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EVALUATING HUNTING SUCCESS OF PEN-REARED AND WILD NORTHERN BOBWHITE IN A RECLAIMED KENTUCKY MINELAND

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ABSTRACT

Northern bobwhites (*Colinus virginianus*) have experienced severe population declines across their distribution. In order to address population declines and to continue providing hunting opportunities, multistate efforts have been undertaken to stabilize and restore bobwhite populations. Ongoing efforts using the National Bobwhite Conservation Initiative's quail focus area approach have so far demonstrated success throughout Kentucky. However, population increases in the Peabody Bobwhite Focal Area, in western Kentucky, have not been correlated to increases in perceived hunter success. Consequently, some sportsmen question the effectiveness of focal area conservation. In response to hunter concerns, we tested dog hunting ability with wild and pen-reared bobwhites. We also measured evasive behaviors of wild bobwhite using radiotelemetry. During the 2013–2014 and 2014–2015 hunting seasons we conducted 114 dog trials. Dogs detected bobwhite during 46 of 59 (78.0%) pen-reared trials and 16 of 55 (29.1%) wild bird trials. When dogs did not detect wild quail, birds ran away 64.1% of the time and remained motionless 20.5% of the time. Using an information-theoretic approach, we determined that bird type (wild vs. pen-reared) had a significant effect on bird detection, with dogs 8.62 times more likely to detect pen-reared birds than wild birds. We recommend that hunters be informed about differences in dog detection rates between pen-reared and wild bobwhite so that public support needed for wild bobwhite restoration can persist.

As a response to long-term and persistent population declines, more emphasis is being placed on northern bobwhite (*Colinus virginianus;* hereafter, bobwhite) conservation now than at any point in history. Currently, state-wide efforts are underway to restore and enhance vegetation communities that support bobwhite populations, and these conservation efforts have led to site-specific population increases throughout Kentucky (Peters 2014, McKenzie et al. 2015, Morgan and Robinson 2015). However, sportspeople are one of the key catalysts to fund and champion expensive habitat enhancements (Brennan

2015). Scientific monitoring programs may demonstrate successes through increased population abundance; however, if hunters do not experience enhanced hunting success, public support for conservation activities may be fleeting.

Although most studies report a positive correlation between hunter success (coveys flushed per hour) and quail population densities (Smith and Gallizioli 1965, Brown et al. 1978, Palmer et al. 2002, Mecozzi and Guthery 2008, Stribling and Sisson 2009), this trend has not been observed on some Kentucky state-managed lands. For example, within Peabody Wildlife Management Area (PWMA), the bobwhite population has roughly doubled between 2009 and 2013 (Morgan and Robinson 2015); however, perceived hunter success and satisfaction

has not markedly increased. This has led some sportspeople to question the success of management activities. Although little is known about this phenomenon, a number of suppositions have been presented by resource professionals to explain why perceived hunter success has not increased as a response to increased bobwhite densities on PWMA.

The dramatic reduction of wild bobwhite over the past 50 years (Sauer et al. 2014) has fostered a culture of releasing pen-reared bobwhite to satisfy hunter demands while preserving the tradition of hunting (Kozicky 1993, Schulz et al. 2003). A similar paradigm has long existed for sport fishing. Based upon a survey of Kentucky bobwhite hunters, 33% of respondents reported to have hunted pen-reared quail in the 2008–2009 hunting season (Responsive Management 2009). Behavioral differences have been observed between pen-reared and wild quail (Roseberry et al. 1987, Perez et al. 2002, Jung 2010); therefore, hunting pen-reared quail may lead to a decline in both dog and hunter ability to hunt for wild quail. For example, compared with wild quail, pen-reared bobwhites have been observed to be more reluctant to flush when approached (Klimstra 1975, Roseberry et al. 1987) and fly slower and flush shorter distances following disturbance (Perez et al. 2002). Additionally, although wild birds forage in close proximity to escape cover (Brooke et al. 2015, Unger et al. 2015), pen-reared quail forage in areas with less concealing cover (Roseberry et al. 1987), where they may more exposed to hunting parties.

Furthermore, the high hunter success that commonly results from hunting pen-reared birds may alter hunter perceptions regarding harvest expectations. As pen-reared quail are considered to be easier to hunt than wild quail, hunters may become frustrated with low rates of covey detection observed in some wild populations. The coupling of elevated hunter expectations for harvest and limited ability to detect wild birds could be problematic for maintaining support for wild bobwhite restoration efforts.

To fully understand harvest rates, it is important to understand the factors that drive bobwhite detections while hunting. Although research exists on the factors that may influence wild game-bird detection and harvest success (Sisson et al. 2000, Palmer et al. 2002, Asmyhr et al. 2012, Wellendorf et al. 2012), little research exists regarding detection differences between wild and pen-reared birds. Therefore, we designed an experiment with the primary objective to model factors that explain a bird dog's ability to hunt for bobwhite. Specifically, we investigated detection differences between wild and pen-reared bobwhites.

STUDY AREA

This study was conducted at Peabody Wildlife Management Area (PWMA) located in Muhlenberg and Ohio counties in western Kentucky. This reclaimed coal mine site is 3,323 ha in size and is managed by the Kentucky Department of Fish and Wildlife Resources. PWMA is a quail focus area in Kentucky's bobwhite

restoration plan (Morgan and Robinson 2008). Primary vegetation types within the study area have been characterized by Brooke et al. (2015) and they include open herbaceous (36%), mixed-shrub (25%), native warm-season grass plantings (8%), forested woodland (22%), and other (9%). Extensive coverage of sericea lespedeza (*Lespedeza cuneata*) occurs throughout PWMA.

METHODS

Dog trials

To identify research participants, we solicited an application for volunteer dog handlers (limited to 2 dogs/handler) through quail grassroots organizations (e.g., Quail Forever, St. Paul, MN, USA), social media (e.g., Facebook; Facebook, Inc., Menlo Park, CA, USA), and known hunters at PWMA. We screened applications to reduce variability by selecting those that had dogs that were 3–8 years of age and had hunted or participated in field trials ≥5 times/year. We categorized bird dogs into 2 groups: those with little-to-no exposure (≤25% of bird/dog encounters) to pen-reared birds (hereafter, wild dogs), and those with high-to-exclusive exposure (≥75% of bird/dog encounters) to pen-reared birds (hereafter, liberated dogs).

We conducted this study during the 2013–2014 and 2014–2015 bobwhite hunting seasons. During each hunting season we conducted 4 dog trials, with 2 trials conducted early in the hunting season (Oct and Nov) and 2 late in the hunting season (Dec and Jan). There were 4 wild dogs and 4 liberated dogs at each trial date. Each trial required 8 radiomarked wild coveys and 8 pen-reared coveys because we exposed dogs to 1 wild and 1 liberated covey. All wild birds were captured and fitted with radiotransmitters as part of a collaborative research project investigating bobwhite survival and habitat use (Brooke et al. 2015, Peters et al. 2015). As part of this collaborative research, individuals were tracked 3 days/week using radiotelemetry, and birds were assigned to coveys based upon their repeated proximity with other radiotagged birds. Between 2 and 6 radiotagged bobwhite were present within each wild covey. We conducted dog trials on wild individuals more than once, but we limited repetition to 1 early and 1 late season trial per wild covey. During the site selection process for the pen-reared trial, we made efforts to ensure vegetation parameters were consistent between wild and pen-reared trial locations by choosing sites in which wild radiotagged bobwhite were commonly located during companion bobwhite research. Capture, handling, and telemetry protocols of wild birds complied with the University of Tennessee Institutional Animal Care and Use Committee (Permit 2042-0911). Animal care and use protocols for this study were reviewed and approved by the Kentucky Department of Fish and Wildlife Resources.

Dog trials began at approximately 0800 hours at each site (wild and pen-reared sites). Trial teams consisted of a team leader, dog, dog handler, and extra assistants to assist in flushing undetected coveys. Additionally, a

radiotelemetry technician was present during wild bob-white trials. At wild covey trial locations, the telemetry technician located radiotagged individuals within coveys from a distance of $\geq$50 m. The technician, team leader, handler, and leashed dog approached the covey to approximately 100 m downwind. A hunt bearing was established by the telemetry technician. The team leader formally began the trial by directing the handler to keep the dog within the hunting corridor (100 m on either side of the hunt bearing). The dog was unleashed along the hunt bearing and the team leader followed the dog closely noting dog behavior. Dog handlers were instructed to hunt as they would normally, including use of bells, beepers, and whistles. Technicians and team leaders were discrete in use of telemetry and dog handlers were not aware of covey locations. The Global Positioning System (GPS) coordinates of trial start locations were recorded prior to unleashing bird dogs.

During wild bird trials, the telemetry technician constantly monitored radiotagged individuals within coveys to evaluate bobwhite evasive behaviors. When dogs did not detect wild quail, the telemetry technician determined whether the majority of radiotagged birds within the covey either ran away or remained motionless when the dog passed the covey location. Telemetry technicians were highly experienced with tracking bobwhites in the study site because they had been working within this area for 2–3 months prior to trial dates. Any dog point was followed by an attempted handler flush with results noted. We defined a dog point as the action in which a dog stopped, remained motionless, and aimed its muzzle at a potential bobwhite location. An individual bobwhite or covey flush at any time ended the trial. We defined detection as a covey or individual flush by the dog, point followed by an individual or covey flush by the handler, or a point followed by an individual or covey flush by the dog. If the handler and dog passed the covey by $\geq$100 m, the radiotelemetry technician stopped the group.

We conducted trials of pen-reared birds in the same fashion with the exception of the lack of radiotelemetry. We acquired all pen-reared bobwhites from suppliers that raised birds in flight conditioning pens. We soft-released pen-reared birds (Fies et al. 2000) in groups of 8–10, approximately 1–4 hours prior to dog trials. During release, field staff placed the boxed birds on the ground. Field staff uncovered a precut hole in the side of the box and then quietly vacated the area. For pen-reared bird trials, teams approached the soft-release locations to approximately 100 m downwind, at which point they established a hunt bearing and began trials.

If dogs did not detect wild or pen-reared bobwhite on the first pass, teams were rerouted to a corridor perpendicular to the covey as a second opportunity to detect birds. Upon completion of the first trial, the groups reconvened and switched trials. For example, a group starting with wild birds switched to pen-reared birds. The second dog trials began at approximately 1030 hours. Teams stopped a dog trial and we censored it from analysis if wild or pen-reared bobwhite were flushed by the trial team (handler or technicians), independently of detection by the dog.

Immediately following the completion of both wild and pen-reared dog trials, field researchers asked dog handlers to independently complete a hunter survey regarding their experiences. Questions within the survey included 1) what best represents your perspective on wild bobwhite covey behavior during the trial, and 2) what best represents your perspective on liberated bobwhite covey behavior during the trials? There were 4 response choices: 1) as expected, 2) more evasive, 3) less evasive, or 4) no opinion.

Weather Data

Quality Controlled Local Climatological Data were obtained from a National Oceanic and Atmospheric Administration automated weather station located at Madisonville Regional Airport (Madisonville, KY, USA), which was approximately 35 km from the study site. Weather data at this station were recorded at 20-minute intervals. Weather data variables included ambient temperature (°C), barometric pressure (in.Hg), relative humidity (% RH), and wind speed (m/sec). To obtain time specific weather data, we used weather values that were closest to the starting time of the trial. When the trial started between 2 weather recording intervals, we averaged the 2 relevant weather values.

Vegetation Sampling

Following dog trials, we recorded key vegetation components that may influence a bird dog's ability to detect scent within hunt corridors (200-m $\times$ 200-m area bifurcated by the hunt azimuth). We conducted vegetation surveys between 4 and 6 weeks after dog trial dates. We completed vegetation surveys for the early season trials in December and January prior to the start of late-season trials. We completed vegetation surveys for late-season trials in March and early April, prior to the growing season.

We used GPS coordinates recorded at the onset of trials, prior to unleashing bird dogs, as the starting point for vegetation sampling transects. We recorded vegetation data along the original hunt corridor at 4 distance intervals (50 m, 100 m, 150 m, and 200 m). We measured vertical plant structure using a Nudd's Vegetation Profile Board (Nudds 1977). We quantified visual obstruction using a 2-m-tall and 25-cm-wide profile board, consisting of 8, 25 $\times$ 25-cm, alternating black and white intervals (Nudds 1977). We recorded the proportion of vegetation covering each interval at a distance of 10 m and a height of 1.5 m from the east and west sides of the transect. We averaged the 8 visual Nudd's board readings per trial corridor to create a single value per strata for each dog trial location.

We measured openness at ground level using a sight tube (Gruchy and Harper 2014). We mounted a polyvinyl chloride pipe (3.8 cm diam, 15.2 cm long) on a stake 15.2 cm above ground. We held a brightly colored plastic ruler (30.48 cm) in front of the tube opening and moved it away until $\geq$75% of the ruler was obscured by vegetation. We

Table 1. Nudd's visual obstruction profiles ($\pm$SE), percent coverage of primary vegetation types, and sight tube readings at trial locations of dogs' ability to detect wild ($n = 55$) and pen-reared ($n = 59$) northern bobwhite during 2013–2015 at Peabody Wildlife Management Area, Kentucky, USA[a]. Results of 2-sample t-tests (P-values) comparing pen-reared and wild bird trial locations are reported.

Trial group	Nudds4	Nudds6	Nudds8	Native	Nonnative	Grass	Forbs	Woody	Sight tube
Pen-reared									
Mean	20.00	52.93	82.84	20.47	79.53	33.90	63.47	25.00	2.55
SE	2.23	3.71	2.14	1.68	1.68	2.44	2.18	2.00	0.13
Wild									
Mean	21.71	54.13	83.24	23.64	76.36	33.18	54.73	23.05	2.61
SE	2.13	2.84	2.05	2.46	2.46	2.81	2.87	2.62	0.13
t	−0.55	−0.25	−0.13	−1.07	1.07	0.19	2.45	0.59	−0.33
P (2-tailed)	0.583	0.800	0.894	0.285	0.285	0.847	0.016	0.553	0.740

[a] Nudds8: percent vegetation cover at stratum 8; Nudds6: percent vegetation cover at stratum 6; Nudds4: percent vegetation cover at stratum 4; RH: relative humidity; Sight tube: average sight tube value of trial corridors.

measured and recorded the distance from the midpoint of the tube to the ruler. If the ruler was visible at 5 m distance, we considered this a maximum value. We collected data at each of 4 distance intervals (50 m, 100 m, 150 m, and 200 m). We collected sight tube readings 5 m to the east side of the transect to prevent vegetation trampling. We recorded the first reading by sampling perpendicularly from the transect. Observers then moved 1 m forward and collected the second sight tube reading. We averaged sight tube readings to create a single value for each trial location. Finally, we evaluated the entire hunt corridor to obtain an overall visual estimate of species composition. First we evaluated the hunt corridor to determine the percent coverage of native versus nonnative vegetation (i.e., sericea lespedeza). Then we evaluated the hunt corridor to determine the percent coverage of 3 functional vegetation types: grass, forbs, and woody cover.

We averaged vegetation cover (native vegetation, nonnative vegetation, grass, forbs, and woody cover), sight tube, and Nudd's board readings across wild and pen-reared trial locations and compared them using a 2-sample t-test. We designated a P-value of 0.05 and, following Bonferroni correction, considered tests significant at $P < 0.004$.

Logistic Regression

Our response was binary (detection or no detection) and we had several predictive variables, so we used multiple logistic regression analysis with *a priori* model selection to predict the influence of our variables on a dog's ability to detect birds. Before analysis we used a Pearson's correlation matrix to detect highly correlated predictive variables ($|r| > 0.70$). Several variables were highly correlated with other predictive variables and were therefore removed, including dew point and Nudd's board readings at strata 1, 2, 3, 5, and 7. Nudd's board strata 4, 6, and 8 essentially represent distinct classes of vertical vegetation structure: low, mid, and high.

We used second-order Akaike's Information Criterion (AIC$_c$) as a method of model selection (Burnham and Anderson 2002). We developed 18 biologically relevant models using weather variables, trial specifics, vegetation measurements, and dog details. Logistic regression and

model selection were performed using the package 'glm' and 'AICcmodavg' (Mazerolle 2012) in Program R (R Version 3.2.2, www.r-project.org, accessed 11 Nov 2015; R Core Team 2015). Modeled variables included bird type (pen-reared vs. wild), hunting season (2013–2014 or 2014–2015), wind speed (m/sec), time of day, sight tube readings, barometric pressure (in. Hg), ambient temperature ($^\circ$ C), season timing (early vs. late), Nudd's board measurements (intervals 4, 6, and 8), dog experience classification (wild vs. liberated), and percent relative humidity (RH). We did not perform multimodel inference because the top model had AIC$_c$ weight close to 1.0. We assessed statistical significance of model coefficients using 85% confidence intervals (Arnold 2010) with results excluding zero considered statistically significant.

RESULTS

We conducted 114 dog trials during the 2013–2014 ($n = 53$) and 2014–2015 ($n = 61$) bobwhite hunting seasons. Of these 114 trials, 55 were conducted with wild birds and 59 with pen-reared birds. Following Bonferroni correction, vegetation measurements were similar between wild and pen-reared dog trial locations (Table 1). Dogs detected bobwhite during 46 of 59 (78.0%) pen-reared trials and 16 of 55 (29.1%) wild bird trials. During wild bird trials, liberated dogs detected bobwhite in 8 of 24 (33.3%) trials and wild dogs detected bobwhite in 8 of 31 (25.8%) trials. During pen-reared bird trials, liberated dogs detected bobwhite in 22 of 27 (81.5%) trials and wild dogs detected bobwhite in 24 of 32 (75.0%) trials. When dogs did not detect wild quail, we observed birds running away 64.1% of the time and remaining motionless 20.5% of the time. We were unable to confidently identify wild bird responses during 15% of unsuccessful trials. Although we did not statistically analyze the second pass of each trial, we conducted second passes during 44 trials (9 pen-reared and 35 wild), of which dogs detected bobwhite in 55.6% of pen-reared and 22.9% of wild bird second attempts.

Following dog trials, 52 dog handlers participated in posttrial surveys, representing 91.5% of the total trials conducted. When asked what best represents their perspective on wild bobwhite behavior during the trial:

Table 2. Selection for candidate models, from logistical regression, to explain northern bobwhite detection by hunters using dogs at Peabody Wildlife Management Area, Kentucky, USA, 2013–2015.

Model	K[a]	AIC_c[a]	ΔAIC_c[a]	w_i[a]
Bird type (pen-reared vs. wild)	2	132.66	0.00	1
Global	15	153.55	20.89	0
Wind speed	2	159.05	26.39	0
Intercept only	1	159.19	26.54	0
Year	2	160.59	27.93	0
Time of day	2	160.94	28.28	0
Barometric pressure	2	161.07	28.41	0
Ambient temperature + Wind speed	3	161.12	28.46	0
Sight tube	2	161.16	28.50	0
Ambient temperature	2	161.25	28.59	0
Season timing (early vs. late)	2	161.26	28.60	0
Nudds8	2	161.26	28.60	0
Nudds6	2	161.27	28.61	0
Nudds4	2	161.27	28.61	0
Dog experience (liberated vs. wild)	3	161.46	28.80	0
Ambient temperature + Sight tube	3	163.27	30.61	0
Ambient temperature + RH	3	163.32	30.66	0
Ambient temperature + RH + Wind speed + Sight tube	5	165.41	32.75	0

[a] Abbreviations: AIC_c: Akaike's information criterion adjusted for small sample sizes; K: no. of parameters; ΔAIC_c: difference between AIC_c of best fitting and current model; w_i: Akaike's weight; Nudds8: percent vegetation cover at stratum 8; Nudds6: percent vegetation cover at stratum 6; Nudds4: percent vegetation cover at stratum 4; RH: relative humidity; Sight tube: average sight tube reading at trial corridor.

38.5% of participants indicated that they behaved as expected, 57.7% of participants indicated that they were more evasive than expected, 0% of participants indicated they were less evasive than expected, and 3.9% of participants indicated that they had no opinion. When asked what best represented their perspective on pen-reared bobwhite behavior during the trials: 69.2% of participants indicated that bobwhite behaved as expected, 17.3% of participants indicated that bobwhite were more evasive than expected, 9.6% of participants indicated bobwhite were less evasive than expected, and 3.9% of participants indicated that they had no opinion.

Model selection indicated that the most parsimonious model included bird type (wild vs. pen-reared; AIC_c = 132.66; w_i = 1.00; Table 2). Estimated odds of a dog detecting a pen-reared bird were 8.62 times higher than the odds of a dog detecting a wild bird (4.70–16.35 85% CI, β_{wild} = −2.15 ± 0.43 SE). We did not observe a significant relationship in any other variables included in our analysis based on β estimates, because 85% confidence intervals overlapped 0.

DISCUSSION

The results of our study indicated that bird detection was influenced primarily by bird type (wild vs. pen-reared). Based upon odds-ratios, dogs were 8.62 times more likely to detect pen-reared versus wild birds. With the exception of bird type, little association was observed between bird detection and other variables included within our AIC_c models.

Observed differences in detection were likely a result of behavioral or scent emission dissimilarities between pen-reared and wild birds. For example, numerous behavioral differences have been observed between wild and liberated pen-reared bobwhites (Klimstra 1975, Roseberry et al. 1987, Perez et al. 2002, Jung 2010), which may make liberated birds easier to detect. Additionally, scent emission differences between wild and pen-reared birds may have facilitated differences in detection. For instance, pen-reared birds may be more readily detected by dogs because they were temporarily held in soft-release boxes where they were likely exposed to fecal matter increasing scent emission. Behavior and scent emission dissimilarities were likely 2 of the key factors that caused differences in detection between pen-reared and wild bobwhite.

We did not observe an association between dog experience classification (wild vs. liberated) and bird detection. Although not statistically significant, liberated dogs, with greater experience hunting pen-reared birds, were marginally more likely to detect wild coveys than were wild dogs with greater experience hunting wild birds. The similarity in detection rates between wild and liberated dogs is contrary to expectations. Based upon posttrial survey results, 68.6% of participants indicated that they expected liberated dogs to find wild coveys at a lower rate. However, our results do not support this contention. Repeated exposure to pen-reared quail does not appear to decrease the effectiveness of bird dogs when hunting wild quail. It is possible that liberated dogs may have more overall hunting experience (i.e., days in the field) than wild dogs, which may facilitate increased bird detection; however, this is an area that warrants future research.

Although we included a seasonal variable (early vs. late season) in our model, timing of trials did not have an influence on bird detection. Similarly, in Florida and Georgia (Palmer et al. 2002, Wellendorf et al. 2012), time of season was not shown to significantly impact bobwhite hunting success. On our study site, it is likely that either birds uniformly exhibit avoidance behavior throughout the season as a result of high hunt intensity, particularly rabbit (Leporidae) hunting pressure, or our sample sizes may have been too small to detect significant effects of seasonality on bobwhite detection.

Within our study there were a number of research limitations. Although pen-reared quail had no covey affiliation prior to soft-release, we observed birds behaving as a covey following release. Bobwhites are gregarious, so it is unlikely that pen-reared birds separated following soft-release; however, we recognize this possibility as a limitation of our study design. In an effort to prevent pen-reared birds from scattering from the release site, we limited the time between soft-release and the beginning of trials. Our high pen-reared detection rates validate that liberated birds remained in the hunting corridor during trials. We recognize that the scent characteristics of soft-release boxes may have facilitated

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detection of pen-reared bobwhite by dogs; however, we made efforts throughout the study to limit time that coveys were contained within soft-release boxes. Finally, few weather and vegetation variables appeared to influence bird detection. This may be a result of small samples sizes because our study was logistically limited in the number of dates it was conducted. Future research should be conducted to investigate the impact that environmental, especially weather, variables may have on bird detection.

Although we did not directly investigate the factors that influence hunter satisfaction, we postulate that hunting pen-reared quail may have unexpected consequences on hunter perceptions. Many quail hunters in Kentucky hunt pen-reared bobwhite and it is possible that hunter perceptions may influence hunter satisfaction. For example, during participant surveys, most hunters reported that wild coveys were more evasive than expected. The relatively lower detection rates experienced when hunting wild bobwhite, as compared with pen-reared bobwhite, may reduce hunting satisfaction when pursuing wild birds. However, hunters may increase detection rates by thoroughly searching an area repeatedly following a false point because, as our results show, it is likely that wild coveys are remaining motionless or running away when dogs pass a covey location. As our results have demonstrated, a second pass through an area suspected to contain wild birds may be an effective way to increase hunting success. Furthermore, hunters may benefit from using more than 1 dog during hunting trips because research has shown that exploration rates and hunt corridor size increases as the number of dogs within parties increases (Guthery and Mecozzi 2008).

MANAGEMENT IMPLICATIONS

Bird type has the potential to significantly affect detection, with dogs 8.62 times more likely to detect pen-reared birds than wild birds. With a significant proportion of Kentucky bobwhite hunters harvesting pen-reared quail, high detection rates experienced when hunting pen-reared birds may reduce hunting satisfaction with the relatively lower detection rates experienced with wild bobwhite. We suggest that land managers work to educate hunters regarding detection differences between wild and pen-reared birds. Future research is needed to evaluate hunter satisfaction in the context of wild and pen-reared bobwhite.

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