BRUSHPILES: A TIME FOR OPPORTUNITY AND RE-EXAMINATION

W. PAUL GORENZEL, Department of Wildlife and Fisheries Biology, Cooperative Extension, University of California, Davis, CA, 95616

E. LEE FITZHUGH, Department of Wildlife and Fisheries Biology, Cooperative Extension, University of California, Davis, CA, 95616

1989 TRANSACTIONS OF THE WESTERN SECTION OF THE WILDLIFE SOCIETY 25:60-64

Abstract: From the early days of modern wildlife management through the present, brushpiles have been promoted as a management tool for small upland game. Brushpile design and use has changed little since pioneering field trials in Texas in the 1930's and 40's. In California, publications by the Department of Fish & Game and Cooperative Extension have ensconced brushpiles for managing California quail (*Callipepla californica*). Current recommendations call for simple brushpiles with elevated foundations. Brushpiles should be 4.6-6.1 m in diameter and 1.8-2.4 m high. They should be placed no farther than 30 m from escape cover, or at a density of less than 4-5 brushpiles/ha. Despite current guidelines, there are no research-based data regarding optimum construction specifications, placement, replacement, or economics of brushpiles for California quail. Guidelines in textbooks and the popular literature are based on qualitative factors. Firewood cutting on California hardwood rangelands has created not only the raw material for brushpiles on thousands of hectares, but research and management opportunities for quail and nongame birds.

In this paper we examine the use of brushpiles as a management technique for birds. A brushpile (BP) is defined as the logs, limbs, or branches from trees or shrubs piled into a heap or mound. We review the literature to consider the origins and evolution of BPs as a management tool; provide a listing of current construction and placement recommendations; and discuss the research needs and the opportunity for BP use in California's hardwood rangelands.

We thank S. Mastrup for insightful discussions regarding BPs and quail and for being an invaluable associate in our field studies. We thank H. Hamilton and S. Mastrup for comments on the manuscript. This study was partially funded by the Renewable Resources Extension Act, S/L 86-87, Project No. J-620357-21067-7.

LITERATURE REVIEW

Origins and Evolution of Brushpiles

1930's: This decade saw the publication of major wildlife management texts and pioneering field work on BPs. Game Management (Leopold 1933:317-318) influenced the management of wildlife for future decades. This text may have been the first to discuss BPs. Leopold, while not using the term BP, called them "quick and substitute coverts" for cottontails and offered suggestions on materials and placement.

In work that would influence BP design to the present time, Lehmann (1937, 1939) experimented with BPs of two differing designs for northern bobwhite (*Colinus virginianus*). The pole shelter, about 1.8 x 2.1 m in size, consisted of poles or boards laid in 2 or 3 alternating layers on top of wooden uprights 15-36 cm high. A layer of brush was laid over the top of the structure. Grass on one side of the structure was removed to provide a clear view and dusting sites. The second design, called a tent or wigwam shelter, consisted of limbs stacked together like a tepee, then covered with brush laced to the limb-frame with barbed wire. The shelter, about 1.2-1.5 m in diameter and 1.5-1.8 m high, was open in the center for bobwhite movement within. In 15 fenced food patches, each with a pole shelter and a wigwam shelter, bobwhite preferred the wigwam shelters (Lehmann 1939:5-6).

At Tule Lake Wildlife Refuge in northern California, Dill (1939) constructed lean-to shelters, similar to Lehmann's pole shelters, to provide winter cover for California quail. The roof consisted of big sagebrush (*Artemisia tridentata*) piled over a framework of poles supported by posts set in the ground in the front and a low wall of rocks in the rear. The interior was filled with willow brush placed to leave sufficient space for only the entry and exit of quail. An automatic hopper-type feeder was placed next to 30 of the shelters. Quail regularly used the shelters through the winter. Although not calling them BPs, Dill's paper was the first in California to describe and use the elevated-foundation design that would become common in later years.

1940's: This period is marked by experimentation with different designs and an increased understanding of the value of BPs for selected species.

Linduska (1947) measured the thermal advantages of BPs in winter and use by the eastern cottontail (*Sylvilagus floridanus*). A textbook by Trippensee (1948) promoted BPs for rabbits, bobwhite, and pheasant. Trippensee mentioned a new use of BPs by apple growers to lessen rabbit damage in orchards. Branches pruned in the fall or winter were piled to provide food and cover until spring, making the rabbits less likely to feed on live trees (Trippensee 1948:37).

Lehmann (1948) described BP studies for bobwhite from the early to mid-1940's in southern Texas. This work continued the field trials from the 1930's and represented the most comprehensive test-

ing of different designs and field installations in the literature. Several kinds of elevated-foundation and wigwam (later called tepee) BPs were built. Wigwam types again proved superior; the favored design consisted of brush piled over a supporting tepee frame of seven 15-20 cm diameter posts and net-wire fencing. Plantings at the base grew to provide a permanent canopy.

In another trial wigwam BPs were built with different grouping and 10 and 15 BPs were used consistently while groups of 5 BPs or less were not (Lehmann 1948:187).

Emlen and Glading (1945) recommended the elevated-foundation design from Lehmann (1937). They suggested that BPs near orchards harbor pests and should be burned every spring.

1950's: Only one publication of note about BPs appeared during this period. MacGregor (1950) described the artificial roost for California quail. This was a modification of the elevated-foundation design, with a BP supported by a pipe and wire frame elevated 2 m above the ground.

1960's: In California, Department of Fish and Game popular publications continued to promote BPs. Bauer (1962) again recommended the elevated-foundation design from Emlen and Glading (1945) and stated that BPs should be located within 61 m of other escape cover. Speth (1962:4) asserted that BPs and artificial roosts were successful and mentioned two cooperative projects with sportsmens groups, landowners, and public agencies to improve quail habitat.

In Oklahoma, Schemnitz (1961) observed that scaled quail (*Callipepla squamata*) used man-made structures including Christmas-tree BPs. Schemnitz cited several popular publications on scaled quail use of BPs and suggested that BPs could increase populations in cover-deficient areas.

Not mentioned in prior editions, BPs achieved a new status in the third edition of Wildlife Management Techniques. Yoakum and Dasmann (1969:200) provided specific guidelines about BPs for western quail. Repeating Bauer's (1962) statement of placing BPs within 61 m of other escape cover, they also recommended BPs be: no more than 0.4 km from water; 1.5-1.8 m in diameter; 0.9 m high; elevated 15 cm above the ground on a rock or limb framework; placed at a density of 2.5 BPs/ha in clearings of 40 ha or more. Yoakum and Dasmann also gave specific BP guidelines for cottontails, wild turkey (*Meleagris gallopavo*), and javelina (*Tayassu tajacu*).

1970's: With the publication of important management texts, this period saw the continued promotion of BPs along with specific guidelines for field installations. Burger (1973:103) in a practical text recommended using an elevated foundation with piles 3.0-4.6 m in diameter, 1.5 m high, and placed to provide travel lanes or escape cover near feeding or nesting areas. In *The California Quail*, Leopold (1977) again recommended the elevated-foundation design depicted in Emlen and Glading (1945). Leopold described two new approaches: a system developed by Ray Conway in Yuba County using a bulldozer to create small BPs, and movable BPs used by Ian McMillan in San Luis Obispo County to encourage quail foraging into coverless terrain.

Giles (1978:152-154) recognized that BPs are attractive to more than game species. He stated BPs tend to be species-or group-specific and most valuable to species with low cruising radii. Each BP has a zone of influence over which wildlife are attracted. A manager's objective is to disperse BPs throughout the habitat so that every part lies within a zone of influence. Giles provided specific details for optimum BP designs including size, height, placement specifications, thermal advantages, costs ($10/BP), longevity (10 years), and expected wildlife population changes.

1980 to present: This period saw continued interest in BPs as a management tool, consideration of BP economics and use by nongame species, and the start of a quantitative approach in examining wildlife use of BPs. In the fourth edition of the *Wildlife Management Techniques Manual*, Yoakum et al. (1980:345) repeated the text from the third edition, but reduced the recommended BP density from "one pile per acre" to 1/ha. They listed BP values from Warrick (1976) and recognized BP use by white-crowned sparrows (*Zonotrichia leucophrys*) and Harris' sparrows (*Zonotrichia querula*). They suggested BPs should not be a specific practice, but instead a by-product of other land treatments (e.g., timber harvest, stand improvement, land clearing).

In California, Fitzhugh (1983) emphasized use of BPs for quail. For escape cover Fitzhugh recommended BPs 3.7-4.6 m in diameter and 1.8-2.4 m high. Smaller BPs (2.4-3.7 m in diameter, 0.6-1.5 m high) on hunted areas would provide better and safer shooting without obstructing the shooter's view. They could also be dismantled easily for retrieval of wounded birds.

In Texas Guthery (1980, 1986) offered recommendations based on Lehmann's (1939) designs. Guthery estimated initial costs of $5 and $40, and a life span of 3 and 5 years for tepee and elevated-foundation BPs, respectively. Culminating the management-oriented BP literature was Martin and Steele (1986). Primarily a literature review, it is perhaps the best single reference available for BPs.

Quantitative, data-based studies related to BPs also appeared in the 1980's. Characteristics of bobwhite loafing cover described by Johnson and Guthery (1988)

have direct application to BPs. In a pen and field study Boyer (1989) evaluated bobwhite use of five different man-made shelters, including the tepee and elevated-foundation designs. Several publications (e.g., Caraco et al. 1980, Grubb and Greenwald 1982, Lima 1987, Lima et al. 1987) examined songbird foraging behavior, risk aversion, or use of cover. Although not specifically about BPs, these papers gave insight into how some passerines use BPs. Swihart and Slade (1985) determined the effect of BPs on a potential quail predator, the hispid cotton rat (*Sigmodon hispidus*).

CURRENT BRUSHPILE RECOMMENDATIONS

To consolidate the findings from our literature review and personal observations during three years of BP studies in northern California we suggest the following design and installation guidelines.

Design and Construction

The relatively complicated framework of tepee-design BPs limits the size to which they can be easily built. We recommend a simple, elevated-foundation design. Although the foundation can be elaborate (e.g., a metal gate on cement blocks), materials available on site are usually sufficient. If possible, use limbs 15 cm or more in diameter as a base laid in two or more alternating layers to create runways and internal space within the pile. On firewood harvest sites, limbs >15 cm will not be available, so use the largest limbs remaining (usually firewood cutters will leave everything less than 7.6-10 cm) and other features (e.g., stumps, previously downed logs, rocks) to give elevation.

Complete the BP by filling the center and gaps in the outer canopy with smaller limbs and branches. The outer canopy should be dense enough to stop predators but still allow access for the target species. Rot resistant trees and shrubs with stiff, angular branching patterns form looser piles and maintain their loft longer. Plants such as valley oak (*Quercus lobata*), blue oak (*Q. douglasii*), interior live oak (*Q. wislizenii*) are excellent materials. If cut with their leaves on, some oaks, in particular live oaks, may retain leaves on the branches for six months or more, adding an extra measure of visual concealment to the BP. Orchard prunings, although readily available, may not be the best quality materials; often they are short, relatively straight, and leafless.

BPs 4.6-6.1 m in diameter and 1.8-2.4 m high, slightly larger than suggested by Fitzhugh (1983), provide escape cover for quail and songbirds. Small BPs 1.5-1.8 m in diameter and 0.9 m high (Yoakum et al. 1980:345) may serve to stop running quail or shelter a nest, but would be inadequate to shelter a covey from an aerial predator.

Placement

Locate BPs wherever increased habitat use and escape cover are desired. Adult California quail will not forage into the open any farther than 15 m (Sumner 1935:194). Cover requirements are more restrictive for adults with chicks under the age of six weeks; broods forage no farther than 3 m from cover (S. Mastrup, pers. commun.). For quail, build BPs no farther than 30 m from other escape cover. Any opening of 30 x 30 m or greater is a candidate for a BP. Recommendations (Yoakum and Dasmann 1969) to build 2.5 BP/ha in large clearings of 40 ha or more for scaled quail would result in a 64 m distance between BP centers if they were uniformly distributed. Although adjacent BPs would be well within the 180-275 m flight capability of California quail (Leopold 1977), the middle 34 m between them would probably remain unused as foraging areas. At 1BP/ha (Yoakum et al. 1980), spacing between BPs would be 100 m, leaving 70 m distance between piles unused for foraging. We recommend at least 5 BPs/ha to increase use of large clearings by California quail.

Brush stands heavily grazed by livestock may benefit from BPs. Often the ground under and between the individual shrubs lacks hiding spots. BPs built immediately next to or around existing shrubs provide a more complex cover unit than either component alone and protect the shrubs from browsing. BPs built in a donut-shape centered over the stumps of stump-sprouting species (e.g., live oaks) provide cover and are eventually replaced by the growing woody shoots. This method is especially applicable to firewood harvest sites.

Do not place BPs where they could be a fire hazard. Do not locate BPs along levees or earthen dams where they might obstruct inspection or attract ground squirrels whose burrowing might weaken the structure. BPs in some rangeland areas may provide sheltered burrow sites for California ground squirrels (*Spermophilus beecheyi*).

Longevity

In time a BP decays and settles, eventually ceasing to be functional for the target species when the openings and interior spaces are too small for entry. The rate of decomposition depends on materials used, construction design, climatic factors (e.g.,rainfall, wind), and the presence of livestock. Decay rates are probably less in arid climates and when cattle are absent.

Fitzhugh (1983) said BPs would be useless in three to five years; however, recent bird counts from sites in northern California revealed some oak BPs 7 to 8 years old still used by songbirds and quail (W. P. Gorenzel and S. Mastrup, unpubl. data). Measurements of oak BPs with known starting heights show an average decrease in height of 31% after one year but with internal space still adequate for bird use (Gorenzel and Fitzhugh, unpubl. data).

Maintenance

Periodically inspect BPs for adequate internal space and renovate as needed with new materials placed on top. BPs that have lost their value for birds may be removed by burning, but other wildlife uses (e.g., den sites for small rodents, reptiles) will be lost.

Costs

Costs for BPs in California are not documented and are variable depending on the number and design of the BPs, personnel and equipment needs. On firewood harvest sites BPs are inexpensive and are created as a natural by-product of the harvest process.

Research Needs and Opportunities

The use of BPs has changed little since Lehmann's original field trials in the 1930's and 40's. Despite the detailed recommendations in the literature and our additions above, most applications are based on anecdotal accounts, undocumented field observations, tradition, repetition from previous publications, or conjecture. We found no research-based studies with supporting data about California quail and BP use, yet BPs are routinely recommended for quail. We do not imply that all recommendations are inappropriate, but a quantitative approach is needed if we are to apply BPs in the best possible manner.

We suggest the following subjects for research:

1. Review of the Pittman-Robertson funded, unpublished research reports regarding BPs and quail.
2. A survey of California Fish and Game management areas and private fee-hunting clubs to determine the location and number of BPs installed, designs used, costs, and target species response.
3. Identification of species using BPs, seasonal use patterns, design and size preferences of different species. These factors may vary on a regional basis.
4. Population response to BPs--is carrying capacity increased or is distribution merely shifted?
5. Optimum placement scenarios regarding density per unit of area (e.g., 30/ha or 5/ha?) and distance to other habitat features (e.g., other BPs, escape cover, water).
6. Wildlife use over time -- how does it change?
7. Longevity -- what is the functional lifetime of a BP?
8. Rejuvenation -- is top-dressing of old BPs an effective method to increase wildlife use?
9. Economics -- what are the costs of making or removing BPs, the value of livestock forage removed by BPs, and the contribution of BPs to hunting area lease values.
10. Long-term models integrating different management activities, such as a model for sustained firewood harvest tied to BP rejuvenation or replacement needs.
11. Development of predictive models rating BP use potential. Such models developed on a regional basis would provide guidelines for new BPs and also identify existing BPs of low value for removal.

CONCLUSION

Conservation of the hardwood rangelands in California is a major concern (Schmidt and Tietje 1987). Comprising about 3.0 million ha dominated by oaks (Bolsinger 1988), these lands represent the most important California quail habitat remaining. Although hardwood rangelands are beset with a number of management concerns (e.g., residential development, rangeland conversion, poor oak regeneration), firewood cutting is of great interest and offers the best opportunity for quail and nongame bird management. Bolsinger (1988) found evidence of cutting on 313,000 ha, with about 121,000 ha cut within the last five years, suggesting a rapid expansion in firewood cutting.

Firewood harvest creates slash, the raw materials for BPs. Usually the slash is piled to be burned later or left for wildlife. Large numbers of BPs can be created. On the Sierra Foothills Range Field Station in Yuba County, woodcutters felled 1,349 trees on seven patch cuts totaling 5.8 ha. They built 378 BPs averaging 13.6 m^2 and 1.3 m high, about the size recommended for hunted areas by Fitzhugh (1983). BP density averaged 65.2/ha (W. P. Gorenzel and S. Mastrup, unpubl. data).

The quantities of BPs available on harvest sites offer excellent opportunities for experimental manipulations and quail management. Researchers and managers should make every effort possible to preserve and use these resources while management systems are under development. With an appropriate research-based educational program aimed at private landowners, we may be able to enhance quail and nongame bird populations through the wise use of BPs.

LITERATURE CITED

BAUER, O. 1962. Improving land for California valley quail. Calif. Dep. Fish and Game Manage. Leafl. No. 8. 10pp.

BOLSINGER, C.L. 1988. The hardwoods of California timberlands, and savannas. USDA For. Serv. Pacific Northwest For. and Range Exp. Sta., Portland, OR. PNW-RB-148. 148pp.

BOYER, D.A. 1989. Evaluation of feeders, waterers, and shelters for use in bobwhite management. M. S. Thesis. Texas A&I Univ., Kingsville, TX. 56pp.

BURGER, G.V. 1973. Practical wildlife management. Winchester Press. New York, N.Y. 218pp.

CARACO, T., S. MARTINDALE, AND H.R. PULLIAM. 1980. Avian time budgets and distance to cover. Auk 97:872-875.

DILL, H.H. 1939. Winter feeding and shelters for the California valley quail. Trans. N. Am. Wildl. and Nat. Resour. Conf. 4:474-477.

EMLEN, J.T., Jr., AND B. GLADING. 1945. Increasing valley quail in California. Univ. Calif. Agric. Exp. Sta. Bull. 695. 56pp.

FITZHUGH, E.L. 1983. How to increase California quail populations. Univ. of Calif. Div. Agric. Sci. Leafl. 21325.

GILES, R.H., JR. 1978. Wildlife management. W. H. Freeman and Co., San Francisco, Calif. 416pp.

GRUBB, T.C., JR., AND L. GREENWALD. 1982. Sparrows and a brushpile: foraging responses to different combinations of predation risk and energy cost. Anim. Behav. 30:637-640.

GUTHERY, F.S. 1980. Bobwhites and brush control. Rangelands 2:202-204.

_____. 1986. Beef, brush and bobwhites. Caesar Kleberg Wildl. Res. Inst., Texas A&I Univ., Kingsville, TX. 182pp.

JOHNSON, D.B., AND F.S. GUTHERY. 1988. Loafing coverts used by northern bobwhites in subtropical environments. J. Wildl. Manage. 52:464-469.

LEHMANN, V.W. 1937. Increase quail by improving their habitat. Texas Game, Fish and Oyster Comm., Austin, TX. 44 pp.

_____. 1939. Habitat improvements for quail. Texas Game, Fish and Oyster Comm. Bull. No. 17. 12pp.

_____. 1984. Bobwhites in the Rio Grande Plain of Texas. Texas A&M University Press. College Station, TX. 371pp.

LEOPOLD, A. 1933. Game management. Charles Scribner's Sons, New York, N.Y. 481pp.

LEOPOLD, A.S. 1977. The California quail. Univ. of Calif. Press, Berkeley. 281pp.

LIMA, S.L. 1987. Distance to cover, visual obstructions, and vigilance in house sparrows. Behaviour 102:231-238.

_____, K.L. WIEBE, AND L.M. DILL. 1987. Protective cover and the use of space by finches: is closer better? Oikos 50:225-230.

LINDUSKA, J.P. 1947. Winter den studies of the cottontail in southern Michigan. Ecology 28:448-454.

MacGREGOR, W.G. 1950. The artificial roost-a new management tool for California quail. Calif. Fish and Game 36:316-319.

MARTIN, C.O., AND J.L. STEELE, JR. 1986. Brush piles. U.S. Army Corps of Engineers Waterways Exp. Sta. Tech. Rep. EL-86-13, Vicksburg, Miss. 19pp.

SCHEMNITZ, S.D. 1961. Ecology of the scaled quail in the Oklahoma panhandle. Wildl. Monogr. No. 8. 47pp.

SCHMIDT, R.H., AND W.D. TIETJE. 1987. Coordinating wildlife management with hardwood conservation: the extension approach. Trans. W. Sect. Wildl. Soc. 23:33-35.

SPETH, J. 1962. A better place to live...key to more quail. Outdoor Calif. 23:3-4.

SUMNER, E.L., JR. 1935. A life history study of the California quail, with recommendations for its conservation and management. Calif. Fish and Game 21:275-342.

SWIHART, R. K., AND N. A. SLADE. 1985. Seasonal use of brushpiles by the hispid cotton rat (*Sigmodon hispidus*). J. Mamm. 66:577-580.

TRIPPENSEE, R.E. 1948. Wildlife management upland game and general principles. McGraw-Hill Book Co., Inc., New York, NY. 479pp.

WARRICK, C.W. 1976. Artificial brush piles. USDI Bur. Land Manage. Tech. Note 290. 5pp.

YOAKUM, J., AND W.P. DASMANN. 1969. Habitat manipulation practices. Pages 173-231 *in* R.H. Giles, Jr., ed. Wildlife management techniques, Third Ed. The Wildlife Society, Washington, D.C.

_____, _____, H. R. SANDERSON, C. M. NIXON, AND H. S. CRAWFORD. 1980. Habitat improvement techniques. Pages 329-403 *in* S. D. Schemnitz, ed. Wildlife management techniques manual, Fourth Ed. The Wildlife Society, Washington, D.C.