Forestry Effects on Riparian Areas

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Abstract

Past forestry practices were developed and applied at the stream-reach scale. New forestry focuses on a landscape scale to provide wood products while maintaining ecosystem and community processes. The effect of all forestry practices (e.g., logging, road building, planting, thinning, and slash) on the riparian areas is considered since these areas are part of the landscape. In new forestry, more effort is directed in the planning effort to define site objectives and to understand the implications of each site objective at the landscape scale. This planning provides management with greater flexibility in applying forestry practices to all areas of the landscape as well as in the riparian areas. New forestry is implemented by using the different forestry practices to finesse the stream-reach scale to meet the established objectives in terms of the functional relationship at the landscape scale.

FOREST RIPARIAN HABITATS

Logging and other forestry-related activities have profound influences on riparian areas and streams. How important these riparian systems are with respect to the total forest can be summarized in terms of plant diversity, wildlife habitat, developed recreation, and lumber yield (Figure 1). The example describes the relative importance of riparian areas as natural resources that are typical for a forest on the western slopes of the Cascade Range. The potential for lumber yield is less in riparian areas when compared to good, mesic upland sites due to saturated soils late into the growing season or cobbly soils that tend to be overdrained.

An acceptable functional definition for riparian areas was presented in the paper by Hawkins.[1] Many of the functional relationships associated with riparian areas extend well beyond what would be considered a "normal" riparian-area boundary and up the hillslope. If the concept is to manage by objectives, then practical boundaries must encompass elements of the upland, e.g., the sources for coarse woody debris input to the stream.

[1]See Hawkins, this volume, page 3.

Functional links exist among upland elements, the riparian area, and the channel. Often these links between forest riparian vegetation and channel elements are illustrated in the context of an aquatic organism-centered model (Figure 2). Structural links also exist. Some of the attributes of a forest riparian area include diversity in physical structure that results in a richness of biological species. The vertical and horizontal diversity of physical structures provides an abundance of edges. These differences can be illustrated by comparison of narrow, deeply incised channels to wide valley channels with significant floodplains. The frequency of the disturbance regime in a wide valley contributes to the vertical and horizontal heterogeneity. Tree-stand ages differ markedly between riparian areas developed on contrasting geomorphic surfaces. Valley landforms influence stream ecosystems by providing a variety of physical substrates to produce riparian vegetation diversity, a longitudinal spatial distribution, and complex strata of riparian vegetation. Disturbance regimes associated with stream/riparian systems tend to be linear: upstream disturbance influences downstream structure and function. Thus we need to have a basinwide, rather than simply a stream-reach, perspective when considering the management of riparian areas.

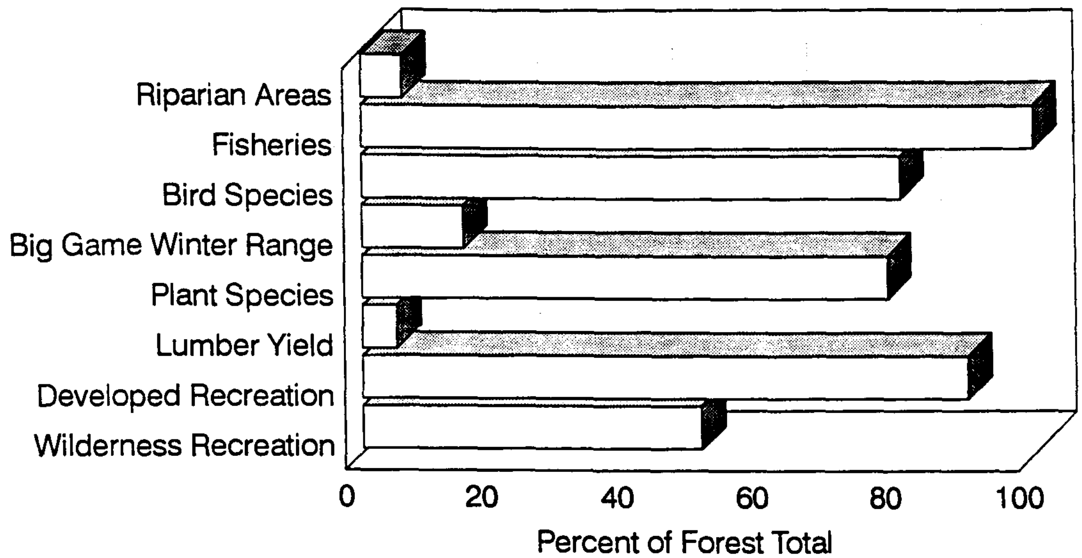


Figure 1

ECOSYSTEM FUNCTION AND ITS RELATIONSHIP TO FOREST PRACTICES

An important management concern is the influence of forest practices on some functional relationships of riparian areas. There are silvicultural treatments other than logging that need to be considered, such as planting or afforestation, thinning, and slash treatments. Forest practices that are possible in a riparian area include no logging, a perfectly acceptable management decision; control of slash by burning and/or piling; and the planting of trees, shrubs, and forbs that are common to thinning, commercial, and precommercial practices. These techniques can alter the physical structure and species composition of a system to meet management objectives.

One of the most obvious functional relationships is the shading of the stream by an adjacent tree stand. If there is a set of profound changes that logging has on a stream, it is the removal of adjacent vegetation that permits exposure of the stream to full sunlight. The greater solar radiation may increase stream temperatures and accelerate in-stream primary productivity.

Another effect of logging is to alter the type and timing of fine-scale organic inputs during the winter. This detritus provides primary production for the aquatic community and represents a significant portion of the energy base. By logging, certain species and their associated inputs can be removed. Other species with desirable properties can be introduced or reintroduced by forest practices. Since the rate of processing of organic inputs is plant-species dependent, it may be possible to regulate the mix of amounts, timing, and quality of organic inputs to the stream. This regulation may be accomplished by thinning without removal, logging, and planting.

The importance of organic inputs such as coarse woody debris in channel structure and integrity is discussed in other papers in this volume.[2] Coarse woody debris plays an important role in the retention of sediments, slowing of the movement of water out of the basin, and the capture of other organic material. The retention aspects allow processing of organic material by some organisms prior to a general energy availability or breakdown. If a riparian area occurs without roughness elements, i.e., with no coarse woody debris to capture the sediments or with no organic matter, energy is relatively rapidly exploited. By adding a few roughness elements, material begins to collect and riparian systems begin to rebuild. Streamside tree stands that deliver coarse woody debris provide habitat to endangered species such as the Pacific Giant Salamander. These riparian forests also provide habitat and migration corridors for a rich variety of wildlife, such as the spotted owl of the Northwest.

Riparian areas also capture nutrients that are transported from the hillslope. The filtering by riparian areas of water transported downslope has been likened to tertiary sewage treatment processes.

[2]See Hawkins and Swanson, this volume.

PROBLEMS OF SCALE

On the western slopes of the Cascade Range, the hydrology is altered by clear-cut patch logging. When patch cutting produces cleared areas over 40 to 50 percent of basins several thousand hectares in size, storm peak flows tend to be larger. This landscape-scale logging activity affects the riparian area by increasing the frequency with which the near-stream vegetation is disturbed by flowing water.

Situations differ tremendously, and there is a considerable variation in these natural systems. For example, on the west side of the Cascades, summer base flows from recently logged areas have dropped to below prelogging levels. How long this effect will persist is not known, though it appears to be related to a shift in vegetation composition. Species in the earlier successional communities tend to be more profligate in their water use. By thinning, the species mix can be controlled. Selective planting can produce a species mix that is less apt to transfer water. These potential activities come under the general rubric of forestry. The forest riparian area provides material to strengthen the banks and roots that promote stream-bank integrity. Logging tends to destabilize the banks and thereby to destabilize the system.

The period of time it takes for different functions to recover to prelogging levels (e.g., inputs of nutrients and litter and shading along small third-, fourth-, and fifth-order streams) is relatively rapid (<500 years) (Figure 3). If the riparian forest is totally clear-cut, a long period of time must pass before large woody debris enters the channel in any significant amount through natural processes.

NEW FORESTRY AND FUNCTIONAL RECOVERY OF RIPARIAN AREAS

The promise of new forestry with "twice" the nutrient cycling power and "extra" animal ingredients involves the viewing of objectives and practices designed to meet those objectives in a slightly different way. The recovery time for many of these functions can be much shorter with the application of new-forestry principles. One of the primary objectives of new forestry is to provide, at a landscape scale, commodities such as timber and pulp and paper while simultaneously maintaining ecosystem and community processes, long-term site productivity, biological diversity, and aesthetic improvement. Visitors to the new-forestry units state that they are equally ugly when compared to the old "industrial strength" clear-cut, broadcast-burning approaches. These individuals are correct; but at the landscape scale, the visual effect is much softer. This kind of approach tries to maintain some of the ecosystem processes of the site, e.g., the retention of green trees, hard and soft snags, and a fair amount of woody debris on the forest floor. New forestry prescribes burning only a portion of the forest for slash cleanup and fire-hazard reduction rather than the more typical broadcast burning.

New forestry also prescribes the retention of a

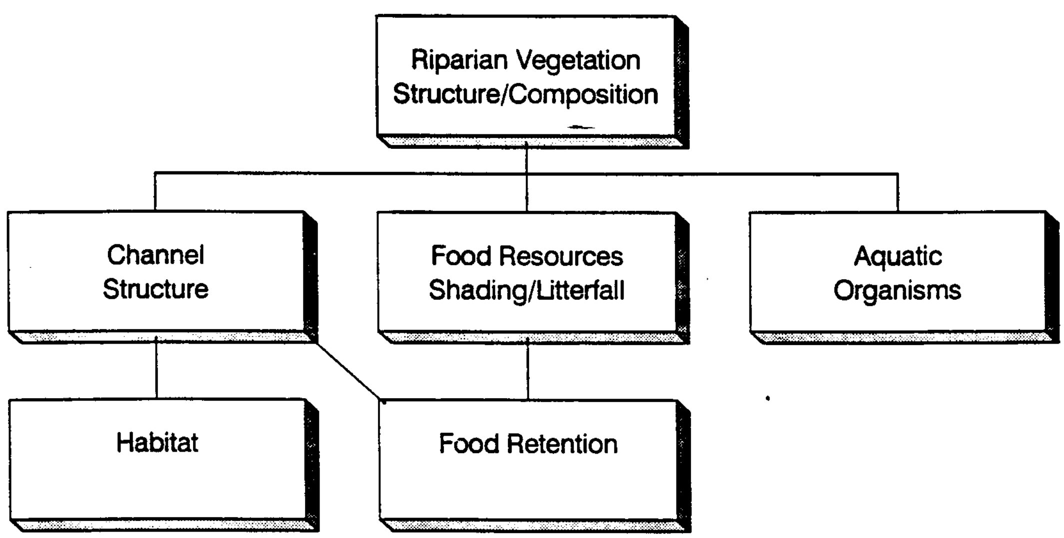


Figure 2

large portion of the overwood, which appears similar to a shelterwood logging activity to those familiar with traditional forest practices. These activities are accomplished for a slightly different set of objectives that must be clearly defined. In any reach-sized management plan or site plan, a site analysis must first be performed. The site analysis must provide site characteristics and scaling sensitivities. The greater share of the planning effort is spent defining your site objectives. Only then can a reasonable move be made from the site plan to a set of prescriptions that represents the best current working hypotheses related to the consequences of logging, other forestry-related activities, or any activity. After this effort, a reach where a stream is flowing can be entered and the riparian-management boundaries can be finessed to achieve the proposed management objectives in terms of the functional relationships discussed earlier.

The reach scale can be finessed, but it is important that the landscape scale be considered. Thus, whatever riparian-management program is constructed, the reach-scale prescriptions and objectives must be placed within the context of the complete landscape. The watershed should be the smallest unit of consideration. Management must be considered at a much larger scale than the reach scale. By thinking at the landscape scale, the decision may be to avoid the riparian forest or it may be something else entirely. The choice may be to enter the riparian forest to cut selected trees to enrich the stream with coarse woody debris because the reaches upstream or downstream are impoverished. A key element is the clarification of objectives, remembering that the narrow riparian area is profoundly enforced by adjacent uplands and that any riparian-management plans should be couched in terms of the overall landscape-management plan.

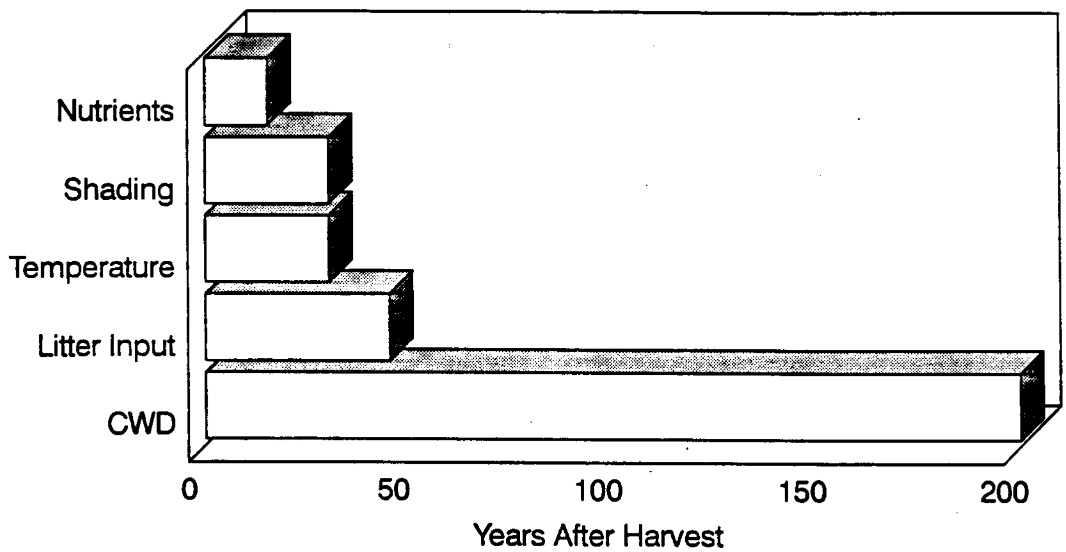
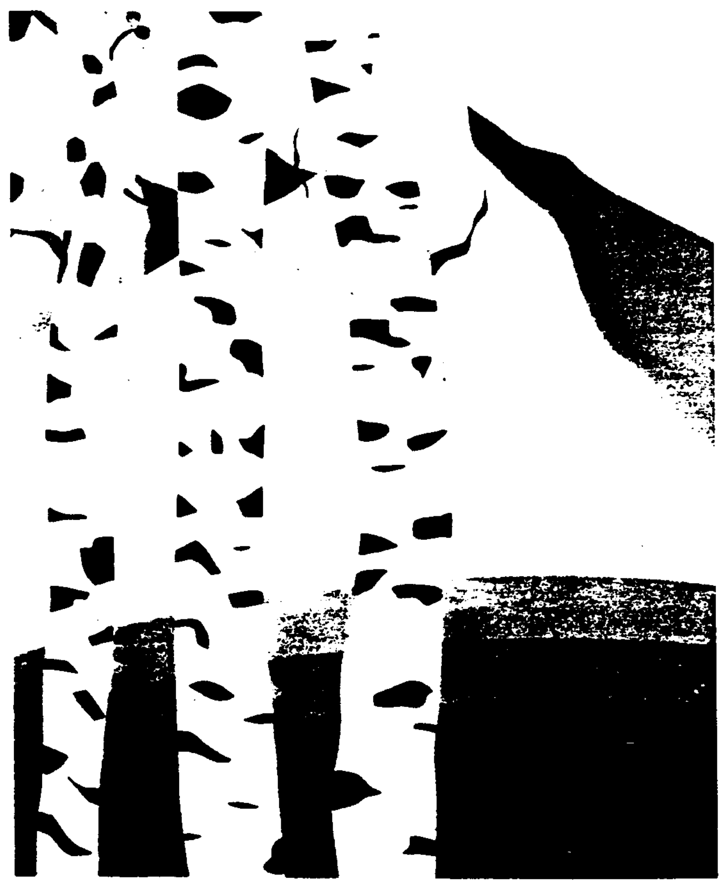


Figure 3

Riparian Resources

A Symposium on the Disturbances, Management, Economics, and Conflicts Associated with Riparian Ecosystems



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