

Altitudes attained by migrating monarch butterflies, *Danaus p. plexippus* (Lepidoptera: Danaidae), as reported by glider pilots

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Glider pilots at four different locations in North America have observed *D. plexippus* flying at altitudes ranging from 600 to 1250 m. Three of the observers reported that the butterflies were soaring in thermals, and one observer reported that they occasionally enter clouds.

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Des pilotes de planeurs de quatre régions différentes d'Amérique du Nord affirment avoir vu voler des *D. plexippus* à des altitudes allant de 600 à 1250 m. Trois des pilotes précisent que les papillons observés planaient dans des thermiques et l'un d'entre eux a signalé qu'ils pénétraient parfois dans les nuages.

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Monarch butterflies (*Danaus plexippus plexippus* L.) employ soaring flight during their annual migration to the overwintering sites in Mexico (Gibo and Pallett 1979; Schmidt-Koenig 1979). Soaring butterflies are gliding in rising air currents (lift) and as a result are able to gain or maintain altitude and fly cross country with very little expenditure of energy (Gibo and Pallett 1979). The commonest form of lift results from convection and consists of rising bubbles or columns of air that are warmer than the surrounding air. These systems are termed thermals.

Current understanding of the limits and effectiveness of this flight strategy is limited owing to the ground-based observation techniques employed in the previous studies. Gibo and Pallett (1979) used 7 × 35 field glasses and were able to determine that soaring *D. plexippus* can ascend in lift to at least 300 m. However, the butterflies were often difficult to observe when they flew near low clouds or achieved altitudes greater than 200 m. In addition, when high-flying butterflies glided straight overhead without pausing to circle, it was often difficult or impossible to determine if they were gaining, maintaining, or losing altitude. The differences are critical, because in the two former cases they would be soaring in thermals, and in the latter case they would be gliding in stable or descending air. Observations by Schmidt-Koenig (1979) concentrated on the direction of flight and the influence of wind but were also restricted because his methods were similar to those of Gibo and Pallett (1979).

Unless the butterflies can be observed at higher altitudes, their behaviour noted, and the corresponding lift conditions measured, only partial knowledge of their strategies is possible. A research tool that can make

these observations possible is the sailplane or glider. A pilot flying in a glider could observe the behaviour of any butterflies encountered and then obtain additional information, such as altitude, from the navigational instruments. These techniques have been used successfully by researchers studying soaring flight in birds (e.g., Pennycuik 1972; Raspet 1960).

In order to sample a large geographical area, I decided to obtain reports of *D. plexippus* sightings from glider pilots in the United States and Canada. A notice was placed in the February issue of *Soaring* (February circulation = 19 100) requesting reports on Monarch butterflies sighted during glider flights, particularly information on altitude, locality, and date of *D. plexippus* observed soaring in thermals. This preliminary effort produced 11 responses, 4 of which described sightings of *D. plexippus* at altitudes greater than 600 m above the ground. Table 1 shows that all the observations were in the eastern half of North America and extended from southern Ontario to Missouri. Three of the observers reported that the sightings occurred during August and September, months of peak migratory activity in each area. The highest altitudes above ground level reported for the butterflies were 1250 m near Cooperstown, New York, and 1200 m near St. Louis, Missouri. Three of the observers reported that the butterflies were definitely soaring in thermals. Mr. Van Dyke (observer 3), also reported that in the St. Louis region migrating butterflies flew near the ground until convection started, usually around midmorning. Afterwards, the butterflies were observed ascending in thermals and tended to accumulate near cloud base. He has also observed *D. plexippus* entering clouds. Soaring birds also fly near cloud base and have been observed to enter clouds on occasion

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TABLE 1. Reported flight altitudes of *D. plexippus* at four locations in North America

Observer No. and name	Locality	Month	No. of sightings	Altitude (m) above ground	Soaring in lift
(1) V. Werneburg	Rockton, Ontario	August	1	900	Yes
(2) E. B. Wells	Cooperstown, New York*	September	1	1250	—
			1	>600	—
(3) W. O. Maxwell	Dayton, Ohio	—	N†	>600	Yes
(4) J. Van Dyke	St. Louis, Missouri	September	N†	1000–1200	Yes

*Nearest major town or city to area of flight.

†Frequent observations of butterflies at stated altitude.

(Pennycuik 1972). However, *D. plexippus* soaring near cloud base may not be able to avoid ascending into the clouds because the lift is often quite strong in this region.

The advantages gained by a butterfly that has soared to an altitude of 1200 m or more are obvious. The glide ratio of *D. plexippus* has been conservatively estimated as 4:1 (Gibo and Pallett 1979). Consequently, when a butterfly soaring at 1200 m leaves the lift, it can still glide 4800 m (4×1200 m) or almost 5 km before nearing the ground and having to resume powered flight. However, by manoeuvring to remain within the thermal as long as possible, a soaring butterfly gains a free ride downwind. Because wind velocities usually increase with altitude, maximum cross-country distances are achieved by soaring as high as possible.

It is apparent from the above observations that previous ground-based observations on flight strategies in *D. plexippus* (e.g., Beall 1941; Gibo and Pallett 1979; Kanz 1977; Luggier 1890; Schmidt-Koenig 1979; Shannon 1916; Urquhart 1960; Williams *et al.* 1942) examined only a small portion of the air column that the migrating butterflies actually occupy. Research based on this pilot project is continuing and more detailed information on *D. plexippus* flight strategies is anticipated.

NOTE ADDED IN PROOF: Two additional sightings were recently reported. Using the same format as Table 1, the observations were as follows: B. Michener, Hinkley, Illinois, August, 490 m, in lift; J. Beals, Greene, New York, October, 760 m, not noted if lift present.

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