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# THREAT AVOIDANCE BEHAVIOR AND LAND USE OF THE NORTHERN BOBWHITE IN THE ROLLING PLAINS OF TEXAS

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## ABSTRACT

Northern bobwhites (*Colinus virginianus*) are an economically important species for several regions within the state of Texas. Bobwhites, along with their fiscal importance, fill a key role within the ecosystem as an *r*-selected common prey species. However, throughout the past few decades, bobwhite populations have plummeted to record lows. Currently many studies are investigating possible causes behind this precipitous decline, but efforts to discover better land management practices that provide preferred habitat for bobwhites should not be abandoned. Current landscape recommendations related to bobwhite escape cover stem from data collected on anthropogenic threats to bobwhites (i.e., coveys flushed by human disturbance). Bobwhites have a multitude of non-anthropogenic threats in the wild, and the existing data may lack important information regarding threat-specific avoidance behavior. Predation is a primary cause of bobwhite mortality, and we focused on bobwhite anti-predatory behavior and resulting land-use strategies with an ultimate goal of providing management recommendations to increase bobwhite survival. We designed and conducted an experiment to investigate not only bobwhite responses to anthropogenic threats, but also their responses to common natural predators. We investigated bobwhite behavioral and use of cover actions in response to 4 threat types: researchers, hunters, raptors, and nocturnal mammals. We collected data from January through March in 2010 and from November 2010 through March 2011. We measured characteristics of bobwhite flushing behavior, flight speed, and land and vegetative use when presented with specific threats. We located radio-marked coveys and conducted a walk-through for the researcher threat, if necessary, to cause the birds to flush. The hunter and raptor threats were conducted similarly with introduction of pointing dogs and shotgun blasts for the hunting scenario, and introduction of a trained northern goshawk (*Accipiter gentilis*) to give chase to bobwhites in the raptor scenario. We followed the same methods as the researcher treatment when creating the nocturnal mammal treatment, but conducted the test at night and followed the birds' flight with a thermal imaging scope. There was a significant difference in landing cover among threat types with bobwhites selecting shrubs for landing cover when pursued by a raptor ( $P < 0.0001$ ), whereas they showed no selection for shrubs when flushed by the other threat types. Bobwhites landed in live oak (*Quercus virginianus*) mottes and hackberry (*Celtis reticulata*) shrubs with the highest frequency, followed closely by wolfberry (*Lycium barbarum*), lote bush (*Ziziphys obtusifolia*), and Englemann's pricklypear (*Opuntia engelmannii*) when escaping the raptorial threat. These 5 species accounted for 49% of all shrubs used (19 total species) as escape cover in the raptor treatment. Obstructive vegetative height was higher at landing sites when bobwhites were presented with a raptor ( $P < 0.0001$ ) or hunter ( $P = 0.033$ ) threat; however, bobwhites displayed no selection for obstructive vegetative height when presented with a researcher or nocturnal mammal threat. Further analyses will include modeling environmental and experimental parameters to find likely predictors of bobwhite threat avoidance behaviors, such as flushing speed, flight speed, and flight distance; behaviors that arguably affect energy expenditure and may interact with bobwhite health and predator avoidance capabilities. Our results suggest that land management recommendations based solely on anthropogenic threats may be insufficient to enable successful bobwhite escape strategies from raptors. Considering the availability and 'integrity' of shrubs as escape cover from raptors when contemplating brush management plans may enhance bobwhite management. We expect to provide threat-specific land management recommendations for bobwhites related to shrub species and density as well as grass density with continued analysis of these data.

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