

There are a number of points in the *State Water Supply Enhancement Plan* (2014) (hereafter referred to as *the Plan*) with which we agree. (1) We agree that Texas faces very serious water supply challenges in the future, particularly during the inevitable drought periods. (2) We agree that extensive portions of the State that once were grasslands and savannas are now woodlands. (3) We agree that managing brush or woody plants potentially provides many benefits—including increased forage production, richer biodiversity, improved wildlife habitat, and rejuvenation of small springs. For these reasons, brush management is an indispensable practice on Texas rangelands. **However, we fundamentally disagree with the Plan's underlying tenet that brush management is a viable strategy for increasing water supplied from Texas rangelands.** The weight of scientific evidence, as highlighted in several recent reviews (e.g. National Academy of Sciences 2008), is quite clear that there is little support for this assumption.

Evidence presented in the Plan in support of the assumption that brush management will enhance water supplies is equivocal and does not acknowledge much of the research conducted over the past decade. Further, the Plan relies heavily on reports that have not been published or vetted in peer-reviewed journals. We contend that based on the current understanding of rangeland hydrology (Huxman et al. 2005, Shafroth et al. 2010, Archer et al. 2011, Moore and Heilman 2011) that a more appropriate tenet would be that brush management will NOT increase water yields.

With respect to Texas, considerable research has been done in the last ten years by a number of scientific teams. None of these studies has provided the slightest evidence that brush management is a viable strategy for increasing water supplies. Because most of these studies were not mentioned in the Plan, we briefly summarize below the key findings of recent research in three major rangeland areas: the Rolling Plains, the Edwards Plateau, and South Texas. In addition, we summarize findings of recent work related to invasive shrubs in riparian zones. More detailed reviews can be found in various scientific reports, the most recent and comprehensive being Archer et al. (2011).

For the Rolling Plains region, there is solid evidence that brush control will not increase water supply. The scientific evidence for this conclusion is very strong and consistent across many studies (Carlson et al. 1990, Dugas and Mayeux 1991, Wilcox 2002, Wilcox et al. 2006a). Ironically, the strongest evidence comes from the North Concho Project, cited in the Plan as a success story. The North Concho Project has been one of the more comprehensive and coordinated brush-control efforts in Texas. Between 2000 and 2005, about 1200 km² of the 3100-km² watershed was cleared of both mesquite and juniper in the hope of increasing flows. As highlighted by Saleh et al. (2009), water planners were projecting that flows in the North Concho would increase three- to fivefold as a result of this \$14 million program. However, not only has there been no perceptible increase in flow in the North Concho to date, there may even have been declines since the brush-control program

was implemented. This important finding, well-documented in the scientific literature (Wilcox et al. 2008, Wilcox et al. 2010), was not noted in the Plan. In spite of the obvious failure of this project, TSSWCB continues to inappropriately market the North Concho Project as a success story.

The situation in the Edwards Plateau is more complicated. Indeed, there is good evidence that at small scales shrub clearing has led to decreases in interception and evapotranspiration and increases in flow from small springs and seeps (Huang et al. 2006, Owens et al. 2006, Wilcox et al. 2006b, Heilman et al. 2009). However, other studies examining both streamflow and cave recharge following brush clearing have found no changes (Wilcox et al. 2005, Gregory et al. 2009, Bazan et al. 2013). More significantly, a recent study (also ignored in the Plan) clearly documents that at broad scales, streamflow has increased at the same time that brush cover has increased—calling into question the viability of removing shrubs to further increase streamflow (Wilcox and Huang 2010). The reasons for these apparently contradictory findings are complex but appear related to the fact that infiltration rates in shrubland soils are higher than those in overgrazed grassland soils. In other words, in spite of popular perceptions to the contrary, increases in woody plants have not caused streamflow in the Edwards Plateau to decline but in fact have contributed to higher streamflows. In summary, at this time there is no evidence that water supply in the Edwards Plateau region can be increased via shrub control.

The one area of Texas rangeland where measurable water-yield gains may be achieved through brush management are the shrublands and woodlands overlying the Carrizo Wilcox Aquifer in South Texas. In this area, because of the deep and sandy soils, both water and tree roots may penetrate to great depths. As shown in one study, the removal of trees and shrubs may result in increased groundwater recharge during wet years, but these increases are modest and short-lived (Moore et al. 2012). Thus, brush management as an economically viable strategy for increasing water yield in this region, while meriting additional research, appears unlikely.

The Plan further suggests that clearing of invasive riparian vegetation (salt cedar and Russian olive) also offers the opportunity for water salvage. This notion is consistent with the results of some earlier work (including our own) (Wilcox et al. 2006b). However, recent comprehensive and high-level scientific reviews provide compelling evidence that there is little opportunity for increasing water supplies through removal of these shrubs (Shafroth et al. 2010, Doody et al. 2011). These conclusions have been largely verified in Texas where salt cedar was eradicated along 60 river miles of the Pecos River between 1999 and 2001. Yet, to date there is no scientific evidence of any measureable influence on streamflow in the Pecos (McDonald et al. 2013).

Because it has yet to be demonstrated that large-scale brush management can increase water yields, the Plan is asking that modeling analysis be used to justify brush management. We have nothing against models and use them in our own work; but we caution that modeling results can be, and have been in the past, quite

misleading if not just plain wrong in their projections. The best (or worst) example of this is the SWAT model that projected a fivefold increase in the streamflow of the North Concho River following brush clearing (Saleh et al. 2009). Modeling results are but one perspective and should not supersede other evidence that brush management will not result in increases in water supply. Further—models can be easily manipulated to produce the desired results.

The scientific evidence is overwhelming that shrub control will NOT increase water supply in Texas. Scientists at Texas A&M and Texas AgriLife Research have been at the forefront of this research and have published their results in highly respected scientific journals. None of these results have been challenged or disputed and have been largely accepted in the general scientific community. Further, two large-scale shrub-clearing projects have already been carried out in Texas (North Concho River, Pecos River), both funded by federal and state sources, on the premise that they would increase water supply. But in both cases, these projects have been a bust in terms of any measurable increases in water.

For these reasons, we argue that the feasibility studies called for in the Plan would not be an effective strategy for dealing with the real and serious water challenges in Texas. As such, we believe the Plan as currently designed is a poor use of taxpayer money and we recommend that it not go forward.

Again, we reiterate: brush management is an indispensable practice on Texas rangelands and it may be appropriate for local, state, and federal governments to provide assistance—both technical and financial. However, it strikes us as disingenuous and misleading to make an argument to Texas taxpayers that there is reason to expect that brush management will improve water supply in Texas. This simply is not the case.

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