

# Hunter opinions on potential white-tailed deer antler point restrictions (APR) in District 1

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August 17, 2020

**Executive summary:** While not satisfied with mature white-tailed buck opportunity, hunters are split on the value of its management with the majority, especially those hunting in District 1, not supportive of further restricting regulations. Hunters were not supportive of any reduction in general season opportunity in the district but 2- and 3-pt APR, with exceptions, were the least opposed.

The Social and Economic Sciences Research Center in Washington State University (WSU-SESRC) administered this online opinion survey on behalf of WDFW. Invitations to complete the survey were sent by email to all deer hunters reporting effort in Districts 1,2,3 or 6 in any of the last four license years (2016-2019), Washington residents older than 18 at the time of the survey and not opted out of email communications for their WILD account. Two reminder emails were sent in following weeks to non respondents.

The survey instrument consisted of 13 questions, a mixture of informative (for example “how many years did you hunt...”) and opinion/rating on dichotomous (“Yes”, “No”) or polytomous (“Strongly agree”, “Agree”, . . . , “Strongly disagree”) ordinal scales.

Most questions contained multiple items or statements for respondents to score. In addition to reporting frequencies and proportions of hunter responses, cumulative logit models were used to quantify interactions between question items. Two parameters estimated in this analysis were  $\hat{\beta}$ , the average difference in *satisfaction*, *support* or *agreement* between items across all ordinal categories, and  $\hat{\delta}$ , a measure of dependency between ordinal categories and individual *satisfaction*, *support* or *agreement* across response patterns to all items. See Appendix at the end of this document for details on how these metrics were derived and interpreted.

## 1 Demographics

A total of 13,110 hunters responded to the survey for an overall return rate of 29.3% deer hunters. Participation was greater from hunters that reported white-tailed harvest and hunting in District 1 in the past (Table 1). Note, stratification in Table 1 is based on annual harvest reports of 2016-2019. A larger percentage of hunters in the survey (66.4%) reported hunting white tailed in District 1 in the last 10 years and only a small number of hunters responding did not hunt for white-tailed at all (Table 2). County of residence (Ferry/Stevens/Pend Oreille or other) and age did not seem to disproportionately impact response rates.

Table 1: Responses stratified by harvest reports, county of residence and average age.

	WT D1	Hunt D1	WT else	Hunt else	Reside D1	Reside else	Age
Surveyed	7,091(16%)	9,813(22%)	7,238(16%)	20,567(46%)	3,571(8%)	41,138(92%)	49 ± 16
Hunters responding	2,799(21%)	2,877(22%)	2,497(19%)	4,937(38%)	1,089(8%)	12,021(92%)	52 ± 15
% return	39.5	29.3	34.5	24	30.5	29.2	

## 2 Hunting experience

The majority of hunters have been hunting white-tailed in addition to other deer species over 10 years (Table 2). For those hunters that did not hunt for white-tailed, low availability of mature bucks was the third most common reason cited but significantly less than distance and access (Table 3). Note, 37 hunters did not answer on any of the items and 171 explicitly answered “No” to all available reasons, implying a reason other than the choices listed. However, only 173 of those that did not hunt stated they are not interested in hunting white-tailed deer in WA compared with 524 that answered “yes”.

Table 2: Species hunted in the last 10 years by number of years deer hunting in Washington.

	1-5 year		6-10 years		Over 10 years	
	n	%	n	%	n	%
no WT	152	10.4	84	6.0	474	4.7
Exclusive WT	364	24.9	234	16.7	1,156	11.5
WT+	943	64.6	1,085	77.3	8,454	83.8

Table 3: Hunter response to “What are the reasons you have not hunted...”

	n	% <sup>†</sup>	$\hat{\delta}$
Too far to travel	311	36.8	0.127 ± 0.098
Not enough access	286	33.8	0.885 ± 0.132
Not enough mature bucks	195	23.0	2.519 ± 0.422
Not enough deer	185	21.9	2.771 ± 0.507
Limited opportunity to harvest antlerless deer	161	19.0	1.295 ± 0.178
I hunt white tailed deer in other state	72	8.5	0.04 ± 0.166

<sup>†</sup> item specific percent answering “yes” out of total (yes , no , no answer).

Being outdoors and enjoying nature was the most important item to the white-tailed deer hunting experience with shooting a buck ranking the lowest (Fig. 1). The differences between being outdoors and other items ( $\hat{\beta}$ ) steadily declined from -0.93 (being with friends and family) to -2.76 (shooting a mature buck). In contrast  $\hat{\delta}$  values exhibited a pattern of low values for harvest outcome items filling the freezer, shooting buck and shooting a mature buck (0.12, 0.21, 0.3 respectively) compared with the others (1.6, 1.8, 2.7 for introducing a new hunter, being outdoors and being with friends/family respectively).

Despite scoring low in *importance*, hunters were clearly not satisfied with the number of mature bucks seen while hunting (Table 4). It was the only item a majority of hunters scored as **not at all satisfied** with, while on all other items, hunters scored **somewhat satisfied** at higher rates than **not at all**. High correlations between all three “numbers seen” items (deer, bucks, mature bucks) may have contributed to the high  $\hat{\delta}$  values.

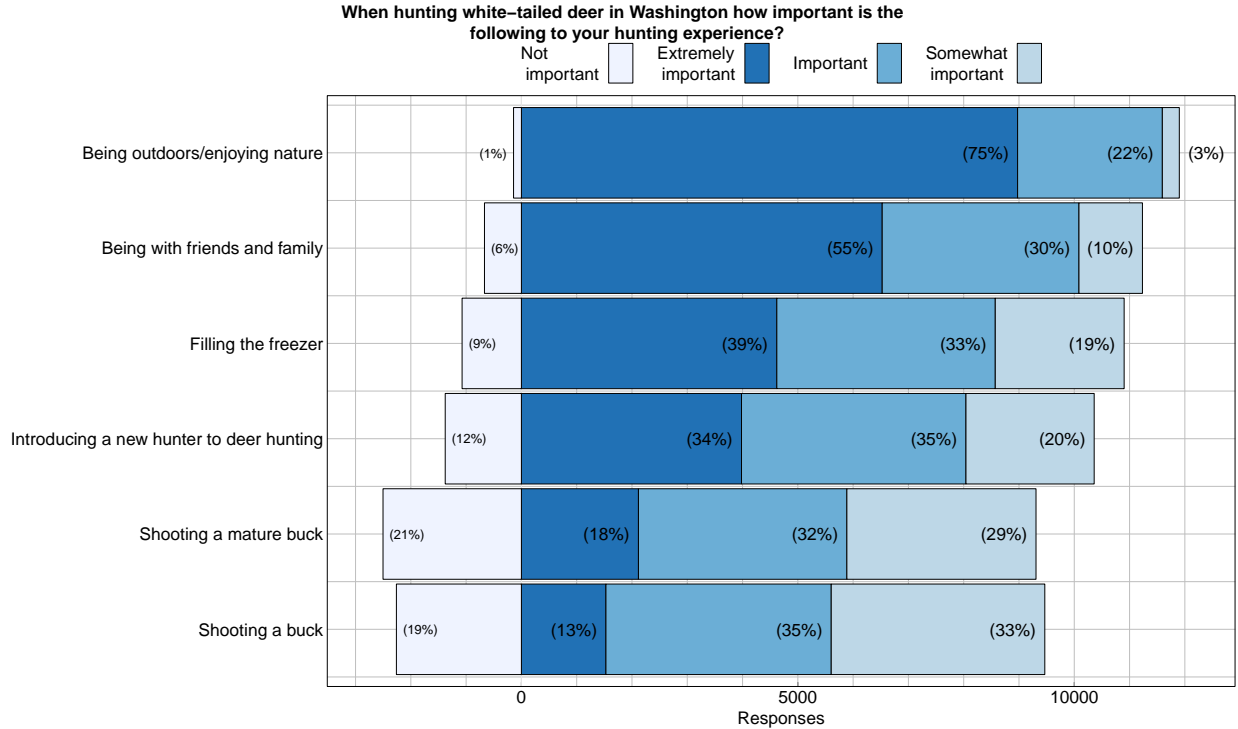


Figure 1: Number of hunters scoring items in terms of *importance* sorted top to bottom on  $\hat{\beta}_j$ . Numbers in parenthesis are % of total responses to an item not including missing answers. May not sum to 100% due to rounding.

Table 4: For each of the following factors, please tell us how satisfied you are with your white-tailed deer hunting experience in Washington.

	n				$\Delta\hat{\beta}^\dagger$	$\hat{\delta}^\ddagger$
	not at all	somewhat	satisfied	very		
The number of mature white-tailed bucks seen while hunting	6,160	3,882	1,715	218	-1.393 ± 0.024	2.670
The number of white-tailed bucks seen while hunting	4,661	4,775	2,284	282	-0.925 ± 0.024	3.622
The number of other hunters encountered while hunting afield	3,649	4,755	3,160	385	-0.529 ± 0.023	0.764
The number of white-tailed deer seen while hunting	2,974	4,776	3,616	594	-0.251 ± 0.023	2.649
The length of the white-tailed deer hunting season	2,941	4,076	4,348	621	-0.085 ± 0.024	0.748
Access to white-tailed deer hunting areas	2,513	4,444	4,347	663	0.003 ± 0.023	0.995
The timing of the white-tailed deer hunting season	2,188	4,401	4,781	626	0.134 ± 0.023	0.847
Your overall white-tailed deer hunting experience in Washington.	1,834	5,625	4,063	502		2.095

<sup>†</sup> Average difference in importance from the reference item (last). Measured on the latent logit scale.

<sup>‡</sup> 3-way interactions between items 1,2 and 4 precluded deriving stable standard error estimates.

The majority of dissatisfied hunters agreed or strongly agreed regulations are too restrictive and disagreed (or disagreed strongly) regulations should be more restrictive (Fig. 2). Hunters opposing added restrictions were the vast majority of all hunters and 60.5% of those dissatisfied with mature buck opportunity and not necessarily agreeing regulations are too restrictive.

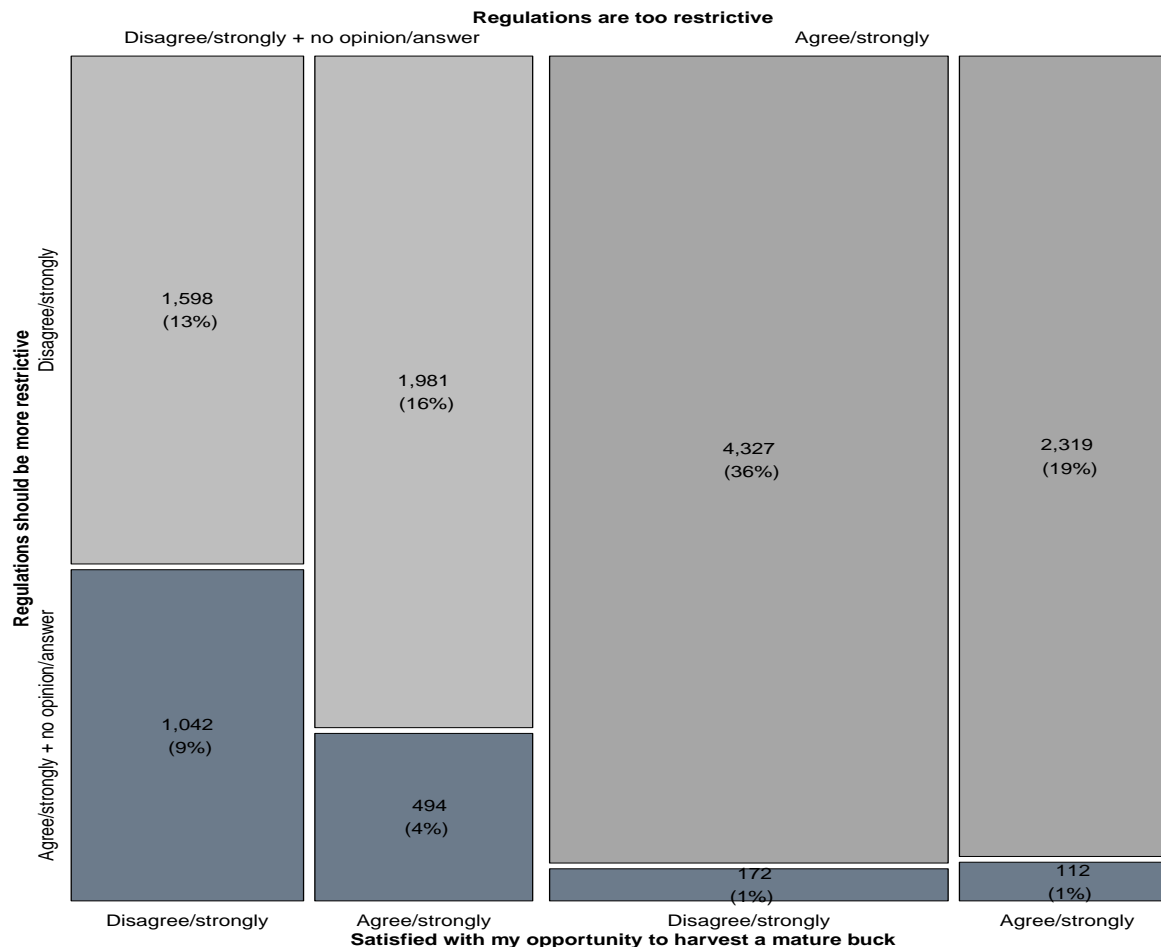


Figure 2: 3-way interactions of hunter agreement that regulations should be more restrictive (left - blue vs. gray shade) given current level of restrictions (top - dark vs. light shade) and satisfaction with mature buck hunting (bottom). Cells are proportional to values indicating number of respondents. For example, 4,327 (36%) respondents disagreed (or strongly disagreed) with being “Satisfied with my opportunity to harvest a mature buck” but also agree or strongly agree current regulations are too restrictive and disagree (strongly) regulations should not be made more restrictive. Conversely, only 1,042 (9% of of all hunters) in the bottom left cell were dissatisfied with mature buck harvest and thought regulations are not restrictive and should be made more restrictive. 649 hunters that did not answer or answered “no opinion” to satisfaction with mature buck hunting are not shown.

### 3 Management in GMUs 101-121

Before being presented with specific management options hunters were asked if they hunted in northeast WA (a map of District 1 GMUs provided) and were presented with a general statement about management for mature bucks (Table 5). Overall, hunters were split on the question of managing for more mature bucks but with majority of hunters that hunted

District 1 in the last 10 years disagreeing more strongly than those who did not. As expected, stronger opinions (in both directions) on the management in District 1 are held by those that hunt there relative to those that do not.

Table 5: How strongly would you disagree or agree that white-tailed deer populations in northeast Washington should be managed to produce more mature white-tailed bucks, even if it means reduced opportunity for hunters.

Hunt D1	Disagree strongly	Disagree	N/A/O	Agree	Agree strongly
Yes	1,995 (25.8%)	2,245 (29.1%)	280 (3.6%)	1,993 (25.8%)	1,211 (15.7%)
No	492 (12.6%)	995 (25.5%)	800 (20.5%)	1,176 (30.1%)	442 (11.3%)
N/A	131 (13.1%)	258 (25.7%)	200 (19.9%)	249 (24.8%)	165 (16.5%)

For the most part hunters were opposed to all seven potential management strategies presented for District 1 with none of the items receiving more than a total of 46% support and strong support (Fig. 3). Relative to 4-pt APR and other restrictions on general season structure, 2- and 3-pt APR were the least opposed but even for those items the number of hunters that **strongly opposed** was comparable with those that **support** and approximately 3 times those that **strongly support**. This pattern contributed to a model estimated average *support* ( $\hat{\beta}$ ) for 3-point APR just  $-0.054 \pm 0.03$  lower than 2-pt (not significant) and with  $\hat{\delta}$  value of  $-1.151 \pm 0.035$  compared with  $-0.672 \pm 0.028$  for 2-pt. In contrast a 4-pt APR was  $-0.775 \pm 0.03$  lower than 2-pt with  $\hat{\delta}$  value of  $-1.196 \pm 0.037$ .

Consistent with the previous results, those hunters that did not support any of the APRs cited “adequate numbers of mature bucks” significantly less than any other reason (Table 6). A high  $\hat{\delta}$  estimate for item 2 (“limit opportunity”) relative to all other items supports a conclusion that majority hunter opinion reflected in this survey was dissatisfaction with the number of mature bucks does not warrant limiting opportunity via added restrictions.

Table 6: Reasons for not supporting APR

	n	%	$\hat{\delta}$
Satisfied with the current ‘Any Buck’ strategy	3,292	88.2	$1.831 \pm 0.122$
Limit opportunity for all hunters	3,057	81.9	$2.662 \pm 0.202$
Limit opportunity for youth, disabled, or senior	2,944	78.9	$1.922 \pm 0.121$
May result in an increase of non-legal bucks	2,631	70.5	$1.226 \pm 0.075$
There is already an adequate number of mature bucks in the population	2,197	58.9	$1.363 \pm 0.084$

Those that supported at least one of the APR options, mostly supported district wide implementation (Table 7) but also supported exceptions for youth, senior and disabled hunters (Fig. 4).

Table 7: In which Game Management Units should apply antler-point restrictions?

	All	None	Some	101	105	108	111	113	117	121
n	4,962	1,030	2,742	1,183	1,083	1,160	1,247	1,303	1,509	1,516
%	56.8	11.8	31.4	43.1	39.5	42.3	45.5	47.5	55.0	55.3



# Appendix

This appendix is not intended to be a comprehensive review of proportional odds or item-response theory but to briefly outline the approach used to quantify hunter opinion in this survey. Numerous resources available on these topics can provide more details on statistical justifications and mechanisms for these inferential methods.

In the simple case of a question scoring multiple items with **yes/no** answers, the frequencies of responses determine the relative rankings of different items. The proportions of **yes/no** answers can also be viewed as the probability respondents, that naturally vary in their opinions, are beyond the mid-point of a latent (unobserved) continuous scaled variable ( $Y^*$ ) representing *support*, *satisfaction* or *agreement*. For example, the probability a hunter chosen at random is “*supportive* of item  $x_2$  relative to  $x_1$ ” is comparable to “more hunters answered **yes** on  $x_2$ ”.

This latent variable motivation can be extended to the case a continuous  $Y^*$  is binned into more than two categories ( $Y_k, k \in K$  usually 4 or 5) on an ordinal scale such as 1- **very dissatisfied**, 2- **dissatisfied**, ... (Fig. 5). In this case the cumulation of probabilities a respondent is beyond each cutoff  $\alpha_{k-1}$  provides a measure of relative difference between items. We fit a proportional odds model to estimate  $\beta$ , the natural log odds a response is  $\leq k$  for item  $x_2$  relative to  $x_1$ , using all cumulative logits simultaneously [1, Agresti, 2002]. In this model cutoff values are estimated from data which, as in Fig. 5, allows for non-equal distances (on the logit scale) between categories. For example, often the difference between “disagree” ( $Y = 2$ ) and “agree” ( $Y = 3$ ) may be larger than “agree” ( $Y = 3$ ) and “strongly agree” ( $Y = 4$ ) or “not at all satisfied” to “somewhat satisfied” to “satisfied” which gets accounted for in the estimation of  $\beta$ .

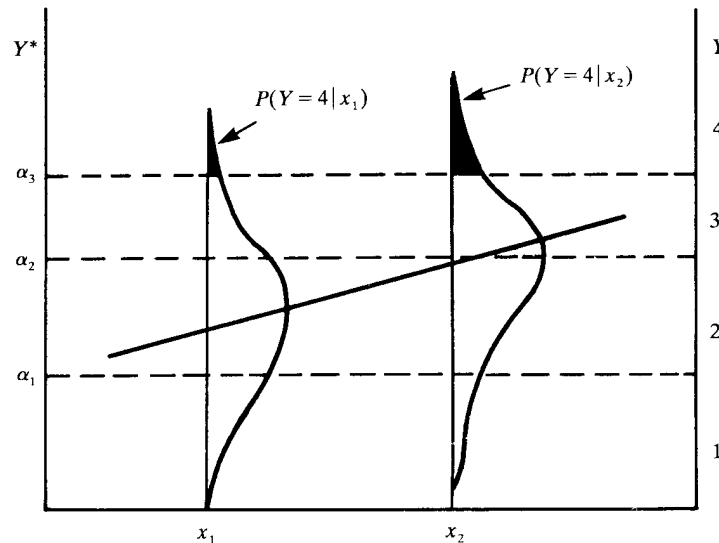


Figure 5: An illustration of the latent variable motivation to analysis of ordinal data from Agresti’s (2002) Figure 7.5. Two items ( $x_1, x_2$ ) are scored on the ordinal scale  $Y \in \{1, 2, 3, 4\}$  (right axis) corresponding to the increasing continuous  $Y^*$  latent variable (left-axis). In the proportional odds model the slope of the line ( $\hat{\beta}$ ) is jointly estimated with the latent cutoff values of transition between categories ( $\hat{\alpha}$ ).

This model can be further extended in two ways. First, since the same respondent is rating all items, data can be considered clustered around an individual random effect. In other words, an individual’s “place” on the latent scale can impact the patterns of response such that they may score all items as **strongly disagree** and **disagree** compared with

another individual that may have the same rankings for items but a different range of responses. Second, not all items may have the same cutoff values because the “translation” of ordinal categories to the latent scale can differ even as they are presented together in the same question. For example consider the scorings on Fig. 1, hunters may have different considerations and therefore scale of *importance/satisfaction* for items related to the hunting experience (such as being outdoors) vs. a specific outcome (a successful harvest).

We used the **ltm** package [2, Rizopoulos, 2006] in program **R** [3, R Core Team, 2020] to fit the unconstrained graded response model [4, Samejima, 1969] for respondent  $i$  scoring their attitude toward item  $j$  as one of  $k$  levels:

$$Pr_{ij}(Y \leq y_{[k]}) = \frac{e^{\delta_j(\theta - \alpha_{jk})}}{1 + e^{\delta_j(\theta - \alpha_{jk})}}$$

where  $\delta_j$  is the discrimination parameter denoting the item specific “slope” of the above boundary characteristic function,  $\theta$  is the level of the latent trait and  $\alpha_{j1} < \alpha_{j2} < \dots < \alpha_{jk-1}$  are item specific boundary locations (cutoffs). The same model applied to dichotomous questions (a single  $\alpha_j$ ) reduces to a simple item-response model.

It is important to note that by allowing item specific boundaries the focus shifts from estimating differences between items across cutoffs, to the analysis of individual patterns of response across items. Thus, higher  $\hat{\delta}_j$  values suggest a response pattern consistent with individual variance in opinion, not whether the probability of a  $\leq k$  response to item  $x_j$  is high or low (Fig. 6).

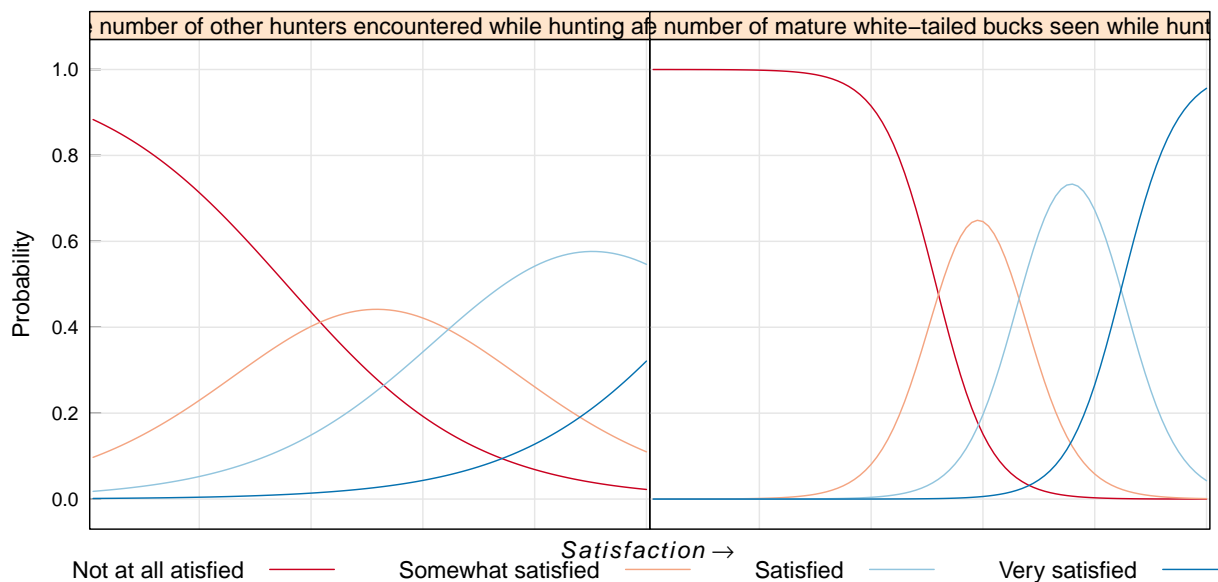


Figure 6: Characteristic curves for select items from Table 4 representing moderate (left) and high (right)  $\hat{\delta}$ . Panels range on a latent scale between -3.8 and 3.8 (95% of the logistic distribution).

While hunters are not as dissatisfied with crowding as with the number of mature bucks (Table 4), dissatisfaction is “across the board” where the likelihood of a **not at all satisfied** answer in the left panel declines slowly such that even hunters mostly satisfied with other items are not likely to be very satisfied with crowding. In contrast dissatisfied hunters are almost guaranteed to be dissatisfied with the number of mature bucks (left side of the right panel) but the probability of the **not at all satisfied** answer declines sharply as the item does well to differentiate dissatisfied from satisfied hunters.



## References

- [1] Agresti, A. (2002). Categorical data analysis. Second edition. John Wiley & Sons, Inc. Hoboken, New Jersey; 3
- [2] Rizopoulos, D. (2006). ltm: An R package for Latent Variable Modelling and Item Response Theory Analyses, *Journal of Statistical Software*, 17 (5), 1-25. URL <http://www.jstatsoft.org/v17/i05/>; 3
- [3] R Core Team (2020). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>; 3
- [4] Samejima, F. (1969). Estimation of latent ability using a response pattern of graded scores. *Psychometrika* 34, 1-97; 3