

WESTERN BARK BEETLE SEMIOCHEMICAL WORKING GROUP--ANNUAL MEETING
San Bernardino National Forest Supervisor's Office
San Bernardino, California
February 5-7, 1991

The annual meeting of the Western Bark Beetle Semiochemical Working Group (I think that's what we call ourselves!) was convened in San Bernardino, CA on February 5, 1991. Calling the meeting to order and chairing the distinguished body was Tom Hofacker, WO. In attendance were:

WO: Tom Hofacker, FPM
Jesus Cota, FPM
Bob Bridges, FIDR

PNW: Gary Daterman, Corvallis
Lonne Sower, Corvallis
Skeeter Werner, Fairbanks

PSW: Pat Shea, Davis

FPM:

R-1 Ken Gibson, Missoula
R-2 Ken Lister, Lakewood
Curtis O'Neil, Lakewood
R-4 Dave Holland, Ogden
Steve Munson, Ogden
Ralph Thier, Boise
R-5 Bruce Roettgering, San Francisco
Laura Merrill, San Francisco
John Wenz, Sonora
R-6 Iral Ragenovich, Portland
Dave Bridgwater, Portland
R-8 Ken Swain, Atlanta

IDL: Ladd Livingston, Coeur d'Alene

Phero Tech: Staffen Lindgren, Delta, B.C.

The meeting began with a discussion of Tom's assignment to organize a national bark beetle "steering committee"--and how that would relate to the presently constituted (tho' loosely!) bark beetle "working group." We briefly described the functions of each group, as perceived by various individuals, and decided to table further discussion until Thursday.

Almost as an extension of that topic, Gary informed those not previously aware that he has been charged with developing a national bark beetle R D & A plan by March 1. He had chaired a meeting the preceding week in Portland at which an outline for the proposed plan was prepared. He passed out copies of the outline and asked for comments from anyone wishing to. He further noted that a few individuals (namely: himself, Iral, Dave, Tom, and Bob) would forego the field trip on Wednesday to further refine the proposal as begun in Portland.

With that, we began the meeting in earnest--going through 1990 ACTIVITIES on a beetle-by-beetle basis:

Western Pine Beetle

Pat: Described some experimental work done in R-5, with John and Bruce, looking at various enantiomers of verbenone and their effectiveness in reducing the attraction of WPB pheromone baits in Lindgren funnel traps. The test was conducted in the pine and mixed conifer types west of the Sierras.

Preliminary results showed the verbenone blend most effectively reducing attraction was 97%(-)/3%(+). Nearly as good was a 50/50 blend of (-) and (+) verbenone. Data suggests a mixture of 97%(+)/3%(-) may actually serve as an attractant. The baited traps, up for the entire flight season helped them establish some WPB flight periodicities, as well. Pat had a handout with methods and results. Anyone wanting a copy who did not get one could contact Pat.

Ralph: Conducted a similar set of tests in southern Idaho, with slightly different results. Tho' their most effective antiattractant was also the 97%(-) blend, the next most effective was 75%(+)/25%(-). The test was a replicate of the R-5 test, so not sure why the difference. Ken Swain noted that work done with verbenone against SPB in the southeast shows high concentrations of (-) verbenone also acts as inhibitor at "normal" elution rates. At low rates of elution there seems to be some attractive properties. Staffen added that some of their work with WPB and verbenone indicated that attraction could only be reduced by about half, under the best of conditions. They've also observed that low rates of verbenone may serve as an attractant for WPB. He further noted that Tim Paine (CA) has shown combinations of verbenone and ipsdienol may be an effective antiaggregant for WPB.

In some of their "operational" efforts to reduce WPB-caused PP mortality, they compared end-of-season mortality recorded in 2.5-acre blocks which had been baited with WPB tree baits, baited and had verbenone capsules hung in them, or verbenone capsules alone. Though overall mortality was less than in 1989, there was no statistical difference in mortality between the three treatments.

In "containment" efforts using WPB tree baits, they believe that baiting infested spots does contain beetles in place. They are not sure, however, that beetles are not attracted from outside the stand as well. Unbaited spots did not experience the increased level of new attacks as did baited ones.

Their "spray and bait" areas from 1989 are still being evaluated--mostly thru the use of yearly aerial photography. In 5, 640-acre blocks, they baited trees (on a somewhat random basis), then treated baited trees and all within a 20-foot radius with carbaryl. About all they know for now is that the baits attract lots of beetles and carbaryl kills a lot! Not sure if area-wide protection is being afforded to unattacked trees.

Mountain Pine Beetle

Steve: In a cooperative project between R-2, R-4 and INT, verbenone was used to protect PP from attack by MPB. Rather than a spacing basis, as used in previous verbenone tests, a verbenone capsule was hung on each unattacked tree larger than 8" dbh. Blocks were 2.5 acres. Capsules per block ranged from 53-200, and averaged 122. There were ten replicates of each treatment: verbenone or no verbenone. Post-treatment evaluations showed no treatment effect. Analysis of verb capsules at the end of the season revealed almost 95% of the verb remained in the capsules. A different elution rate is likely needed.

Also reported on a follow-up project on the SNRA near Ketchum, ID. Compared treatment effect on MPB attacks in LPP stands on 2.5-acre blocks. Treatments were: no bubble caps/acre, 20 caps/acre and 40 caps/acre. No treatment effect was observed. Again, believe elution rate is the problem. Handed out a preliminary report summarizing all data presented.

Ken L.: Use of MPB tree baits in "bait and spray" trials. Field observations suggest there was some treatment effect. Are anticipating long-term evaluations using aerial photos.

Pat: Reported on the Aerial Verbenone Project conducted in R-1 and R-4. A handout contained graphs showing swath width determination results as well as elution rate results as determined thru weekly measurements of field-collected beads analyzed at both PNW and Phero Tech. Those data indicate that after 21 days in the field, more than 80% of the verbenone was gone from beads. Data were collected for the E-30 beads only. Final table of unanalyzed data showed virtually no treatment effect in reducing number of new attacks in LPP stands. A possible reason for poor results may have been unusually late beetle flights--after most of verbenone had dissipated. At present time, not sure of future of verbenone or need for additional testing.

Staffen: Described tests conducted in B.C. to evaluate effectiveness of verbenone in protecting LPP stands from MPB attack. Blocks, 150 meters square, were divided into 3 strips, each 50 meters wide and 150 meters long. Each side "strip" was baited with MPB tree baits. The center strip was treated with verbenone bubble capsules. Results showed more "successful" attacks in the baited strips, and more "unsuccessful" attacks (pitchouts) in the verbenone strips.

In another test, they compared the effectiveness of verbenone beads against bubble capsules. In direct comparisons, the bubble caps appeared to be more effective in preventing MPB attacks. They were not sure about the origin of attacking beetles, however, nor how that information might have affected their evaluation.

In yet another test of verbenone bubble caps--this one in southeast B.C.--little treatment effect was noted.

In continuing evaluations of MPB tree baits, trying to determine the effect of reducing the myrcene component of the baits. In smaller-diameter stands, there seemed to be some difference in baits of different components. In larger-diameter stands, no difference noted between baits containing myrcene and those which didn't. However, unbaited stands had as many new attacks as baited ones. Still, will continue to evaluate the possibility of reducing or eliminating myrcene (because of some inherent health risks in handling it) from the standard tree bait.

Curtis: Posed a question concerning the number of unsuccessful attacks (PO's) noted in verbenone-treated areas. Staffen suggested it likely is the result of verbenone's masking of natural attractant sources--resulting in fewer mass attacks, and consequently, more partial, or "unsuccessful" attacks. He also remarked that verbenone appears to be more effective at lower beetle populations.

Tom: Suggested the need to assess each Region's thinned stands and their response to mountain pine beetle outbreaks. He asked that each Region which has such stands, from which data is collected on an on-going basis, submit a list of those stands or areas to him by Thursday. Tom was subsequently given a list of stands from Regions 1, 2 and 5. Others may be forthcoming. The future use of that information is open to considerable speculation!

Spruce Beetle

Skeeter: Currently engaged in a 5-year program to identify more effective

aggregative pheromones and develop operational uses for them. In addition to the standard bait containing alpha-pinene and frontalin, additional compounds containing MCOL and its (+) and (-) enantiomers, as well as verbenene and its (R) and (S) enantiomers will be evaluated. Compounds are being evaluated using funnel traps and baited trees. Also looking at elution rates, formulations, and trying to identify regional differences in numbers of beetles trapped. Results of 1990 field tests were submitted. In summary, MCOL greatly increased the effectiveness of the standard bait. The addition of verbenene enhanced bait effectiveness in interior Alaska, but not in the southcentral part of the State.

In the lower 48, spruce beetle populations are generally low. Epidemic populations exist in R-4 (Boise Zone), but most efforts are concentrated on salvaging beetle-killed trees before their value is lost.

Douglas-fir Beetle

Ralph: Evaluating the effectiveness of various baiting strategies in "bait and cut" programs and well as use of baits to enhance attractiveness of trap trees. Stands in which the following strategies were used are being evaluated:

- Live trees, unbaited (check)
- Live trees, spring baited
- Trap trees, fall dropped, spring baited
- Trap trees, fall dropped, unbaited
- Trap trees, spring dropped, unbaited

Each treatment was replicated three times. Data regarding attack density, gallery length, and "spill over" have been collected, but not yet analyzed.

He also noted they are using baits operationally in areas to be clearcut.

Ladd: Indicated IDL is using tree baits operationally--spring baiting. Particularly useful along road rights-of-way. He has baited trap trees in the past (after dropping) and has noticed little difference in number of new attacks between baited and unbaited trees. He has observed baited trees appear to be more heavily attacked on the lower bole than an attacked, unbaited tree. Also has noted baited trees do not compete well with naturally-attacked trees.

Ken G.: Detailed results of "bait and cut" test conducted in northern Idaho in 1989. Six infested Douglas-fir stands were selected. Three were baited at recommended rate (50-meter grid), three were not. Post beetle flight evaluations showed baited stands had up to 20 times the number of new attacks as did unbaited ones. Consider "bait and cut" to be operational for Douglas-fir stands to be regenerated.

Dave B.: Don't use DFB tree baits in R-6. Most of their DFB activity is associated with areas that have been heavily defoliated by WSBW for several years. They mostly just salvage dead trees.

Bruce: Mentioned that DFB is not usually a serious problem in R-5. In coastal DF, outbreaks sometimes occur following stand disturbances of some kind. In those cases, outbreaks can be economically devastating. Interior DF is most often found in mixed-conifer stands, and is rarely a problem.

Staffen: Noted that trapping studies done by Hal Wieser in Alberta have shown DFB baits are greatly enhanced by a "secret ingredient" which he was not at liberty to divulge. Using that formulation, much higher beetle numbers have been trapped.

In regards to MCH, Staffen told of some aerial applications done in B.C. to protect standing DF from beetle attack. The work was not replicated and too little data was collected to make meaningful conclusions from.

Fir Engraver

Staffen: In response to a question regarding Borden's attempts to identify the attractant pheromone for the FE, Staffen indicated he's not sure what progress has been made. He knows some work has been done, but not sure what the present status is. There appears to be a predominant host component that is a major attractant, but a beetle compound is probably involved as well. He did mention that researchers at UBC have developed a new method of identifying insect pheromones that may be helpful in this effort.

Jeffrey Pine Beetle

Pat: Little work is currently being done on this beetle because populations are too low to work with effectively.

Pine Engravers

Ken G.: Shared data he had received from South Dakota. Rich Dorset (State), and Judy Pasek (FPM, R-2) both used funnel traps operationally to reduce beetle-caused mortality in thinned stands and adjacent areas. Traps were baited with ipsdienol, in what Rich believed was a 50%(+)/50%(-) racemic mixture. Both were quite pleased with results they achieved, and consider the strategy to be operational. Reports of their works are available from Rich and Judy.

Staffen: Reported on some antiaggregative work done by Borden in B.C. in '90. Data suggest standing trees were protected from attacks of Ips pini by a mixture of verbenone and ipsenol, applied as beads.

Western Balsam Bark Beetle

Staffen: Indicated not much work being done to identify the pheromones of this beetle. There is from time to time quite a bit of SAF mortality throughout the NW. A grad student at UBC has shown that exo-brevicommin appears to be an attractant, and endo-brevicommin may be an antiaggregant. Borden is exploring the role of host volatiles.

Southern Pine Beetle

Ken S.: Believes "push-pull" strategies are effective in stopping spot infestation growth and protecting adjacent, uninfested stands. They bait and cut in "new" attack areas to concentrate beetles and use verbenone in adjacent areas they wish to protect. They consider this an operational treatment for for small spot infestations.

They have applied verbenone as polymer sprays, but were not happy with results. Have used polyethylene bags, but they lacked consistency in elution rates. Now use a "bubble cap-like" bag which is more uniform. Work is being impacted by environmental concerns--red-cockaded woodpecker and loss of habitat, e.g.

PLANS FOR 1991

Jeffrey Pine Beetle

Pat: May do some funnel trapping if populations can be found. Would like to evaluate pheromone or other attractant sources. May use infested boles. Heptanol and host volatiles are being evaluated. Consider low-level screening.

Western Balsam Bark Beetle

No one planning to work with this beetle or its pheromones this year. Fairly low priority.

Fir Engraver

Pat: Indicated Tim Paine (CA) is doing some work with this beetle in 1991. Of local interest in California--many would be interested in reducing mortality if some means were available. FE affects red fir in CA, white fir and grand fir in other parts of the West--often causing significant amounts of mortality, particularly when associated with root disease or drought. Will likely have more interest as "new perspectives" take effect. May become more important as we look at biodiversity and resources other than timber.

Douglas-fir Beetle

Lonne: A cooperative pilot project to evaluate the effectiveness of MCH in protecting standing DF from DFB attack will be conducted in 1992. Cooperators will be R-1, R-4, R-6 and PNW. Plot selection--likely on the Payette NF in R-4, possibly in R-6--will occur in 1991. Will select 25 10-acre plots--5 reps of 5 treatments: 0, 3, 10, 30, and 100 grams MCH per acre. Will be aerial application of 525 beads.

Discussion then centered on potential supplier of MCH and its registration status. FS in the process of completing a Technology Transfer Agreement with Phero Tech at the present time. Phero Tech is interested in pursuing, but only if there is a future market.

Registration status a little up in the air--apparently needing additional Tier I tests. Shouldn't need a great deal of time or effort either one. Current EUP may have expired (I'm still checking) in May, 1990. If so, that will have to be extended before work can begin this year (which means SOON!). Later, a question arose concerning geographic areas covered by the EUP. That will need to be addressed as the extension process for the EUP is undertaken. In the meantime, there are additional questions to be resolved regarding water solubility, elution rate in currently-used beads (Phero Tech vs Macro melt), etc. R-1 will send Staffen a supply of the old Macro melt beads to use as comparison to the current E-30 bead. Will also send some to PNW (Lonne) for the same purpose. Jesus noted that EPA still requiring some toxicity testing and that Wildlife International (a Maryland firm) may undertake that testing. He also spoke to the agreement that is being worked out between the FS and Phero Tech. As previously noted, Phero Tech can't afford to put a lot into the process until they have a little better idea what the future market will be like. Appears to be something of a conundrum--but we all hope not an insurmountable one.

Be that as it may, for '91, R-2 is needing 750 MCH bubble caps and R-4 wants 2200 for testing various protection strategies this coming field season. R-2 wants to protect DF seed trees--a study plan has been prepared. R-4 will be testing the protection of uninfested trees in 2.5-acre blocks on the Payette NF. Tests will be similar to the work being done with WPB, verbenone and tree baits. In this case, DFB, MCH and tree

baits. In addition, PNW would like to have the 8.5 kg of MHC formulated and loaded in beads that will be needed for the pilot test in '92. For spruce beetle work in Alaska, Skeeter would like to have 8 pounds of formulated beads.

That led to a discussion on purchasing the MCH from Phero Tech. Was resolved that WO (Jesus) will coordinate the purchase for R-2 and R-4. Individuals from those regions will check with him at the appropriate time. Skeeter will order his own directly. Staffen cautioned that Phero Tech is using a new procedure to manufacture the MCH bubble caps and that orders should be placed as soon as possible. In order to receive caps by April 1, order should be placed by Feb 10 (4 days ago!).

Spruce Beetle

Skeeter: Has plans to continue work previously started in evaluating the formulation of the attractant pheromone complex. Will work with John Borden, Simon Fraser University, and Hal Wieser, University of Calgary. They will evaluate components of standard tree bait, plus MCOL and other spruce beetle pheromones and their enantiomers (a study plan was presented).

Will conduct a test of an aerial application of MCH to see if they can prevent beetle attacks in downed trees in gasoline rights-of-way. That project will be done cooperatively with PSW (Pat).

Would like to investigate the antiaggregative properties of limonene. In some testing it seems to inhibit beetle attacks. Limonene is apparently one of the more abundant volatiles in a vigorous spruce. That work may not be done until '92.

Finally, will be looking at the effect of competing pheromones of spruce beetles and Ips perturbatus. Hopes to do that in downed trees rather than funnel traps.

Ralph: May consider testing the new "improved" tree bait if available. Also going to test MCH in protecting high-value trees (similar to DF/DFB work). Will look at bait efficiency--number baits per acre--in bait and cut tests. Will bait similar stands at the rate of 0, 2, and 5 baits per acre. Evaluation of bait effectiveness will be done after beetle flight.

Mountain Pine Beetle

Ken G.: Operational use of MPB tree baits on several ranger districts in '91. Basically using the "containment" strategy in conjunction with regeneration harvests.

Steve: Indicated they will be cooperating with INT in evaluating different elution rates for verbenone bubble caps if they are available for this field season. They may not be. Would also like to test verbenone's ability to protect high-elevation whitebark pine and limber pine stands from MPB. Would also like new bubble caps for that work.

Bruce: Interested in protecting high-value sugar pines that have been bred for blister rust resistance. Is verbenone a possibility? Could use carbaryl, but would like an alternative to chemical sprays. What are the options? Polymer sprays, bubble caps, beads? Staffen noted that some new technology may be developed that we have not yet considered. What interest, time and money is available to develop that technology? Probably beyond the

feasibility for this year, but Pat may do some investigating. At the same time, others who are interested should get involved--may take administrators and Congressional delegates working with EPA to loosen some inhibitory restrictions on pheromone uses.

Western Pine Beetle

John: Will continue work begun in '90--working with PSW to evaluate antiaggregative properties of the various racemic mixtures of verbenone. Will also evaluate verbenone plus ipsdienol. Most work will be done with funnel traps. Following promising work done by Tim Paine. At this point they are uncertain about timing--in '90 they got pretty early flights. These tests should help establish flight periodicities of WPB in that part of its range. At the same time will be using Ips baits to determine flight periods of I. pini and I. paraconfusus.

Ralph: Will be evaluating baiting efficiency as described for spruce beetle. Will bait areas at rates of 0, 2, and 5 per acre. Each will be replicated 10 times.

Pine Engravers

Pat: PSW and R-5 will be jointly testing verbenone and ipsdienol as a means of reducing standing-tree mortality. Both slash piles and thinned areas where slash is broadcast will be treated. Broadcast treatment will be done with hand application of beads. Piles will be treated with bubble caps. Three different rates of treatment (?) will be replicated 10 times. The strategy being tested is that of keeping the overwintering population from colonizing the slash in the spring. That should reduce considerably subsequent summer flights of the beetles and resultant damage to standing trees. Will be working primarily with Ips paraconfusus.

Ladd: Will be replicating a similar test in northern Idaho, but working with I. pini. Will probably be working with broadcast slash only. For this test will evaluate the effectiveness of verbenone and ipsdienol. Treated blocks will be 50 meters square. Five blocks will receive hand-applied beads of each compound, five will not. This same test will be replicated in R-4 (southern Idaho) and R-1 (eastern Montana). Ralph and Ken G. will be cooperators--as will John Borden. It would be desirable to demonstrate the effectiveness of this strategy--which could become a much-needed replacement for the "green chain" now used.

Ken G.: In addition to the test described by Ladd, we will conduct some mass-trapping evaluations, also in eastern Montana. We will use the same strategy used satisfactorily in South Dakota in '90. Standard ipsdienol baits will be used. Want to look at "spillover"--which often occurs in trapping efforts with other bark beetles. Hasn't been a problem with Ips.

Skeeter: Indicated some mass trapping may be done on State lands in Alaska.

As an aside, a discussion developed concerning the much addressed question, "Where do 'repelled' beetles go?" That is something we should all attempt to assess. Staffen mentioned work done with MPB showed marked beetles were trapped as far as 2K away from emergence site. Bob told of efforts to describe that phenomenon in the SPB model being used in the southeast.

That concluded the bark beetle discussion and plans for '91. Tom finished the day with a brief discussion on the proposed bark beetle steering committee. Its primary function will be to review and recommend bark beetle projects proposed for special funding. Will also help develop research needs and

technologies. On Thursday will also discuss the future of the bark beetle "working group" as presently organized.

Wednesday, February 6

Field Trip to San Bernardino NF. Hosted by Bruce and Laura with assistance from Doug Pumphrey and Kathy Valenzuela, San Jacinto RD; Jim Bridges, retired Forest silviculturist; and Dave Neff and Kevin Turner, CDF.

Sites visited included Indian Vista, where WPB is severely affecting Coulter pine; Garner Valley where a combination of WPB, Ips, and annosus root disease is killing high numbers of Jeffrey pine; and residential sites in Idyllwild. There the problems attendant to urban forestry, insect infestations, drought, and fire were discussed.

Thursday, February 7

Tom led discussion on the need to develop a national bark beetle steering committee--similar to ones in place for defoliators, seed and cone insects, etc. (see letter from Jim Space, dated December 18, 1990). Tom has been designated the committee chair. Once organized, the committee will be responsible for reviewing special projects relating to bark beetles, developing research and technology needs, and suggest priorities for current and proposed projects. Tom envisions the committee being made up of 10-12 individuals representing FPM, FIDR, States, universities and private industry. He encouraged those who would like to serve on the committee, or nominate a candidate, to contact him in the near future.

With the development of the steering committee, and its defined role, we discussed the need for the continuation of the "working group" which has been in existence since 1988. After some discussion, it was the consensus of the group that there exists the need for both bodies. We in the working group have largely contented ourselves with project coordination and tracking. We don't see the steering committee filling that role, yet it's one we all believe serves a valuable purpose. That being the case, we decided that we will continue, with Dave Holland as group "leader" (a fairly inauspicious title for such an august position, I'd say!). Dave will attempt to convene those who can and want to meet, to discuss future direction, following the NFIWC in Denver (he will try to set something up for the afternoon of March 28).

We agreed that whatever role we see ourselves fulfilling, it will have to be in conjunction with guidelines provided by the new bark beetle R D & A, being put together under Gary's leadership. That proposal has yet to be submitted, but will be by March 1. By the time our group meets again, in late March, we should know more about that.

Most of the remainder of the meeting involved discussions relative to special project funding, timing of project submittal, the role of MAG in the whole process--as well as the new steering committee, the setting of Regional priorities for special projects, and how all of us who conduct bark beetle projects of one kind or another can, and should, work together to assure that our efforts do result in quantifiable and useful products. We further need to recognize the opportunities and obligations we have to work as closely as we can with the land managers whom we serve. Necessary also is the involvement of the public, on whose land most of us work.

The meeting was adjourned at about 11:30 a.m. (PST).

BARK BEETLE FIELD TRIP

San Jacinto Ranger District, San Bernardino National Forest

February 6, 1991

0800 Leave SBNF Supervisor's Office
Stop #1: Vista Grande Station -- rest stop
Stop #2: Indian Vista
LUNCH Keenwild -- movies, slides
Stop #3: Garner Valley
Stop #4: Roosevelt Plantation
Stop #5: Idyllwild
1800 Return to San Bernardino

Personnel

Doug Pumphrey -- District Ranger, San Jacinto Ranger District, Idyllwild

Kathy Valenzuela -- Resource Officer, San Jacinto Ranger District, Idyllwild

Kevin Turner -- Forester, California Department of Forestry and Fire Protection, Idyllwild

Bruce Roettgering -- Entomology Group Leader, USDA FS, San Francisco

Laura Merrill -- Entomologist, USDA FS, San Francisco

Jim Bridges - Former Supt. S.B. NF.

Dave Neff - CDF, Calif. Reg. Mgr.

- Major people problems -- about 30% of CA's pop (30mm) in Southern CA. On San Jacinto RD, do cut some timber, but recreation, wildlife major mgt. concerns. Because of drought, serious bark beetle problems (Ips, Scolytus) but also root diseases, other problems exist.

POINTS OF INTEREST

Vista Grande

Historic site -- old CCC camp
Non-native trees planted around station: giant sequoias, cedar, western white pine

Indian Vista

Coulter pines on upper slopes. Unusually large trees, unusually large numbers of trees killed.
Pests include Ips spp., Dendroctonus spp., flathead borers.
Mixed conifers in drainages: Coulter pine, Jeffrey pine, ponderosa pine, incense-cedar, white fir.

Garner Valley

Jeffrey pine, annosus root disease, western dwarf mistletoe, Ips spp., D. valens, Melanophila californica.
Very sandy soil, severe drought problems

Roosevelt Plantation

Unusual kill of 7-year-old plantation of Jeffrey pine seedlings by Chrysobothris caurina (Buprestidae).

Idyllwild

Best sites in Forest.
Jeffrey and ponderosa pines with Ips spp., Dendroctonus spp.; incense-cedar with true mistletoe.
Private lots, each with its own management objectives.
County ordinance prevents removal of trees greater than 6 inches DBH without a permit (cost: \$175).
Most stands are overstocked. CDFFP has IPM and direct control programs.

General Conditions

In 1976, moisture levels were high and tree mortality was low (Smith and Roettgering). In 1980-81, conditions were much drier and tree mortality was higher (DeNitto and Pierce). Most mortality is caused by pest complexes rather than by single species. California is now in its fifth year of an unusually severe drought.

There is no lumber industry in southern California. Forests here are managed for recreation, watersheds, and wildlife. Wildfire is a serious concern because of the high degree of urbanization of the forests.