

Green Power’s Solar Terms Butterfly Phenological Survey Record-High Number of Butterfly Species in 18 Years Heat Waves Change Emergence Patterns

Green Power has released the latest findings of its Solar Terms Butterfly Phenological Survey. The survey was initiated in 2005 to continuously study the relationship between local butterfly species, their numbers and the solar terms, providing insight into the variations in butterfly emergence patterns. Summarizing the results from the latest period (covering 24 solar terms from “Spring Commences” in February 2022 to “Severe Cold” in January 2023), the survey results from the past year indicated a total of 128 butterfly species – a new high since the initiation of the survey – recorded in two butterfly hotspots, Shing Mun Country Park and Tai Po Kau Nature Reserve. The survey also recorded over 4,800 individual butterflies. Furthermore, the survey revealed significant changes in butterfly species, individual numbers and emergence patterns in recent years. These changes are believed to have been influenced by the effects of global warming, and they are expected to have long-term negative implications on the overall local ecosystem.

Helen Yau, Green Power’s Assistant Senior Education & Project Manager, noted an increase in the number of butterfly species since 2005. In the latest survey, a new record-high of 128 species were identified, which is a 9% increase from the average of the past 17 years. In addition, four butterfly species were recorded for the first time, including the Lesser Gull (*Cepora nadina*), Silver Royal (*Ancema blanka*), Fluffy Tit (*Zeltus amasa*), and Narrow Spark (*Sinthus nasaka*). The first three species are new in Hong Kong, and all of them belong to tropical butterfly species. According to **Yau**, due to the increasing impact of global warming, there has been a notable increase in the number of butterfly species originating from tropical regions being recorded in Hong Kong in recent years, contributing to a continuous growth in the overall number of local butterfly species.

There have also been significant changes in the emergence patterns of local butterfly species. Using the example of the five common Swallowtail butterflies in Hong Kong, **Yau** remarked that changes have been observed in the emergence peak and number of butterflies in recent years. The five common Swallowtail butterflies in Hong Kong include the Paris Peacock (*Papilio paris*), Red Helen (*Papilio helenus*), Common Mormon (*Papilio polytes*), Great Mormon (*Papilio memnon*), and Spangle (*Papilio protenor*). These butterflies are larger in size, more abundant in number and widely distributed, making them easy to observe.

In the past, these five common Swallowtail butterflies exhibited stable emergence patterns, typically with three peaks throughout the year during Vernal Equinox (late March), Corn-on-Ear (early June), and Frost (late October). During these solar terms, a large number of butterflies would be recorded. **Yau** explained that Swallowtails would begin to emerge from their pupa as temperatures gradually rise back to above 20 degrees Celsius in spring, resulting in the first peak of the year during Vernal Equinox (late March). The lifespan of adult Swallowtails generally ranges from one to two months, and they complete their reproductive cycle before reaching the end of their lifespan. The new generation of butterflies then gradually emerges in May, resulting in the second peak during Corn-on-Ear (early June), which usually marks the highest number of butterfly sightings in the year. As summer approaches, butterfly reproduction is affected by the scorching heat. This includes a rise in larvae mortality rates. Some butterflies may prolong their pupal stage to avoid the heat, and only emerge in October when temperatures start to drop below 27 degrees Celsius, ushering in the final peak of the year.

Warmer Weathers Alter Butterfly Cycles

However, survey data from the past five years have revealed changes in the aforementioned emergence patterns of Swallowtails. **Yau** explained that based on records from the Hong Kong Observatory, the average temperature over the past five years has risen by approximately 1 degree Celsius from that of the period between 2005 and 2017. Moreover, the average temperature in late February has increased by 1.2 degrees Celsius. Due to this early rise in temperature, Swallowtails have been emerging as early as during the Spring Showers (late February). The number of butterfly sightings during the Spring Showers over the past five years has nearly doubled compared to the previous average, indicating earlier butterfly activity. Additionally, due to the overall warmer temperatures throughout spring, the number of Swallowtails has remained at higher levels, making the first peak in butterfly numbers during the spring season less prominent than before.

Comparing historical records of heat wave warnings, **Yau** noted that in the past, these warnings were more commonly seen at the end of May or early June. However, they have consistently been issued in early May in the past five years. Last year, the Observatory issued the earliest recorded heat wave warning in April. This indicates that heat waves are arriving earlier in Hong Kong, causing the second peak in Swallowtail numbers during summer to occur earlier in Corn Forms (late May). The number of butterfly sightings during Corn-on-Ear (early June) in the past five years has declined by 50% from the previous average as well, and the overall number of Swallowtails recorded during summer has also decreased. In addition, the third peak in butterfly numbers that used to occur during Frost (late October) has become less pronounced in recent years, and this is due to a more even distribution of Swallowtail numbers during summer and autumn.

Impact of Phenological Disruptions Should Not Be Overlooked

Yau pointed out that the emergence patterns of Swallowtails have been impacted by heat waves, and such changes in butterfly emergence patterns are not unique to Hong Kong. Similar studies elsewhere have found that butterflies are emerging earlier in spring and prolonging pupal stages in the summer. She remarked that Swallowtails, with their abundance in number and reliance on nectar as a food source, play a vital role as pollinators for local plants. Therefore, the altered emergence patterns of these butterflies will have significant implications for the pollination and fruiting of local plant species. However, she has not observed any significant changes in the flowering periods of certain plants (e.g. Lidded Cleistocalyx (*Cleistocalyx operculatus*), Acronychia (*Acronychia pedunculata*) and Prickly Ash (*Zanthoxylum avicennae*)) that bloom during peak summer. In other words, with the significantly reduced number of Swallowtails during the flowering period of these plants, the chances of successful pollination and fruiting will decrease, which could ultimately impact birds and mammals that feed on their fruits.

Last year, the United Nation Environment Programme released a report titled “Phenology: Climate change is shifting the rhythm of nature”, which highlighted that species with shorter life cycles, including butterflies, are more susceptible to rapid changes in response to climate variations, while it may take several decades for change to become apparent in species with longer life cycles, such as trees. Phenological disruptions resulting from climate change will have profound impact on the environment and require careful monitoring. It is imperative that relevant authorities take prompt, appropriate measures to address the challenges posed by climate change.

About Solar Terms Butterfly Phenological Survey

Green Power launched the first of its kind Solar Terms Butterfly Phenological Survey in 2005. The survey covers Shing Mun Country Park and Tai Po Kau Nature Reserve and collects butterfly data in the long term for analysis and comparison. Since ancient time, the solar terms have been used by traditional farmers to predict climate and crop harvest. The butterfly survey is carried out during the solar terms to record the number of butterfly species and investigate any changes and correlation.