Attachment to R5 Pesticide-Use Advisory Memorandum 06-01

Responding to Issues Raised by CATs Concerning Borax (Sporax®)

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This paper is set up to roughly follow the outline of many of the letters we have received from Californians for Alternatives to Toxics (CATs) over the last several months concerning projects that include the use of Sporax. Each set of statements made by CATs is followed by either a recommendation for a response, or a suggestion for improving your environmental analysis. These recommended responses and suggestions are indented and italicized.

NOTE: For the most part, these responses are not meant to be 'cut and pasted' into your NEPA documents. They provide suggestions on how your NEPA document should be constructed. Before you use any particular response or suggestion, please take the time to read and understand them.

The paper follows this outline:

1. Sporax Use
    a. Inadequate Pesticide Application Information Disclosure
    b. Borax Effectiveness
2. Alternatives
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3. Sporax (Borax) Human Health Hazards
4. Sporax (Borax) Potential Environmental Effects

1. Sporax Use

a. Inadequate Pesticide Application Information Disclosure

The Forest provides very little information regarding their proposed use of this toxic chemical. All we know from looking at the environmental analysis document is that borax is to be applied to all freshly cut pine, white fir, and incense cedar stumps >8" in diameter on all fuel treatments for all action alternatives. The Forest must provide a comprehensive description of the proposed borax applications, and the criteria that will define and determine them within the environmental analysis document.

Over what total acreage will Sporax be applied? Will borax actually be used over all the acres proposed for DFPZ fuel treatments? The Forest must clearly state within the environmental analysis document the actual acreage and determining factors for identifying potential borax treatment locations within the project area. Do all stumps and all species need treatment?

Are trees within or immediately adjacent to the project area infected with annosus root rot disease? Are there infection centers within the project area? According to USDA Forest Service scientists, borax stump treatment is only recommended for those timber production sites with known annosus disease potential and where cultural control is not viable (Schmitt et al. 2000). Has the Forest attempted cultural control (see alternatives section below)? Can the Forest practice responsible silviculture without using borax? "Annosus root disease is a normal part of most forest ecosystems in the West contributing to structural and compositional diversity" (Schmitt et al. 2000). Is the Forest managing the project area for the best timber production or natural forest ecosystem conditions? If the Forest feels the need to apply over 1,000 pounds of pesticides on over 1,000 acres of our public forestlands, then at the least it must demonstrate a need for such actions within NEPA documentation

> *While it is true that H. annosum is a natural component of our forested environments, it is also true that in some environments, its effects are now more serious than in the past. This notion, that H. annosum is a natural and therefore benign part of forest ecosystems does not recognize that, in many cases, we are dealing with altered forest ecosystems that do not necessarily behave as they did in their past evolutionary history (Otrosina 1998, Otrosina, 2005).*
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> *Suggestions for improving your environmental analysis document:*
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> *The purpose and need of the environmental analysis document should clearly indicate that annosus root disease is a problem in the area and how we know that (e.g., white fir annosus pockets throughout the area, cutting white fir, hence the need for treatment, etc.). The environmental analysis document, under the Alternatives heading (as described in the R5 EA format and content example) should then clearly describe where Sporax will be applied, to what species, timing, method, etc.*

What kind of terrain, aspect, slope, soils, and vegetation density will borax be applied? At what proximity to water sources might it be applied? At what proximity to sensitive and non-targeted native vegetation will borax be applied? At what proximity to wildlife, including TE&S, MIS, and species of special concern, will borax be applied? What safety precautions will be taken to protect all of these resources? All this information should be clearly defined and made easily accessible within the environmental analysis document.

What time of year and under what weather conditions will it be applied? Are there times that borax use would not be needed (like hot dry times)? Are there weather conditions that would prohibit the use of borax (rainy or wet and causing it to easily wash off stumps)? All application criteria and safety designs must be included in the environmental analysis document.

What safety measures are being taken to protect workers, the public and resident plants and wildlife?

Suggestions for improving your environmental analysis document:

Chapter 2 of the environmental analysis document should describe the practices that will be used when applying Sporax. The following are examples of such statements:

- *Applications will follow all State and Federal rules and regulations as they apply to pesticides*
- *Sporax will not be applied within xx feet of running water*
- *Sporax will be applied to all conifer stumps within 1 hour of creation*
- *Sporax will not be applied within xx feet of known TES plants*
- *Sporax will not be applied when rain is falling.*

Since Sporax is a pesticide, there must be a FS-2100-2 (Pesticide Use Proposal) completed and approved prior to the DN or ROD being signed. This should be in your project file. The project file should contain a spill plan tiered to your Forest spill plan. Sporax applicators and other handlers should be trained as per California state regulations.

<u>b. Borax Effectiveness</u>

CATs raises the issue of whether or not borax treatments are needed for this project. The Forest responds by stating that annosum root rot disease occurs in and near the project area. While the occurrence of root rot disease within the project area certainly justifies consideration of borax treatments, it may not be the most effective, or ecologically sound method to prevent annosus spread.

CATs raises the issue of whether or not borax treatment are universally effective for annosus root rot prevention. Evidence exists, that borax may not be effective, and the Forest fails to acknowledge this. The Forest must disclose all information, even opposing scientific views within NEPA documentation. In a study review of research on annosus root rot disease, US Forest Service Region 5 scientist R.S. Smith Jr. reported, "there is continuing concern that annosus can infect stumps via the roots rather than just through the stump surface, and that borax treatment may not be fully successful in preventing the disease" (Smith, 1989). Also an even more interesting study was done by Region 5 Forest Service scientists, which reviewed the efficacy of borax stump treatment in protecting trees from annosus root disease. The authors reported that borax might be ineffective because it washes off stumps and that high stump densities in thinning harvests make it difficult to apply. Evaluation done twenty years after thinning operations revealed that plots with borax-treated stumps did not have significantly lower annosus infection than did untreated stands" (Edmonds at al. 1989).

Suggested responses to these comments, or the basis for a discussion in the Alternatives section of the EA, when describing alternatives considered but eliminated from detailed study:

The study by Edmonds et al, 1989 is within a different habitat and treats different species of conifers than would be found in most of Region 5. The stands in this study were in coastal areas of Northwest Oregon and Washington, where rainfall patterns and amounts are different than most of California. The species studied in Edmonds et al, 1989 was western hemlock. As for borax use, in Edmonds et al, 1989 (page 92), it states that "Borax does not appear to be effective for operational use in coastal Washington, although it may be effective if applied very carefully to stumps, particularly those close to the remaining trees". As stated in Russell et al (1973), the inconsistency in efficacy shown in early tests of dry borax on western hemlock stumps in western Washington was attributed to the characteristically dry surfaces of freshly cut western hemlock stumps, the borax being washed off during rainy periods, and the difficulty of retaining dry borax on sloping stump surfaces. Russell et al (1973) and Nelson and Li (1980) also determined that with proper care in application, borax was effective as a stump treatment in western hemlock. The review by Smith, 1989 describes borax as not being completely successful in keeping *annosus out of true fir stands because of other avenues of infection, notably through root contact. However, he does state that borax is effective in blocking stump infection of true fir (Smith, 1989, page 14).*

The study described as showing that high stump densities in thinning treatments make borax difficult to apply is not referenced, so cannot be verified. Many projects in Region 5 have demonstrated the operational capability of applying borax in harvest treatments.

Several studies have demonstrated the efficacy of using borax as a stump treatment in California. Graham (1971) demonstrated the efficacy of borax on Jeffrey and ponderosa pine. Smith (1970) demonstrated that borax prevented infection of white fir stumps. Kliejunas (1989) summarized the existing literature on borax effectiveness in the eastside pine type.

2. Alternatives

Stump treatment with borax is only recommended for sites with known annosus root disease potential and where cultural control is not viable (Schmitt et al. 2000). Has any cultural control been proposed, evaluated or analyzed? The Forest Service needs to analyze annosus disease prevention alternatives for this project. The Forest has failed to present a reasonable range of alternatives regarding control of annosus root rot disease. Alternatives to avoid and minimize potential environmental impacts need to be considered when ever pesticides are included as part of proposed actions. The Forest must objectively evaluate non-Sporax alternatives within the environmental analysis document.

This list of references and potential alternatives listed and discussed below should not be considered exclusive, but only as a sample of the information available to the Forest, should it take the time to research and propose pesticide free root disease control alternatives. The Forest should not rely simply on the fact that borax has been long used or heavily used as of late. Annosum root disease has reached endemic proportions under current management practices that obviously haven't been working. Such project design and pest treatment is lazy and constitutes a failure of responsible forest stewardship.

Suggestions for improving your environmental analysis document:

The analysis of the use of pesticides, under NEPA, is no different than the analysis of any other action. CATs' statement that the proposed use of pesticides requires us to develop alternatives to avoid or minimize environmental impacts is not correct. Alternatives should be developed in response to significant issues, and meet the purpose and need, regardless of what type of project is being proposed.

<u>a. Non-Sporax Alternatives</u>

At CATs we are sensitive to the need to protect trees that make up our public forestlands from annosus root rot disease and related mortality. However, we are concerned that the Forest is not using a true integrated pest management (IPM) strategy in dealing with this fungus. The Forest is ignoring the cause of annosus spread and needs to focus on controlling the vectors that facilitate its movement.

<u>Stop logging</u> - Logging has been shown by multiple studies to increase annosus root disease occurrence in western forests for a number of conifer species. The disease typically appears in stands several years after logging and is associated with stumps and logging wounds in remaining trees (Smith 1989). The incidence of annosus root disease increases as logging increases. Logged stands have a higher occurrence of the disease than un-entered stands, and stands with a history of multiple entries have the greatest rate of infection (Goheen and Goheen 1989). Chavez et al. (1980) found that western hemlock tree infections increased greatly after thinning. Also thinning actions provide fresh stump sources and wounds to live trees from logging equipment, which can

become infection courts for airborne annosus spores, and do contribute to higher rates of infection in thinned stands (Edmonds et al. 1989). In a stand that had been logged five to ten years earlier, annosus root disease was found on 89% of the stumps (Filip et al. 1992).

It seems obvious that logging, and in particular thinning timber operations are responsible for the rapid spread of *Heterobasidion annosum*. Less logging means less annosus root rot disease, and appears to be an essential step for protecting the trees in our national forests. While this may affect the Forest Service's love-fest with commercial timber operators, it would be the best way to preserve biodiversity in our public forestlands. The Forest needs to consider conducting fuels and vegetation management using prescribed burns, goats and other less intrusive methods. Stop re-entering stands with commercial timber equipment and reduce the spread of annosum disease that way.

Suggestions for improving your environmental analysis document:

Obviously this issue needs to be addressed in terms of the project's purpose and need. If the purpose and need section of the environmental analysis document adequately supports the action of cutting trees, then an alternative that doesn't cut trees would not meet the purpose and need. One could also say that the No Action alternative considers the alternative of not cutting trees. Probably would be good to describe the annosus root disease impacts under the No Action alternative.

Interesting to note that in Chavez et al (1980), the authors state that "the highly significant increase of infection by H. annosum in remaining trees is mostly attributable to the untreated stumps left from the precommercial thinning". Kliejunas (1989) cites studies showing that in eastside pine that annosus incidence was greatly reduced in boraxed stands vs. non-boraxed stands. Logging in areas that are susceptible to annosus will result in increased levels of annosus <u>if stumps are not treated</u>.

<u>Log Carefully</u> - Experts recommend that the Forest carry out thinning operations carefully to reduce incidence of tree wounds. Schmitt et al (2000) recommend requiring logging techniques that minimize damage to residuals during intermediate forest entries and removing injured trees at these times. The Forest should be requiring logging techniques that minimize accidental thinning wounds as part of the proposed actions. If the Forest's goals truly include forest health (rather than timber production) then careful, manual cutting (chainsaws) of smaller trees is one method of preventing annosum disease spread in the project area.

Suggestions for improving your environmental analysis document:

Careful logging is always a good idea in partial cut stands. It has been demonstrated, especially in white fir, that logging damage provides points of entry for H. annosum. If design standards are in place to reduce residual damage, they can be described as being, at least in part, responsive to the prevention aspect. Design features that can be effective are such things as choosing the season of logging, marking leave trees, using particular skidtrail layouts, use of bumper trees, limiting log length, using directional felling or the use of feller/bunchers and forwarders (Refer to Aho et al 1983).

In a study of coastal British Columbia thinnings, it was suggested that the increase of H. annosum infection "can be minimized by thinning before age 15, by cutting only trees less than 10 cm in diameter and by thinning during low risk seasons" (Morrison and Johnson 1999).

Suggested responses to these comments, or a basis for discussion in the Alternatives section of the EA, when describing alternatives considered but eliminated from detailed study:

The quotation is from the abstract. The sentence just before that quote is "Colonization of <u>*precommercial*</u> <u>*thinning*</u> *stumps by H. annosum occurs throughout the coastal region of British Columbia, and this will increase the incidence of butt rot" [underlining added]. This study is based on precommercial thinnings in stands up to 8" in diameter in the coastal zone of British Columbia (Douglas fir, western hemlock, amabilis fir, and Sitka spruce). Their conclusion about 10 cm is not entirely supported by the data, as the relationship between dbh and percent of surface area colonized is linear, and in the case of all but the amabilis fir, is not very steep (increasing stump diameter increases percent infected, but not by much). Age at time of thinning and season of thinning were not significant variables for percent of infection, although the data showed a response. This study, focusing on small diameter stems, cannot be used to justify a decision to limit the upper diameter of harvested trees. The fact that small stems are less likely to be affected by annosum root disease is already incorporated into our Regional direction on the use of Sporax (USDA Forest Service 1994b). In Filip et al 1992, the results showed that the rate of infection of untreated true fir stumps 5-10 years after cutting was not related to stump diameter in the range sampled (12 to 23 inches+).*

This would again seem to support the idea of the Forest lowering the maximum DBH limit from 30" or 20" to a more reasonable 15" or less. Then the incidence of annosum disease spread would be significantly lower, Sporax would no longer need to be included in the project (see below discussion), and fuel reduction, ladder fuels, canopy breaks could all still occur.

Refer to the discussion about no logging (above). Less tree cutting would equal less risk of annosus if borax is not used as a preventive treatment, but would it meet your project's purpose and need?

<u>Timing of logging</u> - The Forest should also thin only when reproductive basidiospore populations in the air are at their lowest (cold winter or hot dry summer months) (Schmitt et al. 2000; Ammon and Patel 2000; Filip and Morrison 1998). Has the Forest evaluated this option? Spores are not produced in extreme cold, very high heat, or during prolonged droughts, and stump colonization is unlikely when stump temperatures are high and relative humidity is low (Schmitt et al 2000). The Forest could only cut in sensitive areas during these times and thus eliminate the need for Sporax applications and reduce the potential spread of annosum disease.

Suggested responses to these comments, or a basis for discussion in the Alternatives section of the EA, when describing alternatives considered but eliminated from detailed study:

Cutting when annosus spores are lowest has been suggested, but there are no data or studies to support the efficacy of such a treatment in California. Morrison (1999) determined there was no significant difference in season of cutting in coastal British Columbia. Schmitt et al (2000) state that restricting cutting to summer months may reduce potential of stump and wound colonization, but give no data to evaluate, nor do they state that this would eliminate the need for Sporax. Ammon and Patel (2000) recommend thinning during dry, hot months in the SE US or during winter months in the NE US, but also give no data to evaluate, nor do they state that this would eliminate the need to treat the stumps otherwise. Phelps et al (undated) demonstrated that in the SE US, summer thinning only slightly reduced infection over controls and that borax treatment was much more effective. Filip and Morrison (1998) and Stambaugh (1989) report that cutting in the summer (April thru August) in the SE US, south of latitude 34°N appears to reduce losses caused by annosus root disease. Filip and Morrison (1998) state that seasonal logging has not been demonstrated in the interior west to be effective. In Russell et al (1973), monthly spore patterns in Washington and Oregon peaked in the fall, with a lesser peak in the spring, but airborne spores were present in large numbers nearly year-round. In James and Cobb (1984), spores are produced in the Stanislaus and San Bernardino National Forests throughout the year. In their summary, Filip and Morrison (1998) state that although many materials have been *tested, in the western US only borax is recommended and used operationally. Based on the data in James and Cobb (1984) and Russell et al (1973), it is likely that in the relatively mild climate of California where spores are produced throughout the year, restricting logging to a certain season would not be effective in reducing annosus root disease infection.*

<u>Prescribed burning</u> - *Heterobasidion annosum* can be eradicated or reduced by a couple of simple pre and post harvest techniques. One is using prescribed burns. Two pre-thin burns (one at least six months before thinning) and one or more post-thin burns will destroy reproductive basidiocarps and eliminate litter and other favorable annosus habitat and basidiocarp development environments (Ammon and Patel 2000, Filip and Morrison 1998). The Forest should utilize prescribed burns in an attempt to eliminate *Heterobasidion annosum* in the project area as well as to start restoring the project area back into a historic fire regime.

Suggested responses to these comments, or a basis for discussion in the Alternatives section of the EA, when describing alternatives considered but eliminated from detailed study:

It appears that a study by Froelich et al, (1978) is the basis for the particular recommendations on using prescribed fire. In this study, underburns were set in 10-24 year old loblolly and slash pine plantations in the southeast US. Two pre-harvest burn prescriptions were tested: a fall burn, about a year before thinning, followed by either a late summer/early fall burn about a month before thinning, or a winter burn about 9 months before thinning. Post-thinning fires were in the winter. Results showed that in most plots, there was a reduction in infected trees as a result of burning. Many plots still showed substantial infection levels after burning, although lower than the controls.

Ammon and Patel (2000) and USDA Forest Service (1977) recommend the particular sequence of burning as tested in Froelich et al (1978), but they don't state that this would eliminate the need to treat the stumps otherwise. Filip and Morrison (1998) reference the study by Froelich et al (1978) yet they make no mention of prescribed fire for annosus disease prevention anywhere else in North America. Otrosina et al (2002) found no significant difference in annosus levels in a 40-year old longleaf pine plantation underburned during the winter. Schmitt et al (2000) recommends prescribed burning as a treatment to reduce white fir in mixed conifer stands that naturally would have been dominated by ponderosa pine, but say nothing about prescribed burning as a prevention treatment for annosus root disease.

There is no literature supporting prescribed burning as a control of annosus in California ecosystems. In the Western US, annosus conks are most often found inside stumps or under the bark. In the Southeast US, where the burning method was developed, conks are formed in the duff at the base of trees and could be killed by prescribed fire. Prescribed burning would not be feasible as a control method for annosus because of the need to destroy the stumps. In 1994, a field trial was attempted in which fire would be used to destroy infected stumps (Pronos 1994). This trial was unsuccessful because the stumps were still too wet to burn, even three years after harvest.

<u>Stump and Root Removal</u> - Borax treatment is not effective in areas where stumps are already infected (Schmitt et al 2000, Ammon and Patel 2000). The most effective annosus treatment is removal of infected stumps in these areas (Schmitt et al 2000). Mechanically removing and burning stumps and attached roots in infested sites seems like common sense and should be incorporated by the Forest as part of the proposed actions. It would greatly reduce the risk of annosum disease spread and substantially improve forest health without the need of introducing a toxic pesticide (assuming reforestation with native desirable species occurs post project). This will allow regeneration of forests by minimizing the possibility of new regeneration contacting infected roots (Goheen and Otrosina 1998).

Suggested responses to these comments, or a basis for discussion in the Alternatives section of the EA, when describing alternatives considered but eliminated from detailed study:

Schmitt et al (2000) doesn't say Sporax treatments are not effective in areas where stumps are infected, but rather says that borate treatment of already-infected stumps is not effective (page 9). Schmitt et al also doesn't say that removal of stumps is the most effective treatment, and in fact states that minimizing site disturbance is a positive step to be taken. In Ammon and Patel (2000), it states that Sporax may aggravate the problem if applied to stump surfaces in already diseased plantations, because Sporax will prevent natural competitors to annosus from establishing themselves on the treated stumps. They recommend using P. gigantea fungus within already infected sites. There is no definitive data that the use of Sporax exacerbates an annosum problem. This may occur when residual roots of cut trees are severely damaged and infection may occur thru the damaged roots. There is no experimental evidence of this theory mentioned in Ammon and Patel (2000) that originated in the SE US. On the other hand, one may apply the reasoning that saprophytic decomposing fungi would quickly colonize the distal, dead and dying roots of cut stumps and thus isolate infected tissue to small enclaves within roots. Again, there is no experimental evidence other than our knowledge of the competitive saprophytic capacity of H. annosum, which is quite low.

Stump removal – From FSH 3409.11 (USDA Forest Service 1994a) comes the following: "Stump Removal. Removal of stumps and roots infected with H. annosum would reduce the amount of inoculum of the fungus on the site, and allow for earlier successful revegetation of the site with susceptible conifers. Stump removal as a suppressive method is being tested in several recreation sites, and its efficacy has not yet been demonstrated." I don't know if there is any other more recent data on efficacy. Obviously stump removal would be overkill in areas away from known centers, where we are trying to prevent new centers. Stump removal would also have concerns from the soil scientists and others. Kliejunas et al (2005), and other references on stump removal, state that stump removal is expensive and disruptive to the site. Kliejunas et al states that "although direct control appears feasible in some situations, prevention remains the preferred and least costly method of annosus root disease management in recreation areas."

Use of bio-pesticides - *Phlebiopsis gigantea*, an aggressive, highly competitive fungus is recommended as a borax alternative, as it colonizes stumps to the exclusion of the annosum root rot fungus (Annesi et al. 2005; Pratt et al. 2000; Ammon and Patel 2000; Pratt 1999; Filip and Morrison 1998; Rishbeth 1963). *Phlebiopsis gigantea* is incapable of causing disease in standing trees and is not regarded as hazardous to human health (Pratt 1999). It has been utilized as a biological control agent for annosum root rot for approximately 40 years in Europe (Pratt et al. 2000). Canadian scientists have been testing *P. gigantea* for the same purposes and have been getting good results (Laflamme). In the southeast part of the US it has been shown that *P. gigantea* is completely effective in preventing stump colonization by *H. annosum*, with a cost only slightly more than that of borax (Filip and Morrison 1998).

Streptomyces griseoloalbus, an actinomycete isolated from the rhizoplane of the nitrogen-fixing nodules of a common California native, has been identified as a strong antagonist of annosus, and a possible biological control in the Pacific Northwest (Rose et al. 1980).

Suggested responses to these comments, or a basis for discussion in the Alternatives section of the EA, when describing alternatives considered but eliminated from detailed study:

The use of Phlebiopsis gigantea as a biocontrol for annosus root disease has been known since the mid-1950's, based on experiments conducted in England on Scots pine and Corsican pine by John Rishbeth. This particular agent is not as consistent as borax; in Rishbeth (1963) and Rose et al (1980), there are discussions of how P. gigantea is not as effective on some conifer species, *including western hemlock and Douglas fir. Work by Laflamme and others in red pine in Ottawa, Canada shows promising results (Roy et al 2003). There is experience with this fungus in Europe on Scots pine, Norway spruce, and Corsican pine (Annesi et al 2005; Pratt 1999; Pratt et al 2000), and it was recommended to and used by private forest landowners and the USDA Forest Service in the past in the SE US (USDA Forest Service 1977), but its use was discontinued when US EPA determined it needed to be registered (Cram, undated). That it is still showing up on cooperative extension websites such as Ammon and Patel (2000) is interesting, considering that its use would not be legal (it is noted that the use of borax is strongly supported in Ammon and Patel (2000), and is described as "inexpensive, effective, safe, and easy to apply"). Treating with P. gigantea is not feasible at this time as it is not registered as a biopesticide either with US EPA or California, and there are no efficacy data for California forest conditions. There are data suggesting that Phlebiopsis gigantea would not be efficacious in California because it is too dry in summer and fall (Rishbeth 1963; Blakeslee and Stambaugh, 1974).*

Streptomyces griseoloalbus is not currently available for use (neither registered, nor marketed). The study by Rose et al (1980) involved western hemlock, and contained no quantitative data concerning the effectiveness of S. griseoloalbus as a preventive treatment on wood substrates. A follow-up study by Nelson and Li (1980) showed that although the S. griseoloalbus protected western hemlock stumps better than the controls (31% infected stumps vs 75%), it wasn't as effective as borax (0% infected stumps). There is no efficacy data from California that supports its use. There is a currently registered biopesticide that is related to the S. griseoloalbus considered in Rose et al (1980) - Streptomyces griseoviridis Strain K61, commercially available as Mycostop. This product is registered for seed rot, root and stem rot, and wilt caused by various fungi in ornamentals and forest seedlings. It is not registered as a stump treatment for annosus root disease. It is unknown whether Mycostop would be effective against annosus root disease.

Either of these materials, P. gigantea or S. griseoloalbus, would be considered a biopesticide and would need both US EPA and California pesticide registration. This method of control may be feasible in the future if efficacy can be demonstrated in California and if they are registered as biopesticides by both US EPA and California. Until such time as both efficacy and registration are met, these two biological agents remain untenable options.

<u>Replanting with resistant species</u> - Stump treatment with borax is only recommended for sites with known annosus root disease potential and where cultural control is not viable (Schmitt et al. 2000). For example species manipulation, replanting and retaining more resistant species, is a great way to prevent annosum disease spread (Schmitt et al 2000, Goheen and Otrosina 1998).

Suggested responses to these comments, or a basis for discussion in the Alternatives section of the EA, when describing alternatives considered but eliminated from detailed study:

This is already recognized as a method to reduce impacts from annosus root disease. From the R5 Supplement to FSH 3409.11 (Chapter 60)(USDA Forest Service 1994a): Species Conversion. Because of host specificity of H. annosum, favor the non-infected host species. In mixed conifer stands with infected true firs, the stand may be converted to pines and incense-cedar with little risk of subsequent infection, assuming this makes sense ecologically. If pines are infected, favor true fir, again if it makes sense ecologically. (Of course, borax should be used on the stumps during this conversion process.) In recreation areas, favor existing hardwoods or the non-infected conifer species. Since hardwoods are resistant, the fungus will eventually die out over a period of 2 to 4 decades, depending on stump size. Then, take steps to regenerate the conifers.

<u>Use of soil as an effective stump treatment</u>

Suggested responses to these comments, or a basis for discussion in the Alternatives section of the EA, when describing alternatives considered but eliminated from detailed study:

The following is from Dr. Gary Chastagner, Washington State University (personal communication with John Kliejunas, Feb 2, 2004): "I have been looking at the possibility of using dirt as a stump treatment to control annosus root rot infections. I have conducted a series of field trials, which have all had a variety of problems that have prevented me from assessing the effectiveness of this treatment. I have also conducted several trials where I have cut a disk from stumps and then applied various treatments prior to inoculation. These disks were then incubated under lab conditions and then evaluated for their effectiveness in preventing infection. In these trials, Sporax has been the only material that has consistently worked. Applications of urea and dirt to the surface of the disks has worked in some tests, but not others. At this point, I still recommend the use of Sporax. Additional testing is clearly needed to determine if covering stumps with dirt has the potential to provide consistent control of infection." Rishbeth (1963) indicates that soil over the top of stumps can create an environment conducive to repeated infections by H. annosum over time.

b. Alternative Sporax Application Rates

Thus far the Forest has failed to provide a clear and easily understandable justification within the environmental analysis document for proposed extreme Sporax application rates.

CATs recognizes that typically borax is applied at a rate of between 0.5 and 1.0 lbs per acre (as per other US Forest Service projects and personal communication with Forest Service silviculturists and project leaders). Why is the Forest proposing to apply it at 2.5 times the normal rate? CATs has found that many projects really require far less borax, more in the range of 0.5 pounds per an acre or less for effective annosum root disease prevention. Has the Forest considered using less borax? The Forest must clearly state within the EIS the process and supporting rationale with which it has determined the rate of borax application for the proposed actions.

Suggested responses to these comments, or a basis for discussion in the Alternatives section of the EA, when describing alternatives considered but eliminated from detailed study:

Pesticide use report data from the forests in Region 5 over the last five years indicate that the average application rate for Sporax is 1 pound per acre. There is considerable variability in this average amount (minimum of 0.08 lbs/acre, maximum of 6 lbs/acre). 90% of the applications were 2.5 lbs/acre or less. Without local history of applications, 1 lb/acre would be a good average to use, with the statement that up to 2.5 lbs/acre could occur. However, it is important to keep in mind that the application rate is dependent upon the number and size of stumps treated per acre, and that the Sporax label rate of one pound per fifty square feet of stump surface is the 'normal rate'. This is the rate at which Sporax is being applied with Region 5; it just works out mathematically to an average of one pound per acre.

Could the Forest feasibly reduce the borax use to larger diameter stumps (>15" or >18")? The literature on *Heterobasidion annosum* referenced by the Forest states that "new disease foci are usually associated with large host stumps, 0.5 meter or greater in diameter" (Goheen and Otrosina 1998, Dekker-Robertson 2005). Since half of a meter is a little over 19 inches, why not only apply it to large stumps >18" to protect from the occurrence of new disease centers?

The disease travels very slowly from root to root spread, at a rate of between 0.5 and 1.5 meters per year (Schmitt et al 2000, Goheen and Otrosina 1998). Hence the primary concern is spore travel and new infection centers. Again, the Forest only needs to consider borax on large stumps associated with new colonizations, those greater than 18 inches in diameter.

Could the Forest restrict borax applications only to stumps of certain tree species (like the more susceptible white fir)? At a minimum, the Forest should evaluate the potential of restricting borax use to only within certain forest types, such as White Fir and thus reducing borax application acreage. This makes sense when reading the project DEIS, when it is stated that white fir stands have the greatest incidence of annosum in the project area, although there are some infections in mixed conifer and pine stands. Schmitt et al (2000) state that true firs are especially susceptible to annosus root disease. The Forest concurs that white fir tends to be the most susceptible to adverse effects from annosum root disease. Then why not restrict potential borax use to only where it is most needed (white fir dominated areas) and will be most effective?

> *Suggestions for improving your environmental analysis document:*
>
> *From the R5 Supplement to FSH 3409.11 (Chapter 60)(USDA Forest Service 1994a): R-5 FSM 2303 requires treatment of all conifer stumps in recreation sites. The same direction shall apply to other high value areas, such as progeny test sites, seed orchards, and areas of high value trees, such as giant sequoia groves. In eastside pine or mixed conifer type stands, where surveys have indicated high levels of annosus root disease, treatment of conifer stumps 12 inches or greater in diameter is highly recommended during chainsaw felling. When mechanical shearers are used, the minimum diameter should be reduced to 8 inches. These areas include the eastside pine and eastside mixed conifer types on the Modoc, Lassen, Plumas, Tahoe, Sequoia and Inyo National Forests; the Goosenest Ranger District, Klamath National Forest; and the McCloud Ranger District, Shasta-Trinity National Forests.*
>
> *In all other areas, consider stump treatments on an individual stand basis. The line officer is responsible for the decision to treat freshly cut conifer stumps, and shall base that decision on information available for the specific situation in the particular stand in question.*
>
> *In 2004, Kliejunas and Woodruff revisited the 12 and 8 inch diameter recommendations for the eastside pine and mixed conifer types (Kliejunas and Woodruff 2004). They evaluated several stands that had been harvested 1-2 decades previously. Based on this evaluation, they recommended modifying the direction in FSH 3409.11 to say that within the eastside pine and mixed conifer type, that all stumps 14 inches in diameter or larger be treated.*
>
> *Currently the data in Kliejunas and Woodruff (2004) for raising the recommendation are only within the eastside pine type. Application of this 14 inch diameter limit to other forest types within Region 5 increases the risks of annosus root disease and should be discussed with your zone's Forest Pathologist.*
>
> *Raising the diameter limit above the 8 or 12 inches in FSH 3409.11 or the 14 inches supported by Kliejunas and Woodruff (2004) increases the risk of infection and is not supported by research conducted within California.*

3. Sporax (Borax) Human Health Hazards

Application of any pesticide is controversial and comes with inherent hazards and risks. These potential effects and impacts must be accounted for, analyzed, and evaluated as alternatives and under environmental effects as part of the NEPA environmental impact assessment process. The use of borax is no different. A project of this size requires the completion of a project specific risk analysis and evaluation. CATs expects the Forest to provide a project specific risk analysis and evaluation of human health safety and environmental impacts if borax is to remain part of the proposed actions.

Suggestions for improving your environmental analysis document:

There is no requirement within NEPA or any FSH/FSM that would require a project-specific human health and safety or environmental pesticide-use risk assessment when using Sporax. The disclosure of human health effects and environmental impacts must be sufficiently rigorous to inform the public and the decision maker as to the impacts of the alternatives. Sufficient NEPA referencing of existing documents should address any potential human health and environmental impacts from the use of Sporax.

The analysis and evaluation of potential human health risks associated with borax application for this project are woefully inadequate. Studies and toxicity information on borax raise issues of potential human health concerns that must be addressed as part of this project within the environmental analysis document. The primary reference document used (Dost et al 1996) is not peer reviewed, is not NEPA reviewed, is almost 10 years old and does not contain borax toxicological analysis regarding this specific project. The environmental analysis document fails to fully inform the public and the decision maker of potential toxicological issues.

Suggestions for improving your environmental analysis document:

Dost et al (1996) is a document written by professional toxicologists concerning the risks of using borax for stump treatments. This document should be referenced within the EA/EIS which is an acceptable practice. The 1996 publication by Dost et al concludes that "the evidence indicates that workers who apply borax…to cut stumps are not at risk of adverse effects due to boron exposure" (Dost et al, 1996, page 61).

EPA and DPR registration does not imply inherent pesticide product safety, nor does it negate the need for project specific toxicological analysis. These are very serious and realistic health concerns that the Forest has thus far failed to disclose. Simply falling back on the old, if used as directed potential for effects are negligible, is not acceptable.

Suggestions for improving your environmental analysis document:

This is a correct statement, as the courts have called our analysis of pesticide effects inadequate if it largely consists of our saying the applications are 'safe' or without effect based on the fact that these products are registered with both the US EPA and the State. This type of statement should not be found within our environmental analysis documents. Instead we should be discussing how our analysis (such as is found in Dost et al) indicates that there are risks to humans and wildlife but that these risks are acceptably low.

Studies have prompted concern that borax is a human reproductive toxin (US EPA 2004, US EPA 1993, USDA Forest Service 1995). A borax feeding study resulted in blood and metabolism disorders and effects to the testes, endocrine system, brain weight, and size ratios among various organs and glands (US EPA 1993). The US Forest Service (1995) reports that studies indicate chronic exposure to borax may cause reproductive damage and infertility. In the US EPA's Toxicological Review of Boron and Compounds (2004) the developing fetus of mammals is considered one of the most sensitive targets. The other most sensitive target is the testes of males, and adverse effects include testicular degeneration (US EPA 2004; USDA Forest Service 2003). During reproductive and developmental toxicity studies, maternal liver and kidney effects, decreased weight gain, and decreased fetal body weights were observed. At the highest dose level, no offspring were produced in two of the studies as well as prenatal mortality observed (US EPA 1993). After three generations were fed 1.03% borax, chronic toxicity was detected, as reproductive organs for both sexes were affected and fertility was reduced (USFS 1995). The Forest must disclosure this information and evaluate this risk as part of any action alternatives including Sporax applications.

Suggestions for improving your environmental analysis document:

Pages 17 – 24 of Dost et al (1996) describes general toxicological effects of boron exposures in mammals; pages 39 – 51 focus on the reproductive effects of boron exposure. The studies described in these sections of Dost et al (1996) are the same as those described in US EPA 1993, 2004, and USDA Forest Service 1995. The use of Dost et al (1996) adequately describes the mammalian toxicology of borax. Dost et al recognizes that borax and boron are potential reproductive toxicants with specific potential effects on the testes.

From a NEPA perspective, it is important to adequately reference (i.e., summarize within the environmental analysis document) the Dost et al document if issues of human health or mammalian health are being discussed. The symptoms that are described in the CATs letter are the potential effects from chronic over-exposure, which is not expected from the use of borax in a forested situation.

As of 1995, the US EPA had not required inhalation studies for borax, so little is known about acute inhalation toxicity, although chronic exposure to borax dust has caused workers to develop respiratory irritation (USDA Forest Service 1995). In a study published in the British Journal of Industrial Medicine involving 629 borax factory workers, symptoms consistent with chronic bronchitis and acute respiratory irritation were related to borax exposure (Garabrant et al 1985).

The EPA warns of the potential for dermal and inhalation exposure among applicators and people reentering treated areas (US EPA 1993).

Suggestions for improving your environmental analysis document:

Dost et al (1996), pages 27-28 discuss occupational exposures, primarily through inhalation, and the resulting effects (respiratory irritation). These occupational exposures represent high concentrations of boron within confined industrial facilities. The findings in Dost et al (1996) are consistent with the findings in Garabrant et al (1985) which also represented a confined industrial borax manufacturing facility. These findings are not directly relevant to forestry uses of Sporax because of the confined situation in the studies, but do show that inhalation exposure to borax is likely to result in respiratory irritation. As stated on page 54 of Dost et al (1996): "Inhalation of significant amounts during typical forestry application is highly unlikely. In an industrial setting, workers have been exposed over full time work schedules over extended periods with no evidence of effect other than transient upper respiratory irritation."

From US EPA (1993) comes the following summary statement: "Applicators and others in treatment areas may be exposed to boric acid and its sodium salts during or after application. However, there is no reasonable expectation that these pesticide uses may constitute a hazard or risk to people involved in, or near to, handling or application activities. Proper care and adhering to label directions and precautions should reduce exposure and any associated risk."

Borax has been placed in Toxicity Category I for acute eye irritation effects (US EPA 1993, RED Facts; USFS, Fact Sheet 1995). Sporax has a signal word of danger and the label describes the hazards to humans as follows: "DANGER. Corrosive. Causes irreversible eye damage. Harmful if swallowed. Do not get in eyes or on clothing" (Wilbur-Ellis, Sporax label). Borax is rapidly absorbed through damaged skin (USFS 1995). What precautions will the Forest be taking to protect applicators and the public from these dangers? Why is this information not disclosed or analyzed within the EIS?

Suggestions for improving your environmental analysis document:

A statement in the Alternatives section of the EA (description of the proposed action) that says that all applications would follow state and federal pesticide regulations means that the following California requirements would be implemented: adequate training of applicators will be conducted, that medical aid will be available, that wash water and eye wash water will be on site or nearby, and that personal protective equipment will be used (in this case, eye protection, gloves, long-sleeved shirt, and long pants).

The US Forest Service (1995) admits that there is insufficient information available to determine the potential for adverse health effects of humans from contacting or consuming borax treated vegetation, water, or animals. Mushrooms could be potentially contaminated by borax and pickers/consumers easily poisoned by borax applications within relevant units. These potential impacts must be evaluated.

Suggested responses to these comments, or consider these points when writing your environmental analyses:

Exposure estimates for workers and the public are difficult to calculate because of the low likelihood that any non-applicator, vegetation, or animal will be dosed. Deer and cattle are not attracted to free borax, so it is unlikely that humans would be secondarily exposed through eating venison or beef. As stated on page 60 of Dost et al (1996): "Measurement of herbs and foliage at distances up to 5 m from stump and at various times after application do not show differences from measurements prior to application…surface litter is also not altered". Water contamination of nearby streams is not expected.

The US EPA warns of the potential for dermal and inhalation exposure among applicators and people reentering treated areas (US EPA 1993). The Worker Protection Standard (WPS) for Agricultural Pesticides (40 CFR 156 and 170) established an interim restricted-entry interval (REI) of 12 hours for boric acid and its sodium salts (US EPA 1993). Will the Forest be imposing any such safety requirements?

Suggestions for improving your environmental analysis document:

Application of Sporax to cut stumps is not considered treatment of an agricultural crop, hence the Worker Protection Standards, including the REI do not apply. The Sporax label describes appropriate personal protective equipment that must be worn by the applicator. If the Forest decides on a local entry restriction, it should be described in the Alternatives section of the EA (description of the proposed action).

The green consumer website reports "The most significant toxicity concerns for borax center around ingestion poisoning and its reproductive toxicity through ingestion…the California US EPA is currently evaluating it [borax] for possible consideration as a reproductive toxin under Proposition 65" (GreenConsumer.cc 2005).

Suggested responses to these comments, or consider these points when writing your environmental analyses:

Boric acid and its sodium salts were proposed for listing as a reproductive toxicant under Proposition 65 in a public notice issued by the State of California in August 1997. According to the California Office of Environmental Health Hazard Assessment (OEHHA), the August 1997 listing proposal was subsequently dropped based on a decision that the regulatory criteria for listing had not been met. More recently, OEHHA is reconsidering this decision, and may issue a new proposal to list borax (Oshita 2005). As of July 2005, boric acid has not been entered onto the Proposition 65 list.

CATs is aware of incidences where borax has been spilled into adjacent stream systems at the staging areas. We are also aware of accidents associated with mixing that has compromised the health of workers. At a minimum, the US Forest Service must develop safety protocols for mixing and staging areas and include these within the EIS. The protocols should include identification of areas suitable for staging and mixing that pose little threat to stream systems in the case of an accidental spill. Workers need to be sufficiently trained and experienced in safety procedures for mixing and transporting borax, as well as first-aid response, in the event of accidental contact or exposure. First aid materials must be readily available at all project sites (on-site), and include access to running water for flushing borax particles. This information must be described within the EIS. Simply stating that BMPs and product label restrictions will be followed is not adequate.

Suggestions for improving your environmental analysis document:

Application of Sporax does not require mixing of any components therefore reports of accidents involving mixing would not make sense and are not known in the Region. If there have been spill incidents into streams, these have not been reported to the Regional Office. CATs give no details in their letter. As per FSH 2109.14, (USDA Forest Service 1994b) all pesticide incidents must be reported to the Regional Office (Regional Pesticide-Use Specialist). Incorporation of a spill plan into the project file is necessary. A statement in the Alternatives section of the EA (description of the proposed action) that says that all applications would follow state and federal pesticide regulations would imply that adequate training will be conducted, that certain first aid materials will be available, that wash water and eye wash water will be on site or nearby, and that personal protective equipment will be used.

4. Sporax (Borax) Potential Environmental Effects

The analysis and evaluation of potential environmental effects associated with borax applications for this project are woefully inadequate. The Forest simply, and incorrectly, states that Sporax has not been shown to cause toxicity to soil, water, or plants. The Project Vegetation Report states that only high levels of Sporax are considered toxic to soil microorganisms and plants, and estimates that these levels are higher than what is typically used for stump treatments. Yet this admits that borax is toxic to soils microorganisms and plants and this project proposes to use borax at a rate of 2.5 times the normal application rate. Studies and toxicity information on borax, as discussed below, raise issues of potential environmental health concerns that must be addressed as part of this project within the environmental analysis document.

Borax is used as an insecticide and "relatively high concentrations of boron compounds are toxic to insects, even when used in forests (USDA Forest Service 1995). What about the impact of the proposed borax applications to beneficial insects and pollinators? What impacts will this have on biodiversity and ecosystem functioning?

While there are no studies investigating the impacts of borax on amphibians, CATs is concerned that this salt, which remains active for a year in soils, may be having major impacts on amphibian populations. Amphibians, while aquatic during reproductive and other times, also are terrestrial and travel across the land. Amphibians are especially sensitive to chemicals and are believed to be useful indicator species within forest ecosystems. Borax salts do not naturally occur within forest settings and amphibian populations have been quickly declining within forest systems. What impact on amphibian populations is occurring from the current widespread application of borax in our public forests?

Suggestions for improving your environmental analysis document:

As stated earlier, there is no normal application rate, although the Regional average is 1 pound/acre and 90% of applications are at 2.5 pounds per acre or less. The label states that 1 pound of Sporax should cover 50 square feet of stump surface, so obviously the number and size of treated stumps will dictate the rate of application on a per acre basis.

The Dost et al (1996) document discusses toxicity of borax and boron to mammals (refer to human toxicology discussion above); birds (pages 28-30, 50-51); fish and amphibians (pages 30-36 and Table 1); and terrestrial and aquatic invertebrates and fungi (pages 36-39). This document needs to be referenced in the EA/EIS and used when discussing project effects to wildlife. There is one study in the literature that involved amphibians (Birge and Black 1977, as referenced in Dost et al 1989) which showed that leopard frogs were about as sensitive as tested fish.

The Fact Sheet (USDA Forest Service 1995) states that borax is relatively non-toxic to bees (LD50 > 362 ppm), while recognizing that high concentrations of boron compounds are toxic to insects, and borax is used for insect control in some cases. It is known that boron compounds have insecticidal properties. US EPA (1993) states that beneficial insects will not be at risk from the uses of boric acid compounds. Since Sporax is only applied to stumps by the Forest Service and not broadcast sprayed, it is unlikely that there would be widespread exposure to insects. Exposure of insects that are on the treated stump surface may result in toxicity to the individual.

Borax is generally active in soils and it remains unchanged in the soil for one year or more. High rainfall conditions can cause borax to leach rapidly and soil microorganisms do not break it down. Borax is partially soluble in water (USDA Forest Service 1995). The USDA Forest Service (1995) warns not to apply directly to water or to areas where surface water is present and not to contaminate water when disposing of equipment washwaters or rinsate. While boron salts have been observed to occur naturally in most unpolluted waterways, some areas have boron occurring in concentrations shown to be toxic to plants (US EPA 1993). What precautions will the Forest be taking to keep borax out of water sources?

Suggestions for improving your environmental analysis document:

The Alternatives section of the project EA/EIS should state any design criteria for minimizing risks to water quality. Such items as a spill plan, restricting applications due to weather (rain, wind, etc), and/or buffers along live water should be described. In the case of buffers, mentioning any timber harvest buffers would be important (as we won't treat where we don't harvest).

While the EA states that Sporax is "quickly absorbed into the sap in the stump", there is evidence of it washing off stumps (Edmonds et al 1989). The EA states that Sporax does not readily move through soils" which is contradicted by the USFS' own Pesticide Fact Sheet for Borax which states that under high rainfall conditions it may leach rapidly through the soil (USFS 1995).

Suggested responses to these comments, or consider these points when writing your environmental analyses:

The 1995 pesticide fact sheet states that the potential for borax leaching is low, since borax is absorbed to the mineral particles in the soil, however it recognizes that under high rainfall conditions leaching may occur. The Edmonds et al (1989) study, upon which the statement in the Fact Sheet is based, involved coastal northwest Oregon and Washington where the rainfall amounts and distribution are different than in most parts of California. In Chavez et al (1980), which established plots in the same area, they described annual rainfall amounts as250 cm (98 inches). Under such high rainfall conditions, Sporax must be applied carefully, which is what is stated in Edmonds et al (1989): "[borax] may be effective if applied very carefully to stumps, especially those close to the remaining trees" and was demonstrated in Nelson and Li (1980). In California forest conditions, and if Sporax is applied correctly, leaching is not expected to occur. Limited monitoring (Dost et al 1996) indicates that levels of boron in soil were not above *background levels after treatment of nearby stumps. In addition, in the Dost et al, 1996 document states that even if a spill of borax were to occur, it is unlikely that measured amounts in water would be above background, natural levels of boron in water.*

Borax may be toxic to many essential soil microorganisms at high levels (USDA Forest Service 1995) and thus may adversely affect nutrient cycling functions within the ecosystem. This could mean major long-term changes in forest biodiversity from the proposed actions, especially at the extreme proposed application rates and acreage.

Suggested responses to these comments, or consider these points when writing your environmental analyses:

There is little data on effects of borates on non-target fungi. It is unlikely that application of Sporax on stumps would result in increases in boron or borates in the soil above background levels (Dost et al 1996). Therefore effects to soil fungi and other micro-organisms would not be expected. If spilled or mis-applied, localized effects could occur, however any effects would be restricted to a relatively small portion of the environment.

Borax's primary breakdown product in soils is boron. While boron is an essential nutrient for plants, high levels of borax will kill vegetation and thus it can be used as a nonselective herbicide (USDA Forest Service 1995). The Forest Service reports that in high concentrations borax is "lethal to plants." It is also known to bio-accumulate in plants (Phelps et al. undated). The Sporax label reinforces this concern as it states, "Borax carelessly spilled or applied to cropland or growing plants – including trees or shrubs – may kill or seriously retard plant growth" (Wilbur-Ellis). The USFS borax fact sheet (1995) warns "Borax may be a hazard to endangered plant species if it is applied to areas where they live" when applied as a forest fungicide on stumps. Also borax's noncrop herbicidal use may harm endangered or threatened plants. Therefore the US EPA is requiring three phytotoxicity studies (regarding seed germination, seedling emergence and vegetative vigor) to assess these risks (US EPA 1993). These potential impacts must be analyzed and evaluated if Sporax is to remain part of the proposed actions. The Forest reports that several sensitive plants exist in the project area, yet the environmental analysis document fails to analyze impacts of borax on these species.

CATs wonders what kind of impacts borax is having on invasive plants and noxious weeds? Could borax be providing an additional disturbance and clearing space for weed proliferation? Is borax's fertilizing properties providing a soil medium friendlier for exotics than native plant species?

Suggested responses to these comments, or consider these points when writing your environmental analyses:

It is recognized that boron is an essential nutrient in plants; however boron can also act as an herbicide. Apparently the difference in doses between boron's effectiveness as a nutrient and its effect as an herbicide are not very distinct, and vary from species to species. Agricultural use of boron as a foliar fertilizer or fungicide generally occurs in the range of 0.9 to 9 lbs/acre (borax equivalent) while as a soil fertilizer, borax would be applied at a rate of 9 to 18 lbs/acre (Travis et al 2003, US Borax 2005). Above an application rate of 20 pounds borax per acre, there are indications that borax would act as an herbicide (27 pounds per acre is recommended as a control of creeping Charlie (Glechoma hederacea) in turf grass in the Midwest (Lunsford 1998)). Applied at very high rates (670 to 1,770 pounds borax per acre) it will act as a soil sterilant (WSSA 2002, US EPA 1993, Kimball et al 1956). US EPA (1993) states that borax can be applied to treat Klamath weed at a rate of 3-4 pounds/100 square feet (equivalent to 1,300 to 1,700 pounds/acre).

The average application of borax in Region 5 is 1 pound per acre while the heaviest application reported over the last five years was at 6 pounds per acre; 90% of the applications are at or below 2.5 pounds per acre. Admittedly there is little information on the levels of borax that result in negative plant effects, however, these rates of application are within the range used and recommended as foliar fertilizer applications on various agricultural crops and a factor of 10 times lower than recommended as a selective herbicide on turf grass. If Sporax was applied to foliage or the soil at the same rates as it is applied on the cut stump (1 pound/50 square feet), it would be applied in the range that would act as a soil sterilant (870 pounds per acre). The careful application onto the stump surface and the prompt cleanup of spillage is necessary to avoid effects to vegetation in close proximity to stumps. Because of the application method, it is not expected that plants would be routinely exposed to Sporax. As stated in Dost et al, 1996 (page 11), limited monitoring data does not indicate treatment-related increases in boron content of adjacent foliage, litter, or soil, after stump treatment.

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