The Effect of a Leaf Feeding Beetle on Big Sagebrush in British Columbia

WILLIAM L. PRINGLE

Research Officer, Canada Department of Agriculture, Range Experimental Farm, Kamloops, B. C.

This is a report of a startling natural phenomenon that occurred when an insect population multiplied to such proportions that it all but eliminated a common range plant over a very large area. This does not presume to give any final answers or explain why or how this situation developed, or where it will eventually end. It is designed primarily to relate what has happened to date regarding the sagebrush that has been affected. If it does nothing else it should impress upon us that nature herself sometimes takes matters into her own hands to help right the wrongs caused by man.

In July 1954 a beetle identified as *Trirhabda pilosa* Blake, hereafter referred to as *T. pilosa,* was discovered by the author on big sagebrush *(Artemisia tridentata* Nutt) near Kamloops, British Columbia. At this time a patch of sagebrush less than two acres in extent was seen to have turned a rusty brown color. Closer examination revealed myriads of small metallic blue larvae stripping the surface layers from the leaves. A few mature insects were collected and subsequently identified through the Field Crops Insect Laboratory, Science Service in Kamloops. Final identification was made by Mrs. D. H. Blake, who originally named the species.

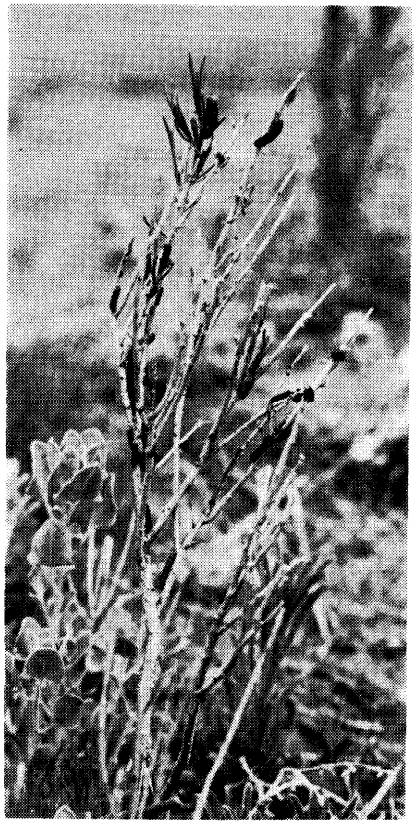

FIGURE 1. *T. pilosa* adult on big sage brush approximately nine times actual size.

Description of the Beetle

T. pilosa, a beetle of the *Chrysomelid* family, has a shiny green lustre and is about 5 to 7 mm. long, (Figure 1). A full description is given by Blake (1931). Pringle (1955) outlined the life history as follows: the insect overwinters as an egg which is laid under the bark or in the duff at the base of the plant. Larvae emerge during early June and chew the sage leaf surface during which times they pass through several stages. Mature larvae are about a centimeter long, bluish black with a metallic lustre. Early in July larvae concentrate in the debris and soil at the base of the plant where they pupate. The pupal stage lasts 1 to 2 weeks at the end of which time adults emerge. Arnott (1957), made a study of the life history of the insect and reported that mature larvae caged on sagebrush in the laboratory on July 13 had stopped feeding by July 21 and entered the soil, by which date some in the field had pupated. The first adults emerged from these caged pupae on July 28. Heavy infestations of adults persist in the field throughout August during which time oviposition takes place. Adult populations apparently die out gradually during September.

The beetles were considered host specific to big sagebrush because they starved to death in the laboratory on four other sagebrush species common to the area as well as rabbit brush and goldenrod.

Spread of the Insect Over 4 Years

During the year of discovery the beetles emerged in large numbers and by August had spread out and were visible on sagebrush up to a mile from the original site. Spread must have been accomplished by flight but no beetles were seen flying that year. In the spring of 1955, visual observations showed that 90 percent of the sagebrush over the original two-acre patch was dead. It was most interesting that the shrubs used by ants as aphid pasture were not damaged to any degree and hence survived to stand out like flags. In some cases the ants died out and plants protected in this manner were utilized and killed in the following season by hatching larvae. Figure 2 shows this situation on a single plant growing close to an ant hill that was active in 1955 but was abandoned sometime in 1956 and a residual population of *T. pilosa* all but killed it during 1957.

During 1955 larvae showed up in abundance on sagebrush over an estimated 1500 acres. By June

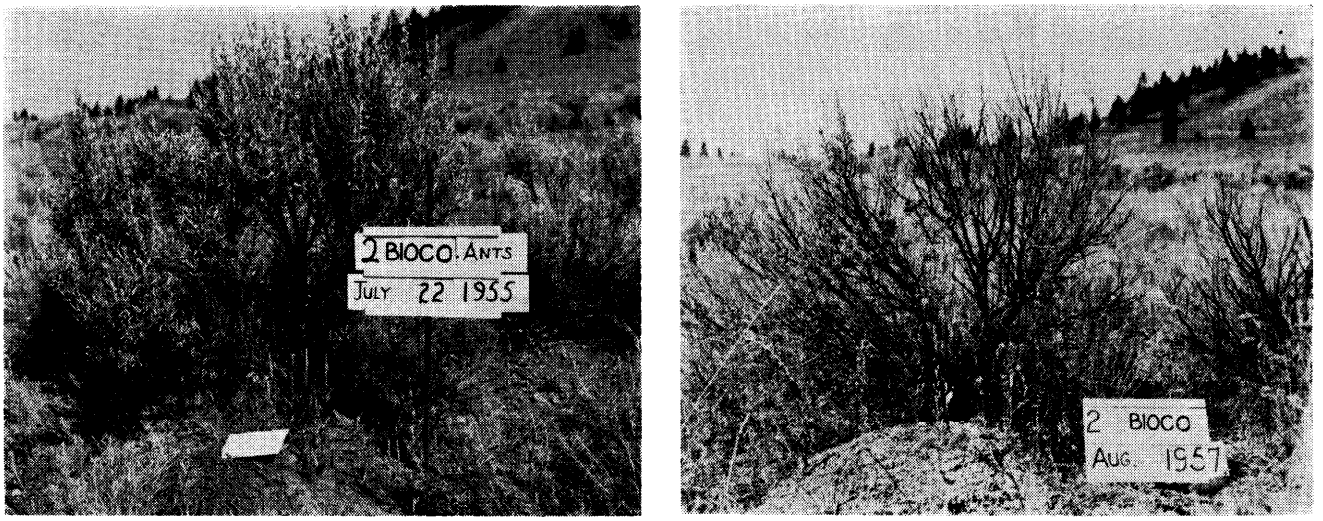

FIGURE 2. *Left:* A single big sagebrush plant growing near an ant hill pictured in 1955 showing lush foliage. *Right:* The same plant two years later after the ant hill had died, allowing beetles to feed and almost kill it.

of 1956 the sagebrush on this acreage appeared 70 to 80 percent dead. It was during July 1956 that beetles became extremely numerous over a wide area and were observed in full flight during one very warm bright day. Lack of suitable host plants no doubt forced them to seek fresh sagebrush that had not been defoliated by larval chewing. At this time it was estimated that between 2500 and 3000 acres of sagebrush range had been affected. During 1958 insects were active in localized areas of sage range up to 5 miles from their origin.

Ecology of T. pilosa

It should be pointed out that sagebrush over the affected area occurs between 2000 and 3000 feet altitude. The insects were first seen at the higher altitude on an area which was at one time homesteaded, hence the sagebrush here must be regarded as an invader. On this type of land the insect has caused a high degree of kill. On the dryer sites at lower altitudes between 1100 and 2000 feet, which is the native range of big sagebrush, little or no damage is done. This lack of damage may be attributed to the dryer, warmer environment. It is apparent that the insect is unable to build high enough populations to cause extensive damage to sagebrush on the lower grassland sites. Where it occurs on brown or dark brown soils of the mid or upper grassland its depredations have not slackened pace.

Huffaker (1957) using *Hypericum perforatum* Linn., and simulating destruction by *Chrysolina gemellata* Rossi., demonstrated that death is not caused directly by the loss of foilage or from competition for sunlight but was the result of the inability of the greatly reduced foliage to maintain a sufficiently extensive root system, associated with the absence of adequate subsurface soil moisture during summer. Perhaps this same reasoning may hold true in the rapid destruction of big sagebrush by *T. pilosa.*

Recording Changes in Plant Cover

When it was seen how rapidly changes in the plant cover could occur through the action of *T. pilosa* it was decided to utilize 100-foot line transects as a means of recording changes in the sagebrush stands. This work was started in July 1955 with the establishment of studies on four sites. The first year only one line was laid out with two more being added the following season. The name used for this project was BIOCO contracted from Biological Control. Intercepts were read for living foliar material as well as dead stems and branches. A scale of 1 to 5 was set up denoting the extent of damage to the shrub. Each segment on this scale was considered a condition class.

1. Undamaged.
2. Slightly chewed.
3. Medium damage, turning brown.
4. Severe damage, plant completely brown and dying, or only one or two branches living.
5. Plant dead. Twigs and branches brittle.

Notation was also made as to the presence of larvae, beetles, ants, and height of the plant and general condition of the sagebrush stand.

The lines were recharted each year and totaled for number of plants and percent total sagebrush. This was then broken down to percent occurring in each of the five condition classes.

The four original sites were at varying altitudes and exposures. Site 1 was lost the first

Table 1. Changes occurring to sagebrush plants over the 4-year period on Site 2

Year	Number of plants per line	Ground cover of sagebrush	Condition class 1	2	3	4	5
		(Percent)					
1955*	16	30.5	100	—	—	—	—
1956	16	22.8	1.7	2.0	8.8	1.7	6.6
1957	17	24.6	—	4.0	20.4	25.0	50.6
1958	18	21.1	20.3	3.4	2.7	28.6	45.0

* One line only, rest are averages of three 100-foot lines.

year when the stakes were stolen. Site 3 was lost after two years when it was completely churned up in a strip-mining operation during a search for copper ore. Sagebrush on this site located at almost 3000 feet was very vigorous and uniform. At the time of site establishment beetles were present. One year later on the three 100-foot transects only a single plant appeared alive of 50 plants tallied. This was located in close proximity to an ant hill. It was indeed unfortunate in view of the high percentage kill that this area could not be sampled the next season to determine if any regrowth had occurred.

Site 2 was located in a mixed stand of big sagebrush having both mature and small plants at an altitude of 2300 feet. On this site grazing was continuous and heavy. A few beetles were present when the first line was established in 1955. The data in Table 1 present the changes that occurred to the sagebrush plants over the 4-year period.

Site 4 was located, after Site 1 was lost, at 2400 feet in a fairly vigorous stand of sagebrush representative of a large area of north-facing slope over which the beetles were prevalent in 1956. In 1957 the area had the appearance of a badly killed stand with an occasional patch of living or recovering sagebrush centered around an ant hill. Table 2 presents the changes in sagebrush plants on Site 4 over a 3-year period.

In a third area where beetles appeared in large numbers in 1957 and where the sagebrush was too large to operate a line transect, 40 plants were tagged along a line and notes made on their condition. Tagged plants ranged from 2 to 7 feet in height with the majority being over 5 feet. Table 3 shows that the number of dying and dead plants jumped in one year from 5 to 85 percent of the stand due largely to beetle activity. Most plants had only one or two minor branches surviving with the majority of the plant being dead and brittle. Plants in this condition were placed in Class 4. This accounts for the high number of Class 4 plants and a relatively low number of dead sagebrush. Of the 11 plants harboring beetles in 1958, 6 had ants in 1957.

From the data it is obvious that *T. pilosa* is capable of destroying sagebrush to the extent of 50 percent of the stand. It is also obvious that many factors such as altitude, micro-climate, extent of grazing and age of stand enter into the degree of killing.

Looking at figures for Site 2 we see that 1957 showed the highest amount of kill and by 1958 many plants which were in Class 3 had completely recovered. This means that the insect must do a complete job in the first or second year. Indeed this has been observed. When the wave of beetles moves on it rarely leaves behind enough survivors to mop up the living plants.

On Site 4 a slightly different story was told. Here the high population of ants prevented the beetles from overcoming any more than 40 percent of the plants. During 1958 many Class 2 and 3 plants returned to normal.

To date *T. pilosa* has made some spectacular changes in plant associations where it has occurred in abundance. Perhaps the depredations have been more spectacular to the eye than to the measuring tape, at least so it would appear from the limited

Table 2. Changes occurring in sagebrush plants over the 3-year period on Site 4

Year	Number of plants per line	Ground cover of sagebrush	Condition class 1	2	3	4	5
		(Percent)					
1956	16.3	15.7	3	1.0	53.2	—	29.2
1957	19.0	21.5	15.6	22.7	15.7	15.0	39.0
1958	19.0	16.5	31.0	4.0	10.0	15.0	39.0

Table 3. Changes in the condition of 40 sagebrush plants from 1957 to 1958

Year	Number of plants harboring Beetles	Ants	Condition class 1	2	3	4	5
			(Number of plants)				
1957	38	10	6	12	20	1	1
1958	11	1	0	1	5	26	8

data presented. When first discovered it was thought to be a small local outbreak which, for natural reasons, would be gone the next year. It has now held on for over four years and increased meteorically.

Long Range Plantings

Anticipating the value of this insect as a means of reducing big sagebrush some artificial moving of them has been attempted. To do this about 1000 adult beetles were collected and transported to a new area where they were released on sagebrush, preferably where it appeared to be an invader. Of four transplants made during 1956 only one has shown any degree of success to date.

T. pilosa a Native Insect

Several questions still remain unanswered. Where did the beetle come from and how was its population build-up enhanced? The insect is alleged to be native of British Columbia. W. J. Brown, Entomology Division, Ottawa, informed Arnott (1957) that in the Canadian National collection there are specimens of *T. pilosa* from Seton Lake, Nicola and Summerland in British Columbia. The author corroborated this with an inspection of these collections.

We may hazard an answer to its explosive build-up by examining conditions which favor its reproduction. In the areas where it has achieved most success the sagebrush is a weed. Under such conditions sagebrush has prevented the grazing which aided its entry in the first place. Litter build-up was accelerated and sagebrush plants for the most part became mature, putting the whole plant complex in a delicate balance. Climatic factors, too, may have enhanced this native insect which found conditions in these stands more than suitable for existence and the population "exploded".

Another explanation is that perhaps the insect is a physiological form which has arisen through mutation and is better adapted to live under existing conditions. Because of this, the population "exploded" causing spectacular results in the sagebrush stands near Kamloops.

Whether these insects will remain with us long enough to serve as agents in the control of big sagebrush is a matter for speculation. Perhaps their natural parasites will catch up and level them to insignificance. To date the amount of damage done, if compared with the cost of chemicals to bring about the same control of sagebrush, warrants a good deal of study. If nothing else, it will point the way to looking more closely at our plant-insect relationships with a view to making a practical contribution toward the control of unwanted plants. If it is found that the recently discovered population of *T. pilosa* can be utilized to control big sagebrush on certain locations it must be emphasized that range rehabilitation through its use could only be achieved if accompanied by good range management.

LITERATURE CITED

ARNOTT, D. A. 1957. Occurrence of *Trirhabda pilosa* Blake (Coleoptera: Chrysomelidae) on sagebrush in British Columbia, with notes on life history. Entomological Society of B. C. Proc. (1956) Vol. 53.

BLAKE, D. H. 1931. Revision of the species of beetles of the genus *Trirhabda* north of Mexico. Proc. U. S. Nat. Mus. 79 (2).

HUFFAKER, C. B. 1957. Fundamentals of biological control of weeds. Hilgardia 28:3.

OFFICE OF THE EXECUTIVE SECRETARY
P. O. BOX 5041, PORTLAND 13, OREGON

JOURNALS NEEDED

One dollar per copy will be paid by the Executive Secretary for the following issues of the Journal mailed to his office in good condition:

Vol III, Nos. 1 and 4, January, Octber 1950
Vol. IV, No. 1, January 1951
Vol. V, Nos. 2 and 3, March, May 1952
Vol. IX, Nos. 1 and 2, January, March 1956
Vol X, Nos. 2, 3 and 5, March, May, September 1957
Vol. XI, No. 1, January 1958
Vol. XII, No. 6, November 1959