

The History and Advancement of Change Detection Methods in Forest Hydrology

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Eighty-seven years after the first *paired*-catchment study at Wagon Wheel Gap, Colorado, forest hydrologist and natural resources managers are still working to understand the effects of forest management practices on hydrology and water quality. The highly variable nature of catchment responses to disturbance, whether it be harvesting, fire, insect and disease, or species replacement, depends on catchment scale, climate, forest type, geology, topography, as well as variability in harvest location, harvest type, vegetation type, and measurement error. Decades of field and experimental research has been conducted to evaluate the effects of disturbance on many different watershed attributes and many different analysis methods have been developed and employed to answer this question.

The first catchment studies were conducted during the later nineteenth century in Western Europe. Early studies were based on comparisons of watersheds with different forest covers irrespective of different physical processes, and researchers were not yet able to quantitatively describe relationships between different catchments. Many of these studies were based on observational data, without the benefit of modern statistical analysis to explain similarities and variations between study catchments. Ultimately, researchers were unable to discern if forest management practices impacted hydrology.

Statistical pairing of catchments offers the ability to identify respective roles of forest cover, internal watershed behavior, and climate variability between different catchments, establishing a “baseline” for reference, leading to the paired-catchment study design (Hewlett and Pienaar, 1973). The first true paired-catchment experiment took place at Wagon Wheel Gap in southwestern Colorado. The objective of this study was to quantitatively evaluate the effects of harvesting on the timing and volume of streamflow, erosion, and sediment (Bates, 1921).

Since the Wagon Wheel study, the paired-catchment design has been used world-wide as a method for discerning the effects of resources management on hydrology and water quality (Bosch and Hewlett, 1982; Brown et al., 2005). More recently, field catchment studies have been supplemented with numerical simulations from hydrologic models to reduce temporal and spatial variability in paired-catchment studies and infer process-level changes in catchment behavior (Zegre, 2008).

References

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