Surveillance Optimization Project for Chronic Wasting Disease

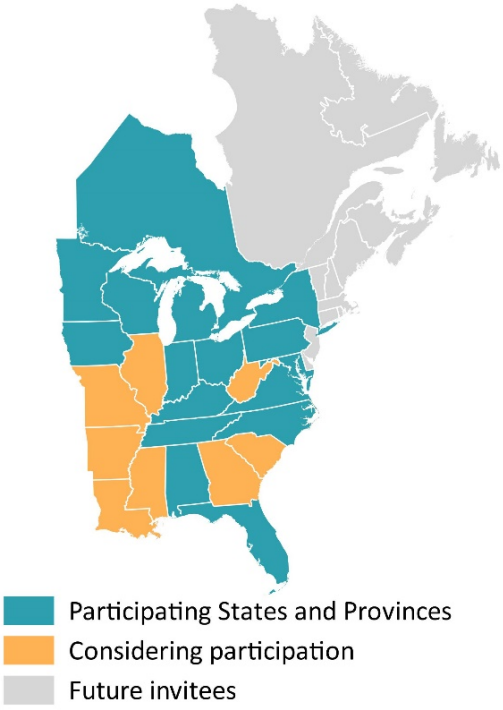
Chronic wasting disease (CWD) is a fatal degenerative neurological disease in captive and free-ranging cervids. Since the disease was first recognized in mule deer in Colorado in the 1960s, it has spread steadily across North America. Annually, state and provincial wildlife agencies throughout North America dedicate significant resources to CWD surveillance, outbreak response, and management.

The Surveillance Optimization Project for Chronic Wasting Disease (SOP4CWD) is a multi-institution collaboration that uses mathematical modeling and data science to help state and provincial wildlife agencies use their resources efficiently and develop data-driven surveillance and management programs.

A COALITION OF WILDLIFE AGENCIES AND RESEARCH INSTITUTIONS

The project is led jointly by the Cornell Wildlife Health Lab at Cornell University and the Boone and Crockett Quantitative Wildlife Center at Michigan State University. USGS contributes to the project as a research partner. Initial funding was provided by the Michigan Department of Natural Resources and New York State Department of Environmental Conservation.

All state and provincial wildlife agencies in Eastern North America are invited to participate. Sixteen wildlife agencies have already joined and eight more have initiated the process. The participation of more wildlife agencies strengthens the partnership and improves project outcomes. Wildlife agencies that can contribute financially are encouraged to do so to ensure the long-term sustainability of the project.



Wildlife agencies participate by contributing CWD surveillance data and information about their CWD surveillance activities and needs. All partners are welcome to attend planning meetings and contribute ideas to help shape the direction and priorities of the project. Participating wildlife agencies gain access to tools and resources in development by project partners.

DATA-DRIVEN SURVEILLANCE

Mathematical modeling and data science are being used to enhance our overall understanding of the spread of CWD. SOP4CWD merges analytical techniques of risk weighting, Bayesian modeling, and geospatial analysis with machine learning algorithms to aggregate surveillance data, mathematically explore and rank alternative sampling strategies, and generate summary reports and recommendations for state agencies to target surveillance efforts and enhance early detection.

KNOWLEDGE TRANSFER

The success of the project will be measured by the benefits it provides to participating states. Understanding each state's surveillance objectives and workflows will be essential to shaping the surveillance model and developing the system. An in-person project kickoff meeting between state wildlife agency representatives, project leads, modelers, and developers was held in East Lansing, Michigan in January 2020. At this meeting, state agencies shared information about their surveillance programs and discussed the mathematical modeling and data science tools available to improve CWD surveillance. Additional online project meetings are held to keep partners updated and to exchange ideas.

MATHEMATICAL MODEL DEVELOPMENT

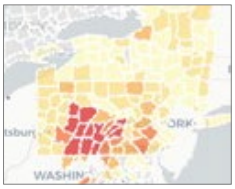
Model developers are creating linkages between extant modeling formulas and data science techniques to synthesize regional data into actionable surveillance recommendations. Model development includes the mathematical derivation, software development, validations, and efficiency assessments of a new suite of software applications. These applications will provide, for instance, stakeholders with estimates of CWD risk and surveillance recommendations.

SURVEILLANCE SYSTEM DEVELOPMENT

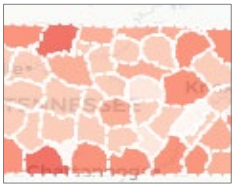
A team of application and database developers is building a regional CWD surveillance system designed to integrate with existing wildlife agency CWD surveillance programs. The system will include a CWD data warehouse and suite of web applications that provide wildlife agencies with CWD surveillance data management, analysis, and reporting features. It will integrate the mathematical modeling tools developed during the course of the project.

A user-friendly interface for agency personnel will allow managers and field staff to explore sampling strategies, track progress to sampling goals, and provide data summaries and reports in real time during the hunting season. The data contributed by wildlife agencies will enhance the analyses and information available regionally, increasing our collective knowledge of CWD and improving every agency's planning capacity.

EXAMPLE APPLICATIONS

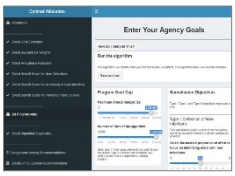


Positives App
This user interface displays annual numbers of CWD positive deer in participating states and provinces, as well as testing and incidence summaries by county and population segment.



Hazard and Persistence App
This app displays anthropogenic risks for CWD introduction and deer demographic characteristics to identify counties where CWD is likely to be introduced and where the disease is likely to spread rapidly.

Habitat Risk App
This app depicts the risk that any given area will harbor a CWD-positive deer and the risk that a deer of a specific population segment will test positive for CWD.



Optimization App
This user interface is used to run and display results from the surveillance optimization algorithms. Recommended surveillance quotas for are based on the best available epidemiological, spatial, hazard, environmental, and biological data.

DEPLOYMENT AND MAINTENANCE

SOP4CWD is following a continuous development/deployment process. Functional project components are released as soon as they are functional. Future directions and component prioritization will reflect the needs of participating wildlife agencies.

CONTRIBUTIONS FROM PARTICIPATING STATES

State agencies provide important information about their CWD surveillance programs, including workflows and objectives. This information sharing ensures that the project accounts for states' needs and that products can be integrated seamlessly into state CWD surveillance programs.

Contributed data from participating states are essential for the initial development of the surveillance model. The following data related to CWD surveillance programs and activities is critical for model development:

CWD Testing Data	All sampling and test data including the animal's age and sex, date of harvest or death, location of harvest or death, why the animal was tested (for example: hunter harvest, clinical suspect, roadkill), test method, and result.
Population Demographic Data	Agency data including population estimates, location-specific buck-doe ratios, and any additional demographic information.
Population Management and Hunting Data	Agency information on population management activities, including numbers of harvested animals, hunting seasons and dates, location-specific tags and success rates, and number of hunters.
CWD Introduction Risk Hazard Data	Information on locations of taxidermists, meat processors, and captive cervid facilities and any related data.
CWD Surveillance Activity Data	Agency data including emphasis on particular locations, staffing, and policies around disease management areas.

FOR MORE INFORMATION

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