

SERPENTINOPHILES FROM CALIFORNIA AND ACROSS THE WORLD GATHER IN MAINE TO HIGHLIGHT RECENT RESEARCH ON SOIL-BIOTA RELATIONS OF SERPENTINE OUTCROPS

by *Nishanta Rajakaruna*

Serpentine loosely refers to a broad group of minerals associated with the weathering of ultramafic (high iron and magnesium-containing) rocks. Soils associated with such rocks often differ from more widespread soils, being less fertile and having high concentrations of heavy metals. The extreme chemical and physical nature of such serpentine soils generates habitats that are biologically unique.

SERPENTINE ECOLOGY IN CALIFORNIA

Serpentine ecology is not a foreign concept to California's botanists. After all, serpentine is the state rock and serpentine outcrops within the Californian Floristic Province harbor 12.5% of California's endemic plants (Safford et al., 2005). The 176 species endemic to Californian serpentines is a remarkably high number given that only 670 taxa are associated with serpentine soils in California, a substrate covering less than 1.5% of the state. California has been blessed with many botanists who have had life-long love affairs with the state's serpentine outcrops, in particular the half century-long professional commitment by California native and pioneer of serpentine research Arthur Kruckeberg.

Serpentine outcrops throughout California provide settings for spectacular displays of our native plants. The fascinating stories associated with soil-biota relations of California's serpentine have been well documented (e.g., Kruckeberg, 2002; Alexander et al., 2007). Efforts to conserve two such unique habitats

here in California, Coyote Ridge (Santa Clara County) and Edgewood Park (San Mateo County), were recently highlighted in the Winter 2008 issue of *Fremontia*, the journal of the California Native Plant Society.

SIXTH INTERNATIONAL CONFERENCE ON SERPENTINE ECOLOGY (JUNE 16-23, 2008)

Thus, it was no surprise that 17 of the total 51 oral presentations at the recently concluded Sixth International Conference on Serpentine Ecology (www.coa.edu/serpentine) in Bar Harbor, Maine, were based on studies from California's serpentine outcrops. Twelve of the 93 delegates attending the conference were from California or were presenting on California's serpentine soil-biota relations. Other regions represented at

the conference included Albania, Australia, Bulgaria, Canada, Czech Republic, Cuba, France, India, Iran, Italy, Japan, Morocco, New Caledonia, New Zealand, Portugal, Russia, South Africa, Spain, Sri Lanka, United Kingdom, and eastern USA, making it one of the most truly international of the 6 Serpentine Ecology conferences held to date. The conference was a testimony that serpentine outcrops are fast-attracting a wide range of researchers from across the world as model habitats for ecological studies.

Serpentine ecology conferences have their origins in California. The first conference was held in 1991 at the University of California, Davis. Subsequently, conferences have been held in New Caledonia (1995), South Africa (1999), Cuba (2003), and Italy (2006), always highlighting a region with intriguing serpen-

Participants of the Sixth International Conference on Serpentine Ecology. The 93 serpentinophiles represented 21 countries. Photograph courtesy of the College of the Atlantic.





TOP: A serpentine endemic of the New Idria area, San Benito monardella (*Monardella antonina* ssp. *benitensis*), with a tarantula hawk wasp (*Pepsis formosa*). Photograph by Ryan O'Dell. • BOTTOM: Recently-discovered Green Mountain maidenhair fern (*Adiantum viridimontanum*) from Deer Isle, Maine. This fern was previously recorded from only Vermont and Québec. Photograph by the author.

tine soil-biota relations. The conferences provide an opportunity for the gathering of serpentiniophiles from around the world, every two to four years, to share and discuss their findings related to the broad and interdisciplinary field of serpentine ecology. The meetings provide a setting for serpentiniophiles across many disciplines and many regions to establish profitable collaborations; the conference in Maine was no different from its predecessors. The conferences always feature a mid- and post-conference tour to regional outcrops. This year's participants visited Deer Isle, Maine, a

well-botanized serpentine body in coastal Maine (Rajakaruna et al., 2009) for the mid-conference tour, and the magnificent Mount Albert, Gaspésie Provincial Park, Québec, for the post-conference tour. The highlight of the mid-conference tour was the confirmation that a fern discovered in 2004 by the author was Green Mountain maidenhair fern (*Adiantum viridimontanum*; Pteridaceae), an allotetraploid derivative of Aleutian maidenhair fern (*Adiantum aleuticum*) and the common maidenhair fern (*Adiantum pedatum*). Green Mountain maidenhair fern was previously only recorded from a few sites in Québec and Vermont and is globally rated as vulnerable (G3; www.natureserve.org).

Topics discussed at the Sixth International Conference on Serpentine Ecology were grouped under the themes of geology/soils, biota, ecology/evolution,

physiology/genetics, and applied ecology, illustrating the multifaceted effects of unusual geologies in generating and maintaining biodiversity. Participants included botanists, zoologists, ecologists, pedologists, geologists, microbiologists, evolutionary geneticists, and conservation biologists. Attendees of the conferences are a unique group of researchers that work across disciplines in effective collaborations to explore the fascinating relationships that exist between extreme geologies and life, from cells and whole-organisms to communities and ecosystems.

PRESENTATION HIGHLIGHTS FROM CALIFORNIAN SERPENTINE ENTHUSIASTS

Several presentations from California's serpentine enthusiasts highlighted the need to address pressing issues in biodiversity and conservation with respect to serpentine biota. Susan Harrison (University of California, Davis) and Ellen Damschen

Serpentine endemics of the New Idria area, California (FROM TOP TO BOTTOM): Rayless layia (*Layia discoidea*); Talus fritillary (*Fritillaria falcata*); San Benito evening primrose (*Camissonia benitensis*). Photographs by Ryan O'Dell.





Serpentine barrens of the New Idria area of San Benito County. Photograph by the author.

(Washington University, St. Louis) presented their ongoing research on the effects of climate change on California's serpentine plants, stressing that plants associated with serpentine may be more likely to go extinct under predicted climate change scenarios than their non-serpentine counterparts. Their conceptual framework for assessing the impacts of climate change on serpentine endemics parallels the recent models highlighted by David Ackerly (University of California, Berkeley) and colleagues (Loarie et al., 2008) on the effects of climate change on California's endemic plants. Ryan O'Dell (Bureau of Land Man-

agement, Hollister Field Office) highlighted his research on the flora of the New Idria serpentine mass in San Benito County and the challenges and triumphs associated with re-vegetating serpentine barrens of the region. New Idria is home for

many rare Californian endemics, including *Camissonia benitensis* (Onagraceae), *Fritillaria falcata* (Liliaceae), *Layia discoidea* (Asteraceae), and *Monardella antonina* ssp. *benitensis* (Lamiaceae). The conference also highlighted another area of

growing interest, the study of plant-fungal relations in serpentine soil. Shannon Schechter (University of California, Berkeley) presented her dissertation research on the relationships between plant ecotypes of *Collinsia sparsiflora* (Scrophulariaceae) and distinct arbuscular mycorrhizal fungi (AMF) assemblages, showing that serpentine and non-serpentine ecotypes of *C. sparsiflora* have distinct AMF associations. Her work

Californian native and pioneer of serpentine ecology research, Dr. Art Kruckeberg (right), with fellow serpentine researchers Dr. Dick Walker (left) and Dr. Rosalina Berazain-Iturralde (center), following a field trip to a serpentine outcrop in Cuba. Photograph by the author.



was recently published in the journal *Molecular Ecology* (Schechter and Bruns, 2008). A noteworthy addition to the serpentine conference was the participation of Dawn Cardace, a researcher from the NASA Ames Research Center, Moffett Field, California. She highlighted her work on how serpentinization processes can create microbial habitats in the cool, dark subsurface on Earth and possibly other planetary bodies. A central goal of her work is to link mineralogy and habitability to remotely target extraterrestrial microbial habitats in the ongoing search for life beyond Earth's boundaries. Little

did serpentinophiles realize how their model habitat for ecological studies could be linked to extraterrestrial research!

UPCOMING PROCEEDINGS AND CONFERENCE

Overall, the conference was an immense success, providing an effective stage for serpentine enthusiasts to gather and share their work on rocks, soils, plants, insects, other biota, and even extraterrestrial research associated with this unique habitat. The proceedings of the conference will soon be published by

the Humboldt Field Research Institute, Steuben, Maine as part of a special issue of their journal, *North-eastern Naturalist*. The publication has been made possible from generous support from California Native Plant Society, USDA Forest Service (Pacific Southwest Region), Missouri Botanical Garden, Maryland Native Plant Society, Maine Space Grant Consortium, Barrick Gold of North America, College of the Atlantic (Bar Harbor, Maine), and several private donors. The next conference is scheduled for 2011 in Portugal with a post-conference tour to explore serpentes of Spain. We look forward to an even stronger California presence at the next conference.



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