

SAES-422

Accomplishments Report

Project/Activity Number: NC1209

Project/Activity Title: North American Interdisciplinary Chronic Wasting Disease Research Consortium (herein, Consortium)

Period Covered: July 2023-June 2024

Annual Meeting Date(s): May 15, 2024

Participants: Our current list of members (n=74):

Debbie McKenzie (chair), Jason Bartz, Kurt VerCauteren, Hui Li, Mark Ruder, Mark Zabel, Qingzhong Kong, Pam Skinner, David Walter (vice chair), Wei Zhang, Scott Wells, Justin Greenlee, Eric Cassman, Allen Herbst, Daniel Storm, David Hewitt, Dwayne Etter, Miranda Huang, Patrice Klein, Steve Demarais, Tom DeLiberto, Jennifer Malmberg, Krysten Schuler, Peter Larsen, Rodrigo Morales, Marc Schwabenlander (past chair), Shigetoshi Eda, Tracy Nichols, Michael Zhang, Shuping Zhang, David Schneider, Sonja Christensen, Christopher Jennelle, Daniel Grove, David Williams, Daniel Walsh, Evelyn Merrill, Julie Blanchong, Kim Pepin, Lisa Muller, Russ Mason, Noelle Thompson, Rachel Ruden, Scott Hull, Tyler Harms, Don White, Mandy Kamps, Bryan Richards, Neelam Poudyal, Rich Stedman, Becky McPeake, Bruce Lauber, Tricia Hebdon, Tiffany Wolf, Binod Chapagain, Tabitha Graves, Michelle Gibison (secretary), Will Janousek, Robert Piel, Gavin Cotterill, Stuart Lichtenberg, David MacFarland, Lindsay Parrie, Hermann Schaetzl, Sabine Gilch, Corey Anderson, Bill Severud, David Fulton, Heather Inzalaco, Jenn Ballard, Paul Burr, Paulina Soto, Ron Shikaya, Qi Yuan

Brief summary of minutes of annual meeting: The Consortium held its annual meeting on May 15th, 2024, in Minneapolis, MN, USA. This was a closed meeting for NIMSS members of the Consortium, in which 27 members attended. This meeting was sponsored/funded by the University of Minnesota Research and Innovation Office, and the University of Minnesota Center for Prion Research and Outreach (MNPRO).

Accomplishments: In the past year, the Consortium continued to build upon past accomplishments and move forward on new ones. The 5 “state-of-the-science” papers mentioned in the previous report were combined into a single document and have been published in *Pathogens* ([doi: 10.3390/pathogens13020138](https://doi.org/10.3390/pathogens13020138)). Ten additional papers were published by collaborations within the consortium. New collaborative grants were funded. We admitted 9 new members. The membership in attendance voted unanimously to submit a renewal for the project in Fall 2024.

Based on input at the 2023 annual meeting, the five original objectives of the Consortium have been expanded to include objectives pertaining to i) zoonotic potential of CWD and ii) environmental CWD prion contamination. The original objectives were: i) to develop a national CWD tissue and reagents repository, ii) to identify and/or create large-scale research facilities for controlled CWD research, iii) to improve CWD diagnostics, iv) to evaluate management strategies

across state boundaries and v) to use social science to inform CWD management. The Consortium has made significant progress towards addressing these objectives.

Objective 1a: Development of a national CWD tissue and reagents repository.

This objective has moved forward with two approaches for developing repositories for CWD positive materials, a virtual repository and a physical repository. The virtual repository is being developed with USGS FORT taking the lead, with assistance from the CWD Warehouse out of Cornell University. USDA-NWRC (see below) is also involvement in the development of the virtual repository.

The USDA-NWRC in Fort Collins, CO has established a physical facility for storing CWD tissues and materials as well as tissues from animals infected with various other diseases. Metadata will be associated with each sample to include strain type (if available) and animal Prnp profile. The repository will use FreezerWorks to maintain the data. Dedicated personnel, Kelly Nelson, has been hired to maintain the metadata and the tissue archive.

Several consortium members, including Debbie McKenzie (UALberta, retiring soon and needing to store 30+ years of prion tissues), Dan Storm (Wisc DNR, looking to give away large amounts of tissues) and Allen Herbst (USGS-NWHC, variety of strains and tissues needing storage and archiving) have expressed interest in contributing to both the physical and virtual repositories.

Objective 1b: To assess the zoonotic potential of CWD

The subcommittee held a group meeting on March 8, 2024. They discussed the current status of CWD zoonosis studies and risk assessment, challenges ahead, plan for membership expansion, and plan for public education on CWD zoonosis. Questions that arose during the group meeting as well as the full consortium meeting: i) how would zoonotic transmission be “proven”, ii) possibility that zoonotic transmission, on first passage, would be sub-clinical (transfusions etc. in humans would result in secondary passages) and only present in non-CNS tissues (i.e., spleen). There is a need for increased autopsy of suspected CJD cases to facilitate characterization of possible CWD in transmission to humans.

Objective 1c: To enhance methods and approaches for measuring CWD in the environment

This group is headed by Dr. Lichtenberg. In subgroup meetings, the members reviewed the current status of research in this area and next steps needed for environmental prion deposition, transmission, detection, and remediation. The subgroup agreed that the biggest question is the extent to which environmental prions contribute to disease transmission, requiring a multi-disciplinary approach. Two potential short-term projects were decided upon: 1) characterize the relative amount (as infectious or seeding units) of prions shed by infected animals over the course of the disease, and subsequently 2) estimation of global deposition in the environment by infected animals over the course of disease.

Objective 2: Identification and/or creation of large-scale research facilities for CWD research

Allen Herbst has become a lead of this objective (replacing Steve Demarais); he joins the standing lead, Dave Hewitt. The group has developed and is maintaining a list of sites where CWD research is being conducted by consortium members along with the capabilities and capacities of those sites. Eight sites are now being used by consortium members to test different hypotheses concerning CWD transmission. Funding support for controlled CWD transmission studies was

obtained at the US Geological Survey and experiments are expected to commence in 2025. Additional capacity is also being established at USDA facilities. This objective has led to collaborations/research that likely would not have happened without the consortium.

Objective 3: Improvement of CWD Diagnostics

Collaborative work continues for developing a standardized real-time quaking-induced conversion (RT-QuIC) assay protocol by USDA Agricultural Research Service (ARS), the United States Geological Survey, University of Wisconsin Madison, the National Institute of Health Rocky Mountain Laboratory, and USDA Veterinary Services. Thus far, the standardized protocols have been utilized to blindly test characterized, white-tailed deer rectal and tonsil biopsies as well as medial retropharyngeal lymph node (MRPLN) samples. Rectal biopsy samples were tested utilizing two different substrates, one from USGS and one from the Minnesota Prion Research and Outreach (MNPRO) group at the University of Minnesota. The manuscript has been recently published. The rectal biopsy data, including the cross-laboratory reproducibility study data, was compiled and reviewed by the National Veterinary Services Laboratories (NVSL) diagnostic review committee. Although the test shows promise, the results are too variable for the USDA to use in the current CWD program across multiple NAHLN laboratories. APHIS is working closely with several partners to evaluate ways to improve the reliability of the assay. RT-QuIC protocol development and testing of blinded MRPLN samples has been completed at USDA ARS Pullman, WA using substrate from MNPRO. Samples that were non-detect by immunohistochemistry (IHC) but positive by RT-QuIC have been inoculated into a transgenic mouse bioassay to differentiate the rate of true false positives versus the rate at which RT-QuIC may detect CWD at an earlier time point than IHC.

Future plans include providing case definitions and standardizing the terminology associated with CWD diagnostics, RT-QuIC and PMCA; establishing criteria for which assays are most useful for which sample type and how diagnostics are determined (procedures for testing and verification of results). We are also developing guidelines for retaining some positive samples for follow up testing when there may be a discrepant result. A long-term goal is development of methods for rapid strain typing for CWD, which would allow us to clarify how strains are defined by their biological and molecular properties.

Objective 4: Evaluation of management strategies across state boundaries

Thanks to funding provided by the USDA, a CWD coordinator has been hired. The coordinator will move this objective forward by helping to coordinate efforts. This subcommittee is meeting regularly, including an in-person meeting in East Lansing in August 2023. The subcommittee is working through developing and implementing a structured decision-making process to guide the development of a common understanding of the problem this effort will address, the associated objectives, the potential alternative action plans and ways to assess the impacts of our effort.

We have identified three modules: i) Ecology (deer population actions), ii) epidemiology (management actions around transmission, e.g., carcass disposal, baiting, food plots) and iii) sociological (how do we achieve modules i and ii by leveraging stakeholders). For the ecology module, we have identified 3 alternatives with a target density of 40-60 deer/sq mile of habitat for experimental units (quarter township in size). Ideally treatment will continue for 6 years. For the epidemiology module, we are discussing a feasible degree of treatment. In the last module, we are establishing what we want to see done and determining how to get stakeholders to help meet

management goals. Once the sociological module is solidified, we will reach out to social scientists to help design and initiate the research.

The team is encouraging states to apply for USDA funding to support this effort. As USDA funding is for a maximum of 2 years (1 year funding with the possibility of a 1-year No Cost Extension), this funding could initiate the research but would not be sufficient to sustain it.

Objective 5: Using social sciences to inform CWD management

Members of the group have received funding from USDA's Wild Cervid Management and Research program to do social science research on CWD outreach efforts. This work will provide recommendations on how CWD outreach efforts can be aligned and tailored to context. Work is led by Cornell University with several consortium members serving on the project advisory group and assisting with aspects of the research.

Accomplishments: A main accomplishment of the Consortium is facilitating interdisciplinary collaboration. The continued interactions of Consortium members have led to scientific collaborations that would not have been possible without the Consortium. Members of the Consortium have successfully landed grants and submitted grants to the National Science Foundation, the United States Department of Agriculture, the United States Geological Survey and the National Institutes of Health. The rich output of products from these efforts listed below in "Publications" and provided on the Consortium website demonstrates the importance of the Consortium.

The Consortium also continues to conduct communication and outreach on CWD-related topics. Based on discussions at the annual meeting, the consortium decided to generate a one-page informational document on "selective breeding and release of captive white-tailed deer for CWD prevention and management". Jennifer Malmberg, Mark Ruder and David Walter led writing of the document. The finished document, once reviewed and approved by the Consortium members, will be posted on the consortium's website (<https://www.cwd-research.com>). This website has a public facing area with general information regarding CWD, the projects, public outlets of CWD information, publications, and a members-only section of the web page that houses information and notes about past meetings and other information for members.

Impacts: The impacts of the above accomplishments are multifold. Each objective was selected as a CWD research priority. Ultimately the tissue repository will be a source of CWD field isolates from a wide-ranging geographic location across North America that will facilitate assessment of the distribution and frequency of CWD strains in North America. It is also proposed that this repository will provide uniform standardized CWD-infected and uninfected sources of tissue for diagnostic development, mitigation testing and for basic research purposes. The establishment of large-scale CWD research facilities is important for evaluating potential management actions at a scale that will allow for normal ecological and epidemiological processes to occur while still permitting experimental manipulation. The improvement of CWD diagnostics is foundational to answer key questions about the epidemiology of CWD and permitting rapid and efficient detection of CWD prions. Evaluating management strategies across state boundaries is critical to organize CWD response efforts and accelerate the identification of effective CWD management strategies. Lastly, it is becoming increasingly evident that successful CWD intervention strategies require societal support to be effective. The last objective is aimed at improving the social science tools and

understanding to allow for successful implementation of CWD management. As the Consortium matures and develops, we have identified other research foci that should be addressed. Therefore, with the addition of sub-objectives - risk of human transmission/zoonotic potential, and environmental contamination and transmission - we expanded to tackle new questions, while not abandoning the original objectives. Thus, this project is having and will continue to have important impacts for increasing the understanding and management of CWD on multiple levels.

Publications:

Carlson CM, Thomas S, Keating MW, Soto P, Gibbs NM, Chang H, Wiepz JK, Austin AG, Schneider JR, Morales R, Johnson CJ, and Pedersen JA. 2023. Plants as vectors for environmental prion transmission. *iScience*. <https://doi.org/10.1016/j.isci.2023.108428>

Leong AD, Lauber TB, Siemer WF, Hurst J, Stedman RC, Schuler KL and McComas KA. 2023. Social-psychological factors influencing risk perceptions of chronic wasting disease on social media, *Human Dimensions of Wildlife*, DOI: 10.1080/10871209.2023.2293020

Soto P, Bravo-Risi F, Benavente R, Lichtenberg S, Lockwood M, Reed JH, Morales R. 2023. Identification of chronic wasting disease prions in decaying tongue tissues from exhumed white-tailed deer. *mSphere*. <https://doi.org/10.1128/msphere.00272-23>

Soto P, Bravo-Risi F, Kramm C, Gamez N, Benavente R, Bonilla DL, Reed JH, Lockwood M, Spraker, TR, Nichols T, Morales, R. 2024. Nasal bots carry relevant titers of CWD prions in naturally infected white-tailed deer. *Embo Reports*. <https://doi.org/10.1038/s44319-023-00003-7>

Huang MHJ, Demarais S., Banda A, Strickland BK, Welch AG, Hearst S, Lichtenberg S, Houston A, Pepin KM, and VerCauteren KC. 2024. Expanding CWD disease surveillance options using environmental contamination at deer signposts. *Ecological Solutions and Evidence*, 5, e12298. <https://doi.org/10.1002/2688-8319.12298>

Inzalaco HN, Brandell EE, Wilson SP, Hunsaker M, Stahler DR, Woelfel K, Walsh DP, Nordeen T, Storm DJ, Lichtenberg SS, Turner WC. 2024. Detection of prions from spiked and free-ranging carnivore feces. *Sci Rep*. 14(1):3804. PMID: PMC10869337.

Thompson NW, Butts DJ, Murillo MS, O'Brien DJ, Christensen SA, Porter WF, Roloff GJ. 2024. An individual-based model for direct and indirect transmission of chronic wasting disease in free-ranging white-tailed deer, *Ecological Modelling*, Volume 491, 110697, ISSN 0304-3800, <https://doi.org/10.1016/j.ecolmodel.2024.110697>.

Didier A, Bourner M, Kleks G, Zolty A, Kumar B, Nichols T, Durynski K, Bender S, Gibison M, Murphy L, Ellis JC, Dong DW, Kashina A. 2024. Prospective fecal microbiomic biomarkers for chronic wasting disease. *Microbiol Spectr* 12:e03750-22. <https://doi.org/10.1128/spectrum.03750-22>

Schwabenlander MD, Bartz JC, Carstensen M, Fameli A, Glaser L, Larsen RJ, Li M, Lindsey LL, Oliver JD, Shoemaker RL, Rowden G, Stone S, Walter WD, Wolf TM, and Larsen PA. 2024 Prion Forensics: A Multidisciplinary Approach to Investigate CWD at an Illegal Deer Carcass Disposal Site. *Prion*. doi: 10.1080/19336896.2024.2343298

Walter WD, Hanley B, Them CE, Mitchell CI, Kelly J, Grove D, Hollingshead N, Abbott RC, and Schuler KL. 2024. Predicting the odds of chronic wasting disease with Habitat Risk software. *Spatial and Spatio-temporal Epidemiology* 49:100650.