

STATUS AND PROBLEMS OF NORTH AMERICAN GROUSE

A Contribution from the Wilson Ornithological Society Conservation Committee

North American grouse fall into three overlapping groups: the ptarmigans—Willow (*Lagopus lagopus*), Rock (*L. mutus*), and White-tailed Ptarmigan (*L. leucurus*)—breeding on the arctic tundra, in the far northern brushlands, and above timberline on mountain tops; the forest dwellers, Blue (*Dendragapus obscurus*), Spruce (*Canachites canadensis*), and Ruffed Grouse (*Bonasa umbellus*); and lastly, the grouse of prairies and plains, of forest edges and openings, the Greater and Lesser Prairie Chickens (*Tympanuchus cupido* and *T. pallidicinctus*), Sharp-tailed (*Pedioecetes phasianellus*) and Sage Grouse (*Centrocercus urophasianus*). Each group, by the nature of its environment, has been affected differently by the pressures of modern civilization. As a result, population status and the problems of survival differ more from group to group than from species to species within a group.

In this report we will give most attention to those species whose status is least secure. For generalized maps of the distribution of all species except Willow and Rock Ptarmigan, see Aldrich and Duvall (1955).

The ptarmigans are a widespread and successful group. As sources of human food, as distinct from sport hunting, it is likely that since prehistoric times the Willow and Rock Ptarmigan have had greater importance than any other grouse. Because their range is generally thinly populated by man and little changed by his activities, ptarmigan have not been much affected by this levy on their numbers. Sport hunting over their range as a whole has not been a large factor, but hunting is bound to increase in limited areas such as parts of Alaska and those sections in northern Canada near the increasing number of mining centers.

Newfoundland is a special case. There are no other upland game birds there in hunt-able numbers, although Ruffed and Spruce Grouse have recently been introduced in small numbers. The ptarmigans, and especially the larger and more accessible Willow Ptarmigan, are highly prized for hunting. Willow Ptarmigan appeared to be decreasing at an alarming rate in the early 1950's, especially on the Avalon Peninsula (Wildlife Management Institute, 1955), but by 1960 the population was high again (A. T. Bergerud, 1961, verbal). Studies now in progress may help to explain such fluctuations and to lead to a management program. It now appears that fire plays an important role in the ecology of Willow Ptarmigan: fire encourages *Vaccinium*, a valuable source of food, while the absence of fire allows the successional replacement of *Vaccinium* by *Kalmia*, which has little or no value for ptarmigan (Bergerud, *ibid.*).

The White-tailed Ptarmigan is the only species resident in the United States. Much of its high mountain range is now, and is likely to remain, relatively undisturbed, and hunting is so difficult that it is not often attempted. In a few places, however, grazing of alpine meadows may have seriously reduced and even eliminated ptarmigan populations. Possible examples occur in Montana in the Whitefish, Bitterroot, Flint Creek, and Anaconda-Pintlar Ranges, and in the Beartooth Plateau-Absaroka Range complex. Ptarmigan are gone from these places where old records—unfortunately not supported by specimens—suggest that they formerly occurred (R. S. Hoffman, 1960, letter). Grazing may have affected ptarmigan habitat in some areas in Washington (F. Zwickel, 1960, letter). Grazing drove ptarmigan almost to extirpation in the mountains of northern New Mexico many years ago (Ligon, 1927); they are now seen occasionally only on Costilla Peak, apparently as stragglers from nearby Colorado (J. S. Ligon, 1960, letter).

The Blue Grouse is a thriving species of the Douglas fir (*Pseudotsuga*) region of the far West (Beer, 1943). It is one of the major game birds over much of its range, as in British Columbia, western Alberta, Washington, Oregon, California, Idaho, Montana, Colorado, and Wyoming. In southeastern Alaska it is seldom hunted because of the difficult terrain in which it lives (R. B. Weeden, 1960, letter). In Utah, Nevada, Arizona, and New Mexico it is much less abundant than in the more northern parts of its range. Unlike most mountain dwellers, the Blue Grouse breeds at lower elevations, often as far down as the foothills, and moves to the mountain tops just below timberline for the winter. Most observers speak of the upward movement as beginning in summer (e. g., Wing, 1947; Hoffman, 1956), and Marshall (1946) relates it to the progressively later ripening of fruit at higher altitudes; Bendell (1955) dates the movement on Vancouver Island as beginning as early as late April for cocks and July for hens and young. As a result of this movement, the more easily hunted lower slopes hold only a part of the population by the time hunting seasons normally open, and a large part of the population is by then dispersed over the larger and less accessible winter range. In at least one area in California this upward movement and dispersal does not occur (Hoffman, 1956).

Lumbering and fire in the heavily forested coastal region have increased the primeval breeding range of the Blue Grouse, and the wintering range has been little affected. The net result has been an increase in the Blue Grouse population (J. F. Bendell, 1960, letter). In some places, for example Vancouver Island (Hatter et al., 1956) and parts of western Washington (F. Zwickel, 1960, letter), forest succession after cutting has already gone well beyond the early stages which are best for Blue Grouse. However, future cuttings will probably sustain a long-continuing population at a moderately high level. These same successional factors are also at work in the southern and more eastern parts of the range, but livestock grazing on the lower slopes presents a potential, and in places an actual, threat to breeding habitat. The problem is already recognized. For example, in Washington, B. L. Lauckhart (1960, letter) writes: "Our best blue grouse populations have developed on our department-owned big game winter ranges, where we have purchased the land and eliminated grazing of domestic livestock"; I. O. Buss (1960, letter) adds: "Although blue grouse, ruffed grouse, and Franklin grouse enjoy very good to excellent habitat conditions (status) today, it is entirely possible that the extensive ranges of these birds will be affected significantly when agricultural (particularly grazing) advancement infringes on the breeding range of the foothills of the mountains." Overgrazing appears to be reducing the breeding range of the Blue Grouse in Idaho, where the population has been on the decline for the past two or three decades (E. G. Bizeau, 1960, letter). Montana is currently measuring the effects of grazing on both Blue and Sharp-tailed Grouse (R. L. Eng, 1960, letter).

The Spruce Grouse is one of the most widely distributed North American grouse and one of the least understood. It is generally considered to be a bird of deep climax coniferous forests and swamps, but in parts of Ontario, Michigan, and Minnesota it is found in fair numbers in natural jack pine (*Pinus Banksiana*) stands. J. Hatter (1960, letter) writes of British Columbia: "It is my feeling that a certain amount of fire with the resultant openings in the climax forest does improve conditions for Spruce Grouse." It has the largest range of all grouse in Alaska, where it is a major game bird (Buckley, 1954). It is abundant enough to be hunted in Washington, Idaho, and Montana, although hunting pressure is generally light. In contrast, it occurs infrequently to rarely over much of the eastern part of its range. Scarcity is by no means caused only by the advance of civilization, for there appear to be regions of scarcity and of abundance in wilderness country as well. This is not to say that it has not been affected by civilization, for cer-

tainly there has been much loss of habitat and some harassment of remaining populations along the southern part of the eastern half or more of the geographic range. In Ontario south of Lake Nipissing, for example, the species has disappeared from all but a few localities (Lumsden, 1960, letter). Considering the vast range which it still occupies, one cannot call the Spruce Grouse a threatened species; nevertheless, this may be cold comfort for ornithologists in those eastern states where the bird is now rare. A full-scale study of the ecology and population dynamics of the Spruce Grouse is clearly needed, but we do not know of a single current example.

The Ruffed Grouse is the best known of the forest grouse, and the one that lives in closest association with civilized man. Where topography and climate have favored the large-scale conversion of forest to plowland, the Ruffed Grouse has been wholly wiped out over considerable areas, or reduced to small colonies in scattered farm woodlots. This happened as early as 1752 in parts of Pennsylvania (Bartram, quoted in Bump et al., 1947), and has been most conspicuously true in the southern and eastern parts of the range in Ohio, Indiana, Illinois, Kentucky, Tennessee, Iowa, Missouri, and in the southern parts of Ontario, Michigan, Wisconsin, and Minnesota. It has wholly or virtually disappeared from its once fairly large range in Arkansas, and from the smaller areas of former range in Alabama, Georgia, Nebraska, and Kansas (Aldrich and Duvall, 1955). Nor has the process of habitat destruction come to an end. In Ohio about 50,000 acres of agricultural land are currently lost to suburbs and industry each year, with woodlots and other timbered areas being cleared at a corresponding rate as replacement acres for agriculture (T. J. Peterle, 1960, letter).

However, where large stretches of forest have been partially broken up by the introduction of farms, or where such farms have been abandoned and the fields allowed to revert naturally to forest, Ruffed Grouse have been considerably increased over their primeval numbers. Second growth after fires and lumbering have similarly benefited Ruffed Grouse over a geographically enormous area, both by producing interspersed former monotypes and by turning forest succession back to the younger stages which are far more productive of Ruffed Grouse than mature stands are.

Both destruction and improvement of Ruffed Grouse range are constantly going on, and sometimes the same piece of ground has been affected more than once in historic times. Northern Wisconsin, for example, became much better Ruffed Grouse habitat when the old forests were logged off and replaced by younger stands. Today, however, much of the second-growth forest has passed beyond optimum conditions for Ruffed Grouse and the total population is probably now, or certainly soon will be, smaller than it was at its greatest. And in the earlier settled parts of the country like New England, the second growth itself has been cut, and cut again, with corresponding changes in grouse abundance.

The Ruffed Grouse is superb for sport hunting. On the basis of its wide distribution (coast to coast), total numbers (well into the millions), and annual kill (millions), it takes first place among all the grouse as a sporting bird. Furthermore, habitat management is now practiced, as with other game species in many areas where the population is not endangered, to make a fair population larger in order to improve hunting. There is already available a considerable body of technical knowledge. One of the most important problems still to be solved is how to fit Ruffed Grouse management into forest management. Silvicultural methods are changing and already are very different from those that produced such abundant crops of grouse and deer in the past. Large pine plantations, often established at the expense of vitally important openings, are virtually worthless for wildlife, but are an increasingly large part of modern forestry programs. Group-selection-

cutting is aimed at maintaining an essentially closed canopy, and by that very fact tends to discourage both the mixture of plant species and of age classes which Ruffed Grouse must have.

It is not simple to manage a forest so as to produce sustained crops of both timber and wildlife. Wildlife is most abundant in young forests and in forests with a mixture of age classes most of which are young. It follows that almost any cutting will benefit wildlife sooner or later and in some degree. Cuttings are sometimes planned deliberately to benefit deer and Ruffed Grouse. But such glittering generalities as "the best forest management is the best game management," while sometimes true, do an enormous disservice by glossing over the ecological complications and outright contradictions which can be overcome only by direct and forthright action.

It is the grouse of open country and the forest edge—Greater and Lesser Prairie Chickens, Sage Grouse, and the three southern races of the Sharp-tailed Grouse—that are faring worst in modern times.

The Heath Hen, the eastern race of the prairie chicken, became extinct in 1932. The Attwater's Prairie Chicken, the southern race and the southernmost grouse in all the world, is on the verge of extinction. Once common on the coastal prairies of Texas and Louisiana, it is now restricted to scattered, isolated colonies in parts of 11 counties in Texas (P. B. Uzzell, 1960, letter). We estimate the total population at *less than one per cent of its former numbers*. There is no mystery about the cause of this decline: it is the conversion of prairie sod to rice fields and other crops, and the overgrazing of virtually all the remaining grassland. Time is running out. If the Attwater's Prairie Chicken is not to follow the Heath Hen, action will have to be taken at once. This is not just a question of protection against hunting: there has been no open season since 1937, yet the population continues to shrink. Neither is it a question of restocking, for there is no stock to be had; and if there were, could it be expected to fare any better than the wild birds already present? The solution lies in habitat management—in giving back, in some small measure, what has been taken away. If the Attwater's Prairie Chicken is finally lost it will not be through lack of knowledge of what to do, but through lack of doing. What needs to be done has been known for 20 years (Lehmann, 1941).

The Greater Prairie Chicken, with a much larger geographic range, is in better case than the Attwater's, but over much of its range the story is the same. Most of the original range has been plowed or grazed out of existence. Most of the acquired range to the north and west has been destroyed and fragmented through the same causes, as well as by the return of the forest to the new range in the Michigan and Wisconsin cutover. Thus, Greater Prairie Chickens are now gone from their primeval range in Ohio, Kentucky, Arkansas, and Texas. They occur now in Iowa only as occasional stragglers in the northeast and southwest corners (M. E. Stempel, 1960, letter). There are still prairie chickens in Indiana, but the *total population in the spring of 1960 is estimated at 98 birds* (W. B. Barnes, 1960, letter); in Illinois, where there are perhaps 100 small colonies in 25 counties (R. E. Yeatter, 1960, letter); in Missouri, mainly southwest of the Missouri River (D. M. Christisen, 1960, letter); and in eastern Kansas and eastern Oklahoma. Within the acquired range, which once was larger than the presettlement range, prairie chickens remain in about 16 counties in the northeastern Lower Peninsula of Michigan (G. A. Ammann, 1960, letter); in about 16 counties in central and northern Wisconsin; in about 500 square miles in northwest Minnesota (A. B. Erickson, 1960, letter; Farnes, Erickson, and Stenlund, 1960); in a few areas scattered throughout approximately 5,000 square miles of east central North Dakota (M. D. Johnson, 1960, letter); in South Dakota primarily in about 20 per cent (2,000 square miles) of a block of seven counties, plus a few

small outlying colonies (D. R. West, 1960, letter); in a broad band totaling some thousands of square miles along the eastern and southern edges of the central Nebraska Sandhills and to some extent within the Sandhills (L. L. Mohler, 1956, letter; M. D. Schwilling, 1960, letter); and in the northeast corner of Colorado, mainly in Yuma County (W. W. Sandfort, 1960, letter). The "millions of prairie chickens in Canada" that one hears about are sharp-tails. It is possible that a few true prairie chickens still persist near the lakes of central Alberta (M. C. Hammond, 1960, letter). One—*one*—was seen in Saskatchewan in 1959 by the one man who cannot be challenged, Roger Tory Peterson (verbal). Manitoba has a few reports of single birds within the last few years but "we do not know of one single flock to date" (R. E. McWhorter, 1960, letter). Ontario's one remaining colony, on Manitoulin Island, is probably disappearing, due to the invasion of sharp-tails (H. C. Lumsden, 1960, letter).

While complete and precise figures are not available, it is not far off to say that about 85 per cent of the presettlement range of the Greater Prairie Chicken has been expropriated and destroyed by being put to other uses. Perhaps the acquired range has fared a little better, but the Greater Prairie Chicken now occupies a range that is no more than about 10 to 20 per cent of the range at the time of its maximum extent. Populations are low over much of the present range, and reports from most areas indicate that habitat continues to disappear and the prairie chickens with it.

There are, however, encouraging signs at long last. Oklahoma is a particularly bright spot. The Greater Prairie Chicken once occurred there over the eastern two-thirds of the state. From about 1900 to 1925–1932 the habitat was severely damaged by plowing and overgrazing, finally accentuated by drought. The population dropped to the lowest level known (estimated at a few thousand birds in 1925) and the occupied range shrank to about 5,000 square miles in the northeast part of the state (Duck and Fletcher, 1945). The drought ended in the 1930's and the grass came back; more important—for drought is a recurring thing—there has been a change in land use which is favorable to prairie chickens. Many ranchers have learned that their lands are not suited to cultivation but will yield the greatest profit as grazing land. Further, range management is changing toward less intensive grazing—"take half and leave half"—again because this is best from the strict economic viewpoint. Under such a grazing regime, prairie chickens also thrive. Not only has the population on the residual range increased, but substantial areas elsewhere in Oklahoma have "come back" to the point where they can again support prairie chickens. A total of 830,000 acres has already been examined and found suitable, and considerably more is probably suitable but not yet appraised. A project under the direction of Karl F. Jacobs has transplanted 586 wild-trapped birds to restoration areas in seven counties over the last five years, in order to re-establish prairie chickens without waiting for natural spread to do the job. The transplantings have in most cases been successful and will be continued (Jacobs, 1959 and letter, 1960).

Kansas and Nebraska are experiencing a similar improvement in the condition of grasslands, and show encouraging gains in prairie chicken populations (D. C. Coleman, 1960, and M. D. Schwilling, 1960, letters). Habitat improvement is less general in the north, however. South Dakota had excellent production in 1958 but a very poor year in 1959 (D. R. West, 1960, letter), while in North Dakota the grasslands in the prairie chicken range are "still depleted" and the small colonies still present are "barely holding their own" (A. T. Klett, 1960, letter).

The importance of the changing trend in range management for cattle cannot be over-emphasized. If the scheme of "take half and leave half" is widely adopted and made permanent, the prairie chicken may change from an endangered species to a major

game bird in the western parts of its range. The same trend in grassland management strongly implies possible betterment in some areas for the Lesser Prairie Chicken, Sharp-tailed Grouse, Sage Grouse, and Blue Grouse as well as many other kinds of wildlife.

Farther east there are also encouraging developments for prairie chickens. Prairie chicken management is primarily land management; before one can manage land one must have some control over it. A movement to buy land for prairie chickens has started and is gaining momentum. The first piece was bought in Indiana in 1945, when 640 acres were bought with funds raised by the Izaak Walton League plus matching monies from the Pittman-Roberston program. Wisconsin's scatter-pattern plan (Hamerstrom, Mattson, and Hamerstrom, 1957) is moving ahead: from 1954 through 1960 a total of 1,885 acres on the Buena Vista Marsh has been privately purchased and leased to the state (Olson, 1961). These acres were bought by individuals, by the Prairie Chicken Foundation, the Wisconsin Conservation League, and the Wisconsin Society for Ornithology. The state of Wisconsin has bought 560 acres on the adjoining Leola Marsh. Michigan has started scatter-pattern purchase on its Missaukee County area (Ammann, 1957:168-9 and letter, 1960). Missouri started a similar program in 1959 by buying 1,440 acres of native prairie in St. Clair County, to which a series of smaller parcels will be added (C. W. Schwartz, 1960, letter). Illinois is currently raising money for land purchase through its Prairie Chicken Foundation, composed of the Illinois Audubon Society, Illinois Federation of Sportsmen's Clubs, Illinois Division of the Izaak Walton League, and the Illinois Chapter of the Nature Conservancy (R. E. Yeatter, 1960, letter). Twenty areas in northwestern Minnesota, totaling 20,000 acres, have been bought by the state as part of its wetlands program; most were bought primarily for waterfowl but all have prairie chickens on them (A. B. Erickson, 1960, letter). The Fish and Wildlife Service, on its refuges in Nebraska and the Dakotas, has recently started a prairie chicken-sharp-tail management program embracing annual display ground census, attempts to restock prairie chickens on the Sand Lake Refuge (South Dakota), and—most important—a determined effort to modify the pattern of hay mowing and to cut back grazing by permittee livestock (H. K. Nelson, 1960, letter; M. C. Hammond, 1960, letter). The Service is under pressure in some quarters to relax its mowing and grazing restrictions again and is to be commended for continuing its attempt to replenish the sadly depleted stock of prairie chickens on federal refuge lands. Both Illinois and Wyoming have tried introductions of wild stock.

The Lesser Prairie Chicken has a relatively small, horseshoe-shaped range along the east edge of New Mexico, across the panhandle of Oklahoma, the southeastern tip of Colorado, southwestern Kansas, and along both sides of the boundary between western Oklahoma and northeastern Texas. This is primarily grazing country, with little cropland. Overgrazing has been a serious problem, especially in times of drought. The Lesser Prairie Chicken has survived two severe droughts in the last 30 years.

In Kansas the Lesser Prairie Chicken nearly disappeared during the drought of the 1930's but showed considerable recovery by the 1950's (Baker, 1953; Schwilling, 1955); their numbers still seem to be increasing somewhat (D. C. Coleman, 1960, letter). Booming ground counts in Oklahoma (Copelin, 1959 and unpublished reports and letters 1955-1960) show increases from 1957 through 1959 but were still only about half of the high count for the late 1930's. Similar counts in New Mexico show an increase from 1953 through 1958 (L. G. Frary, 1955-1958, unpublished reports). Booming ground counts in Texas show a drop of more than 50 per cent as between 1942 and 1953 on two study areas. Most of this was attributed to the drought of 1952-53. Both areas have been censused each year since 1953, and although one of the two has shown some recovery, neither has reached 50 per cent of the 1942 count (A. S. Jackson, 1960, letter and unpublished reports).

Although Lesser Prairie Chickens are currently on the increase, their range and total numbers are nevertheless much reduced over presettlement days. They are particularly vulnerable at two points. Since they depend on medium and tall grasses in a region of low rainfall, their habitat is very sensitive to overgrazing. Furthermore, low shrubs, particularly shinnery oak (*Quercus havardii*) and sand sagebrush (*Artemisia filifolia*), which are also highly important parts of the habitat, are increasingly being killed with herbicides in the interest of pasture improvement. Although the trend toward moderation in grazing holds a great deal of promise, it is likely that many ranch owners who are progressive enough to adopt the new plan of grazing management would also practice brush removal.

New Mexico was the first to recognize—at least to the point of doing something about it—that the key to the welfare of the Lesser Prairie Chicken lies in the control of grazing. From 1938 to 1951, the state bought 22,844 acres and leased 800 acres for a total of 23,644 acres in 19 tracts, from which livestock has been fenced out. Grass recovery has been slow because of drought and severe damage by overgrazing in the past; nevertheless, these areas are considered to be of major importance in New Mexico's program of Lesser Prairie Chicken management. The U. S. Forest Service administers an area of about 107,000 acres in Morton County, Kansas. This is one of the recently established National Grasslands (U. S. Forest Service, 1960), and it has great potential for Lesser Prairie Chickens. Grazing has already been restricted on National Grasslands in southeastern Colorado (W. W. Sandfort, 1960, letter). On these areas and on New Mexico's Lesser Prairie Chicken restoration areas, where public ownership guarantees land control, it should be possible to work out the details of land management needed for the species, especially details related to tolerable limits of grazing, brush removal, burning, amount of cultivation, if any, which might be beneficial, and to carry forward a long-term gobbling ground census, etc.

The situation for sharp-tails is more complex. Little is known about the three northern races, *phasianus*, *caurus*, and *kennicottii*. It is generally taken for granted that they are getting along all right, for their range has not yet been much influenced by civilization. However, the exploitation of the far north has begun, and the northern birds will be less and less isolated as time goes on.

The southern races already feel the pinch. Two of them, *campestris* and *columbianus*, are in serious trouble. Sharp-tails of the prairie race, *campestris*, are already long gone from Illinois, Iowa, southern Wisconsin, and southern Minnesota. They are still abundant in parts of southwestern Ontario and in the parklands of southern Manitoba and east central Saskatchewan, but in northern Michigan, Minnesota, and Wisconsin—especially Wisconsin—they are rapidly being crowded out of existence. In this part of their earlier range they were found in bogs, blowdowns, and burns within the forest boundary, and in the extensive zone of brushland (also the result of fire) which lay along the edge between forest and prairie. Lumbering followed by fire in the slashings, and pioneer farming in the cutover, enormously expanded the primeval range in all three states for a time; but fire protection, natural forest succession, pine plantations, and modern clean farming within the successful farm communities in the cutover, have all played their part in taking away the new range until there is far less range than there was in the first place. Wisconsin has now planted to pine most of the primeval barrens as well as the abandoned farm fields, and effectively prevents the creation of new openings by its exceptionally efficient fire protection system (Hamerstrom, Hamerstrom, and Mattson, 1952). Michigan will have sharp-tails for a longer time and Minnesota longer still,

but without deliberate sharp-tail management all three states will fairly soon find sharp-tails on the rare bird list.

There is much still to be learned about the details of sharp-tail management, but in both Michigan and Wisconsin real progress has been made. The main difficulties in the way of a vigorous program are two: First, sharp-tail openings in the forest, particularly old fields and burns, are often the easiest areas to machine-plant to conifers. Large areas of monotypic plantations are regarded with increasing suspicion by foresters themselves. Nevertheless, in the competition for forest openings—a competition in which subsidies for tree planting play a very important part—sharp-tails are still coming out a poor second best. Secondly, sharp-tail populations are strongly cyclic, and a great many hunters lose interest when populations are low and hard to hunt; this, of course, discourages administrators in charge of public programs. Nevertheless, some lands are now being managed for sharp-tails, especially in Michigan (Ammann, 1957) and Wisconsin (Newman, 1959).

The western race *columbianus* has been hardest hit of all. It is gone from California (A. S. Leopold, 1960, letter), occurs in one small area (if it is still there) in New Mexico, is rare in Utah (about 1,500 birds—J. B. Low, 1960, letter), Nevada, and Oregon; rare or uncommon in Idaho and Washington except for a few counties in which it is still abundant enough to be hunted; and it is sometimes locally fairly abundant but is generally not common in parts of western Colorado, western Wyoming, and extreme western Montana. The only sizable populations left are in British Columbia, particularly in the Peace River, Vanderhoof, and Prince George regions, where land clearing and grain growing are still on a limited enough scale to have benefitted sharp-tails (Hatter et al., 1956). Overgrazing and intensive cultivation have been the primary causes of the decline of this race: see, for example, Buss and Dziedzic (1955). It is not likely that the rich wheatlands of the West will ever be restored to sharp-tail habitat, but changes in grazing practices do offer some hope.

The plains sharp-tail, *jamesi*, has the largest range of all six races and is by all odds the most successful of the three southern sharp-tails. While it has lost ground in the eastern and southernmost parts of its range—in the eastern parts of North Dakota, South Dakota, and Nebraska, and in all its former range in northwest Kansas—and while it has been thinned out over much of its range by overgrazing and cultivation, particularly wheat farming, it still occurs in impressive numbers over large parts of the Dakotas, Nebraska, and eastern Montana. There are fair to good populations in parts of northeastern Colorado and northern Wyoming. In the Prairie Provinces of Canada it reaches numbers little short of fabulous at the highs of the population cycle. Within the limits set by land use (and with a cautious hedge to allow for the influence of the unexplained grouse cycle), reproductive success appears to be high in cool-moist summers and low in hot-dry summers, with two to three cool-moist summers to be expected in each decade in South Dakota, for example (D. R. West, 1960, letter).

There is little deliberate management of the plains sharp-tail other than the regulation of hunting. Actually, little management is needed over the range as a whole, because this grouse is maintaining itself well and lives in a region of rather low human population and hunting pressure. Such general wildlife management practices as the planting of shelterbelts of trees and shrubs in the wheat country, the development of small water areas and their attendant variety in vegetation, and provision of winter food in some areas in the north, all undoubtedly benefit sharp-tails. Moderation of grazing pressure in rangelands would have a wider effect than any management applied directly and specifically for sharp-tails. The most conspicuous example of land man-

agement for this race is the program of grassland management which has been started by the Fish and Wildlife Service on the waterfowl refuges in the Dakotas and Nebraska, already mentioned in the section on the Greater Prairie Chicken.

The Sage Grouse has shown dramatic and not fully understood changes in abundance. It was once the leading upland game bird in most western states, but by 1937 had become so scarce over much of its range that it seemed close to extirpation (Patterson, 1950, 1952). Today it is again abundant enough to be a major game bird in a number of states, although both total range and total numbers are much reduced. Thus, the estimated kill in 1959 was 43,811 in Wyoming (D. A. Johnson, 1960, letter), 23,300 in Idaho (E. G. Bizeau, 1960, letter), 23,200 in Montana (R. L. Eng, 1960, letter), 17,304 in Oregon (R. U. Mace, 1960, letter), 15,335 in Colorado (C. E. Rogers, 1961, letter), and 11,738 in Nevada (C. W. Crunden, 1961, letter). By contrast, California hunts Sage Grouse in two to five counties and kills about 2,000-3,000 annually (California Department Fish and Game, 1958); Washington kills only about 2,000 annually (B. L. Lauckhart, 1960, letter); and the estimated kill in 1959 in Utah was "over 1,800" (C. M. Greenhalgh, 1960, letter). The Sage Grouse comes east in small numbers as far as the westernmost counties of North and South Dakota and Nebraska, and its range extends north into a narrow strip along the southern edges of southwestern Saskatchewan and southeastern Alberta. The species disappeared earlier from New Mexico and British Columbia. New Mexico successfully reintroduced Sage Grouse on a small scale by transplantings, and British Columbia is now trying to restock in the same manner.

Sage Grouse are closely dependent upon sagebrush (*Artemisia* spp.) throughout the year, and wholly so in winter. Ranchers consider sagebrush undesirable. They would rather have more grass for their sheep and cattle. Sagebrush eradication programs, subsidized with federal money, are "cleaning up" an ever increasing area and this, added to the overgrazing which has been chronic on much of the remaining Sage Grouse range, seriously affects Sage Grouse populations in many states.

Most of the states within the range of the species have had research studies in progress at one time or another, and several do at the present time. The most informative was that of Patterson (1952) who concluded that: (1) the largest Sage Grouse populations are in those states with the lowest human populations, (2) overgrazing by domestic livestock was the most important factor in the great reduction in numbers of Sage Grouse and other game in the early 1900's, (3) programs to eradicate sagebrush in order to improve grasslands for grazing are ecologically unsound and damage the range for Sage Grouse and other wildlife, and for domestic livestock as well, in the long run, and that (4) reclamation of sagebrush lands for agricultural purposes is the most serious threat to the welfare of Sage Grouse populations.

There are state or federal restoration areas for Sage Grouse in several states, for example, Washington, Oregon, Nevada, and Utah (and probably others). Other management measures which have been tried include the development of water supplies, transplanting of wild stock to speed re-establishment where natural spread was slow, and, of course, regulation of hunting. It has been pointed out in no uncertain terms, however, that regulation of permittee grazing on the public lands of the West is the governing factor (Patterson, 1952). Just as abuses of grazing on public lands caused the great decline of the early 1900's, so did later readjustments toward more reasonable livestock numbers bring about the increase in Sage Grouse which led to the much improved population levels of the present day. The implications for the future management of the Sage Grouse are abundantly clear.

In fact, the tetraonids as a group illustrate remarkably well a fundamental ecological

principle: that the welfare of any species is basically determined by the condition of its habitat. Modern man is now one of the major forces, often the most important, in shaping habitats. Ultimately, the preservation or destruction of many species is in our hands.

ACKNOWLEDGMENTS

This report is largely based on material not yet published. We are glad to acknowledge the help so generously given by 42 wildlifers in other states and in Canada and have identified them in the text. In almost every case the contribution of each man is greater than the one or two points at which his name is mentioned, for most of them sent information on all grouse in their respective states or provinces. Our thanks also to R. A. McCabe, T. G. Scott, and R. E. Yeatter for critically reading the manuscript.

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