Better Red than Dead

by Andy Davis

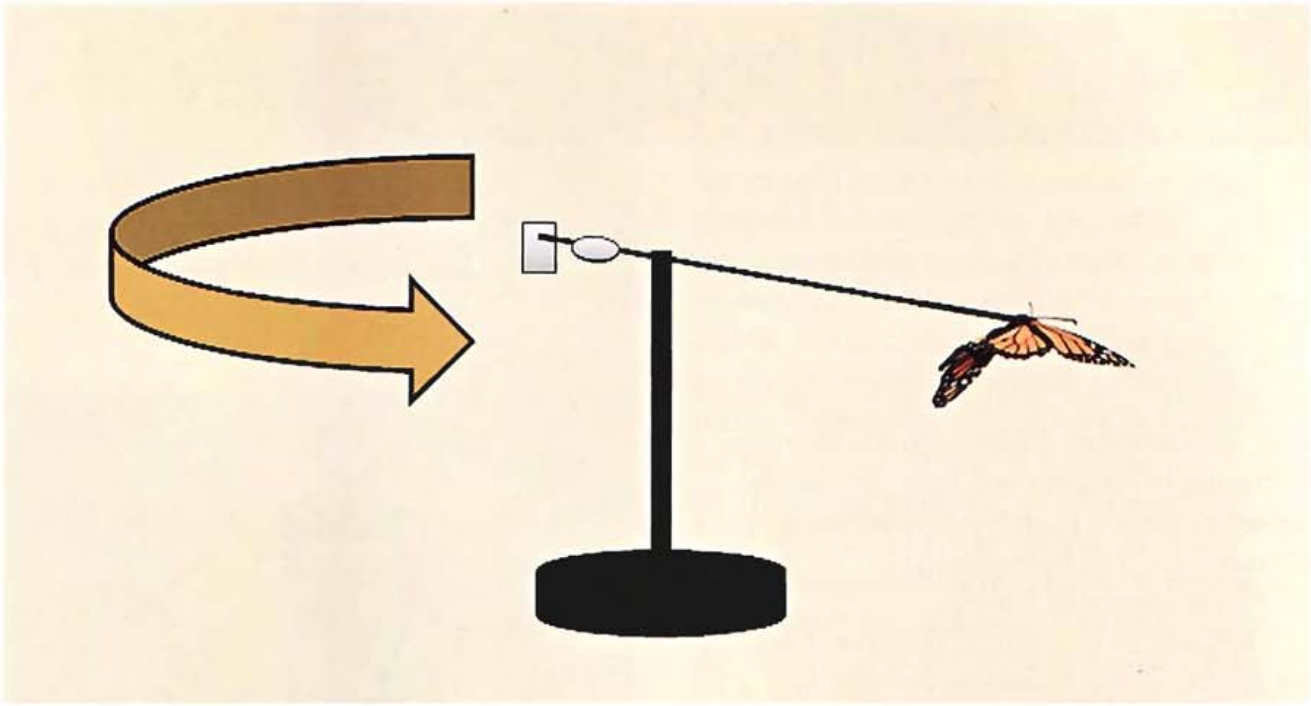
The next time you see a Monarch up close, either through binoculars or in a good photograph you've taken, take a careful look at the color of its wings. Most people know that Monarchs have distinctive orange wings with black borders, but it is less well-known that they have a subtle degree of variation in the brightness, or hue, of their orange color. Some individuals can have deeper shades of orange, even approaching red, while others can have a lighter orange, almost yellow color. Why is this? Recently, we published the results of a collaborative research project that explored the biological significance of this color variation.

The idea for the project started when I was capturing fall-migrating Monarchs for a scientific study and noticed that many of them appeared to have wings that were redder than those I'd seen in the summer. After careful examination of several Monarch collections, made both in the fall and summer, it turned out that this was a real difference I was seeing. This made me wonder if redness was somehow related to flight ability, since, for the migrants, the ability to fly long distances would be of paramount importance (less so for the summer Monarchs).

Last year I set about testing this idea by re-examining a series of experiments that had been conducted by students under the supervision of myself and Dr. Sonia Altizer. These projects all involved measuring flight performance (flight speed, endurance, etc.) of Monarchs using an apparatus that is the butterfly equivalent of a treadmill (in entomological terms, a 'flightmill'). A colleague at the Emory University Physics Dept. (Horace Dale) built this device for us (see diagram on page 19) for the initial project and we have also used it for two subsequent projects. The projects all differed in their goals but the methods for each were essentially the same — we glued a small wire to the back of the Monarchs (it does not hurt them or hinder their wing movements), then attached the wire to the carbon rod, which turns on a pivot. A flag passed through a data-logger on each revolution, which allows us to monitor how fast the Monarchs fly and for how long (time and distance). Some Monarchs fly on this device for less than 10 minutes, while others keep flying for several hours!

We had taken a digital image of all Monarchs before they were placed on the flight mill, using a standard flatbed scanner connected to a computer. From the scanned images, we can use special computer software to precisely assess the shade of orange on each Monarch's wings. So, when I went back and examined the orange color of all Monarchs that were used in flight mill experiments (a total of 121 Monarchs), it turned out that in all three experiments, the redder the Monarch, the farther it flew! This pattern held true even after we accounted for things like wing size, shape and gender (females tend to fly farther than males). While all Monarchs in the experiments were reared in the lab (i.e., they were non-migrants), these results still were consistent with my prior observation that migrant Monarchs tend to be redder than breeding, non-migrant monarchs.

The reason for this link between redness and flight is not yet clear, although we do know that in the lab, redder Monarchs tend to live longer, and are larger overall, suggesting that redness is an index of individual quality (the redder the better!) with this species, and that redder Monarchs are simply superior in



A Monarch "flightmill" was used to test the endurance of Monarchs. During the test, flower boxes placed around the circular flight path provided incentives for the Monarchs to continue flying.

Jeffrey Glassberg (2)

all aspects, including flight ability. If so, this would be similar to what we see with many species of brightly-colored birds, where bright plumage is a sign of high fitness. In the future we hope to explore questions relating to why some Monarchs become redder than others. For example, another colleague (Dr. Michelle Solensky) and I have plans to examine the effect of caterpillar nutrition on adult wing color. Another idea is to look at the redness of Monarchs that are reared on different species of milkweeds. In fact, there are many questions we would like to tackle in the theme of Monarch wing color, so stay tuned for updates!

Left: Two Monarchs show variation in the intensity of the red-orange color of their wings.

Left top: Oct. 31, 2006. National Butterfly Center, Hidalgo Co., TX.

Left bottom: Dec. 7, Dec. 7, 2004. National Butterfly Center, Hidalgo Co., TX.