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An Alternative Interpretation of Plasma Selenium Data from Endangered Patagonian Huemul Deer (*Hippocamelus bisulcus*)

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To help inform recovery efforts, Chihuailaf et al. (2014) reported plasma mineral concentrations in endangered huemul deer (*Hippocamelus bisulcus*). They described plasma selenium (Se) concentrations as similar to those of other cervids and within reference intervals for white-tailed deer (*Odocoileus virginianus*), citing McDowell et al. (1995). However, according to McDowell et al. (1995), 75% of their samples were below the critical Se concentration (0.06 ppm) by North American cattle standards and 50% were <0.03 ppm, suggesting "severe deficiency." Flueck and Smith-Flueck (2008, 2011) presented indirect evidence supporting the hypothesis that disease and failure to recover in remnant huemul subpopulations is linked to mineral imbalances, particularly Se. Recognition of Se deficiency as an underlying cause of poor population performance and providing appropriate remediation has improved wild ungulate recruitment, including for some endangered species (Flueck et al. 2012).

Although having reference plasma mineral values will be important for huemul recovery, inferring "normal" values from populations with deficient individuals may inadvertently introduce bias. The standard for nutritional and medical purposes is to establish reference values from healthy populations, and reference intervals imply categorization to aid in recognizing deficiencies and toxicities. By stating the plasma Se reference interval to be 0–127 ppm (Chihuailaf et al. 2014), rather than using interval categories (e.g., McDowell et al. 1995), all values, including those potentially reflecting deficiency, were merged into one category, suggesting this interval represents healthy blood Se levels and perhaps confounding others' interpretations in the context of huemul conservation.

Selenium-deficient vegetation and resultant livestock disease in Chile (Wittwer et al. 2002), and indirect evidence (Flueck and Smith-Flueck 2008), signal that Se deficiency potentially impacts huemul. We believe that considering the plasma Se levels reported by Chihuailaf et al. (2014) as reference values merits further discussion. In deficient areas, ungulates commonly have blood Se levels below detection limits. These samples are then included in analyses using values below the detection limit. As noted by Chihuailaf et al. (2014), 4 of their 11 samples were not included in the reference range because values were below detection limits. To offer an alternative interpretation, we simulated a sample (n=7) with the use of the reported range values, median, and similar mean±SD (679±436 ppm Se vs. 680±468 ppm Se). With the use of the reported detection limit value for the additional four samples, we categorized all 11 resulting values as severely deficient (<0.03 ppm), deficient (0.03–0.06 ppm), marginal (0.06–0.1 ppm), or sufficient (>0.1 ppm) (McDowell et al. 1995). Under this approach, most reported huemul plasma Se values are severely deficient (64%) or deficient (9%), with a minority of the values marginal (18%) or adequate (9%). This pattern resembles that for white-tailed deer (McDowell et al. 1995; reviewed by Flueck et al. 2012). The data reported by Chihuailaf et al. (2014) suggest that most huemul were Se deficient by North American cattle standards. The role of Se deficiency thus merits further consideration in explaining huemul declines and in conservation efforts, especially given that soils in huemul habitat are Se deficient (Flueck et al. unpubl. data).

LITERATURE CITED

Chihuailaf RH, Stevenson VB, Saucedo C, Corti P. 2014. Blood mineral concentrations in the endangered huemul deer (*Hippocamelus bisulcus*) from Chilean Patagonia. *J Wildl Dis* 50:146–149.

Flueck WT, Smith-Flueck JM. 2008. Age-independent osteopathology in skeletons of a South American cervid, the Patagonian huemul (*Hippocamelus bisulcus*). *J Wildl Dis* 44:636–648.

Flueck WT, Smith-Flueck JM. 2011. Recent advances in the nutritional ecology of the Patagonian huemul: Implications for recovery. *Anim Prod Sci* 51:311–326.

Flueck WT, Smith-Flueck JM, Mionczynski J, Mincher BJ. 2012. The implications of selenium deficiency for wild herbivore conservation, a review. *Eur J Wildl Res* 58:761–780.

Flueck WT, Smith-Flueck JM, Mincher BJ, Winkel LHE. 2014. Soil selenium levels corroborate direct evidence of selenium deficiency in endangered Patagonian huemul deer (*Hippocamelus bisulcus*). In press.

McDowell LR, Forrester DJ, Linda SB, et al. 1995. Selenium status of white-tailed deer in southern Florida. *J Wildl Dis* 31:205–211.

Wittwer F, Araneda P, Ceballos A, et al. 2002. Glutathion peroxidase activity (GSH-Px) in grazing dairy cattle in the south of Chile (IXth Region) and their relation with selenium contents in the forage. *Arch Med Vet* 34:49–57.

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