# Bird Community Response to Timber Stand Improvement and Snag Retention[1]

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*ABSTRACT. Avian surveys were conducted from May–July, 1985 on four study areas in the Moshannon State Forest, Clearfield Co., PA. We compared bird populations and communities in Timber Stand Improvement areas to Timber Stand Improvement areas with snags retained (TSI vs. TSI + SNAG, respectively). Bird numbers averaged 1.7 times higher on the TSI + SNAG area than on the TSI area. Average species richness also was significantly higher on TSI + SNAG. Retention of snags was important to bark-gleaning and cavity-nesting birds. During TSI operations, forest managers can improve habitat for cavity-nesting and bark-gleaning birds by leaving snags. The costs of leaving snags is low, and the long-term benefits provided by insectivorous birds outweigh the costs.*

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Silvicultural practices that disturb forest understory and overstory vegetation affect birds in different ways depending on a species' particular habitat requirements (Conner et al. 1975, Titterington et al. 1979, Crawford et al. 1981, Conner et al. 1983, Niemi and Hanowski 1984). Timber stand improvement (TSI) is a practice whereby forests are thinned by the removal of dead, dying, diseased, suppressed, or low-quality trees (Smith 1962). Many trees removed in TSI operations could be classified as snags. Snags are defined as any dead or partly dead tree large enough to be used by birds for nesting or roosting, usually at least 10 2 cm (4 in.) dbh and at least 1.8 m (6 ft.) tall (Thomas et al. 1979). Dead or diseased trees with abundant numbers of arthropods are also important feeding sites for some birds. TSI cuts that eliminate most of these dead and diseased trees may significantly affect bird communities within these stands by removing nesting, roosting, and feeding sites.

Research on relationships of snags to avian populations has been conducted in many areas of the United States (Conner 1978, Evans and Conner 1979), but very little work has been done in the Northeast, especially with regard to the effects of snag retention and timber-management practices on forest birds.

Our objective is to compare bird populations and communities in stands subjected to TSI cuts versus stands subjected to modified TSI cuts with snag retention (TSI + SNAG). Results of our study will be valuable to forest wildlife managers interested in minimizing the effect of thinning operations on forest birds.

## STUDY AREA

The study was conducted at Moshannon State Forest, Clearfield Co., Pennsylvania, in 1985. Four study areas were chosen based on similarity of elevation (500 to 600 m), slope (about 20%), aspect (southern), and vegetation structure and composition. The TSI study areas were 70.4 and 59.5 ha and shared a common border along one side 700 m in length. The TSI + SNAG areas were 46.1 and 59.5 ha and were located away from the TSI study sites 9.7 km and 43.4 km, respectively.

### Vegetation

Timber types on all 4 study areas and on areas surrounding study sites were very similar. Dominant overstory trees consisted of northern red oak, white oak, red maple, black cherry, and pitch pine. Dominant ground cover consisted of leaf litter, *Vaccinium sp.*, and various species of ferns. Canopy closure averaged between 55 and 76%. Extent of defoliation by gypsy moths on all areas was <5% during the study.

TSI thinnings on two areas and TSI + SNAG thinnings on the other two areas were conducted during 1983–84. All study areas were thinned to 400–550 trees/ha and basal areas of 24.1–25.7 $m^2$/ha (105.2-112.0 $ft^2$/ac). Because thinnings were part of a TSI program, the percentage of each stand that was cut varied slightly according to number of trees on a particular study area that were dead, dying, malformed, or low-quality. Generally, thinning took about 20 to 25% of the basal area within each stand. Residual tree height averaged 19 m on all areas. Avian data and the majority of the vegetation data were collected in 1985.

A total of 256 and 277 snags was reserved on the 2 TSI + SNAG study sites. These snags were distributed as evenly as possible over 20-ha areas (12.8 and 13.9 snags/ha, respectively) within each of the TSI + SNAG stands. As many snags as possible were removed during thinning operations on the two TSI stands. A careful survey of the TSI stands revealed some snags remaining after thinning. However, TSI + SNAG stands had 2.2 times as many snags and 3.6 times as much basal area in snags as did the TSI stands after the thinning operation. Snags retained on the TSI + SNAG areas averaged 39 cm dbh and 13.6 m tall. An effort was made to select snags for retention that already had cavities present. Retained snags averaged 1.1 cavities per tree. Retained snags were predominately red oak, red maple, black cherry, and pitch pine. The majority of these snags was in the 4.0 stage of decay based on the series of tree deterioration (Thomas et al. 1979). In stage 4 of tree decomposition, most major limbs are missing, and bark is slipping over 50% of the tree.

## METHODS

Bird surveys covered a central 10-ha area (1000 × 100 m transect) within each study site. Survey belts were located as far as possible from study area borders to minimize edge effects. Surveys were conducted between 0600 and 1000 EDT, and at least eight were run on each area from late May–early July 1985. Surveys were distributed between study areas as evenly in time (hour and day) as possible. All birds sighted or heard within 50 m of

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either side of the transect center line were recorded and mapped by an observer moving at a slow walk (Conner and Dickson 1980). "Fly-overs" were excluded. Surveys were not conducted on days when it rained or when wind exceeded 20 km/hr.

Numbers of individual birds of each species and numbers of individual birds of all species combined were determined for each survey. These measures of avian populations were analyzed using ANOVA procedures (Luginbuhl et al. 1987).

Birds were organized into foraging and nesting guilds (Root 1967). The number of birds within each guild on TSI and TSI + SNAG study areas were compared using ANOVA procedures.

Tree diameter, density, and canopy closure were quantified in 0.05 ha circular plots located at 50-m intervals along the 1000-m transect used for bird surveys. Low-growing woody vegetation was quantified in the center of each plot by counting woody stems present within a 1-$m^2$ circle at heights of 0.1, 0.5 1.0, 1.5, and 2 m above the ground. Percent canopy closure was estimated by viewing vertically through a 5-cm tube. ANOVA procedures were used to determine if differences existed in vegetation structure that could explain abundance and distribution of birds on the study areas.

## RESULTS AND DISCUSSION

Study areas with snags contained more birds and a higher number of species than study areas without snags. Bird numbers averaged 1.7 times higher ($F = 37.9$, $df = 30$, $P < 0.0001$) on the TSI + SNAG area than on the TSI area (Table 1). In some cases species, e.g., brown creepers, which rely on snags for foraging and nesting, were more than 7 times more plentiful on TSI + SNAG areas (Table 2). Species richness was also significantly higher ($F = 18.9$, $df = 30$, $P < 0.0001$) on TSI + SNAG compared to TSI (Table 1).

**Table 1. Mean number of birds and mean number of bird species per survey conducted at Moshannon State Forest, Clearfield Co., Pennsylvania, on timber stand improvement with snags retained (TSI + SNAG) and timber stand improvement (TSI) study areas May–July, 1985. Numbers in parentheses indicate number of surveys conducted.**

| | Study Area | |
|---|---|---|
| | TSI + SNAG | TSI |
| Number of birds | 54.9 (17)* | 31.9 (16) |
| Species of birds | 18.5 (17)* | 13.2 (16) |

* ANOVA indicates significant difference between values in TSI + SNAG versus TSI stands at $P < 0.0001$.

We found that snags were important to birds occupying bark-gleaning and cavity-nesting guilds. When birds were stratified into foraging and nesting guilds (Table 3), bark-gleaning foragers and cavity nesters were significantly more numerous ($F = 6.21$, $df = 30$, $P < 0.0185$, and $F = 9.08$, $df = 30$, $P < 0.0052$, respectively) in the TSI + SNAG area. Members of these two guilds, brown creeper, white-breasted nuthatch, and downy and hairy woodpeckers, may have been greater in the TSI + SNAG than TSI areas because the snags provided more foraging substrate for bark gleaners and a greater number of hollow trees for cavity nesters.

Others have shown also that availability of snags in forests is positively correlated with cavity-nesting bird abundance, diversity, and species richness (e.g., Balda 1975, Yahner 1987). Conversely, removal of snags has been shown to decrease cavity-nesting birds by as much as 52% (Scott 1979) in some areas.

Use of snags is not always restricted

**Table 2. Average number of birds seen or heard per survey at Moshannon State Forest, Clearfield Co., PA, in timber stand improvement with snags retained (TSI + SNAG) versus timber stand improvement (TSI) study areas from May–July 1985.**

| | Study Area | | | |
|---|---|---|---|---|
| | TSI + SNAG | | TSI | |
| | Area 1 | Area 2 | Area 1 | Area 2 |
| Number of surveys: | 8 | 8 | 8 | 9 |
| American redstart (*Setophaga ruticilla*) | 1.50 | 3.44 | 3.38 | 2.25 |
| American robin (*Turdus migratorius*) | 0.75 | 1.56 | 0.13 | 1.50 |
| Blue jay (*Cyanocitta cristata*) | 0.25 | 0.44 | 0.13 | — |
| Brown creeper (*Certhia americana*) | 0.75 | 1.89 | 0.25 | — |
| Black-capped chickadee (*Parus atricapillus*) | 0.13 | 1.00 | 1.50 | 0.13 |
| Brown-headed cowbird (*Molothrus ater*) | — | 0.11 | — | 0.25 |
| Black-throated green warbler (*Dendroica virens*) | — | 0.11 | 0.88 | 0.38 |
| Chipping sparrow (*Spizella aborea*) | 2.00 | 2.67 | 1.13 | 1.38 |
| Chestnut-sided warbler (*Dendroica pensylvanica*) | 1.13 | 2.00 | 0.25 | — |
| Common yellowthroat (*Geothlypis trichas*) | 10.38 | 3.22 | 0.88 | 1.63 |
| Dark-eyed junco (*Junco hyemalis*) | 0.38 | 0.56 | 1.25 | 0.50 |
| Downy woodpecker (*Picoides pubescens*) | 0.75 | 0.78 | 0.50 | 0.50 |
| Eastern wood-pewee (*Contopus virens*) | 1.88 | 2.56 | 2.00 | 2.00 |
| Great crested flycatcher (*Myiarchus crinitus*) | 0.50 | 0.56 | — | — |
| Hairy woodpecker (*Picoides villosus*) | 0.63 | 0.56 | 0.13 | 0.25 |
| Indigo bunting (*Passerina cyanea*) | 0.63 | 0.89 | 1.88 | 2.25 |
| Least flycatcher (*Empidonax minimus*) | 0.13 | 5.56 | 1.25 | 5.25 |
| Ovenbird (*Seiurus aurocapillus*) | 0.38 | 2.00 | 1.88 | 2.25 |
| Pileated woodpecker (*Dryocopus pileatus*) | 0.38 | 0.11 | — | — |
| Red-eyed vireo (*Vireo olivaceus*) | 4.38 | 5.44 | 7.00 | 5.00 |
| Rose-breasted grosbeak (*Pheucticus ludovicianus*) | 1.88 | 1.89 | 0.25 | 0.38 |
| Rufous-sided towhee (*Pipilo erythrophthalmus*) | 8.25 | 6.33 | 2.25 | 0.50 |
| Scarlet tanager (*Piranga olivacea*) | 2.50 | 2.78 | 1.38 | 0.38 |
| Veery (*Catharus fuscescens*) | 0.50 | 1.67 | 0.13 | — |
| White-breasted nuthatch (*Sitta carolinensis*) | 2.75 | 3.33 | 1.38 | 2.75 |
| Wood thrush (*Hylocichla mustelina*) | 0.25 | 1.33 | — | — |

Scientific names according to Eisenmann et al. (1982).

Table 3. Average number of birds per guild on timber stand improvement with snag retention (TSI + SNAG) versus timber stand improvement (TSI) study areas in Moshannon State Forest, Clearfield Co., PA, from May–July 1985. Numbers in parentheses indicate number of surveys conducted.

| Guild | TSI + SNAG (17) | TSI (16) |
|---|---|---|
| Insectivore | | |
| Ground gleaner | 4.6 | 2.9 |
| Bark gleaner | 6.0a | 2.6 |
| Lower-canopy gleaner | 15.8c | 8.3 |
| Upper-canopy gleaner | 2.5 | 2.8 |
| Air sallier | 5.8 | 5.3 |
| Omnivore | | |
| Ground forager | 10.1c | 3.5 |
| Lower canopy forager | 3.0 | 2.4 |
| Upper canopy forager | — | — |
| Nest | | |
| Ground-herb | 2.4 | 2.1 |
| Shrub-sapling | 24.7c | 10.5 |
| Tree twig | 10.1 | 9.7 |
| Tree branch | 3.8 | 2.9 |
| Cavity | 6.5b | 2.6 |

ANOVA indicates significant difference between TSI + SNAG versus TSI at: a = $P < 0.05$, b = $P < 0.01$, and c = $P < 0.0001$.

to cavity-nesting birds. For example, in Virginia where snags were left in a clearcut stand, a variety of cavity- and noncavity-dependent birds were observed using the retained snags: red-tailed hawks (Conner and Adkisson 1974a), eastern bluebirds (Conner and Adkisson 1974b), and woodpeckers (Conner and Crawford 1974, Conner et al. 1975).

Besides bark-gleaning and cavity-nesting guilds, three other guilds also showed higher numbers in TSI + SNAG compared to TSI (Table 3). Lower-canopy insectivores and ground-feeding omnivores were 1.9 and 2.9 times more numerous on TSI + SNAG versus TSI study areas. Likewise, birds in the shrub-sapling nesting guild were 2.3 times more abundant on TSI + SNAG areas compared to TSI areas. Greater numbers of ground-shrub-sapling inhabiting birds on the TSI + SNAG study areas may have resulted from the greater availability of low-growing vegetation available. There was significantly greater woody plant material present from ground through 1.5-m on TSI + SNAG than on TSI sites (Table 4). This probably provided protected and productive low foraging areas and shrub-nesting sites for omnivorous, shrub-nesting species, e.g., rufous-sided towhees, dark-eyed juncos, and chipping sparrows. Other species, like common yellowthroats, that feed in low-canopy and nest in the shrub strata, also probably benefited from the abundance of shrub cover on the TSI + SNAG area.

The dense growth of low vegetation on the TSI + SNAG areas is probably a response to the distribution of the remaining overstory trees after the TSI operation. Overstory basal area on the TSI + SNAG areas (24.1 $m^2$/ha, 105.2 $ft^2$/ac) was no different ($F = 0.49$, $df = 77$, $P > 0.488$) than the basal area on TSI areas (25.7 $m^2$/ha, 112.0 $ft^2$/ac). On the TSI + SNAG, however, the basal area was distributed in fewer trees/ha than on TSI (419.5 versus 529.5 trees/ha, respectively; $F = 8.63$, $df = 77$, $P < 0.01$). The result was a more patchy and open canopy on the TSI + SNAG areas: 47.1% open canopy on TSI + SNAG versus 27.3% open canopy on TSI ($P < 0.001$, $F = 7.56$). The more open canopy allowed additional sunlight to reach the forest floor, permitting the low plant growth to flourish. Birds that responded to the more open canopy on the TSI + SNAG plots include edge or open-canopy species, such as great crested flycatchers and chipping sparrows (e.g., Crawford et al. 1981, Thompson and Capen 1988). Further, fewer but larger trees in the TSI + SNAG plots provided more suitable habitiats for various bark foragers, such as downy, hairy, and pileated woodpeckers.

## MANAGEMENT IMPLICATIONS

This study demonstrates that forest managers can support a greater number of cavity-nesting and bark gleaning birds by leaving snags when using standard TSI operations. The costs of leaving snags is low, and long-term benefits provided by insectivorous birds have been documented in many studies (Baldwin 1958, Knight 1958, Otvos 1965, 1979, Shook and Baldwin 1970, Koplin 1972, Jackson 1979, Torgersen and Campbell 1982, Torgersen et al. 1983, Torgersen et al. 1984). Insectivorous birds can play a very important role in controlling forest-defoliating insects, especially when these insects occur in sparse populations (Dowden et al 1953, Morris et al. 1958, Campbell et al. 1977, Campbell et al. 1983, Smith 1985). All cavity-nesting and bark-gleaning birds that occurred in greater numbers on TSI + SNAG study areas compared to TSI study areas were insectivorous.

In this study we reserved about 13 to 14 snags/ha (5 to 6 snags/ac) during TSI operations and found up to 7 times as many individuals of some bark-gleaning, cavity-nesting species on those areas. Various species of snag-using birds differ in the number of snags they require per unit area of land (Thomas et al. 1979). While this study did not attempt to test the effect different levels of snag retention might have on bird population levels, we do feel that forest managers can significantly improve insectivorous bird habitat by retaining at least as many snags as we did in this study.

In addition, we recommend that managers attempt to select snags for retention that already have cavities present. This is a positive indication that primary cavity nesters (birds that construct cavities) have found a particular tree's size and condition acceptable to spend time constructing a cavity. A snag with cavities present will probably provide more "bird-years" of use than one in the same stage of deterioration with no cavities present.

When planning TSI operations forest managers need to weigh these advantages of snag retention against the potential disadvantages of snag retention, such as snags susceptibility to fire and potential to fall (McClelland and Frissell 1975) or to harbor insects and diseases. ☐

Table 4. Mean number of woody stems at various heights per 1 $m^2$ sample plot in Moshannon State Forest, Clearfield Co., PA. Counts conducted on timber stand improvement with snags retained (TSI + SNAG) and timber stand improvement (TSI) study areas from June–August, 1985.

| Stem height interval (m) | Mean stems/$m^2$ | | | | |
|---|---|---|---|---|---|
| | TSI + SNAG | TSI | df | P > F | F |
| 0.0–0.1 | 25.5 | 4.1 | 77 | 0.0002 | 15.18 |
| 0.1–0.5 | 3.4 | 0.4 | 77 | 0.0001 | 19.34 |
| 0.5–1.0 | 1.3 | 0.2 | 77 | 0.0035 | 9.05 |
| 1.0–1.5 | 0.7 | 0.2 | 77 | 0.0247 | 5.25 |
| 1.5–2.0 | 0.3 | 0.2 | 77 | 0.1783 | 1.84 |

LITERATURE CITED

BALDA, R. P. 1975. Vegetation structure and breeding bird diversity. P. 59–60 *in* Proc.: A symposium on management of forest and range habitats for nongame birds. USDA For. Serv. Gen. Tech. Rep. WO-1.

BALDWIN, P. H. 1958. Overwintering of woodpeckers in bark beetle-infested spruce-fir forests of Colorado. Internat. Ornith. Congr. 12:71–84.

CAMPBELL, R. W., R. J. SLOAN, AND C. E. BIAZAK. 1977. Sources of mortality among late instar gypsy moth larvae in sparse populations. Environ. Entomol. 6(6):865–871.

CAMPBELL, R. W., T. R. TORGERSEN AND N. SRIVASTAVA. 1983. A suggested role of predacious birds and ants in the population dynamics of the western spruce budworm. For. Sci. 29:770–790.

CONNER, R. N., AND C. S. ADKISSON. 1974a. Red-tailed hawks utilization of clearcuts. The Raven. 45(4):83–84.

CAMPBELL, R. W. 1974b. Eastern bluebirds nesting in clearcuts. J. Wildl. Manage. 38:934–935.

CAMPBELL, R. W., AND H. S. CRAWFORD. 1974. Woodpeckers foraging in Appalachian clearcuts. J. For. 72:564–566.

CAMPBELL, R. W., ET AL. 1975. Woodpecker nesting habitat in cut and uncut woodlands in Virginia. J. Wildl. Manage. 39:144–150.

CAMPBELL, R. W. 1978. Snag management for cavity nesting birds. P. 120–128 *in* Management of southern forests for nongame birds. Workshop Proc., USDA For. Serv. Gen. Tech. Rep. SE-14.

CAMPBELL, R. W., AND J. G. DICKSON. 1980. Strip transect sampling and analysis for avian habitat studies. Wildl. Soc. Bull. 8:4–10.

CAMPBELL, R. W., J. G. DICKSON, B. A. LOCKE, AND C. A. SEGELQUIST. 1983. Vegetation characteristics important to common songbirds in east Texas. Wilson Bull. 95:349–361.

CRAWFORD, H. S., R. G. HOOPER, AND R. W. TITTERINGTON 1981 Songbird population response to silvicultural practices in central Appalachia. J. Wildl. Manage. 45:680–692.

DOWDEN P. B., H. A. JAYNES, AND V. M. CAROLIN. 1953. The role of birds in a spruce budworm outbreak in Maine. J. Econ. Entomol. 46(2):307–312.

EISENMANN, E., ET AL. 1982. Thirty-fourth supplement to the American Ornithologists' Union check-list of North American birds. Auk. 99(3):1–16.

EVANS, K. E., AND R. N. CONNER. 1979. Snag management. P. 214–225 *in* Management of north central and northeastern forests for nongame birds. Workshop Proc., USDA For. Serv. Gen. Tech. Rep. NC-51.

JACKSON, J. A. 1979. Insectivorous birds and North American forest ecosystems. P. 1–7 *in* The role of insectivorous birds in forest ecosystems. Academic Press, Inc.

KNIGHT, F. B. 1958. The effects of woodpeckers on populations of the Englemann spruce beetle. J. Econ. Entomol. 51(5):603–607.

KOPLIN, J. R. 1972. Measuring predator impact of woodpeckers on spruce beetles. J. Wildl. Manage. 36(2):308–320.

LUGINBUHL, R. C., S. D. SCHLOTZHAUER, AND J. C. PARKER. 1987. SAS/STAT guide for personal computers. Sas Institute Inc., Cary, NC. 1028 p.

MCCLELLAND, B. R., AND S. S. FRISSELL. 1975. Identifying forest snags useful for hole-nesting birds. J. For. 73(7):414–417.

MORRIS, R. F., ET AL. 1958. The numerical response of avian and mammalian predators during a gradation in the spruce budworm. Ecol. 39:487–494.

NIEMI, G. J., AND J. M. HANOWSKI. 1984. Relationships of breeding birds to habitat characteristics in logged areas. J. Wildl. Manage. 48: 438–443.

OTVOS, I. S. 1965. Studies on avian predators of *Dendroctonus brevicomis*, Le Conte (Coleoptera: Scolytidae) with special reference to Picidae. Can. Entomol. 97(11):1184–1199.

OTVOS, I S 1979 The effects of insectivorous bird activities in forest ecosystems: An evaluation. P. 341–374 *in* The role of insectivorous birds in forest ecosystems. Academic Press, Inc.

ROOT, R. B. 1967. The niche exploitation pattern of the blue-gray gnatcatcher. Ecol. Monogr 37:317–350.

SCOTT, V. E. 1979. Bird response to snag removal in ponderosa pine. J. For. 77:26–28.

SHOOK, R. S., AND P. H. BALDWIN. 1970. Woodpecker predation on bark beetles in Engelmann spruce logs as related to stand density. Can Entomol. 102:1345–1354.

SMITH, D. M. 1962. The practice of silviculture Wiley, New York. 578 p.

SMITH, H. R. 1985. Wildlife and the gypsy moth Wildl. Soc. Bull. 13:166–174.

THOMAS, J. W., ET AL. 1979. Snags. P. 60–77 *in* Wildlife habitats in managed forests: the Blue Mountains of Oregon and Washington. USDA For. Serv. Agric. Handb. No. 553. 512 p.

TITTERINGTON, R. W., H. S. CRAWFORD, AND B. N. BURGASON. 1979. Songbird responses to commercial clear-cutting in Maine spruce-fir forests. J. Wildl. Manage. 43:602–609.

THOMPSON, F. R. III, AND D. E. CAPEN. 1988 Avian assemblages in seral stages of a Vermont forest. J. Wildl. Manage. 52:771–777.

TORGERSEN, T. R., AND R. W. CAMPBELL. 1982 Some effects of avian predators on the western spruce budworm in north central Washington Environ. Entomol. 11:429–431.

TORGERSEN, T. R., R. R. MASON, AND H. G PAUL. 1983. Predation on pupae of Douglas-fir tussock moth, *Orgyia pseudotsugata* (McDunnough) (Lepidoptera: Lymantriidae). Environ Entomol. 12:1678–1682.

TORGERSEN, T. R. ET AL. 1984. Avian predators of Douglas-fir tussock moth, *Orgyia pseudotsugata* (McDunnough) (Lepidoptera: Lymantriidae) in southwestern Oregon. Environ. Entomol 13:1018–1022.

YAHNER, R. H. 1987. Use of even-aged stands by winter and spring bird communities. Wilson Bull. 99:218–232.

# Racial Diversity of Black Locust in Growth Rate and in Susceptibility to the Locust Twig Borer[1]

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*ABSTRACT: Twenty-five different geographic sources of black locust trees from Ohio, Maryland, West Virginia, and Virginia were studied for 3 years in a replicated experiment in Maryland. Significant differences were found in heights, diameters, kiln-dry weights, and susceptibility levels to locust twig borer. None of these variables were related to either longitude or latitiude of the seed source. However, high-elevation sources included more rapidly growing populations than those from low elevations. The third-year sprouts of the most productive source had the kiln-dry weights equivalent to 70,000 kg/ha. This suggests that selected black locust sources may qualify for short-rotation mass yield of energy. The most outstanding in kiln-dry weight per square growth space were some sources from Tucker, Randolph, and Mineral counties of West Virginia.*

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Black locust is a deciduous tree native to the eastern United States. Its natural range extends along the Appalachian Mountains from Pennsylvania to Georgia, and west to Missouri and Oklahoma. In addition, it has been planted in every state of the United States and abroad, particularly in Germany, and is considered one of the most widely planted trees in the world (Cuno 1930, Feher 1935, Blumke 1950). Maryland alone plants about 100,000 black locust trees annually.

Black locust is a highly valued tree from several aspects. As a member of the family *Leguminosae*, it is capable of adding nitrogen to the soil by the process of associated nitrogen-fixing bacteria. This qualifies it for reclamation of nitrogen-poor strip mine spoil banks. Wood of black locust is highly noted for its hardness, strength, and durability (Raber 1936, Cuno 1930). It is highly resistant to rotting and has long been used for outdoor framing and fence posts (Cope 1942, Ginther 1933). Maryland foresters can readily sell its pole-sized cuts at three times the value of other species of similar age. By policy, one nearby large wood-using corporation considers black locust too valuable for use as pulpwood. Instead, it is marketed for rustic fence rails and posts (pers comm., Bruce Brenneman, Westvaco, Inc.). Many enterprises in the Appalachian region depend solely on products of black locust. Much infor-

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