Cuatrociénegas Wetlands (Coahuila de Zaragoza, Mexico)

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The Cuatrociénegas wetland complex has been described as a "sea in the desert" (Espinosa et al. 2005). The wetland complex consists of around 500 water bodies approximately 840 km^2 in size within the arid Chihuahuan Desert in the mountainous Northern Mexican Highlands (Figures 1 and 2), truly an oasis in the dry landscape. Mountains surround Cuatrociénegas which is essentially a bowl in the terrain that does not drain to the sea. Springs feed this area and are connected via systems of channels where the water from a deep aquifer is being continuously circulated from magmatic heat. Thus, even though this region receives less than 200 mm of precipitation per year the streams and rivers as well as ponds and lakes here are groundwater-fed (Figure 3).

Scientists have discerned that the water at Cuatrociénegas exhibits similar marine osmolarity and properties as Precambrian oceans such as unbalanced nutrient stoichiometry that allow microbial mats and stromatolites to flourish (Souza et al. 2018; Figure 4). During rains the mountains that surround Cuatrociénegas release gypsum into the basin. Gypsum is a common mineral but is a rarity in the form of sand. Gypsum rich sand dunes and outcrops here form one of only three such dune fields found in all the Americas.

The result of these specialized habitats and isolation is high biological diversity and unique species that are found nowhere else in the world (Souza et al. 2012). Álvarez and Ojeda (2019) note that there are at least 38 endemic species in this wetland complex. Eight endemic fish species (Minckley 1984) have been described. A survey of crustacean diversity revealed 45 species representing 4 classes, 18 families, and 32 genera and seven endemic species - three copepods, two amphipods, one isopod, and one shrimp (Álvarez and Villalobos 2019). There are 7 amphibian and 46 reptile species, of which 2 amphibian and 9 reptiles are endemic to Cuatrociénagas (García-Vázquez et al. 2019). Ochoterena and others (2020) report 297 species in 60 families of vascular plants growing on gypsum outcrops, of which 15 are endemic.

Figure 1. The basin of the Cuatrociénegas wetland complex (green symbol) is surrounded by mountains. It is located in northern Mexico, about 265 km west of Laredo, Texas. (Source: Imagery taken from the Wetlands of Distinction webpage utilizing Map data @2022 INEGI Imagery @ 2022 TerraMetrics)

Figure 2. The Cuatrociénegas wetland complex is a unique landscape containing numerous endemic species of plants and animals. (Photo by Tatiana Lobato-de Magalhães)

Figure 3. Springs feed water bodies such as this pond that are connected through channel systems to a deep aquifer. (Photo by Tatiana Lobato-de Magalhães)

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Figure 4. Unique geological conditions that favor diverse microbial communities are found at Cuatrociénegas. (Photo by Tatiana Lobato-de Magalhães)

Cuatrociénagas is internationally recognized by UNESCO (as Cuatrociénegas Biosphere Reserve) as well as a wetland of international importance under the RAMSAR treaty (as Área de Protección de Flora y Fauna Cuatrociénegas). In 2006 U.S. and Mexican officials signed a Joint Declaration of Sister Park Partnerships to encourage collaboration between parks. As a result, the White Sands National Park and Cuatrociénagas were paired due to both being located in the Chihuahuan Desert and having the unique gypsum dune fields in an arid environment.

Human activities threaten the Cuatrociénegas wetland complex in numerous ways. Industrial mining and extraction of gypsum and minerals from the dune fields destroy habitat. Agricultural activities create irrigation channels that pull aquifer water from the area, while overgrazing and burning for livestock harms vegetation.

The SWS Wetlands of Distinction Program seeks to raise public awareness of wetlands and their benefits to human health and well-being and to the environment. While most of the designated wetlands are in the United States, recently the Program was expanded to include wetlands from other countries. The Cuatrociénegas wetland complex was the first Latin American wetland to join the program and currently is the only wetland from the region on the list. Consequently we are seeking nominations of other Latin America wetlands. Contact information, details about the nomination process, and a searchable map of current Wetlands of Distinction can be found on our website https://www.sws.org/wetlands-of-distinction/. We look forward to adding more Latin American wetlands to the Program in the future.

REFERENCES

Álvarez, F., and M. Ojeda. 2019. The fauna of the Cuatro Ciénegas Basin, a unique assemblage of species, habitats, and evolutionary histories. *Animal Diversity and Biogeography of the Cuatro Ciénegas Basin*. pp 1-10. https://link.springer.com/chapter/10.1007/978-3-030-11262-2_1

Álvarez, F., and J. Villalobos. 2019. Crustaceans from the Cuatro Ciénegas Basin: diversity, origin, and endemism. *Animal Diversity and Biogeography of the Cuatro Ciénegas Basin*. pp. 77-90. https://link.springer.com/chapter/10.1007/978-3-030-11262-2_6

Espinosa, L.A. Escalante, L. Eguirte, and V. Soauza. 2005. El mar en el Desierto y su importancia para la conservación. CONABIO. *Biodiversitas* 58: 7-11.

García-Vázquez, U., M. Trujano-Ortega, A. Contreras-Arquieta, O. Ávalos-Hernández Omar, O. Escobedo-Correa, and P. Corcuera. 2019. Diversity of amphibians and reptiles in the Cuatro Ciénegas Basin. *Animal Diversity and Biogeography of the Cuatro Ciénegas Basin*, pp. 175-188. https://link.springer.com/chapter/10.1007/978-3-030-11262-2_13

Minckley, W. L. 1984. Cuatro Cienegas fishes: research review and a local test of diversity versus habitat size. *Journal of the Arizona-Nevada Academy of Science* 19(1): 13–21. http://www.jstor.org/stable/40024286.

Ochoterena, H., H. Flores-Olvera, C. Gómez-Hinostrosa, and M. Moore. 2020. Gypsum and plant species: a marvel of Cuatro Ciénegas and the Chihuahuan Desert. *Plant Diversity and Ecology in the Chihuahuan Desert*: 129-165. https://link.springer.com/chapter/10.1007/978-3-030-44963-6_9

Souza, V., J. Siefert, A. Escalante, J. Elser, and L. Eguiarte. 2012. The Cuatro Ciénegas Basin in Coahuila, Mexica: an astrobiological Precambrian park. *Astrobiology* 12(7): 641-647. Accessed November 15, 2021. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3426885/

Souza, V., A. Moreno-Letilier, M. Travisano, L. Alcaraz, G. Olmedo, and L. Eguiarte. 2018a. The lost world of Cuarto Ciénegas, a relictual bacterial niche in a desert oasis. *eLIFE* 2018; 7:e38278.