

## Western Ecological Research Center

# Publication Brief for Resource Managers

**Release:**  
May 2005

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## Forest Turnover Rates and Forest Productivity Vary in Parallel

Forests provide humans with economically important and often irreplaceable products and services, and affect global climate by acting as sources and sinks of heat-trapping carbon dioxide. Yet the possible responses of forests to ongoing environmental changes are poorly understood. In a recent article published in *Ecology Letters*, USGS scientists Drs. Nate Stephenson and Phil van Mantgem show that birth and death rates of trees vary in parallel with global and regional patterns of forest productivity.

In less productive forests, such as coniferous forests growing at high latitudes, a century or more can pass before half of all trees die and are replaced with new growth. In contrast, in the world's most productive forests — tropical forests growing on fertile soils — half of all trees die and are replaced by new growth in only thirty years. Similar patterns appear at much smaller spatial scales. Over a 1900-meter elevational gradient in the Sierra Nevada of California, turnover rates of coniferous forests vary by almost a factor of four.

Faster turnover of trees means that more productive forests may also be those likely to respond most rapidly — positively or negatively — to environmental changes. Thus, managers wishing to establish forest monitoring programs for change detection may wish to devote extra effort toward monitoring their most productive forest types.

Much emphasis has been placed on the possibility that forest die-offs will be triggered by environmental changes that reduce forest vigor — such as climatic drying. Stephenson and van Mantgem's study suggests that forests may also be affected by environmental changes that are generally thought to increase forest

### Management Implications:

- More productive forest types may be quicker to respond to environmental changes than less productive forest types. This may be particularly relevant to the design of monitoring programs for change detection.
- Environmental changes that increase forest productivity (e.g., nitrogen deposition or certain climatic changes) may also increase forest turnover rates, with the potential for cascading effects on wildlife, biodiversity, and forest carbon storage.

vigor and productivity — such as nitrogen deposition and increasing precipitation. Specifically, environmental changes that lead to increased forest productivity may also lead to increased forest turnover rates (birth and death rates), which in turn may have cascading effects on other properties of forest ecosystems. For example, increased forest turnover might lead to forests that are more heavily dominated by younger and smaller trees, which in turn could affect wildlife populations and biodiversity.

Additionally, increased dominance by younger and smaller trees can lead to changes in forest carbon storage. Given the central importance of forests to the global carbon cycle (hence global climatic change), and the increasing importance of carbon storage to international treaties and trading of carbon credits, it is important to develop a solid understanding of the relationships among forest productivity, turnover, and carbon storage.

*Stephenson, N. L., and P. J. van Mantgem. 2005. Forest turnover rates follow global and regional patterns of productivity. Ecology Letters 8:524–531.*