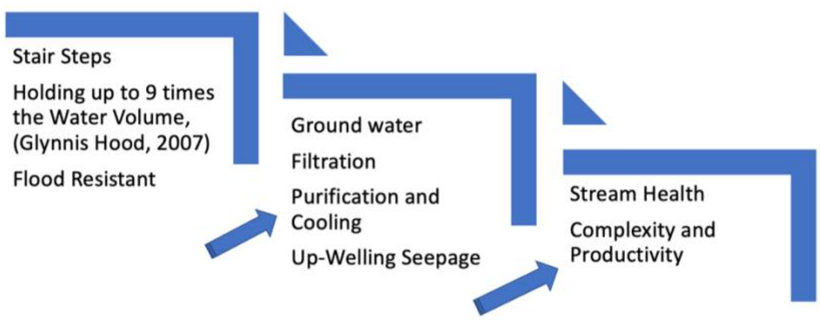


Illustration of how beaver dams act as speed bumps to stabilize stream geomorphology.[27]

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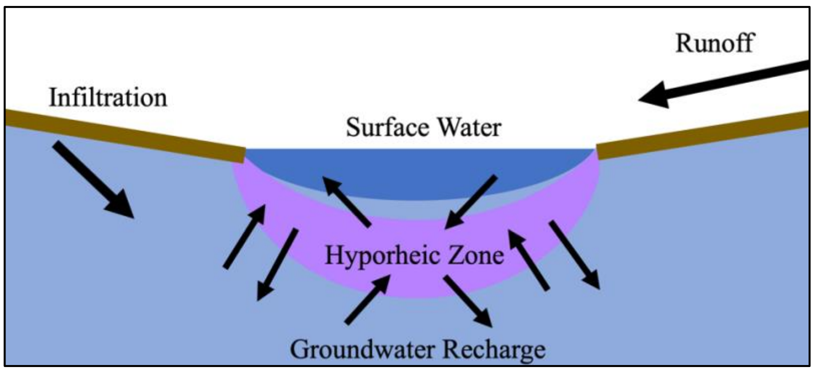
[25] *See* Johnston, C. A. (2015). Fate of 150-year-old beaver ponds in the Laurentian Great Lakes Region. *Wetlands*, 35(5), 1013–1019. https://doi.org/10.1007/s13157-015-0688-5.

[26] *See* Liao, Q., Boucher, R., Wu, C., Noor, S. M., Liu, L., Rock, M., Flanner, M., & Holloway, L. (2020). Hydrological Impact of Beaver Habitat Restoration in the Milwaukee River Watershed. Milwaukee Metropolitan Sewerage District; https://www.beaverinstitute. org/wp-content/uploads/2023/03/Beaver-Hydrology-impact-in-Milwaukee-final-1.pdf.

[27] *See* Glynnis A. Hood and Suzanne E, Bayley (2008). Beaver (Castor canadensis) mitigate the effects of climate on the area of open water in boreal wetlands in western Canada. *Biological Conservation* 141: 556-67.

26. The ponded water also vastly increases the volume of the hyporheic zone, an area of sediment and porous space under a stream bed where there is a mixing of groundwater and surface water. This unseen zone is largely underappreciated for its water quality importance. This region is critical to restoring chemical stability by filtering pollutants (especially nitrates) out of the stream for cleaner water.[28] As the hyporheic zone cleans water through filtration, it also recharges groundwater. Further, the interface and mixing with groundwater moderates water temperatures, so they are cooler in summer and warmer in winter. The hyporheic zone also creates habitat and shelter for fish, plants, and organisms. Each dam works as a filtration device. When dams are in a series, each one strengthens the overall integrity by providing a series of filtration systems. The overall net effect from beaver complexes is that they stabilize the hydrology of riparian systems, improve stream health, clean the water, and support biodiversity.



27. A fully matured beavered watershed system "supports an assemblage of organisms similar to that produced by long-term evolutionary processes,"[29] through the creation of habitat and species-rich wetlands necessary for high biological integrity. Indeed, beaver ponds are akin to coral reefs or rainforests in their importance to biodiversity, and beaver ponds in the western Great Lakes region facilitate a rich diversity of species.

28. Beaver dams also add a large volume of fresh water to an ecosystem, expanding upon an invaluable resource that is in increasingly short supply. Of the total water volume on earth, saltwater accounts for 97.5% and fresh water just 2.5%. Of this fresh water, 68.7% is in the form of ice and permanent snow cover in the Arctic, the Antarctic and mountain glaciers; 30.1% is in the form of fresh groundwater; and only 1.2% is in lakes, reservoirs, and river systems.[30]

29. A recent study of beaver reintroduction in Montana demonstrates the relationship between beaver activity and retention of fresh water resources.[31] Beaver were reestablished in 2006 and allowed to modify the landscape over an 11-year period. During this time, the gradual

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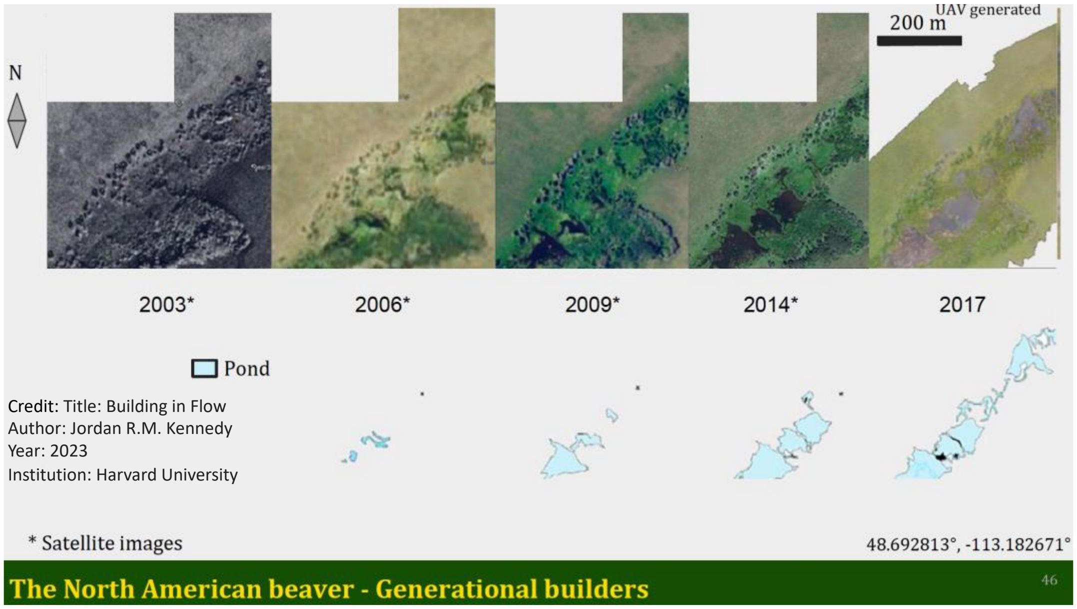
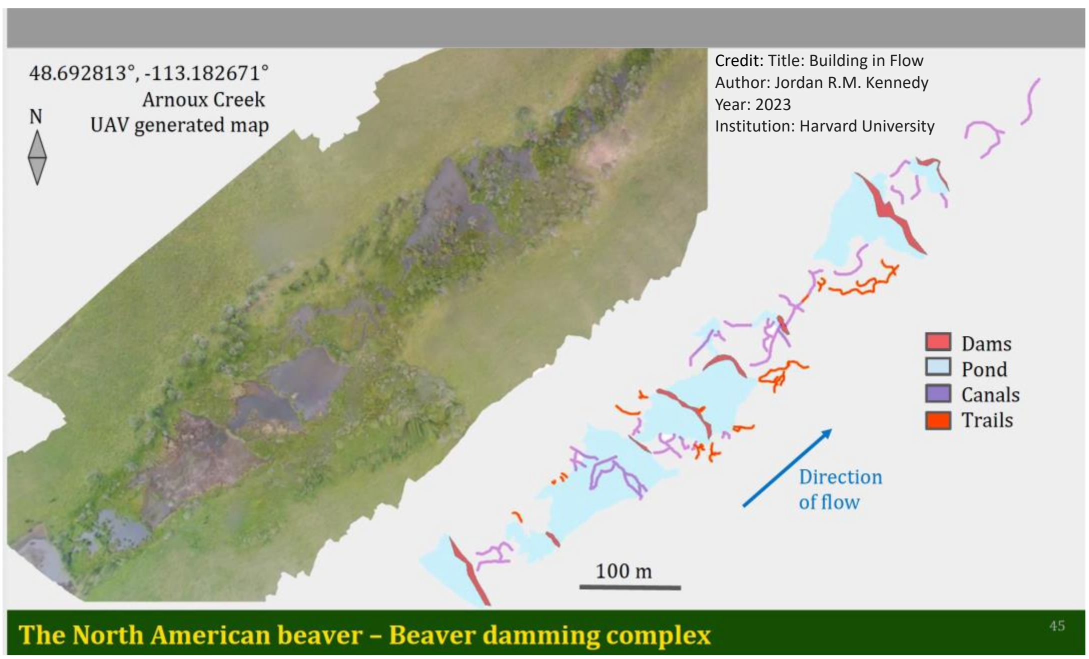
[28] *See generally*, Rupiper, A. (2022). Dam! Impacts of Beaver Dams on Surface and Groundwater Quality. Iowa Water Conference 2022.
[29]Salmon Web (2002). "Biological integrity and the index of biological integrity." https://www.cbr.washington.edu/salmonweb/bibi/biomonitor.html.
[30] Water Science School (June 6, 2018). "Where is Earth's Water?" U.S.G.S., https://www.usgs.gov/special-topics/water-science-school/science/where-earths-water (last visited May 22, 2023).
[31] Kennedy, J.R.M. (2023). *Building in Flow*. Doctoral dissertation, John A. Paulson School of Engineering and Applied Sciences, Harvard University, Cambridge. ProQuest Dissertations Publishing.

development of beaver dams, ponds, canals, and trails restructured the stream, connecting it to the floodplain, and vastly increasing surface water. Illustrations from the study (below) show the increase in surface water and resulting complex of ponds and catchments.





B. 2013 EA is Based on Outdated Assumptions about Wisconsin Beaver Population and Management Program

1. New analysis is needed to account for changes in state beaver management.

30. Wildlife Services' 2013 decision to continue the Wisconsin Beaver Elimination Program included an ongoing commitment to ensure it would not harm the Wisconsin beaver population. The 2013 EA specifies that: "Wildlife Services works with WDNR to ensure that damage management actions do not result in adverse impacts on beaver populations."[32] Meanwhile, the 2013 FONSI indicates Wildlife Services will coordinate with WDNR to "continue to monitor the impacts of its activities on the issues analyzed in detail in the EA including impacts on the state beaver population and non-target species that could be affected by beaver damage management activities."[33]

31. However, to the extent that Wildlife Services could perform any meaningful monitoring of the impact of the Wisconsin Beaver Elimination Program at the time of the 2013 EA, that became impossible after 2014, when WDNR stopped preparing estimates of the state beaver population.[34] Prior to 2014, helicopter surveys were WDNR's "primary means" of assessing beaver population changes.[35] However, WDNR ceased performing helicopter surveys after 2014 due to lack of funds.[36] It has not prepared beaver population estimates since that time.[37]

32. Prior to this, in 1991 WDNR divided the state into four beaver management zones.[38]

[32] USDA-APHIS Wildlife Services, 2013 EA at 33.
[33] USDA-APHIS Wildlife Services, 2013 FONSI at 6.
[34] Hirchert & Harris (2020) at 1.
[35] WDNR, 2015 Beaver Plan at 42-43.
[36] Hirchert & Harris (2020), at 1.
[37] *See* WDNR, Wisconsin Wildlife Reports, at https://dnr.wisconsin.gov/ topic/WildlifeHabitat/reports.html (showing last beaver population estimate from 2014).
[38] WDNR, 2015 Beaver Plan at 9.

Beginning in 1992, it conducted fall helicopter quadrat surveys every three years to estimate beaver population levels in Zones A and B, the northern one-third of the state.[39] It did not conduct surveys in the southern two-thirds of the state (Zones C and D), but extrapolated estimates for these zones based on harvest numbers reported by trappers.[40] At the time of WDNR's last helicopter survey in 2014, it estimated there were 9,890 beaver colonies in the northern one-third of the state—a 43% decline from the 17,270 colonies estimated after the 1995 survey.[41]

33. The 2013 EA relies upon the conclusions and management objectives of the Wisconsin beaver management plan developed in 1990, more than two decades before the 2013 EA.[42] WDNR issued a new beaver management plan in 2015 (2015 Plan), which changed the state's approach to beaver management, and included greater recognition of the important role beaver play in healthy ecosystems.[43] While the 1990 Beaver Management Plan had aimed to significantly reduce the beaver population, the 2015 Plan seeks to maintain a "relatively stable population" of beaver across the state, including allowing a slight increase in Zones A and B, maintaining Zone C at the current level, and allowing a slight decrease in Zone D.[44] Unfortunately, WDNR has done little to follow through on the commitments it made under the 2015 Plan.

34. The 2015 Plan also acknowledged the need for "better information on beaver harvest, population status, ecological impacts, and societal views and values."[45] In addition to anticipating continued helicopter surveys in northern Wisconsin to monitor beaver populations, the 2015 Plan called for the development of improved methods for monitoring beaver populations in the southern two-thirds of the state.[46] However, none of this work has been done. At the Beaver Task Force meeting in December 2022, Lydia Margenau of WDNR's Office of Applied Science presented information on the use of "Annual Fur Trapper Survey" data and "catch-per-effort" rates as a potential replacement for assessing beaver population trends.[47] However, this data does not provide reliable information on beaver population status but only shows the time and effort it takes some trappers to catch beaver and how many beaver they killed.[48] There was no plan to utilize technology or any other improved methodology to obtain more accurate population estimates.[49]

35. The 2015 Plan also commits to convening the state "Beaver Task Force" in 2020 to "review beaver population trends and recommend adjustments to population trend objectives as

[39] *Id*. at 43.
[40] *Id*.
[41] *Id*.
[42] USDA-APHIS Wildlife Services, 2013 EA at 14.
[43] WDNR, 2015 Beaver Plan at 29-31.
[44] *Id.* at 6, 8.
[45] *Id.* at 17.
[46] *Id.*
[47] WDNR (2022). Draft Minutes from Beaver Task Force Meeting (Mead Wildlife Area, Dec. 16, 2022). WDNR, Milladore, Wisc., at 2.
[48] *Id.*
[49] *Id.* Notably, WDNR has resisted calls to monitor beaver trapping with digital technology, such as GIS technology operated through handheld devices that would allow for a cost-effective and reliable way to monitor the number of beaver killed each year and the locations where they are killed.

appropriate."[50] However, the task force did not meet until December 2022.[51] During that meeting, the task force was unable to review population trends because it did not have any reliable data on those trends, and it did not make any final decisions or recommendations regarding population objectives.[52]

36. WDNR's estimates of annual beaver mortality and harvest rates are also unreliable. Private trappers are responsible for most beaver mortality in Wisconsin.[53] WDNR's current trapping policy allows a 6-month beaver trapping season in the two northern zones and a 5-month season in the southern zones, with unlimited take through any method of trapping.[54] Wisconsin does not require trappers to report the number of beaver they kill each year and does not impose any tagging requirements.[55] Wisconsin also allows landowners to trap or shoot beaver on their land year-round without a license and to destroy beaver dams without a permit.[56] As a result, WDNR does not know how many people are trapping beaver, when or where they are trapping, or how many beaver are killed each year. The 2013 EA acknowledged that there was no system in place to verify the number of beaver killed by trappers each year.[57]

37. In 2022, for example, WDNR sent surveys to 6,000 registered trappers, of whom only 42.7% returned the questionnaires. From this response of less than 50%, WDNR made the projection that "an estimated 1,897 people trapped 15,351 beaver for the 2021-22 season."[58] There is currently no method in place to verify such estimates.

38. In addition, WDNR has not performed any analysis of how many beaver should be in different areas of the state, so even if it had accurate population estimates, it would have no scientific basis for conclusions that the beaver population in certain areas should be either increased or decreased.[59] The existing four beaver management zones are too large to be properly managed, because each watershed within these zones has its own set of unique ecosystem characteristics. To do any meaningful analysis of the state Wisconsin beaver population, WDNR should evaluate beaver populations by individual watersheds broken down into smaller subbasins in the range of 15,000-30,000 acres. To guide watershed population management, the WDNR and WS must utilize widely accepted and scientifically peer-reviewed published studies to explain the process for accurately estimating potential carrying capacity for beaver in a given watershed. These studies estimate the carrying capacity based on examining land characteristics, stream mile length, and average colony size within a similar ecosystem region scaled to a watershed. Further,

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[50] WDNR, 2015 Beaver Plan, Strategy 1.1.6, at 8.
[51] WDNR (2022). Draft Minutes from Beaver Task Force Meeting (Mead Wildlife Area, Dec. 16, 2022). WDNR, Milladore, Wisc., at 1.
[52] *Id.* at 2-3, 13.
[53] WDNR, 2015 Beaver Plan at 44.
[54] *See generally*, WDNR (2022). 2022 Wisconsin Trapping Regulations, https://widnr.widen.net/s/gvf7mgqfht/trappingregulations_web.
[55] *Id.*
[56] *Id*.
[57] USDA-APHIS Wildlife Services, 2013 EA at 58. There is also no system for collecting data concerning the use of non-lethal devices to prevent mitigate beaver-related property damage.
[58] Dhuey, B., & Rossler, S. (2022). Beaver Trapping Questionnaire 2021-2022 (WDNR 2021-22 Trapping Questionnaire). WDNR, at 1.
[59] WDNR, 2015 Plan at 8.

these carrying capacity models can be refined to include human development to create a cultural carrying capacity model, as exemplified in Appendix C.[60]

39. To summarize, WDNR: (1) has never analyzed what optimal beaver populations would be statewide, or in different watersheds; (2) stopped doing population surveys or compiling estimates of the state beaver population after 2014; (3) has no means for evaluating trends in the beaver population, although its last estimate noted a continued precipitous decline; (4) has changed its objectives to focus on maintaining or increasing the beaver population; (5) does not have any reliable means of estimating the number of people who trap beaver every year, how many beaver they kill, or where those beaver are being killed; and (6) keeps no records of the number or location of beaver killed or dams destroyed by landowners every year.

40. The 2013 EA must be revised to address the significant changes to WDNR's Beaver Management Program after 2013 which include the adoption of a new 2015 Plan and their cessation of direct population monitoring. The lack of reliable information about current state beaver populations renders it impossible to perform any meaningful assessment of the impact of the Wisconsin Beaver Elimination Program.

2. *Wisconsin Beaver Elimination Program has Significantly Exceeded the Number of Beaver Kills Evaluated in the 2013 EA*

41. The 2013 EA acknowledges the need for ongoing monitoring of the Wisconsin Beaver Elimination Program, indicating it will be "reviewed each year to determine if the impacts of WS beaver damage management activities are consistent with the impacts presented in this analysis."[61] Wildlife Services neglected to monitor the program for several years, and when it began to do so in 2020, it discovered that its activities greatly exceeded those that had been evaluated in the 2013 EA, killing far more beaver that it had anticipated.[62]

42. Wildlife Services failed to perform any of the promised annual reviews of the program until 2020, when it finally released a monitoring report reviewing its operations for the prior six years.[63] The 2020 review concluded that a revision to the EA was necessary because Wildlife Services had been killing more than three times the number of beaver each year than it had anticipated under the 2013 EA.[64]

43. Between 2007 and 2011, Wildlife Services killed between 863 and 1,285 beaver annually, for an average of 1,066 killed each year.[65] When these figures are added to the number

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[60] *See* Appendix C: Beaver Carrying Capacity Model for discussion elaborating upon this model and using it to calculate the carrying capacity for the Marengo River basin and the Upper Brunsweiler River Basin.
[61] USDA-APHIS Wildlife Services, 2013 EA at 18.
[62] This also impacts Native American tribes in Wisconsin, by undermining failing to protect the rights of tribal members to harvest beaver on treaty ceded lands as established by the Voigt decision.
[63] *See generally*, Hirchert & Harris, 2020 Monitoring Report.
[64] Hirchert & Harris (2020) at 1-2 (showing increase in number of beaver killed each year from 2013 to 2019, with Wildlife Services reporting 3,464 killed in 2019); USDA-APHIS Wildlife Services, 2013 EA at 57, Table 4.1, and 59 (Wildlife Services killed an average of 1,066 beaver a year from 2007-2011 and expected future take to be similar).
[65] USDA-APHIS Wildlife Services, 2013 EA at 57, Table 4.1.

of beaver that trappers reported killing, the result shows that Wildlife Services and private trappers combined to kill approximately 48% of the state beaver population during that time period—well over the 30% sustainable "harvest" level set in Wildlife Service's 1997 programmatic EIS.[66]

44. In this same time period, the Wildlife Services take of beaver averaged about 3% of the total estimated cumulative take during these years and about 2% of WDNR's estimate of the total beaver population.[67] Going forward, Wildlife Services indicated that "[f]uture WS take of beaver for damage management is expected to be similar to recent years and will not exceed 2.5% of the estimated beaver population.[68]

Table 4.1 Beaver taken by WS for wildlife damage management in Wisconsin and harvested by licensed fur trappers and, 2007 - 2011[1].

	FY 2007 (Trapping Season 2006-07)	FY 2008 (Trapping season 2007-08)	FY 2009 (Trapping season 2008-09)	FY 2010 (Trapping season 2009-10)	FY 2011 (Trapping season 2010-11)	Average
# Beaver removed by WS	906	1,126	1,149	863	1,285	1,066
# Beaver harvested by licensed trappers	48,716	29,924	37,425	31,049	25,540	34,531
Total Take of Beaver In Wisconsin	49,622	31,050	38,574	31,912	26,825	35,597
% WS Take of Total Beaver Take	0.02	0.04	0.03	0.03	0.05	0.03
Estimated Wisconsin Beaver Population	93,100	66,800	66,800	66,800	80,473	
% of State Beaver Population Removed by WS	0.01	0.02	0.02	0.01	0.02	0. 02
% of State Beaver Population Removed by Fur Trappers	0.52	0.45	0.56	0.46	0.32	0.46
% of State Beaver Population Removed by All Sources	0.53	0.46	0.58	0.48	0.33	0.48

[1] Year indicates the federal fiscal year (October 1 thru September 30) and the Wisconsin trapping season (October-April).

Table 4.1 from the 2013 EA.[69]

45. In every year of operations under the 2013 EA, however, Wildlife Services has killed substantially more beaver than the 1,066 per year anticipated by the 2013 EA. From 2013 through 2022, Wildlife Services shot, trapped, and drowned 28,141 Wisconsin beaver—nearly three times the level anticipated by the 2013 EA.[70] Those numbers have risen steadily nearly every year, with Wildlife Services killing a record 3,492 beaver in 2022.[71] Similarly, Wildlife Services

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66 *Id*. at 59.
67 *Id.*
68 *Id.*
69 USDA-APHIS Wildlife Services, 2013 EA at 57.
70 *See generally*, USDA-APHIS, Program Data Reports, Program Data Report G - Animals Dispersed / Killed or Euthanized / # Burrows/Dens Removed or Destroyed / Freed or Relocated (2013-2022); https://www.aphis.usda.gov/aphis/ ourfocus/wildlifedamage/SA_Reports/SA_PDRs.
71 *Id.*

estimated in the 2013 EA that it would take only 3% of the total number of beaver killed each year, but it has exceeded that estimate in every year since. Although WDNR has not updated statewide population estimates since 2011, the number of beaver that Wildlife Services killed in 2022 would constitute 5% of the average estimated beaver population of 74,794 during 2006-2011—twice the 2.5% that the 2013 EA promised Wildlife Services would not exceed.[72] Based on WDNR's estimate that private trappers killed 15,351 beaver during the 2022 season,[73] Wildlife Services was responsible for killing 22.7% of all beaver killed in 2022—*more than seven times the percentage forecasted in the 2013 EA.*

Beaver Killed by Wildlife Services in Wisconsin: 2013-22[74]					
Year	**Beaver Killed**	**Departure from 2013 EA Baseline**	**% of 2013 EA Baseline**	**Private Licensed Take**	**% of Licensed Take**
2013	1,268	202	119%	29,374	**4.3%**
2014	1,455	389	136%	25,544	**5.7%**
2015	1,461	395	137%	25,062	**5.8%**
2016	1,958	892	184%	21,844	**9.0%**
2017	2,699	1,633	253%	20,020	**13.5%**
2018	2,867	1,801	269%	18,122	**15.1%**
2019	3,464	2,398	325%	20,569	**16.8%**
2020	3,296	2,230	309%	31,683	**10.4%**
2021	3,068	2,002	288%	30,568	**10.0%**
2022	3,492	2,426	328%	15,351	**22.7%**
Total	**28,141**	**14,368**		**238,137**	

46. The 2013 EA does not identify how many beaver dams Wildlife Services expected to destroy going forward, although it concluded that these activities would not have a significant impact on wetlands because (1) with the exception of when Wildlife Services destroys dams for the purpose of enhancing trout streams, most dam removals involves areas that were only recently flooded; and (2) Wildlife Services only removes dams affecting about 1,800 of approximately 13,000 miles of trout streams.[75]

47. As addressed below, the 2013 EA's discussion of the impact of dam removal is plainly inadequate in light of current science regarding the crucial role that beaver structures play

[72] USDA-APHIS Wildlife Services, 2013 EA at 59.
[73] WDNR, 2021-22 Trapping Questionnaire at 1.
[74] *See generally*, USDA-APHIS, Program Data Reports, Program Data Report G - Animals Dispersed / Killed or Euthanized / # Burrows/Dens Removed or Destroyed / Freed or Relocated (2013-2022); https://www.aphis.usda.gov/aphis/ ourfocus/wildlifedamage/SA_Reports/SA_PDRs; *see also* Hirchert & Harris (2020) at 1; Hirchert & Harris (2021) at 1; Hirchert & Harris (2022) at 1; *and* WDNR 2021-22 Trapping Questionnaire.
[75] USDA-APHIS Wildlife Services, 2013 EA, at 70.

in the ecosystem. Even given the limited discussion in the 2013 EA, the dramatic increase in the number of dams that Wildlife Services destroys each year constitutes significant new information that demands a new evaluation. From 2013 through 2021, Wildlife Services reported destroying 14,796 beaver dams, with that number increasing more than 60% between 2013 and 2021.[76] In addition, a large number of these were destroyed because they were located on trout streams. For example, data collected by Wildlife Services indicates that 1,279 of the 3,068 beaver it killed in 2021 (41.7%) were targeted due to trout stream projects, while trout stream projects as a whole accounted for only 207 out of 822 (25.1%) of the total number of Wisconsin projects for that year.[77]

Beaver Killed by Wildlife Services in Wisconsin: 2013-2021[78]			
Year	**Dams Dug**	**Dams Blown**	**Total Dams Destroyed**
2013	971	120	1,091
2014	1,200	151	1,351
2015	1,275	186	1,461
2016	1,405	208	1,613
2017	1,746	235	1,981
2018	1,507	178	1,685
2019	1,808	222	2,030
2020	1,631	184	1,815
2021	1,582	187	1,769
Total	**13,125**	**1,671**	**14,796**

48. While the 2020, 2021, and 2022 monitoring reports acknowledge that the dramatic increases in activity points to the need for a new environmental review, they nevertheless conclude the Wisconsin Beaver Elimination Program has not had a "significant adverse effect on the state's beaver population" due to "stable or increasing beaver populations."[79] As explained above, however, that lack of reliable population estimates makes this assurance meaningless. Neither Wildlife Services nor WDNR has identified adequate information to support the assertion that beaver populations are "stable or increasing," let alone at optimal levels to benefit the surrounding ecosystems.

49. Indeed, the limited data that is available indicates an alarming decline in the state's beaver population. The 2013 EA concedes, if WDNR was correct in finding that cumulative beaver take between 2007 and 2011 equaled 48% of the total beaver population, then "beaver populations

[76] *See generally*, APHIS-USDA Wildlife Services, Wisconsin Beaver Activity (Raw data) (2013-2021). Annual data reports, released by USDA-APHIS in response to FOIA Request No. 2023-APHIS-00294-F (Jan. 10, 2023).
[77] *Id*.
[78] *See generally*, APHIS-USDA Wildlife Services, Wisconsin Beaver Activity (Raw data) (2013-2021). Annual data reports, released by USDA-APHIS in response to FOIA Request No. 2023-APHIS-00294-F (Jan. 10, 2023).
[79] Hirchert & Harris (2020) at 2; Hirchert & Harris (2021) at 2, Hirchert & Harris (2022) at 2.

would be declining precipitously."[80] The 2013 EA also notes the "potential for error in the state system for estimating the beaver population and beaver harvest."[81] However, the 2013 EA goes on to conclude that the estimated cumulative take between 2007 to 2011 must be inaccurate because WDNR's equally flawed population estimates from 1998 to 2011 "appear indicative of a stable or gradually decreasing state beaver population, consistent with WDNR state objectives."[82] That is, rather than treating all of these numbers with caution, the 2013 EA selectively accepts the statistics that support Wildlife Services' preferred alternative, the continuation of the Wisconsin Beaver Elimination Program, and dismisses those that do not.

50. Notably, the 2013 EA's questionable conclusion that beaver populations are stable or gradually decreasing conflicts with WDNR's subsequent assertion in the 2015 Plan that beaver populations had experienced a "long term population decline" between 1995 and 2014.[83] The 2013 EA predates this information as well as the additional evidence provided by WDNR's last helicopter survey in 2014, which indicated a 43% decline since 1995.[84] Similarly, the 2013 EA did not anticipate the discontinuation of these surveys, which has left WDNR and Wildlife Services with no means to verify current populations or determine whether this precipitous population decline has continued.

51. Wildlife Services acknowledged the need for a new assessment in the monitoring reports conducted during the past three years, beginning with its acknowledgment in 2020 that:

> Take of beaver exceeded levels anticipated in the EA in 2017-2019. Based on conversations with cooperators including the WDNR, requests for WS-WI to take beaver are likely to exceed levels established in the EA. Additionally the WDNR has discontinued collecting the population data that WS used to assess impacts on beaver in the EA. A revision of the EA is warranted to address increased take of beaver and develop a new strategy for assessing WS-WI impacts on the beaver population.[85]

52. The 2021 monitoring report was even more explicit, stating that "in the absence of current WDNR beaver population data the actual relationship between WS take and the beaver population is unclear."[86] The 2022 report included a similar conclusion, while recognizing that "requests for WS-Wisconsin to take beaver are likely to remain at elevated or increasing levels."[87]

53. Because the 2013 decision to continue the Wisconsin Beaver Elimination Program was based on unreliable and inaccurate population estimates, it may be contributing significantly to the continued precipitous decline of the Wisconsin beaver population, even as WDNR has

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[80] USDA-APHIS Wildlife Services, 2013 EA at 59.
[81] *Id.*
[82] *Id.*
[83] WDNR, 2015 Beaver Plan at 20.
[84] *Id.* at 43.
[85] Hirchert & Harris (2020) at 8.
[86] Hirchert & Harris (2021) at 6.
[87] Hirchert & Harris (2022) at 7.

adjusted its strategy to focus on maintaining or increasing the population. Given the sensitivity of the beaver population to overexploitation, there is an urgent need for Wildlife Services to reevaluate the impact of this program through a new environmental analysis.

3. 2013 EA Does Not Account for the Impacts the Wisconsin Beaver Elimination Program Has Had on Other Species

54. The 2013 EA anticipates that a "relatively small number of non-target animals may be unintentionally captured and killed by Wisconsin Wildlife Services during [beaver damage management] activities depending upon the alternative selected."[88] The 2013 EA indicates that the Wisconsin Beaver Elimination Program will only "occasionally" kill non-target species such as otter, raccoons, and turtles."[89] However, it acknowledges that "the potential for greater use of lethal methods may lead to an increase in the kill of non-target species."[90]

55. The 2013 EA identifies otters, muskrats, raccoons, fish, and turtles as the non-target species most likely to be captured in beaver traps and snares.[91] The 2013 EA reports that river otters are the species most frequently captured by mistake, with Wildlife Services killing 60-100 otters as bycatch between 2009 and 2011.[92] The 2013 EA indicates that this number represents approximately 7-14%, of the 700-900 otters that trappers killed each year, out of a total state population of 9,000 to 11,000 otters.[93] However, as in the case of beaver population estimates, these are numbers are based on voluntary surveys returned by a sample of licensed trappers.

56. River otters are keystone aquatic predators that provide ecological services across their territories, which typically averages about 15 square miles. River otters are listed as a protected species under Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).[94] River otter are apex predators that maintain species balance and biodiversity within ecosystems. For example, Holland et al. (2018) "found positive associations of indices of biodiversity such as macroinvertebrate [index of biotic integrity], fish species richness, and mussel richness with occupancy by river otter and mink."[95] In addition, river otters are indicator species that are an "excellent biomonitor of food web and environmental contaminant exposure in this river system."[96] The historic decline of North American river otter populations strongly correlates with the elimination of beaver ponds and wetlands caused by

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[88] USDA-APHIS Wildlife Services, 2013 EA at 27.
[89] USDA-APHIS Wildlife Services, 2013 EA at 55.
[90] *Id*.
[91] USDA-APHIS Wildlife Services, 2013 EA at 27.
[92] *Id.* at 66-67.
[93] *Id.*
[94] UNEP, Convention on International Trade in Endangered Species of Wild Fauna and Flora, Appendix II (updated Feb. 23, 2023), available at: https://cites.org/eng/disc/text.php.
[95] Holland, Schauber, Nielsen, & Hellgren (2018). Stream community richness predicts apex predator occupancy dynamics in riparian systems. *Oikos*, *127*(10), 1422–1436, at 1433. https://doi.org/10.1111/oik.05085.
[96] Wainstein, Harding, O'Neill, et al. (2022). Highly contaminated river otters (Lontra canadensis) are effective biomonitors of environmental pollutant exposure. *Environmental Monitoring and Assessment*, 194(10) at 19. https://doi.org/10.1007/s10661-022-10272-9.

beaver extirpation in the late 1800s.[97]

Wildlife Services staff posing with six dead beaver and one river otter that was accidentally killed.[98]

57. The 2013 EA concludes that bycatch of otter "will not adversely affect the viability of the statewide otter population,"[99] but also states that WDNR's population estimates showed a decline in otter populations between 1994 and 2008.[100] Here again, as with the numbers indicating a decline in beaver populations, Wildlife Services summarily dismisses this statistic as attributable to a revised population model.[101] However, in light of new information, the evidence showing a decline in otter populations would correspond to the decline in beaver populations during the same period.[102]

58. Notably, the 2013 EA indicates that Wildlife Services' beaver management activities account for 7-14% of estimated river otter bycatch, but only 3% of the total beaver harvest.[103] This suggests that the professional trappers of Wildlife Services are 2-4 times more likely to accidently kill river otters than private trappers. Alternatively, this number could suggest that private trappers significantly underreport the number of river otters that they accidentally kill. However, the 2013 EA offers no analysis of the statistics that show that Wildlife Services kills a disproportionately high number of river otters.

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[97] Internet Center for Wildlife Damage Management, "Otters," https://icwdm.org/species/carnivores/ otters/ (last visited March 20, 2023).
[98] Photo credit: Center for Biological Diversity, obtained through Freedom of Information Act request to Wildlife Services.
[99] USDA-APHIS Wildlife Services, 2013 EA at 66-67.
[100] *Id.* at 66.
[101] *Id.*
[102] WDNR, 2015 Beaver Plan at 20, 43.
[103] USDA-APHIS-Wildlife Services, 2013 EA at 57.

59. More recently, between 2013-2022, Wildlife Services has reported that its beaver removal activities resulted in the accidental killing of around 1,091 river otter, and more than 1,000 other animals such as ducks, turtles, birds, and at least two bald eagles.[104] In addition, the number of non-target animals killed in recent years has increased, with Wildlife Services mistakenly killing an average of 146 river otters per year between 2017 and 2022.[105] This pattern is also evident in the chart below, showing bycatch numbers for 2013-2021.[106]

Nontarget Species	2013	2014	2015	2016	2017	2018	2019	2020	2021
Bass, Largemouth	-	-	1	-	-	1	1	-	1
Bears, Black	-	-	-	-	-	1	-	-	-
Catfish, Bullhead	1	-	-	-	-	-	-	-	-
Coots, American	1	1	-	-	-	-		-	-
Deer, White-tailed	1	-	-	-	3	1	1	3	1
Ducks, American Black	1	-	-	-	-	-	-	-	-
Ducks, Mallard	3	7	3	2	3	7	7	12	4
Ducks, Merganser, Common	-	2	-	-	-	1	-	1	1
Ducks, Merganser, Hooded	2	-	1	3	1	-	2	1	1
Ducks, Merganser, Red-breasted	-	1	-	-	-	-	-	-	-
Ducks, Teal, Blue-winged	-	-	-	-	2	1	-	1	-
Ducks, Teal, Green-winged	-	-	-	-	1	-	1	-	-
Ducks, Wood	-	-	-	1	7	2	3	4	2
Eagles, Bald	1	-	-	-	-	-	1	-	-
Fishers	-	1	-	-	-	-	-	-	-
Fish (Other)	-	-	-	-	-	3	1	1	2
Geese, Canada	-	4	3	-	8	7	7	1	20
Grebes, Pied-billed	1	-	-	-	1	-	-	-	-
Herons, Great Blue	-	-	1	4	2	1	1	2	-
Minks	-	1	1	-	2	1	-	5	3
Muskrats	29	39	48	45	136	82	75	97	83
Otters, River	78	82	99	106	152	140	149	140	146
Raccoons	16	23	24	37	37	28	33	60	39
Swans, Trumpeter	-	-	-	-	1	-	-	-	-
Turtles (other)	-	-	-	1	-	-	-	-	-
Turtles, Blanding's	-	-	-	-	-	-	1	-	2
Turtles, Common Snapping	7	5	9	29	20	46	21	51	41
Turtles, Spiny Softshell	-	-	-	-	2	-	-	1	-

Nontarget species (bycatch) killed by Wildlife Services, as reported in 2020-2022 Monitoring Reports.

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[104] Hirchert & Harris (2020) at 2-3, Hirchert & Harris (2021) at 2-3, Hirchert & Harris (2022) at 3.
[105] *Id.*
[106] *See* Hirchert & Harris (2020), Table 2, at 2-3; Hirchert & Harris (2020) at 2-3; Hirchert & Harris (2021) at 2-3; Hirchert & Harris (2022) at 3.

60. The 2013 EA emphasizes that "Wildlife Services personnel are experienced and trained in wildlife identification" and will "select the most appropriate methods for taking targeted animals and excluding non-target species."[107] However, this assertion is not borne out by the numbers, which indicate that Wildlife Services kills a large number of non-target species each year. [108]

61. The 2013 EA does not examine the impact that killing beaver and destroying beaver ponds have on otter habitat. LeBlanc et al. (2007) found that river otter live within beaver created ponds and wetlands, with their abundance being significantly higher around active beaver ponds than inactive beaver ponds.[109] Because river otter rely on the ponds and wetland systems that beaver create, the widespread killing of beaver and destruction of beaver dams eliminates habitat crucial to river otter survival. As Wildlife Services kills more beaver and destroys more beaver dams and ponds each year, it is increasingly important to evaluate the impact of these activities on river otter, especially when combined with the increasing number of otter Wildlife Services kills as bycatch each year.

62. As recent reports demonstrate, Wildlife Services has not only failed to minimize the killing of non-target species, but is now killing significantly more non-target animals than it did in 2013. As a result, Wildlife Services may be disrupting the balance between predators and prey and causing significant damage to Wisconsin ecosystems. The 2013 EA must be immediately updated to evaluate and prevent this potential ecological damage.

C. The 2013 EA is Based on Outdated Studies and Assumptions Contradicted by the Best Available Science

63. The 2013 EA relies heavily on authorities that were already more than 25 years old at the time it was published. Many of these sources are now out-of-date as a result of improved methodologies and additional findings uncovered by more recent research. The 2013 EA references a total of 144 sources, ranging in publication date from 1935 to 2012.[110] Of these, nearly one third—47 of the 144 sources (32.6%)—were published between 1935 and 1988, or at least 25 years before the completion of the 2013 EA, and are now more than 35 years old. In contrast, only 56 of the sources (38.9%) were published in 2000 or later, or within the last 23 years.

64. As discussed below, some sections of the 2013 EA are based on outdated information, including many of its findings in support of aggressive beaver removal. Indeed, some studies relied upon in 2013 are no longer valid. An additional decade of research has revealed significant new information about beaver ecology and impacts on landscapes and watersheds. There is now a much broader scientific consensus concerning of the importance of beaver in providing ecological services and maintaining healthy watersheds. This includes significant new research addressing the role of beaver in mitigating the adverse impacts of climate change. It is

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[107] USDA-APHIS Wildlife Services, 2013 EA at 62.
[108] Hirchert & Harris (2020) at 2-3.
[109] LeBlanc, Gallant, Vasseur, & Léger (2007). Unequal summer use of beaver ponds by river otters: Influence of beaver activity, pond size, and vegetation cover. *Canadian Journal of Zoology*, *85*(7), 774–782, at 777. https://doi.org/10.1139/z07-056.
[110] *See* USDA-APHIS Wildlife Services, 2013 EA, Appendix B: Literature Cited, at 80-90.

critical that the 2013 EA be immediately updated to address current research that confirms the importance of beaver in ecosystem management and watershed maintenance, and corrects many of the outdated and mistaken beliefs on which the Beaver Elimination Program was premised. An updated EA should also consider new information regarding the effectiveness of non-lethal techniques to reduce beaver damage.

1. 2013 EA Does Not Comport with Recent Science Regarding the Central Role Beaver Play in Creating Healthy Ecosystems and Habitat for Other Species

65. The 2013 EA defines normal beaver behavior (building of dams to create wetlands, increase river connectivity, and support biodiversity) as damaging.[111] However, the overwhelming weight of the scientific evidence challenges this old prejudice, and shows that beaver structures are increasingly crucial to creating healthy ecosystems and essential habitat for other species.

66. The 2013 EA briefly acknowledges that beaver and beaver dams contribute to the formation and maintenance of beneficial wetlands that provide many important ecological services,[112] but fails to provide any meaningful analysis of how the Wisconsin Beaver Elimination Program destroys wetlands and their services. The 2013 EA includes a section heading for "impacts on wetlands," but the title is misleading. After stating that "some people are concerned [that]… removal of beaver or breaching/removing beaver dams from an area will result in the loss of a certain wetland habitat and the plant and animal species and other ecological benefits associated with those habitats,"[113] the section goes on to suggest that only long-established wetlands have value and others should be removed.[114] It asserts that any ecosystem impacts will be minimal because Wildlife Services will follow restrictions imposed by the Army Corp of Engineers to "minimize any impacts" and "[t]he intent of intent of most dam breaching/removal is not to drain established wetlands."[115] This purported analysis thus draws a false distinction between "established wetlands" and beaver-created wetlands, asserts without any foundation that the Wisconsin Beaver Elimination Program will not damage "established wetlands," and disregards the ecological services, habitat value, and other benefits that beaver-created wetlands provide.

67. It is indisputable that killing beaver and destroying beaver dams eliminates wetlands, which are crucial to combating the dual threats of climate change and the global biodiversity crisis. As WDNR now states on its website:

> "Wetlands are part of the water cycle of all ecosystems, and their location in the landscape allows them to function as a buffer between upland areas and surface waters (Weller 1981). Wetlands perform a number of natural functions that benefit natural ecosystems and society. Water quality is often dependent upon wetlands because they serve to trap sediment, remove nutrients, protect shorelines and

[111] *Id*. at 11-13.
[112] *Id*. at 9.
[113] *Id*. at 30.
[114] *Id*. at 31-32.
[115] *Id*. at 32.

slow the effects of flood water. They also serve as both discharge and recharge areas for groundwater and provide habitat for many species of plants and animals (Stearns 1978). In part due to these functions, wetlands exhibit higher biological productivity than most other community types, and support rare biota. Currently, 43% of all federally-listed threatened and endangered species use wetlands at some point in their life cycles (Feierabend 1992). In Wisconsin, 32% of the state's listed species are wetland dependent. Further loss or degradation of wetlands would affect a disproportionate share of Wisconsin's rare species."[116]

68. The impact of the Wisconsin Beaver Elimination Program on biodiversity needs to be reassessed in light of new information that was not available in 2013. This includes the increasing number of beaver and beaver dams destroyed by Wildlife Services and growing weight of scientific evidence confirming the importance of beaver to healthy ecosystems.[117] As ecosystem engineers, beaver restore degraded wetlands and streams, increase biodiversity and species-richness, and aid in water storage and carbon sequestration.[118] For example, Pollock et al. (2014) found that beaver and beaver dams help to combat incision in streams and to restore the natal geomorphology of degraded streams, which leads to healthier watersheds and river systems.[119] Nummi et al. (2019) "found that both mammalian species richness (83% increase) and occurrence (12% increase) were significantly higher in beaver patches than in the controls."[120] As discussed below, beaver are also critical to building climate resiliency and mitigating the damage from wildfires, droughts, and high flood events.[121] For example, Dittbrenner et al. (2022) found beaver wetland complexes can increase water storage and decrease stream temperatures, all of which create habitats in which other species can survive climate change.[122] Especially with high flood

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[116] WDNR (Aug. 30, 2022), Wetland Communities of Wisconsin, https://dnr.wi.gov/topic/EndangeredResources/Communities.asp?mode=group&Type=Wetland (last visited May 31, 2023).

[117] *See also*, Appendix D: Additional Resources, sections 1-6, and 8.

[118] *See, e.g.*, Law, A., Gaywood, M. J., Jones, K. C., Ramsay, P., & Willby, N. J. (2017). Using ecosystem engineers as tools in habitat restoration and rewilding: Beaver and wetlands. *Science of The Total Environment, 605–606,* 1021–1030. https://doi.org/10.1016/j.scitotenv.2017.06.173; *See also*, Appendix D: Additional Resources, sections 1, 2, and 8.

[119] Pollock, M. M., Beechie, T. J., Wheaton, J. M., Jordan, C. E., Bouwes, N., Weber, N., & Volk, C. (2014). Using beaver dams to restore incised stream ecosystems. *BioScience*, 64(4), 279–290. https://doi.org/10.1093/biosci/biu036.

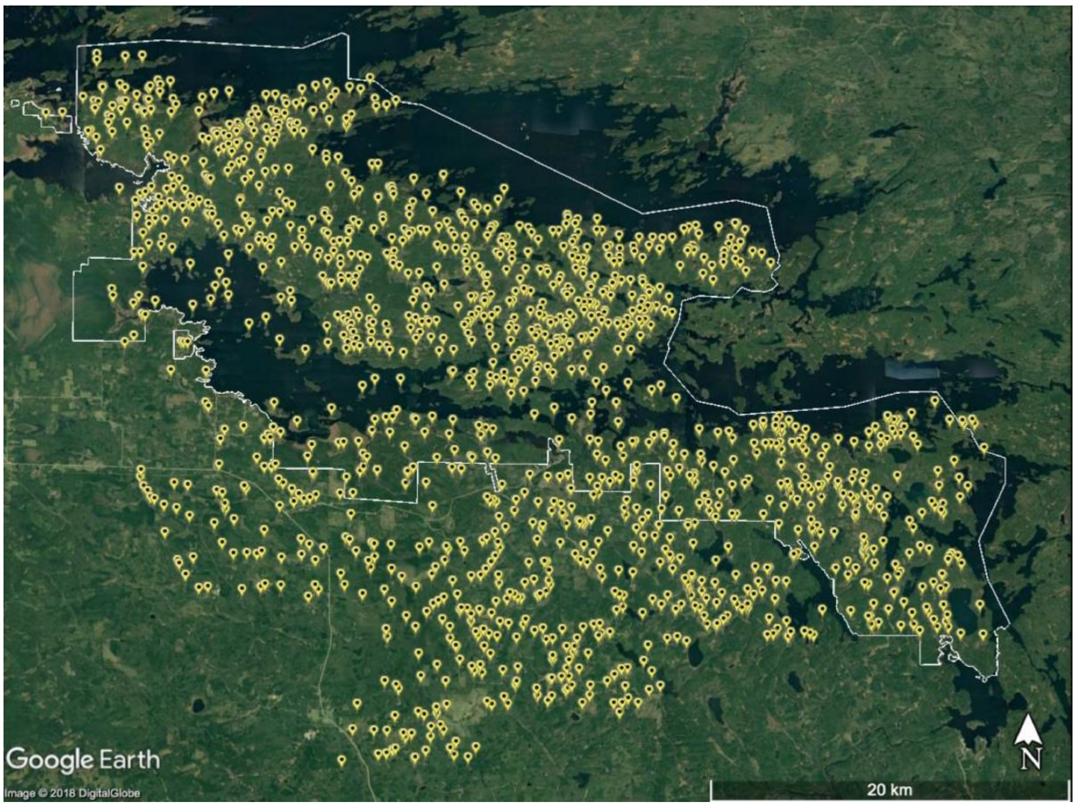
[120] Nummi, P., Liao, W., Huet, O., Scarpulla, E., &; Sundell, J. (2019). The beaver facilitates species richness and abundance of terrestrial and semi-aquatic mammals. *Global Ecology and Conservation*, 20:1. https://doi.org/10.1016/j.gecco.2019.e00701.

[121] *See* Fairfax, E., and Whittle, A. (2020). Smokey the Beaver: beaver-dammed riparian corridors stay green during wildfire throughout the western USA. *Ecological Applications* 30(8), https://doi.org/10.1002/eap.2225; Liao, Q., Boucher, R., Wu, C., Noor, S. M., Liu, L., Rock, M., Flanner, M., & Holloway, L. (2020). Hydrological Impact of Beaver Habitat Restoration in the Milwaukee River Watershed; *See infra* at section III.C.2, and Appendix D: Additional Resources, sections 1, 5, and 6.[122] Dittbrenner, B. J., Schilling, J. W., Torgersen, C. E., & Lawler, J. J. (2022). Relocated beaver can increase water storage and decrease stream temperature in headwater streams. *Ecosphere*, *13*(7) at 9. https://doi.org/10.1002/ecs2.4168 .

[122] Dittbrenner, B. J., Schilling, J. W., Torgersen, C. E., & Lawler, J. J. (2022). Relocated beaver can increase water storage and decrease stream temperature in headwater streams. *Ecosphere*, *13*(7) at 9. https://doi.org/10.1002/ecs2.4168 .

events more frequently occurring across Wisconsin, the stabilization and water storage beaver provide to healthy ecosystems will be critical in supporting climate resiliency and maintaining healthy ecosystems.

69. For example, scientists have observed remarkable transformations where beaver populations have been restored and protected, such as in Voyageurs National Park, which covers 325 square miles in northeast Minnesota.[123] The park has been off limits to trapping since it was established in 1975, and now has one of the highest beaver densities in North America.



Map showing Active Beaver Lodges in Voyageurs National Park.[124]

70. As the beaver population in Voyageurs National Park has recovered over the past 48 years, numerous species have started to flourish, including moose, raptors and waterbirds, and a variety of aquatic species. Monitoring efforts in the park from 1973 to 2016 documented more than 124 non-fish species that used beaver impoundments for at least some part of their life history, including 61% of the mammals documented in the park (35 of 57 species), 30% of the birds (77 of 254 species), 100% of the amphibians (10 of 10 species), and 20% of the reptiles (2 of 5

[123] ational Parks Traveler (n.d.) "Under the willows: Beaver as a Keystone Species at Voyageurs National Park." https://www.nationalparkstraveler.org/2022/12/under-willows-beaver-keystone-species-voyageurs-national-park (last visited May 30, 2023).
[124] *Id.*

species).[125] For example, the study revealed that the park contained 31 great blue heron rookeries, all of which were in are beaver ponds, and 172 osprey nests, 83% of which were in beaver ponds.[126]

71. In fact, all of the species discussed in the 2013 EA use habitat created by beaver impoundments.[127] The ponds and wetlands that beaver create provide habitat and forage areas for other aquatic mammals such as mink, muskrat and otters; raptors such as eagles and osprey; rare songbirds such as Kirtland's warblers; waterbirds such as the endangered whooping crane, and a wide variety of reptiles, amphibians, and insects.[128] Indeed, Cooke and Zack (2010) "found that total species richness, total abundance, and aquatic assemblage abundance were each positively correlated with dam density."[129]

72. More recently, Zero and Murphy (2016) found that by creating wetland habitat, "beaver can play an integral role in the conservation of pond-breeding amphibians such as leopard frogs."[130] Further, Anderson and Hood (2014) found that "beaver canals provided habitat for adult wood frogs and also functioned as movement corridors for emigrating [young-of-the-year] frogs, with possible implications for survival to maturity, meta-population dynamics and nutrient transfer between aquatic and terrestrial environments."[131]

73. Beaver ponds also provide essential habitat for migratory waterfowl. This includes nesting, foraging, and resting spots during migration, which is instrumental to maintaining bird migration routes, including the Mississippi Flyway, which, as shown below, cuts across the western Great Lakes region and Wisconsin.[132] A large study conducted by Ducks Unlimited found that beaver ponds provided important breeding habitat for mallard, wood ducks, hooded mergansers, buffleheads, common goldeneyes, American black ducks, blue- and green-winged teal, American wigeon, and ring-necked ducks.[133]

74. In addition to creating open water habitat for migratory birds, aquatic mammals, amphibians and reptiles, the U.S. Fish and Wildlife Service (USFWS) recognizes that beaver dams spread water and raise water tables, increasing riparian vegetation and side channels that increase

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[125] Johnson, C. A. (2018). *Beaver: Boreal Ecosystem Engineers*. Springer International PU, at 265.
[126] *Id.* at 266.
[127] USDA-APHIS Wildlife Services, 2013 EA at 62-63.
[128] *See generally*, Johnson, C. A. (2018). *Beavers: Boreal Ecosystem Engineers*. Springer International PU.; *and* Appendix D: Additional Resources, section 2.
[129] Cooke, H. A., & Zack, S. (2008). Influence of beaver dam density on riparian areas and riparian birds in shrubstepp
https://doi

Map of North American flyway zones reconstructed from data on banded birds.

[130] Zero, V. H., & Murphy, M. A. (2016). An amphibian species of concern prefers breeding in active beaver ponds. *Ecosphere*, *7*(5), at 10. https://doi.org/10.1002/ecs2.1330.
[131] Anderson, N. L., Paszkowski, C. A., & Hood, G. A. (2014). Linking aquatic and terrestrial environments: Can beaver canals serve as movement corridors for pond-breeding amphibians? *Animal Conservation*, *18*(3), 287–294. https://doi.org/10.1111/acv.12170.
[132] *See* Humburg, D.D. (n.d.). "Understanding waterfowl: The flyways." Ducks Unlimited. https://www.ducks.org/conservation/waterfowl-research-science/understanding-waterfowl-the-flyways (last visited May 30, 2023).
[133] Batt, B. (June 24, n.d.). "Understanding Waterfowl: Beaver Ponds and Breeding Ducks." Ducks Unlimited, https://www.ducks.org/conservation/waterfowl-research-science/understanding-waterfowl-beaver-ponds-and-breeding-ducks (last visited May 30, 2023).

Map of North American flyway zones reconstructed from data on banded birds.[134]

habitat for many other species.[135] In fact, more species rely on riparian areas than any other habitat type,[136] including many sensitive, threatened, and endangered species.[137] Expanding riparian vegetation can also increase biodiversity and provide habitat connectivity and migration corridors to link otherwise fragmented habitat.[138]

75. In fact, the 2013 EA acknowledges that USFWS "estimates that up to 43% of [threatened and endangered] species rely directly or indirectly on wetlands for their survival."[139] For example, the Blanchard Cricket Frog is a Wisconsin endangered species that "can be abundant

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[134] Humburg, D.D. (n.d.). "Understanding waterfowl: The flyways." Ducks Unlimited. https://www.ducks.org/conservation/waterfowl-research-science/understanding-waterfowl-the-flyways (last visited May 30, 2023).
[135] U.S. Fish and Wildlife Service (USFWS) (2023), *The Beaver Restoration Guidebook: Working with Beaver to Restore Streams, Wetlands, and Floodplains* (2023 Beaver Restoration Guidebook), v. 2.02, at 5-6, https://www.fws.gov/sites/ default/files/documents/The-Beaver-Restoration-Guidebook-v2.02_0.pdf.
[136] National Research Council (NRC) (2002), *Riparian Areas: Functions and Strategies for Management*, at 109-110. The National Academies Press, https://doi.org/10.17226/10327.
[137] *See generally,* USFWS, Listed species with spatial current range believed to or known to occur in Wisconsin, ECOS, https://ecos.fws.gov/ecp/report/species-listings-by-state?stateAbbrev=WI&stateName=Wisconsin&statusCategory =Listed (last visited March 23, 2023).
[138] NRC, *Riparian Areas: Functions and Strategies for Management*, The National Academies Press (2002), https://doi.org/10.17226/10327 at 110, 127.
[139] USDA-APHIS Wildlife Services, 2013 EA at 10, 22, 26, 27, 52, 55, and 75.

around beaver-created wetlands and lowland swamps."[140] Nevertheless, the 2013 EA concludes without support that "[i]t is not anticipated that the Wisconsin Wildlife Service program would result in any adverse cumulative impacts to [threatened and endangered] species."[141]

76. The 2013 EA also specifically excludes consideration of impacts to biodiversity, on the premise that it works to ensure that its actions "do not result in adverse impacts on beaver populations," and its take is only "a small proportion of the total population and insignificant to the viability and health of the population."[142] That assertion was troubling even in 2013, but has become impossible to maintain in the year since, during which time Wildlife Services has shot, trapped, and drowned 28,141 Wisconsin beaver[143]—nearly three times the level anticipated by the 2013 EA.[144] Indeed, Wildlife Services reports that it killed 3,492 beaver in 2022 alone,[145] which constitutes 22.7% of the total number of beaver estimated to have been killed in that year.[146] This is not a negligible impact.

77. In addition, Wildlife Services reports destroying 14,796 beaver dams between 2013 and 2021.[147] The destruction of these beaver dams also eliminated beaver ponds and wetland complexes that brought significant benefits to the surrounding ecosystems. The changes imposed on these waterways and ecosystems as a result of widespread beaver dam elimination were neither anticipated nor evaluated in the 2013 EA.[148] The assertion that beaver dam elimination on this scale has negligible impacts on biodiversity is both unsupported and contrary to scientific evidence.[149] The impacts of the Beaver Elimination Program on biodiversity is significant and must be evaluated.

78. The 2013 EA also claims, without support, that "[t]he following resource values within Wisconsin would not be adversely impacted by any of the alternatives analyzed: soils, geology, minerals, flood plains, visual resources, air quality, prime and unique farmlands, timber, and range."[150] However, mounting scientific evidence shows that beaver structures have positive impacts on soils and hydrogeology, including by preventing erosion, reducing sedimentation, mitigating extreme flood events, enhancing flood plains, and recharging the water table.[151] Systematically removing beaver structures eliminates these benefits, which is not a negligible

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[140] *See generally* Indiana Herp Atlas (n.d.). "Blanchard's Cricket Frog." https://inherpatlas.org/species/acris_blanchardi (last visited April 23, 2023).
[141] USDA-APHIS Wildlife Services, 2013 EA at 52.
[142] *Id*. at 33-34.
[143] *See* USDA-APHIS, Program Data Reports, Program Data Report G - Animals Dispersed / Killed or Euthanized / # Burrows/Dens Removed or Destroyed / Freed or Relocated (2013-2022); https://www.aphis.usda.gov/aphis/ourfocus/wildlifedamage/SA_Reports/SA_PDRs.
[144] USDA-APHIS Wildlife Services, 2013 EA at 59.
[145] *See* USDA-APHIS, Program Data Reports, Program Data Report G - Animals Dispersed / Killed or Euthanized / # Burrows/Dens Removed or Destroyed / Freed or Relocated (2013-2022); https://www.aphis.usda.gov/aphis/ourfocus/wildlifedamage/SA_Reports/SA_PDRs.
[146] *Id.*
[147] Hirchert & Harris (2022), at 1.
[148] USDA-APHIS Wildlife Services, 2013 EA, at 33-34.
[149] *See* Appendix D: Additional Resources, section 1 and 2.
[150] *Id.* at 51.
[151] *See generally*, Appendix D: Additional Resources, sections 1, 3, and 5.

impact.

79. New information also confirms that beaver dams have beneficial impacts on water quality. While the 2013 EA notes that sediments accumulate in beaver ponds, it fails to recognize that beaver dams create a filtering effect that reduces sedimentation of streambeds below the ponds.[152] For example, Puttock et al. (2018) found that beaver impoundments create localized sediment deposits and mitigated the loss of sediment downstream, which stores nutrients and reduces pollutants, contributing to cleaner water downstream.[153] In contrast, breaching beaver dams destabilizes and releases sediments causing increased sediment loads downstream.[154] Other recent studies also confirm that beaver dams improve water quality by enhancing temperature moderation, nutrient cycling, and contaminant removal.[155]

80. New information from research addressing the hydrological services provided by beaver dams is also significant and merits further evaluation. Although the 2013 EA acknowledges that beaver ponds "increase surface and groundwater storage which can help reduce problems with flooding by slowing the downstream movement of water during high-flow events and help to mitigate the adverse impacts of drought,"[156] it nevertheless identifies flood damage to crops, infrastructure, and other property as a key justification for beaver dam removal.[157] In effect, the 2013 EA recognizes that beaver dams can cause isolated flooding that occasionally threatens public safety by flooding roadways or infrastructure, but ignores the fact that beaver structures can also reduce more serious flooding by increasing water storage capacity upstream from vulnerable infrastructure, farms, and homes. As discussed further below, the flood control benefits associated with beaver dams also includes mitigation of the extreme flood events increasingly associated with climate change. Accordingly, the EA's assertion that its "beaver damage management activities do not jeopardize public health and safety" is inaccurate because it fails to acknowledge or consider the growing body of research indicating that beaver dam removal can increase flood risk and flood damage.[158]

81. Notably, in the new edition of The Beaver Restoration Guidebook, published earlier this year, USFWS notes that beaver impoundments dissipate energy during floods, by diverting water into multiple small channels, and that they attenuate flood peaks by retaining water behind dams and in the subsurface.[159] Other recent studies have confirmed these findings.[160] For example, Pollack et al. (2014) found that established beaver dams reduce the speed of water downstream

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[152] USDA-APHIS Wildlife Services, 2013 EA at 30-31.
[153] Puttock, A., Graham, H. A., Carless, D., & Brazier, R. E. (2018). Sediment and nutrient storage in a Beaver Engineered Wetland. *Earth Surface Processes and Landforms, 43*(11), 2358–2370. https://doi.org/10.1002/esp.4398; *see also* Appendix D: Additional Resources, section 3.
[154] USFWS, 2023 Beaver Restoration Guidebook at 8.
[155] USFWS, 2023 Beaver Restoration Guidebook at 7-10.
[156] USDA-APHIS Wildlife Services, 2013 EA at 9.
[157] *Id.* at 7, 69.
[158] USDA-APHIS Wildlife Services, 2013 EA at 52.
[159] USFWS, 2023 Beaver Restoration Guidebook at 5.
[160] *See generally*, Appendix D: Additional Resources, sections 5 and 6.

and repair stream incisions that contribute to high energy flow.[161] In addition, Liao, et al., (2020) conducted a study to estimate the potential flood control benefits of 52 beaver dams across the Milwaukee River Watershed, and found that during simulated storm events, the beaver dams reduced peak flow by 37%.[162] The economic value of beaver flood control services is also significant, and "[h]aving beavers restore watersheds to reduce flooding is perhaps the most cost-effective method to mitigating peak flows."[163] Again, this is significant new information that was never considered in the 2013 EA.

82. It is urgent that Wildlife Services conducts an updated environmental assessment to address new scientific information concerning the ecological and hydrological services provided by beaver, the adverse consequences of eliminating these benefits, and the dramatic increase of its destruction of beaver and their dams over the past decade.

2. 2013 EA Fails to Account for Increasing Importance of the Role Beaver Play in Mitigating the Impacts of Climate Change

83. The 2013 EA did not consider the impact that the Wisconsin Beaver Elimination Program would have on climate change. However, in the period since the 2013 EA was prepared, the world has increasingly recognized that the impact on climate change must be taken into account in resource management decisions.

84. Recent research has confirmed that beaver are the world's most effective climate engineers, increasing stores of carbon to mitigate climate change; moderating the impact of increasingly severe storms, fires, droughts, and flooding; and creating habitat essential to allow other species to survive a warming earth.[164] Protecting and expanding beaver populations is thus key to implementing the kind of nature-based climate solutions backed by several federal initiatives.[165]

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[161] Pollock, M. M., Beechie, T. J., Wheaton, J. M., Jordan, C. E., Bouwes, N., Weber, N., & Volk, C. (2014). Using beaver dams to restore incised stream ecosystems. *BioScience*, *64*(4), 279–290, at 289. https://doi.org/10.1093/biosci/biu036.

[162] Liao, Q., Boucher, R., Wu, C., Noor, S. M., Liu, L., Rock, M., Flanner, M., & Holloway, L. (2020). Hydrological Impact of Beaver Habitat Restoration in the Milwaukee River Watershed, 57-58. Milwaukee Metropolitan Sewerage District; https://www.beaverinstitute. org/wp-content/uploads/2023/03/Beaver-Hydrology-impact-in-Milwaukee-final-1.pdf.

[163] *Id*. at 83. Enlisting beaver to reduce peak flood flows could be instrumental in preventing severe flooding, such as the July 2016 flood that devastated communities on the Bad River Reservation in Northern Wisconsin; *see* USGS, Flood of July 2016 in Northern Wisconsin and the Bad River Reservation. U.S. Geological Survey Scientific Investigations Report 2017–5029 (2017), https://doi.org/10.3133/sir20175029.

[164] *See generally* Appendix D: Additional Resources, section 6 and 9.

[165] *See e.g.,* The White House (Nov. 2022). Opportunities To Accelerate Nature-Based Solutions: A Roadmap For Climate Progress, Thriving Nature, Equity, & Prosperity, https://www.whitehouse.gov/wp-content/uploads/2022/11/Nature-Based-Solutions-Roadmap.pdf ; The White House (Jan. 20, 2021). Executive Order on Protecting Public Health and the Environment and Restoring Science To Tackle the Climate Crisis, https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/20/executive-order-protecting-public-health-and-environment-and-restoring-science-to-tackle-climate-crisis/; The White House (Jan. 27, 2021), Executive Order on Tackling the Climate Crisis at Home and Abroad, https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/27/executive-order-on-tackling-the-climate-crisis-at-home-and-abroad/; The White House (April

85. Beaver are essential to mitigating climate change because the wetlands that they create act as a natural carbon storage sink.[166] In a petition to President Biden earlier this year asking him to issue an executive order protecting beaver on federal land,[167] Western Watersheds Project summarized recent science about the carbon storage potential of beaver-created wetlands:

- Beaver-created wetlands can store 195 to 478 metric tons of carbon per hectare-meter of soil, depending on type and location.[168]

- This is 3-10 times more carbon than a virgin forest, 6-14 times more than a secondary forest, and 7-35 times more than a grassland.[169]

- Wetlands can store carbon for longer residence times (> 1,000 years) than upland forest soils (100s of years).[170] This is an important contribution given the long-term challenge of climate change.

86. Beaver structures also mitigate the harm caused to wildlife, humans, and the environment by the severe storms, fires, droughts and flooding that climate change is making increasingly common. In areas prone to drought, beaver ponds restore moisture to the soil, while in wetter climates, their dams and ponds help slow floodwaters.[171] In addition, beaver create natural firebreaks and fire-resistant landscapes, with a 2020 study showing that areas with healthy beaver populations experienced one-third less damage from forest fires than those without.[172] Following a forest fire, scientists have observed that beaver dams act as sediment filters, catching debris that would otherwise kill fish and other downstream wildlife.[173]

22, 2022), Executive Order on Strengthening the Nation's Forests, Communities, and Local Economies, https://www.whitehouse.gov/briefing-room/presidential-actions/2022/04/22/executive-order-on-strengthening-the-nations-forests-communities-and-local-economies/.

[166] *See* Appendix D: Additional Resources, section 8.

[167] Bronstein, A., & Fouty, S. (Feb. 27, 2023). "Biden Beaver Letter." Western Watersheds Project, https://www.westernwatersheds.org/wp-content/uploads/2023/02/Biden-Beaver-Letter.pdf.

[168] *See* Environmental Protection Agency (EPA) (2016). "Greenhouse Gas Equivalencies Calculator," https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator (last visited April 17, 2023); Bronstein, A., & Fouty, S. (Feb. 27, 2023). "Biden Beaver Letter." Western Watersheds Project, https://www.westernwatersheds.org/wp-content/uploads/2023/02/Biden-Beaver-Letter.pdf.

[169] Wohl, E. (2013). Landscape-scale carbon storage associated with Beaver Dams. *Geophysical Research Letters*, *40*(14), 3631–3636. https://doi.org/10.1002/grl.50710.

[170] Valach, A. C., Kasak, K., Hemes, K. S., Anthony, T. L., Dronova, I., Taddeo, S., Silver, W. L., Szutu, D., Verfaillie, J., & Baldocchi, D. D. (2021). Productive wetlands restored for carbon sequestration quickly become net CO2 sinks with site-level factors driving uptake variability. *PLOS ONE*, *16*(3). https://doi.org/10.1371/journal.pone.0248398.

[171] USFWS, 2023 Beaver Restoration Guidebook at 4-7.

[172] Fairfax, E., and Whittle, A. (2020). Smokey the Beaver: beaver-dammed riparian corridors stay green during wildfire throughout the western USA. *Ecological Applications.* 30(8), https://doi.org/10.1002/eap.2225.

[173] Whitcomb, I. (2022). Beaver Dams Help Wildfire-Ravaged Ecosystems Recover Long after Flames Subside. *Scientific American.* Available at: https://www.scientificamerican.com/article/beaver-dams-help-wildfire-ravaged-ecosystems-recover-long-after-flames-subside/. Scientists are initiating further studies on this phenomenon, although the observation is supported by prior studies on the role beaver play in filtering sediment and mitigating pollution. *See also* Puttock, H. Graham, A. Cunliffe, M. Elliott, R. Brazier. (2017). Eurasian beaver activity increases water storage, attenuates flow and mitigates diffuse pollution from intensively-managed grasslands, *Science of The Total*

87. Finally, beaver create and maintain the habitat necessary for a large variety of species to survive on a warming earth, including mammals, fish, amphibians, reptiles, insects, and plants. Beaver dams and the resulting ponds create hydrostatic pressure which forces cold groundwater to well up downstream, cooling streams and creating cold and cool water complexity that provides crucial habitat for fish species like trout and salmon.[174]

88. The central role that beaver play in an effective national climate action plan was described in a paper last year that was co-authored by a scientist from the National Oceanic and Atmospheric Administration's National Marine Fisheries Service:

> It may seem trite to say that beaver are a key part of a national climate action plan, but the reality is that they are a force of 15–40 million (Naiman et al., 1988) highly skilled environmental engineers. We cannot afford to work against them any longer; we need to work with them. …In [some] situations, our first step may be policy changes: for example, if floodplains are intact, but beaver management actions (e.g., the lethal removal of beaver that impact the built environment) prevent population persistence sufficient to further recover these landscapes. Regardless of our role in the conversation, beaver inspired or implemented process-based restoration should be a primary strategy to achieving healthy riverscapes (Macfarlane et al., 2015; Pollock et al., 2015). A stream where beaver thrive is a resilient, productive stream (Pollock et al., 2014). Flourishing beaver populations can be our partner in combating climate change and a bellwether of our progress.[175]

89. The 2013 EA fails to reflect the urgency of the climate change crisis, or our current understanding of the crucial role beaver play mitigating the impact of climate change and increasing climate resiliency. In my opinion, there is an urgent need for Wildlife Services to suspend the current Wisconsin Beaver Elimination Program and revise its environmental analysis to assess the degree to which the Wisconsin Beaver Elimination Program is negating nationwide efforts to fight climate change.

3. 2013 EA is Based on Outdated and Discredited Information Regarding Beaver Impacts on Trout and Cold-Water Systems

90. The 2013 EA repeatedly asserts that dam removal is necessary to maintain cold water trout fisheries because beaver dams raise stream temperatures.[176] In doing so, the 2013 EA

Environment, 576, 430-43.

[174] *See* Munir, T., & Westbrook, C. (2021). Thermal characteristics of a beaver dam analogues equipped spring-fed creek in the Canadian Rockies. *Water*, *13*(7), 990. https://doi.org/10.3390/w13070990; Ronnquist, A. L., & Westbrook, C. J. (2021). Beaver dams: How structure, flow state, and landscape setting regulate water storage and release. *Science of The Total Environment*, *785*, 147333. https://doi.org/10.1016/j.scitotenv.2021.147333.

[175] *See* Jordan, C. E., & Fairfax, E. (2022). Beaver: The North American Freshwater Climate Action Plan. *WIREs Water*, *9*(4). https://doi.org/10.1002/wat2.1592.

[176] USDA-APHIS Wildlife Services, 2013 EA at 12-13, 16, 26, 31, 34, 37, 38, 54, 58, 71, 95.

perpetuates a myth that gained traction in the 1950s and continues to influence Wisconsin's beaver policies, even though it has been discredited by more recent science. Indeed, this myth is a core driver for the Wisconsin Beaver Elimination Program. A list of cooperative agreements for 2023 shows that 78% of the 354 Wisconsin streams for which Wildlife Services has been contracted to kill beaver and destroy beaver dams are being targeted because they contain trout habitat.[177]

91. In fact, even based on the science available at the time of the 2013 EA, Wildlife Services was forced to "agree that there are many examples of situations where beaver ponds have a beneficial impact on fish populations (Bergman et al. 2007, Pollock 2007, Rossell et al. 2005)."[178] Nevertheless, it dismissed these studies in favor of anecdotal evidence that predates current scientific understanding of the dynamics of beaver-trout relationships, to conclude that "beaver ponds have been shown to have an adverse impact on trout populations in areas like Wisconsin."[179]

92. The 2013 EA concedes that it cites to "old studies" for the proposition that beaver adversely impact trout habitat, and that "[m]ore recent studies indicate that beaver ponds can be quite beneficial to some species of fish."[180] Specifically, seven of the ten sources that the 2013 EA cites to support its assertion that beaver harm trout streams are dated from 1935 to 1980,[181] and contain theories that have been thoroughly debunked by more recent science. For instance, the 2013 EA's assertion that "Patterson (1951) found beaver impoundments in the Peshtigo River Watershed caused significant negative impacts to trout habitat by raising water temperatures, destroying immediate bank cover, changing water and soil conditions, and causing silt accumulations in spawning areas," references Sayler (1935), Cook (1940), Sprules (1940), and Bailey and Stevens (1951) as studies confirming these findings.[182] However, the overwhelming weight of science now shows that these conclusions reached more than 70 years ago are inaccurate.[183]

93. More recent studies with improved sampling methods have revealed that many beaver ponds display temperature stratification with significantly cooler water at lower depths. In fact, USFWS now recognizes that beaver ponds have a moderating effect on stream temperatures and retain layers of cooler water at lower depths, which provides refugia for cold-water fish on warm days.[184] Majerova et al. (2015) found that the ponds and wetlands that beaver create stabilize stream temperatures during times of fluctuation.[185] Weber et al. (2018) found that "increased dam and pond creation contributes to moderation of diel temperature cycles during periods of low surface flow by increasing water storage, and encouraging surface water-groundwater

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[177] *See generally*, 2023 WDNR-USDA Cooperative Agreement Streams List (Source: WDNR Fisheries Biologist Bradd Sims record request).
[178] USDA-APHIS Wildlife Services, 2013 EA at 38.
[179] *Id.*
[180] *Id.* at 38.
[181] *Id.* at 12-13 (section 1.6.1).
[182] *Id.*
[183] *See* Appendix D, Additional Resources, section 4.
[184] USFWS, 2023 Beaver Restoration Guidebook at 9; *see also* Appendix B: Comments by Dr. Ben Dittbrenner.
[185] *See* Majerova, M., Neilson, B. T., Schmadel, N. M., Wheaton, J. M., & Snow, C. J. (2015). Impacts of beaver dams on hydrologic and temperature regimes in a mountain stream. *Hydrology and Earth System Sciences*, *19*(8), 3541–3556. https://doi.org/10.5194/hess-19-3541-2015.

exchange."[186] Dittbrenner, et al., (2022) found that "active beaver ponds constructed by both long-established and newly relocated colonies caused stream cooling and increased surface and groundwater storage during summer low-flow conditions," therefore supporting cold-water streams and trout that reside within them.[187]

94. Meanwhile, other recent research has shown that beaver change water and soil conditions for the better. Brazier et al. (2020) found that beaver ponds "increased water availability, raised water tables, and increased interaction with aquatic and riparian vegetation," and that these changes "have all been shown to impact positively upon biogeochemical cycling and nutrient fluxes."[188] Other studies have also emphasized the essential role beaver play in promoting cleaner water and creating healthier stream systems.[189]

95. Finally, science has debunked longstanding concerns that beaver complexes cause the accumulation of sediment that harms spawning areas. While it is true that beaver structures reduce the velocity of stream flow, which in turn slows down sediment transfer and creates a potential build up in some areas, this process is not necessarily harmful to fish habitat. For example, Pollack et al. (2014) found beaver dams create a reduction in stream power and "allow sediment to accumulate on the streambed and floodplain while also reducing bank erosion."[190] This process protects streams from high levels of erosion that threatens stream morphology. Moreover, the accumulated silt does not necessarily decrease fish spawning and populations, but rather shifts the locations where spawning occurs. Pollack et al. (2003) found that, "While beaver dams have led to the siltation of spawning habitat and probably restrict access to spawning grounds for some species, there is little evidence of negative population-level effects. Because beaver ponds trap sediments and dampen floods, siltation and scouring of spawning gravels further downstream may be reduced, making determination of an overall negative population effect problematic."[191]

96. Thus, changes to the hydrology and geomorphology of stream systems from beaver activity does not inherently mean that fish populations will be negatively impacted; instead, the system as a whole changes, usually for the better. Indeed, organizations seeking to restore watersheds have encouraged beaver to return, because they are essential to creating balance within those ecosystems. For example, the National Forest Foundation is encouraging beaver to return to watersheds on the Colorado river because they create "the right conditions for natural processes to

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[186] Weber, N., Bouwes, N., Pollock, M. M., Volk, C., Wheaton, J. M., Wathen, G., Wirtz, J., & Jordan, C. E. (2017). Alteration of stream temperature by natural and artificial beaver dams. *PLOS ONE, 12*(5) at 20. https://doi.org/10.1371/ journal.pone.0176313.

[187] Dittbrenner, B. J., Schilling, J. W., Torgersen, C. E., & Lawler, J. J. (2022). Relocated beaver can increase water storage and decrease stream temperature in headwater streams. *Ecosphere*, 13(7), at 14. https://doi.org/10.1002/ ecs2.4168.

[188] Brazier, R. E., Puttock, A., Graham, H. A., Auster, R. E., Davies, K. H., & Brown, C. M. (2020). Beaver: Nature's ecosystem engineers. *WIREs Water*, *8*(1), at 12. https://doi.org/10.1002/wat2.1494.

[189] *See generally,* Appendix D: Additional Resources, sections 3 and 5.

[190] Pollock, M. M., Beechie, T. J., Wheaton, J. M., Jordan, C. E., Bouwes, N., Weber, N., & Volk, C. (2014). Using beaver dams to restore incised stream ecosystems. *BioScience*, 64(4), 279–290, at 289. https://doi.org/10.1093/ biosci/biu036. *See also* Appendix D: Additional Resources, section 3.

[191] Pollock, M., Heim, M., & Werner, D. (2003). Hydrologic and geomorphic effects of beaver dams and their influence on fishes, at 16. *American Fisheries Society Symposium*.

resume, thus 'letting nature do its thing.'"[192]

97. Indeed, numerous academic papers and peer-reviewed studies now show that beaver complexes have a significant beneficial impact on trout and salmonid species, because they increase forage, create greater biodiversity, improve stream health and water quality, reduce flooding, and stabilize stream temperature.[193] In 2018, a meta-analysis of 44 published studies examining trout/beaver interactions on Midwestern streams showed that beaver have beneficial impacts on trout.[194] Multiple additional studies have demonstrated the importance of beaver ponds in providing habitat for juvenile fish.[195] For example, Bouwes et al. (2016) found "compelling evidence that beaver increased the quantity of juvenile habitat" and "that water temperatures stayed the same or decreased throughout reaches with beaver ponds, and that diel fluctuation was dampened."[196] Other studies have shown that beaver ponds provide habitat for aquatic insects that comprise an important food source for fish.[197] In 2016, WDNR Fisheries Biologist Kirk Olson concluded the following:

> We found that Salmonid biomass, specifically brook trout, was substantially greater within a beaver impounded reach relative to non-impounded reaches. Movement of all three marked Salmonid species, across a wide range of sizes, passed beaver dams 0.9 m in height in both upstream and downstream directions. Summer water temperature was not substantially warmer downstream of the beaver impoundments as water temperatures remained within the range optimal for brook trout. Given these results, and the recent findings of several authors (e.g. Pollock et al. 2004, Bennett et al. 2014 Malison et al. 2015, Bouwes et al. 2016), we feel that further investigations on the influence of beaver dams on Wisconsin trout populations are warranted.[198]

98. The substantial evidence presented in recent studies of beaver-fish interactions overwhelmingly supports the proposition that beaver activity has numerous beneficial impacts on fish populations, and rejects the EA's premise that fish are harmed by beaver. Notably, the 2013

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[192] *See e.g.*, Dunbar, E. (n.d.). "What is low-tech process-based restoration, and how can it help the Colorado River?" National Forest Foundation, https://www.nationalforests.org/blog/low-tech-process-based-restoration-and-the-colorado-river (last visited April 10, 2023).

[193] *See* USFWS, 2023 Beaver Restoration Guidebook at 7-9, 14-17; *see also* Appendix D: Additional Resources, sections 3, 4 and 5.

[194] *See* Johnson-Bice, S. M., Renik, K. M., Windels, S. K., & Hafs, A. W. (2018). A review of Beaver-salmonid relationships and history of management actions in the Western Great Lakes (USA) region. *North American Journal of Fisheries Management*, *38*(6), 1203–1225. https://doi.org/10.1002/nafm.10223.

[195] *See generally,* Appendix D: Additional Resources, section 4.

[196] Bouwes, N., Weber, N., Jordan, C. E., Saunders, W. C., Tattam, I. A., Volk, C., Wheaton, J. M., & Pollock, M. M. (2016). Ecosystem Experiment reveals benefits of natural and simulated beaver dams to a threatened population of steelhead (Oncorhynchus mykiss). *Scientific Reports*, *6*(1) at 7-8. https://doi.org/10.1038/srep28581.

[197] *See e.g.,* Fuller, M. R., & Peckarsky, B. L. (2011). Ecosystem Engineering by Beavers affects Mayfly Life Histories. *Freshwater Biology*, *56*(5), 969–979. https://doi.org/10.1111/j.1365-2427.2010.02548.x. *See also* USFWS, 2023 Beaver Restoration Guidebook at 14-17.

[198] Olson, K. (2016). "DRAFT: Influence of Beaver Dams on Naturally Reproducing Trout and Salmon in Rocky Run, Douglas County, WI," at 8-9. WDNR.

EA cites only four sources from the prior 25 years that support its hypothesis that beaver harm fish: a 2011 opinion survey,[199] and three internal project reports completed by former WDNR fisheries manager Ed Avery between 1992 and 2004, which did not meet accepted standards for scientific rigor and were not subject to peer review.[200]

99. In fact, while the Avery studies purported to show that beaver dams increase stream temperature, a subsequent analysis of his work revealed no significant correlation between beaver dams and stream temperature.[201] In a 2008 graduate thesis, Jon Popelars reviewed Avery's analysis and showed that there was no significant correlation between beaver dams and higher summer stream temperatures.[202] Instead, Popelars found that increases in stream temperatures were directly related to increases in ambient temperature (air temperature).[203]

100. Avery's conclusion that the removal of dams increases trout survival was also fatally flawed. For his 1992 study about the effects of removing dams in northeastern Wisconsin, Avery oversaw the removal of over 400 beaver dams in the Pemebonwon River system.[204] While he was conducting his study, fishing clubs were releasing hatchery trout in the same areas. Contrary to his hypothesis, he later admitted that there was zero overwinter survival of trout in the areas where the dams had been removed.[205] Avery did not understand that beaver ponds warm the water during winter and cool the water in summer. His work did not consider the hydrology or the thermodynamics of the hyporheic zone (the region where there is a mixing of shallow groundwater and surface water).[206] He did not recognize that removal of the dams disrupted the stream structure and eliminated the warmer water that could provide a refugia for fish over the winter, allowing some of the stream sections to freeze all the way to the bottom of the stream bed.

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[199] USDA-APHIS Wildlife Services, 2013 EA at 10. The 2013 EA reports the results of the survey as follows: "A total of 571 respondents represented a number of interests including interested citizens (47%), trout anglers (46%), landowners (36%) or trappers (35%). Among trappers, acknowledgement of beaver damage to trout streams as a common problem was substantial (61%). Among the entire group, a majority (68%) found the level of all beaver damage to be acceptable though they were accepting of beaver removal on trout streams (58%) and a majority (54%) also felt that beaver populations were, to varying extents, damaging to trout populations. They further strongly supported beaver removal on class 1 trout streams (68%) and more supported beaver removal on Class 2 trout streams (46%) than opposed (39%)." But this survey merely shows the impact that WDNR's propaganda has had on the average person, who does not understand how beaver impact hydrology. WDNR perpetuated the myth that beaver damage trout streams through publications, posters, and fishery pamphlets, and then surveyed people to see if the message had sunk in. It is also important to note that this survey was not a representative study of the Wisconsin public perspective—only .00042% of the total Wisconsin population traps and yet trappers made up 35% of survey respondents.

[200] USDA-APHIS Wildlife Services, 2013 EA at 80 (listing reports by Ed Avery from 1992, 2002, and 2004) and 83 (referencing 2011 Beaver Trapper Questionnaire).

[201] *See generally,* Popelars, J. (2008). Using GIS to Reevaluate Beaver Dam Effects on Local Environments in Northern Wisconsin Brook Trout Streams During the 1980s. Graduate thesis, Department of Resource Analysis, Saint Mary's University of Minnesota, Winona, MN 55987; https://gis.smumn.edu/GradProjects/PopelarsJ.pdf.

[202] *Id.*

[203] *Id.*, at 11.

[204] *See generally*, Avery, E. L. (1992). Effects of Removing Beaver Dams Upon a Northern Wisconsin Brook Trout Stream. WDNR.

[205] Boucher, Robert (May 16, 2017). Personal interview with Ed Avery.

[206] *See generally*, Appendix D: Additional Resources, sections 1, 5 and 6.

101. Avery's research also examined the claim that beaver dams pose a significant obstacle to fish passage.[207] To examine this question, Avery stunned and marked fish above a beaver dam, and then moved those fish below the dam and conducted a follow-up survey to see if any of those fish had migrated back through the dam.[208] In all cases, he found that they had.[209] However, the study nevertheless states that the findings were inconclusive. Later in a personal interview, Avery admitted that he could not believe these results and therefore dismissed them as inconclusive.[210] Because the finding did not fit into Avery's previously held assumptions, he rejected its validity.

102. The 2013 EA asserts that "Avery (1992) found wild brook trout populations in tributaries to the north branch of the Pemebonwon River (PR) in northeastern Wisconsin improved significantly following the removal of beaver dams."[211] Although Avery noted that brook trout populations moderately increased in the tributaries, the assertion that wild brook trout populations "improved" is not supported by the full report. To the contrary, Avery's report conceded that "[b]oth density and biomass of wild brook trout populations in the PR declined following removal of beaver dams and did not recover during the study period."[212] Similarly, it acknowledged that "the sport fishery on the PR, which included both wild and stocked brook trout improved during the second year following removal of beaver dams but exhibited a catastrophic decline during the fourth year after dam removals."[213] Finally, Avery reported that "continued but less intensive sampling failed to suggest an overall positive response in the brook trout population 6.3 years after removal of beaver dams."[214]

103. In fact, these failures make sense, because the removal of dams would cause the water temperatures in main river to increase during the summer. Meanwhile, the tributaries would likely stay cooler because they have a higher percentage of springs and groundwater inflow, providing a refugia that trout would seek out—temporarily causing the population in the tributaries to increase. Thus, while the immediate results from a given sample area after beaver dam removal may have shown larger brook trout populations, the dam removal proved harmful in the long term because it destroyed the hydrological structures that moderate stream temperature in both the winter and the summer.

104. In sum, Avery's work does not stand up under scientific scrutiny, and has been thoroughly discredited and contradicted by subsequent science. Nevertheless, the myths that he helped to perpetuate remain a pillar of WDNR's disastrous trout management policy.[215]

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[207] Avery, E. L. (1992). Effects of Removing Beaver Dams Upon a Northern Wisconsin Brook Trout Stream. WDNR.
[208] *Id.*
[209] Boucher, Robert (May 16, 2017). Personal interview with Ed Avery.
[210] *Id.*
[211] USDA-APHIS Wildlife Services, 2013 EA at 13.
[212] Avery, E. L. (1992). Effects of Removing Beaver Dams Upon a Northern Wisconsin Brook Trout Stream, at 34. WDNR.
[213] *Id.* at 34.
[214] *Id.* at 34.
[215] *See* Kobilinsky, D. (2023, February 28). "Removing beaver dams to protect Massive Brook Trout." The Wildlife Society, https://wildlife.org/removing-beaver-dams-to-protect-massive-brook-trout/ (last visited April 3, 2023).

105. Wildlife Services has an obligation to examine Avery's conclusions critically, with reference to the wealth of recent science that shows beaver have positive impacts on cold-water streams and enhance fish survival. Indeed, it is urgent that Wildlife Services reexamine its conclusions about the relationship between beaver and trout through an updated assessment, because the desire to restore trout streams continues to be the driving factor behind a large percentage of the beaver the Wildlife Services kills and the dams it destroys.

Example of breached beaver pond from Avery's study.

4. 2013 EA Does Not Account for Recent Science on Humaneness of Beaver Trapping

106. The 2013 EA also fails to consider that beaver trapping is inherently inhumane and does not consider recent science focusing on the humaneness of trapping. Several recent studies have examined this question and cited standards for properly evaluating humaneness as a factor in beaver management.

107. The 2013 EA asserts that lethal trapping will be conducted as humanely as possible. But *humane beaver trapping* is an oxymoron. The most prevalent trapping method used by Wildlife Services is to catch beaver in body gripping traps that hold them underwater until they drown.[216] The American Veterinary Medical Association identifies drowning as an unacceptable method of euthanasia,[217] and finds that "kill traps do not consistently meet the [Panel on Euthanasia] criteria for euthanasia."[218] Despite admitting that the AVMA finds drowning unacceptable, the 2013 EA dismisses those concerns by simply stating, "but provides no details on

[216] USDA-APHIS Wildlife Services, 2013 EA at 69.
[217] U.S. Department of Health and Human Services. (2020). AVMA Guidelines for the Euthanasia of Animals: 2020 Edition, at 58. National Institutes of Health. https://www.avma.org/KB/Policies/Documents/euthanasia.pdf.
[218] *Id.* at 46.

the reasons for this decision."[219] However, the reasons for this conclusion are self-evident, and could be discovered with minimal research.[220]

108. As noted in Proulx, et al., (2022), "[a]nimal welfare science has developed rapidly in recent years, and a wide range of measures are available to evaluate the welfare of animals such as those caught or otherwise affected by snares or other traps (Broom and Johnson 2019; Broom 2022). Many of these measures indicate anxiety, distress, fear, pain and other negative feelings."

109. Serfass (2022) summarizes the application of these measures to the submersion traps that Wildlife Services typically uses to kill beaver:

> Because submersion sets involve the use of either killing or restraining traps with the intent of killing the animal underwater, trapping systems must be assessed for their effectiveness to quickly render animals unconscious, and to hold animals without serious physical injuries, high distress, and significant physiological changes.[221]

Not only do submersion traps fail to kill beaver quickly, they can also cause major injuries. Recent studies have noted that beaver may develop infection from these injuries and suffer for a long period of time before death.[222]

110. By modern measures, drowning is a particularly inhumane way to kill beaver. Although the Association of Fish and Wildlife Agencies (AFWA) refuses to set criterion for the humaneness of kill traps that drown wildlife, it has evaluated humaneness for other types of traps based on a single criterion: the time required for an animal to become irreversibly unconscious after being captured.[223] Performance criteria are based on traps set on land, with 70% of trapped animals in the sample needing to be irreversibly unconscious within 300 seconds.[224]

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[219] USDA-APHIS Wildlife Services, 2013 EA at 30.
[220] Ludders, John & Schmidt, Robert & Dein, F. & Klein, Patrice. (1999). Drowning is not euthanasia. *Wildlife Society Bulletin*. 27. 666-670.
[221] Serfass, T. L. (2022). Animal welfare issues pertaining to the trapping of North American river otters: a review of the adequacy of the river otter BMP. In G. Proulx, editor. *Mammal Trapping–Wildlife Management, Animal Welfare & International Standards*, pp. 23-48. Alpha Wildlife Publications, Sherwood Park, Alberta, Canada.
[222] Rosell, F. N., & Campbell-Palmer, R. (2022). *Beavers: Ecology, Behavior, Conservation, and Management*. Oxford University Press at 279.
[223] *See generally* Association of Fish and Wildlife Agencies (2016). Best Management Practices for Trapping Beaver in the United States. https://www.fishwildlife.org/application/files/2615/2105/0542/Beaver_BMP_2016.pdf.
[224] *Id.*

A beaver drowned by Wildlife Services after being caught in a foothold trap.[225]

111. Because of their ability to conserve oxygen when swimming underwater, it can take more than 20 minutes for beaver to drown. During that time, trapped beaver will be panicked and struggle to find a way out, in some cases breaking their teeth, until they die. Those who assert that drowning is a humane way to kill aquatic mammals often site to a 1982 study by Gilbert and Gofton that compared drowning rates between mink, muskrat, and beaver by taking one animal at a time, placing them in a trap, and waiting for them to drown while monitoring vitals and signs for struggles.[226] However, the study found that while mink and muskrat drowned more quickly, beaver held on much longer. In fact, it found that, on average, beaver struggled underwater for a full eight minutes, had brain activity for nine minutes, and held a heartbeat for 15 minutes.[227] One beaver, labeled B25, struggled for almost 13 minutes, and maintained a heartbeat for 20 minutes.[228] The study authors concluded that these results fell outside the standards for humane euthanasia established by the Federal Provincial Committee for Humane Trapping of Canada.[229]

112. In an article for the *Wildlife Society Bulletin*, "Drowning is Not Euthanasia," Ludders et al. (1999) further refute the idea that drowning is humane, citing evidence that drowning causes stress and pain before dying from hypoxia and anoxia (not CO2-induced narcosis).[230] The authors conclude that "any technique that requires minutes rather than seconds to produce death [cannot] be considered euthanasia."[231]

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[225] Photo credit: Center for Biological Diversity, obtained through Freedom of Information Act request to Wildlife Services.
[226] *See generally,* Gilbert, F. F., & Gofton, N. (1982). Terminal dives in mink, muskrat and Beaver. *Physiology & Behavior*, 28(5): 835–840. https://doi.org/10.1016/0031-9384(82)90200-1.
[227] *Id.*
[228] *Id.*
[229] *Id.*
[230] *See generally*, Ludders, J. W., R. H. Schmidt, F. J. Dein, and P. N. Klein (1999). Drowning is not euthanasia. *Wildlife Society Bulletin*, 27: 666-670.
[231] *Id.*; *and* Ludders, J. W., R. H. Schmidt, and F. J. Dein, and P. N. Klein (2001). Drowning can no longer be considered euthanasia: reply to Bluett. *Wildlife Society Bulletin*, 29: 748-750.

113. Further, lethal trapping causes major disruption to the family unit, especially when an adult parent beaver is killed.[232] With new family units, mothers who are killed leave behind newborns inside the lodge who are often left to starve and die.[233] Thus, the cruelty of lethal trapping often extends beyond just the initial beaver that is killed.

114. Finally, submersion traps are indiscriminate, and often kill non-targeted species like otter, muskrats, raccoons, and turtles. Between 2013-2022, Wildlife Services reported that its beaver removal activities resulted in the death of around 1,091 river otter, and more than 1,000 other animals such as ducks, turtles, birds, and at least two bald eagles.[234] A recent study (Serfass 2022) focused on the humane implications of using body-gripping traps to drown otter, observing that otter can remain underwater for 8 minutes, and thus "endure an extended period of pain and suffering if killed by drowning."[235] Serfass (2022) also pointed out that young otters are typically born between February and April, and that trapping during these times will often lead to the death of female otters involved in litter rearing, leaving the pups to die.[236] He concluded that wildlife managers needed to address the AVMA's finding that drowning was not humane and that "[c]riteria need to be established for what constitutes a timely, humane death caught in restraining traps used as killing traps in submersion sets."[237]

115. The assertion that beaver cause damage does not eliminate the obligation to ensure that they are treated humanely, especially when humane non-lethal alternatives are often more effective and more cost-effective.[238] As Proulx et al. (2022) concluded:

> Mammals considered to be pests, or trapped for food or fur, have the capacity to feel pain and fear and to suffer just like humans or any other vertebrate animal. Their welfare should be scientifically assessed. However undesirable the impact of these animals on humans, whenever control methods are considered, their effects on the welfare of affected animals should be carefully considered. Where there are adverse effects of a species considered to be a pest, a cost-benefit analysis comparing these with the extent of poor welfare of the pest and non-target animals caused by the control method may be reasonable. However, some control, capture and killing methods have such extreme effects on an animal's welfare that, regardless of the potential benefits, their use is never justified

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[232] Rosell, F. N., & Campbell-Palmer, R. (2022). *Beavers: Ecology, Behavior, Conservation, and Management*. Oxford University Press at 278.
[233] Personal correspondence with Beaver Deceivers founder Skip Lisle, https://beaverdeceivers.com.
[234] Hirchert & Harris, 2020 Monitoring Report at 2-3, 2021 Monitoring Report at 2-3, 2022 Monitoring Report at 3.
[235] *See generally*, Serfass, T. L (2022). Animal welfare issues pertaining to the trapping of North American river otters: a review of the adequacy of the river otter BMP, at 41. In G. Proulx, editor. *Mammal Trapping–Wildlife Management, Animal Welfare & International Standards*, pp. 23–48. Alpha Wildlife Publications, Sherwood Park, Alberta, Canada.
[236] *Id.* at 42.
[237] *Id*. at 41.
[238] *See also* USFWS, 2023 Beaver Restoration Guidebook, at 117-125.

(Sandøe et al. 1997; Broom 1999).[239]

5. 2013 EA Relies on Outdated, Incomplete, and Inaccurate Cost-Benefit Analysis

116. The 2013 EA also misrepresents the true costs and benefits of the Wisconsin Beaver Elimination Program, because it fails to use current information about the enormous economic benefit from healthy beaver populations or to properly evaluate the costs of non-lethal beaver management alternatives.

117. The 2013 EA claims that killing beaver protects millions of dollars of natural resources by preventing beaver damage and protecting trout habitat.[240] It supports this claim with reference to studies that were already between 19 and 34 years old at the time of the 2013 EA.[241] Setting aside the dubious merit of these claims based on outdated science, the 2013 EA fails to balance its cost-benefit analysis with any effort to quantify the true costs of killing beaver and destroying their dams, such as lost wetlands and ecosystem services. This inconsistency is striking.

118. It is hard to place an economic value on the loss of Wisconsin's precious wetlands. According to WDNR, "32% of the state's listed species are wetland dependent," but "Wisconsin has lost 47% of its original ten million acres of wetlands."[242] However, by failing to place a value on the wetlands lost due to the Wisconsin Beaver Elimination Program, the 2013 EA presents an unacceptably skewed picture of the program's costs and benefits. New studies showing the value of beaver in enhancing wetlands, riparian habitat, water storage, flood control, and mitigating adverse effects of climate change underscore that the positive value of retaining beaver must not be trivialized in comparison to the alleged benefits of beaver removal.

119. Each year, the United States spends millions of dollars to restore wetlands.[243] But beaver do this work for free, providing billions of dollars in ecological services. As the USFWS Guidebook reflects, there is growing interest in tapping the natural proclivity of beaver in watershed improvement projects by restoring beaver to areas in need of enhanced wetlands, water storage, habitat, and flood control.[244] For example, a 2020 study found that restoring beaver to the Milwaukee River Watershed could reduce the peak flow during high water events by over 37% on average and provide as much as $3.346 billion in ecological services by creating stormwater

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[239] *See generally*, Proulx, G., Allen, B. L., Cattet, M., Feldstein, P., Iossa, G., Meek, P. D., Serfass, T. L. and Soulsbury, C. D. (2022). International Mammal Trapping Standards—Part II: Killing Trap Systems. In Proulx, Gilbert (ed.) *Mammal Trapping: Wildlife Management, Animal Welfare & International Standards*. Alberta, Canada. Alpha Wildlife Publications. 259-272.

[240] USDA-APHIS Wildlife Services, 2013 EA at 16.

[241] USDA-APHIS Wildlife Services, 2013 EA at 11 (citing studies on economic damage caused by beaver from 1979, 1982, 1983, and 1994).

[242] WDNR (Aug. 30, 2022). "Wetland communities of Wisconsin." WDNR, https://dnr.wi.gov/topic/EndangeredResources/Communities.asp?mode=group&Type=Wetland.

[243] *See e.g.*, EPA. (n.d.). "Federal Funding for Wetlands." EPA, https://www.epa.gov/wetlands/federal-funding-wetlands (last visited April 4, 2023); WDNR (n.d.) "Wetland Restoration." WDNR, https://dnr.wisconsin.gov/topic/Wetlands/restoration.html (last visited April 4, 2023); Hansen, L. R., Hellerstein, D., Ribaudo, M., Williamson, J., Nulph, D., Loesch, C., & Crumpton, W. (2015). Targeting Investments to Cost Effectively Restore and Protect Wetland Ecosystems: Some Economic Insights. USDA.

[244] USFWS, 2013 Beaver Restoration Guidebook at vii, 47 (goals), 132-186 (case studies).

storage to prevent downstream flooding of homes and urban areas.[245] Researchers also estimated that beaver restoration could protect over 500 homes that are currently in the floodplains, protecting these communities from potential destruction of infrastructure.[246] Restoration of wetlands and flood plains has also been identified as an important climate adaptation strategy to reduce flood risk and protect water quality in the Midwest.[247]

120. The 2013 EA also fails to place any value on the impacts of beaver removal on recreational values and tourism, such as the growing wildlife watching industry.[248] By continuing to remove beaver and beaver structures from 1,800 miles of streams in the public forest, Wildlife Services continues to destroy crucial habitat that would provide invaluable wildlife watching opportunities. Notably, in a 2014 survey of more than 10,000 people, WDNR found that 84% of the public participates in wildlife watching.[249] Similarly, a U.S. Fish and Wildlife Services study published in 2014 examined the economic impacts of wildlife watching in 2011, and found that wildlife viewing in Wisconsin for that year alone involved 2,359,000 participants and contributed more than $1,488,857,000 in tourist revenue.[250] The removal of beavers and beaver dams not only eliminates opportunities to watch beaver, but also eliminates opportunities to view all of the other species that utilize beaver ponds and beaver-enhanced habitat.

121. In addition, the 2013 EA does not consider new or complete information concerning the costs and benefits of using non-lethal means to prevent beaver damage to property or flooding of roadways or bridges. Although the 2013 EA discusses direct costs of some non-lethal damage mitigation, it does not assess the added economic value associated with maintaining beaver on the landscape.[251] Current information indicates that non-lethal management may be more cost-effective in the long, that it is becoming more cost effective as more land managers utilize and refine these tools, and that it results in ecological benefits of significant value.[252] The 2013 EA also omits any consideration of costs and benefits associated with live trapping and relocating beaver to advance watershed improvement projects.

122. Flow devices are some of the most effective and cost-effective non-lethal methods

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[245] Liao, Q., Boucher, R, and Rock, M. (2021). 2019/2020 Beaver Restoration Study: Modeling the Milwaukee River watershed to measure the potential flood mitigation benefits of beaver-created wetlands to restore the natural hydrology and reduce flooding during high water events. Presentation to the Milwaukee Metropolitan Sewer District (May 27, 2021). College of Engineering and Applied Sciences, University of Milwaukee, Wisconsin.

[246] *Id*.

[247] U.S. Climate Resilience Toolkit, Midwest Region, "Biodiversity and Ecosystems," https://toolkit.climate.gov/regions/midwest/biodiversity-and-ecosystems (last visited March 24, 2023).

[248] The goals of the 2013 EA include providing a "healthy sustainable environment and a full range of outdoor opportunities; To ensure the right of all people to use and enjoy these resources in their work and leisure; To work with people to understand each other's views and carry out the public will." USDA-APHIS Wildlife Services, 2013 EA at 20.

[249] WDNR. (2015). Fish, Wildlife and Habitat Management Plan, at 4. WDNR, https://dnr.wisconsin.gov/sites/default/files/topic/Fishing/Pubs_FishWildlifeHabitatPlan.pdf.

[250] Caudill, J. (2014). Wildlife Watching in the U.S.: The Economic Impacts on National and State Economies in 2011, Addendum to the 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation. Arlington, VA: U.S. Fish & Wildlife Service at 7.

[251] USDA-APHIS Wildlife Services, 2013 EA at 36-37.

[252] *See, e.g.*, Shockey, Jakob. (2022). Best Management Practices for Pond Levelers and Culvert Protection Systems, at 4. The Beaver Coalition, Jacksonville OR.

to mitigate beaver damage. These utilize a piping system to raise or lower the surface water level of beaver ponds. Flow devices can be modified to fit the landscape and needs of each individual stream, making it an adaptable tool for management. When properly installed and maintained, flow devices have been found to have high success rates and last 5-10 years.[253]

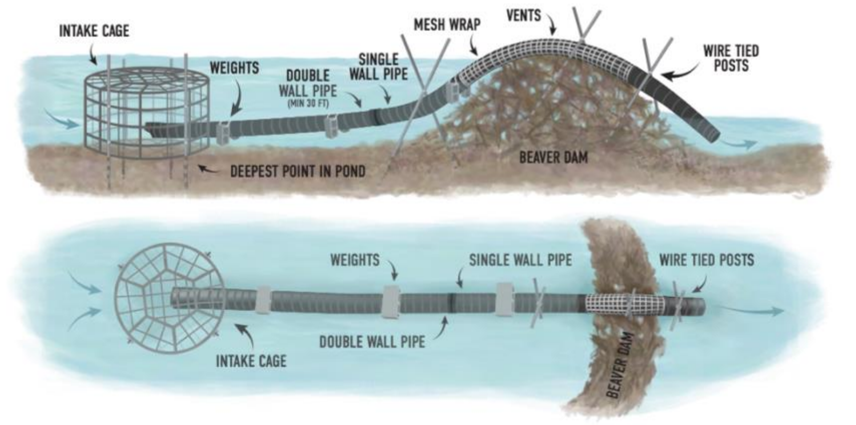

Figure 1. Standard pond leveler with no modifications.

123. In addition, a 2019 study by the Beaver Institute made the following findings regarding the cost using flow devices in the town of Billerica, Massachusetts:

> Since 2000, a total of $83,731 has been spent by the town on flow device installations and maintenance for 43 no-trap sites. The average flow device costs $1,500 and lasts an average of 10 years before needing replacing, for an annualized cost $150. The monitoring and maintenance of a flow device site averages $79 per site per year. Therefore, each beaver conflict that is managed with flow devices costs an average of $229 per site per year."[254]

By contrast, the Beaver Institute found lethal removal was about twice as expensive:

> Since 2000, the cost of beaver trapping and beaver dam breaching at the 12 "No Tolerance Zones" has totaled $51,350, or $225 per site per year. The monitoring costs for these 12 sites averages an additional $184 per site per year. Therefore, the annualized cost for each site managed with trapping is $409 per year.[255]

Overall, the Beaver Institute found that using flow devices on 43 sites instead of continuous beaver

[253] *Id.*
[254] Callahan, M., Berube R., and Tourkantonis, I. (2019). Billerica Municipal Beaver Management Program, 2000 - 2019 Analysis, at 5. The Beaver Institute, https://www.beaverinstitute.org/wp-content/uploads/2023/03/ Callahan-et-al-2019-Beaver-Report-Billerica-Municipal-Beaver-Management-Program-2000-2019-Analysis.pdf.
[255] *Id.*

and dam removal saved taxpayers $7,740 annually.[256]

124. While town leadership had initial concerns that non-lethal management would result in more conflict, the Beaver Institute study showed that over 16 years, conflict sites only increased from 42 to 55, less than one new beaver problem per year.[257] Within Billerica, there were 55 beaver management sites, with 43 successfully managed with non-lethal water control devices and the other 12 managed with trapping. All 43 sites were successful, despite having traditionally been managed with lethal trapping. By using this integrated approach, the town decreased the number of beaver it trapped from 1,250 to 222 over 19 years.[258] Since beaver were no longer being removed, their colonies "create[d] an average of 10 wetland acres with their dams, or 380 total wetland acres that would not exist if the beaver were trapped." [259] This equated to an estimated $2 million in free ecological services each year, or $35 million between 2000 and 2019.[260]

125. Other recent studies have also found that non-lethal methods are more cost effective than lethal methods.[261] For example, Hood et al. (2018) installed 12 flow devices to reduce flooding by beaver in Alberta, Canada, and developed a cost–benefit analysis.[262] In their results, they found that flow devices created a "net benefit of $81,500 for 12 sites over 3 years and $179,440 over 7 years."[263] Other large case studies are under way. For example, the Ministry of Transportation of Ontario is studying the effectiveness of variety of techniques, including exclusionary screens, diversion dams, and flow devices "to providing both turtle passage and beaver exclusion from drainage culverts on highways."[264] The Ministry has emphasized the environmental benefits of using flow devices, since preserving wetlands is one of the government's primary goals, and the use of non-lethal devices mean that beaver "continue to exist and construct wetlands resulting in 'no net loss' of wetland habitat."[265]

126. The 2013 EA also fails to consider these significant potential benefits of beaver relocation, which it disregards due to liability concerns, and concludes is ineffective based on the mixed results of relocation efforts studied between 11 and 61 years earlier.[266] As a result of this outdated science, the 2013 EA dismisses live capture and relocation as a potential alternative to lethal measures.

127. However, more recent studies have shown that effective relocation is possible where relocation sites are selected correctly, and that such relocation can contribute significantly

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[256] *Id*
[257] *Id.* at 4.
[258] *Id.* at 5.
[259] *Id.* at 6.
[260] *Id.*
[261] *See* Appendix D: Additional Resources, section 7.
[262] Hood, G. A., Manaloor, V., & Dzioba, B. (2017). Mitigating infrastructure loss from Beaver Flooding: A cost–benefit analysis. *Human Dimensions of Wildlife*, *23*(2), 146–159; https://doi.org/10.1080/10871209.2017.1402223.
[263] *Id.* at 157.
[264] Gunson, K., & Danby, R. (2020). Beaver Exclusion-Turtle Passage & Reptile Exclusionary Fence Concept Designs: Literature Review and Field Testing, at 4. Ministry of Transportation of Ontario.
[265] *Id.* at 37.
[266] USDA-APHIS Wildlife Services, 2013 EA at 48-49 (citing studies from 1952, 1958, 1965, 1983, 1987, 1992, 1995 and 2002).

to watershed restoration efforts.[267] For example, in 2008, the Methow Project began to restore beaver to the Methow Valley in Okanogan County, Washington utilizing live trapping and relocations.[268] By 2015, researchers reported that the project had released 274 beaver to 61 locations.[269] They estimated that "the key economic benefits of beaver project salaries, project expenditures, ecosystem benefits, and costs avoided [were] estimated to have contributed at least $605,000 to Okanogan County residents in 2015 and nearly $4 million since [they] began the expanded project in 2008."[270] Further, they found that beaver relocation created an additional "780 acres of wetland habitat, 19 acres of pond surface, 780 acres of riparian habitat, and improved 19 miles of stream habitat," and that "4,875 acres of adjacent upland habitat were improved because of beaver dams built."[271]

128. In sum, the 2013 EA failed to evaluate the true costs of beaver removal in terms of lost ecosystem services, watershed improvement, flood control, climate resilience, and recreational activities. It also fails to provide an adequate cost-benefit analysis of non-lethal alternatives to killing beaver and destroying their dams. New studies and information released after the 2013 EA have provided significant new information to support this evaluation. The 2013 EA must be updated to address this new information and provide a balanced accounting of the true costs of lethal removal, including lost benefits, and to address current information concerning the costs and benefits of nonlethal management alternatives that retain beaver on the landscape.

IV. CONCLUSION

129. The Wisconsin Beaver Elimination Program has been a significant tragedy in American wildlife policy. It has done untold damage to Wisconsin's wildlife population, wetland ecosystems, stream geomorphology, water quality, and the capacity of the state to mitigate the impact of climate change. The program should be suspended until Wildlife Services completes a new environmental assessment of the program and completes a full Environmental Impact Statement that considers the following: (1) the significant increase in beaver killed and dams destroyed since the 2013 EA was approved; (2) the fact that Wildlife Services no longer has any population estimates to provide a basis for assessing the impact of the Wisconsin Beaver Elimination Program; (3) the change in WDNR policy which no longer seeks a decrease in the beaver population; (4) a growing and significant body of science regarding how beaver create healthy ecosystems,are essential to preserving biodiversity, reduce flooding, and restore watershed hydrology; (5) a growing recognition of the role beaver play in mitigating the impacts of climate change, and of the importance of considering climate change when assessing environmental impact; (6) the fact that there is no longer any credible science showing that beaver harm trout; (7)

[267] *See generally*, USFWS, 2023 Beaver Restoration Guidebook; Pilliod, D. S., Rohde, A. T., Charnley, S., Davee, R. R., Dunham, J. B., Gosnell, H., Grant, G. E., Hausner, M. B., Huntington, J. L., & Nash, C. (2017). Survey of beaver-related restoration practices in rangeland streams of the Western USA. *Environmental Management*, *61*(1), 58–68. https://doi.org/10.1007/s00267-017-0957-6 .

[268] *See* Woodruff, K. (March 2016). Methow Beaver Project Accomplishments 2015. City of Seattle, https://www.seattle.gov/light/Environment/WildlifeGrant/Projects/Woodruff%202016%20Methow%20Beaver%20Project%20Accomplishments.pdf; "Methow Beaver Project." (n.d.). https://methowbeaverproject.org/ (last visited April 2, 2023);

[269] Woodruff, K (March 2016). Methow Beaver Project Accomplishments 2015, at 5.

[270] *Id.* at 9.

[271] *Id.* at 9.

a growing consensus that the methods used by Wildlife Services are inhumane; and (8) new data and information showing that nonlethal measures can address issues of beaver damage in a more cost-effective way, while maintaining the enormous benefits beaver provide to the larger ecosystem.

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APPENDICES A-D

Appendix A: Robert Boucher's Resume

Robert Bruce Boucher
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Cell (414) 315 8360 E-mail rboucher1@me.com, or rboucher@superiorbc.org

SUPERIOR BIO-CONSERVANCY Founder, Board President, 2021 to present. SBC is a non-profit conservation organization founded in 2021, focused on conserving, restoring, and protecting the biodiversity, wildlands connectivity, climate resilience, Tribal ceded rights, and the biological integrity of the Laurentian Forest Province in Wisconsin, Minnesota, Michigan, and Ontario. It's a health care plan for the biodiversity of this region of the planet. www.superiorbioconservancy.com

CEDAR LAKES CONSERVATION FOUNDATION (CLCF) - West Bend, WI. 2013 to 2017.
www.conservecedarlakes.org., Executive Director, CLCF founded in 1974 is the oldest conservation land trust in Wisconsin. Responsibilities included all aspects of non-profit land trust management and operations including oversight of staff and venders. Initiating real estate negotiations with sellers and oversight to closing of contracts for purchase of fee simple properties and conservation easements. Land stewardship and management of 2,400 acres of property, comprised of 58 properties.

MILWAUKEE RIVERKEEPER, Milwaukee, Wisconsin 1994 to 2002
https://www.milwaukeeriverkeeper.org/ Founder and Executive Director, Riverkeeper, Milwaukee RIVERKEEPER is a non-profit conservation organization for the Milwaukee River Watershed. Its mission is to protect water quality and wildlife habitat in the river corridor and to advocate for sound land use in the watershed. Responsibilities included all aspects of non-profit management from start up, including program development, membership, operations, events, and successfully advocated projects that received $18,750,000 in funding from government agencies to protect, restore and conserve riparian areas. Program responsibilities included the development of science based eco-system management programs and policy contacts to support those goals.

Education: M. S., University of Wisconsin, Madison, 2002
Major focus: Water Resource Management "Ecosystem Management of Watersheds"
Boston University, Boston, Mass. Graduate Program in Physiology of Exercise 1976
B.A., St. Norbert College, DePere, Wisconsin 1973, Major: Social Philosophy

Professional experience includes numerous conferences and professional training workshops in beaver management, non-profit management, project management, grant writing, media relations, ecosystem management, watershed protection, storm water management and the design of natural stream channels. Recognized expert on how beaver impact the hydrology of watersheds.

Presented at the Following

- The State of the Beaver Conferences in Oregon in 2015 and 2017
- BeaverCon, the National Beaver Conference, in 2020 and 2022
- Key presenter at The Center for Watershed Protection National Conference in 2021.
- The 9th International Beaver Symposium in Brasov, Romania in 2022
- Invited Presenter at the Voigt Intertribal Taskforce in 2023

Affiliations and past board membership

- Advisor to the Beaver Institute, https://www.beaverinstitute.org Conflict resolution and expertise in landscape hydrology and the ecology of beavers.
- Member of the WDNR Beaver Taskforce
- Policy and Beaver restoration program advisor to Milwaukee Riverkeeper, UWM and MMSD.
- Wolf and beaver policy advisor to the Sierra Club (Wisconsin John Muir Chapter)
- Committee on the Environment, River Hills. (Past Chairman)
- Member of the "Lake Michigan Forum" Advises US-EPA, on policy and Great Lakes concerns.
- Waterkeeper Alliance, serving as the Great Lakes Representative, a national organization that supports 450+ licensed "Waterkeeper" non-profit organizations in the US and internationally. Licensed Riverkeeper: Garrison, N.Y. (Board member 1999-2002)
- "Gathering Waters" a state land trust support organization. Madison, WI (Board member 1997-1999)
- "Great Lakes United" a Great Lakes Basin region wide international advocacy organization. Buffalo, N.Y. (Board member 1996-1998)
- "Schlitz Audubon Nature Center" an educational nature center. Milwaukee, WI (Board member 1978-80)
- Citizen advisor to the Wisconsin DNR for the Lower Wisconsin River project. This 92-mile scenic easement is the largest conservation easement project in Wisconsin (1982-85)
- Member of the Milwaukee County Grounds Land Use Committee (1997 -1999)
- Member of Association of State Floodplain Managers (1998-2000)

Awards

2001 Milwaukee County Grounds State Forest award, 1997 National American Rivers, "Urban Hometown River Award" and the 1997 River Alliance of Wisconsin "River Champion Award." Wisconsin Trout Unlimited award 1997 For Outstanding Contribution to the Preservation of the Water Resource of Wisconsin. 1996-1997 Rockroller Award, Abel Corporation.

Appendix B: Additional Comments by Dr. Ben Dittbrenner

Dr. Ben Dittbrenner
Associate Teaching Professor
Director, Environmental Science and Policy MS program
Marine and Environmental Sciences
Northeastern University

1. While the focus of this EA is to ‘protect cold water streams’, it consistently ignores the impacts to all other species that also rely on the aquatic habitat that removed when dams are breached. This is probably wishful thinking, but if this EA (and all these similar documents) adequately captured the impacts to species by dam and wetland removal, I suspect that they would be unable to convincingly argue for this course of action.

2. There is an insufficient and biased review of the literature on the tradeoffs between costs and benefits of beaver. The literature review is not only highly biased, but also focused on ecological implications at low spatial scales. There is a wealth of literature at site, reach, and landscape scales that explore how beaver effect ecological and bio-physical relationships, human-valued ecosystem services, and human-centered features. Many of these can be quantified to compare economic tradeoffs. As required by NEPA regulations, these tradeoffs need to be adequately evaluated to capture the true costs and benefits of beaver and implications of large-scale removal of this species. I’m also curious what the implications to other regulations such as state and federal wetland rules are. The large-scale removal of beaver across a region will lead to substantial decline in wetland acreage and go against no net loss rules. Further analysis is required.

3. Beaver and stream temperature is highly complex and site specific. It is likely that in shallow beaver ponds, water temperature is higher than the associated streams. However, in deeper ponds where there is thermal stratification, they can provide important refugia for cold-water fish in the summer when even stream systems may be warmer than preferred. Many older studies lacked sufficient spatial granularity to differentiate between stream and pond temperatures at depth. It is not sufficient to take one single measurement in a wetland as surface and groundwater flow dynamics are extremely complex. Fish, on the other hand, continue to move until they find a good spot, so while scientists may not capture the range of thermal variability in a system, the fish will identify cold-water holding spots.

4. Failure to adequately and thoroughly evaluate all the impacts and benefits of beavers prevents an accurate evaluation of the alternatives analysis required in the EA. I think that this could be a procedural violation of the NEPA process.

5. An alternative view: The problem may not be entirely with the EA, but how Wildlife Services and WDNR are then implementing the EA – It’s a policy problem. Their policy is not in line with what has been suggested in the EA.

Appendix C: Beaver Carrying Capacity Model

Widely respected, peer-reviewed studies of unexploited beaver populations have established accepted scientific methods by which one can accurately estimate the potential carrying capacity of a given watershed.[272] Based on review of *The Beaver: Natural History of a Wetland Engineer*, in Chapter 11 titled "Population Densities and Dynamics", beaver densities (the number of colonies per unit of stream lengths) can be derived by comparing several studies of unexploited populations in areas with habitats similar to that of Wisconsin. Utilizing older studies, I updated the model to fit modern wildlife management in 2020, as shown below and published in the study titled "Hydrological Impact of Beaver Habitat Restoration in the Milwaukee River Watershed."[273] Below is an updated model created in 2020 based on previously established peer-reviewed studies to calculate the carrying capacity of beavers on a watershed. This can give us an average density of a colony of one per every 1.07 miles of stream length. Translated to metric it would be 0.66 colonies per kilometer of stream length. We can also take similar studies to derive an average number of beavers per family colony size in areas that have similar habitat to Wisconsin for potential beaver densities. With that, we come up with an average of 5.4 beavers per family colony group. You also need to take into consideration within a basin calculation the effects of development for agriculture and urbanization and reduce the population by that percentage of a landscape. The formula would look like this:

$$Population = River\ miles \times 1.07 \left(\frac{colonies}{mile}\right) \times 5.4 \left(\frac{beavers}{family}\right) \times (1 - \%\ urban)$$

and the beaver colony in each subwatershed is

$$Beaver\ colonies = \frac{Population}{5.4 \left(\frac{beavers}{family}\right)}$$

[272] See generally, Bergerud, A. T., & Miller, D. R. (1977). Population Dynamics of newfoundland beaver. *Canadian Journal of Zoology*, *55*(9), 1480–1492. https://doi.org/10.1139/z77-192 ; Boyce, M. S. (1974). *Beaver Population Ecology in interior Alaska*. University of Alaska.; Busher, P. E., & Lyons, P. J. (1999). Long-term population dynamics of the North American Beaver Castor canadensis on Quabbin Reservation, Massachusetts, and Sagehen Creek, California. *Beaver Protection, Management, and Utilization in Europe and North America*, 147–160. https://doi.org/10.1007/978-1-4615-4781-5_16 ; Henry, D. B., & Bookhout, T. A. (1969). Productivity of beavers in northeastern Ohio. *The Journal of Wildlife Management*, *33*(4), 927. https://doi.org/10.2307/3799327; Müller-Schwarze, D., & Schulte, B. A. (1999). Behavioral and ecological characteristics of a "climax" population of Beaver (castor canadensis). *Beaver Protection, Management, and Utilization in Europe and North America*, 161–177. https://doi.org/10.1007/978-1-4615-4781-5_17; Nordstrom, W. R. (1972). *Comparison of trapped and untrapped beaver populations in New Brunswick*.; Shelton, P. (1962). Ecological studies of beavers, Wolves, and moose in Isle Royale National Park, 1961-1962. https://doi.org/10.37099/mtu.dc.wolf-annualreports/1961-1962.

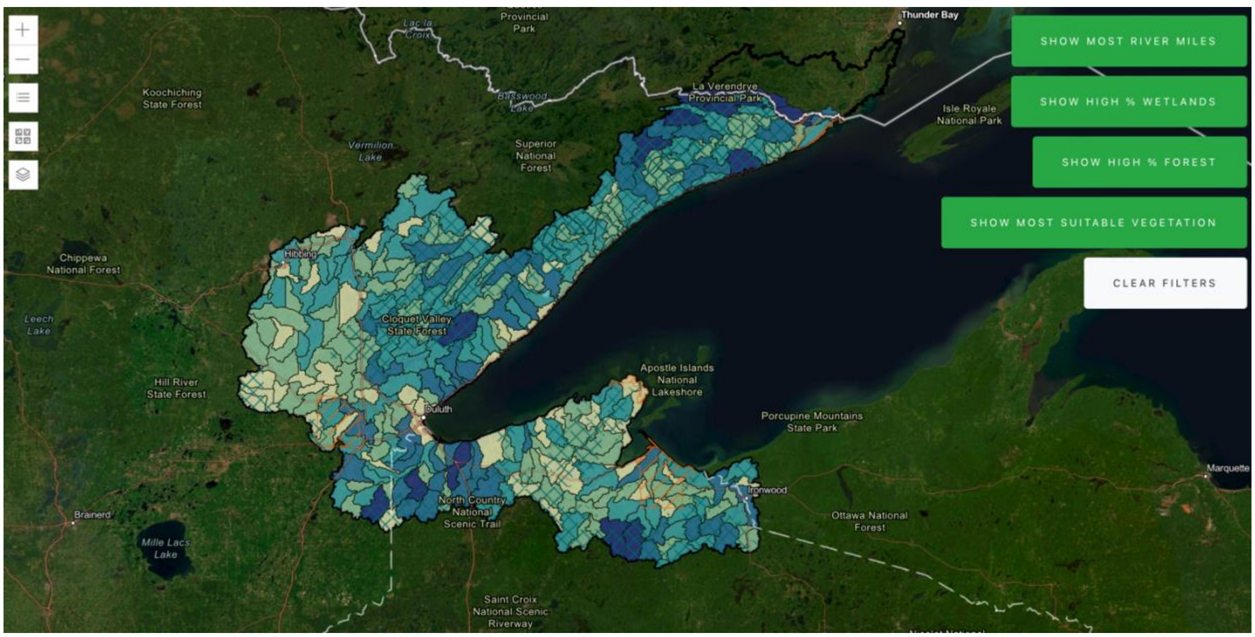
[273] Liao, Q., Boucher, R., Wu, C., Noor, S. M., Liu, L., Rock, M., Flanner, M., & Holloway, L. (2020). Hydrological Impact of Beaver Habitat Restoration in the Milwaukee River Watershed. Milwaukee Metropolitan Sewerage District; https://www.beaverinstitute.org/ wp-content/uploads/2023/03/Beaver-Hydrology-impact-in-Milwaukee-final-1.pdf.

For effective wildlife management, each subbasin in a watershed should be managed as an individual management unit, like an organism of a cell, to ensure the landscape health. Beavers should be maintained and encouraged to stabilize the geomorphology of the catchment.

This measuring formula was applied in 2021 by Galen Kanazawa where he developed a tool to analyze watersheds potential carrying capacity of beaver.[274]

By separating watersheds into subbasins, you can analyze each one for its' potential beaver population. For example, using current 2020 USGS data sets we can calculate the following of the Marengo River a headwater basin. It is 37,147 acres; Wetland acres, 7,544.61; Percent Wetland 20.31; Percent Forest 74.33; Percent developed or agriculture 2.56; Percent of suitable or preferred vegetation 75.4; Total River miles 75.2. This would support a potential beaver population of 423 individuals.

Similarly, the Upper Brunsweiler River basin shown is 34.984 acres, with Wetlands of 11, 240.64 acres, 2.45% agricultural, has 64.89 river miles with a potential beaver population of 366 individuals. Given this type of USGS data, you can calculate over a given region what a potential beaver population should be to garner the highest potential of water quality and biodiversity benefits. These tools can be effective to understand and manage the land characteristics and hydrology of each basin.



Pictured is the beaver population catchment basin modeling tool developed by Galen Kanazawa (2021) for his GIS MS at the University of Wisconsin. Each subbasin pictured above along the western drainage of Lake Superior is analyzed for scale, forage, wetlands, river miles and the potential beaver population potential.

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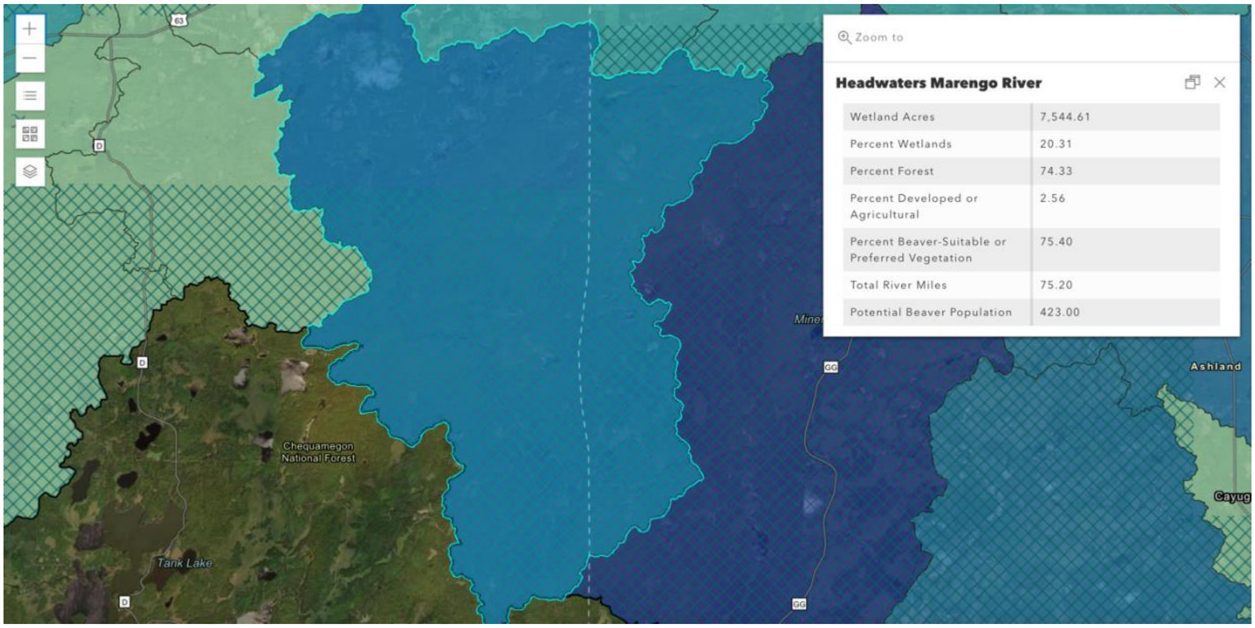
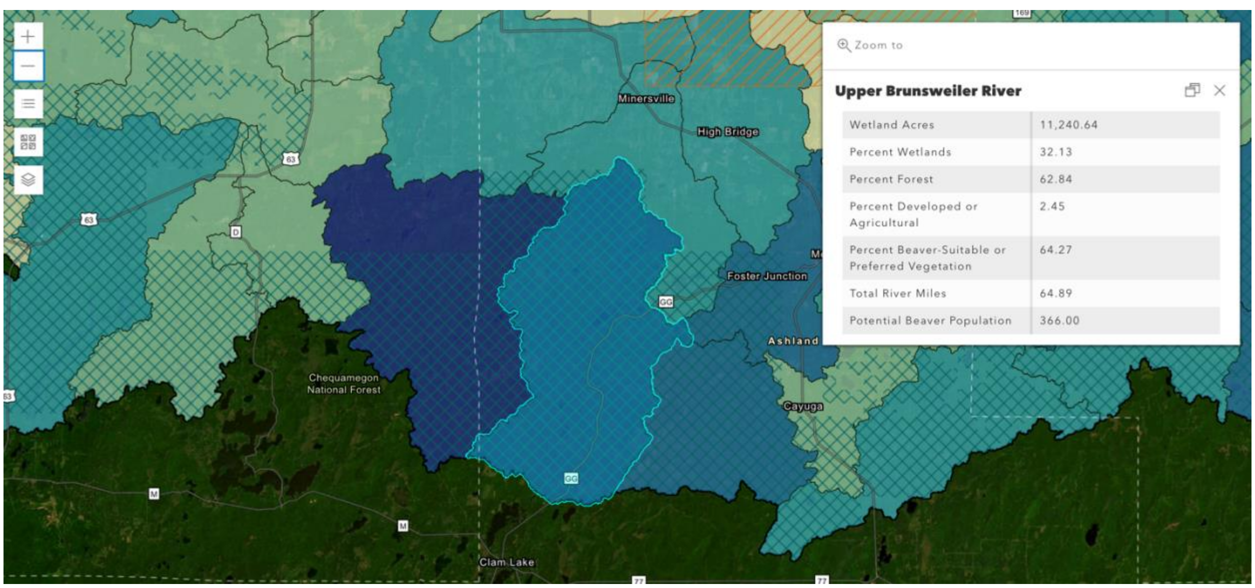
[274] See https://gkanazawa.github.io/Beaver-Populations/#viewDiv



Pictured is an example of data from the beaver population catchment basin modeling tool for the Headwaters of Marengo River.



Pictured is an example of data from the beaver population catchment basin modeling tool for the Upper Brunsweiler River.

Appendix D: Supporting Documents by Topic

Full-text copies of all sources are provided for download from the following online folder: https://5609432.app.box.com/s/ux68xtoxfe3cn8jnldxuta0hvayect35

1. Beaver Wetlands and Riparian Systems

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