



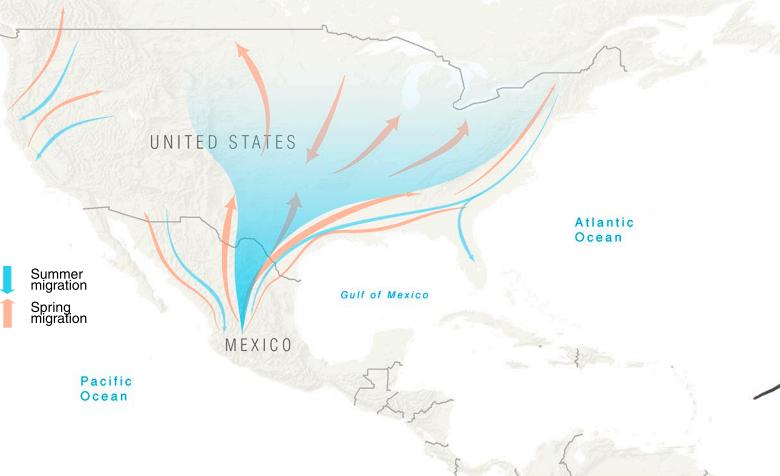
# Navigate, migrate, survive

Butterflies may fit in the palm of your hand, but some species can fly across continents, covering several thousand of kilometers. These extraordinary feats are often seasonal, and can produce magical displays where individuals aggregate in their thousands. But do migrating butterflies know where they are going? And how do they get there?

## The navigators

Many species of butterflies and moths migrate large distances between cold and hot, or wet and dry seasons. Painted Lady butterflies (*Vanessa cardui*) have one of the longest seasonal migrations in the 'old world', flying

up to 4,000 km from Europe to sub-saharan Africa every winter. Migrating species can also fly remarkably high, up to 2 km. The migration of the monarch butterfly (*Danaus plexippus*) across North America (map below) is one of the most famous events in nature.



**The monarch journey**  
As winter approaches monarch butterflies in North America fly up to 4,500 km south to Mexico and southern California, where they overwinter in huge numbers. Each individual enters diapause, conserving energy. As the days become longer, the butterflies return north, completing the journey over several generations.



## How do monarchs know where to go?



### A sun compass

To navigate long distances a human needs a map and a compass to know where they are and what direction they're going. Whether or not Monarchs have an internal 'map' is debated. But we know they have a compass. Monarchs use the sun as a compass, using its position to direct their flight towards north or south.



### Antennal clocks

Because the sun moves across the skyline during the day, Monarchs have to 'correct' their compass according to the time of day to avoid getting lost. They use an internal "clock" that is sensitive to changing light levels to tell what time of day it is. Surprisingly, this clock seems to be located in the antennae!



### A magnetic compass

Navigating by sunlight can be tricky when the weather turns cloudy. Some evidence suggest Monarchs have a back up plan, and are able to detect the Earth's magnetic field and integrate this information with their sun compass to maintain a steady heading.



### Monarchs in decline

Scientists use paper tags to monitor Monarch populations. Although globally abundant, in recent years the numbers in the most famous overwintering sites have been in decline, raising concerns that one of nature's great spectacles may be threatened. The decline has been linked to changing weather conditions and lower availability of plant resources used by migrating butterflies.