Natural and Logging Disturbances in the Temperate Rain Forests of the Central Coast, British Columbia

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Abstract

Natural disturbances create and maintain structural diversity and frame the spatial and temporal processes of ecosystems, in both forests and aquatic systems. Thus, they are the foundation for ecosystem-based management. However, the landscape patterns resulting from natural disturbances are poorly known in the coastal temperate rain forests of British Columbia, nor has the pattern of logging been documented in comparison. Further, coastal temperate rain forests are a diverse physiographic region comprising many geomorphic provinces. Geomorphic disturbances are somewhat spatially predictable, based on geomorphology. However, variations in patterns of wind disturbance with physiography are poorly understood. Finally, there is the practical question as to whether investigating natural disturbances is feasible using existing timber inventory information. Disturbance patterns over the past 140 years were investigated at the regional and local scales for the Central Coast of BC (approximately 1.5 million ha), using a combination of air photo interpretation and GIS timber inventory data bases. Wind disturbances were investigated in two other regions; the west coast of Haida Gwaii, to investigate the influence of geomorphic province on patterns on wind disturbance; and the 1906 wind storm on the east side of Vancouver Island, to compare patterns observed in other regions with those of a known storm event and to the test methods for detecting wind disturbances.

At the regional scale, young/mature forest (< 140 years old) comprised 3.1% of the forested area. The majority of forest was old growth, late successional forest > 140 years old. Stand-replacing disturbances were rare, with a rotation period of 4,400 years. With

respect to disturbance type, wind disturbances were rare, comprising 0.3% of forested area. The remaining natural disturbance patches was equally divided between geomorphic disturbances (1.4% forested area) and fire (1.3% forested area), although spatial distributions varied. Wind and geomorphic events were dispersed over the study area, while fire was confined to one watershed. Logging affected 5.4% of the forested area, with one-third of that area historic logging not recorded in the GIS data base. Half the logging has occurred in the past 20 years, with the remaining half over 120 years. Patterns of stand-replacing wind disturbances varied between physiographic regions. They were present in productive forest types in the Hectate Lowland and the west coast of Haida Gwaii, but absent in the Coast Mountain watersheds. In all cases, including the 1906 storm event, extent was small, < 5% of forested area.

At the watershed scale, natural disturbances were evenly distributed between valley bottoms and uplands, 6% of forested area in each case. Logging, however, was disproportionately concentrated in valley bottoms (81 $\pm$ 4%). On average, 59% of the valley bottom areas were logged, often as one contiguous patch, with a rotation period 20 times higher than that of natural disturbances. None of these contrasting patterns were evident without considering their spatial context as logging affected a small area of each watershed (12 $\pm$ 4% of forested area). With respect to disturbance processes in the riparian zone, debris flows and avalanches were common in watersheds, usually reaching the main channel. For large (> 20,000 ha) watersheds, 53 $\pm$ 4% the valley bottom area consisted of active floodplain, and 71 $\pm$ 15% of the active floodplain area was associated with anastamosing and braided channels.

There are several implications for ecosystem-based management from the results of this study. Current logging patterns are not within the range of natural variability for extent, frequency, patch size or spatial distribution, especially in the valley bottoms of watersheds. Thus to minimize further impacts to ecosystem function, any future harvest activities need to retain the old-growth matrix and minimize creation of young forest patches, especially in valley bottoms where the matrix has already been considerably altered. Given the evidence for the extent of unstable channel types in larger watersheds,

the natural meander of rivers may extend to historic as well as contemporary fluvial landforms in valley bottoms, and they may need to be protected in their entirety so as to not interfere with natural disturbance patterns. Valley bottoms of watersheds, including alluvial floodplain forests, need to be a conservation and restoration priority, especially for larger watersheds with the most complex alluvial floodplain development. They have been the most modified by past practices and are well recognized as the keystone ecosystem for biodiversity in coastal temperate rain forests. Finally, information about disturbance patterns at the landscape scale relevant to ecosystem-based management can be determined from readily available data sources, air photos and GIS timber inventory data bases.