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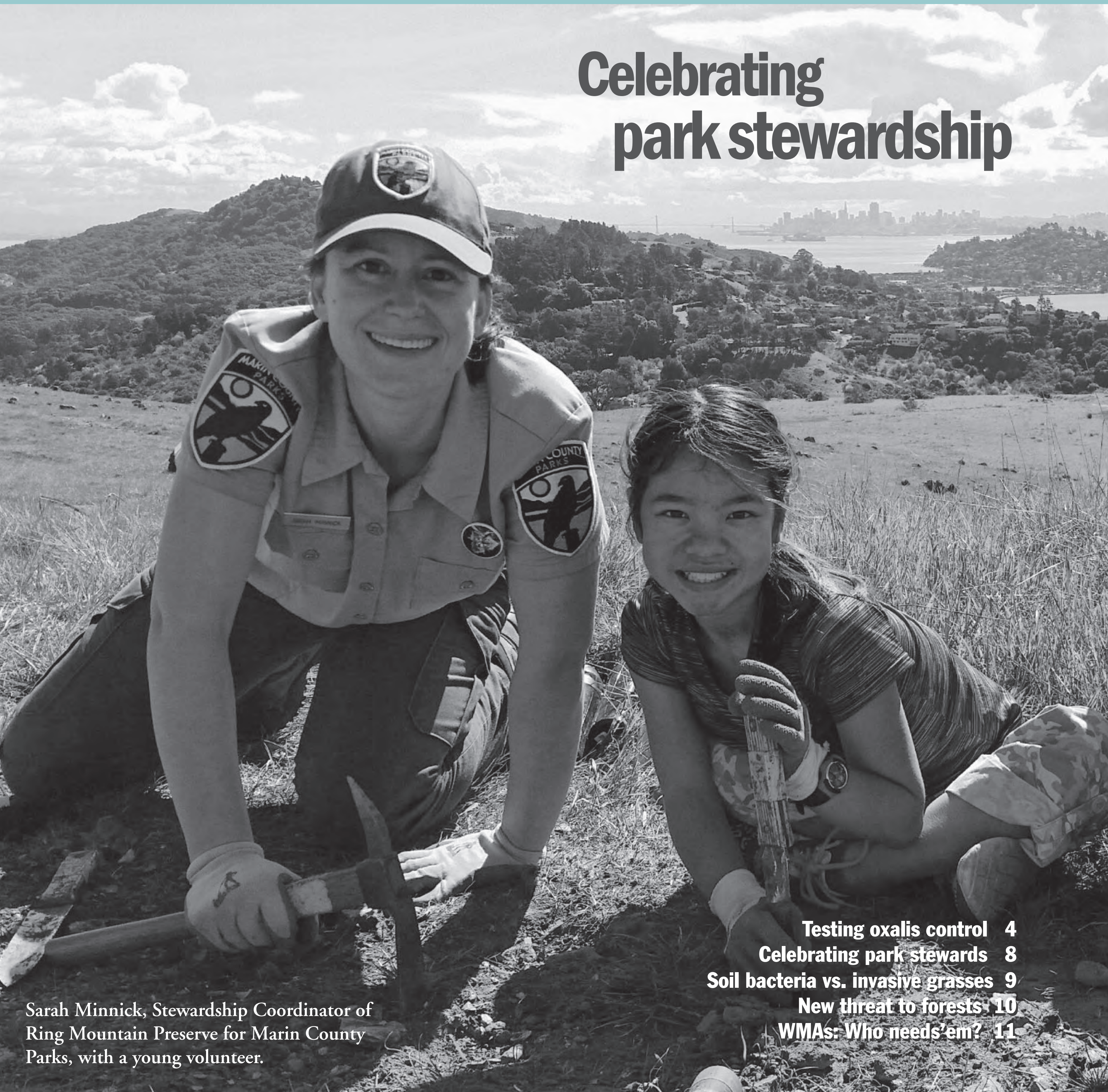
# Cal-IPC News

*Protecting California's Environment and Economy from Invasive Plants*

Newsletter of the California Invasive Plant Council



## Celebrating park stewardship



Sarah Minnick, Stewardship Coordinator of Ring Mountain Preserve for Marin County Parks, with a young volunteer.

# Native soil bacteria as biocontrol

*By Travis Bean, UC Riverside and Elise Gornish, UC Davis, bean@ucr.edu*

**Cheatgrass** invades pinyon/juniper/sagebrush country in the intermountain west, changing the vegetation community by altering the wildfire regime. *BLM photo from the Salt Lake Tribune.*

Biological control of invasive plants can have many advantages over more conventional management methods, namely the potential for regional scale control of target species over the long term if the control agent can be effectively established. It also avoids the often-unpopular use of herbicides and the habitat disturbances involved with mechanical and physical control. However, because biological control often relies on moving the control agent from one region to another, it can require extensive research to ensure there is neglible risk of unwanted impacts on non-target native or desirable organisms. In the best case, the control agent would be native to the region, just not present in sufficient numbers to cause the desired effect on the target invader.

This is an actual scenario that may yield a novel tool for managing invasive Eurasian winter annual grasses in the western United States, thanks to USDA-ARS researchers in Oregon and Washington. They have recently publicized the results of a long-term field trial investigating the utility of native soil bacteria for selective control of the cheatgrass (*Bromus tectorum*, a.k.a. downy brome), jointed goatgrass (*Aegilops cylindrica*), and medusahead (*Taeniatherum caput-medusae*), while not adversely impacting native plant species.

Research into this promising management tool started in the 1980s in eastern Washington when *Pseudomonas* (a common genus of soil bacteria native to much of the western U.S. and elsewhere) was found on the roots of stunted winter wheat and associated with a reduction in tiller number in affected plants. Recognizing that many of the Eurasian winter annual grasses which are ecosystem transformers in the western U.S. are close relatives of wheat, researchers wondered if the bacteria might also negatively affect these invaders and offer a potential management tool to mitigate their negative effects on biodiversity and productivity of range and croplands. To investigate this possibility, researchers have screened over 20,000 potential bacterial candidates through greenhouse experiments and field trials over the last 20 years located around the inland Pacific Northwest for selective control of cheatgrass, medusahead, and jointed goatgrass.

Recently, they made a breakthrough with *Pseudomonas fluorescens* strain ACK55. By using ACK55 similarly to a pre-emergent herbicide, researchers found that at a rate of one pint of active culture (1 x 108 colony forming units mL$^{-1}$) per acre, sprayed in the fall prior to emergence of the target invasive plant species, *P. fluorescens* ACK55 is extremely effective at controlling cheatgrass, jointed goatgrass, and medusahead by inhibiting root cell elongation and tiller initiation. In fact, a single application appears to be adequate for almost eliminating these annual weeds from the seed bank in the long-term (4-5 years). This is about the normal lifespan of *P. fluorescens* in the soil.

Other positive results that would increase its utility in an Integrated Pest Management (IPM) program for Eurasian winter annual grasses include tests of over 200 non-target plants demonstrating that the bacteria do not affect crop or native species, meaning that *P. fluorescens* can provide selective control of the target invaders. In the presence of *P. fluorescens*, crops and natives are able to competitively dominate the suppressed weeds and increase in cover. Research has also found that *P. fluorescens* does not inhibit fish, birds, bees, and other insects. Moreover, since the strain has no known anti-fungal or anti-bacterial activity, it is not expected to disturb the native microbial communities.

As is the case with pre-emergent herbicides, which this biological control agent most resembles in terms of application protocols, researchers have stressed that several other factors, such as soil properties, temperatures, and precipitation, can

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mediate treatment effectiveness, specifically noting that the bacteria may not perform as well under hot and arid conditions experienced in summer months. As with all invasive plant management and restoration methods, timing is critical; along with cooler temperatures, precipitation is required within two weeks of application for the bacteria to effectively colonize the soil. This means that successful application relies heavily on seasonal precipitation and a lack of unseasonably warm fall weather, which may be more limiting in future years under some climate change scenarios.

*P. fluorescens* ACK55 is currently undergoing the EPA registration process, which can take about 17 months. If accepted by EPA, the inoculate could be available for widespread use. In California, pathogens intended for controlling weeds require authorization from the California Department of Pesticide Regulation, and other states may have similar requirements.

Other than state-specific restrictions on using pathogens for invasive plant control, there are also the hurdles of propagation: what is the cost of growing enough of the bacteria to supply it to farmers, ranchers and conservationists interested in using it to control invasive winter annual grasses in the western U.S.? Because it's likely to be cost-prohibitive to apply the bacteria to all of the millions of acres currently infested by these problem species, the researchers suggest that a more targeted approach be considered. One approach would be direct application of the bacteria to leading edges of existing infestations to quarantine existing populations and prevent spread into new areas. Other priority targets are firebreaks to control wildfire spread and recently burned areas where the existing population of invasive grasses is restricted to the seed bank, allowing the bacteria to have the largest impact.

Additionally, site-specific factors may limit effectiveness of the bacteria for invasive grass control. As we often hear restoration ecologists and practitioners emphasize, control tools are most effective when used as part of an IPM program, rather than as a stand-alone treatment. In fact, as the researchers themselves suggest, the bacteria is unlikely to be successful if simply applied to invasive grass monocultures, as the grasses will simply regenerate given sufficient time. Instead, researchers suggest that post-emergent herbicides be applied to reduce the standing crop of invaders, while also applying the bacteria to attack germinating seedlings and provide seed bank control over the longer term. Seeding or planting natives or desirable forage species can help reestablish a diverse and resilient plant community that can resist or prevent recolonization by invasive grasses.

## For more information:


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