

Interactive comment on “Aerobiology and passive restoration of biological soil crusts” by Steven D. Warren et al.

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The reviewer claims to have reviewed this manuscript previously. That is likely true, but the reviewer's conclusions were are badly flawed then, as they are now. That BSC restoration on a large scale, using currently available technology, it factual. I personally spearheaded and/or funded many of the earlier efforts in the United States. Most were dismal failures. The author points to the Chinese experience. However, most of the reported successes are based on passive techniques, not active techniques. BSCs have been passively renewed since before science became involved. How do you think crusts first became established? It was natural. Man did nothing; in fact man was not even here yet. That crusts can be cultured in flasks or ponds is true. Indeed, I have done it! But getting them onto the landscape is much more difficult, and finan-

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cially unfeasible. I concentrated on trying to incorporate live cyanobacteria into pellets which could be stored for long periods of time, and then distributed using techniques that do not involve water. Successful techniques could then be possible when climatic conditions allowed, and were not dependent on human application of large quantities of water. Early attempts all failed. Cyanobacteria were unable to escape pellets made of alginate or starch. Clay pellets were promising. Early laboratory trials while the cyanobacteria were alive seemed promising. We subsequently produced tons of inoculant, and shipped it to Alamogordo, NM and Dugway, UT for field trials. Both trials failed completely. Trying to decipher the reasons for the failure, a phycologist friend at Colorado State University put the pellets under a microscope. He determined that all cyanobacteria had died. The clay had apparently dessicated the cyanobacteria beyond their capacity to recover. We then tried to grow the cyanobacteria on cloth. We found that they grew best on hemp fabric. We then cut the fabric into tiny squares for application. We found that the process was most successful when the fabric was lightly raked into the surface few millimeters of the soil. We tried it at a site in the Great Basin Desert. After one year, we found that the cyanobacteria had moved into the soil. We determined, as you say, to report the technique was ready to "come on-line." We took measurements after two years, and found that untreated plots had cyanobacterial concentrations as great or greater than the treated plots. I recalled that the area was subject to frequent dust devils. That led me to explore passive dissemination of BSC organisms in depth, and conclude that airborne organisms are both natural and frequent. I have concluded that the phenomenon may be seasonal and episodic, but it is nonetheless important and essential.

I suggest that the reviewer is biased in his/her assessment that my conclusions are "in error." Yes, my work has been focused largely on the U.S. experience. I would remind the reviewer that that is where the bulk of all related efforts have taken place. I have not ignored the work in China. The work that he/she refers to as being successful involves primarily passive restoration, and depends on naturally occurring BSC organisms that enter the area through passive means. While I sincerely hope for the best in any work



with which they are involved, I have my doubts. I believe their work would get much more traction if they would prove their efforts rather than criticize that of others. And, as a matter of fact, a company in Grand Junction, Colorado has also experimented with hydro-applications. While that work, too, showed great promise in the beginning, the company is no longer in business, primarily because nobody was willing to fund the effort on a commercial scale. We must consider the scale of the need. There are many millions of hectares in the U.S. alone that could potentially benefit from a successful and economical remediation strategy. As stated in the manuscript, an approach that limits unnatural disturbance in arid ecosystems may have greater potential to limit the need for reclamation.

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