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Grouse Hunting Regulations and Hunter Typologies in Norway

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Sustainable game management relies on satisfied hunters. Satisfaction determinants are seldom uniform across all hunters and may therefore be difficult to accommodate. Latent class analysis (LCA) is a probabilistic model-based approach to categorizing hunter typologies (by, e.g., their attitudes and preferences). We applied LCA to large-scale survey data relating to grouse hunting regulations in Norway (3,293 respondents). We identified three typologies with regard to importance of bag size *("The Experience Seeker" 43%, "The Bag Oriented" 32% and "The Northern Traditionalist" 25%) and* crowding tolerance *("The Semi-tolerant Mainstream" 85%, "The Laissez Faire" 11%, and "The Passionate Crowd-avoiding" 4%). We could not find a single set of typologies that conformed to both aspects, which suggests that studies of this kind are more likely to be successful if target-specific. We conclude that knowledge of typologies is valuable for tailoring local hunting regulations, provided their actual distribution is identified at the appropriate scale.*

Keywords bag limit, game, harvest, willingness-to-pay, ptarmigan

Introduction

Declining grouse populations is a pressing management issue worldwide (Storch, 2007). The underlying causes are complex, and no study has yet identified a single factor that explains the declines at larger spatial scales. The most prominent threat seems to be habitat loss, degradation, and fragmentation (e.g., Marzluff & Neatherlin, 2006; Webb, Boarman, & Rotenberry, 2004). All of these are changes that are long-lasting and not easily reversed. Simultaneously, we see growing evidence that game-bird hunting

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may be more additive to natural mortality than previously held (Connelly, Hagen, & Schroeder, 2011; Pedersen et al., 2004; Pöysä et al., 2004; Sandercock, Nilsen, Brøseth, & Pedersen, 2011; Sedinger, White, Espinosa, Partee, & Braun, 2010; Smith & Willebrand, 1999).

Harvest regulations thus seem inevitable for mitigating grouse population declines. Management agencies implementing these regulations face a partly conflicting quest; they must achieve the ecological goal without overly restricting the hunting opportunities and thereby jeopardizing hunter satisfaction. Grouse hunting has a considerable socioeconomic impact. In Norway, for example, there are about 55,000 ptarmigan hunters[1] (out of a population of 4.8 million people; Statistics Norway, 2010a), and they annually spend approximately €1,200 each on activities directly related to grouse hunting (Andersen et al., 2009; Pedersen & Karlsen, 2007; Storm, 2007).

As advanced by Hendee (1974), hunter satisfaction has many components and is therefore best looked at by a "multiple-satisfaction approach" (e.g., Frey, Conover, Borgo, & Messmer, 2003; Hayslette, Armstrong, & Mirarchi, 2001; Hazel, Langenau, & Levine, 1990; Manfredo, Fix, & Teel, 2004; Schroeder, Fulton, & Lawrence, 2006; Woods, Guynn, Hammitt, & Patterson, 1996). This literature also shows that satisfaction determinants are seldom uniform across all hunters, who can therefore be grouped into distinct typologies.

The concept of typologies is statistically challenging, though, because it normally consists of unobservable qualitative variables that may be identified only indirectly through related stated manifests (Goodman, 1974). An increasingly popular method for modeling these data is latent class analysis (LCA) (Dean & Raftery, 2010). Compared to traditional clustering methods based on Euclidean distance (e.g., the *K*-means method), LCA clustering is based on distributional probability which involves less arbitrarily set cluster criteria and more rigorous statistical testing (Magidson & Vermunt, 2002). With such a model-based approach, formal tests using Bayesian techniques can therefore be set up to check the validity of the findings (for a general introduction, see Hagenaars & McCutcheon, 2002).

In this study, we used LCA clustering to identify typologies among Norwegian grouse hunters based on attitudinal data and willingness-to-pay obtained in a nationwide survey. Our aim was to establish hunter typologies to aid in the specific implementation of harvest regulations. Although the subject of general hunter typologies has been thoroughly covered over a number of decades, few studies have applied the theory to specific game management problems. One notable example is Ward, Stedman, Luloff, Shortle, and Finley (2008). That study identified two main typologies among deer hunters in Pennsylvania and determined that "Deer-Damage Managers" would be more useful than "No-Damage Traditionalists" for counteracting the prevalent deer overabundance in the area.

There are only two means to regulate a game harvest: (a) controlling the number of hunting permits and/or (b) controlling the yield taken by each hunter. In terms of hunter satisfaction, this relates to the hunters' *crowding tolerance* and how the hunters rate the *importance of bag size*, respectively. Accordingly, these are the two main themes addressed in this article. While crowding may be considered part of the bag size (more hunters generally means fewer birds available per hunter, given the same total quota), crowding should also be assessed independently as it includes other aspects that relate to hunter satisfaction (such as safety concerns and experiencing solitude). If hunters comprise distinct typologies with regard to crowding and bag size, game managers may use this knowledge to tailor hunting regulations more precisely.

Method

Recipient Sample

Invitations to take part in the survey were sent by personalized e-mail letters to those who had applied electronically for grouse hunting permits through the two large public agencies "Norwegian State-Owned Land and Forest Enterprise" and "The Finnmark Estate" (together managing roughly 50% of all outfields in Norway). The original e-mail invitation was sent May 25, 2010, a reminder was sent September 9, 2010, and the survey was closed October 1, 2010. The majority of the respondents (83%) completed the questionnaire prior to the reminder. We sent 8,129 invitations, of which 256 were negated because of failed delivery, leaving 7,873 potential respondents. Prior to the analyses we omitted 20 foreign, blank, or irrational questionnaires (e.g., age stated to be 110 years).

In addition to the direct e-mails, open invitations to participate in the survey were posted on various Norwegian hunting-related websites. An e-mail filter was used to facilitate the participation of only new and unique respondents. Descriptive analyses of the response data did not reveal any deviations between the Internet participants and those invited by e-mail, and therefore the two samples were pooled.

Questionnaire

The questionnaire was built with a digital platform provided and administered online by QuestBack Ask&Act™ (Oslo, Norway). It consisted of a total of 26 main questions, arranged in three sections. The first and last section contained questions about demography and hunting habits. A middle section contained questions addressing attitudes and willingness-to-pay, largely through the use of what-if scenarios. The answering format for numerical and complex attitudinal questions was left open (i.e., fill-in boxes) to avoid scale bias (Mitchell & Carson, 1989), while for more simple categorical questions it was specified (tick boxes or balanced point scales). Topics that we deemed particularly difficult were addressed twice in two differently phrased questions (reverse-keying).

No questions were mandatory and, when relevant, the respondent had the option of choosing "unknown" or "other, please specify." The majority of the respondents in our survey completed most of the questionnaire: 59% answered all of the 26 questions, 22% left out 1–2 questions and 8% left out 3–4 questions.

Data Analyses

The survey generated 25 variables of relevance for this article. For variables that addressed the same subject, we checked for positive correlation and omitted those with the lowest standard deviation as these are less likely to detect distinct typologies (Dean & Raftery, 2010). Continuous variables were transformed into <10 categories, retaining the original distribution of data. Variables were designated as either characterizing (i.e., demographics and hunting habits) (Table 1) or attitudinal (Table 2).

LCA are normally conducted top-down, beginning with full models and refining these by removing variables that are not useful (Vermunt & Magidson, 2004). In our case, the number of variables first needed to be reduced to make the practical procedure feasible (25 variables comprise millions of possible models). We therefore did preliminary LCA by systematically running blocks of 3–5 attitudinal variables against all possible

Table 1
Characterizing variables used to identify grouse hunter typologies in Norway, based on a nationwide survey in 2010 ($N = 3{,}293$)

Variable	Proportion or mean ± *SD*
C1. Region (place of living)[a]	see Figure 1
C2. Sex	
Male	95%
Female	5%
C3. Gross annual personal income	€61,320 ± 24,858
C4. Annual spending related to grouse hunting[b]	€1,371 ± 1,593
C5. Distance traveled from home to current hunting area (km)	342 ± 487
C6. Number of grouse hunting days/year	15 ± 12.0
C7. Hunts grouse also in late season (Nov–Jan)	59%
C8. Hunts on own property (landowner)	8%
C9. Number of years hunted grouse throughout life	18 ± 12.0
C10. Number of grouse terrains used throughout life	median 8
C11. How often hunts with dogs	
Always	43%
Sometimes	16%
Never	41%

Variables that were part of one or more significant latent class models are shown in bold.
[a]Regions comprise the following counties: east = Oslo/Akershus/Østfold/Vestfold/Buskerud/Telemark, south = Aust-Agder/Vest-Agder, west = Rogaland/Hordaland/Sogn&Fjordane, middle = Oppland/Hedmark/Møre&Romsdal/Sør-Trøndelag/Nord-Trøndelag, north = Nordland/Troms/Finnmark.
[b]Including hunting fees, equipment, travel costs, accommodation, and food during the hunt.

combinations of characterizing variables. Five characterizing variables were nonsignificant in all such partial models and omitted from the dataset (C2–C5 and C8, Table 1). We then repeated the procedure for attitudinal variables only, starting out with those three having the highest variance and going systematically back-and-forth with inclusion and exclusion of variables. Five nonsignificant attitudinal variables were thereby omitted (A1d–e, A6–A8, Table 2). The 15 remaining variables were used in a final LCA starting from the full model and following the exploratory inclusion–exclusion procedure (Dean & Raftery, 2010). Correlated variables were not simultaneously included in a model (e.g., "number of hunting days/year" and "hunts grouse also in Nov–Jan", $r = .425$, $df = 3{,}271$, $p \leq .001$).

We used the likelihood-ratio goodness of fit in relation to the degrees of freedom ($L^2 > df$ indicates a good model fit, Vermunt & Magidson, 2005) and classification errors to determine if a variable contributed significantly to a model. When the final set of significant models had been determined, we also used these statistics as well as the log-likelihood Bayesian Information Criterion (BIC_{LL}) to rank model parsimony and to select the optimal number of latent classes. Because our purpose was mainly identification and not prediction, we chose *BIC* over Akaike's Information Criterion (*AIC*) because of *BIC*'s stronger penalty for additional parameters (Clarke, Fokoué, & Zhang, 2009).

Table 2
Attitudinal variables used to identify grouse hunter typologies in Norway, based on a nationwide survey in 2010 (N = 3,293)

Variable	Proportion or mean ± *SD*
A1. Hunting satisfaction factors (1 = *most*, 5 = *least important*)	
a. To bag a lot of grouse	3.2 ± 0.76
b. To see a lot of grouse	1.7 ± 0.77
c. Not seeing other hunters	2.6 ± 0.99
d. Being social	1.8 ± 0.95
e. Being in intact nature	2.3 ± 1.06
A2+A3. Willingness-to-pay per bagged bird (WP)	€13 ± 6.9
Increasing with bag size	36%
Decreasing with bag size	42%
Bell-shaped	1%
Not affected by bag size	21%
A4. Bag size with maximum WP (number of birds bagged per day)	5.7 ± 2.30
A5. Wants to pay for bagged yield rather than with a fixed fee	
Interested	38%
Not interested	62%
A6. View on current levels of hunting fees (1 = *inexpensive*, 5 = *expensive*)	
Leasing private land	4.6 ± 0.79
Buying hunting permits on public land	3.2 ± 0.90
A7. Density at which temporary hunting ban accepted (bird encounters/day)[a]	6.5 ± 2.27
<10 bird encounters/day	92%
≥10 bird encounters/day	2%
Never	6%
A8. Prefer a daily or weekly bag limit	
Daily	1%
Weekly	54%
No preference	45%
A9+A10. Crowding tolerance (1 = *acceptable*, 5 = *unacceptable*)	
If seeing 1–2 hunter groups/day in a large, open terrain	1.9 ± 1.30
If seeing 5–6 hunter groups/day in a large, open terrain	2.7 ± 1.44
If seeing 10+ hunter groups/day in a large, open terrain	3.4 ± 1.79
If seeing 1–2 hunter groups/day in a more secluded terrain	2.4 ± 1.57
If seeing 5–6 hunter groups/day in a more secluded terrain	3.3 ± 1.75
If seeing 10+ hunter groups/day in a more secluded terrain	3.6 ± 1.97

Variables that were part of one or more significant latent class models are shown in bold.
[a]Normally encounter rate was stipulated in the question to be 20 birds/day.

The LCA was conducted using the cluster analysis available in Latent GOLD® (version 4.5, Windows XP). All remaining statistics were run in Minitab® 15 (Minitab Inc.). Measurements of central tendency are given as mean ± 1 SD (the median is given when the data strongly deviated from the normal distribution).

Results

Respondent Characteristics

The response rate in the invited e-mail survey was 40% (3,127 out of 7,873 responded), and the open Internet survey generated 186 additional responses. The 3,293 grouse hunters that comprise our respondent sample were slightly overrepresented by hunters from northern versus central Norway (Figure 1), but the geographical distribution overall followed that of registered ptarmigan hunters in Norway (Statistics Norway, 2010b) ($\chi^2 = 19.4$, $df = 4$, $p \leq .001$). The large majority of respondents were men (95%), as is the situation for all registered hunters in Norway (94%). Their average gross income was €61,320, which is equal to the general income for Norwegian men (€58,054 Statistics Norway, 2009).

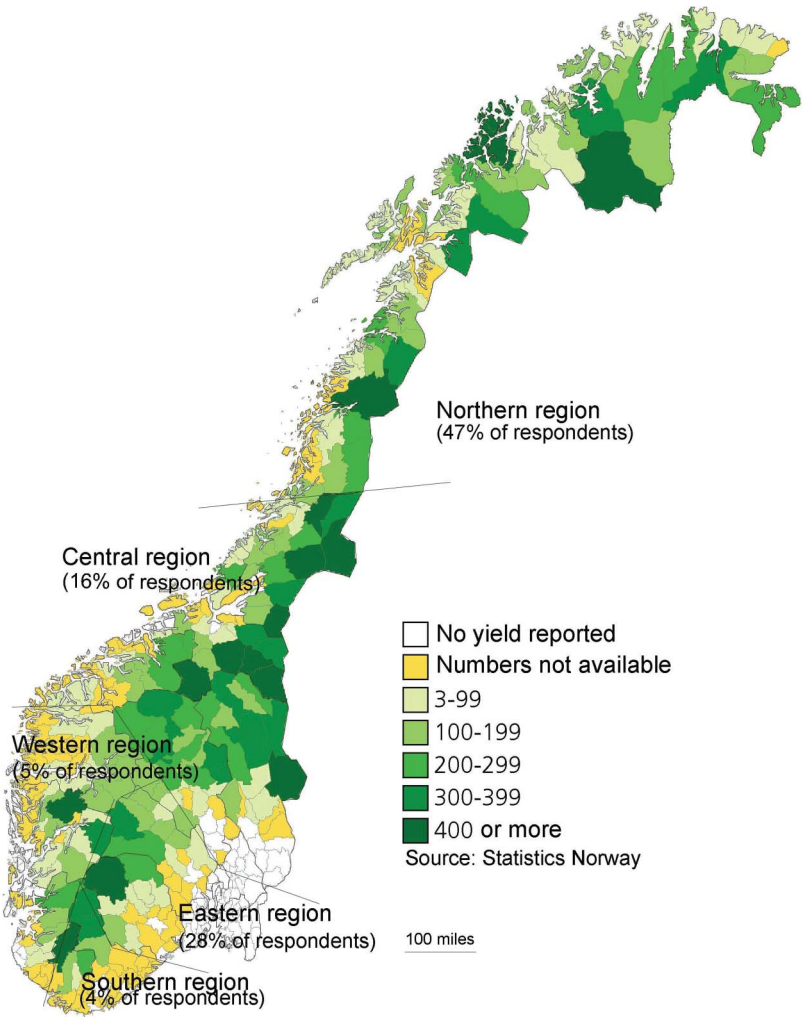

Figure 1. Geographical distribution of hunters who participated in a survey of grouse harvest regulations in Norway 2010, and the reported grouse harvest at the municipality level (number of birds shot per hunter, 2010–11 season; color figure available online).

Collectively, the respondents represented a total of 18,435 "hunting years" (the number of years hunting grouse during 2005–09, summed over all hunters). Of these 82% included buying hunting permits on public land, 6% leasing private terrains and 11% hunting for free. As many as 79% of the hunting days occurred in the two first months of the season (the Norwegian season runs from September 10 to March 15).

Hunter Typologies

When classifying the respondents into typologies, the two aspects of primary importance were *importance of bag size* and *crowding tolerance.* The latent class analyses revealed several significant models for both aspects, with 10 variables being part of the most parsimonious ones (Table 3). A noticeable distinction was that the variables addressing *importance of bag size* and *crowding tolerance*, respectively, were not simultaneously included in the models. We therefore present typologies for the two separately.

Importance of Bag Size. BIC-values were slightly lower for some of the models with four or five typology classes, but the 3-class models all had the lowest classification errors. Because the drop in *BIC* was marked when going from two to three typology classes, and then leveled out, we consider the 3-class models to be equally parsimonious, and even better in terms of practical interpretation, than the 4- or 5-class models.

We therefore labeled three hunter typologies with regard to *importance of bag size* (Figure 2A): "The Bag Oriented" (class 1), "The Northern Traditionalist" (class 2), and "The Experience Seeker" (class 3), making up 32%, 25%, and 43% of the respondents, respectively. Broadly summarized, "The Bag Oriented" was the most eager in terms of hunting days and willingness-to-pay for larger bags, while "The Experience Seeker" was satisfied with lower bags and fewer hunting days. "The Northern Traditionalist" resembled "The Bag Oriented" in terms of hunting days, but with a much lower willingness-to-pay.

Crowding Tolerance. The selection of number of typology classes was less clear-cut for *crowding tolerance*. Generally, both *BIC*-values and classification errors differed only slightly between the 3- and 4-class models. We therefore opted to label three hunter typologies even with regard to *crowding tolerance*: "The Semi-tolerant Mainstream" (class 1), "The Passionate Crowd-avoiding" (class 2), and "The Laissez Faire" (class 3), making up 85%, 4%, and 11% of the respondents (Figure 2B).

Discussion

Groups of people behave differently depending on the problem at hand, and therefore the interpretation of attitudinal latent segments should not be too stringent (Goodman, 2002). This was aptly illustrated by the lack of overlap in significant variables for our two key aspects: the typologies identified with regard to *importance of bag size* and *crowding tolerance*, respectively, did not consistently contain the same individual hunters. Studies identifying latent segments within such a diverse group as a nationwide sample of grouse hunters are thus likely to be more successful if they are target-specific rather than general.

Of the three typologies identified with regard to *importance of bag size*, "The Bag Oriented" conforms to the most conventional hunter type, whose motivation for being a hunter is mainly consumptive. "The Experience Seeker" represents a culturally newer generation, and is hunting mainly for appreciative reasons. These two are the furthest apart on the functional–hedonistic gradient of nature views, where the latter seems to steadily

Table 3
Latent class models of grouse hunter typologies in Norway, based on a nationwide survey in 2010 ($N = 3,293$)

Variables in model	No of classes	BIC_{LL}	L^2	df	p-value	Classification error
importance of bag size						
A2. Willingness-to-pay per bagged bird (WP)[a]	2*	14,628	2,156	1,543	≤0.05	0.001
A3. WP in relation to increased bag size	**3***	**13,874**	1,363	1,538	1.00	**0.036**
C1. Region (place of living)	4*	13,846	1,296	1,533	1.00	0.082
C6. Number of grouse hunting days per year	5	13,795	1,207	1,528	1.00	0.115
A2. Willingness-to-pay per bagged bird (WP)[a]	2	18,788	2,033	1,770	≤0.05	0.016
A3. WP in relation to increased bag size	**3**	**18,202**	1,410	1,765	1.00	**0.051**
A4. Bag size with maximum WP	4	18,172	1,343	1,760	1.00	0.080
C1. Region (place of living)	5	18,151	1,284	1,755	1.00	0.140
A1. Bagging vs. seeing birds[b]	2	20,504	2,065	1,890	≤0.05	0.013
A2. Willingness-to-pay per bagged bird (WP)[a]	**3**	**19,780**	1,302	1,885	1.00	**0.038**
A3. WP in relation to increased bag size	4	19,802	1,286	1,880	1.00	0.122
C6. Number of grouse hunting days per year	5	19,801	1,246	1,875	1.00	0.177
crowding tolerance						
A9. Crowding tolerance (CT)[c]	2*	9,670	1,461	2,326	1.00	0.029
A10. CT in relation to encounter rate	**3***	**9,573**	1,317	2,320	1.00	**0.067**
C1. Region (place of living)	4*	9,567	1,264	2,314	1.00	0.058
C6. Number of grouse hunting days per year	5	9,643	1,293	2,308	1.00	0.198
C11. How often hunts with dog						
A9. Crowding tolerance (CT)[c]	2	9,675	2,010	2,637	1.00	0.030
A10. CT in relation to encounter rate	**3**	**9,583**	1,863	2,630	1.00	**0.067**
C1. Region (place of living)	4	9,582	1,807	2,623	1.00	0.056

C7. Hunts grouse also in Nov–Jan C11. How often hunts with dog	5	9,620	1,789	2,616	1.00	0.198
A9. Crowding tolerance (CT)[c]	2	9,726	920	1,080	1.00	0.024
A10. CT in relation to encounter rate	**3**	**9,627**	773	1,074	1.00	**0.067**
C1. Region (place of living)	4	9,619	718	1,068	1.00	0.053
C6. Number of grouse hunting days per year	5	9,661	712	1,062	1.00	0.279

p-values > .05 indicate significant models. The three most parsimonious variable sets (separated by blank rows) for each of two key aspects are shown. In each model, 3-class models were deemed to be the best alternative (low BIC_{LL} and classification errors). Models marked with (*) are illustrated in detail in Figure 2.

[a]Average for the three different bag sizes (1–3, 8–10, and 15–20 birds/day).

[b]Difference in score between "To bag a lot of grouse" and "To see a lot of grouse."

[c]Average for the six various encounter rates and terrain types.

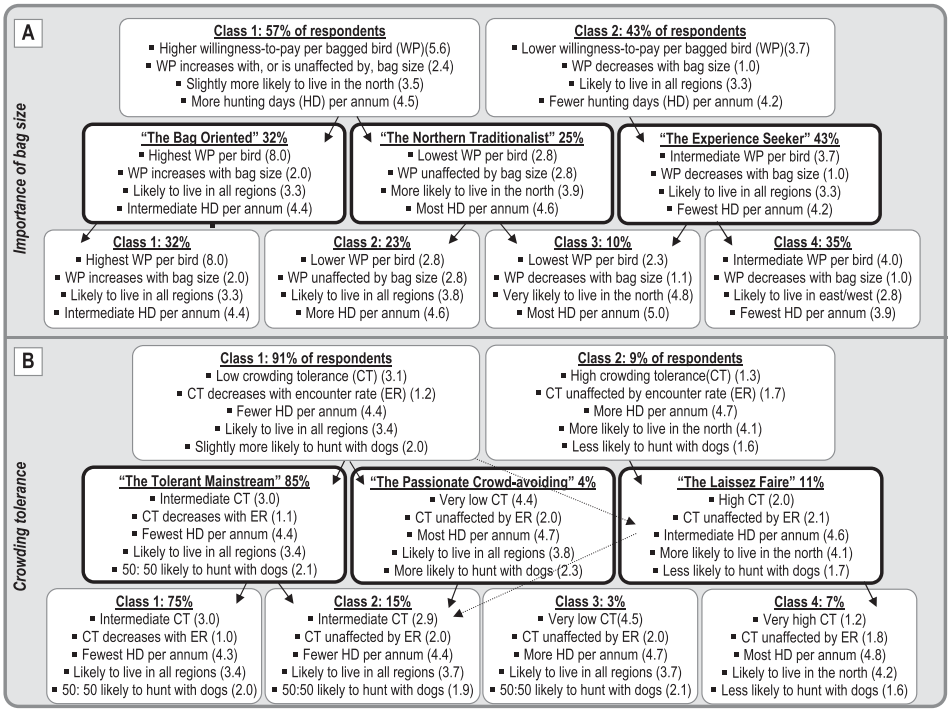

Figure 2A–B. Latent class modeling of grouse hunter typologies in Norway, based on a nationwide survey from 2010 ($N = 3{,}293$). For both *importance of bag size* and *crowding tolerance* 3-class models were deemed to be the most parsimonious. Numbers in parentheses are average class scores, for example, in the 2-class model for *crowding tolerance*, the hunters in the second class had more than twice as high a tolerance than the hunters in the first class.

replace the former throughout Europe because of increased urbanization (Buijs, Pedroli, & Luginbühl, 2006). Conformingly, there were more experience seekers than bag oriented hunters even among our respondents.

With regard to *crowding tolerance*, mainly northern hunters were identified as "The Laissez Fair," the most tolerant typology. Allegedly, sharing is easier when resources are plentiful (Hamilton, 1964), as is the case in the rural northern parts of Norway versus the more developed south. The northern region, however, has more visiting hunters (approximately two thirds of the hunters), and the local hunters may not be equally tolerant to all hunter segments. Comments such as "*nonlocal hunters use dogs to vacuum-clean the terrain at the start of the season*" were frequently given by northern hunters in the open commentary fields of the questionnaire. Their tolerance may therefore not stem from cordiality, but rather originate from a wish to generate local income (Willebrand, 2009).

Inclusion of any bag related variables had negligible effects in the crowding models. This may indicate that crowding did not significantly affect the respondents' valuation of bag size, which is further supported by the finding that there were 85% "Semi-tolerant mainstream." If so, this has important regulatory implications as a strong limitation of hunting permits may not always be socioeconomic viable in game management. On public land in Norway, for example, game managers have an obligation to offer people access to small game hunting. It should be noted, though, that while the hunters were quite tolerant, their tolerance clearly decreased with encounter rate and is therefore not inexhaustible.

At what scale will the hunter typologies be representative of the hunting population in a given area? Because the respondents in our study were drawn from a nationwide sample, their typologies should apply to the general grouse hunter in Norway. One potential source of socioeconomic bias is that invitations were only sent to hunters who had bought their permit electronically (Solomon, 2001). However, the Internet coverage in Norway currently runs as high as 92% of all households (Statistics Norway, 2011), and if there are groups missing in our survey it is more likely due to established habits (e.g., older people being more inclined to buy permits on paper only). In any way, the local distribution of typologies is expected to differ from our nationwide sample. Ideally, managers using typologies for applied purposes at smaller scales should first identify the distribution locally.

For a study of latent segments to be useful, the expressed attitudes must be adequate depictions of the true attitudes. According to Baumgartner and Steenkamp (2001), the most common response biases are: [dis]acquiescence (automatically [dis]agreeing with statement as presented), carelessness (lack of motivation), central tendency (systematically avoiding extremes), extreme tendency (to gain stronger influence), and desirability (pretending to be better than one is). Our use of open answering formats and lack of mandatory questions should largely have eliminated the first three. The last two, on the other hand, may still apply. Their influence on the categorical clustering should be weak, though, because both are amplifications of—rather than directional deviations from—the respondents' true attitude. Either way, the high number of respondents is likely to counterbalance the effects of a few cases of deliberate response styling.

Both 3- and 4-class models were statistically defensible in our study, and it is arguable which number of classes is preferential in an applied context. The main change when going from three to four classes was a further splitting of already small groups. We doubt a management regime can be sufficiently fine-tuned to tailor for 3% of the hunter segment. Small typology classes still have theoretical value, though. Groups that are small today may be large tomorrow, and LCA clustering can be used to identify changes in typology distributions over time (Magidson & Vermunt, 2004).

We conclude that knowledge of hunter typologies can facilitate a more precisely determination of the optimal implementation of harvest regulations. If regulations are set simply based on the average hunter, they may end up reducing much of the hunting opportunities to no avail. In an area with mainly "Experience seekers," for example, it may be wiser to keep a low bag limit than to reduce the number of permits. Large properties that can offer a wide range of hunting options may also use the typologies to channel different hunters to specific areas, such as "The Bag Oriented" to where there are the most shooting opportunities. Future studies should investigate further the socio- and bioeconomic benefits of such a diversified management regime.

Note

1. Ptarmigan *spp*. are not the only grouse species in Norway, but the national hunting registry only specify ptarmigan. The remaining grouse species are grouped with other small game.

References

Andersen, O., Kaltenborn, B. P., Pedersen, H. C., Storaas, T., Faye-Schjøll, E., & Solvang, H. (2009). Survey among willow ptarmigan hunters after hunting season 2006/07. Data and key findings from The Grouse Management Project 2006–2011. *NINA Report*, *379*, 1–44. (English abstract)

Baumgartner, H., & Steenkamp, J.-B. (2001). Response styles in marketing research: A cross-national investigation. *Journal of Marketing Research*, *38*, 143–156.

Buijs, A. E., Pedroli, B., & Luginbühl, Y. (2006). From hiking through farmland to farming in a leisure landscape: Changing social perceptions of the European landscape. *Landscape Ecology*, *21*, 375–389.

Clarke, B., Fokoué, E., & Zhang, H. H. (2009). *Principles and theory for data mining and machine learning*. New York, NY: Springer Press.

Connelly, J. W., Hagen, C. A., & Schroeder, A. (2011). Characteristics and dynamics of Greater Sage-Grouse populations. In S. T. Knick & J. W. Connelly (Eds.), *Greater Sage-Grouse: Ecology and conservation of a landscape species and its habitats* (pp. 53–67). Berkeley, CA: Studies in Avian Biology Series (vol. 38), University of California Press.

Dean, N., & Raftery, A. E. (2010). Latent class analysis variable selection. *Annals of the Institute of Statistical Mathematics*, *62*, 11–35.

Frey, S. N., Conover, M. R., Borgo, J. S., & Messmer, T. A. (2003). Factors influencing pheasant hunter harvest and satisfaction. *Human Dimensions of Wildlife*, *8*, 277–286.

Goodman, L. A. (1974). The analysis of systems of qualitative variables when some of the variables are unobservable. Part I-A modified latent structure approach. *American Journal of Sociology*, *79*, 1179–1259.

Goodman, L. A. (2002). Latent class analysis: The empirical study of latent types, latent variables and latent structures. In J. A. Hagenaars & A. L. McCutcheon (Eds.), *Applied latent class analysis* (pp. 3–55). Cambridge, MA: Cambridge University Press.

Hagenaars, J., & McCutcheon, A. (2002). *Applied latent class analysis models*. New York, NY: Cambridge University Press.

Hamilton,W. D. (1964). The genetical evolution of social behaviour I and II. *Journal of Theoretical Biology*, *7*, 1–16 and 17–52.

Hayslette, S. E., Armstrong, J. B., & Mirarchi, R. E. (2001). Mourning dove hunting in Alabama: Motivations, satisfactions, and sociocultural influences. *Human Dimensions of Wildlife*, *6*, 81–95.

Hazel, K. L., Langenau, E. E., & Levine, R. L. (1990). Dimensions of hunting satisfaction: Multiple-satisfactions of wild turkey hunting. *Leisure Sciences*, *12*, 383–393.

Hendee, J. C. (1974). A multiple-satisfaction approach to game management. *Wildlife Society Bulletin*, *2*, 104–113.

Magidson, J., & Vermunt, J. K. (2002). Latent class models for clustering: A comparison with K-means. *Canadian Journal of Marketing Research*, *20*, 37–44.

Magidson, J., & Vermunt, J. K. (2004). Latent class models. In D. Kaplan (Ed.), *The Sage handbook of quantitative methodology for the social sciences* (pp.175–198). Thousand Oaks, CA: Sage Publications.

Manfredo, M. J., Fix, P. J., & Teel, T. L. (2004). Assessing demand for big-game hunting opportunities: Applying the multiple-satisfaction concept. *Wildlife Society Bulletin*, *32*, 1147–1155.

Marzluff, J. M., & Neatherlin, E. (2006). Corvid response to human settlements and campgrounds: Causes, consequences, and challenges for conservation. *Biological Conservation*, *130*, 301–314.

Mitchell, R., & Carson, R. (1989). *Using surveys to value public goods: The contingent valuation method*. Washington, DC: Resources for the Future.

Pedersen, H. C., & Karlsen, D. H. (2007). *Alt om rypa: Biologi, jakt og forvaltning*. Oslo, Norway: Tun forlag AS. (in Norwegian)

Pedersen, H. C., Steen, H., Kastdalen, L., Brøseth, H., Ims, R. A., Svendsen, W., & Yoccoz, N. G. (2004). Weak compensation of harvest despite strong density-dependent growth in willow ptarmigan. *Proceedings Royal Society London Series B*, *271*, 381–385.

Pöysä, H., Elmberg, J., Gunnarsson, G., Nummi, P., Sjöberg, G. G., & Sjöberg, K. (2004). Ecological basis of sustainable harvesting: Is the prevailing paradigm of compensatory mortality still valid? *Oikos*, *104*, 612–615.

Sandercock, B. K., Nilsen, E. B., Brøseth, H., & Pedersen, H. C. (2011). Is hunting mortality additive or compensatory to natural mortality? Effects of experimental harvest on the survival and cause-specific mortality of willow ptarmigan. *Journal of Animal Ecology*, *80*, 244–258.

Schroeder, S. A., Fulton, D. C., & Lawrence, J. S. (2006). Managing for preferred hunting experiences: A typology of Minnesota waterfowl hunters. *Wildlife Society Bulletin*, *34*, 380–387.

Sedinger, J. S., White, G. C., Espinosa, S., Partee, E. T., & Braun, C. E. (2010). Assessing compensatory versus additive harvest mortality: An example using Greater Sage-Grouse. *Journal of Wildlife Management*, *74*, 326–332.

Smith, A., & Willebrand, T. (1999). Mortality causes and survival rates of hunted and unhunted willow grouse. *Journal of Wildlife Management*, *63*, 722–730.

Solomon, David J. (2001). Conducting web-based surveys. *Practical Assessment, Research & Evaluation*, *7*, 19.

Statistics Norway (2009). Statistikkbanken: subject 05, table 05039. (in Norwegian). Retrieved from http://statbank.ssb.no/statistikkbanken/

Statistics Norway (2010a). Statistikkbanken: subject 10, table 05634. (in Norwegian). Retrieved from http://statbank.ssb.no/statistikkbanken/

Statistics Norway (2010b). Statistikkbanken: subject 10, table 03951. (in Norwegian). Retrieved from http://statbank.ssb.no/statistikkbanken/

Statistics Norway (2011). Statistikkbanken: subject 10, table 06215. (in Norwegian). Retrieved from http://statbank.ssb.no/statistikkbanken/

Storch, I. (2007). Conservation status of grouse worldwide: An update. *Wildlife Biology*, *13*, 5–12.

Storm, H. N. (2007). *Product development and value creation of grouse hunting*. MS thesis, University of Life Sciences, Ås, Norway.

Vermunt, J. K., & Magidson, J. (2004). Latent class models. In D. Kaplan (Ed.), *The Sage handbook of quantitative methodology for the social sciences* (pp. 175–198). Thousand Oaks, CA: Sage Publications.

Vermunt, J. K., & Magidson, J. (2005). *Latent Gold 4.0 user's guide*. Belmont, MA: Statistical Innovations.

Ward, K. J., Stedman, R. C., Luloff, A. E., Shortle, J. S., & Finley, J. C. (2008). Categorizing deer hunters by typologies useful to game managers: A latent-class model. *Society & Natural Resources*, *21*, 215–229.

Webb, W. C., Boarman, W. I., & Rotenberry, J. T. (2004). Common raven juvenile survival in a human-augmented landscape. *Condor*, *106*, 517–528.

Willebrand, T. (2009). Promoting hunting tourism in north Sweden: Opinions of local hunters. *European Journal of Wildlife Research*, *55*, 209–216.

Woods, G. R., Guynn, D. C., Hammitt, W. E., & Patterson, M. E. (1996). Determinants of participant satisfaction with quality deer management. *Wildlife Society Bulletin*, *24*, 318–324.