

Collaboration on the Vertical Frontier: AAC Mountaineers Assist with Yosemite National Park Lichen ATBI

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In the end we will conserve only what we love. We love only what we understand. We will understand only what we are taught.

— *Baba Dioum, Senegalese Poet-Conservationist*

Yosemite's imposing cliff faces are so prominently colored that they appear to have been streaked with paint. The nature of these streaks has been debated: are they mineral stains, or are they alive? Far beyond the reach of most NPS biologists, it has been difficult to investigate.

Yosemite launched its lichen all taxa biological inventory (ATBI) with support from the Yosemite Fund, and the NPS Centennial Challenge Initiative in 2007. For two consecutive years, the American Alpine Club (AAC) assisted by supplying more than 25 skilled climbers. Carrying forward the vision of John Muir, who was also an AAC member, these climbers relished the chance to actively participate as "citizen-scientists." Their skills allowed NPS botanists to safely explore Yosemite's spectacular cliffs (Figure 1).

Lichen communities are uniquely tuned to their environment and can be useful bio-monitoring tools. Yosemite receives high levels of nitrogen deposition from California's Central Valley sources which is likely altering lichen communities. Lichens may also be good early indicators of climate change. Air pollution, particularly nitrogen deposition originating from California's Central Valley agricultural, industrial, and urban centers, is affecting Yosemite's naturally nitrogen-poor ecosystems. In some areas of Yosemite, the nitrogen deposition levels are up to ten times higher than natural background levels, and lichens indicative of high nitrogen levels are already common.

Similarly, climate change is thought to already have altered the forest structure and vegetation patterns in Yosemite. It is also likely that the ongoing warming trend will cause cold-adapted species, presently at the southern extent of their ranges, to retract northward. Species that are more heat and drought-tolerant may remain and perhaps expand their ranges northward. Such trends have been documented in lichen communities in Europe, and appear to be going on in Yosemite as well.

Although ATBIs, such as this project, are extremely valuable, they are often challenging to fund and staff. By using the AAC citizen scientist volunteers, we are able to minimize costs and staffing while establishing a monitoring baseline which can play a critical role in the preservation of Yosemite's native organisms and natural processes. At the same time, using citizen scientists allows us to fulfill our roles to engage and educate the public and increase



Figure 1. An AAC climber and NPS scientist Martin Hutten rappel down a seasonally dry section of Vernal Fall in Yosemite Valley to gather lichen samples.

its sense of stewardship toward our national parks. Our success in creating this powerful connection to parks and the natural environment is eloquently described by one of the project's citizen scientists, world-renowned mountaineer and AAC member, Carlos Buhler:

This world of lichen is something that climbers see up close every day without knowing very much about it, so it's a chance for me to learn more about the world in which I live. I doubt I'll ever look at lichen the same way again. We cannot see accurately into our environmental future. Yet the natural environment we have grown to love, nurture, and believe in, is changing at amazing speed. Our minds are challenged to interpret what we see occurring on a macro level, let alone a microscopic one. But it is clear that identifying and mapping these micro level shifts in the natural balance of our wild areas will help us to interpret the impacts, and give an indication of the direction these changes will have on the ecosystems that sustain us.

Methodology

Our project methodology consists of three basic phases:

1. Compile baseline list from herbaria and literature to understand what species are known to occur and which species are expected to occur.

2. Determine under-sampled, lichen-rich habitats in Yosemite:
 - Collect voucher specimens of lichens suspected to be new to Yosemite, and solicit help from the AAC to reach lichens in difficult-to-access vertical areas.
 - Identify a large proportion of the Yosemite flora in difficult lichen groups, and, toward that end, establish a partnership with the McCune lab at OSU through the Cooperative Ecosystem Studies Unit (CESU).
 - Refine our search through the “Yosemite Lichen Blitz 2009,” during which we will bring in lichen taxonomists whose expertise will likely complement the current lichen list.
 - Publish findings—the central Sierra Nevada flora is not well documented.
3. Installation of permanent sampling plots to document changes in lichen community composition due to nitrogen deposition and climate change (presently unfunded).

Project results to date

Only about 100 lichen species were previously known from Yosemite, whereas about 500 species are expected. The present list has grown to about 250, but many specimens still need to be identified. The AAC climbers collected almost 400 specimens from difficult-to-access micro-habitats on Yosemite’s great walls, and on other cliff faces. Significant finds included *Solorina spongiosa*, which is the second record for California (Figure 2), and multiple species apparently new to the Sierra Nevada.

In the next several years, we hope to be able to document as many as 500 different lichen species in Yosemite as additional, unexpected species will also inevitably be discovered. Unexpected finds include occurrences well beyond the known boundary of a species’ range. Such occurrences are particularly important for conservation, because it is in these presumably isolated populations where the process of speciation, the refinement and development of a species’ characters, runs its course. Our work is especially timely for those species that are presently at the southern extent of their range because they could, otherwise, be locally extirpated in a rapidly warming climate before scientists have a chance to document their presence in the park.

After the 2009 efforts, the majority of Yosemite’s common lichens will be known, and park resource managers will have the baseline information needed to begin to design future monitoring projects to document the effects of air quality and climate change on Yosemite’s lichen communities.

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Figure 2. *Solorina spongiosa*. Crista-Lee Mitchel, AP photo.

mountaineers, we could not have sampled some interesting habitats. Jack Hoeflich and Lorna Illingworth of Yosemite Search and Rescue assisted with equipment, logistics, and staff time. Thanks to Heather Root, Bruce McCune, and Daphne Stone for assistance with difficult lichen identifications.