Washington Department of Fish and Wildlife

Geographical Distribution and Prevalence of Hoof Disease in Southwestern Washington Elk Based on Hunter Surveys

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Introduction

Reports of lameness and deformed hooves in free-ranging Roosevelt elk (*Cervus elaphus roosevelti*) have occurred sporadically in southwest Washington for over a decade; however, the apparent number and geographical distribution of these reports increased dramatically in 2008. Informal surveys conducted by Washington Department of Fish and Wildlife (WDFW) staff during the winter of 2008-2009 revealed that up to 80% of observed herds in the area contained affected individuals. Within affected groups of elk, between 30-90% of the elk were lame or had deformed hooves, with a wide variation in the severity of individual cases. Both sexes and all age classes, including calves, appeared to be affected. Interviews with several large animal veterinarians who practice in the affected area did not reveal the existence of a similar condition in domestic livestock.

In March 2009, in collaboration with the Washington State University College of Veterinary Medicine, WDFW undertook a preliminary investigation to better characterize the hoof deformities being seen and to examine possible causes. Complete post-mortem examinations and ancillary diagnostic tests were performed on 5 elk from within the known affected area, and 3 apparently unaffected elk from a nearby area with no history of reports of lameness or hoof deformities. Necropsy, radiology, histopathology, bacterial culture, virus isolation, and parasitology were in all cases unremarkable and failed to indentify an underlying cause of hoof disease. Selenium and copper levels in liver tissue were severely deficient based on domestic livestock normal values (Han and Mansfield, 2009). It is not known whether the selenium and copper levels were abnormally low for elk in this area.

To gain a better understanding of the distribution and prevalence of hoof disease in southwestern Washington elk over time, during the summer of 2009 we surveyed hunters who had successfully harvested elk in the affected region during the preceding 10 years. We questioned them about their observations of groups of elk, as well as the elk they had harvested. Here, we report the findings from this survey.

Study Area

This study was conducted in the Puget Sound Lowlands in the southwestern region of Washington, focusing on 21 Game Management Units (GMU's) within 10 counties, corresponding to WDFW Administrative Region 5 (Figure 1). Habitat types and land use designations in this region fall within the Puget Trough Province and primarily consist of large areas of temperate coniferous forest (*Tsuga heterophylla, Psuedotsuga menziesii, Thuja plicata*), pasture and farmlands, urbanized areas and lesser amounts of deciduous forest. The climate is categorized as Maritime with mild wet winters and cool dry summers (Franklin and Dyrness 1973).

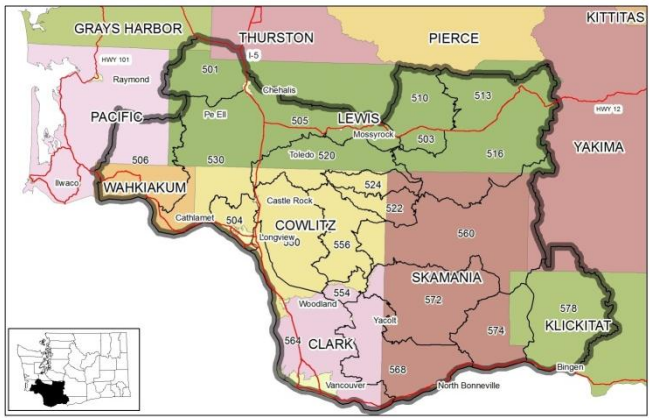

Figure 1. Elk hoof disease study area

Methods

Survey Recipient Selection

The WDFW hunter report database was queried to produce a list of hunters who harvested elk in 2008 within the 7 GMU's previously reported to have elk exhibiting lameness or hoof deformities (504, 505, 520, 530, 550, 556, 564), as well as selected surrounding GMU's where lameness or deformities had not been reported (501, 506, 554, 560). We randomly chose 300 successful hunters from GMU's reported to contain affected elk and 204 successful hunters from GMU's where the problem had not been reported. The survey was sent to each hunter, along with a pre-addressed and stamped return envelope.

Hunter Survey

Hunters were asked to provide the following information for each observation: year, month, GMU, specific location information if available, elk group size and number of individual elk within the group that were limping. In addition, hunters were asked to record the year they first observed limping elk and the nearest city or GMU of this observation. Hunters who had harvested elk in the affected area were asked whether the elk had deformed hooves; and if so, which limbs were affected; and the age and sex of the harvested elk. Lastly, we asked for their contact information.

Data Management and Analysis

Data were entered into an Access database, although observations lacking specific data (year, GMU or numbers of animals seen) were removed from map development and analysis. Maps were created using ArcGIS (version 9.3; ESRI, Redlands, Calif).

Prevalence of limping elk was calculated by dividing the total number of affected elk by the total number of elk observed for a given GMU. Prevalence calculations were completed only for those years where reports were received from at least 16 GMU's and in those GMU's with at least 10 elk reported having been seen (years 2008 and 2009).

Results

Geographical Distribution

In the year **2000,** limping elk were reported in GMU's 501, 505, and 520. Reports of the condition spread to GMU's 530 and 506 in **2002**; followed by the addition of GMU's 504 and 550 in **2004;** GMU's 564, 554, and 560 in **2005**; GMU's 556 and 516 in **2006;** GMU 574 in **2008;** and GMU's 568 and 578 in **2009**. Reports of limping elk progressed from the north to the west, then south and east in a counter-clockwise manner over the course of 10 years (Figure 2). The reported distribution of affected elk in the study area occurs within 15 GMU's which encompass 13,838 km² (3.4 million acres).

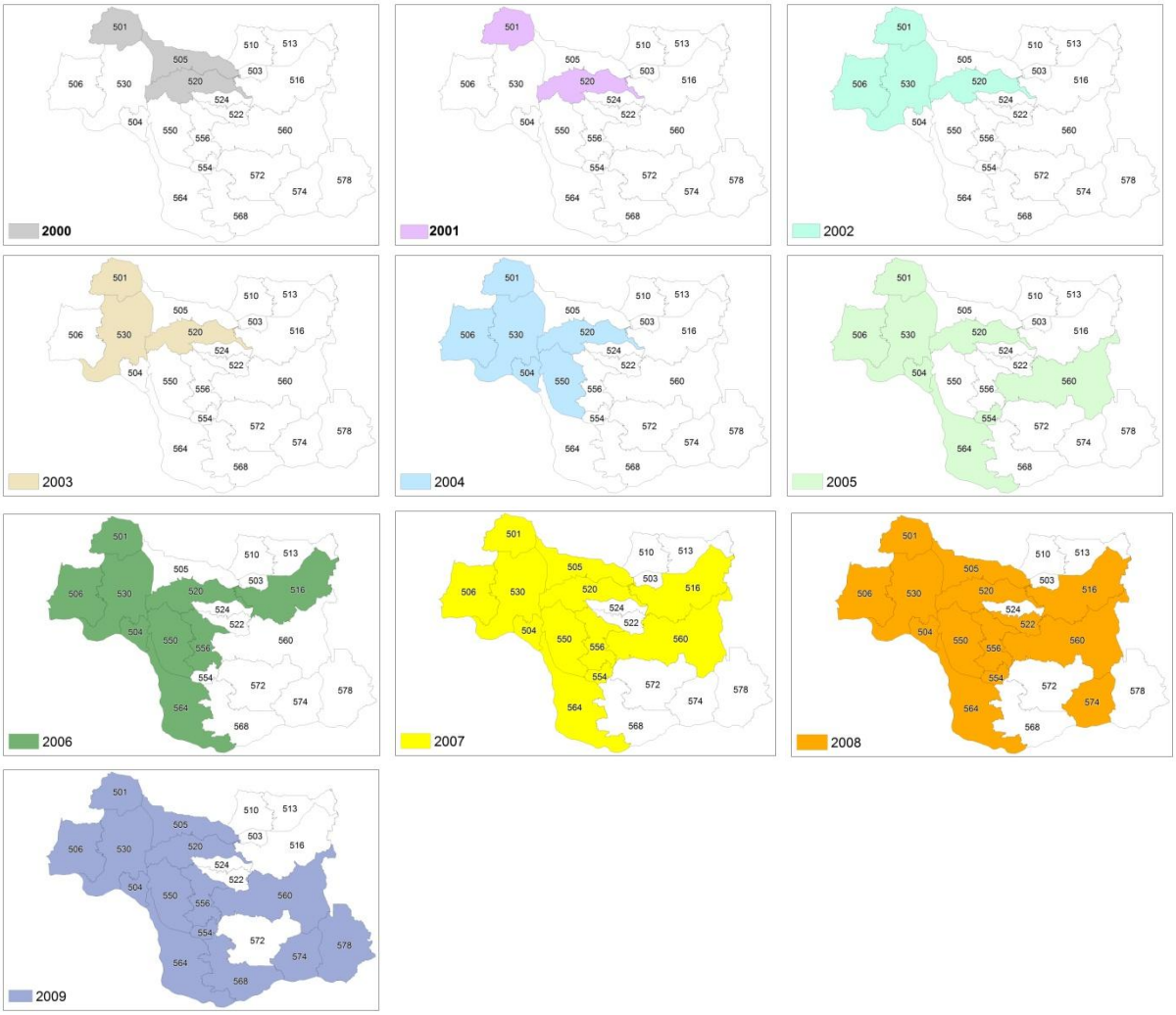

Figure 2. Geographic distribution of limping elk between 2000 and 2009 in southwestern Washington.

Prevalence

Prevalence of limping elk by GMU was calculated from reports for years 2008 (n=87) and 2009 (n=93). Thirty-seven percent of elk groups observed in **2008** contained limping elk, with the highest prevalence in GMU 504 (36%), followed in descending order by GMU's 530 (23%) , 506 (11%), 554/564 (5%), 550 (3%) and 520/560 (≤ 0.5%). Fifty-five percent of elk groups observed in **2009** contained limping elk, with the highest prevalence in GMU 530 (24%), followed by GMU's 504 (15%), 506 (12%), 564 (11%), 568 (10%) and 550/520 (3%) (Figure 3).

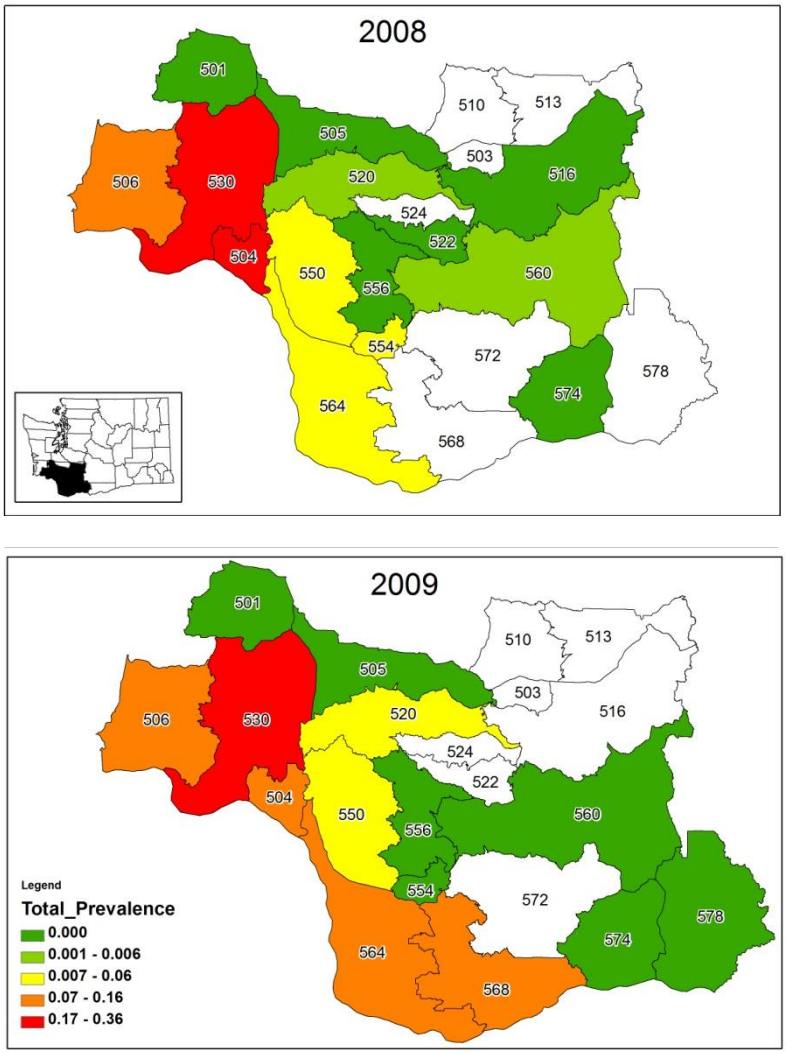

Figure 3. Prevalence of limping elk by GMU during years 2008 and 2009 in southwestern Washington.

Thirty-two of 136 (24%) survey respondents reported that they had harvested an elk with one or more deformed hooves over the previous decade. The sex distribution of affected animals was 14 males, 16 females, and 2 unreported, with all but one being adults. It is unknown whether harvest restrictions may have biased the demographic results reported. Hind limbs were reported affected more than forelimbs, although this difference was not significant.

Summary and Conclusions

Between 2000 and 2009, limping elk were observed in 15 GMU's encompassing 13,838 km² (3.4 million acres) in southwest Washington. The highest prevalence of limping elk was west of the Interstate 5 corridor in GMU's 504 and 530, with 36% and 24% of elk affected, respectively. The distribution of limping elk progressively spread from the northern-most GMU's of the study area to the west, south and east, increasing from 3 affected GMU's in 2000 to 15 affected GMU's in 2009. The observed pattern of disease through time and space is most compatible with a transmissible or genetic etiology.

Problems inherent to retrospective recall surveys are well documented. These include recall failure, recall bias, the tendency to telescope significant observations forward in time, demographic biases associated with responses, and many others (Sudman and Bradburn 1974, Dex 1991, and Bound *et al.*2001). Pyy-Martikainen and Rendtel (2009) suggest that survey-based event history analysis should be interpreted with caution, and we agree. Nonetheless, retrospective surveys are often the only practical method available to acquire information. They are routinely utilized within the field of veterinary epidemiology and can provide valuable insight into the etiology of particular diseases (Selby et al., 1976). In the current study, results corroborate the impressions of local wildlife biologists and officers with respect to the severity and spread of this condition. We therefore believe that our findings reasonably describe the geographic distribution and prevalence of limb deformities and lameness in southwestern Washington elk during the decade spanning 2000-2009.

Acknowledgements

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