Relationships Within the Valley Floor Ecosystems in Western Olympic National Park: A Summary

Jerry F. Franklin, Frederick J. Swanson, and James R. Sedell

ABSTRACT

The major findings of the South Fork Hoh River research team emphasize interrelationships among components of the Olympic valley-bottom ecosystems. Geomorphic structures provide the basic template for both terrestrial and aquatic communities. Vegetation has significant reciprocal impacts on geomorphic processes, however, and is a major element in formation of the most productive aquatic habitats. The South Fork pulse illustrates accomplishments possible with intense, short-term interdisciplinary research efforts and the valuable functions National Parks can perform as benchmark areas to compare with exploited land systems.

Other papers in this report consider geomorphology, forest communities, Roosevelt elk, and aquatic habitats and communities. There is some tendency to lose sight of the entire valley-bottom ecosystem in these more component-oriented presentations, however.

The objective in this paper is to racapitulate the major findings of the South Fork research pulse with an emphasis on interrelationships among various components and processes. We also suggest broader implications for Park management and point out how the Park is serving as a control or baseline site for interpreting man's impacts on adjacent managed landscapes and establishing guidelines for improved management. National Parks provide the rare opportunities to study natural, undisturbed, valley-bottom forests and river ecosystems.

Jerry F. Franklin and Frederick J. Swanson, U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station, Forestry Sciences Laboratory, 3200 Jefferson Way, Corvallis, Oregon 97331; and James R. Sedell, Weyerhaeuser Company, Forest Research Laboratory, 505 N. Pearl Street, Centralia, Washington 98531.

GEOMORPHIC RESULTS

Landforms can be viewed as the template on which the terrestrial and aquatic communities of the valley-bottom ecosystems develop. While geological processes determine the initial conditions, biological processes are significant modifiers. Vegetation-geomorphic interactions are particularly important in the cases of small streams and river bars and terraces which are entirely the interplay between vegetation and fluvial processes.

Woody debris creates some of the most conspicuous vegetation influences on geomorphic processes. Fluvial processes mobilize large amounts of woody debris, particularly by undercutting and uprooting trees on forested alluvial flats and higher terraces. Stabilized debris in the main river channel is important in setting up gravel bars, protecting pioneering vegetation from high flows and from buffeting by floated organic debris, and regulating flow into river side channels, thereby creating the especially productive off-channel aquatic habitat. Woody debris in off-channel and tributary habitats also provides physical stability (Swanson 1980), a diversity of biological habitats, and an ecosystem energy base both by retaining fine allochthonous material and directly through decomposition (Cummins 1980).

Four major categories of aquatic habitat are identifiable in river valleys: the main river channel with fast, turbid, silty water; river off-channel, such as side channels partially isolated from the main stream; terrace tributary, which is low gradient and generally carries clear, slow-moving water; and valley wall tributary, typically a high gradient stream with clear, fast water. Geomorphic, hydrologic, and vegetation factors combine to determine the basic types and arrangements of aquatic habitats.

AQUATIC RESULTS

Off-channel and terrace tributary habitats are of overwhelming importance for productivity of aquatic ecosystems of the South Fork and similar, broad, alluviated valleys in western Washington. These relatively protected sites have abundant, diverse food resources for both invertebrates and fish. Coho and cutthroat trout use these areas for rearing. Terrace tributaries provide important shelter when the main channel is in flood.

Glacial silt limits productivity of some parts of the main channel ecosystem, but not others. Primary production in fast water areas of the channel is severely limited by the scouring action of silt and fine sand being transported in suspension much of the year. Silt deposition in the few quiet water sites of the main channel prevents full utilization by invertebrates of these potentially very productive areas. Spawning is not greatly reduced by the fine sediment because hydraulic conditions prevent excessive accumulation in the major spawning sites where pools tail out into the heads of riffles.

Productivity of valley wall tributaries is limited by the extremes of high and low flows and the dense conifer overstory which reduces primary production by shading. Limited pool area and the difficulty of moving from pool to pool along these high gradient channels constrain use of valley wall tributaries by fish.

Large organic debris is an important factor in shaping microhabitats in each of these types of stream environments.

TERRESTRIAL RESULTS

The forest communities are strongly related to landform or geomorphic surface. Alnus rubra stands dominate youthful fluvial deposits and mature Picea sitchensis-Tsuga heterophylla forests occupy older, higher surfaces. In the study area, different Picea-Tsuga communities are formed on upper and lower terraces, although dominant trees on both terraces are approximately the same age and cannot be considered successionally related. The vegetation-landform model proposed for the main fork of the Hoh River (Fonda 1974) does not fit the South Fork, which probably reflects historical differences in timing and patterns of forest disturbances such as floods.

Mature valley-bottom Picea sitchensis-Tsuga heterophylla forests contrast with those found elsewhere in the coastal P. sitchensis zone of the Pacific Northwest (Franklin and Dyrness 1973). Stands, especially those on lower terraces, are open with relatively low density of above-ground biomass and numerous openings of up to a hectare or more. Picea is reproducing successfully, earning recognition as a climax tree species on these sites. While the relative success of Picea and Tsuga reproduction appear to have oscillated over the past century, there is no evidence that either is going to be replaced successionally. Grazing by Roosevelt elk is a factor that may favor survival of Picea reproduction over that of Tsuga, but grazing is almost certainly not the sole cause of variation in reproductive success. Wind and floods appear to be the major environmental factors disrupting these valley-bottom forests, while wildfire appears to be inconsequential.

Coarse woody debris is an extremely important structural feature of the terrace forests. Woody debris occupies much of the forest floor and contains large masses of carbon and nutrients. Reproduction of trees on older terrace surfaces is confined almost exclusively to rotten logs and associated stumps and root wads. Logs vary significantly in their value as nurseries depending upon log species, decay state, and terrace level. Forest renewal is dependent on seedbeds of coarse woody debris.

APPLICATIONS

The South Fork of the Hoh River appears to be the archetype of the western Olympic Mountain river valley ecosystem. Fluvial landforms and processes, mature Picea-Tsuga terrace forests, and valley-bottom aquatic habitats are well represented. The valley habitats have undergone minimal modification from adjacent mountain sideslopes and river tributaries in comparison with the other four major river valleys of the western Olympic Mountains. It therefore seems appropriate to manage and utilize the South Fork valley as a primary site for research on Olympic rainforests and associated streams.

Recognition that off-channel and terrace tributary habitats are aquatic hotspots and essential to anadromous fish in the Olympic river valleys has implications for managers inside and outside the Park. Park managers should locate trails, roads, and other developments so as to have minimum impact on these features. Resource managers outside the Park should appreciate the importance of providing off-channel and terrace tributary habitats with at least as much protection as the main channel. Rehabilitation of such habitats may be essential in areas where they have been destroyed by logging or road construction activities.

The significance of woody debris is further documented for both scientists and resource managers. Debris can now be seen to play important roles in larger streams and rivers, roles which must be accounted for by land managers in programs of riparian management and stream cleanup. The role of woody debris as critical seed bed in coastal forest types has implications on lands managed for timber production as well as on lands reserved from development.

CONCLUSIONS

The South Fork study demonstrates the use of a National Park and Biosphere Reserve as a benchmark site for scientific research and a control area for adjacent manipulated landscapes. The only remaining natural examples of river valleys in the coastal region are within Olympic National Park. The knowledge gained in the pulse study has extended our understanding of northwestern ecosystems to a distinctive variant (the rain forest) and a larger scale (river drainage).

Finally, the pulse in the South Fork of the Hoh River demonstrates the numbers and types of data that can be gathered by an interdisciplinary research team in a short time span. A successful project is based on substantial logistical planning and a balance between careful definition of objectives and ample opportunity to pursue promising leads and for serendipitous discoveries.

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