

# Preliminary Findings of the Southwest Monarch Study

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## Introduction

The Boyce Thompson Arboretum, with the help of a grant from the Monarch Migration Project West out of Seattle, Washington, began tagging wild monarch butterflies (*Danaus plexippus*) as a part of its Southwest Monarch Study in September, 2003. The purpose of this research is to determine the migration behavior of monarch butterflies in the southwestern United States. Up until 2003, very little attention had been given to the desert southwest in terms of monarch butterfly activity.

Monarch migration theory has centered around the idea that the Continental Divide is a natural dividing line between eastern and western populations of monarchs in the United States and Canada. The theory has been that monarchs east of the Continental Divide migrate south while those west of the Continental Divide migrated south and west to overwintering sites along the Pacific coast, from northern California south to Baja, California (Brower, 1995).

The tagging of monarch butterflies, allowing the tracking of individual butterflies, began in 1937 with the work of Dr. Fred Urquhart of the University of Toronto. In January, 1975 Urquhart's research team made the discovery of the overwintering sites in the Transvolcanic Range located approximately 200 miles northwest of Mexico City in the state of Michoacan, Mexico (Urquhart, 1976).

In 1992, the Monarch Watch organization at the University of Kansas began tagging monarch butterflies in the eastern United States. In the western United States, several individuals and organizations have tagged butterflies at the overwintering sites in California.

Research conducted at the Arizona- Sonora Desert Museum (ASDM) from 1998-2001 brought into question the notion that the Continental Divide formed a natural barrier between the two populations of monarchs. ASDM's study put forward the idea that monarchs in Arizona and Sonora, Mexico were in fact traveling south, rather than west, in opposition to the accepted migration route of western monarchs (ASDM, 2006).

The ASDM data however was based largely on anecdotal observation of flight bearings rather than the tracking of individual butterflies. Robert Michael Pyle came to a similar

conclusion using similar methods in his book *Chasing Monarchs* (Pyle, 1999).

Monarch butterfly research at the Boyce Thompson Arboretum is focused on three primary questions. First, what is the destination of migrating monarchs passing through the southwest? Secondly, which species of milkweeds (*Asclepidaceae*) do monarchs use as a larval food plant while they are in Arizona and the southwest. Thirdly, is there a "year-round" breeding population of monarchs in Arizona or are the monarchs witnessed in summer and fall simply passing through on their way from someplace else to someplace else? The purpose of this article is to present preliminary data relating to the first and second questions.



**Figure 1.** *Asclepias linarea* hosting a monarch caterpillar in Molino Basin near Tucson.

## How Do You Tag a Butterfly?

The challenging part of the tagging process is locating areas where monarchs abound in the late summer and early autumn. The Southwest Monarch Study begins tagging in August and continues until the flow of monarchs dries up, typically late October or early November.

A small fraction of monarchs use Arizona as a travel corridor when compared to locations in the eastern United States. So, while tagging fifteen monarchs in a morning for Indiana may be a subpar day, for Arizona it would be a noteworthy day. Among the "hot spots" for finding monarchs in late summer in Arizona are Arivaca Cienega and Sonoita Creek in Santa Cruz County, and the Canelo Hills, San Pedro River Valley, and Cave Creek in Cochise County.

Capturing the monarch is no easy feat either. Monarchs tend to become more active as the day goes on, therefore the best

opportunities for bagging monarchs is usually in the morning. Successful captures typically require waiting on the monarch to perch on a twig or flower. After capturing the monarch, remove it from the net by grasping the butterfly by the leading edge of the forewings, with the wings held together over the insect's back. Frequently the barbs on the insect's legs will hook on the net, but a gentle tug typically dislodges the insect.



**Figure 2.** This tagger is correctly holding the butterfly by the leading edge of its forewings. The tag is placed on the middle of the discal cell of the right hindwing. (Adriane Grimaldi).

The tags that are used are 5/16" diameter stickers, light blue in color, each with an individual identification number and contact email address. The tags are affixed to the discal cell of the underneath side of the hindwing of the butterfly. Press down firmly on the tag to be sure that it is securely attached to the wing. Prior to releasing the insect it is important to record data. This data includes the tagger's name, tag number, date, gender of the butterfly, location, and what the butterfly was doing when it was captured.

**Table 1.** Number of monarchs tagged since 2003.

Year	Wild	Farm-raised	Total
2003	65	0	65
2004	60	422	482
2005	92	646	738
2006	116	816	932
<b>Total</b>	<b>333</b>	<b>1884</b>	<b>2217</b>

**Results**

The Southwest Monarch Study has tagged over 2000 monarchs since tagging began in 2003 (see Table 1). Many of these monarchs have been farm-raised insects as a part of the Monarch Pavilion activities at the Desert Botanical Garden (DBG) in Phoenix. Each year DBG conducts education activities relating to monarch butterflies during its Monarch Pavilion exhibit in October. Among these activities are programs about the tagging efforts of the Southwest Monarch Study, which include tagging demonstrations. DBG has worked diligently to acquire the necessary permits from state and federal officials to release tagged monarchs.

It is important to note that the 26 percent increase in wild monarchs tagged between 2005 and 2006 was the result of a concerted effort to recruit citizen scientists from throughout Arizona to help with the tagging. Three tagging trainings took place in southern Arizona during August and September of 2006. Nearly 60 citizen scientists participated in the training with ten individuals actively pursuing and tagging monarchs on their own following the training.

Of the 2217 monarchs tagged since the 2003, the study has acquired recovery information for eight butterflies (see Table 2). The table indicates one of the problems frequently encountered with citizen science projects, that being incomplete data. Recovery data for Monarch H826 was sent via email to the study, including a digital image of the butterfly. Unfortunately the sender of the email did not provide any location information.

**Table 2.**

Tag #	Location Tagged	Distance (miles)	Trek Bearing (degrees)	Year	Recovery Location
D978	DBG	1197	128	2004	Michoacan, Mexico
E472	DBG	8	187	2004	Awhatukee, AZ
H826	DBG	?	?	2005	?
I828	DBG	23	284	2005	Youngton, AZ
I828		37	246	2005	Tonapah, AZ
H475	DBG	3	289	2005	Phoenix, AZ
K664	DBG	2	51	2006	Scottsdale, AZ
?	?	Approx. 1200	?	2006	Michoacan, Mexico

The monarch recovered in Michoacan, Mexico in 2006 presented its own set of challenges. The finder of this butterfly was a monarch researcher who had captured the monarch for butterfly mass studies. Unfortunately the monarch escaped before tag information could be recorded.

Another interesting piece of data is Monarch I828. This butterfly was actually recovered twice. The butterfly was photographed in Youngtown, Arizona approximately 23 miles from its release location. Two days later the same butterfly was spotted again by a homeowner in Tonopah, Arizona 37 miles from the previous sighting.

The trek bearings of these few butterflies that have been recovered indicate that there is no clear pattern of travel of these butterflies. Monarchs D978 and E472 were recovered south and southeast of their release locations. Monarchs I828 and H475 were recovered west of their release points while K664 was recovered northeast of the release point. The short distance traveled by H475 and K664 could indicate a search for nectar rather than a migratory heading.

Another aspect of the study is to determine milkweed preferences of reproductive female monarchs in Arizona. Currently the Boyce Thompson Arboretum does not have a captive breeding program for monarchs, therefore milkweed preferences need to be ascertained from anecdotal evidence presented by milkweed monitoring citizen scientists. While this anecdotal evidence can be very subjective based on the location of monitors, season of monitoring, and other factors, the anecdotal information has yielded some food for thought. Southwest Monarch Study milkweed monitors observed wild populations of *Asclepias asperula*, *A.*

*speciosa*, *A. tuberosa*, *A. subulata*, and *A. subverticillata* throughout the course of the growing season. Of these species, only *A. subverticillata* was ever found to be hosting monarch caterpillars. In isolated observations, *A. linaria* and *A. nyctaginifolia* were also found to be hosting caterpillars. As a part of this aspect of the study, an attempt has been made to propagate as many species of native Arizona milkweed as possible at the Boyce Thompson Arboretum. During the course of 2006, eleven *Asclepias* species were growing in one and two gallon pots at the Arboretum (see Table 3).

On two occasions during the summer and fall of 2006, fertile female monarchs visited the "milkweed patch" and laid eggs. Data was collected regarding which species of *Asclepias* were chosen for egg laying by these fertile females. Upon discovery of these larvae and eggs, the individual plant hosts were covered with a net bag to prevent larvae from traveling from one plant to another.

Since Arizona milkweeds have various growth forms including shrubs, sub-shrubs, single-stemmed upright perennials and others, it was determined to record data as caterpillars per stem since whole plants could vary greatly in terms of available forage for a caterpillar.

While the results presented in Table 3 are too minimal to justify a statement of preference of these monarch females, the results do present possible trends to study further. The two females in question obviously stayed away from certain *Asclepias* species including *A. subulata*, *A. albicans*, *A. asperula*, and *A. linaria*.

**Table 3.** Host Preferences by Monarch butterflies

stems	August 21, 2006			stems	December 2, 2006	
	Monarch caterpillars	caterpillars per stem	<i>Asclepias</i> species		Monarch caterpillars	caterpillars per stem
372*	0	0	<i>albicans</i>	372*	0	0
39	2	0.0513	<i>angustifolia</i>	29	19	0.6552
38	0	0	<i>asperula</i>	24	0	0
4	0	0	<i>brachystephana</i>	4	0	0
87	25	0.2874	<i>erosa</i>	0	0	0
9	3	0.3333	<i>latifolia</i>	0	0	0
23	0	0	<i>lemmoni</i>	0	0	0
12	0	0	<i>linaria</i>	12	0	0
30	6	0.2000	<i>oenotheroides</i>	15	0	0
276*	0	0	<i>subulata</i>	276*	0	0
1251*	11	0.0088	<i>subverticillata</i>	1251*	1	0.0008

\*estimate

The females also appeared to be attracted to *A. angustifolia* and *A. erosa*, even though those species presented a minority of the total population of *Asclepias* available to choose from.

### Conclusion

Obviously the results presented here are very preliminary, but at the same time they propose some interesting ideas. Much more study is needed regarding monarch migratory behavior in Arizona and the southwest. Further study is also required regarding the utilization of southwestern milkweed species by reproductive monarchs.

While taking a citizen science approach to this research has certain drawbacks, as mentioned previously, it also provides unique opportunities not easily garnered with such a large research area and such a mobile research subject. The recruitment of capable citizen scientists is every bit as important to the study as is the acquisition of nets and tags. Citizen scientists interested in participating in this important research should contact the author or the Boyce Thompson Arboretum at 520-689-2723. (All photos by author unless otherwise indicated.)

### Literature Cited

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- Urquhart, F.A. 1976. Found at Last: the Monarch's Winter Home. *National Geographic* 150: 161-173.



**Figure 4.** *Asclepias subverticillata* growing in a wet ditch near Pine, AZ (Gila County)



**Figure 5.** *Asclepias erosa* growing along Alamo Dam Road in La Paz County, AZ.



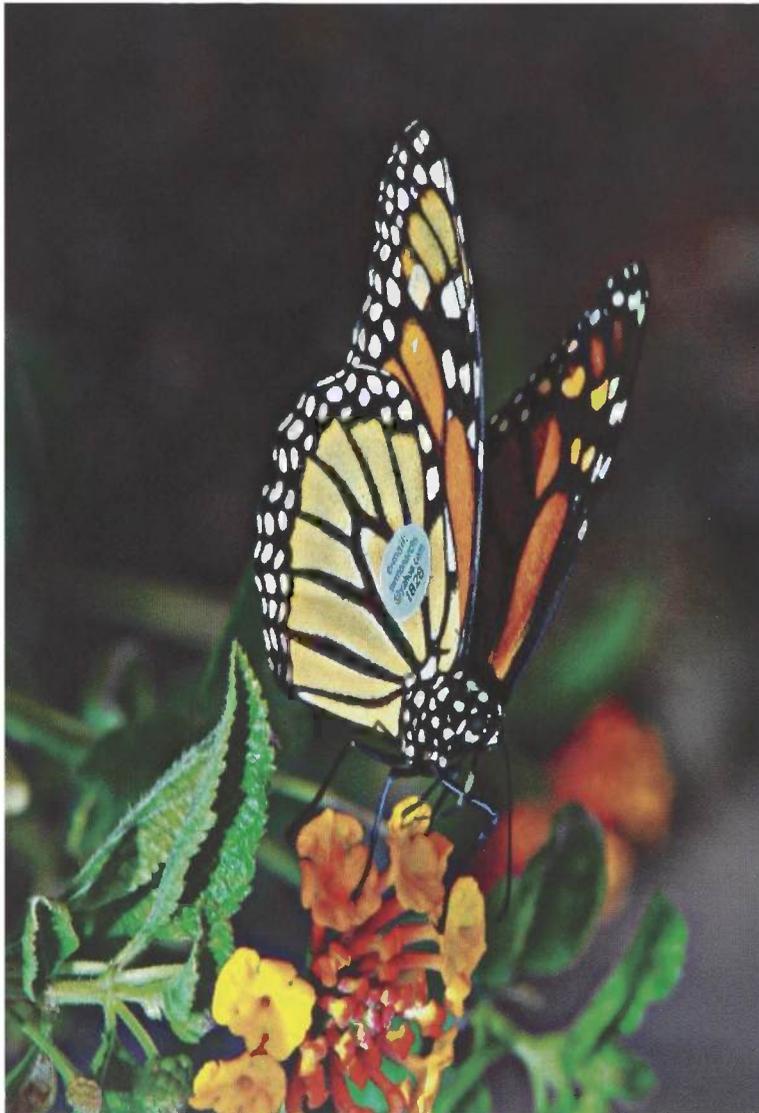
**Figure 6.** Monarch H826, recovery location unknown. Author unknown.



**Figure 7.** A tagging training session near Palominas, AZ.



**Figure 8.** A young tagger looking eye to eye with a monarch butterfly.



**Figure 9.** Monarch 1828 was recovered twice on its journey west (Earle Robinson)