Water Quality and Wildlife Habitat in Pine Stands on Delmarva

Well-managed forests offer many benefits: forest products, watershed protection, habitat for wildlife, recreational opportunities, beauty, and privacy. Many forest owners are interested in promoting wildlife habitat and protecting basic environmental functions like clean water on their property. Most also need some income from the forests to support ownership costs, be a sound investment in land use, and enable landowners to pass down land to younger generations. Revenue from timber sales is an economic incentive to keep the land in forest, fundamental to environmental function and quality of life. On the Delmarva Peninsula, the most reliable income has been from loblolly pine (*Pinus taeda*), a native, fast-growing, adaptable species with consistently available markets. This paper identifies some management options for blending water quality protection and wildlife habitat goals with income-producing wood products.

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WATER QUALITY AND FORESTS

Forests are the least polluting major land use, so *keeping forests of any type on the land* is the most important element for protecting water quality. Forests take up nutrients like nitrogen and phosphorus and capture them in stable organic forms that are not easily leached or eroded into water. The large trees are the backbone of the system, but forest functions also rely on forest soils, litter layer, shrubs, small trees, herbaceous plants, and all the insects and animals that keep it going. While keeping forest cover is the critical element, particular water quality functions depend on forest type, condition, and landscape position.

Forest type: Pines have longer active growing seasons, especially in milder climates, so they take up nutrients for more of the year. Hardwoods like oaks, maples, and poplars tend to have higher nutrient uptake rates when active than pines[1]. Oak and beech have leaf litter that is more difficult to breakdown and less likely to leach nutrients to nearby streams, while leaf litter from maples releases nutrients more easily[6]. Native tree species are encouraged, as these tend to support other ecological elements like wildlife and insects that favor a stable forest community and balanced nutrient cycles.

Forest condition: Actively growing forests tend to have higher rates of nutrient uptake. Forest health problems, such as trees defoliated by gypsy moths, can release nutrients into streams[5], like a short-circuit in the nutrient cycle. Forest condition affects responses to eventual disturbances, whether ice storms, windthrow, insect, disease, or fire. Maintaining multiple layers in the forest, from understory plants to shrubs, young regenerating trees, mid-canopy trees and overstory trees, creates more options for a forest to retain nutrients, especially after a disturbance.

Landscape position: Some parts of the forest are critical for intercepting water and nutrients. Streamsides, floodplains, seeps, and toes of slopes all tend to intercept more water flow, so have more opportunity for reducing nutrients. Actual flow patterns vary and can be difficult to identify from the surface, but areas nearer water generally will have higher potential for affecting water quality. In addition to nutrient reductions within the stream buffer, trees build capacity of the stream itself. Shade, woody debris, and leaf litter support an array of aquatic fauna and flora that capture nutrients even after they reach the stream. Maintaining continuity of forest buffers further increases resiliency of the stream system, so continuously buffered streams can maintain healthy functions longer than unevenly buffered streams, even with similar levels of watershed disturbances[3]. Other areas of the landscape can be more vulnerable to erosion, such as steep slopes or erodible soil types, and require more careful management.

Managing for water quality

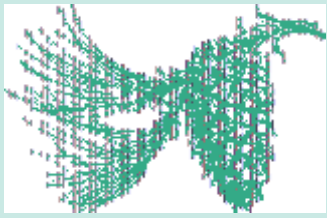
Maintaining forest land use is fundamental for protecting water quality over the watershed, so growing a forest that the landowner can afford to keep there is important. Rich and diverse forests offer varied responses to disturbances, and more options to recover functions quickly. Avoiding or minimizing disturbance in wetter and steeper areas also protects water quality.

Harvests are the land manager's major tool to affect future stand composition and condition. Harvesting also removes some stored nutrients and keeps forests in actively growing states that maximize nutrient uptake. Best management practices during harvest, site preparation, or any forest operation are critical for preventing sediment in waterways or loss of stream shade. Harvest planning puts roads and skid trails in the most efficient and least sensitive areas. Proper road drainage allows access while avoiding direct impacts on streams, diverting water to infiltrate on the forest floor and avoiding direct ditches to waterways. Using logging mats to access wetter sites can allow the harvest without excessive rutting and loss of soil productivity, the future growth potential of the forest.

Harvest type and timing can shape the future forest stand. Genetically improved, disease-resistant seedlings are available, and may be desired for fast growth and hardiness. Natural regeneration is low-cost and can provide a range of native species; however, the new trees can be very patchy, too crowded, or include invasive species. Disturbance patterns, and the stands they created, have changed dramatically over the years. Historically, when wildfires periodically burned across the landscape, oaks with their thicker bark and vigorous resprouting survived better than thin-barked red maple and sweetgum. In a settled landscape, some management is needed to maintain natural communities. Options include prescribed fire, herbicides, thinning, and planting. Heavy thinning in pine stands without follow-up herbicide treatment can allow some hardwoods to grow in between pines, although at noticeable cost to pine growth rate.

WATER QUALITY SUMMARY

- *Plan some mix in species, either within a stand or variation in stand types;*
- *Harvest to sustain active growth and promote structural diversity;*
- *Assure that harvesting BMPs are carefully applied, especially buffers and stream crossings;*
- *Plan for an economically sustainable forest;*
- *Consider hardwood elements in pine stands for diversity of species and structure, maintained by prescribed fire or reduced herbicide rates.*



WILDLIFE HABITAT

Wildlife habitat requirements vary tremendously from species to species, and generally encompass food, water, shelter, and breeding needs. Recommendations here focus on maintaining a range of species inhabiting forests.

Food and water: A diversity of trees that offer food sources at different seasons creates better habitat for wildlife. Trees can offer hard mast, nuts like acorns, walnuts, beechnuts, or hickory nuts that keep over the winter, or soft mast, fruits like crabapples, serviceberry, persimmon, paw-paw, plum, or elderberry that are seasonally abundant. Understories of shrubs, grasses, and other herbaceous plants can offer browse throughout the year. Since water is essential to many birds and animals, maintaining food sources and shelter in buffers and wetlands is particularly important.

Shelter and breeding habitat: Forests have multiple layers of vegetation, offering different habitat niches for a variety of species. Many types of wildlife use dead or downed wood, from the very visible and vocal woodpeckers to more reclusive amphibians. Leaving some live and dead trees in a harvest can increase habitat diversity. Buffers are an especially important place to leave snags, cavity trees, trees leaning over water and downed large woody debris; they are near water sources, important for most species, and can contribute to aquatic as well as terrestrial habitat. Vernal pools, ponded water present only in the springtime, often are a mainstay for amphibians, and should be identified and marked in spring to be able to minimize disturbance during any later management operations. Variety in stand types should also be considered to encourage a variety of species. Some species use clearings (early successional habitat that has more forage and insects), while others rely on the large canopies and trunks of older forests. Maintaining stands of different age and species composition creates varied habitat, particularly where management allows wildlife populations to migrate over time (for example, using travel corridors, stream buffers, limited harvest sizes, and retention of woody debris)[4].

Managing for habitat diversity

Diversity can come from different stand types, different stand ages, and species within a stand. Carrying lower basal areas of trees can allow other smaller shrubs and browse to increase. Oaks are a mainstay of hard mast wildlife food sources, and historically were favored by landscape-scale wildfire. Current management options to encourage oaks include prescribed fire, lower levels of herbicides that oaks tolerate better than gum or maple, and planting. Prescribed burning can reduce some vegetation competing with desired species, stimulate sprouting species, and improve browse. Prescribed fire can benefit and renew native forest communities, but results can be unpredictable, both in timing (can be delayed by weather that is too wet or too dry) and extent (patchy coverage of burn). Pine stands can also be managed as uneven-aged forests; smaller, more frequent harvests offer lower amounts of income but more frequently; these types of stands usually are maintained with the assistance of prescribed fire[2,8].

Where prescribed fire is not available or practical, herbicides can be used to affect species composition. Imazapyr, active ingredient in Arsenal©, is more lethal for sweetgum and red maple than for oaks. Trials on the Lower Eastern Shore found substantial control of hardwoods, with some oak survival, even at half of normal rates, with greater hardwood resprouting at the lower rates. Some people are reluctant to use herbicides, questioning whether it is safe in their neighborhood even with national testing requirements and application restrictions. Forest lands generally have the least intensive use, periodic rather than annual; label restrictions and required practices, such as not spraying directly over water, are used to prevent any impairment of water quality[7]. Replicated water quality sampling in waterways with a 50- foot spray buffer did not detect any imazapyr two days or two weeks after application on the Lower Eastern Shore using standard aerial procedures and a 100-ft spray buffer. Existing safeguards served to keep active ingredients where they were intended and prevent impacts to stream water quality.

WILDLIFE HABITAT SUMMARY

- *Encourage diverse species, stand ages, and structure, including trees and shrubs providing nuts, fruit, and browse;*
- *Mark vernal pools in spring;*
- *Minimize disturbance in buffers and vernal pools;*
- *Keep trees leaning over water;*
- *Keep snags and shaded fallen logs;*
- *Use prescribed burns to stimulate browse and encourage favored species;*
- *Where prescribed burns are impractical, consider low herbicide rates to selectively favor important wildlife species like oaks.*

COSTS AND BENEFITS TO INCOME

Several management options for increasing water quality and wildlife habitat call for increasing species diversity, encouraging some hardwood trees in pine stands. Landowners should understand effects on income flows and investments when making decisions early in the life of the stand. Some of the practices, like lower rates of herbicide use or natural regeneration, mean lower costs to landowners. However, overall pine volumes will be lower, reducing a significant future income source.

Net present value is used to compare investment alternatives, discounting future income streams at a set %/year to develop a value in current dollars. A 5% rate was used for this analysis. A 40-year rotation of pure loblolly pine, with commercial thins at 20 and 28 years, can have a net present value (NPV) of $560/acre at 2003 average prices[9]. Including 30% hardwoods is likely to reduce NPV by half; pine growth is slowed with hardwood competition enough that fewer trees reach sawtimber size by the intended harvest date, and the value of the hardwoods is diminished because it is much farther in the future (e.g., 60 years or more, usually). Including 10% hardwoods is likely to have more limited impacts on future income, less than 20% lower NPV.

Other income sources can take advantage of wildlife potential, such as hunting leases. The NPV of a hunting lease at $15/acre is about $225, 40% of the pure-pine-stand NPV[9]. Although the annual amounts are low, their value in investment analysis is substantial because cash flow occurs every year rather than after a couple decades. If landowners choose to lease land for hunting, the supplemental income can compensate economically for unharvested hardwoods or foregone pine volume. Landowners can usually lease hunting rights regardless of species or forest condition, so it does not depend directly on species or stand diversity. Firewood markets favor hardwoods, but cut trees should be marked to assure that desired species and ages of trees are kept.

Managing for multiple goals is a lot like diversifying an investment portfolio. Timber markets forty or eighty years from now are unpredictable at best. Products with good performance characteristics like pine are likely to continue to be in demand. However, new markets continue to develop and can build demand for previously low-value species, as happened with particle boards.

Landowners can afford to manage land for a diversity of objectives, but should understand the options and tradeoffs. If watershed health and wildlife habitat are important goals for the landowner, increasing diversity of species and structure in pine stands can help meet these goals. There are several ways to keep conservation effective and affordable, targeting stands with mixed species and multiple canopy layers near water and as connections among habitat elements, leaving snags and mature oak or fruit trees.

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