

# The Forest Steward's Journal

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## Journal of the Forest Stewardship Foundation

*The MISSION of the Forest Stewardship Foundation is to “educate and inform landowners, natural resource professionals and the general public about the science and ecology of forest lands, the many values derived from forested lands and the principles of sustainable forest land development.”*

*DISCLAIMER: As in the past, we again advise that this information is submitted for your interest only. The Foundation's mission, as indicated above, is to “educate and inform”, not to advocate or persuade. The Foundation takes no position, either endorsing or opposing, approving or disapproving, any of the assertions or arguments in the contributed information.*



## From the Chair

Happy New Year! On tap for 2020 is the 11th annual landowner conference in Helena after moving it to Butte in 2019. This year's event will be on Friday May 1 at the Delta Hotels Helena Colonial. The following day at the Colonial hotel we will be hosting a morning insect and disease workshop presented by Amy Gannon, Montana DNRC specialist. Amy's workshop ties right in with our recent series of articles on insects and disease including this edition of the journal.

Dr Peter Kolb, MSU Extension Forestry Specialist and Amy Gannon have co-authored a very interesting article on Douglas fir's response to environmental changes that should be of great interest to landowners and professional foresters alike. We also have articles from August Kramer on insect pests of Douglas fir as well as the use of MCH pouches to deter Douglas fir beetles.

This year's landowner conference is titled "Becoming the Best Forest Steward Possible". Gary Ellingson of Northwest Management Inc. (NMI) has been busy putting together another great agenda of subjects you won't want to miss. He promises that there will be something for everyone. Our foundation has enjoyed a great relationship with NMI over the history of the landowner workshops.

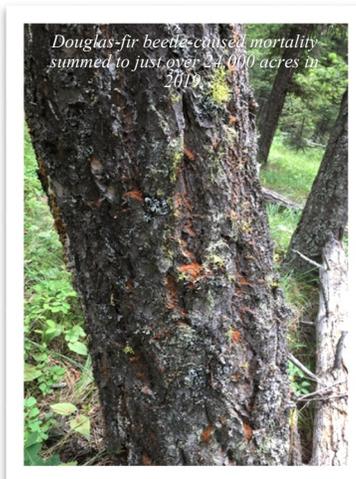
A new wrinkle in our fundraising activities is AmazonSmile. If you are like a lot of us who shop on Amazon you can log on to <https://smile.amazon.com> and select the Forest Stewardship Foundation as your favorite charity. Once you have done that you can shop [smile.amazon.com](https://smile.amazon.com) as you normally would on Amazon. (0.5%) of your purchase then goes to our foundation thanks to you at no additional cost to you.

I'll look forward to seeing you all in Helena.

Ed Levert, Chair

## Insect Pests of Douglas-Fir

*August Kramer, Montana DNRC Forest Pest Management Program Specialist*



Douglas-fir beetle caused mortality summed to just over 24,000 acres in 2019.

Douglas-fir (*Pseudotsuga menziesii*) is one of Montana's most abundant and widely distributed tree species. Douglas-fir is moderately shade-tolerant, which allows it to grow in the understory of established forests as well as in more open settings. In addition to its ability to grow on a wide variety of sites, Douglas-fir holds high status as a tree of economic and ecological importance. Like all conifers in Montana, Douglas-fir is susceptible to a broad array of insect and disease pests. Many pests are active in Montana's forests, but Douglas-fir beetle, western spruce budworm, and Douglas-fir tussock moth were among the most notable pests affecting Douglas-fir during the summer of 2019.

Douglas-fir beetle (*Dendroctonus pseudotsugae*), has been slowly expanding through Montana's Douglas-fir forests, and this summer was no interruption to the recent trend. Adult Douglas-fir beetles bore through the bark of Douglas-fir trees into the live layer of the tree called the cambium. They then excavate galleries in which they lay their eggs. When the eggs hatch, the larvae continue to spread through the cambium, destroying tissues that are vital to the survival of the tree. Douglas-fir beetle tends to prefer hosts that are large, old, and otherwise stressed – perhaps by drought, fire, defoliation, or disease. It is not uncommon to see a proliferation of Douglas-fir beetle around the edge of a fire scar or in a root disease pocket. While seemingly opportunistic, these beetles have been known to rise to outbreak levels, infesting unhealthy and healthy trees alike. Numerous isolated pockets of boring dust produced by Douglas-fir beetle accumulating in bark crevices of an infested tree. Photo taken by August Kramer.

Western spruce budworm (*Choristoneura freemani*) is the most ubiquitous defoliator in the state. In its larval form it feeds on the new foliage of Douglas-fir, true fir, and spruce. In heavily infested areas, western spruce budworm may also feed on older needles, buds, and even developing cones. Larvae are quite distinctive with a brown body and two columns of ivory-colored spots running down their back. Western spruce budworm thrives in densely stocked stands of Douglas-fir, particularly if there are multiple canopy levels. Like all caterpillars, western spruce budworm larvae cannot run particularly fast or far – instead, they travel from tree to tree by releasing a small strand of silk from the end of their abdomen. This strand of silk produced acts like a sail, allowing larvae to float through the air to their next host. In stands with multiple canopy layers, it is more likely that the larvae will be intercepted by a new host before hitting the ground. Mature tree mortality resulting from western spruce budworm defoliation is uncommon, but trees defoliated year after year may become more susceptible to Douglas-fir beetle infestation. In 2019, just under 556,000 acres of forest were affected by western spruce budworm.

Douglas-fir tussock moth (*Orgyia pseudotsugata*) achieved some notoriety in certain parts of the state this year, most notably around Missoula. This insect feeds primarily on the foliage of Douglas-fir, and during outbreak years can completely denude a full-grown tree. Douglas-fir tussock is sometimes found feeding on the same trees as western spruce budworm, and the damage they cause may look very similar. However, Douglas-fir tussock moth looks quite different from western spruce budworm in that they are armed with large tufts of hairs, called tussocks, on their backs. These hairs can dislodge if the larvae are disturbed, and may cause irritation of the skin, eyes, and respiratory system—a condition called “tussockosis”. Outbreaks usually occur every seven to ten years, and typically only last three to four years. Outbreaks are naturally regulated by a few different factors, one of which is tied to the morphology of the adult insects. In this species, female moths don't develop functional flight wings. This means that it is quite difficult for populations to spread into new areas naturally. Instead, female moths tend to lay eggs on host material very close to where mating occurred. However, new infestations can occur if egg masses are deposited onto recreational equipment such as trailers and campers. Another factor that limits the extent of Douglas-fir tussock moth outbreaks comes in the form of a naturally occurring virus called nuclear polyhedrosis virus (NPV). This virus affects the moths and their larvae, causing discoloration, stress, cessation of feeding, and eventually liquefaction and death. NPV builds up in the moth population as the moths become more numerous, until the population can no longer keep up with the mortality and ultimately crashes, usually after three to four years. In 2019, an estimated 12,000 acres of forest were affected by Douglas-fir tussock moth.

Montana's forests are home to many more insects and diseases – Helena DNRC will be holding a forest landowner insect and disease workshop in May, which will provide information, resources, and on-the-ground experience with identifying and managing forest pests. Please visit <http://dnrc.mt.gov/divisions/forestry/forestry-assistance/pest-management>, or call the Forest Pest Management program at (406) 542-4330.



Douglas-fir tussock moth larva. Photo taken by Amy Gannon.

## MCH Application for Douglas-Fir Beetle

*August Kramer, Montana DNRC Forest Pest Management Program Specialist*



*Douglas-fir beetle galleries beneath the bark of a Douglas-fir tree. Photo taken by August Kramer.*

Douglas-fir beetle is a common pest of Montana's forests, and as the name suggests, this insect infests Douglas-fir trees. A single Douglas-fir beetle is unable to kill a tree on its own, however many beetles attacking a tree simultaneously may overcome the tree's defenses and successfully kill it. In order to coordinate their efforts, many beetles rely on chemical signals called pheromones. Adult beetles in search of a new host tree receive a variety of chemical signals through the air, some of which are produced by trees, and some produced by other beetles. When a beetle begins attacking a tree, it releases what is known as an aggregation pheromone. This signal tells other beetles in the area to come to the tree that is being invaded and help with the attack. Once a tree has reached its carrying capacity, the insects inside the tree release a second pheromone called an anti-aggregation pheromone. This signal is the beetle equivalent of a

"no vacancy" sign, expressing to other beetles that the tree is already full of beetles and cannot support any more attacks.

Beetles initiate an attack by boring through the bark of the tree. Beneath the bark of their host, the Douglas-fir beetles chew through the live layer of material called the cambium. Female beetles enter first, excavating individual channel-like galleries that extend 12 to 36 inches up the bole of the tree. As the female beetles navigate up the tree, they lay eggs in small notches on the edge of the gallery. Larvae hatch from the eggs and continue feeding beneath the bark, destroying material that the tree needs to survive. Over the course of the summer, the larvae grow larger and eventually pupate. Most Douglas-fir beetles complete pupation before the end of summer and overwinter in their original host trees as adults. The new adult beetles then emerge from their host trees in May or June, leaving their now-dead host tree in search of another.

Many bark beetles produce unique gallery patterns depending on their species, and Douglas-fir beetle is no exception. Douglas-fir beetle galleries consist of a large, vertical parental gallery that is filled with compacted boring dust produced during the excavation process. As the female beetle excavates, she lays eggs in groups of 6 to 12 in alternating groups on the side of the gallery. When the eggs hatch and the larvae begin feeding, the result is a staggered, fan-like pattern of larval galleries.

Douglas-fir beetle is often thought of as a somewhat opportunistic bark beetle due to its preference for trees with advanced age, fire damage, drought stress, defoliation, or disease issues. While these types of trees are more susceptible to infestation, seemingly healthy neighboring trees may be infested if Douglas-fir beetle is able to proliferate. Douglas-fir beetles at outbreak levels have proven to be very aggressive, killing unhealthy and healthy trees alike.

Management of Douglas-fir beetle can take many different forms – sometimes we remove unhealthy trees from a stand or to use preventative sprays, but there are many situations in which these actions may not be appropriate or effective. One option that is readily available and relatively inexpensive is a compound called methyl cyclo-hexanol, or MCH. MCH is a synthetic compound that mimics the anti-aggregation pheromone of Douglas-fir beetle, tricking the beetles into thinking that a healthy tree is already full of beetles. It is deployed in a small semi-permeable pouch that can be fixed to the bark of a Douglas-fir tree with a staple or nail.

MCH can be applied on individual trees or throughout a stand. If treating individual high-value trees, two to three pouches can be applied to the north face of the tree. To treat a stand, apply 30 pouches/acre (spaced roughly 38 feet apart), about six feet from the ground on the north side of the tree.

MCH is a preventative measure, meaning that it must be applied prior to beetle emergence in the spring to be effective. MCH is not effective against mountain pine beetle or western pine beetle and is only effective against Douglas-fir beetle for one season. MCH is available from a variety of sources, including hardware stores, tree pest specialists, and online manufacturers, and distributors. The current price for pouches is approximately \$2.00 per pouch.

For more information, please refer to the USDA handbook *Using MCH to Protect Trees and Stands from Douglas-fir Beetle Infestations*.

## Logging Experiences of a Small Land Owner

*Robert Bellows, Montana Forest Stewardship Foundation Member*

My wife Laura and I have been active in the annual Montana Forest Stewardship Landowner Conference since 2006 and participated in the MSU Extension Service Forestry School in 2008. These contacts are the extent of my exposure to forest management.

Our family moved on the farm outside of Bozeman in 1951 and the only tree removal occurring since then was for firewood, fence posts and poles and a small area logged in 2004. Our forest area is approximately 40 acres in total size consisting primarily of a mature Douglas-fir stand. Two years ago I noticed some dead or dying Douglas-fir trees. The affected trees were some of our largest ones and tended to be in close bunches so I thought that the problem was probably related to competition for water and nutrients. But last year additional individual dead and dying trees appeared in scattered locations that were some distance from the original groups of dead and dying trees. I suspected this was possibly due to the western spruce budworm problem that occurs every year here, but the infestation and death loss was not typical of a western spruce budworm infestation. The tree trunks were covered with pitch, bark dust was coming from small holes in the tree bark and some dying trees had red needles. We were losing many of our largest and oldest trees.

I contacted some experts including MSU Extension Forester Dr. Kolb and the Gallatin County Extension Agent Josh Bilbao and they both indicated it sounded like a Douglas-fir bark beetle infestation. I cut a section of bark off one of the trees and Josh looked at it he said immediately it was a bark beetle problem. Dr. Kolb suggested I contact a forest manager and get their recommendations.

I was acquainted with Gary Ellingson of Northwest Management, Inc. (NMI) as we had visited at several Forest Landowner Conferences. I had reservations that a consulting forester would not be interested in working with an area as small as ours, but that seemed to be a logical starting point and couldn't hurt to ask. My wife and I arranged to meet with Gary at the 2019 Conference in Butte and had a very good meeting. He agreed with our diagnosis and explained in detail what needed to be done and, yes, NMI would be interested in handling the problem. He answered all my questions in detail as to logging contractors, log buyers, slash handling, firewood, truckers, State and Federal regulations, liability and insurance, payment records, costs in general and who and what records would be kept. That, frankly, was a very reassuring meeting since this was a totally new experience on my part. We agreed that Gary and Luke Fehlig (NMI forester) would conduct a survey of the problem area and go from there.

Since this was my only experience in this area of operations I had a number of "on location" questions and concerns. I wanted the insect problem addressed, but wanted a forest remaining for family enjoyment and possibly some grazing of livestock. I said be conservative in tree removal, no clear cutting other than the dead and dying trees. But I also wanted conservative tree removal for good forest management. Gary had mentioned that the machines used in the tree harvest would require a 35 foot working area between trees for machine passage and I could only visualize 35 foot road trails all through the timber. Gary and Luke took me to a local, recently completed project area to reassure me that was not the case. I must mention that after their initial survey and marking work I had them come back twice to add more tree cutting as I considered their suggested tree cutting was too conservative. They marked all trees that will be cut with blue marking paint near the base of the tree and on the trunk for identification by the log cutting operator and for future reference in post-job survey.

NMI personnel have proven to be well acquainted with all aspects and participants in the logging industry. Contacts for the logging operation were made with two well qualified companies and contacts with sawmills for log purchase involved more than one source. This assured they were protecting my interests in selecting operators and maximizing income. Just this past week we had the Osler Logging Crew arrive on our property to begin harvest operations. We hope to complete the project over a span of several weeks so tree removal can be completed well before spring. This spring we are planning to place MCH patches throughout our forest area to help deter Douglas fir beetles from infesting the remaining trees. Unfortunately the Douglas-fir beetle infestation continues unabated on neighboring properties.

I would caution individuals considering a project similar to mine. Do not approach the job as a big money making undertaking. By the time you pay for logging, trucking, forestry consulting fees, etc. there is not a lot of dollars left. But this must be balanced with the satisfaction you are doing your best to manage your forest and the cost of doing nothing would ultimately be greater.



*Pictured from left to right are Jeremy Osler (Osler Logging), Luke Fehlig (NMI forester), & Robert Bellows (landowner).*



*Complete harvest area*

## Inland Douglas-fir Management Challenges

*Peter Kolb, MSU Extension Forestry Specialist and Amy Gannon, Montana DNRC Entomologist*

Of all the tree species that grow across Montana and Idaho, the inland variety of Douglas-fir (*Rocky Mountain Douglas-fir Pseudotsuga menzeisii* var. *glauca*) is probably the most common tree species found across the landscape due to its ability to grow across a wide variety of environments from dry to wet, warm to cold, and sunny to moderately shaded. It has relatively light seed that can catch wind currents and disperse up to 2 miles, and a moderate resistance to wildfires, wind, snow damage and insects gives it an ability to survive in many locations. Douglas-fir wood is highly versatile for a variety of wood products and across Montana it is a preferred species purchased by most sawmills. Foresters have a love/hate relationship with this species, however, loving it because it can grow well and regenerate fairly easily on a natural basis (Picture 1), and sometimes hating it because it can regenerate with such density and aggressiveness that it can stagnate and suppress pine or larch regeneration when those species are preferred for a particular site. In such situations expensive precommercial thinning is required to prevent a stagnant stand of juvenile Douglas-fir saplings from developing that are also a wildfire hazard. In addition, its seeming robustness and ability to grow in most locations can fool a forester or landowners into thinking that Douglas-fir is an easy to manage species. In reality, it can be very sensitive to intermediate treatments such as aggressive thinning designed to enhance residual tree vigor and fire resistance, sometimes resulting in unexpected mature tree mortality (Picture 2).



*Picture 1. Overstory of 100-year old Douglas-fir at about a 16x16 foot spacing and 170 trees per acre = 20,000 bdft and about 3000 seedlings per acre regeneration.*



*Picture 2. Shelterwood harvest where residual mature Douglas-fir trees decline and die within 10-15 years.*

So what details have we learned about this wonderful but sometimes frustrating species that might be helpful? Many landowners and foresters are familiar with the usual array of insects and diseases affecting Douglas-fir: *Armillaria* root disease, western spruce budworm, Douglas-fir beetle, dwarf mistletoe, and more recently across western Montana, Douglas-fir tussock moth. The signs and symptoms of each of these are distinguishable with a little training, a really great key, or even an internet search. But as mentioned, there have been increasingly common cases of mature Douglas-fir fading and dying with none of the usual insects and diseases present, or at pest levels not commonly associated with tree mortality. Entomologists and pathologists that have looked into these situations and even felled the trees and peeled the bark have mostly found them infested with a number of otherwise minor native beetles that typically attack only dead and dying trees.

As with any living organism, including humans, we can sometimes get too focused on single causes of sickness, whether it is a bark beetle or this year's strain of the flu for us. It is always helpful to also take a broader look at the overall picture of our environment and life style. In the case of Douglas-fir, many assume it will grow well wherever it is found because of its versatility as a species. Give it enough light and space to grow and everything will be fine. However, trees in general do not always choose the best place to grow, or the most resilient growth form. For them to establish, their seed needs to find a safe site where rodents, birds and fungi will not eat them, and enough moisture and the right temperature for the seeds to germinate and seedlings to

get adequate water, nutrients and light. The needs of a seedling are quite small compared to a larger tree, and as trees get larger they can outgrow the resource availability of the site they established on. In addition, seedlings develop a growth form that best takes advantage of the local environment they are developing in. Douglas-fir is especially adept at doing this, developing a flatter crown with flatter needles to grow in the shade, a pointy crown and more rounded needles for full sunlight, deeper roots when water is only available in deep rock fissures, or shallow roots when most soil nutrients and surface water is available right under the



*Picture 3. This underburned area where the organic layer was consumed shows the relatively shallow root crown and root system that Douglas-fir can develop on many sites, predisposing it to damage from fires and sudden changes in stand conditions that allow full sunlight to heat the soil surface.*

Douglas-fir are thinned, the stumps of trees that have neighboring Douglas-fir roots attached may stay alive for many years creating the “living stump” phenomenon. Some nature writers have confused this with an anthropomorphic ideal of neighboring trees “helping” the less fortunate tree that was cut down, when in reality the resource (water and nutrients) gathering capacity of an additional root system is worth keeping alive by feeding it sugar. When this relationship no longer pays back to the intact tree the stump is cut off. Mature Douglas-fir will often have a significant curve in their stem (called “sweep”) because as juveniles they developed next to a mature tree and grew outward from the stem in search of light.



*Picture 4. Initial conversion a dense stand of mature Douglas-fir to a more widely spaced condition that allows better soil water availability for roots, sunlight for crowns, room for residual trees to grow and wildfire resilience should leave an estimated 50% residual surface shade on the site to protect roots. This is especially important on south and west aspects.*

temperatures in excess of 150 °F, which is lethal to plant tissue when exposed to such temperature for more than 1-5 minutes. Thus a tree that has the majority of its root system immediately under the nutrient and moisture rich organic layer found on top of the mineral soil, as is typical for a closed canopy Douglas-fir forest, may experience significant root dieback when the canopy is thinned enough for direct sunlight to hit the soil surface. The effects of such soil heating drives soil moisture deeper into the soil as well as kills the majority of the fine feeder roots, which might be as high as 90% of the root system of a mature shade grown Douglas-fir. Shallow soils over bedrock, gravelly soils with poor water holding capacity and shallow clay layers in the soil all can exacerbate this problem for shallow rooted species such as shade grown Douglas-fir, grand and subalpine fir, and western red cedar. Alternatively, Douglas-fir that develops in more open stands where soil surface heating promotes deeper root development throughout the life of the tree, or trees on North or East aspects where direct sunlight is not as important an issue will rarely suffer from soil heating related root mortality.

organic layer of a shaded forest setting where tap-rooted species such as ponderosa pine or larch are competing for deeper soil resources (Picture 3).

It is also suspected that Douglas-fir can wrap its roots around the roots of deeper rooted species and parasitize water from them. Have you ever noticed that many Douglas-fir seedlings will develop and grow best right next to an older ponderosa pine? Such water parasitism has been documented in other species such as sugar maples and is called “hydraulic lift”. Douglas-fir can draw soil water down to a suction of -28 bars whereas ponderosa pine only to about -19 bars. This suction gradient allows some species to outcompete others for limited soil water – pine grass and elk sedge for example can extract water with a suction of -30 bars, and sagebrush has been measured to exert a suction of up to -40 bars. The aggressive roots of Douglas-fir can even splice into neighboring roots of other Douglas-fir, stealing water and sugar from them. When some

Keeping the opportunistic growth characteristics of Douglas-fir in mind, the issue of mature Douglas-fir trees suddenly dying when the area around them has been cleared of other trees in a thinning action might be looked at with a different angle. Any tree species, but especially those that are very adaptable in their growth habits, will grow a crown and root system that gives it the best light, water and nutrient availability. When that environment is suddenly changed, trees cannot simply move their needles, branches and root systems to a new location. The result is often referred to as “harvest shock” and something commonly noticed as “sunscald” on the branches, stem and needles, where the full energy of the sun suddenly overheats plant tissue designed to grow in a shaded environment that get maybe 5-10% of full sunlight. Sun scald tends to be more common on more shade tolerant species such as grand fir. But what we often overlook in such situations is the change in energy balance on the soil surface, and roots underneath. A shaded soil surface rarely gets warmer than 60-70 °F, however, a soil surface exposed to direct sunlight on a southern or western exposure in Montana can reach

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Thinning trees to provide better sunlight and soil resources as well as fire hazard resilience is a great cultural practice for helping trees grow larger and longer. But it is not always as simple as it seems, especially for mature Douglas-fir. Tree crowns can be a good reflection of root systems, and small tree crowns that develop in a crowded forest indicate a smaller root system that is very susceptible to wind blow-over and soil heating. For Douglas-fir and its highly adaptable growth form, changing a dense stand to a more open stand needs to be done very carefully and gradually, especially on poor soils and south and west aspects. A dense stand of trees will create 80% or greater shade to the soil surface, and should not be opened to more than an estimated 50% soil surface shade at any one time. Ten years might be a minimal time to allow residual trees to adapt to their new environment – the larger and more mature the trees, the longer it takes for them to adapt to a new environment, and for some trees with shallow root systems they may never be able to adapt. A sudden change will result in major root damage, which results in the tree dying from drought stress. In nature nothing gets wasted, thus often an already dead tree from drought stress that is green (think of a cut Christmas tree) will be infested by a variety of insects and fungi that want to feast on the sugar rich inner bark that has no defense at this point. The attack may come from the normal list of tree killing insects that are moving in for an easy meal, or from what are considered normal secondary saprophytic insects and fungi – much depends on the time of year and local populations of the various insects and pathogens. Douglas-fir gives the appearance of being an incredibly robust and adaptable species, which it is with respect to being able to establish itself as a seedling across many locations. Mature Douglas-fir, however, is very sensitive to rapid changes in its immediate environment and needs to be treated carefully and gradually over time. Examining soils and root structure around trees before treatment can offer good indications of potential impacts on root systems. Multiple thinning treatments over time that gradually increase tree spacing can also be more beneficial to the pocket book as 16+ inch diameter Douglas-fir is capable of adding 20-30% more volume over a 10 year period, a respectable rate of value return for any investment.

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## **Please Join the Forest Stewardship Foundation**

Through memberships of only \$25/year we have been able to secure grants, publish and distribute the semi/annual Forest Stewards Journal to over 1200 addresses and co-sponsor the annual forest landowner conference and insect and disease workshop. Making forest education happen across the state is what we are all about. Over the past 25+ years these efforts have also included conservation easement and succession planning workshops, sponsorships of forest stewardship workshops along with a host of other efforts.

As a non-profit organization our board members are not paid, but are passionate about this cause. Your membership means a great deal to our continuing success. Our membership has steadily increased over time to 130 members. Please consider joining the foundation by completing the membership application form/envelope found in each winter's edition of the Journal or by going to our website at: <https://www.ForestStewardshipFoundation.org>.

Thanks for your help.  
Ed Levert, Chair

