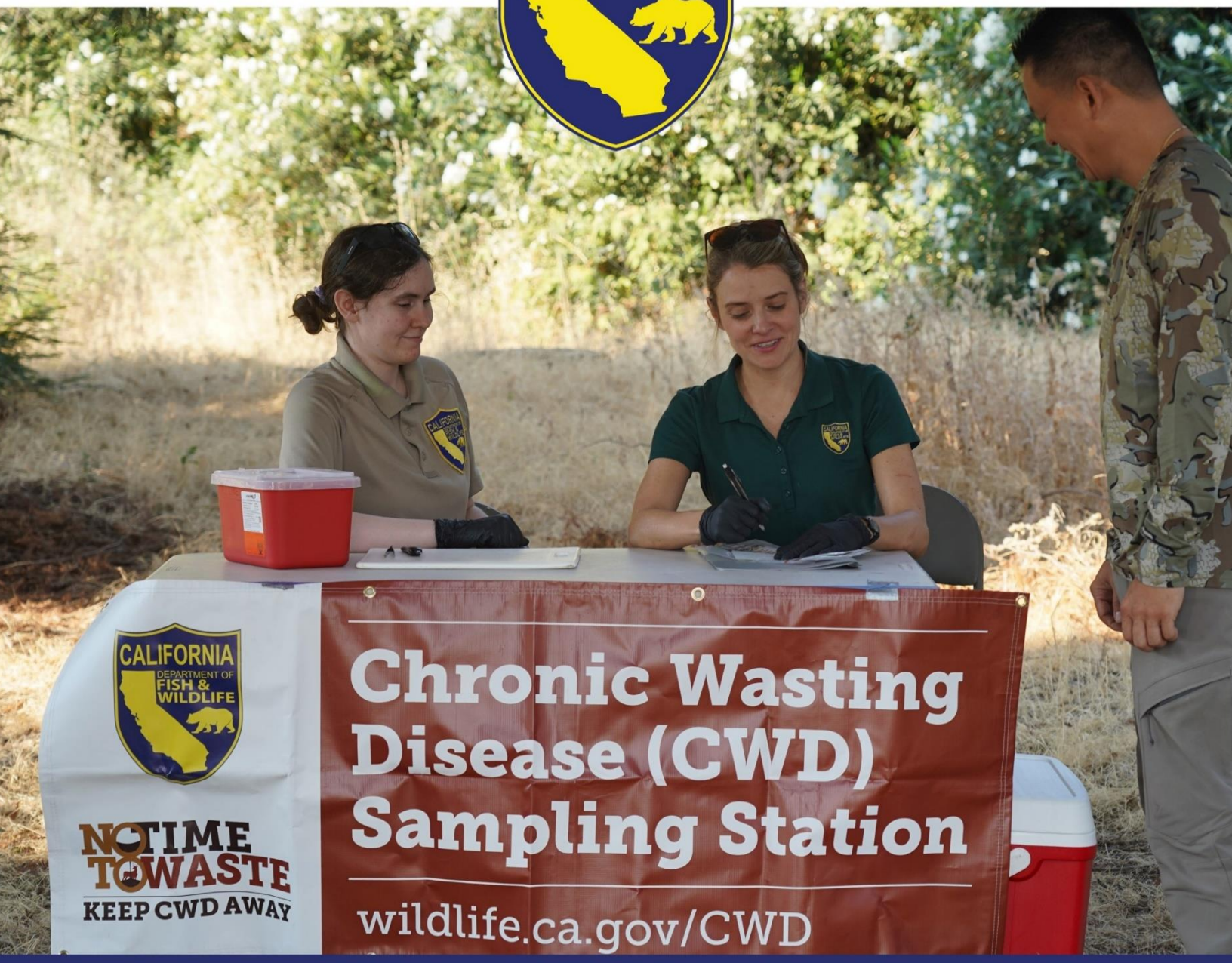
CALIFORNIA'S CHRONIC WASTING DISEASE (CWD) MANAGEMENT PLAN

August 2024



California Department of Fish and Wildlife - 715 P Street, Sacramento, CA 95814

Approvals

California's Chronic Wasting Disease Management Plan, having been reviewed by the California Department of Fish and Wildlife's Chronic Wasting Disease Task Force and Wildlife Management Committee and members of the Western Association of Fish and Wildlife Agency's Wildlife Health Committee, is approved for immediate use and guidance for the surveillance, response, and management of chronic wasting disease in California.

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Table of Contents

Executive Summary

Chronic wasting disease (CWD), a fatal neurological disease of cervids, was confirmed in California for the first time on May 6, 2024. Caused by an infectious protein or prion, CWD is the most significant disease of management concern for free ranging deer and elk in North America with potential implications for deer and elk populations, hunter interest and opportunity, and public health. This plan provides an adaptive and sustainable framework for the surveillance, response, and management of CWD in California's deer and elk herds. Surveillance focuses on efficient disease detection where CWD has not yet been detected, estimating prevalence and geographic distribution where CWD has been detected, and supporting CWD-related management or research actions. We divide the state into five sampling units and use adaptive management practices, risk assessment, deer population abundance estimates, and hunter harvest reports to optimize surveillance targets and sampling efforts. Following new detections of CWD, initial response actions will focus on increased surveillance efforts in affected areas to determine the scope of the outbreak. All tools at our disposal should be used to increase sampling efforts around initial disease foci to determine the scope of the outbreak and inform appropriate near- and long-term management actions to mitigate disease spread, transmission, and prevalence where feasible. Finally, this plan outlines recommended long-term management strategies to mitigate prevalence and spread of CWD once it has become established in a population.

Acknowledgments

This plan came about through the hard work and critical review of numerous individuals and groups. We would like to thank: Drs. Dan Walsh and Mary Conner for their critical review of the statewide surveillance plan; members of the California CWD Task Force for ongoing CWD management planning discussions, review of drafts, excellent comments, and ongoing sampling and education efforts; members of the Western Association of Fish and Wildlife Agencies' Wildlife Health Committee and Dr. Todd Cornish for their review and comments on the final draft of this plan; and Dr. Mike Miller for his in depth review of this plan and willingness to field multiple questions while finalizing this plan. A special thanks to Dr. Brett Furnas, David Cassidy, Julie Garcia, and Brian Leo for adding their expertise and knowledge on estimating deer populations and deer management in California. Additional special thanks to Drs. Beatriz Martinez-Lopez and Carlos Gonzales-Crespo of the University of California Davis for their discussions about sampling size and CWD risk assessment.

Purpose and Overview

The purpose of this plan is to provide a framework to accomplish California's chronic wasting disease (CWD) management goals:

I. **Prevent the introduction and establishment of CWD in California.**
II. **Detect CWD in California at the lowest possible prevalence.**
III. **Respond efficiently and effectively to initial CWD detection(s) in California to inform realistic management actions and outcomes.**
IV. **Outline long-term management options to reduce CWD prevalence within affected herd(s) and minimize spread to naïve herds.**
V. **Communicate CWD-related information to the public, partners, and staff.**

Specific Objectives and Activities to accomplish these management goals are detailed in subsequent sections. This plan is meant to be versatile and adaptable as science and management change over time.

Jurisdiction and Authority

The California Fish and Game Code (FGC) includes various provisions for the preservation, conservation, and maintenance of wildlife resources under the jurisdiction and influence of the state, including alleviation of public health or safety problems caused by wildlife (FGC §1801) and establishes the California Department of Fish and Wildlife (CDFW) as the trustee agency for the conservation, protection, and management of fish and wildlife (§1802). The FGC requires that a deer management plan be developed for restoration and maintenance of healthy deer herds in California (FGC § 453), including by reducing natural mortalities and maintaining habitat (FGC § 454). Additionally, FGC §1001 grants CDFW the authority to take wildlife for the prevention or relief of suffering and FGC §1008 directs CDFW to investigate diseases and problems relating to birds, mammals, or fish. The Fish and Game Commission (hereafter the Commission) has the authority to promulgate regulations for the entry, importation, transportation, possession, keeping or confinement of any and all wild animals that are imported into the state (FGC § 2120), including cervids which are defined as wild animals under FGC § 2118(b). FGC § 2118.2 generally prohibits the importation of elk. FGC § 200 provides the Commission with the authority to regulate the take and possession of mammals and other species. These underpinning authorities for regulations involving the take and importation of big game species are found in Title 14 of the California Code of Regulations. Finally, the Commission may adopt emergency regulations for the protection of wildlife if there is an immediate threat to public health, safety, and welfare, or the population or habitat of any species (FGC § 219).

Adaptive Management Framework

In this disease management plan, we outline an adaptive framework for CWD surveillance, response to initial detection(s), and long-term management applicable statewide and at

species management units. Adaptability and sustainability are crucial for ensuring long-term effectiveness of this plan. To achieve this, standardized data collection and analysis from surveillance, response, and management actions and regular reviews of current science, will be used to inform ongoing actions and necessary adaptations. CDFW will review surveillance data and efforts annually utilizing current risk assessment, surveillance strategies, diagnostic tests, and epidemiologic models to adapt strategies. Response actions will provide local information to inform near- and long-term management strategies. Efficacy of management strategies will be assessed over time and strategies refined to support current CWD and species management goals.

Incorporating data from CWD surveillance activities and Deer Conservation Unit (DCU) monitoring plans into risk and disease spread models specific to California could help optimize surveillance, response, management, and outreach. A tiered system based on management considerations and risk assessments may identify DCUs, hunt zones, or deer herds as high, medium, or low risk. Risk level will help prioritize the rapidity and intensity of the management action(s) needed, ranging from sustained multi-faceted approaches to potential non-intervention. To be sustainable, management actions must be realistic and garner sufficient public and stakeholder support to be maintained for extended periods, 5-10 years or more, to see effects. Long-term management plans should encompass a multi-faceted approach, necessitating investments in public involvement, communications, data collection, experimental design, and program evaluation.

Chapter 1: Chronic Wasting Disease Background

Chronic wasting disease (CWD) is the most significant disease affecting cervids (deer, elk, moose, caribou) in North America. Caused by an infectious protein called a prion, CWD is always fatal, there is no vaccine or treatment, and all cervid species native to North America are susceptible. First described in wild-born captive-reared mule deer at a research facility in Fort Collins, Colorado (Williams and Young 1980), CWD was subsequently detected in Colorado's free-ranging elk mule deer (1981 and 1985, respectively), free-ranging white-tailed deer in Nebraska and South Dakota (2001), and free-ranging moose in Colorado (2005) (Haley and Hoover 2015). Despite efforts to manage the disease, CWD continues to spread in the United States and Canada and has been detected in free-ranging reindeer and moose in Scandinavia (Benestad et al. 2016, Åkerstedt et al. 2021) and captive sika deer and red deer in South Korea (Saunders et al. 2012).

On May 6, 2024, CWD was confirmed in California for the first time in two adult male mule deer. One was found dead of unknown causes in a residential community in Madera County on September 20, 2023. The other died after being struck by a vehicle near Bishop, Inyo County, on February 6, 2024. Samples from these deer were received at WHL in February and March 2024, respectively, and sent to the Washington Animal Disease Diagnostic Laboratory (WADDL), Pulman, WA on April 4, 2024. Preliminary detections were reported to the California Department of Food and Agriculture and WHL on April 29, 2024, and confirmation completed by USDA's National Veterinary Services Laboratory, Ames, IA, on May 6, 2024. The current distribution of CWD in the U.S. and Canada can be found at the USGS National Wildlife Health Center's website Distribution of Chronic Wasting Disease in North America (usgs.gov).

Deer and elk are exposed to infectious CWD prions through direct contact with infected animals or contaminated environments. Infectious prion (PrP^{CWD}) is taken up by lymphoid tissues and interacts with the host's normal cellular prion (PrP^{C}) causing them to misfold to the disease-causing form. As the infection propagates in this manner, prions can be found in most tissues including muscles (meat), blood, glandular fluids, saliva, feces, and urine, but the highest concentrations remain in the central nervous system (Saunders et al. 2012). Ultimately, PrP^{CWD} aggregates cause microscopic sponge-like holes in the brain which leads to clinical disease. Animals in the end stages of CWD exhibit lowered head and ears, excessive drooling, bruxism (teeth grinding), listlessness, unwillingness to flee, ataxia, emaciation, and ultimately death (Williams and Young 1980).

The time from exposure to clinical disease can take months to years. Infectious prion can be excreted in saliva, urine, and feces prior to developing any clinical signs. This means that apparently healthy but infected animals can expose other animals to infectious prions and contaminate the environment. Most every tissue can harbor infectious prion, including blood, antler velvet, placenta, and muscle and decaying carcasses or gut piles seed the environment with infectious prion (Escobar et al. 2020). Prions associated with CWD and

other related diseases (e.g. scrapie of domestic sheep) can remain infectious in the environment for years, potentially 15+ years as suggested in one scrapie study (Georgsson et al. 2006). Certain soil constituents can increase infectivity by binding to prions and prions can be taken up by some plants (Pritzkow et al. 2015).

Environmental contamination and persistence of infectious prions are important for the maintenance and spread of CWD and there is no feasible way to decontaminate a natural environment once prions have been introduced (Haley and Hoover 2015). Additionally, deer movement patterns and spatial dynamics play a pivotal role in the transmission and movement of CWD on the landscape. Studies of home range sizes, migration behaviors, and interactions between different deer age classes provide insights into the mechanisms by which CWD spreads within deer populations across various landscapes. Older age class males tend to have the highest prevalence of CWD, followed by older females, which may be due to behavior and a broader home range (Escobar et al. 2020).

Deer and elk populations with high CWD prevalence will decline in the long-term (Monello et al. 2014, Edmunds et al. 2016, DeVivo et al. 2017). Polymorphisms in host prion protein gene (*PRNP*), which codes for the cellular prion (PrP^{c}), influence host susceptibility to CWD and transmission of prions between species. Landscape features may affect the frequency and distribution of these polymorphisms within and between deer populations (Moazami-Goudarzi et al. 2021, Koutsoumanis et al. 2019). Understanding *PRNP* genotypic frequencies and distributions may help predict expected prevalences and relative risk of CWD across deer populations. This could be important when considering management actions in response to CWD detection. Left unmanaged, CWD could negatively impact California's cervid populations. This Management Plan provides an adaptive framework to guide, implement and maintain CWD surveillance, response, and management actions to mitigate the effects of CWD on California's deer and elk populations.

Public Health Considerations

There is no evidence that CWD can affect humans, but caution is warranted, and we advise not consuming any parts from a CWD-positive animal. Transgenic mice experiments suggest that the CWD prion is incompatible with the human cellular prion and thus unable to convert them to the disease-causing form (Kurt and Sigurdson 2016). However, different CWD strains with differing host susceptibility and disease patterns have recently been discovered. This work has also shown that individual hosts may harbor different CWD strains and that more strains are likely to evolve (Otero et al. 2022). Following Europe's mad cow disease outbreak, consumption of BSE tainted meat was linked to a variant form of Creutzfeldt-Jacob disease (vCJD) in humans (Houston and Andreoletti 2018). At a minimum, the link between BSE and vCJD suggests that at least some animal prions are capable of crossing species barriers to cause disease in humans, and while the risk to humans is low, it may not be zero. The World Health Organization (WHO) and the U.S. Centers for Disease Control and Prevention (CDC) recommend we "keep the agents of all known prion diseases from entering the human food chain" (CDC website, *Chronic Wasting Disease*).

Chapter 2: Preventing CWD Spread

Once a disease becomes established in a wild population there are often very few management options available, and successes are limited. Prevention is generally the most effective management strategy for diseases affecting wildlife and remains a priority for CWD. While CWD was recently detected in California for the first time, identifying and effectively mitigating risk factors for the spread of CWD is still important for preventing the spread of CWD within and beyond California. At least 13 groups of risk factors for the spread of CWD have been identified (Koutsoumanis et al. 2019) but not all are potential targets for preventive measures. The Association of Fish and Wildlife Agencies' (AFWA) Technical Report on Best Management Practices for CWD (Gillin and Mawdsley 2018) identified five specific risk factors where regulations, enforcement, and education are most likely to be effective. These can be summarized simply as movement of live cervids and their products (including urine and gametes), movement of hunter-harvested cervids and their parts, and preventing unnatural concentrations of cervids. Identifying and implementing actions to mitigate these risk factors should be prioritized based on feasibility, effect, and sustainability.

California regulates the possession, movement, and importation of live cervids and their products (California Code of Regulations Title 14 sections 671, 676, 681, and 714); the importation of hunter-harvested carcasses and tissues (T14 section 712); and unnatural concentrations of cervids e.g. through feeding or baiting (T14 sections 251.3, 257.5, and 475). Compliance with and enforcement of these regulations remains important to mitigate the spread of CWD. To foster public awareness of these important regulations and to increase participation in CWD surveillance, response, and management efforts, the CDFW Office of Communication, Education, and Outreach (OCEO) supports a multimedia CWD educational outreach campaign that includes videos, emails, social media posts, posters, fliers, and trade show attendance to inform hunters, meat processors, taxidermists, tribes, and other partners. A CWD website (wildlife.ca.gov/CWD) was established to serve as an informational hub for details on surveillance activities, best practices, educational materials, and how to contribute to management efforts.

Informed partners are critical for implementing best practices for the movement and disposal of the most infectious materials, promoting active involvement in sampling efforts, reporting harvests, and ensuring proper disposal of positive animals and materials. Through training, enforcement, and educational outreach campaigns directed at hunters, meat processors, taxidermists, and enforcement, CDFW continues to increase awareness of important CWD-related regulations and best practices, the important reasons behind them, and how best to comply. Motivations for sustainable CWD surveillance, response, and management strategies must be clearly communicated and it is crucial that resources are available to ensure all stakeholders are engaged and invested in the state's management of CWD (Vaske 2010).

Chapter 3: Surveillance

California's CWD surveillance strategy seeks to detect CWD at the lowest prevalence attainable with limited resources. Once CWD is established in a population the environment is seeded with infectious prion and it is infeasible, if not impossible, to eradicate the disease (WAFWA 2017). Early detection is the most important factor when considering management options. However, there are tradeoffs and the need to detect CWD early or at the lowest possible prevalence must be balanced against the cost of such surveillance. The most efficient and reliable way to detect CWD as early as possible is to establish and maintain a robust, active surveillance program utilizing known CWD risk factors to direct sampling efforts (Walsh and Miller 2010, Walsh 2012, Heisey et al. 2014, Jennelle et al. 2018).

The World Organisation for Animal Health (WOAH) defines surveillance as the "systematic ongoing collection, collation, and analysis of information related to animal health and the timely dissemination of information so that action can be taken." (OIE 2024) This section provides a statewide surveillance framework to detect CWD in California's deer and elk populations as early as possible. Surveillance efforts will focus predominantly on actively sampling and testing free-ranging cervids, predominantly black-tailed and mule deer, for CWD. Pertinent samples and data will be collected to regularly assess surveillance sensitivity and efficiency. Surveillance will advise and direct any response or management actions, but intensities may need to adapt and vary over time and space depending on CWD and populations management priorities. Collecting accurate population data will be critical to inform surveillance activities and management actions.

Sampling Units and Targets

We used deer population estimates (CDFW unpublished data), deer harvest, deer management goals, and historic CWD surveillance to merge one or more of the eleven DCUs, which in turn consist of one or more deer hunt zones (CDFW 2024), to create five representative Disease Sampling Units (DSU) (Figure 2). Stratifying the state into smaller, discrete sampling units enhances the efficiency and flexibility of our surveillance program. These smaller sampling units allow for better statistical inferencing, eliminates variables within sampling units and reduces sampling biases. Location data will be collected and managed at the GPS coordinate or Deer Hunt Zone levels to allow for fine scale analyses within and between DSUs.

Our surveillance target is to test 300 deer per DSU per sampling period (calendar year). We reviewed other states' CWD surveillance plans and compared multiple statistical models for estimating sample sizes to arrive at these sampling targets (Appendix I). Surveillance strategies must strike a balance between optimizing detection probabilities and limited resources for sampling and testing. Detection probabilities and prevalence estimates can be analyzed using multi-year aggregates. If annual targets cannot be reached, we can utilize published sample weights (Walsh 2012, Heisey et al. 2014, Jennelle et al. 2018) or rolling, multi-year assessments to estimate detection probabilities. Exceeding surveillance targets provides greater detection probabilities and more accurate prevalence estimates.

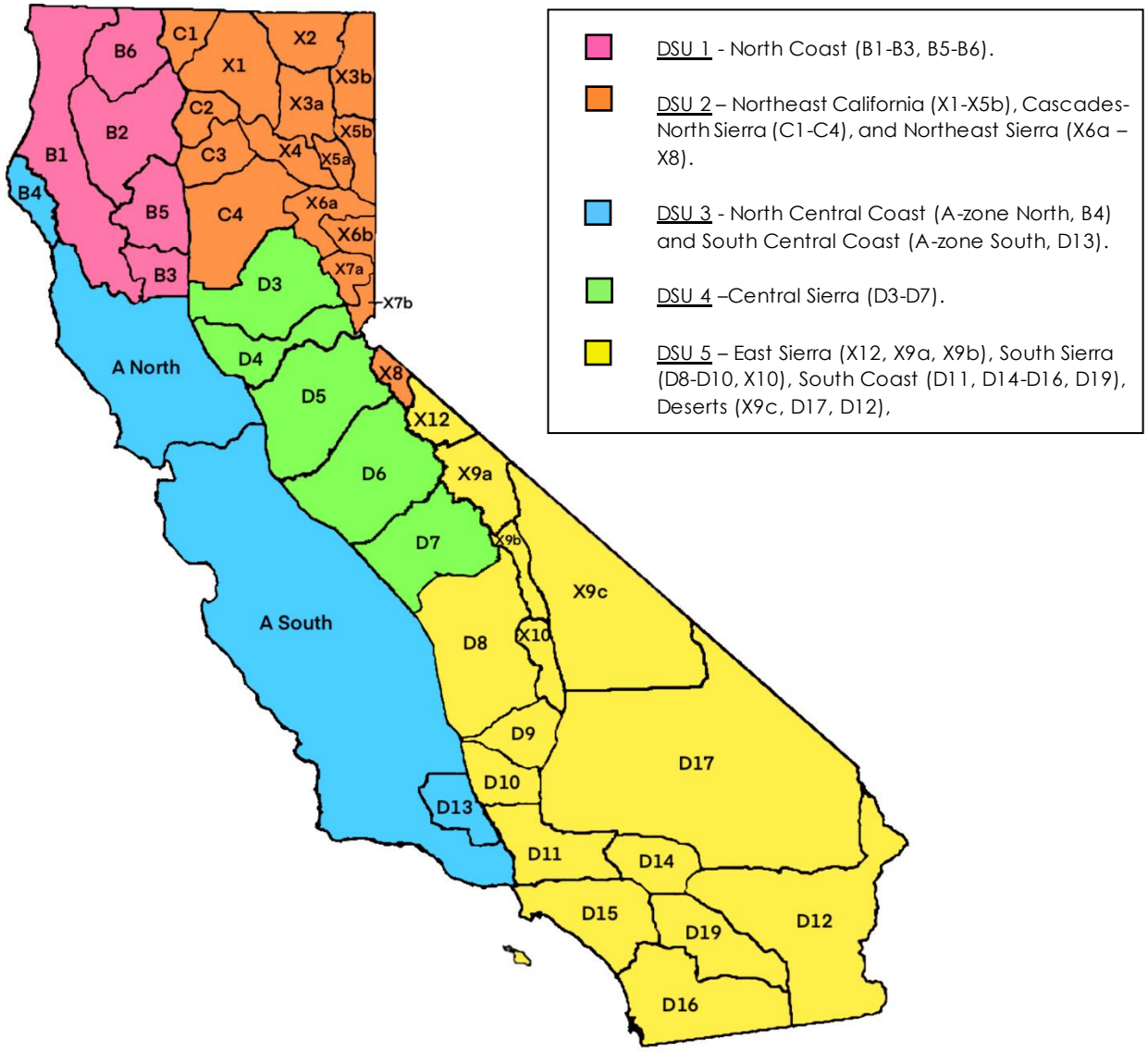

Figure 2 – California's deer Disease Sampling Units (DSU) 1-5 derived by combining existing Deer Conservation Units (DCU).

Surveillance Optimization and Weighted Sampling

California's CWD surveillance efforts will prioritize testing 1) hunter-harvested deer (99% of California's deer harvest is buck), 2) sick deer and elk, and 3) opportunistically sampling and testing roadkill and any other deer and elk mortalities (Table 1). This adapts a weighted surveillance strategy that uses risk factors from CWD endemic populations to estimate real weights of samples from different sampling streams (Walsh 2012). Weighted sampling methods can increase surveillance efficiencies by 1) focusing surveillance efforts on highest weighted samples such as clinical animals, roadkill, or adult hunter-harvested males; and 2) by using "point values" based on these weights to reach 300 sample "points" for detection

probability goals. The published sample weights were not calculated for California deer populations and may not be accurate for California's deer populations. However, the weights are at least plausible and their rank order applicable when considering California. In the absence of data specific to California, our surveillance goals are to sample 300 deer per DSU using published weights to preferentially sample and test animals with the highest probabilities of being CWD-positive, i.e. hunter-harvested adult male deer, roadkill, and clinical animals. If needed, we can still apply "point values" based on the published sample weights to reach sampling targets or estimate detection probabilities (Walsh 2012, Heisey et al. 2014, Jennelle et al. 2018).

Table 1: Surveillance streams and sampling methods for CWD. Actively sampling from a combination of the following sources (Surveillance Streams) is necessary to meet our surveillance targets for each sampling unit.

Surveillance Stream	Sampling Methods (not limited to)
Hunter harvest	a. Sampling harvests at: i. Check stations. ii. Meat processors and taxidermists. b. Harvest head drop-offs. c. Hunters sample their own harvests and submit to CDFW. d. Wardens or biologists visiting hunting camps.
Clinically ill deer and elk	a. All cervids sent to the WHL or the California Animal Health and Food Safety (CAHFS) labs for postmortem examinations. b. Field necropsies performed by CDFW staff or partners to determine cause of death and samples submitted to the WHL.
Roadkill	a. CDFW staff and partners (CalTrans, County Works, salvage permits, etc.) collecting samples from deceased animals. b. Identify roadkill hotspots, both location and timing, to identify times and locations to sample multiple animals.: i. CDFW data ii. U.C. Davis Road Ecology Center iii. iNaturalist iv. CalTrans
Other mortality sources	a. CDFW staff or partners sampling from project animals. b. Local or County Animal Services Officers. Depredation permits

Optimizing disease surveillance depends upon understanding what risk factors apply to susceptible populations. Careful consideration of risk factors and environmental conditions should be considered both within a DCU and statewide to optimize CWD surveillance. A

California-specific agent based CWD risk and disease spread model has been developed in collaboration with the U.C. Davis Center for Animal Disease Modeling and Surveillance (CADMS) and recent detections can be used to evaluate our risk assessment. These and other tools can be used to help optimize surveillance (e.g. Cornell's SOP4CWD) and evaluate response and management scenarios to both direct surveillance and better inform decision-makers. These tools will be utilized whenever possible within the framework outlined in this plan to optimize efficiency and efficacy of surveillance, response, and management actions.

Sample Diagnostics

Chronic wasting disease is a United States Department of Agriculture (USDA) program disease, a disease important to U.S. agriculture security, and carries additional USDA-defined requirements and standards for diagnostic testing. While free-ranging wildlife do not fall within the purview of USDA program disease standards, most wildlife agencies, including CDFW, follow USDA-approved CWD testing methodologies. The highest rates of detecting PrP^{cwd} are found in the medial retropharyngeal lymph nodes (RPLNs) of infected mule deer (Spraker et al. 2002a, b, Wild et al. 2002, Fox et al. 2006), white-tailed deer (Keane et al. 2008a, b),and Rocky Mountain elk; however, 14% of elk will have PrP staining only in the brainstem and not in RPLN (Spraker et al. 2004). Current USDA-approved CWD tests include immunohistochemistry (IHC) and enzyme-linked immunosorbent assay (ELISA) done on medial RPLN or obex (a specific region of the brainstem). There is significant interest in developing more sensitive and rapid assays for CWD and CDFW will continue to monitor current science and approved tests, adjusting modalities if/when appropriate to maximize test sensitivity, specificity, and surveillance efficiency. For statewide CWD surveillance, CDFW will focus surveillance efforts on black-tailed and mule deer collecting RLPN tissue and testing by ELISA. Both RPLN and obex will be collected and tested opportunistically from elk.

Specific sampling and storage techniques are adaptable, adjusting as new information emerges. Positive results in any new area may warrant confirmation by IHC and Western blot (WB) assays performed either by the National Veterinary Services Laboratories (NVSL) in Ames, Iowa, or by a certified National Animal Health Laboratory Network (NAHLN) laboratory. This confirmation may delay final results. Sub-samples of RPLN or obex will be held in ultracold freezers for at least two years and a sub-sample of positive samples will be archived. CWD surveillance samples may be used for additional disease surveillance, genetics, or other management or research purposes whenever possible. One or more contracts with animal diagnostic laboratories in the NAHLN will be maintained to perform ELISA testing or IHC confirmation of any positive samples.

Chapter 4: Response Following Initial Detection(s) of CWD

Due to the long incubation period (months to years) and the lack of rapid and reliable animal-side or antemortem tests for CWD, there will be a significant lag (years) from the time of initial CWD introduction into a deer or elk population and our first detection of CWD in that population. It is also likely that by the time we detect CWD in a population, multiple infected animals will be on the landscape excreting infectious prions and seeding the environment with infectious CWD prions. Thus, eradication of the disease will almost certainly be infeasible if not impossible and CDFW's response to initial detections in a new population will seek to inform realistic management actions and outcomes.

Initial response objectives

1. Increase surveillance efforts locally to:
    a. Determine the geographic extent of CWD.
    b. Determine the prevalence of CWD in deer and/or elk within the affected population(s).
2. Decrease transmission rates and environmental contamination by:
    a. Increasing harvest/take to decrease population and CWD prevalence.
    b. Implementing carcass disposal and movement requirements.
3. Collect pertinent information and samples to:
    a. Direct long-term management decision making and strategies,
    b. Support current applied research or potential future research.
4. Provide accurate information about CWD to public; state, federal, and local agency; University; and other partners.

Enhanced surveillance combined with local demographic and habitat data will direct evidence-based management actions that incorporate local disease, population, and habitat factors. It is important to note that local prevalence and population density within a sampling unit can vary considerably. A systematic and collaborative approach will be needed to appropriately initiate and administer any response to initial or unique CWD detections in California.

Initial response actions

1. Enact communications plan for initial detection (WHL).
    a. Inform WHL chain of command.
    b. Inform Regional Manager(s) for the Region CWD was detected.
    c. If the CWD-positive cervid was hunter harvested, contact hunter,
        i. Inform of suspect or confirmed positive test result,
        ii. Confirm exact location the animal was harvested,
        iii. Provide CDC recommendations not to consume.
        iv. Advise of proper disposal.
    d. Prepare press release if warranted.

*NOTE initial detection will likely come first as a suspect or presumptive positive via ELISA testing. Confirmation via IHC or WB may come days to weeks later.

2. Establish a (formal or informal) CWD response team to develop and execute appropriate response actions and facilitate communication about the outbreak. For example, an Incident Command Structure (ICS) could be implemented, or an informal Response Team identified. Team members should include:
    a. Regional Response Lead or Incident Commander. Provided by the Region in which the initial detection occurs. If detection(s) span multiple Regions, Deputy Director will identify the individual in this role.
    b. WHL's CWD lead.
    c. Wildlife Branch's Deer Species Lead.
    d. Public Information Officer.
3. Establish CWD Management Zone(s) (CMZ)
    a. A CMZ will be defined as any deer hunt zone within a 5-mile-radius of where a CWD-positive animal was taken, excluding A Zone.
    b. CMZs are amendable based on locations of additional or distant detections and management actions.
    c. CMZ Objectives (not limited to):
        i. Increase surveillance within and adjacent to CMZ to determine prevalence and geographic distribution. Consider:
            1. Mandatory testing of deer taken within a CMZ
            2. Increase hunting tags within CMZ,
            3. Add late season (post rut) or special hunts,
            4. Allow antlerless hunts.
            5. Consider targeted removals.
            6. Evaluate regularly and adjust based on surveillance results.
        ii. Consider carcass handling, movement, storage, and disposal rules.
        iii. Consider emergency rules for rehabilitation, restricted species, and fallow deer farming permitted facilities within or adjacent to the CMZ.
    d. Implement emergency regulatory rulemaking process to support CDFW's initial response.
4. Provide regular surveillance reports for the CMZ.

Initial response efforts will focus on intensive surveillance within CMZs to estimate CWD prevalence and geographic extent of the disease. Continued monitoring following the initial detection will be used to assess the evolving CWD situation. The CWD Response Team or Incident Command will determine appropriate management actions to mitigate disease spread and prevalence, or to simply monitor without active management, based on initial and ongoing response actions, management feasibility, and likely effectiveness. Long-term management strategies are outlined for implementation after the initial response. A communication plan ensures the timely dissemination of detection information, findings, and actions to partners, stakeholders, and the public, fostering transparency and engagement in CWD management efforts.

Chapter 5: Long-Term Management after Detection

Chronic wasting disease is challenging to manage. Once it becomes established in an area, eradication is usually infeasible if not impossible to achieve (Miller and Fischer 2016, WAFWA 2017). Our surveillance strategy aims to detect CWD at the lowest prevalence attainable with limited resources and our response strategy seeks to provide information required to determine scope of the outbreak to inform management decision. It is unlikely that eradication of the disease will be feasible. CWD management efforts will focus on stabilizing, and where appropriate reducing, disease prevalence within affected herds and minimizing spread to naïve herds. This management framework is intended to help CDFW Regions identify realistic disease control objectives, such as monitoring CWD outbreaks and decreasing deer densities near disease foci to decrease disease prevalence and transmission.

Effective long-term management is inextricably linked with appropriate and on-going CWD surveillance (Chapter 3). Long-term management strategies and goals should be based on the prevalence and distribution of CWD in California. Obtaining reliable distribution and prevalence data early in the planning and execution of a management plan (Chapter 4) will greatly improve the effectiveness of future CWD control efforts. In other states, CWD control efforts have been hampered by an initial underestimation of CWD prevalence and geographic distribution in an affected area and the time needed to see effects from any actions. An early/proactive and sustained intervention when CWD is initially detected will be the most successful in suppressing CWD epidemic growth and spread. Utilizing WAFWA's adaptive management recommendations for CWD (WAFWA 2017), the following long-term management strategies are recommended for California.

Reduce Artificial Points of Cervid Aggregation

It is important to identify and limit artificial point-sources of food, minerals, and water that could cause deer or elk to aggregate. Artificial aggregation of hosts increases transmission of CWD due to high host concentration and close contact. Additionally, these could serve as environmental reservoirs of infectious CWD prions. Feeding of game species is illegal in California and increased enforcement of these feeding bans by local wardens may be needed to remove leaky grain bins or bags, haystack yards, artificial feeders or feeding stations, and mineral bins attracting large numbers of cervids. Wardens and biologists will work with 1) the WHL and the Deer Program to identify artificial points of cervid aggregation and 2) producers, landowners, and agriculture authorities to eliminate these point-sources and reduce the density of deer to mitigate CWD risk. The environmental accumulation and persistence of prions is a significant factor affecting CWD transmission and has been shown to be an important driver of population impacts of CWD (Almberg et al. 2011). Both the direct and indirect transmission of CWD prions can occur within and between cervid species that congregate around shared resources.

Harvest Management

Another important strategy to stabilize or decrease CWD prevalence and transmission is the use of hunting pressure to reduce population densities at both regional and local scales (WAFWA 2017, Miller et al. 2020, Conner et al. 2021). Harvest management strategies can vary greatly under different scenarios and decisions will be made at the individual hunt zone level, with guidance from CDFW's Game Conservation Program and this CWD management framework. Several factors must be considered when determining whether manipulating harvest is a useful tool for CWD management: local and regional CWD prevalence and deer density, sustainability of the harvest manipulation(s), socio-bio-political factors, and DCU management goals.

Recommended harvest strategies to manage CWD include increasing buck harvest, increasing harvest of prime-age bucks, and shifting harvest to more closely align with peak breeding season (WAFWA 2017, Conner et al. 2021). Increased harvest of prime-age bucks can be effective in decreasing CWD prevalence because CWD infection rates are typically higher in that group than other demographic groups. Most of the deer harvested in California are bucks. Increasing buck harvest as a sole measure to manage CWD in California would be difficult and may not produce adequate results but strategies that encourage harvesting more prime-age bucks could be effective in decreasing CWD prevalence. Additionally, shifting harvests to align with peak breeding season (Conner et al. 2021) could be effective in California. Where deer densities are high, adding or increasing doe or antlerless harvest may be effective at decreasing deer densities and density-dependent transmission of CWD in those populations.

Managers should use available information, both specific to the herd in question and the current knowledge and resources available for CWD management, when considering harvest management to address CWD in an area. More than half of California counties have veto authority for antlerless harvest (FGC sections 458 and 459), so local support of proposed management actions will be needed. Increasing available hunting tags, promoting harvest bias toward older males based on point class, instituting additional antlerless hunts and either-sex hunts to reduce abundance and density, adjusting season dates to increase hunter success, or adding late season (post-rut) hunts are all potential harvest manipulations that could be used to manage CWD. Sustained harvest applied over a series of successive hunting seasons has been shown to be the most effective in long-term management of CWD (Miller et al. 2020, Conner et al. 2021). Population growth rates, additive and compensatory mortality factors, and cervid spatial ecology incorporating known migration routes and seasonal movement patterns will be important factors for managers to consider when implementing CWD mitigation strategies. Disease surveillance may reveal spatial clusters of CWD, which can increase the success of direct, more targeted harvest approaches.

Take Targeting Disease Foci

In addition to the above strategies, selective removal of cervids from CWD-positive areas or known infected animals can be quite effective at reducing CWD prevalence. Intensive deer removal focused around CWD case clusters, or "hotspot" culling, can be implemented in several different ways including through licenses (e.g., quota, party/partner, damage control licenses, or PLM program opportunities where hunt access is given on private property), sharpshooters (e.g., agency or non-agency), or a combination of both. For example, targeted winter culling around known CWD-foci or specific winter ranges can build on ongoing, prior fall harvest programs to maximize removal of infected individuals (WAFWA 2017).

Evaluating and Assessing Efficacy of Management Action

A Before-After-Control-Impact (BACI) study design should be used to evaluate management actions and evaluation periods for any manipulation should be a minimum of 5 and ideally 10 years (WAFWA 2017). Site selection(s) for BACI designs should be considered carefully. In California, we are collecting and maintaining surveillance information at the hunt zone level or finer (e.g. GPS coordinate) and could use either DSUs, DCUs (CDFW 2024), or deer hunt zones as control and impact units, depending on outbreak parameters. We will categorize units based on key characteristics, such as age structure, sex ratios, and habitat, to create matched demographic groups for comparisons under the BACI study design. If sufficient data at the DCU level does not exist for appropriate comparisons, we will use the DSUs as control and impact units.

Continued surveillance, within both control and impact units, will be key for 1) collecting necessary data to effectively target and evaluate management actions and 2) early detection of new CWD foci and sources of infection. These surveillance activities may be augmented with live animal or environmental sampling and testing options, but only when appropriate or available. For example, once CWD is detected in a population, tonsillar (Schuler et al. 2018) or rectal mucosa biopsies (Spraker et al. 2009) may be useful for answering specific research or management questions as outlined in research proposals or DCU plans.

Where CWD has been detected, DCU management and monitoring goals and objectives should consider CWD management objectives, options, and actions. For example, in DCUs with modest or increasing CWD prevalence (e.g. ≥3% among adult males or females) deer management objectives may support management actions to reduce CWD prevalence or limit further increase in CWD prevalence within that DCU. Whereas DCUs with low prevalence (e.g. < 3% among adult males or females) may warrant management actions to prevent an increase in prevalence (WAFWA 2017). Higher CWD prevalence rates in a DCU or herd may warrant aggressive management actions within a DCU plan, but deer management goals and objectives should be weighed against feasibility and expected outcomes.

Roles and Responsibilities

1. Wildlife Branch, Wildlife Health Lab, CWD Lead:
   a. Program development, maintenance, and oversight.
   b. Surveillance, response, and management planning and implementation.
      i) Sampling strategies and targets.
      ii) Sample collection, receipt, processing, and testing.
      iii) Response and long-term management support.
   c. Disease-related regulatory proposal.
   d. Training CDFW staff and partners (train the trainers).
   e. Research and program funding.
   f. Communication, reporting, and data sharing.
   g. CWD Response or Incident Command Team member for any CWD-related response.
2. Wildlife Branch, Game Management Unit:
   a. Deer and elk population management.
   b. Population estimation and monitoring.
   c. Hunting tags and regulations.
   d. CWD Response or Incident Command Team member for any CWD-related response.
3. CDFW Regions, Managers and Biologists - implementation of CWD program goals and objectives (included but not limited to):
   a. Sample collection,
   b. Sample submission to WHL,
   c. Local stakeholder outreach and communication,
   d. Local response and management actions.
   e. Training seasonal staff and outside partners.
   f. Points of Contact (POC) for local CWD surveillance, response, and management activities.
   g. Provides CWD Response Team Lead or Incident Commander for CWD-related response.
4. Office of Communication, Education, and Outreach:
   a. Communication and marketing specialists to support CWD program outreach goals.
   b. Outreach coordinator(s) to facilitate stakeholder education and communication.
   c. Public outreach campaign and educational program development.
   d. Multi-media outreach development.
   e. CWD Response or Incident Command Team member for any CWD-related response.
5. Law Enforcement Division:
   a. Enforcement of regulations (hunting, disease prevention, disease mitigation).
   b. Support CWD sampling.
   c. Hunter education training and support.
6. Hunters and Hunting Organizations, community support and involvement:
   a. Sample collection and submission.
   b. Regulatory compliance for CWD prevention and mitigation.
   c. Community support for CWD prevention and mitigation efforts.
7. Collaborative Partnerships:

a. Agencies (state, federal, and tribal) supporting CDFW's prevention, surveillance, response and management goals and activities.
b. Non-governmental organizations facilitate community support of CWD program goals and activities.
c. Businesses (e.g. meat processors and taxidermists) support surveillance activities and best practices to prevent importation and spread of CWD.
d. Universities supporting CWD-related research activities.

Data and Sample Management

Surveillance (sampling and testing), response, and management strategies may change based on the availability of diagnostic assays, resources, disease detections, and management or research priorities. For example, once CWD is detected in a population for the first time, surveillance intensity will likely increase through one or more mechanisms, e.g. increased hunter harvest, special hunts, increased opportunistic surveillance through roadkill or other mortality sources, etc. Additionally, management or research priorities may alter surveillance or management approaches and strategies. For data continuity, CWD sampling data cards are available and include a minimum dataset to be collected from each animal sampled:

- Location animal died – hunt zone at a minimum, GPS (UTM) coordinates preferred.
- Age and sex.
- Date of death (postmortem samples).
- Date and location (GPS or address) of sample collection.
- Sample collector's name and affiliation (contact information if outside of CDFW).
- Reason for sampling or surveillance stream (e.g. hunter harvest, roadkill, predation, disease, project, salvage, etc.).
- If hunter harvested, include:
    - Hunting tag/document number (at a minimum).
    - GO ID - a unique number generated and assigned to an individual customer's record by the Automated License Data System (ALDS).
    - Hunter's name and contact information.

When a CWD tissue sample is collected by a meat processor or taxidermist then the minimum information required is the date sample was collected, meat processor or taxidermist (vendor) name, hunter's first and last name, GO ID, and document (tag) number. All other pertinent information can be gleaned from ALDS.
https://wildlife.ca.gov/CWD/Meat-Processor-or-Taxidermist

Samples and associated data/data cards will be sent to the WHL to be organized and processed for CWD testing via ELISA. Data will be entered into a Lab Information Management System (LIMS) or similar database. Samples will be processed to confirm appropriate lymph node or obex tissue is present. Lymph nodes will be bisected, half of each

lymph node will go to the diagnostic lab for testing, the remaining halves held at WHL for archive or additional testing if needed. Once data and samples are entered, processed, and organized, batched samples will be sent to the diagnostic laboratory for CWD testing via ELISA. Once samples are sent to the lab for testing, turnaround time for results it typically 2-4 weeks. Any samples that had indeterminant results or insufficient tissue testing via ELISA, will be processed at the diagnostic lab and screened for CWD prions via IHC. Once testing is completed results will be sent to the WHL and entered into the LIMS. Results from hunter-harvested animals will be available on our CWD website (https://wildlife.ca.gov/CWD), searchable via hunting tag (document) number. Summary surveillance results will be available on our website and updated at least annually.

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Appendix I: Sample Size Calculations

Wildlife disease surveillance is a balance between the need or desire to detect a disease at the lowest possible prevalence and resource availability to accomplish that surveillance. Resources are always a limiting factor and should be weighed against the design prevalence (Figure 1). We compared multiple methods and multiple design prevalence scenarios to determine appropriate sample sizes for California's Disease Sampling Units. For example:

Sample Size of Proportions (or Poisson)

n = Sample size

α = Desired confidence level (95% CI)

P = Estimate prevalence = 0.01 = 1%

$$n = \frac{-\ln(1-\alpha)}{P}$$

$$299.57 = \frac{-\ln(1-0.95)}{0.01}$$

The equation calculates sample size needed to detect at least one positive case with a specified confidence. It determines the probability of not detecting a positive case and subtracts this from 1 to find the probability of detecting at least one positive case. Both sample size of proportion and Poisson use the same mathematical function when dealing with rare events or low prevalence rate. The Poisson distribution is derived as a limit of the binomial distribution as the number of trials becomes large and the probability of success in each trial becomes small leading to similar equations for sample size calculations.

Cumulative Distribution Function (CDF) for Sample Size

p = capture probability = prevalence = 0.01 = 1%

n = number of samples (trails)

r = events

P = estimated prevalence

$$\Pr(X > 0) = 1 - (1-p)^n$$

$$0.05 = 1 - (1-0.01)^n$$

$$ln(0.05) = n \cdot \ln(0.99)$$

$$n = \frac{\ln(0.05)}{\ln(0.99)}$$

Taking the natural logarithm on both sides:

So, the sample size n is approximately 298.

$$n = \frac{-2.9957}{-0.01005} = 298.08$$

Summary

- **Proportions/Poisson**: The equation $n = \frac{-\ln(1-\alpha)}{P}$ assumes a continuous approximation for the detection of rare events.
- **CDF**: The equation $\Pr(X > 0) = 1 - (1-p)^n$ explicitly considers the discrete nature of the binomial distribution, focusing on the probability of observing zero versus one or more positive cases.
- They yield similar results in low prevalence approximation.

Figure 1: Sample size comparisons for different design prevalences using sample size of proportions equation, $n = \frac{-\ln(1-\alpha)}{P}$. Increasing sample sizes are needed to reliably detect disease at lower prevalence.