

Michael W. Miller, Jonathan P. Runge, A. Andrew Holland, Matthew D. Eckert. Hunting Pressure Modulates Prion Infection Risk in Mule Deer Herds.

Model selection suggested that *license group*third2yr* was the best explanatory model (Table S2). The nearest model – *license group*TFM2yr* – was not competitive ($\Delta\text{AIC} = 11.8$). We present results from the best model, including odds ratios of infection as a function of every 100-license increase.

Increases in license number positively correlated with the chance of adult male deer harvested 1–2 years later being free from apparent infection (i.e., test-negative) in six of the 12 areas (Fig. S1, Tables S3, S4). License groups (= hunt areas) exhibiting a positive correlation between increased licenses and chances of harvested adult male deer being disease-free included 004 (odds ratio [OR]: 1.71, 95% confidence interval [CI]: 1.57–1.87), 005 (OR: 17.04 CI: 5.00–58.10), 009 (OR: 1.24, CI: 1.07–1.44), 011 (OR: 1.28, CI: 1.22–1.34), 012 (OR: 1.20, CI: 1.17–1.24), and 041 (OR: 4.42, CI: 1.21–16.15).

Four areas had 95% confidence intervals that overlapped an even odds ratio (i.e., no statistical relationship): 007 (OR 1.00, CI: 0.42–2.36), 020 (OR 1.19, CI: 0.96–1.49), 022 (OR 1.16, CI: 0.89–1.52), and 027 (OR 0.72, CI: 0.47–1.10).

Two areas showed a negative correlation between increased licenses and chances of staying chronic wasting disease-free: license groups 003 (OR: 0.56, CI: 0.45–0.68) and 018 (OR: 0.82, CI: 0.73–0.91).

An effect pooling chronic wasting disease results over all license groups indicated a positive relationship between increasing licenses and harvested deer being chronic wasting disease-free (OR: 1.16, CI: 1.14–1.17), although the model associated with this result (*third2yr*) had $\Delta\text{AIC} \sim 723$ (Table S2).

Table S1. Six Colorado, USA, mule deer (*Odocoileus hemionus*) herds, the license groups (called ‘hunting areas’ in the main text) within herds used in our analyses, their approximate spatial size, related game management units (GMUs), chronic wasting disease history and prevalence at the beginning and end of the 2002–2018 study period, and range of numbers of licenses sold in the relevant hunting seasons from 2000–2017.

Herd	License group	GMUs	Area (km ²)	Chronic wasting disease history & prevalence (<i>n</i>) ^a			Number of licenses season ^b (range)	
				Year first detected ^c	2002–2003	2017–2018	Third only	Third+Fourth +Management
Bear’s Ears (~34,000) ^d	003	3, 301	2,306	2002	0.5% (200)	13.3% (803)	586–1,164	586–1,164
	004	4, 14, 214, 441	3,369	2002	0.9% (233)	25.2% (606)	338–1,552	347–1,571
	005	5	774	2002	3.4% (29)	22.2% (108)	46–201	51–201
Red Feather-Poudre Canyon (~10,000)	007	7, 8	1,746	1996	4.6% (108)	11.1% (72)	152–340	298–468
	009	9, 19, 191	2,871	<1990	15.3% (307)	6.3% (350)	200–597	672–1,102
White River (~44,000)	011	11, 211	2,701	2002	1.9% (231)	18.8% (334)	250–2,033	252–2,033
	012	12, 13, 23, 24	4,446	2002	1.5% (390)	23.1% (354)	411–2,514	416–2,514
	022	22	3,123	2002	1.0% (102)	2.9% (244)	120–833	120–833
Middle Park (~15,000)	018	18, 28, 37, 371	4,137	2003	1.1% (262)	2.8% (632)	623–1,585	758–1,844
	027	27, 181	1,286	2002	1.1% (90)	5.2% (212)	174–524	251–609
Big Thompson (~ 7,000)	020	20	2,561	<1990	12.1% (272)	12.6% (214)	117–367	386–1,217
Grand Mesa North (~18,000)	041	41, 42, 421	3,820	2002	0.3% (288)	1.6% (490)	950–1,558	1,043–1,558

^a Prevalence (number positive/number sampled, expressed as a percentage) measured in 2002 or 2003 and in 2017 or 2018 among ≥2 yr old, male mule deer harvested in the respective hunting areas; sample size (*n*) shown in parentheses.

^b Hunting season for which licenses were issued. See Materials and Methods for details of Colorado deer hunting season dates in context of this study.

^c Year in which the first case of chronic wasting disease was detected within respective hunting areas; unlikely that the “first case” represented the true first occurrence.

^d Average post-hunt population size estimated from herd management models (2000–2017), rounded to the nearest 1,000.

Table S2. Logistic regression model selection results from Colorado, USA, 2002–2018. K is the number of parameters in the model, AIC is Akaike’s Information Criterion, Δ AIC is the difference in AIC units between the low-AIC model and the model referenced. Five variables, alone and in combination, were included in the analysis: the geographically-defined hunting area composed of one or more game management units (*license group*; Fig. 1), the number of third season licenses sold the year prior (*third*), the average of the numbers of third season licenses sold for the 2 years prior (*third2yr*), and the same two metrics for the sum of third, fourth, and later management season licenses (*TFM*, *TFM2yr*). A model with no explanatory variables (*null*) also was included for comparison.

Model	K	AIC	ΔAIC
<i>license group*third2yr</i>	24	8573.4	0.0
<i>license group*TFM2yr</i>	24	8585.1	11.8
<i>license group*third</i>	24	8610.1	36.7
<i>license group*TFM</i>	24	8631.8	58.4
<i>license group+third2yr</i>	13	8822.4	249.0
<i>license group+third</i>	13	8857.8	284.4
<i>license group+TFM2yr</i>	13	8904.0	330.6
<i>license group+TFM</i>	13	8932.2	358.8
<i>license group</i>	12	9270.4	697.0
<i>third2yr</i>	2	9296.6	723.2
<i>Third</i>	2	9316.0	742.6
<i>TFM2yr</i>	2	9459.6	886.2
<i>TFM</i>	2	9484.2	910.8
<i>Null</i>	1	9794.9	1221.5

Table S3. Maximum likelihood parameter estimates (logit scale), standard error (SE), a 95% lower and upper confidence limits (LCL and UCL, respectively) for harvested male mule deer (*Odocoileus hemionus*) staying disease free per 100 hunting licenses. License group 018 is the intercept.

Parameter	Estimate	SE	95% LCL	95% UCL
Intercept	6.592	0.777	5.06908	8.11492
LicenseGroup 003	1.728	1.2396	-0.701616	4.157616
LicenseGroup 004	-7.9795	0.8242	-9.594932	-6.364068
LicenseGroup 005	-6.7841	0.9063	-8.560448	-5.007752
LicenseGroup 007	-3.7287	1.3707	-6.415272	-1.042128
LicenseGroup 009	-5.2902	0.8339	-6.924644	-3.655756
LicenseGroup 011	-6.1181	0.7971	-7.680416	-4.555784
LicenseGroup 012	-6.3384	0.791	-7.88876	-4.78804
LicenseGroup 020	-5.2063	0.8198	-6.813108	-3.599492
LicenseGroup 022	-3.3161	0.9235	-5.12616	-1.50604
LicenseGroup 027	-1.8417	1.1857	-4.165672	0.482272
LicenseGroup 041	-19.355	7.6527	-34.354292	-4.355708
third2yrRun	-0.2026	0.0554	-0.311184	-0.094016
third2yr*LicenseGroup 003	-0.3866	0.1168	-0.615528	-0.157672
third2yr*LicenseGroup 004	0.7413	0.0712	0.601748	0.880852
third2yr*LicenseGroup 005	3.0384	0.6281	1.807324	4.269476
third2yr*LicenseGroup 007	0.2021	0.4423	-0.664808	1.069008
third2yr*LicenseGroup 009	0.4185	0.0941	0.234064	0.602936
third2yr*LicenseGroup 011	0.4463	0.0608	0.327132	0.565468
third2yr*LicenseGroup 012	0.3859	0.0575	0.2732	0.4986
third2yr*LicenseGroup 020	0.3774	0.1253	0.131812	0.622988
third2yr*LicenseGroup 022	0.3499	0.1476	0.060604	0.639196
third2yr*LicenseGroup 027	-0.1314	0.2256	-0.573576	0.310776
third2yr*LicenseGroup 041	1.689	0.6632	0.389128	2.988872

Table S4. Odds ratio estimates and Wald confidence limits per 100 licenses.

License Group	Odds Ratio	95% Confidence Limits	
003	0.555	0.454	0.679
004	1.714	1.570	1.871
005	17.044	5.000	58.095
007	1.000	0.423	2.362
009	1.241	1.069	1.440
011	1.276	1.215	1.340
012	1.201	1.166	1.238
018	0.817	0.733	0.910
020	1.191	0.956	1.485
022	1.159	0.886	1.515
027	0.716	0.466	1.099
041	4.421	1.211	16.149

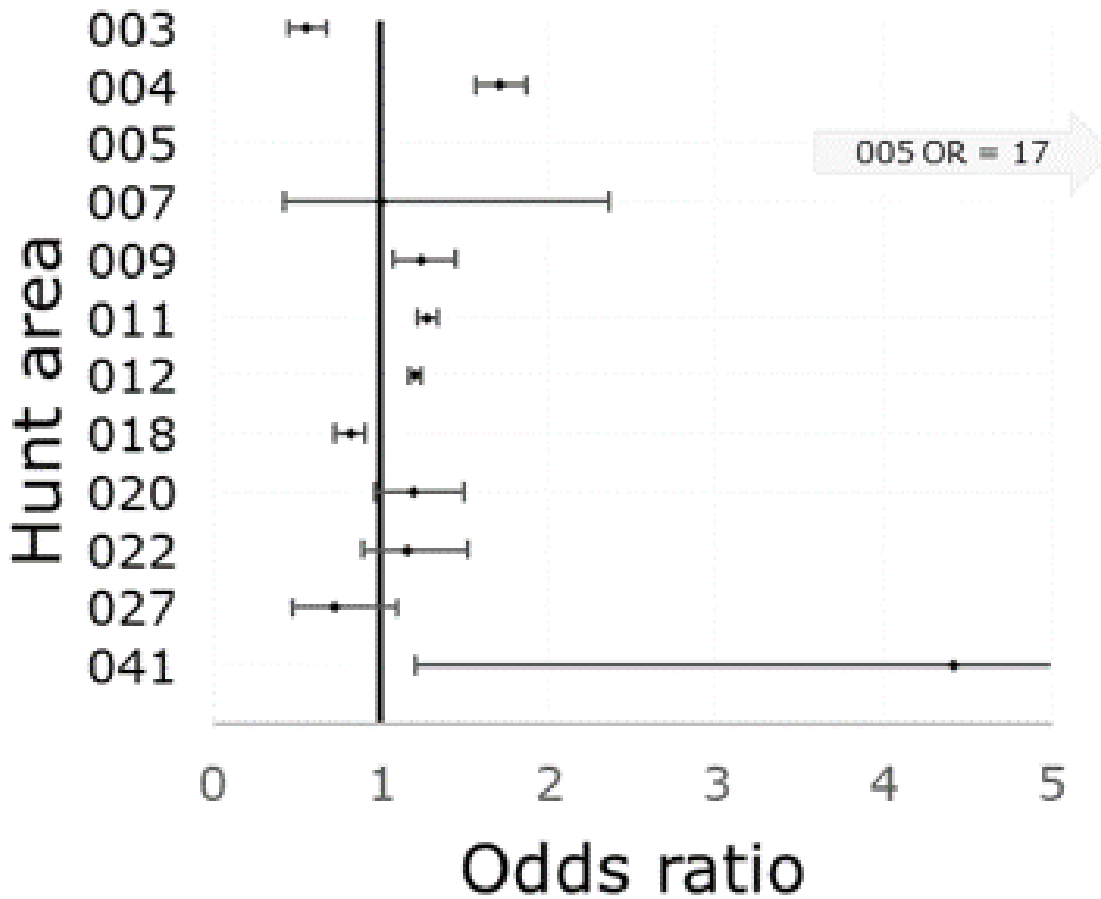


Figure S1. Odds ratios (OR) for the average number of hunting licenses added in an area in the prior 2 years affecting the chance of harvested adult male mule deer being chronic wasting disease-free in the year of harvest in the same area. Changes in license number positively correlated with the chance of adult male deer harvested 1–2 years later being free from chronic wasting disease in six of the 12 areas. Note that the OR values for area 005 exceeded the x-axis limit; see Table S4.