



# MIGRATION OF MONARCH BUTTERFLIES

Logeswari.C<sup>1,\*</sup>, Kaaviya Sri.K<sup>1</sup>, Dhivya.P<sup>1</sup> and Athithya.A<sup>2</sup>

<sup>1</sup>UG Scholar, <sup>2</sup>Assistant professor, Department of Entomology, Rover Agriculture College, Perambalur, Tamilnadu.

## ABSTRACT

Millions of North American monarch butterflies undergo a stunning long-distance migration to reach their overwintering grounds in Mexico. Migration allows the butterflies to escape freezing temperatures and dying host plants, and reduces infections with a virulent parasite. In this we discuss the multigenerational migration journey, its evolutionary history, pathway, climate affecting factors. Monarchs use bidirectional time- compensated sun compass for orientation, which is based on a time- compensating circadian clock that resides in the antennae, and which has a distinctive molecular mechanism. The monarch butterfly has emerged as an excellent system to study the ecological, neural, and genetic basis of long distance animal migration.

## INTRODUCTION

Monarchs are native to North and South America, but spread throughout much of the world in the 1800's (Kronforst et al. 2014). Monarch butterflies embark on a marvelous migratory phenomenon. They travel between 1,200 and 2,800 miles or more from the northeast United States, and southwest Canada to the mountain forest in central Mexico, where they find the right climate conditions to hibernate from the beginning of November to mid-March. The monarch butterfly is known by scientists as *Danaus plexippus*, which literally means "sleepy transformation". The name evokes the species ability to hibernate. Adult monarch butterflies possess two pair's brilliant orange-red wings, featuring black veins and white spots along the edges. Males, who possess distinguishing black dots along the veins of their wings, are slightly bigger than females. Each adult butterfly lives only about four to five weeks.



Fig1: MIGRATION OF MONARCH

## 1. EVOLUTIONARY HISTORY

The researchers analyzed the monarch's evolutionary origins using genetic comparisons. They traced the ancestral lineage of monarchs to a migratory population that likely originated in the southern U.S. or Mexico. The monarch's current worldwide distribution appears to stem from three separate dispersal events to Central and South America; across the Atlantic and across the Pacific. The monarch's North American origin runs counter to a long-standing hypothesis that the butterfly originated from a non-migratory tropical species, which later developed the ability to migrate. While historical records have suggested that the monarch's dispersal across the Pacific and Atlantic occurred in the 1800s, the analysis indicated the monarch actually crossed the oceans thousands of years ago. The authors note that more work needs to be done to fully document the butterfly's evolutionary history. The four stages of the monarch butterfly are the egg, the larva (caterpillar), the pupa (chrysalis), and the adult butterfly. The generations are actually four different butterflies going through these four stages during one year, until it is time to start over again with stage one and generation one.



**FIG 2: LIFECYCLE OF MONARCH BUTTERFLY**

## 2. MONARCH MIGRATION

Each year, over the course of a few generations, monarch's make an incredible journey across North America to overwintering sites in Mexico and California.

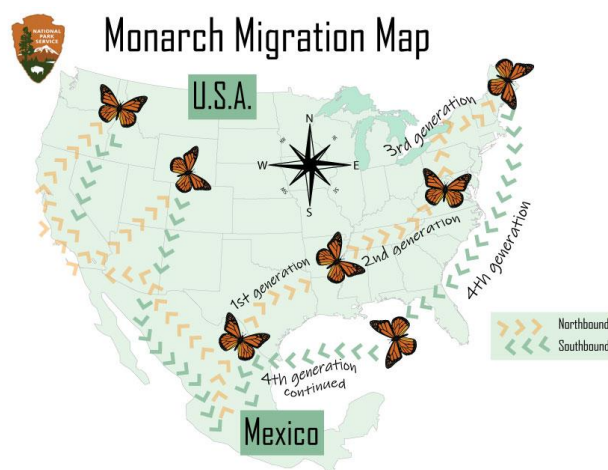
### 2.1 EASTERN MONARCHS

They migrate from the US-Canadian border to central Mexico, covering nearly 3000 miles. Decreasing day length and temperatures, along with aging milk weed and fewer nectar sources trigger a change in monarchs; this change signifies the beginning of the migratory generation. Unlike summer generations that live for two to six weeks as adults, in the migratory generation can live for up to nine months. Most monarch butterflies that emerge after about mid-August in the eastern US enter reproductive diapause and begin to migrate south in search of the overwintering grounds. From across the eastern US and Southern Canada, monarchs funnel towards Mexico. Along the way, they find refuge in stop over sites with abundant nectar sources and shelter from harsh weather. Upon reaching their destination in central Mexico beginning in early November, monarch aggregate in oyanel fir trees on South-West facing mountain slopes. These locations provide cool temperatures, water and adequate shelter to protect them from predators and allow them to conserve enough energy to survive winter. In March, this generation begins the journey North into Texas and Southern states, laying eggs and nectaring as they migrate and breed. The first generation offspring from the overwintering population continue the journey from the Southern US to

recolonize the Eastern breeding grounds, migrating Northern through the central latitudes in approximately late April through May. Second and third generations populate the breeding grounds throughout the summer.

## 2.2 WESTERN MONARCHS

They fly to Pacific coast in winters, moving around 300 miles. Adult monarch west of the Rocky Mountains leave overwintering sites along the California coast in February and March and head inland in search of milkweed on which to deposit their eggs. Once first generation monarch eggs reach adulthood, they disperse east across the Central Valley and north across most of the western states. Second and third generation monarchs live and die throughout spring and summer, generally staying in the same areas where they hatched. The fourth generation emerges in late summer to fall (Orley R Taylor *et al.*, 2021). This migratory generation lives 6-9 months, compared to the 2-5 weeks of earlier generations. Western migratory monarchs also differ biologically from non-migratory generations; they are in a state of reproductive diapause, meaning their reproductive diapause, meaning their reproductive organs do not mature until later in adult stage. In February and March, reproductive diapause ends and the annual cycle starts anew. Milkweed and nectar plant availability throughout the spring, summer, and fall will benefit western monarchs.



**FIG 3: PATHWAY OF EASTERN AND WESTERN MONARCH BUTTERFLIES**

## 3. SITE SELECTION

North American monarchs travel from their summer breeding grounds to overwintering locations. Site selection in monarchs is especially mysterious. The overwintering groves don't learn the route from their parents since only about every fourth to fifth generation of North American monarch migrates. Monarchs use Sun compass and Magnetic compass for site selection.

### 3.1 SUN COMPASS

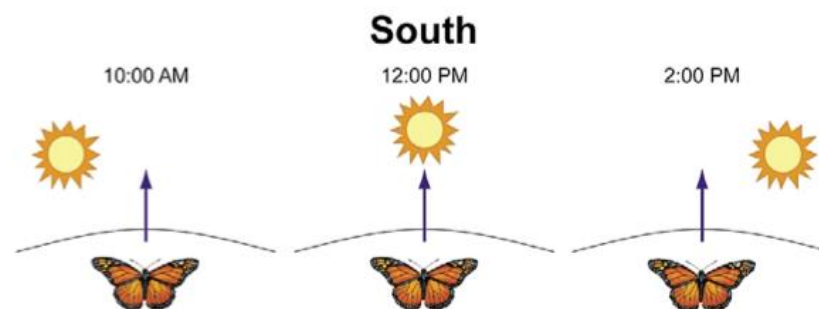
Since monarchs migrate during the day, the sun is the celestial cue most likely to be useful in pointing the way to the overwintering sites. This proposed mechanism is called a "sun compass" Klaus Schmidt-Koenig (1985). Monarchs may use the angle of the sun along the horizon in combination with an internal body clock to maintain a south westerly flight path.

For example: If monarch's internal clock reads 10 am then the monarch will fly to the west of the sun to maintain a southern flight direction. When the monarchs internal clock reads noon (12 pm), the monarchs instincts tell it to fly straight towards the sun, while later in a day the monarchs instincts tell it to fly to the east of the sun.

However, this would have to be combined with the use of some other kind of cue. If all the monarchs in eastern and central North America maintained a southwesterly flight, they could never all end up in the same place. It has been proposed that mountain ranges are important land marks used by monarchs during their migration.

### 3.2 MAGNETIC COMPASS

Scientists have suggested that monarchs may use a magnetic compass to orient, possibly in addition to a sun compass or as a “back-up” orientation guide on cloudy days when they cannot see the sun. Studies of migratory birds have indicated that the registered angle made by the earth’s magnetic field and the surface of the earth James Kanz (1977). These angles point south in the northern hemisphere and north in the southern hemisphere. The use of magnetic compass requires short wave UV light. With UV light being allowed to enter the flight simulator, eastern migratory monarchs consistently oriented themselves south. The light- sensitive magneto sensors reside in the adult monarchs antennae. While the expert consensus remains that the sun compass is the monarch’s primary compass for navigation, the authors suggests migratory monarchs use the magnetic compass to augment their sun compass(S.M. Reppert.2004).



**FIG 4: SUN COMPASS AND MAGNETIC COMPASS OF MONARCH**

### 4. CLIMATE CHANGE AFFECTING MIGRATION:

Monarchs are threatened by deforestation of wintering forests in Mexico, disruptions to their migration to their caused by climate change and loss of native plants (milkweed species, all nectar-producing native plants) along their migratory corridors. The migratory monarch butterfly known for its spectacular annual journey of up to 4000 kilometers across the Americas, has entered the **IUCN RED LIST** of threatened species as endangered, threatened by habitat destruction and climate change. Climate change disturbs the monarch butterflies the annual migration pattern by affecting weather condition in both wintering grounds and summer breeding grounds. Colder, wetter winters could be lethal to these creatures and hotter, drier summers could shift suitable habitats north. Abnormal patterns of drought in the US and Canada breeding sites may have caused adult butterfly deaths and less plant food for caterpillars.

### 5. INTERESTING FACTS

- A monarch can fly up to 2700 miles (4345 km). With the same weight to distance ratio, that would be same as a robin flying to the moon and the most of the way back. The longest recorded flight for a monarch was one tagged in Nova Scotia and recovered in central Mexico a distance of 2690 miles (4200 km).
- Monarch caterpillars are eating machines! They grow in size by shedding their old skin to reveal a larger new skin (exoskeleton) underneath. They molt or shed their skin five times before entering the pupal stage. The entire caterpillar stage lasts about 9-14 days under normal summer temperatures.
- Monarchs east of the Rockies winter along the California coast where they roost in eucalyptus trees and Monterey pines and Monterey cypresses. In winter they spread across 300+ sites from Baja California to

north of San Francisco small number of monarchs also spend the winter in the lower deserts of Arizona and California.

## CONCLUSION

The long, seasonal migration of the monarch butterfly distinguishes the species from its peers. It is the only butterfly known to make a two way migration similar to birds. The monarch butterfly migration is the longest within the insect kingdom as they under a tedious migratory journey of 4634 kilometers. Conserving the monarch population is important for many reasons, from ecological reasons to educational and inspirational ones.

## REFERENCES

- 1) Repper.S.M.2004.Polarised light helps monarch butterflies navigate. *Curr. biol.*
- 2) Kanz.J.E.1977. The orientation of non-migrant and migrant monarch butterflies. Ph.D Dissertation. Med Ford, Massachusetts: Tufts university.
- 3) Schmidt Koenig K. 1985.Migration strategies of monarch butterflies. *Contributions in marine science (CONTRIB.MAR.SCI)* 68.
- 4) Kronforst M.R.et al., 2014. The genetics of monarch butterfly migration and warning colouration. *Nature* 514 (7522), 317 312.
- 5) Orley R Taylor .et al., 2021. An ecological evidence of eastern and western monarch butterflies. *Conservation Science and Practice* 3(7),e432.