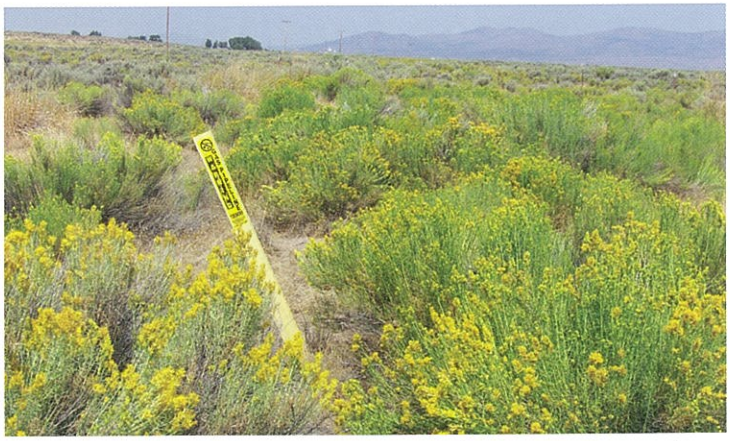
stretch of gas pipeline right-of-way along Highway 395, between Susanville and Alturas. He says his work in 1993 resulted in native areas that remain 95% free of the cheatgrass that otherwise surrounds the area, and that his original test plot site has been permanently preserved as a BLM Natural Study Area. He is traveling to Nevada later this year to provide workshops sharing his approach to controlling cheatgrass in the Great Basin.

Another of Dremann's favorite accomplishments is the property owned by Michael Shaw south of Santa Cruz, where 70 acres of grasslands have "gone from 99% weed cover in 1992 to 95% natives today, with over 100 native plant species reappearing, including two new to science." The Shaw project was published as the cover story in the June 2002 issue of the journal *Ecological Restoration*.

On the other end of the spectrum, Dremann is frustrated with what he describes as failures to restore habitat, especially grassland habitat that has been designated as critical for endangered species. Grassland work has persisted on San Bruno Mountain, site of the nation's first HCP in 1982 to protect the Mission blue butterfly, without much progress in his eyes. Similarly, he says that actions taken to restore the endangered Santa Cruz tarplant on the coast — burning, scraping and grazing — have not brought the plant back in significant numbers after 30 years of management.

If Dremann's methods are potentially more effective than business-as-usual restoration, why are they not more widely adopted in public land management? Dremann sees a potential bias in government agencies toward traditional sources of knowledge, like academia, and says that they are risk-adverse to trying something new.

Dremann has an unusual presentation style for ecological concepts. Take his image of "zombie ecosystems," in which native species have stopped reproducing. By studying the "age pyramids" of individual plants within populations, he suggests that most populations of species such as Great Basin wild rye in Nevada and galleta grass in New Mexico stopped producing seedlings decades ago when soil nutrient levels dropped below the threshold required for seedling survival of those plants. Likewise, many of California's oak woodlands are producing few seedlings, despite abundant acorns.



Revegetation along the 100-mile Tuscarora gas pipeline in Lassen County, where Dremann addressed the cheatgrass problem with local native grass seeds, fertilizers and sawdust. "Twenty-five years later," he says, "local shrubs have moved in, producing a beautiful, diverse, 95% weed-free Great Basin sagebrush habitat." Photo: Craig Dremann

Another subject that Dremann thinks we should be watching closely is the study of bio-precipitation, an active area of research in atmospheric science. Bacteria blown into the atmosphere become nuclei for ice as part of the process of raindrops forming. Researchers have found that high percentages of snow start with biological ice nucleation.

The main biological agent associated with rain forming has been *Pseudomonas syringae*, better known as a crop pathogen. These bacteria have the ability to cool vapor into precipitation at warmer temperatures than do dust and salt particles. Fungi in the *Fusarium* genus are now being found to play a similar function when they contribute aerosol particles to the atmosphere.

Dremann worries about how the elimination of native grassland and native vegetation understory in California may contribute to increasingly frequent drought. We don't know which of our thousands of native plant species are host plants for *P. syringae*, but Dremann maintains that it's likely that vegetation management impacts precipitation, and warns that we should attend to this if we don't want to "end up like Anasazi or Indus Valley civilizations" that declined due to extended drought.

To learn more about Craig Dremann and his work, visit *www.ecoseeds.com/sagefix* where you can see his eight steps toward rangeland success, a link to his fertilizer protocol, and the program for his 2019 "SageFix" workshops in Carson City, NV. Craig sets up workshops anywhere in the West where there is demand. Contact him if interested at *rwc-seed@batnet.com*.

EXTRACTABLE NUTRIENTS

Test	Result	Sufficiency Factor
Available-N	61 ppm	0.3
Phosphorus (P) - Olsen	92 ppm	0.7
Potassium (K)	143 ppm	0.3
Potassium - sat. ext.	0.4 meq/L	
Calcium (Ca)	3087 ppm	0.8
Calcium - sat. ext.	2.6 meq/L	
Magnesium (Mg)	682 ppm	1.3
Magnesium - sat. ext.	1.3 meq/L	
Copper (Cu)	4.1 ppm	1.4
Zinc (Zn)	23 ppm	2.1
Manganese (Mn)	6 ppm	0.3
Iron (Fe)	150 ppm	1.4
Boron (B) - sat. ext.	0.20 ppm	0.7
Sulfate - sat. ext.	1.3 meq/L	0.4
Exch Aluminum		

SOIL TEST RATINGS: Very Low | Low | Medium | Optimum | Very High

NO3-N: 13 ppm

NH4-N: 48 ppm

Total Exchangeable Cations(TEC): 215 meq/kg

Cu, Zn, Mn and Fe were analyzed by DTPA extract.

Soil nutrient report from Waypoint Analytical in San Jose. Craig Dremman uses their A17 package, specifying "data only in bar graph."