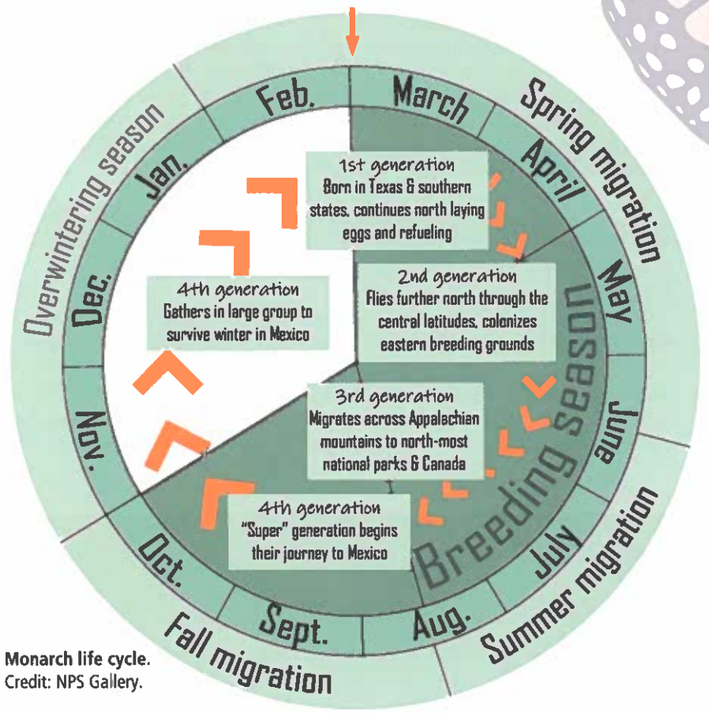
River Connections—
Flowing Rivers and Monarch Migration

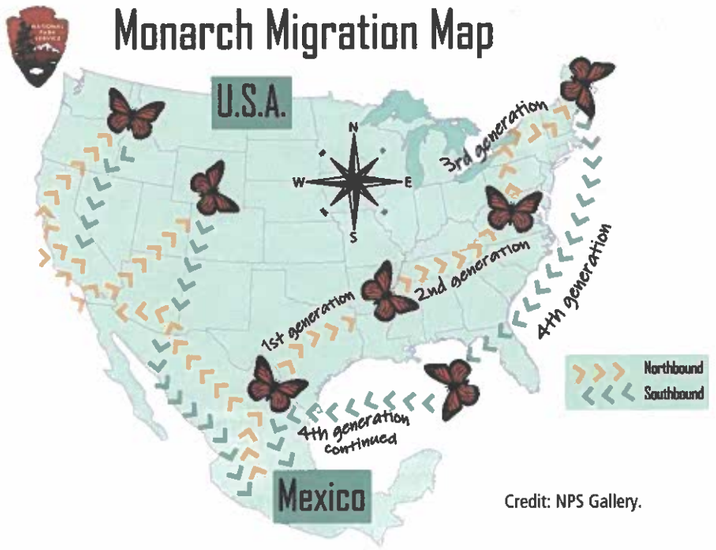
Monarch butterflies (*Danaus plexippus*) are a cultural icon and have a symbolic value as they travel across North America. As temperatures cool in the fall months, monarch butterflies begin migrating south into central/southern California, southern Arizona, and Mexico to overwinter in warmer temperatures. In the Spring, monarchs move north over multiple generations for feeding and breeding. Along the way they seek nectar plants and milkweed (*Asclepias* spp.) plants to sustain their journey and to provide breeding grounds for the next generation of monarchs. In both cases, monarchs follow river corridors (Morris, et al., 2015) in the desert Southwest, as they provide important breeding and nectaring habitat. Monarchs cross borders without any considerations as they are driven by instinct to move south and seek forests for protection and overwintering sanctuary.

In December of 2020, the USFWS determined that listing monarchs under the Endangered Species Act was warranted but precluded, which means that protection is recommended but other species have a higher priority for conservation/protection. With the eastern population declining by approximately eighty percent and the western population by 99.9 percent, there is a substantial probability of a quasi-extinction over the next twenty years (Semmens, et al., 2016). Monarchs are threatened by the loss of breeding habitat which is thought to be a main driver of population declines. Milkweed is essential for monarch breeding and its loss is a result of direct and indirect human impacts. The farming industry and the intensive use of glyphosate (e.g. Round-Up) has decreased milkweed abundance in agricultural fields (Pleasants, et al., 2012). Before herbicides were introduced, plowing the fields was the main way of removing weeds. This physical disturbance made perfect growing conditions for milkweed seeds to thrive. However, today the use of herbicides in glyphosate resistant crops has drastically reduced milkweed in ag lands. (Pleasants, et al., 2012). Industry development and urban sprawl are also significant factors in the decline of monarch habitat. Additionally, increased mowing in rural and urban areas along roadsides has decreased milkweed production even more. If managed properly, these roadsides could be transformed into prime pollinator habitat instead of weedy

Antonio Ruvalcaba holding a monarch butterfly. Photo: Emily Spencer, NPS.



Monarch life cycle.
Credit: NPS Gallery.



Credit: NPS Gallery.

species requiring spraying and mowing (Kasten, et al., 2016). Other factors such as ozone pollution and increased carbon dioxide levels which cause climate change, are affecting the condition and distribution of milkweed plants (David, et al., 2018).

Monarch butterflies are unique insects that go through multiple generations when migrating. When migrating north, monarchs will go through multiple life cycles, reproducing then dying off after two to six weeks, resulting in an average of four generations. However, when migrating South, monarchs in the last generation, also called the "super generation" live up to ten months and travel more than 3,000 miles to warmer climates in Mexico, California, or Arizona. To accomplish this phenomenal migration, these monarchs do not breed immediately and instead conserve their energy for the long journey by storing fat in both caterpillar and butterfly life stages. They also time their migration to coincide with optimal habitat conditions which includes nectar flowers for butterflies and milkweed for caterpillars. Milkweed plants are the only food source for monarch caterpillars and are therefore obligate for breeding, providing all the nourishment the monarch needs to transform the monarch caterpillar into the adult butterfly. Cardenolides in milkweed make monarchs poisonous to most predators, allowing monarchs to thrive. When there is no milkweed, there are no monarchs.

Monarch caterpillar frass (feces) found along the Green River. Photo credit: Sonya Popelka, NPS.

Grand Canyon National Park and Dinosaur National Monument are both part of the Colorado River system that supports a critical monarch butterfly migration flyway and offer host plants that are essential for monarch survival. In general, pollinators need nectar trails consisting of patches of flowering plants to refuel during migration. Certain milkweed species like horsetail milkweed (*Asclepias subverticillata*) and spider milkweed (*A. asperula*) are commonly found at 7,000 feet in elevation like at the Grand Canyon South Rim. Other species such as broadleaf milkweed (*A. latifolia*) are found below 7,000 feet, which includes the inner canyon along the river. At Dinosaur National Monument, milkweed species including showy milkweed (*A. speciosa*) and swamp milkweed (*A. incarnata*) thrive. Massive efforts are currently underway to address the problem of diminishing milkweed and monarch habitat. However, given the scope of this challenge it is essential to work together. No matter where you live, you can get involved with monarch conservation through citizen science.

From July to October 2021, Suzanne El-Haj and Antonio Ruvalcaba served as interns through the Latino Heritage Internship Program (https://latinoheritageintern.org), a partnership between Environment for the Americas (birdday.org) and the National Park Service. Suzanne worked at Grand Canyon National Park as a Biological Science Technician while Antonio worked at Dinosaur

National Monument as a Science Communication and Resource Monitoring intern. Both of their work focused on advancing monarch butterfly conservation efforts through resource stewardship, community science, and education and outreach. The river is a unique environment and both of them were able to experience a journey through public lands by whitewater rafting during their internships.

The waters of the Green, Yampa, and Colorado Rivers connect Grand Canyon National Park and Dinosaur National Monument. Just as the river flows so do the animals that migrate. Specifically, we think monarch butterflies use these river corridors to migrate North and South. Most of the data we have on monarchs today heavily relies on community science efforts and especially on the river community.

REPORTS FROM THE RIVER

Down the Colorado River

Before my internship, I never thought I would get the opportunity to raft the famous Colorado River. The purpose of the river mission was to monitor the effect that Glen Canyon Dam has on the riparian zone of the river. The dam has created fluctuating water levels which allows for growth of plants along the river shore. Some of these plants are invasive and some native, and some of them have a negative impact for boaters wanting to camp on the shores as well as impacts on protection for cultural resource sites. While on the river, I also contributed to my own project, monitoring milkweeds and monarchs.

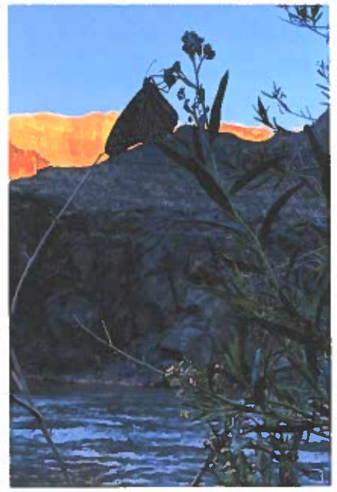
Suzanne with Colorado river and NPS boat behind her during river mission. Photo: Meagan Dreher, NPS.

My river experience started by hiking down to Phantom Ranch and meeting up with the Grand Canyon National Park Vegetation crew. Over the course of ten days, we traveled about 200 miles through the river and stopped every couple hours to work. Our work consisted of clearing vegetation and managing invasive plants via hand pulling, digging, and herbicide application along the shores. The work was labor intensive and conditions in the canyon were extreme. However, to my surprise, I enjoyed every bit of it. Whitewater rafting through the Grand Canyon was an unforgettable experience that I will always cherish. Over the course of the trip there were no milkweed sightings, however there were monarchs present, about 25 monarchs in total were documented.

Antonio stops to survey for monarch evidence in Lodore Canyon. Photo: Sonya Popelka, NPS.

Down the Green River

As part of my internship, I was able to participate in a four-day rafting trip down the Green River in Dinosaur National Monument. The goal of the trip was to survey for monarch butterflies during peak fall migration and gain knowledge about corridor usage. We launched at the Gates of Lodore, which was an amazing view which almost felt like going into Jurassic Park. The journey ended at Split Mountain. The trip was eye opening in many aspects, we saw monarchs along their way, indicating a usage of such habitat. The habitat along the river was full of nectaring resources, such as western goldenrod. We searched for eggs and caterpillars throughout the milkweed, only to come up empty handed. However we did see chewing marks and even old egg casings on the milkweed. Milkweed is abundant in this stretch of river, and previous years surveys found all life cycles present. Overall we were able to spot eleven adults during their time on the river. This river trip surveyed only four days out of the year, but communities can come together helping to gather information about monarchs throughout their range in the West year-round. Tagging efforts help us understand movement of adults and provide clues of migration patterns. The internships, from two very unique environments, allowed both of us to experience the river and participate in monarch conservation.



Monarch resting inside the canyon. Photo: Meagan Dreher, NPS.

HOW YOU CAN GET INVOLVED

Immediate action is needed to prevent species extinction. This action can be as simple as uploading data onto the Western Monarch Milkweed Mapper (https://www.monarchmilkweedmapper.org) (WMMM) database. This is a user-friendly resource because anyone who has access to the website or the phone application, called Monarch SOS, can enter data on monarch or milkweed sightings. Take a photo of either a monarch butterfly or milkweed when you see it. Then upload that data. The website will then identify the type of milkweed you uploaded. Data submitted to WMMM will help researchers determine the distribution, phenology, and conservation needs of monarchs and milkweeds in the West. It will also help individuals learn about monarchs, their host plants, and ongoing conservation efforts for these species.

Another great avenue for monitoring monarchs and milkweeds is the Monarch Joint Venture webpage. Here you can join the Integrated Monarch Monitoring Program (IMMP) listserv and learn about program updates. Similar to WMMM, this resource is essential in understanding how monarchs interact with their environment and tracking population and habitat as it changes over time.

Additionally, Survey123 is a survey platform that has been growing over the last few years. Advantages of the platform for wildlife include creating, sharing, and analysis of observations, such as for bighorn sheep and monarch butterflies. An example of this platform for pollinator surveys we used is the Utah Pollinator Pursuit. The application allows for the user to report observations on individual monarchs as well as their lifestage and habitat/plant information. Projects like UPP and Southwest Monarch Study encourage the general public to participate in science. The rafting community can contribute to monarch conservation by submitting observations of monarchs using river corridors, an area where data is scarce. Your reports may help answer questions about when, where, and how many monarchs use rivers for migration each year.

Suzanne El-Haj and Antonio Ruvalcaba

About the authors:

Suzanne El-Haj is a first generation Argentinian-Palestinian student in this country. She resided most of her young life in South Texas, in the Rio Grande Valley. It is a region known for its abundance of rare bird species, butterflies, and migratory paths along the Rio Grande River. The river acts as a natural barrier between the United States and Mexico in this region. Just as monarch butterflies use the river to travel, so do the people of this border town region. After graduating with her bachelor's degree in Sustainable Agriculture and Environmental Science, she took the opportunity to intern at Grand Canyon National Park.

Antonio Ruvalcaba is a first generation Mexican-American, who comes from the Central Valley of California. He obtained his bachelor's in Wildlife Conservation and Management from Humboldt State University. Many people think of the Central Valley as mainly agriculture but it actually has wildlife all around. After high school, involvement with the San Joaquin River opened his eyes to the ecological importance of river systems. His passion for river systems was born one summer, when he worked at camp teaching various water sports on the river. His passion for wildlife grew as he explored the area, leading him to Humboldt State University.

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Additional Resources:

- Western Monarch Milkweed Mapper : www.monarchmilkweedmapper.org
- Monarch Joint Venture : www.monarchjointventure.org
- Ay Mariposa Film : www.aymariposafilm.com
- Southwest Monarch Study : swmonarchs.org
- Utah Pollinator Pursuit : https://sites.google.com/view/utahpollinatorpursuit/projects
- Latino Heritage Internship Program : latinoheritageintern.org