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POTENTIAL DOUGLAS-FIR TUSSOCK MOTH DAMAGE IN NORTHERN IDAHO IN 1974 BASED ON A 1973 FALL EGG MASS SURVEY

by

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ABSTRACT

An epidemic of Douglas-fir tussock moth was detected in northern Idaho in 1972. In 1973, aerial surveys showed that nearly 100,000 acres contained various degrees of visible defoliation. An egg mass survey of five reporting units made in the fall of 1973 determined potential for damage in 1974. Based on new egg mass densities and new to old egg mass ratios, damage is predicted to be sufficiently high to warrant control on 34,138 acres in the Coeur d'Alene unit, 64,779 acres in the St. Joe unit, 4,433 acres in the Clearwater unit, 4,762 acres in the Craigmont unit, and 33,501 acres in the Nezperce unit. Total acres qualifying for treatment are 141,613. In addition, some damage might occur on 81,554 acres within the five units. These areas will be further evaluated to determine if they qualify for treatment.

INTRODUCTION

Outbreaks of the Douglas-fir tussock moth, *Orgyia pseudotsugata* McD., have occurred in northern Idaho on a cyclic basis. History of these outbreaks has been reviewed by Tunnock (1973).

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Indications that the current outbreak was building up were discovered in Coeur d'Alene, Idaho, during 1971 when several ornamental firs were defoliated (Tunnock and Honing, 1971) and in 1972 when egg masses were found within a 100-acre logging unit near Charles Butte, St. Joe National Forest, Idaho (Tunnock, 1972). A February 1973 egg mass survey conducted in areas of previous outbreaks substantiated the buildup and predicted a minimum of 50,000 acres of visible defoliation (Livingston and Tunnock, 1973). Aerial surveys completed during the summer of 1973 showed nearly 100,000 acres with varying degrees of visible defoliation (Tunnock, et al., 1973).

The tussock moth is an important defoliator of true firs, *Abies* spp. L., and Douglas-fir, *Pseudotsuga menziesii* var. *glauca* (Beissner) Franco, over much of western North America. In Idaho, the favorite hosts are Douglas-fir and grand fir, *Abies grandis* (Dougl.) Lindl. However, if preferred food is scarce, the tussock moth will feed on any coniferous species.

Damage to trees is caused by the newly hatched larvae feeding on new foliage, causing it to shrivel and turn brown. By mid-July, larger larvae feed on both new and old foliage, first stripping the tops of trees and outermost portions of branches, then feeding into the inner crown (Mason and Baxter, 1970; Wickman, et al., 1971). While many trees are only top killed, occasionally they may be completely defoliated and killed in one season (Tunnock 1964). Trees weakened through defoliation have been reported to suffer pronounced growth loss, and many are subsequently attacked by bark beetles (Wickman, 1963).

To predict what this outbreak would do in 1974, a broad-scale egg mass survey was conducted during October and November 1973. The survey was a cooperative effort of a special task force established by the Northern Rockies Forest Pest Action Council. Participants included the State of Idaho Department of Public Lands; U.S. Forest Service, Region 1; Potlatch Forests, Inc.; Bureau of Indian Affairs; Corps of Engineers; and University of Idaho.

The following were the objectives of the egg mass survey:

1. Determine potential 1974 tussock moth population levels in and adjacent to the aerially visible defoliated areas.

2. Determine extent of infested area outside aerially visible defoliated areas.

3. Predict potential defoliation for 1974.

4. Classify areas where applied control may be advisable.

5. Estimate impact of natural factors (parasites, predators, disease, etc.) on the 1974 tussock moth population.

This report describes results of an egg mass survey, which provides, in part, the biological basis for recommendations for or against applied control in the various infested areas of northern Idaho. Additional observations will be made to estimate levels of natural virus incidence and other factors which might influence 1974 population levels. These will be reported at a later date.

METHODS

The zone of infestation was divided into five survey units. These units were designated Coeur d'Alene, St. Joe, Clearwater, Craigmont, and Nezperce.

Plots to be sampled were tentatively marked on maps to gather information within and around all known defoliated areas and within adjacent areas where defoliation had occurred in past outbreaks. Plots were established on the basis of access and availability of host type. Where access was available, every section within the defoliated areas was sampled. Helicopters were used in some of the roadless areas of the Nezperce unit.

Eight trees were sampled in each plot. A sample plot consisted of four limbs cut from the midcrown of each of eight trees. The extreme length and width of the foliar area of each branch, the number of new and old egg masses, and the presence or absence of cocoons on each branch were recorded. Five new egg masses were collected from each plot when new egg masses were found. These eggs are to be hatched in February to determine incidence of nucleopolyhedrosis virus on the plot. Also, the number of viable eggs per thousand square inches of foliage will be determined from new egg masses on each plot.

Survey data was utilized to compute number of new and old egg masses per thousand square inches of foliage, the ratio of old to new egg masses, and the abundance of cocoons for each plot. Resultant data was analyzed by a key developed by the working group of the Interagency Douglas-fir Tussock Moth Steering Committee to determine areas qualifying for control at this time.

1.	No survey data collected in the area[3/]	(6)
1a.	Survey data collected in the area	(2)
2.	No new egg masses on plots - low risk[4/]	
2a.	New egg masses on plots	(3)

3/ Usually a land section of approximately 640 acres in size, but can be smaller if necessary in order to determine treatment needs more precisely.

4/ Low risk = control not necessary for these areas.

3.	Egg mass density equal to or greater than 0.1 per thousand square inches of foliage - high risk[5/]	(7)
3a.	Egg mass density less than 0.1 per thousand square inches of foliage	(4)
4.	New to old egg mass ratio 1:1 or greater - high risk	(7)
4a.	New to old egg mass ratio less than 1:1	(5)
5.	Average egg mass count on time plots 15 or more - high risk	(7)
5a.	Average egg mass count on time plots less than 15 - low risk	
6.	Unsampled areas (sections) adjacent to one or more areas (sections) which equal or exceed the high risk criteria above - high risk	(11)
6a.	Unsampled areas (sections) not adjacent to one or more areas (sections) which equal or exceed the high risk criteria above - low risk	
7.	Virus level equal or greater than 50 percent - low risk	
7a.	Virus level less than 50 percent	(8)
8.	Area (plot) located in defoliation class I or II - high risk	(10)
8a.	Area (plot)located in defoliation class II or IV	(9)
9.	Virus level equal or greater than 30 percent - low risk	
9a.	Virus level less than 30 percent - high risk	(10)

5/ High risk = control recommended for these areas.

10. Viable egg density in sampled areas less than 20 eggs per 1,000 square inches foliage - low risk

10a. Viable egg density on sampled areas equal or greater than 20 eggs per 1,000 square inches foliage - high risk.

11. Unsampled area adjacent to an area meeting the high risk criteria <u>after</u> the virus and viable egg levels have been determined - high risk

11a. Unsampled area not adjacent to an area meeting the high risk criteria <u>after</u> the virus and viable egg levels have been determined - low risk.

RESULTS

A total of 400 plots were established within the five units. Table 1 summarizes data (Appendix Table 1) from all plots which contained new egg masses. New and old egg masses per thousand square inches of foliage and old to new egg mass ratios are listed.

Table 1.--Summary of data from plots with new Douglas-fir tussock moth egg masses

Unit	Number of plots containing new eggs	Range of egg masses per 1,000 sq. in. foliage		Range of old to new egg mass ratios
		New	Old	
Coeur d'Alene	28	.01 to .73	0 to .12	1:0.3 to 1:35
St. Joe	64	.01 to 3.6	0 to 1.5	1:0.2 to 1:22
Clearwater	5	.05 to .10	0 to 2.5	1:0.07 to 1:2
Craigmont	4	.02 to .31	.04 to .29	1:0.5 to 1:1.2
Nezperce	31	.02 to 5.3	0 to 1.3	1:0.03 to 1:7
Total	132			

Table 2 summarizes data (Appendix Table 2) taken from all plots which did not contain new egg masses. The presence of cocoons only, old egg masses, or no evidence of tussock moth activity are listed.

Table 2.--Summary of data from plots which did not contain new Douglas-fir tussock moth egg masses

Unit	Number of plots with no new eggs	Number of plots containing: Cocoons only	Old egg masses	No cocoons or eggs
Coeur d'Alene	45	24	6	15
St. Joe	147	77	21	49
Clearwater	27	11	9	7
Craigmont	16	11	3	2
Nezperce	33	15	5	13
Total	268	138	44	86

Table 3 shows the results of the surveys on the five units by presenting the number of acres with possible tussock moth activity, acres of recommended control, and acres that might need to be sprayed after further evaluation. Narrative descriptions of each unit follow table 3.

Table 3.--Acres of possible activity, proposed treatment, and treatment option in northern Idaho during 1974

Unit	Possible activity	Proposed treatment	Treatment option
Coeur d'Alene			
State and private		4,172	2,008
Forest Service		29,966	12,726
Subtotal	55,081	34,138	14,734
St. Joe			
Coeur d'Alene IR		4,500	0
State and private		45,352	36,681
Forest Service		14,927	5,615
Subtotal	234,549	64,779	42,296
Clearwater			
State and private		2,686	861
Forest Service		1,747	547
Subtotal	81,552	4,433	1,408
Craigmont			
State and private		4,762	7,162
Forest Service		0	0
Subtotal	21,338	4,762	7,162

Table 3.--Acres of possible activity, proposed treatment, and treatment option in northern Idaho during 1974, con.

Unit	Possible activity	Proposed treatment	Treatment option
Nezperce			
State and private		1,312	1,045
Forest Service		32,501	14,909
Subtotal	112,301	33,501	15,954
North Idaho total	504,821	141,613	81,554

Coeur d'Alene unit.--The Coeur d'Alene unit consists of an area bordered on the south and east by the Coeur d'Alene River, by Coeur d'Alene Lake on the west, and extending north across Interstate 90 into the headwaters of the Skitwish, Marie, Stoney, and Curran Creek drainages.

An isolated population site due east of Dalton Gardens, Idaho, on the ridge containing East and West Canfield Buttes was also sampled.

Aerial detection surveys during 1973 found 1,880 acres with visible defoliation due to the tussock moth. Fall egg mass surveys indicated some activity (cocoons, larvae, or old egg masses) on a total of 55,081 acres. Of this, 34,138 acres (fig. 1) have a population that warrants control, with 14,734 additional acres that may need treatment, pending further investigation.

This area did not show any defoliation in 1972 and appears to contain a building population. There is a distinct possibility that this unit could increase in size during 1974 as survey crews found tussock moth cocoons in most plots on the northern edge of the area. The infestation may extend farther north than could be sampled at this time.

St. Joe unit.--This area is the largest unit within the current Idaho infestation. It is roughly bordered on the north by the St. Joe River, on the west by the Idaho-Washington border, on the south by Idaho Highway 81, leading from Moscow to Elk River and extending to the east as far as Range 3 east, Boise Meridian.

Aerial detection surveys conducted in 1973 located a total of 70,000 acres with varying degrees of defoliation. No defoliation was observed in 1972. Subsequent monitoring has shown the Douglas-fir tussock moth might be active on approximately 234,549 acres. Fall egg mass surveys have shown that there is a high risk for damage on 64,779 acres (fig. 2) with populations being high enough to recommend control. In addition,

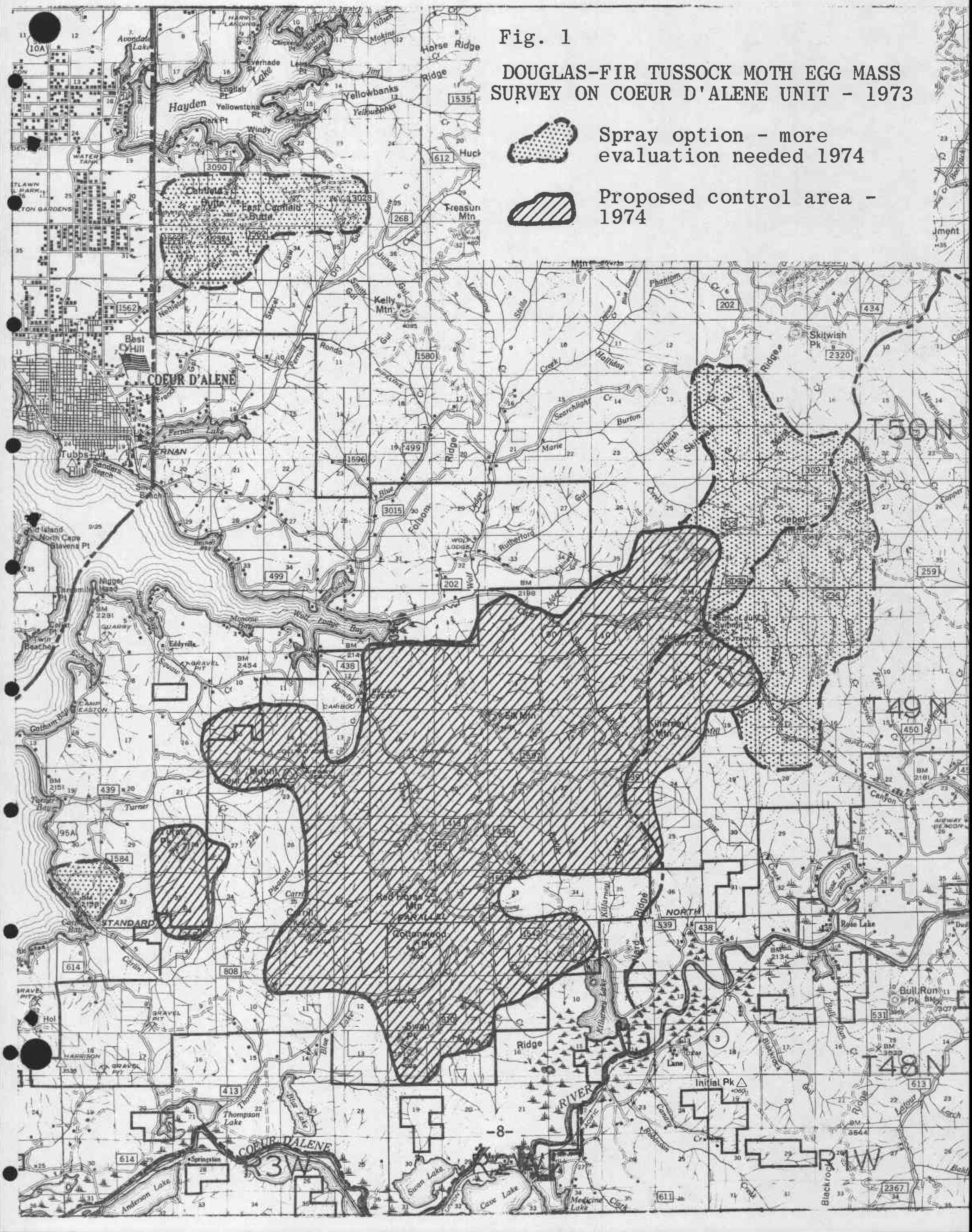

Fig. 1

DOUGLAS-FIR TUSSOCK MOTH EGG MASS SURVEY ON COEUR D'ALENE UNIT - 1973

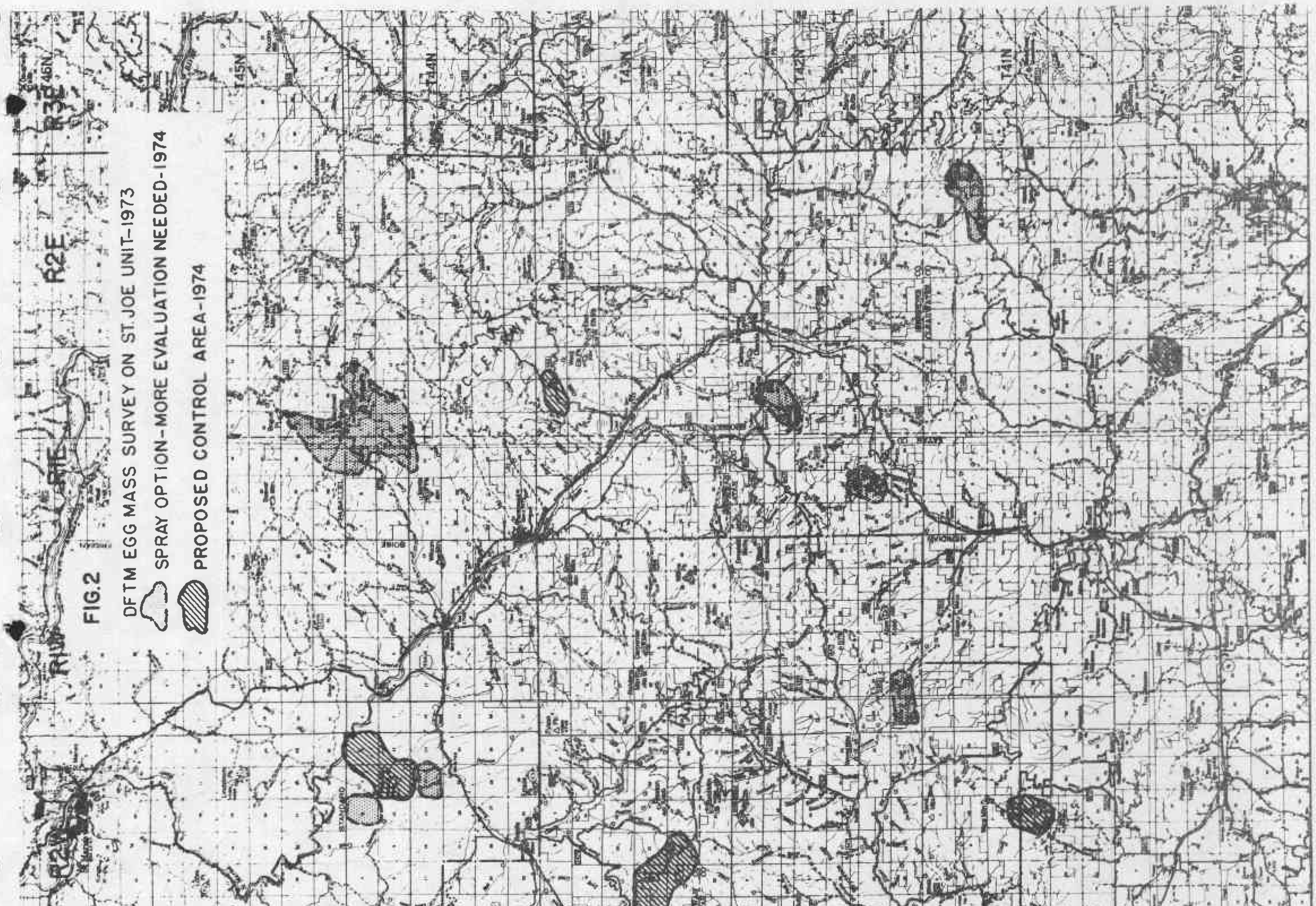
FIG.2
DFTM EGG MASS SURVEY ON ST. JOE UNIT-1973
SPRAY OPTION-MORE EVALUATION NEEDED-1974
PROPOSED CONTROL AREA-1974
R5W
R4W
R3W
R2W
R1W
R1E
R2E
R3E
T46N
T45N
T44N
T43N
T42N
T41N
T40N

there are 42,296 acres with populations that may warrant control pending further investigation.

The Douglas-fir tussock moth population in this unit is in numerous widely scattered epicenters. The largest population centers are in a chain between Plummer and Moscow. These contain the majority of the areas where control is recommended. This is the same basic area where outbreaks of the tussock moth developed in 1945 and 1964.

Clearwater unit.--Only 120 acres were defoliated in this unit which is in Clearwater County between the North Fork of the Clearwater River and the Middle Fork to the south.

Egg mass counts classified 4,433 acres (fig. 3) as high risk for defoliation in 1974 and control is recommended. There is potential for defoliation of an additional 1,408 acres which may also need treatment in 1974. There was evidence of tussock moth populations in 81,552 acres within this unit.

Craigmont unit.--This infestation lies in the area between the Salmon and Clearwater Rivers. The known population is in an irregular band surrounding the Soldiers Meadows Reservoir area southwest of Winchester and southeast of Lewiston.

Aerial surveys during 1973 showed 4,000 acres with visible defoliation. Subsequent egg mass surveys and ground reconnaissance have shown some tussock moth activity in a total of 21,338 acres. Of this total 4,762 acres (fig. 4) have populations that warrant control, with an additional 7,162 acres that may need treatment pending further investigation.

Immediately to the south of this unit there is an extensive infestation of the western spruce budworm, *Choristoneura occidentalis* Freeman. The defoliation caused by the budworm may be masking additional Douglas-fir tussock moth populations similar to that in the Nezperce unit.

This is the first time that Douglas-fir tussock moth has been found in this area.

Nezperce National Forest unit.--This unit lies in Idaho County between the Middle Fork of the Clearwater River to the north and the Salmon River to the south. Defoliation occurring in 1973 was visible from the air on 23,000 acres mainly on the Selway and Salmon River Ranger Districts. Damage was heaviest on the Salmon District and some tree killing occurred in pure stands of Douglas-fir from 10 to 50 acres in size.

On the Salmon River District, egg mass counts classified 11,587 acres (fig. 5) as high risk and control is recommended for these areas. In addition, further sampling may indicate another 6,915 acres will need treatment. Altogether, there was possible tussock moth activity within 33,796 acres on this District.

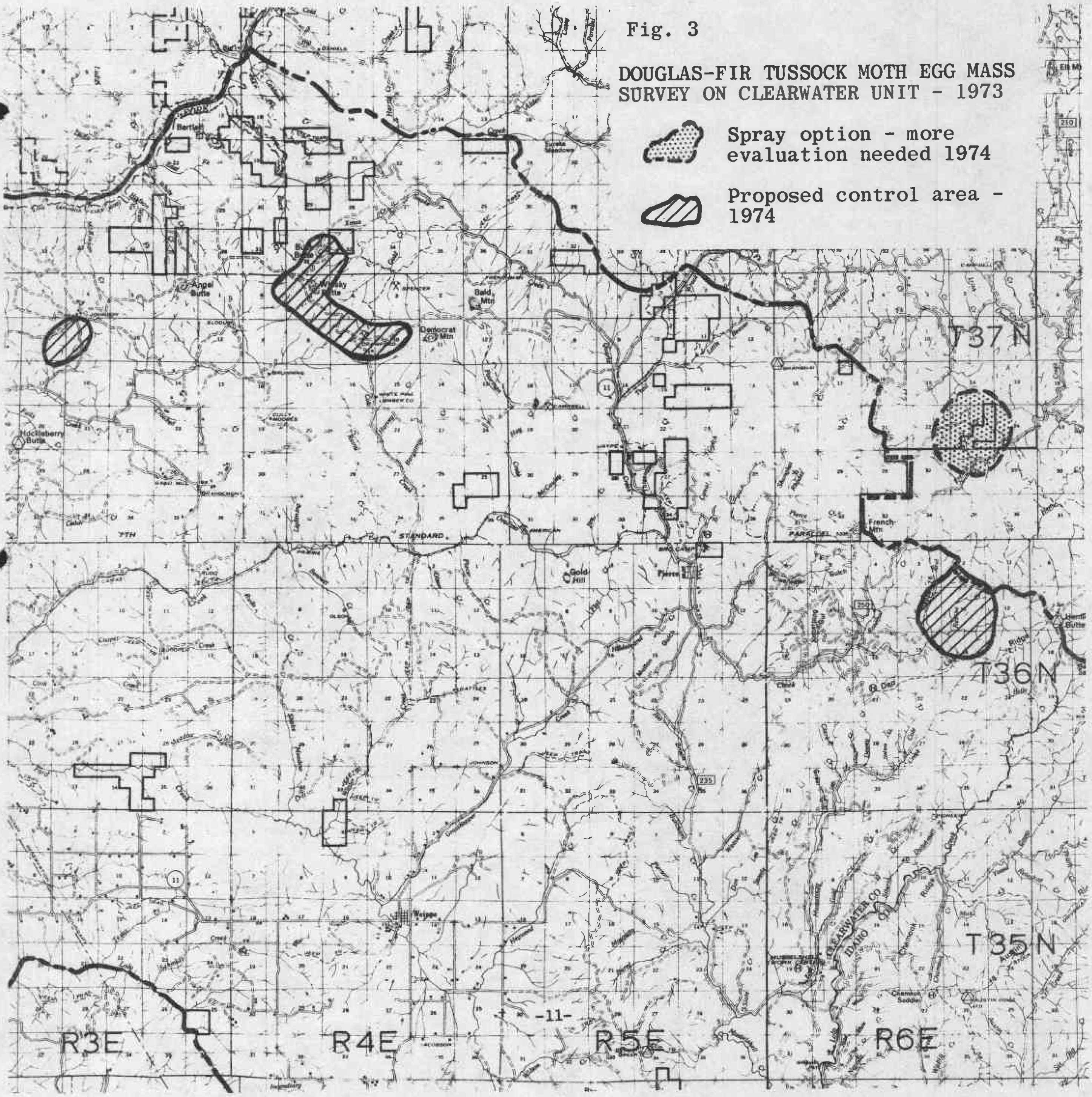

Fig. 3

DOUGLAS-FIR TUSSOCK MOTH EGG MASS SURVEY ON CLEARWATER UNIT - 1973

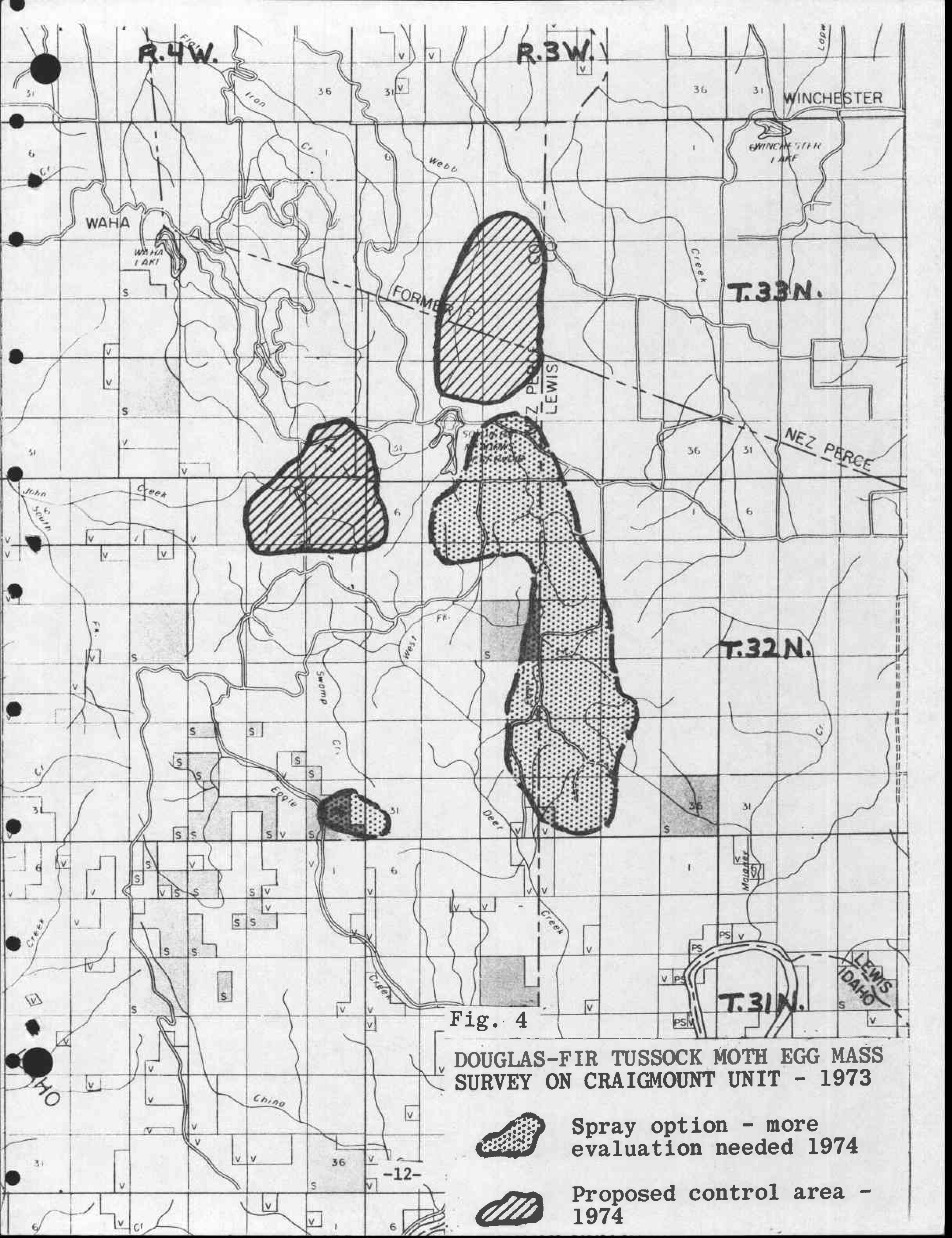

Fig. 4

DOUGLAS-FIR TUSSOCK MOTH EGG MASS SURVEY ON CRAIGMOUNT UNIT - 1973

Spray option - more evaluation needed 1974

Proposed control area - 1974

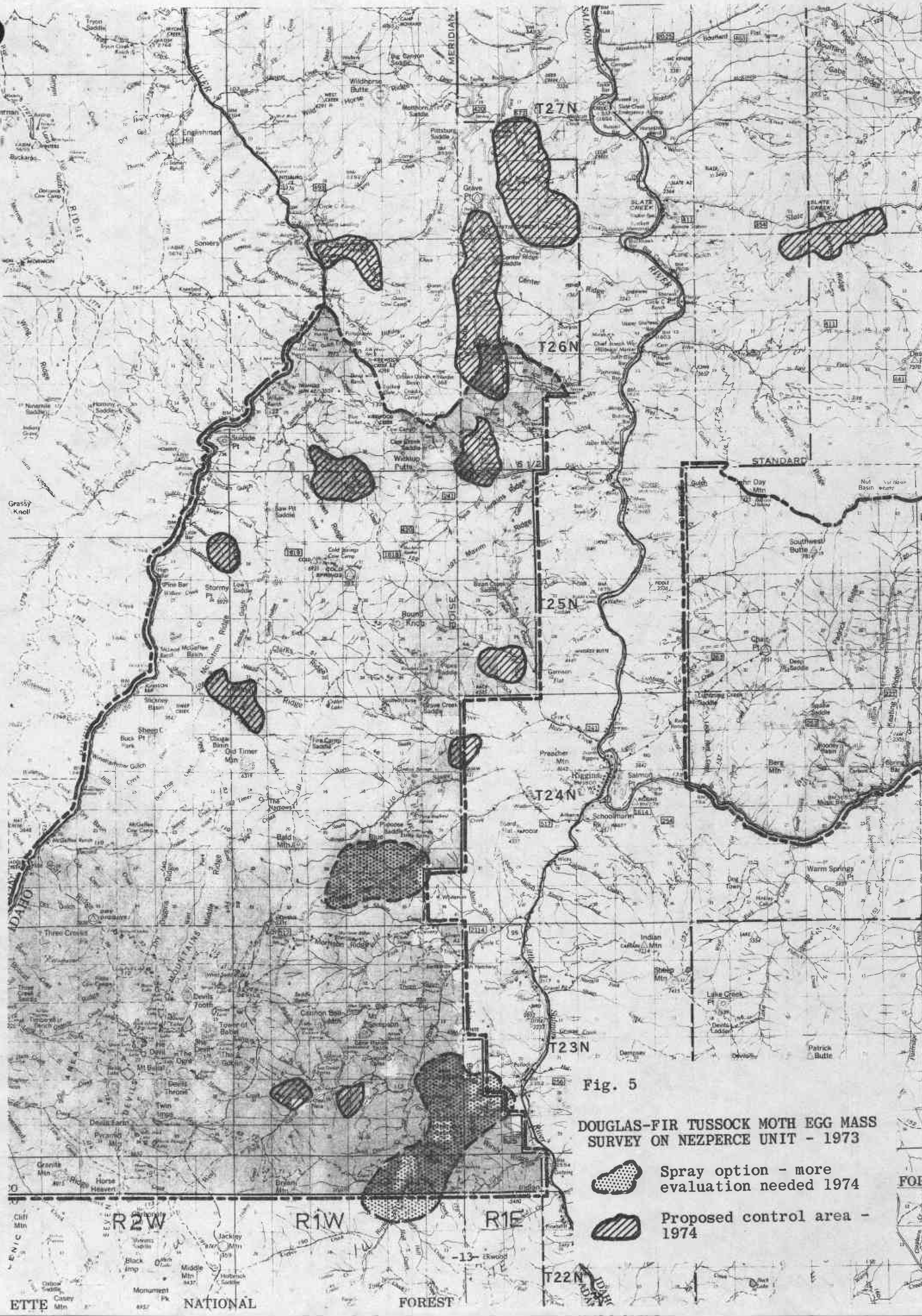

Fig. 5

DOUGLAS-FIR TUSSOCK MOTH EGG MASS SURVEY ON NEZPERCE UNIT - 1973

On the Selway District 21,914 acres (fig. 6) need treatment with an additional 9,039 acres of potential control area. Tussock moth infestation may occur over a total of 78,505 acres.

Totals for the Nezperce unit are:

Total area of possible activity	116,301 acres
Proposed spray area	33,501 acres
Spray potential area	15,954 acres

DISCUSSION

Within the five units there are numerous areas presently not included within the proposed or potential spray blocks that are thought to harbor tussock moth populations capable of causing unacceptable damage. Generally they are adjacent to existing proposed spray blocks. These areas were not sampled due to lack of access or suitable sample trees. Control decisions for these areas will be based on further evaluations including an aerial survey made after egg hatch and just prior to the intended treatment date.

During February 1974, eggs from new egg masses collected from many of the plots will be hatched in the laboratory to determine virus incidence. The key on pages 3, 4, and 5 will be used to decide whether the percentage of virus on a plot makes it high or low risk. If it falls into the low risk category, the area will be subtracted from the proposed spray acreage. Viable egg density on the plots will also be considered at this time. Additional areas that may be removed from consideration for chemical treatment include portions of the Coeur d' Alene and Nezperce units.

If the percentage of natural virus is sufficiently low within these two areas, they will be selected as sites for testing the nucleopolyhedrosis virus and the bactierium, *Bacillus thuringiensis*. The virus will be applied at the rate of 100 billion polyhedra in 2 gallons of water per acre, and the bacteria will be applied at the rate of 1 pound in 2 gallons of water per acre.

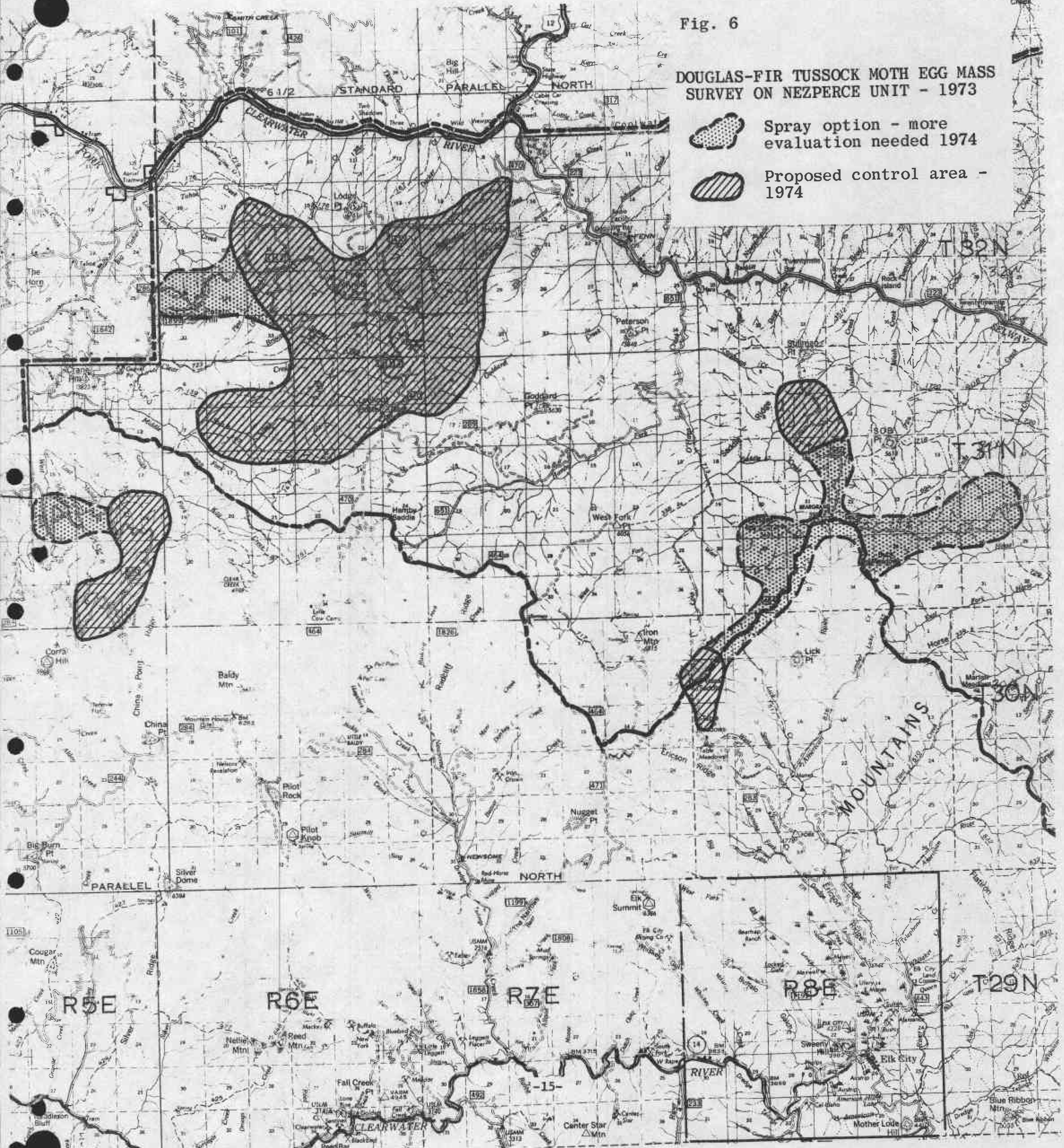

Fig. 6

DOUGLAS-FIR TUSSOCK MOTH EGG MASS SURVEY ON NEZPERCE UNIT - 1973

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Appendix Table 1.--Analysis from plots in northern Idaho containing new egg masses in 1973

Unit	Plot location	Egg masses/1,000 sq. in. foliage New	Egg masses/1,000 sq. in. foliage Old	Ratio Old:New
Coeur d'Alene	T. 49 N., R. 3 W., sec. 33	.04 ± .04	0	0:1
	T. 49 N., R. 2 W., sec. 26	.14 ± .14	0	0:2
	T. 49 N., R. 2 W., sec. 32	.01 ± .01	.02 ± .02	1:1
	T. 50 N., R. 2 W., sec. 36	.01 ± .01	0	0:1
	T. 48 N., R. 2 W., sec. 7	.02 ± .02	0	0:1
	T. 49 N., R. 3 W., sec. 36	.03 ± .03	0	0:1
	T. 48 N., R. 3 W., sec. 2	.12 ± .08	0	0:6
	T. 48 N., R. 2 W., sec. 4	.03 ± .03	0	0:1
	T. 49 N., R. 2 W., sec. 2	.01 ± .01	.02 ± .02	1:1
	T. 49 N., R. 2 W., sec. 23	.03 ± .03	0	0:1
	T. 49 N., R. 2 W., sec. 9	.05 ± .03	.02 ± .02	1:2
	T. 49 N., R. 2 W., sec. 8	.09 ± .05	0	0:3
	T. 49 N., R. 2 W., sec. 7	.06 ± .04	.01 ± .01	1:2
	T. 49 N., R. 2 W., sec. 14	.06 ± .03	0	0:4
	T. 49 N., R. 2 W., sec. 12	.02 ± .02	0	0:1
	T. 49 N., R. 2 W., sec. 16	.23 ± .06	.06 ± .03	1:4
	T. 49 N., R. 2 W., sec. 16	.47 ± .08	.12 ± .06	1:4
	T. 49 N., R. 3 W., sec. 25	.73 ± .18	.08 ± .05	1:9
	T. 49 N., R. 3 W., sec. 14	.49 ± .17	.03 ± .03	1:7
	T. 49 N., R. 3 W., sec. 24	.65 ± .18	.02 ± .02	1:35
	T. 48 N., R. 2 W., sec. 5	.01 ± .01	0	0:1
	T. 49 N., R. 2 W., sec. 21	.15 ± .08	0	0:5
	T. 49 N., R. 2 W., sec. 20	.02 ± .02	0	0:1
	T. 49 N., R. 2 W., sec. 22	.14 ± .06	.04 ± .04	1:5
	T. 49 N., R. 2 W., sec. 29	.32 ± .13	.04 ± .04	1:13
	T. 49 N., R. 2 W., sec. 31	.02 ± .02	0	0:1
	T. 49 N., R. 2 W., sec. 29	.01 ± .01	.10 ± .07	1:.3
	T. 48 N., R. 2 W., sec. 6	.01 ± .01	0	0:1
St. Joe	T. 42 N., R. 3 W., sec. 16	.02 ± .02	.01 ± .01	1:2
	T. 43 N., R. 3 W., sec. 22	.44 ± .17	.16 ± .08	1:4.5
	T. 42 N., R. 4 W., sec. 11	.21 ± .09	0	0:5
	T. 43 N., R. 5 W., sec. 22	.28 ± .12	.11 ± .07	1:1.6
	T. 42 N., R. 4 W., sec. 2	.91 ± .33	0	0:17
	T. 44 N., R. 3 W., sec. 18	.02 ± .02	.37 ± .11	1:6.6
	T. 44 N., R. 2 W., sec. 11	.04 ± .02	0	0:2
	T. 43 N., R. 4 W., sec. 5	.52 ± .17	.09 ± .04	1:3
	T. 45 N., R. 4 W., sec. 10	.01 ± .01	.02 ± .02	1:1
	T. 46 N., R. 4 W., sec. 35	.17 ± .08	0	0:4
	T. 43 N., R. 3 W., sec. 17	.07 ± .07	.07 ± .07	1:1
	T. 43 N., R. 4 W., sec. 18	.79 ± .37	.12 ± .09	1:6
	T. 45 N., R. 4 W., sec. 28	.67 ± .18	.11 ± .04	1:5
	T. 43 N., R. 4 W., sec. 6	.02 ± .01	.01 ± .01	1:2

Unit	Plot location	Egg masses/1,000 sq. in. foliage New	Old	Ratio Old:New
St. Joe	T. 44 N., R. 2 W., sec. 1	.08 ± .08	.03 ± .03	1:1
	T. 42 N., R. 3 W., sec. 32	.01 ± .01	.03 ± .03	1:1
	T. 41 N., R. 2 W., sec. 22	.07 ± .07	0	0:1
	T. 43 N., R. 2 W., sec. 28	.18 ± .08	.04 ± .04	1:5
	T. 43 N., R. 2 W., sec. 20	.02 ± .02	0	0:1
	T. 43 N., R. 2 W., sec. 19	.64 ± .17	.02 ± .02	1:22
	T. 40 N., R. 1 E., sec. 12	.08 ± .04	.06 ± .04	1:1
	T. 40 N., R. 4 W., sec. 6	.02 ± .02	.09 ± .09	1:1
	T. 40 N., R. 4 W., sec. 7	.14 ± .07	.15 ± .08	1:1.3
	T. 44 N., R. 3 W., sec. 26	.01 ± .01	0	0:1
	T. 42 N., R. 4 W., sec. 24	.24 ± .10	.22 ± .17	1:1.6
	T. 42 N., R. 4 W., sec. 13	.10 ± .05	.89 ± .24	1:.2
	T. 43 N., R. 3 W., sec. 35	.04 ± .03	0	0:2
	T. 42 N., R. 3 W., sec. 18	.66 ± .31	.11 ± .08	1:4
	T. 43 N., R. 5 W., sec. 27	.11 ± .08	0	0:2
	T. 44 N., R. 3 W., sec. 32	.15 ± .09	.03 ± .02	1:4
	T. 43 N., R. 4 W., sec. 12	.08 ± .05	0	0:4
	T. 42 N., R. 4 W., sec. 1	.07 ± .05	.05 ± .05	1:2
	T. 42 N., R. 3 W., sec. 19	.28 ± .16	.36 ± .16	1:.7
	T. 43 N., R. 4 W., sec. 8	.35 ± .10	0	0:12
	T. 42 N., R. 4 W., sec. 3	.47 ± .12	.04 ± .03	1:6
	T. 42 N., R. 3 W., sec. 6	.18 ± .09	.01 ± .01	1:7
	T. 42 N., R. 3 W., sec. 8	.02 ± .02	0	0:1
	T. 43 N., R. 4 W., sec. 26	.42 ± .30	.16 ± .08	1:2
	T. 42 N., R. 3 W., sec. 29	3.6 ± .53	1.5 ± .35	1:2.5
	T. 43 N., R. 5 W., sec. 12	.03 ± .02	.17 ± .07	1:.2
	T. 43 N., R. 4 W., sec. 17	.34 ± .10	.06 ± .04	1:5
	T. 43 N., R. 5 W., sec. 24	.35 ± .09	.02 ± .02	1:13
	T. 43 N., R. 4 W., sec. 18	.09 ± .05	0	0:3
	T. 45 N., R. 4 W., sec. 2	.09 ± .09	0	0:1
	T. 43 N., R. 4 W., sec. 18	.11 ± .04	.26 ± .07	1:.7
	T. 42 N., R. 4 W., sec. 18	.03 ± .03	0	0:1
	T. 44 N., R. 3 W., sec. 17	.76 ± .21	.06 ± .03	1:8.6
	T. 43 N., R. 4 W., sec. 32	.06 ± .05	.02 ± .02	1:2
	T. 43 N., R. 4 W., sec. 35	.68 ± .23	.11 ± .06	1:5.6
	T. 43 N., R. 3 W., sec. 26	.22 ± .17	.01 ± .01	1:5
	T. 43 N., R. 3 W., sec. 4	.44 ± .13	0	0:12
	T. 43 N., R. 4 W., sec. 33	.02 ± .02	0	0:1
	T. 43 N., R. 1 E., sec. 2	.03 ± .03	.08 ± .06	1:.5
	T. 45 N., R. 4 N., sec. 33	.04 ± .03	.07 ± .04	1:.7
	T. 43 N., R. 4 W., sec. 18	.64 ± .14	.17 ± .05	1:3
	T. 44 N., R. 4 W., sec. 11	.07 ± .04	0	0:4
	T. 45 N., R. 4 W., sec. 21	.12 ± .06	.07 ± .03	1:1.4
	T. 45 N., R. 4 W., sec. 16	.06 ± .04	0	0:4

Unit	Plot location	Egg masses/1,000 sq. in. foliage New	Egg masses/1,000 sq. in. foliage Old	Ratio Old:New
St. Joe	T. 45 N., R. 3 W., sec. 17	.02 ± .02	.05 ± .04	1:.5
	T. 45 N., R. 3 W., sec. 36	.04 ± .04	0	0:1
	T. 45 N., R. 3 W., sec. 15	.09 ± .05	.03 ± .03	1:3
	T. 44 N., R. 3 W., sec. 8	.03 ± .02	0	0:2
	T. 40 N., R. 5 W., sec. 13	.05 ± .03	0	0:2
	T. 41 N., R. 3 W., sec. 5	.04 ± .04	0	0:1
Clearwater	T. 36 N., R. 6 E., sec. 11	.09 ± .09	1.7 ± .70	1:.5
	T. 37 N., R. 3 E., sec. 9	.09 ± .06	.13 ± .07	1:.7
	T. 37 N., R. 4 E., sec. 5	.06 ± .06	0	0:1
	T. 37 N., R. 4 E., sec. 9	.10 ± .07	.04 ± .04	1:2
	T. 37 N., R. 6 E., sec. 23	.05 ± .03	2.5 ± .72	1:.07
Craigmont	T. 33 N., R. 3 W., sec. 29	.31 ± .13	.29 ± .10	1:1.2
	T. 33 N., R. 3 W., sec. 20	.08 ± .06	.08 ± .03	1:.5
	T. 33 N., R. 3 W., sec. 17	.31 ± .13	.29 ± .10	1:1.2
	T. 32 N., R. 4 W., sec. 1	.02 ± .02	.04 ± .04	1:1
Nezperce	T. 23 N., R. 1 W., sec. 29	.51 ± .19	.34 ± .16	1:1.7
	T. 23 N., R. 1 E., sec. 30	.02 ± .02	.29 ± .10	1:.1
	T. 26 N., R. 1 E., sec. 31	.46 ± .35	.05 ± .05	1:4
	T. 25 N., R. 1 E., sec. 31	.54 ± .52	1.2 ± .38	1:.2
	T. 27 N., R. 1 E., sec. 33	1.8 ± 1.2	0	0:2
	T. 31 N., R. 5 E., sec. 24	.10 ± .08	.01 ± .01	1:2
	T. 32 N., R. 6 E., sec. 21	.52 ± .24	.04 ± .04	1:7
	T. 32 N., R. 6 E., sec. 34	.22 ± .11	.08 ± .05	1:2.5
	T. 31 N., R. 8 E., sec. 9	.05 ± .05	0	0:1
	T. 31 N., R. 5 E., sec. 35	.09 ± .04	0	0:4
	T. 30 N., R. 8 E., sec. 7	.06 ± .06	0	0:1
	T. 24 N., R. 1 E., sec. 7	.02 ± .02	0	0:1
	T. 32 N., R. 7 E., sec. 31	.28 ± .16	0	0:3
	T. 24 N., R. 1 W., sec. 6	1.2 ± .26	.36 ± .15	1:2.3
	T. 27 N., R. 2 E., sec. 34	.14 ± .05	0	0:6
	T. 27 N., R. 1 E., sec. 20	.02 ± .02	0	0:1
	T. 26 N., R. 1 E., sec. 19	.56 ± .32	0	0:3
	T. 31 N., R. 7 E., sec. 6	.41 ± .29	.74 ± .34	1:.4
	T. 32 N., R. 6 E., sec. 36	.22 ± .18	0	0:2
	T. 31 N., R. 6 E., sec. 10	.18 ± .09	0	0:4
	T. 32 N., R. 7 E., sec. 17	.10 ± .06	0	0:3
	T. 32 N., R. 6 E., sec. 25	.10 ± .05	0	0:3

Unit	Plot location	Egg masses/1,000 sq. in. foliage New	Egg masses/1,000 sq. in. foliage Old	Ratio Old:New
Nezperce	T. 31 N., R. 6 E., sec. 8	.03 ± .03	0	0:1
	T. 26 N., R. 1 W., sec. 33	1.9 ± .65	.64 ± .35	1:6
	T. 26 N., R. 1 W., sec. 4	2.0 ± .41	.82 ± .19	1:2.4
	T. 26 N., R. 1 E., sec. 7	2.5 ± 1.2	0	0:6
	T. 22 N., R. 1 W., sec. 2	.03 ± .03	1.3 ± .25	1:.03
	T. 25 N., R. 2 W., sec. 13	.40 ± .40	.38 ± .26	1:.5
	T. 26 N., R. 1 W., sec. 3	5.3 ± 3.7	.49 ± .15	1:5.4
	T. 26 N., R. 1 E., sec. 6	.33 ± .21	.02 ± .02	1:3
	T. 23 N., R. 1 W., sec. 27	.48 ± .20	.06 ± .03	1:4.3

Appendix Table 2.--Survey data from plots in northern Idaho containing no new egg masses in 1973

Unit	Plot location	Cocoons only	Old egg masses	No cocoons or egg masses
Coeur d'Alene	T. 51 N., R. 3 W., sec. 30			X
	T. 51 N., R. 3 W., sec. 29	X		
	T. 51 N., R. 3 W., sec. 28	X		
	T. 51 N., R. 3 W., sec. 27	X		
	T. 51 N., R. 3 W., sec. 26	X		
	T. 51 N., R. 3 W., sec. 25			X
	T. 51 N., R. 3 W., sec. 32	X		
	T. 51 N., R. 3 W., sec. 35			X
	T. 50 N., R. 1 W., sec. 18		X	
	T. 50 N., R. 1 W., sec. 20	X		
	T. 50 N., R. 1 W., sec. 21	X		
	T. 50 N., R. 1 W., sec. 30	X		
	T. 50 N., R. 1 W., sec. 28	X		
	T. 50 N., R. 1 W., sec. 31	X		
	T. 50 N., R. 1 W., sec. 33	X		
	T. 50 N., R. 2 W., sec. 34			X
	T. 49 N., R. 2 W., sec. 4	X		
	T. 49 N., R. 2 W., sec. 1		X	
	T. 49 N., R. 1 W., sec. 6	X		
	T. 49 N., R. 1 W., sec. 4	X		
	T. 49 N., R. 1 W., sec. 7	X		
	T. 49 N., R. 1 W., sec. 17		X	
	T. 49 N., R. 2 W., sec. 11	X		
	T. 49 N., R. 2 W., sec. 10	X		
	T. 49 N., R. 3 W., sec. 16			X
	T. 49 N., R. 3 W., sec. 15	X		
	T. 49 N., R. 2 W., sec. 18			X
	T. 49 N., R. 2 W., sec. 19	X		
	T. 49 N., R. 3 W., sec. 21			X
	T. 49 N., R. 3 W., sec. 28	X		
	T. 49 N., R. 3 W., sec. 27			X
	T. 49 N., R. 2 W., sec. 30			X
	T. 49 N., R. 2 W., sec. 28		X	
	T. 49 N., R. 2 W., sec. 27	X		
	T. 49 N., R. 1 W., sec. 31			X
	T. 49 N., R. 2 W., sec. 36			X
	T. 49 N., R. 2 W., sec. 35			X
	T. 49 N., R. 2 W., sec. 34			X
	T. 48 N., R. 2 W., sec. 3	X		
	T. 48 N., R. 3 W., sec. 1	X		
	T. 48 N., R. 3 W., sec. 11			X
	T. 48 N., R. 3 W., sec. 12			X
	T. 48 N., R. 2 W., sec. 8		X	
	T. 48 N., R. 2 W., sec. 17		X	
	T. 48 N., R. 2 W., sec. 18	X		

Unit	Plot location	Cocoons only	Old egg masses	No cocoons or egg masses
St. Joe	T. 44 N., R. 1 E., sec. 23	X		
	T. 44 N., R. 2 E., sec. 30	X		
	T. 44 N., R. 2 E., sec. 32			X
	T. 43 N., R. 2 E., sec. 12			X
	T. 43 N., R. 2 E., sec. 24		X	
	T. 43 N., R. 5 W., sec. 26			X
	T. 43 N., R. 4 W., sec. 28			X
	T. 43 N., R. 4 W., sec. 25	X		
	T. 43 N., R. 3 W., sec. 34	X		
	T. 42 N., R. 2 W., sec. 9	X		
	T. 42 N., R. 3 W., sec. 5	X		
	T. 42 N., R. 3 W., sec. 10	X		
	T. 42 N., R. 3 W., sec. 9	X		
	T. 42 N., R. 3 W., sec. 7	X		
	T. 42 N., R. 4 W., sec. 8			X
	T. 42 N., R. 4 W., sec. 9	X		
	T. 42 N., R. 4 W., sec. 16	X		
	T. 42 N., R. 4 W., sec. 14	X		
	T. 42 N., R. 3 W., sec. 17			X
	T. 42 N., R. 3 W., sec. 22	X		
	T. 42 N., R. 3 W., sec. 21	X		
	T. 42 N., R. 3 W., sec. 20	X		
	T. 42 N., R. 4 W., sec. 23			X
	T. 42 N., R. 4 W., sec. 21	X		
	T. 42 N., R. 3 W., sec. 27	X		
	T. 42 N., R. 3 W., sec. 28	X		
	T. 42 N., R. 3 W., sec. 30	X		
	T. 42 N., R. 4 W., sec. 27			X
	T. 42 N., R. 3 W., sec. 33	X		
	T. 42 N., R. 3 W., sec. 34	X		
	T. 42 N., R. 3 W., sec. 35	X		
	T. 41 N., R. 3 W., sec. 4			X
	T. 41 N., R. 2 W., sec. 7			X
	T. 41 N., R. 2 W., sec. 9			X
	T. 41 N., R. 2 W., sec. 17	X		
	T. 41 N., R. 2 W., sec. 28	X		
	T. 41 N., R. 3 W., sec. 20			X
	T. 41 N., R. 5 W., sec. 23	X		
	T. 41 N., R. 5 W., sec. 21			X
	T1 41 N., R. 5 W., sec. 29			X
	T. 40 N., R. 5 W., sec. 10			X
	T. 40 N., R. 5 W., sec. 11	X		
	T. 40 N., R. 4 W., sec. 5	X		
	T. 40 N., R. 4 W., sec. 4	X		
	T. 40 N., R. 4 W., sec. 3	X		
	T. 40 N., R. 4 W., sec. 1	X		

Unit	Plot location	Cocoons only	Old egg masses	No cocoons or egg masses
St. Joe	T. 46 N., R. 4 W., sec. 29		X	
	T. 46 N., R. 4 W., sec. 26	X		
	T. 45 N., R. 5 W., sec. 10		X	
	T. 45 N., R. 3 W., sec. 12	X		
	T. 45 N., R. 4 W., sec. 20	X		
	T. 45 N., R. 4 W., sec. 32	X		
	T. 45 N., R. 3 W., sec. 31		X	
	T. 44 N., R. 2 W., sec. 3	X		
	T. 44 N., R. 2 W., sec. 6	X		
	T. 44 N., R. 3 W., sec. 4	X		
	T. 44 N., R. 3 W., sec. 6	X		
	T. 44 N., R. 4 W., sec. 3		X	
	T. 44 N., R. 4 W., sec. 4			X
	T. 44 N., R. 3 W., sec. 15	X		
	T. 44 N., R. 3 W., sec. 14			X
	T. 44 N., R. 2 W., sec. 18	X		
	T. 44 N., R. 2 W., sec. 14	X		
	T. 44 N., R. 2 W., sec. 20	X		
	T. 44 N., R. 3 W., sec. 22	X		
	T. 44 N., R. 5 W., sec. 28			X
	T. 44 N., R. 3 W., sec. 33	X		
	T. 44 N., R. 3 W., sec. 35			X
	T. 43 N., R. 1 W., sec. 16		X	
	T. 43 N., R. 2 W., sec. 9	X		
	T. 43 N., R. 3 W., sec. 5			X
	T. 43 N., R. 3 W., sec. 9	X		
	T. 43 N., R. 4 W., sec. 13	X		
	T. 43 N., R. 4 W., sec. 24		X	
	T. 43 N., R. 3 W., sec. 29		X	
	T. 43 N., R. 5 W., sec. 2		X	
	T. 43 N., R. 4 W., sec. 4	X		
	T. 43 N., R. 4 W., sec. 7	X		
	T. 43 N., R. 5 W., sec. 9			X
	T. 43 N., R. 5 W., sec. 13		X	
	T. 43 N., R. 5 W., sec. 14		X	
	T. 43 N., R. 4 W., sec. 19	X		
	T. 43 N., R. 4 W., sec. 21	X		
	T. 45 N., R. 1 W., sec. 24			X
	T. 45 N., R. 1 E., sec. 27		X	
	T. 45 N., R. 1 E., sec. 33	X		
	T. 45 N., R. 1 E., sec. 34		X	
	T. 44 N., R. 1 E., sec. 4	X		
	T. 44 N., R. 1 E., sec. 1	X		
	T. 44 N., R. 1 E., sec. 10		X	
	T. 44 N., R. 1 E., sec. 11	X		

Unit	Plot location	Cocoons only	Old egg masses	No cocoons or egg masses
St. Joe	T. 40 N., R. 4 W., sec. 10	X		
	T. 40 N., R. 4 W., sec. 11	X		
	T. 40 N., R. 4 W., sec. 12	X		
	T. 40 N., R. 4 W., sec. 20			X
	T. 40 N., R. 4 W., sec. 22	X		
	T. 40 N., R. 4 W., sec. 24			X
	T. 40 N., R. 4 W., sec. 26	X		
	T. 40 N., R. 3 W., sec. 6		X	
	T. 40 N., R. 3 W., sec. 5	X		
	T. 40 N., R. 3 W., sec. 4	X		
	T. 40 N., R. 3 W., sec. 8	X		
	T. 40 N., R. 3 W., sec. 11	X		
	T. 40 N., R. 3 W., sec. 17	X		
	T. 40 N., R. 3 W., sec. 21	X		
	T. 43 N., R. 2 W., sec. 35		X	
	T. 43 N., R. 1 W., sec. 31		X	
	T. 42 N., R. 1 W., sec. 5		X	
	T. 42 N., R. 1 W., sec. 1		X	
	T. 42 N., R. 1 W., sec. 15		X	
	T. 42 N., R. 1 W., sec. 32	X		
	T. 42 N., R. 1 E., sec. 11	X		
	T. 42 N., R. 1 E., sec. 29	X		
	T. 42 N., R. 3 E., sec. 9			X
	T. 42 N., R. 3 E., sec. 17			X
	T. 42 N., R. 3 E., sec. 29		X	
	T. 41 N., R. 3 E., sec. 30			X
	T. 41 N., R. 2 E., sec. 11	X		
	T. 41 N., R. 2 E., sec. 10	X		
	T. 41 N., R. 2 E., sec. 7	X		
	T. 41 N., R. 2 W., sec. 11	X		
	T. 41 N., R. 2 W., sec. 13	X		
	T. 40 N., R. 2 W., sec. 14	X		
	T. 40 N., R. 1 W., sec. 7	X		
	T. 40 N., R. 1 E., sec. 20			X
	T. 40 N., R. 1 E., sec. 28			X
	T. 40 N., R. 2 E., sec. 4			X
	T. 40 N., R. 3 E., sec. 6			X
	T. 40 N., R. 3 E., sec. 17	X		
	T. 40 N., R. 3 E., sec. 20			X
	T. 40 N., R. 3 E., sec. 29			X
	T. 40 N., R. 3 E., sec. 35			X
	T. 39 N., R. 3 E., sec. 17			X
	T. 39 N., R. 3 E., sec. 19			X
	T. 39 N., R. 2 E., sec. 7			X
	T. 39 N., R. 2 E., sec. 17			X
	T. 39 N., R. 2 E., sec. 16			X

Unit	Plot location	Cocoons only	Old egg masses	No cocoons or egg masses
St. Joe	T. 39 N., R. 2 E., sec. 20			X
	T. 39 N., R. 1 E., sec. 35			X
	T. 39 N., R. 1 W., sec. 22			X
	T. 39 N., R. 1 W., sec. 27			X
	T. 38 N., R. 1 W., sec. 5			X
	T. 38 N., R. 1 E., sec. 4			X
	T. 38 N., R. 1 E., sec. 8			X
	T. 38 N., R. 1 E., sec. 17			X
	T. 38 N., R. 1 E., sec. 19			X
	T. 38 N., R. 1 E., sec. 29			X
Clearwater	T. 39 N., R. 4 E., sec. 27	X		
	T. 38 N., R. 4 E., sec. 28			X
	T. 38 N., R. 4 E., sec. 32	X		
	T. 37 N., R. 4 E., sec. 1	X		
	T. 37 N., R. 4 E., sec. 10	X		
	T. 37 N., R. 4 E., sec. 13	X		
	T. 37 N., R. 3 E., sec. 2	X		
	T. 37 N., R. 3 E., sec. 5			X
	T. 37 N., R. 3 E., sec. 7			X
	T. 37 N., R. 3 E., sec. 16			X
	T. 37 N., R. 3 E., sec. 30	X		
	T. 37 N., R. 1 E., sec. 24			X
	T. 36 N., R. 4 E., sec. 21			X
	T. 36 N., R. 4 E., sec. 23			X
	T. 39 N., R. 5 E., sec. 15	X		
	T. 39 N., R. 5 E., sec. 21	X		
	T. 39 N., R. 5 E., sec. 33		X	
	T. 38 N., R. 6 E., sec. 13		X	
	T. 38 N., R. 7 E., sec. 7		X	
	T. 38 N., R. 7 E., sec. 22		X	
	T. 37 N., R. 7 E., sec. 5		X	
	T. 37 N., R. 7 E., sec. 22		X	
	T. 37 N., R. 7 E., sec. 33		X	
	T. 37 N., R. 6 E., sec. 32		X	
	T. 36 N., R. 7 E., sec. 17	X		
	T. 36 N., R. 7 E., sec. 31		X	
	T. 35 N., R. 7 E., sec. 9	X		
Craigmont	T. 33 N., R. 3 W., sec. 9	X		
	T. 33 N., R. 3 W., sec. 16	X		
	T. 33 N., R. 3 W., sec. 32	X		
	T. 33 N., R. 3 W., sec. 33		X	

Unit	Plot location	Cocoons only	Old egg masses	No cocoons or egg masses
Craigmont	T. 33 N., R. 4 W., sec. 35	X		
	T. 33 N., R. 2 W., sec. 17			X
	T. 32 N., R. 4 W., sec. 2		X	
	T. 32 N., R. 4 W., sec. 36		X	
	T. 32 N., R. 3 W., sec. 5	X		
	T. 32 N., R. 3 W., sec. 9	X		
	T. 32 N., R. 3 W., sec. 15	X		
	T. 32 N., R. 3 W., sec. 21	X		
	T. 32 N., R. 3 W., sec. 22	X		
	T. 32 N., R. 3 W., sec. 26			X
	T. 32 N., R. 3 W., sec. 27	X		
	T. 32 N., R. 3 W., sec. 28	X		
Nezperce	T. 32 N., R. 6 E., sec. 16		X	
	T. 32 N., R. 6 E., sec. 24	X		
	T. 32 N., R. 6 E., sec. 30	X		
	T. 32 N., R. 6 E., sec. 29	X		
	T. 32 N., R. 6 E., sec. 31			X
	T. 31 N., R. 5 E., sec. 3	X		
	T. 31 N., R. 5 E., sec. 22	X		
	T. 31 N., R. 6 E., sec. 12	X		
	T. 31 N., R. 6 E., sec. 24			X
	T. 31 N., R. 6 E., sec. 34	X		
	T. 31 N., R. 7 E., sec. 19	X		
	T. 31 N., R. 7 E., sec. 23	X		
	T. 31 N., R. 7 E., sec. 30			X
	T. 31 N., R. 7 E., sec. 33			X
	T. 31 N., R. 8 E., sec. 15	X		
	T. 31 N., R. 8 E., sec. 29		X	
	T. 31 N., R. 8 E., sec. 28	X		
	T. 31 N., R. 9 E., sec. 19	X		
	T. 30 N., R. 7 E., sec. 11			X
	T. 30 N., R. 6 E., sec. 4			X
	T. 30 N., R. 6 E., sec. 9			X
	T. 28 N., R. 1 W., sec. 14			X
	T. 28 N., R. 1 W., sec. 13	X		
	T. 28 N., R. 1 W., sec. 25			X
	T. 27 N., R. 2 E., sec. 35		X	
	T. 25 N., R. 1 W., sec. 6		X	
	T. 25 N., R. 2 E., sec. 28			X
	T. 25 N., R. 2 E., sec. 25			X
	T. 25 N., R. 2 E., sec. 36			X
	T. 24 N., R. 1 W., sec. 26	X		
	T. 24 N., R. 1 W., sec. 27		X	
	T. 24 N., R. 1 W., sec. 33			X
	T. 23 N., R. 1 W., sec. 20	X		