

MONARCH WATCH



DEDICATED TO EDUCATION, CONSERVATION, AND RESEARCH

MAY 1999 • VOL. 7 • No. 1

1998 SEASON SUMMARY

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HOW TO REACH MONARCH WATCH.	BACK COVER

Monarch Watch is a cooperative network of students, teachers, volunteers and researchers dedicated to the study of the biology of the Monarch butterfly, *Danaus plexippus*.

Our goals are: to further science education, particularly in primary and secondary school systems; to promote the conservation of Monarch butterflies; and to involve thousands of students and adults in a cooperative study of the Monarchs' spectacular fall migration.

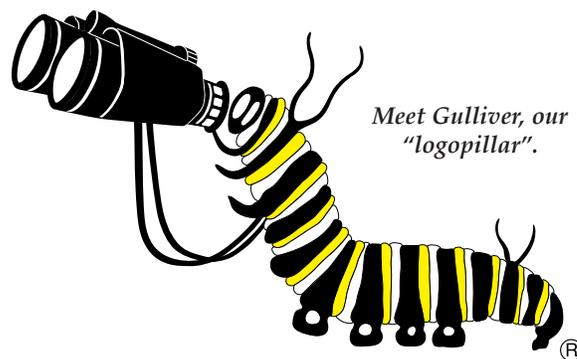
The project is directed by Dr. Orley R. "Chip" Taylor (Department of Entomology, University of Kansas) in collaboration with Brad Williamson (Olathe East High School), Dr. Bill Calvert (Texas Monarch Watch) and Dr. Karen Oberhauser (University of Minnesota).

Monarch Watch wishes to thank all members, taggers, participants and contributors. We appreciate your enthusiastic cooperation and assistance in furthering the goals of this program.

Thank you to the regional coordinators - without your assistance things would be even more hectic in our lab!

Thank you to all the students and staff at KU who so ably assist with the program - Jim Lovett, Dana Wilfong, Stephanie Darnell, and the entire Critter Crew.

A special thank you goes out to all of you who send us cards, letters, photographs, news clippings, and other neat stuff. It is really exciting for us to see Monarch Watchers in action, and it is so rewarding to learn of the positive experiences that people have with Monarchs and Monarch Watch.



On the cover: Clustered Monarchs in Oyamel fir tree at Mojonera Alta, an overwintering site on Sierra Chincua in Michoacán, Mexico. Mojonera Alta was visited by Ken Brugger on 2 Feb 1975 (SEE PAGE 24).
Photo by O.R. Taylor, December 1998.

This publication is funded by tagging memberships, tax-deductible contributions to Monarch Watch and a grant from the Kansas Department of Fish and Wildlife. This year's summary was authored and prepared by Orley R. Taylor (Department of Entomology, University of Kansas, Lawrence, KS 66045) with the invaluable assistance of three remarkably talented individuals - Jim Lovett, Dana Wilfong and Stephanie Darnell. © 1999 Monarch Watch.

INTRODUCTION

This publication represents the seventh season of Monarch Watch. In 1992, we sent out two news releases asking for volunteers to tag Monarchs. I had no idea at the time how this small project would change my life nor did I envision Monarch Watch as it is today. It's fair to say that Monarch Watch runs my life and continues to lead me into new areas of public education and lines of research that I hadn't anticipated. Each year brings new adventures and connections that seem to arise simply because Monarch Watch exists.

In the paragraphs that follow, I will highlight some of these adventures and summarize new developments concerning Monarchs and Monarch Watch during the past year.

HYDROGEN ISOTOPE RESEARCH

As a scientist and someone interested in Monarch conservation, the most exciting event of the year was the publication of the first paper summarizing the hydrogen isotope collaboration of Monarch Watch (and our many volunteers) with Drs. Wassenaar and Hobson of Environment Canada. A chronology for this study is given on page 30 and a review of the entire project is given on page 22. The results of this study were surprising and have led to concerns about the development of transgenic plants (PAGE 48) that could have a negative impact on milkweed populations within and adjacent to cropland. The possibility of a decline in the abundance of milkweed in the future and the need to establish credibility with our colleagues in Mexico has prompted me to editorialize about the need for milkweed conservation and restoration (PAGE 20).

ORIENTATION AND NAVIGATION

Our research on orientation and navigation of migrating Monarchs has become very exciting. The goal of this research is to determine how Monarchs navigate as they move across the continent to Mexico. We are currently working on a series of experiments to determine whether Monarchs use a magnetic compass to navigate. In a recent publication, we showed that Monarchs were disorientated when exposed to a strong magnetic pulse. In another paper, we will present data on the responses of migratory Monarchs to magnetic fields (PAGE 17). Unfortunately, I can't reveal the results of this study until it's published. Stay tuned.

RECOVERIES IN 1998

Tag recoveries made history in the winter of 1998-99. To date, 399 tags applied by Monarch Watch volunteers in the fall of 1998 have been recovered in Mexico! I can hardly believe it, but it's true. Tagged Monarchs have been found in areas adjacent to the overwintering sites in Mexico since 1958. However, it wasn't until 1975 that the first one was found *within* an overwintering area - when the first two of these sites were located by Ken and Cathy Brugger (PAGE 24). (Only 147 tagged Monarchs had been recovered in Mexico from the fall of 1957 through the winter of 1998.) The break-

through in tag recoveries started last winter with David Marriott of the Monarch Program (San Diego). He organized the guides who were assisting with the production of an IMAX film to look for tags among the dead butterflies on the forest floor while they were waiting for the film crew to finish their shooting. David rewarded the workers for the recovered tags and billed me later for his expenses. Frankly, I was a bit concerned about this, and two years ago I had urged people not to buy tags since this could lead to disruption of the colonies by those seeking tags and possible corruption of the data. David argued that neither of these things would happen, and he eventually wore down my resistance to offering pesos for the tags. While visiting El Rosario in December, I decided to offer 50 pesos per tag, and we told the guides that several people acting on the behalf of Monarch Watch would buy the tags during the course of the winter. My hope was that this incentive would increase the recoveries from 10-15, our average recovery rate, to *maybe* 20-30 recoveries. Wow, was I wrong! Fifty pesos proved to be a big incentive and we ended up paying an unanticipated \$2500 for recovered tags. Is the data worth the cost? Yes! For the first time we have enough recoveries to actually work with the data. From these data we can calculate recovery rates as a function of distance, estimate mortality rates of the migrants, and calculate the total size of the migratory population (PAGE 18). This is a breakthrough in terms of getting at the dynamics and demography of the migratory population. We've gone beyond simply verifying where the Monarchs in Mexico originate. This is where I wanted to be, but I never thought we'd get here. The recovery rates were just too low. If you tagged 200 Monarchs in 1998, there is a good chance one of your tags was recovered (PAGE 27). In previous years, you had to tag 1000-5000 Monarchs to have a good chance for a recovery.

MONARCH POPULATION SIZE & CONSERVATION

The lower migratory population in the fall of 1998 and the relatively small overwintering population of 60 million Monarchs (68% of which were located at El Rosario and Sierra Chincua, PAGE 18) again emphasize the fragile and vulnerable nature of the Monarch migration. No doubt the lower number of Monarchs this year facilitated recovery of tags since the 80,000 butterflies tagged in 1998 represented a larger proportion of the total population than in previous years. Although the high tag recovery rate suggests that survival of the migrants and the tagged butterflies is relatively high (PAGE 20), it's still worrisome that >30% of the tagged butterflies end up on one mountainside. The over-

(“INTRODUCTION” CONTINUED ON PAGE 4)

EACH YEAR IT BECOMES MORE DIFFICULT TO CHOOSE AMONG THE POSSIBLE ITEMS TO INCLUDE IN THIS ANNUAL SUMMARY. WE APOLOGIZE IF YOUR FAVORITE TOPIC HAS NOT BEEN COVERED. WE WELCOME YOUR SUGGESTIONS FOR INCLUSION IN THE SUMMARY FOR 1999.

("INTRODUCTION" CONTINUED FROM PAGE 3)

wintering population is too concentrated. Such concentrated populations are vulnerable to catastrophic events such as snow, freezing rain, and deforestation. We are right to be concerned about the long-term preservation of the eastern Monarch population. The shrinking forests in the region could concentrate the Monarchs even further in the future.

A MONARCH DOCUMENTARY

Late in the summer we agreed to assist a Japanese video production company (NHK) with a long documentary on the Monarch migration (PAGE 50). There are ups and downs associated with such commitments, but this production was beneficial to me personally in a number of ways that were unanticipated. Through the film making, I had the opportunity to meet and interview Ken Brugger (PAGE 24). Ken and his wife, Cathy, were the first outsiders to be led by local guides to overwintering Monarch colonies in 1975. I was fortunate to meet Ken; his health was failing and he died 6 weeks later (PAGE 25). In December, more by good luck than design, we located Don Benito Juárez (age 96), the person who first guided Ken and Cathy Brugger to one of the overwintering colonies on Cerro Pelon on 2 January 1975 (PAGE 24). We worked extensively with Eduardo Rendon and Eligio Garcia during the filming in Mexico and I became aware of the important role each has had in providing basic information on the number of overwintering Monarchs and the factors that contribute to Monarch mortality (PAGE 47).

ABOUT MONARCH WATCH

As Monarch Watch has grown, we have had to add personnel. Last year at this time, Stephanie Darnell joined our staff as Assistant Director. Stephanie assists with the search for grant funds, works on curriculum development, gives talks at schools and nature centers, answers a ton of email and helps return some of your phone calls. It's been a great help to have Stephanie on the staff.

Adopt-A-Classroom (PAGE 44), a program we initiated last spring to help the schools in the Monarch Reserve in Mexico, is going well. Our goal is to raise funds to purchase materials for science and math kits for the schools in the Reserve. We are very grateful to Janis Lentz, an award winning teacher from Jackson Elementary in McAllen, Texas, who developed the kits and the curriculum. In addition to the kits, we have asked schools to send us usable school supplies that might otherwise be discarded at the end of the school year. Presently, we've assembled materials for 30 kits, and we will deliver these together with a large number of donated books and school materials to Mexico in the coming months.

To raise additional money for Adopt-A-Classroom, Dana Wilfong, program assistant to Monarch Watch, spearheaded the development of the Millennium Butterfly Garden Kit (PAGE 54). The kit contains 25 packets of nectar-producing and larval food plants and also includes a booklet describing garden care and design. These kits are great for schools and they contain enough seeds for several gardens.

Jim Lovett continues to improve the Web site in addition to

his other duties and in February a newly-redesigned site went online. Jim also added a tracking system to the site last summer (PAGE 42) and given the number of unique visitors per day, it looks like we're on track to receive more than 100,000 visitors for the year - that's a lot of Monarch Watchers!

We are trying to make Monarch Watch a self-sustaining operation. Our educational and promotional items are provided at the lowest possible cost. Sale of these items together with your contributions provide the funds to run the tagging program and support student-scientist collaborative research. We need your support to continue this program. We are still seeking funds to develop additional collaborative studies and curricular materials. ▼

--Chip Taylor

SCAN A MONARCH!

Do you have a scanner? If so, you can scan live (chilled) Monarchs into your computer. Once the scan is complete, the butterflies can be tagged and/or released. Once the images are in the computer, your students can measure wing length, wing area, size of spots, amount of wing area missing, etc. using a freeware program called Scion Image. This program can be used to objectively quantify the amount of wing wear, scale loss and/or fading by using an average condition of several fresh specimens as your standard.

Scion Image is an extended version of NIH Image (rsb.info.nih.gov/nih-image), written at the National Institutes of Health. This program may be used to capture, display, analyze, enhance, measure, annotate, and output images.

Scion Image is available free of charge for both Macintosh and Windows 95/98/NT and may be downloaded from www.scioncorp.com Scion provides full technical support to users of Scion Image.

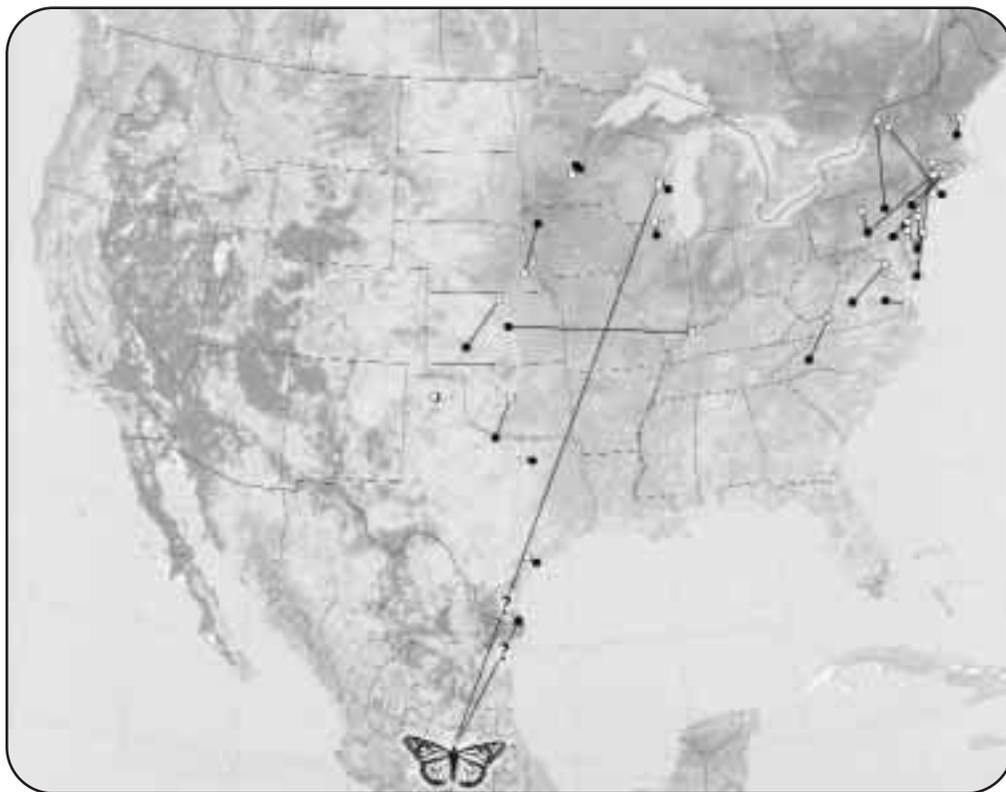
To chill the butterflies, put them in envelopes in boxes and place these on ice or in a refrigerator for at least 30 minutes. Scanning both sides of the wings only takes a couple of minutes once you have developed a routine. The butterflies take several minutes to recover from the chilling and start moving. The chilling will not harm the butterflies as long as temperatures are above freezing.

Place pencils on either side of the Monarch to protect the butterfly as you close the lid of the scanner. To keep track of each specimen, place a number alongside the specimen (face down!) just before you scan it. You will find a scanned Monarch and suggested measurements at www.MonarchWatch.org/class/studproj/mass.htm.

Measurements of the scanned Monarchs can be used by students to answer questions about asymmetry of the wings, differences between the sexes, and natural variability in size and shape. The results of the wing measurements can be integrated with the size and mass research project described on our Web site.

1998 MONARCH RECOVERY MAPS

RECOVERIES WITHIN THE UNITED STATES AND CANADA



This map represents Monarchs (N=29) tagged in 1998 and recovered at distances of 10 miles or greater within the United States and Canada.

Open circles = tagging sites
Closed circles = recovery sites

? - This Monarch (Tag XA226) was recovered in Texas on 6 April 1999 and is believed to have overwintered in Mexico.

(SEE RECOVERY DATA ON PAGE 6)

ORIGINS OF TAGGED MONARCHS RECOVERED IN MEXICO

Monarchs tagged in the United States, Canada, and Mexico recovered at the overwintering sites in Mexico during the winter of 1998-1999 (or previously unreported). Recoveries lacking complete data (N=11) are excluded.

This was a record-breaking year for recoveries in Mexico (N=418).

Tagged in 1998: 399

* Tagged in 1997: 15

* Tagged in 1996: 3

* Tagged in 1995: 1

* *Previously unreported or recently acquired from local residents.*

(SEE RECOVERY DATA ON PAGE 6)



1998 SEASON TAG RECOVERIES

This is a summary of tagged Monarchs recovered during the winter of 1998-99, listed by distance traveled. Due to space limitations, only Monarchs that traveled at least 1 mile are included here. A more complete data set may be found on our Web site. Recovery maps for the United States and Mexico generated using these data appear on page 5.

Please help by returning your data sheets. Our objective is to obtain accurate recovery data and use these data to establish the migratory routes taken by Monarchs. The ratio of recoveries to the numbers tagged helps us establish the effectiveness of our program. To obtain information on the numbers of Monarchs that were tagged, we need to have the data sheets returned to us. It is very time consuming and costly to track down recoveries without the data sheets. **Thanks!**

NUMBER OF MONARCH WATCH TAGGING KITS SENT OUT	1720
NUMBER OF MONARCH WATCH TAGS DISTRIBUTED	> 220,000
ESTIMATED NUMBER OF MONARCHS TAGGED (BASED ON RETURNED DATA SHEETS)	65-80,000
MOST MONARCHS TAGGED BY ONE GROUP OR INDIVIDUAL.	~3500
(TERRY CALLENDER & STUDENTS OF WAMEGO HIGH SCHOOL; WAMEGO, KS)	
NUMBER OF MONARCH WATCH TAGS RECOVERED WITHIN THE UNITED STATES AND CANADA	29
NUMBER OF MONARCH WATCH TAGS RECOVERED IN MEXICO	430
TOTAL MONARCH WATCH RECOVERIES REPORTED IN THIS SUMMARY.	459

Tag No.	Tagger	Tag City, State	Tagged	Reported	Report City, State	Reporter	Miles
XA226 [†]	Laura Lichtfuss	Oshkosh, WI	09/25/98	04/06/99	Rancho Viejo, TX*	Stoker	1814/476
WJ990 [†]	Lynn Frazier	Columbia, CT	08/29/98	03/01/99	El Rosario, MX	Korb	2231
BG365	Ian Morris	Wallingford, CT	09/03/98	02/10/99	El Rosario, MX	Korb	2199
WK478	Daniel Carmody	West Haven, CT	09/21/98	02/17/99	El Rosario, MX	Monarch Program	2186
WK499	Daniel Carmody	West Haven, CT	09/26/98	04/05/99	Angangueo, MX	Monarch Program	2186
ZW447	John & Sandra Charlton	Brighton, ONT	09/07/98	02/10/99	El Rosario, MX	Korb	2135
MS692 ^{††}	Donald Davis	Brighton, ONT	08/28/97	03/01/99	El Rosario, MX	Korb	2124
DC854	Donald Davis	Toronto, ONT	09/14/98	02/19/99	El Rosario, MX	Donahue	2050
YZ031 [†]	Eloise Douty	Loganton, PA	09/21/98	02/19/99	El Rosario, MX	Martín	1998
WN900	Theodore Sirko	Gettysburg, PA	09/07/98	04/05/99	Angangueo, MX	Monarch Program	1947
WN906	Theodore Sirko	Gettysburg, PA	09/11/98	02/20/99	El Rosario, MX	Donahue	1947
WR120	Cathy Patrick	Glenmont, MD	09/15/98	03/10/99	El Rosario, MX	Monarch Program	1922
WU868	John Pogacnik	Perry, OH	08/30/98	02/22/99	El Rosario, MX	Korb	1892
SD585	Jerome Wiedmann	Painesville, OH	09/06/98	02/17/99	El Rosario, MX	Monarch Program	1886
ZS531	Jerome Wiedmann	Painesville, OH	09/13/98	02/10/99	El Rosario, MX	Korb	1886
WX466	Jennifer McAulis	Kirtland, OH	09/05/98	02/20/99	El Rosario, MX	Donahue	1876
WX536	Julie Clemens	Cleveland, OH	09/12/98	02/19/99	El Rosario, MX	Donahue	1859
AC207	Prairie Wetlands Learning Center	Fergus Falls, MN	08/20/98	03/03/99	El Rosario, MX	Monarch Program	1859
AC383	Prairie Wetlands Learning Center	Fergus Falls, MN	08/25/98	02/22/99	El Rosario, MX	Korb	1859
ZN486	Paul Viger	Campbell, MN	09/03/98	02/10/99	El Rosario, MX	Korb	1844
ZN490	Paul Viger	Campbell, MN	09/08/98	12/28/98	El Rosario, MX	Korb	1844
ZO069	Paul Viger	Campbell, MN	09/04/98	03/01/99	El Rosario, MX	Korb	1844
XO720	Lee Peterson	Rockford, MI	09/18/98	12/31/98	Sierra Chincua, MX	Rojas	1832
SI287 ^{††}	Zoe Rochester	Amery, WI	09/19/97	02/20/99	El Rosario, MX	Donahue	1831
YH359	Dana Wloch	Monroe, MI	09/20/98	03/11/99	El Rosario, MX	Monarch Program	1826
YH613	Dana Wloch	Monroe, MI	09/20/98	02/17/99	El Rosario, MX	Monarch Program	1826
YH637	Dana Wloch	Monroe, MI	09/20/98	12/28/98	El Rosario, MX	Korb	1826
BS711	Julie Clemens	Lakeshore Park, OH	09/14/98	04/05/99	Angangueo, MX	Monarch Program	1825
XA195 [†]	Laura Lichtfuss	Oshkosh, WI	09/21/98	02/19/99	El Rosario, MX	Martín	1814
XF723	Anthony Jay	Morris, MN	08/28/98	02/10/99	El Rosario, MX	Korb	1813
AJ936	Dave Novar	Stillwater, MN	09/22/98	02/19/99	El Rosario, MX	Donahue	1809
BH235	Paula Waggy	Franklin, WV	09/21/98	03/10/99	El Rosario, MX	Monarch Program	1808
AE475	Betty Klitzke	Mounds View, MN	09/25/98	02/10/99	El Rosario, MX	Korb	1807
XT476 [†]	Elise Martin	Osseo, MN	09/03/98	03/10/99	El Rosario, MX	Monarch Program	1806
XA820	Judy Thoren	Buffalo, MN	08/27/98	03/10/99	El Rosario, MX	Monarch Program	1804
MQ156 [†]	Terry Kerns	Bridgeport, WV	09/03/97	02/17/99	El Rosario, MX	Monarch Program	1801
AJ434 [†]	Claudia Nelson	St. Paul, MN	09/16/98	02/10/99	El Rosario, MX	Korb	1798
AG947 [†]	Sandra Anderson	Plymouth, MN	09/28/98	12/28/98	El Rosario, MX	Korb	1798
AI731 [†]	Terry Vick	Minneapolis, MN	09/28/98	02/17/99	El Rosario, MX	Monarch Program	1797
NT274 ^{††}	Lanette Christensen	W. St. Paul, MN	09/06/97	03/14/98	Sierra Chincua, MX	Petzsch	1795

Tag No.	Tagger	Tag City, State	Tagged	Reported	Report City, State	Reporter	Miles
AE504	Arnold/Druskin/Borer/Burton	Wayzata, MN	09/25/98	02/19/99	El Rosario, MX	Martín	1794
AE545	Arnold/Druskin/Borer/Burton	Wayzata, MN	09/25/98	02/20/99	El Rosario, MX	Donahue	1794
ZN995	Beth Key	Minnetonka, MN	08/20/98	02/17/99	El Rosario, MX	Monarch Program	1792
ZN931	Megan, Alison, & Conner Key	Minnetonka, MN	08/12/98	04/05/99	Anganguero, MX	Monarch Program	1792
AU148	James Little	Bucyrus, OH	09/19/98	03/01/99	El Rosario, MX	Korb	1779
AB700	Farmington Elementary School	Farmington, MN	09/04/98	02/10/99	El Rosario, MX	Korb	1777
AB755	Farmington Elementary School	Farmington, MN	09/04/98	02/17/99	El Rosario, MX	Monarch Program	1777
AB802	Farmington Elementary School	Farmington, MN	09/05/98	03/10/99	El Rosario, MX	Monarch Program	1777
AB928	Farmington Elementary School	Farmington, MN	09/06/98	02/22/99	El Rosario, MX	Korb	1777
AB274	Farmington Elementary School	Cannon Falls, MN	08/19/98	02/17/99	El Rosario, MX	Monarch Program	1772
AB370	Farmington Elementary School	Cannon Falls, MN	08/30/98	02/20/99	El Rosario, MX	Donahue	1772
AB395	Farmington Elementary School	Cannon Falls, MN	08/30/98	02/19/99	El Rosario, MX	Martín	1772
AB808	Farmington Elementary School	Cannon Falls, MN	09/05/98	04/05/99	Anganguero, MX	Monarch Program	1772
AB929	Farmington Elementary School	Cannon Falls, MN	09/06/98	12/30/98	El Rosario, MX	Rendón	1772
AG262 [†]	Barbara Brown	Madison, MN	09/22/98	03/03/99	El Rosario, MX	Monarch Program	1772
XF435	Tracey Piepenburg	Madison, MN	09/03/98	02/20/99	El Rosario, MX	Donahue	1772
AD246	Jim Gilbert	St. Peter, MN	09/03/98	04/05/99	Anganguero, MX	Monarch Program	1746
AD259	Jim Gilbert	St. Peter, MN	09/10/98	02/10/99	El Rosario, MX	Korb	1746
YJ188	Greg Munson	Rochester, MN	08/21/98	02/20/99	El Rosario, MX	Donahue	1744
YJ401	Greg Munson	Rochester, MN	08/28/98	03/03/99	El Rosario, MX	Monarch Program	1744
YJ409	Greg Munson	Rochester, MN	08/28/98	03/01/99	El Rosario, MX	Korb	1744
YK478	Greg Munson	Rochester, MN	09/05/98	02/19/99	El Rosario, MX	Donahue	1744
ZG104 [†]	Lee Zieke Lee	Burr Oak, IA	09/20/98	03/03/99	El Rosario, MX	Monarch Program	1717
QZ599 [†]	Karen Nance	Cresco, IA	09/02/97	04/01/98	El Rosario, MX	Marriott	1707
XP818	Carl Ek	Oak Park, IL	10/10/98	02/19/99	El Rosario, MX	Martín	1701
XP855	Carl Ek	Oak Park, IL	10/10/98	02/17/99	El Rosario, MX	Monarch Program	1701
ZT039	Jim, Linette, Grant, Lucas Langhus	Monona, IA	08/28/98	12/30/98	El Rosario, MX	Morena	1698
ZT076	Jim, Linette, Grant, Lucas Langhus	Monona, IA	08/30/98	02/10/99	El Rosario, MX	Korb	1698
ZT195	Jim, Linette, Grant, Lucas Langhus	Monona, IA	08/30/98	03/01/99	El Rosario, MX	Korb	1698
ZT203	Jim, Linette, Grant, Lucas Langhus	Monona, IA	08/30/98	02/22/99	El Rosario, MX	Korb	1698
ZT280	Jim, Linette, Grant, Lucas Langhus	Monona, IA	08/29/98	02/10/99	El Rosario, MX	Korb	1698
ZT297	Jim, Linette, Grant, Lucas Langhus	Monona, IA	08/30/98	03/10/99	El Rosario, MX	Monarch Program	1698
ZT319	Jim, Linette, Grant, Lucas Langhus	Monona, IA	08/30/98	12/13/98	El Rosario, MX	Brower	1698
CC496	Frank Taylor	Radford, VA	09/21/98	02/19/99	El Rosario, MX	Donahue	1689
ZS359	Jerry Wiedmann	Magnolia, MN	09/10/98	04/05/99	Anganguero, MX	Monarch Program	1679
YX692	Stacey Newbrough	Fredericksburg, IA	09/01/98	02/10/99	El Rosario, MX	Korb	1679
XL437	Mary Babcock	Hartford, SD	09/13/98	04/05/99	Anganguero, MX	Monarch Program	1672
XL875	Mary Babcock	Hartford, SD	09/13/98	12/31/98	Sierra Chincua, MX	Rendón	1672
YX741 [†]	Stacey Newbrough	Tripoli, IA	09/15/98	03/10/99	El Rosario, MX	Monarch Program	1668
XH223	Mary Babcock	Sioux Falls, SD	09/25/98	02/17/99	El Rosario, MX	Monarch Program	1667
XH339	Mary Babcock	Sioux Falls, SD	09/01/98	02/19/99	El Rosario, MX	Donahue	1667
XL484	Mary Babcock	Sioux Falls, SD	09/24/98	12/30/98	El Rosario, MX	Rendón	1667
XL578	Mary Babcock	Sioux Falls, SD	09/07/98	02/10/99	El Rosario, MX	Korb	1667
XL594	Mary Babcock	Sioux Falls, SD	09/06/98	02/17/99	El Rosario, MX	Monarch Program	1667
XL736	Mary Babcock	Sioux Falls, SD	09/25/98	02/19/99	El Rosario, MX	Martín	1667
XL867	Mary Babcock	Sioux Falls, SD	09/13/98	04/05/99	Anganguero, MX	Monarch Program	1667
DP697	Chris Kline	New Burlington, IN	09/19/98	02/10/99	El Rosario, MX	Korb	1667
OF750 [†]	David Schanze	Rowe, IL	09/25/97	02/10/99	El Rosario, MX	Korb	1666
XY650	Edna Peters	Rockwell, IA	08/31/98	03/03/99	El Rosario, MX	Monarch Program	1666
OB396 [†]	Mary Babcock	Lennox, SD	09/08/97	04/01/98	El Rosario, MX	Marriott	1653
XZ017	Shawn Gehlsen	Spencer, IA	09/02/98	02/20/99	El Rosario, MX	Donahue	1653
XY888	Mickey Johnson	Waterloo, IA	09/04/98	03/11/99	El Rosario, MX	Monarch Program	1646
YX616	Paula Buchholz	Greenville, IA	09/09/98	03/10/99	El Rosario, MX	Monarch Program	1645
XZ095	Shawn Gehlsen	Paullina, IA	09/09/98	02/19/99	El Rosario, MX	Martín	1637
CF479	Mark Roberts	Grand Mound, IA	09/25/98	02/10/99	El Rosario, MX	Korb	1633
CF529	Mark Roberts	Grand Mound, IA	09/25/98	03/03/99	El Rosario, MX	Monarch Program	1633
AS343 [†]	Nancy Johnston	Manlius, IL	09/08/98	12/28/98	El Rosario, MX	Korb	1630
BX122	Royce Bitzer	Ames, IA	09/18/98	03/01/99	El Rosario, MX	Korb	1596
BX166	Royce Bitzer	Ames, IA	09/27/98	03/10/99	El Rosario, MX	Monarch Program	1596
BX171	Royce Bitzer	Ames, IA	09/27/98	03/11/99	El Rosario, MX	Monarch Program	1596

Tag No.	Tagger	Tag City, State	Tagged	Reported	Report City, State	Reporter	Miles
SF810 [†]	Linda Zalatel	Huxley, IA	09/16/97	04/05/99	Angangueo, MX	Monarch Program	1588
SG011 [†]	Patrice Peterson	Johnston, IA	09/09/97	12/16/98	El Rosario, MX	Martínez	1573
ZN731	Chuck Safris	Urbandale, IA	09/11/98	02/22/99	El Rosario, MX	Korb	1567
ZO337	Bruce Weber	Missouri Valley, IA	09/10/98	03/01/99	El Rosario, MX	Korb	1539
ZO503	Bruce Weber	Missouri Valley, IA	09/11/98	02/19/99	El Rosario, MX	Donahue	1539
ZO510	Bruce Weber	Missouri Valley, IA	09/11/98	04/05/99	Angangueo, MX	Monarch Program	1539
DO762	Mark Seier	Lindsay, NE	09/17/98	02/17/99	El Rosario, MX	Monarch Program	1535
DQ843	Cindi Pollmann	Drakesville, IA	08/23/98	02/17/99	El Rosario, MX	Monarch Program	1533
DR200	Cindi Pollmann	Drakesville, IA	08/23/98	04/05/99	Angangueo, MX	Monarch Program	1533
BW593	Mike Williams	Fremont, NE	09/27/98	12/28/98	El Rosario, MX	Korb	1526
ZE752	Ken Staroska	Omaha, NE	09/10/98	03/24/99	El Rosario, MX	Calvert	1518
ZE760	Ken Staroska	Omaha, NE	09/10/98	02/17/99	El Rosario, MX	Monarch Program	1518
DY261	Nancy Hubbard	Council Bluffs, IA	09/28/98	03/01/99	El Rosario, MX	Korb	1517
ZA849	Nancy Hubbard	Council Bluffs, IA	09/07/98	02/17/99	El Rosario, MX	Monarch Program	1517
ZA898	Nancy Hubbard	Council Bluffs, IA	09/14/98	03/01/99	El Rosario, MX	Korb	1517
DR286	Tonya Hadden	Council Bluffs, IA	09/26/98	04/05/99	Angangueo, MX	Monarch Program	1517
XH849 [†]	Lisa Hendrixson	Stendal, IN	09/05/98	02/17/99	El Rosario, MX	Monarch Program	1506
ZI466 [†]	Anne May DeWaard	Pigeon Forge, TN	09/21/98	03/10/99	El Rosario, MX	Monarch Program	1504
ZC043	Kathy & Lina Reed	Malvern, IA	09/17/98	02/17/99	El Rosario, MX	Monarch Program	1504
ZN764	Chuck Safris	Des Moines, IA	09/11/98	03/01/99	El Rosario, MX	Korb	1492
ZF028	Courtney Potter	Lincoln, NE	09/23/98	03/03/99	El Rosario, MX	Monarch Program	1481
ZF092	Rosemary Thornton	Lincoln, NE	09/27/98	04/05/99	Angangueo, MX	Monarch Program	1481
BN869	Jane Koch	Hastings, NE	09/11/98	02/19/99	El Rosario, MX	Martín	1456
BN894	Jane Koch	Hastings, NE	09/11/98	02/19/99	El Rosario, MX	Martín	1456
BN923	Jane Koch	Hastings, NE	09/11/98	02/19/99	El Rosario, MX	Donahue	1456
DK925	Jane Koch	Hastings, NE	09/12/98	02/19/99	El Rosario, MX	Martín	1456
DL063	Jane Koch	Hastings, NE	09/11/98	02/17/99	El Rosario, MX	Monarch Program	1456
DP236	Jane Koch	Hastings, NE	09/15/98	02/10/99	El Rosario, MX	Korb	1456
ED587	Jane Koch	Hastings, NE	09/22/98	03/10/99	El Rosario, MX	Monarch Program	1456
ED680	Jane Koch	Hastings, NE	09/12/98	02/19/99	El Rosario, MX	Martín	1456
ED862	Jane Koch	Hastings, NE	09/22/98	02/17/99	El Rosario, MX	Monarch Program	1456
ED906	Jane Koch	Hastings, NE	09/22/98	02/19/99	El Rosario, MX	Donahue	1456
DG342	Marie Oughton	St. Louis, MO	09/21/98	03/24/99	El Rosario, MX	Calvert	1442
ZY354 [†]	Tom Bratkowski	St. Louis, MO	09/26/98	12/30/98	El Rosario, MX	García	1442
DH586	Kurk Wiedel	Hebron, NE	09/22/98	04/05/99	Angangueo, MX	Monarch Program	1431
DH617	Kurk Wiedel	Hebron, NE	09/25/98	03/10/99	El Rosario, MX	Monarch Program	1431
CF750	Brady Alexander	Mankato, KS	09/23/98	12/30/98	El Rosario, MX	Rendón	1401
CF837	David Walton	Mankato, KS	09/24/98	02/10/99	El Rosario, MX	Korb	1401
CF927	Derek Clark	Mankato, KS	08/24/98	02/17/99	El Rosario, MX	Monarch Program	1401
CH013	Kristene Beck	Mankato, KS	08/24/98	02/17/99	El Rosario, MX	Monarch Program	1401
CF816	Monica Minear	Mankato, KS	09/23/98	03/10/99	El Rosario, MX	Monarch Program	1401
BJ476	Gene Lamb	Ft. Leavenworth, KS	09/23/98	03/03/99	El Rosario, MX	Monarch Program	1399
AO454 [†]	Pamela Pollard	Independence, MO	10/10/98	03/01/99	El Rosario, MX	Korb	1391
WA279	Dan Dickinson	Kansas City, MO	09/27/98	02/20/99	El Rosario, MX	Donahue	1390
WA479	Dan Dickinson	Kansas City, MO	10/10/98	03/03/99	El Rosario, MX	Monarch Program	1390
CX103	Trisha Campbell	Lee's Summit, MO	10/02/98	02/10/99	El Rosario, MX	Korb	1379
CL293	A.J. Mueller	Wamego, KS	09/25/98	03/03/99	El Rosario, MX	Monarch Program	1375
CK890	Andrew Sylvester	Wamego, KS	09/24/98	04/05/99	Angangueo, MX	Monarch Program	1375
CL200	Andrew Sylvester	Wamego, KS	09/24/98	02/10/99	El Rosario, MX	Korb	1375
CL627	Brandon White	Wamego, KS	09/25/98	02/19/99	El Rosario, MX	Donahue	1375
CJ088	Cara McPeak	Wamego, KS	09/17/98	04/05/99	Angangueo, MX	Monarch Program	1375
CJ165	Cara McPeak	Wamego, KS	09/17/98	12/28/98	El Rosario, MX	Taute	1375
CJ689	Cara McPeak	Wamego, KS	09/18/98	02/10/99	El Rosario, MX	Korb	1375
SZ875 [†]	Chad Addington	Wamego, KS	09/16/97	02/17/99	El Rosario, MX	Monarch Program	1375
CK592	Clint Bever	Wamego, KS	09/22/98	02/19/99	El Rosario, MX	Donahue	1375
CL468	Clint Bever	Wamego, KS	09/28/98	02/17/99	El Rosario, MX	Monarch Program	1375
CL654	Dustin Goehring	Wamego, KS	09/25/98	03/10/99	El Rosario, MX	Monarch Program	1375
CM107	Dustin Goehring	Wamego, KS	10/01/98	04/05/99	Angangueo, MX	Monarch Program	1375
CM155	Dustin Goehring	Wamego, KS	10/01/98	02/19/99	El Rosario, MX	Donahue	1375
CM158	Dustin Goehring	Wamego, KS	10/01/98	03/01/99	El Rosario, MX	Korb	1375

Tag No.	Tagger	Tag City, State	Tagged	Reported	Report City, State	Reporter	Miles
CK724 [†]	Dusty Francis	Wamego, KS	09/24/98	02/19/99	El Rosario, MX	Donahue	1375
CI781	John Van Petten	Wamego, KS	09/15/98	12/28/98	El Rosario, MX	Korb	1375
CI828	John Van Petten	Wamego, KS	09/16/98	02/17/99	El Rosario, MX	Monarch Program	1375
CI877	John Van Petten	Wamego, KS	09/16/98	02/19/99	El Rosario, MX	Martín	1375
CJ497	John Van Petten	Wamego, KS	09/18/98	03/01/99	El Rosario, MX	Korb	1375
CK218	John Van Petten	Wamego, KS	09/17/98	03/01/99	El Rosario, MX	Korb	1375
CK275	John Van Petten	Wamego, KS	09/21/98	02/22/99	El Rosario, MX	Korb	1375
CK278	John Van Petten	Wamego, KS	09/21/98	02/10/99	El Rosario, MX	Korb	1375
CL749	John Van Petten	Wamego, KS	09/28/98	02/22/99	El Rosario, MX	Korb	1375
CL755	John Van Petten	Wamego, KS	09/28/98	02/10/99	El Rosario, MX	Korb	1375
CL779	John Van Petten	Wamego, KS	09/28/98	02/19/99	El Rosario, MX	Donahue	1375
CL898	John Van Petten	Wamego, KS	09/25/98	02/19/99	El Rosario, MX	Donahue	1375
CK374	Kendal Herman	Wamego, KS	09/22/98	02/19/99	El Rosario, MX	Donahue	1375
CJ631	Lindsay McCart	Wamego, KS	09/18/98	12/31/98	Sierra Chincua, MX	Rojas	1375
YQ692	Marsha Collins	Wamego, KS	09/21/98	03/01/99	El Rosario, MX	Korb	1375
YQ921 [†]	Marsha Collins	Wamego, KS	09/17/98	02/10/99	El Rosario, MX	Korb	1375
YR052	Marsha Collins	Wamego, KS	09/21/98	02/22/99	El Rosario, MX	Korb	1375
CK392	Melissa Brooks	Wamego, KS	09/22/98	02/17/99	El Rosario, MX	Monarch Program	1375
CI735	Sarah Watt	Wamego, KS	09/17/98	02/22/99	El Rosario, MX	Korb	1375
CK152	Sarah Watt	Wamego, KS	09/18/98	03/03/99	El Rosario, MX	Monarch Program	1375
CK701	Sarah Watt	Wamego, KS	09/24/98	02/19/99	El Rosario, MX	Martín	1375
CK804	Sarah Watt	Wamego, KS	09/24/98	02/10/99	El Rosario, MX	Korb	1375
CL501	Sarah Watt	Wamego, KS	09/25/98	03/11/99	El Rosario, MX	Monarch Program	1375
CI850	Shelley Roblyer	Wamego, KS	09/16/98	12/28/98	El Rosario, MX	Korb	1375
CL430	Shelly Hulinsky	Wamego, KS	09/25/98	02/10/99	El Rosario, MX	Korb	1375
CK000	Terry Callender	Wamego, KS	98 Season	02/17/99	El Rosario, MX	Monarch Program	1375
CK610	Terry Callender	Wamego, KS	09/22/98	04/05/99	Anganguero, MX	Monarch Program	1375
CL015	Terry Callender	Wamego, KS	98 Season	02/19/99	El Rosario, MX	Donahue	1375
TC551 [†]	Ascension Elementary School	Overland Park, KS	09/17/97	04/05/99	Anganguero, MX	Monarch Program	1374
XM260	Jacalyn Goetz	Overland Park, KS	10/11/98	03/10/99	El Rosario, MX	Monarch Program	1374
RQ713 [†]	Carol Williamson	Olathe, KS	09/22/97	02/17/99	El Rosario, MX	Monarch Program	1371
XG260	Erik Nelson	Olathe, KS	09/24/98	02/10/99	El Rosario, MX	Korb	1371
XG316	Erik Nelson	Olathe, KS	09/24/98	01/25/99	Valle de Bravo, MX	Vergeer	1371
CP440 [†]	Jenna Nelson	Olathe, KS	10/02/98	02/19/99	El Rosario, MX	Martín	1371
EE056	Laura Wester	Olathe, KS	09/26/98	04/05/99	Anganguero, MX	Monarch Program	1371
EE073	Laura Wester	Olathe, KS	09/29/98	02/10/99	El Rosario, MX	Korb	1371
EE152	Paula Donham	Olathe, KS	09/30/98	02/20/99	El Rosario, MX	Donahue	1371
EE250 [†]	Paula Donham	Olathe, KS	10/09/98	03/01/99	El Rosario, MX	Korb	1371
EE258	Paula Donham	Olathe, KS	09/09/98	02/19/99	El Rosario, MX	Martín	1371
EE674	Paula Donham	Olathe, KS	09/29/98	03/10/99	El Rosario, MX	Monarch Program	1371
EE678	Paula Donham	Olathe, KS	09/29/98	03/10/99	El Rosario, MX	Monarch Program	1371
EE699	Paula Donham	Olathe, KS	09/29/98	03/10/99	El Rosario, MX	Monarch Program	1371
EE793	Paula Donham	Olathe, KS	09/30/98	03/10/99	El Rosario, MX	Monarch Program	1371
EA324	Shineman	Olathe, KS	09/28/98	02/17/99	El Rosario, MX	Monarch Program	1371
YQ438	Nate Brown	Wabaunsee, KS	09/28/98	02/20/99	El Rosario, MX	Donahue	1371
BJ840	Diane Kent/Gibson	Manhattan, KS	09/08/98	02/17/99	El Rosario, MX	Monarch Program	1371
BJ913	Diane Kent/Gibson	Manhattan, KS	09/17/98	02/17/99	El Rosario, MX	Monarch Program	1371
XG150	Becky Jamison	Lawrence, KS	09/11/98	03/03/99	El Rosario, MX	Monarch Program	1370
AY928	Calvin Cink	Lawrence, KS	09/05/98	02/17/99	El Rosario, MX	Monarch Program	1370
SW856 [†]	Ken Highfill	Lawrence, KS	09/15/97	02/17/99	El Rosario, MX	Monarch Program	1370
YQ055	Ken Highfill	Lawrence, KS	09/26/98	03/10/99	El Rosario, MX	Monarch Program	1370
YQ157	Ken Highfill	Lawrence, KS	09/26/98	03/03/99	El Rosario, MX	Monarch Program	1370
YQ198	Ken Highfill	Lawrence, KS	09/26/98	02/17/99	El Rosario, MX	Monarch Program	1370
BH391	Sandra Perez	Lawrence, KS	09/20/98	04/05/99	Anganguero, MX	Monarch Program	1370
XF110	Sandy Collins	Lawrence, KS	09/24/98	02/10/99	El Rosario, MX	Korb	1370
XM992	Walter Knapp	Topeka, KS	09/27/98	04/05/99	Anganguero, MX	Monarch Program	1370
CE466	Stone Nature Center	Topeka, KS	09/21/98	04/05/99	Anganguero, MX	Monarch Program	1370
CE470	Stone Nature Center	Topeka, KS	09/21/98	02/22/99	El Rosario, MX	Korb	1370
CE514	Stone Nature Center	Topeka, KS	09/23/98	02/10/99	El Rosario, MX	Korb	1370
CE754	Stone Nature Center	Topeka, KS	10/01/98	03/10/99	El Rosario, MX	Monarch Program	1370

Tag No.	Tagger	Tag City, State	Tagged	Reported	Report City, State	Reporter	Miles
CE841	Stone Nature Center	Topeka, KS	10/01/98	03/01/99	El Rosario, MX	Korb	1370
BJ217	Calvin Cink	Baldwin City, KS	09/26/98	02/17/99	El Rosario, MX	Monarch Program	1359
EB214	Letitia Keenan	Oakley, KS	09/30/98	03/03/99	El Rosario, MX	Monarch Program	1353
BN170	Janeen Brown	WaKeeney, KS	09/24/98	02/19/99	El Rosario, MX	Donahue	1345
YR892	Janeen Brown	WaKeeney, KS	09/23/98	03/03/99	El Rosario, MX	Monarch Program	1345
YR939	Janeen Brown	WaKeeney, KS	09/22/98	02/22/99	El Rosario, MX	Korb	1345
YT667	Janeen Brown	WaKeeney, KS	10/05/98	02/22/99	El Rosario, MX	Korb	1345
YT686	Janeen Brown	WaKeeney, KS	09/06/98	03/03/99	El Rosario, MX	Monarch Program	1345
AJ313 [†]	Erin Townsend	Sharon Springs, KS	09/25/95	02/17/96	Sierra Chincua, MX	Gonzalez	1340
CQ977	Andrew Conard	Salina, KS	09/21/98	02/17/99	El Rosario, MX	Monarch Program	1338
CR013	Katrina Bethe	Salina, KS	09/21/98	02/19/99	El Rosario, MX	Donahue	1338
CR242	Tasha Schultz	Salina, KS	09/24/98	02/19/99	El Rosario, MX	Donahue	1338
YR231	Brian Schmidt	Hays, KS	09/15/98	03/10/99	El Rosario, MX	Monarch Program	1335
YU858	Brian Schmidt	Hays, KS	09/21/98	02/17/99	El Rosario, MX	Monarch Program	1335
YU162	Curt Moore	Hays, KS	09/21/98	03/03/99	El Rosario, MX	Monarch Program	1335
YR835	Dustin Rogers	Hays, KS	09/21/98	02/22/99	El Rosario, MX	Korb	1335
YU499	Evan Pollock	Hays, KS	09/29/98	02/19/99	El Rosario, MX	Donahue	1335
YR581	Greg Clingingsmith	Hays, KS	09/28/98	02/17/99	El Rosario, MX	Monarch Program	1335
RF266 [†]	Jerod Goodale	Hays, KS	09/13/97	02/17/99	El Rosario, MX	Monarch Program	1335
YR238	Kyle Tutak	Hays, KS	09/15/98	03/03/99	El Rosario, MX	Monarch Program	1335
YU158	Kyle Tutak	Hays, KS	09/16/98	02/10/99	El Rosario, MX	Korb	1335
YU386	Megan Kroeger	Hays, KS	09/29/98	02/20/99	El Rosario, MX	Donahue	1335
YR553	Patricia Blocksome	Hays, KS	09/27/98	03/01/99	El Rosario, MX	Korb	1335
YW037	Patricia Blocksome	Hays, KS	09/28/98	02/19/99	El Rosario, MX	Donahue	1335
YR409	Ty Coker	Hays, KS	09/20/98	03/24/99	El Rosario, MX	Calvert	1335
XR081	Marvin Harrell	Lebo, KS	09/19/98	04/05/99	Anganguero, MX	Monarch Program	1326
BZ209	Christian	Emporia, KS	09/22/98	12/31/98	Sierra Chincua, MX	Rendón	1322
BX495	Colleen Mitchell	Emporia, KS	09/29/98	02/10/99	El Rosario, MX	Korb	1322
BX533	Jared Dakin	Emporia, KS	10/05/98	02/17/99	El Rosario, MX	Monarch Program	1322
XR208	Katie Scherich	Emporia, KS	10/07/98	02/10/99	El Rosario, MX	Korb	1322
EP914	Grant Linder	Lindsborg, KS	10/01/98	03/03/99	El Rosario, MX	Monarch Program	1321
ZB728	Pat Bauer & Kola Johnson	Lindsborg, KS	98 Season	03/01/99	El Rosario, MX	Korb	1321
ZB731	Pat Bauer & Kola Johnson	Lindsborg, KS	98 Season	03/10/99	El Rosario, MX	Monarch Program	1321
XW168	Michael Hegan	Marion, KS	09/17/98	02/10/99	El Rosario, MX	Korb	1310
XW181	Nathan Fish	Marion, KS	09/17/98	02/17/99	El Rosario, MX	Monarch Program	1310
EB829	Jonea Hartshorn	Timken, KS	10/03/98	04/05/99	Anganguero, MX	Monarch Program	1308
EB836	Jonea Hartshorn	Timken, KS	10/04/98	02/19/99	El Rosario, MX	Donahue	1308
EB845	Jonea Hartshorn	Timken, KS	10/04/98	03/01/99	El Rosario, MX	Korb	1308
DT746	Barbara Claassen	Mc Pherson, KS	09/28/98	03/10/99	El Rosario, MX	Monarch Program	1307
CQ166	Michael Craig	Mc Pherson, KS	09/18/98	02/22/99	El Rosario, MX	Korb	1307
CQ167	Michael Craig	Mc Pherson, KS	09/18/98	02/19/99	El Rosario, MX	Martín	1307
CR317	Michael Craig	Mc Pherson, KS	09/19/98	02/20/99	El Rosario, MX	Donahue	1307
CR427	Michael Craig	Mc Pherson, KS	09/23/98	02/17/99	El Rosario, MX	Monarch Program	1307
CR505	Michael Craig	Mc Pherson, KS	09/19/98	02/10/99	El Rosario, MX	Korb	1307
CR521	Michael Craig	Mc Pherson, KS	09/19/98	01/27/99	El Rosario, MX	Manwaring	1307
AU889	Tim Shaw	Mc Pherson, KS	09/17/98	12/28/98	El Rosario, MX	Korb	1307
AW038	Tim Shaw	Mc Pherson, KS	09/21/98	02/17/99	El Rosario, MX	Monarch Program	1307
EG569	Tim Shaw	Mc Pherson, KS	09/24/98	03/03/99	El Rosario, MX	Monarch Program	1307
BQ881	Karen Engle	Madison, KS	09/29/98	02/17/99	El Rosario, MX	Monarch Program	1304
BK638	AJ Overton	Goessel, KS	09/16/98	02/10/99	El Rosario, MX	Korb	1301
EG675	Alexis York	Goessel, KS	09/18/98	03/01/99	El Rosario, MX	Korb	1301
BK681	Darla Funk	Goessel, KS	09/17/98	03/03/99	El Rosario, MX	Monarch Program	1301
EL753	Derek Deurksen	Goessel, KS	09/28/98	04/05/99	Anganguero, MX	Monarch Program	1301
BK356	Jeremy Voth	Goessel, KS	09/15/98	02/17/99	El Rosario, MX	Monarch Program	1301
BK174	Jessica Schroeder	Goessel, KS	09/19/98	03/01/99	El Rosario, MX	Korb	1301
EL486	Josh Schmidt	Goessel, KS	09/26/98	02/17/99	El Rosario, MX	Monarch Program	1301
EL411	Josh Voth	Goessel, KS	09/22/98	03/03/99	El Rosario, MX	Monarch Program	1301
EL316	Lance Hiebert	Goessel, KS	09/24/98	02/10/99	El Rosario, MX	Korb	1301
EL292	Taylor Schmidt	Goessel, KS	09/27/98	02/22/99	El Rosario, MX	Korb	1301
EL951	Taylor Schmidt	Goessel, KS	09/24/98	03/01/99	El Rosario, MX	Korb	1301

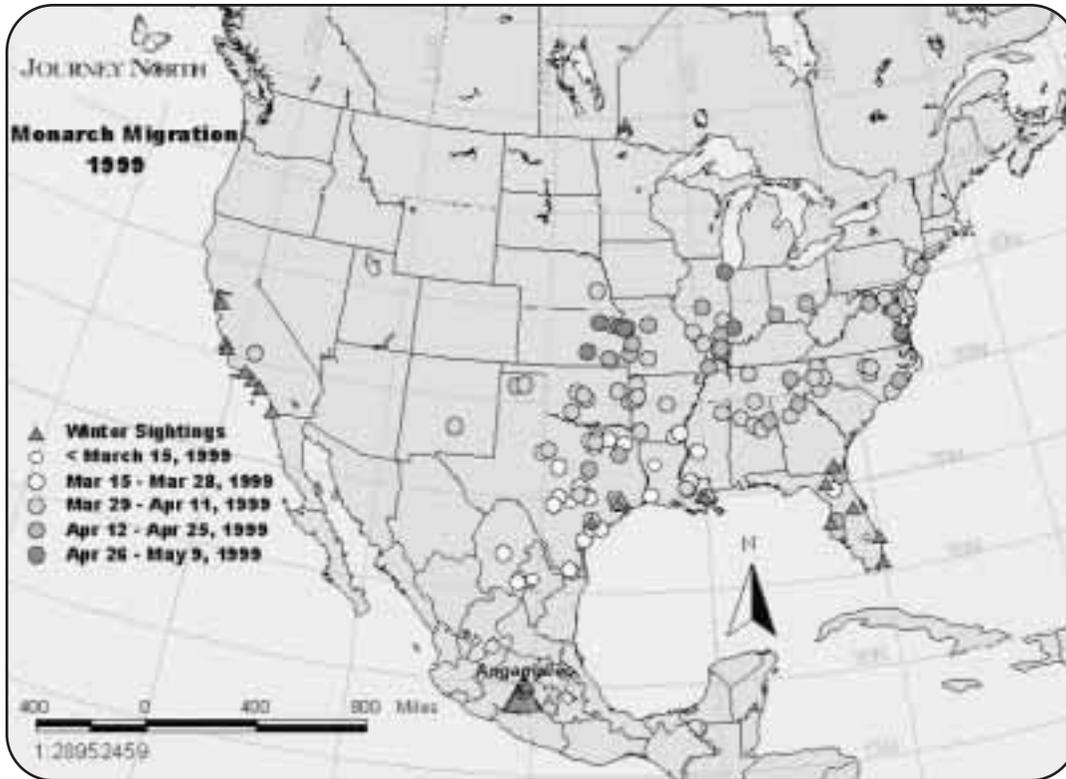
Tag No.	Tagger	Tag City, State	Tagged	Reported	Report City, State	Reporter	Miles
CI310	Al Neufeld	Moundridge, KS	09/18/98	02/17/99	El Rosario, MX	Monarch Program	1297
EC036	Al Neufeld	Moundridge, KS	09/29/98	03/11/99	El Rosario, MX	Monarch Program	1297
EC080	Al Neufeld	Moundridge, KS	09/29/98	02/10/99	El Rosario, MX	Korb	1297
EC191	Al Neufeld	Moundridge, KS	09/29/98	03/11/99	El Rosario, MX	Monarch Program	1297
CG196	Brice Loganbill	Moundridge, KS	09/16/98	12/28/98	El Rosario, MX	Korb	1297
CG352	Dan Challans	Moundridge, KS	09/17/98	12/30/98	El Rosario, MX	Soto	1297
CG365	Jennifer McClure	Moundridge, KS	09/17/98	02/10/99	El Rosario, MX	Korb	1297
EC728	Joe Krehbiel	Moundridge, KS	09/30/98	02/19/99	El Rosario, MX	Donahue	1297
EC860	Jonathan Nathan	Moundridge, KS	09/29/98	02/20/99	El Rosario, MX	Donahue	1297
CI578	Kristi Stucky	Moundridge, KS	09/21/98	04/05/99	Anganguero, MX	Monarch Program	1297
CI557	Kristy Stucky	Moundridge, KS	09/21/98	03/10/99	El Rosario, MX	Monarch Program	1297
ED220	Matt Thiesen	Moundridge, KS	09/29/98	02/10/99	El Rosario, MX	Korb	1297
CF972	Matthew Autrey	Moundridge, KS	09/21/98	02/17/99	El Rosario, MX	Monarch Program	1297
CI567	Paul Galle	Moundridge, KS	09/21/98	03/24/99	El Rosario, MX	Calvert	1297
CI672	Paul Galle	Moundridge, KS	09/21/98	03/24/99	El Rosario, MX	Calvert	1297
CI685	Paul Galle	Moundridge, KS	09/21/98	02/19/99	El Rosario, MX	Martín	1297
AS384	Karen Fulk	Hesston, KS	09/15/98	02/19/99	El Rosario, MX	Martín	1293
AS405	Karen Fulk	Hesston, KS	09/15/98	12/28/98	El Rosario, MX	Korb	1293
AU619	Karen Fulk	Hesston, KS	09/16/98	04/05/99	Anganguero, MX	Monarch Program	1293
AU705	Karen Fulk	Hesston, KS	09/17/98	02/19/99	El Rosario, MX	Donahue	1293
DU937	Karen Fulk	Hesston, KS	09/23/98	03/10/99	El Rosario, MX	Monarch Program	1293
DW102	Karen Fulk	Hesston, KS	09/21/98	12/28/98	El Rosario, MX	Korb	1293
EN217	Karen Fulk	Hesston, KS	09/27/98	03/10/99	El Rosario, MX	Monarch Program	1293
EN236	Karen Fulk	Hesston, KS	09/27/98	02/10/99	El Rosario, MX	Korb	1293
EN269	Karen Fulk	Hesston, KS	09/27/98	02/20/99	El Rosario, MX	Donahue	1293
EN282	Karen Fulk	Hesston, KS	09/27/98	03/01/99	El Rosario, MX	Korb	1293
BQ941	Roni Caffrey's 3rd Gr.	Hesston, KS	09/17/98	02/22/99	El Rosario, MX	Korb	1293
BQ985	Roni Caffrey's 3rd Gr.	Hesston, KS	09/17/98	04/05/99	Anganguero, MX	Monarch Program	1293
DU968	Roni Caffrey's 3rd Gr.	Hesston, KS	09/23/98	02/20/99	El Rosario, MX	Donahue	1293
DU979	Roni Caffrey's 3rd Gr.	Hesston, KS	09/23/98	02/19/99	El Rosario, MX	Martín	1293
YR161	Mary Clark	Buhler, KS	09/26/98	02/17/99	El Rosario, MX	Monarch Program	1291
EH506	Betty Taylor	Hutchinson, KS	09/26/98	02/17/99	El Rosario, MX	Monarch Program	1285
DQ466	Sharon Richardson	Hutchinson, KS	09/19/98	02/19/99	El Rosario, MX	Martín	1285
BX683	Billy Jackson	El Dorado, KS	09/17/98	03/03/99	El Rosario, MX	LeMaster	1276
BZ263	Billy Jackson	El Dorado, KS	09/18/98	04/05/99	Anganguero, MX	Monarch Program	1276
ZN678	Charles Green	El Dorado, KS	09/18/98	02/19/99	El Rosario, MX	Martín	1276
AP281	Pam Martin	St. John, KS	09/24/98	02/19/99	El Rosario, MX	Donahue	1276
AP134	Pam Martin	Stafford, KS	09/19/98	12/28/98	El Rosario, MX	Korb	1274
DO279	David Clement	Andover, KS	09/23/98	03/10/99	El Rosario, MX	Monarch Program	1265
DO286	David Clement	Andover, KS	09/23/98	02/17/99	El Rosario, MX	Monarch Program	1265
CD533	Ron Turner	Andover, KS	10/05/98	02/17/99	El Rosario, MX	Monarch Program	1265
CD560	Ron Turner	Andover, KS	10/07/98	03/11/99	El Rosario, MX	Monarch Program	1265
CD679	Tami Kincaid	Andover, KS	09/27/98	03/10/99	El Rosario, MX	Monarch Program	1265
BL165	Albert Brouwer	Wichita, KS	09/16/98	04/05/99	Anganguero, MX	Monarch Program	1263
XZ531	Botanica, Wichita Gardens	Wichita, KS	09/28/98	02/22/99	El Rosario, MX	Korb	1263
XZ934	Botanica, Wichita Gardens	Wichita, KS	09/15/98	02/10/99	El Rosario, MX	Korb	1263
CQ501	Jim Mason	Wichita, KS	09/26/98	03/01/99	El Rosario, MX	Korb	1263
ZO382	Karen Koch	Wichita, KS	09/23/98	02/17/99	El Rosario, MX	Monarch Program	1263
DP828 ⁺	Karla Jahn	Wichita, KS	09/21/96	12/15/98	Sierra Chincua, MX	García	1263
ZB298	Karla Jahn	Wichita, KS	09/28/98	03/11/99	El Rosario, MX	Monarch Program	1263
ZB347	Karla Jahn	Wichita, KS	09/28/98	03/03/99	El Rosario, MX	Monarch Program	1263
EO292	Kristin Mefford	Wichita, KS	09/29/98	03/11/99	El Rosario, MX	Monarch Program	1263
EO305	Kristin Mefford	Wichita, KS	09/28/98	02/22/99	El Rosario, MX	Korb	1263
EP697	Kristin Mefford	Wichita, KS	10/01/98	03/01/99	El Rosario, MX	Korb	1263
EP740	Kristin Mefford	Wichita, KS	10/01/98	03/10/99	El Rosario, MX	Monarch Program	1263
DK264	Tammy Decker	Wichita, KS	09/30/98	04/05/99	Anganguero, MX	Monarch Program	1263
DK273	Tammy Decker	Wichita, KS	09/30/98	02/20/99	El Rosario, MX	Donahue	1263
XT805	Carol Parker	Goddard, KS	09/28/98	02/22/99	El Rosario, MX	Korb	1259
CH834	Paula Barker	Derby, KS	09/24/98	02/22/99	El Rosario, MX	Korb	1254
CH933	Paula Barker	Derby, KS	09/22/98	03/01/99	El Rosario, MX	Korb	1254

Tag No.	Tagger	Tag City, State	Tagged	Reported	Report City, State	Reporter	Miles
XT852	Carol Parker	Pratt, KS	09/30/98	04/05/99	Angangueo, MX	Monarch Program	1252
DY436	Connie Meigs	Pratt, KS	09/24/98	02/17/99	El Rosario, MX	Monarch Program	1252
DY465	Connie Meigs	Pratt, KS	09/26/98	03/01/99	El Rosario, MX	Korb	1252
DY469	Connie Meigs	Pratt, KS	09/26/98	02/22/99	El Rosario, MX	Korb	1252
EP671 [†]	Connie Meigs	Pratt, KS	10/06/98	02/10/99	El Rosario, MX	Korb	1252
XW389	Connie Meigs	Pratt, KS	09/17/98	02/10/99	El Rosario, MX	Korb	1252
EA253	Linda Koehn	Mullinville, KS	09/29/98	04/05/99	Angangueo, MX	Monarch Program	1246
XS207	Anne Reusser	Harmon Township, KS	10/03/98	03/10/99	El Rosario, MX	Monarch Program	1234
AK463	Tonya Van Hook	St. Marks, FL	10/24/98	02/10/99	El Rosario, MX	Korb	1232
CP827	Shelly Swafford	Harper, KS	09/23/98	02/22/99	El Rosario, MX	Korb	1231
BR096	Cochran	Hugoton, KS	09/25/98	03/01/99	El Rosario, MX	Korb	1220
ES991	Dusty Swinney	Hugoton, KS	10/05/98	03/03/99	El Rosario, MX	Monarch Program	1220
BR342	Stephanie H.	Hugoton, KS	10/01/98	03/24/99	El Rosario, MX	Calvert	1220
DR498	Mike Carney	Jenks, OK	10/08/98	02/22/99	El Rosario, MX	Korb	1162
AZ307	Rosemary Smith	Guthrie, OK	10/08/98	03/01/99	El Rosario, MX	Korb	1136
UT680	Donna Griffin	Butler, OK	09/26/98	02/22/99	El Rosario, MX	Korb	1112
HV669 [†]	Angie Huckleberry	Bethany, OK	10/04/96	01/01/97	Cerro Pelón, MX	Monarch Program	1111
ZK455	Hannah Christian	Hammon, OK	10/12/98	02/19/99	El Rosario, MX	Donahue	1111
ZK457	Hannah Christian	Hammon, OK	10/12/98	12/31/98	Sierra Chincua, MX	Rendón	1111
ZK478	Hannah Christian	Hammon, OK	10/15/98	03/01/99	El Rosario, MX	Korb	1111
AS598	Anne Michalski	Oklahoma City, OK	10/13/98	03/24/99	Sierra Chincua, MX	Calvert	1110
BE132	Cassy Bouchereau	Oklahoma City, OK	10/14/98	03/10/99	El Rosario, MX	Monarch Program	1110
ZH768	David Walker	Oklahoma City, OK	10/06/98	02/22/99	El Rosario, MX	Korb	1110
ZH843	David Walker	Oklahoma City, OK	10/07/98	03/10/99	El Rosario, MX	Monarch Program	1110
ZH984	David Walker	Oklahoma City, OK	10/08/98	02/10/99	El Rosario, MX	Korb	1110
ZI015	David Walker	Oklahoma City, OK	10/08/98	02/22/99	El Rosario, MX	Korb	1110
BE229	J.L. Dennis Elementary	Oklahoma City, OK	10/12/98	03/13/99	El Rosario, MX	Barron	1110
BL828	Paul Southerland	Oklahoma City, OK	10/08/98	12/28/98	El Rosario, MX	Korb	1110
BL833	Paul Southerland	Oklahoma City, OK	10/08/98	02/17/99	El Rosario, MX	Monarch Program	1110
BM033	Paul Southerland	Oklahoma City, OK	10/09/98	12/12/98	El Rosario, MX	Escandón/García	1110
BM121	Paul Southerland	Oklahoma City, OK	10/09/98	02/19/99	El Rosario, MX	Donahue	1110
BD183	Peggy Shirey	Oklahoma City, OK	10/12/98	02/19/99	El Rosario, MX	Donahue	1110
BD229	Peggy Shirey	Oklahoma City, OK	10/12/98	03/10/99	El Rosario, MX	Monarch Program	1110
BE515	Peggy Shirey	Oklahoma City, OK	10/07/98	02/19/99	El Rosario, MX	Donahue	1110
BB098	Putnam City Senior High School	Oklahoma City, OK	10/09/98	03/03/99	El Rosario, MX	Monarch Program	1110
BB111	Putnam City Senior High School	Oklahoma City, OK	10/08/98	02/17/99	El Rosario, MX	Monarch Program	1110
BB118 [†]	Putnam City Senior High School	Oklahoma City, OK	10/08/98	02/22/99	El Rosario, MX	Korb	1110
BB604	Putnam City Senior High School	Oklahoma City, OK	10/08/98	02/17/99	El Rosario, MX	Monarch Program	1110
BB838	Putnam City Senior High School	Oklahoma City, OK	10/08/98	02/22/99	El Rosario, MX	Korb	1110
BC405	Putnam City Senior High School	Oklahoma City, OK	10/11/98	02/10/99	El Rosario, MX	Korb	1110
QL472 [†]	Scott Martin	Oklahoma City, OK	10/07/97	03/10/99	El Rosario, MX	Monarch Program	1110
BC510	Sharon Shrum	Oklahoma City, OK	10/13/98	02/19/99	El Rosario, MX	Donahue	1110
BC552	Sharon Shrum	Oklahoma City, OK	10/13/98	02/19/99	El Rosario, MX	Donahue	1110
AX277	Vicki Allred	Oklahoma City, OK	10/08/98	03/01/99	El Rosario, MX	Korb	1110
DK548 [†]	Jim Edson	Monticello, AR	10/11/98	03/01/99	El Rosario, MX	Korb	1096
DK600	Jim Edson	Monticello, AR	10/15/98	03/03/99	El Rosario, MX	Monarch Program	1096
ZG854	Pat & Walter Reif	Norman, OK	10/08/98	12/28/98	El Rosario, MX	Korb	1095
ZG579	Donna Rolland	Anadarko, OK	10/12/98	02/19/99	El Rosario, MX	Martín	1077
DL420	Andrew Key	Addison, TX	10/19/98	02/10/99	El Rosario, MX	Korb	947
DL350	Lance Hardgrave	Addison, TX	10/15/98	02/19/99	El Rosario, MX	Donahue	947
DL524	Lance Hardgrave	Addison, TX	10/15/98	02/19/99	El Rosario, MX	Donahue	947
NL413	Alta Montgomery	Grapevine, TX	10/07/98	02/17/99	El Rosario, MX	Monarch Program	942
NL427	Alta Montgomery	Grapevine, TX	10/10/98	02/17/99	El Rosario, MX	Monarch Program	942
NL429	Alta Montgomery	Grapevine, TX	10/10/98	02/10/99	El Rosario, MX	Korb	942
NL491	Alta Montgomery	Grapevine, TX	10/17/98	04/05/99	Angangueo, MX	Monarch Program	942
EG993	Carolyn Womack	Grapevine, TX	10/11/98	04/05/99	Angangueo, MX	Monarch Program	942
EH006	Carolyn Womack	Grapevine, TX	10/11/98	04/05/99	Angangueo, MX	Monarch Program	942
ZL261	Jenny Singleton	Grapevine, TX	10/07/98	04/05/99	Angangueo, MX	Monarch Program	942
QO275 [†]	Donn Byrne	Tyler, TX	10/02/98	02/10/99	El Rosario, MX	Korb	930
UW248	Susan Throckmorton	Hawley, TX	10/28/98	02/20/99	El Rosario, MX	Donahue	902

Tag No.	Tagger	Tag City, State	Tagged	Reported	Report City, State	Reporter	Miles
UW325	Susan Throckmorton	Hawley, TX	10/12/98	04/05/99	Angangueo, MX	Monarch Program	902
UW367	Susan Throckmorton	Hawley, TX	10/13/98	03/10/99	El Rosario, MX	Monarch Program	902
UW388	Susan Throckmorton	Hawley, TX	10/19/98	03/11/99	Sierra Chincua, MX	Monarch Program	902
UO592	Gary Musgrave	Abilene, TX	10/18/98	03/10/99	El Rosario, MX	Monarch Program	892
US132	Gary Musgrave	Abilene, TX	10/19/98	02/10/99	El Rosario, MX	Korb	892
YC355	Julia Baker	Abilene, TX	10/03/98	03/03/99	El Rosario, MX	Monarch Program	892
YC692	Julia Baker	Abilene, TX	10/17/98	02/20/99	El Rosario, MX	Donahue	892
YC704	Julia Baker	Abilene, TX	10/17/98	04/05/99	Angangueo, MX	Monarch Program	892
ET978	Kiri, Emily & Bryne Ulmschneider	Midland, TX	10/25/98	02/20/99	El Rosario, MX	Donahue	872
UK629	Kiri, Emily & Bryne Ulmschneider	Midland, TX	10/11/98	02/10/99	El Rosario, MX	Korb	872
DG244	Connie Williams	Waco, TX	10/14/98	03/10/99	El Rosario, MX	Monarch Program	849
ZL487	Bruce Backlund	San Angelo, TX	10/19/98	02/10/99	El Rosario, MX	Korb	823
ZZ458 [†]	Marti Adair	Austin, TX	10/14/98	01/29/99	Herrada, MX	D'Acosta	791
ZZ482 [†]	Marti Adair	Austin, TX	10/16/98	03/10/99	El Rosario, MX	Monarch Program	757
CB726	Deb Williams	Huxley, IA	09/11/98	09/26/98	Fritch, TX	Webb	610
ZM264 [†]	Lionel & Sylvia White	Corpus Christi, TX	10/17/98	03/01/99	El Rosario, MX	Korb	590
WC113	Sondra Cabell	Geneva, KY	09/10/98	09/30/98	Lindsborg, KS	Linder/Giles	546
HA207 [†]	Rocío Treviño	Monterrey, NL (MX)	10/23/96	12/15/98	Sierra Chincua, MX	García	428
DL842	Rocío Treviño	Saltillo, COAH (MX)	10/27/98	03/11/99	Sierra Chincua, MX	Monarch Program	411
DL845	Rocío Treviño	Saltillo, COAH (MX)	10/27/98	03/11/99	Sierra Chincua, MX	Monarch Program	411
DL958	Rocío Treviño	Saltillo, COAH (MX)	10/30/98	02/19/99	El Rosario, MX	Donahue	411
DM021	Rocío Treviño	Saltillo, COAH (MX)	11/03/98	03/10/99	El Rosario, MX	Monarch Program	411
WC309	John Bowe	Northampton, MA	09/27/98	10/08/98	Chincoteague, VA	AINS	334
NW260	Mary Koes	Potsdam, NY	09/11/98	09/23/98	Drums, PA	Denke	257
YY967	Carol Fuller	Tupper Lake, NY	09/18/98	09/22/98	Westhampton Bch, NY	Dermody	252
ZZ050 [†]	Norma Snow	West Hartford, CT	08/24/98	08/29/98	Camp Hill, PA	Hibner	242
WE923	Chris Higley	Storrs, CT	09/16/98	10/06/98	Oxford, PA	Quillin	240
CF842	David Walton	Mankato, KS	09/24/98	10/02/98	Dodge City, KS	McCollough	171
CC501	Frank Taylor	Radford, VA	09/25/98	10/30/98	Marion, NC	Carson	167
ZF048	Rosemary Thornton	Lincoln, NE	09/24/98	10/05/98	Paullina, IA	Gehlsen	158
NQ674	Glenda Jordan	Clinton, MD	09/27/98	09/30/98	Sweet Briar, VA	Cambell	145
WK015	Lynn Frazier	Columbia, CT	09/15/98	09/21/98	Morris Plains, NJ	Murray	128
AX110	Sharon Shrum	Oklahoma City, OK	09/12/98	09/19/98	Wichita Falls, TX	Bell	122
EA219 [†]	William & Stephen Kustka	Marlboro Twnshp, NJ	10/07/98	10/20/98	Cape May Point, NJ	Sutton	103
EA219 [†]	William & Stephen Kustka	Marlboro Twnshp, NJ	10/07/98	10/20/98	Cape May Point, NJ	Zemaitis	103
YY979 [†]	William Ferguson	Jersey Shore, PA	08/29/98	09/19/98	Carlisle, PA	Horn	69
WT327 [†]	Marie Thierjung	Norfolk, VA	09/11/98	09/26/98	Prince George, VA	Hargrave	61
CO014	Bonnie Smith	Haddonfield, NJ	10/07/98	10/11/98	Stone Harbor, NJ	Wechsler	60
WF598	Mary Ann Manaresi	Tuckerton, NJ	09/23/98	09/30/98	Cape May Point, NJ	Zemaitis	57
WG394 [†]	Kathy Jewett	Portland, ME	09/11/98	09/16/98	Portsmouth, NH	Mirick	51
EZ366 [†]	J. Soehnlein	Beloit, WI	10/23/98	11/01/98	Rochelle, IL	Hadaway	42
ZM182 [†]	Harlen Aschen	Victoria, TX	11/22/98	11/23/98	Port Lavaca, TX	Nolen	26
UW915 [†]	Jenny Singleton	Grapevine, TX	10/16/98	11/26/98	Garland, TX	Maher	26
XC447 [†]	Kathryn Wedge	Neenah, WI	09/03/98	?	New Holstein, WI	Pfiel	24
YN243	Jan Welsh	Chanhassen, MN	08/15/98	08/18/98	St. Paul, MN	Lund	23
DB773 [†]	Cindy Peterson	Chanhassen, MN	10/08/98	10/10/98	Brooklyn Center, MN	Hagstrom	19
WM633	Marlene Dyer	Southampton, PA	09/19/98	09/20/98	Philadelphia, PA	McCloskey	13
NK068	Karen Oberhauser	?	?	09/28/98	Buffalo, TX	Gee	?
XZ846	Botanica, Wichita Gardens	?	?	12/30/98	El Rosario, MX	García	?
MW320	Sarah Dalton	?	?	02/10/99	El Rosario, MX	Korb	?
BF679	Robin Grasmick	?	?	02/19/99	El Rosario, MX	Donahue	?
CQ406	Harry Gregory	?	?	03/03/99	El Rosario, MX	Monarch Program	?
OL470	Craig Hensley	?	?	02/17/99	El Rosario, MX	Monarch Program	?
BF077	Bob Melton	?	?	12/28/98	El Rosario, MX	Korb	?
DA348	Mary Oberg	?	?	03/01/99	El Rosario, MX	Korb	?
DA382	Mary Oberg	?	?	03/01/99	El Rosario, MX	Korb	?
NK076	Karen Oberhauser	?	?	02/10/99	El Rosario, MX	Korb	?
SK300	Lucy White	?	?	02/19/99	El Rosario, MX	Donahue	?
CB963	Judy Younger	?	?	04/05/99	Angangueo, MX	Monarch Program	?

* = See "?" on recovery map, p. 5. † = Monarchs reared under various conditions. ‡ = Tags applied prior to 1998 season and recovered this season (or previously unreported).

OTHER RECOVERIES AND REPORTS



The Monarch Spring Migration through 9 May 1999.

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The following are additional recoveries reported to Monarch Watch during the 1998 tagging season. Please note that the tags listed below are not Monarch Watch tags (SEE FOOTNOTE).

Tag No.	Tag*	Tagger	Tag City, State	Tagged	Reported	Report City, State	Reporter	Miles
24333	U	Don Davis	Toronto, ONT	09/19/98	03/10/99	El Rosario, MX	Monarch Program	2050
24387	U	Don Davis	Toronto, ONT	09/20/98	03/03/99	El Rosario, MX	Monarch Program	2050
24628	U	Don Davis	Toronto, ONT	09/20/98	03/03/99	El Rosario, MX	Monarch Program	2050
115010	B	Monarch Monitoring Project	Cape May, NJ	09/10/98	03/01/99	El Rosario, MX	Korb	2010
115860	B	Monarch Monitoring Project	Cape May, NJ	09/29/98	02/18/99	El Rosario, MX	Korb	2010
115864	B	Monarch Monitoring Project	Cape May, NJ	09/29/98	12/13/98	El Rosario, MX	Brower	2010
116508	B	Monarch Monitoring Project	Cape May, NJ	09/25/98	02/18/99	El Rosario, MX	Monarch Program	2010
116756	B	Monarch Monitoring Project	Cape May, NJ	09/26/98	03/10/99	El Rosario, MX	Monarch Program	2010
132293	B	Monarch Monitoring Project	Cape May, NJ	10/05/98	02/18/99	El Rosario, MX	?	2010
982	S	Gayle Steffy	Denver, PA	09/20/91	02/20/92	El Rosario, MX	Monarch Program	2010
08042	S	Gayle Steffy	Drumore, PA	09/09/98	02/19/99	El Rosario, MX	Donahue	1986
4134	S	Gayle Steffy	Drumore, PA	09/20/95	02/??/99	El Rosario, MX	Monarch Program	1986
111025	B	Lori Hayes ?	Kelleys Island, OH	?	03/01/99	El Rosario, MX	Korb	1831
112261	B	Doris Stifel	Maumee Bay St Pk, OH	09/03/98	98 Season	El Rosario, MX	?	1807
155119	B	Park Personnel	Maumee Bay St Pk, OH	09/10/98	02/18/99	El Rosario, MX	Monarch Program	1807
155158	B	Park Personnel	Maumee Bay St Pk, OH	09/10/98	03/03/99	El Rosario, MX	Monarch Program	1807
155228	B	Park Personnel	Maumee Bay St Pk, OH	09/11/98	02/18/99	El Rosario, MX	Monarch Program	1807
155308	B	Park Personnel	Maumee Bay St Pk, OH	09/13/98	03/11/99	Cerro Pelón, MX	Monarch Program	1807
75196	U	?	?	?	03/03/99	El Rosario, MX	Monarch Program	?
100549	B	Tag issued by Lincoln Brower	?	?	02/19/99	El Rosario, MX	Donahue	?
105247	B	Tag issued by Lincoln Brower	?	?	03/24/99	El Rosario, MX	Brower	?
118031	B	Tag issued by Lincoln Brower	?	?	04/05/99	Anganguero, MX	Monarch Program	?
132293	B	Tag issued by Lincoln Brower	?	?	02/18/99	El Rosario, MX	Monarch Program	?

* B = Lincoln Brower Tag; S = Gayle Steffy Tag; U = Fred Urquhart Tag.

MONARCH RECORDS

These records were gleaned from the annual reports of the Insect Migration Association, a program run by Fred and Norah Urquhart from 1963-1993, and from the records of Monarch Watch (1992-1998). If we have overlooked an important record or made any mistakes in these reports, please let us know!

LONGEST KNOWN FLIGHT: 2880 MILES (4608 KILOMETERS)

Tagged by Don Davis near Brighton, Ontario, on 10 September 1988 (in Urquhart's tagging program) and recaptured on 8 April 1989 in Austin, TX. It is assumed that this Monarch spent the winter in Mexico.

MOST MIGRATING MONARCHS TAGGED BY ONE INDIVIDUAL OR GROUP IN ONE YEAR: 12,397

Terry Callender and his students at Wamego High School (Wamego, KS) tagged these Monarchs in 1996.

MOST MONARCHS TAGGED BY ONE INDIVIDUAL OR GROUP: 33,000

Fred Urquhart tagged these Monarchs at the roosts in Mexico over a period of 4 years.

HIGHEST TOTAL NUMBER OF MONARCHS RECOVERED IN MEXICO, TAGGED BY ONE GROUP/INDIVIDUAL: 47

Terry Callender and his Wamego High students (Wamego, KS): 1993 (1); 1994 (1); 1996 (3); 1997 (4); 1998 (38).

Don Davis (Ontario, CAN) has 23 recoveries: 1985 (1); 1986 (2); 1990 (1); 1991 (10); 1992 (2); 1994 (2); 1997 (1); 1998 (4).

MOST WESTERN ORIGIN OF MONARCH REPORTED IN MEXICO:

Midland, TX (longitude 102:06:01W) • Tagged by Kiri, Emily & Byrne Ulmshneider on 11 October 1998.

MOST EASTERN ORIGIN OF MONARCH REPORTED IN MEXICO:

Columbia, CT (longitude 72:18:06W) • Tagged by Lynn Frazier on 29 August 1998.

MOST NORTHERN ORIGIN OF MONARCH REPORTED IN MEXICO:

Fargo, ND (latitude 47:03:03N) • Tagged by Gary Brekke on 30 August 1997.

MOST SOUTHERN (U.S.) ORIGIN OF MONARCH REPORTED IN MEXICO:

Corpus Christi, TX (latitude 27:42:21N) • Tagged by Lionel & Sylvia White on 17 October 1998.

MOST NORTHERN ORIGIN FOR A RECOVERED MONARCH:

Millburn, Newfoundland - Tagged in Urquhart's tagging program in 1972, recovered in Fairhope, AL.

MOST UNUSUAL RECOVERY SITE: HAVANA, CUBA

Tagged by E.R. McDonald of Port Hope, Ontario (in Urquhart's program) on 25 September 1968.

EARLIEST AND LATEST TAGGING DATES KNOWN FOR MONARCHS REPORTED AT COLONY SITES IN MEXICO:

NORTH AMERICA

12 August (1998) - Tagged by Megan, Alison & Conner Key in Minnetonka, MN; Monarch Watch Tag ZN931

28 October (1998) - Tagged by Susan Throckmorton in Hawley, TX; Monarch Watch Tag UW248

KANSAS ALONE

5 September (1998) - Tagged by Calvin Cink in Lawrence, KS; Monarch Watch Tag AY298

11 October (1998) - Tagged by Jacalyn Goetz in Overland Park, KS; Monarch Watch Tag XM260

OTHER NOTABLE RECOVERIES

RETURN FLIGHT: Tag XA226, Monarch was tagged in the fall by Laura Lichtfuss in Oshkosh, WI and reported in the spring in Rancho Viejo, TX (This Monarch is assumed to have overwintered in Mexico.)

FIRST RECOVERIES IN MEXICO FOR MONARCHS TAGGED IN... (ALL WERE TAGGED IN THE FALL OF 1998)

FLORIDA: Tag AK463, Tonya VanHook, St. Mark's, FL.

CONNECTICUT: Tag BG365, Jan Morris, Wallingford, CT; Tags WK478 & WK499, Daniel Carmody, West Haven, CT; and Tag WJ900, Lynn Frazier, Columbia, CT.

NEW JERSEY: Six tags were recovered from Walton/Brower Collaboration in Cape May, NJ (PAGE 14)

WEST VIRGINIA: Tag BH235, Paula Waggy, Franklin Jr. High, Franklin, WV and Tag MQ156, Terry Kearns, SWOOPE, Bridgeport, WV.

TENNESSEE: Tag ZI466, Anne May and Wanda DeWaard, Pigeon Forge, TN.

HIGHEST RECOVERY RATE/500 TAGS: Paula Donham & Brad Williamson with 1 recovery/70 tagged Monarchs.

LARGEST NUMBER OF RECOVERIES IN MEXICO PER GROUP IN ONE YEAR (38) AND ALL YEARS (47):

Terry Callender and his students at Wamego High School, Wamego, KS.

SEASONAL MONARCH POPULATIONS

In each Season Summary and Pre-Migration Newsletter sent out with the membership/tagging kits, I provide a qualitative assessment of the condition of the Monarch population in eastern North America. These assessments are based on reports posted to our Email Discussion List (Dplex-L, which has 430 subscribers), emails, faxes, phone calls, letters, and my personal experience. I wish to emphasize that the assessments are qualitative. More quantitative information on population sizes and dynamics is needed to understand Monarch biology and to develop sound environmental policy if we wish to sustain Monarch populations. --*Chip Taylor*

SPRING 1998

In the spring of 1998, there were no reports of clustering or large numbers of migratory Monarchs moving north from Mexico. The number of sightings of adult Monarchs was modest and only a few observers reported success in finding eggs and larvae on milkweeds. The number of reports of spring Monarchs reported to Journey North (www.learn-er.org/jnorth) was about 60% of the total reported for 1997.

The pattern of recolonization in 1998 was different from that recorded in the preceding four years by Journey North. In previous years, the Monarchs expanded through the coastal plain and up the east coast earlier than they advanced into the midwest. In 1998, the most rapid movement northward occurred in the central midwest. Although the number of spring Monarchs was lower in 1998, their arrival times at new locations were near the long term averages.

Why was the spring migration so low? The preceding fall migration had been exceptional. The migration through Lawrence, Kansas was the largest seen in 20 years, and for a few days in mid-September 1997, 50-100,000 Monarchs used the Haskell - Baker Wetlands on the south edge of Lawrence as a temporary resting and feeding site. Dick Walton (www.concord.org/~dick/mon.html) also reported a record number of fall migratory Monarchs in Cape May, New Jersey. Subsequently, large overwintering populations in Mexico were recorded by Eligio García. What happened to all these Monarchs and why was the spring recolonization so poor? A large portion of the overwintering population appeared to have survived the winter, although there was evidence of mortality at some of the overwintering sites due to freezing weather in December. However, judging by their wing-wear and amount of fat bodies, the Monarchs appeared to be in poor condition in late February. Water was scarce at the roost sites due to the extreme El Niño-related drought that prevailed through the winter and this may have further stressed the Monarchs. Drought conditions encountered by the surviving Monarchs as they moved through northern Mexico and into Texas may also have taken a toll on the population. This scenario is one possible explanation for the relatively low number of Monarchs throughout the United States in the spring and

early summer of 1998.

SUMMER 1998

Monarch numbers remained low throughout the summer of 1998. Generally, the conditions appeared to be favorable for milkweed growth. Also, there were no periods of extremely high temperatures nor large areas of the breeding range with drought conditions; both of which are frequently associated with low fall Monarch populations. Unusual numbers of earwigs, a type of predaceous insect, were reported from Minnesota to New York. It is unclear whether the earwigs had an impact on Monarch numbers by eating eggs and larvae.

By mid-July it was apparent from numerous reports to Dplex-L (PAGE 42) that Monarchs had reached all parts of the breeding range. However, the numbers were normal or below normal for that time of year. I still had hope for a large fall population and another spectacular migration, but the number of Monarchs in the last generation of the season was relatively low. In my opinion, the most important predictor of the fall migration is the abundance of egg-laying females across the northern breeding area from 20 July - 5 August. The fall population is usually robust if the number of females during this period is substantial, there is an abundance of milkweed in good condition, and the weather is favorable.

In the 1997 Season Summary you will find a brief discussion of Monarch population dynamics (pages 12-13). The discussion leads to this question: "How many female Monarchs must be produced in the fall to have one that survives to reproduce in the spring?" It seems probable that a 20-fold increase is needed in the last generation to keep the Monarch population from declining. This means that on average each female laying eggs from 20 July to 5 August would need to contribute 20 females to the migratory population. Any factor that limits egg laying (such as drought which reduces nectar available to females), or survival of the larvae (such as high temperatures or predation) could drastically reduce the fall population and hence, the prospects for the following year. The assumption that a 20-fold increase is needed to achieve population replacement is based on estimates of mortality during the fall migration (50%), as well as at the overwintering sites (65%), and during the spring remigration (65%). There is some basis for the previous two estimates, the last one is a guess. These may not be realistic estimates, but if they are, and you start with 1000 females in the fall, only 61 (6%, ~1/20) would survive to reproduce. Perhaps only a 10-fold increase is needed to sustain the population from one year to the next under favorable conditions from October through April. In other years, particularly if the conditions at the overwintering sites are extremely harsh or debilitating, a forty-fold increase may be necessary to avoid a decline. If we wish to understand Monarch population dynamics, we need to

achieve a better understanding of the year to year variation in mortality during the migratory period.

MONARCH MONITORING PROJECT

WWW.CONCORD.ORG/~DICK/MON.HTML

JOURNEY NORTH - WWW.LEARNER.ORG/JNORTH

FALL 1998

The fall migration was unremarkable, especially in contrast to the migrations of the previous two years. With the exception of scattered reports from Nebraska and Kansas, few concentrations of roosting Monarchs were sighted during the fall. Monarchs were present in most locations but the numbers seemed to be down everywhere and tagging in most areas was only moderately successful. The weather during the fall migration was warmer than usual and fewer weather fronts with northwesterly winds passed through the midwest in September and October. Storm fronts appear to concentrate the Monarchs. In some cases, the Monarchs seem to ride the fronts and occasionally tagged Monarchs are found southeast of their origin following the passage of fronts with strong northwesterly winds. The best quantitative assessment of Monarch numbers again comes from Dick Walton's monitoring program in Cape May. Dick and his volunteers recorded an average of 47 Monarchs per hour on their transects. This contrasts with a low of 10 seen per hour in 1992 and highs of 85/hr in 1994 and 107/hr in 1997. The average for all 7 years of Dick's monitoring program is 47.6 Monarchs per hour. Thus, in New Jersey, the 1998 population appeared to be close to the long term average. It's still unclear whether the numbers of Monarchs recorded at Cape May are representative of the entire eastern Monarch population. However, the highs and lows seem to correspond to the qualitative assessments we've made of Monarch numbers over the same period.

WINTER 1998

There were a number of alarming newspaper accounts of low Monarch numbers at the overwintering sites in Mexico this past winter. The numbers of Monarchs were certainly lower than in 1996 and 1997, but these were years with high population numbers. Were the numbers really down or were they average? We don't know. Eligio García counts the number of trees and measures the areas occupied by Monarchs at each of the known overwintering sites every winter. However, Eligio has only been conducting these surveys for the last few years so there is no clear sense of the long term average for the number of overwintering Monarchs. This past winter Eligio estimated the total area occupied by Monarchs for all the overwintering sites to be 5.55 hectares. If we use the Brower estimate of 10 million Monarchs per hectare, the number of overwintering Monarchs in 1998 was close to 55.5 million. If we use the Calvert estimate (pers. com.) of 13 million Monarchs per hectare, the number of overwintering Monarchs was 72.15 million. Both estimates assume that all the overwintering colonies were found and measured. Estimates of the total overwintering population will be needed for many more

winters to establish the pattern of population fluctuations. These data are critical. Changes in weather patterns due to global warming, new agricultural practices in the United States, and loss of habitat at the overwintering sites could all have a significant negative impact on Monarch numbers in the future. This information is required to save the eastern Monarch population. Without data on population trends, it will be difficult to convince the governments of Canada, the United States, and Mexico to adopt effective conservation policies to protect Monarchs. ♡

ORIENTATION AND NAVIGATION

How do Monarchs find their way to the overwintering sites in Mexico? As the seasons change in late summer, what are the cues used by Monarchs to initiate the migration and how do they "read" the environment in a way that enables them to navigate across the continent? We have been attempting to answer these questions. In our first paper on this subject (1) we showed, with a clock-shifting experiment, that directional orientation is guided by the use of a sun compass. An unpublished study by Marty Hyatt (2) shows that Monarchs may also use polarized light for orientation. However, in the midwest it is common to see Monarchs migrate en masse under overcast skies when the position of the sun and other celestial cues are unavailable. The ability to migrate in the absence of celestial cues suggests that Monarchs may also use a magnetic compass. To test this hypothesis we exposed migratory Monarchs to a strong magnetic pulse (3) and compared the orientation behavior of these Monarchs with the orientation of sham treated and natural controls under the same field conditions. The results were dramatic. The Monarchs treated with the magnetic pulse were completely disorientated and we saw behaviors such as crashing into the ground and tight upward spirals that we had never seen in previous orientation experiments. Collectively, these Monarchs flew in random directions while the sham treated and natural control butterflies maintained southwesterly headings typical for migratory Monarchs in eastern Kansas. These results demonstrate for the first time that Monarchs are sensitive to magnetic fields and suggest that magnetic perception is incorporated into the navigational system. We have taken these studies one step further (4) and will report on the findings once the results are published. (Pigeons are also disorientated when exposed to a magnetic pulse but quickly recover. We presume the Monarchs used in these experiments recovered and resumed normal flight shortly after their release.)

1. Perez, S., O.R. Taylor, and R. Jander. 1997. A Sun compass in Monarch butterflies. *Nature* 387: 29.

2. Hyatt, M. 1993. The use of sky polarization for migratory orientation by Monarch butterflies. Ph.D. Dissertation, University of Pittsburgh.

3. Perez, S., O.R. Taylor, and R. Jander. 1999. The effect of a strong magnetic field on Monarch butterfly (*Danaus plexippus*) migratory behavior. *Die Naturwissenschaften* 86 (3):140.

4. Etheredge, J., S. Perez, O.R. Taylor, and R. Jander. 1999. Monarch butterflies (*Danaus plexippus* L.) use a magnetic compass for navigation. (in press).

MONARCH POPULATION SIZE

Since we can't use the standard mark and recapture procedure (PAGE 27) for estimations of the size of the fall migratory population, is there any indirect way we can derive an estimate? Yes, but we have to make a substantial number of assumptions. In the following text I will outline a number of conditions and assumptions which, if generally valid, lead to the conclusion that there were roughly 294-360 million Monarchs in the migratory population in 1998.

ESTIMATED POPULATION PARAMETERS

To derive the population estimate it was necessary to use estimates of: 1) the total area occupied by Monarchs at all overwintering sites, 2) the number of Monarchs per unit area (density), 3) the proportion of the total area represented by the Monarchs at El Rosario, (the overwintering site at which most of the tags were recovered), 4) the total number of Monarchs tagged, and 5) the rate of mortality of overwintering Monarchs from the time of their arrival to the time when most tags were recovered.

The total area occupied by Monarchs this past winter was estimated by Eligio García to be 5.55 hectares (2.2 acres per hectare). For my calculations, I've rounded this to 6 hectares. If we use the Brower extrapolation of 10 million Monarchs per hectare, the estimate for the overwintering population is 60 million Monarchs. The population at El Rosario occupied 2 hectares (about 33% of the total) and therefore, had approximately 20 million Monarchs early in November/December 1998. I've assumed that 50% of the Monarchs that arrived in November were alive during the period (mid-January through March) when most of the tags were recovered. This is a safe assumption since mortality increases steadily throughout the overwintering period and differs among roosts and years.

NUMBER OF MONARCHS TAGGED

This past fall we issued more than 220,000 tags but how many Monarchs were actually tagged? Unfortunately, we have to estimate because some of the taggers do not return their records. There are two ways to estimate the number of Monarchs tagged. The most direct method is to average the number of records per page with several subsamples, and to multiply this by the total pages of records. The indirect method is to estimate the mean number of recoveries per number tagged from taggers with large numbers of tagged Monarchs. The former method yields an estimate of 65,500 Monarchs tagged and the latter yields a rate of 1 recovery per 200 Monarchs tagged. Since approximately 400 Monarchs were recovered at El Rosario, about 80,000 Monarchs were tagged in the fall of 1998 - if this average is representative of all tagging.

SURVIVAL OF TAGGED MONARCHS

Let's apply these estimates of population and recovery parameters to El Rosario and then to the entire population.

If we assume: 1) we tagged 65,500 Monarchs; 2) these Monarchs were distributed at random to all of the colonies as suggested by the isotope study (PAGE 22); and 3) El Rosario contained 33% of all the overwintering Monarchs at the beginning of the season, then the maximum number of tagged Monarchs destined for El Rosario was 21,615. However, some unknown portion of the Monarchs do not survive the journey. Although we don't know the number that die on their way to Mexico, we can ask how many tags would be "at risk" (i.e., available for recovery) if certain percentages survived. For example, if 66.6% survived, there would be 14,396 tags/20 million or one tag per 1389 butterflies. Similarly, if 33.3% survived, there would be 7198 tags/20 million or one tag per 2779 butterflies. This gives us an idea of the average number of butterflies that need to be examined to recover 1 tag.

As a second estimate, we can use 80,000 as the base rather than 65,500 (33% of 80,000 is 26,640 tags). This would be the maximum number of tags at risk of recovery at El Rosario if all tagged Monarchs survived. Assuming that half (10 million) of the 20 million Monarchs that arrived at El Rosario are alive in late winter (when most of the recoveries are made) we can bracket the ratios of tags at risk to the total number of Monarchs in the population under different assumptions about the survival of tagged butterflies. Again, this gives us the number of butterflies alive per tag.

If 60% (15,984) of all tagged Monarchs (26,640) survive to the time of recovery and 400 are recovered, the recovery rate is 2.5% of the tags at risk and there is one tag per 626 butterflies in the population of 10 million.

If 40% (10,656) of all tagged Monarchs survive to the time of recovery, the recovery rate is 3.8% of the tags at risk and there is one tag per 938 butterflies in the population.

If 20% (5,328) of all tagged Monarchs survive to the time of recovery, the recovery rate is 7.5% and there is one tag per 1877 butterflies in the population.

If 10% (2,664) of all tagged Monarchs survive to the time of recovery, the recovery rate is 15% and there is one tag per 3754 butterflies in the population.

We can interpret these recovery rates as the proportion of all butterflies alive that had to be viewed to recover 400 tags. In other words, if there were only 2664 tags at risk, to recover 400 tags would have required the local searchers to view 15% of the population or roughly 1,500,000 butterflies. This would mean one recovery for every 3750 butterflies viewed.

These estimates of the tags at risk (FIGURE 1) bracket the possibilities, but we don't really know whether the number was closer to 15,984 or 2664.

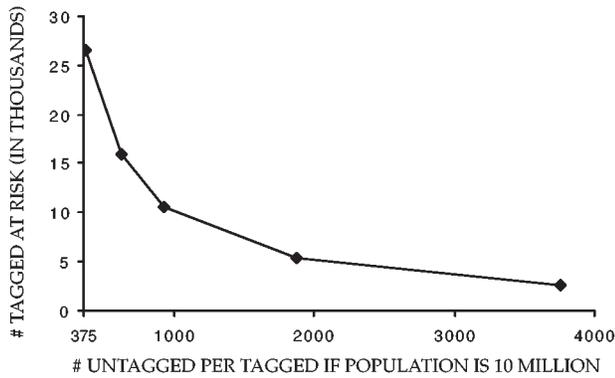


Figure 1. Relationship of the numbers of tagged butterflies to numbers untagged in a population of 10 million Monarchs. This also represents the mean number of Monarchs viewed to make one recovery.

SEARCH EFFORT

We also don't know the amount of search effort (number of person hours) involved to find the 400 tags. The searching was concentrated along the watercourses being visited by the butterflies. The butterflies are concentrated at these water sites 2-6 hours per day depending on the temperature and cloud condition. Searchers generally were able to find 1-2 tags per day's effort. The question is: what proportion of the total population of Monarchs at El Rosario were viewed by the searchers over the entire search period?

Because not all the butterflies can be viewed to see if they are tagged due to their positions in trees, their distances from observers, etc., we have to make some additional assumptions about the percentage of the population viewed by those seeking tags. If we have an estimate of the percentage of the total population that was viewed, we can estimate the average number of butterflies that must have been viewed to obtain each tag. Was it 3750 per tag as suggested above or fewer than this?

If the search effort viewed 50% (5 million) of all Monarchs surviving at El Rosario (10 million) to find 400 tagged butterflies, the searchers found 1 tag per 12,500 butterflies. Therefore, there were a total of $800/26,640$ tags [$2 \times 400/5$ million = $800/10$ million] at risk at the time of recovery (3%) in the entire population.

If they scanned 25% of all Monarchs and found 400 tags, the searchers found 1 tag per 6,250 butterflies. Therefore, there were 1600 (6%) tags at risk at the time of recovery.

If 12.5% were viewed, there was 1 tag per 3,120 and about 3200 (12%) tags at risk at the time of recovery.

If the numbers viewed to find 400 tags were less than 12.5% of the total population, the proportion of tagged butterflies surviving is even higher (FIGURE 2).

If we use the estimates of the population viewed as a basis for making predictions of those alive and the numbers tagged were actually 65,500 rather than 80,000, the proportion surviving to the time of recovery is higher. If there were 65,500 tagged with a maximum of 33% (21,812) expected for

El Rosario, and if 12.5% of the butterflies were viewed, $3200/21,812 = 14.7\%$ of the tagged Monarchs were alive during the recovery period.

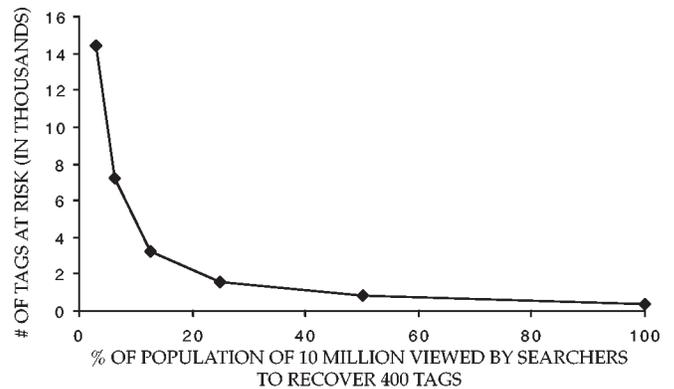


Figure 2. Percent of population viewed by tag searchers to recover 400 tags. Note that when lower numbers of Monarchs need to be scanned to recover 400 tags, the probable number of tags at risk is higher.

SIZE OF THE MIGRATORY POPULATION

Let's do some more backward math. We can estimate the proportion of tagged Monarchs that died enroute to El Rosario if we have a good estimate of the number of tagged Monarchs that are alive (at risk) during the observation period and have a good measure of the rate of mortality of tagged and untagged Monarchs through the overwintering period. Further, we could estimate the size of the eastern North American Monarch population that started the migration in late August 1998 by assuming that survival was similar for tagged and untagged Monarchs during the migration.

We still have to make assumptions, so let's assume that to make 400 recoveries the local people viewed between 12.5 and 25% of the 10 million butterflies. Let's use 18% as our estimate (one tag per 4500 butterflies and 2222 tags at risk in the total population). We have already assumed 50% mortality for the total population and if 2222 is 50% of the number of tagged butterflies that arrived at El Rosario, then 4444 tagged butterflies arrived at El Rosario. If we assume that 65,500 were tagged and 33% of these or 21,812 could be expected at El Rosario, then $4444/21,812 = 20.4\%$ survived to reach El Rosario. On the other hand, if 80,000 were tagged, the percentage drops ($4444/26,640$) to 16.7%. If these are realistic estimates of survival, what does this say about the size of the entire migratory population? If the mortality rates are similar for tagged and untagged Monarchs and the 20 million Monarchs that arrived at El Rosario are only 20.4% of those that attempted the journey, then the total that started the migration is 98 million or 120 million (using 16.7% survival). Note: if only 9% of the population was viewed to recover 400 tags, these estimates become 49 and 60 million.

If the 6 hectares of butterflies at all the overwintering sites combined represent the total Monarch area with 10 million butterflies per hectare (a total of 60 million Monarchs), the

(“POP SIZE” CONTINUED ON PAGE 20)

“POP SIZE” CONTINUED FROM PAGE 19)

estimates for the number making the trip are 294 million and 360 million (FIGURE 3). This estimate assumes that all of the overwintering sites are known. We are also assuming 10 million butterflies per hectare. If either of these assumptions is incorrect, the total population could be much larger or smaller. For example, the mean number of Monarchs per hectare is only 5 million, the total migratory population is much smaller. On the other hand, the Monarch population is larger if the 10 million per hectare estimate is too low or there are some unknown overwintering sites.

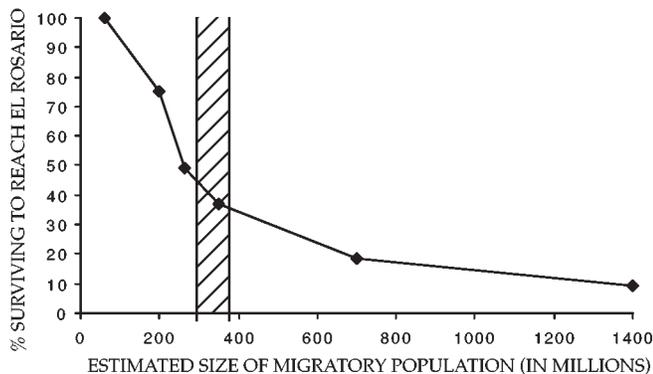


Figure 3. Estimated size of the migratory Monarch population based on percent surviving to reach overwintering colonies. The migratory population in 1998 was estimated to be 294-360 million butterflies (hatched region on graph) based on estimates of mortality, number of Monarchs tagged, and the percentage of the population viewed to recover 400 tags.

As you can see from this exercise, estimating the numbers of migrating Monarchs involves many assumptions and conditions, and the totals of 294-360 million could be in error by 100 million or more. Nevertheless, bracketing the possibilities based on recapture rates, rates of mortality, and search effort is a promising approach. Refinements of this method in the future should yield better approximations of the total number of Monarchs in the fall population. ♣

--Chip Taylor

MILKWEED RESTORATION

Milkweeds are the basis for the Monarch population. These are the only suitable host plants for Monarch larvae. Although the common milkweed (*Asclepias syriaca*) is abundant in many places and often becomes established on disturbed sites, it is disappearing due to urbanization around our cities and may soon decline in rural areas with changes in agriculture (PAGE 48). Milkweeds are also eliminated by roadside spraying and mowing, practices which are detrimental to many forms of wildlife.

Clearly, if we want Monarchs, we have to protect milkweeds. When discussing the conservation problems associated with protecting the forests in the Monarch Reserve in Mexico, our Mexican colleagues frequently point out that those of us in the Monarch breeding areas are doing nothing to protect milkweeds or Monarchs. They have a good point. We ask them to contribute to Monarch conservation but we aren't proactive on Monarch conservation in our own countries. It's time for a change. Those of us interested in Monarchs need to promote Monarch and milkweed conservation in the United States and Canada.

The first step is to establish the connection between Monarchs and milkweeds with the public, state, and local officials who make decisions regarding management of our roadsides and public lands. We should encourage our states to consider adopting a management plan similar to that found in Iowa. The Iowa plan, known as the Integrated Roadside Vegetation Management Program (www.uni.edu/~irvm/index.html) has effectively restored 900 square miles of roadsides and public lands for wildlife. In addition, we can actively promote restoration of milkweeds on lands from which they have been eliminated. Local milkweed seeds can be saved in the fall for use in restoration projects the following spring. We can also add milkweeds to our gardens and those at schools. These are all small steps and they may not offset the annual loss of milkweed habitat but we must start somewhere and we need to demonstrate to our Mexican colleagues that we are truly interested in Monarch conservation.

CONTROLLING APHIDS AND THRIPS IN GREENHOUSES

Milkweeds (*Asclepias curassavica*, *A. physocarpa*, and *A. incarnata*) grown indoors are often attacked by aphids, usually the oleander aphid (*Aphis nerii*), thrips (*Thysanura*) and spider mites. In my experience, spider mites are only a problem on *A. incarnata* and I don't have a non-chemical solution to these pests. Aphids and thrips have piercing-sucking mouthparts and feeding by these insects can have a negative effect on milkweed growth. The aphids are usually not a problem on large plants but they can affect seedlings. The thrips, if completely uncontrolled, can significantly damage leaves and kill plants. The aphids can be contained (though not completely controlled) by a small hymenopteran parasite, *Aphidius colemani*. The *Aphidius* females insert their eggs into the aphids which become "mummified" when the wasp larva spins a cocoon inside the abdomen of the aphid. When mature, the wasp emerges from a circular hole in the aphid's abdomen. The wasps cause extinctions of small aphid populations but in our greenhouse as soon as one aphid population disappears another appears elsewhere. Now that *Aphidius* is established, the aphids are not the problem they were in the past. The thrips are controlled with predaceous mites, *Hypoaspis miles*. We added two containers with 25,000 mites to the greenhouse in the fall as the thrips population was beginning to increase. The thrips began to noticeably decline after 6 weeks and we haven't had to treat the plants for thrips all winter. *Hypoaspis* mites partially control the fungus gnats and shore flies that frequently become established in potting soil. If you are interested in these or other biological control agents, contact us or search the Web using *Aphidius*, *Hypoaspis*, or biological control as keywords.

MORTALITY RATES

The population estimates for 1998 (PAGE 18) are based, in part on the assumption that 50% of the Monarchs arriving at El Rosario are alive during February and March when most of the tags are recovered. Unfortunately, there are no comprehensive studies of the total mortality at the overwintering sites in the literature (MEXICAN RESEARCHERS, PAGE 47). Such studies are difficult because the colonies move downslope as the season progresses, often into areas which are less accessible. In February, if one goes to the ridgetops where the colonies first formed in November, you can follow the path of the colony as it moved downhill by the carpet of dead Monarchs on the forest floor. Millions die but what are the reasons for their deaths and what proportion of the total population dies during the 135-day overwintering period (10 November - 25 March)?



Monarchs killed by birds, probably grosbeaks, at Mojonera Alta, December 1998.

*Photo by
O.R. Taylor.*

The causes of death fall into the following categories: predation, accidental death, physiological death, and catastrophic mortality. Predation on Monarchs by black-backed orioles (*Icterus galbula*), black-headed grosbeaks (*Pheucticus melanocephalus*), and by mice, specifically *Peromyscus melanotis*, has been studied in some detail (Alonso-Mejía et al. 1998; Glendinning 1993). Bird predation can be significant and Alonso-Mejía et al. (1998) estimated that 15.5% of the Monarchs at Sierra Chincua were killed by birds in 1994. Predation by *Peromyscus* is limited to the Monarchs found within a meter of the surface. Nevertheless, mice may kill up to 5% of the overwintering Monarchs (Glendinning et al. 1988). Accidental death (e.g., falling branches and being trampled by visitors) probably represents a small proportion of the total mortality. Physiological death, represented by intact butterflies found dead on the forest floor, may be the largest and most enigmatic category of mortality. The researchers call these butterflies DWACS, an acronym for "dead without a cause". DWACS can be found from the moment the first butterflies arrive in November to the end of the season. Many of the dead butterflies have depleted fat bodies and extremely worn, often broken, wings. The butterflies appear to be worn out and this mortality is understandable. More puzzling are the dead butterflies with well developed fat bodies and excellent wing condition. Why do these butterflies die in large numbers? There is no answer to this question. A superficial examination in the field indicates the butterflies are "healthy" and lack any obvious pathology such as bacterial or protozoan infections.

One possible explanation is that the DWAC butterflies were unable to metabolize enough sugar (trehalose) from the fat bodies to sustain themselves - a type of physiological starvation. Although the breakdown of fats produces metabolic water, the Monarchs need additional moisture. It's possible that many die in what appears to be excellent condition because of insufficient water to run the metabolic system. If this is correct, drought could contribute substantially to the overwintering mortality. However, the effect of drought would be subtle and difficult to document.

Catastrophic mortality due to snowstorms, freezing rains, and sub-freezing temperatures produces dramatic headlines and descriptions of millions of dead butterflies. These episodes are what ecologists call "density independent mortality" and do not occur every year but sometimes account for significant mortality. The deaths of 2.5 million Monarchs were recorded in the Zapatero colony (Sierra Chincua) during and following a period of snow, freezing rain, and extreme low temperatures in January 1981 (Calvert et al. 1983). Based on the size of the colony (0.65 hectares), and using 13 million butterflies per hectare, Bill Calvert (pers. com.) estimates about 30% of the butterflies died due to this storm.

In summary, I don't know whether the 50% mortality used to make the population estimates is high or low but it may be close. By consulting Figures 1-3 (PAGES 19-20) you can determine what the overall population estimate would be if we set the estimated mortality at either 25% or 75%. ♡

On the left, a dead male Monarch with missing abdomen, typical of grosbeak predation and on the right, a DWAC female in "perfect" condition.

*Photo by
O.R. Taylor.*



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TRACKING MONARCHS WITH ISOTOPES

This report summarizes the collaborative research between Monarch Watch and Environment Canada scientists Leonard Wassenaar and Keith Hobson on the natal origins of Monarchs overwintering in Mexico.

By O.R. Taylor, L.I. Wassenaar, and K.A. Hobson

BACKGROUND

Local and long-distance movements of organisms have been tracked by biologists using a wide variety of marking techniques. All of these methods require an initial capture, marking, and recapture of numerous individuals; until now. Len Wassenaar and Keith Hobson of Environment Canada recently developed a new means of tracking migratory species that by-passes the initial step of capturing and marking a portion of the population. Their method uses naturally occurring stable isotopes of hydrogen and carbon as a chemical signature in the migratory species.

Deuterium, a stable isotope of hydrogen, occurs naturally in trace concentrations in rainwater across the North American continent. Concentrations of deuterium correspond to climate, elevation, and the prevailing source of moisture that makes up rainfall. In other words, the ratio of deuterium to hydrogen in rainwater changes as a function of temperature, relative humidity, and location on the continent. In theory, each individual, whether plant or animal, acquires chemical or "home" isotopic signals based on the ratios of hydrogen isotopes in rainwater and carbon isotopes acquired through photosynthesis or ingestion. Plants and foodwebs supported by those plants, often have characteristic stable isotope ratios of carbon that can vary according to photosynthetic pathway and ambient temperature and moisture conditions. As nutrients are taken up by plants, the isotopes are incorporated into the plant tissues. Insects that eat the plants, birds that eat the insects, and foxes that eat the birds, all derive local isotopic signals that can be traced back to the rainwater and plants at the base of the foodweb. They are what they eat isotopically as are we.

In order for the signal to be useful for tracking migrants, several conditions are necessary. Individuals must acquire the isotopes in one place (usually the birthplace), and the signal cannot change as an individual moves to a new location during migration. Body parts that meet these requirements are biochemically inert, like hair, feathers or wing membranes. In 1995, when Monarch Watch began a collaborative project with Wassenaar and Hobson, it wasn't clear whether Monarchs would acquire the expected home signal from the milkweeds they consumed as larvae or whether the isotopic ratios could provide the resolution needed to facilitate tracking. Our goal was to establish and quantify the origins of Monarchs that arrived at the overwintering sites in Mexico. However, many experiments were needed to verify the isotope analysis and home signal concept. The chronology of the project is outlined on page 30.

METHODS

To establish the geographic origins of Monarchs arriving in Mexico, we needed information from both controlled laboratory experiments and field studies. Control studies were conducted to determine whether a correlation existed between the deuterium concentration in water, plants, and Monarchs as well as carbon isotope concentration between plants and Monarchs. Tropical milkweed, *Asclepias curassavica*, plants were grown in the laboratory under lights using three different concentrations of deuterium in the water. Monarchs were reared on each group of plants and samples of water, soil, leaves, and adult Monarchs were sent to Saskatoon for analysis. We asked volunteers to "wild" rear Monarchs to determine the home signals for Monarchs throughout the eastern population and to map the isotope gradients across the Monarch breeding range.

To support this aspect of the project, Monarch Watch provided Monarch rearing kits to selected volunteers. The kit contained 20-30 Monarch eggs, envelopes in which to return the adult butterflies, paper towels in which to dry the milkweed leaves, ziplock bags, labels, data sheets, an addressed return mailing box, and relatively simple rearing and handling instructions. One hundred thirty kits were sent to volunteers in July and August 1996-97. The volunteers reared the Monarchs on naturally occurring milkweeds that were watered only by rainfall. When the rearing was completed, the participants forwarded 3 male and 3 female Monarchs to Monarch Watch with a sample of the dried milkweed leaves on which the larvae were reared. The samples were labeled with the name of the volunteer, location, and date.

Samples of dead Monarchs from each of the thirteen overwintering colonies in Mexico were obtained for isotopic analysis by Wassenaar and Hobson in February and March of 1997.

Samples of butterflies and plants from both the control and field studies, as well as the Monarchs collected from the colonies in Mexico, were analyzed for hydrogen and carbon isotopes at the Environment Canada stable isotope laboratory in Saskatoon. The wings of the Monarchs were used for analysis. The isotopes are chemically bound to the dead tissue that comprises the wing membrane and the ratios do not vary once the wings are formed. The technical aspects of the isotopic analysis and the interpretation of the data to create maps of isotopic gradients are described in a paper (Hobson, Wassenaar, and Taylor) to appear in the journal *Oecologia* in July 1999.

RESULTS AND DISCUSSION

The laboratory tests showed that the deuterium levels in the water, soil, plants, and Monarchs were closely correlated. In other words, the deuterium content of the Monarchs was similar to that found in the water used to grow the plants. Similarly, stable-carbon isotope ratios in plants could be

readily correlated with those in Monarchs raised on those plants. This established that the deuterium-hydrogen ratio moves through the food chain in a predictable manner and that the ratio constitutes a valid "home signal" for the Monarchs. Analysis of the many samples of Monarchs reared by volunteers showed distinct gradients of hydrogen isotopes across eastern North America (FIGURE 1), similar to temperature isoclines seen on weather maps. Surprisingly, carbon-13 also showed a distinct geographic pattern. These gradients are not the same for the two elements. Because each specimen gave two chemical signals, one for hydrogen and another for carbon, it was possible to identify the general region of the natal origin of each butterfly. For example, the hydrogen signal may indicate a broad latitudinal area of possible origin for a specimen but the carbon signal helped to narrow the region to a much smaller area.

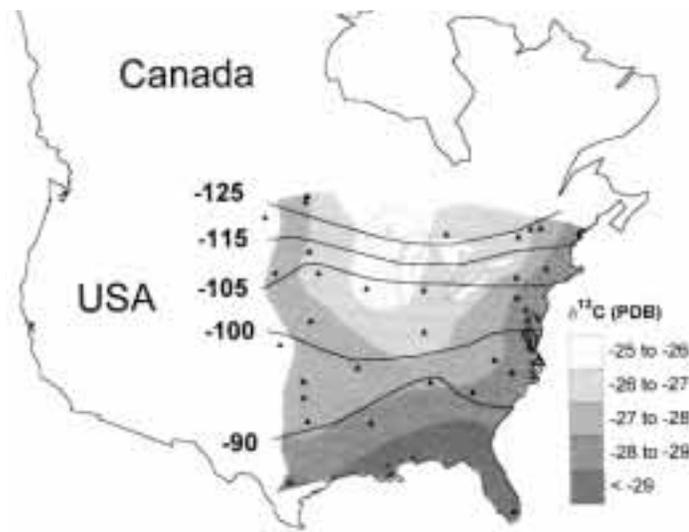


Figure 1. Patterns of hydrogen and carbon isotopes in Monarch wings from origins (▲) in eastern North America.

Wassenaar and Hobson were able to construct a map for the natal origins of the Monarchs in Mexico (FIGURE 2) by using both isotopic home signals for over 600 Monarchs obtained from 13 overwintering colonies. The Monarchs reaching each colony appear to originate from all areas of the northern breeding range. Two of the colonies appeared to have somewhat higher proportions of butterflies from more northerly parts of the range, but in general, the Monarchs are well mixed when they reach Mexico. Tagging results also show mixing at the overwintering sites, though they are restricted to fewer colonies and individuals.

The map of natal origins (FIGURE 2) shows that 50% of the 1996 Monarchs originated from eastern Nebraska to western Pennsylvania. This result is surprising. It is easy to get the impression that a higher proportion of the Monarchs originate from the area north of the 50% zone. These are the regions where the highest densities of larvae are reported late in the summer. Assuming the isotopic analysis is correct, how can we explain the lower than "expected" number of northern Monarchs reaching Mexico? There are two possibilities, either the death rate during the migration reduces

the proportion of the Monarchs of northern origin reaching Mexico or there are more Monarchs produced in the mid-west than we realize.

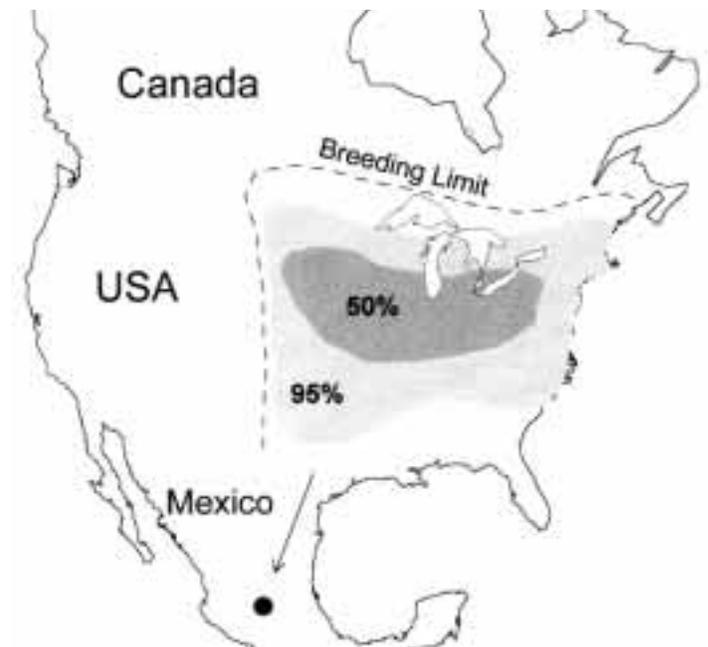


Figure 2. Natal origins of Monarchs at overwintering colonies in Mexico.

Some of the most intensively farmed land of the United States occurs within the 50% boundary. This is the major region of corn and soybean production. This region is intensively farmed with relatively few pastures and limited acreage of weedy roadsides and natural areas. It would seem logical that many of the Monarchs in this area mature on the milkweeds in field crops. The density of common milkweed and blue vine in field crops depends on the degree of weed control by the growers. Blue vine is uncommon along roadsides but can become so abundant in cornfields in eastern Kansas that beekeepers harvest blue vine honey. Comprehensive surveys for the abundance of milkweeds and Monarch larvae in field crops are needed. However, reports from growers and those who survey for corn insects indicate Monarchs are sometimes abundant in these crops. If a high proportion of the midwestern Monarchs originate in cropland, there is reason for concern. Changes in agriculture have the potential to reduce both milkweeds and Monarchs (PAGE 48).

The natal origin map represents the distribution of origins for one year. In retrospect, the overwintering population in 1996-97 was the largest recorded in the last 5 years and it may have been one of the largest overwintering populations in several decades. Would the map look the same in down years such as 1998 or in years with pronounced droughts in the breeding areas? We can't be sure, but probably not. This study establishes the utility of a method and provides a baseline against which to measure future changes in Monarch populations. Many questions have been answered but more remain.

("TRACKING" CONTINUED ON PAGE 25)

IN PURSUIT OF A LITTLE HISTORY

On the 14th of December I had an extraordinary experience that connected me with the discovery of the Monarch overwintering sites in Mexico. The Telecom film crew (SEE PAGE 50) decided to visit Cerro Pelón, the mountain where Ken Brugger was led to the first Monarch colony. The purpose of the trip was to interview the local residents of the village of Macheros about the history of this discovery and to visit the specific roost site which is now known as Carditos. With the video camera running as we interviewed several guides, we discovered that the man who led Ken



Don Benito Juárez.

Photo by Yasuo Kasugai.

Brugger to Carditos was still alive and lived just 200 yards from where we stood! We hadn't expected to find Ken Brugger's guide since we had been told that all the original participants were now deceased. With great anticipation, we marched down the hill in search of Don Benito Juárez. We found Don Benito, an active 96 year-old, at his home. He graciously gave us a long on-camera interview on the politics which developed subsequent to the discovery of overwintering Monarchs on Cerro Pelón.

When we visited Ken Brugger in October he let us borrow and duplicate his slides. One of these slides shows Monarchs and an index card with "2 January 1975, Cerro Pelón" written on it. This was evidently the date on which Ken and Cathy Brugger were led by Don Benito (then 73) to Carditos. When asked if he had to search the mountains for the butterflies, Don Benito said, "No, I led the Bruggers directly to the site." His answer indicated that he knew of the site prior to the arrival of the Bruggers. So how long did he know of the location of the overwintering Monarchs? Don Benito replied that he had discovered the area while hunting with his father when he was 12-14 years old (about 1915). Did anyone in the community know of Monarch locations before this date? No. Don Benito did not remember the Bruggers by name but he described them as an American with a Mexican wife who always wore something around her neck. In several of the Brugger pictures, Cathy can be seen wearing what appears to be a small field pack around her neck.

After the interview we drove to the base of the trail that leads to the top of the mountain and the Carditos overwintering site. The last two kilometers to the summit is a steep climb. Wishing to duplicate Ken Brugger's original trip, the Telecom crew had arranged for horses. I hadn't been on a horse since 1973, 2 years before Ken Brugger's trip to Cerro Pelón. The horse got me up the trail, and I was thankful, but clearly we did not communicate well with each other since

he frequently stopped when I wanted him to go. I never did see the video of my horsemanship, but it must have been pretty funny since it was not used by Telecom in the final edit.



When we reached Carditos, we surveyed the area for the size of the population and examined many of the dead butterflies on the forest floor. The area of Carditos is small, only about 0.1 hectare. It only contained about 1 million Monarchs using an estimate of 10 million Monarchs per hectare. The butterflies appeared to be in excellent condition and most had minimal wing-wear and well-developed fat bodies. The forest floor was scattered with wings and butterflies without abdomens - an indication of predation by grosbeaks. We did not find dead butterflies with eviscerated abdomens which is typical of predation by orioles. With this latter type of predation, the butterfly appears to be unharmed but, upon closer inspection, one can see that the abdomen has been stripped open along the side and the abdominal contents removed.

At the end of our sightseeing, the Telecom crew wanted to interview me about the history of the discovery of Monarchs and what we had found at Carditos. One of the questions was - can you describe this overwintering site for us? I described the site as a ring of oyamel fir trees containing butterflies that surrounded an open area. Two days later I reread the 1976 National Geographic article which quotes Ken Brugger, "We have found them - millions of Monarchs - in evergreens beside a mountain clearing." Carditos was supposed to be the site that Don Benito had led the Bruggers but was it? The slide with the 2 January 1975 date is labeled "Los Ranchitos" not Carditos. Does this mean that the Bruggers were taken to a different site? Was Ken Brugger confused about the name or had the name changed? At present, there are ten named Monarch areas on Cerro Pelón but Los Ranchitos is not among them.

Another slide in the Ken Brugger archive shows Monarchs and a card reading: "Monera Alta, 2 Feb. 1975" (SEE PHOTO, NEXT PAGE). *Mojonera* Alta is one of the three named overwintering sites on Sierra Chincua. Thus, in the space of one

month Ken and Cathy Brugger had located two of the Monarch overwintering areas. The photos in the National Geographic article of August 1976 were taken by Albert Moldvay, apparently at



Photo by Ken Brugger.

Cerro Pelón, on a trip he took with the Bruggers, and by Bianca Lavies in January 1996 as she accompanied Fred and Norah Urquhart on their first trip to the locations discovered by the Bruggers. One or more of the Lavies pictures may have been taken at Sierra Chincua, probably at Mojonera Alta. Apparently, in an attempt to protect these locations, and perhaps conceal them from other scientists, neither Cerro Pelón nor Sierra Chincua are mentioned by Fred Urquhart in the article. We visited Mojonera Alta with the film crew on December 15th and there I saw the largest and most dense concentration of Monarchs I'd seen in my trips to the overwintering sites. I couldn't help but wonder about how Ken Brugger must have felt as he first walked through the Oyamel's festooned with Monarchs. Surely, some of the local residents had seen these masses of butterflies. However, through his communications with the Urquharts, Ken Brugger may have been the first person to witness and fully comprehend the significance of these Monarch aggregations. ♡

For more information on the discovery of the Monarch overwintering sites in Mexico, please see:

Brower, L. P. 1995. Understanding and misunderstanding the migration of the Monarch butterfly (*Nymphalidae*) in North America: 1857-1995. *Journal of the Lepidopterists' Society*, 49:304-385.

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("TRACKING" CONTINUED FROM PAGE 23)

ACKNOWLEDGEMENTS

This project was funded by Environment Canada, the Canada-Mexico International Partnerships Program, the Manitoba Model Forest Project, and Monarch Watch. The Mexican component of the project was supported by INE and INIFAP (Michoacán, Mexico). We wish to thank all Monarch Watch volunteers who so generously gave of their time to rear Monarchs for this project. Special thanks to Kari Rogg who ably coordinated the shipping and communications with our volunteers.

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KENNETH BRUGGER (1918-1998)

Monarch enthusiasts lost one of their own, Kenneth Brugger. Mr. Brugger passed away at his home in Austin, Texas, on 25 November 1998, at the age of 80. Mr. Brugger and his wife, Cathy, were the first to discover the Monarch overwintering sites in Mexico in January 1975 while working with Fred and Norah Urquhart. His discovery provided an important piece of information concerning the mystery of the Monarch's fall migration.

Mr. Brugger was born 16 June 1918, in Kenosha, Wisconsin, to Oswald and Carrie Lindemann Brugger. As a youth growing up in Wisconsin and Illinois, his interests included racing on bicycles and ice skates. He graduated from Bradford High School in Kenosha, WI in 1937, and then attended Milwaukee School of Engineering. He was a mechanic at his father's garage until World War II. He served in the U.S. Army from June 1942 until December 1945, and was assigned to work in cryptology in the Signal Training Regiment at Fort Monmouth, NJ. In the army, he developed an interest in homing pigeons, and continued to rear and race pigeons until his death.

Mr. Brugger worked at Simmons Co. and Jockey International until his retirement in 1965. At Jockey International, Mr. Brugger worked on textile machines. He is credited with developing the process which compresses cotton fibers to the point that the fibers will spring back in the wash to compensate for shrinkage. After his retirement, he worked as a textile consultant in Texas and Mexico.

His travels to Mexico began his association with Monarchs and Dr. Urquhart. In a Mexican newspaper, Mr. Brugger read Dr. Urquhart's plea for volunteers to help track the annual fall migration of Monarch butterflies. Mr. Brugger recalled driving through a storm of Monarchs in the transvolcanic mountains west of Mexico City. After corresponding with Dr. Urquhart, Mr. and Mrs. Brugger returned to the area in the winter of 1974 to where the "Monarch storm" had been spotted. On 2 January 1975, the Bruggers discovered one of the overwintering sites of the Monarchs.

In the Mexican culture, Monarchs are believed to be the souls of the dead. Kenneth Brugger has once again returned to a great place surrounded by Monarchs.



MONARCH RANGE EXPANSION

During the last century Monarchs exhibited a sudden and spectacular expansion of their distribution from the Americas to many isolated regions in the Pacific and Atlantic. Presently Monarchs are found in Australia, New Zealand, Hawaii, and many smaller land masses throughout the Pacific including the Mascarene Islands off the east coast of Africa. In the Atlantic, Monarchs are found in the Azores, Canaries, Gibraltar, and southern Spain. In all of these locations, Monarchs utilize introduced milkweeds, primarily *Asclepias curassavica* (Tropical milkweed), and *A. physocarpa* (Swan plant). Therefore, the milkweeds had to be introduced before the butterflies for the Monarchs to become established. Curiously, Monarchs have not established populations in several regions where milkweeds occur naturally, e.g. South Africa and islands in the northern Pacific. In addition to milkweeds, there are numerous other danaine butterflies in these regions. These areas should have been accessible to Monarchs during the expansion period, 1845-1890. If Monarchs did reach these areas, their failure to colonize successfully could be due to direct or indirect interactions with the native species. However, failure to colonize is a side issue. The real questions are: Why did Monarchs suddenly expand their distribution? What were the conditions that led to these colonizations? For example, why did Monarchs appear periodically in England and northern Europe after 1876 (Ackery and Vane-Wright 1984) but not before this time?

Three factors might explain this expansion: steamships, European colonization of the south Pacific, and missionaries. Steamships crossed the Atlantic on a regular basis in the 1840's and largely replaced slower sail driven craft by the 1870's. The steamships reduced the travel time from America to Europe from months to weeks and eventually to 4-5 days. Intervals of a week or less are short enough for Monarchs to survive aboard ship in the rigging or in cargo, and there are numerous anecdotal accounts of such stowaways. European colonies were well established in Australia and New Zealand by the 1840's. These countries together with Hawaii, which had Monarchs and milkweeds as early as 1845 (Vane-Wright 1993), served as points of departure for missionaries who fanned out to the islands of the eastern Pacific. The missionaries may have been the source of the milkweed (Smithers, pers. com.). Milkweed was valued for its "down" (termed "coma" by botanists) which could be used to make pillows. Whether pillows or other products were made from milkweeds isn't

certain but the plants became established along with the missionaries and other settlers. It seems likely that these human colonizations were followed by shipments of domestic animals and their forage aboard steamships. The cut forage may have contained milkweeds as well as Monarch larvae and pupae. Monarch pupae probably survived in these shipments with the emerging adults becoming the source of new Monarch populations.

This scenario for Monarch expansion is similar to the explanation given for the colonizations by many European insects and plants around the world. The ability of Monarchs to fly great distances and their capacity to survive as adults in a quiescent state for days and even weeks together with their high reproductive rate, may also have been significant factors in these colonizations.

Alternative explanations, such as the provocative Columbus hypothesis offered by Vane-Wright (1993), require deforestation of eastern North America followed by an invasion of milkweeds that provided the host plant base for a Monarch population explosion. Transoceanic dispersal is also required, and as I read Vane-Wright, I envision a maladapted megapopulation spinning off dispersing Monarchs in all directions. The distribution and abundance of milkweeds may have increased in the formerly forested areas but surely it was a slow process and such changes may have been offset by destruction of the milkweed-rich prairies as they were converted to farm-

land. There is no evidence that Monarch numbers increased due to changes in milkweed populations in the last century. Further, the migration is not haphazard. Analysis of orientation and navigation behavior (PAGE 17) suggests Monarchs reorient when blown off course, and recaptures of tagged Monarchs indicate high proportions of the migratory Monarchs arrive at the overwintering sites in Mexico (PAGE 19). Although Monarchs have an extraordinary flight capacity and have been known to arrive en masse on Bermuda, 800 miles east of the mainland (Hilburn 1989), there is no credible evidence that Monarchs fly at night which would be needed for transoceanic flights of 3-4 days. Energetics are another limitation since it seems unlikely that Monarchs have the energy capacity for such sustained flights. Nor is there evidence that Monarchs are transported across the oceans by storms or laminar airflow. If passive transport by wind were common, Europeans would have been familiar with Monarchs for as long as they were interested in insects. Stowaways on ships may be the best explanations for



A male Monarch sunning himself just before "take-off".

Photo by Ruth-Ann Harrod.

September-October Monarch sightings reported in England and northern Europe in recent years but it may also be that Monarchs are swept up from the Cannaries, Azores or Spain on weather fronts late in the season. Isotopic ratios (PAGE 22) could probably be used to establish the geographic origins of these Monarchs. More information and speculation on the range expansion of Monarchs can be found in the references. ♡

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THE MONARCH "LOTTERY"

If you tagged 200 Monarchs in 1998, there is a good chance one of your tagged Monarchs was recovered in Mexico. At this writing (8 April), we have had 317 recoveries for 65,500 butterflies for which we have records - that's one recovery per 207 tagged. In Kansas, recovery rates varied from 1/70 (9 per 626 at Olathe East), 1/98 (15 per 1464 at Moundridge), 1/102 (34 per 3494 at Wamego), 1/167 (12 per 2005 at Hays), 1/194 (10 per 1939 at Goessel), to 1/211 (3 per 633 at Hugoton). Across the country, a few people were lucky and had one or more recoveries even though they tagged fewer than 50 Monarchs while others tagged hundreds without having a recovery. Don Davis of Toronto wondered if there was something wrong with our tags since he had 3 recoveries in 491 alar wing tags and only 1 in 2340 Monarch Watch tags. Dick Walton's crew at Cape May, New Jersey, tagged 7500 Monarchs and had 6 recoveries in Mexico. Similarly, Tonya Van Hook near Tallahassee, Florida, had one recovery among 341 tagged butterflies. Over the next few months we will be analyzing the recovery data to determine whether recovery rate is a function of distance.

MARK AND RECAPTURE

Our Monarch tagging program is a type of mark and recapture study. Biologists use mark and recapture methods to establish the sizes of populations, to determine birth and death rates, to establish the rates of immigration and emigration, to look for behavioral differences among age cohorts and between the sexes, and to track the movements of individuals as they move through the study area. To obtain estimates for any of these population parameters, certain conditions must be met. For example, if we want to use the mark and recapture method to estimate population size, we have to conform to the following conditions: all individuals to be marked must be collected at random; subsequently the population should be randomly sampled several times for unmarked and marked individuals; there can be no births or deaths nor immigration or emigration between the period of marking and the periods of recapture. If these conditions are not violated, the Lincoln-Peterson index can be used to estimate population size. To make these estimates you need to know the number of individuals marked (at risk of recapture) and the number of marked in a random sample collected subsequent to the marking period.

$$\frac{\text{Number marked in sample}}{\text{Total caught in sample}} = \frac{\text{Number marked in total population}}{\text{Total population size}}$$

For example, if we collected 10 marked Monarchs in a sample of 200 and we had previously marked (or tagged) 300, what is the estimated size of the population?

$$\frac{10 \text{ marked in sample}}{200 \text{ caught in sample}} = \frac{300 \text{ marked in total population}}{6000 \text{ Total population size}}$$

Because there can be sampling error, multiple samples are obtained to arrive at a population estimate. In the classroom, you can demonstrate mark and recapture methods by putting known numbers of blue marbles in a bag with a large (and unknown) number of white marbles. Samples of marbles can be withdrawn (without looking) from the bag and the proportions of blue and white determined several times to derive estimates of the total number of marbles in the bag. After the estimates have been obtained, the students can count the total population to determine if the estimates are accurate. The exercise can be modified to show the effect of sample size on the accuracy of the estimate.

Mark and recapture has been used successfully to measure the size of breeding Monarch populations. However, direct use of mark and recapture methods to estimate the size of the migratory Monarch populations isn't possible because the butterflies emigrate from the area, not all of them go to the same place and many die during the migration. In addition, new individuals which have recently emerged, join the migration after part of the population has been marked.

Although we can't use this approach directly to measure the size of the migratory population, we can use the recapture rate in Mexico together with estimates of mortality and total population size to obtain a rough approximation of the total Monarch population in the fall of 1998 (SEE "POPULATION SIZE" ON PAGE 18).

AUSTRALIAN MONARCHS

INTRODUCTION

Australia is the land of koalas, kangaroos, wombats, echidnas, emus, the platypus (that enigmatic egg-laying mammal), and thousands of species of unique plants. It is also home to numerous introduced species including Monarchs and honey bees. In January, my wife, Toni, and I had the opportunity to travel to Australia to participate in an international meeting on social insects in Adelaide. After the meeting, we explored southeastern Australia following a zigzag course from Adelaide to Sydney. Along the way, we visited wildlife parks, coastal eucalyptus forests, and played tourists. However, we also stopped to visit David James (a Monarch researcher), spoke with Courtney Smithers who has written several papers on Monarchs, and spent four days with beekeepers to learn about beekeeping down under. Several days were spent looking for milkweeds and Monarchs along the Colo River and other sites described by James and Smithers (pers. com.) as being good for Monarchs. Milkweeds were hard to find and Monarchs were relatively uncommon even though it was midsummer. Unfortunately, we



didn't have time to visit coastal Queensland to the north where Monarchs are said to be more abundant. Naturally, I was curious about the biology of Monarchs in Australia and was anxious to learn what I could about their adaptations to this new land.

The following is a brief summary, mostly gleaned from the literature, of the general biology of Monarchs in Australia.

--Chip Taylor

HISTORY AND DISTRIBUTION

Monarchs were first reported from Brisbane, Queensland in 1871. The population was quite large when first reported and may have been present for several generations (Smithers 1973a). Monarchs spread rapidly and by 1907 occupied a North-South strip along the eastern coast (Kitching and Scheermeyer 1993). At present, Monarchs breed on introduced host plants within a large J-shaped area along the east coast with the crook of the J swinging to the west to include Adelaide. Isolated populations occur in central Australia, Perth, and a small area on the north coast. Vane-Wright (1993) explains the arrival of Monarchs in Australia and the Pacific within the framework of what he calls the "Columbus hypothesis". Yet the explanation for

the colonization of Australia and numerous islands in the Pacific may be much simpler (PAGE 26).

MIGRATION AND OVERWINTERING BEHAVIOR AND PHYSIOLOGY

Although Monarchs breed on introduced milkweeds over a large area in eastern Australia and a few other areas as well (FIGURE 1), they overwinter in four regions near the coasts from April to August. In the Sydney basin and near Adelaide, portions of the Monarch population become non-reproductive and cluster in trees for several months. This behavior has not been reported from Queensland where the population appears to remain reproductive all year. Very little seems to be known about the behavior of Monarchs in western Australia near Perth. James (1993) has studied the overwintering behavior in detail. He concludes that the non-reproductive and relatively sedentary state in Monarchs should be termed reproductive dormancy instead of reproductive diapause because it is a more facultative condition than seen in typical diapausing species. He reached this conclusion based on experiments that demonstrated induction of the non-reproductive state was temperature dependent. A condition so sensitive that reproductive and non-reproductive Monarchs could usually be found in the same area. The climates in the overwintering areas are not as cold as those in Mexico and are more variable through the fall and winter than those of the overwintering sites along the California coasts. The overwintering clusters are not large - usually numbering a few hundred to thousands of butterflies. The breeding season extends from September to March in the Sydney area and there are typically three-four generations per year.

As you can see from the map (FIGURE 1), Monarchs extend their range from the overwintering regions in the spring only to return in the fall. Is this migration or simply range expansion? It's probably both. For the portion of the population that remained reproductive, the appearance of milk-

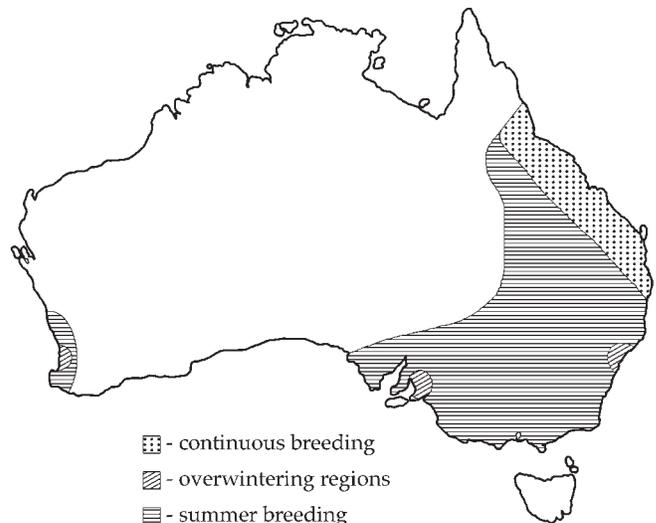


Figure 1. Monarchs in Australia. Map modified from James 1993.

weeds in the spring allows them to expand into new territory. They are true migrants if non-reproductive Monarchs return to the general area from which they originated at the end of the previous season. Fall migrants generally move in an easterly and northeasterly direction to reach the overwintering sites in the Sydney area. The direction of movement of fall migrants in other parts of Australia is not known.

HOST PLANTS

Although native species of the milkweed family (*Asclepiadaceae*) are used as host plants by 12 resident Monarch relatives, none of these species are used as hosts by Monarchs. Instead, Monarch larvae feed on a number of introduced milkweeds, particularly the relatively widespread *Asclepias physocarpa/fruticosa* (Swan plant, South Africa) and *A. curassavica* (Tropical milkweed, tropical Americas). Other hosts include *A. arborescens/roundifolia* (Africa), *A. tuberosa* (Butterfly weed, North America), *A. semilunata* (Uganda hemp, Africa), *Calotropis procera* (Giant milkweed, Africa, India), *Calotropis gigantea* (Crown flower, Africa), *Oxypetalum coeruleum* (Tweedie, Bolivia), and *Araujia hortorum* (Wild kapok, South America). Although larvae have been reared on the last two species, females have not been observed to lay eggs on these plants (Smithers 1973a). These host plants are found in fields, roadsides and in gardens along the eastern and south central coasts of Australia and in Perth in the western part of the continent. The host plants and Monarchs are rarer as one moves inland from the coastal areas. Curiously, Monarchs are not known to feed on native milkweeds although some of the Australian relatives of the Monarchs such as *Danaus chrysippus* are known to use the introduced milkweeds. Numerous questions remain unanswered concerning the coevolution of the many species of milkweed butterflies and their host plants.

PARASITES AND PREDATORS

Introduced species are often able to proliferate in their new environments because they are relatively free from attacks by native parasites and predators. This is not the case for the Monarchs in Australia. Smithers (1973b) has recorded numerous instances of bird predation on adult Monarchs, possible mammalian predation, and attacks on eggs and larvae by the usual list of predaceous insects and parasites. The list includes cockroaches and ants that eat eggs; and stink bugs (*Pentatomidae*), wasps (*Sphecidae*), and tachinid flies (*Tachinidae*) that attack larvae. Adult Monarchs are also prey for spiders and mantids. Viruses occasionally decimate the population when the larval population has a high density. Mortality due to these factors is often so high,



Monarch larva parasitized by a Tachinid, *Winthermia diversa*. The fly's eggs are visible against the black stripes of the larva. Photo by O.R. Taylor.

especially late in the season, that relatively few Monarchs survive to the adult stage. We found spores of *Ophryocystis elektroscirrha*, the protozoan parasite, on three of the four specimens we examined from the Colo River area west of Sydney. This parasite is a frequent problem for those who breed Monarchs from wild stock for more than two generations in the U.S. and Canada and may also be a problem when Monarchs are reared in Australia (James, pers. com.). The effect of this parasite on natural Monarch populations is still not clear.

RESEARCH

Although a good deal is known concerning the biology of Monarchs in Australia, there is much remaining to be discovered. Courtney Smithers is retired and no longer working on Monarchs, and David James recently moved to Washington State University. Carolyn Nelson, who has worked on host plant chemistry, no longer appears to be active. The only active researchers appear to be Myron Zalucki (University of Queensland, Brisbane) who continues to study many aspects of Monarch biology and Jane Hughes (Griffith University, Brisbane) who is studying population genetics of Monarchs. ♣

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4TH OF JULY BUTTERFLY COUNT

Each year the North America Butterfly Association (NABA) sponsors a program to census butterflies throughout North America, the 4th of July Count. This one-day census involves volunteer participants conducting a butterfly count of all butterflies sighted within a selected 15-mile diameter area. The counts usually occur during a four week time period around the 4th of July. The count data are compiled and published every year. If you are interested in participating in a count this year, contact NABA to find out if a count exists in your area. If there is not an annual count in your area, encourage a local nature center or butterfly club to participate in one. For more information on the 4th of July Count and how to conduct a count, contact:

NABA Butterfly Count
2533 McCart • Fort Worth, TX 76110
Email: naba@naba.org • Online: www.naba.org

ISOTOPE RESEARCH TIMELINE

Some research projects take years to fully conceive, plan, finance, coordinate, and conduct. Even more time may be required to analyze and summarize results for publication. Publication involves many revisions and delays as a result of the peer review process. Often, it is a year or more from the time a revised manuscript is accepted by the editor of a scientific journal until it's published. From start to finish, the Monarch hydrogen isotope project took nearly 4 years to complete. The following is a brief chronology of the Monarch isotope project.

1995 June: Wassenaar and Hobson decided to apply stable isotope techniques they developed for songbirds to migratory Monarch butterflies. The Monarch was selected because of its relatively restricted and accessible breeding and overwintering range. Proposals were written and 2 years of funding was subsequently obtained from Environment Canada, the Canada-Mexico International Partnerships Program, and the Manitoba Model Forest Project (twin of the Monarch Butterfly Model Forest).

1995 September-October: Wassenaar and Hobson contacted Monarch Watch to discuss collaborative research.

1995 December: Wassenaar and Hobson traveled to Mexico to work out arrangements with Mexican authorities to collect dead Monarchs at each of the overwintering sites. Arrangements were made with local authorities for a winter 1996/1997 sampling. Local INIFAP contact, Constantino Orduña Trejo, managed to get permission from INE to sample all known overwintering sites - no small feat!

1996 February: Taylor began growing *Asclepias curassavica* for controlled lab experiments. Plants were grown in three groups with different concentrations of deuterium in the water.

1996 April: Taylor raised separate groups of Monarch larvae on the treated plants and sent samples of the adult Monarchs, leaves, soil, and water to Saskatoon for analysis of isotopic ratios.

1996 July-August: Rearing kits containing Monarch eggs and instructions were sent to 99 volunteers in states and provinces east of the Rockies.

1996 October: Eighty-eight Monarch and milkweed samples obtained from volunteers were sent by Monarch Watch to the Saskatoon lab. Samples were analyzed over the next 5 months.

1997 February-March: Wassenaar and Hobson collected samples of dead Monarchs from all known overwintering colonies in Mexico for isotopic analysis.

1997: Monarchs reared in Kansas as controls were processed and analyzed for hydrogen and carbon isotopes in Saskatoon.

1997 July-August: Rearing kits containing Monarch eggs and instructions were sent to an additional 31 volunteers in states and provinces east of the Rockies.

1997 March-June 1998: More than 600 Monarchs from the overwintering sites were processed and analyzed for hydrogen and carbon isotopes in Saskatoon. Up to 20-30 Monarchs were processed per week.

1997 November: Preliminary results were presented by Wassenaar and Hobson at the North American Conference on the Monarch Butterfly in Morelia, Mexico.

1998 April: Preliminary results were presented at Stable Isotope Ecology Conference in Saskatoon.

1998 August: The technical manuscript on the methods used to analyze and interpret the isotopic ratios for lab and wild reared Monarchs was prepared and submitted to *Oecologia*, a scientific journal.

1998 September: The manuscript on the natal origins of overwintering Monarchs was submitted to *Proceedings of the National Academy of Sciences* (PNAS).

1998 December: The PNAS paper on natal origins was published.

1999 January: Extensive media coverage followed publication of the PNAS paper.

1999 July: The technical paper on methods and analysis of results will be published in *Oecologia* in July.

THANK YOU, VOLUNTEERS!

We wish to thank all of the volunteers who raised Monarchs and provided samples of Monarchs and milkweed for the isotope study. Without the samples provided by these cooperators it would not have been possible to map eastern North America for the hydrogen and carbon isoclines and to establish natal origins for Monarchs from overwintering colonies in Mexico. Our requests for volunteers to participate in the isotope studies in the 1995 and 1996 Season Summaries produced 99 volunteers in 1996 and 31 from selected areas in 1997. Unfortunately, since we only needed a few samples from each region, we had to turn down many requests to participate in this program.

We also wish to thank Kari Rogg, former Monarch Watch program assistant, who so ably coordinated sending out the kits and communicated with the participants. Several enthusiastic participants created Web sites to document their participation in the isotope study, check one of them out at



www.esc13.tenet.edu/granger/monarch.html

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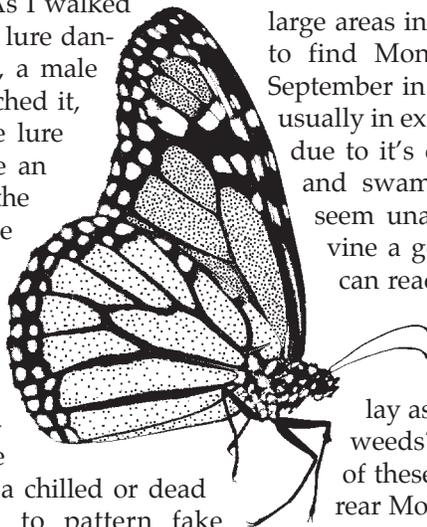
CHALLENGES TO STUDENTS

Each year we pose questions and challenges for students. We try to pose questions that students can answer with relatively simple experiments. Our goal is to promote independent research by students and the ideas we've suggested could be adopted for research fairs. Teachers have told us they use these challenges as the basis for "active learning" in their classes. We hope this continues. We are interested in the results of these projects, and students completing these studies are encouraged to send their completed projects to us so that they may be shared with others via the Monarch Watch Web site.

THESE CHALLENGES ARE APPROPRIATE FOR MIDDLE SCHOOL AND ABOVE. STUDENTS USING THESE CHALLENGES AS THE BASIS FOR RESEARCH PROJECTS SHOULD SUBMIT THEIR REPORTS TO US BY 31 JANUARY 2000 FOR A CHANCE TO WIN A MONARCH WATCH T-SHIRT OR A POSTER.

APPROACH BEHAVIOR

On a recent Sunday, I was fishing in my favorite pond with one of the most effective lures for bass in this area - an orange and black imitation crawfish. As I walked along a trail beside the pond, with the lure dangling from the end of my fishing rod, a male Monarch approached the lure. He touched it, flew off and came back to inspect the lure again. Curious behavior, but I can see an experiment coming, can't you? Did the male Monarch approach the lure because it looked like a female or perhaps a flower? How could we find out if this was mate-seeking or flower-seeking behavior or just a response to a moving object? Here's how I'd design a test to distinguish between the alternative possibilities. First, find a life-size side view image of a Monarch or use a chilled or dead Monarch for a model from which to pattern fake Monarchs. Then make Monarch silhouettes of several colors and then draw the veins and some of the white dots. The models should look like Monarchs from both sides. The models can be attached to 1/4 inch dowels or green garden stakes with the head uppermost and the body parallel to the stake. To make observations of approach behavior, find a good patch of milkweed (or flowers being visited by Monarchs) populated with reproductive Monarchs (not migrants - why not?). The models should be placed at the top of the milkweeds in a position that would be typical for Monarchs at rest on the plants. Since I don't know whether this system will attract Monarchs, the first test would include 9 models, 3 each of the different colors with one of the colors being orange. Next, take notes on all the butterfly



activity and record approaches to the models by sex. Contacts, durations of the approaches, and unusual behaviors should be recorded. What could be said if both sexes or only males approached the models? What could be said about the role of color and pattern in eliciting approach behavior? Additional experiments may need to be conducted to answer this question. What happens if we use models of different sizes? What about the role of movement? Once you have an idea of how to design and present the models, you may wish to try some variations with moving models. Do these suggestions give you ideas for how to test for flower color preferences by Monarchs? Oh, and what about clustering behavior of migrants? Do clustering Monarchs seek out other Monarchs or do they just happen to land on the same trees?

Will the approach experiment work? I don't know, but I'd bet on it. We've conducted similar experiments with sulfur butterflies with paper models ranging from pale yellow to light green. One of the models was so effective the males tried to mate with it! Females never approached the models.

BLUE VINE VS OTHER MILKWEEDS

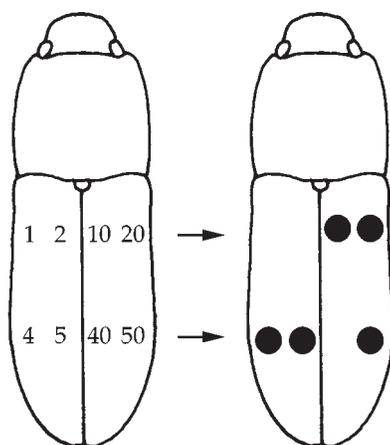
Blue vine (*Cynanchum laeve*) is not considered an important Monarch host plant. However, this plant is common over large areas in the midwest and in eastern Kansas. It's easy to find Monarch larvae on blue vine in August and September in this region. At this time of year, blue vine is usually in excellent condition with many soft fleshy leaves due to its continuous growth. In contrast, the common and swamp milkweeds have senescent leaves which seem unattractive to ovipositing females. But is blue vine a good host for Monarchs? We know Monarchs can reach maturity on this plant but many questions remain unanswered. Do Monarchs reared on blue vine grow at the same rate? Do they get as large? Do they live as long, mate as often, lay as many eggs, etc. as they would on other milkweeds? It would be easy for students to answer most of these questions by making notes as they carefully rear Monarchs on blue vine and other milkweeds.

MARK AND RECAPTURE:

MONARCHS AND MILKWEED BEETLES

How many are there? How much do they move from place to place? How long do they live, or how long are they resident in the area? We can answer these questions for Monarchs and many other types of organisms in carefully conducted studies (MARK AND RECAPTURE, PAGE 27). These studies are very instructive for students and relatively easy to manage. Those of you living in Florida and along the Texas coast could conduct these studies with Monarchs during the winter months, especially in areas where tropical milkweed, *Asclepias curassavica*, is common in gardens and roadsides. Such studies could be conducted during the summer months in more northerly locations. If you can't

conduct mark and recapture studies with Monarchs, most areas have local species of butterflies, beetles or even land snails that could be used to illustrate the method. A good midsummer candidate for such studies is the common milkweed beetle, *Tetraopes tetraophthalmus*. This red and black beetle feeds on milkweed foliage as an adult and the larvae feed on milkweed roots. These behaviors confine this species to milkweed patches. How many beetles are there per unit area and how much do they move among patches, etc.? To answer these questions you need at least two milkweed patches, paints and brushes (Testor's hobby paints work well), notebooks, and cups to collect the beetles. These are slow beetles and easy to catch. You should use a marking system that allows you to tell the number you've given each specimen so that you can "read" the recaptures without collecting the beetles. Imagine the left and right wing covers with four marking positions, two forward and two toward the rear of the beetle. On the left side designate the front positions as 1 and 2 and the rear as 4 and 5. On the right side the positions become 10, 20, 40, 50. Using these positions additively, you can mark 99 individuals. For example, to mark individual 89, you mark the 4 and 5 positions on the left and the 10, 20 and 50 positions on the right. Once you've used numbers 1-99, you can change the color of the paint. You can use this system to mark butterflies as well, but if the butterfly is large enough, you can simply write a number on the discal cell (a large, mitten-shaped cell) on the underside of either hindwing with a fine-tipped permanent marker. ♡



$$(4 + 5 + 10 + 20 + 50 = 89)$$

Once you've used numbers 1-99, you can change the color of the paint. You can use this system to mark butterflies as well, but if the butterfly is large enough, you can simply write a number on the discal cell (a large, mitten-shaped cell) on the underside of either hindwing with a fine-tipped permanent marker. ♡

CONGRATULATIONS!

Thanks to all of the students who submitted research projects based on the challenges in last year's Season Summary. We appreciate the time and effort you dedicated to these projects and hope you learned something new about Monarchs and research as you conducted your study.

The selection criteria was based on the type of experiment, observations made during the experiment, and the written report. Individual winners received a certificate and a Monarch Watch T-shirt; group winners received a certificate and a Gulliver pin. The students' research projects will be featured in the *Challenges to Students* section of the Monarch Watch Web site. Check 'em out!

Question 1:

WHAT IS THE BEST FOOD FOR ADULT MONARCHS?

Taylor Pelan and Jill Stara
Mrs. Eller's 2nd Grade
St. Mary's School
David City, NE

Question 2:

ARE CATERPILLARS ATTRACTED TO OR REPELLED BY LIGHT?

BEST REPORT BY AN INDIVIDUAL

T.G. Schoenberg
4th Grade (Quest)
Heatherstone Elementary
Olathe, KS

BEST REPORT BY A GROUP

Brett Hausauer, Sam Li, Elke Mermis,
Allyx Oborn, Colin Smalley, and Nick Klug
5th Grade (Quest)
Heatherstone Elementary
Olathe, KS

SAVING MONARCHS

The following is a modified portion of an interview that appeared in the April 1999 issue of *Environmental Review*.

What can be done to assure the Monarch migration isn't lost?

I'm not sure. In the Monarch Reserve in Mexico, there is a very complex mix of social, political, economic, biological, and cultural issues that must be dealt with. I doubt that any of the scientists or other interested parties are sufficiently knowledgeable to comprehend all the nuances of these issues or wise enough to weave a fabric of compromise that will serve the interests of all the people as well as the butterflies.

We need a collective effort that involves all three countries. We need to bring the local residents, Monarch specialists, hydrologists, agricultural specialists, foresters, economists, sociologists, and politicians to the table to work out a sustainable development plan for the region. It is critical that the local people be involved in the decisions and that they view the development plan to be in their best interests. I favor a 40-year management plan for the forests that incorporates knowledge of productivity, promotes reforestation, and management of diseases and pests, etc. However, the plan must be more comprehensive than just forest management. Ultimately, it's the politicians who make the decisions on conservation issues such as these. Collectively we can work out an excellent plan. We are not likely to succeed in saving the Monarchs unless we have the support from the politicians and the financial backing of the three governments, non-governmental organizations and international development agencies. Our job, therefore, is twofold: to devise a sound long-term plan and convince the politicians to support it. --Chip Taylor

FEATURED TEACHERS

Many, many teachers have used Monarchs to further the education of their students. Some have mentored students through research projects, written curricula, created Web sites, and led students on field trips. Others have used Monarchs to go beyond the science curriculum to teach math, languages, geography, and history. Teachers have used Monarchs and the resources provided by Monarch Watch and the Monarchs in the Classroom curriculum as the basis for grants to support technology improvement, construction of vivariums, creation of butterfly gardens, and support for field trips. We salute all of you who have contributed so unselfishly to the education of your students and would like to honor all of you on these pages. Unfortunately, our space is limited and, of course, we do not know what all of you are doing. The following are teachers who have made substantial contributions by furthering Monarch education. We will feature additional teachers next year.

HARLEN E. AND ALTUS B. ASCHEN **VICTORIA CHRISTIAN MIDDLE SCHOOL, VICTORIA, TX**



Altus and Harlen have taught a combined 67 years in Port Lavaca, Texas. They "retired" from the public schools there and have now commuted and taught an additional five years at Victoria Christian School in Victoria, Texas. Altus teaches language arts and speech, and Harlen teaches math, sci-

ence, and computer technology to 6th, 7th, and 8th graders. Five years ago they created a backyard haven for birds and butterflies. The Aschens are fortunate to live in an area along the Texas coast where small populations of Monarchs reproduce throughout the winter. Harlen and Altus make the local Monarchs part of the curriculum for their school and K-8 students are active in rearing, tagging, and releasing Monarchs. Classes make comparative observations of mating, egg-laying, fertility, size and mass of reared and wild Monarchs. Students also grow milkweed which is distributed to local gardens. Harlen enthusiastically posts his observations and questions to Dplex. This past winter he maintained our interests in Monarchs (and inspired many daydreams of warmer weather) through his numerous reports on Monarch activity. Harlen posted his first message to Dplex on 1 November 1997 and this has been followed by more than 300 postings. His questions have elicited many thoughtful answers from Monarch experts on the list. Harlen is using the email discussion list to educate himself and others. This is the exactly the purpose of the list - thanks

Harlen! You can see Harlen's Monarch pictures and visit the Aschen's backyard, where many of the Monarch observations are made, by logging onto their Web site at www.homestead.com/monarch1

JANIS M. LENTZ **JACKSON ELEMENTARY SCHOOL, Mc ALLEN, TX**

Janis Lentz has a B.S. in Geology with a preK-6th grade teaching certificate. She is knowledgeable in Spanish and is certified to teach English as a second language. She's taught 4th and 5th grade predominantly



Spanish-speaking children for 13 years and works hard to develop their English proficiency through reading, writing, and speaking about Science in a constructivist classroom. She encourages cooperative inquiry based, hands-on activities in her classroom. Janis is a technology trainer for the McAllen ISD, a technology consultant, and Web site evaluator. She has presented workshops at local, state, national, and international conferences on integrating technology into curriculum.

Janis uses the Monarch Watch Web site, among others, to teach literacy. "Gulliver's Story," an active learning exercise developed by Monarch Watch (PAGE 54), is used as the reading text while they raise Monarchs collected from the milkweeds on the school grounds. Students are encouraged to initiate their own projects. Last year, Ashley (one of Janis's students) taught herself and her fellow students, how to hand-pair Monarchs. Her class presents Monarch workshops to local classrooms using students as teachers. Her "students-teaching-students" method was included in the recent Japanese video on Monarchs. A Monarch teaching



Two of De Cansler's students present their Monarch research project at the second annual Monarch Fair in Minnesota (SEE PAGE 41).

Photo by O.R. Taylor.

video featuring Janis's students has been nominated for a state-wide award. Janis has helped us greatly with Adopt-A-Classroom. She developed a Math and Science curriculum for the schools in the Monarch Reserve in Mexico which has been translated into Spanish. Janis also initiated the idea of collecting year-end school supplies from classrooms and unused books from school depositories for redistribution in Mexico.

RANDALL J. WARNER FRONTIER TRAIL JUNIOR HIGH, OLATHE, KS

Randy began teaching science in Olathe in the fall of 1987. During his short teaching career he has won numerous awards. Most recently he received the Kansas Presidential Award for Science Teaching. Randy covers a lot of ground teaching both life and physical science. Terminal velocity is more than just a



text lesson or lab exercise - it's skydiving! Recently, Mr. Warner did just that. It's recorded on 35mm and video for proof, and he's posted it on his Web site as well. He did it for teaching, of course! Although it's hard to believe he has the time, Randy is intently working on a Masters Degree in Education Technology Leadership and raises money for Monarchs and several other worthwhile causes.

Randy's students participate in Monarch Watch each fall. Students capture, tag, and release Monarch butterflies after recording such information as sex, condition, and sometimes size measurements. Monarchs are also raised in a captive breeding project to study their life cycle. Using a Ken-a-Vision Video Flex camera and a VCR he has recorded the Monarch's metamorphosis. He has even made a slide show from the video of the entire life cycle using video capture software. Many of these images, as well as numerous others, can be found on his Web site. Randy's site reflects the breadth of the projects in which he involves his students. The site also contains many useful teaching resources. You can stop by and visit Randy and his students on the Web at: home.unicom.net/~warnerr/monarch.htm

LEE'S SUMMIT, MO SCHOOL DISTRICT

A few fortunate schools each year receive grant money from various funding sources. The grant proposal is usually initiated by an idea to involve students in a project. But what happens to the project after the grant monies run out? Does the project continue or does interest dwindle when the investigators are no longer being monitored? The school district of Lee's Summit, Missouri has a success story to tell.

In 1996, the Lee's Summit school district was awarded a grant from the Missouri Department of Elementary and Secondary Education for \$59,000 to develop their program, "Winging It!". "Winging It!" involves the district's 13 elementary schools, and the participants included approximately 1200 third graders, 170 ASPIRE students (the 4-6 grade gifted students), and 50 teachers.

The program provided an opportunity for the students to participate in studying the Monarch butterfly using scientific research skills while communicating within and beyond the classroom. The grant enabled the district to provide internet connections to all the elementary schools allowing the students to communicate with Monarch experts and to share experiences with other schools. Digital cameras, computers, televisions, and VCRs were purchased to create multi-media presentations, computer video documentaries, and student newsletters of the scientific studies conducted.

"Winging It!" incorporated Monarch Watch into their program by being involved in the tagging and student-scientist projects. Monies from the grant were used to purchase larvae to rear in the classrooms, butterfly nets, and Monarch Watch tags. While tagging the Monarchs the students had reared or captured, they would also measure and record the wing span of each Monarch. The students undertook a food preference study while rearing their larvae in the classroom. The students weighed, observed, and recorded the results of the larvae reared on two types of milkweed, common and blue vine. The observations were shared with other schools and Monarch Watch.

The students' opportunities were expanded to the outdoor classroom. Butterfly gardens were planted at each of the schools. The students are able to observe the life cycle of the Monarch butterfly in its natural environment on milkweed plants growing in the gardens. Seeds were collected from the plants to regenerate the gardens again in the spring. The gardens provided nectar sources for the fall migrating Monarchs allowing the students an opportunity to capture and tag the migrants.

The program's activities were expanded and improved the following year. In fact, "Winging It!" was such a huge success in 1996 that it was awarded a continuation grant of \$33,000 in 1997. Unfortunately, the grant monies ceased after 1997, but "Winging It!" continues to flourish. To this date, the program still involves the 13 elementary schools in Lee's Summit with approximately 40 teachers participating. The students continue to study Monarch butterflies and cultivate the butterfly gardens. The program continues to be incorporated into subjects other than science such as writing, mathematics, and geography.

The "Winging It!" program demonstrates that success is not defined by the amount of monies received or the ability to purchase as much equipment as possible. The success of the program was the knowledge and enthusiasm gained by the students and teachers. "Winging It!" is a true success story.♥

FREQUENTLY ASKED QUESTIONS

ARE ALL OF THE MONARCH PROGRAMS THE SAME?

Monarch Watch, Monarchs in the Classroom, Journey North, and the Monarch Program are different programs. The general goals of these programs are similar and complimentary, yet each is somewhat different due to the training and specific objectives of their directors.

Monarch Watch is a collaborative network of students, teachers, volunteers, and researchers dedicated to the study of the biology of the Monarch butterfly (*Danaus plexippus*). Our goals are to further science education, particularly in primary and secondary schools; to promote conservation of Monarch butterflies; and to involve thousands of students and adults in a cooperative study of the Monarchs' fall migration. The project is directed by Orley R. "Chip" Taylor.

Monarch Watch

Department of Entomology, Haworth Hall
University of Kansas, Lawrence, KS 66045

1.888.TAGGING (U.S. only) • 1.785.864.4441 phone/fax
www.MonarchWatch.org • monarch@ukans.edu

"Monarchs in the Classroom" was the title for a National Science Foundation grant on which Karen Oberhauser and Chip Taylor were co-principal investigators. As part of this grant, Karen and her associates developed an extensive curriculum (K-6) on Monarchs under this name and it is now the title for her Monarch program. Karen focuses on teacher training and assisting local schools with their Monarch activities. Monarchs in the Classroom has sponsored two "Monarch Research Fairs" for schools in Minnesota.

Dr. Karen Oberhauser

Department of Ecology, University of Minnesota
1987 Upper Buford Circle, St. Paul, MN 55108
1.612.624.8706 • 1.612-624-6777 fax
karen.s.oberhauser-1@tc.umn.edu

Journey North is an educational program devoted to following the spring migrations and phenology of many species including Monarchs. Participants report sightings which are used to generate maps and weekly reports showing the progress of the migrations and of spring.

Although the program is primarily for secondary school students, the reports contain information valuable to adults as well. Each fall participating schools in the United States send symbolic paper Monarchs to schools in Mexico. Journey North is directed by Elizabeth [Donnelly] Howard.

Journey North

18150 Breezy Point Road
Wayzata, MN 55391

1.612.476.6470 • 1.612.339.7056 fax
www.learner.org/jnorth • jnorth@learner.org

The Monarch Program was established in October of 1990 as an educational public benefit organization in conjunction

with California Monarch Studies, Inc. Objectives of the Program include: preserving Monarch breeding and overwintering habitats, monitoring Monarch migrations, promoting educational programs, supporting related Conservancy issues, and encouraging the study of plant and insect relationships through butterfly gardening. The Monarch Program is directed by David Marriott. [see contact information below]

WHY DON'T YOU SHIP MONARCHS OR TAGS WEST OF THE ROCKIES?

There are two distinct North American Monarch populations, one east and one west of the Rockies. Our conservation and tagging program is focused on the former, which summers from east-central Canada southward, and overwinters in a few large roosts near Mexico City. The western population summers from western Canada to California, and overwinters in California. The two populations may be genetically distinct, and we do not ship any of our stock or tags to the west coast. Also, west coast conservation issues are different from those in the east. If you're interested in learning more about the Western population, write or call:

Monarch Magic • PO Box 711 • Ashland, OR 97520 • 541.482.3429 • 1.800.60monarch • monamagc@wave.net

The Monarch Program • PO Box 178671 • San Diego, CA 92177 • 619.944.7113 • monarchprg@aol.com

GN Butterfly Farm • PO Box 604 • Danville, CA 94526 • 510.820.4307 • bgendron@pacbell.net

WHERE IS MY TAGGED MONARCH?

The tags for the Monarch butterflies have our address on them as well as a unique number. If your butterfly is found dead or captured and released, it is our hope that the finder will inform us by mail of the recovery/recapture of the tagged Monarch. Usually the finders tell us the tag number and indicate where and when the butterfly was found. The numbers for all the tags are organized in our computer so that by looking up the tag number we can determine to whom the tag was issued. When a tagged

Monarch is recovered, we look up the tagging information on their data sheets, then we contact the tagger to inform them of the recovery. This information is then sent back to the person who reported the tag with a letter and certificate thanking them for their cooperation.



CAN I USE LAST YEAR'S TAGS THIS YEAR?

We discourage using last year's tags this year for a couple of reasons. It is more difficult for us to keep track of the tags issued over several years rather than in just one season. More importantly, the manufacturer tells us that the adhesive on the tag ages significantly with time and loses its adhesive qualities. If you use last years tags, the chances of

obtaining a recovery are likely to be reduced. We appreciate the thought of not wasting the tags but the fact is they have a limited shelf-life.

WHAT CAUSES PUPAE TO DIE AND TURN BLACK?

There are many factors that can cause Monarch pupae to die and turn black. The two most common causes of pupal mortality are parasitism by tachinid flies and infections of a protozoan (*Ophryocystis*). The former can be avoided by rearing the pupae indoors or under netting if outdoors. For netting, we use 5-gallon paint strainers and sleeves made from Remay cloth (SEE PAGE 55). High humidity in rearing containers favors infections by *Nosema*, which leads to larval mortality. Bacteria and viruses can also cause pupae to turn black. Pupae may also die for reasons that may be related to developmental problems. The neogregarine protozoan, *Ophryocystis*, can also cause this condition. A discussion on how to control this parasite may be found on our Web site (www.MonarchWatch.org). Pupae will also turn black and die about 48 hours after they have been exposed to freezing temperatures.



A Monarch pupa that has been parasitized by a tachinid fly.

Photo by Jacalyn Goetz.

WHAT ARE TYPICAL MORTALITY RATES FOR LARVAE?

If all goes well with the rearing (no disease, starvation, ants, etc.) you should have 60-90% survival to the adult stage. Most of the mortality occurs during pupation and emergence from the pupae. Even with perfectly healthy larvae that are well-fed, it is not uncommon to lose 10% of the stock at both pupation and emergence. It is probably wise to plan for 75% survival and to regard better results as a bonus for a job well done. Many people have had better than 75% success. The lower success rates are hard to evaluate because we don't know how the larvae were maintained. Most of the difficulties appear to be due to inadequate feeding and rearing conditions which are too humid. High humidity contributes to the development of infections by a protozoan (*Nosema*) and several bacteria. You should succeed if you keep a good supply of fresh food plants and the rearing chamber dry.

WILL THE MONARCH BE ABLE TO EMERGE FROM A FALLEN PUPA (CHRYSLIS)?

If the pupa was not damaged in the fall, the butterfly should be able to emerge normally. Butterflies can emerge normally from a pupa even if it is not hanging. In fact, almost none of our pupae are hanging at the time of emergence. It is important to have the pupa resting on a rough surface so the butterfly can pull itself free of the pupal cuticle. It is also necessary to have a rough vertical surface for the butterfly to climb up on. For a description of a simple emergence cage please see our Web site's *Rearing Monarchs* section

and "Hints and Tips" on page 43 of this newsletter.

IS THERE ANY WAY OF STORING MILKWEED FOR WINTER FEEDINGS?

Several people have experimented with different ways of storing milkweed (i.e. freezing, vacuum packing) for winter feeding. Milkweed cells are ruptured during the freezing, moisture is lost, and the tissues become soft. Therefore, these plants do not remain attractive to larvae for very long once they have thawed. The leaves also seem to be readily attacked by fungi after freezing. There has been some success with this method but the number of larvae that can be reared in this way is limited. A few people have successfully reared larvae on dried milkweed leaves that have subsequently been re-hydrated.

BESIDES MILKWEED, WHAT DO MONARCHS EAT?

The larvae only eat plants in the milkweed family (*Asclepiadaceae*). There are 106 species of milkweeds in North America. Many of these species have become uncommon and a few are rare and endangered (e.g., *Asclepias meadii*) due to the destruction of habitats. Please visit the *Milkweed* section of our Web site for complete information.

The adult Monarchs obtain nectar from flowers. Nectars in butterfly flowers typically contain 15% or less of dissolved sugars, trace amounts of vitamins and minerals, and in some cases, small quantities of amino acids. Monarchs in captivity can be fed dilute sugar or honey water, diluted fruit juices or slices of fresh watermelon. The *Rearing Monarchs* section of our Web site contains more information on the care and feeding of Monarchs.

WHY CAN'T I ATTRACT BUTTERFLIES TO MY BUTTERFLY HOUSE?

We have never heard of a butterfly house actually attracting butterflies. Butterfly houses are intended to be used as overwintering shelters, and there are only 3-4 butterfly species in each locality that overwinter as adults. Monarchs will roost in trees or shrubs, and won't use butterfly houses or other shelters. Other butterflies will overwinter in wood piles or leaf litter rather than using the houses. Butterfly houses are great as decorations but usually house other species of insects and spiders rather than butterflies.

WHY DO WE CATCH MORE MALE THAN FEMALE MONARCHS?

In general, if you collect Monarchs at flowers you will obtain more males than females. This sex ratio is often quite biased in favor of males. On the other hand, if you collect the butterflies at roosts, the sex ratio is nearly equal or only slightly favors males. The sex ratio at the roost is probably more representative of the whole population since most the butterflies go to the roosts. Males appear to have a higher metabolic rate and may need to forage more extensively at flowers than females resulting in biased ratios at flowers. Some researchers suspect that females roost higher in trees than males. If this is true, the sex ratio in a roost would change in relation to the height above ground. ♡

THE BEST OF DPLEX

INCORPORATING MONARCHS INTO TEACHING STANDARDS

A message sent to Dplex-L by Harlen Aschen last fall sparked an interesting thread. Harlen was concerned by local schools in Texas not accepting his offer of Monarch larvae for their classrooms. One teacher finally gave Harlen a straight answer that they couldn't fit Monarchs into their TEKS (Texas Essential Knowledge and Skills). Karen Oberhauser of the University of Minnesota and "Monarchs in the Classroom" offered the following comments regarding this issue:

We have found that many teachers are concerned about adding to the materials that they are already required to cover in the classroom. In response to this, and to help teachers who need to justify adding Monarchs to their full schedules, we have indexed the Monarchs in the Classroom curriculum guides to the National Science Education standards, and to the Minnesota Education Graduation Standards in all subject areas. We only have hard copies of this index right now, but will make it available on the WWW when we can.

With regards to state standards: Wouldn't it be great if we could set up a virtual committee that includes Monarch teachers from as many states as possible, and start documenting the connections between what we do in the classroom with Monarchs and state standards? We have started this project with MN and national standards. If there are teachers out there who are familiar with their state standards and are willing to work with this, please send a message to me, and I will try to coordinate this.

Karen Oberhauser <Karen.S.Oberhauser-1@tc.umn.edu>

The following are a few of the comments concerning this issue:

In my school district in San Antonio, there are science specialists. In middle school we're looking at using Monarch Watch and Journey North in what we call long term data collection which will help kids when it comes to the science TAAS test (Texas Assessment of Academic Skills). We have to worry about TEK's and TAAS. So tell those elementary teachers that it will help kids in middle school when they take the TAAS test!

Debbie Clegg <DebClegg@aol.com>

In response to teacher fears that using Monarchs will not match the standards of the TEK, Virginia Malone of Hondo, Texas, listed the National Science Education Standards mis-

sion statement and statements from TEKS. She concluded that "all fit nicely with Monarch butterfly studies."

Virginia also stated:

I have been working with elementary teachers and the TEKS and find many have science phobias. Unless the caterpillar comes with an attached lesson plan these teachers shy away. If the caterpillars are introduced as reading or math then they have no problem. Suggest to teachers that students make big books of their Monarchs and present these to lower grades or have a grade appropriate book to suggest. Students can make math problems associated with their Monarchs. This works especially well with addition, subtraction, multiplication, division, fractions, percents, etc.

Other list members offered suggestions on how to incorporate Monarchs into their curriculum.

When I went from teaching a first/second grade to a third grade, there was never a question in my mind that my Monarchs were going with me. In the first and second grade I taught the life cycle of the butterfly. This year I incorporated our third grade food chain and weather instrument units with the raising of over 50 Monarchs! The students are now creating a spread sheet with the tagging data. It was a wild fall, as I have

never raised so many: escapees were found everywhere: under tables, in folded (Monarch) game sheets, under chairs! We had some on bare branches in the open- very exciting. The students kept science journals of the life cycle- I feel that, since I never tire of observing this miracle, and always learn something new, that they would benefit also. We studied the food chains by studying the milkweed ecosystem. The release of each of "their" Monarchs was incredibly powerful because the students used homemade weather instruments to collect real data. In short, no matter what grade I teach, I feel that the Monarch can fit in and not be an add on!

Susan Gilbert <sjkg@aol.com>

SUGGESTIONS FOR TEACHER TRAINING

If the training session is after school or a Saturday morning workshop, FEED THEM.

Give the teachers a printed outline of what you are going to cover. Leave ample space. They will take notes on the outline.

Let them actually DO the elementary lesson. I have a mental mapping lesson. It is called "Mexico in a Pizza Box". The teachers walk away with the 3D map that they have made. If they have



This tagged Monarch was spotted and photographed by Doug Wechsler in Stone Harbor, NJ (SEE RECOVERY DATA ON PAGE 13).

Photo by Doug Wechsler.

done the lesson themselves they are more likely to use it with their students.

Give them a copy of EVERY idea you present. They have to have an original that they can use. You do not want to have them to have to go to Maps On File and search high and low for the map you used. They need to leave the session with every thing that they need.

Provide the teachers with a formal written plan of the lesson that you presented. Include those infamous standards, by which we judge (gauge is perhaps a softer word) all things.

Have door prizes. No matter how small the prizes, teachers love to have something tangible they can use back in their classrooms.

With the teachers with whom I have worked, once I get them started, the Monarchs work their own magic.

Mary Alice Aguilar <agui1280@dpnet.net>

Here are a couple more ideas that teachers have said helped to make training programs I've been involved in more meaningful:

Whenever possible make it possible for teachers to receive recertification credit.

Allow time for teachers to reflect on how they could use this new material in their particular setting and time to share their ideas with each other. Very rarely do teachers (especially elementary level) have the time to sit down and talk with their colleagues. They always seem to find it a valuable experience when they do.

Plan for a follow-up session so that teachers can share their actual experiences, successful or otherwise.

Pat Miller <pmiller@cablenet-va.com>

LONG-TERM MONITORING

The world is changing and if we wish to preserve species and habitats we value, we need to understand how they are being affected by these changes. Efforts to conserve a species or population will fail unless we have sound knowledge of its biology and population dynamics.

In the case of the Monarch, we need data on the factors that contribute to birth and death rates in the reproductive portion of the year (March - September) and death rates during the migratory period (August - April). The long term pattern of fluctuations in population size must be established before we can examine the data for cause and effect relationships. In Mexico, Eligio García has been measuring the total area occupied by Monarchs in the overwintering colonies for the last three years. These measures give us a solid estimate of the number of Monarchs that have reached Mexico each winter. Since 1992, Dick Walton has been using a transect method to monitor the fall migratory population as it moves through Cape May, NJ. Long-term monitoring programs such as these are needed in several areas. In February we received a letter from Dr. Tonya Van Hook stating that she has established a long term monitoring program at St. Mark's National Wildlife Refuge near Tallahassee, Florida. Dr. Van Hook, who recently obtained her Ph.D. from the University of Florida under the direction of Dr. Lincoln Brower, has written several papers on Monarchs. The programs led by Dick Walton (dick@concord.org) and Tonya Van Hook (vanhook@freenet.tlh.fl.us) rely on volunteers. If you are interested in assisting with these monitoring programs, please contact them via email.

POPULATION CHALLENGE

In the discussion of Monarch population size (PAGE 18) I outlined a method for estimating the size of the migratory Monarch population from the tagging data. Listed below are some questions based on this method. To answer these questions, assume that 80,000 butterflies were tagged and that the Monarchs at El Rosario constitute 15% of the total overwintering population. It will help to examine the Figures in the text.

If only 18.5% of the tagged and untagged migratory Monarchs survive the migration and only half of these survived to the period of observation when the tags could be collected, how many butterflies would you have to examine to recover 400 tags assuming the population contained 10 million butterflies during the observation period at El Rosario?¹ Suppose the number of Monarchs that survive to the observation period at El Rosario is only 6.5 million, how many Monarchs would you need to examine to recover 272 tags?² (ANSWERS BELOW)

Removal of the tags from live butterflies followed by release of these butterflies is similar to "sampling without replacement" since the recovered tags are removed from the population. This means that with each sampling the tags are no longer at risk of being found. Thus, the "population" of tagged butterflies declines faster than that of the untagged butterflies. If we have 3000 tags at risk at the start of an observation period and find one tag per 10,000 butterflies and collect 40 tags during the first week at the start of the observation period, how many butterflies would we have to examine to collect each tag during the 7th week if 242 tags had been recovered in previous weeks? Assume there is no mortality of tagged or untagged Monarchs during the period.³ What is the outcome if just the untagged population experiences 3% mortality per week?⁴

This year there was one recovery for every 200 tags applied. This rate of recovery was facilitated by the extraordinary effort of local residents to recover tags this year. Suppose that next year we also tag 80,000 Monarchs and the residents make the same effort to recover tags in terms of person hours but only recover 127 tags. How would you explain the lower number of recoveries?

Answers: 1. 3.6 million 2. 1.59 million 3. 10,877 4. 24,989 million (9060/tag)

LETTERS TO MONARCH WATCH

For several years the Monarchs have chosen our acreage west of Sioux Falls, South Dakota, as a gathering and resting place...This year we learned about your tagging program from the Outdoor Campus in Sioux Falls. We invited staff and volunteers from the Outdoor Campus to come to our place during Labor Day weekend, and in two sessions we were able to tag approximately 300 Monarchs...I am so delighted that respected institutions such as yours are investing heavily in protection of the Monarch and education about the Monarch. We will continue to work with the Outdoor Campus in Sioux Falls to help in any way we can. Incidentally, I plan to use the poster I have ordered to teach my grandson's kindergarten class about Monarchs. If I am given an opportunity, I'll share with other classes in his school as well.

[Note: Seven Monarchs tagged in Sioux Falls in 1998 have been recovered in Mexico!]

Cindy Wika
Sioux Falls, SD

I want to commend you all on the dedication and love you bring to this worthwhile and fascinating project. This is really "hands-on" science, and I know the kids and I will never forget our experience with our 'pillars and butterflies. Many thanks for a high-quality operation, and a wonderful Web site!

Linda McBride
Glen Allen Elementary School
Glen Allen, VA

I enjoyed participating in your program. I teach first grade and this was the first time that I had ever completed a unit on butterflies. I work with an at-risk student population and this project I feel will be one that they will always remember. This unit was unique to our school and for our area...I would like to do this next year but even on a larger scale! Thank you for your program!

Christine Swift
Longfellow Elementary
Muncie, IN

This was a very exciting project to do with our elementary students at Bolton Center School. I am the K-3 Art teacher and my colleagues teach 1st Grade. Our students were able to watch eggs turn to caterpillars then butterflies in the art room but also in our 1st Grade classrooms. They studied all about Monarchs and made beautiful Monarchs in art class. All butterflies were released by the children. We hope just one of our butterflies will be found!!! This will be so exciting for our kids.

We established a butterfly and bird garden right outside our classroom windows 4 years ago and this was the first year we found our own caterpillar on our milkweed that students had planted!!!

Lauren Howroyd
Bolton Center School
Bolton, CT

I am a naturalist for a county in Iowa so not only do I get to enjoy the Monarch experience, but I also get to share the experience with

school children. This year I visited about 10 school classes to share with them the remarkable story about Monarch butterflies.

Melanie Perry, Naturalist
Cass County Conservation Board
Atlantic, IA

I have been a member of the "Monarch Watch" for the last three years. I got involved when our local Herb Farm had a class on Butterfly gardening. Jerry [Zeidler] presented the program and had some eggs he wanted people to raise. When I got home I got very excited & thought, gee what a great project for me to share with my grandchildren. Every day they stopped or called to see how our eggs - caterpillars - cocoons [pupae] were doing.

Now every summer the kids can't wait to help tag the Monarchs or to see how many different species of butterflies we got in our garden.

This year my 6 year-old granddaughter, Shawn, started learning about butterflies in school, her teacher invited me to speak to her class - what a great experience!

My youngest daughter, Kelly, was preparing a speech for her public speaking class in college this fall when I asked her what her subject was she said Monarch butterflies. When I read her speech I had no idea she had read so much on the Monarchs or how much she loved working on my hobby with me. Little did I know the day I took that class how many lives I would touch or what a joy I would have along with a wonderful education I would get from this. I want to thank you & your staff for all the hard work you all put into this project. I hope to continue my membership for many years to come.

Theresa Andreas
Berwick, PA

I continue to get great response from schools, the public and organizations with Monarch tagging programs. Keep the program going. It is a great way to teach science, connect people to what is happening in their backyards, and connect them to what is happening in another part of the world. We also continue to receive media coverage of tagging activities.

I enjoy checking in on the listserve discussions. Please keep one list. The mix of information and observations from professors, backyard enthusiasts, teachers, butterfly watchers and naturalists is interesting and informative. The challenges to some statements or observations are part of the science process. I have learned a great deal from the Monarch Watch program. My family and I enjoy tagging outings. I have been able to reach thousands of people with Monarch tagging programs. Keep up the great work!

Ann M. Burns
Jackson County Conservation Board
Maquoketa, IA

This was our second year to participate in the Monarch Watch tagging program. My students and my family enjoy it tremen-

dously. We were not able to use all our tags simply because we did not have our "kits" with us at the right place and time. We vow to always be prepared from now on. (I keep a net and container in my vehicle at all times now.) My goal is to equip all our vehicles with the necessities before next year's migration season. Even if it means removing the spare tire and jack. After all, which do you use more often?

Brenda Christian
Hammon Elementary
Hammon, OK

Another year has passed, and with it another tagging season. It was an exciting tagging season, although we were disappointed in the low numbers of larvae and butterflies found.... And once again, little Ellen quickly filled in anything I had left out of my talks, and had the self-appointed, very important job of confirming gender before the tagging occurred. (She may be the only 4 year old in the state who can tell the sex of a Monarch butterfly!)

This year we spoke at more schools; 35 classrooms, and over 800 students. However, the number of butterflies tagged was lower than last year. Although this was discouraging and disappointing, it was also a terrific opportunity to discuss with students how weather, other environmental factors, people, development, etc. affect butterfly populations, and to extrapolate how that might also affect us. We had some wonderful discussions with these budding scientists, and they asked some very appropriate questions. (Thank you for getting back to me so quickly by e-mail with answers to some of those questions!)

Thank you for such a terrific program, and the wonderful opportunity to participate. I look forward to next year!

Kathy Jewett
Portland, ME

I have really enjoyed helping you folks again this year. I also collected eggs & caterpillars, and succeeded in raising approximately 250 butterflies!! It's overwhelming to watch the transformation: my view of the world has been permanently - and positively - affected. Thanks for letting me help you. I look forward to the 1999 migration.

Kathy Arnold
Columbia, PA

We were very disappointed to find only three caterpillars this year but even a few Monarchs did their magic on my class. The children love learning about these magnificent animals and become very protective of the creature they have come to know. It is truly an awesome experience each year to raise, tag, and release our butterflies. There is something so special in the eyes and hearts of each of my students as they stand there and watch this small creature launch itself out into the world.

This year, however, our hands on experience did not end here. I felt, for the first time, I really had an opportunity to do more than just brainstorm ideas about why the Monarchs might be in trouble and how we can prevent their possible extinction. We actually became active participants in helping the Monarch through your

ADOPT - A - CLASS project.

We came up with a plan where we could earn our own money by recycling pop cans (saving the earth), buying an education kit (valuing education), and helping the butterflies. We collected cans from the whole school and managed to double our original goal. In addition our media specialist donated a kit from our book fair monies. We also wrote, spoke publicly, used our keyboarding skills, worked as a group for a common cause, felt very powerful for ten year-olds, and more than accomplished our goal.

We thank you for this opportunity. We would like you to use the enclosed monies to buy three kits in the name of Amberly Elementary School.

Mrs. Karen Rieser and the Mighty Monarchs
Amberly Elementary School
Portage, MI

MONARCH SCIENCE FAIR

The Second Annual "Monarchs in the Classroom" Monarch Fair was held on December 5, 1998 at the Science Museum of Minnesota in St. Paul. The Monarch Science Fair was coordinated by Karen Oberhauser and her students at the University of Minnesota. Approximately 97 6th-8th grade students representing 18 schools throughout Minnesota participated in the Fair. The research projects focused solely on Monarch butterflies. The research topics ranged from food preference (Do Monarch larvae prefer young or mature milkweed leaves?) to development rates of pupae (The effect of temperature on a developing chrysalis). Student presenters created posters and displays to illustrate their research and stood by their exhibits to explain their projects to the public and the "scientific committee" consisting of Karen and her students. All the students were awarded a Monarch Watch Migration T-shirt for participating in the Research Fair.



The mentors of the students were teachers who attended a summer workshop conducted by Karen and her students. At the workshop, teachers were instructed on how to conduct independent research using Monarch butterflies. Once school began in the fall, teachers used their research skills to guide students through the scientific process as the students worked on their own research projects. By proceeding from observation, to question, to hypothesis, through development of methods, and tests of the hypothesis, students gained hands-on experience and an understanding of the scientific method. Monarchs facilitate this learning process because they are fascinating to the students and are easy to work with.

TECH NOTES

NEW WEB SITE DESIGN

Long-time Monarch Watch Web surfers have seen the Web site undergo many changes over the years. This year the site was redesigned and reorganized in an attempt to make it easier to navigate and more enjoyable to use. We've also added a lot of new material and will continue to do so just as fast as we can. As always, we welcome your questions, comments, and suggestions about the Web site's design and content. Also, if you have photographs, drawings, essays, student projects or any other type of Monarch-related material that you would like to see added to our site, please drop us a line and we'll figure out the easiest way to get your materials online. Thanks!



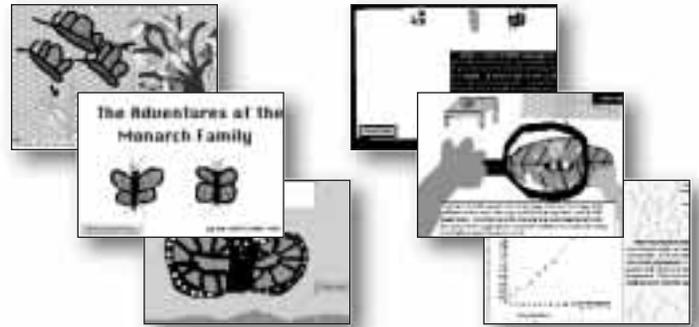
EXTREME TRACKING

Many of you have commented on the little "electric globe" icon on the Monarch Watch homepage and some have even been curious enough to click on it to see what would happen. On 1 July 1998 we began using "eXTReMe Tracking" to generate reports and statistics about the visitors to our Web site. We now have access to all sorts of information including the number of unique visitors each hour/day/week/month, where they are coming from (76 countries and counting!), what type of computer systems they are using (Mac/PC, monitor resolution, etc.), what keywords they are using to find us with search

engines, and a whole lot more. Please feel free to check out this information for yourself by clicking on eXTReMe's icon located at the bottom of our Web site's homepage at www.MonarchWatch.org

HYPERSTUDIO PRESENTATIONS

HyperStudio is an easy-to-use multimedia authoring program that is currently being used by millions of K-12 and college teachers and students all over the globe. Slide show



presentations (called "stacks") complete with animation, audio, and video are quickly and easily created and may be distributed via Email or the Web. A retail software package is required to create HyperStudio presentations (site licenses are available for schools). However, the software necessary to play the presentations is FREE and available for download from the "official" HyperStudio Web site at www.HyperStudio.com. This site also provides lots of information about this software and features sample stacks that will give you an idea of what you can do. We added a "HyperStudio Stacks" section to the multimedia gallery on the Monarch Watch Web site and have already received a few submissions that will be online soon!

CU-SEEME

VIDEO CONFERENCING WITH MONARCH WATCH



17 February 1999: Twenty-five students were able to interact with Monarch Watch face-to-face, even though they were more than 1000 miles away. Sound impossible? Thanks to a couple of camera-equipped computers, some free software and the internet, this connection was made. Janis Lentz's fourth and fifth grade students from Jackson Elementary School in McAllen, Texas, called up Monarch Watch at the University of Kansas for a "face-to-face" video conferencing session. The kids asked questions, shared their own experiences with Monarchs and were even able to see a Monarch butterfly emerging from its chrysalis (since it was a male Monarch, they decided we should name him "Al").

The Web is a great place to start learning more about this cool technology. Check out our Web site at www.MonarchWatch.org/help/tech.htm for some links to get you pointed in the right direction.

0.0 fps●WAITING● (12 cap)

Receiving0 Kbps (15 cap)

DPLEX-L EMAIL LIST

The Monarch Watch Email Discussion List (Dplex-L) continues to grow and mature. Each year the number of subscribers and the quality of the messages increases. Currently, more than 430 teachers, students, Monarch enthusiasts, and Monarch researchers are subscribed to the List. This diversity keeps the list fresh and makes it a wonderful resource for all sorts of Monarch information. Please see the back cover for details about joining Dplex.

CONGRATULATIONS!

Journey North won the 1999 Webby Award for education and was named the top education site on the Web by the International Academy of Digital Arts and Sciences. The Webby Awards (www.webbyawards.com) are dubbed the "Oscars of the Internet". Journey North follows the spring migrations of the Monarch butterfly and other species and conducts the symbolic migration with Monarchs created by children (Journey South) in the fall. Over 4000 classrooms in Canada and the U.S. make use of this outstanding program. Visit them on the Web at www.learner.org/jnorth 🦋

MONARCH HINTS AND TIPS

Many of the letters, faxes, and emails we receive contain helpful hints and suggestions. Here are just a few of the ideas shared by Monarch Watch participants over the last year.

TAGGING HINT

This year we tried something different and it seemed to work great. We took the tag cards and taped them to index cards. Then we copied the numbers from the tags on the opposite side. Now everyone carried their own tags and a pen and were able to catch, tag, log and release. We found it works better if you have a shirt with a pocket to carry the tags and your pen. When we are finished tagging for the day we transfer the information onto the official log sheet.

*The Clement Family
Andover, KS*

DEALING WITH MORTALITY

I do want to share an idea with any teachers that might have this happening in the future. Our children were so sad when our Monarchs died that we had to turn it into a positive lesson. I read the book "Dog Heaven" by Cynthia Rylant. We then brainstormed about what our Monarchs might be doing in "Monarch heaven." The children wrote the dearest stories and it seemed to help them feel better.

*Lee Hammons
Dallas, TX*

CONSTRUCTING A VIVARIUM

We began our adventures by constructing a vivarium ... The vivarium was made of wooden hoops, nylon tulle, and string. The vivarium was hung in the school library so all students and staff could have easy access...We captured the caterpillars on the dill and parsley plants in our school's OWL project. The students began bringing black swallowtail caterpillars from home. Within 13 days, the first of 31 black swallowtail butterflies had emerged from their chrysalides. We were ever so excited!!

The Monarchs began arriving in early September and since then the students have carefully captured, tagged, and released 144 Monarchs. We learned how to determine sex, how to carefully handle the butterflies and to keep the records. We have applied all the tags we ordered this year, and the Monarchs just keep appearing outside our windows, on our flowers, and in the trees. Our students are so excited...

We also ordered 6 Monarch caterpillars from KU. Three of those Monarchs have emerged and have been released. We call those our KU butterflies.

Currently, there are two sphinx moths in our vivarium. There are two chrysalides of sphinx moths and several woolly bear caterpillars. There is no end to the students' excitement as they go about watching for new additions to the vivariums.

Teachers have presented a couple of programs for adults in our

community and the families of our students who visited school at Open House were absolutely fascinated with our project.

Students have written reports, done butterfly art, studied insects on the Internet, and watched a number [of] videos about insects and butterflies.

Thanks for all the good work you do with the students of Kansas. We have learned a lot and developed a new appreciation of butterflies.

*Marlene Krug
Bickerdyke Elementary School
Russell, KS*

MONARCH PUPPETS FOR EDUCATION

In the past, I have used a Monarch hand puppet to "dress up" school presentations. I cut out two Monarch shapes from "non-fusible interfacing" (a strong white fabric that doesn't ravel - available at fabric stores). They are about a foot wide and 6 [inches] high. I then colored both pieces in a Monarch pattern with magic markers and glued the edges together, leaving a hole in the tail end for my hand. Since the wings are so wide, the puppet "flies" very nicely through the classroom.

*Heidi McAllister
Texcoco, Mexico*

NOT HANGING PUPAE FOR EMERGENCE

I've had many swallowtail, Monarch, and painted lady chrysalids (luna, cecropia, and polyphemus cocoons as well.) emerge from the floor of a container or cage. They just need a rough surface to allow them to crawl up the side(s) and to the top of the container to hang after emergence. Paper toweling works nicely, as does bridal netting. Just lay it across the bottom, up the sides, and secure some across the ceiling of the container if it has a slick surface. The container also needs to be large enough to allow the wings to expand as the butterfly hangs vertically.

*Cindy Hepp
Campbell Hill, IL*

HOPE FOR THE FLOWERS

"Hope for the Flowers" by Trina Paulus recently celebrated its 25th anniversary in September 1997. "Hope for the Flowers" is "a tale - partly about life, partly about revolution, and lots about hope for adults and others (including caterpillars who can read)". The story is told by two caterpillars, Stipe and Yellow, who strive to understand the meaning of life and are caught up in the climb to the top of the "caterpillar pillar". This is a wonderful story with a heart-warming message for readers of all ages.

Trina is active in environmental politics, composting, sludge, and permaculture which is the creation of self-sustaining communities. And in her spare time, she raises Monarch butterflies!

For more information on the book and Trina, you can visit her on the Web at www.hopefortheflowers.com

ADOPT-A-CLASSROOM

We have pledged to provide resources to the communities (ejidos) in the vicinity of the overwintering areas in Mexico. During a visit to the El Rosario ejido in November of 1997, we defined how Monarch Watch can help the ejidos. Our solution is to obtain instructional materials for the local schools.



Schools within the Monarch Reserve in Mexico.

Photos by Journey North.

The schools within the Monarch Reserve are simple cinder block buildings. The classrooms are small with high windows, many have poor lighting, some have no electricity and most rooms are crowded with crude and uncomfortable desks for the children. The teachers write lessons on worn-out blackboards. Basic textbooks are available, but workbooks, writing materials and even paper are scarce. Library resources and supplemental teaching aids, which have proven to be so effective in teaching the concepts of math and science, are almost totally lacking in these

Monarch Watch would like to thank all those who made contributions of \$100 or more to the Adopt-A-Classroom program this past year including: John Beck, Jr.; Shaun Case; Sandra DeVries, Lake Mills School; Kelly Dewitt, West Ottawa High School; Paula Donham, Frontier Trail Junior High; Marian Goodding; Joan & John Graham; Grapevine Garden Club; Dona Little; Fran Ludwig; Colleen Mitchell, Logan Avenue Elementary; Marcie O'Conner; Karen Rieser, Amberly Elementary School; Kathy Rose; Chuck Safris; Carol Scott, Heartland Butterfly Farm; Robert Small, The Michoacán Reforestation Fund; Helen W. Taylor; Sara Throop; Diane Topping, Bethel Manor Elementary School; Victor Volkman, E. Klopp Library; Sarah West, Germantown Friends School; Vermeer Sales & Service; and Mary Whittlesey. We would also like to thank those who sent us school supplies that were collected at the end of their school year including: Randi & Lina Reed from Chantry Elementary School and Patty McLeod from Bangor Christian School.

HELP US HELP SCHOOLS IN THE MONARCH RESERVE!

Adopt-A-Classroom is a program that Monarch Watch has initiated to provide educational materials and classroom supplies to the schools within the Monarch Reserve in Mexico. By helping these schools we can provide resources that were previously unavailable to these communities, and we can show our concern and support for the conservation of the Oyamel fir forests and the Monarch butterflies that overwinter in this region.

For more information on Adopt-A-Classroom, please see the brochure included with this Season Summary. If you did not receive a brochure, please contact us and we will gladly send one. Thanks!

schools. This is where we can help. Working with innovative teachers, we have designed a basic math and science kit which contains instructional materials appropriate for the classrooms in Mexico. Each of these kits costs \$100 and we need your help in raising funds to purchase materials for these educational kits.

In addition to monetary contributions, there are other ways in which you can help. The schools in Mexico need supplies. At many schools in the United States, excess materials - everything from paper clips to crayons and paper, etc. - are discarded at the end of the school year. Why not send them to us? We will have these materials sorted and sent to Mexico. We are also seeking used slide viewers, overhead projectors, and percussion instruments such as drums and tambourines.

We hope that you can assist us with this effort to help the schools in the Monarch Reserve. Please contact us if you have any questions - Thank You! 🍀



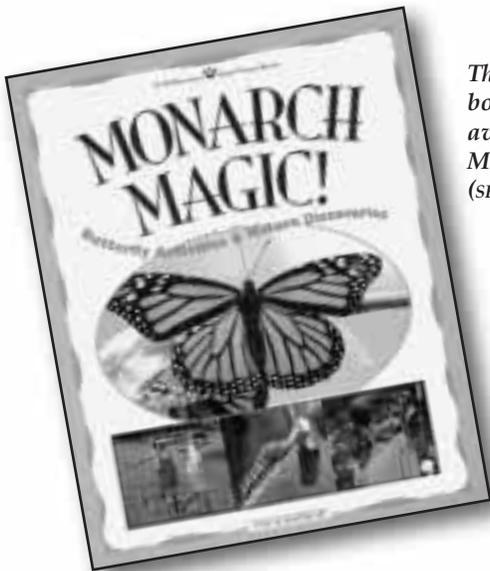
Mrs. Karen Rieser's 4th Grade Class (aka "The Mighty Monarchs") at Amberly Elementary School in Portage, MI, recycled more than 2000 cans and contributed \$300 to our Adopt-A-Classroom program. Way to go! Photo by Karen Rieser.

Read about their "Monarch Adventure" on our Web site at: www.MonarchWatch.org/gallery/essay/monadv.htm

Lick-and-Stick Butterfly Stickers

Reprinted with permission from Monarch Magic! by Lynn Rosenblat ©1998, Williamson Publishing Company, Charlotte, VT 05445, 800-234-8791, \$12.95.

Homemade stickers are great for sealing envelopes, decorating stationery, or sticking on notebooks. Just moisten the back and you're ready to start sticking!



This wonderful book is also available from Monarch Watch (SEE PAGE 54).

WHAT YOU NEED:

- Paper, or pictures from magazines of monarch caterpillars and butterflies
- Scissors
- Markers or tempera paint
- 1 tablespoon (15 ml) flavored gelatin mix
- 2 tablespoons (25 ml) boiling water (grown-ups only!)
- Heatproof container
- Paintbrush

WHAT YOU DO:

1. Cut paper into butterfly or caterpillar shapes; then, draw or paint details colorfully.
2. To make "sticker gum," pour gelatin into a heatproof container. Ask a grown-up to add the boiling water. Stir until the gelatin is dissolved. Cool, but don't let harden.
3. Brush sticker gum onto the back of the shapes. Let the gum dry. Re-wet later when ready to use.
4. Stick on your Butterfly stickers!

Crafty Tip: If the gelatin hardens, simply set the container in a pan of hot water to turn back to a liquid.

Butterfly Song by Laurence Cutts, Tallahassee, FL.

BUTTERFLY

I once was a worm, and ug-ly was I, I crawled on wig- i- ly
feet, And eve-ry plant I hap-pend to see, I thought was some- thing to
eat. But then one day soon, I spun a co- coon, lay so still I thought I might
die, But then I hatched out and be- hold I had changed to a beau- ti- ful but- ter-
fly. I can fly. I can fly, I have wings I must try, No more wig- i- ly crawl- ing says
I, I can fly, I can fly, I can soar way up high, I'm a beau- ti- ful but- ter- fly.

LOGGING IN MEXICO

Each year brings reports of illegal and legal logging in and near the Monarch overwintering sites in Mexico. These accounts are often alarmist in tone and difficult to substantiate but all of us who have visited the Monarch Reserve and the surrounding area have seen the logging trucks and the numerous sawmills. Deforestation is clearly underway in the region and, though it is being promoted in several locations, reforestation is probably insufficient in replacing the trees that are removed. How serious is the problem? As outsiders, it's probably impossible for us to know. However, PROFEPA, a Mexican organization responsible for monitoring compliance with laws to protect the environment, recently issued a report on their assessment of logging in the Monarch reserve and surrounding area. The following is an edited version of the text sent to Dplex-L (PAGE 42) by Lincoln Brower on 20 April 1999. The original article was published in *Reforma*, a newspaper in Mexico City on 18 April 1999. The article was authored by Homero Aridjis, a well known poet and environmental activist in Mexico.

THE SIZE (EXTENT) OF THE LOGGING (IN THE MONARCH RESERVE). BY SR. HOMER ARIDJIS

Translated by Monica Missrie

A few days ago millions of Monarchs began their return to the U.S. and Canada, after having spent about five months in the protected and non-protected sanctuaries of the states of Michoacán and Mexico. Now that the butterflies have left, these areas will be invaded by loggers, who will take advantage of the lack of visitors and guards to cut oyamel legally and illegally, but more so illegally, as has been demonstrated by audits performed by PROFEPA (The Mexican Attorney General's Office for the Environment) in January and February of this year. Of 10 forest audits carried out in authorized land holdings in the Monarch butterfly region in Michoacán, it was found that the owners of four of these holdings had committed serious irregularities and six mild ones. Seven audits were performed in Ocampo, one in Angangueo, two in Aporo and one in Zinapécuaro. Two more are pending. The forestry and campesino organizations of this area belong to the National



Monarchs in flight in their overwintering habitat, areas that are threatened by logging.

Photo by O.R. Taylor.

Campesino Confederation. The four municipalities where the irregularities were registered are Aporo, Ocampo and Zinapécuaro. Of a total volume of 9,447m³ authorized by SEMARNAP, these four logged 19,790m³, that is, they illegally extracted 10,143 m³, an excess exploitation of 109.5 percent in an area of 189.97 hectares. The laws that were broken are: Article 47, fractions: III, XIII and XIV of the

Forestry Law. The main irregularities were not having documentation accounting for the legal origin of the wood, logging trees in land holdings without authorization from SEMARNAP, and logging trees using hammers from another land holding. The security measures imposed by PROFEPA were confiscation of tools, suspension of the logging, economic sanctions and reforestation. The ejidos belonging to the Campesino Confederation where the most logging was recorded were: Ejido San Agustín Ucareo, Zinapécuaro municipality; Ejido "El Rosario", Ocampo municipality; Ejido Arroyo Seco, Aporo municipality; and Emiliano Zapata, Ocampo municipality. The logging totals for the four ejidos are: Illegal logging: 4,033m³; (excess) volume: 6,309m³; illegally extracted volume: 10,343m³; volume authorized by SEMARNAP: 9,447m³; total extracted volume: 19,790m³; excess exploitation: 109 percent; audited surface: 189.97 hectares. In 11 municipalities in the state of Michoacán (among them Ciudad Hidalgo, Zinapécuaro, Tlalpujahua and Zitacuaro) 1,127m³ of illegally extracted volume was recorded, with a volume of illegal pine wood of 828m³ and 289m³ of oyamel, as well as white cedar and oak. In five industries (PROFEPA didn't furnish their names) in Angangueo, Zitacuaro, Charo and Morelia, serious irregularities were found, with a total of 739m³ of illegal wood; the volume of pine was 675m³ and of oyamel, 61m³.

This proves that the biggest problem in the Monarch butterfly sanctuaries (protected by the government since 1986) is logging. This also reinforces the conclusions some investigators and I reached when we toured the sanctuaries this season. There is a growing proliferation of big and small sawmills surrounding the entire area of the Monarch Butterfly Biosphere Reserve; there are many trucks loaded with trees going in and out of the sawmills on the Angangueo, Ocampo, Tlalpujahua and Zitacuaro highways. In El Rosario, the sanctuary with the highest economic benefits thanks to ecotourism, logging continues. A quarter of a kilometer above the area where visitors are allowed, fierce devastation of the oyamel forest, confirmed by the PROFEPA audit, was observed. Furthermore, in the area open to visitors trees that had been slashed with knives to weaken them and justify their cutting were also observed. The sawmill detected last year at the foot of Sierra Chincua, near the Tlalpujahua highway, even though officially said to be outside the protected area, has increased in size and large piles of oyamel logs can be found on the premises.

The fact that Mexico, the U.S., and Canada, the countries that make up NAFTA, are incapable of maintaining the physical integrity of the oyamel forests, and guaranteeing the survival of the Monarch migratory phenomenon, shows how cosmetic environmental agreements are. What is most alarming is that loggers seem to be intent on destroying the sanctuaries before the government can take adequate and effective measures to protect them. ♡

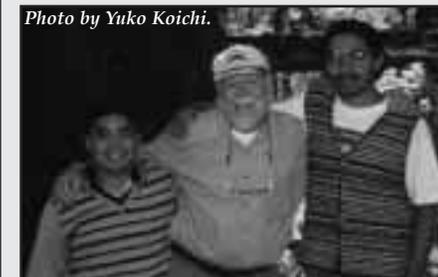
MEXICAN RESEARCHERS

The Japanese film excursion to Angangueo had an unanticipated side benefit: it gave me the opportunity to become acquainted with two Mexican Monarch researchers, Eduardo Rendón-Salinas and Eligio García-Serrano.

I had met Eligio García briefly on an earlier trip but was not familiar with his work. Eligio works for both the Instituto Nacional de Ecología and SEMARNAP, an organization in Mexico which is similar to the U. S. Fish and Wildlife. Eligio's assignment, in part, is to visit and measure all the overwintering Monarch colonies. Eligio and his co-workers count the occupied trees and measure the total area for each colony. The data is used to provide estimates of the size of the overwintering Monarch population. The

total hectares occupied by Monarchs early in the season is the only real measure of the size of the Monarch population.

I was familiar with Eduardo Rendón. Eduardo was kind



(l-r) Eduardo, Chip, Eligio.

enough to send us the data for five tagged Monarchs he had recovered in the last several years. Eduardo is working on several Monarch projects, which when completed, will serve as the basis for his thesis at the Instituto de Ecología at the National University of Mexico in Mexico City. One of Eduardo's projects is an in-depth study of the causes of mortality in the overwintering colonies. His study should provide the data needed to gain a better understanding of the total overwintering mortality and the year-to-year variation in this mortality. In the future, these data can be used to refine population estimates such as those I've made on pages 18-20. --Chip Taylor

A TOUR FOR TEACHERS TO MONARCH OVERWINTERING SANCTUARIES IN MEXICO

Each year for the past 12 years, Bill Calvert has conducted natural history oriented tours to visit the Monarch butterfly colonies in Mexico's Transvolcanic Belt. For the past two



years, these trips have been tailored to the interests of school teachers. Local schools are visited to learn about the Mexican school system and some of the problems of teaching in rural Mexico in addition to seeing millions of Monarch butterflies at two overwintering sites. The teacher trip includes an archeological component that features visits to two pyramids not generally known to the public. There is also an opportunity to view many bird and plant species endemic to central Mexico as well as boreal and tropical dry deciduous forest in the same day. A slide show is shown which features many aspects of Monarch biology, scientific research, and the conservation biology of the species. The interactions of local people with Monarchs, deforestation in rural Mexico, and the impact of Monarchs on the local economy are also discussed and viewed first hand. Informal discussions suggest how simple science experiments can be done in and out of the classroom using the Monarch butterfly as a teaching tool both to enlighten children and help scientists learn about the migratory phenomenon. Accommodations are chosen for their charming setting, physical beauty and/or biological interest. Anyone interested in receiving more information about the teacher trips, please contact Bill Calvert at wcalvert@bga.com.

HYDROGEN ISOTOPES VS TAGGING

How is the report by Wassenaar and Hobson in *Proceedings of the National Academy of Sciences* (PNAS) on the natal origins of Monarchs (as indicated by hydrogen and carbon isotopes ratios in their wings) going to affect the tagging program?

I don't anticipate that there will be any effect on the tagging program. The data provided by the two types of studies are different and the results from each method are used to answer different questions. The isotope study gives us relative proportions of Monarchs from different regions of the country that reach the overwintering sites in Mexico. The tagging study doesn't do this and was never intended to provide this kind of information. Tagging does not give the proportional origins of Monarchs arriving in Mexico since most of the Monarchs are tagged while en route and not at the point of their natal origins.

Recoveries within the United States provide information on the paths taken by the Monarchs to reach Mexico. In addition, we are learning how the movement of Monarchs is affected by wind and weather patterns. We are using the recoveries to determine the distances traveled per day, and the time course for the entire migration. Each recovery also gives us a vector or direction from the point of the tagging to the site of the recovery. These data are analyzed by region to determine if there is a pattern for these vectors across the country. Our first publication on this subject will appear shortly. The results of this study show patterns of orientation expected for different regions assuming the Monarch's goal is to reach the region along the Texas/Mexico border. The southwesterly orientation shown in these data is consistent with several theories of Monarch navigation (see *Tactics and Vectors* at: www.erin.utoronto.ca/~w3gibol/).

TRANSGENICS AND MONARCHS

Nature faces overwhelming challenges that are initiated by man. Monarchs face habitat destruction annually at their overwintering sites in Mexico and throughout their breeding areas in the United States and Canada. The breeding grounds are continually being destroyed by urbanization. Monarchs are now faced with a new challenge due to the development and utilization of transgenic crops in agriculture.

Transgenic crops are plants that are genetically engineered to have desirable traits. This biotechnology involves transferring the desired genetic material from one organism into another. Commercially grown crop varieties are being genetically engineered to have resistance to diseases, certain insects, and herbicides. Other desirable traits include agronomic characteristics such as nutrient content or tolerance to drought and certain soil types. Transgenic crops provide a new age of technology to growers around the world.



Monarch larvae appear to feed exclusively on milkweeds. Here a larva munches on a milkweed leaf after "flagging" it.

Photo by O.R. Taylor.

There are several advantages to using transgenic crops. As mentioned above, the crops have resistance to diseases, insects, and herbicides. This reduces pesticide exposure to the environment and growers. SRI Consulting Report of 1997 (Larry Larson, Dow AgroSciences, pers. com.) predicts that the utilization of transgenic crops will reduce pesticide use by 23-36% by the year 2005. Reduction in pesticides also reduces the management costs for growers. In some transgenic crops, growers are also seeing an increase in yield due to reduced pest pressures.

Unfortunately, there are also disadvantages to using transgenic crops. Transgenic crops are not a "silver bullet" or cure-all to pest control in the field. Insects and weeds exposed to a high level of the transgenic crops may develop resistance, and in turn, produce "superinsects" or "superweeds". If resistance occurs, there may also be cross-resistance to other methods of control used by the growers. Another issue is the effect on non-target organisms. The majority of transgenic crops are released for use with little or no long-term research being conducted to determine effects on non-target organisms such as Monarch butterflies.

The development and utilization of transgenic crops in the

Midwest could have a dramatic impact on the Monarch population. The findings of the hydrogen isotope study show that the wings of Monarchs contain isotopic signatures which are characteristic of their region of origin (PAGE 22). The results were surprising in that they showed 50% of the Monarchs originated from the agricultural heartland of the United States, particularly the regions with the highest acreage of corn and soybeans crops in which milkweeds are often common (FIGURE 2, PAGE 23).

The landscape of the central United States is dominated by cropland. Milkweeds such as common milkweed, *Asclepias syriaca*, and blue vine, *Cynanchum laeve*, are predominant hosts for the Monarch in the Midwest. Unfortunately, these milkweeds are considered noxious weeds by growers and are targeted for elimination with the use of crop rotation, plowing, disking, and herbicides. Milkweeds are moderately resistant to these types of control methods. One method of controlling milkweeds is the use of herbicides, but this is relatively limited because currently agricultural crops are not resistant to the herbicides. However, soybeans and corn have recently been developed to be resistant to a broad spectrum herbicide, Round-up, the most effective herbicide for broadleaf plants including milkweed. The utilization of these Round-up Ready® crops may have a dramatic effect on the distribution and abundance of milkweeds in croplands.

The impact can be measured by examining past usage of herbicides in soybeans from data compiled in the Agricultural Resources Management Survey conducted during the fall of 1997 by the National Agricultural Statistics Service (<http://usda.mannlib.cornell.edu>). Out of 12 states surveyed in the Midwest, soybean acreage accounted for 51 million acres. Most of those acres (97%) were treated with herbicides. Round-up's active ingredient is glyphosate, and glyphosate accounted for 25% of the average treated acreage. Illinois had the most soybean acreage from the states surveyed with 9.9 million acres planted in 1996. Glyphosate was applied to 30% of those acres. The release of Round-up Ready® soybeans may trigger a decrease in other herbicides used, but may also cause an increase of Roundup applications. This in turn could decrease the availability of milkweeds in cropland for Monarchs.

Another type of transgenic crop that may have an impact on Monarch populations is Bt (*Bacillus thuringiensis*) corn. Bt corn is genetically engineered to contain a gene from *Bacillus thuringiensis*, a bacterium found in the soil. The Bt gene creates a protein that is fatal to certain insects, especially Lepidopteran species. The Bt corn has been engineered to be effective against economic corn pests such as European corn borer larvae. The use of Bt corn reduces the need for chemical applications of pesticides because the insecticidal properties are incorporated within the plants cells. At this time, the Bt gene is expressed throughout the

corn plant. Therefore, the Bt gene may be expressed in the corn pollen which would expose non-target organisms to the Bt toxin. Due to the selective nature of the Bt toxin on Lepidopteran species, Bt toxin in corn pollen could be dispersed onto surrounding milkweeds and ingested by Monarch larvae. The effects of Bt corn pollen on Monarchs are being studied by researchers at Cornell and Iowa State Universities. The first study on this subject is being published in *Nature* as we are going to press (CITATION BELOW). Many additional studies are needed to determine the effect of Bt toxin on Monarchs and other non-target organisms.

Losey, J.E., L.S. Rayor, and M.E. Carter. 1999. Transgenic pollen harms monarch larvae. *Nature*. May 20.

Transgenic crops will not be a passing trend unless complications arise. The advantages of transgenic crops currently outweigh the complications. SRI Consulting Report of 1997 (Larry Larson, Dow AgroSciences, pers. com.) predicted that of the 58 million acres of corn to be planted in 2000, 25 million acres (43%) will be transgenically engineered. By 2005, the percentage of corn acreage in transgenics will increase to 75% of the total acreage. The new transgenics expected on the market by 2000 incorporate multiple modes of action into one plant. For example, a transgenic corn due out this year by DeKalb Genetics incorporates both Bt and herbicide-tolerant genes. This area of biotechnology is moving very rapidly with little consideration for the long-term consequences of the use of such plants on natural systems.

What can we do to lessen the potential impact of transgenic crops on the Monarch population? The best answer is to continue to expand our efforts in promoting Monarch conservation. The establishment of Monarch habitats at school yards, parks, nature centers, and our own backyards is an excellent start to Monarch conservation. To increase public awareness, we need to continue educating the children and public about the Monarch's amazing life cycle and its host plant. Butterfly gardening should also be encouraged not only for human pleasures but for sustaining Lepidopteran life. These small steps will make a difference in the conservation of Monarch populations in the future.

An example of Monarch habitat preservation is the program "Integrated Roadside Vegetation Management" (IRVM) at the University of Northern Iowa in Cedar Falls, Iowa. IRVM promotes maintaining native grasses and wildflowers as roadside vegetation. They contend that natural roadsides add benefits such as beautification, habitat enhancement, and prairie restoration. They provide a seed mix to applicants that qualify for their program. The seed mix includes butterfly weed, *Asclepias tuberosa*, a prairie perennial and host plant for Monarchs. For more information regarding the IRVM program, please contact them at 1.319.273.2813 or see their Web site at www.uni.edu/~irvm/index.html

Biotechnology is rapidly changing the future of the agricultural practices. Let's try to lessen biotechnology's impact on Monarch populations in the United States. Become active in preserving the Monarch butterfly! ♡

BUTTERFLY FESTIVALS

The 2nd Annual **Butterfly Flutterby Festival** in **Grapevine, Texas** will take place on 16 October 1999. The Flutterby Festival honors the Monarch butterfly by featuring it in several different displays and events. At the festival, participants can witness Monarchs emerging from their chrysalides or participate in tagging and releasing the Monarchs. The festival hosts a parade with kids and their pets dressed as butterflies. Other activities during the festival include music, entertainment, food, and crafts. Children's activities include face painting, story-telling, art contests, and a petting zoo. For more information, please contact the Grapevine Visitors Bureau at 1.800.457.6338 or www.tourtexas.com/grapevine.



Nicole Gaither flutters her Monarch wings as she receives the Best Costume Award during the 1998 Butterfly Flutterby in Grapevine, TX.

Photo: Grapevine Visitors Bureau.

Paris, Arkansas will be hosting the 3rd Annual **Mt. Magazine International Butterfly Festival** on 11-13 June 1999. The festival features a variety of activities for all ages. Seminars will be presented on topics related to butterflies, and one of the speakers will be Monarch Watch's Arkansas Regional Coordinator, Jim Edson. There will be crafts, entertainment, and food available. Special events include a parade, merchant open house, and photo exhibits. Admission to the festival is a one dollar donation per person and children under 3 are admitted free. For more information, please contact Paris Chamber of Commerce: 1.501.963.2244 or www.butterflyfestival.com.

The 1999 **Texas Butterfly Festival** will be held in **Mission, Texas** on 22-24 October. The festival will host nationally known speakers such as John Acorn, Jeffrey Glassberg, John and Gloria Tveten, and the keynote speaker, Robert Michael Pyle. The festival includes field trips to area gardens, wildlife refuges, state parks, nature centers, and Audubon centers. A post festival field trip will be taken to northeastern Mexico. Call the Mission Chamber of Commerce at 1.800.580.2700 or email Joanna Rivera, Festival co-chair at JRivera528@aol.com for more details. Visit the festival Web site at:

www.mission.lib.tx.us/chamber/butter.html

The **Festival of Butterflies** at Powell Gardens will be held 13-15 August 1999 in **Kingsville, Missouri**. The festival features a butterfly exhibit in Powell Gardens' glass conservatory, guest lectures on butterflies, and children's activities. Nature walks will be led by the staff throughout the beautiful grounds at Powell Gardens. Admission for the festival is adults \$6, Seniors \$5, Youth (5-12) \$2, and children under 4 free. For more details, call 1.816.697.2600.

JAPANESE FILM

Last fall we were approached by NHK, the Japanese equivalent of the Public Broadcasting Service, to assist them in the production of a video for a series called "Our Loving Earth". In each episode of the series, a scientist leads the audience on a natural history adventure. In this case, the concept was to follow the fall migration of the Monarch and to show how the internet and other means of electronic communication were being used to track the migration. We started the filming in October in Kansas where the objective was to film the immature stages of Monarchs, make the internet connection, and conduct extensive interviews on many subjects related to Monarchs. In mid October, we flew to Austin, Texas and then drove to Uvalde, to follow the migration through that part of Texas. On the return to Austin, we arranged to meet with Ken Brugger, the person credited with locating the Monarch overwintering locations in Mexico and bringing them to the attention of the scientific community.



The film crew (l-r): Taketo Yoshida (interpreter/mexican coordinator), Kaoru Kawada (director), Yasuhiro Anzai (grip/sound), Yuko Koichi (interpreter), Yasuo Kasugai (cameraman).

Photo by O.R. Taylor.

Ken met me at the door of his home on 13 October. I interviewed him for about 30 minutes on camera about the history of the discovery of the Monarch overwintering sites in Mexico. Ken retold the story of how he answered an advertisement in a Mexican newspaper by Fred Urquhart who was looking for someone to track down the possible location of overwintering Monarchs. Ken and Cathy Brugger subsequently searched the mountains west of Mexico City and after several weeks, during which they were shot at from a distance and accused of being prospectors, they finally connected with a guide who, on 2 January 1975, led them to an overwintering site on Cerro Pelón (PAGE 24).

Although Ken appeared to be in relatively good health for a man of 80, he indicated that he was suffering from several illnesses and didn't expect to live much longer. As we parted, Ken agreed to let us borrow some of the slides he had taken at the time of the discovery. Later, we scanned in and archived 200 of Ken's slides. Two slides, one dated 2

January 1975 and another 2 February 1975 apparently indicate dates when the colonies at Cerro Pelón and Sierra Chinqua were discovered.

Unfortunately, the Ken Brugger interview and many other hours of video footage with Monarch specialists such as Bill Calvert, Karen Oberhauser, and Elizabeth [Donnelly] Howard were not included in the final version of the film. Hopefully, some of this footage will be incorporated in an English language version of this production in the future.

To complete the story of the migration, we returned to Texas in December and from there we traveled to Saltillo, Mexico where we met and interviewed Rocío Treviño. Rocío directs Correo Real (Royal Mail), an outreach and educational program in Mexico. She provided us with a Mexican perspective on the migration and the educational issues involving Monarchs.

Shortly after we arrived in Mexico City we connected with Eduardo Rendón who accompanied us to Angangueo for filming at Sierra Chinqua. Eduardo is one of several young scientists from Mexico who have been studying Monarchs (PAGE 47). Eduardo and his colleague, Eligio García, served as the resident experts on the biology of the Monarchs for the film.

Video production sometimes gets in its own way because tape, unlike film, is cheap and reusable. There is a tendency to just keep the camera running and the ratio of footage obtained to that which is usable can be 50 or even 70 to 1. The sheer volume of footage can be an impediment to editing. In this case, the ratio was high (in part) because we frequently operated in three languages: Japanese, English and Spanish. The camera was used to capture all the translations so the person editing would know the context and content of the dialog in each scene. Editing this production must have been very confusing. The final production was long (87 minutes) and the lead character (me) was kinda boring. The voice used to provide the translations for me in voice-over was deeper, richer, and more authoritative than my own. Too bad I couldn't understand a word I said. ♡

--Chip Taylor



Monarchs fill the sky in areas near overwintering sites in Mexico.

Photo by O.R. Taylor.

MONARCH SPEAKERS

Looking for someone to present a program on Monarchs for your organization's next meeting? Need a guest speaker in your classroom to talk about Monarchs and butterflies? Below we have provided a list of individuals by state that present programs on Monarchs and butterflies with their contact information and requested fees for the programs. A few of the presenters have listed specific regions that they cover within their state. If a region is not listed, please contact the presenter to find out if they are willing to present in your area.

ARKANSAS

Jim Edson
870.460.1966 • edson@uamont.edu
Fees are negotiable.

KANSAS

Jackie Goetz
Johnson County Extension
913.764.6300 • goetz1@swbell.net
Jo. Co. area; honorariums appreciated.

Jim Mason
Great Plains Nature Center
316.683.5499 • jmason@ink.org
Wichita area; donations accepted.

Brad Williamson
913.780.7120 work
913.764.6036 home
bwilliam@sound.net
Fees depend on program.

KENTUCKY

Sondra Cabell (Western KY)
270.826.4424
jaudubon@henderson.net
Fees: \$10-25

Laura Lang (Eastern KY)
800.858.1549
Laura.Lang@mail.state.ky.us
Limited number of programs.

MAINE

Kathy Jewett
207.878.5724 • kjewett1@maine.rr.com
Preschool-grade 5; fees negotiable.

MARYLAND

Denise Gibbs
Black Hill Regional Park
301.916.0220
Washington DC area.; fees vary.

MICHIGAN

Matt Douglas
616.771.3893 • mmerd2@ix.netcom.com
Western MI; fees depend on location.

Anne Okonek
Monarch Butterfly Project
906.474.6442 x 119
No fee.

Lee Petersen
616.874.7140
Western MI; donations appreciated
and passed to U of M Research Fund.

MINNESOTA (U of M)

Karen Oberhauser
612.624.8706
karen.s.oberhauser-1@tc.umn.edu
Fee: \$60-100

Michelle J. Solensky
612.625.5735 • wats0094@tc.umn.edu
Fees include travel costs incurred.

Elizabeth Goehring
612.624.8706 • egoeh0005@tc.umn.edu
Fee: \$60

Michelle Prysby
651.645.7072 • prys0004@tc.umn.edu
Fee: \$60

MISSOURI

Dan Dickinson
816.943.0079
ddickins@gwe.leesummit.k12.mo.us
Kansas City area; fees negotiable.

NEW JERSEY

Jim Kupcho
732.634.8674 • LP63044@home.com
No fees; donations accepted for
handout expenses.

NEW YORK

Chantal Speglevin
914.967.5150 • nature@ci.rye.ny.us
Fee: \$60 (1 hour presentation).

NORTH CAROLINA

Nina Elshiekh, Ph.D.
919.967.3027 • naebean@hotmail.com
Fee: \$40 (1 hour presentation).

OHIO

Sarah Dalton
Blendon Woods Metro Park
1069 West Main St.
Westerville, Ohio 43081
msdalton@earthlink.net

Doris Stifel
3331 Hughes Dr.
Toledo, Ohio 43606
dstifel@pop3.utoledo.edu
Throughout Ohio and south Michigan
Adult programs: \$50-100+

OKLAHOMA

Bob Melton
405.495.5200 x 284
bmelton@putnamcityschools.org
Fees are negotiable.

PENNSYLVANIA

Judith Levicoff
215.576.1359
thebutterflylady@juno.com
Fees: \$150-250 plus materials.

Ba Rea
412.487.2214
barea@schiffprinting.com
Pittsburgh area; fees depend on
length of presentation.

Jane Ruffin
1013 Great Springs Road
Rosemont, PA 19010
Kathleen Shafer
570.966.6193 • fourk@ptd.net
All age groups.

Richard Stringer
610.371.5260 or 610.670.1163
stringerrichard@msn.com

WEST VIRGINIA

Kris Gesner
304.645.7069
oma00034@mail.wvnet.edu
Donation for expenses appreciated.

BUTTERFLY HOUSES & EXHIBITS

This year when you are planning your summer vacation, try to visit a butterfly house! Below we have provided several butterfly houses or exhibits that will be open this summer throughout the United States and Canada. If you know of anything that we may have missed, please let us know!! Check out our Web site for more details (hours, admission, etc.).

UNITED STATES

California - Vallejo

Butterfly Habitat
at Six Flags Marine World
Information: 707.644.4000

Colorado - Westminster

Butterfly Pavilion & Insect Center
Information: 303.469.5441
www.butterflies.org

Delaware - Hockessin

Delaware Nature Society's Butterfly House at Ashland Nature Center
Information: 302.239.2334 ext. 25
www.dca.net/naturesociety/butterflyhouse.htm

Florida - Fort Lauderdale

Butterfly World in Tradeswind Park
Information: 954.977.4400
www.butterflyworld.com

Florida - Winter Haven

Wings of Wonder Butterfly Conservatory at Cypress Gardens
Information: 800.282.2123
www.cypressgardens.com

Georgia - Pine Mountain

Cecil B. Day Butterfly Center at Callaway Gardens
Information: 800.225.5292
www.callawaygardens.com

Indiana - Evansville

Flying Colors
at Mesker Park Zoo & Botanic Garden
Information: 812.435.6143
www.evansville.net/~mpzoo

Kansas - Wichita

Butterfly House at Botanica
Information: 316.264.0448
www.botanica.org

Louisiana - New Orleans

Butterflies in Flight at Audubon Zoo
Information: 800.774.7394
www.auduboninstitute.org

Massachusetts - Westford

Butterfly Place at Papillon Park
Information: 978.392.0955
www.butterflyplace-ma.com

Minnesota - Apple Valley

Butterfly House at Minnesota Zoo
Information: 800.366.7811
www.mnzoo.com

Missouri - Branson

Butterfly Place
Information: 417.332.2231
www.butterflyplace.com

Missouri - St. Louis

Sophia M. Sachs Butterfly House & Education Center
Information: 314.361.3365
www.butterflyhouse.org

New York - Bronx

Butterfly Zone at Bronx Zoo
Information: 718.367.1010
www.wcs.org



North Carolina - Durham

Magic Wings Butterfly House at Museum of Life & Science
Information: 919.220.5429
www.ncmls.citysearch.com

Ohio - Cincinnati

Butterflies in Wonderland Exhibit at Krohn Conservatory
Information: 513.352.4080
www.cinci-parks.org

Pennsylvania - Hershey

Butterfly House at Hershey Gardens
Information: 717.534.3492

Pennsylvania - Philadelphia

Live Tropical Butterflies at Academy of Natural Science
Information: 215.299.1000
www.acnatsci.org

Texas - Galveston Island

Rainforest Pyramid at Moody Gardens
Information: 800.582.4673

Texas - Houston

Cockrell Butterfly Center at Houston Museum of Natural Sci.
Information: 713.639.4629
www.hmns.org

Washington - Seattle

Butterflies & Blooms exhibit at Woodland Park Zoo
Information: 206.684.4800
www.zoo.org

Washington - Seattle

Tropical Butterfly House and Insect Village at Pacific Science Center
Information: 206.443.2001
www.pacsci.org

Wisconsin - Madison

Olbrich's Butterfly Bonanza at Bolz Tropical Conservatory
Information: 608.246.4550
www.ci.madison.wi.us/olbrich/butterfly.html

Wisconsin - New London

Mosquito Hill Nature Center's Butterfly House
Information: 920.779.6433

Wisconsin - Milwaukee

Butterflies Alive! at Milwaukee Public Museum
Information: 414.278.2700
www.mpm.edu

CANADA

Alberta - Edmonton

Butterfly House at Devonian Botanic Garden
Information: 780.987.3054

British Columbia - Victoria

Butterfly Exhibit at Victoria Butterfly Gardens
Information: 250.652.3822
www.victoriabc.com/attract/butterfly.htm

Ontario - Niagara Falls

Niagara Parks Butterfly Conservatory at Niagara Parks Botanical Gardens
Information: 877.642.7275 (toll-free)
www.niagaraparks.com

REGIONAL COORDINATORS

The following is a list of the 1999 coordinators and how they can be contacted. If you live within a region covered by a coordinator, you should send your orders for memberships and additional tags to them and they will send you these materials in August. Please do this as soon as possible (before July 1st) so the regional coordinators know how many tags to order from us. However, if you wish to order other items from Monarch Watch in addition to your membership, you should send your request directly to us. This will save you some postage and be less confusing.

ARKANSAS

Jim Edson
Univ. of Arkansas at Monticello
School of Mathematical
and Natural Sciences
Monticello, AR 71656-3480
1.870.460.1966 or 1.800.844.1054
1.870.460.1316 fax • Edson@uamont.edu
Check payable to: AR Monarch Watch

INDIANA

Donald B. Fisher
6356 N. Kingsley Dr.
Indianapolis, IN 46220-2184
1.317.475.9770
Check payable to: Donald B. Fisher

KENTUCKY

(Eastern) Laura Lang
KY Dept. of Fish & Wildlife
#1 Game Farm Road
Frankfort, KY 40601
1.800.858.1549
Laura.lang@mail.state.ky.us
Check payable to:
KY Afield Gift Shop

(Western) Sondra Cabell
(SW Indiana also)
Audubon State Park
3100 US 41 North, P.O. Box 576
Henderson, KY 42420
1.270.826.4424
jaudubon@henderson.net
Check payable to:
Audubon State Park

MICHIGAN

Dr. Matthew Douglas
Grand Rapids Community College
Department of Biology
143 Bostwick NE
Grand Rapids, MI 49504
1.616.771.3893
mmrd2@ix.netcom.com

MINNESOTA

Karen Oberhauser
University of Minnesota
Department of Ecol, Evol & Behav
100 Ecology Bldg.
St. Paul, MN 55108
Check payable to:
U of M Monarch Fund

Dan Newbauer
Richardson Nature Center
8737 E. Bush Lake Rd.
Bloomington, MN 55438
1.612.941.7993
dnewbauer@hennepinparks.org
Checks payable to: Dan Newbauer

MISSISSIPPI

Joy Anderson
Horticulture Agent
DeSoto County
3260 Highway 51 S.
Hernando, MS 38632
1.601.429.1343
joya@ext.msstate.edu

NEW YORK

Chantal Speglevin
Rye Nature Center
873 Boston Post Road, P.O. Box 435
Rye, NY 10580
1.914.967.5150
nature@ci.rye.ny.us
Check payable to: Rye Nature Center

NORTH CAROLINA

Mike Dunn
NC Museum of Natural Science
P.O. Box 29555
Raleigh, NC 27626
1.919.733.7450 x 620
mikedunn@aol.com
Check payable to:
Museum Extension Fund

OHIO

Julie Clemens
2258 Lamberton Rd.
Cleveland, OH 44118
1.216.371.4373
jtclemens@ameritech.net
Check payable to: Julie Clemens

OKLAHOMA

Bob Melton
Putnam City Schools
5401 NW 40th
OK City, OK 73122-3398
1.405.495.5200 x 284
bmelton@putnamcityschools.org
Check payable to: OSTA

Lynn Michael
9843 E. 500 Rd.
Claremore, OK 74017-1361
1.918.341.0743

PENNSYLVANIA

Jerry Zeidler
2197 Southard Road
Trout Run, PA 17771
1.570.435.4506

TENNESSEE

Debbie Bruce
Wild Birds Unlimited
1787 N Germantown Parkway
Cordova, TN 38018
1.901.681.9837

TEXAS

Bill Calvert - Coordinator
Nancy C. Schneider - For Tag Orders
Texas Parks & Wildlife
Wildlife Diversity
3000 IH-35 South, Suite 100
Austin, TX 78704
1.512.912.7011
1.800.468.9719 - TX Monarch Hotline
nancy.schneider@tpwd.state.tx.us
Check payable to:
TX Parks & Wildlife HQ

WEST VIRGINIA

Terry Kerns
SWOOPE
Rt. 6, Box 211
Fairmont, WV 26554
1.304.363.0981
kanawha@aol.com
Check payable to: SWOOPE



CANADA

Nomad Scientists
Harold Spanier or Brian Visser
3285 Cavendish Blvd Ste 605
Montreal, Quebec H4B 2L9
nomade@cam.org
1.514.481.3456 (English & French)

PROMOTIONAL & EDUCATIONAL ITEMS

ITEMS AVAILABLE AS PREMIUMS

Monarch Watch is funded through contributions made by individuals and organizations interested in promoting science education in primary and secondary schools. For a contribution of \$25 (\$10 tax-deductible) we will send either a Rearing or Garden Kit to the student or school of your choice.

Rearing Kit #2 contains twelve 3-5 day-old Monarch larvae which must be transferred to milkweed plants to feed. Pupation will occur in 10-12 days and adults will emerge 10-14 days after pupation. These butterflies can be used for classroom instruction, student projects or to start a classroom breeding population. Instructions included. Please note: Rearing Kit #1 has been discontinued until further notice.



Our **Millennium Butterfly Garden Kit** contains 25 seed packets (~100 seeds each) of annuals and perennials which are known butterfly nectar plants and/or host plants for butterfly larvae. A 24-page gardening guide is included and also available separately. Pre-ordering is encouraged for kits to be delivered in time for spring planting.

MILLENNIUM BUTTERFLY GARDEN KIT



MONARCH WATCH

1.888.824.4464 • monarch@ukans.edu • www.MonarchWatch.org

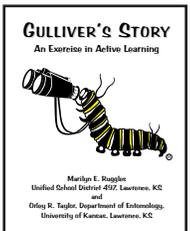


1999 Tagging/Membership Kit. This kit includes 24 self-adhesive tags with detailed instructions in a short PreMigration newsletter (sent in August) and a Season Summary newsletter (sent the following May). Additional 96-tag sheets are available to members.

ALL TAG ORDERS FOR THE 1999 SEASON MUST BE RECEIVED BEFORE 10 OCTOBER 1999.

Monarch Magic! Butterfly Activities & Nature Discoveries. More than 100 stunning full-color photos with easy to follow text let you experience the Monarch's complete life cycle and spectacular migration. Lots of fun activities and projects are also included! Ages 4-12, 96 pp.

The Butterfly King Video. The life history of the Monarch, as told by a caterpillar as he progresses from one life stage to the next. Bundled with this video is "Gulliver's Story" an active learning exercise for grades 2-4. 20 min.



The Monarch: A Butterfly Beyond Borders Video. This is the most up-to-date treatment of the dilemmas we face in trying to maintain Monarch populations and their spectacular migration in eastern North America. The footage obtained at the Monarch overwintering sites in Mexico is truly spectacular. Licensed for home use only. 47 min.

Migration T-shirt. This 100% cotton T-shirt is printed on both sides in black and brilliant Monarch orange with lots of migrating Monarchs! Adult sizes M, L, XL, and XXL.



PLEASE NOTE: WE DO NOT SHIP TAGS OR MONARCHS TO AREAS WEST OF THE ROCKY MOUNTAINS. ALSO, DUE TO HIGH SHIPPING COSTS AND THE NEED FOR PERMITS, MONARCH WATCH WILL NO LONGER BE ABLE TO SEND REARING KITS TO CANADA. HOWEVER, IF YOU CONTACT US, WE WILL BE GLAD TO DIRECT YOU TO SIMILAR PROGRAMS IN YOUR AREA. THANKS!

Adult Monarch Watch T-shirt. This 100% cotton T-shirt features Gulliver on the upper left chest and two large Monarch butterflies on the back. Adult sizes M, L, and XL.



Youth Monarch Watcher T-shirt. This 100% cotton T-shirt features Gulliver and "I'm a Monarch Watcher!" on the front and two large Monarch butterflies on the back. Sizes: Youth S and Adult S.



Monarch Watch Canvas Tote. This 15" x 22" canvas tote bag with zipper closure features Gulliver "watching" Monarchs and includes an inside zippered pocket.



Gulliver Pin. This 1" x 1" three-color gold pin features Gulliver, our "logopillar," and represents a dedication to the conservation of the Monarch and its migration.

Butterfly Nectar Mix. This mix includes everything you wouldn't normally find in your kitchen. Makes 1 liter of nectar and will not ferment.



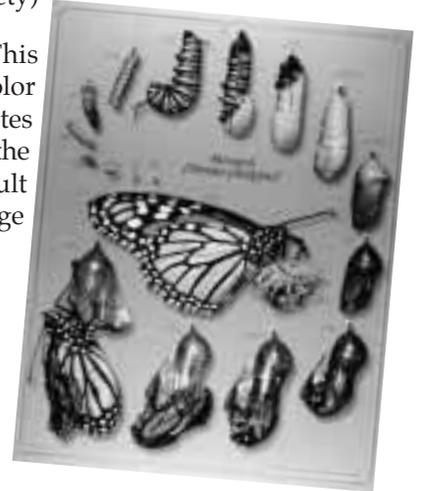
Remy Cloth Sleeve. Slip this 16" x 36" breathable sleeve over your milkweed plant to protect your Monarch larvae from parasites and predators outdoors.



Game of Monarch Life. Learn about the life cycle and migration of Monarch butterflies in this challenging board game. Large laminated game board, dice, playing pieces, challenge cards and instructions included. Ages 6-12.

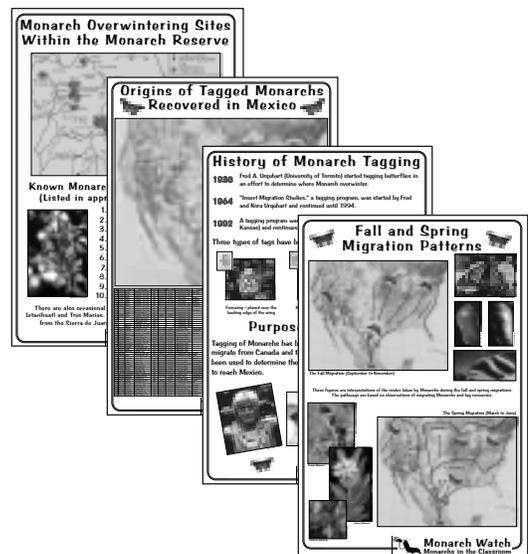
Milkweed Seeds. Individual packets of four varieties of milkweed: common, swamp, tropical and blue (sand) vine. An instruction sheet is included to get you started. (~100 seeds of each variety)

Life Cycle Poster. This beautiful 18" x 22" full-color laminated poster illustrates the transformation of the Monarch from egg to adult and the approximate age at each stage.



Season Summary Newsletter. This 50+ page newsletter is available in the spring following the tagging season and is included in the annual tagging membership listed above. It contains tag recovery data, tips and ideas for teachers and students, observations on Monarch populations, new information on Monarch biology and a whole lot more! Summaries from previous tagging seasons (1994-1998) are also available while supplies last.

Large-Format Educational Posters. We've developed four educational posters that depict various aspects of the Monarch Migration. These 24" x 36" full-color laminated posters are available in English, Spanish, and French - please see our Web site for previews and descriptions.





Collage created by Jim Lovett using photos provided by: Julie Clemens, Paul B. Southerland, O.R. Taylor, and Journey North.

HOW TO REACH MONARCH WATCH

WE'RE IN THE BUSINESS OF SHARING KNOWLEDGE, SO IT'S IMPORTANT THAT YOU KNOW HOW TO REACH US AND ACCESS INFORMATION. THERE ARE SEVERAL WAYS TO DO THIS:

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HAWORTH HALL • UNIVERSITY OF KANSAS • LAWRENCE, KS 66045**

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EMAIL: MONARCH@UKANS.EDU

ONLINE: WWW.MONARCHWATCH.ORG

**EMAIL DISCUSSION LIST: SEND THE MESSAGE "INFO DPLEX-L" TO LISTPROC@UKANS.EDU
FOR INFORMATION ON HOW TO JOIN.**



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