

## Woodland clearance alters geomorphic, hydrologic, and pedogenic drivers of ecosystem services: examples from the southern Blue Ridge (USA) and the French western Pyrenees Mountains

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The southern Blue Ridge (USA) and French western Pyrenees both are humid-temperate mountains where native woodlands have been cleared on soils formed in residuum and colluvium on hillslopes. Forest removal increased rates of erosion and sediment yield that drove both negative and positive ecosystem services. For example, the supportive ecosystem service of soil formation was diminished on eroded hillslopes, but may have been enhanced by accumulation of sediment on bottomlands far downstream from the highland source areas. Negative effects on provisional ecosystem services (e.g. water supply) resulted in aggraded bottomlands by increasing the depth to the water table. Legacy effects linger on hillslopes that reforested (diminished soil properties), and ongoing alteration of pedogenic and hydrologic processes affect pastures that persisted from cleared woodlands. Beyond those general similarities, pastures of the two regions exhibit very different pedogenic pathways and ecosystem service outcomes. Soils of the Blue Ridge pastures adhere to a typical degradation scenario of erosion, compaction, and reduced infiltration capacities, whereas Pyrenees pastures exhibit soil qualities trending in the opposite direction and arguably now are better quality soils than their forested predecessors. Major differences in temporal duration and management styles apparently have led to such contrasts in soil quality. The Blue Ridge pastures are only tens to hundreds of years old, whereas Pyrenees pastures are thousands of years old. Blue Ridge pastures are maintained by mowing with tractors and year-round grazing primarily with beef cattle, whereas Pyrenees pastures (outfields) lack tractors and are only grazed seasonally (summer), primarily with sheep. Fire is rarely used as a management tool in the Blue Ridge, while Pyrenees pastures frequently are burned. Such management practices, and their influence on pedogenic and hydrologic processes, generally have resulted in negative ecosystem services in the Blue Ridge (degraded soils and water holding capacity) versus some positive ecosystem services in the Pyrenees. That is, the soils of the Pyrenees pastures store more carbon and provide equal or better water infiltration and storage capacity than their native forested predecessors, while that is not the case in the Blue Ridge. Stratigraphic proxies from colluvial deposits in the Pyrenees attest to a past when the management practices were erosional and degradational, (within the Bronze Age through Roman times), but more recent management practices appear to be sustainable and have resulted in improved soil quality. Both mountain ranges share some negative impacts, but the Pyrenees offer an example of anthropic landscape conversion where certain pedogenic and hydrologic processes have been enhanced and result in some positive ecosystem services and sustainable outcomes.