

INTRODUCTION

This report covers budworm control work carried out under the direction of the California Department of Forestry (CDF) within the Trinity Zone of Infestation during fiscal year 1984-85. 88,000 acres of budworm-infested forest land in Trinity and Shasta counties were aeriually sprayed in May 1985 with *Bacillus thurengiensis* (B.t.) to protect the Douglas-fir trees on intermingled private and federal lands. This work was carried out under the provisions of Public Resources Code Sections 4712-4718 which authorize CDF to engage in forest insect control.

CDF entered into separate Insect Control Agreements with each owner of land within the project area to document their respective financial commitment. Federal agencies agreed to pay the entire cost of spraying their lands within the project. Private owners agreed to pay one half the cost of treating their respective lands and CDF agreed to pay the other half. The total cost of the project was \$393,848.76 or \$4.48 per acre. *but is cheap work it?*

In addition to their financial commitment, contributed services were provided by CDF, the U. S. Forest Service, Santa Fe Pacific Timber Company, Paul Bunyan Lumber Company, Bureau of Land Management, and Champion International Corporation. These

services included planning, pre-spray insect and host evaluation, spray equipment calibration, spray deposit assessment and post-spray insect status evaluation. Throughout the rest of this report, the companies and agencies named above will be referred to collectively as the "cooperators".

THE INFESTATION

Significant budworm defoliation of Douglas fir trees was first reported in 1982. The causal insect was identified as Choristoneura carna californica Powell, a western budworm for which there is no approved common name. Entomologists and foresters from governmental agencies and private timber companies began monitoring the budworm outbreak and the effects on the forest resource. By June 1983, defoliation was occurring on 93,000 acres. In October 1983, the Director of Forestry declared the area affected by the budworm to be the Trinity Zone of Infestation covering approximately 290,000 acres. At their November 1983 meeting, the State Board of Forestry approved the declaration and authorized the use of funds which might be made available to control the infestation.

In February 1984, the Forest Service completed the Western Budworm Environment Assessment (EA) in cooperation with the Bureau of Land Management, major landowners and CDF. The EA was

prepared to evaluate alternatives for the management of the budworm outbreak. In April 1984, the Shasta-Trinity National Forest Supervisor published a decision to adopt the "defer action" alternative. The cooperating agencies and private landowners concurred with the decision. The consensus was that cost of control would exceed the benefits to be derived. Monitoring efforts continued.

The infestation had increased to 130,000 acres by June 1984 and entomologists predicted that an additional 10,000 acres would be damaged in 1985. The total area at risk was 240,000 acres, including 185,000 acres of Douglas fir type.

In November 1984, the major private landowners requested CDF assistance with a project to control the budworm since CDF is the agency responsible for protection of private forest resources in California. The owners stated that they were incurring unacceptable losses as a result of severe budworm damage. Santa Fe Pacific estimated that they would suffer a growth loss of 25.7 million board-feet, valued at \$2.57 million, through 1988 if the budworm outbreak continued through the 7-year cycle experienced elsewhere in the west. The owners also requested that the U. S. Forest Service and the Bureau of Land Management control the budworm on their respective lands because of the intermingled

pattern of private and federal lands. The public agencies agreed to cooperate with the private owners to implement a control project which would be biologically and economically effective.

In subsequent meetings, the cooperators delineated the areas of high priority for control efforts. The net area proposed for spraying was about 88,000 acres. Santa Fe Pacific owns about 36,000 acres of this. Other private ownership totals about 7,400 acres. The U. S. Forest Service manages about 45,000 acres within the control area and the Bureau of Land Management is responsible for about 600 acres.

Selection of the areas to be sprayed was based primarily on the intensity of infestation, with consideration also given to how defoliation would affect the values at risk, i.e. recreational (U. S. F. S.) vs. commercial timber (private), and how the pattern of the various ownerships impacted one another as the decision to spray or not spray an area was made (in a "checkerboard" ownership pattern it was generally not feasible to spray individual sections and not spray surrounding sections).

ORGANIZATION

Because of the private landowners' request for assistance and CDF's responsibility to protect private forest resources, CDF took the lead and a CDF Project Director was appointed to head

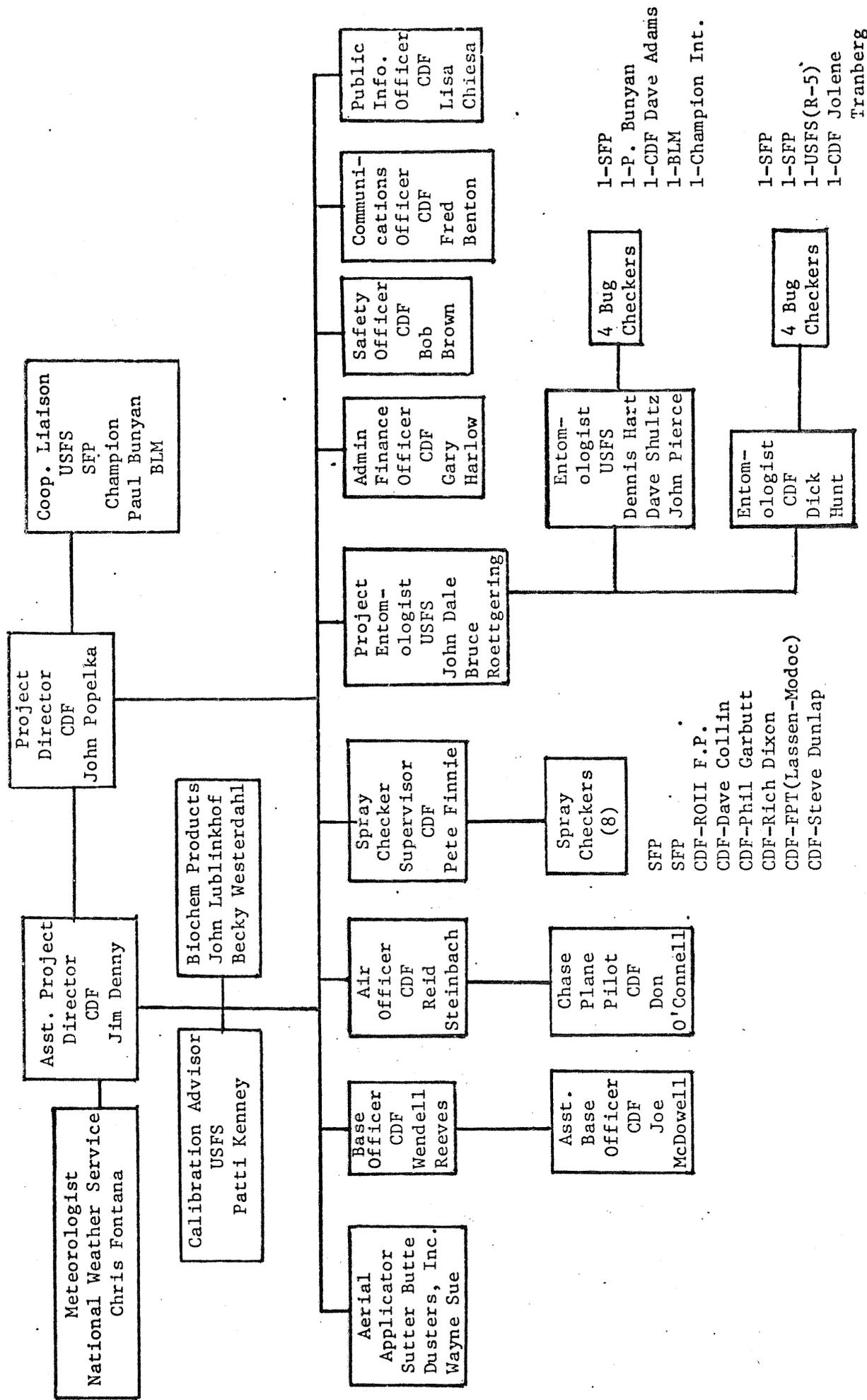
the project.

In subsequent cooperators meetings a project organization chart was developed and personnel from each of the cooperators were selected to perform duties within the organization. As can be seen from the attached organization chart, CDF personnel (20) made up a large part of the organization, but the other cooperators provided valuable help for the field operations with 7 persons from the USFS, 5 from Santa Fe Pacific, and one each from Paul Bunyan Lumber Co., BLM and Champion International.

The U. S. Forest Service Region V Forest Insect and Disease Management staff provided valuable services in all phases of budworm and host evaluation. Personnel of the USFS Forest Pest Management Methods Application Group in Davis were helpful in planning the aerial spray operation and literally conducted all calibration and characterization of aircraft spray systems.

The aerial applicator, Sutter Butte Dusters, Inc. of Live Oak, California had four personnel on the project during spray operations. There were two pilots and two ground support personnel who performed all mixing and loading as well as maintenance and repair of the contractor's equipment.

BUDWORM CONTROL PROJECT ORGANIZATION



CONTROL WORK

Early in the planning stages, the cooperators recognized that aerial treatment of selected portions of the infestation area with *Bacillus thuringiensis* (B.t.) was the most viable control method. B.t., a naturally occurring bacteria which affects only the larvae of certain insects such as the budworm, was to be aerially applied in late spring when larvae were actively feeding and most susceptible to B.t. This material is registered by the Environmental Protection Agency and the California Department of Food and Agriculture for control of budworm. It has been used for budworm control in several areas of the United States and Canada.

The B.t. formulation selected through competitive bidding was Bactospeine[®] F.C., a flowable concentrate manufactured by Biochem Products of Montchanin, Delaware. It was diluted 2 parts Bactospeine to one part water. A sticker-extender, Bond, produced by Loveland Industries, Inc., Loveland, Colorado was added to the spray mix to protect it from being washed off the foliage in the event of rain soon after application.

The project area was divided up into 23 sub-watersheds considered to be identifiable as spray units for scheduling of spray application when insect and host status was suitable. For best

control possibilities, one half of the budworm larvae should be in 3rd and 4th instar (development stage) and the new foliage should be flushed or open enough to be exposed to the spray particles. As each area was released by entomologists for spraying, the release date was posted on a control map. These areas were then scheduled for spraying as soon as possible, since ten days is generally considered to be the maximum time during which tree and insect conditions remain optimum for spraying.

With the permission of the Trinity County Board of Supervisors, a project headquarters known as Budworm Base was established at Trinity Center Airport on the shore of Trinity Lake. Budworm Base facilities included a CDF command trailer with radio and telephone communications, a CDF 5,000 gallon water trailer, a portable weather station and tie-down space for the CDF-operated airplane used in observing and directing the spray operations. Sutter Butte Dusters located their aircraft, mixing and loading truck and Bactospeine storage tanker on the airport parking apron adjacent to Budworm Base.

All contractor and Budworm Base personnel were housed and fed at motels and restaurants in Trinity Center about a mile from the airport.

In preparation for the operational spraying, the aerial

applicator fitted two Ayres Turbo-Thrush fixed-wing aircraft with spray booms equipped with "Unimizer" spray nozzles and flew them to Trinity Center Airport in early May. These planes were high-performance turbine-engined agricultural spray aircraft suited for high elevation, rough terrain operations.

On May 9 and 10, the aircraft spray systems were calibrated for flow volume per acre and characterized for droplet size. Biochem Products representatives assisted Patti Kenny from the USFS Forest Pest Management staff with this testing to obtain a flow of .515 gallons of spray mix per acre at a droplet size of 125 microns Volume Median Diameter (VMD). By the end of the second day both planes were operational for spraying and the first sub-watershed spray unit was released by the project entomologist. Key project personnel including the spray plane pilots were given familiarization flights over the project area to acquaint them with the spray boundaries and the restricted flight areas around the three known eagle nest sites.

Before dawn on May 11, spray checkers based at Weaverville CDF Fire Station drove out to the first unit scheduled for spraying. They placed water sensitive spray cards throughout the unit and took up vantage points where they could observe the aerial spray patterns and take local weather readings with their belt weather

kits.

As soon as the spray checkers were in position, the CDF air officer and his pilot flew in a Cessna 337 aircraft and circled above the spray unit to await the arrival of the spray planes. At Trinity Center Airport, B.t. spray material was mixed and loaded through a closed system into the Turbo-Thrush spray planes. After the early morning winds died down, they took off and began operational spraying under the direction of the CDF air officer who was in radio communication with the pilots and the spray checkers, watching to make sure the spray was reaching the tree crowns.

By early afternoon, the air temperature rose and relative humidity went down. It appeared the spray was no longer reaching the trees so spray operations were stopped for the day. The spray cards were picked up and spray deposition verified by spray checkers.

Because of operational problems with the water-sensitive spray cards, it was decided that dye should be added to the spray mix and dye-sensitive cards should be used. A red food dye, FD&C #40, was added to all subsequent spray mixes and dye-sensitive Kromekote cards were used for spray deposit assessment.

Spraying continued daily as spray units were released and weather conditions permitted. Spraying was suspended as early as 0815 on some days and as late as 1200 on others. Generally, low humidity and high air temperature conditions caused rapid drying of the spray and limited spray operations to the early morning hours.

The last plane-load of spray material was applied just before noon on May 24th. During the 12 days of spray operations, 45,227 gallons of spray mix were applied to the project area. The average actual application rate based on the acreage estimated from the project map was .511 gallons/acre. This was within one percent of the planned rate of .515 gallons per acre.

POST-SPRAY EVALUATION

Shortly after the aerial spraying was completed, entomologists and their staff of bug checkers collected foliage samples from treated and untreated plots and made budworm larvae counts to assess the short-term effects of the spray. Untreated plots averaged 12 larvae per 100 buds while treated plots averaged 7 larvae per 100 buds, so it is apparent the B.t. spray had reduced the larval population.

Even before the results of the post-spray larval counts were available, entomologists and company foresters had made the

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general observations that dead and sick budworm larvae were evident and that there was less defoliation than expected. The subjective evaluation was that the spray had been effective.

As is common in evaluating budworm infestation, aerial mapping and an egg mass survey were conducted in August to predict budworm population trends and measure the long term effects of the spray project. The aerial mapping effort proved to be futile as there was little visual difference between the upper crowns of treated and untreated trees.

The results of the egg mass survey show that there are fewer egg masses and fewer eggs per mass than last year both in treated and untreated portions of the infestation. On the basis of this data, the Project Entomologist predicts that the defoliation damage throughout the infestation will be considerably less in 1986.

COST-SHARING

Apportionment of costs of this project was based on land ownership within the boundaries of the spray area. Acreage of the respective ownerships was determined from Trinity County Assessor records. The attached table shows the treatment acreages and cost-shares for each of the cooperators and the collective acreage and cost shares for the "other private"

landowners. A detailed breakdown for these owners can be found in the Appendix.

BUDWORM CONTROL PROJECT

COST-SHARE SUMMARY

LANDOWNER	ACRES	TREATMENT COST	LANDOWNER SHARE	CDF SHARE
Santa Fe Pacific Tmbr	35,943	\$ 161,024	\$ 80,512	\$ 80,512
Champion Int.	1,658	7,428	3,714	3,714
Paul Bunyan Lmbr. Co.	958	4,292	2,146	2,146
Other Private Owners	3,966	17,768	8,884	8,884
U.S. Forest Service	44,726	200,372	200,372	0
BLM	580	2,598	2,598	0
Totals	87,831	\$ 393,482	\$ 298,226	95,256

1. \$4.48 x Acres
2. 50% of Treatment Cost (Private Landowners)
3. 100% of Treatment Cost (Federal Landowners)
4. 50% of Treatment Cost of Private Lands
5. Less Than Actual Cost (\$393,848.76) because of round-off in \$4.48/Acre Charge.

BUDWORM CONTROL PROJECT

COST SUMMARY

Aerial Application	\$121,190.22
Bactospeine [®] F. C.	227,102.94
Use Tax	13,626.18
Bioassay	4,800.00
Bond (Sticker Extender)	8,018.90
Spray Cards and Dye	1,386.89
Travel and Per Diem	9,632.20
Security Patrolman	1,631.62
Fuel	1,697.33
Miscellaneous Expenses	4,762.48
Total	\$393,848.76