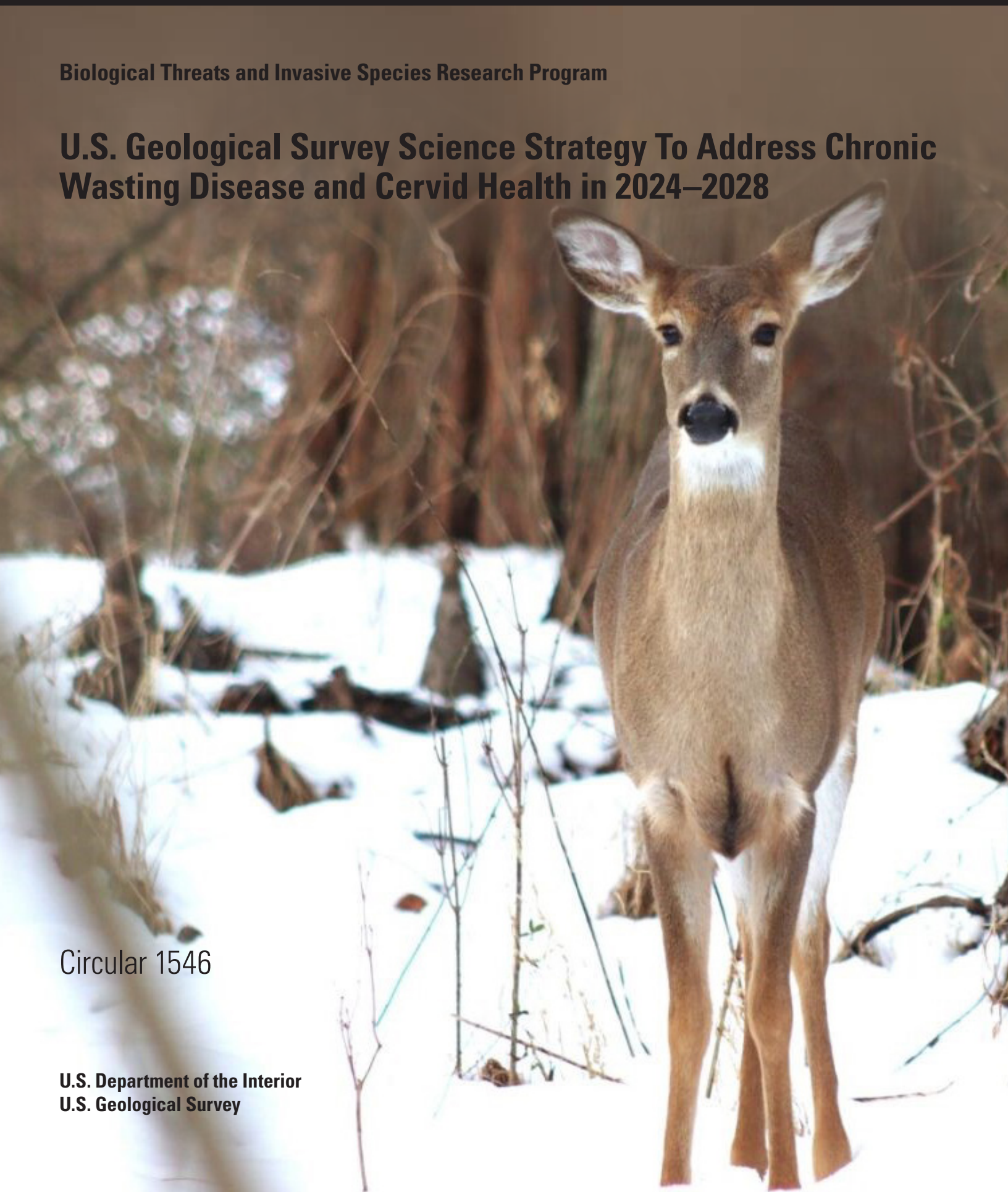
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U.S. Geological Survey Science Strategy To Address Chronic Wasting Disease and Cervid Health in 2024–2028



Circular 1546

U.S. Department of the Interior
U.S. Geological Survey

Cover. Photograph of white-tailed deer by Alena Rinaldi, U.S. Geological Survey.

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By Jason Ferrante, Jonathan Cook, Paul Cross, and M. Camille Hopkins

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U.S. Geological Survey, Reston, Virginia: 2024

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Suggested citation:
Ferrante, J., Cook, J., Cross, P., and Hopkins, M.C., 2024, U.S. Geological Survey science strategy to address chronic wasting disease and cervid health in 2024–2028: U.S. Geological Survey Circular 1546, 23 p., https://doi.org/10.3133/cir1546.

ISSN 2330-5703 (online)

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Abbreviations

APHIS	Animal and Plant Health Inspection Service (USDA)
BTRP	Biological Threats and Invasive Species Research Program
CWD	chronic wasting disease
DOI	U.S. Department of the Interior
EMA	Ecosystems Mission Area (USGS)
EPA	U.S. Environmental Protection Agency
FWS	U.S. Fish and Wildlife Service
FY	fiscal year
MOA	memorandum of agreement
NPS	National Park Service
URL	uniform resource locator
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey

U.S. Geological Survey Science Strategy To Address Chronic Wasting Disease and Cervid Health in 2024–2028

By Jason Ferrante, Jonathan Cook, Paul Cross, and M. Camille Hopkins

Abstract

Chronic wasting disease (CWD), a neurological disease similar to scrapie in goats and sheep, has been spreading since the 1960s throughout cervid populations in the United States. It is currently detected in 30 States and now also extends to Canada, Korea, and Scandinavia. CWD is a fatal disease caused by an infectious abnormally folded prion protein. Population-level effects of CWD on localized subpopulations of white-tailed deer (*Odocoileus virginianus)*, mule deer (*Odocoileus hemionus*), and elk (*Cervus elaphus*) have been documented. While susceptible to CWD, free-ranging moose (*Alces alces*) and reindeer (*Rangifer tarandus*) populations do not currently appear to be as severely affected.

The mission of the U.S. Geological Survey (USGS) Chronic Wasting Disease and Cervid Health Science Team is to deliver integrated science to build resiliency into free-ranging cervid populations through more effective management of CWD, build capacity for ungulate health science, and enhance cervid health information sharing across USGS science centers and cooperative research units as well as with stakeholders. The USGS can play an important role in supporting regional and (or) national capacity building by providing resources and guidance to local, State, and Tribal management entities and by providing tools to enhance disease management. The USGS Ecosystems Mission Area's Biological Threats and Invasive Species Research Program (BTRP) is the lead Federal program for free-ranging wildlife disease research and surveillance.

The BTRP is relied upon by Congress, as well as local, State, and Tribal partners, to provide quality science that allows for informed decisions to be made about wildlife disease policy, planning, and management. The information provided by our research gives policy makers and the public the understanding needed to improve management preparedness and response.

This document describes the U.S. Geological Survey Science Strategy To Address Chronic Wasting Disease and Cervid Health. It lays out a 5-year science strategy (2024–2028) for continued USGS research to study CWD in free-ranging cervids and their environments. The strategy includes improving detection methods, advancing our understanding of the mechanisms of transmission, incorporating the human dimensions and socio-economic effects of CWD in scientific studies, developing tools for decision making, and understanding potential effects of this disease on ecosystem health.

Introduction

The health of free-ranging cervid (members of the deer family) populations is being affected by a fatal neurological disease known as chronic wasting disease (CWD), which is caused by abnormally folded prion proteins. Population-level effects of CWD on localized subpopulations of white-tailed deer (*Odocoileus virginianus)*, mule deer (*Odocoileus hemionus*) and elk (*Cervus elaphus*) have been documented (Monello and others, 2014; Edmunds and others, 2016). While susceptible to CWD, free-ranging moose (*Alces alces*) and reindeer (*Rangifer tarandus*) populations do not currently appear to be as severely affected. This prion disease, which also impacts captive cervids, is spread directly through animal-to-animal contact. Through environmental contamination, CWD can be indirectly spread through infectious biological material (such as saliva, urine, feces, and infected carcasses). This disease is not currently known to infect humans or noncervid livestock, although research in laboratory settings using mice and monkeys is raising concerns about human susceptibility (Wang and others, 2021).

Similar to scrapie in sheep and goats, and bovine spongiform encephalopathy (mad cow disease) in cows, CWD is caused by pathogenic prions, which are infectious abnormal host proteins characterized by their misfolded shape relative to normal prions. Prions are primarily found in the brain and other central nervous system tissues, as well as the lymphatic system of mammals.

First identified in captive cervids in Colorado in the late 1960s, CWD was later detected in free-ranging animals in the 1980s. CWD has continued to spread, affecting cervids in at least 32 States in the United States and 4 Provinces in Canada (fig. 1). Internationally, CWD has been detected in Finland, Norway, South Korea, and Sweden (Sohn and others, 2002; Silva, 2022). Since the Congressional directive in 2003 (app. 1), U.S. Geological Survey (USGS) scientists have increased their study of CWD, and many of their reports are listed in appendix 2 to show the various

approaches taken; for example, studies of disease ecology and epidemiology, risk assessments, mathematical modeling, and development of surveillance strategies and mitigation tools (Hopkins and others, 2019).

The USGS is the lead Federal science agency for research and surveillance related to diseases in free-ranging wildlife (Federal Emergency Management Agency, 2019). As such, the USGS provides unbiased science on free-ranging cervid health (including CWD) to inform CWD management by natural resource agencies. Other agencies in States, Tribal Nations, and the Federal Government are responsible for cervid health management, including surveillance efforts. The Federal agencies are primarily in the U.S. Department of the Interior (DOI)—U.S. Fish and Wildlife Service (FWS) and National Park Service (NPS)—and in the U.S. Department of Agriculture (USDA). USGS scientists across the United States are working to understand the pathology of CWD, assess and predict the spread and persistence of CWD in wildlife and the environment, and enhance tools for early detection and control.

This document describes the U.S. Geological Survey Science Strategy To Address Chronic Wasting Disease and Cervid Health in 2024–2028 (which will be informally referred to as "the science strategy"). It was prepared by scientists on the U.S. Geological Survey Chronic Wasting Disease and Cervid Health Science Team (app. 3).

The USGS is broadly engaged with the States, which have the statutory authority to manage wildlife populations, as well as Tribal management partners to improve our understanding of the human dimensions and socio-economic effects of this disease. With regards to cervid health, the phrase "human dimensions" refers to understanding preferences, attitudes, and behaviors of local communities as related to local cervid populations, including reliance on the herds as an economic resource or source of sustenance. In addition, USGS scientists help develop strategies to balance diverse management objectives using systems modeling and decision analysis approaches for natural resource management based on an understanding of the users and the applications of data and technology. In fiscal year 2022 (FY22), the USGS and the U.S. Environmental Protection Agency (EPA) initiated collaborative research on the environmental spread and persistence of CWD through carcasses to provide safe carcass disposal recommendations.

Congressional Mandates

Appropriations language during FY21 for the USGS Ecosystems Mission Area (EMA) included a congressional mandate to provide science to support the CWD response (Public Law 116–260; app. 1). The language from U.S. Congress, House Committee on Appropriations (2021, p. 1370) included directions to perform the following actions:

1. [D]evelop early detection tools and compounds to disrupt transmission of the disease,
2. [Conduct] research … [on] ... carcass disposal methods to mitigate the spread of chronic wasting disease,
3. [D]evelop recommendations for carcass disposal methods that are compliant with relevant Federal regulations, and
4. [W]ork in collaboration with the Fish and Wildlife Service to aid State and Tribal wildlife agencies in the application of existing human dimensions research to the management and prevention of chronic wasting disease.

These mandated actions persisted into FY22 and FY23 appropriations language and are represented by several objectives found in this science strategy. In FY24, funding continued at the FY23 level for continued facilitation of these efforts as described in the Senate Report 118–83 (quoted in app. 1 of this document).

The USGS is also mentioned in CWD-directed tasks under America's Conservation Enhancement Act, which was passed in 2020 (Public Law 116–188, Section 104 [16 U.S.C. 667h]). The tasks include data sharing for the National Academy of Sciences study on CWD transmission in cervids as well as participation on the CWD Task Force. The USGS has been actively engaged in the DOI-USDA CWD Steering Committee (formerly DOI CWD Task Force). In FY21, the USGS signed a memorandum of agreement (MOA) with the USDA/Animal and Plant Health Inspection Service (APHIS)/ Wildlife Services (WS) (U.S. Government Accountability Office, 2023) that "facilitates collaboration," "creates efficiencies," "integrates capabilities," and "enhances readiness in addressing diseases at the human-domestic animals-wildlife interface" (APHIS Agreement # 21–7100–0461–M, p. 1). This MOA is relevant for CWD research because of the disease's effect on both captive and free-ranging cervids as well as the close interactions that humans have with cervids during agricultural, hunting, and recreational activities.

Big-Game Migration Corridors and Cervid Health

In 2018, the USGS began working in collaboration with western States to map big-game migration corridors, stopovers, and winter ranges, with a primary focus on mule deer and elk (U.S. Department of the Interior, 2018; Kauffman and others, 2020). In FY22, the mapping of ungulate migrations was leveraged to understand how ungulate movements may affect CWD dynamics (Kauffman and others, 2024). Similar efforts have been conducted by the USGS Northern Rocky Mountain Science Center for bovine brucellosis (Rayl and others, 2021).

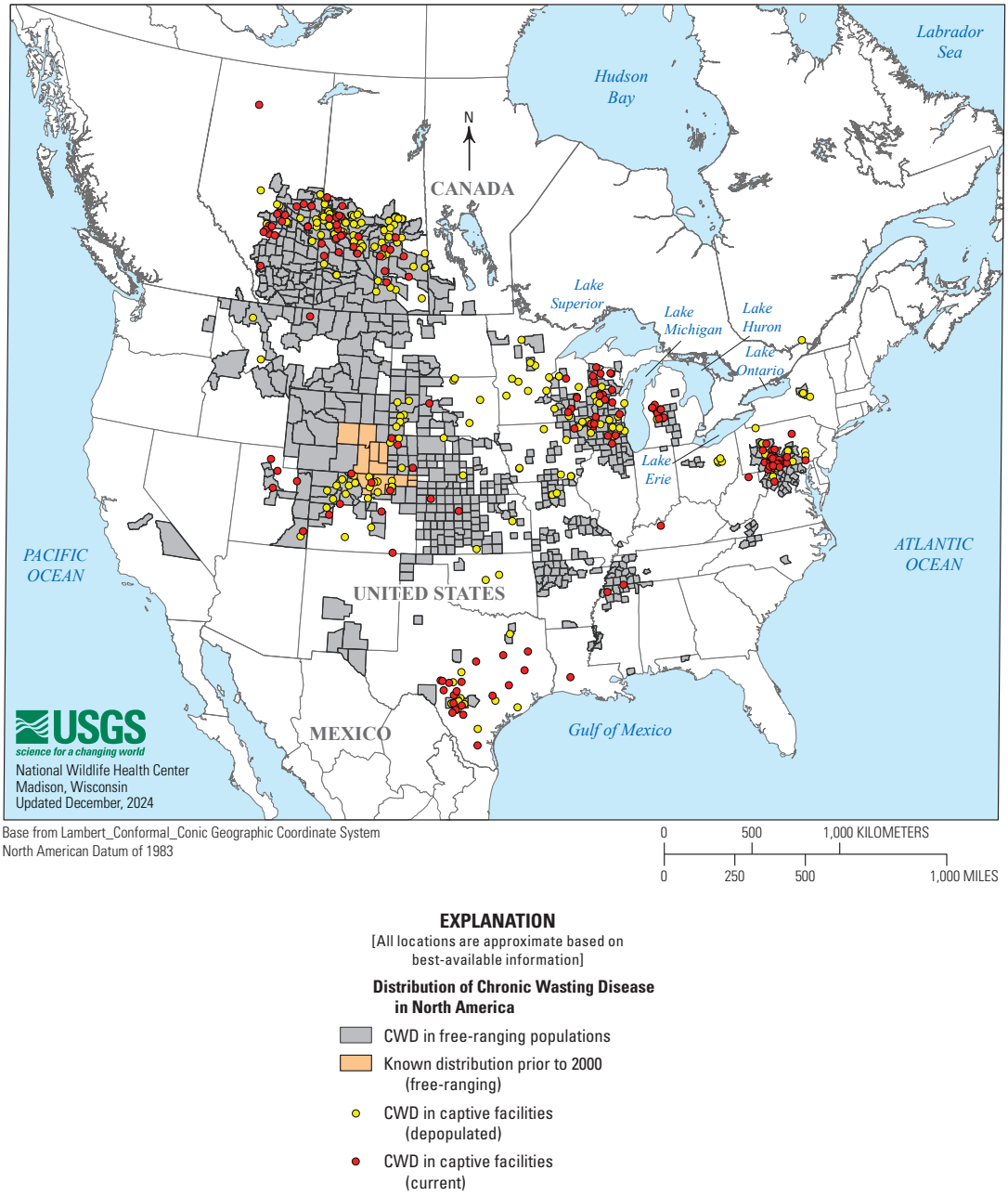


Figure 1. Map showing the distribution of chronic wasting disease in cervids in Canada and the conterminous United States, updated in December 2024. The shading shows areas in Canada and the United States where CWD was present in free-ranging populations in 2024 and before 2000. Colored circles represent depopulated and current captive facilities where CWD was detected. From https://www.usgs.gov/centers/nwhc/science/expanding-distribution-chronic-wasting-disease. Credit: Bryan Richards, U.S. Geological Survey.

USGS Science Strategy To Address Chronic Wasting Disease and Cervid Health in 2024–2028

The USGS science strategy to continue research on CWD in free-ranging cervids and their environments begins with the development of tools to augment the detection of prions and other markers of CWD infection and expands to include a greater understanding of the ecosystem processes and long-term effects of the disease on animals and environments. Five goals were developed by the science team to incorporate existing and future CWD-related research efforts and build capacity in several critical areas (fig. 2). These goals can help the science team realize the vision of leveraging our expertise in modern research, modeling, and decision-making approaches for responding to CWD in the conterminous United States. Objectives were defined for each goal, as described below.

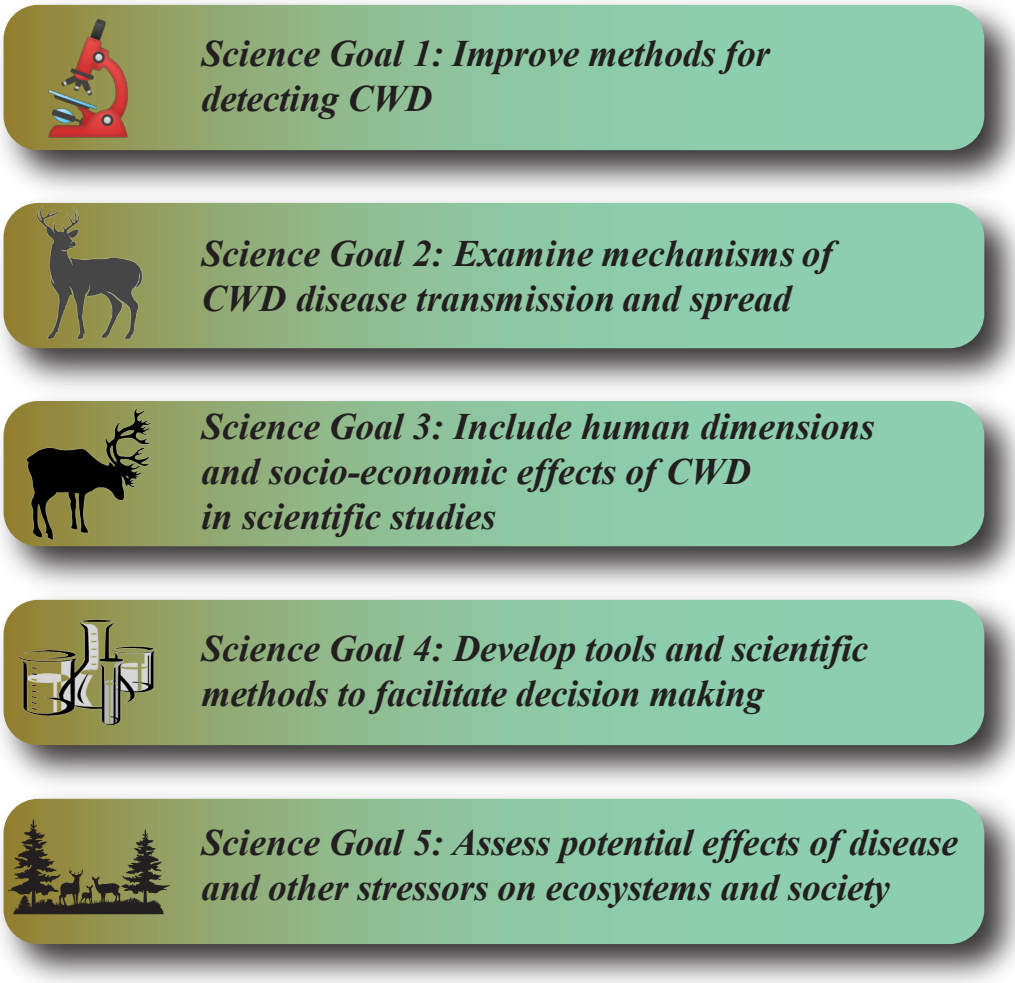


Figure 2. Illustration showing icons for the five science goals developed by the U.S. Geological Survey Chronic Wasting Disease and Cervid Health Science Team for 2024–2028. CWD, chronic wasting disease.

Science Goal 1: Improve Methods for Detecting Chronic Wasting Disease

USGS scientists are actively investigating CWD detection methods that may improve the efficiency or effectiveness of detecting CWD infection. This goal is intended to support other DOI bureaus, the USDA, States, and Tribes that are responsible for leading surveillance efforts, by ensuring that effective methods are validated and transferred to end users, new approaches are supported, and the appropriate infrastructure and networks are in place to facilitate the use of such methods in the laboratory and field by the scientific and management communities.

- Objective 1.1: Advance disease diagnostic applications to improve detection of CWD
- Objective 1.2: Transfer CWD detection tools to stakeholders for implementation and provide the necessary training for those using said tools who are engaged in cervid management and (or) CWD research and surveillance activities

Science Goal 2: Examine Mechanisms of Chronic Wasting Disease Transmission and Spread

The USGS has diverse capabilities in the fields of wildlife health, population dynamics, disease ecology, quantitative ecology, and data science. In combination, these capabilities can be used to examine the mechanisms of CWD transmission and spread across landscapes and the potential relationship of disease to management actions, such as environmental decontamination, carcass disposal, and land or cervid population management practices.

- Objective 2.1: Enhance our understanding of the CWD disease ecology within hosts
- Objective 2.2: Evaluate CWD dynamics within and between host populations
- Objective 2.3: Evaluate the dynamics of prions in the environment and the associated risk of indirect transmission

Science Goal 3: Include Human Dimensions and Socio-Economic Effects of Chronic Wasting Disease in Scientific Studies

The USGS contributes to the understanding of wildlife disease effects on communities and economies and has a long history of scientific collaboration with local, State, and other Federal agencies. This goal is motivated by the need of natural resource management agencies to better understand the relationship between CWD and the communities that rely on healthy cervid populations. In turn, agencies also need to learn how the behaviors, land use, and values of the communities affect CWD transmission and environmental persistence. USGS human dimensions research takes a regional and (or) national approach to inform management agencies about options for increasing acceptance of their mitigation efforts by the diverse communities they serve.

- Objective 3.1: Assess the relationships between CWD and the societal, economic, and cultural values of local communities, States, and Tribal Nations
- Objective 3.2: Identify near- and long-term effects of CWD on subsistence hunting and food security
- Objective 3.3: Describe and incorporate societal, economic, and cultural information into decision support and policy analyses

Science Goal 4: Develop Tools and Scientific Methods To Facilitate Decision Making

USGS scientists are focused on providing decision support to local, State, Tribal, and Federal decision makers. As part of this goal, our scientists are developing decision support models to assess CWD risk, to predict and forecast future disease outcomes, and to help decision makers evaluate tradeoffs in CWD-focused management actions.

- Objective 4.1: Develop and use decision-making and systems-modeling approaches to help guide effective management and target future research efforts
- Objective 4.2: Develop more efficient sampling and surveillance strategies
- Objective 4.3: Evaluate the effectiveness of different management interventions

Science Goal 5: Assess Potential Effects of Disease and Other Stressors on Ecosystems and Society

Over time, CWD occurrence and persistence may change due to interactions with other ecosystem processes. The USGS is focused on developing science that improves our understanding of long-term stressors and how these stressors might interact to alter ecosystems and affect humans.

- Objective 5.1: Assess interactions between CWD and other cervid population stressors
- Objective 5.2: Assess CWD effects on ecosystem processes and wildlife health
- Objective 5.3: Assess long-term societal, economic, and cultural effects of CWD

Acknowledgments

The science strategy in this circular is a result of the collaboration of the members of the U.S. Geological Survey Chronic Wasting Disease and Cervid Health Science Team as listed in appendix 3.

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Station where hunters can drop off samples to be tested for the presence of chronic wasting disease (CWD). Photograph by Jeff Corbett, U.S. Geological Survey.

Appendixes 1–3

Appendix 1. Congressional Language Mandating U.S. Geological Survey Studies of Chronic Wasting Disease

Appendix 2. Selected Publications by U.S. Geological Survey Authors on Chronic Wasting Disease as of May 2024

Appendix 3. Members of the U.S. Geological Survey Chronic Wasting Disease and Cervid Health Science Team

Appendix 1. Congressional Language Mandating U.S. Geological Survey Studies of Chronic Wasting Disease

This appendix provides a summary of direction and funding from Congress to the U.S. Geological Survey for fiscal years 2003–2024 to support studies of chronic wasting disease.

Table 1.1 has quotations from Congressional reports and links to the sources.

Table 1.1. List of House and Senate reports along with final appropriations legislation mentioning chronic wasting disease for fiscal years 2003–2024.

[Terms: CWD, chronic wasting disease; FY, fiscal year]

Quotation from Congressional report	Uniform resource locator (URL)
FY 2024	
Senate report 118–83, p. 45: The bill provides the enacted level to research the predominant pathways and mechanisms of the transmission of chronic wasting disease [CWD] in wild, captive, and farmed populations of cervids in North America. In carrying out this research, the Survey may consult, partner, or contract with the Animal and Plant Health Inspection Service, the National Academy of Sciences, State and Federal public and private entities, and any CWD task forces and working groups. In particular, the Committee encourages research and investment into carcass disposal methods to mitigate the spread of CWD, and the Committee urges the Survey to consult with the Environmental Protection Agency, the Federal Emergency Management Agency, and States to develop recommendations for carcass disposal methods that are compliant with relevant Federal clean air and water and solid waste regulations. The Committee also encourages the Survey to work in collaboration with the Fish and Wildlife Service to aid State wildlife agencies in the application of existing human dimensions research to the management and prevention of CWD.	https://www.congress.gov/118/crpt/srpt83/CRPT-118srpt83.pdf
Conference report P.L. 118-42: The agreement provides … funding for research on … Chronic Wasting Disease at the fiscal year 2023 enacted level.	https://www.congress.gov/congressional-record/volume-170/issue-39/senate-section/article/S1223-1?q=%7B%22search%22%3A%22118+congressional+record+Vol.+170+No.+39%22%7D&s=10&r=2

Table 1.1. List of House and Senate reports along with final appropriations legislation mentioning chronic wasting disease for fiscal years 2003–2024.—Continued

[Terms: CWD, chronic wasting disease; FY, fiscal year]

Quotation from Congressional report	Uniform resource locator (URL)
FY 2023	
House report 117–400, p. 41: The recommendation also provides $4,720,000 for research on chronic wasting disease in wild populations of cervids.	https://www.congress.gov/117/crpt/hrpt400/CRPT-117hrpt400.pdf
Senate markup, p. 45: The bill provides $5,720,000 to research the predominant pathways and mechanisms of the transmission of chronic wasting disease [CWD] in wild, captive, and farmed populations of cervids in North America. In carrying out this research, the Survey may consult, partner, or contract with the Animal and Plant Health Inspection Service, the National Academy of Sciences, State and Federal public and private entities, and any CWD task forces and working groups. In particular, the Committee encourages research and investment into carcass disposal methods to mitigate the spread of CWD, and the Committee urges the Survey to consult with the Environmental Protection Agency, the Federal Emergency Management Agency, and States to develop recommendations for carcass disposal methods that are compliant with relevant Federal clean air and water and solid waste regulations. The Committee also encourages the Survey to work in collaboration with the Fish and Wildlife Service to aid State wildlife agencies in the application of existing human dimensions research to the management and prevention of CWD.	https://www.appropriations.senate.gov/imo/media/doc/INTFY23RPT.PDF
Final conference report 50–348, p. 1540: *Biological Threats and Invasive Species Research Program*.—The agreement provides $46,622,000 including $4,970,000 for chronic wasting disease (CWD) and maintaining the direction for CWD contained in the joint explanatory statement accompanying Public Law 117–103.	https://www.govinfo.gov/content/pkg/CPRT-117HPRT50348/pdf/CPRT-117HPRT50348.pdf

Table 1.1. List of House and Senate reports along with final appropriations legislation mentioning chronic wasting disease for fiscal years 2003–2024.—Continued

[Terms: CWD, chronic wasting disease; FY, fiscal year]

Quotation from Congressional report	Uniform resource locator (URL)
FY 2022	
House report 117–83, p. 41: The recommendation also provides $4,720,000 for research on chronic wasting disease in wild populations of cervids. The Survey should continue to collaborate with partners, including institutions of higher education that have expertise in biology, ecology, and epidemiology of prion diseases, to develop early detection tools and compounds to disrupt transmission of the disease.	https://www.congress.gov/117/crpt/hrpt83/CRPT-117hrpt83.pdf
Senate report, p. 44: The bill provides $5,720,000 to research the predominant pathways and mechanisms of the transmission of chronic wasting disease [CWD] in wild, captive, and farmed populations of cervids in North America. In carrying out this research, the Survey may consult, partner, or contract with the Animal and Plant Health Inspection Service, the National Academy of Sciences, State and Federal public and private entities, and any CWD task forces and working groups. In particular, the Committee encourages research and investment into carcass disposal methods to mitigate the spread of CWD, and the Committee urges the Survey to consult with the Environmental Protection Agency, the Federal Emergency Management Agency, and States to develop recommendations for carcass disposal methods that are compliant with relevant Federal clean air and water and solid waste regulations. The Committee also encourages the Survey to work in collaboration with the Fish and Wildlife Service to aid State wildlife agencies in the application of existing human dimensions research to the management and prevention of CWD.	https://www.appropriations.senate.gov/imo/media/doc/INTRept_FINAL.PDF

Table 1.1. List of House and Senate reports along with final appropriations legislation mentioning chronic wasting disease for fiscal years 2003–2024.—Continued

[Terms: CWD, chronic wasting disease; FY, fiscal year]

Quotation from Congressional report	Uniform resource locator (URL)
FY 2022—Continued	
Conference report 47–048, p. 1436: *Biological Threats and Invasive Species Research Program.*—The agreement provides $40,431,000 including $4,720,000 for chronic wasting disease. In carrying out chronic wasting disease research, the Survey should continue to collaborate with institutions of higher education as directed in House Report 117-83 and may consult, partner, or contract with the Animal and Plant Health Inspection Service, the National Academy of Sciences, State and Federal public and private entities, and any chronic wasting disease task forces and working groups. Collaboration should continue with partners to develop early detection tools and compounds to disrupt transmission of the disease. In particular, the agreement encourages research and investment into carcass disposal methods to mitigate the spread of chronic wasting disease, and the Survey is urged to consult with the Environmental Protection Agency, the Federal Emergency Management Agency, Tribes, and States to develop recommendations for carcass disposal methods that are compliant with relevant Federal clean air and water and solid waste regulations. The Survey is also encouraged to work in collaboration with the Fish and Wildlife Service to aid State and Tribal wildlife agencies in the application of existing human dimensions research to the management and prevention of chronic wasting disease. [Accompanies Public Law 117-103.]	https://www.govinfo.gov/content/pkg/CPRT-117HPRT47048/pdf/CPRT-117HPRT47048.pdf

Table 1.1. List of House and Senate reports along with final appropriations legislation mentioning chronic wasting disease for fiscal years 2003–2024.—Continued

[Terms: CWD, chronic wasting disease; FY, fiscal year]

Quotation from Congressional report	Uniform resource locator (URL)
FY 2021	
House report 116-448, p. 44: The recommendation provides $2,720,000, $1,000,000 above the enacted level, for research on chronic wasting disease in wild populations of cervids. The Survey should continue to collaborate with partners, including institutions of higher education that have expertise in biology, ecology, and epidemiology of prion diseases, to develop early detection tools and compounds to disrupt transmission of the disease.	https://www.congress.gov/116/crpt/hrpt448/CRPT-116hrpt448.pdf
Senate report 116–123, p. 45: The Committee provides an increase in funds for a total of $1,000,000 to research the predominant pathways and mechanisms of the transmission of chronic wasting disease in wild, captive, and farmed populations of cervids in North America, including identifying significant gaps in the current scientific knowledge regarding transmission pathways. In carrying out this research, USGS may consult, partner, or contract with the Animal and Plant Health Inspection Service, the National Academy of Sciences, and other public and private entities.	https://www.congress.gov/116/crpt/srpt123/CRPT-116srpt123.pdf

Table 1.1. List of House and Senate reports along with final appropriations legislation mentioning chronic wasting disease for fiscal years 2003–2024.—Continued

[Terms: CWD, chronic wasting disease; FY, fiscal year]

Quotation from Congressional report	Uniform resource locator (URL)
FY 2021—Continued	
Final explanatory statement, p. 51: The Committee recommends an additional $5,000,000 above the fiscal year 2020 enacted level to research the predominant pathways and mechanisms of the transmission of chronic wasting disease in wild, captive, and farmed populations of cervids in North America. In carrying out this research, the Survey may consult, partner, or contract with the Animal and Plant Health Inspection Service, the National Academy of Sciences, State and Federal public and private entities, and any chronic wasting disease task forces and working groups. In particular, the Committee encourages research and investment into carcass disposal methods to mitigate the spread of chronic wasting disease, and the Committee urges the Survey to consult with the Environmental Protection Agency, the Federal Emergency Management Agency, and States to develop recommendations for carcass disposal methods that are compliant with relevant Federal clean air and water and solid waste regulations. The Committee also encourages the Survey to work in collaboration with the Fish and Wildlife Service to aid State wildlife agencies in the application of existing human dimensions research to the management and prevention of chronic wasting disease. [Public Law 116–260.]	https://www.appropriations.senate.gov/imo/media/doc/INTRept.pdf
FY 2005	
House report 108–542, p. 58: Within base funding, the Committee directs the Survey to provide an additional $75,000 for the Southeastern Cooperative Wildlife Disease Study for chronic wasting disease research.	https://www.congress.gov/108/crpt/hrpt542/CRPT-108hrpt542.pdf

Table 1.1. List of House and Senate reports along with final appropriations legislation mentioning chronic wasting disease for fiscal years 2003–2024.—Continued

[Terms: CWD, chronic wasting disease; FY, fiscal year]

Quotation from Congressional report	Uniform resource locator (URL)
FY 2004	
House report 108–330, p. 109–110: Changes to the House for biological research include … decreases of $1,025,000 for invasive species, $625,000 for chronic wasting disease research, and $650,000 for science on DOI lands. [Report accompanies Public Law 108–108.]	https://congress.gov/108/crpt/hrpt330/CRPT-108hrpt330.pdf
FY 2003	
House report 107–564, p. 65: Within the funds provided for biological research and monitoring, $2,700,000 is earmarked for chronic wasting disease research. The Committee directs the Department of the Interior and the Department of Agriculture, working with the appropriate Interior Bureaus, to provide a coordinated, detailed, and comprehensive budget request as part of the 2004 budget. [FY 2003 Interior appropriations were enacted in Public Law 108–7.]	https://www.congress.gov/107/crpt/hrpt564/CRPT-107hrpt564.pdf

Appendix 2. Selected Publications by U.S. Geological Survey Authors on Chronic Wasting Disease as of May 2024

This list shows the breadth of work by U.S. Geological Survey (USGS) authors on chronic wasting disease through May 2024.

Almberg, E.S., Cross, P.C., Johnson, C.J., Heisey, D.M., and Richards, B.J., 2011, Modeling routes of chronic wasting disease transmission—Environmental prion persistence promotes deer population decline and extinction: PLoS One, v. 6, no. 5, article e19896, 11 p., https://doi.org/10.1371/journal.pone.0019896.

Bailey, J.D., Berardinelli, J.G., Rocke, T.E., and Bessen, R.A., 2008, Prominent pancreatic endocrinopathy and altered control of food intake disrupt energy homeostasis in prion diseases: Journal of Endocrinology, v. 197, no. 2, p. 251–263, https://doi.org/10.1677/JOE-07-0516.

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Bennett, J.P., Rodriguez, C.M., and Johnson, C.J., 2012, Prion protein degradation by lichens of the genus *Cladonia*: Lichenologist (London, England), v. 44, no. 4, p. 523–531, https://doi.org/10.1017/S0024282912000102.

Blanchong, J.A., Grear, D.A., Weckworth, B.V., Keane, D.P., Scribner, K.T., and Samuel, M.D., 2012, Effects of chronic wasting disease on reproduction and fawn harvest vulnerability in Wisconsin white-tailed deer: Journal of Wildlife Diseases, v. 48, no. 2, p. 361–370, https://doi.org/10.7589/0090-3558-48.2.361.

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Blanchong, J.A., Samuel, M.D., Scribner, K.T., Weckworth, B.V., Langenberg, J.A., and Filcek, K.B., 2008, Landscape genetics and the spatial distribution of chronic wasting disease: Biology Letters, v. 4, no. 1, p. 130–133, https://doi.org/10.1098/rsbl.2007.0523.

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Appendix 3. Members of the U.S. Geological Survey Chronic Wasting Disease and Cervid Health Science Team

U.S. Geological Survey (USGS) scientists from across the Nation contributed to the USGS Science Strategy To Address Chronic Wasting Disease and Cervid Health in 2024–2028. The list below names the members of the USGS Chronic Wasting Disease and Cervid Health Science Team with their organizational affiliation in parentheses.

M. Camille Hopkins, Project Manager (Headquarters, Ecosystems Mission Area)

Cameron Aldridge (Fort Collins Science Center)

David Blehert (National Wildlife Health Center)

Scott Chiavacci (Northeast Science and Decisions Center)

Nicholas Cole (Fort Collins Science Center)

Jonathan Cook (Eastern Ecological Science Center)

Gavin Cotterill (Northern Rocky Mountain Science Center)

Paul Cross (Northern Rocky Mountain Science Center)

Maite De Maria Mulet (Wetlands and Aquatic Research Center)

Brian Dugovich (Northern Rocky Mountain Science Center)

David Edmunds (Fort Collins Science Center)

Jason Ferrante (former employee, Wetlands and Aquatic Research Center)

David Fulton (Minnesota Cooperative Research Unit)

Tabitha Graves (Northern Rocky Mountain Science Center)

Allen Herbst (National Wildlife Health Center)

Maggie Hunter (Wetlands and Aquatic Research Center)

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Blake Lowrey (Northern Rocky Mountain Science Center, formerly Wyoming Cooperative Research Unit)

Wynne Moss (Northern Rocky Mountain Science Center)

Bryan Richards (National Wildlife Health Center)

Michael Runge (Eastern Ecological Science Center)

Glen Sargeant (Northern Prairie Wildlife Research Center)

Rudy Schuster (Fort Collins Science Center)

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ISSN 2330-5703 (online)
https://doi.org/10.3133/cir1546