



Manipulation of Grazing to Improve or Maintain Wildlife Habitat

Jerry L. Holechek; Raul Valdez; Sanford D. Schemnitz; Rex D. Pieper; Charles A. Davis

Wildlife Society Bulletin, Vol. 10, No. 3. (Autumn, 1982), pp. 204-210.

Stable URL:

<http://links.jstor.org/sici?sici=0091-7648%28198223%2910%3A3%3C204%3AMOGTIO%3E2.0.CO%3B2-P>

Wildlife Society Bulletin is currently published by Alliance Communications Group.

Your use of the JSTOR archive indicates your acceptance of JSTOR's Terms and Conditions of Use, available at <http://www.jstor.org/about/terms.html>. JSTOR's Terms and Conditions of Use provides, in part, that unless you have obtained prior permission, you may not download an entire issue of a journal or multiple copies of articles, and you may use content in the JSTOR archive only for your personal, non-commercial use.

Please contact the publisher regarding any further use of this work. Publisher contact information may be obtained at <http://www.jstor.org/journals/acg.html>.

Each copy of any part of a JSTOR transmission must contain the same copyright notice that appears on the screen or printed page of such transmission.

JSTOR is an independent not-for-profit organization dedicated to and preserving a digital archive of scholarly journals. For more information regarding JSTOR, please contact support@jstor.org.

MANIPULATION OF GRAZING TO IMPROVE OR MAINTAIN WILDLIFE HABITAT¹

JERRY L. HOLECHEK, *Department of Animal and Range Sciences, New Mexico State University, Las Cruces, NM 88003*

RAUL VALDEZ, *Department of Fishery and Wildlife Sciences, New Mexico State University, Las Cruces, NM 88003*

SANFORD D. SCHEMNITZ, *Department of Fishery and Wildlife Sciences, New Mexico State University, Las Cruces, NM 88003*

REX D. PIEPER, *Department of Animal and Range Sciences, New Mexico State University, Las Cruces, NM 88003*

CHARLES A. DAVIS, *Department of Fishery and Wildlife Sciences, New Mexico State University, Las Cruces, NM 88003*

Abstract: Most rangelands by necessity must be managed for multiple use. Research is increasingly showing that dual use of rangeland by livestock and wildlife is often compatible when livestock grazing is carefully managed and wildlife needs are considered. Specialized grazing systems show potential for amelioration of negative impacts of livestock grazing on wildlife habitat.

WILDL. SOC. BULL. 10:204-210

Increases in both livestock and wildlife production will be necessary on both public and private rangeland in coming years because of rapid human population growth (Cook 1979, Council for Agricultural Science and Technology 1974). Therefore, wildlife and range managers must fully understand the impacts of different livestock grazing methods on wildlife.

A compromise must be reached on most public ranges between production of wildlife and livestock. Currently most public agencies are directed by law to manage their land for multiple use. This challenges both range and wildlife managers to develop livestock grazing methods that will result in optimal production of these commodities. Our objective is to discuss how grazing can be manipulated to improve wildlife habitat and to promote compatibility between livestock and wildlife.

WILD UNGULATES

Grazing systems can be used to minimize livestock grazing impacts on wild ungulates. In some cases, livestock grazing can be used to improve wild ungulate habitat.

Skovlin et al. (1968, 1976) found mule deer (*Odocoileus hemionus*) and elk (*Cervus elaphus*) in Oregon preferred deferred-rotation cattle grazing to season-long grazing because the former provided elk and mule deer with pastures free from cattle disturbance. Komberc (1976) reported similar findings with mule deer in Montana. Reardon et al. (1978) found that a 7-pasture, rapid-rotation grazing system supported higher white-tailed deer (*O. virginianus*) densities than continuous or 4-pasture deferred-rotation grazing systems in Texas. They concluded that deer prefer to stay in periodically deferred pastures and the more frequent the deferment, the higher the preference for the system. Merrill et al. (1957) reported white-tailed deer made greater use of deferred-rotation pastures than those grazed continuously at higher rates.

¹ Journal Article 920, Agricultural Experiment Station, New Mexico State University, Las Cruces, NM 88003.

Cattle have been used effectively to improve elk winter range in Oregon (Anderson and Scherzinger 1975). The grazing strategy involved using cattle to partially defoliate grasses in the late spring and early summer so the remaining forage cured in a highly nutritious state. Care was taken to remove cattle before the end of the growing season to ensure that adequate high quality forage remained for the elk. On the Bridge Creek Wildlife Management Area (WMA) there were about 320 elk counted annually between 1961 and 1964 with no cattle grazing. Cattle grazing was initiated to improve forage quality in 1964, and by 1974 the elk had increased to about 1,190. Because there was no experimental control, it cannot be determined whether grazing management or some other factor caused increased elk numbers.

Spring grazing of cattle or sheep effectively increased available browse to mule deer (Jensen et al. 1972, Smith and Doell 1968, Smith et al. 1979). This grazing strategy resulted in livestock eating primarily understory grasses and shrubs that compete with bitterbrush (*Purshia tridentata*). The productivity of the bitterbrush was increased because of reduced competition. Care was taken to remove sheep from the area before the understory forage species matured or excessive use of the bitterbrush occurred. In British Columbia (Willms et al. 1978, 1979) and Oregon (Leckenby 1968) light to moderate summer grazing of bunchgrass (*Agropyron spicatum*) range by cattle improved these ranges for mule deer in the spring and fall because nutritious new growth was more available than on ungrazed range.

UPLAND GAME BIRDS

Results from studies examining specialized grazing system impacts on upland game birds have been inconsistent. Because different upland game bird species have different habitat requirements, the most effective grazing method depends on the game bird species, type

of vegetation, and terrain involved. Rest-rotation and deferred-rotation grazing systems are beneficial to most game bird species because they provide pastures free from disturbance during nesting and other critical seasons. However, this benefit may be offset if heavy use occurs in the grazed pastures.

In northern Nevada, rest-rotation grazing has improved sage grouse (*Centrocercus urophasianus*) habitat (Neel 1980). Forbs are important foods of sage grouse in the summer (Klebenow 1969, Klebenow and Gray 1968). Neel (1980) reported in Nevada that rest-rotation management increased forb abundance and that moderately grazed meadows were more attractive to sage grouse than protected meadows. However, because of lack of cover, overgrazed meadows were not used.

Sharp-tailed grouse (*Pediacetes phasianellus*) may not adapt to conventional grazing systems (Sisson 1976). In Montana, rest-rotation grazing appeared detrimental to sharp-tails because the birds did not adjust to changing grazing patterns (Nielson 1978). This grazing system did not improve range condition or wildlife habitat. However, the stocking rate of grazed pastures was too heavy for maintenance of an adequate vegetation residue.

In northeastern Oregon, blue grouse (*Dendragapus obscurus*) on the Bridge Creek WMA may have benefited from a specialized livestock grazing system designed to improve the quality of winter forage for elk (Anderson and Scherzinger 1975). Prior to the initiation of livestock grazing, blue grouse were rarely seen during the summer nesting season. They became a common sight after a cattle grazing plan was implemented. Although there was no experimental control, the increase may have resulted from the stimulation and opening up of stagnant vegetation by carefully controlled defoliation.

Limited livestock grazing has potential as a tool for maintaining Attwater's (*Tympanuchus cupido attwateri*) and greater prairie

chicken habitat (*T. c. cupido*). However, overgrazing has been a more important factor limiting prairie chicken populations than undergrazing (Hamerstrom and Hamerstrom 1961). Attwater's prairie chickens avoid matted, thick cover of ungrazed coastal prairie (Kessler and Dodd 1978, Lehmann 1941). However, carefully controlled rotational grazing by livestock along with burning and mowing can be used to maintain optimal cover conditions (Kessler and Dodd 1978). This same strategy could benefit greater prairie chickens in the eastern part of their range (Westemeier 1972).

Bobwhite quail (*Colinus virginianus*) numbers were higher under a high intensity, low frequency (HILF) grazing system than under continuous or a 4-pasture deferred-rotation (4 PDR) system during a 2-year study in southern Texas (Hammerquist-Wilson and Crawford 1981). In this study, continuous grazing was superior to the 4 PDR system. They attributed the high numbers of quail in the HILF and continuous pastures to the greater amounts of bare ground and tall forbs and the lesser amounts of grass that occurred in these pastures compared with 4 PDR pastures. Stoddard (1931) reported that few bobwhite were found in dense stands of grass in the southeastern United States. Dense stands of grass support few preferred quail food items (Jackson 1969, Kiel 1976). Bare ground in conjunction with tall forbs appears to provide the most desirable surface for bobwhite movement and feeding (Hammerquist-Wilson and Crawford 1981).

Livestock grazing in conjunction with prescribed burning provides bobwhite with optimal habitat in the Southeast. Reid (1954) reported that under light or moderate grazing there is little overlap of quail and cattle diets on longleaf pine (*Pinus palustris*) range. He found that light or moderate cattle grazing maintained important quail foods and permitted free movement of quail.

In southcentral New Mexico, wild turkeys (*Meleagris gallopavo merriami*) showed no

preference for either grazed or ungrazed rest-rotation pastures (Jones 1981). However, in southern Texas, a 4-pasture, deferred-rotation grazing system appeared beneficial because it provided wild turkeys with better nesting habitat than continuous grazing (Merrill 1975). Jones' (1981) study was conducted in mountainous terrain where livestock use was moderate and where practically no use occurred on steep slopes which were used by turkeys for nesting. The Texas studies were conducted in relatively flat topography. Blakey (1944) suggested that establishment of 40–200 ha exclosures for each 1,200–2,000 ha of rangeland would be beneficial to turkeys in Texas. He recommended grazing be excluded from these areas for 24-month periods. However, the effectiveness of grazing exclosures has never been tested.

Montezuma quail (*Cyrtonyx montezumae*), greater prairie chickens in the western part of their range, lesser prairie chickens (*T. pallidicinctus*), bobwhite quail in the southwestern U.S., and sharp-tailed grouse in the western part of their range in the United States are very sensitive to livestock grazing because they require later successional stages and terrain that allow broad access to cattle. In years with near or above average precipitation light or moderate grazing does not severely affect these birds in most localities (Brown 1978). However, in drought years serious population declines occur because of reduced cover and food (Brown 1978, Hamerstrom and Hamerstrom 1961). These declines can be greatly magnified by grazing that is poorly controlled (Brown 1978). Brown (1978) suggested that interspersions of ungrazed exclosures through grazed pastures could be effective in maintaining cover for these game birds during critical times of the year and during drought. However, Webb (1981) reported a lack of evidence that exclosures were an effective tool for increasing bobwhite quail populations in Texas. The value of exclosures as a wildlife habitat improvement tool needs study. Reduc-

ing stocking rates is usually cheaper than building fences.

Populations of many upland game birds associated with riparian zones such as California quail (*Lophortyx californicus*), ring-necked pheasants (*Phasianus colchicus*), ruffed grouse (*Bonasa umbellus*), Gambel's quail (*L. gambeli*), and bobwhite could probably be enhanced by temporary or permanent fencing of sections along waterways. This practice has shown promise for improvement of habitat of many nongame wildlife species (Duff 1979, Winegar 1977); however, its value to upland game birds has not been investigated.

Upland game birds with high mobility that live in rugged terrain such as chukar partridge (*Alectoris chukar*), mountain quail (*Oreortyx pictus*), white-tailed ptarmigan (*Lagopus leucurus*), and blue grouse may benefit most from specialized grazing systems involving deferment. These birds can usually find adequate cover (i.e., chukar partridge use rocky hill-sides) if grazing is light or moderate, but in the spring they need a good vegetative cover and freedom from disturbance for nesting and brood rearing. A grazing system that allows part of the range to be deferred during the nesting and brood-rearing season should be effective.

WATERFOWL

Livestock grazing has been quite detrimental to many species of waterfowl when not carefully controlled (Braun 1978). Grazing systems show potential for amelioration of these adverse impacts.

In Montana, rest-rotation grazing increased waterfowl production when compared with season-long grazing (Gjersing 1975, Mundinger 1976). The rested and spring-grazed pastures under this system accumulated enough vegetation to provide conditions suitable for waterfowl production the following year. Under the rest-rotation grazing system, 4 times as many broods were produced/year as under

season-long grazing (Gjersing 1975). In southern Texas, carefully planned grazing that provides deferment, particularly during the growing season, can be used to mitigate the effect of cattle grazing on shoreline vegetation and to maintain good stands of waterfowl plant foods (Whyte and Cain 1981, Whyte et al. 1981). Evans and Krebs (1977) suggested that spring deferment of grazing around stock-watering ponds in the northern Great Plains would improve nesting use by waterfowl and shorebirds. They also reported that implementation of rest-rotation grazing would be less costly than pond fencing. Their recommendations were based on a 7-year study of waterfowl and shorebirds on man-made, stock-watering ponds in South Dakota.

Excessive accumulations of vegetation are sometimes detrimental to waterfowl (Kirsch and Kruse 1972). The Oregon Fish and Wildlife Commission uses controlled grazing to manipulate vegetation on the Ladd Marsh and Summer Lake Management Areas. Limited grazing or burning every 1-3 yrs has increased blue-winged teal (*Anas discors*) production in Iowa and South Dakota (Bennett 1938, Burgess et al. 1965, Glover 1956, Kaiser et al. 1979). Native plant communities in good condition with matted mulch had the highest nest success and density in the study by Kaiser et al. (1979). Both excessive rest or overgrazing favor degradation of habitat by causing Kentucky bluegrass (*Poa pratensis*) invasion into the plant community. Burning, resting, haying, and controlled grazing were mentioned as tools to maintain optimal conditions for blue-winged teal (Kaiser et al. 1979).

NONGAME WILDLIFE

Most of the adverse effects of grazing on nongame wildlife occur in riparian zones where livestock tend to congregate and linger. Adverse impacts include the elimination of food and cover and a general reduction in habitat diversity.

Loss of woody deciduous plants is the major effect of heavy, uncontrolled grazing on riparian vegetation (Duff 1979, Glinski 1977). Although many biologists have suggested that only livestock exclusion will result in riparian habitat recovery, recent studies have shown carefully controlled grazing will give reasonable recovery at some locations (Kimball and Savage 1977, Vogler 1978). Separate fencing and management of riparian zones may be the quickest method of improvement. Because of cost this practice is only suitable for the more critical streams; destocking and rotation grazing show potential as practical means of restoration for small streams (Kimball and Savage 1977). Grazing sheep that are controlled by herding in place of cattle is an alternative for some locations (Platts 1981). Separate fencing and delayed livestock grazing on riparian meadows is a potential means for improving both vegetation and livestock production that is being studied by U.S. Forest Service personnel at the Starkey Experimental Range and Forest in northeastern Oregon.

CONCLUSIONS AND MANAGEMENT CONSIDERATIONS

Grazing, when carefully controlled, can be a useful tool for enhancement of wildlife habitat. However, the frequency, intensity, and timing of livestock grazing for maximum wildlife benefits may be different than what would be used for maximum livestock production. In some cases burning and/or mowing give better results than livestock grazing when the primary goal is wildlife habitat improvement. Other situations may require some combination of grazing, burning, and/or mowing. The wildlife manager must keep in mind that each situation is unique and, therefore, requires a separate analysis and a different prescription. Generalizations are difficult to make because habitat needs vary tremendously among wildlife species.

Any grazing program that results in exces-

sive defoliation of a pasture in order to rest another pasture will probably fail in the long run from the standpoint of vegetation, wildlife, and livestock. For many range plants, a year or more of rest does not compensate for a year of excessive use (Cook and Child 1971). Whenever use is considered, the amount of forage removed is not nearly so important as the amount of residue that remains. This is critical for maintenance of wildlife, soil, and vegetation. Condition of most ranges will deteriorate when 50% or more of grazable vegetation is used on a year-to-year basis (Hyder 1953). Hyder (1953) based proper range use upon leaving critical residues rather than on removal of a certain percentage of the herbage produced because yearly vegetation growth on western ranges fluctuates greatly in response to precipitation. During drought years even moderate use (removal of 40–60% of the annual growth) often leaves an inadequate residue for wildlife and site protection. If evaluation of grazing intensity were based on a stubble height rather than percentage use, managers would have a common reference point for decision making that reflects grazing severity from the standpoint of wildlife, livestock, and vegetation. Unlike percentage use, stubble heights can be easily measured (Valentine 1970).

Knowledge concerning how grazing can be manipulated to maintain or improve wildlife populations is still quite limited. In the West there are vast tracts of federal land that must be managed for multiple use. We believe that research regarding the development of grazing strategies for wildlife and range enhancement of these lands should be a high priority.

LITERATURE CITED

- ANDERSON, E. W. AND R. J. SCHERZINGER. 1975. Improving quality of winter forage for elk by cattle grazing. *J. Range Manage.* 28:2–7.
- BENNETT, L. J. 1938. *The blue-winged teal: its ecology and management.* Collegiate Press, Inc., Ames, IA. 144pp.

- BLAKEY, H. L. 1944. Wild turkey vs. range management. *Tex. Game and Fish* 2(10):14-15.
- BRAUN, C. E. 1978. Management of national wildlife refuges in the U.S.: its impacts on birds. *Wilson Bull.* 70:309-321.
- BROWN, D. E. 1978. Grazing, grassland cover and gamebirds. *Trans. N. Am. Wildl. Natl. Resour. Conf.* 43:477-485.
- BURGESS, H. H., H. H. PRINCE, AND D. L. TRAUGER. 1965. Blue-winged teal nesting success as related to land use. *J. Wildl. Manage.* 29:89-95.
- COOK, C. W. 1979. Meat production potential on rangelands. *J. Soil and Water Conserv.* 34:168-171.
- AND R. D. CHILD. 1971. Recovery of desert plants in various states of vigor. *J. Range Manage.* 24:339-344.
- COUNCIL FOR AGRICULTURAL SCIENCE AND TECHNOLOGY. 1974. Livestock grazing on federal lands in the eleven western states. *J. Range Manage.* 27:174-181.
- DUFF, D. A. 1979. Riparian habitat recovery on Big Creek, Rich County, Utah. Pages 91-92 in O. B. Cope, ed., *Forum-grazing and riparian/stream ecosystems*. Trout Unlimited, Denver, CO.
- EVANS, K. E. AND R. R. KREBS. 1977. Avian use of livestock watering ponds in western South Dakota. U.S. Dep. Agric. For. Serv. Gen. Tech. Rep. RM-35. Fort Collins, CO. 11pp.
- GJERSING, F. M. 1975. Waterfowl production in relation to rest-rotation grazing. *J. Range Manage.* 28:37-42.
- GLINSKI, R. L. 1977. Regeneration and distribution of sycamore and cottonwood trees along Sonoita Creek, Santa Cruz County, Arizona. Pages 116-123 in R. R. Johnson and D. A. Jones, eds., *Importance, preservation and management of riparian habitat: a symposium*. U.S. Dep. Agric. For. Serv. Gen. Tech. Rep. RM-43.
- GLOVER, F. A. 1956. Nesting and production of blue-winged teal in northwest Iowa. *J. Wildl. Manage.* 20:28-46.
- HAMMERQUIST-WILSON, M. M. AND J. A. CRAWFORD. 1981. Response of bobwhites to cover changes within 3 grazing systems. *J. Range Manage.* 34:213-215.
- HAMERSTROM, F. N., JR. AND F. HAMERSTROM. 1961. Status and problems of North American grouse. *Wilson Bull.* 73:284-294.
- HYDER, D. N. 1953. Grazing capacity as related to range condition. *J. For.* 51:206.
- JACKSON, A. S. 1969. A handbook for bobwhite quail management in West Texas Rolling Plains. *Tex. Parks and Wildl. Bull.* 48. 77pp.
- JENSEN, C. H., A. D. SMITH, AND G. W. SCOTTER. 1972. Guidelines for grazing sheep on rangelands used by game in winter. *J. Range Manage.* 25:346-352.
- JONES, K. H. 1981. Effects of grazing and timber management on Merriam's turkey habitat in mixed conifer vegetation of southcentral New Mexico. M.S. Thesis. New Mexico State Univ., Las Cruces, NM. 62pp.
- KAISER, P. H., S. S. BERLINGER, AND L. H. FREDRICKSON. 1979. Response of blue-winged teal to range management on waterfowl production areas of southeastern South Dakota. *J. Range Manage.* 32:295-299.
- KESSLER, W. B. AND J. D. DODD. 1978. Response of coastal prairie vegetation and Attwater prairie chickens to range management practices. Pages 473-476 in D. N. Hyder, ed., *Proc. 1st. Int. Rangeland Congr. Soc. for Range Manage.*, Denver, CO.
- KIEL, W. H., JR. 1976. Bobwhite quail population characteristics and management implications in south Texas. *Trans. N. Am. Wildl. Natl. Resour. Conf.* 41:407-420.
- KIMBALL, J. AND F. SAVAGE. 1977. Diamond Fork aquatic and range habitat improvements. U.S. Dep. Agric. For. Serv. Gen. Inf. Ref. 4, Ogden, UT. 19pp.
- KIRSCH, L. M. AND A. D. KRUSE. 1972. Prairie fires and wildlife. *Proc. Annu. Tall Timbers Fire Ecol. Conf.* 11:289-303.
- KLEBENOW, D. A. 1969. Sage grouse nesting and brood habitat in Idaho. *J. Wildl. Manage.* 33:649-662.
- AND G. M. GRAY. 1968. Food habits of juvenile sage grouse. *J. Range Manage.* 21:80-83.
- KOMBEREC, T. J. 1976. Mule deer population ecology, habitat relationships, and relations to livestock grazing management in "breaks" habitat of eastern Montana, and range relationships of mule deer, elk and cattle in a rest-rotation grazing system during winter and spring. *Mont. Res. Proj. W-120, R-6, 7, Study N-136-1.4, Job 2.* 79pp.
- LECKENBY, D. A. 1968. Influences of plant communities on wintering mule deer. *Proc. Conf. West. Assoc. State Game and Fish Comm.* 48:1-8.
- LEHMANN, V. W. 1941. Attwater's prairie chicken: its life history and management. U.S. Fish and Wildl. Serv., N. Am. Fauna 57. 62pp.
- MERRILL, L. B. 1975. Effect of grazing management practices on wild turkey habitat. Pages 108-113 in L. K. Halls, ed., *Proc. 3rd natl. wild turkey symp.* The Texas Chapter, The Wildlife Society, San Antonio, TX.
- , J. G. TEER, AND O. C. WALLMO. 1957. Reaction of deer populations to grazing practices. *Tex. Agric. Prog.* 3:10-12.
- MUNDINGER, J. G. 1976. Waterfowl response to rest-rotation grazing. *J. Wildl. Manage.* 40:60-68.
- NEEL, L. A. 1980. Sage grouse response to grazing management in Nevada. M.S. Thesis. Univ. of Nevada, Reno, NV. 48pp.
- PLATTS, W. S. 1981. Effects of sheep grazing on a riparian-stream environment. U.S. Dep. Agric. For. Serv. Res. Note Int-307. Ogden, UT. 6pp.
- REARDON, P. O., L. B. MERRILL, AND C. A. TAYLOR, JR. 1978. White-tailed deer preferences and hunter success under various grazing systems. *J. Range Manage.* 31:40-42.
- REID, W. H. 1954. Multiple land use: timber, cattle, and bobwhite quail. *J. For.* 52:575-578.

- SISSON, L. 1976. The sharp-tailed grouse in Nebraska. Nebr. Game, Fish and Parks Comm., Lincoln, NB. 88pp.
- SKOVLIN, J. M., P. J. EDGERTON, AND R. W. HARRIS. 1968. The influence of cattle management on deer and elk. *Trans. N. Am. Wildl. Natl. Resour. Conf.* 33:169-181.
- , R. W. HARRIS, G. S. STRICKLER, AND G. A. GARRISON. 1976. Effects of cattle grazing methods on ponderosa pine-bunchgrass range in the Pacific Northwest. *U.S. Dep. Agric. For. Serv. Tech. Bull.* 1531. 40pp.
- SMITH, A. D. AND D. D. DOELL. 1968. Guides to allocating forage between cattle and big game on big game winter range. *Utah Div. Fish and Game Publ.* 68-11. Salt Lake City, UT. 65pp.
- SMITH, M. A., J. C. MALECHEK, AND K. O. FULGHAM. 1979. Forage selection by mule deer on winter range grazed by sheep in spring. *J. Range Manage.* 32:40-45.
- STODDARD, H. L. 1931. The bobwhite quail: its habits, preservation and increase. Charles Scribner's Sons, New York, NY. 550pp.
- VALENTINE, K. A. 1970. Influence of grazing intensity on improvement of deteriorated black grama range. *N.M. State Univ. Agric. Exp. Stn. Bull.* 553. 20pp.
- VOGLER, J. P. 1978. Effects of grazing, clearing and stream channelization on riparian and associated vegetation of Guthrie County, Iowa. M.S. Thesis. Iowa State Univ., Ames, IA. 68pp.
- WEBB, W. M. 1981. Response of bobwhites to habitat management in the Rolling Plains of Texas. M.S. Thesis. Texas Tech. Univ., Lubbock, TX. 57pp.
- WESTEMEIER, R. L. 1972. Prescribed burning in grassland management for prairie chickens in Illinois. *Proc. Annu. Tall Timbers Fire Ecol. Conf.* 12:317-338.
- WHYTE, R. J. AND B. W. CAIN. 1981. Wildlife habitat on grazed or ungrazed small pond shorelines in South Texas. *J. Range Manage.* 34:64-68.
- , N. J. SILVY, AND B. W. CAIN. 1981. Effects of cattle on duck food plants in southern Texas. *J. Wildl. Manage.* 45:512-516.
- WILLMS, W., A. W. BAILY, A. MCLEAN, AND R. TUCKER. 1981. The effects of fall defoliation on the utilization of bluebunch wheatgrass and its influence on the distribution of deer in spring. *J. Range Manage.* 34:16-21.
- , A. MCLEAN, R. TUCKER, AND R. RITCEY. 1979. Interactions between mule deer and cattle on big sagebrush range in British Columbia. *J. Range Manage.* 32:299-304.
- WINEGAR, H. H. 1977. Camp Creek channel fencing—plant, wildlife, soil and water response. *Range-man's J.* 4:10-13.

Received 30 April 1981

Accepted 8 January 1982.

