CHANGES IN THE DISTRIBUTION AND ABUNDANCE OF COLUMBIAN SHARP-TAILED GROUSE IN WASHINGTON

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ABSTRACT

Columbian sharp-tailed grouse (Tympanuchus phasianellus columbianus) were historically found in shrub steppe, meadow steppe, steppe, and deciduous shrub communities throughout much of eastern Washington. The current range, consisting of 8 relatively small, isolated, populations, is less than 3% of historic range. Information collected since 1954 indicates 58% of 107 known lek complexes are currently vacant. Many of the vacant lek complexes (53%) are in areas where sharp-tailed grouse have been extirpated since 1954. Based on annual changes in number of birds counted on lek complexes, the number of sharp-tailed grouse in Washington declined by about 92% since 1954 to 858 birds in 1998. Historic and recent declines of sharp-tailed grouse appear linked to dramatic declines in quantity and quality of native habitat.

Key words: Columbian sharp-tailed grouse, *Tympanuchus phasianellus columbianu*s, abundance, distribution, shrub steppe, survey, Washington

Columbian sharp-tailed grouse (*Tympanuchus phasianellus columbianus*) historically occurred in California, Oregon, Washington, Nevada, Idaho, Utah, Montana, Colorado, Wyoming, British Columbia, and likely New Mexico (Aldrich 1963, Dickerman and Hubbard 1994). By the early 1970s, Columbian sharp-tailed grouse were extirpated from California, Nevada, and Oregon. However, as a result of recent transplant efforts, a small population of sharp-tailed grouse has been reestablished in northeastern Oregon (Snyder et al. 1999). Efforts are also underway to reestablish sharp-tailed grouse in northern Nevada (S. Stiver, pers. comm.). Although some localized populations of sharp-tailed grouse have recently increased in portions of Colorado, Utah, and Idaho, most populations are substantially reduced from historic levels (Giesen and Braun 1993; Connelly et al. 1998; McDonald and Reese 1998). Populations in British Columbia, Idaho, and Colorado are considered sufficient to support limited hunting seasons ($ 5000 birds in each population), whereas populations in Washington, Montana, Utah, and Wyoming are too small (# 1000 birds) (J. W. Connelly, pers. comm.).

The abundance and distribution of Columbian sharp-tailed grouse have clearly declined within the state of Washington (Yocom 1952; Buss and Dziedzic 1955; Washington Department of Fish and Wildlife 1995; Hays et al. 1998). In 1998, this decline lead to the state listing of the Columbian sharp-tailed grouse as a threatened species (Hays et al. 1998). The long-term decline of sharp-tailed grouse has been attributed to dramatic alteration of native habitat due to cultivation and degradation (Buss and Dziedzic 1955; McDonald and Reese 1998). Native

habitats include grass-dominated nesting habitat and deciduous shrub-dominated wintering habitat, both of which are critical for sharp-tailed grouse (Giesen and Connelly 1993; Connelly et al. 1998). The objective of this paper is to describe historic changes in distribution and abundance of Columbian sharp-tailed grouse that resulted in their 1998 listing and relate these declines to changes in habitat quantity and quality. We also discuss the significance of this information in relation to the development of alternative management strategies necessary to recover sharp-tailed grouse in Washington.

METHODS

Lek surveys

Male sharp-tailed grouse congregate on lek sites during spring to perform breeding displays and to mate with females (Connelly et al. 1998). Although most lek sites are traditional, some leks occasionally change or 'shift' locations annually forming clusters of locations in which the most widely separated annual locations are # 1 km apart (MAS, unpubl. data). We define these clusters as 'lek complexes'. Lek complexes are clearly spatially separated from each other.

We examined survey results of lek complexes conducted during 1954-1998 (Washington Department of Fish and Wildlife 1995; Hays et al. 1998) to obtain information on changes in sharp-tailed grouse distribution and abundance. Surveys of lek complexes during 1954-1969 usually consisted of a single count of birds attending a lek complex during the breeding season and did not represent a standardized effort. Surveys were expanded during 1970-1989, including

additional searches for new and/or previously undiscovered lek complexes and multiple ($ 2) visits to specific lek complexes. During 1990-1998 we attempted to visit all sharp-tailed grouse lek complexes in Washington on $ 2 occasions each year.

Distribution

We examined historic records and published literature on the distribution of sharp-tailed grouse throughout Washington (McClanahan 1940; Yocom 1952; Buss and Dziedzic 1955; Aldrich 1963; Zeigler 1979; Connelly et al. 1998; McDonald and Reese 1998). Because most of the earlier descriptions of sharp-tailed grouse distribution in Washington were based on relatively large-scale maps, they were often inaccurate. Consequently, we refined the historic distribution in Washington based on available records within areas that were not included on previous maps. We also removed some areas from the historic distribution that were clearly mountainous and unlikely to have supported sharp-tailed grouse in the past.

Lek complex locations and > 1,000 miscellaneous observations of sharp-tailed grouse between 1990 and 1998 were used to define current distributions. All of the active lek complexes and virtually all of the recent observations were within the boundaries of the current populations. The current distribution excluded 20 observations associated with recently vacated lek complexes or birds that appeared to be ‘wandering’ long distances from existing populations.

Abundance

Attendance of lek complexes was analyzed by using the highest number of birds observed on a single day for each lek complex each year. Average attendance at all lek complexes was used to evaluate annual population change and compare populations of sharp-tailed grouse in Washington with populations in other regions (Connelly et al. 1998). Rates of population change were analyzed by comparing the total number of birds counted at all lek complexes counted in consecutive years; or in 3 cases in the 1950s and 1960s, 2- to 4-yr intervals. Because sampling was occasionally biased by size and accessibility of lek complexes, lek complexes not counted in consecutive years or on both ends of a specific 2- to 4-yr interval were excluded from the sample for that specific interval. Annual rates of population change were then used to estimate annual spring populations from 1998 to 1954. The 1998 initial population was estimated by multiplying lek attendance numbers for each lek complex by 2; assuming that lek counts include mostly males and the male:female sex ratio is approximately 1:1 (Hays et al. 1998).

We used sharp-tailed grouse harvest data to help determine if estimates of past population size, and hence population declines, were realistic. Sharp-tailed grouse were legally harvested in Washington between 1953 and 1987 (excluding 1957) (Washington Department of Fish and Wildlife 1998). Estimates of harvest were only available for 1974 to 1980 in Washington; the harvest estimates were obtained with questionnaires sent to about 10% of the hunters as part of an annual assessment of harvest (Washington Department of Fish and Wildlife 1998). We estimated harvest rate by dividing harvest by estimated population size; we then compared

estimates of harvest rate with estimates for Columbian sharp-tailed grouse in Idaho (Connelly et al. 1998). Data on bag checks of hunters were available for 1959-1980. Because sharp-tailed grouse and sage grouse (*Centrocercus urophasianus*) were combined in a single prairie grouse category, only bag check data from regions where sharp-tailed grouse comprised $ 90% of the harvest were included. Analysis of harvest data consisted of linear regressions between spring population size (independent variable) and harvest during the following autumn (Proc REG, SAS Institute 1988).

Habitat

We examined changes in habitat within the historic range of sharp-tailed grouse using 1990 vegetation maps produced by the Interior Columbia Basin Ecosystem Management Project (ICBEMP) (Quigley et al. 1996) and interpreted by McDonald and Reese (1998). The habitat categories for ICBEMP included grassland, sagebrush (*Artemisia* spp.), herbaceous wetland, wetland shrub, cropland, and non-habitat (for sharp-tailed grouse). Potential habitats used by sharp-tailed grouse likely include grassland, sagebrush, herbaceous wetland, and wetland shrub (Oedekoven 1985; Marks and Marks 1988; Gardner 1997; McDonald 1998). Historic and current quantities of potential sharp-tailed grouse habitat were compared within the historic distribution of sharp-tailed grouse.

We used a Thematic Mapper (TM) sensor onboard the Landsat satellite to examine 1993 habitat data within the historic and current distribution of sharp-tailed grouse. Digital data from

TM channels 3, 4, 5, and 7 representing reflective light energy from the red, near-infrared, and two mid-infrared wavelength bands respectively, were used in an unsupervised cluster analysis which produced 175 possible habitat types (J. Jacobson, pers. comm.). Field data from ground reconnaissance during 1995-1997 characterized these habitat types, and that information was combined into 5 general habitat types including: 1) shrub steppe (including meadow steppe and steppe, Daubenmire 1970); 2) cropland; 3) CRP (federal Conservation Reserve Program in which cropland was converted to perennial grass; usually crested wheatgrass, *Agropyron cristatum*); 4) forest/shrub; and 5) other (wetland, barren, and sand dunes). CRP was included in the cropland category in the ICBEMP analysis.

RESULTS

Distribution

Most available evidence indicates that sharp-tailed grouse historically were widely and abundantly distributed throughout eastern Washington (Fig. 1). Lewis and Clark observed this species on the plains of the Columbia (Bent 1932) and David Douglas observed large numbers while traveling on the Columbia River between The Dalles (Washington-Oregon border) and Kettle Falls (close to British Columbia) in 1826 and 1827 (Douglas 1914). Because earlier descriptions of the historic distribution of sharp-tailed grouse in Washington often included mountainous areas that likely were not occupied and excluded areas that were apparently occupied (McClanahan 1940; Yocom 1952; Jewett et al. 1953; Aldrich 1963; McDonald and Reese 1998), we modified the historic distribution accordingly (Fig. 1). The revised map differs

from previous maps in numerous ways including the addition of the Methow River corridor and the exclusion of the Blue Mountains and Kettle River Range. The estimated historic distribution of Columbian sharp-tailed grouse in Washington spanned 79,865 km^2.

One hundred and seven lek complexes in Washington were documented with 1,416 observations of displaying birds between 1954 and 1998 (Fig. 2). Sharp-tailed grouse observations were reported on 1,838 additional occasions during the same time period. Although most lek complexes consisted of only one known location, one lek complex consisted of $ 10 locations that appeared to move on an annual or biannual basis. Movements of lek locations appeared to be more common with smaller lek complexes or with leks monitored for many years. Sixty-two (57.9%) of the lek complexes are currently vacant (Fig. 2). Thirty-three (53.2%) of the vacant lek complexes are in portions of the historic range that are no longer occupied. The remaining 29 vacant lek complexes (46.8%) reflect declines in density within occupied portions of the historic range.

Based on the distribution of active lek complexes and 1,669 miscellaneous observations between 1990 and 1998, sharp-tailed grouse appear to persist in eight relatively isolated populations that are separated by at least 20 km; Chesaw (70 km^2 area east of Oroville), Horse Springs Coulee (61 km^2 area southwest of Oroville), Tunk Valley (342 km^2 area northeast of Omak), Scotch Creek (79 km^2 area northwest of Omak), Greenaway Spring (340 km^2 area south of Omak), Dyre Hill (308 km^2 area south of Brewster), Nespelem (513 km^2 area north of Grand Coulee), and Swanson Lakes (521 km^2 area west of Davenport) (Fig. 1, 2). Twenty-three of the

45 active leks (51.1%) are on private land, 11 (24.4%) are on state or federal land, and 11 (24.4%) are on Colville tribal land. Three of the remaining 8 populations are dominated by state land, one is dominated by state and federal land, and one is dominated by Colville tribal land. The current distribution of sharp-tailed grouse covers approximately 2,234 km^2 or about 2.8% of the historic distribution. A relatively recent and rapid decline in distribution is illustrated by 20 observations of Columbian sharp-tailed grouse outside the current distribution since 1990 (Fig. 1). Most of the recent observations outside the established range represent known populations that have disappeared or been reduced since 1990. In contrast, sharp-tailed grouse have been recorded on 2,448 occasions within their current distribution since 1990.

Abundance

Major declines of sharp-tailed grouse occurred throughout the Palouse prairie between the late 1800s and the 1920s (Buss and Dziedzic 1955). Declines in other portions of Washington were steady throughout most of the 1900s (McClanahan 1940; Yocom 1952; Aldrich 1963; Miller and Graul 1980). Although early declines in the abundance of sharp-tailed grouse were poorly documented, they resulted in increased hunting restrictions (Yocom 1952). Hunting of sharp-tailed grouse was terminated in Whitman County in 1919 and statewide between 1933 and 1952. Although restrictive hunting seasons (2- to 9-d length, 1 to 2 bag limit) were eventually re-established between 1953 and 1987 (excluding 1957) in portions of Okanogan, Lincoln, Grant, and Douglas counties, statewide hunting was terminated in 1988 (Washington Department of

Fish and Wildlife 1995). Sharp-tailed grouse hunting is still permitted on the Colville Indian Reservation by Tribal members, but the harvest rate appears to be very low (< 5% of spring population, MAM, unpubl. data).

Average maximum attendance at lek complexes ($\bar{0}$ = 10.1, n = 715) between 1954 and 1998 appeared to decline at an annual rate of 1.3% (r^2 = 0.06, P = 0.10) (Fig. 3). The 1998 population estimate, based on lek counts, was 858: 410 at Nespelem; 162 at Swanson Lakes; 86 at Dyre Hill; and 200 in the Okanogan River areas (Tunk Valley, Greenaway Spring, Chesaw, Horse Springs Coulee, and Scotch Creek).

Analysis of annual changes in attendance at lek complexes indicate that the population declined an average of 4.8% (SE = 2.6%) per year between 1954 and 1998 (Fig. 4). The population declined in 24 of 39 (61.5%) year-to-year intervals (3 intervals were longer due to the lack of lek counts during 1956 to 1958, 1967, and 1969). These annual changes were used to estimate historical populations; the estimated population in 1954 was 10,138. The overall population declined almost continually between 1954 and 1998, particularly during the 1960s and 1970s, when the estimated population declined from about 10,000 to less than 1,000 birds (Fig. 4). The overall estimated decline was 91.5% between 1954 and 1998.

Harvest data collected during the 1974-1980 period indicated that the average annual harvest was about 467 birds; an average of 18.4% (SE = 1.6%) of the estimated spring population. Harvest rates of 3 to 10% of spring populations were observed for Columbian sharp-tailed grouse in Idaho (Connelly et al. 1998). There was no clear relationship between spring

population size and harvest during the following autumn ($r^2 = 0.01$, $P = 0.80$), perhaps because the sample size was only 7. Regular bag checks of hunters during 1959-1980 resulted in observation of 294 (range of 1 to 38 per yr) prairie grouse (the vast majority sharp-tailed grouse). Estimated population size tended to be positively correlated with the annual number of prairie grouse in the bag check ($r^2 = 0.17$, $P = 0.06$). Number of prairie grouse in the bag check declined at a significant ($r^2 = 0.24$, $P = 0.02$) and comparable rate (66%) to the decline in the estimated population (81%) during the 1959-1980 interval.

The remaining populations declined dramatically between 1970 and 1998 (not enough data to include years prior to 1970). The Okanogan River populations (Tunk Valley, Greenaway Spring, Chesaw, Horse Springs Coulee, and Scotch Creek) declined 92%, Dyre Hill declined 67%, Nespelem declined 69%, and Swanson Lakes declined 70%. Between 1988 and 1998, declines in Okanogan River, Dyre Hill, and Swanson Lakes populations were 69%, 39%, and 20% respectively, while the population at Nespelem increased 36%. The Okanogan River populations, which displayed the largest declines during both intervals, experienced a large vacancy rate on leks that were once relatively well-attended. The lek vacancy rate was 70% in the Okanogan River, 65% in Swanson Lakes, 58% in Dyre Hill, and 26% in Nespelem areas.

Habitat

Historic densities of sharp-tailed grouse were likely highest where shrub steppe, meadow steppe, and steppe habitats were intermixed with riparian, mountain shrub, and forest edge

habitats (Yocom 1952; Oedekoven 1985; Marks and Marks 1988; Meints et al. 1992; Giesen and Connelly 1993; Gardner 1997). Historic habitat (based on ICBEMP data) within the historic distribution of Columbian sharp-tailed grouse consisted of 44% sagebrush, 25% grassland, 1% herbaceous wetland, < 1% wetland shrub, and 30% non habitat (McDonald and Reese 1998). Current habitat (based on ICBEMP data) within the historic distribution consisted of 16% sagebrush, 1% grassland, 0% herbaceous wetland, < 1% wetland shrub, 51% cropland, and 32% non habitat (McDonald and Reese 1998). The overall habitat changes illustrate a 76% decline in native sharp-tailed grouse habitat from 70% in the late 1800s to 17% in 1990. These results are consistent with 1986 data illustrating a 59% loss of shrub steppe habitat due to cultivation in Washington (Dobler et al. 1996).

Habitats (based on TM data) found within the current distribution of sharp-tailed grouse include 68% shrub steppe, 11% cropland, 5% CRP, and 14% forest/shrub (Table 1). This is in contrast to areas where sharp-tailed grouse are extirpated; 36% shrub steppe, 38% cropland, 4% CRP, and 18% forest/shrub. Primary sharp-tailed grouse habitats (shrub steppe and CRP) were 79% more common within occupied areas than unoccupied areas. Although the Dyre Hill area was relatively unusual in that there was 50% cropland, it also contained 12% CRP (Table 1).

DISCUSSION

The maximum attendance of birds at lek complexes in Washington averaged 10.6 for annual counts between 1954 and 1998 and 10.1 for 41 counts in 1998. The estimates for Washington were comparable with average counts of Columbian sharp-tailed grouse in other

regions including 8.8 to 12.1 in Idaho (Parker 1970; Marks and Marks 1987), 9.9 to 11.4 in Colorado (Rogers 1969; Giesen and Braun 1993), 12.0 in Utah (Hart et al. 1950), and 7.9 to 17.2 in British Columbia (Ritcey 1995). Although estimates of annual variation in lek attendance are often used to evaluate population trends (Giesen and Braun 1993; Ritcey 1995; Connelly et al. 1998), average lek size can be influenced by the number of small or satellite leks that are occupied by young and/or subordinate males that are unable to become established on the primary leks (Rippin and Boag 1974). Data on average lek attendance also typically ignores lek complexes that become vacant, as shown in numerous situations in Washington. Consequently, it is likely that the best surveys of sharp-tailed grouse require a relatively complete count of birds on all leks in a region.

Remaining populations of Columbian sharp-tailed grouse in Washington are extremely small and isolated, reflecting substantial long-term declines in both distribution and abundance. The large magnitude of the downward trends indicate the overall conclusions are not likely to be altered by potential biases associated with lek counts. For example, the high estimate for harvest rate in Washington (18%) during 1974-1980 supports the possibility that the overall population, and hence population decline, may have been underestimated. Although it is difficult to address the potential impact of harvest on the past sharp-tailed grouse populations (Yocom 1952), it is clear that most populations in Washington continued to decline, even though the last hunting season was in 1987.

The declining distribution and abundance of sharp-tailed grouse in Washington are

clearly related to the long-term changes in habitat availability (Yocom 1952; Buss and Dziedzic 1955). The overall quantity of potential habitat has declined about 76% from historic levels (McDonald and Reese 1998) and the overall quantity of shrub steppe has declined about 59% (Dobler et al. 1996). The effects of widespread habitat alteration are clear in many areas, but particularly in Whitman County where sharp-tailed grouse were virtually eliminated as > 80% of the Palouse prairie was cultivated between the late 1800s and the 1920s (Buss and Dziedzic 1955). These observations are consistent with 1990 data showing that shrub steppe and CRP were about 79% more common within occupied areas than unoccupied areas. Although the primary factor resulting in the loss of native habitat was conversion of native habitat to dryland farming (Yocom 1952; Buss and Dziedzic 1955), dams along the Columbia River resulted in additional loss of habitat due to flooding and indirect loss of habitat due to expansion of irrigated farming.

Although habitat quality is difficult to measure on a large scale, declining quality of shrub steppe habitat in eastern Washington appears to be a significant factor in the decline of numerous species, including sharp-tailed grouse (Dobler et al. 1996). Numerous factors have been identified to explain the declining suitability of shrub steppe habitat including: 1) removal of sagebrush as part of various agricultural practices; 2) degradation of native habitat as a result of overgrazing by livestock; and 3) fragmentation of native habitat into relatively small and isolated patches (Hays et al. 1998).

The long-term prospects for management of sharp-tailed grouse habitat and populations

are complicated by land ownership, current land-use realities, and small isolated populations. The 3 populations < 100 km^2 in size (Chesaw, Horse Springs Coulee, Scotch Creek; Table 1) may be too small to support viable populations (Hamerstrom et al. 1957; Bouzat et al. 1998; Westemeier et al. 1998). All current populations appear to be separated from the nearest population by distances $ 20 km; a substantial quantity of the habitat between existing populations consists of wheatfields, orchards, and reservoirs. Although much habitat management on state, federal, and tribal land is currently designed to benefit sharp-tailed grouse, management programs should expand to incorporate both public and private lands into integrated management areas large enough to support viable populations (Hamerstrom et al. 1957; Westemeier et al. 1998).

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Table 1. Distribution of habitats (1993 Thematic Mapper) in Washington in relation to sharp-tailed grouse populations.

	Proportion of area dominated by each habitat (%)					Area (km^2)
Population	Shrub steppe	CRP	Cropland	Forest/shrub	Other	Total
Total population	67.8	5.2	11.3	14.2	1.5	2,234
Tunk Valley	69.6	1.2	1.5	27.5	0.2	342
Greenaway Spring	78.7	2.1	3.6	14.5	1.2	340
Chesaw	46.0	3.9	0.0	49.9	0.2	70
Horse Springs Coulee	89.4	0.0	3.4	6.7	0.6	61
Scotch Creek	69.3	0.9	4.7	23.7	1.4	79
Dyre Hill	42.0	12.0	44.5	0.7	0.8	308
Nespelem	65.7	6.9	5.1	19.6	2.7	513
Swanson Lakes	77.0	5.6	13.0	2.4	2.0	521
Unoccupied range	36.4	4.4	38.0	17.7	3.4	77,631
Historic range	37.3	4.4	37.3	17.6	3.4	79,865

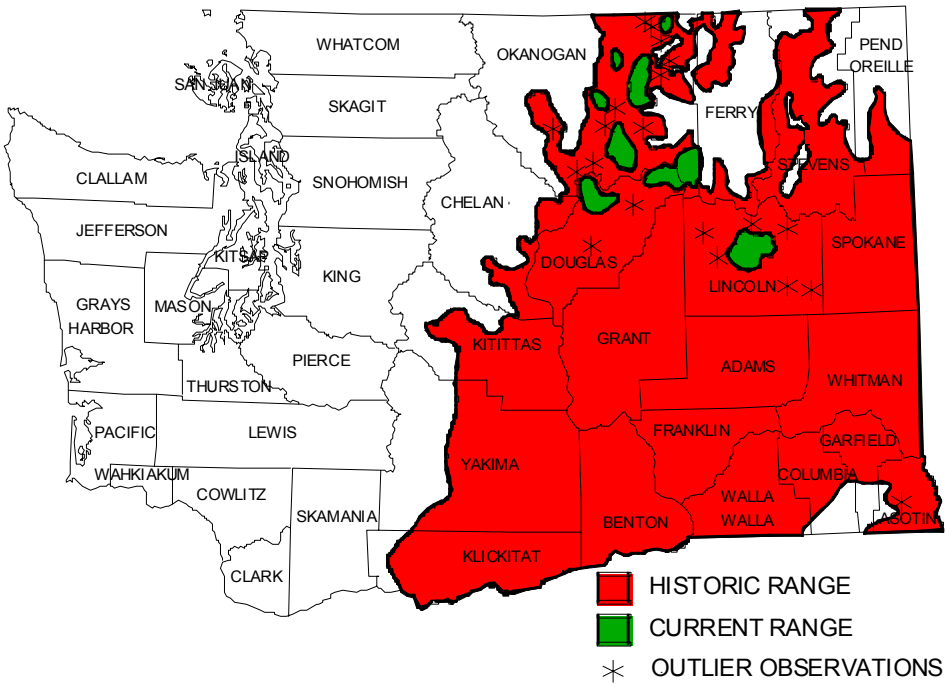

Figure 1. Historic and current range of sharp-tailed grouse among counties in Washington, 1998. Twenty recent (since 1990) observations outside the current range are represented by asterisks.

Sharp-tailed Grouse Distribution in Washington (Schroeder et al. 2000)
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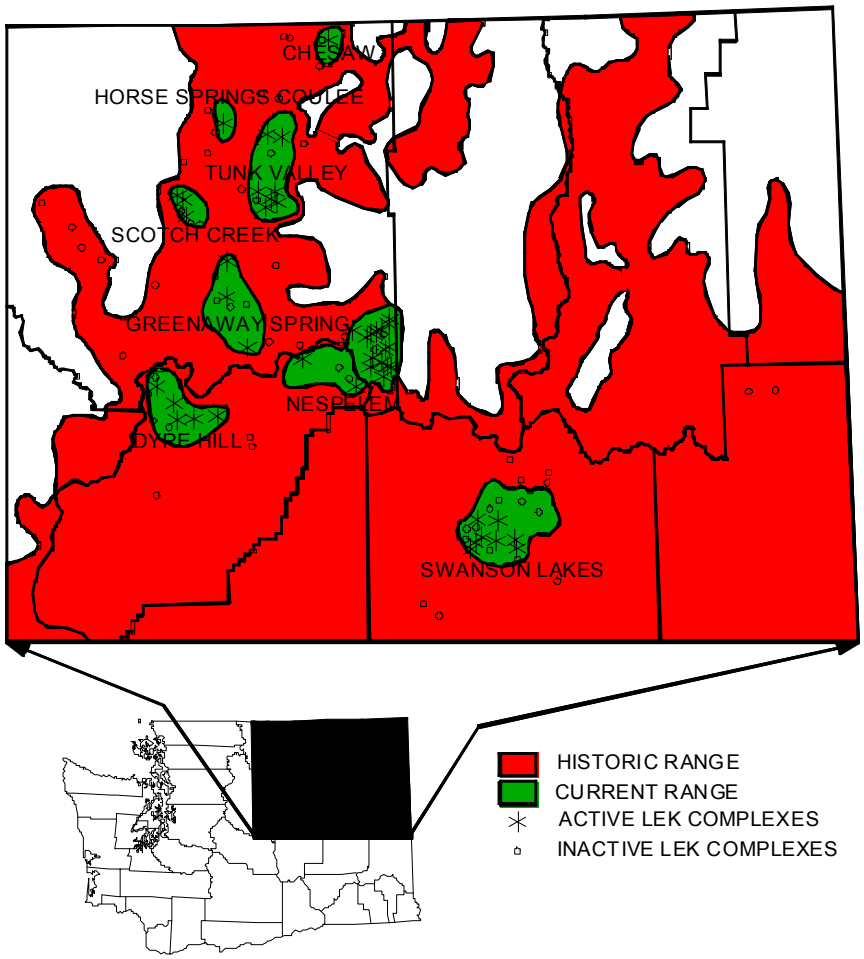

Figure 2. Historic and current range of sharp-tailed grouse in relation to active and inactive lek complexes in northeastern Washington, 1998.

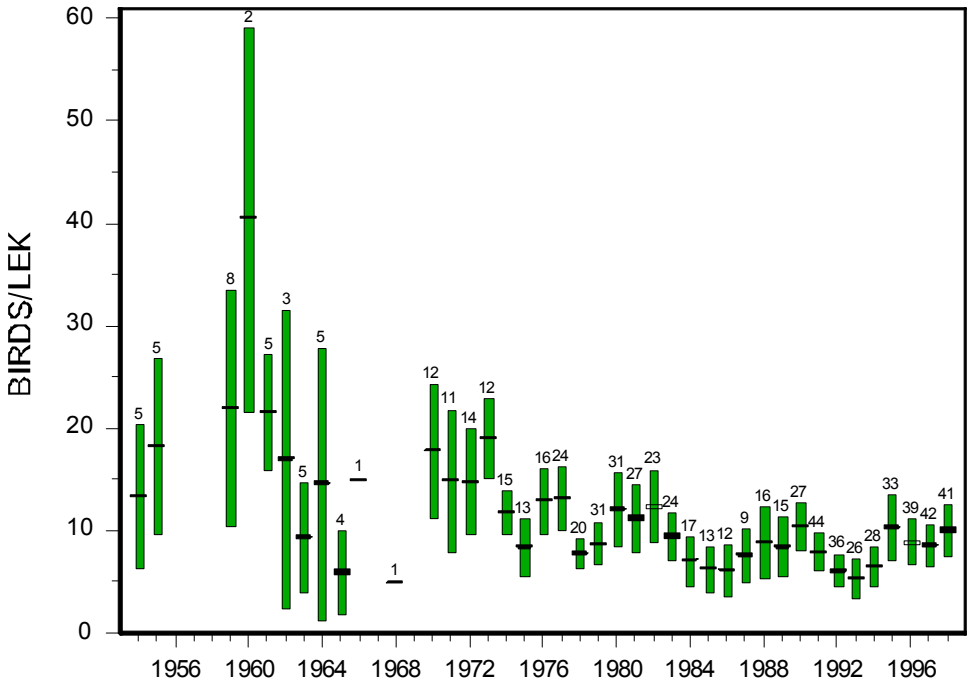

Figure 3. Average maximal number of sharp-tailed grouse observed on leks in Washington, 1954-1998. The means are represented by horizontal lines and the 95% confidence intervals by rectangles; the number of sampled leks is given for each year.

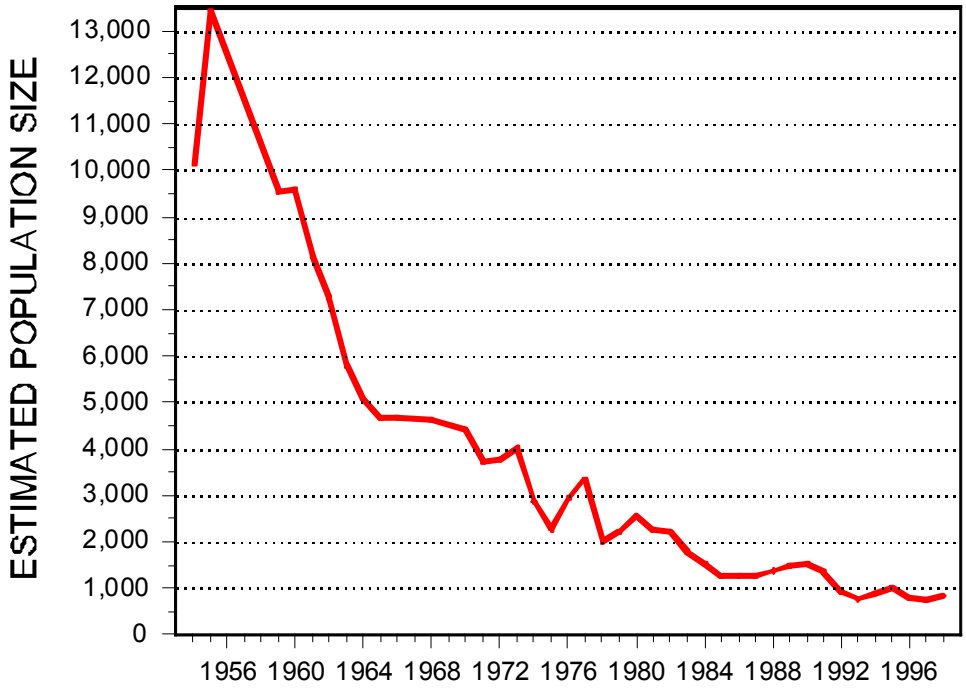

Figure 4. Estimated population size for sharp-tailed grouse in Washington, 1954-1998.