UC Agriculture & Natural Resources
California Agriculture

Title
Research highlights

Permalink
https://escholarship.org/uc/item/68h3z6qn

Journal
California Agriculture, 73(2)

ISSN
0008-0845

Author
Crowder, Lucien

Publication Date
2019

DOI
10.3733/ca.2019a0003

Copyright Information
Copyright 2019 by the author(s).This work is made available under the terms of a Creative Commons Attribution-NonCommercial-NoDerivatives License, available at https://creativecommons.org/licenses/by-nc-nd/4.0/

eScholarship.org Powered by the California Digital Library
University of California

Research highlights

Recent articles from the Agricultural Experiment Station campuses and UC ANR's county offices, institutes and research and extension centers.

Potential improvements to reforestation practices identified

Online: https://doi.org/10.3733/ca.2019a0003

In many forests in the western United States, increasingly frequent and severe wildfire and drought have hindered capacity for successful forest reforestation. Efforts to re-establish forests are often complicated by challenges such as high mortality rates for seedlings and saplings amid water stress and repeat fire events. Standard reforestation practices center on establishing dense conifer cover through gridded planting, followed by shrub control and pre-commercial thinning. These intensive management practices are increasingly constrained by factors such as shrinking budgets for, and work forces on, public lands. A team drawn from the Department of Plant Sciences at UC Davis and the Department of Environmental Science, Policy and Management at UC Berkeley assessed recent research into reforestation practices in the western United States, examining which practices might benefit from adjustment. They specifically examined whether replantings characterized by regular tree spacing increase the risk of future mortality. They also examined how the density, spatial arrangement and species composition of replantings might be modified to foster greater survival amid recurring fire and drought. The authors suggest that large areas of contiguous tree mortality can most productively be replanted in three distinct zones: a peripheral zone near sources of live tree seeds, where regrowth depends on natural recruitment; a second zone, beyond effective seed dispersal but nonetheless accessible, where both regularly spaced and clustered seedlings are planted in patterns varying with water availability and potential fire behavior; and a third zone on steep, remote terrain where reforestation efforts are limited, in practice, to establishing founder stands. The authors also recommend that prescribed fire be employed in reforested areas to build fire resilience in developing stands.


Malcolm North/U.S. Forest Service

Burned and logged forests have traditionally been replanted with pine seedlings planted on a regularly spaced grid (*top*, at 50 years old), which does not develop the mature forest clump and gap spacing (*bottom*) that historically was produced by frequent low-intensity fire, a pattern associated with forests resilient to drought and wildfire.

North MP, Stevens JT, Greene DF, et al. 2019. Tamm review: Reforestation for resilience in dry western U.S. forests. Forest Ecol Manag 432:209–24. https://doi.org/10.1016/j.foreco.2018.09.007

Local reforestation program plays key role in landowner decisions after devastating fire

Amid increasingly severe wildfire and the growing threat of climate change, California's Forest Carbon Plan identifies reforestation as one means of carbon sequestration and climate mitigation. Researchers from the Department of Environmental Science, Policy and Management at UC Berkeley and from UC Cooperative Extension (UCCE) interviewed 27 owners of nonindustrial forest land whose properties had burned in a 2014 wildfire in the central Sierra — and who were eligible to participate in a program offered by the nearby resource conservation district, a locally governed entity charged with providing tools and technical assistance to protect land and water resources. The interviews were designed to gain insight into landowners' perceptions of burned forest land; their vegetation management decisions after the fire; and their experiences with programs that provide reforestation assistance. Many landowners reported that fire-related landscape changes had provoked an intense, lasting emotional reaction in them. All respondents reported that they had wanted to reforest their land but one-third reported that they would not have done so if the resource conservation district had not offered a free reforestation program. Though many respondents recognized the value of replanting for purposes of climate mitigation, few considered the possibility that adapting


Marc Meyer, U.S. Forest Service

reforestation prescriptions could provide climate benefits. The authors suggest that reforestation projects for climate change mitigation should also include outreach emphasizing the benefits that climate-adapted forest management practices confer on efforts to maintain and enhance resilience in the face of climate change.

Waks L, Kocher SD, Huntsinger L. 2019. Landowner perspectives on reforestation following a high-severity wildfire in California. J Forest 117(1):30–7. https://doi.org/10.1093/jofore/fvy071



Performing genetic analysis of chinook salmon in Oregon's Rogue River, UC Davis scientists found a robust association between migration phenotype (spring run or fall run) and a single genetic locus. A dramatic change in allele frequency at this locus explained the rapid phenotypic shift that researchers observed after a recent dam construction.

Loss of spring-run chinook salmon is rapidly followed by loss of potential for recovery

Phenotypes are the overall observable characteristics of individual organisms. Variation in phenotype is crucial if species and populations are to persist over the long term, but human activity has substantially shifted and reduced phenotypic variation across many taxa. The underlying mechanisms (genetic or environmental) and long-term consequences of such shifts, however, are often unclear. UC Davis researchers including Tasha Thompson, Sean O'Rourke and Michael Miller of the Department of Animal Science investigated widespread changes, caused by dam construction and other anthropogenic activities, in the adult migration characteristics of wild chinook salmon. Performing genetic analysis of chinook salmon in Oregon's Rogue River, they found a very robust association between spring-run or fall-run migration phenotype and a single genetic locus. Further, they found that a dramatic change in allele frequency at this locus explained a rapid phenotypic shift observed after recent dam construction. The researchers' modeling suggests that continued selection against the spring-run phenotype could lead to rapid and complete loss of the spring-run allele. Meanwhile, the researchers' empirical analysis of chinook salmon populations that have already lost the spring-run phenotype indicates that these populations are not acting as sustainable allele reservoirs. Analysis of ancient DNA suggests that the spring-run allele was once abundant in a Northern California habitat that will soon become accessible to fish through a large-scale dam removal project, but the researchers report that re-establishment of the spring-run phenotype in this restoration project (and others) will struggle to overcome widespread declines in, or extirpation of, the spring-run phenotype and allele. These results indicate that, without conservation action, human activities can eliminate important adaptive variation as well as the potential to recover it.

Thompson TQ, Bellinger MR, O'Rourke SM, et al. 2019. Anthropogenic habitat alteration leads to rapid loss of adaptive variation and restoration potential in wild salmon populations. P Natl Acad Sci USA 116(1):177–86. https://doi.org/10.1073/pnas.1811559115

Large amounts of organic carbon stored in deep alluvial soils

Active floodplains are thought capable of storing large amounts of organic carbon in subsoils that, originating from erosion within the floodplain's watershed, were subsequently deposited in the floodplain. Researchers including Kristin Steger, then of the Department of Viticulture and Enology at UC Davis, and Joshua Viers of the School of Engineering at UC



Results from a study conducted in a floodplain of the lower Cosumnes River suggest that alluvial soils in floodplains store large amounts of carbon for which global carbon models do not account.

Merced conducted a study to assess organic carbon pools in alluvial floodplain soils that are affected by human-induced changes in floodplain deposition and land use. The researchers took and evaluated 33 soil cores in the lower Cosumnes River — 23 soil cores 3 meters in depth and 10 cores 7 meters in depth. They estimate that approximately 59% of the organic carbon in the 7-meter profiles was stored in the top 2 meters. Their data indicates that use of arable land has already altered the stable isotopic signature in the top meter. The researchers' radiocarbon dating and their analysis of soil mercury content indicate that overlaying soils in the cores underwent a substantial sedimentation phase as a result of upstream hydraulic gold mining beginning in the 1850s. The authors report that deep alluvial soils in floodplains store large amounts of organic carbon for which global carbon models do not account, representing a shortcoming in our understanding of human-induced interference in carbon cycling.

Steger K, Fiener P, Marvin-DiPasquale M, et al. 2019. Human-induced and natural carbon storage in floodplains of the Central Valley of California. Sci Total Environ 651(1):851–8. https://doi.org/10.1016/j.scitotenv.2018.09.205

Emissions from California sheep production quantified

Amid concerns over animal agriculture's contributions to global warming, the greenhouse gas emissions of U.S. livestock production systems have been the subject of considerable research. The environmental impact of U.S. sheep production, however, had never been studied through life cycle assessments and with a case study methodology. A team of researchers from the Department of Animal Science at UC Davis, UCCE and the UC ANR Hopland Research and Extension Center conducted a life cycle assessment that analyzed five meat sheep production systems in California, the nation's leading sheep producer. For the research — the first research project specifically to examine the carbon footprint of the California sheep industry and to consider both wool and meat production across the state's varied sheep production systems — team members derived data from producer interviews and from existing literature, analyzing it in terms of flock outputs such as market lamb meat, breeding stock, two-day-old lambs, culled adult meat and wool. They utilized four methane prediction models, including two prominent models associated with the Intergovernmental Panel on Climate Change. They found that, across all case studies, enteric methane production was the largest single source of greenhouse gas emissions, accounting for an average of 72% of total emissions. Emissions from feed production — primarily emissions associated with manure and credited to feed — averaged 22% of total emissions. The researchers also studied water usage in sheep production systems, determining that whole-ranch water usage ranged from 2.1 to 44.8 metric tons per kilogram (252 to 5,380 gallons per pound) of market lamb, with the usage credited almost entirely to feed production. Overall, the results accorded with similar studies focused on meat sheep production systems in the United Kingdom, as well as with studies of California cattle raised using practices similar to those examined in the researchers' work.

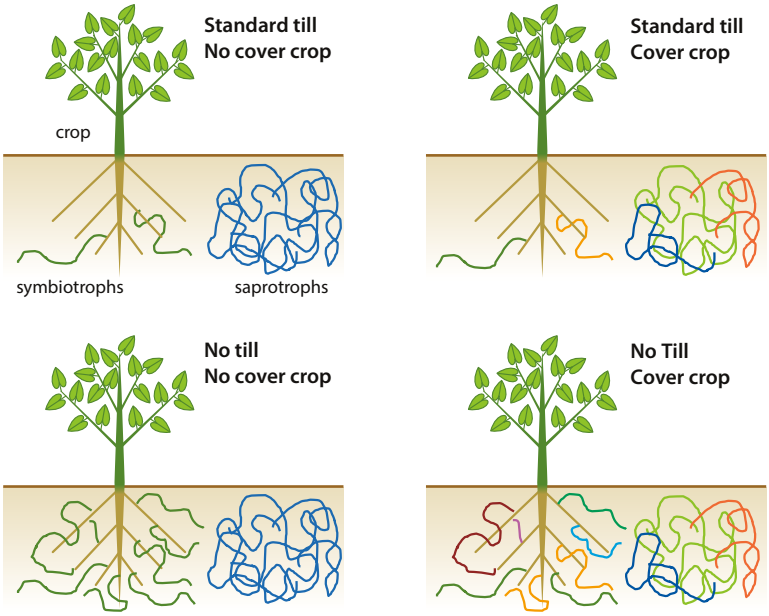


To determine the carbon footprint of California's sheep industry, a team of UC Davis and UCCE researchers conducted a life cycle assessment of five meat sheep production systems. They found that enteric methane production accounted for an average of 72% of total emissions, and feed production an average of 22%.

Dougherty HC, Oltjen JW, Mitloehner FM, et al. 2019. Carbon and blue water footprints of California sheep production. J Anim Sci 97(2):945–61. https://doi.org/10.1093/jas/sky442

Cover cropping and no-till can benefit soils' fungal composition

In row-crop and grassland soils, fungi provide essential ecosystem services. Saprotrophic fungi play important roles in nutrient mobilization, organic matter decomposition, carbon cycling and creation of soil structure. Symbiotrophic fungi expand the surface



Effect of no-till and cover cropping on relative abundance and diversity of symbiotrophic and saprotrophic fungi. No till leads to higher proportion of symbiotrophs while cover crops lead to increased fungal diversity.



Researchers assessed home-packed lunches over a school week, using a digital imaging procedure to determine how often, and how many servings of, fruits and vegetables were packed in school lunches.

area of roots, allowing roots greater access to water and nutrients (in exchange for carbon). Fungi, however, are more sensitive than other microorganisms to physical disturbance. Adopting no-till as a conservation management practice eliminates or greatly reduces both disruption of fungal hyphal networks and redistribution of organisms and nutrients in the soil profile. Use of cover crops, meanwhile, provides more abundant and varied sources of organic carbon. To further investigate how conservation management practices affect soil fungal communities, a research team composed of Radomir Schmidt and Kate Scow of the Department of Land, Air and Water Resources at UC Davis, as well as UCCE Specialist Jeffrey Mitchell of the Department of Plant Sciences at UC Davis, conducted a long-term, row-crop field experiment in California's Central Valley, measuring the effects on fungal communities of tillage practices and cover cropping. Their results showed that cover cropping increased species diversity while no-till practices shifted the ratio between symbiotrophs and saprotrophs in favor of the former. The researchers report that shifts in fungal community composition induced by management techniques could lead to greater resilience in ecosystems and could provide crops with greater access to limiting resources.

Schmidt R, Mitchell J, Scow K. 2019. Cover cropping and no-till increase diversity and symbiotroph:saprotroph ratios of soil fungal communities. Soil Biol Biochem 129:99–109. https://doi.org/10.1016/j.soilbio.2018.11.010

Factors related to nutrition in home-packed lunches investigated

Many children in the United States eat fewer servings of fruit and vegetables than dietary experts recommend. Such dietary behaviors often persist into adulthood and are associated with development of chronic disease. As children enter the late–elementary school years, they consume increasing proportions of their nutrition outside the home, including during lunchtime at school. Research indicates that roughly 30% to 40% of students eat lunches packed at home and that the nutritional quality of home-packed lunches is lower than that of lunches provided at school. Little research, however, has focused on factors associated with the nutritional quality of home-packed lunches. A team of UC Davis researchers — including Carolyn Sutter of the Department of Human Ecology (now at the University of Illinois), Jennifer Taylor of the Graduate Group in Nutritional Biology (now at UC San Diego), and Lenna Ontai and Adrienne Nishina of the Department of Human Ecology — conducted a study to determine whether parents with greater nutritional knowledge pack lunches containing more fruit and vegetables; whether authoritative parenting (a parenting style in which parents are both demanding of children and responsive to their needs) is related to how many servings of fruit and vegetables are packed; and whether family financial stress and children's involvement in packing lunches are related to the servings of fruit and vegetables provided. Parents recruited for the research project completed questionnaires about their parenting approaches and family situations and completed daily reports about children's level of involvement in lunch packing. Researchers assessed home-packed lunches over a school week, using a digital imaging procedure to determine how often, and how many servings of, fruits and vegetables were packed in school lunches. Researchers applied statistical techniques to the data they derived, finding that families with higher levels of nutrition knowledge tended to pack more fruit over the course of the week; authoritative parenting was associated with more servings of vegetables across the week; family financial stress was associated with higher rates of never packing vegetables; and that children's involvement in lunch decisions was associated with packing more fruit and vegetables across the week. The researchers' findings suggest that home-packed lunches might contain more fruits and vegetables if outreach programs provided nutrition information to parents and encouraged children to involve themselves in lunch-packing decisions.

Sutter C, Taylor JC, Nishina A, Ontai LL. 2018. Parental and family predictors of fruits and vegetables in elementary school children's home-packed lunches across a school week. Appetite 133:423–32. https://doi.org/10.1016/j.appet.2018.12.003