The Woodland Steward
Promoting the Wise Use of Indiana's Forest Resources

The Ugly of Forest Management

By Dan Shaver

Think for a minute about pre-European Indiana. Indiana was 85% forestland. Trees were everywhere. You may have heard this phrase, but I want you to picture it. A squirrel could climb up a tree along the Ohio River and then cross Indiana from tree to tree and never touch the ground. Picture that, tree to tree across Indiana. What did you picture? Did you picture a squirrel in a 3-year-old baby tree? Or did you picture a squirrel in a big mature tree with spreading branches?

We are conditioned to think that pre-European Indiana was uniformly blanketed by old growth forest. True, there would have been a lot of old forest in Indiana pre-European settlement. But there was also a lot of young forest, burned over forest and tornado damaged forest. The forests of Indiana are disturbance loving ecosystems. They were before European settlement and they still are today.

In March 2012 an F4 tornado ripped through Clark State Forest with winds exceeding 200 mph. The tornado laid flat big trees and snapped over other trees. The tornado cleared a swath of over 1000 acres of forestland in minutes. It was ugly.

Do you know what was there the year after the tornado?

A one-year-old forest. The next year, some plants did well, some did not. Some birds loved it, some did not. Some animals were displaced, some were not. But the forest lived on. No species went extinct. The forest system was resilient. So it accepted and absorbed this disturbance. Birds like eastern towhees, yellow breasted chats, whip-poor-wills, and indigo buntings very soon occupied the area. What looked like devastation to us was beautiful to these birds. But it can be ugly to us. It changes what we know, changes what we may love.

Good Forest management is a controlled disturbance meant to mimic a tornado, a fire, an ice storm or straight line winds. We use timber harvesting to change the light levels in the forest, to stimulate regeneration, and to change the very structure of the forest. But it can be controversial, it can be hard to understand, and it can be ugly.

When we cut timber there can be cut trees strewn about the forest, there is big machinery moving through the woods and occasionally residual trees are damaged or even knocked over. If the forester decides to create an opening in the woods, it can be shocking to walk out into. And there are roads. To get the equipment in and the trees out we have to build roads that are sometimes dusty, muddy or contain ruts and water. They are ugly.

But as with the tornado, or ice storm, or timber harvest, the forest lives on. What we see as ugly, may be exactly what certain plants, or insects, or animals need. When we create an opening, there are many native seeds that have lain dormant in the soil for years. Now is their chance to grow and flourish.

When we harvest timber, we can take a forest, a beautiful forest, with tall trees, dense overstory and habitat for many species, and turn it into an equally nice forest, benefitting those animals that need disturbance. For example, studies have shown that a managed forest with a more open understory and space around canopy trees creates foraging and

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Calendar of Events

June 11 - 14
Walnut Council national meeting
Lafayette, Tippecanoe County
Field tours, workshops. Daily registration available.
Call 765-583-3501 or
walnutcouncil@walnutcouncil.org.

June 13-15
Thousand Cankers Disease National Research Meeting
Lafayette, Tippecanoe County
Call 765-583-3501 or
walnutcouncil@walnutcouncil.org.

June 21
Southern Indiana Cooperative Invasives Management (SICIM) Annual Meeting
9:00 am to 3:45 pm
Spring Mill State Park, Lawrence County
Contact: ccoon@fs.fed.us.

June 22
Forestry & Wildlife Habitat Field Day
Martell Forest, Tippecanoe County
Contact: Angie Miller,
Angela.Garcia-Miller@in.nacdnet.net.

July 29
Knox County Nature Days
9:00 am to 2:00 pm
Oubache Trails Park, Vincennes, IN
For more info: willem.drews@in.nacdnet.net

September 9
Nature Daze 2017
9:00 am – 3:00 pm
CYO Camp Rancho Framasa, Brown County
http://www.bcnwp.org or info@bcnwp.org.

September 23
Dubois County Invasive Species Awareness Coalition Service and Learning Day
Dubois County Park
Contact: (812) 482-1171 Ext. 131 or
judi.brown@in.nacdnet.net.

November 3-4
Woodland Owner Annual Conference and Field Tour
Columbus Clarion hotel, Bartholomew County
Contact: ifwoa1@gmail.com or www.ifwoa.org.

Woodland Steward Earns National Award

The Indiana Woodland Steward earned the Gold Award for "Newsletters, Series of Articles" category from ANREP, the Assocation of Natural Resources Extension Professionals. The award recognizes the Woodland Steward as an outstanding educational resource that demonstrate innovation, usefulness and impact. ANREP is a national association for Cooperative Extension Service (CES) professionals working in environmental education, fisheries, forestry, wood sciences, range, recreation, waste management, water, wildlife, energy and related disciplines.

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The opinions expressed by the authors do not necessarily reflect those of the Woodland Steward Institute. The objectives of the newsletter are to provide general and technical natural resource information to woodland owners of Indiana, improve information distribution and build support for responsible forest resource management.

Member Organizations
Indiana Woodland Steward Institute

Utilization of American Black Walnut Plantation Thinnings

By Daniel Cassens and Lenny Farlee

American Black Walnut *(Juglans nigra L.)* is North America's most valuable commercial hardwood species. It is highly prized in the domestic and international markets for fine face veneer and lumber. These two products are the raw material for the furniture, cabinet, architectural millwork, flooring and paneling industries.

The species is wide ranging from the East coast to the Great Plains and from southern Minnesota and Michigan to the southern coastal plain. However, from a commercial perspective, the highest quality material, especially for veneer, is found in the northern Corn Belt region. The species accounts for only about two percent of all the hardwood lumber cut.

Because of its economic and aesthetic value for lumber and veneer, and the potential for nut production the species has been widely planted. Early settlers on prairie regions east of the Mississippi River were noted to have planted trees prior to the Civil War. The Timber Culture Act (1873) encouraged tree planting on the western planes. Walnut was undoubtedly a significant species. By the 1960's planting walnut plantations was not uncommon. Plantation establishment continued with the Conservation Reserve Program. The number of acres in Walnut plantations is not known. Considerable research on genetic improvement has been done and continues.

The heartwood of walnut is a beautiful chocolate brown but the sapwood is white. The sapwood can stain to a grey color in the log or during lumber drying. The industry steams green walnut lumber at about 230 degrees Fahrenheit which darkens the sapwood but it can still be distinguished. Steaming also reportedly makes the heartwood color more uniform. The commercial industry prefers a more uniform product but some individuals and custom woodworkers prefer the more natural and variable color of un-steamed walnut. Actively managed plantation trees are typically fast-growing and contain wide bands of sapwood. Landscape trees and even some vigorous timber trees can have a sapwood band of two inches or more. It is not uncommon for the commercial industry to sort pieces with a high sapwood content and market them at a reduced price.

The development of small, thin kerf, portable band mills over the last 25 years is a factor which could contribute to the utilization of plantation thinnings. Compared to heavy duty and expensive traditional band and circle mills, these newer relatively inexpensive mills are now common place, are portable, and have a minimum kerf (the thickness of the blade-cut in the wood) yielding more lumber and less sawdust waste.

In plantation establishment, trees are often planted about 8 to 10 feet apart in rows. Close spacing of trees in plantations helps develop straight stems through competition between

Figure 1. (left) A 47-year old well cared for walnut plantation at Martell Forest in Tippecanoe County, Indiana. Figure 2. (right) Unmanaged walnut plantation of unknown age.

tree crowns. This competition also helps to keep side limbs small and naturally pruned through shading or more easily mechanically pruned to produce clear wood. This close spacing necessitates thinning as tree crowns begin to compete to maintain vigorous growth of the trees to be grown to harvestable size. Unfortunately, these small stems removed in thinnings have no or very little economic value and many landowners are reluctant to thin even though the remaining trees would benefit. Figure 1 shows a 47 year old walnut plantation that has been well cared for and Figure 2 shows a 30 year old plantation in need of thinning.

In an attempt to encourage landowners to appropriately thin walnut plantations and to evaluate the potential use of these thinnings we initiated a study of 6 plantation grown walnut

Table 1. Tree and log characteristics for six plantation walnut trees.

DBH Inches	DIB Butt Log Top End Inches	Butt Log Length in Feet	Tree Volume Doyle FC78	Total Log Length in Feet	Average Radius of Sapwood Butt End Inches	Top End Inches
9.3	7.1	8	-	24	2.2	1.2
10.3	7.7	8	-	32	1.8	1.2
11.2	8.5	8	-	32	2.5	1.4
13.3	10.5	8	58	26	2.6	1.9
15.0	12.0	8	95	26	3.2	2.0
18.0	15.0	12	155	25	2.0	1.1

trees ranging in diameter from 9.3 to 18 inches. We are not encouraging the harvesting of small diameter plantation walnut trees other than to improve the growth rate and future value of the remaining trees. Small walnuts with good potential to produce high quality logs may provide good investment returns as they grow in volume and increase in unit value. Cutting quality trees just as they reach marketable size can limit your long-term income potential. Not cutting lower-quality trees competing with your quality trees slows the growth and gain in value of those good trees.

In April of 2016, 6 plantation-grown black walnut trees of various sizes were harvested and milled on a portable band mill to assess the volume, quality and value of lumber that might be recovered in a thinning operation. Five 35-year old trees planted in 1981 by Walt Beineke, were donated by ArborAmerica, Inc. of West Point, IN., and the largest of the six trees came from a 1968 plantation at the Purdue University FNR Martell Forest. The first five trees were Purdue Number One grafts planted on a fairly well drained deep sandy loam soil, considered a good walnut site. Purdue Number One is a walnut tree selected for good timber form and propagated by grafting stem sections from the parent tree onto walnut root stock. There was some overdosing with simazine herbicide during the first six years and one end of the plantation has a high water table which negatively impacted growth. The plantation averages about 12 inches DBH (diameter at 4.5 feet above ground) giving a growth rate of 0.34 inches per year. The plantation was well managed for the first six years followed by no management for 12 years. When Arbor America purchased the property, the plantation was once again managed.[1] The sixth and largest tree came from a 47-year old well managed plantation nearly adjacent to the Arbor America property. Table 1 summarizes tree and log data.

The logs were processed using a portable band mill, and the lumber, separated by trees, was sent to Pike Lumber Company, Akron, IN for professional scaling and grading, and comments on marketability. One-half of the lumber was steamed and the rest was left un-steamed for comparison and to explore potential markets for sappy walnut lumber. The lumber was then kiln dried. Indiana Hardwood Specialists of Spencer, IN processed it into flooring and Enviro Finishing of Richmond, IN., applied an environmentally friendly solvent free coating that is cured with UV light.

For walnut, the rigor of the National Hardwood Lumber Grading rules is substantially reduced compared to the standard grades for other species, providing opportunities for smaller boards to meet higher grade standards. F1F is First and Seconds one face. It is essentially an FAS board (the top grade) on one face and a Number 1 common grade on the back side. These two grades are often combined in the market place and sold for the same price. For walnut graded on a cutting unit basis (the typical method for all hardwood lumber), the board must measure at least 5"x 8', have minimum clear cuttings at

Table 2. Lumber grade yield and value by log for each of the six logs studied.,

DBH Inches	Total Doyle Log Volume BDF	FIF+BDF/ % of vol.	$/MBF[1]	$	1C BDF	MBF[1]	$	2C BDF	S/MBF	$	Total[1] BDF	Overrun Percent For tree*	Total $
9.3	12	----- /0%	-----	-----	1	1270	1.27	40	-----	29.20	41	242	30.47
10.3	13	3 /6.4%	2515	7.55	6	1270	7.62	38	730	27.74	47	262	42.91
11.2	22	7 /9.5%	2515	17.61	11	1270	13.97	56	730	40.88	74	236	72.46
13.3	35	28 /31.8%	2515	70.42	7	1270	8.89	53	730	38.69	88	151	118.00
15.0	86	52 /41.9%	2515	130.78	17	1270	21.59	55	730	40.15	124	48	192.52
18.0	180	116 /57.1%	2515	291.74	40	1270	50.80	47	730	34.31	203	13	376.85

$/MBF are derived from the Hardwood Market Report April 15, 2016.

MBF = 1000 board feet, BDF = board feet, F1F+ = First and Seconds, one face grade or better, 1C = #1 common grade, 2C = #2 common grade.

*Overrun is the amount of extra lumber volume yielded after cutting as compared to the estimated volume from log rule measurements. The Doyle Log Scale tends to under-estimate volume of small diameter logs and thin-kerf mills naturally produce more useable wood and less sawdust than conventional mills.

Figure 3. (left) Extensive sapwood of the butt end of the five smaller butt logs. Figure 4. (right) Narrow sapwood at 12-foot height on larger tree.

least 4"x 3' or 3"x 6' and have a minimum yield of 83.3% clear on one face. Number 1 Common cuttings must measure at least 3" x 3' or 4"x 2' and yield at least 66.6% clear. Number 2 common walnut has a minimum clear cutting of 2" or wider containing at least 72 square inches and yield 50%. Most walnut lumber will grade at least 2C. In addition to grading walnut lumber on a cutting unit basis, 6' and 7' boards can be graded on a defect basis. In this situation, the size of defects is limited and the number of defects is simply counted. This allows many of these short pieces to be graded FAS. There are additional details about the grades that can be viewed at: http://www.nhla.com/rulesbook. These rules represent the minimum standard that can be advertised by firms using them, but firms may exceed these standards in sorting or grading to meet the needs of customers and prevailing markets.

Table 1 provides size and volume data on the trees and logs as well as the average sapwood radius. Figure 3 shows the excessive sapwood on the five smaller logs and Figure 4 shows the narrower sapwood on the larger log where the 12- foot log was cut. The radius of the sapwood on the butt end for these logs is always greater than at the top. Some of the sapwood on the butt end is likely to be milled off due to taper in butt logs. Also the radius of sapwood on the largest log is less than that for all of the other logs with one exception.

Table 2 shows that the three largest diameter trees, 13.3, 15 and 18 inches DBH, produced 32%, 42%, and 57% F1F and better grade lumber, respectively, which is priced at nearly twice the value of the next lower grade, #1 common. The three smallest trees, 9.3, 10.3 and 11.2 inches DBH, produced 0%, 6.4% and 9.5% F1F and better lumber. Based on the April 15, 2016 Hardwood Market Report the total lumber values are also given.[2]

The 18 inch DBH tree was 47 years old when processed and the value of the lumber was $376.85. The next largest tree (15 inch DBH) was 34 years old and yielded a lumber value of $192.52 subject to discounting for excess sap. The value of standing timber is usually subject to many variables and therefore hard to estimate. Using the 2015 Indiana Forest Products Price Report we can estimate the value of the two largest trees. Assuming the 18-inch tree had a prime butt log

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Figure 5. The five surfaced boards on the right show the range in quality and color of heartwood and sapwood after steaming. The five pieces on the left are unsteamed.

Figure 6. Manufactured flooring showing a range of board quality in both natural (left) and steamed lumber (right).

Black Walnut Plantation Thinnings

Continued from page 5

and two Number two logs, the delivered log value is $231.47. Assuming $200.00 to log and haul the value of the standing tree becomes $196.14. Similarly, the 15-inch tree has one Number two log and two Number three logs with a value of $65.07. The value of the standing tree is estimated to be $47.87.

Mill Management indicated the narrow, short, low grade and sappy lumber (Fig. 5) for all but the largest tree could be sold into the Asian market but at just 60% of the value indicated in Table 2. So despite the fact that these boards technically met grade standards, they would not be sold at prevailing domestic values. The larger tree was acceptable at prevailing market values. The company processing the flooring said that the sappy lumber would be usable for their "rustic" grade. In a normal run of steamed Walnut lumber, they separate the boards with heavy sap and market it for very nearly as much money as the non-sappy flooring. The lumber from the large log was typical of current commercial production.

The traditional industry will not have much interest in plantation grown trees until they reach at least 13 inches DBH. Eighteen inch DBH trees are certainly marketable. One landowner has had some success in marketing plantation trees by combining their sale with adjacent traditional timber sales.

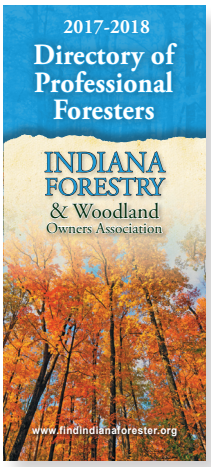
These smaller trees will produce lumber that can be used locally or perhaps manufactured into paneling or flooring. Figure 6 shows the appearance of finished flooring for both steamed and unsteamed boards. Some individuals may prefer the white sapwood and heartwood contrast while others would prefer the more uniform appearance. The company that manufactured some of the boards into flooring indicated they had no problem marketing rustic (low grade) sappy walnut. The product can be sold but it is not likely to be an economically viable operation until trees are at least the 15-inch DBH and substantial volumes are available at one site.

Until plantation Walnut trees reach at least a 15 inch DBH, they will not have much commercial value. However, the lumber from these smaller trees can still be useful on a local use basis or because of an intrinsic value. The ultimate objective is to manage these mid aged plantations for maximum growth, quality and value. This will require the removal of smaller, lower quality trees regardless of whether they are used or not. The remaining trees will increase in value and benefit the landowner as well as the wood manufacturing industry.

Daniel Cassens is a Professor of Wood Products in the Department of Forestry and Natural Resources at Purdue University. Lenny Farlee is an Extension Forester with the USDA Hardwood Tree Improvement and Regeneration Center located at Purdue University.

[1]Personal communication with Walt Beneke, W. Lafayette, IN.
[2]Hardwood Market Report April 15, 2016.

New Directory of Professional Foresters Available Online



The 2017-18 edition of the Directory of Professional Foresters is now available online at www.findindianaforester.org. An interactive search feature allows the user to search by location for a forester in their area. Users can also look up a forester's contact information or background. The directory is also online as a PDF document to view or download. For paper copies of the directory contact Indiana Forestry & Woodland Owners Association at ifwoa1@gmail.com.

Indiana's forest resources are highly productive and if properly managed can improve their productivity and economic return while providing many other benefits: habitat for wildlife; watershed protection; aesthetically pleasing views, and recreation. It is highly recommended that landowners work with a professional forester who can help them develop an appropriate plan to meet their objectives.

Tree Farmer of the Year

Jim Carrier of Manilla, Indiana was recognized as the 2016 Tree Farmer of the Year at the Tree Farm breakfast at the Indiana Hardwood Lumberman's Association convention in February. Picture left to right: Ted McKinney, Director of Indiana Department of Agriculture, Denise Carrier, Jim Carrier, and Robert Burke, Chairman of Indiana Tree Farm Committee.

2016 Indiana Logger of the Year

By Ken Day

Buchan Logging, Inc. is the 2016 Indiana Logger of the Year. Buchan Logging was selected for professionalism in carrying out logging operations, dedication to protect forest resources and water quality, outstanding relationships with landowners, and attention to training and safety. Buchan was recognized at the Tree Farm Breakfast at the Indiana Hardwood Lumberman's Association (IHLA) convention in Indianapolis on February 8, 2017.

Evidence of their professionalism is demonstrated by over 50% of their logging jobs over the last five years has been from repeat landowners. They take care of the land and other resources through the proper use of cable skidders, grapple skidders, crawler skidders, and loaders. Water quality is protected by use of Best Management Practices (BMP) through proper lay out of skid trails and log landings prior to the beginning of the logging operation and installing water bars and seeding the areas after the logging is complete.

Buchan Logging, Inc. is truly a family affair consisting of Dan along with his five sons, Cliff, Brent, Ned, Jay, and Wayne, and bookkeeper daughter Nan. Buchan also employs a forester and another employee to make up three logging crews. Their annual production is about 3 million board feet of sawlogs and veneer logs. Buchan Logging has previously been recognized as Logger of the Year in 2008 and 1997.

Dan has been a licensed timber buyer for over 32 years and a longtime member of IHLA and Indiana Forest Industry Council (IFIC). According to Dan the biggest improvement for the industry has been Soren Erickson classes. These classes emphasizes proper cutting and felling techniques and use of safety equipment. Dan has hosted several of these classes which benefits other loggers as well as his staff.

Training and safety is an important part of how Buchan conducts its operations. All employees keep up-to-date with cutting and skidding training, and CPR and First Aid. They have attended IHLA Lumber Grading Short Course, and training on Gypsy Moth, Emerald Ash Borer, Pesticide Use, Storm Salvage, Fish and Wildlife, and the Game of Logging. Buchan even has an ASE Certified Auto and Truck mechanic on staff.

The Logger of the Year award is sponsored by Indiana Tree Farm. Recognition of outstanding professionalism in sustainable forestry practices is one of their objectives. Education is the other objective. Awardees are selected by the Indiana Tree Farm Committee which is composed of 30 members representing a cross section of forestry professionals in the state.

Ken Day is retired Forest Supervisor of the Hoosier National Forest.

Ask the Steward

By Dan Ernst

Question: Last year I had some timber cut from my woods. They did a pretty good job overall, but the logger left the tops laying all over. What should I do with them?

Answer: Tree tops after a harvest can be rather unsightly, but in many ways are more beneficial to the woods if they are left behind by the logger. The tops can be utilized for firewood, or simply left to decay and returned their stored nutrients and carbon (organic matter) to the forest soil. In the meantime they will provide excellent habitat to a large number of forest organisms, herptiles and other wildlife. Tree tops should not be left in flowing streams where they may cause debris dams, flood problems or streambank erosion.

In visually sensitive areas tops can be cut for firewood, or lopped so they lay closer to the ground. Most tops will decay in 3-5 years and will be unusable for firewood in only 1-3 years depending on species. You can also create wildlife brushpiles by stacking tree top material over a large log or tree stump. Build the pile with large material on the bottom to allow for some open den or escape space for wildlife. Creating a few piles is a lot of work, but a good project to involve the family for a day in the woods. Using a chainsaw? Be safe and demonstrate! Equip yourself and teach safety by wearing proper gloves, chaps, eye and ear protection. Boots and a hardhat too! I love my hardhat with a face shield and built-in ear muffs. In the end- tree tops aren't so bad when you view them differently.

Question: I love my woods, am an avid hiker and was excited to learn that Indiana has some premier hiking trails- including a 60 miler on the State Forestry.

Answer: Trails! What a great way to experience the woods and get a workout at the same time. For those who enjoy the challenge of long distance trails there are over 20 hiking and backpacking trails in Indiana at least 10 miles in length on DNR and Hoosier National Forest lands. This includes the Knobstone Trail- most often referred to as the KT. At 60 miles it is Indiana's longest foot path and traverses four DNR properties. The KT begins near Borden, IN at the Deam Lake State Recreation Area (a DNR Forestry property), then winds North through Clark State Forest, Elk Creek Fish & Wildlife Area and then up through Jackson-Washington State Forest where it currently ends at the Spurgeon Hollow Lake parking lot. The trail can also be accessed at a trailhead in Washington County's Delaney Park. It is a rough and rugged trail traversing Indiana's hills, hollow and knobs. While short sections near some trailheads can make for a pleasurable day hike, the KT is considered a backpack trail and often used by hikers training for the challenge of the Appalachian Trail. As the trail works its way through the working lands of the State Forest, hikers will experience diverse forests, great changes in elevation, vistas and solitude. An interesting point for many is the section crossing through 2012 Henryville tornado which downed over 500 acres of forest near the high point of 'Round Knob'. For more information on the KT visit www.in.gov/dnr/forestry/4224.htm and for Indiana's lost distance trails www.in.gov/dnr/outdoor/4238.htm

The Ugly of Forest Management

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nesting habitat for cerulean warblers, a species thought to have declined at least in part because we haven't been disturbing our forests enough and in the right way.

Many times, we deaden trees as part of our forest management work. We kill them to let in sunlight and mimic what fire would do to thin barked trees. In one case on land I manage, a tree we intentionally deadened became a priority one Indiana bat maternity colony. There may have been over 90 federally endangered Indiana bat pups raised under its bark. That's 90 federally endangered bats alive and well because we disturbed the forest. Now is their chance and there's nothing ugly about that!

Disturbance to the forest is ugly. Timber harvesting is ugly. There is no way around this. We like big trees and shady woods. But what we like does not always fit the needs of the forest or the species that depend on that forest. We have changed the landscape in Indiana. It was probably never true that a squirrel could go from the Ohio River to Michigan without leaving a tree. But it is true that disturbance does not function within the forest like it once did. We may not like forest disturbance, we may not like the looks of a timber harvest, but there is a kind of beauty in giving those species that depend on it a chance at survival. Even if it is ugly to us.

The Woodland Steward newsletter gives you the information to make good management decisions and helps you understand why we manage the forest, even if it is ugly. Thank you for supporting the Woodland Steward Newsletter. We have included a donation envelope in this issue of the newsletter if you would like to continue receiving the newsletter and help us print and mail three issues a year to landowners across Indiana please consider donating.

The Callery Pear – Friend or Foe?

By Kalli Dunn, Mike Saunders, and Mike Jenkins

Callery pear, also known as flowering pear or Bradford pear, is among the most popular ornamental trees in the eastern United States. The precocious flowering of the species is one of the first signs of spring in the Midwest and Callery pear is a common feature of plantings, urban trees, downtown areas, and suburban developments. Unfortunately, the species is rapidly developing into an aggressive invader of native forest, savanna, and prairie habitats across the eastern United States. Expansion of Callery pear into these habitats represents a significant problem for land managers as the species has the potential to outcompete and suppress native species that are much more desirable for wildlife habitat and timber production.

Figure 1: Callery pear actively stump sprouting post cut.

At Purdue University, we have been working on a research project investigating the community effects of a Callery pear invasion on a native hardwood forest located in southern Indiana. We are working to identify potential dispersal agents and pathways of Callery pear as a function of genetic diversity across the population. Understanding the effects of Callery pear on native communities and the role of genetic diversity as it relates to dispersal are of the utmost importance in designing effective management for this and other invasive species.

We have found that Callery pear has the potential to outcompete oaks and other native species; contributing to the oak regeneration failure problem throughout eastern North America. This is a function of similarities in desired growing conditions of the species. Oaks are relatively shade intolerant requiring a more open midstory and understory layer that allows sunlight to reach the forest floor to effectively regenerate. Callery pear is an opportunist. This species will rapidly invade and dominate areas of available light; with its rapid growth rate, it is able to overtop and outcompete more shade-tolerant competitors. Therefore, identifying and controlling Callery pear in your woodlands should be a goal of management. Otherwise, Callery pear stems will continue to invade new areas, increase in density, and eventually have the potential to eliminate regeneration of native species.

Controlling this emerging invasive species can be a challenge. Callery pear has a deep, strong tap root that limits pulling even small stems. Additionally, it actively stump sprouts meaning when cut or girdled, follow up cut-stump herbicide application will be necessary to kill an individual plant. Finally, the general form of most stems is rather spindly with leaves congregated close to the stem (and each other). This limits the efficacy of many broadcast foliar herbicides unless spray volumes or herbicide concentrations are high; this in turn, can lead to non-target damage on the native flora you may be trying to protect. In general, successive mechanical and/or herbicide treatments are most successful in effectively controlling and eradicating this species.

Catching invasions early during their establishment is an important factor in effective control. Individual Callery pear can grow very quickly and be capable of producing pollens and viable seed as early as three years. The species also produces abundant fruits and seeds which are readily dispersed by several bird species including European Starlings and American Robins. This means Callery pear can quickly establish and develop high population density in new areas. Ease of control of Callery pear is a factor that is

relatively dependent on population density making control of spread and removal of the species quite difficult where density is high.

In many areas of its expanding range, Callery pear does not appear to be exerting significant pressure on native communities; it commonly exists alongside native species. However, the species has been prone to explosive development in degraded woodlands and grasslands, particularly near urban and suburban areas. Further, there is evidence, in more mature invasions such as the one we study in southern Indiana, that the influence and dominance of Callery pear may be leading to overall shifts in forest structure and composition. From our research observations, Callery pear can dominate areas that have undergone natural and anthropogenic canopy disturbances that increased available light. Its rapid growth rate allows the species to quickly overtop native seedlings and begin to shade them, thus preventing regeneration of more desirable timber species.

Controlling any invasive species in its early stages of expansion is an important means of mitigating negative ecosystem impacts in the future. The goal of this research is to gain a better understanding of exactly how Callery pear is influencing native communities in order to develop the best management practices for control of Callery pear in order to preserve our healthy Indiana forestlands.

Kalli Dunn is a graduate student in the Department of Forestry and Natural Resources at Purdue University. Mike Saunders is an associate professor of ecology and natural resources in the Department of Forestry and Natural Resources at Purdue University. Mike Jenkins is an associate professor of forest ecology in the Department of Forestry and Natural Resources at Purdue University.

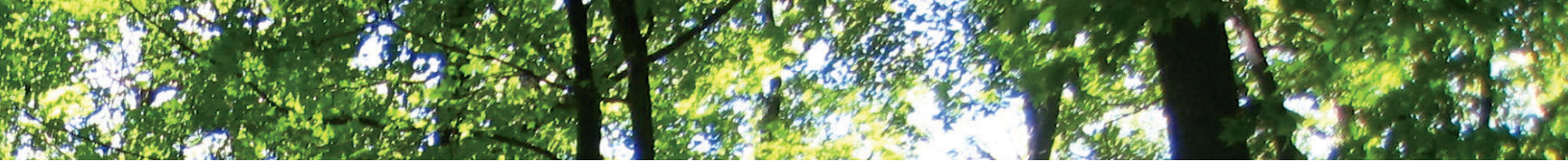
All photos by Kalli Dunn

Figure 2: Early spring blossoms of Callery pear.

Figure 3: Young stem of Callery pear, demonstrates the numerous and large thorns.

Figure 4: Callery pear seedling with long taproot.

Figure 5: High density seedling patch of regenerating Callery pear.



What do our Private Woodland Owners Know and Are Doing about Invasive Plants in Indiana?

By Mysha Clarke and Zhao Ma

Invasive plants are nonnative (or alien) plant species to the ecosystem under consideration whose introduction does or is likely to cause economic or environmental hard or hard to human health[1]. Invasive plants can displace native plants, reduce wildlife habitat, and reduce forest health, productivity and resilience[2-4]. Invasive plants are one of the leading causes of biodiversity loss; approximately 42% of threatened or endangered species in the United States are at risk primarily due to invasive plant and animal species[5,6]. Invasive species are costing the American public an estimated $137 billion each year due to productivity loss and management costs such as herbicide application[7]. More locally, Indiana landowners and managers spent $5.85 million in 2012 alone to manage invasive plants according to a survey conducted by the Invasive Plant Advisory Committee of the Indiana Invasive Species Council[8].

The majority of woody invasive plants in the United States were introduced for horticultural purposes, while many of the herbaceous invasive plants were introduced through crop seed contaminated with weed seed or through seeds in soil brought over from other countries[9,10]. Today, consumers can still find invasive plant species sold as ornamentals in nurseries around the country[11,12]. The most prominent characteristics of invasive plants include large amount of seeds for dispersal, aggressive competition of available resources, rapid reproduction, absence natural enemies or pests in the established ecosystems, and high tolerance of various environmental conditions particularly under climate change[13-15].

It is very important to know what private woodland owners know and are doing to control invasive plants on their property. In the United States, 36% of woodlands are owned by 10.7 million private individuals and families[16]; and in Indiana, 87% of the timberland are owned by approximately 190,000 private landowners[17]. Each landowner may assume responsibility for only a small portion of the total damages caused by invasive plants; however, together their individual decisions to manage or not to manage will determine the success or failure of invasive plant control across the landscape. Some landowners opting not to control invasive plants will increase the control costs for neighboring private and public landowners by allowing their land to act as an invader propagule source[18,19]. Therefore, invasive plant control is not just an individual problem but a community- and landscape-level problem that transcends all property lines.

The Policy and Human Dimensions Lab in the Department of Forestry and Natural Resources at Purdue University recently completed a study focusing on invasive plant management on private woodlands. As part of this study, we interviewed 25 forestry professionals and private woodland owners, and surveyed 2,600 randomly selected private woodland owners in the state. The objective of this study was to assess (1) private woodland owners' current knowledge and awareness of invasive plants and the associated management strategies; (2) management actions that they have taken to control invasive plants; (3) the types and sources of information used to assist them in making invasive plant management decisions; and, (4) the challenges and opportunities associated with managing invasive plants on private woodlands. Below is a brief summary of the survey results from this study.

Who are the private woodland owners in Indiana?

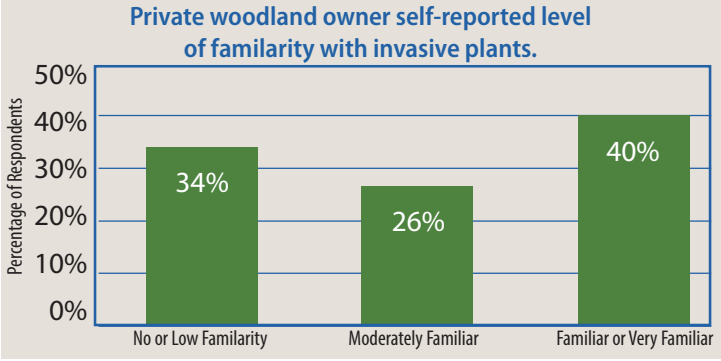
The size of land holding varies greatly among private woodland owners in Indiana. Based on our survey results, respondents owned between 1 and 2,000 acres of woodland with a mean of 81 acres. Thirty-seven percent of our respondents were the single owner of their woodland, 52% owned their woodland with their spouse or another individual, and the remaining 11% owned their woodland jointly with multiple people. On average, our survey respondents had been the owner of their woodland for 25 years, although there were also some brand new owners as well as long-term owners with more than 50 years of experience. Thirty percent of our survey respondents were considered absentee owners who lived more than 1 mile away from their woodland. About 20% of our survey respondents had a written forest management plan, and over a third had participated in the Indiana Classified Forest and Wildlands Program. Generally speaking, our survey respondents were older (an average of 63 years old), and many were retired (49%). Although the majority of our survey respondents were men, women were the primary owner and decision maker for a quarter of the private woodlands represented by our survey sample. Most private woodland owners nationwide derive little income from their woodland; in fact, our survey respondents reported that on average 1% of their household income was coming from their woodland.

Also similar to the private woodland owners nationwide (Butler et al. 2016), our survey respondents owned their woodland mostly for amenity rather than resource extraction reasons. Their top five reasons for woodland ownership were: (1) to enjoy scenery or beauty, (2) to protect or improve wildlife habitat, (3) to protect nature and biological diversity, (4) to pass land onto children or other heirs, and (5) for privacy. Only a third of our survey respondents owned their woodland for the purpose of producing timber products, such as logs or pulpwood.

What do private woodland owners know about invasive plants in Indiana?

Our survey results suggest that 40% of private woodland owners in Indiana were familiar or very familiar with invasive plant problems. These landowners could identify some or all of the invasive plant species around where they lived. At the same time, a little over a third (34%) of our survey respondents reported no or low familiarity with invasive plants. These landowners had never heard of invasive plants before taking the survey, or had heard of them but did not know much about them. The remaining 26% of our survey respondents reported moderate familiarity, meaning that they knew about invasive plants but could not identify specific invasive plant species.

Our survey results also suggest that private woodland owners have noticed a large number of invasive plants species on their property in Indiana. The table below contains all the species reported by our survey respondents, as well as the percentage of survey respondents who reported those species. Notably, multiflora rose was the most noticed species on private woodlands in Indiana.



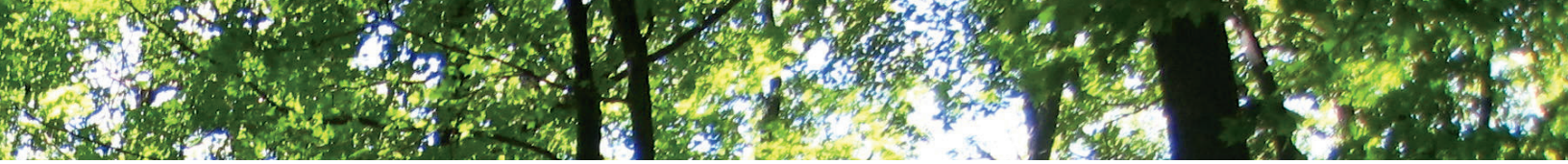
When asked about how they first noticed or became aware of invasive plants on their woodland in Indiana, 15% of our survey respondents reported that a forestry or natural resource professional from a federal or state program saw invasive plants on their property and told them about it, while 10% were told by their family and friends. In addition, 15% of our survey respondents saw information about invasive plants in a forestry newsletter or magazine and then found them on their property, while 11% learned about invasive plants from the media (e.g., newspapers, television, radio, etc.).

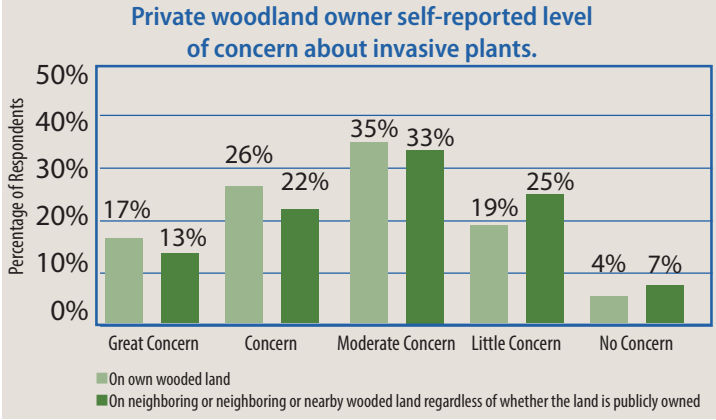
Invasive Plant Species	% of Survey Resondents
Multiflora rose	64%
Asian bush honeysuckle	33%
Japanese honeysuckle	29%
Autumn olive	28%
Other (written-in: Russian olive, wild grape vine, canary grass, etc.)	23%
Garlic mustard	20%
Ailanthus/tree of heaven	19%
Burning bush	13%
Common buckthorn	8%
Japanese stilt grass	6%
Periwinkle	6%
Winter creeper	5%
Japanese barberry	4%
Callery pear or Bradford pear	4%
Privet	4%
Paulownia	2%
Glossy buckthorn	2%

Regardless of landowner awareness of invasive plant problems in general or on their property, the majority of our survey respondents were concerned about invasive plants. Over three quarters (77%) reported a moderate to great level of concern about invasive plants on their own woodland, while 68% reported a moderate to great level of concern about invasive plants on neighboring or nearby privately or publicly owned woodland.

What are private woodland owners doing about invasive plants in Indiana?

Many private woodland owners in Indiana are already taking actions to manage invasive plants on their property. Generally speaking, their actions fall into four categories: physical removal, chemical treatment, obtaining information and seeking assistance, and discussing the problem with neighbors and other landowners. The table below shows the wide range of self-reported actions by our survey respondents. While many private woodland owners may be actively engaged in invasive plant management, it is important to note that 38% of our survey respondents reported having done nothing about invasive plants. This is concerning because unmanaged properties may become a





seed source of invasive plants and undermine the long-term effectiveness of control actions taken by other landowners.

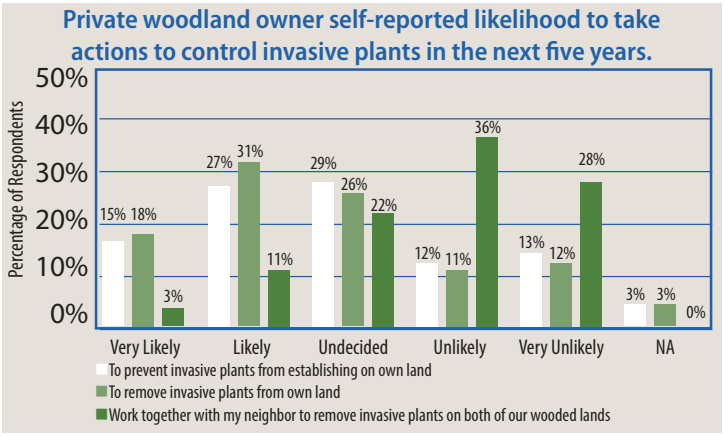
Despite the wide range of actions taken to control invasive plants, private woodland owners generally do not have a lot of confidence in their own ability to effectively prevent and remove invasive plants. Only 20% of our survey respondents reported that they were confident or very confident in their own ability to remove invasive plants from their woodland, and even a smaller percentage (12%) reported confidence regarding preventing invasive plants from establishing on their woodland. Moreover, in terms of overall effort, 79% of our survey respondents believed that Indiana as a whole was not doing enough about preventing and removing invasive plants from private woodlands.

Invasive Plant Control Actions	% of Survey Respondents
I pulled or cut invasive plants on my wooded land.	39%
I inspected my wooded land for invasive plants.	34%
I applied herbicides to kill invasive plants on my wooded land.	31%
I searched for information about invasive plants on the Internet.	15%
I talked to my family about invasive plants.	14%
I contacted a forestry/NR professional about invasive plants.	11%
I talked to other woodland owner (not my neighbor) about invasive plants.	10%
I talked to my neighboring woodland owner about invasive plants.	8%
I sought technical assistance from a forestry/NR professional about removal.	5%
I participated in workshops or information sessions about invasive plants.	5%
I sought financial assistance from a state or federal program to remove.	4%
I used prescribed fire to kill invasive plants on my wooded land.	3%
I participated in a county/state/federal program assisting landowners to remove.	2%
I worked with my neighbor to remove from both of our wooded lands.	2%

What do private woodland owners plan to do about invasive plants in Indiana?

Looking into the next five years, 42% of our survey respondents reported that they were likely or very likely to take actions to prevent invasive plants from establishing on their woodland, and 49% were likely or very likely to take actions to remove invasive plants from their woodland. This also means that over half of private woodland owners did not plan to take any actions in the next five years.

Another result that is worth noting is that among those who had plan to take actions, most planned to work individually rather than working together with their neighbors and other woodland owners to tackle the problem. At the same time, 67% of our survey respondents believed that effective control and removal of invasive plants requires woodland owners to work together, and 43% believed that Indiana needs some coordinated effort to control invasive plants on private woodlands. In fact, many felt a certain level of social pressure



within the landowner community to control invasive plants. Specifically, 71% of our survey respondents said if their neighbors were controlling or removing invasive plants from their woodland, they would feel the need to do the same; or if other woodland owners (not necessarily their neighbors) were controlling and removing invasive plants, they would feel the need to do the same. Further, most of our survey respondents (69%) believed that a "good" woodland owner should control or remove invasive plants from their property to reduce potential spread onto other neighbors' property.

These results suggest that many private woodland owners view the invasive plant problem as a land stewardship problem that all landowners share the responsibility to address. This further suggests a need for perhaps more opportunities for private woodland owners to communicate with each other, voluntarily coordinate their individual actions, collaborate in terms of sharing information and equipment, and support each other as they engage in this important yet challenging task of invasive plant control. Such collective efforts, however, are unlikely to occur without facilitation and assistance. Sixty-nine percent of our survey respondents told us that although the idea of landowners working together sounds great, it would be hard to implement. Many (62%) stated that this is partly because it is difficult for private woodland owners to self-organize and cooperate with one another on their own.

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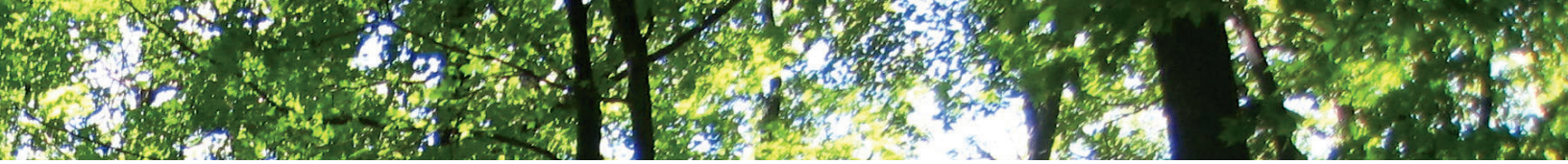

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Crew logging beech for basket stock (left). First quality beech logs for basket stock, Paoli, Indiana circa 1934 (right). According to the photo, a premium of $2.00 per MBF is paid for these or $18 per MBF (20" and over clear). Other logs are $16 per MBF. Photos by Roy C. Brundage.

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