

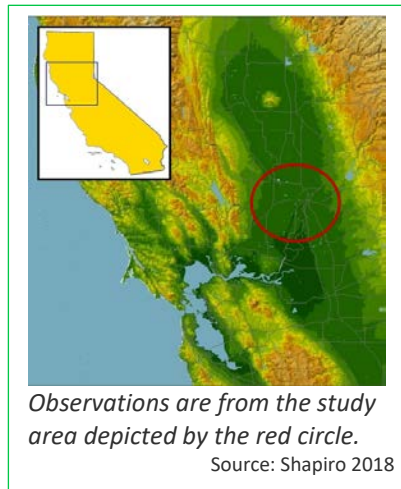
Spring flight of Central Valley butterflies

Over the past 45 years, common butterfly species have been appearing in the Central Valley earlier in the spring.



Observations over a 45-year period show that butterfly species are collectively appearing at an earlier date in the spring in California's Central Valley. Shifts in the seasonal timing of life-history events, such as flowering, bird migration, and the hatching of butterflies and other insects, is one way that plants and animals respond to changes in climatic and environmental conditions. Changes in the timing of butterfly emergence could alter ecological processes such as predator-prey relationships and pollination of plants.

An early-springtime butterfly appearance for some species in the Central Valley is linked with warmer and drier winter conditions in the region in recent decades. The study area is located in the Central Valley portions of three counties: Sacramento, Yolo and Solano (see circled area on map). These findings complement results from similar studies in higher-latitude climates, demonstrating an apparent widespread response of spring butterflies to warming and drying conditions.



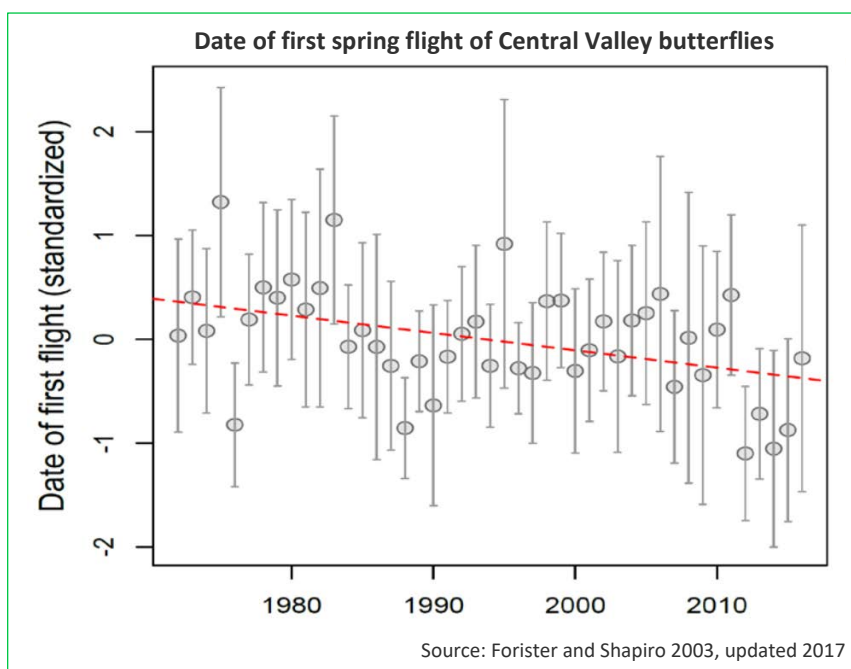
Observations are from the study area depicted by the red circle.

Source: Shapiro 2018

What does the indicator show?

Since 1972, the date when butterflies are first observed in the spring is occurring earlier in this Central Valley region. The date when the first adult of a species is observed in the field is recorded as the "date of first flight." On the graph below, each circle represents the dates of first flight aggregated across 23 butterfly species. The lower the value on the graph, the earlier the date.

The 23 butterfly species studied are not responding in the same manner. Nine have been appearing earlier by about one month over the past 45 years. Two species showed significant trends for emerging *later* in the spring. No trend was noted for the remaining 12 species.



Source: Forster and Shapiro 2003, updated 2017





Why is this indicator important?

This indicator tracks the response of common butterfly species as a way of studying biological shifts that may be impacted by a changing climate. Warmer temperatures can advance insect larval growth and promote earlier adult emergence. Higher winter maximum temperatures and drier winter conditions were associated with early butterfly appearance. The availability of their food (nectar) and host plants may be a factor in the timing of butterfly emergence. Plant resources may in turn be affected by changes in habitat, such as urban development or agricultural operations.

Studies investigating relationships between biological shifts and climate have largely been conducted in higher, temperate latitudes, where minor climatic changes can have large effects on species. In contrast, species living in lower latitudes like the Central Valley, which have large fluctuations in temperature and precipitation, are likely to be less sensitive to a changing climate. The trend towards earlier spring appearance for butterflies occurred during a period of increasing temperatures and drier conditions, including a recent five-year drought. This suggests that Central Valley butterflies are not only responding to changing climate conditions, but they are doing so in a way that is similar to butterflies from higher-latitude climates.

Climate warming is increasingly disrupting life-history events but the consequences of such disturbances on population dynamics and species interactions are not well understood. Changes in time-sensitive relationships, such as hatching, migration and predation can alter the rates of reproduction and survival, leading some populations to decline and others to increase in abundance. It is not known if earlier spring appearances of Central Valley butterflies are having impacts on butterfly populations themselves or on other species.



For more information about this and other climate change indicators, visit:
<https://oehha.ca.gov/climate-change/report/2018-report-indicators-climate-change-california>