

Climate Mitigation in California: The importance of conserving carbon in deserts



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As climate change continues to accelerate, it is essential to protect natural habitats that act as carbon sinks. When these areas are developed and disturbed, additional carbon is released into the air and the plants and soils in those ecosystems are impacted, reducing their ability to absorb and store carbon. Studies around the world have shown that desert ecosystems can act as important carbon sinks. With desert ecoregions comprising 27% of California, protecting this biome can contribute to securing carbon stores in the state. By limiting development, excessive OHV use, livestock grazing and other activities that disturb desert soils, the state can help ensure these carbon reserves stay in the ground and out of the atmosphere.

Carbon Capture in Deserts

There are several ways in which deserts store carbon. To start, desert plants store carbon in their biomass just as other plants do; through photosynthesis, plants take in CO₂ from the air and convert that into tissue. Many desert plants also have important relationships with underground fungi: roots bond with these fungi in a mutually beneficial relationship. As part of this relationship, the plants transfer carbon to the mycorrhizae, which also store carbon. The majority of stored and sequestered carbon, however, is in soils. Plant or animal excretion and decomposition releases some carbon, which reacts with calcium in the desert soil to create calcium carbonate crystals. Since some desert plants' roots grow to over a hundred feet, these crystals, called caliches, can be deep underground. Caliches build into larger chunks over time and create carbon sinks. Additionally, when the root fungi die, they leave behind their waxy coating, which aggregates and helps keep carbon in the soil. For their storage and sequestration potential, arid-semiarid soils are considered the third largest global pool of carbon (Emmerich 2003).

California Carbon Sinks

The most conclusive evidence of California desert carbon storage potential comes from a 10-year study in the Mojave Desert at the Nevada Desert Free-Air CO₂ Enrichment Facility (NDFE). This study compared plots of desert with current CO₂ levels to plots with projected 2050 CO₂ levels. To do this, they piped extra CO₂ over the plots. At the completion of the study, the researchers compared the carbon between the plots with current CO₂ levels and those with projected CO₂ levels. They found that the plots that received extra carbon were able to store significantly more carbon than those that received current carbon levels. This indicates that as atmospheric CO₂ levels rise, deserts will have increased capacity to sequester in response to projected elevated atmospheric CO₂. Deserts store 9.7% of California carbon and based on the NDFE experiment, and this amount may increase with climate change. A report by the National Parks Service shows that Death Valley and Joshua Tree National Parks and the Mojave National Preserve were within the top 10 park units with the highest annual net ecosystem carbon balance.

Quick take

- Desert ecosystems provide important carbon storage functions now and in the future given climate change.
- Conserving California deserts can help ensure that the stored CO₂ stays in the ground.
- Key results include:
 - Inland deserts account for 10% of the state's total stored carbon.
 - 7% of carbon-rich areas in California deserts may already be impacted by human activities.
 - Ensuring sufficient desert representation in conserved areas will protect unique species assemblages and ecosystem services.

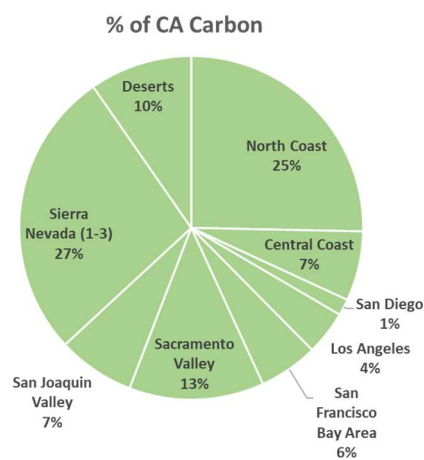
Read more about the desert carbon storage process here: <http://www.desertrep.org/?p=2270>

Read the full scientific article for this experiment here: <https://doi.org/10.1038/nclimate2184>

Results

The data indicate that 27% of lands within the state of California fall within desert ecoregions (Inland Desert and Sierra Nevada-East). These lands alone account for nearly 10% of the total carbon stored in the state. Importantly, the top carbon-rich locations in deserts are less impacted by human activity compared to other ecoregions: 7% overlap with areas of higher human footprint compared to nearly one quarter of carbon-rich areas in the San Joaquin Valley. Currently, 42% of carbon-rich areas in desert regions fall into areas managed for conservation. An additional 35% fall on public lands managed for multiple uses (including extractive activities). Based on these results, California deserts sequester and store a significant amount of the state's carbon. Though desert environments have relatively low sequestration on a per area basis, they represent a large proportion of the state's area and are relatively undisturbed by human activity.

Carbon can be stored in a number of different reservoirs. Here we analyzed total ecoregion carbon in above- and belowground biomass and in soil ([Soto-Navarro et al. 2020](#)). We compared the top carbon-rich areas for each ecoregion with human footprint metrics and the protected areas database of the U.S.



Map highlighting carbon-rich areas (top 20%) within each ecoregion and current coincidence with higher human disturbance. Sierra Nevada – East was combined with the Inland Desert ecoregion to represent California's deserts as a singular unit.

Recommended Actions

Given their carbon storage capabilities, conservation of large, intact desert areas could have a high return on investment for climate mitigation. Decision-makers will need to account for desert ecosystems in short- and long-term conservation planning efforts to ensure the persistence of these ecosystem services under future climate change scenarios. Great opportunity exists for desert protections on public lands, but some carbon-rich areas could benefit from private lands conservation, especially around the Salton Sea. Particular care should be taken in recognizing Death Valley (Sierra Nevada – East sub ecoregion) as a desert ecosystem that is unique and separate from others in the Sierra Nevada ecoregion. Failing to do so results in underestimation of Death Valley's carbon storage potential, which has been noted in other works. Finally, local stakeholders, Tribes and desert communities should be part of the decision-making process to ensure that those groups disproportionately impacted by conservation (or other) efforts in this ecoregion are well represented.

Questions?

Lindsay Rosa, Defenders of Wildlife,
lrosa@defenders.org

Susy Boyd, Mojave Desert Land Trust, susy@mdltr.org

Moises Cisneros, Sierra Club,
moises.cisneros@sierraclub.org

Pat Flanagan, Morongo Basin Conservation Association,
patflanagan29@gmail.com