

REPORT
OF
INSECT RECONNAISSANCE AND CONDITIONS ON
KAIBAB NATIONAL FOREST
AND
GRAND CANYON NATIONAL PARK
For 1925

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PREFACE

THE SURVEY

Object

In order to obtain information as to the character and status of the current Plack Hills beetle epidemic on the Kaibab National Forest and Grand Canyon National Park, a survey was made by the Bureau of Entomology, with the assistance of the Forest Service and Park Service, of the entire Kaibab plateau between September 10th and October 13th of the past year.

In addition to the above objective information was secured on a number of other points such as the effect from the control work of 1924 and 1925, the percentage of trees missed in spring control spotting, in fall spotting, and the correlation between emergence and subsequent attack.

Methods

In general the same estimating methods used in last year's survey were followed. The sample half section plots, laid out last year, were again cruised and the trees killed in 1924 and 1925 tallied and mapped. Sample strips were also run thru each township and the loss of 1924 tallied. In this way, it was possible to tell whether or not the sample plots were representative of the surrounding territory and to determine whether the beetles had moved into new territory.

Since a very thorough survey was made last year, it was not necessary to repeat the taking of a great deal of other data, and so it was possible to cover the area quite adequately in a short space of time and at less expense.

Surveys made by the control crew spotters and the writer form the basis for the estimates on the Grand Canyon National Park.

Personnel

The crew for this year consisted of F.P. Keen, Associate Entomologist in charge; Alden Adams, Spotter; and Reed Crain, compassman. The two assistants had previously been employed in the control work, and were familiar with spotting methods.

Cost

The work accomplished by the crew consisted in the check crusing of 4,960 acres and the running of 153 miles of additional strips. The represented a 4.7% cruise of the entire area of 363,000 acres. The cost was as follows:

Bureau of Entomology (1 man)

Salary	\$268.12	
Subsistence	8.25	
	<u>\$276.37</u>	\$276.37

Forest Service (2 men)

Salaries	\$158.20	
Subsistence	75.39	
Transportation	40.36	
Total	<u>273.95</u>	\$273.95
		<u>\$550.32</u>

Total cost

PROJECT CONDITIONS AND FUTURE PLANS

The general information, such as the past history of the areas, the location, timbered acreage, resources, insects responsible for damage, and extent of old losses was covered quite thoroughly in the report of last year by Keen and Van Biskirk.

RECENT LOSSES

A summary of the yearly losses indicate that during the recent epidemic 143,000,000 board feet of timber requesting 13% of the stand have been killed. These yearly losses are as follows:

Table 1.

<u>Attack of</u>	<u>No. trees killed</u>	<u>Volume killed</u>	<u>Per cent of Stand killed</u>
1919 to 1922 in. (4 yrs.)	362,000	104,000,000	9.5%
1923	82,000	25,000,000	2.3%
1924	56,000	14,000,000	1.3%
Total for epidemic of 6 yrs.	500,000	143,000,000	13.1%

A preliminary estimate of the 1925 losses indicates that they will be approximately as follows:

	<u>Trees killed</u>	<u>Volume killed</u>	<u>Per cent of Stand</u>
1925 (endemic)	11,000	3,600,000	.3%

LOCATION AND STATUS OF INFESTATION

One point which has previously been observed is the general northwardly progress of the beetle epidemic. Old epidemic centers have declined and adjacent new centers farther north have increased. This occurrence was repeated in 1924. The heavy centers on Moquitch and Castle Ridges declined very markedly but all of the territory north of Moquitch increased except where the control work was conducted. Even some of the very heavily infested sections near Mile-and-a-Half, which were not treated, continued to increase. South of Moquitch the infestation increased along the ridges west of previously epidemic areas, while throughout the mixed stand and in the old epidemic centers the infestation decreased.

In the attacks of 1925 there was a heavy decline throughout the entire area which amounted to a reduction in the losses of about 80%. This undoubtedly was due for the most part to the operation of natural control factors. On treated areas there was a further reduction due to the control work but the difference between treated and untreated areas was not well marked.

Two maps accompany this report which show the intensity and location of the infestation for 1924 and 1925. The same legend has been used as for the maps accompanying last year's report and these maps taken together represent in a graphic manner the progress of the infestation throughout the forest.

Taking the units up in more detail:-

1. Jacob Lake Unit.

As was stated in last year's report, the attacks of 1924 were "heavier than the previous year as shown by the new trees found." The cruise of the check sections this year show that the 1924 infestation practically doubled over that of 1923.

This area was recommended for control and was worked in a very thorough manner by the Forest Service in the spring of 1925.

In checking the area in the fall of 1925, hardly a new infested tree could be found on the treated area while outside only a very few scattered infested trees were located.

2. Treated Area of 1924 (Murray Lake Region)

The northern portion of this area simply held its own following the control work. Some sections even increased. The east half of Section 15, T 38 N, R. 2 E., increased from 110 trees in 1923 to 178 in 1924. The more heavily infested sections further south were reduced very markedly by the control. Section 32 T 38 N, R. 2E, was reduced from 3207 trees to 538 trees. The west half of section 34 of the same township from 900 trees to 145 trees.

Surrounding the treated area the infestation increased throughout. In many cases it more than doubled. There is every reason to believe, therefore that all of the treated area would have increased if the work of 1924 had not been done.

The northern portion of this area was again treated in 1925 by the Forest Service and cruises through two treated sections in the fall of 1925 failed to reveal a single well infested tree. A few trees of small diameter, less than 10 inches, which has been scorched by the control fires had succumbed to the fire injury and to flathead borers of Ips. The Black Hills beetle was conspicuous by its absence. On Section 22 just south of the treated area a number of trees were found with normally heavy brood of the Black Hills beetle.

3. Mile-and-a-Half

There was a very conspicuously marked line between the treated sections of 1924 and untreated sections in this vicinity. Treated areas had been reduced 80% while the untreated sections adjacent to the work increased fully 60%. This brought about a very marked differentiation between the treated and untreated areas.

However, there was a big drop in the number of all attacks of 1925 representing a reduction of fully 80%. Even so, some of the sections still carry an epidemic infestation, since a section carrying 4,000 trees would still have 800 trees on it. Therefore, there are still some large groups of new infestation on the ridges just west and east of the Monston cabin. Nowhere else on the area was any quantity of new infestation found although Section 22 T 38 N, R 2 E, will probably have 160 newly infested trees.

4. Moquitch to Dry Park.

There was a very decided reduction in the losses of 1924 over 1923 throughout the heavy killings of the last few years and through the mixed stand. As was noted last year, the infestation of 1924 spread out to the west along the ridges and there was a tendency for these outlying sections to increase.

With the attack of 1925 this infestation dropped to an endemic status leaving a vast area of black trunks as a record of its passings.

5. Pleasant Valley

The infestation of 1924 showed a reduction of about 20% over that of 1923 in this region.

Along the western edge of Pleasant Valley a few groups of 1924 became quite conspicuous. But practically no ^{new} infestation of 1925 could be found, so it would appear that natural factors have brought all of this area under control.

6. The Little Mountain

The Little Mountain takes in all of the timbered area west of Dry Park and Lookout Canyon.

Previous to 1924 all of this timber carried an endemic infestation with the exception of the area just west of Dry Park which was treated in 1922 and again in the fall of 1924.

With the attacks of 1924 there was a heavy increase in the infestation along the ridges of the area west of the more heavily infested areas of 1923. Within a mile or two of Dry Park the infestation did not increase but remained constant.

For the 1925 attacks, there was a big reduction throughout the entire area. However, this natural reduction was not as much on some of the sections of this area as on some of the other sections farther north or south. One the area treated in 1924, there was very little new infestation in this respect being no different from the untreated sections.

7. Kanabownits

All of the country south of Dry Park around to the Basin showed an increase in infestation along the tops of the ridges where yellow pine predominate and west of the earlier groups. Some areas were quite conspicuous with groups of newly infested tree, notably on Quaking Asp Ridge, Squaw Point, Big Springs Ridge, and Kanabownits.

This was, however, a temporary flare up because ^{very} few newly infested (1925 attack) trees could be found in the vicinity of these groups, and like the other areas on the mountain the 1925 loss subsided.

8. Powell Plateau

An examination was made of Powell Plateau in August 1925 to determine if the Black Hills beetle was working in the isolated timber of this Plateau.

Although most of the timbered area was covered pretty thoroughly no Black Hills beetle infestation could be found. A few trees had died in recent years which showed evidence of insect work but in every case the insects were other species such as D. approximatus, D. convesifrons, D. barberi and Ips spp.

9. The Basin

An examination of the Basin area during July showed a considerable increase in beetle activity along the ridges from the Basin south to Tiyo Point. One group of ten trees was located and numerous groups of from three to four trees were found.

The area along the Grand Canyon Highway just east of the Basin which was treated in the spring of 1924 was found to be fairly free from insect loss. The control work here brought about at least a 50% reduction in the losses.

On account of the increase in the 1924 loss in the region, the treating of the area was recommended to the Park Service to be carried out in the fall of 1925. But a later examination by the spotters of the control camp, which was established on Greenland Plateau, showed that the 1925 attacks had failed to develop and the infestation had naturally died out.

10. Greenland Plateau

The infestation of 1923 was treated on this plateau by the Forest Service in the spring of 1924. The work was carried on so late, however, that many beetles escaped and the reduction in the losses amounted to about 50%. When we consider, however, that in all probability, the infestation of this area would have increased in 1924, the control really made a very good showing.

A preliminary cruise made in the fall of 1924 indicated that there was still sufficient infestation to warrant a recleaning. So plans were made and a \$5,000 allotment secured by the Park Service for this work. With this allotment, the plateau was again very thoroughly treated by the Park Service in the spring of 1925.

In the fall of 1925 another camp was placed on the plateau to clean up the slash from the 1924 operation and to pick up any new infestation which could be found. But the cleanup had been so complete, that ~~taken~~ with the natural reduction which occurred, scarcely an infested tree could be found. Where 2,600 trees had been treated in the spring of 1925 only 20 trees were located in the fall work and only two of these had developed normal broods.

In general

In general therefore, it may be said that with the exception of the infestation around Mile and a Half, the recent Black Hills epidemic on the Kaibab Plateau is now at an end.

The table at the end of this report gives the total number of trees killed by beetles during 1924 and 1925 throughout the area.

RESULTS SECURED FROM CONTROL

The evidence from the first two years of control, as reported last year, showed very tangible reductions in the losses of the following year wherever the work was carried on intensely. Thus the work of 1922 on the Wylie Point brought about a reduction of 518 trees to 16 trees. A high reduction from the work of 1923 was secured along the western edge of the Moquitch and Corral Lake units. Similar results were secured from the work of 1924.

Results of 1924 Control Work.

The preliminary examination made in the fall of 1924 indicated that good reductions had been secured on the treated area. This conclusion was further verified by the examination of this year.

There was in fact a very well marked line between the treated and untreated areas, particularly along the southern line of the treated area where the work stopped in the very middle of an extremely heavy killing. Just across the line in the untreated territory the infestation increased 60% while on the treated area an 80% reduction was secured. In fact the entire area north of Moquitch Canyon showed a very pronounced increase wherever the control work was not carried on.

The following Table (2) shows the results on the treated and untreated check sections north of Moquitch Canyon:

Table 2

Comparison of Losses of 1923 and 1924 on
Treated and Untreated Check Sections
North of Moquitch.

<u>Untreated</u>				
Check Sections	Acres	Loss of 1923	Loss of 1924	Increase %
T 39 N R 1 E Sec. 25E $\frac{1}{2}$	320	18	38	111%
39 2 22E $\frac{1}{2}$	320	36	78	117%
38 1 23E $\frac{1}{2}$	320	28	94	236%
37 2 8N $\frac{1}{2}$	80	498	796	60%
	NW $\frac{1}{4}$			
Total cruised	1040	580	1006	73%
<u>Treated</u>				
Areas		Loss of 1923	Loss of 1924	Decrease %
T 38 N R 2 E Sec. 10W $\frac{1}{2}$	320	90	73	19%
Sec. 15E $\frac{1}{2}$	320	110	178	62%
Sec. 34W $\frac{1}{2}$	320	900	145	84%
Sec. 32	640	3207	538	83%
Total cruised	1600	4307	934	78%

Thus on untreated areas for every 100 trees infested in 1923, 173 trees were killed in 1924. While on the treated areas, for every 100 trees infested in 1923 and treated at a cost of \$1.14 per tree, 22 trees were killed in 1924. Thus the control may be said to have prevented the destruction of 151 trees for every 100 trees treated at a cost of 75 cents each.

Table 3

Comparative losses of 1923 and 1924 on Greenland Plateau

T 33N R 4E Section	Loss of 1923 untreated	Loss of 1924 (On same area)	Decrease %
10	56	22	61%
14	129	73	43%
15	1527	446	71%
16	75	35	53%
22	720	508	53%
23	409	212	48%
25	328	127	61%
26	735	275	62%
27	193	200	6%
35	201	47	77%
36	474	158	67%
Totals	4847	2103	57%

The above table shows that the treatment of 1924 was followed by a 57% reduction in the losses. The only section which increased was section 27 which was adjoined on two sides by untreated timber which had been assumed to be fairly free from infestation and which on later examination showed for 1924 a loss averaging close to 100 trees per section.

No check sections were available which could be cruised to compare with the above treated areas. However, we know in a general way that the losses for 1924 were heavier in the region of the Basin and other portions of the forest and undoubtedly would have increased on Greenland if the control had not been conducted.

Thus, it is evident that the control work of 1924 carried on against a generally increasing infestation was a very effective agency in reducing the beetle losses.

Results from 1925 Control work

The control work of 1925, on the other hand, carried out against a naturally decreasing infestation showed only slightly better results than were secured on untreated areas. Both areas declined so much that it is hard to distinguish the effect of control from the effect of the natural factors.

On the **check sections** north of Moquitch we have the following results from the 1925 treatment:

Table 4.

Comparison of losses of 1924 and 1925 on
Check Sections North of Moquitch.

Check sections	<u>Treated Section</u>		
	1924 loss treat- ed in 1925	1925 loss (Fall Spotting)	% Decrease
T 38 8 N. R 2E Sec. 10W $\frac{1}{2}$	90	10	89%
15E $\frac{1}{2}$	184	26	86%
T 39 N. R 2E Sec. 22E $\frac{1}{2}$	78	8	90%
	352	44	88%

<u>Nearest three untreated sections</u>			
	1924 loss	1925 loss	% Decrease
T 38 N. R. 1E Sec. 25E $\frac{1}{2}$	38	8	79%
T 38 N. R. 1E Sec. 23E $\frac{1}{2}$	94	15	85%
T 38 N. R. 2E Sec. 34W $\frac{1}{2}$	145	14	90%
	277	37	87%

Thus, it is evident that the most tangible results from control have been those secured when control has been applied against an increasing infestation.

RECOMMENDATIONS FOR FUTURE WORK

As yet the reasons for the sudden decline of 1925 are not thoroughly understood. The bark counts which were made just before the emergence of the 1925 broods indicated that there had been a heavy mortality of the beetles in the trees between the egg and the adult stages. But the reasons for this mortality are as yet undetermined.

So far there is no evidence to show that these epidemics come in any regular cycles but it is more than probable that they may increase or decrease any year in response to outside influences.

Control work has been shown to be an effective agency in reducing beetle population and in saving timber. It is well therefore, to apply control wherever the beetles are aggressive and not place too much dependence upon natural control factors.

For this reason the safest plan would be to treat the only remaining epidemic center on the forest, that near Mile and a Half as a precaution against a possible increase should conditions again become favorable for the beetles. This area may decline again in 1926 or it may increase, as yet have no way of telling. The safest thing to do would be to clean up this center and take no more chances. This would require the treating of approximately 3,000 trees at a total cost of about \$5,000 during the spring of 1926.

The only reason for not treating this infestation center would be the desirability of having some infestation left with which to carry on the studies now under way on the Kaibab, and to see whether this center will again decline in 1926 without further treatment. Whether it does or not will however, mean nothing unless we are able to determine the causes. It may be possible to do this, this coming year. The problem of how and why infestations rise and decline is one of the biggest problems ahead of us, and until this is solved the only thing to do is to blindly go ahead and do control whenever the infestation becomes epidemic and continue it until nature's balance is again restored. The control work which has been carried on so far shows that this at least is the safest course and will pay in the timber saved.

In the future a close watch should be kept on the Kaibab forest and whenever an epidemic starts control measures should be promptly applied. We have found that the greatest effect from control has been secured when it has been applied to an increasing infestation. If this is done, there is every reason to believe that the serious epidemics which have prevailed in the past may be largely avoided.

Table 5

Number of trees killed in 1924 and 1925 throughout Kaibab Plateau

<u>Township</u>	<u>1924</u>		<u>1925</u>	
	<u>Endemic</u>	<u>Epidemic</u>	<u>Endemic</u>	<u>Epidemic</u>
T 40 N, R 2 E	190		40	
T 39 N, R 1 E	340	100	190	
T 39 2 E	1,550	1,350	580	
T 38 1 W	40	0	10	
T 38 1 E	820	1,530	750	
38 2 E	420	7,580	1,400	220
37 1 W	400	240	130	
37 1 E	730	4,020	670	
37 2 E	920	12,530	800	1,760
37 3 E	440	1,730	340	120
36 1 W	580	0	120	
36 1 E	660	4,130	850	
36 2 E	920	950	260	
36 3 E	1,070	600	340	
35 1 E	1,770	210	700	
35 2 E	1,230	210	290	
35 3 E	350	0	70	
34 1 E	480	0	100	
34 2 E	1,570	380	390	
34 3 E	1,680	0	340	
34 4 E	290	0	60	
33 2 E	40	0	10	
33 3 E	1,050	0	210	
33 4 E	440	2,240	200	
32 4 E	220	0	50	
Total	18,200	37,800	8,900	2,100
Total trees	56,000		11,000	
Total Volume	14,000,000		3,000,000	
Per cent of stand	1.27		.27	