Condition and Trend of the Big Sagebrush/Needleandthread Habitat Type in Nevada

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Highlight: *Condition and trend of the big sagebrush/needleandthread habitat-type was studied at 23 sites in northern and eastern Nevada. An inference approach was used to quantify range trend in one field season. The habitat-type was located and described in excellent, good, fair, and poor condition. Trend relationships show that needleandthread is a decreaser, while big sagebrush, squirreltail and green rabbitbrush are increasers. Quantitative guidelines are developed for each condition class.*

Condition and trend of range vegetation are of primary concern to range managers. Sound range management plans depend on an understanding of secondary succession. *Range condition* is defined as "range health" and *range trend* as "change away from or toward a desirable condition" (Bailey, 1945). In addition to direction, Bailey states that "range trend has aspects of velocity and selectivity." The concept of range condition can be traced back to the turn of the century when workers such as Smith (1895), Griffith (1903), and Wooton (1908) recognized deteriorated range condition and recommended that stocking be such as to "improve the condition" of the range. Sampson (1919) made the first major contribution to our knowledge of condition classification. The four broad stages in plant succession he described correspond closely to present day condition classes of excellent, good, fair, and poor. Humphrey (1945) developed a condition classification which was based on current production and expressed in terms of the amount the same site should produce.

Dyksterhuis (1949) and Parker (1954) first proposed quantitative ecology as a means of evaluating condition and trend. Dyksterhuis (1949) grouped species, based upon response to grazing, into a quantitative system of range classification. Species were grouped and identified as "decreasers," "increasers," and "invaders." These groupings were graphed to show their relative cover in relation to percentages of climax vegetation and in response to years of overgrazing. The course of degeneration was divided into

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four condition classes. Parker (1951 and 1954) developed a similar procedure based on forage density, composition, and vigor, wherein a plant species is listed in one of three groups: (1) desirable, (2) intermediate, and (3) undesirable. Johnson and Reid (1964) evaluated the range condition on a pine/bunchgrass range in Colorado. They classified range condition by the relative production of desirable plants and stated that the "desirable plants increase or decrease with improvement or deterioration of the range."

Our objectives were to measure vegetation changes as found on the big sagebrush/needleandthread habitat-type in Nevada and to develop guidelines to evaluate the health of this habitat-type with quantitative condition classes.

The habitat-type is defined by Daubenmire (1952) as "the collective area which is capable of supporting the same homogeneous climax plant association."

Study Areas

Study areas were two rangeland watersheds: 1) Rock Springs Watershed (T45N, R18E) located 46 miles southeast of Wells, Nevada, and 2) Duckwater Watershed (T14N, R55E) located 33 miles southeast of Eureka.

The big sagebrush/needleandthread habitat-type was found at elevations of 5,340 to 6,580 feet on west, northwest, north, northeast, or south-facing modern drainageway floodplains and smooth and dissected alluvial fans of 1 to 12%. Soils are members of a sandy, mixed, nonacid, frigid family of Typic Torripsamments and are usually found on modern drainageway floodplains of canyons dissecting many of the north-south trending mountain ranges found in the Great Basin.

Big sagebrush dominates the vegetation, with needleandthread most abundant on sites which appear in good condition; otherwise, bluestem wheatgrass, squirreltail, and Sandberg bluegrass are the most abundant grasses.

Methodology

Vegetation trend can be measured by various techniques. For example, vegetation can be inventoried at the time a plot is established and reinventoried every few years. A second approach is to measure vegetation inside and outside an exclosure at the time of construction, and reinventory at appropriate intervals. In this method a control is provided. However, both procedures require a period of several years to detect vegetation trend.

The inference technique, used in this study, requires a much shorter time period. It is assumed that study areas have approximately the same site potential, i.e., if any one of the sites is given the proper use or degree of rest, it could attain a condition equal to or approaching the best condition. The best condition site can be defined as that site nearest climax or nearest a preconceived quantitative expression of excellent condition. Habitat-types can be recognized from vegetative, climatic, soil, and topographic features, and can be located and studied in several different successional states. An inference technique has the advantage that results can be obtained at the end of any given field season. The principal disadvantage is inherent in the difficulty of interpretation brought about by seeming differences or similarities in site potential.

A total of 23 macroplots were placed within predetermined boundaries of the big sagebrush/needleandthread habitat-type. Relict areas, water developments, and fence line contrasts were used to study the habitat-type in various successional stages. The study sites were determined to have a similar effective environment. Elevation, soil, aspect, and latitude were homogeneous. Where slight differences occurred in elevation and aspect, it was judged that these differences were compensating in effect and each study site had potential to produce the same climax vegetation.

Soils belonging to the same family offer the best evidence that site potentials are equivalent. Soil families are classified on the basis of their characteristics that influence plant growth. The soil classification unit serves as an index to site potential and reflects the result of a great variety of ecological parameters that have not been fully described and perhaps cannot be.

Basal area and crown cover measurements were obtained in a 100-ft square macroplot by a modification of the tech-

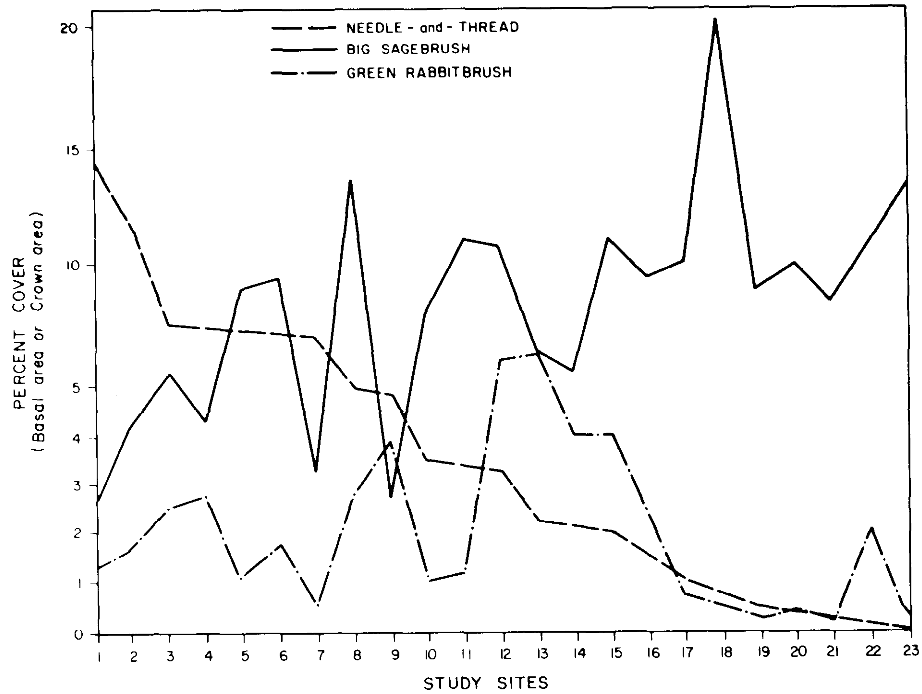

Fig. 1. *Cover increase-decrease curves for needleandthread, big sagebrush, and green rabbitbrush by study site.*

Table 1. Mean and range values computed for 12 characteristics of 23 locations of the big sagebrush/needleandthread habitat-type.

Characteristic	Mean	Range
Big sagebrush (% crown cover)	8.45	2.0 to 20.8
Rubber rabbitbrush (% crown cover)	1.59	0.0 to 5.8
Needleandthread (% basal area)	4.04	0.1 to 14.1
Total perennial shrubs (% crown cover)	10.04	4.0 to 21.0
Bare ground (%)	38.56	26.0 to 55.0
Litter (% cover)	54.93	37.5 to 74.0
Pavement (% cover)	5.87	0.0 to 12.5
Rock (% cover)	0.61	0.0 to 5.0
pH A1	6.87	6.2 to 7.9
Conductivity A1 (m hos/cm)	0.18	0.1 to 0.4
Organic matter A1 (%)	1.41	0.6 to 2.6
Cation exchange capacity A1 (meq/100 g)	6.30	3.4 to 9.5

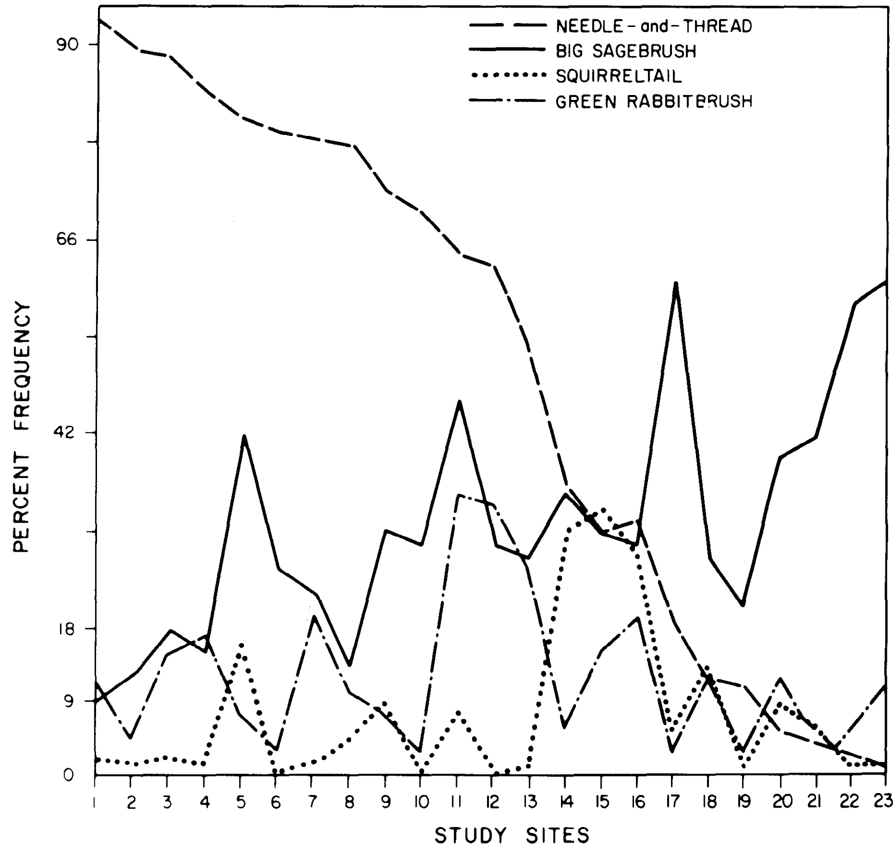

Fig. 2. *Frequency increase-decrease curves for needleandthread, big sagebrush, squirreltail, and green rabbitbrush by study site.*

nique described by Poulton and Tisdale (1961). Frequency sampling procedures (Hyder, et al., 1963) were used to provide an estimate of relative abundance and homogeneity. A 20- by 20-inch frame was used. Bare ground, litter and pavement (1/4 to 1 inch in diameter) and rock (> 1 inch in diameter) were determined by an adaption of the point frame method (Goddall, 1952).

An all-possible simple linear correlation analysis was used to detect relationships among certain species and other variables encountered in the habitat-type.

A soil profile description was made at each macroplot with the procedures outlined in the Soil Survey Manual (U.S. Dep. Agr., 1951) and the Seventh Approximation (U. S. Dep. Agr., 1960). The following parameters were selected because they have been suggested as indicative of vegetation and soil relationship (Eckert, 1957). Samples from the A1 and B2 horizons were analyzed for conductivity (mhos/cm), pH (from a saturated paste), and organic matter (%). Cation exchange capacity (meq/100g) was determined only on those samples from the A1 horizon (U. S. Dep. Agr., 1954). Family level identifications were made in accordance with the Seventh Approximation (U. S. Dep. Agr., 1960) and revisions (U. S. Dep. Agr., 1970).

Table 2. Mean and range in frequency values (%) of plant species computed for 23 locations on the big sagebrush/needleandthread habitat-type, all study sites combined.

Species	Mean	Range
Big sagebrush (*Artemisia tridentata* Nutt.)	30.93	9.0 to 56.0
Green rabbitbrush (*Chrysothamnus visicidiflorus* (Hook.) Nutt.)	12.54	0.0 to 35.0
Needleandthread (*Stipa comata* Trin. and Rupr.)	52.15	1.0 to 95.0
Indian ricegrass (*Oryzopsis hymenoides* Roem. and Schult.)	10.46	0.0 to 52.5
Sandberg bluegrass (*Poa secunda* Presl.)	20.04	0.0 to 86.5
Bluestem wheatgrass (*Agropyron smithii* Rydb.)	33.56	0.0 to 61.5
Squirreltail (*Sitanion hystrix* (Nutt.) J. G. Smith)	12.44	0.0 to 78.5
Prickly phlox (*Leptodactylon pungens* (Torr.) Rydb.)	3.48	0.0 to 16.5
Cheatgrass (*Bromus tectorum* L.)	6.22	0.0 to 62.5
Longleaf phlox (*Phlox longifolia* Nutt.)	5.41	0.0 to 26.5
Cryptantha (*Cryptantha micrantha* (Torr.) Jtn.)	5.00	0.0 to 37.0
Total perennial shrubs	46.08	18.0 to 81.5
Total perennial grasses	133.87	94.0 to 208.5

Results and Discussion

Basal Area and Crown Cover

Table 1 shows the mean and range fo: 12 characteristics (basal area, crowr cover, soil features) from 23 locations Significant correlations are discussed be low. Needleandthread, the dominant per ennial grass, an increaser, was arrayec from high to low as an indication oi condition by site (Fig. 1).

Needleandthread is negatively cor related (r = –.567) with big sagebrusł (Fig. 2). This relationship suggests that a: needleandthread decreases in basal area big sagebrush crown cover increases Quantitatively, needleandthread de creased from 7.5 to 1.4% basal area as bię sagebrush increased from 1.3 to 13.5% crown cover.

Big sagebrush is positively correlated (r = .931), with total perennial shrubs, denoting the dominance of this shrub ir the habitat-type. Big sagebrush is alsc positively correlated (r = .477) witł conductivity of the A1 horizon, indicatinę that total salts tend to increase with ar increase in crown cover.

The cover of perennial shrubs is cor related (r = .431 and r = .466) suggestinę that perennial shrubs occur with greatei cover on sites of higher conductivity and organic matter. Organic matter is positively correlated (r = .462) with cation exchange capacity.

The correlation coefficients for frequency data are similar to those computed for basal area and crown cover but in some instances are higher (Table 2). The dominant perennial grass, needleandthread, expresses a highly significant negative relationship with big sagebrush (r = –.633) and squirreltail (r = –.606) (Fig. 4). This strongly suggests that big sagebrush and squirreltail increase as needleandthread decreases. For example, as needleandthread frequency approaches 81%, big sagebrush nears 8% (Fig. 2). Likewise, needleandthread nears 83% as squirreltail frequency approaches 0%. The data also indicate that needleandthread and blue stem wheatgrass are negatively related (r = –.344). However, this relationship is not significant.

Big sagebrush shows a positive relationship (r =.571) with squirreltail, which helps to verify that these two species are increasers in this habitat-type. Big sagebrush is highly correlated (r = –.542) with perennial grass frequency. This offers evidence to substantiate the statement that perennial grasses decrease as big sagebrush increases. Big sagebrush and organic matter are positively correlated (r = .587), suggesting that this species occurs with a high frequency on sites with high organic matter or causes high organic matter, depending on site location. These results are similar to those obtained with cover data.

Green rabbitbrush was positively correlated with prickly phlox (r = .506) and longleaf phlox (r = .603), but was negatively related to cheatgrass (r = −.422). This suggests that green rabbitbrush, prickly phlox, and longleaf phlox respond similarly in the habitat-type, and that green rabbitbrush is more abundant on sites with less cheatgrass.

Sandberg bluegrass and bluestem wheatgrass are correlated with total perennial grasses (r = .460 and r = .518, respectively), indicating that these two grasses are important in the perennial grass component. Cheatgrass has high frequency values on sites where pH (r = .695), conductivity (r = .644), and cation exchange capacity (r = .473) were also high relative to other sites in the series studied.

Conductivity and pH were correlated (r = .688), and cation exchange capacity has a positive relationship with organic matter (r = .462). These relationships were natural expectations.

Increase-Decrease Curves

Increase-decrease curves are based on significant correlations. These curves are not actually increase-decrease curves over time but are curves based on greater or lesser amounts of important species. This variation is a result of the habitat-type occurring in different conditions, each on sites with similar site potential. It is assumed that deterioration took place over time and that the dominant perennial grass will decrease first under grazing pressure, thus allowing less desirable species to increase.

Macroplot locations are arrayed on the basis of decreasing needleandthread. Big sagebrush and green rabbitbrush crown cover is plotted against needleandthread to show their response to inferred differences in condition (Fig. 1). As needleandthread decreases, big sagebrush definitely increases. Green rabbitbrush, however, increases to a certain point then decreases.

Frequency data from the big sagebrush/needleandthread habitat-type shows curves similar to those obtained from cover data (Fig. 2). As needleandthread decreases in frequency from 95 to 1%, big sagebrush increases from 9 to 59%; squirreltail also increases from 1 to

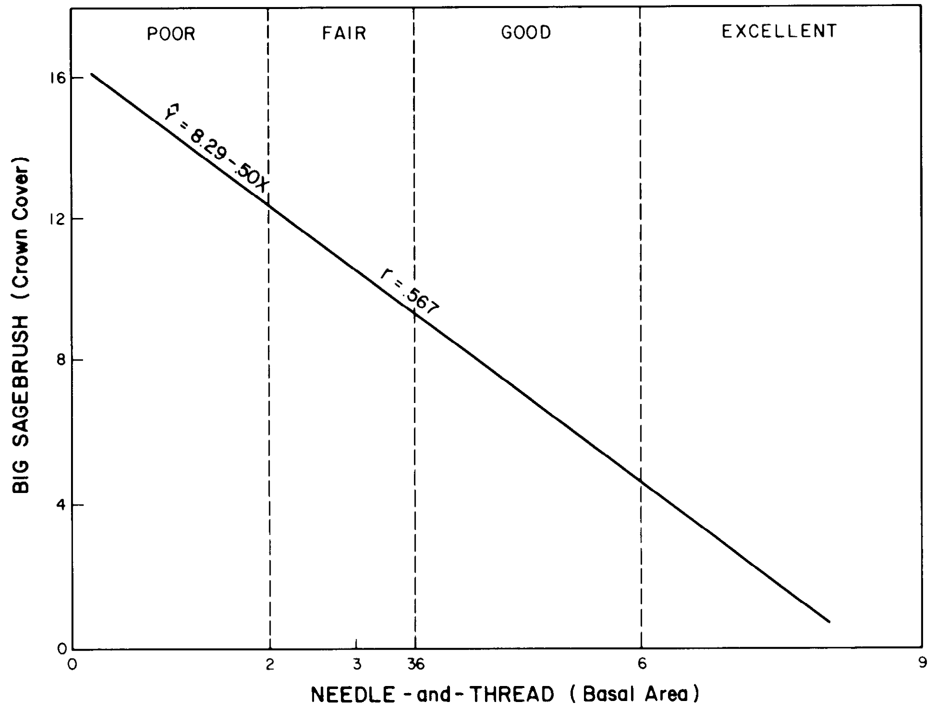

Fig. 3. *Condition classes as developed from cover data, showing the relationship between big sagebrush and needleandthread.*

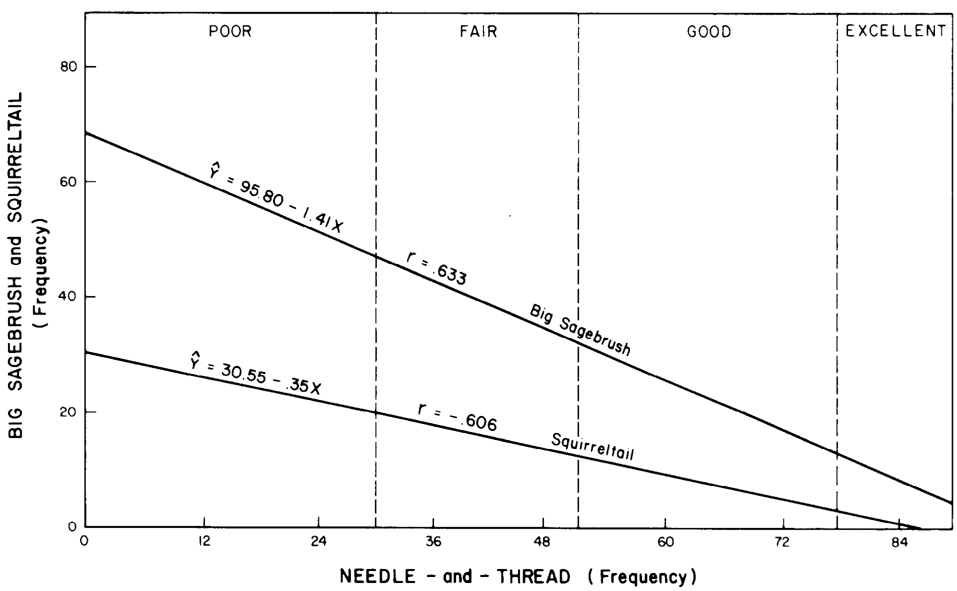

Fig. 4. *Condition classes as developed from frequency data, showing the realtionship of big sagebrush and squirreltail with needleandthread.*

30%. Green rabbitbrush shows a similar pattern, increasing from 11 to 32%, then decreasing to 13%.

Condition Classes

Condition classes are developed using several significant species. Cover and frequency data arrayed for the dominant perennial grass are divided into excellent, good, fair, and poor condition using natural breaks in the data. The regression lines for those species significantly correlated with the dominant perennial grass are plotted in Figs. 3 and 4. These lines eliminate irregularity in the relationships, thus allowing more than one species to be used in developing criterion for the condition classes.

Condition classes as developed suggest that when the habitat-type is in excellent condition, the cover of needleandthread would be about 6% and that big sagebrush would fall between 1 and 4.5% (Table 3). When frequency of occurrence

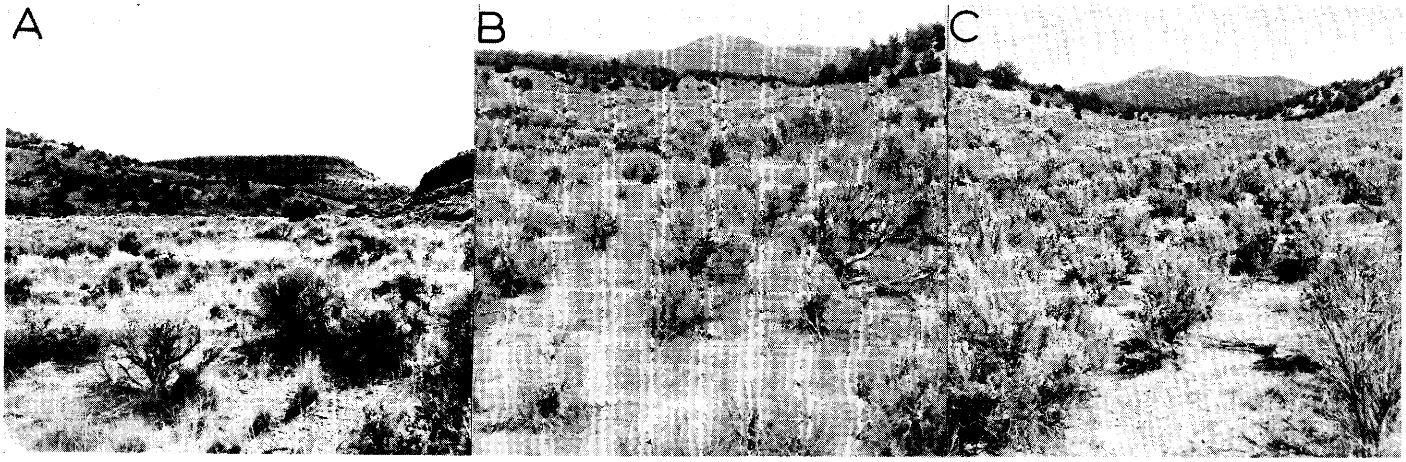

Fig. 5. *The big sagebrush/needleandthread habitat-type in (A) excellent, (B) good, and (C) poor condition. Sites B and C were in the same drainage bottom with site C being closer to a source of livestock water.*

is used to portray excellent condition, needleandthread would have a 78% frequency, big sagebrush between 4 and 13%, and squirreltail less than 3% (Figs. 1 and 3).

Conversely, when the habitat-type is in poor condition, the cover of needleandthread would be less than 2% and big sagebrush between 12 and 16%. The frequency of needleandthread would drop to less than 30%, big sagebrush increase to between 46 and 67%, and squirreltail frequencies would be above 20% (Figs. 1 and 3).

This habitat-type in excellent condition would have relatively little big sagebrush, but needleandthread would be very abundant (Fig. 5). When the habitat-type starts to deteriorate by grazing or other means, the dominant grass, needleandthread, would decrease and big sagebrush, squirreltail, and yellowbrush increase (Fig. 5).

Needleandthread is not eliminated from the habitat-type all at once, but as deterioration continues the plants are gradually reduced in basal area, height, and overall vigor. This reduction continues until needleandthread is eliminated from shrub interspaces (Fig. 5c), leaving surviving plants protected under the shrubby species. This reduction in the dominant perennial grass releases less desirable species, allowing them to increase.

Table 3. Frequency (%) and cover (%) of needleandthread, big sagebrush, and squirreltail by condition classes for the big sagebrush/needleandthread habitat-type.

Condition class and measurement	Needleandthread	Big sagebrush	Squirreltail
Excellent			
Frequency*	78.0 +	5.0 to 13.0	0.0 to 3.0
Cover	6.0 +	1.0 to 4.5	**
Good			
Frequency*	51.0 to 78.0	13.0 to 32.0	3.0 to 12.0
Cover	3.6 to 6.0	4.5 to 9.2	**
Fair			
Frequency*	30.0 to 51.0	32.0 to 46.0	12.0 to 20.0
Cover	2.0 to 3.6	9.2 to 12.3	**
Poor			
Frequency*	0.0 to 30.0	46.0 to 67.0	20.0 to 30.0
Cover	0.0 to 2.0	12.3 to 16.4	**

* Frequency samples refer to presence and absence determinations in a 20- by 20-inch frame.
**Cover not estimated.

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