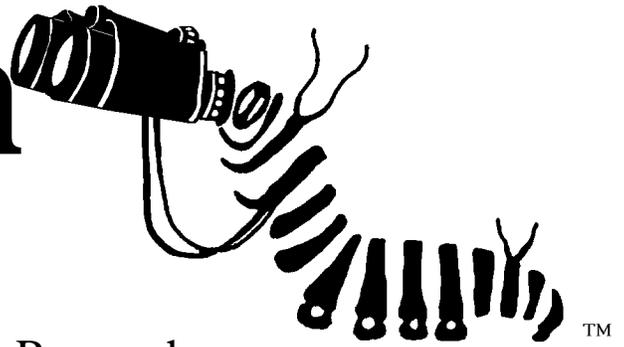


Monarch Watch



Dedicated to Education, Conservation and Research May 1997 • Vol. 5 • No. 1

1996 Season Summary

FALL MIGRATION (September - October 1996)

Best in 5 years? Best in 10 years? Best in 20 years? In a word, the fall migration was AWESOME!!! This was certainly the most spectacular migration in the five year history of Monarch Watch, and several long time Monarch observers suggested this was the best migration in 20 years. Why? We aren't sure, but more on this question later. (SEE "POPULATIONS" ON PAGE 4)

The fall migration was characterized by observations of amazing concentrations of Monarchs at both temporary roosts and in the air. On at least 4 occasions, advancing weather fronts "pushed" or "carried" uncountable numbers of Monarchs in southerly directions. (SEE "WEATHER" ON PAGE 9)

Wamego, KS is a hot spot for roosting Monarchs in the fall. This season so many Monarchs arrived late on the afternoon of 12 September that Terry Callender, a high school teacher who is locally known for promoting tagging by his students, received 30 calls that evening and the next day, informing him of Monarch roosts within and around the city. Subsequently, Terry and an army of his students tagged over 12,000 Monarchs!! (SEE "LIFETIME" ON PAGE 3)

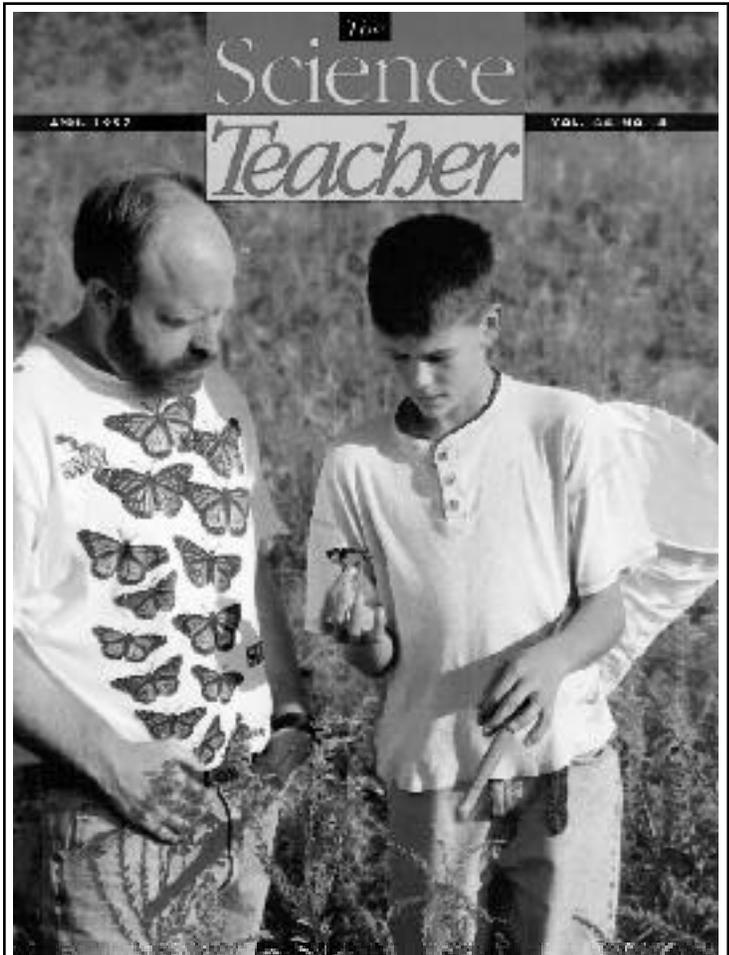
Tagging success was much higher this year and there were relatively few disappointed taggers compared with 1995. We sent out 1450 tagging kits and approximately 117,000 tags. A large proportion of the data sheets were returned and from these we estimated that over 49,000 Monarchs were tagged by Monarch Watch participants in 1996! This means that over 40% of the tags issued were actually applied to Monarchs. Wow! This took us by surprise. In 1995, we issued 80,000 tags and only 17,000 (21%) were used. Approximately 90,000 Monarchs have been tagged by Monarch Watch participants since we began this program in 1992 and more than half of these were tagged in 1996, which again emphasizes the massive size of the fall population last year.

And what are we learning from the tagging? Actually, we are learning a great deal about the migration. A complete listing of all recoveries for the 1996 tagging season may be found on the Monarch Watch web site and a summary of these data is included here. (SEE "RECOVERIES" ON PAGES 5-8)

IMPROVEMENTS AND NEW INITIATIVES

Membership in Monarch Watch continues to increase. We now have approximately 1500 members and supply Monarch educational materials to at least 700 additional schools and individuals. As we grow, we strive to improve the dissemination of our educational services.

(CONTINUED ON PAGE 3)



Where can I get a Monarch T-shirt like that?! (SEE ORDERFORM INSERT)
Photo by Curtis Blagburn. Reprinted with permission by National Teachers Association, *The Science Teacher*, April 1997.

Monarch Watch 1996 Season Summary

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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' 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).

We couldn't do it without you...

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 the lab!

Thank you to all the students at KU who so ably assist with the program, especially Jim Lovett and Kari Rogg.

A special thank you goes out to all of you who send us cards, letters, photographs, newspaper 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.

Finally, we wish to offer our apologies to all who had difficulties contacting us last fall. The scope of the migration and the large number of new taggers really took us by surprise and we were not fully prepared for the consequences. For several weeks we were inundated with 50-100 communications a day, and there were only a couple of us here to respond to everyone! We did our best, but we just couldn't keep up with it all.



This project was supported, in part,
by the

National Science Foundation

Opinions expressed are those of the authors
and not necessarily those of the Foundation

This publication is funded by tagging memberships, contributions to Monarch Watch and an NSF grant for curriculum development. This year's summary was authored and prepared by Orley R. Taylor (Department of Entomology, University of Kansas, Lawrence, KS 66045) with the assistance of two incredibly talented individuals - Jim Lovett and Kari Rogg. © 1997 Monarch Watch. All rights reserved.

Perhaps the greatest improvement this past year was made in the Monarch Watch List, Dplex-L. In September we reached a critical number of knowledgeable, geographically distributed subscribers to the list. The result was a vigorous and enthusiastic tracking of the fall migration. There were many fascinating reports of the migration. The overall quality of the reports and the positive attitudes and helpfulness of the subscribers made Dplex-L an exceptional list. And it continues to get better. See the back cover for information on how to subscribe to Dplex-L.

Jim Lovett, our webmaster, has been working for the last several months on a major revision of the Monarch Watch web site. (SEE PAGE 31) This revision should be completed in June. The new materials will be more user friendly, but more importantly the web site will be broader in content and richer in substance. The biggest and most useful improvement will be the incorporation of the curricular materials developed by Dr. Karen Oberhauser and the teachers she has worked with over the past several summers at the University of Minnesota. These materials are biologically accurate and have been extensively tested in many classrooms. Although the web site will provide access to these materials, many of you will want to have a desk copy for your classroom. These booklets can be obtained directly from Karen Oberhauser. (SEE BOX BELOW)

The new web site will also contain a section which emphasizes student - scientist collaborative projects (SEE "STUDENT" ON PAGE 16).

Monarch Guides

The curriculum guides include basic information on Monarch biology and incorporate activities and exercises appropriate for each grade level: K-2, 3-6, and 6-8. Each booklet (approximately 80 pages) is available for \$8.00* **NEW!** A Field Guide to Monarch Caterpillars is now available for \$7.00* All booklet orders should be sent to:

Dr. Karen Oberhauser
Dept. of Ecology, Evolution and Behavior
University of Minnesota
1987 Upper Buford Circle
St. Paul, MN 55108

*SHIPPING INCLUDED. NO PURCHASE ORDERS PLEASE.

These projects provide an opportunity for students to contribute data to projects designed to answer basic questions concerning the biology of Monarch butterflies.

What's next? A Monarch Watch CD-ROM with all the content of the web site and lots more! We have been working toward this goal for some time and we are getting closer. We will keep everyone posted throughout its development and let you know when it becomes available.

Our newest project might be called "Mexico outreach" or, as we prefer to call it, "El Convenio" (The Contract, SEE "EL CONVENIO" ON PAGE 32). The basic idea is to establish a contract between Monarch Watch and the leaders at the principal ejidos which

manage the most visited roost sites in Mexico. In exchange for cooperation by the ejido members for the retrieval of information on recovered tagged butterflies at the roost sites, Monarch Watch will provide the ejidos with resources which will benefit each community. We have established a special fund for contributions toward this effort. (SEE ORDERFORM INSERT)

Monarch Watch membership is growing but not without some growing pains due to limited staff to handle the volume of requests and some nip and tuck finances. As you can see from this summary, we are improving in our capacity to fulfill our mission and we are doing everything we can to keep costs down. Once again our membership fee for 1997 will be \$10. With this membership you will receive a tagging kit with instructions and a Season Summary which is sent the following May. We ship the tagging kits in August so please renew your membership as soon as possible. We have a very difficult time dealing with membership renewals which arrive after 20 August. Thanks for your support and cooperation!

Once in a Lifetime

Last fall's Monarch migration presented one group of students with an opportunity they may never see again. Incredible numbers of Monarchs arrived in Wamego, KS and stayed for more than 10 days, making it possible for Terry Callender and the students at Wamego High School to tag 12,397 Monarchs! To put this effort into perspective, we estimated that the total number of Monarchs tagged in 1995 was 17,000; and the previous record for number of Monarchs tagged by a student group was 1,995. Students collected thousands of Monarchs at roosts each evening and brought them to school the next morning to be stored in refrigerators until they could be tagged and released. The numbers of butterflies brought to school each day were so large that Terry asked the students to stop collecting them on the 5th or 6th day. According to Terry, if they had had more student power, more tags and more time they could have tagged thousands of additional Monarchs.

Wamego seems to be a special place, and large numbers of Monarchs settle there every year for a few days enroute through Kansas. However, the unusually large number that arrived this year and their persistence at roosts made this a special experience for the students, who realized that they may never see such concentrations of Monarchs again. With this in mind, they made a special effort to take advantage of this opportunity and they did an extraordinary job. Congratulations to you, Terry and to your students and many, many thanks for your contributions to Monarch Watch.

Monarch Populations 1996 - 1997

WINTER 1996-1997

It is always difficult to obtain reliable estimates of the numbers of Monarchs at the overwintering sites in Mexico, but all returning visitors to the roosts this winter agreed that the numbers of Monarchs appeared to be much higher than previous years. One estimate placed the number of wintering Monarchs at 160 million which is much higher than the estimates of 60-120 million arrived at by various experts over the last several years. However, no two experts agree on the numbers each year and there doesn't appear to be a universally accepted way of estimating the size of these overwintering populations.

Dr. Karen Oberhauser and her research team visited the roosts again this winter and Karen has provided a detailed report of the experience. (SEE "SOJOURN" ON PAGE 12)

SPRING 1997: OFF TO A GREAT START!!!

Observations of the spring migration are usually scattered and rather unexciting. Relatively few Monarchs are seen by most observers and the numbers of eggs and larvae reported from most locations are usually few. Not so this year! The numbers of adult Monarchs reported from TX, AR, GA, MD, OH and points in between have been astonishing and the numbers of eggs and larvae are unusually high. In many locations the leading edge of the northern migrants seem to be ahead of the milkweeds and there have been many observations of multiple ovipositions on single plants. This is certainly a great start to the season but is it too good? Some experts are worried that this is an ominous sign, that perhaps the Monarchs have left the roosts too early, that they will exhaust their food supply and so on. Perhaps there is reason for concern, but we are skeptical. Every population has its ups and downs and nature has a way of dealing with them.

Unusual spring observations

There were many unusual Monarch sightings this spring. In some areas (MA, NJ, PA, IN, VA) Monarchs appeared earlier than usual and in other regions (TX, OK, KS) they were "on time". The following reports emphasize the large numbers of migrants seen in this spring's migration.

29 March, Jim Edson, Monticello, AR - Monarchs were seen in several locations near Monticello - "all moving from west to east. Near the town of McGehee, wild plum trees were in bloom and dozens of Monarchs were in each tree. When I got home, a teacher in Dumas (a town about thirty miles northeast) said a crabapple tree in bloom in a friend's yard was covered with Monarchs. She estimated a hundred or more."

16 April, James Adams, Dalton GA- "First of all, the Monarchs were extremely early; secondly, they were in numbers like I have never seen in the spring; and thirdly, there were instances, even on cloudy days, where I saw Monarchs get up in the wind and travel like they do in the fall - directed flight (in this case

SW to NE) some 100 feet off the ground."

1-3 May, Denise Gibbs, Gaithersburg, MD - "hundreds of Monarchs seen in 1-acre milkweed meadow on my property; many ovipositing multiple eggs on single 2" high milkweed shoots. Milkweeds being used for oviposition are: *Asclepias syriaca*, *A. incarnata*, and *A. tuberosa*. Most, but not all, Monarchs appear faded in color but wings do not appear to be tattered. No tags were seen. This is the largest number of Monarchs I have ever seen in one place during the northward migration. We had winds from the south for 2 days - may have contributed to the large numbers."

Overwintering males - how far north do they go?

Very few Monarchs are collected and examined in the spring; therefore, we don't have a good answer for this question. However, observations of mating pairs give us a partial answer. This spring, mating pairs were reported from: Myrtle Beach, SC (13-17 April, Jim Ellis); Oklahoma Prairie, north of Oklahoma City, OK (19-20 April, Bob Melton); Williams Hill, Pope County, IL (20 April, Judy K. De Neal). In each case, the Monarchs were described as faded and worn in appearance, suggesting that these were Monarchs that had overwintered in Mexico.

Why were there so many Monarchs last fall?

Truthfully, we don't know and we don't have a good clue. We do know that the spring of '96 started off poorly. We didn't see our first Monarch in Lawrence, KS until 16 May and Lincoln Brower said that the number of Monarchs found in his early summer survey in Door County, WI was the poorest he had ever seen. The mid-summer reports were so-so and there was nothing in the 4th of July counts to suggest that a big fall migration was imminent. Even the reports from early August, although promising, did not give a portent of things to come. We missed it. What happened? We can only surmise that the reproductive success in late July and early August (of the adults that give rise to the fall migrants) was spectacularly successful. Was this due to favorable weather, the amount of milkweed in the north or other factors? We aren't sure, but it is clear that we need a better method of tracking the mid- and late-summer Monarch populations. Karen Oberhauser has designed a program to census milkweed patches for eggs and larvae. (SEE "LARVAL MONITORING" ON PAGE 16) This is a pilot program, but hopefully this approach will provide better predictions of fall populations in the future.

Monarch Watch Tag Recoveries

This is a summary of recovered Monarchs tagged in 1996, listed by distance travelled. Due to space limitations, only Monarchs that travelled at least 1 mile are included here. Recovery maps for the U.S. and Mexico appear on page 8.

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!**

1996 Monarch Watch Tagging Summary

Number of tagging kits sent out1450
Number of tags distributed117,200
Estimated number of Monarchs tagged (based on returned data sheets)49,600
Most Monarchs tagged by one group or individual, fall 199612,397
 (Terry Callender and students of Wamego High School (KS)...WOW!!!)
Number of recovered tags177
 (Recovered in Mexico: 10)

Tag No.	Mon Sex	Tagger	Where Tagged	Date Tagged	Date Recovered	Where Recovered	Observed or Reported by	Interval	Est. Distance
IV 301	M	Linnea Evans/Kevin Young Kenyon-Wanamingo M. S.	Wanamingo, MN	9/4/96	3/4/97	Sierra Chincua, Mexico	Lincoln Brower	6 mo	1760 m
MC 648	M	Gary Cadogan	Mt. Carroll, IL	9/30/96	Feb. 97	El Rosario, Mexico	Don Davis/ Leonard Hooton	5 mo	1660 m
EB 370	F	Aaron Wurtz/T. Callender Wamego High School	Wamego, KS	9/18/96	Feb. 97	El Rosario, Mexico	David Marriott	5 mo	1375 m
MK 276	F	Billy Dreball/T. Callender Wamego High School	Wamego, KS	9/14/96	Feb. 97	La Herrada, Mexico	David Marriott	5 mo	1375 m
KN 176	F	Melissa Brooks/T. Callender Wamego High School	Wamego, KS	9/12/96	3/10/97	El Rosario, Mexico	Amma Szal	6 mo	1375 m
JS 252	F	Paul Sheets/Randy Warner Frontier Trail Jr. High	Olathe, KS	9/24/96	Mar. 97	Sierra Chincua, Mexico	Bill Calvert	5 mo	1370 m
BP144*	F	F. Northam/Donna Cooper Hays High School	Hays, KS	9/18/95	Feb. 96	El Rosario, Mexico	David Marriott	5 mo	1340 m
DY663***	F	Mary Moreira Windom Open School	Minneapolis, MN	9/16/96	10/23/96	Mathis, TX	Mr. & Mrs Wayne Hollar	37 d	1191 m
JA714	F	Darrell Anderson	Claremore, OK	9/30/96	Mar. 97	El Rosario, Mexico	Len Wassenaar	6 mo	1190 m
DJ 274***	M	Janice Catledge Alice Harte Elementary	New Orleans, LA	10/2/96	Feb. 97	El Rosario, Mexico	David Marriott	5 mo	950 m
JZ 511	F	Marcia Whitmore C.R. Hanna Elem. (5th)	Orion, IL	9/9/96	10/12/96	Abilene, TX	Joel Lambert	33 d	802 m
EY996	?	Gary Cadogan	Clinton, IA	10/12/96	11/5/96	Coward, SC	Ralph Matthews	24 d	786 m
HW 535	M	Dan Dickinson	Kansas City, MO	10/14/96	11/10/96	Dauphin Island, AL	Giff Beaton	27 d	712 m
ES 735	M	Karyl McLean	Fredonia, NY	10/1/96	10/20/96	Folly Beach, SC	John McCord	19 d	676 m
HW 521	M	Dan Dickinson	Lenexa, KS	10/12/96	11/4/96**	Houston, TX	Barb Hill	23 d	634 m
EB 274	M	Casey Frisbie/T. Callender Wamego High School	Wamego, KS	9/17/96	10/20/96	Cranfills Gap, TX	Robert Rodstrom	33 d	519 m
EP597	M	Kelli Culbertson/T. Callender Wamego High School	Louisville, KS	9/21/96	10/8/96	DeLeon, TX	Casey Jones	17 d	508 m
DS 491	F	Harry Gregory	Hutchinson, KS	9/21/96	10/13/96	Ballinger, TX	Colleen Darnell	22 d	451 m
IV 489	F	Kevin Young	Wanamingo, MN	9/5/96	9/12/96	Versailles, MO	Chris Gerlt	7 d	405 m
HB 709	F	5th & 6th Graders Cordley Elementary School	Lawrence, KS	9/30/96	10/10/96	Pilot Point, TX	David Hausman	10 d	396 m

More Tag Recoveries!

Tag No.	Mon Sex	Tagger	Where Tagged	Date Tagged	Date Recovered	Where Recovered	Observed or Reported by	Interval	Est. Distance
DO 599***	F	Dixie Quincy Iola Middle School	Iola, KS	10/2/96	10/27/96	Tyler, TX	Bobbie Harris	25 d	384 m
DT 298	M	Jennifer M. King	Wise Point, VA	10/5/96	10/21/96	Crisfield, MD	Michael and Tempie Bonaparte	16 d	376 m
MC 551	M	Gary Cadogan	Clinton, IA	9/20/96	10/5/96	Louisville, KY	Beth Miozza	15 d	341 m
JN 817	M	Jim Youll/Donna Cooper Hays High School	Hays, KS	9/11/96	9/29/96	Comanche, OK	Dorothy Thomas	18 d	320 m
IZ 280	M	John & Sandra Charlton	Point Petre, Ontario, Canada	10/7/96	10/16/96	Hamilton Township, NJ	David P. Moskowitz	9 d	298 m
KH 568	M	Scott Martin Putnam City High School	Oklahoma City, OK	9/25/96	12/12/96**	Novice, TX	Pam and Billy Kincaid	78 d	269 m
HI 001	F	Kami Kabril/T. Callender Wamego High School	Louisville, KS	9/18/96	10/4/96	Oklahoma City, OK	Neil Garrison	16 d	269 m
JV 294	M	Beverly Moritmer, Delphos Attendance Center	Delphos, KS	9/18/96	10/2/96	Collinsville, OK	Minnie Beck	14 d	227 m
DA772***	M	Maggie Desch U-32 High School	East Montpelier, VT	9/18/96	9/22/96	Charlestown, RI	Susan Carpenter	4 d	204 m
EW 680	M	Tag issued to: Justin Wood Southwest Jr. High	Lawrence, KS	9/2/96	9/28/96	Chouteau, OK	Emanuel M. Yoder	?	192 m
DS 300	F	Harry Gregory	Hutchinson, KS	9/20/96	9/25/96	Weatherford, OK	Alex Schaack	5 d	180 m
KE 313***	M	Daniel Breidenstein	Geneseo, IL	9/23/96	10/1/96**	Arthur, IL	Cory Kauffman	8 d	149 m
IT 900	M	Craig Underwood	Borodino, NY	9/29/96	10/7/96	Portland, PA	B.J.B.	8 d	148 m
JE 907	M	Karol Gregory	Derby, KS	10/2/96	10/15/96**	Oklahoma City, OK	Brian Birchell	13 d	144 m
CT 029	F	Annie McIntyre	Merrick, NY	9/26/96	10/2/96	Cape May Point, NJ	Gayle Steffy	6 d	138 m
IW 703	M	Terry Kerns	7 mi from Fairmont, WV	8/24/96	8/31/96	Marmet, WV	Shirley J. Halstead	7 d	115 m
JJ 826	M	Michele Harrold	Charles City, IA	9/10/96	9/7/96**	New Sharon, IA	Andy Pickering	2 d	110 m
KM 517	F	Stephanie Reinert/John Wachholz Salina Central High School	Salina, KS	9/13/96	9/21/96	Topeka, KS	Sue Mollenkamp	8 d	105 m
ES 356	M	Shane Neel/T. Callender Wamego High School	Wamego, KS	9/22/96	10/1/96**	Hillsdale, KS	Jeff, Nancy and Sarah Brower	9 d	87 m
JA853***	M	Suki Easter	Durham, NH	10/16/96	10/19/96	Quabbin Reservoir, MA	Sharon Shea	3 d	85 m
EC 748	M	Megan McDowell/T. Callender Wamego High School	Wamego, KS	9/13/96	9/22/96	Baker Wetlands, Lawrence, KS	John Fayman	9 d	60 m
KN 625	M	Cal Cink Biol. Dept., Baker Univ.	Baker Wetlands, Lawrence, KS	9/15/96	9/16/96	Wamego, KS	Chad Divine	1 d	60 m
CX 069	F	Marti Adair/McDairbert Class Travis Heights Elem.	Austin, TX	10/29/96	11/19/96	Bluffton, TX	Mrs. Grace G. Onstott	21 d	59 m
EO 157	M	John McCord	Folly Beach, SC	10/14/96	10/26/96	Hilton Head Island, SC	Sandy Garrett	12 d	56 m
DT 926	M	Brian Filbey	Windsor, Ontario	10/5/96	10/18/96**	Curtice, OH	Karen A. Montey	13 d	50 m
MI 832	F	Lee Petersen	Rockford, MI	9/19/96	9/24/96	Saugatuck, MI	Dawn L. Stafford	5 d	46 m
JA535	F	Larry J. Brindza	Snickers Gap, VA	9/20/96	9/25/96	Luray, VA	Robert F. McCarty	5 d	42 m
IS 260	M	Emily Shirey & Kris Gesner	Lewisburg, WV	9/19/96	10/1/96	Salem, VA	David L. Hutchinson	12 d	41 m

Still More Tag Recoveries!

Tag No.	Mon Sex	Tagger	Where Tagged	Date Tagged	Date Recovered	Where Recovered	Observed or Reported by	Interval	Est. Distance
JJ 799	F	Michele Harrold	Charles City, IA	9/7/96	9/10/96	Cedar Falls, IA	Nichole Thalman	3 d	39 m
KB 495	M	Bob Adams Texas Christian Academy	Addison, TX	10/10/96	10/11/96**	Fort Worth, TX	Kathleen Woods	1 d	33 m
JK 078	M	Darrell Terbush	Valley Center, KS	9/16/96	9/25/96**	Mulvane, KS	Kristine & Jacob Little	9 d	26 m
JM 123	M	Tony Blackwell	Fredonia, KS	9/19/96	9/19/96	Independence, KS	Dianna Graves	0 d	22 m
EH 973	F	Brian Molone/T. Callender Wamego High School	Paxico, KS	9/15/96	9/19/96	Wamego, KS	Melissa Robbins	4 d	12 m
ET 899	M	Brad Williamson Olathe East High School	Olathe, KS	9/25/96	9/27/96	Overland Park, KS	Gabriel Price	2 d	11 m
CV 690	M	Caroline Werth Sedgwick Elementary	Sedgwick, ME	9/27/96	10/1/96	Stonington, ME	Sandra Weed	4 d	10 m
CX 824***	M	Ann Marie Colton	Prt Washington, NY	8/24/96	9/10/96	W. Hempstead, NY	Bill Belford	17 d	9 m
EB 011	M	Lee Fabel Webster Open School	Minneapolis, MN	10/16/96	10/22/96	Minneapolis, MN	Christine Oss	6 d	7 m
KZ 000	M	Carolyn Womack	Hurst, TX	10/25/96	11/4/96**	Arlington, TX	Julie Ann Harvey	10 d	7 m
HD 051 HD 347 HD 446 HC 048	M F F M	Jeni Flear/T. Callender Wamego High School	Belvue, KS	9/26/96	10/1/96**	Wamego, KS	Jordan Palmateer	5 d	7 m
CT 674***	M	Dr. Thomas J. Riley Dept. of Entomology, LSU	Baton Rouge, LA	10/8/96	10/9/96	5 mi SE of Baton Rouge	Joe Parker	1 d	5 m
DW 078	M	Molly Ashcraft	St. Paul, MN	9/25/96	9/27/96	St. Paul, MN	Nate Michelson	2 d	3 m
DV 579	F	Virginia Malone	3 mi. E of Hondo, TX	11/3/96	11/11/96	Hondo, TX	Carla & Wesley Blackwell	8 d	3 m
KN 107	M	Bradon Campbell/T. Callender Wamego High School	Louisville, KS	9/12/96	9/13/96	Wamego, KS	Dale Davies	1 d	3 m
EH 419	F	Sarah Pittenger/T. Callender Wamego High School	Louisville, KS	9/20/96	9/20/96	Wamego, KS	Sarah Watt	0 d	3 m
DV 651	F	Marsha Collins 3rd Grade West Elementary	Wamego, KS	9/16/96	9/17/96	Louisville, KS	Kami Kabil	1 d	3 m
DV 660	M	Marsha Collins 3rd Grade West Elementary	Wamego, KS	9/16/96	9/17/96	Louisville, KS	Kami Kabil	1 d	3 m
KO 685	M	Marsha Collins 3rd Grade West Elementary	Wamego, KS	9/16/96	9/18/96	Louisville, KS	Kami Kabil	2 d	3 m
HY 802	?	Vicki Allred Putnam City North H.S.	Oklahoma City, OK	9/30/96	10/1/96	Oklahoma City, OK	Tom Bailey	1 d	2 m
DP 521	M	Walter Knapp	Topeka, KS	10/12/96	10/13/96**	Topeka, KS	Nancy Mote	1 d	2 m
DX 480	F	Cecelia Peterson Nettleton Magnet School	Duluth, MN	10/12/96	10/12/96	Duluth, MN	Nick Meiers	0 d	1 m
CT 641	M	Chip Clint	Dallas, TX	9/24/96	9/24/96	Dallas, TX	Karen A. Upton	0 d	1 m
015 MH*	?	Sylvestre Sorola	?	?	Feb. 96	El Rosario, Mexico	David Marriott	?	?

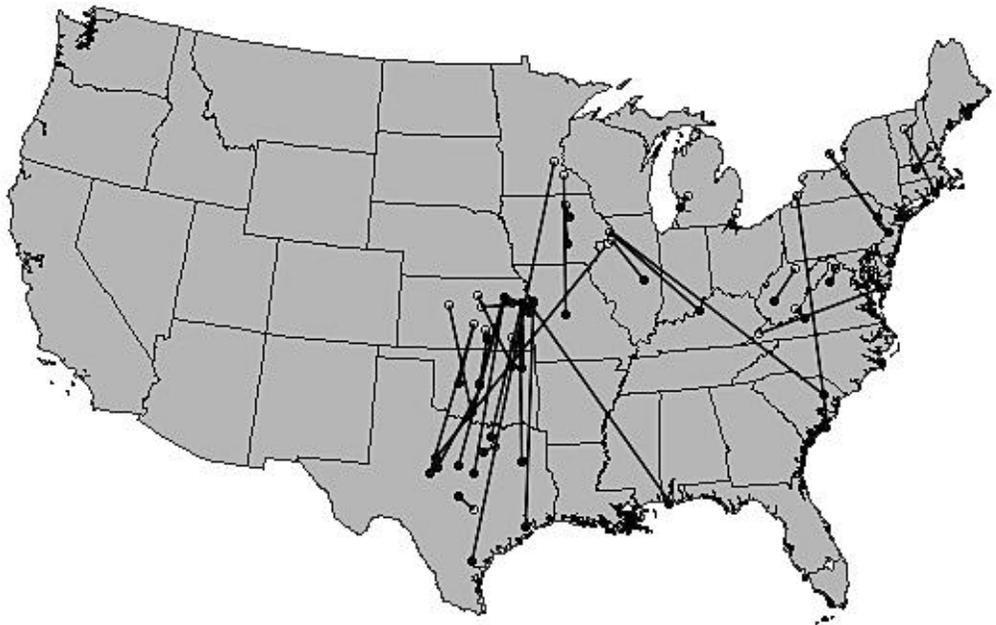
* 1995 season recoveries; reports of these recoveries were received after publication of the 1995 Season Summary

** approximate dates

***Monarchs reared indoors (SEE "DOTHEYMIGRATE" ON PAGE 19)

Monarch Recovery Maps

1996 Monarch Recoveries in the United States



Open circles = tagging sites
Closed circles = recovery sites

Note the two Monarchs that originated in the midwest and were recovered in the southeast.
(SEE "WAYWARD MONARCHS" ON PAGE 9)

Tagging Sites of Monarchs Recovered in Mexico

This map represents all published records from the Insect Migration Program (1964 -1994) and Monarch Watch (1992-1996) of Monarchs (N=79) tagged in the United States and Canada which have been recovered at the roost sites in Mexico.

Note the lack of recoveries of Monarchs tagged in the southeast.
(SEE "WHY TAGMONARCHS" ON PAGE 24)



Monarchs and Weather Fronts in 1996

The following are reports of large concentrated numbers of Monarchs moving on advancing cold fronts. Such observations have been reported before but it is not clear how often they occur nor how important they are to the advance of the migrants in a southerly direction. If the Monarchs stay on these fronts, the wind conditions could carry the butterflies southward at a very rapid rate. We are looking for a way to obtain more systematic observations of how Monarchs move on these fronts, for which we need a wide ranging group of spotters and radar reports.

Movement on a Weak Front

Chaska, Minnesota, 7 September, 5:45pm

Christopher Marshall witnessed a massive aggregation of migrating Monarchs flying south, travelling at elevations ranging from 3 feet to "as far as the eye could see up against an overcast sky," and spanning "as far as the eye could see west to east." The Monarchs appeared to be spaced at 1-2 feet, taking about 10-15 minutes to pass over. The location of the observation, the numbers reported, and the time of day made this an unusual event. Such concentrations are not usually reported from northern areas, although they are not uncommon in Texas and Mexico. Weather data obtained by Christopher Marshall from the nearest recording weather station indicates that this observation was preceded by or coincident with the passage of a weak cold front.

Movements on Strong Fronts

Point Pelee National Park, Ontario, Canada

17 September, morning

Propelled by a strong northeast wind, a "wall" of Monarchs struck out across Lake Erie. Timed counts of these Monarchs yielded conservative estimates of 4000+ Monarchs passing every minute, continuing at the same rate for 90 minutes. A final estimate by Tom Hince, Chief Naturalist at the park, indicated 350,000 Monarchs took part in the exodus from the tip of Point Pelee.

Lawrence, Kansas, 23 September, 4:17pm

Preceded by an afternoon of unusually still conditions, a front came through the area with sustained north winds, bringing hundreds of high flying Monarchs where before there had been almost none. This pulse of butterflies passed quickly, in just over 5 minutes. Sandra Perez measured vanishing bearings of these butterflies ranging between 160° and 210°.

Olathe, Kansas (25 miles east of Lawrence)

23 September, 4:50pm - 5:25pm

Brad Williamson witnessed a large wave of Monarchs riding the cold front's northerly winds. Scanning the sky with binoculars, no drop off in numbers of Monarchs was visible to the east or west. Timed counts of Monarchs during this event produced an estimate of between 35,000 and 70,000 butterflies within sight.

Hawley, Texas, 17 October, 8:00am

Susan Throckmorton observed "a long cloud, very dark at the bottom. Ahead of the cloud were swirling Monarchs by the thousands as high as the eye could see upward and in either direc-

tion." Susan reported that large numbers of Monarchs had been visiting her flower garden and roosting nearby preceding this event, but that few were seen immediately after the front passed through.

Wayward Monarchs

Most fall recaptures of Monarchs indicate that they are moving in a S-SW direction, directly toward the roosts in Mexico. The exceptions to this rule usually occur in the eastern states, where we have observed a pattern of Monarchs making short-distance movements to the SE. However, this year there were two Monarchs from the midwest that made long-distance (over 700 mile) movements in a distinct SE direction:

EY 996, tagged by Gary Cadogan in Clinton, IA - and -

HW 535, tagged by Dan Dickinson in Kansas City, MO (SEE PHOTO ON PAGE 20; WHAT'S UNUSUAL ABOUT THIS PHOTO?? - ANSWER ON PAGE 31)

In 40 years of tagging Monarchs, similar movements have been observed only a couple of times, with shorter distances and a more southern direction. How did these two Monarchs get so far off track? These wayward Monarchs were tagged within two days of each other, and we suspected this was not a coincidence. An examination of weather maps* obtained online from Purdue University indicated that two major fronts moved across the United States in the days following the butterflies' releases. The winds behind both fronts were generally from the W-NW as these fronts crossed the eastern half of the United States. We speculate that the butterflies were blown off course by a solid week of winds blowing to the east. This brings attention to the fact that Monarchs need to be "smart" fliers because they are not particularly strong fliers. They must be aware of the wind conditions and take advantage of the best conditions for southward flight; otherwise, they may be blown far off course.

*You can download these maps for yourself from Purdue University's Weather Processor Image and Map Archive at: <http://wxp.atms.purdue.edu/archive/index.html>

Monarch World Records

These world 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 (1992-1996). If we have erred or overlooked an important record, please let us know.

Longest known flight: 2880 miles

Tagged by Don Davis near Brighton, Ontario, on September 10, 1988, (from Urquhart's tagging program) and recaptured on April 8, 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 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: 5

Terry Callender and Wamego High students had 1 Mexico recovery in 1993, 1 in 1994, and 3 in 1996

Most western origin for a Monarch recovered in Mexico: Sharon Springs, KS (longitude 101:45:06W)

Tagged by Erin Townsend on September 25, 1995

Most eastern origin for a Monarch recovered in Mexico:

Keene, NY (longitude 73:47:33W)

Tagged by Mark Gretch on September 19, 1995

Most northern origin for a Monarch recovered in Mexico:

Braham, MN (latitude 45:43:22N)

Tagged by James Brazil in 1989 (from Urquhart's tagging program)

Most southern origin for a Monarch recovered in Mexico:

Eagle Pass, TX (latitude 28:42:32N)

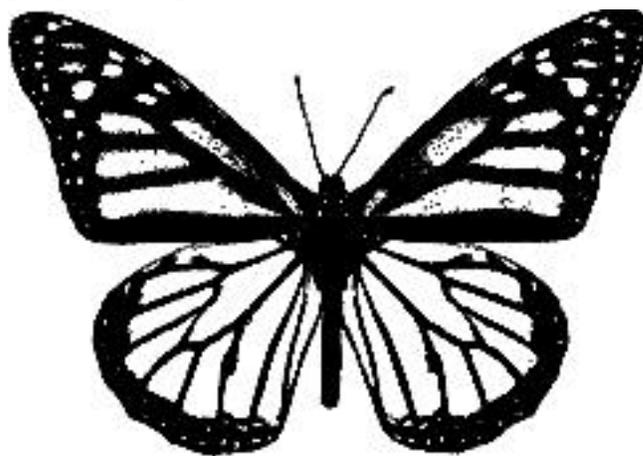
Tagged by an associate from Urquhart's tagging program in 1971

Most northern origin for a recovered Monarch: Millburn, Newfoundiana

Tagged by an associate from Urquhart's tagging program in 1972, recovered in Fairhope, AL

Most unusual recovery site: Havana, Cuba

Tagged by an associate from Urquhart's tagging program in 1969



How long does it take Monarchs to complete their life cycle?

In general, at near room temperature, Monarchs spend about 3 days as an egg, about 15 days as a larva, and about 12 days as a pupa. However, the rate of the development of Monarchs in all life stages depends on temperature. As the temperature increases, the rate of development increases in a linear relationship. The minimum temperature for development ranges from about 10-14°C (50-57°F); at temperatures above 33°C (91°F), development is retarded.

(Zalucki, M.P. 1982. Temperature and rate of development in *Danaus plexippus* L. and *D. chrysippus* L. (Lepidoptera: Nymphalidae). J. Aust. Ent. Soc. 21: 241-246)



Drawings taken from Monarch Watch Curriculum guides (SEE PAGE 3 FOR MORE INFORMATION)

New Monarch Research

Monarchs Use a Sun Compass

One of the great Monarch mysteries is how do inexperienced Monarchs from Colorado to New England and the Canadian provinces all find the same traditional roosts in Mexico each year? What environmental information is used by Monarchs to guide their migratory flights? Do they use the sun as a compass, are they guided by the earth's magnetic field, do they follow structural features of the landscape such as rivers and mountains, or do they use a combination of these, or perhaps some undiscovered method? To begin to find the answer to this question, we conducted an experiment last fall in which we determined that the position of the sun is one cue that Monarchs use to navigate.

Many animals are able to use the sun to orient their migratory movements, but their interpretation of the sun's position depends on their knowledge of the time of day. In other words, if an animal's internal clock says that it is morning, it will interpret the position of the sun to be in the east, regardless of the sun's actual position. Experimenters have demonstrated sun compass use by controlling the timing of lights to shift the internal clocks of subjects. This change in internal clocks causes the animals to misinterpret the position of the sun and change their direction of movement in a predictable way.

To determine whether Monarchs use a sun compass to orient their migratory flight, we collected migrating Monarchs during

September 1996 and maintained them in the laboratory for 9-15 days under a light-dark cycle six hours later than natural lighting conditions. We then released Monarchs individually in an open field and watched each Monarch for 1-5 minutes, running behind to estimate its body orientation. Clock-shifted Monarchs were compared to Monarchs which were held in the lab but not time-shifted, and to naturally migrating Monarchs.

Both of the control groups flew in the predicted SSW direction. However, the clock-shifted butterflies flew toward the WNW. Even though it was 3:00pm, the clock-shifted butterflies "thought" it was 9:00am, and flew in a direction to the west of the sun's position. This study demonstrates that Monarch butterflies in North America use sun compass orientation during their fall migration, identifying for the first time a major orientation mechanism for Monarchs. That Monarchs can still manage to orient toward the SSW on overcast days suggests that they also have alternative ways of orienting in the correct direction.

The citation for this study is:

Perez, S., O. R. Taylor and R. Jander. 1997. A Sun compass in monarch butterflies. *Nature*. Vol 387, No 6628, p. 29.

Selected Recent Publications on the Biology of Monarch Butterflies

Anderson, J. B., Brower, L. P. 1996. Freeze-protection of overwintering monarch butterflies in Mexico: Critical role of the forest as a blanket and an umbrella. *Ecological Entomology* 21:107-116

Brower, L. P. 1996. Monarch butterfly orientation: missing pieces of a magnificent puzzle. *J. Exp. Biol.* 199:93-103

Calvert, W. H. 1996. Fire ant predation on monarch larvae (Nymphalidae: Danainae) in a central Texas prairie. *J. Lep. Soc.* 50:149-151

Leong, K. L. H., Yoshimura, M. A., Williams, H. 1997. Instar susceptibility of the monarch butterfly (*Danaus plexippus*) to the neogregarine parasite, *Ophryocystis elektroscirrha*. *Journal of Invertebrate Pathology* 69:79

Oberhauser, K. S. 1996. Fecundity, lifespan and egg mass in butterflies: Effects of male-derived nutrients and female size. In review.

Oberhauser, K. S., Cansler, D., Feitl, A. 1996. Genetics of a "zebra" pigment mutation in the larvae of *Danaus plexippus* L. (Nymphalidae: Danainae). *J. Lep. Soc.* 50:237-244

Oberhauser, K. S., Hampton, R., Jenson, B., Weisberg, S. 1996. Variation in sperm precedence patterns in monarch butterflies (*Danaus plexippus*): Effects of male size, mating history, and time. In review.

Troyer, H. L., Burks, C. S., Lee, R. E. 1996. Phenology of cold-hardiness in reproductive and migrant monarch butterflies (*Danaus plexippus*) in southwest Ohio. *Journal of Insect Physiology* 42:633-642

Walton, R. K., Brower, L. P. 1996. Monitoring the Fall Migration of the Monarch Butterfly *Danaus plexippus* L. (Nymphalidae: Danainae) in Eastern North America: 1991-1994. *J. Lep. Soc.* 50:1-20

Sojourn in Mexico

A report from Dr. Karen Oberhauser, University of Minnesota
Department of Ecology, Evolution, and Behavior

Last week two U.S. research teams returned from a ten-day sojourn (February 26 - March 7) to the Monarch overwintering colonies in Mexico, where we renewed our sense that the migration of the eastern North American population of Monarch butterflies is the most amazing biological phenomenon in the world. Our trip was full of incredible biology, wonderful people, good weather, hard work, and a conviction that it will take many years to fully understand everything we observed. Sonia Altizer, Liz Goehring, Kari Guertz, Dr. Karen Oberhauser and Michelle Prysby from the University of Minnesota worked on population monitoring, disease incidence, and reproductive biology. Dr. Lincoln Brower from the University of Florida and Sweet Briar College and Christopher O'Neal from the University of Michigan worked on the availability and importance of nectar sources in the colonies. We were joined by Eduardo Rendon Salinas and Eneida Montesinos Patino from the University of Mexico, and Monica Missrie, an interpreter from Mexico City. We also spent a day with long-time Monarch researcher, Dr. William Calvert.

destruction in other sites, which could force the Monarchs to less disturbed locations. The increased numbers could also be due to a strong 1996 summer reproduction period and fall migration, and a relatively easy winter. Eneida visited several other sites in conjunction with her studies of the genetics of eastern Monarchs, and her impression was that Monarch numbers at these sites were also high compared to other years.

We have not begun a complete analysis of the data we collected in Mexico, but our initial observations are interesting. We collected data on the wing condition, size and sex ratio of butterflies that were roosting (in inactive clusters on the trees), flying, and mating every day. While we have not made a formal comparison with the condition of butterflies from last year, our impression is that the butterflies are in better condition this year. Almost every sample we collected was female-biased, with sex ratios from 60 to 70% female. This is very different from the Monarch colonies in California, where the sex ratios are extremely male-biased at the end of the season. Only a small percentage of females had mated (we can tell this by gently palpating the abdomen). This also contrasts with California, where most females have mated at the same time relative to their departure from the colonies.

As was true last year, very few of the Monarchs overwintering in Mexico this year were infected with the protozoan parasite (*Ophryocystis electroscirrha*) that infects most of the western Monarch population and is a problem for many people who rear Monarchs. Sonia's dissertation work focuses on testing several hypotheses for the large differences in infection levels of different populations, and determining how the parasite is transmitted from one individual to another. This work is very relevant to recent arguments about transporting Monarchs between populations. We used the scotch tape sampling method that she developed early in her work to determine whether over 2000 butterflies are infected with this parasite! This method causes no damage to the butterflies, and is now being used by researchers throughout the U.S.



Dr. Karen Oberhauser, a leader in Monarch biology research and curriculum development

We worked at the Sierra Chincua reserve, just east of Angangueo, Michoacan. There were three distinct Monarch colonies on the mountain. For reasons still not completely understood, the Monarchs move to lower altitudes over the course of the winter; they were first located near the top (at an elevation of 3300

m), but the three sites that were occupied during our visit are now further down the southern slope of the mountain. While we were there, we actually got to see one of the colonies move further downhill, an amazing experience! We worked in a site called Arroyo Barranca Honda (elevation 2900 m), which is only open to researchers, although another Chincua site is open to the public for the first time this year.

This was the second visit to the sites for the Minnesota team and Chris, and the 20th (!) for Lincoln. We all had the impression that there were more Monarchs at Chincua than in past years, although the cause for this increase is uncertain. It is possible that more Monarchs overwintered at Chincua because of habitat

Lincoln and Chris are studying the importance of nectaring to overwintering Monarch survival. They measured the amount of nectar available in flowers, determined the duration and amount of foraging at different flower species, and the amount of nectar in Monarch crops (their crops are similar to our stomachs). While a complete understanding of the importance of different energy sources to the Monarchs awaits detailed data analysis, it seems likely that most overwintering butterflies are not dependent on nectar for survival, but instead subsist primarily on stored lipid reserves. This is important, because some people have suggested that cutting trees to promote flower growth might help the butterflies. All of us are very concerned about

logging in the reserves, and feel that arguments for promoting understory nectar plant growth by cutting overstory trees are largely without basis.

We collected behavioral data on mating attempts for hundreds of



**Monarch eggs on *Asclepias glaucescens*, a milkweed species which occurs near the roosts in Mexico.
Photo supplied by Adrian M. Wenner.**

pairs of Monarchs (mating attempts are defined as struggles between two butterflies on the ground as the male attempts to mate). Many of these attempts last several minutes, and may even involve two males! It appears that most females try to avoid mating at this time. This could be because they will not begin laying eggs for at least several weeks and the costs of mating outweigh any benefits they might receive from mating this early. Karen is working to understand what factors influence the outcome of individual mating attempts and overall female mating frequency in overwintering colonies in Mexico and California, and in summer populations.

We brought 400 butterflies back to Minnesota, where we are determining how mating and access to host plants affect the timing of female diapause termination. Diapause is the non-reproductive, hibernation-like state in which Monarchs overwinter, and Liz's thesis work is to determine what environmental factors influence both the beginning and end of diapause in Monarchs. While there is a great deal of mating activity in the colonies in both California and Mexico near the end of the overwintering period, most females do not have mature eggs at this time.

In addition to doing research, we encountered many wonderful people. We met with members of one of the ejidos that own land on Chincua. This impressed upon us the fact that not being able

to cut timber from the protected areas represents a severe financial hardship, and they are very interested in working together to devise ways in which both the livelihood of the people and the Monarch sites can be preserved. Income from tourists visiting the colonies will be important, but this is seasonal and as yet cannot compensate for lost timber dollars. We left the meeting feeling both elated with the open communication and shared interest, and still somewhat daunted by the magnitude of the problems. We also spent a morning visiting an elementary school in Angangueo with a group from the Science Museum of Minnesota, six U.S. schools, and the Children's Museum in Mexico City. We visited classrooms, talked to students and teachers, and saw the butterflies they had made for the Journey North's "Journey South" program (The paper butterflies made by Mexican students will actually make a journey north to US classrooms!) The highlight of this visit was playing with students in the school courtyard where they were eating a hot lunch of tortillas cooked over gas burners. We learned some Spanish and English from each other, took lots of pictures, and together marveled at the thousands of Monarch butterflies overhead!

Tagged Monarch seen leaving roosts

"Here's another remarkable happening that occurred as we were driving to the Herrada colony. The colony was in the process of dispersing that day and the state highway nearby was so full of flying Monarchs that vehicle traffic was forced to a crawl (a Monarch storm?). As we were driving slowly along, with the windows open, the Monarchs could be touched as they flew closely along side the truck. Suddenly, our Mexican guide shouted "Look a tag!" and sure enough, a Monarch with a tag was flying right along side the truck in plain view for about 30 seconds. The driver jammed on the breaks - to catch it? But it disappeared into the thousands of others and was lost from sight. Amazing!"

- Len Wassenaar, Email communication 12 March 1997

Accessible Monarch Overwintering Sites in California

This list was originally compiled by C. Nagano, Natural History Museum of Los Angeles County, 1 November 1987 and revised by Walter Sakai on 1 April 1991 and 8 May 1996. For more information about the best time to visit the sites, directions to and regulations at the sites, and various Monarch festivals and events, see Dr. Sakai's web site at:
www.smc.edu/smc/departments/lifsci/sakai/monarch.htm

Ardenwood Historic Farm

34600 Ardenwood Blvd, Fremont, CA94555 (510)796-0663
This may be the most reliable site in the East Bay Area of San Francisco Bay.

Natural Bridges State Beach

2531 West Cliff Drive, Santa Cruz, CA 95060 (408)423-4609
Located just north of the city of Santa Cruz, it is one of the most accessible sites with a wheel chair and stroller accessible ramp leading down to the Monarch viewing platform.

Pacific Grove

Contact the Friends of the Monarch, PO Box 51683, Pacific Grove, CA93950 (408)375-0982 - Behind the Butterfly Grove Inn, clusters form on the Monarch Sanctuary (formerly the Dively property). The other nearby site is at George Washington Park located a few blocks away.

Andrew Molera State Park

This is a little known colony along the Big Sur coast. A modest hike through the Environmental Campground will take you to Cooper's Cabin, which is surrounded by eucalyptus trees.

Sebastiani's Store

It is the only place of business in San Simeon, so the store is hard to miss. There is a large grove of eucalyptus trees just across the street to the north.

Morro Bay State Park

Situated in scenic Morro Bay in San Luis Obispo County, the park contains several butterfly overwintering sites. Check with the rangers at the entrance for specifics. A larger colony can be found in the nearby golf course. Check the eucalyptus windrows along the 3rd and 8th fairways.

Sweet Springs Marsh Preserve

Located in Los Osos at the south end of Morro Bay, this is an Audubon Society natural area. The Monarchs roost in the eucalyptus windrow next to Ramona Road.

Montana de Oro State Park

A large colony is located in the park at Camp KEEP. Take the only road into the park and turn left into Camp KEEP. There is a group of ranger residences to the right and the camp is further up the hill. The Monarchs cluster in the small drainage to the left.

Pismo State Beach

The other large and accessible colony is located along the southern edge of the North Beach campground. One can either enter the campground and park in the designated areas at the south end of the campground or park along Highway 1 and walk in.

Ellwood Main

This is the premier site in southern California with close to 100,000 Monarchs in good years. Located east of Santa Barbara in the town of Goleta (UCSB).

Carpinteria State Beach

There is a good sized colony (5-10,000) of Monarchs along the north side of Carpinteria Creek. The site is on private land, in an area called Salzgerber Meadow.

Camino Real Park in San Buenaventura

Directions to this site is complicated. It is best to use a Thomas Guide or an AAAMap. The Monarchs roost in the creek which is lined with eucalyptus trees and is called Arundell Barranca. A larger site is found further up the Barranca north of Telegraph Road and south of Loma Vista Road.

Big Sycamore Canyon

This is part of Point Mugu State Park and is located along the coast (Hwy 1) of the Santa Monica Mountains.

Leo Carrillo State Beach

This is a colony of several thousand Monarchs in the eucalyptus grove that line Mulholland Highway, north of Highway 1 along Arroyo Sequit Creek.

Huntington Beach Central Park

Located in Orange County, the cross streets are Golden West to the west, Slater to the north, Gothard to the east, and Talbert to the south.

Doheny State Beach

This site is located in Orange County near Dana Point.

Monarch Migration Reserves

Last year, the Canadian government's designation of Long Point and Point Pelee (Ontario) as "Monarch Migration Reserves" prompted us to investigate the possibilities of establishing similar protected sites in the United States. We asked Monarch Watchers to notify us of monarch roosting sites on federal or state lands that could potentially be designated as migration reserves. Although we still need to do some research on the best way to establish such reserves in the United States, we remain very interested in pursuing this objective. If you know of any monarch roosting sites located on federal or state lands, please contact the MW with this information. Here is a list of the potential sites which have been brought to our attention so far.

Hiawatha National Forest

8181 US Highway 2
Rapid River, MI 49878

Pictured Rocks National Lakeshore

P.O. Box 40, Sand Point Road
Munising, MI 49862

Dyess Airforce Base

226 Commissary Road
Abilene, TX 79607

Sandy Hook Park

Gateway National Recreation Area
Floyd Bennett Field
Building 69
Brooklyn, NY 11234

Devil's River State Natural Area

HCR 1 Box 513
Del Rio, TX 78840

Landmark Inn State Historical Park

402 Florence St.
Castroville, TX 78009

Colorado Bend State Park

Box 118
Bend, TX 76824

Dinosaur Valley State Park

Box 396
Glenn Rose, TX 76043

Seminole Canyon State Historical Park

P.O. Box 820
Comstock, TX 78837

Kickapoo Canyon State Natural Area

P.O. Box 705
Bracketville, TX 78832

South Llano River State Park

HC 15 Box 224
Junction, TX 76849

Possum Kingdom

Box 36
Caddo, TX 76429

Cape May Point, NJ 08212

Baker/Haskell Wetlands, Lawrence, KS

Baker University
Baldwin, KS 66006



**A newly emerged Monarch.
Photo by Marty N. Davis.**

Student - Scientist Projects

Monarch Watch is working to develop student - scientist partnerships, collaborative projects in which students and teachers can participate by collecting data to answer important questions about the Monarch migration. So far we have developed five projects, listed below. To find out more about these projects and how you can get involved, visit our web site at:

www.keil.ukans.edu/~monarch/

TAGGING

Tracking Monarch Migration With Artificial IDs

Only through the cooperative efforts of volunteer taggers will we be able to obtain sufficient recoveries and observations of migratory Monarchs to answer the many important questions about the migration. Participants place ID tags on captured migratory Monarchs and record some basic information. This project is a good way to introduce students to science and have them contribute to a scientific study because Monarchs have a certain "charisma" and a fascinating biology and it's fun to have an excuse to collect butterflies.

ISOTOPES

Tracking Monarch Migration With Hydrogen Isotopes

Continuing on a limited basis in 1997, volunteers selected for this project will raise Monarch larvae, feeding them local milkweed exposed only to natural rainwater. Samples of the milkweed and six adult butterflies will be returned for analysis of the isotope content. This project will help us to establish the "home signals" for Monarchs throughout eastern North America, making it possible to use the isotope content of Monarchs to answer questions about the geographic origins of the butterflies that reach the roosting sites in Mexico.

FLIGHT VECTORS

Tracking Migration With "Snapshots" Of Direction

How do Monarchs "know" which direction to take in their migratory flights? Before we design experiments to test possible answers to this question, we need more information on Monarch navigation in the field. Here is where we need your help: By making systematic records of the directions Monarchs take on their migratory flights, you can help us find some clues to distinguish between the possible answers to this Monarch mystery. Participants will record observations of the vanishing bearings and body orientation of migrating Monarchs, along with some basic weather information.

SIZE AND MASS

Measuring The Effect Of Migration On The Monarch Population (Paula Donham and Orley Taylor)

How is size and/or mass related to survival during the migration? Maybe individuals representing all size and mass combinations survive equally from their origin in the north to the roosts in Mexico, or perhaps certain size and mass classes are more apt to die along the way. We need help from students

throughout the country to find out more about which Monarchs are best equipped to make the journey to Mexico. The challenge is to collect butterflies in September and October, record size and mass measurements, and release them to continue the migration.

LARVAL MONITORING

Assessing Changes In Monarch Population Numbers

(Karen Oberhauser, kober@biosci.cbs.umn.edu)

How does Monarch population size change over the course of a summer, and how do weather patterns and location effect population size? Volunteers are needed to provide the first large-scale assessment of larval densities throughout the course of an entire summer. Participants would need access to a reliable location in which milkweed grows, preferably of at least an acre in size, although smaller sites may be acceptable. Sites would need to be monitored at weekly intervals, and monitoring would involve keeping track of how many milkweed plants you check for eggs or larvae, and the number of individuals observed.



Monarch Watchers: Skyler, Adam and Asher Photo contributed by Patty Delmott.

Challenges to Students

Each year we pose some questions and challenges for students. We know some teachers have used these ideas for classroom discussions and a few students have used Monarchs as the basis for Science Fair or independent study projects, but we haven't received much feedback. I guess you are all shy but there is no need to be. Let's share our experiences and learn from each other. We can't make much progress unless we all communicate. If you have a report on a Monarch project, and wish to share it with others, please send it to us and we will make it available to anyone interested.

This year's challenges are in the form of questions about three Monarch mysteries. Each mystery can be answered in two ways: you can provide an answer or hypothesis; or you can show how you could test a hypothesis, in other words write a short research proposal. If you provide the best answer or proposal for one of these mysteries, we will send you a Monarch Watch migration T-shirt and a Gulliver pin. One answer per student please. Please limit your hypothesis or proposal to one standard page. With permission of the winners, their answers will be posted on the web site.

LAYING ON THE GREEN

It often happens that two different scientists reach opposite conclusions based on tests or observations of what appear to be the same thing. Recently, in response to questions and observations about Monarch butterflies laying eggs on "anything green" Karen Oberhauser maintained that milkweeds or the "essence of milkweed" must be present for egg laying to occur, and she cited the recent study by Haribal, M. and J. Renwick (1996): Oviposition stimulants for the Monarch butterfly - flavonal glycosides from *Asclepias curassavica*. *Phytochemistry* 41:139-144. In this paper, the authors show that one factor that stimulates egg laying is the presence of flavonal glycosides in the leaves. They also showed that females will lay eggs on an opaque material covering a plant; that is, the females laid eggs even though they couldn't see or touch the leaves.

In contrast, in my laboratory, even in the absence of plants, Monarch females laid so many eggs on the green teflon scrubbers we use in our feeders, that we had to stop using them. However, we found that they would seldom lay eggs on the yellow, orange, blue, red or purple scrubbers whether milkweed was present or not. (Richard Esdale also observed egg laying on a yellow plastic sponge soaked in a artificial nectar in the absence of milkweeds).

How can we resolve these apparent differences? The first observation emphasizes the role of scent stimuli and suggests, but does not show, that vision is not important. The second observation implies that vision, and the color green in particular, can be important if combined with other stimuli. What does the green teflon scrubber sitting in the nectar dish have in common with the plants? A little bit of logic and some research will give you the answer.

(HINT: THE COMPOSITION OF THE ARTIFICIAL NECTAR IS SHOWN ON PAGE 29.)

WHY THE BOTTOM?

Monarch females are choosy egg layers and in the wild they place most of their eggs on the undersides of new leaves on milkweed plants. But why do they choose to lay eggs on the undersides when it would appear to be easier, and to take less

time, to lay the eggs on the upper surfaces of the leaves?

This is really pretty easy. Start by asking some questions about the microenvironments found on the upper and lower leaf surfaces. Once you have formulated your hypotheses and logically established why it might be important for females to lay eggs on the undersides of leaves, explain why they don't always do so. In the research proposal, show how you would test your hypotheses.

**Send your entries to us by
31 January 1998
for a chance to win a
Monarch Watch t-shirt and
a Gulliver pin!**

DO MONARCHS COMPETE WITH OTHER SPECIES?

This is a question for young ecologists. What do we mean by competition? What kinds of competition are there? What do organisms normally compete for? If you can give a general answer to these questions, you can then ask if Monarchs compete with other species.

What do you think? Given what you know about the biology of Monarchs and other organisms that Monarchs are likely to interact with, what are your hypotheses regarding the intensity of competition between Monarchs and other species. Whether you think competition is strong or weak, how would you test your hypothesis?

FOR STUDENTS YOUNGER THAN 12 YEARS OF AGE

We know that Monarchs will feed from dishes containing teflon scrubbers and artificial nectar. The teflon scrubbers are available in a variety of colors and the nectar can be easily prepared. The challenge is to design an experiment using the feeders and nectar to show:

1. Whether Monarchs have a color preference.
2. Whether Monarchs prefer nectar with a specific sugar concentration.
3. Whether Monarchs can "remember" or learn a color, nectar type or dish location

(DESIGN FOR ONLY ONE OF THESE)

Classroom Discussion

In biology, especially in ecology, we look for patterns in nature and then we attempt to explain these patterns by systematically testing a series of hypotheses that arise from the questions suggested by our observations. Through objective tests of each hypothesis, we hope to establish the relationship of the pattern to a cause(s). If we are able to conduct experiments and test one variable at a time, we are often able to pinpoint causal relationships quite well. However, experimentation isn't always possible, and we frequently have to look for factors which are correlated with the pattern we seek to explain. But just because a factor is correlated with a pattern does not mean that it "causes" the pattern and we must constantly be aware that "correlation is not causation". With this perspective in mind, let's ask what determines the "pattern" of the spring and fall Monarch migration? What are these patterns?

Spring Migration Pattern

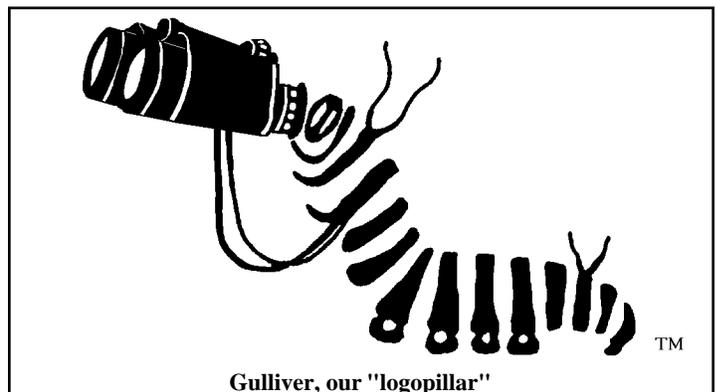
The first Monarchs to arrive from Mexico are reported in Texas in the first week of March. From Texas some spread north into Oklahoma and Kansas but others migrate into Louisiana, Arkansas and other states to the east. It is the rate of spread by latitude and longitude which is of interest. This is the fourth consecutive year in which Journey North (www.learner.org/content/k12/jnorth/) has recorded more rapid recolonization of the eastern states than of the central Midwest. This is a very interesting pattern. If we assume that the pattern is real, and not an artifact of the distribution of observers or schools connected to the internet, and that all the observers are correctly reporting Monarchs and not other butterflies, then the question is: What is the basis, or underlying cause(s), for this pattern? How would we answer this question? Since this is a natural event, and one which is not amenable to experimentation, we must look for factors which are correlated with the pattern. What is your hypothesis? My hypothesis is that the more favorable spring conditions in the SE and along the east coast favor the movement of migrants in this direction. But this is pretty vague. What do I mean by conditions? What do you think is more important, temperature, windspeed and direction, hours of unobstructed sunlight with temperatures over 60°F, availability of flowers with nectar, other factors or some combination of these? Hmmmm. Gets complicated in a hurry, doesn't it?

Such "causes" are hard to sort out, but we have to start somewhere so here's a suggestion: visit the Journey North web site and download the Monarch sightings for the last two springs. Once you have recorded these on a map and can see the progressive recolonization, visit the weather archive (<http://wxp.atms.purdue.edu/archive/index.html>) at Purdue University. This archive contains maps of the United States which give weather patterns, including wind direction, temperatures and other pertinent information. If you have a good computer available, you can make a slide show of the weather patterns. The next task is to compare the migration patterns with the

weather patterns. This is where it gets fun and really challenging. How do you make these comparisons? How do you represent what is happening visually and how do you interpret the results? Keep in mind that it is just as important to know where Monarchs are not seen as well as where they have been reported. This should be a great group project: if you do this, send us a report.

Fall Migration Pattern

The fall migration pattern is almost the converse of the pattern seen in the spring. The Monarchs begin leaving the north central states (Dakotas and Minnesota) first followed by progressive movement southward as one moves to the east at the same latitudes. This pattern is evident in Kansas where large numbers of Monarchs are reported moving south through the western part of the state before any significant numbers are seen in the east at the same latitude. But maybe my impressions are incorrect. We need to establish two things, the actual pattern of the fall migration and the relationship of this pattern to the fall weather patterns, particularly the movement of weather fronts. This could be another group project. Let's do it. Here's how. Have someone in your group subscribe to Dplex-L, the Monarch Watch List, and have members of the team sort through the messages to Dplex and evaluate them for their information on the migration. Record these data on a map in the classroom. Other members of the group can download and evaluate the weather data. My bet is that if the weather team is really on the ball and knows the weather as well as the behavior of the Monarchs, they will be able to predict or anticipate Monarch movements. In other words they will be able to tell the team monitoring Dplex where the next reports are likely to come from. Cool. If your group takes up this challenge, let us know what you find to be the best weather predictor of the Monarch migration.



Rearing Monarchs in the Classroom

What projects can be done with Monarch caterpillars in the classroom?

Monarch larvae can be used to illustrate many biological principles, such as life history, complete metamorphosis, rates of growth, conversion efficiencies (leaf mass to larva mass), the relation of growth rate to temperature and to food quality, and much, much more. The best approach for those less experienced with Monarchs may be to just dive in and discover along with the students. After you and your students have made relevant observations and/or developed more specific questions, you can devise exercises, activities, lessons, and experiments to do with the caterpillars.

What should be done to control disease?

There are several pathogens that cause disease in Monarchs. Two of the most common of these, the protozoans *Nosema* and *Ophryocystis elektroscirrha*, can be controlled by following a couple of simple procedures. Rearing Monarch larvae in an environment with low humidity will reduce infections by *Nosema* as well as certain bacteria and fungi. *Ophryocystis* can be controlled by examining each male and female used in mating or each egg-laying female for the spores of this protozoan on abdominal scales. The scales are gently removed from the butterfly's abdomen with a clear piece of tape and examined at 100x under the microscope. The spores look like small footballs. Pictures of the spores and more information about control of this disease are found on the web site. Because bacterial and protozoan spores, as well as polyhedral viruses, are very persistent, it is extremely important to clean all rearing containers with 10-15% chlorox solution between each rearing.

What percentage of caterpillars will survive to be adult butterflies?

Even with perfect rearing conditions and healthy caterpillars, the survival rate of Monarch larvae is generally only 70-80%. Like all organisms, Monarchs are not perfect. The process of complete metamorphosis presents some pretty tough physiological hurdles to overcome before they emerge as adults. Much of the mortality occurs in the later stages of development. It is not

uncommon to lose 10% of 1st instar larvae, another 10% between the first and fifth instars, 10% when pupating, and 10% as pupae or during emergence. If you get a survival rate above 80% in your Monarch culture, consider yourself a pro!

A New Book for Young Monarch Watchers

An Extraordinary Life: The Story of a Monarch Butterfly
by Laurence Pringle, paintings by Bob Marshall

This gripping narrative, illustrated with glorious full-color paintings, captures the amazing story of one Monarch butterfly's migration across a continent. In the tradition of Holling C. Holling's classic journeys--Minn of the Mississippi, Paddle-to-the-Sea--this informative book follows Danaus from her hatching as a caterpillar in a Massachusetts hayfield through her metamorphosis into a butterfly, culminating in her flight south and her mating and return migration in spring. Along the way to the wintering grounds in Mexico are dangers from weather, predators, and humans--Danaus almost ends her life prematurely on the windshield of a car--but, like millions of other Monarchs, she overcomes these obstacles and completes the journey to a place none of them has ever been.

Sidebars, detailed paintings, and descriptive captions based on the most recent research about Monarchs extend Danaus's story, providing a wealth of interconnections with other animals, geography, people, climate, and history. The story incorporates information about Monarch biology, life history, and ecology, and the book includes short sections on saving the Mexican roosting sites and on raising Monarch butterflies. It is most appropriate for children and adults age 5 and up.

(TEXT TAKEN FROM BOOK JACKET)

Do they migrate? Yes, they do!

We know that Monarchs begin to migrate when day length decreases in late August. Temperatures and the quality of food plants are decreasing at this time as well. One, or a combination of two or more of these factors, leads to reproductive diapause and migratory behavior in Monarchs. But what about Monarchs that are reared indoors? The lighting, temperature, and food plant conditions for these Monarchs may be significantly different than outdoors. Will these Monarchs still migrate? This question was addressed in last year's Season Summary, but we were not able to pose a conclusive answer. However, this year we know of six Monarchs (SEE "RECOVERIES" ON PAGES 5-7) that were raised indoors, tagged, and recaptured a significant distance away; one of these was recaptured in Mexico. In general, these Monarchs were reared under what are probably common classroom conditions. Temperatures ranged from 60-75°, caterpillars were exposed to sunlight from a window or daytime classroom lighting, and food plants were obtained from outdoors. Although we cannot say that Monarchs reared under any conditions will migrate, it appears that most classroom conditions are such that butterflies reared indoors will enter reproductive diapause and will migrate.

Does tagging hinder the ability of Monarchs to migrate?

Many of you have asked questions about the effect of tagging Monarchs on their ability to fly. This is a valid question, which turned into a detailed discussion on Dplex. Edited highlights from this discussion follow. For more information about insect flight, see Roy Beckemeyer's natural flight web page at: www2.southwind.net/~royb/fly.html

Greg Clemens: For some time now I've pondered whether to tag or not to tag Monarchs...I'm just not convinced enough that it doesn't alter the flying ability of the Monarchs, particularly the weaker ones.

Karen Oberhauser: We have a short activity on this in our curriculum guide that was designed in response to many students asking this question. Students should weigh the tags (including the glue) themselves, but it turns out that the tag is about 2% of the weight of an average butterfly.

Greg Clemens: When I think of adding 2% to my body weight that would be 3.5 lbs. Try carrying a brick around for awhile...How do we know that we didn't cause the demise of some tagged Monarchs?

Don Davis: The physiological differences between a Monarch butterfly and a human being are substantial and the analogy of adding 3.5 pounds to a 175 pound body to carry around is erroneous...Can you imagine how high a human being could jump if we were to compare the mass of a human to the mass of a grasshopper! Or if a human baby - in the time that a Monarch butterfly larva develops - were to increase its weight by 2800 times!

Chuck Safris: Because I have seen 'really, really thin' Monarchs and some which may have been three times thicker/fatter this season, it is clear that the Monarch is capable of flying in a wide range of wing loading. I saw no difference in the flying capability of the thin ones or the heavy ones. This suggests high tolerance for the mass of the tag, though the Monarch might stop taking on fat/water when it reaches a preferred weight (mass). This becomes a 'fuel on board' problem which can be overcome by more frequent stops for nectaring. If this is an effect of the tag, could we predict it would cause tagged Monarchs to be the last ones to reach the roosts in Mexico because they had to stop more often to nectar?...As to tipping because of the off axis load, I suspect the Monarch adjusts immediately to this force, just as it would to wing damage from a predator or other misadventure.

Michael Lastufka: One tag stuck to my finger when I released the butterfly. The next day I happened to catch the same one which I immediately turned loose in my Monarch enclosure for

observation. It had a 3 inch piece of dry grass and some dry cypress fronds stuck to the glue on its discal cell. It was amazing to see that it actually flew quite well. The extra weight and drag on the grass appeared to slow its flapping rate. It even compensated for the torque normal to its flight path by twitching motions of its hind wings.

Chip Taylor: What are the most important questions here: Can the Monarchs carry the additional weight? If they can carry the weight, does the tag impede flight? Can the butterfly adjust its flight to compensate for the mass of the tag and its location on the wing? What do we have to know to answer these questions: What is the mass of the butterfly? Does the mass change during migration? Where is the center of lift of the flying Monarch? If mass changes with the addition of the tag or the uptake of nectar, can the Monarchs adjust to maintain the same center of gravity?



A "Wayward" Monarch (SEE PAGE 9) tagged in MO and observed near the AL coast. Photo contributed by Giff Beaton.

Generally, Monarchs increase in mass during the migration; some increase by as much as 40%! How does an increase in mass affect flight? Although it will increase wing loading, an increase in mass will actually improve the gliding efficiency by increasing the glide speed, allowing the Monarchs to move more rapidly from thermal to thermal (D. Gibo and J. McCurdy, 1993 J. Lep. Soc. 47:154-160). This is

quite important since much of the migratory flight consists of soaring or gliding, and flight time when thermals are available is often limited. Gibo and McCurdy have shown that Monarchs compensate for low fat reserves at the beginning of the migration by retaining water in the abdomen in a manner that helps them maintain a center of gravity at a point just behind the thorax. In other words, Monarchs appear to have the ability to adjust their mass to maximize flight efficiency during both powered and gliding flights. All of this is interesting but it doesn't answer the question as to whether the tagging has an effect. Let's be honest, it probably does in some cases. However, the high rate of recoveries in Mexico suggests that the impact of tagging is very low.

Something for Teachers

Monarch Conservation Dilemmas

The governments of Mexico, Canada and the United States, scientists, conservationists and many others are engaged in discussions about how to conserve the Oyamel forests and the overwintering sites for Monarchs in Mexico. This is a complicated issue and it involves some significant conflicts or dilemmas. The basic question is: How do we provide protection to the Monarchs while meeting the very real needs of the local people who occupy these areas?

Karen Oberhauser and her colleagues have created a curriculum designed to allow teachers to explore these issues with students in the classroom. The curriculum, which can be found on the Monarch Watch web site, contains instructions for teachers and outlines activities that can be used to engage students in the discussions. Although these materials are designed for grade levels 4-8, the questions and the dilemmas are similar to those discussed in meetings on Monarch conservation.

Discussion Questions

The following questions can be used for student journals or in large or small group discussions. You and your students will surely think of other questions.

Why is Monarch conservation an issue now? - What value do Monarchs have to humans? - How would you solve the problems that result from conflicts between human needs and the Monarchs' needs? - What is being done to conserve Monarch habitat? - What are pros and cons of tourism in the overwintering sites? - What are the roles and responsibilities of Americans in conserving overwintering sites in Mexico? - What threatens Monarchs in their summer habitat? - Why are threats to the Monarchs winter habitat more dangerous to the population?

Role playing - what would you do if ...?

DILEMMA 1

You are an ejidatarios, a local resident, who owns part of the forested land where the Monarchs overwinter. You depend upon logging the forests for a cash income in order to buy food, clothing and other supplies for your family. Environmentalists have told you not to cut down any more trees because you are reducing the overwintering habitat for Monarchs. What should you do?

Continue logging the forest? - Find another way to support your family? - Continue logging the forest but only cut down the very oldest trees? - Other solutions?

DILEMMA 2

You are hired by the Monarca, A.C., a Mexican conservation organization, to detain local residents as they enter the forest and to persuade them not to continue logging. In the past you logged the forest and were able to pay for an education, which allowed you to get this job. On your first day at work you meet up with an old village friend who is about to enter the forest to log; you know that he has 5 children at home to support. What should you do?

Stop him and tell him to stop logging the forest? - Wait for someone you do not know to come along? - Stop him and talk about old times? - Other solutions?

DILEMMA 3

You are a resident of a village near a little-known Monarch colony high in the mountains called Valle de Bravo. Tourists sel-

dom visit your village because it is difficult to find the path that winds up the mountain. Some villagers wish to develop tourist businesses. Some residents want to build a road cutting a clear path up the mountain in order to attract tourists. You are concerned that such a road would destroy too much forest. Should you:

Support the villagers who wish to build the road? - Oppose the road construction: convince other villagers that the road would be too costly to build? - Talk with other villagers about ways to increase tourism without building the road? - Other solutions?

DILEMMA 4

You are a scientist who has done research on Monarchs in the colonies for the past five years. In addition, you have led groups of interested tourists into the overwintering colonies. It is your hope that tourism will replace logging as a source of income for the people in the villages. Unfortunately you have noticed villagers logging trees on the edges of the forest to make motels for the increasing number of tourists. What should you do?

Stop encouraging tourists to visit the Monarch sites? - Tell the villagers to stop destroying Monarch habitat to build motels? - Work to find new building materials in the area? - Give the money collected from the tourists directly to the local residents, if they will stop building motels? - Other solutions?

Sand Vine or Blue Vine Milkweed

A Useful Milkweed for Late Season Monarchs

For those who raise Monarchs, finding fresh milkweed can sometimes be difficult, particularly as the breeding season progresses and many milkweeds begin to die off. In the midwest, however, sand vine or blue vine milkweed, *Cynanchum laeve*, stays around longer and can be used as a source of fresh foliage much later in the season than many other milkweeds. This vine milkweed has distinctly heart-shaped leaves and white or cream flowers. The following are some observations and notes about sand vine that were posted to Dplex last fall.

Laura Mitchell

(Terre Haute, Indiana):

Today while searching for Monarch eggs along a ditch and railroad tracks, I

found only a few at first on the handful of small milkweed plants growing there. I almost became discouraged when I decided to look at a vine form of milkweed that once in a while I find an egg on. I found egg upon egg on virtually each piece of vine I turned over and searched.

Laura Mitchell (September 2):

I am still finding eggs in Terre Haute, Indiana, but mostly on the sand vine, *Cynanchum laeve*, at a ratio of 10 on sand vine to 1 on [other] milkweeds!

Bob Melton (Oklahoma City, September 4):

Blue vine...is VERY common in these parts. It often grows in chain link fences and on ornamental plantings in suburbs. It usually does not get as lush as it is this year, but a very wet August has it growing very rapidly. Other milkweed types are beginning to fade. But the blue vine is coming on strong and has just started blooming.

Chip Taylor:

Blue/sand vine is used extensively as a host plant by Monarchs



Cynanchum laeve

in late summer in many parts of the midwest. Late in the breeding season (Aug-Sept) the foliage of these plants is usually in good condition, partly because of its indeterminate growth (continuous addition of leaves).

This species is often confused with bindweed, to which it bears a superficial resemblance. Sand/Blue vine is often a pest weed in cornfields and I've had calls from farmers who want to know how all the Monarch pupae ended up on their cornstalks because they couldn't see any milkweed in their fields. They were aware of Sand/Blue vine but did not know it was a milkweed. Some of the most common predators of Monarch larvae are relatively uncommon in cornfields so it's possible that in some areas large numbers of Monarchs are produced in cornfields on *Cynanchum*.

Best Sites to Observe Migrating Monarchs

The following is a list of places where migrating Monarchs of the eastern population tend to congregate year after year. If you know of other sites, please let us know so we can compile a more complete list.

Canada

Presqu'île Provincial Park, near Brighton, Ontario
Long Point Provincial Park, Ontario
Point Pelee National Park, Ontario
Tommy Thompson Park, Toronto, Ontario

Eastern United States

Cape May Point, NJ
Robert Moses State Park, near Massena, NY
Maumee Bay State Park, Toledo, OH
Hiawatha National Forest, Rapid River, MI
Pictured Rocks National Lakeshore, Munising, MI
Tunnel Gap at milepost 415 on the Blue Ridge Parkway, Asheville, NC

Central United States

Baker/Haskell Wetlands, Lawrence, KS
Wichita Mountains, near Lawton, OK
Devil's River State Natural Area, Del Rio, TX
Landmark Inn State Historical Park, Castroville, TX
Colorado Bend State Park, Bend, TX
Dinosaur Valley State Park, Glenn Rose, TX
Seminole Canyon State Historical Park, Comstock, TX
Kickapoo Canyon State Natural Area, Bracketville, TX
South Llano River State Park, Junction, TX
Possum Kingdom, Caddo, TX

The Best of Dplex

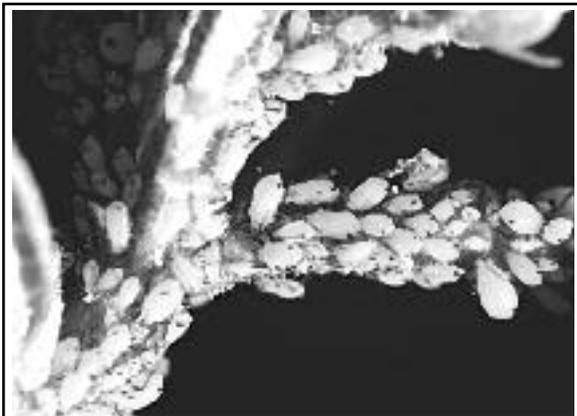
The following are excerpts from the Monarch Watch List, Dplex-L. This is an electronic discussion group which allows subscribers to disseminate news, post observations and reports, ask questions and initiate discussions of topics related to Monarchs. This list was started in mid-1995 and slowly gained subscribers. By August of 1996, there were 150 subscribers and the numbers increased rapidly to almost 300 as the fall migration progressed. The quality of the postings to Dplex has been exceptionally high for a list of this type and over 1100 messages were received in 1996. We are in the process of developing an organized archive for Dplex which will be posted on the web site. To receive more information about the list and how to join in, see "How to Reach Monarch Watch" on the back cover.

ON OBTAINING WIRE FOR CONSTRUCTING A BUTTERFLY NET

Chuck Safris: "It just occurred to me that anyone who is looking for some nice heavy wire to make a hoop for a butterfly net need look no further than the lawn signs of your favorite political candidate. Call your candidate's office and ask for a yard sign, then after the election, help yourself to about 5 feet of heavy metal wire...and don't forget to vote."

ON THE CONTROL OF APHIDS

A series of postings about the best way to control aphids on milkweed led to these suggestions:



Aphids feeding on a milkweed stem.
Photo contributed by Ken Highfill.

Diane Falk: "I might try to use a water misting/spritzing which mimics natural rain action to keep down the colonies. The plants like it too it would seem."

Bobby Gendron: "I have been trying for 6 years to eliminate aphids on my milkweed plants and I have found that the best solution is to just leave them alone and let nature do its thing. Lady Bugs and Lacewings will eat Monarch eggs and newly emerged larvae so I would stay away from introducing them onto your milkweed plants."

Jim Edson: "I transferred a lady bug this morning from the backyard to the sunroom indoors where I keep my milkweed plants. As soon as I placed her on the stem with the aphids, she went about her business eating the aphids...I think I'll order some lady bugs to see if they can get my aphids and spider mites under control."

ON HANGING CHRYSALISES FOR EASY VIEWING

Kathie Read asked about the most effective and least harmful way to re-attach a chrysalis for easy classroom viewing, prompting the following suggestions:

Fran Ludwig: "A teacher in Western MA had a great way to attach loose chrysalises. He tied unwaxed dental floss around the cremaster. The fibers in the floss caught on the hooks."

Susan Gilbert: "I have relocated chrysalids by lassoing the cremaster and sewing them to another place. I also have taken a needle and scooped up the silk thereby detaching the chrysalis and sticking the pin into wherever."

Laura Mitchell: "I have had great success with wood glue for chrysalids with no silk. I lay them on a paper plate, line them up in what will be a hanging position from a curved stick, put the glue on the stick and touch the cremaster to it. However, you have to get a very good alignment and the chrysalis and stick must remain untouched for a few hours."

Don Davis: Another method - where the cremaster is damaged and lacks the knob at the top... is to make a depression in a small piece of cardboard by punching it with a pen or pencil, putting some quick drying glue in the depression, and putting the top (abdominal end) of the pupa upside down in the depression. You may have to use something to keep the pupa upright. After a while, the glue dries, and you can attach the cardboard to a shelf or some surface and the pupa will hang properly."

Ray Newell: "I felt that it was desirable to maintain some flexure ability between the chrysalis and its support to minimize snapping of the cremaster if (when) something gets bumped. Lacking a natural silk pad, I would use a fuzzy fabric and [3M Super Strength] adhesive to attach the cremaster...I would not disturb it for an hour. The fabric can then be glued, maintaining the desired flexibility, wherever desired."

Wanda Hartter uses plastic clothespins and **Greg Clemens** has used a hemostat or an alligator clip made by winding a rubber band around tweezers.

Frequently Asked Questions

If we know where they go, why tag Monarchs?

Yes, we know that most Monarchs east of the Rocky Mountains overwinter in a small number of roost sites in Mexico. However, the purpose of tagging is not to establish that Monarchs fly to Mexico but to determine how they reach these locations. What paths do Monarchs take to reach Mexico and what are the means by which they navigate to arrive at these special places? To obtain adequate answers to these questions we need specific information on the flight directions taken by thousands of Monarchs. At present, the only means of obtaining this information is the old fashioned way - mark and recapture. Each tagged butterfly that is recovered provides several bits of information, the most important of which is the compass heading or bearing from the point of origin to the point of recapture. Since Monarchs surely do not fly in straight lines and may be strongly influenced by wind direction, local topography, availability of flowers with nectar, etc., what data would probably provide the best information about the directions taken by Monarchs originating from any one location? What is your guess, short flights, medium flights or very long flights? My hunch is that flights of medium length and relatively short duration will prove to be the most valuable. Why? Short flights will show too much variation due to wind and local conditions and long flights might not represent the true path if, somewhere along the flight, the course of the butterfly shifts radically due to the presence of mountains or lakes or perhaps major storms.

So we still need data, and lots of it, to solve the pathway problem. As the pathways become clearer, it will be easier to design experiments to determine the mechanisms Monarchs use to navigate during their migrations.

But getting back to Mexico, how many Monarchs tagged in Canada and the United States have actually been found in Mexico? The number is surprisingly small. Only 49 tagged butterflies were recovered in Mexico from 1975-1992 in the tagging program run by Fred and Norah Urquhart of the University of Toronto, and only 30 have been recovered during the first 5 years of the Monarch Watch. Where were these butterflies tagged? The map on page 8 shows these locations, but a more important question might be, where are there gaps in the recovery records? No Monarchs from the mountain states (Montana, Wyoming, Colorado, New Mexico) have been recovered in Mexico, but this isn't too surprising since these areas do not have large Monarch populations and the amount of tagging in this region has been minimal. But what about the Southeast? A check of the records shows that no Monarchs tagged from central Virginia to Missouri and south to east of New Orleans, has ever been found in Mexico! This might also be due to a low number of taggers. However, we do know that millions upon millions of Monarchs move through this region each fall and

there have been many recoveries in the Southeast of butterflies tagged elsewhere. Where do the Monarchs tagged in the SE spend the winter? We still don't know!

Are viceroys likely to be observed while tagging Monarchs?

The number of viceroys on the migration path of Monarchs varies greatly from place to place. Viceroys are usually found near willows, and the wet areas that surround most willow sites usually have good fall flowers that attract Monarchs. Therefore, in some wetland areas, especially in the northern and midwestern states, we would expect to find both viceroys and Monarchs. However, most upland fields and meadows that attract Monarchs contain few if any viceroys. Viceroys are generally smaller than Monarchs and can be distinguished by a black line which runs transversely across the hind wings.

How late in the year can Monarchs be released?

It is important to release Monarchs when it is warm enough for them to fly. It should be at least 60° outside, with some sun and little wind. At temperatures lower than this, Monarchs cannot fly, leaving them susceptible to freezing and to predators such as mice. After the Monarchs reach roosting sites, they can survive much colder temperatures (down to the mid-upper 20's) because the tree canopy provides protection from extreme conditions.

When do Monarchs mate?

Monarch mating behavior is sensitive to light intensity, day length, and temperature. For Monarchs in the wild, this means that mating slows down and eventually ceases as the amount of daylight decreases and the temperatures begin to drop in the early fall. However, for Monarchs in an indoor culture, these conditions can be controlled. The lights in the Monarch Watch mating cage are set to 15.5 hours of light and 8.5 hours of dark each day, with several dark rest periods during the day. This seems to improve mating and feeding behavior. The temperature of our cage is maintained between 74-80°F. If the light intensity is too low, the light period too short, or the temperatures too cold, Monarch mating will be reduced or terminated, but can be restored with exposure to longer days and higher temperatures. Monarchs have delayed sexual maturation with mating generally beginning when they have reached 4-5 days of age. Usually courtship and mating occurs in the mid to late afternoon, and copulations usually last 12-16 hours, terminating before the following morning.

What is the function of the gold spots on the pupa?

The gold spots on the Monarch chrysalis are a mystery that has inspired much curiosity. The gold color is produced not by a pig-

ment, but by structural iridescence. In other words, the metallic luster you see results from the refraction of light from the multiple laminae (layers) of the cuticle of the pupa. The multiple colors seen when oil is spilled on water are produced in the same way. In an attempt to determine the function of these gold spots, Fred Urquhart conducted a series of controlled experiments in the early 1970s. He found that the destruction of these spots caused the wing scales to fade, or reduced the number of scales on the head or abdomen, depending on which spots were destroyed. From this he concluded that the gold spots are associated with scale formation and pigmentation; however, we still do not understand specifically how the gold spots influence these aspects of development. It is possible that the gold spots represent major sites of organization for wing tissue and/or epidermal cells.

What are those maggots that emerge from Monarch larvae?

This parasite of monarch larvae is called a tachinid fly. The parasitic tachinids use species of Lepidoptera (butterflies and moths), sawflies, and beetles as hosts. There are about 1300 species of this fly family in North America, four of which lay their eggs on monarch larvae. Tachinid adults look like spiny houseflies, and the species that live in monarchs are gray and smaller than a housefly. They usually attach eggs to the outside of the monarch larva's body. The eggs hatch, the tachinid larvae burrow into the monarch larva, and then begin feeding on the tissues and fluid inside. The monarch lives and continues to grow until the tachinid larvae are ready to leave. When mature, the fly larvae bores through the skin of the 5th instar larva, or larva in a J shape prior to pupation (chrysalis formation) or even the pupa (chrysalis). The fly larvae drop to the ground where each forms a puparium (a pupa with a hard skin). These larvae undergo metamorphosis within the puparium and emerge as adult flies in about 2 weeks. One of the most common tachinid species to parasitize monarchs is *Lespesia archippivora*.

How can the sex of Monarch larvae and pupae be determined?

The sex of Monarch larvae can be determined only in dissection. Males will have a testis located in the 6th abdominal segment, dorsal to the gut. If you have a last instar male caterpillar, the testis will appear as two bright red or pink sacs; often they appear to be one sac.

To determine the sex of pupae requires only keen eyes or a dissecting microscope. Surrounding the cremaster (the structure from which the pupa hangs) are a series of rings, called abdominal sternites. Within the first ring (9th abdominal sternite) are several paired black dots next to the cremaster; turn the pupa so that you are looking at these dots. If the Monarch is a female, the ring adjacent to the 9th sternite will have a line dissecting it; this line (indicated by the arrow on the diagram) will be centered between the pairs of dots. Male Monarch pupae do not have this line.

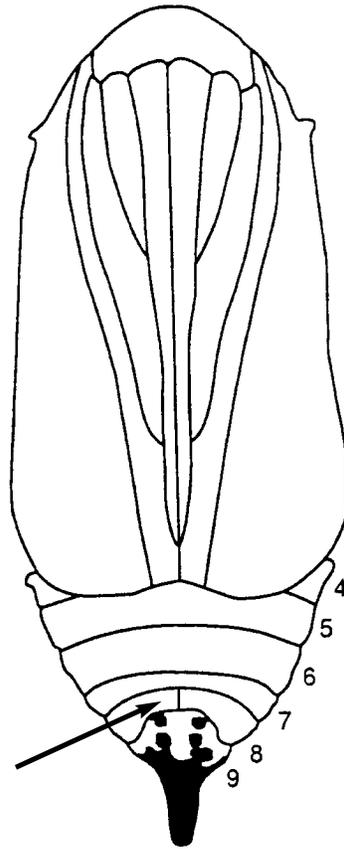


Diagram taken from:
Hughes, P. R., C. D. Radke,
and J. A. A. Renwick. 1993.
A Simple, Low-Input
Method for Continuous
Laboratory Rearing of the
Monarch Butterfly
(Lepidoptera: Danaidae) for
Research. American
Entomologist 39: 109-111.



Charley Page, one of the Page family members who helped Monarch Watch during the summer of 1996.

Letters to Monarch Watch

First let me say what an enjoyable experience this was for our whole family. Travis started the enthusiasm but within days we were all hooked on Monarchs. A couple of notes from someone fairly ignorant in this arena (but not as ignorant as before)... - As the season progressed the butterflies seemed to get smaller - why?? -Maximillian sunflowers were the favorite nectaring source this year in this area. Due to drought, that may have been the only thing to eat.

The most impressive thing that happened was on Oct. 17 about dusk. A front blew through (not the first one, but the first powerful one). I noticed an increase of Monarchs heading south, but it was my husband who happened to look way up in the sky and see millions of Monarchs riding the currents, as high as I could see traveling at various speeds, depending on altitude....Really spectacular!

Cindy Glick
Boerne, TX

It seems at present the only hope for the butterflies is for people to plant flowers for nectaring and laying their eggs on. Also I have been talking to anyone in Michigan Govt that will listen and asking that they let our expressways and roadsides go natural (with just a small area plowed for emergency stops). Maybe if others realize the money paid for mowing could be better used to repair the roads this will come to pass. This would make a natural migration path through the state for our birds and butterflies to utilize. If every state did this we could have natural area from one end of the continent to the other.

Rosita Smith
Plymouth, MI

I just wanted to include a quick note to thank you for all the effort you and the others at KU put in "behind the scenes" to make Monarch Watch possible. In my 20 years of teaching I can't think of another project/activity that has inspired the degree of interest and enthusiasm that this program has. From the kids, their parents, and other teachers the response has been wonderful.

The hydrogen isotope study was an intriguing new extension and it was a thrill to be a part of that. With the understanding that it will take time for results from that study to be developed, the potential wealth of information it promises is really exciting.

At Williams Elementary we kicked off our Monarch studies and the opening of our new school with students tagging and releasing Monarchs from the isotope study at our initial open house. The many positive comments was a good indication of what a successful fall we were in for. Monarchs (dead and alive, egg, larva, chrysalis and adult) soon began arriving at school, not to mention the other butterflies, bugs, caterpillars etc. From 1st graders to 5th graders the subject of butterflies in general and the Monarchs specifically seemed to offer a special fascination. We were able to involve 300+ 3rd, 4th, and 5th graders in actually

applying tags and recording data (with our apologies for any omissions/errors of sex or other data recorded as we work out the bugs of involving as many students as possible). The tags needed quickly exceeded the amounts both I and Kay Dobbs had anticipated. Running out and having to e-mail to order more was a wonderful new experience. We look forward eagerly to the possibility of tagging even more next year.

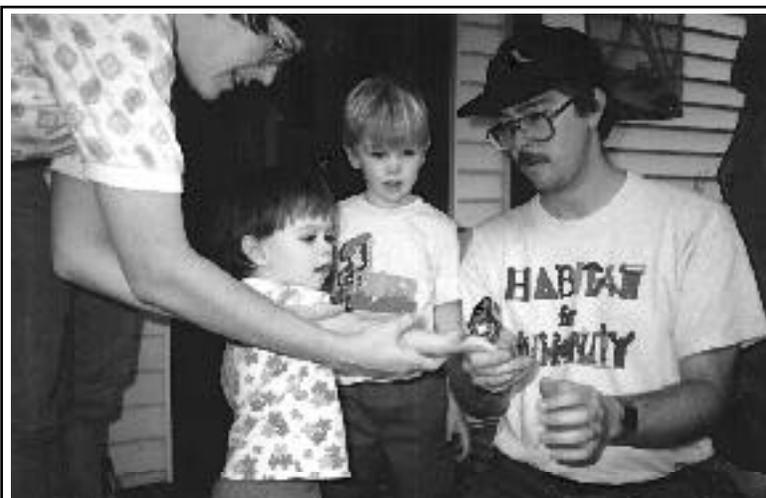
It is hard to imagine, after all this and the "banner year" in regards to the numbers of

Monarchs that passed our way, things getting any better. But it is just this open-ended frontier of possibilities that makes Monarch Watch so appealing and valuable. The direct exposure to "real science" and the inspiration to investigate it has generated among the kids has been very satisfying.

Walter Knapp, Kay Dobbs, and the rest of the Williams Elementary staff
Topeka, KS

I thought you would be really happy to know that YOU made me famous at my school!...I won a blue ribbon for superior achievement at the Rider University Science & Engineering Fair in Trenton, NJ on March 18th. I did change my project a little because none of my tagged Monarchs were recovered. My title was "Are Hand Raised Monarchs Tamer Than Wild Monarchs?" Of course they are you know. Well I just wanted to say thank you again...

Nikki Henderson
4th grade, Robinson School
Trenton, NJ



The Alexanders (Amy, Robin, Eric and Bill) releasing a tagged Monarch in Maryland last fall.

This is the first year my classes have participated in the [tagging] project. We learned much through our errors as well as our successes. This new addition to my normal curriculum has resulted from my attendance in a course at the University of Minnesota St. Paul taught by Dr. Karen Oberhauser this past summer. That course has given me a very pleasant motivation for using the Monarch butterfly as the vehicle to teach scientific method, observing and recording data, creation of new labs by students as well as many other state objectives for Biology I.

Anita Lawson
Bartlesville, OK

I am so excited that I found you! I am a First Grade teacher in Zionsville, Indiana. For the last five years I have taught the life cycle of the Monarch butterfly. What a joy it is to watch the children's eyes sparkle as the golden specks appear on the chrysalis, or as the distended abdomen emerges from the chrysalis! I am pleased to know that I can get tagging kits. This is the perfect culminating activity as we release our adult Monarchs! Our first larva just made his chrysalis today so please send our tags ASAP. Glad I found you!

Susie Cash
Carmel, IN

I have had a great time this fall helping my wife and her McDairBert multi-age class at Travis Heights Elementary School in Austin create their own Butterfly garden and rear, tag, and release Monarchs as part of Monarch Watch. All together, in our first tagging season with Monarch Watch, we were able to tag 96 Monarchs (33 wild-caught and 63 reared from eggs or larvae). About fifty-eight very excited kids, along with their teachers, have been totally fascinated by the opportunity to be able to watch the entire Monarch life cycle "up close and personal". The class was able to witness (in wonder and awe) the entire process of metamorphosis from J-stage to chrysalis, and from imago-stage chrysalis through eclosion and transformation into a flight-ready butterfly. The children cheered and applauded each tagged Monarch as it was released and took flight. It has all been a wonderful educational experience for children, parents, and teachers alike.

Gerry and Marti Adair
Austin, TX

This year all three fourth grade classrooms participated in the fun of collecting larvae and rearing and tagging butterflies. It was a grand experience for everyone...I just received Karen's 3-6 curriculum and it is a magnificent piece of work! Many of the measuring activities I have wanted to do but ran out of energy in creating data sheets, methods, etc. Now it's all been done for me. I love it! This has all been so wonderful! I always hate to see it

come to an end. When the last insect flies away, the students and I feel an emotional depression because all of our "friends" have left.

Christine Parsons
Sand Lake, MI

On Sept. 16 I took a class out to release some tagged Monarchs. As we looked around we found we were in the middle of a Monarch migration across the school grounds. I passed out butterfly nets and the whole class took off racing, leaping and swinging nets across the football field. I don't know when I have ever enjoyed a class more. Every student was completely involved. They were getting more exercise than in phys. ed. and they discovered that being an entomologist might be fun. During a half hour time period well over 100 Monarchs passed over us, but the students succeeded in catching only 15 during that class. As you can guess their antics trying to catch the butterflies were quite humorous.

Paula Waggy
Franklin, WV



Off to Mexico! Students at Holy Spirit Elementary (KS) send a group of tagged Monarchs on their way.
Photo contributed by Jolene Konzem.

Monarch News

Interest in the conservation of Monarch butterflies is increasing and since the last Season Summary (May 96) there have been several meetings at which this topic was discussed. Here are some brief highlights from these meetings as well as news of international agreements concerning Monarchs.

Informal Meeting, Houston, Texas. 16 June 1996

CONSERVATION OF MONARCH BUTTERFLIES:
AN INFORMAL MEETING TO DISCUSS ISSUES AND OPTIONS

Orley R. Taylor and William Calvert

(The following text is an abridged version of a report posted to Dplex-L on 16 July 1997.)

An informal meeting to discuss issues and options concerning the preservation of the Monarch roost sites in the Oyamel fir forests in the states of Michoacan and Mexico was held at the Marriott Hotel at the Houston Airport on 16 June 1996. This meeting was convened and hosted by Jeff Glassberg, Founder and Director of the North American Butterfly Association. A purpose of the meeting was to bring together authorities and conservationists from Mexico with others concerned with Monarch conservation.

The main feature of the meeting was a presentation by Hector Ruiz Barranco from the Instituto Nacional de Ecologia (INE), who represented the Mexican government, of a comprehensive plan for sustainable development of the region containing the Oyamel forests and the overwintering Monarch populations. The complexities of protecting the forests and the Monarchs became clearer as Hector outlined the program favored by his agency.

The region is occupied by 500,000 people, and a large proportion of this population obtains income through subsistence agriculture and harvest of timber from the Oyamel forests. Because ejidos are owned collectively and partly because many ejido inhabitants are Indian in origin and have different cultural backgrounds, concepts of ownership and land use are different from those held by most Americans and Canadians. For example, many of the local residents regard lands set aside for conservation as unused or wasted. Throughout the meeting the point was continually made that any plan for protection of the forests and the Monarch roosts must be based on the realities of the cultures and economics of the region. The region contains 54 ejidos in 18 municipalities located in the Mexican states of Michoacan and Mexico.

The INE plan for sustainable development of the region is very comprehensive and includes an educational component which emphasizes the value of conservation and sustainable harvest of resources. Development of alternative sources of income such as fish farming, clothes production, use of honey bees and development of alternative forest products is an essential part of the plan to improve the standard of living for the people. In theory, alter-

native sources of income will make the residents less dependent on the forests for income.

To date, resources have only been available to implement relatively small portions of this plan. Although our discussion did not encompass all the programs and support that have been available for protection of the forests and the roost sites, it is clear that substantial efforts have been made by the governments of the states of Michoacan and Mexico to protect the roost sites, particularly during the periods when the Monarchs are present. All these efforts are important, but political support and funding for the regional plan is clearly needed to assure long term survival of the forests and the Monarch populations.

After some discussion, there was general support for four proposals: 1 - Establishment of a trilateral commission to advise government agencies on the state of the Monarch butterfly in Canada, the United States and Mexico. 2 - Translation and dissemination of the INE plan with the intent of educating the public and decision makers of the complexities of conserving the forests and Monarch populations. 3 - Investigate the possibilities of obtaining funding for development of the region through the World Bank and other organizations interested in sustainable development. 4 - Establish Monarch migration reserves within the United States, following Canada's lead in this regard, and promote conservation and restoration of hostplant (milkweed) and nectar (flower) sources needed by Monarchs within the United States and Canada.

Department of Interior, Fish and Wildlife Service Meeting, Washington D. C. 10-11 October

The Fish and Wildlife Service hosted a two day meeting to present and discuss current efforts for the conservation of Monarch butterflies on its overwintering grounds in Michoacan, Mexico. During the first day of the meeting representatives of governmental and non-governmental organizations from Mexico presented summaries of their activities in behalf of Monarch conservation. Brief statements were also offered by the North American Butterfly Association, Journey North and Monarch Watch. Discussion on the second day focused on present needs and future actions, coordination of efforts by interested parties and initiatives required for implementation. Topics considered on the second day included past and future funding for protection of the forests and roost areas, the necessity of obtaining accurate and up to date satellite imagery of the forests in the reserves and buffer zones, and the importance of giving serious consideration to sustainable development initiatives for the region.

Department of Interior Report

The first draft of "State and Federal Monarch Activities in the United States" was issued by the Department of Interior on 7 March. This report lists Federal and State programs and activities related to Monarch butterfly education and conservation. Once revised and completed, this will be a useful compendium of all organizations and programs concerned with Monarchs throughout the United States. The introduction to the document is very brief and general and contains no policy statements.

Trilateral Agreement. 2 August 1996

The Council of the NAFTA Commission for Environmental Cooperation signed Council Resolution#96-04 "Cooperation in the conservation of the Monarch butterfly" on 2 August 1996. The Council...HEREBY agrees to:

EXPAND North American cooperative efforts to enhance the conservation of the Monarch butterfly through the development of a North American Butterfly Conservation Program, with a view to ensuring the viability of the Monarch butterfly populations in North America;

SUPPORT the study of the Monarch butterfly, to increase knowledge of its populations and of the ecosystems upon which they depend during their migratory cycle, through the exchange of scientific information on matters such as: the development of comparable monitoring methodologies, the identification of key monitoring sites, and the mapping and description of key Monarch butterfly sites used during their migratory cycle; and RECOMMEND that the Parties consider, in the development of a North American Monarch Butterfly Conservation Program, activities which could include the following: establishment of additional protected areas, public education, site management to improve the Monarch butterfly habitat, eco-tourism relating to the Monarch butterfly, development of demonstration projects involving the participation of local communities in their design and implementation, and formation of partnerships and networks of supporting institutions.

Commission for Environmental Cooperation Meeting 9 May 1997

The Commission for Environmental Cooperation (CEC) in Canada held a brief meeting with representatives of Canada, the United States and Mexico on 9 May to set priorities for Monarch conservation. One of the objectives of the meeting was to discuss the possibility of organizing another North American symposium on Monarchs.

(This meeting seems to be an outcome of the Trilateral Agreement mentioned above.)

Canadian Government declares Monarchs "vulnerable"

COSEWIC, a Canadian government agency which evaluates the population status of rare and endangered species, has designated the Monarch as "vulnerable", defined as "a species of special concern because of characteristics that make it particularly sensitive to human activities or natural events". (abstracted from a posting to Dplex-L (18 April) by Don Davis)

Artificial Butterfly Nectar

Here is a recipe for a non-fermenting artificial nectar which is useful for those wishing to maintain adult Monarchs in the classroom, for experiments or for educational demonstrations. This mixture is far superior to sugar/water, honey/water, and freshcut watermelon and often attracts as many or more feeding Monarchs than do typical butterfly flowers - Pentas, Lantana, Asclepias and Buddleia.

As an alternative to making this from scratch, you can buy a dry mix from Monarch Watch which includes everything you wouldn't normally find in your kitchen (\$2 - makes 1 liter, see order form insert).

Butterfly Nectar Formula

Ingredients:

300 grams sucrose (table sugar)
8 gms. ascorbic acid*
4 gms. sorbic acid*
4 gms. methylparahydroxybenzoate (methylparaben)*
2-3 drops food coloring - red, yellow, etc.
2 drops fruit extract (any kind)
3 pinches pollen**
2000 mL distilled water

Titrate this mixture to a pH of 4-4.5 with either dilute hydrochloric acid or potassium hydroxide. Store in the refrigerator until needed. It stores well for long intervals, and will probably never ferment. Use chore boy teflon scrubbers in shallow dishes as feeders. Clean out these dishes every 7-14 days depending on the rate of evaporation and contamination with scales etc. Top-off the juice in the feeders every other day.

*available from chemical suppliers such as Sigma but you might try your local bakery. These are common ingredients in many commercially available baked goods.

** frozen pollen is available from most health food stores

On the Web...

There are a large number of Internet sites that focus on butterflies, and many of these include information about Monarchs as well. The sites we have selected to list here include helpful information for those who wish to use Monarchs as an educational tool. Note that the familiar (though usually optional) "http://" prefix has been omitted.

MONARCHS

Baker Wetlands Monarch Butterfly Activity

Lawrence High School students at the Baker Wetlands
Ken Highfill, Lawrence High School, Lawrence, KS
www.usd497.k12.ks.us/~lhs_bakerwl/wetlands.html

The Florida Monarch Butterfly Website

information on the biology and migration of Monarchs
Dale and Peggy McClung, St. Petersburg, FL
adver-net.com/FMonHome.html

Butterflies of Cumberland County, New Jersey

the Monarch migration through Cape May, NJ
Robert D. Barber, Rutgers University, Department of Marine and
Coastal Sciences
www.hsrl.rutgers.edu/mon.mig.html

Monarch Butterflies

Monarch natural history, California Monarchs,
a Monarch lexicon, Monarch organizations
Walter H. Sakai, Santa Monica College, Santa Monica, CA
www.smc.edu/smc/departments/lifsci/sakai/monarch.htm

The Blake School Monarch Butterfly Project

reports of student visits to Monarch roost sites in Mexico,
Monarch facts, 2nd grade projects
Jon Dicus, Blake School, Minneapolis, MN
www.blake.pvt.k12.mn.us/campus/projects/upper/monarchs/index.html

C.R. Hanna Elementary School Butterfly Garden

5th grade class project and pictures of a butterfly garden
Marcia Whitmore, C.R. Hanna Elementary, Orion, IL
web.isbe.state.il.us/mwhitmor/crhanna/5Grade.html

Raising Butterflies: A Hydrogen Isotope Experiment

3rd graders raise caterpillars in a Monarch Watch project
Terry Smith, Granger Elementary, Granger, TX
www.esc13.tenet.edu/granger/monarch.html

World Wildlife Fund Factsheet: Monarch Butterfly

information about Monarchs and Monarch conservation
www.wwfcanada.org/facts/monarch.html

Monarch Butterflies

for teachers who want to raise Monarch butterflies
Joette McCaw, Reedurban Elem. School, OH
199.218.201.5/staffwebpages/mccaw/

Monarch Butterfly Activity Menu

Monarch activities for teachers and students
Naomi Brown, First Colony Middle School, Sugarland, TX
www.gsn.org/web/models/ftbend/newfly.htm

Mrs. Lacson's Kindergarten Home Page

student art and comments about the Monarch migration
Amy Lacson, Highland Park Elem. School, Austin, TX
www.hipark.austin.isd.tenet.edu/home/teachers/grade.k/Lacson/main.html

Project Monarch Butterfly

intermediate students collect data on Monarch butterflies
Rosemary Thornton, Fredstrom Elem. School, Lincoln, NE
ngp.ngpc.state.ne.us/Monarch/monarch.html

Journey North

engaging students in a global study of wildlife migration
www.learner.org/content/k12/jnorth/

Ecotourism: A Tool for Sustainable Development

the impact of and possible strategies for ecotourism
Ron Mader, Eco Travels in Latin America
www.greenbuilder.com/mader/planeta/0596/0596monarch.html

BUTTERFLY GARDENING

The Butterfly Website

gardening, raising butterflies, education and conservation
Rick Mikula, Hole-In-Hand Butterfly Farm, Hazleton, PA
mgfx.com/ButterflyLady/

Butterfly Zone

information on which butterflies you will find in your region and
how to attract them, even in an urban setting
www.butterflies.com/

Minibeast World of Insects and Spiders: Garden Gazebo

sources on creating a butterfly garden
Gary A. Dunn, Young Entomologists' Society
www.tesser.com/minibeast/gazebo.htm

North American Butterfly Association

regional information and the "Butterfly Garden News"
www.naba.org/help.html

(CONTINUED ON THE NEXT PAGE)

The Monarch Watch Web Site

www.keil.ukans.edu/~monarch/

Notes from the webmaster...

The Monarch Watch web site is quietly undergoing a transformation. We've been hard at work adding lots of material and the "New and Improved" site should be up and running in June. The address above will take you to the front door of the new site, so be sure to keep it bookmarked! The site is also getting a "tune up" and has already been moved to a faster server, so your access to Monarch Watch should be smoother and faster!

New "Monarch Watchers" Section

This is *your* chance to shine on the web! This cyberspace will include: photos and drawings of Monarchs, Monarch Watchers and classroom projects; Monarch tips and tricks that you have discovered; suggestions for classroom and group projects; accounts of your experiences with the Monarch Watch program; helpful web sites and a whole lot more! Please feel free to contact us and let us know what you want to see in *your* section. More importantly, send us your photos, letters and other contributions so that we can get them online today! If you're sending photographs, please include credits, a brief description and whether you'd like it returned. We look forward to hearing from you!

Our visitors...

The number of visitors to the Monarch Watch web site continues to grow; we estimate that we presently have about 200 visitors every day. The number of visitors from foreign countries is increasing as well, with 53 countries having visited our site so far. Do you know where these countries are? Antigua-Barbuda, Barbados, Brunei, Costa Rica, Czech Republic, Croatia, Dominican Republic, Estonia, Indonesia, Malta, Philippines, Portugal, Taiwan, Thailand, Trinidad-Tobago, Venezuela.

We are always looking for new material for the site. If you have access to photos (milkweed, Monarchs etc.) or other information you feel should be available to Monarch Watchers, please send it to us. We will gladly give you credit for your contribution.

Thanks!

Other News

Urquhart's Tagging Data Summarized

We recently added a summary of 34 years of Monarch recovery data and illustrated these data on six maps.

Monarch Bibliography

More than 1000 of the most important scientific papers and most useful literature relevant to Monarch curriculum were added to our resources section. The bibliography is organized by topic and includes key words and descriptions for many references.

New Curricular Materials

Many new classroom materials and projects will soon be available online. Most of these will be incorporated into the Monarch Watch CD-ROM - coming soon!



(ON THE WEB CONTINUED)

U of K Entomology Youth Facts: Butterflies

explore several activities relating to butterflies Stephanie Bailey,
U of K Department of Entomology
www.uky.edu/Agriculture/Entomology/entfacts/misc/ef006.htm

Butterfly Gardening and Conservation

designing and maintaining a butterfly garden
Missouri Department of Conservation
www.state.mo.us/conservation/nathis/insects/butterf/butterf.html

Butterfly World's Regional Gardening

lists butterflies and host plants by US regions
www.butterflyworld.com/campaign.html

Answer to "What's unusual..."

(SEE "WAYWARD MONARCHS" ON PAGE 9)

This Monarch was tagged in Kansas City, MO and photographed "in copula" near the coast of Alabama. Mating is uncommon in migratory Monarchs.

"El Convenio" Plan

An alternative approach to the purchase of tag recovery data in Mexico

In late February there was an extensive discussion on Dplex concerning the lack of a coordinated effort to obtain the information on tagged butterflies collected at the roost sites in Mexico. At present, most of the recovery information is relayed to us by visitors to the roosts, often researchers and others concerned about Monarchs, who have frequently "paid" for the tags or information about them.

The practice of paying for tags began before Monarch Watch started in 1992. At first glance, this seems like an innocent practice that motivates those who find the tags to save them. However, with an increase in tagging in recent years, interest in the recoveries has also increased and so has their "price". This is fair enough, it is simply supply and demand. But there are at least two possible negative consequences of this practice, the potential for fraud and increased disturbance at the roosts by those seeking valuable tagged butterflies. Regardless of the good intentions of many people in the communities near the roosts, if the price of tags approaches that of a day's wage, and it is close to that now, there will be poaching of Monarchs at the roosts in the same way that there is poaching of the trees within the preserves in the off season. In effect, buying recovered tags is buying "data" and this is a no-no in science since even the hint of false data can cast doubt on the credibility of the enterprise. Continuation of this practice threatens both the science we wish to foster and the Monarch butterflies we wish to protect. It seems clear that an alternative approach is needed.

The roost sites are located on "ejidos" or communally owned areas which are managed by the local inhabitants. This type of land management and communal organization has few analogs in the United States and Canada. Income of the inhabitants of these communities is generally low and resources available to the community leaders to improve the infrastructure of their ejidos is often quite limited. The basic plan for tag recovery is to develop a cooperative program between these communities and Monarch Watch (and/or other organizations/individuals who wish to contribute). In return for helping to coordinate the collection of the recovery data, Monarch Watch will provide support for the local community. The arrangement would take the form of a contract or "Convenio" with the responsibilities of each party clearly defined. In order to provide the leadership of the ejidos with sufficient incentive to cooperate, it will be necessary to identify significant needs in each community which can be provided by Monarch Watch. These needs might involve displays for the education of the public at the roosts, computers, books or other resources for their schools, or even more basic materials. The cost to Monarch Watch would probably be in excess of \$3000 per year, an amount which is about 5-20 times the present cost of the purchased tags. However, this should be money well spent since the agreement will assure integrity to the data collecting process, provide support for the community, rein-

force the value of the butterflies to the local residents, and help develop a sense of common purpose and good will between the local people and others interested in conserving Monarchs.

The agreements would be negotiated by a representative of Monarch Watch who would visit with the community leaders in November of each year coincident with the arrival of the Monarchs at the roosts. Funds to support this community outreach would come from private and corporate contributions to Monarch Watch. If you would like to make a contribution toward this effort, please see the Contribution and Order Form insert.

MONARCA...

Butterfly beyond boundaries

The Monarca Travelling Exhibit, produced by the Canadian Museum of Nature, the Canadian Nature Federation, and the Mexican Embassy in Ottawa, is devoted entirely to the Monarch butterfly.

Scheduled appearances:

Cleveland, OH - Cleveland Museum of Natural History, November 1997 through January 1998

Rochester, NY - Rochester Museum of Natural History, March 16, 1998 through June 2, 1998

Dates pending:

Muncie, IN
Cincinnati, OH

Should any major museum be interested in hosting this very large exhibit, please contact:

Monique Horth
Canadian Museum of Nature
Box 3443, Station D
Ottawa, Ontario, K1P 6P4
mhorth@mus-nature.ca

Details contributed by Don Davis

Hydrogen Isotope Study

Isotopes 1997: Project Announcement

The collaborative project initiated in 1996 to establish the hydrogen isotope signals in Monarch butterflies from Canada and the United States east of the Rockies will continue on a limited basis in 1997.

In spite of the success of last year's program, we weren't able to recruit volunteers from some areas and we need to plug these gaps in the distribution this year to have a complete profile of the isotope ratios in plants and Monarchs for all of Canada and the US east of the Rockies. I know many folks from the areas west of the Rockies would like to participate but our funds for the rearing kits (\$15 each) and the funds available to Wassenaar and Hobson for the isotope analysis are too limited to expand the study to include the areas west of the Rockies at this time.

Wanted: Volunteers!

This year we need applicants from the following states and provinces: Alabama (3), Colorado (3), Florida (north of Miami) (2), Georgia (3), Kentucky (middle) (1), Louisiana (2), Mississippi (3), Montana (3), Nebraska (western) (1), North Carolina (coastal and western) (2), South Carolina (central and eastern) (2), South Dakota (2), Texas (western) (2), Wyoming (3) New Brunswick (2) Newfoundland (2), Nova Scotia (2) and Saskatchewan (2). The numbers in () indicate the number of volunteers which will be selected from each state or province.

If you live in one of these areas and wish to participate, please read the announcement describing the project on the web site so you are fully aware of all of the conditions and commitment required for this project. An application form is provided. Please complete and mail or fax this form to us ASAP. Selected volunteers will be notified at the beginning of July.

Please see "How to Reach Monarch Watch" on the back cover for all contact information.

Do they return?

Do Monarchs which began their migration in the northeast or midwest return to these areas in the spring? The hydrogen isotope method can be used to answer this question. Next spring, if you have an opportunity to collect Monarchs from 10 March to 15 May, anywhere east of the Rockies, they could be used for this study. The Monarchs should be placed in an envelope (with the location, date, collector and condition of the specimen written on the outside) and then placed in a freezer. At a later date, the Monarchs can be sent to Monarch Watch and we will forward them to Canada for analysis.

Isotopes 1996: Project Update

Last year we solicited volunteers to rear Monarchs on foliage of milkweeds exposed only to natural rainwater. The volunteers did an outstanding job, and 88 of 99 volunteers returned samples of plants and butterflies for analysis of their hydrogen isotope contents. This is an incredible success rate for this kind of study and we wish to publicly thank all who participated in this research effort. The responses from the volunteers were extremely positive and only a few had trouble rearing the Monarchs. We also wish to thank those who applied for this program but were not accepted because of their location or the fact that we had too many volunteers from some areas. For many of those who received the rearing kits, the experience was very exciting. At least two groups set up web sites (visit one at: www.esc13.tenet.edu/granger/monarch.html) to describe their Monarch rearing adventures and others sent us long, enthusiastic e-mail messages and letters.



Kari Rogg prepares a mountain of Monarch rearing kits for the hydrogen isotope study.

Analysis of the samples by Len Wassenaar, Keith Hobson and their team are underway and the preliminary results are very exciting. The ratios of the hydrogen isotopes in the plants and butterflies are consistent with ratios expected from rainfall in each of the geographic areas. These ratios will give a general idea of the geographic origin of Monarchs collected in remote locations; however, analysis of these same specimens for carbon isotopes and sulfur content will permit us to define these origins even more precisely. Once our colleagues in Canada finish analyzing the specimens and establishing the "home signals" for Monarchs throughout eastern North America, it will be possible to use the isotope content of Monarchs to answer questions about the geographic origins of the butterflies that reach the discrete roosting sites in Mexico. We may also be able to determine whether Monarchs attempt to return to their region of origin. Results of the project will be added to our web site and announced in the Season Summary.

Regional Coordinators

During our first season (1992) we sent out two news releases asking for volunteers to tag Monarchs. The response to these notices, which appeared in several leading newspapers in the midwest and Texas, was overwhelming and we were soon putting in 16 hour days answering inquiries and sending out tagging kits. We needed help and decided to decentralize the work load with the assistance of regional coordinators. Bill Calvert (Austin, TX) became our first regional coordinator. Bill now works regularly with 700 Monarch Watch volunteers throughout Texas and publishes the Texas Monarch Watch Newsletter. We are now lucky enough to have the assistance of a number of regional coordinators.

The following is a list of coordinators with information on how they can be contacted. If you live within a region covered by a coordinator, you should send your membership check to them and they will send you the basic tagging membership kit in August. Please do this as soon as possible (before 10 July) so the regional coordinators know how many membership kits 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.

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QUEBEC

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1-800-265-6055 (English & French)
Fax: 514-481-1319

1997 Monarch Watch Programs

Tagging memberships in 1997

The annual membership fee is \$10, which helps defray some of the cost of the materials and postage. Monarch Watch members receive: (1) a tagging kit containing 20 tags, 5 practice tags, adhesive, instructions, and short pre-migration newsletter - sent in August and (2) the season summary - sent the following May. If you expect to tag more than 20 Monarchs, additional 100-tag sheets are available for \$5 each.

All tag orders for the 1997 season must be received by October 10, 1997.

If you wish to become a member of the Monarch Watch, please completely fill out the order form insert with your name, address, and order information. Include a check or money order payable to Monarch Fund for the appropriate amount and send it to our address listed on the back cover (SEE "HOW TO REACH MONARCH WATCH"). Please mail your responses as soon as possible in order to avoid delays in the shipping of the kits in August. If you have any other questions or requests, please contact us via Email, fax or telephone. We welcome tax-deductible contributions and offer a choice of educational premiums in return. We also have several promotional and educational items available.

Monarch Rearing Kits

Monarch Watch is funded through contributions made by participants and by individuals and organizations interested in promoting science education in primary and secondary schools. For a \$25 contribution (\$15 is tax-deductible), we will send a Monarch Rearing Kit to the student or school of your choice. We offer two options:

Rearing Kit #1 contains six mature larvae which will pupate 2-3 days after arrival - these will require no additional feeding.

Rearing Kit #2 contains twelve 3-5 day old larvae which should be transferred to milkweed plants and reared in the classroom; these will pupate in about two weeks. **Do not order Kit 2 unless you have milkweed plants available!**

In both cases, the adult butterflies will emerge 10-14 days after pupation (formation of the chrysalis). The butterflies can be used for classroom instruction, student projects, or to start a breeding population in the classroom. A detailed set of instructions is provided with each kit.

Please note: We do not ship tags or Monarchs to areas west of the Rocky Mountains. If you contact us, we will be glad to direct you to similar programs in your area. Thanks!

Other Items

Other items we have available include a Monarch Watch "migration" T-shirt, printed both back and front in black and brilliant Monarch orange (SEE PHOTO ON FRONT COVER); a Monarch life cycle poster that illustrates the transformation of the Monarch from egg to adult and includes the exact age at each stage; packets of seeds from 4 milkweed species (common milkweed, swamp milkweed, blue vine milkweed and tropical milkweed) - these seeds take approximately 8-12 weeks to grow into mature plants; an official Gulliver (our "logopillar") pin; non-fermenting butterfly nectar mix; and copies of previous season summary newsletters. (SEE ORDER FORM INSERT FOR COMPLETE INFORMATION)



This beautiful 18" x 22" full-color laminated Life Cycle Poster is now available from Monarch Watch for \$10.00 (shipping included). It illustrates the transformation of the Monarch from egg to adult and includes the exact age at each stage. It's a great tool for both teaching and reference.

ORDER YOURS TODAY!

Monarch Watch
c/o Orley R. Taylor
Department of Entomology
Haworth Hall
University of Kansas
Lawrence, KS 66045

ADDRESS CORRECTION REQUESTED

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:

US Mail: Monarch Watch - c/o O.R. Taylor - Dept. of Entomology - Haworth Hall - University of Kansas - Lawrence, KS 66045

Telephone: 1 (913) 864-4441

Toll-Free Telephone: 1 (888) TAGGING

Fax: 1 (913) 864-4441 - or - 1 (913) 864-5321

Email: monarch@ukans.edu

Online: www.keil.ukans.edu/~monarch/

Monarch Watch List: send the message "info Dplex-L" to Listproc@listproc.cc.ukans.edu for information on how to join in.

Please note that our (913) area code will change to (785) on 20 July 1997
