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Ford, Chelcy R., Stephanie H. Laseter, Wayne T. Swank, and James M. Vose. 2011. Can forest management be used to sustain water-based ecosystem services in the face of climate change? Ecological Applications 21:2049–2067. http://dx.doi.org/10.1890/10-2246.1

Articles

Can forest management be used to sustain water-based ecosystem services in the face of climate change?

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Forested watersheds, an important provider of ecosystems services related to water supply, can have their structure, function, and resulting streamflow substantially altered by land use and land cover. Using a retrospective analysis and synthesis of long-term climate and streamflow data (75 years) from six watersheds differing in management histories we explored whether streamflow responded differently to variation in annual temperature and extreme precipitation than unmanaged watersheds.

We show significant increases in temperature and the frequency of extreme wet and dry years since the 1980s. Response models explained almost all streamflow variability (adjusted $R^2 > 0.99$). In all cases, changing land use altered streamflow. Observed watershed responses differed significantly in wet and dry extreme years in all but a stand managed as a coppice forest. Converting deciduous stands to pine altered the streamflow response to extreme annual precipitation the most; the apparent frequency of observed extreme wet years decreased on average by sevenfold. This increased soil water storage may reduce flood risk in wet years, but create conditions that could exacerbate drought. Forest management can potentially mitigate extreme annual precipitation associated with climate change; however, offsetting effects suggest the need for spatially explicit analyses of risk and vulnerability.

Key words: climate, Coweeta basin, southern Appalachians, USA, drought risk, forest management, land use, paired watershed, precipitation, streamflow, warming, water supply

Received: November 22, 2010; Revised: February 18, 2011; Accepted: February, 23, 2011

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Cited by

Saskia L. van de Gevel, Justin L. Hart, Mark D. Spond, Philip B. White, Megan N. Sutton, Henri D. Grissino-Mayer. (2012) American chestnut (*Castanea dentata*) to northern red oak (*Quercus rubra*): forest dynamics of an old-growth forest in the Blue Ridge Mountains, USA. *Botany* **90**:12, 1263-1276
Online publication date: 1-Dec-2012.
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