

Transformative, continued from page 21

**Woody plant encroachment:** Large tracts of grasslands and savannas have been converted to woodlands through a process often described as woody plant encroachment. These conversions result from a combination of factors, including overgrazing, reduction in fire frequency, and increases in greenhouse gases. They are likely to significantly affect the water cycle in terms of ecological processes and distribution of water across the landscape. In addition, there is good evidence that a shift from grasses to shrubs diminishes groundwater recharge—although not to a degree important for water supply. Little if any evidence suggests that woody plant encroachment has led to large-scale changes in streamflow, except

where it is accompanied by degradation or desertification. Surface runoff and erosion will be significantly higher under degraded than nondegraded conditions. For example, Wilcox and others (2008) demonstrated that floods in west Texas in the earlier part of the last century were much greater than now because rangelands were much more degraded.

### Looking Ahead

Understanding and mitigating the effects of transformative landscape change will dominate and transform land and watershed management in the future. The rich and diverse legacy of research into the relationship between vegetation management and water yields will provide a solid foundation for building new strategies to meet these future challenges.

Contact Brad Wilcox at [bwilcox@tamu.edu](mailto:bwilcox@tamu.edu).

### References.....

National Academy of Sciences, 2008. *Hydrologic Effects of a Changing Forest Landscape*. Committee on Hydrologic Impacts of Forest Management, 194 pp, National Academies Press, Washington D.C.

Potts, D.F., 1984. *Hydrologic impacts of a large scale mountain pine beetle (Dendroctonus ponderosae Hopkins) epidemic*, *Water Resour. Bull.*, 20(3): 373-377.

Rood, S.B., J. Pan, K.M. Gill, and others, 2008. *Declining summer flows of Rocky Mountain rivers: Changing seasonal hydrology and probable impacts on floodplain forests*, *J. Hydrology*, 349: 397-410.

Stewart, I., D.R. Cayan, and M.D. Dettinger, 2004. *Changes in snowmelt runoff timing in western North America under a "business as usual" climate change scenario*, *Climatic Change*, 62(1-3): 217-232.

Wilcox, B.P., Y. Huang, and J.W. Walker, 2008. *Long-term trends in streamflow from semiarid rangelands: Uncovering drivers of change*, *Global Change Biology*, 14(7): 1676-1689.

## Business Directory



**TAM INTERNATIONAL**

*To discuss your questions and applications, call*  
**1-866-314-9139**

Tel: 1-618-281-9416  
Fax: 1-618-281-9473  
[www.tamintl.com/hydrological](http://www.tamintl.com/hydrological)

**Inflatable Packers**

Applications include:

- Hydrological Testing
- Injection/Withdrawal
- Standard/Custom Sizes/Materials
- Water/Mining/Environmental
- Grouting/Sampling/Geotechnical
- Hydrofracturing
- Recirculation Wells
- Steam Injection
- Reline Casing

Same Day Shipping

**Downhole Flow Control Valves for Aquifer Storage & Recovery**

- Reliable, cavitation free, sand resistant performance
- 2 to 12 inch and larger pump column pipe sizes

**Inflatable Packers**

- Standard & Custom for all applications
- 100 to 7,000 psi; 1-1/2 to 60 inch holes

**Baski, Inc.**    [www.baski.com](http://www.baski.com)    [info@baski.com](mailto:info@baski.com)  
Ph. 303 789-1200 or 800 552-2754    Fx. 303 789-0900  
**1586 South Robb Way, Denver, Co 80232 USA**



**john j ward, rg**  
*groundwater consultant*

---

- water supply
- peer review
- expert witness

- water rights
- litigation support
- due diligence

Tucson AZ

phone: (520) 296-8627  
cell: (520) 490-2435

email: [ward\\_groundwater@cox.net](mailto:ward_groundwater@cox.net)  
web: [www.wardgroundwater.com](http://www.wardgroundwater.com)

Native Trout, continued from page 27

Apache trout metapopulation (see map, page 26). The plan requires removal of some existing barriers and construction of a new barrier farther downstream on the West Fork, thereby increasing Apache trout habitat within the streams from 33.4 to 53.1 km. Although some downstream habitat may be warmer during summer, it will also contain deep, shaded pools that offer cooler refuges.

The new barrier will help isolate downstream non-native fishes from Apache trout. Non-native trout likely will have to be removed from the upstream area by chemical treatment. Regular stream monitoring will be needed to determine the relative status of native and non-native species as well as the effectiveness of barriers and control treatments.

State, federal, and tribal agencies typically lack sufficient funding to restore needed interconnected metapopulations such as in the West Fork of Black River. For Apache trout, the National Fish and Wildlife Foundation, Trout Unlimited, and other nongovernmental groups are providing additional support to create a few larger interconnected stream systems that complement existing recovery programs. These efforts may afford the best opportunity for native southwestern trout to survive a future that is past peak water.

Contact Jack Williams at [jwilliams@tu.org](mailto:jwilliams@tu.org).

### References.....

Hilderbrand, R.H., and J.L. Kershner, 2000. *Conserving inland cutthroat trout in small streams: How much habitat is enough?* *North Amer. J. of Fisheries Management*, 20: 513-520.

Hoerling, M., and J. Eischeid, 2007. *Past peak water in the Southwest*, *Southwest Hydrology*, 6(1): 18-19, 35.

Probst, D.L., K.B. Gido, and J.A. Stefferud, 2008. *Natural flow regimes, nonnative fishes, and native fish persistence in arid-land river systems*, *Ecol. Applic.*, 18(5):1236-1252.