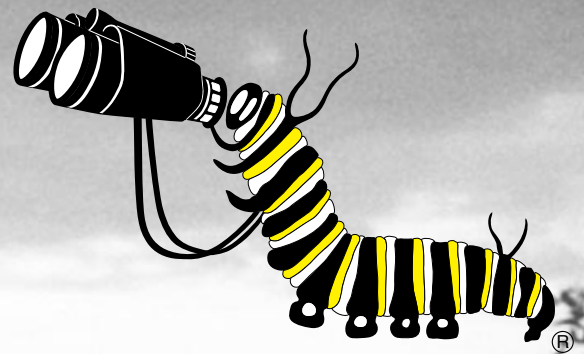


# Monarch Watch



Dedicated to Education, Conservation and Research MAY 1998 • VOL. 6 • NO. 1



1997 SEASON SUMMARY

# 1997 SEASON SUMMARY

## TABLE OF CONTENTS

INTRODUCTION.....	3
HELPING MONARCHS.....	4
TEACHING WITH MONARCHS.....	5
CHALLENGES TO STUDENTS.....	6
ALL ABOUT.....	8
MONARCH MATH.....	9
MONARCHS AND THERMALS.....	10
MONARCH MUTANTS.....	11
MONARCH POPULATION DYNAMICS.....	12
MONARCH REARING TIPS.....	14
"BUTTERFLY" AROUND THE WORLD.....	15
MONARCHS AND GRANTS.....	16
BUTTERFLY GARDENING.....	17
MONARCH MODEL FOREST PROGRAM.....	18
MEETING IN MORELIA, MEXICO.....	19
NEW MONARCH TAGS.....	20
MONARCH RECOVERY MAPS.....	21
1997 SEASON TAG RECOVERIES.....	22
MONARCH RECORDS.....	26
MONARCHS HEAD FOR THE ISLANDS.....	27
MONARCH POPULATIONS '97-'98.....	28
1998 SPRING MIGRATION.....	30
MONARCH BIBLIOGRAPHY UPDATE.....	31
THE BEST OF DPLEX.....	32
FREQUENTLY ASKED QUESTIONS.....	34
LETTERS TO MONARCH WATCH.....	36
MONARCH FUN AND GAMES.....	38
NEWS OF THE WEB.....	40
MONARCH WATCH REGIONAL COORDINATORS.....	41
1998 MONARCH WATCH PROGRAMS.....	42
NEW FROM MONARCH WATCH.....	43
HOW TO REACH MONARCH WATCH.....	BACK COVER

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

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

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

## THANK YOU, THANK 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 and staff at KU who so ably assist with the program - Jim Lovett, Dana Wilfong, Stephanie Darnell and the whole Critter Crew.

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 again 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 few of us here to respond to everyone! We did our best, but we just couldn't keep up with it all.

*On the cover: You're never too young to become a Monarch Watcher! Two-year-old Haley helped capture and tag more than 300 Monarchs at the Baker-Haskell Wetlands last fall.  
Photo by Jill Wells*



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by the

**National Science Foundation**

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

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# INTRODUCTION - WHAT A YEAR!

This publication represents the sixth season of Monarch Watch. Our summaries originally provided details of the results of our tagging program, but each year we have expanded our coverage in areas of education, conservation and research as interest in Monarchs has increased.

Concern for the long term survival of the eastern Monarch population has increased in the last two years as news accounts and scientific reports recount logging activity within the Monarch Reserve. International cooperation and the activities of numerous non-governmental organizations (NGO's) is needed to assure the long term survival of the Oyamel forests which provide the overwintering habitat for Monarchs. Fortunately, the governments of Mexico, Canada and the United States have begun discussing conservation issues (PAGE 19) and several NGO's are attempting to provide assistance to the communities in ways which will help preserve the forests (PAGE 4).

This was the best year to date for our tagging program. In 1997 we issued more tags (>192,000) and had more butterflies tagged (76,000) and recovered at distances of greater than 10 miles (84) than in our two best years of tagging combined. Thanks to the cooperation of David Marriott of the Monarch Program (San Diego) more tagged Monarchs were recovered in Mexico this winter than in all previous years of our program combined. Part of our success can be attributed to the new self-adhesive tags (PAGE 20) we developed in 1997. These tags are easy to apply, apparently persist for the life of the butterfly and have no discernible effect on flight performance or survival of the butterflies. This is a major improvement over the tagging methods used previously.

In addition to tagging, we encourage participation in student/scientist collaborative projects such as size and mass (PAGE 25), isotope tracking (PAGE 9), flight vector studies and larval monitoring.

Education is the main focus of our program and in this issue you will find several suggestions on how Monarchs can be used to introduce scientific concepts and some really neat biology into the classroom. Included in this coverage are several tips on rearing (PAGE 14) and information on butterfly gardening (PAGE 17). To facilitate the teaching of Monarch biology and conservation we have produced new posters and videos (PAGE 43).

We try to keep up-to-date with all the news, magazine articles, and scientific literature concerning Monarchs and summaries on these subjects can be found throughout the text.

ADOPT-A-CLASSROOM (PAGE 4) is our newest initiative. We have been seeking a way for Monarch Watch to make a meaningful contribution to the welfare of the communities in the vicinity of the Monarch overwintering sites in Mexico. With your support, we hope to raise \$20,000 for this project in the coming year. Classrooms in Mexico need supplies and we are undertaking a fundraising effort to purchase materials for Math and Science Kits (\$100/classroom)

designed specifically for the Mexican educational system. We are excited about this program. It is consistent with our educational philosophy and objectives, and offers the opportunity to make a significant contribution to the education and welfare of the young people in the Monarch Reserve. This will be a continuing program and each year we will endeavor to improve the ways in which we can provide assistance to the schools and ejidos in the Monarch Reserve.

For the last three years Monarch Watch (Chip Taylor) and Monarchs in the Classroom (Karen Oberhauser) have benefited from a National Science Foundation grant to support development of curricular and instructional materials on Monarch butterflies. At Monarch Watch we have used this support to develop the Web site, the electronic discussion list, curricular materials, and to provide materials and assistance for those rearing Monarchs in the classroom. Additionally, we have made a substantial effort to engage students in original research through student - scientist collaborative projects. Karen Oberhauser, working with numerous teachers in workshops and several graduate students, produced very popular curriculum guides appropriate for K-8 and a well illustrated Field Guide to Monarch Caterpillars (PAGE 5). A migration game is under development as well and will be available soon. If we wish to continue to develop additional curricular materials, we need to obtain a source of funds earmarked for this purpose. This won't be easy; money for development is difficult to identify and the competition is keen for these funds. In terms of curricular development, we are only half done. We have undeveloped projects for primary, junior high, and high school classrooms - in some sense we have just begun. Monarch Watch and the service and materials we provide will continue whether we succeed in obtaining funding for further development or not.

One of our future projects will be to develop Monarch Science Fairs (PAGE 16). Karen Oberhauser pioneered this concept last year and it proved to be very successful. This is a promising way of accomplishing our objective of getting students involved in original research.

We also plan to build on the success of our student-scientist collaborative projects. We have several projects in mind and these will be announced on the Monarch Watch List and posted to the Web site once they are developed.

Jim Lovett, master of all technologies for Monarch Watch, continues to improve our award-winning Web site (PAGE 40) and is working on our CD-ROM. We have been promising to produce this disc for some time; unfortunately, we have been chronically shorthanded and this project has been repeatedly delayed. With the recent addition of Stephanie Darnell as Assistant Director of Monarch Watch, Jim should have more time for this project and we hope to release the CD before the beginning of the 1998 school year.▼

# HELPING MONARCHS

If you are concerned about Monarchs and wish to assist with the efforts to conserve the overwintering sites in Mexico, you could contribute to one or more of the following programs:

## MONARCH WATCH - ADOPT-A-CLASSROOM PROGRAM

(SEE BOX BELOW)

Our objective is to provide instructional materials, particularly math and science kits, Spanish language story books, references and school supplies to each school classroom in the Monarch Reserve.

Make checks payable to Monarch Watch/Classroom Fund, and mail to: Monarch Watch, Department of Entomology, University of Kansas, Lawrence, KS 66045

### ADOPT-A-CLASSROOM

Last year we pledged, under the title of El Convenio, to provide resources to the communities (ejidos) in the vicinity of the overwintering areas. Our objective was to find a way to assist the communities with the understanding that they would in turn assist us with the recovery of information on tagged Monarchs. During a visit to the El Rosario ejido in November we defined how Monarch Watch can help the ejidos. The solution, which is consistent with our educational objectives, is to obtain instructional materials for the local schools.

The schools in the Monarch Reserve are simple cinder block buildings. The classrooms are small with high windows, many have poor lighting and most are crowded with crude and uncomfortable desks for the children. The teachers write lessons on worn-out blackboards. Basic textbooks are available, but workbooks, writing materials and even paper are scarce. Library resources and supplemental teaching aids, which have proven to be so effective in teaching the concepts of math and science, are totally lacking in these schools. This is where we can help. Working with innovative teachers, we have designed a basic math and science kit which contains instructional materials appropriate for the classrooms in Mexico. These kits cost \$100 each and we need your help in raising funds to purchase the materials for these kits.

For \$100 your group can ADOPT-A-CLASSROOM. We will purchase the materials, assemble the kits and deliver them in the name of your group or in the names of multiple contributors to the schools and classrooms in Michoacan. We will also assemble and deliver, and in some cases purchase, classroom supplies, Spanish language story books, and reference materials for these schools.

If you wish to contribute to these efforts, please use the form at the right and mail it to us at the above address. As a premium for each contribution of \$150 we will send you your choice of any one of our large posters, The Butterfly King/Gulliver Story Video or a Monarch Watch Migration T-shirt and for contributions of \$100, we will send you a Monarch Life Cycle poster.

## MONARCH BUTTERFLY SANCTUARY FOUNDATION

The Monarch Butterfly Sanctuary Foundation (MBSF) is working to develop a model economic program by working with one ejido, a group of local families, that owns land in the Sierra Chincua sanctuary, the largest and most pristine Monarch overwintering area in Mexico. MBSF will tie economic aid, in the form of educational and economic development, to decreasing the number of trees cut in the forest.

Make checks payable to Monarch Butterfly Sanctuary Foundation (MBSF) and mail to: MBSF c/o Karen Oberhauser, 2078 Skillman Avenue, Roseville, MN 55113 USA.

## LA CRUZ HABITAT PROTECTION PROJECT

The goal of La Cruz Habitat Protection Project is to provide resources for reforestation of the overwintering sites in the Monarch Reserve. Reforestation should provide a source of income for the ejidatarios and eliminate the pressure to continue logging in the locations used by overwintering Monarchs.

Make checks payable to MRF/The La Cruz Habitat Protection Project and mail to: MRF c/o Bob Small, 260 Mather Street, Oakland, CA 94611, 1.510.658.6758, Email [danaus@pacbell.net](mailto:danaus@pacbell.net)

### YES - I (WE) WOULD LIKE TO ADOPT-A-CLASSROOM!

- ☐ Please accept this contribution of \$150.00 and as a premium send (choose 1 for each \$150.00 contribution):
- ☐ History and Purpose of Monarch Tagging Poster
  - ☐ Fall and Spring Migration Patterns Poster
  - ☐ Origins of Tagged Monarchs Recovered in Mexico
  - ☐ Monarch Overwintering Sites in Mexico Poster
  - ☐ The Butterfly King/Gulliver's Story Video
  - ☐ Migration T-shirt (circle size) XXL•XL•L•M
  - ☐ I do not wish to receive a premium, thank you.
- ☐ Please accept this contribution of \$100.00 and as a premium send:
- ☐ Monarch Life Cycle Poster
  - ☐ I do not wish to receive a premium, thank you.

Name \_\_\_\_\_  
Organization \_\_\_\_\_  
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# TEACHING WITH MONARCHS

## INTRODUCTION (AKA PEP TALK)

One of my motivations for starting Monarch Watch was to provide the ideas, support and encouragement - a kind of mentoring - that would help students initiate independent



*Chip and his "Critter Crew" - the team of students responsible for maintaining our year-round Monarch population and making sure you get your critters on time! Front Row: Jen, Mary, Chip and Erin; Back Row: Max, Ryan, Jess, and Jason.*

research. This has not worked well, at least I don't think it has. We haven't received the number of student research reports that I had expected. Our attempt to reach students is not a personal approach; it's through the electronic medium and written materials. My style is more Socratic than cookbook and this may put some people off. Karen Oberhauser says my challenges and puzzles are too hard and I don't include enough background or "how-to" methodology in my challenges. This is true, and there is a reason. I hate cookbook science. I hated it as a student and I do everything I can to avoid this kind of teaching as a university professor.

Although cookbook science has its place, students seldom experience a sense of discovery; there is no new learning since the outcome is foretold and there is no failure. Failure is important. New discoveries are derived from failure and not repetitious learning of a recipe provided by someone else. I want students to fail and to learn from these failures. It takes courage on the part of both the student and the teacher or mentor to fail. The system, however, cautions

## IN SCIENTIFIC AMERICAN...

Monarchs and Monarch Watch were the subject of a two-page article which appeared in the "The Amateur Scientist" section of the September 1997 issue of *Scientific American*. The readership of this magazine is primarily composed of non-scientists. These monthly features, written by Shawn Carlson, support the notion that anyone, regardless of their background and training, can become involved in scientific research. Monarch Watch offers this opportunity and the article describes how amateurs can become involved in studying Monarchs using materials developed by Monarch Watch. Check it out!

against failure. We aren't supposed to let our students fail. But, triumph over failure is true success and it leads to discovery, builds character, self esteem and self confidence. Isn't this what we should impart to our students? We need a generation of creative problem solvers, young people with the courage to take on challenges, but we seem to be intent on producing knowledgeable test-takers or performers. What's the answer? How do we get the students away from Nintendo, television and just hanging out? How can we provide them with opportunities for self discovery and the motivation to create, to investigate and to learn? I don't know. Better mentoring perhaps. Let's try it. I like the commercial slogans "just do it" and "no fear" since, for me, they represent a positive attitude that can be taken when confronting a new situation. Many students and teachers fear science. They think they can't do it and it's something only trained people can do. Wrong! Everyone can do science but it won't happen unless we start. Just do it!

## LAST YEAR'S CHALLENGE

The following students answered the challenge - you can too! Last year's challenge to students under the age of 12 was to design an experiment using feeders and nectar to answer any of these questions:

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

We received only one response to this challenge from Ann Will's second grade class at Council Rock Primary School in Rochester, New York. So, from this group, we have chosen three winners - one for each question: Kuangyi Chen (Question #1), Tomasz Kula (Question #2) and Jaya Wen (Question #3). The winners will each receive a Monarch Watch T-shirt and a gulliver pin. The decision was very difficult as each and every entry was well thought out and very interesting. Congratulations to the whole second grade class at Council Rock Primary School. ▼

## CURRICULAR GUIDES

The *Monarchs in the Classroom* curriculum guides are now in their second edition. They include information on Monarch biology and incorporate activities and exercises appropriate for each grade level: K-2, 3-6, and 6-8. Each booklet (approximately 200 pages) is available for \$16.50\*. A Field Guide to Monarch Caterpillars is also available for \$8.00\*. All booklet orders should be sent to:

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

\*SHIPPING INCLUDED. NO PURCHASE ORDERS PLEASE.



# CHALLENGES TO STUDENTS

Each year we pose some questions and challenges for students. We have tried to pose questions that students might answer with relatively simple experiments. Our goal is to promote independent research by students and many, if not all, of the ideas we've suggested could be adopted for science fairs. A few teachers have told us that they use the ideas in these challenges as the basis for discussions in their classes. We hope this continues but we would really like to receive more feedback concerning the usefulness of this approach. The challenges from previous Season Summaries will be assembled and placed on the Web site.

Most of our challenges to date have been appropriate for primary and middle school students. This year we have included some real "toughies" for high school and college students. These are the kinds of questions posed by scientists who study Monarchs.

## PRIMARY AND MIDDLE SCHOOL STUDENTS:

### WHAT IS THE BEST FOOD FOR ADULT MONARCHS?

Adult Monarchs feed on nectar from flowers. Flower nectar used by butterflies usually contains sugars (usually less than 15%), amino acids (small yet significant amounts), and trace amounts of minerals (salts), and vitamins. When we bring Monarchs into the classroom we need to feed them to keep them alive but how can we best do this? How can we mimic the nectar produced by flowers? This is difficult since there is much variation among flowers in the amounts of sugar and amino acids in the nectars. Logically, honey dilut-

bers in shallow cups), two cages for butterflies (see our Web site), and newly emerged or migratory Monarch butterflies. To obtain the best results we should only use male Monarchs (why?) in our cages. You can keep track of individuals by writing a number of each on the discal cell of the wing. What should you measure? Minimally you need to measure how long each butterfly lives but you could also measure the amount of activity and feeding, position in the cage, and the condition of the butterfly upon death.

### ARE CATERPILLARS ATTRACTED TO OR REPELLED BY LIGHT?

Adult Monarchs are attracted to light and will usually fly to the overhead lights or windows if they escape in the classroom. But, what about larvae? Are they attracted to or repelled by light? How could we find out? I haven't tried this but here is a suggestion you can use as a starting point. As you proceed, you may figure out a better method - let us know! Start with two half-inch dowels placed at right angles to each other at their centers (forming a cross). The dowels should be notched and fitted together so that the arms of the cross are at the same level. Glue a circular platform to the center of the cross. This is your caterpillar launching pad. Attach the cross to the top of a vertical rod and set up the apparatus in an area where you can have three of the arms relatively dark and one with a light source (start with 40 watt) placed at 10 inches from the end of one of the arms. The caterpillars (use 5th instars) are placed in the center. There is a 25% chance they will go to the light if light has no influence on the direction they take. If they are attracted to the light the % will be much higher or if repelled much lower. Numerous trials will be needed and simple statistics can be used to determine if the deviations from the expected outcome are significant. This experiment can lead to others such as the relationship, if any, between light and orientation with respect to gravity.

## RAISING MONARCHS AT HOME

If you can't raise Monarchs in your classroom, or even if you can, it might be valuable to have the children raise Monarchs at home where they can make numerous observations each day. One of the teachers who works with Karen Oberhauser has each student grow a milkweed plant from a seed, then gives each of them a Monarch egg to follow through its entire development. Karen reports that the journals and observations produced by this teacher's students are incredible.

ed with water should be the best substitute for nectar followed by a 10-15% sugar water solution. The problem with both of these is that they are easily contaminated and provide a good growth medium for yeast. As the yeast population increases, it produces alcohol and the butterflies either stop feeding or get a little tipsy. Therefore, if we are to run long term tests on the suitability of a nectar substitute, we need a nectar that won't ferment. We have created such a nectar (SEE "NECTAR" ON PAGE 14). The sugar content is roughly 15% and the acidity (ph of about 4) is so high that no yeast can grow in the medium. We also add pollen to the mix and this provides amino acids, salts and vitamins. But how good is it? We don't know. We need to compare our mixture with non-fermenting "nectars" that are available in the supermarket - like Gatorade. Yep, Gatorade is sure worth a try and we might be able to maintain Monarchs on other non-fermenting juice mixtures or even soft drinks. It would be nifty if someone would run the tests. How do we compare two things and what do we measure? To make comparisons we need two types of "nectar", several feeders (pot scrub-

## HIGH SCHOOL AND COLLEGE STUDENTS:

### What is the average duration of travel for Monarchs from a northern point of origin to a specific southern location?

There is no direct way to answer this question. The tagging data doesn't help because there are too few recoveries of live tagged butterflies and it is only from the recoveries of

live Monarchs that we get precise information on time intervals. Nevertheless, we can turn this question into an interesting modeling and statistical exercise by defining some parameters. Suppose that 1000 Monarchs leave Brighton, Ontario on the 5th of September - when will those that survive the trip reach Mexico? We know that the Monarchs arrive at the overwintering sites between 1 November and 1 December. This fact allows us to define the shortest and longest possible intervals and therefore the maximum and minimum average number of miles per day to reach the roosts. The next question concerns the temporal distribution of arrivals for the cohort. Are we dealing with arrival times that are normally distributed or are they skewed to early or late times of the month? If we are dealing with a normal distribution, with mean arrival date of 15 November, we can calculate mean number of miles per day for the cohort. There is perhaps a more interesting question here. The departure time given for our cohort is close to the average date when Monarchs are seen leaving Brighton. What if we have a cohort of Monarchs that leaves Brighton three weeks later, and some do each year, when will these arrive in Mexico. Do the late Monarchs have to travel faster?

### **WHAT PHYSICAL FACTORS CUE THE INITIATION OF DIAPAUSE AND HOW WOULD YOU DETERMINE WHEN LOCAL BUTTERFLIES ARE BECOMING NON-REPRODUCTIVE?**

At the northern limit of their summer distribution (southern Canada), Monarchs which emerge as adults after 20 August are non-reproductive. Their endocrine system, specifically the production of juvenile hormone, is turned off, or at least down, and the reproductive systems are atrophied. Mating behavior is absent and the butterflies are described as being in reproductive diapause. The migration begins during the last few days of August and, as far as we can ascertain, nearly all of the fall migrants are non-reproductive. Yet, in eastern Kansas, at the time these events are occurring in the north, most of the butterflies appear to remain reproductive until 9-12 September when the first wave of migrants arrives. There are two related questions to answer here: What are the factors that result in the induction of diapause and when do the new butterflies in Kansas become non-reproductive? Your assignment is to describe how you would design experiments or tests to answer these questions.

Here is a little additional background that might help you answer these questions. The generation time is temperature dependent and varies from 27-40 days. There are four life stages in Lepidoptera with the following development times for temperatures ranging from 72-82°F.

Egg: 3-4 days

Larva: 12-16 days

Pupa: 9-12 days

Adult: 2-6 weeks in summer

The larva goes through 5 instars and during the last 5 days of the last instar, the caterpillar acquires most (>80%) of its mass. The pupa is a quiescent stage during which the tis-

sues are reorganized to form the adult butterfly.

### **HOW WOULD YOU ESTABLISH THE ENERGY BUDGET FOR MIGRATING MONARCHS?**

Monarchs may well be the only organism that gains in mass as it migrates. Most species feed extensively before initiating a migration and decline in mass as fatty tissues are metabolized to fuel the migration. Hawks migrating from California to Panama do not feed for 5 days or more and sometimes arrive so weakened and depleted of reserves that they can be picked up by hand. Monarchs, however, feed on the nectar of flowers en route and they appear to convert the carbohydrates from floral nectar into fatty tissue. The acquisition of this "fatbody" appears to be crucial to the survival of the overwintering Monarchs since they seem to rely on the metabolism of these fats to get through the winter. To fully understand the relationship between fat storage and survival we need to know the input/output of the system. In other words, we need to define the energy budget for the migrating and overwintering Monarchs. How would you establish an energy budget and determine (estimate) the total number of calories needed to sustain a butterfly that migrates and lives for 8 months? Break the system down into its components and show how you might derive an estimate of the energy needed.▼

### **"GOOD SCHOOLS"**

In a special report in its October 27, 1997 issue, TIME magazine asked, "What Makes a Good School?" The study of Monarchs is given as an example of how to involve students in inquiry / active learning. The article by Steve Wulf begins:

*On a beautiful fall afternoon not long ago, all 120 eighth grade students and four of their teachers at the Olson Middle School in Minneapolis, MN, walked across a grassy playing field down to nearby Shingle Creek. For the past five weeks, they had been raising monarch butterflies - from caterpillar through chrysalis - and now 30 of them were ready for release.*

*Raising butterflies isn't all that easy, as the Olson eighth-graders discovered. Every other day, the students would gather milkweed pods for their charges to eat. They kept journals, which they took home to their parents for evaluation. They rushed in on Mondays to see how their monarchs were doing, but they also struggled with large issues when one of them died.*

*After the butterflies were relocated to long tubes of bridal-veil material, the kids gingerly placed them on sponges filled with honey and water, then took delight as the creatures learned to go to the nectar on their own. Two days before their release, the students ever so carefully attached tiny tags to their hind wings - tags that a University of Kansas professor would use to monitor their migration to Mexico.*

The larvae for this project were supplied by Karen Oberhauser and the tags by Monarch Watch.

# ALL ABOUT...

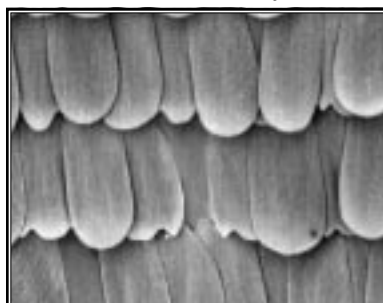
## COLOR

Why are things different colors? Why, for example, are Monarch eggs white, small larvae pale with dark lines, large larvae with black yellow and white bands, pupae emerald green with gold spots and adults orange, black, white and yellow? To answer the *why* question, we must first ask - what are the functions of colors? A list of these possible functions gives us the basis for developing hypotheses concerning the adaptive value of color for the different life stages. Testing our hypotheses will be difficult but it is still useful to discuss all the alternatives and to consider which is most plausible given the available evidence. This color question can easily be developed into an active learning exercise as we have done with Gulliver's Story (SEE PAGE 43).

The functions of color can be grouped in various ways. Functional categories include physiological (thermoregulation), concealing (predator avoidance), and communication (communications to other species - e.g., warning coloration; and communication within a species - species recognition and mate selection). It is also possible that colors are non-functional, e.g., the pale "colors" or better, the lack of color pigments in cave organisms. Which of these color functions might apply to each stage of the Monarch's life history? Once the students have offered an array of hypotheses to explain the colors at each stage, the instructor can then ask the students how they might test each hypothesis.

## SCALES

Monarchs belong to the Order Lepidoptera, which means "scale wings". The wings and body of all adult Lepidoptera are covered with scales. Among insects, only the caddisflies (*Trichoptera*, a group with aquatic larvae) have adults with a similar bodycovering of scales. Why don't flies, bees, beetles, grasshoppers and other insects have scales? Or, perhaps more to the point, why do butterflies and moths have bodies and wings which are covered with scales? What are the possible functions of scales? What are scales anyway? Are they something unique or are they modifications of structures common to other insects? The standard text books of Entomology tell us that scales are modifications of small hairs or setae which are common to all insects. Thus, it appears that they are modifications of pre-existing structures. But, how are they modified, what is their shape, what



Monarch scales SEM photo.  
Contributed by De Cansler

do they do, i.e., how do they benefit the insect or do they? It is relatively easy to look at scales and define their shape, structure and color but it is more difficult to determine their function. However, we can't realistically approach the functional question without studying

the scales in detail and this is something your students can do. To make the study of scales interesting all you need is a set of questions, a plan of study, a dead butterfly (it need not be a Monarch), crystal-clear tape (not Magic Mending Tape), slides, and a compound scope with 100x magnification. Here are some of the questions: Is the entire surface of the body and wings covered with scales? Are there differences which can be seen with the naked eye? Do different parts of the body have scales of different shapes, i.e., are the scales on the leading edge of the wing the same as those elsewhere on the wing or body? How many types of scales can be found over the entire surface? Does the frequency of the types vary with location on the body or wing? Is there an association of scale type with color? What do the scales look like in the scent pouch areas of the males? To properly answer these questions the students should make drawings and make counts of different scale types. A disciplined approach to this study should be quite rewarding. The students will be doing question oriented research which will be original for them.

Once the students have completed a survey of scale types and answered some of these questions, you can return to the question of function. Are the scales designed to be aerodynamic? Is their primary function to carry pigments? Do they have a protective function? Could they have a role in thermoregulation? And, lots more. Once a study on Monarchs has been completed, students could ask similar questions using another species and then could compare and contrast the results of this species with those of the Monarch.

## CONTROLLING DEVELOPMENT

OR... "MOM, CAN I PUT MY CATERPILLAR IN THE REFRIGERATOR?"

If you are rearing Monarchs and are running out of leaves, need to hold butterflies for later tagging, suspect that larvae will pupate or butterflies will emerge over the weekend in the classroom when the students won't be there, DON'T PANIC! There is a solution: use lower temperatures to slow the developmental process. All stages of the Monarch can be refrigerated to control development and careful use of cooling can be used to manipulate egg hatching, larval development, pupation and emergence. Refrigeration works best if the temperatures are in the range of 42-50°F. All life stages should be placed in closed containers in which the humidity is relatively high. We routinely store eggs, larvae and adults in containers in which we have placed a moist paper towel. The following are guidelines we use for refrigeration in the maintenance of our permanent Monarch culture.

Eggs - 1 week

Larvae - 2-3 days

Pupae - 1 week, but 2 weeks is possible

Adults - 3 days, but can be maintained longer with feeding at 3-4 day intervals.▼



# MONARCH MATH

Last fall, I posed the following challenge to Brad Williamson's Olathe East High School Students. Try this challenge with your students and compare your answers to those calculated by Brad's students.

"If I were a Monarch, I would be flying today," said my wife, Toni, as we left in the car for a quick lunch at 12:10 on the 25th of September in Lawrence, KS.

It was a spectacular September day in Eastern Kansas with clear skies, temperatures in the mid-70's and light (5-10 mph) winds shifting from the WNW to the SW as the day progressed. The Monarchs, after being "pinned down" for the better part of three days by drizzle, nearly total overcast skies and low temperatures, were on the move. Monarchs seemed to be everywhere as we drove the mile to the restaurant. As we ate, they kept drifting past my field of view as I gazed out the window in an attempt to collect my thoughts about how to conduct the rest of the day.

The Monarchs kept intruding on my thoughts and finally I gave in and made some counts. The limit of my line of sight was determined by a building 275 feet away and the height of the window which kept me from seeing butterflies which were more than 50 feet in height (estimated from the height of the building at the end of my line of sight). In effect, I was counting the butterflies that crossed a line 275 feet in length from ground level to 50 feet in height. Here are my counts that I scribbled on the back of my lunch receipt:

## Number of seconds per 15 passing Monarchs

- |                |                |
|----------------|----------------|
| 1) 62 seconds  | 4) 89 seconds  |
| 2) 80 seconds  | 5) 153 seconds |
| 3) 105 seconds | 6) 145 seconds |

## HYDROGEN ISOTOPE UPDATE

Two years ago we entered into a collaborative project with Len Wassenaar and Keith Hobson (Saskatoon, Canada) to test the idea that the general area of the natal origin of Monarchs could be determined with the use of hydrogen isotopes. Recently, Keith and Len presented preliminary results of the isotope studies at the meeting in Morelia. The results indicate that the isotopic method is sufficient to establish the natal origins of the Monarchs reaching the overwintering sites in Mexico. Their interpretation is based on the finding that milkweed plants and Monarchs of each region show ratios of hydrogen isotopes anticipated from the long term measurements of these isotopes in rainwater across Canada and the United States. Several scientific papers are being prepared on these findings.

*Thanks again to the many Monarch Watch collaborators from the U.S. and Canada who participated in this study by rearing Monarchs on naturally-occurring milkweeds - it couldn't have been done without you.*

Here's my challenge:

If we assume that my counts are representative of the 39 minutes and 43 seconds Toni and I spent at the restaurant, and that the number of Monarchs passing through my line of sight was generally representative of the area: 1) How many Monarchs passed through my line of sight during our lunch? 2) How many Monarchs passed per linear kilometer during our lunch? and, 3) If we imagine a line between Lawrence High and Olathe East High, how many Monarchs crossed that line in the same time period? To calculate this number we need to know the distance between Lawrence and Olathe.

*[Your students can determine this distance once they have looked at the answers given below by Brad's students.]*

Here are the answers Brad received from three pairs of students. The students based their calculations on a 40 minute observation period.

**Jana Ryan and Melissa Hughes:**

- 1) 340 Monarchs / 275 ft
- 2) 4121 Monarchs / 1 km
- 3) 197,818 Monarchs

**Mike Leins and John Kohler:**

- 1) 357 Monarchs / 275 ft
- 2) 4332 Monarchs / 1 km
- 3) 207,936 Monarchs

**Cathy Hooper and Theresa Schnepf:**

- 1) 341 Monarchs / 275 ft
- 2) 4053 Monarchs / 1 km
- 3) 194,511 Monarchs

*[Why aren't all the answers the same? What are the similarities and differences in the calculations? Which estimate is closest to the correct number?]*

## URQUHARTS NOMINATED

Drs. Fred and Norah Urquhart started Monarch tagging in 1938. Since then they have made major contributions to the study of Monarchs, including co-discovering the Monarch overwintering locations in Mexico. They have just recently been nominated for the Order of Canada, the highest civilian honor awarded in Canada. The Government of Mexico has also recognized their achievements by nominating them for the Mexican equivalent of this award. Congratulations, Drs. Fred and Norah Urquhart, on your many years dedicated to the study of Monarch butterflies.

# MONARCHS AND THERMALS

For those of us interested in the Monarch migration, one of the most exciting developments this year has been the creation of a new Web site known as "Tactics and Vectors" by David Gibo. David is a faculty member at the University of Toronto, Mississauga Campus, a long term student of Monarch migration biology on which he has published a number of papers, and an experienced glider pilot. The site is well organized and easy to navigate. David provides us with an excellent example of how a scientist should start with a clear understanding of the observations he/she is making and how to translate these observations into questions and testable hypotheses. David's approach is objective and self critical, and he shows a concern for the precision of terms used to describe behaviors and the accuracy of the measurements needed to test each hypothesis. The text is very readable and David, while educating us, makes the whole topic lots of fun.

**Check out Gibo's site for yourself at: [www.erin.utoronto.ca/~w3gibo/](http://www.erin.utoronto.ca/~w3gibo/)**

The following is a condensed version of a section on how butterflies use thermals. This is followed by recent observations by Bill Calvert of the Texas Monarch Watch which fit with David's descriptions.

## MONARCHS AND THERMALS

*Classifying a butterfly's flight mode as either flapping, gliding, or soaring, is easy - as long as its flapping. Flapping flight is characterized by regular wing beats and is the main type of flight observed when the butterflies are flying within a few meters of the ground. Most difficulties arise when you have to distinguish between gliding and soaring flight.*

*Gliding and soaring flight are both characterized by the wings being held outspread and still. Although there are a few rules to apply, distinguishing between the two types of flight can be difficult. Gliding butterflies always lose altitude. In contrast, soaring butterflies, by definition, either maintain or gain altitude. Although soaring butterflies seem to defy gravity, they are actually just gliding in rising air. The air is rising as fast, or faster, than the butterfly's gliding rate of descent. A soaring butterfly may circle or fly straight, depending upon the circumstances. Soaring butterflies often fly straight along the rising air on the windward side of a hill, ravine, or building, particularly when it is approximately in line with their preferred direction. Soaring butterflies usually circle when they encounter a small narrow thermal near (e.g., within 10 m - 30 m) the ground and continue to circle as they gain altitude. On the other hand, individuals at higher altitudes may mill about in an apparently haphazard manner or fly straight across thermals. Gliding butterflies seldom circle. Although a gliding butterfly may turn towards trees, or a field of flowers as it gets closer to the ground, in open areas they usually just continue to glide straight ahead,*

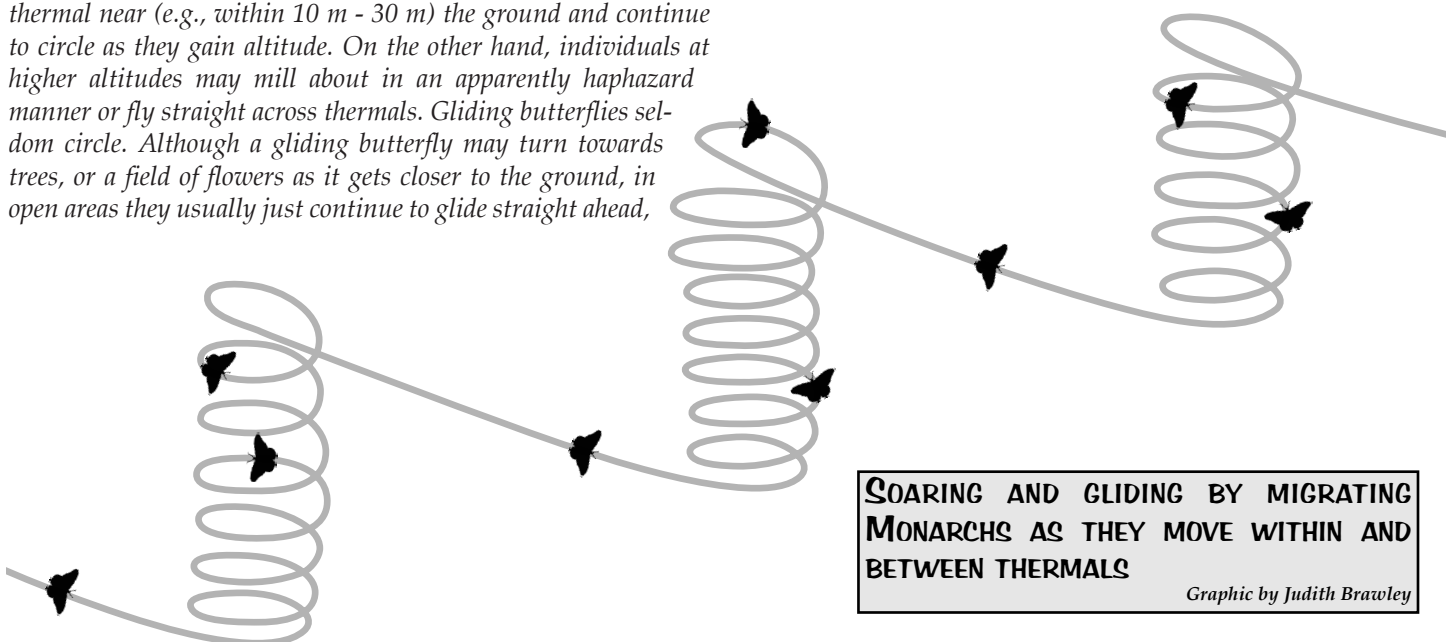
*finally switching to flapping flight within 1-3 meters of the ground. On days with tailwinds and good soaring weather (plenty of fair weather cumulus clouds), Monarch butterflies can often be observed gliding down from high altitudes shortly before sunset as thermal activity finally dies out. Gliding flight can also be apparent when the butterflies abruptly turn out of thermals within about 30 m of the ground.*

**- David Gibo**

## TEXAS MONARCH WATCH NEWSLETTER vol 4:1:p2

*We traveled through the heart of the migratory flyway - the intermontane valleys of Mexico's Sierra Madre Oriental. There we witnessed a clear example of a type of migration that may be more common than previously supposed. Typically the butterflies would fly out of the roosts and then catch a morning thermal over a field and rise lazily upward into the sky circling and gliding, sometimes disappearing from view. During the four day trip we seldom saw them after the morning roost break up, but mid-afternoon they would suddenly appear again in great numbers. Our interpretation of this sequence of events is that the butterflies did indeed fly high out of view most of the day and came down in the afternoon to form roosts. We apply the term 'fall out' to describe these events for the butterflies do indeed seem, literally, to fall out of the sky.*

**- Bill Calvert**



# MONARCH MUTANTS

## WHITE MONARCHS

Among butterflies, the wings of some species are quite variable in color and pattern while others show little variability. Monarchs belong to the latter group and in pattern and coloration they are quite conservative. Nevertheless, if you look at thousands of Monarchs you can find some variation. Much of this variation appears to be due to rearing condi-

eral years ago. They too were "white" because of a blockage of the development of yellow bands on the larva. The larvae

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

were "zebra-like" - black and white instead of yellow, white and black. The "non-yellow allele" is also recessive to wildtype. In this case, even though the larvae are white, the adults are normal.



A White Monarch in Hawaii.

Photo contributed by Dan Petr; for more white Monarch photos visit him at: <http://biology.swau.edu/faculty/petr/photos/hawaii.html>

tions and is non-genetic, but rarely, perhaps 2-3 times each year in the eastern population, observers report seeing "white" Monarchs. This is a true mutation in which the areas of the wings which are normally orange or yellow are white. We might hypothesize that the mutation interferes with the synthesis of the orange pigments in some way which leads to the development of this white or alba phenotype (form). The white butterflies appear to be normal in all other respects and butterfly specialists call this form *nivosus* (snow-like). Although *nivosus* is extremely rare in North America, white Monarchs occur at frequencies of 4-10% in Hawaii. Stimson et al. examined the genetics of *nivosus* and found the white allele is recessive to wildtype and is inherited as a simple Mendelian trait. The larvae have normal pigmentation. Many questions remain unanswered about the *nivosus* form, e.g., why is it so rare, what is the basis of the blockage of normal pigment expression, etc. A number of studies are in progress on *nivosus* and we hope to have some answers to these questions to publish in the next Season Summary.

Stimson, J. & Meyers, L. 1984 [1985]. Inheritance and frequency of a color polymorphism in *Danaus plexippus* (Lepidoptera: Danainae) on Oahu [sic], Hawaii. *Journal of Research on the Lepidoptera* 23:153-160.

If you rear a large number of Monarch larvae, you occasionally see some larvae that make you look twice. Karen Oberhauser found some unusual larvae in her culture sev-



This "criss-cross caterpillar" emerged as an adult female Monarch, mated, and laid eggs. The mysterious X appeared on only one of her offspring.

Photo by Jim Lovett

## CRISS-CROSS CATERPILLARS

And then there are monsters...Well, they aren't really monsters, but they are odd combinations or anomalies of form. These are referred to as teratogens or as teratogenic forms. Most of these forms are developmental in origin but a few may be genetic. The "monster" which appears most commonly in our culture is a criss-cross caterpillar in which two of the segments in the abdomen are "crossed" forming an x on the dorsum (back) of the caterpillar. Occasionally we find caterpillars with two x's. Unfortunately, few of these "X-Filers" survive to the adult stage so we don't know whether the condition is developmental or inherited.▼



# MONARCH POPULATION DYNAMICS

To understand the population dynamics of Monarchs we need to know something about birth rates and death rates. Obviously, if birth rates exceed death rates, populations grow and, if death rates exceed birth rates, populations decline. We can divide the annual cycle for the Monarch into two periods: the interval of population growth or reproductive period when the births exceed the deaths (mid-March to September) and the time of population decline, or migratory period (late August to mid-March). We really don't understand the dynamics of Monarch populations at this time. However, we know a few details about the process of reproduction and there may be ways to use this information to gain some perspective on the changes in numbers within a year and over several years. Along the way we will encounter some unanswered, and in some cases unanswerable, questions.

## HOW MANY MONARCHS START THE MIGRATION TO MEXICO EACH FALL?

We don't know. The number certainly varies from year to year but may be as low as 100 million in some years to as high as half a billion in others.

## WHAT PROPORTION OF THE MONARCHS DIE DURING THE MIGRATION?

We don't know, but it's probable that many millions die enroute due to predation, accidents, storms, starvation and getting lost. The size of the initial overwintering population varies greatly from year to year, but this may depend as much on the method of estimating the numbers as the size of the population. In recent years, the overwintering population has been estimated at 60 million to over 300 million.

## WHAT PROPORTION OF THE MONARCHS THAT REACH THE OVERWINTERING SITES SURVIVE THE WINTER TO MIGRATE NORTH IN MARCH?

We don't know. Large numbers of overwintering Monarchs are eaten by birds. Many die of starvation and millions are killed by winter storms in some years. Even with all this mortality, many millions of Monarchs can still be found at the overwintering sites in early March just before the beginning of the remigration.

## HOW MANY GENERATIONS OF MONARCHS OCCUR FROM MARCH TO SEPTEMBER?

The simple answer is three to five generations but why is there variation? And, how should we think about generations if females on their remigration are laying eggs for 5-6 weeks across 2400 km enroute from Mexico to Kansas? (I'll come back to this question.) Generation time is related to temperature and probably varies from 25-45 days with mean generation time of 32-36 days. In NE Kansas, which is close to the southern limit of the continuously breeding summer Monarch population, this means that in good years, with Monarchs arriving in mid April, there are 5 gen-

erations. There are 4 generations in cold years in which the Monarchs that start the local population (in May) originate from eggs laid in Texas rather than adults that overwintered in Mexico. For the females that produced this first generation in Texas this still means that they have given rise to 5 generations. But, how many generations occur if the eggs laid in Kansas in mid April give rise to adults which arrive in Minnesota in early June. In this case, there are probably only two more generations for a total of three. In other words, the overwintering females that lay eggs as they move northward can, through their progeny, give rise to 3-5 generations.

## HOW OLD ARE MONARCHS WHEN THEY MATE?

Unlike many butterflies that mate soon after emergence, Monarchs undergo a period of maturation during which they seldom mate. Most individuals do not mate until they are 4-6 days of age.

## HOW OFTEN DO THEY MATE?

Mating frequency is high in Monarchs. In the field, the average number of matings for females, as determined by dissection and counts of the number of spermatophores, is usually between 4 and 5. For all butterflies, the averages are between 1.3 and 1.5. In the laboratory, some individual Monarchs show an amazing capacity to mate. Karen Oberhasuer recorded 19 matings for one male!

## WHAT TIME OF DAY DOES MATING OCCUR?

Although Monarchs sometimes mate in the morning, most matings occur from 2-5 in the afternoon. Once paired, the male usually carries the female in flight to a protected area in trees or shrubs.

## HOW MANY EGGS DOES A FEMALE MONARCH LAY?

Monarchs have an extremely high capacity for egg production and this certainly contributes to the success of this species. The average number of eggs laid by wild females is unknown but probably varies greatly depending on the availability of nectar, the abundance and condition of the milkweed plants, as well as climatic conditions. In the laboratory, females frequently produce 400 eggs and not uncommonly 700. Karen Oberhauser obtained over 1000 eggs from one female.

## HOW LONG DO THEY LIVE?

Reproduction is costly and in the summer months the life span is probably 2-6 weeks. Nearly all the Monarchs that leave the overwintering sites in Mexico in mid March are dead by the 1st of May. Although this is a 6 week interval, the average return migration may be less than 3 weeks. Clearly, some Monarchs - probably only a few percent at best - can live from mid-August to the end of the following April, a period of 8.5 months.

## WHAT IS THE RELATIONSHIP AMONG BIRTHS, DEATHS AND POPULATION GROWTH?

If all the Monarch eggs hatched and produced adults, the Monarch population would experience a boom and then a crash as the larvae from succeeding generations consumed all the milkweed and began to starve. When a population is at a steady state (i.e., neither growing nor declining) and birth and death rates are equal, on average, each individual is replaced by another individual. This means that for a female, say one that has laid 400 eggs, only two eggs produce larvae that survive to the adult stage. The replacement rate is 1 in this case. In eastern Kansas, early and midsummer generations of Monarchs appear to be at or near replacement rate since the populations don't increase. However, the last two generations of the year show an increase and by the end of August the number of Monarchs seen per unit time in the field can be more than 100 times greater than the number encountered in late April. Key to the success of the Monarch is the reproductive rate during the last generation of the season. It must be quite high. The question becomes - how many female Monarchs must be produced in the fall to have one that survives to reproduce in the spring? Are 5, 10, 15, or 20 females needed in the fall? We don't know, but because of mortality during the fall migration, the large numbers that die at the overwintering sites due to various causes, and loss of many Monarchs as they migrate northward in the spring, it may take a twenty fold increase in the last generation to keep the Monarch populations from declining. For further details of the predation, parasitism, and diseases suffered by Monarchs, please visit the "Monarch Biology" section of our Web site at [www.MonarchWatch.org/biology/biology.htm](http://www.MonarchWatch.org/biology/biology.htm). ▼

## TRANSGENIC CROPS

Last July, John Hannah of Columbus, NE, posed an interesting question: "How much of the food biomass (milkweeds) for Monarchs is in row crop fields (corn and soybeans) and how much is in ditches and semi-wild places?"

A few years ago this would have been an interesting but academic question and there was no real need to know the answer, at least not right away. Now there is. Agriculture is changing rapidly and one of the new developments is transgenics. Gene transfer technologies now allow scientists to engineer plants, i.e., to introduce genes from one organism into another. Crop varieties are engineered to give them resistance to diseases, certain insects, and even herbicides. Soybeans and corn have recently been modified to be resistant to Roundup, a broad spectrum herbicide that kills broadleaf plants including milkweed. Currently, Roundup cannot be used on these crops without damaging the crops themselves. This is changing with Roundup-resistant plants and, for the first time, farmers have a herbicide that will eliminate milkweeds from their crops. How significant is this? This could be very significant since each year there are approximately 150 million acres of corn and soybeans combined. Last year Roundup-resistant soybeans constituted 13% of the seed sales and Roundup-resistant corn will be available soon. Use of these new varieties could reach 50% in the next 5 years and the impact of their use on Monarch populations could be substantial. When flying over the midwest, cropland dominates the landscape and there doesn't seem to be enough natural habitat to produce the large number of Monarchs we see each fall. Clearly, we need an answer to John Hannah's question.

## TAGGING VS MARKING

Here are some thoughts on tagging versus marking and what can be learned from both of these methods.

If you are dealing with a resident population of Monarchs that is continually reproducing (non-migratory population; e.g., summer populations in the north or winter populations in Gulf Coast states and central to southern Florida) you can follow your Monarchs by either tagging them or by writing numbers on the discal cell with permanent, fine-tipped marking pens (Sharpie, Marks-A-Lot, etc.). Tags have advantages. If your tagged butterflies disperse beyond your local area or migrate, the tag, which contains our address, will usually be returned to us if it is recovered. We would then communicate with you about the recovery and can learn something about local and long distance movements by the Monarchs. If one of your pen-marked butterflies is found 10 miles away, the information will most likely not get back to you because the numbers will not mean anything to an outside observer.

Yet, there are good reasons to use the markers. If your butterflies are local and likely to return to your property or study area, the marking will give you the ability to record

mean residency times - the mean duration from release, or first capture, to last sighting. Although there are data of this type in the Monarch literature, more is needed. Residency times are likely to vary from place to place, with time of year, due to weather conditions, etc. There could also be interesting differences between the sexes. Keeping records of these kinds of data can be very interesting and lots of fun for the observers. If there is enough data, these types of observations could be very valuable. Reports of such records could be posted to the Monarch Watch Web site and the data could be used to gain a better picture of the population dynamics of reproductive Monarchs.

The tags or markers could also be used to obtain estimates of population size. If you, your family, or research team makes an effort to catch and number/tag every Monarch that is found within your area, the data can be analyzed with one or more of the standard mark and recapture formulas to estimate population size. Again, this would be valuable information, especially for the Monarch populations along the Gulf Coast which appear to be reproducing solely on *Asclepias curassavica* during the winter months.

# MONARCH REARING TIPS

## PROTECTING LARVAE ON PLANTS

If you are rearing larvae on plants outdoors and wish to protect them from parasites and predators, the larvae can be protected with sleeves made from 5 gallon paint strainers which you can obtain from your local paint store. The paint strainers with elastic at the open end work best. The larvae are placed in the end of the strainer which is then placed over the milkweed. A baggie tie is used to close the open end of the bag around the stem of the plant.

## REARING CONTAINERS

Monarchs can be reared in many types of containers. We start larvae in a variety of small (1-4 oz) plastic cups with lids and then transfer them once they have reached the third or fourth instar (1/3-2/3 inch). The best containers we've found for larger larvae are octagonal plastic deli containers with black bottoms and clear fold-over lids. We use 6" and 9" containers to rear 6 and 12 larvae, respectively. Paper towels are placed in the bottoms of the containers and the leaves and towels are changed daily. Large larvae (5th instars) need to have leaves added twice a day. Larvae can be removed as they begin to wander or they can be allowed to pupate on the undersides of the lids. The containers can be soaked in 10% Clorox and reused many times.

**Rearing in classrooms with 5-6 year olds, Janice Szczerba, a kindergarten teacher in Maryland, offered the following suggestion:**

*This is the system I use for raising larvae and housing the soon to emerge pupae...*

**Materials:**

*Clear plastic 9 oz. cups - at least 3.5" in height  
(available at most grocery stores)*

*9" paper plates  
plastic zip-lock bags*

*Eggs and 1-5 day old larvae are kept in an inflated baggie. Once they are 6 days old, they each receive their own rearing cup. Holding a cup upright, I place the leaf with the caterpillar attached into the cup. I then place a small paper plate over the opening of the cup and invert the cup and plate with the caterpillar inside. These mini-rearing cages are very easy to clean and add food to, especially for little hands. To clean the cages, my children lift the plastic cup only, leaving the paper plate with the droppings on it. They invert the cup so that it is right side up, making sure the caterpillar is inside. Then, they pick up the plate and dump the droppings. Fresh leaves are added and the clean paper plate is placed once again on top of the cup. Make sure the cup is making contact with the paper plate on all sides and then invert the cup and plate until the next time the leaves need to be changed. Usually, the cages can be cleaned and replenished with fresh food without touching the caterpillar. This is very important to me because 5 and 6 year olds do not have the necessary fine motor muscle control to handle the caterpillars without harming them.*

*The truly wonderful thing about using the individual cups is that each child can see and care for their own creature. Each child keeps a journal to record information about their Monarch. Since the caterpillars are separated, if one should become ill the entire collection will not be lost. I have raised over 200 at one time with only 3 casualties.*

*When the caterpillars are ready to pupate, they climb up to the top of the cup where they first form the J and later the jade-colored chrysalis. Using clear cups, the children can easily observe the progress of their charge. When the adult butterfly emerges, we determine the sex and that child creates 'birth' announcements as an ongoing writing project. The butterfly expands it's wings in the cup by hanging from the shell of the chrysalis. We allow 2-4 hours for the wings to dry and then we take them outside to let them go.♥*

## ARTIFICIAL 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, or fresh-cut 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 grams ascorbic acid\*  
4 grams sorbic acid\*  
4 grams 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 pot 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



# "BUTTERFLY" AROUND THE WORLD

Recently, Akers Pence of the University of Florida (pence@gnv.ifas.ufl.edu) requested information on the word for butterfly in various languages around the world on Entomo-L, an email list for entomologists. The response to this request was excellent. The list that follows can be used to introduce children to the world's languages and geography, as well as the customs and characteristics of the people who speak these languages. Those who like words can point out similarities and differences among the various translations of the English term "butterfly".

Afrikaans.....Skoenlapper  
Albanian.....Flutura  
Arabic.....Abu Daqeeq  
Arabic.....Farasha  
Bangla.....Projapoti



A newly tagged Monarch feeding on thistle.  
Photo by Keith Matz and contributed by Sue Addy

Burmese.....Lapia  
Cherokee.....Kamama  
Croatian.....Leptir  
Czech.....Motyl  
Danish.....Sommerfugl  
Dutch.....Vlinder  
Esperanto.....Papilio  
Estonian.....Lliblikas  
Farsi.....Parvani  
Finnish.....Perhonen  
French.....Papillion  
German.....Schmetterling  
Greek.....Petaluodia  
Hawaiian.....Pulelehua  
Hebrew.....Parpar  
Hindi.....Titli  
Hungarian.....Lepke and Pillango  
Icelandic.....Fidrildi  
Indonesian.....Kupu-kupu  
Irish Gaelic.....Feileacan  
Italian.....Farfalla  
Japanese.....Choo  
Korean.....Nabi  
Latin.....Papilio

Malaysian.....Rama-rama  
Mandarin.....Hu-tieh  
(Hu Die is the official modern pronunciation)  
Maori.....Pepeke'  
Mayan.....Pepen  
Nahuatl (Aztec).....Papalotl  
Nepali.....Putali  
Norwegian.....Sommerfugl  
Palauan.....Bangikoi  
Persian.....Parvaneh  
Polish.....Motyl  
Portuguese.....Borboleta  
Rumanian.....Fluture  
Russian.....Babochka  
Serbo-Croatian.....Leptir  
Sinhala (Sri Lanka).....Samanalaya  
Sotho.....Sororomele  
Spanish.....Mariposa  
Swahili.....Kungu-urumu and Kipepeo  
Swedish.....Fjäril (Fj ril)  
Tagalog (Philippines).....Paruparo  
Taiwanese.....Ya-a  
Thai.....Pee seur  
Turkish.....Kelebek  
Vietnamese.....Buom buom  
Vietnamese.....Ho diep  
Visayan (Philippines).....Kabakaba  
Yiddish.....Zomerfeygele and Flaterl  
Yup'ik eskimo.....Caqelngataq

## ORIGIN OF "BUTTERFLY"

The origin of the term "butterfly" is not known. This is indeed a strange word combination with butter and fly being used to describe the majority of day-flying Lepidoptera most of whom bear no resemblance to butter. Nor are they true flies which belong to the order Diptera; but then common names often do not correspond to the logic of scientists' ways of classification. "Butter" is not the prefix for this group of insects in other languages so the most plausible explanation seems to be that the term was first applied to a common lemon yellow pierid (sulfur butterfly), *Gonepteryx rhamni*, in England and that this specific reference then became popular and was soon used to describe all day-flying Lepidoptera. Something similar seems to be happening in some parts of Canada with the word Monarch. In many places, Monarch has become a generic term to refer to all butterflies and not just *Danaus plexippus*.

# MONARCHS AND GRANTS

Several teachers have used their interest in Monarchs to secure grants that benefit their classrooms and their schools. If you have had similar experiences or have other ideas you'd like to share with others, please let us know!

*Rosemary Thornton and Ron Schinkel at Fredstrom School in Lincoln, NE received a \$46,262 grant from the Excellence in Education fund to carry out a three-year project titled 'Monarchs, Wetlands and the Internet'. The project calls for fourth and fifth-grade students to raise Monarchs in their homerooms. By means of two large, walk-in cages with special light and heat, students raise summer butterflies that mate and reproduce, as well as migrants which they tag and release. The grant money enabled us to buy computers, modems and printers for the participating homerooms, so that teachers and students could learn to access the Internet, especially Monarch Watch ([www.MonarchWatch.org](http://www.MonarchWatch.org))*

## HOW MANY SCHOOLS?

The number of teachers who use Monarchs in their classrooms is apparently quite substantial, perhaps more than 6000. This estimate is derived from the number of schools/teachers which have ordered Monarch Watch educational materials (2000), the number of copies of Karen Oberhauser's "Monarchs in the Classroom" which have been distributed to date (3000), and the numbers of subscribers to the Journey North email list (3000). The overlap among these programs is probably less than 30%. In addition to these teachers, many educators use materials from the Monarch Watch Web site who never contact us. We have no real measure of the effectiveness of the Web site, but we estimate that it receives 200-500 visitors per day. This rate of visitation certainly suggests that there is a fairly large audience for information on Monarchs.

*and Journey North ([www.learner.org/jnorth/](http://www.learner.org/jnorth/)). The computer and science studies are reinforced when students go to their specialist science and computer classes during the week.*

*Also part of the project is a Web page which we set up through the Nebraska Game and Parks Commission. The purpose of the page is to receive and publish Monarch sighting records, as well as to publish student work. You can visit Project Monarch Butterfly on the Web at <http://ngp.ngpc.state.ne.us/monarch/monarch.html>.*

**MONARCH WATCH - [WWW.MONARCHWATCH.ORG](http://www.MONARCHWATCH.ORG)**

**JOURNEY NORTH - [WWW.LEARNER.ORG/JNORTH/](http://WWW.LEARNER.ORG/JNORTH/)**

**PROJECT MONARCH BUTTERFLY -**

**[HTTP://NGP.NGPC.STATE.NE.US/MONARCH/MONARCH.HTML](http://NGP.NGPC.STATE.NE.US/MONARCH/MONARCH.HTML)**

Mary Alice Aguilar (Middletown, DE) combined her interests in Monarchs, Mexico and primary school education to write a successful grant for classroom computers.

*I leveraged Monarchs into a \$20,000 grant for my building! In the proposal (to Bell Atlantic) I showed that there was an integrated unit of study in place but that it was missing the final link - computers for research, participation in scientific studies, and communication with other schools in the three countries. I will organ-*

*ize and run a professional development course about Monarchs for interested fifth-grade teachers. If they take the course they will be given a computer for their classroom.*

*The teachers are excited about the project. I am too!*

From Bob Melton, Oklahoma City, OK we learned of the following achievement:

*Teachers at Dennis Elementary (including Linda Black and patron Virginia Kincaid) wrote and received a \$8,000 grant from the Putnam City Schools Foundation to initiate six new Butterfly Gardens in the school district this spring. (Think of it - they wrote a grant to start gardens in OTHER schools!) To date we have butterfly gardens in nine elementary schools and two middle schools in Putnam City and have outdoor/backyard wildlife areas at each of the three high schools. There are still twelve schools without such outdoor sites, but we hope to gradually establish gardens at every school. This is quite an accomplishment over the last three and a half years and Monarch Watch has been a big reason why it is working. Most of the "gardeners" are active taggers and it is the power of Monarchs that has led them to expand their classrooms into the outdoors.*

## MONARCH SCIENCE FAIR

Karen Oberhauser and her team of students at the University of Minnesota have developed a new way to promote student research of Monarch butterflies. Last summer, thirteen 6th to 9th-grade teachers attended a two-week workshop at the University of Minnesota. The teachers spent two days of the workshop learning how to promote student-directed research.

Once school began, each teacher applied the methods learned in the workshop in their classrooms and encouraged their students to develop their own research projects. After the projects were completed, the teachers brought some of the students to a "Monarch Fair" at the Science Museum of Minnesota in St Paul. Sixty-seven students presented their research in poster format. Student projects ranged from tests for patterns (e.g., When do Monarchs emerge most often over a 24 hour period?) to experiments that involved treatments and controls (e.g., Does milkweed condition affect larval growth?). The styles of the presentations varied from traditional posters to HyperStudio computer productions.

This was a very successful science fair which, because of its location in a museum, gave the public an opportunity to admire the achievements of the students and to learn about Monarch biology and the conservation issues surrounding this magnificent creature.

# BUTTERFLY GARDENING



Photo by Chip Taylor

*Pentas: an excellent choice for your butterfly garden.*

## SORTING MILKWEED SEEDS

Separating milkweed seeds from their silky "coma" can get to be a messy task which can leave the sorter sneezing and covered with "white fluff". We've received several suggestions and tried them all, from shaking, seiving, and flash burning the "silk" to blowing off the fluff. All these methods work but they are messy. Denise Gibbs appears to have solved this problem. Here is her method:

*Place the pods to be harvested in a strong paper shopping bag, reach into the bag to open the pods, fold over the top of the bag and shake very vigorously. Don't open the bag; rather, cut one corner (about a 1" hole) at the bottom of the bag and pour the seeds out. The fluff stays in the bag. It really works and we love it. On the other hand, if you're working with kids, do it the messy way - it's more fun!*

## BOOKS

In a posting to Dplex-L, Don Cook offered the following bibliography for books on butterfly gardening:

Brooklyn Botanic Garden Staff. 1995. *Butterfly Gardening*. Brooklyn NY: BBG.

Glassberg, Jeffrey. 1993. *Butterflies through Binoculars: A Field Guide to Butterflies in the Boston-New York-Washington Region*. NY: Oxford University Press. 160 pp. 40 color plates.

Hamilton, Kersten. 1997. *The Butterfly book. A Kid's Guide to Attracting, Raising and Keeping Butterflies*. John Muir.

Stokes, Donald, Lillian Stokes and Ernest Williams. 1991. *The Butterfly Book: An Easy Guide to Butterfly Gardening, Identification, and Behavior*. Boston: Little, Brown. 96 pp.

Tekulsky, Mathew with Susanah Brown. 1985. *The Butterfly Garden*. Harvard MA: Harvard Common Press. 144 pp.

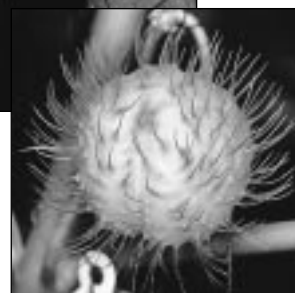
Xerces Society Staff. 1990. *Butterfly Gardening*. San Francisco CA: Sierra Club Books.

Butterfly gardens are becoming more common on school grounds. In the 1995 Monarch Watch Season Summary I listed my top 13 favorite plants for butterflies. The best plants are generally those that bloom continuously, such as: *Pentas*, *Asclepias curassavica* (tropical milkweed), *Stachytarphyta* (blue porterweed) and *Buddleia* (butterfly bush). However, there are a few species which bloom in September which are particularly attractive to Monarchs and other insects. Some of these species should be included in school gardens. *Caryopteris* (blue mist spirea) is an excellent late blooming perennial shrub which is very attractive to a variety of insects. *Sedum* (several varieties), *Tithonia* (Mexican sunflower), *Liatris* (gay feather) and late blooming Zinnias are especially attractive to Monarchs. Late blooming New England Asters and other aster species are nectar sources for the last of the migrating Monarchs and other butterflies.



*Asclepias physocarpa/fruiticosa* pod (right) and flowers (above)  
Experts cannot agree whether this milkweed is one or two species.

Photos by Steven Broyles



## ONLINE RESOURCES

The Butterfly Zone  
[www.butterflies.com/](http://www.butterflies.com/)

University of Kentucky Department of Entomology  
[www.uky.edu/Agriculture/Entomology/entfacts/misc/ef006.htm](http://www.uky.edu/Agriculture/Entomology/entfacts/misc/ef006.htm)

North American Butterfly Association  
[www.naba.org/pubs/ab97a/p22.html](http://www.naba.org/pubs/ab97a/p22.html)

University of Nebraska Cooperative Extension NebGuide  
[www.ianr.unl.edu/pubs/Horticulture/g1183.htm](http://www.ianr.unl.edu/pubs/Horticulture/g1183.htm)

Monarch Watch - Butterfly Gardening  
[www.MonarchWatch.org/garden/intro.htm](http://www.MonarchWatch.org/garden/intro.htm)

Missouri Conservation Department  
[www.state.mo.us/conservation/nathis/insects/](http://www.state.mo.us/conservation/nathis/insects/)



# MONARCH MODEL FOREST PROGRAM

On 12 January 1998, the governments of Mexico and Canada signed an agreement to create a protected forest in Mexico for migrating Monarch butterflies. Each government will contribute \$837,000 (U.S.) each to setting up the 1.96 million acre reserve.

The aim of this project is to encourage sustainable development for the region occupied by the Monarch butterfly during the winter months.

"Sustainable management of this new model forest is aimed at protecting an environment that provides sustenance not only to the Monarch butterfly, but also to nearly a million people," said Mexican Environment Minister Julia Carabias.

The following information about the region and the program was gleaned from news releases provided by International Development Research Center (IDRC).

## GEOGRAPHICAL AND ECOLOGICAL DATA

The Monarch Butterfly Model Forest is located in the eastern part of the state of Michoacan, and the western part of the state of Mexico. It covers an area of 794,922 hectares, of which 284,988 are forested. The region is very mountainous.

## DEMOGRAPHIC, SOCIAL, AND CULTURAL DATA

The model forest lands include 22 municipalities. These municipalities, located in both Michoacan and the state of Mexico, are well known as the prime range for the Monarch butterfly.

Before the Spanish conquest, the Monarch butterfly region was populated by Indians of the Otomi, Mazahua, and Matlatzinca groups. In the wake of the conquest, these people gradually lost their original culture. Today, however, there is still a relatively large indigenous population, scattered in isolated communities among the various municipalities that make up the model forest.

The population numbers 914,516 inhabitants. The inhabitants are divided among 49 campesino communities. The economically active population numbers 197,416, of whom 41 percent are engaged in farming and forestry.

## ECONOMIC ACTIVITIES

Corn is the most widely planted crop, but farmers also grow wheat, rye, tomatoes, potatoes, alfalfa, beans, peas, peppers, and flowers. There has been a notable expansion in the production of fruits, edible mushrooms, and peppers, thanks to the high returns they offer.

The forestry industry produces a variety of products such as timber, sawn lumber, packing cases, furniture, and other articles.

Ecotourism has acquired considerable importance in recent years, particularly in light of attractions such as the Monarch butterfly sanctuaries and the region's many hot-springs.

## OBJECTIVES OF THE PROGRAM

- Improve standards of living for local residents and strengthen the region's economy
- Lead to a more sustainable use of forest resources
- Encourage private investment and strengthen community participation
- Contribute to the conservation of the Monarch butterfly's habitat
- Promote international recognition of the Monarch butterfly region

The program will:

- support productive activities relating to forest resources, in light of the importance of these resources for the region's development
- help to strengthen local social structures on which the region's economic activities depend
- support activities such as: organic farming; greenhouse market gardening; the gathering of shiitake oak mushrooms, matzutake pine mushrooms, raspberries and blackberries; livestock rearing; fish farming; and fish feed production
- reinforce ecotourism projects and tourism development planning for the region, and
- encourage cottage industries.

## ILLEGAL LOGGING IN MEXICO

Lincoln P. Brower sent the following report to Dplex-L 4 February 1998.

*According to the Roanoke Times (Roanoke, Virginia), as read to me by Madeline Love, Sr. Roberto Solis, a reliable source in Mexico, has reported on the San Andreas Overwintering Colony of Monarchs which is the western-most of the known overwintering colonies. As alleged in the article, illegal loggers cut down 660 Oyamel fir trees in and adjacent to the colony, and destroyed perhaps two million Monarch butterflies.*

*The San Andreas colony is one of at least five known overwintering areas in Mexico that were not protected in the original 1986 Presidential Decree. It is currently being reviewed for protection by the Government of Mexico as a result of the NAFTA Tri-national Committee on Environmental Cooperation (US, Canada, Mexico) conference on the Conservation of the Monarch Butterfly that was held in Morelia, Mexico in November, 1997.*

There were a number of other reports from newspapers that echoed this account, but no further details were provided. In a March 11th report, *The Electronic Telegraph* stated that the Group of 100\* called on President Ernesto Zedillo to declare the forest at San Andres a federally protected area, and to halt the logging.

\*The Group of 100 is an elite group of Mexico's top writers, painters, poets, photographers and intellectuals.

# MEETING IN MORELIA, MEXICO

## NORTH AMERICAN CONFERENCE ON THE MONARCH BUTTERFLY

The most significant development in Monarch conservation this past year was the North American Conference on the Monarch Butterfly which was held in Morelia, Michoacan, Mexico from 10-15 November 1997. Growing concern for the long term persistence of the Eastern North American Monarch population inspired the governments of Mexico, Canada, and the United States to sponsor a meeting to develop a strategy for the protection of Monarch butterflies.

The objectives of the conference were: 1) to contribute to our understanding of the conservation issues surrounding the Monarch butterfly from a tri-national and a multi-disciplinary perspective; 2) to provide a forum for dialog among people from Canada, Mexico, the United States and other countries interested in the many facets of Monarch butterfly biology and conservation, including educators, government officials, representatives of conservation groups and scientists; 3) to present initiatives addressing Monarch butterfly ecology, behavior and conservation; and 4) to identify and propose actions which address both the conservation requirements of the Monarch butterfly and associated human needs.

The conference included three days of oral and poster presentations in four thematic areas: 1) Biology, including ecology, reproduction, larval ecology, overwintering biology and migration; 2) Education, including both formal and informal outreach programs, commerce for educational purposes, and butterfly gardening; 3) Conservation and Protection, including population dynamics and monitoring, pesticides and pollutants, socioeconomic problems associated with conservation, restoration projects, reserves and habitat management; and 4) Socioeconomic Issues, including patterns of land use, land ownership/development and environmental deterioration, public participation in consensus building processes, costs and benefits of ecotourism, and trade in Monarch products.

The first three days of the conference were followed by 2 days of open public symposia consisting of roundtable discussions among specialists and representatives of all stakeholders. Specific subjects included: 1) monitoring and data collection; 2) education and communication strategies; 3) sustainable development and Monarch conservation in breeding habitat and overwintering sites in Mexico and California; 4) biodiversity and resource management; and 5) national and international laws, policies and regulations. The final day of the conference was used to integrate the symposia reports into items to be considered for a tri-national action plan.

Proceedings of the papers presented at the meeting are being edited and will be published late this year. Hopefully, the tri-national action plan will soon be completed and made available to the public this year.

This was a remarkable conference in many respects. All three countries were well represented at the meeting and many high ranking officials were present including the Governors of the Mexican States of Michoacan and Mexico and Secretary of the Interior, Bruce Babbitt, from the United States. Concern for the long term conservation of Monarchs and the necessity of strong international cooperation was the predominant theme of the meeting.

There were three major groups of participants at the conference: government officials, scientists and educators, and representatives of the cooperative landholdings (ejidos) within the Monarch Reserve. The ejido representatives had a major, and positive, impact on the tone and content of the discussions. Presentations by some of the ejido members were among the most passionate, articulate and intelligent of the meeting. It was their land, their livelihood, their way of life and their future which was under discussion at this meeting, a meeting composed mostly of outsiders. The ejido members made themselves heard and understood. Their presence and participation gave credibility to the entire undertaking and their positions on the welfare of their communities should have an impact on the recommendations of the tri-national plan.▼

## MIGRATION STUDIES

A number of studies are underway at Monarch Watch on the patterns, processes and underlying mechanisms of the Monarch migration. The following is an abstract of a paper which will be published in the proceedings of the recent conference in Morelia.

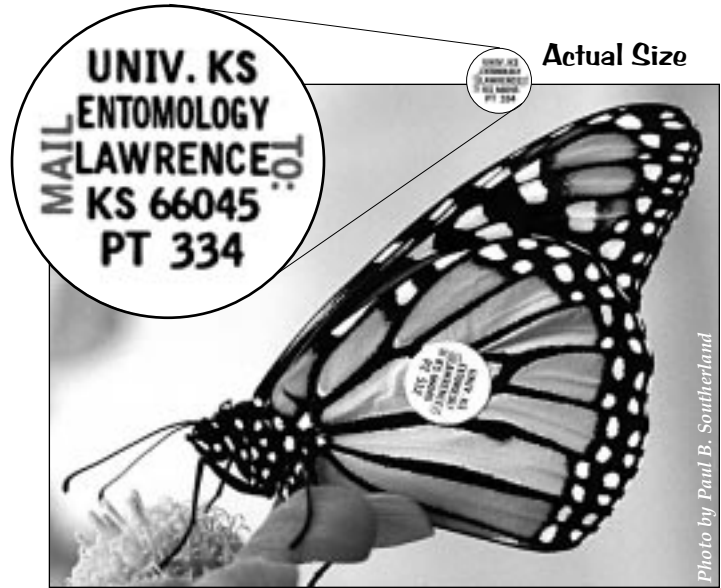
### "Mark and Recapture During the Monarch Migration: A Preliminary Analysis"

Kari A. Rogg, Orley R. Taylor, and David L. Gibo

Monarch butterflies were recently demonstrated to use the sun for orientation during the autumn migration; however, Monarchs' ability to respond to their geographic location has remained unclear. In this study, we analyzed mark-recapture data collected in Monarch tagging programs over a period of 40 years to determine whether Monarchs have a geographic sense. Mean flight directions were analyzed based on geography and net flight distance. We found that the mean direction of flight shifts S to SW as the origin of flight moves west to east and as the origin of flight moves north to south. As flight distance increases, the mean direction of flight also shifts S to SW and the scatter of the flight directions decreases. This shift in flight direction and reduction of data scatter indicates that Monarchs experience SE drift over shorter distances, but ultimately compensate for this drift by re-orienting according to their new position. Thus, Monarchs are shown to orient differentially according to their location, strongly suggesting the use of a geographic sense during migratory flight.

# NEW MONARCH TAGS

New and easier to use tags are now included in our membership kits. Finally, we have "press-on" tags which require no additional adhesive!!! The new tags are made from a polypropylene all-weather stock. The tags are circular (.89cm) and light weight (<.01g) with permanent ink. We developed these tags in response to comments and suggestions by Monarch Watch participants and we are confident that, if you follow our simple instructions, you will find these tags to be far superior to those we have used in the past. Use of the previous tags sometimes resulted in damage to the butterfly. The new tagging system requires only that you place the tag on the discal cell of the underside of one of the hindwings and then press it firmly in place with the ball of your finger or the end of an eraser. The butterfly can be released within seconds and the tag should stay firmly attached to the wing. It is our hope that the tags will last for the life of the butterfly. In cage tests, the tags neither curl nor fall off the wings, problems frequently encountered with the previous tags.



*Megan shows off two of her tagged Monarchs.  
Photo by Randy C. Evans*

## TAGGING TIP

In reference to the removal of the tag from the backing, the children hit upon a handy tip which I've used with all the groups. Each team of two (or three children) is given a toothpick along with their tag sheet. They (not the adults) used the toothpick to pry the tag off the paper backing, and place over the wing. One child pressed the tag. Note that the teacher or parent volunteer held the butterfly. The team of children assisted in the tag removal, placement, and recording of data. Many of the children likened the new tags to the decals they use when they make plastic models. When asked for further details, the children told me, "Mr. Spanier, I would never touch the decal with my fingers; it would get all messy and wouldn't stick so good."  
- Harold Spanier, Canada

## RECOVERIES IN MEXICO

The number of tagged Monarchs recovered in Mexico this past season (N=46) was extraordinary. Our good fortune can be attributed to the efforts of David Marriott, Christian Manion, and 10 local guides at El Rosario all of whom assisted in the production of the Monarch segment of an IMAX film on the subject of animal migrations. Because the film crew needed assistance moving equipment, Marriott was in the position to hire 10 of the local guides, most of whom were his friends. The guides at El Rosario are the people who recover most of the butterflies tagged by Monarch Watch participants and others. Marriott took advantage of the opportunity of working with these men to explain the reasons for the tagging and the goals of both the Monarch Watch and the Monarch Program. His support for the guides, his persistence, and the goodwill he fostered produced an incredible, and totally unprecedented, bonanza of tag recovery data. Forty-two of the 46 recoveries in Mexico this year are due to these efforts.

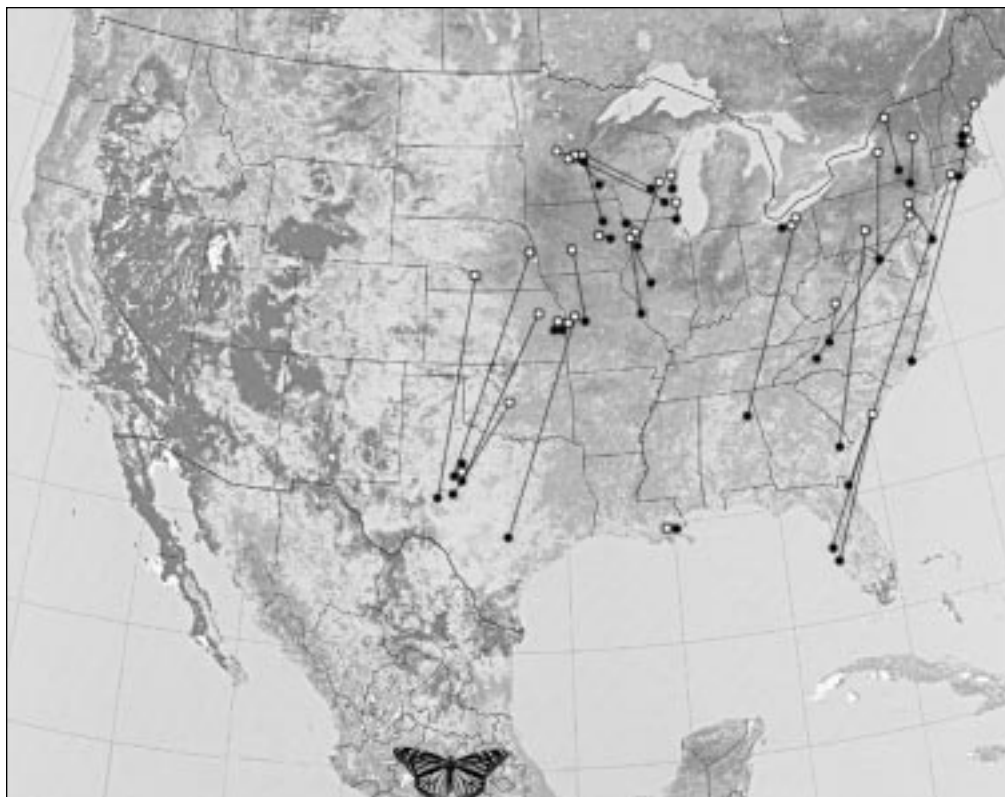
This is an amazing number of recoveries in one season and for the entire history of tagging. Fred and Norah Urquhart began tagging Monarchs over 50 years ago. Surprisingly, 50 years of tagging by the Urquharts and Monarch Watch participants have only produced 102 records of butterflies tagged in Canada and the United States that have been recovered in Mexico, prior to this year. This puts Marriott's achievements in perspective. Within four weeks, by soliciting cooperation from the local guides, Marriott and Manion increased the database for recoveries in Mexico by 30%. This is a fantastic contribution and the data will help us answer many questions about the fall migration.

Marriott's and Manion's efforts, on behalf of the Monarchs, and in this case, Monarch Watch, emphasize the value, indeed the necessity, of cooperation if we are to continue to enjoy the Monarch migration.



# MONARCH RECOVERY MAPS

## 1997 MONARCH RECOVERIES WITHIN THE UNITED STATES AND CANADA



This map represents Monarchs (N=38) tagged in 1997 and recovered at distances of 10 miles or greater within the United States and Canada.

Open circles = tagging sites  
Closed circles = recovery sites

## ORIGINS OF TAGGED MONARCHS RECOVERED IN MEXICO

Monarchs tagged in the United States and Canada which were recovered in Mexico during the winter of 1997-'98. This was a record year for recoveries in Mexico (N=46).

(SEE "RECOVERIES" ON PAGE 20)

Some of the locations marked represent more than one butterfly recovered in Mexico. These locations are: Rochester, MN (2); Wamego, KS (3); Olathe, KS (3); Lawrence, KS (4); Melvern, KS (2); Goessel, KS (4); and Oklahoma City, OK (3).



# 1997 SEASON TAG RECOVERIES

This is a summary of recovered Monarchs tagged in 1997, 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 21.

**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!**

## 1997 MONARCH WATCH TAGGING SUMMARY

Number of Tagging Kits Sent Out. ....	1767
Number of Tags Distributed. ....	>192,000
Estimated Number of Monarchs Tagged (based on returned data sheets). ....	76,000
Most Monarchs Tagged by One Group or Individual. ....	11,405
(Terry Callender & Students of Wamego High School - KS)	
Number of Tags Recovered within the United States and Canada. ....	146
Number of Tags Recovered in Mexico. ....	46
Total Recoveries for 1997 Season. ....	192

Tag No.	Sex	Tagger	Where Tagged	Date Tagged	Date Recovered	Where Recovered	Observed or Reported by	Interval	Est. Distance
RN109*	F	Barbara Mc Gee	Lane Township, PA	9/16/97	3/?/98	El Rosario, Mexico	Monarch Prg.	6 mo	1995 m
NT910	F	Gary Brekke, WWCHS	Fargo, ND	8/30/97	3/?/98	El Rosario, Mexico	Monarch Prg.	6 mo	1909 m
PB278*	F	Steve Gilzow	Milan, MI	9/5/97	3/?/98	El Rosario, Mexico	Monarch Prg.	6 mo	1826 m
NH341*	F	Kari Geurts, U. of Minn.	Egan, MN	9/1/97	3/?/98	El Rosario, Mexico	Monarch Prg.	6 mo	1788 m
SA533*	F	Ralph Bowers Cambridge H.S.	Cambridge, OH	9/12/97	2/1/98	El Rosario, Mexico	Petr Korb	6 mo	1787 m
NH514	M	Bush Gerwill	Rochester, MN	9/5/97	3/?/98	El Rosario, Mexico	Monarch Prg.	6 mo	1744 m
MS424	M	Greg & Linda Munson Midwest Monarch Project	Rochester, MN	9/6/97	3/?/98	El Rosario, Mexico	Monarch Prg.	6 mo	1744 m
OE242	F	Lee Zieke Lee	Burr Oak, IA	8/31/97	3/?/98	El Rosario, Mexico	Monarch Prg.	6 mo	1717 m
NB564	F	Michele Olson O'Brien Co. Cons. Board	Spencer, IA	10/13/97	3/10/98	El Rosario, Mexico	Simon Cruz	5 mo	1653 m
NB348	M	Liz Miller	Ames, IA	9/17/97	3/?/98	El Rosario, Mexico	Monarch Prg.	6 mo	1596 m
MZ872	M	Ben H., C.M.S.	Carroll, IA	9/2/97	3/?/98	El Rosario, Mexico	Monarch Prg.	6 mo	1584 m
OL737	F	Jane Koch	Hastings, NE	9/11/97	3/?/98	El Rosario, Mexico	Monarch Prg.	6 mo	1456 m
RF698	F	Anita Walker	Rural Cloud Co, KS	10/4/97	1/1/98	El Rosario, Mexico	Victor Hugo Castro	3 mo	1390 m
SC453	F	Pat Wakeman Tonganoxie H.S.	Tonganoxie, KS	9/24/97	3/?/98	El Rosario, Mexico	Monarch Prg.	6 mo	1382 m
RB099	F	Chris Coon Wamego H.S.	Wamego, KS	9/12/97	3/?/98	El Rosario, Mexico	Monarch Prg.	6 mo	1375 m
SZ544	M	Nicole Henne Wamego H.S.	Wamego, KS	9/16/97	3/?/98	El Rosario, Mexico	Monarch Prg.	6 mo	1375 m
RD332	M	Suzette Wilson Wamego H.S.	Wamego, KS	9/12/97	3/?/98	El Rosario, Mexico	Monarch Prg.	6 mo	1375 m
RQ219	F	Kevin Kroll Frontier Trail J.H.S.	Olathe, KS	9/16/97	3/?/98	El Rosario, Mexico	Monarch Prg.	6 mo	1371 m
RQ208	M	Will Atkins Frontier Trail J.H.S.	Olathe, KS	9/11/97	3/?/98	El Rosario, Mexico	Monarch Prg.	6 mo	1371 m
RP683	M	Shannon Tamisiea Frontier Trail J.H.S.	Olathe, KS	9/12/97	1/1/98	Cerro Pelon, Mexico	Monarch Prg.	6 mo	1371 m
SD021	M	Sandra Perez	Lawrence, KS	9/12/97	3/?/98	El Rosario, Mexico	Monarch Prg.	6 mo	1370 m
TN186	M	Calvin Cink, Baker Univ.	Lawrence, KS	9/20/97	3/?/98	El Rosario, Mexico	Monarch Prg.	6 mo	1370 m
PN968	M	Calvin Cink, Baker Univ.	Lawrence, KS	9/9/97	3/?/98	El Rosario, Mexico	Monarch Prg.	6 mo	1370 m
NB756	F	Ken Highfill Lawrence H.S.	Lawrence, KS	9/15/97	3/?/98	El Rosario, Mexico	Monarch Prg.	6 mo	1370 m
TN921	M	Beverly Mortimer Delphos Attendance Ctr.	Delphos, KS	9/26/97	3/?/98	El Rosario, Mexico	Monarch Prg.	6 mo	1369 m

Tag No.	Sex	Tagger	Where Tagged	Date Tagged	Date Recovered	Where Recovered	Observed or Reported by	Interval	Est. Distance
PN496	F	Janeen Brown USD 208 District Office	Wakeeney, KS	9/16/97	3/?/98	El Rosario, Mexico	Monarch Prg.	6 mo	1345 m
PO226	M	Patty Delmott	Melvern, KS	9/13/97	3/?/98	El Rosario, Mexico	Monarch Prg.	6 mo	1335 m
PO275	M	Patty Delmott	Melvern, KS	9/13/97	3/10/98	El Rosario, Mexico	Simon Cruz	6 mo	1335 m
PS574	F	Tim Shaw	McPherson, KS	9/26/97	3/?/98	El Rosario, Mexico	Monarch Prg.	6 mo	1307 m
QY430	F	Jeremy Voth Goessel Grade. School	Goessel, KS	9/15/97	2/1/98	El Rosario, Mexico	Petr Korb	5 mo	1301 m
QX733	M	Andy Unruh Goessel Grade School	Goessel, KS	9/22/97	3/?/98	El Rosario, Mexico	Monarch Prg.	6 mo	1301 m
QY293	F	Kent Peters Goessel Grade School	Goessel, KS	9/17/97	2/24/98	El Rosario, Mexico	Simon Cruz	6 mo	1301 m
QX976	M	Bruce Stucky Goessel Grade School	Goessel, KS	9/22/97	3/?/98	El Rosario, Mexico	Monarch Prg.	6 mo	1301 m
RO431	F	Dixie Quincy Iola Middle School	Iola, KS	9/29/98	3/?/98	El Rosario, Mexico	Monarch Prg.	6 mo	1299 m
RI581	M	Dan & Nathan Graber Moundridge Middle School	Moundridge, KS	9/17/97	3/?/98	El Rosario, Mexico	Monarch Prg.	6 mo	1297 m
PW505	F	Lane Schartz	Pratt, KS	10/3/97	3/?/98	El Rosario, Mexico	Monarch Prg.	5 mo	1252 m
PU335	M	Rickey Thompson	Berryville, AR	8/31/97	1/?/98	El Rosario, Mexico	Amado Garcia	4 mo	1225 m
DE200*	F	Carolyn Cegielski Verdigris J.H.S.	Claremore, OK	9/4/97	3/?/98	El Rosario, Mexico	Monarch Prg.	6 mo	1188 m
QL510	F	Scott Martin Putnam City H.S.	Oklahoma City, OK	10/6/97	3/?/98	El Rosario, Mexico	Monarch Prg.	5 mo	1110 m
QI614	M	Neil Garrison Martin Park Nature Ctr.	Oklahoma City, OK	10/6/97	3/?/98	El Rosario, Mexico	Monarch Prg.	5 mo	1110 m
QS019*	F	Butterfly Garden Club J.L. Dennis Elementary	Oklahoma City, OK	10/10/97	3/?/98	El Rosario, Mexico	Monarch Prg.	5 mo	1110 m
PP804	F	Kathleen Hargis	Cache, OK	9/27/97	3/?/98	El Rosario, Mexico	Monarch Prg.	6 mo	1045 m
PX518	F	Curtis Blagburn Trinity Christian Academy	Addison, TX	10/2/97	1/?/98	El Rosario, Mexico	Aremedios de Jesus	3 mo	947 m
PA001*	M	Lynn Frazier	Columbia, CT	8/29/97	10/4/97	Neptune Beach, FL	Kim Corey	1 mo	934 m
NM097	F	Larry Miller	Abilene, TX	10/15/97	3/10/98	El Rosario, Mexico	Simon Cruz	5 mo	892 m
UK569	M	Emmy Ulmschneider	Midland, TX	10/11/97	3/?/98	El Rosario, Mexico	Monarch Prg.	5 mo	872 m
NP793	M	Susan Gilbert Bridge School	East Gloucester, MA	10/2/97	10/10/97	Surf City, NC	Charlotte & Liz Haines	8 d	677 m
OL877	M	Jane Koch	Hastings, NE	9/11/97	?	Big Lake, TX	Jason Wilde	?	670 m
OH399	M	Bruce Weber	Blair, NE	9/19/97	10/6/97	Merkel, TX	Anonymous	17 d	661 m
PX011*	F	Pamela Pollard	Independence, MO	9/7/97	10/19/97	Austin, TX	Don Carlson	1 mo	635 m
NZ819*	M	Julia Cutshall	Huntingdon, PA	10/11/97	11/4/97	Claxton, GA	Nancy Lewis	23 d	614 m
SD441*	M	Tami Locher Geauga Lake District	Chardon, OH	9/14/97	?	Anniston, AL	John Waddell	?	601 m
RD167	F	Thurman Cote Wamego H.S.	Wamego, KS	9/15/97	10/5/97	Buffalo Gap, TX	Claude/Sandy Cavanaugh	20 d	517 m
RN271*	F	Dennis Scholl	Hellertown, PA	9/24/97	9/30/97	Morganton, NC	Crystal Greene	6 d	481 m
QJ923	M	John Mc Cord	Folly Beach, SC	10/28/97	12/20/97	Bradenton, FL	Anonymous	2 mo	391 m
QJ259	F	Marvin Bouknight Charleston Co. Park & Rec.	Folly Beach, SC	10/31/97	12/6/97	Tampa, FL	Lana O'Neal	1 mo	359 m
NG033*	M	Paulette Hauge Kimball Elementary	Kimball, MN	9/25/97	10/2/97	Lannon, WI	Wayne Rummel	7 d	339 m
QS777	F	Scott Martin Putnam City H.S.	Oklahoma City, OK	9/26/97	10/5/97	San Angelo, TX	Rosemary Baker	9 d	325 m
NW641	M	Craig Underwood	Borodino, NY	9/12/97	9/20/97	Sterling, VA	Barbara O'Conner	8 d	272 m
TP760*	F	Kay de Sam Lazaro Capital Hill Magnet	St. Paul, MN	10/2/97	10/11/97	Omro, WI	Hazel Mack	9 d	225 m
OF201	?	Mary Ann Schanze Edward White School	Grand Mound, IA	10/4/97	10/7/97	Hazelwood, MO	Douglas Hinkson	3 d	211 m
PJ323	F	Kathryn Wedge	Neenah, WI	9/1/97	9/16/97	East Moline, IL	Minnie Smith	15 d	208 m
OE682	M	Chuck Safris	Des Moines, IA	9/14/97	9/29/97	Warrensburg, MO	Evan Zupnick	14 d	194 m
NG613*	F	Tammy Pratorius	St. Paul, MN	10/8/97	10/21/97	Oelwein, IA	Bill Poston	13 d	168 m



# MORE RECOVERIES!

Tag No.	Sex	Tagger	Where Tagged	Date Tagged	Date Recovered	Where Recovered	Observed or Reported by	Interval	Est. Distance
TQ520	F	William Recker	Red Mills, NY	10/13/97	10/22/97	Oneonta, NY	Liecha Collins	9 d	160 m
OF778	M	David Schanze	Grand Mound, IA	9/26/97	10/20/97	Franklin, IL	Eugene Breckon	24 d	155 m
RR475	F	Mark Liscinski Pleasant Valley H.S.	Brodheadsville, PA	9/29/97	10/9/97	Ventnor, NJ	Mr&Mrs Tim Morin	10 d	120 m
TE965*	F	Elaine Winslow Hadley - Luzerne School	Lake Luzerne, NY	10/6/97	10/20/97	Liberty, NY	Keith Priere	14 d	114 m
MQ478	M	Curtis	Lewisburg, WV	9/30/97	10/9/97	Elkin, NC	Carol Haynes	9 d	109 m
NF272*	M	Sandra Anderson	Plymouth, MN	10/10/97	10/22/97	Dover, MN	Clarence Carpenter	12 d	98 m
NQ861	M	Jenny Howard	Cumberland Foreside, ME	9/6/97	9/16/97	Amesbury, MA	Deborah Welch	10 d	73 m
OQ270	M	Dennis Wangerin Schlitz Audubon Nat. Ctr.	Bayside, WI	9/9/97	9/17/97	Wadsworth, IL	Cathy Osa	8 d	52 m
MP193*	F	Richard Pinney Denmark H.S.	Denmark, WI	9/8/97	9/29/97	Glenbeulah, WI	Adam Konz	21 d	39 m
QD987	M	Jim Gilbert	Waconia, MN	10/10/97	10/16/97	South St. Paul, MN	Teresa VanSon	6 d	37 m
OD887	M	Carol Boyce Orange Elem. School	Dysart, IA	9/24/97	9/28/97	Cedar Rapids, IA	Susan Armitage	4 d	36 m
NL684	M	Susan Throckmorton	Hawley, TX	10/1/97	10/3/97	Stamford, TX	Norris Russell	2 d	31 m
PA065*	F	Lynn Frazier	Columbia, CT	9/18/97	9/21/97	Groton, CT	Catherine Silver	3 d	28 m
QG823	M	Dan Dickinson	Kansas City, MO	9/25/97	9/26/97	Olathe, KS	Lisa Erickson	1 d	22 m
NA246	F	Gary & Sue Cadogan	Goose Lake, IA	9/7/97	9/27/97	Bellevue, IA	Darlene McGovern	20 d	20 m
TP492	F	Susan Thomas	Metairie, LA	10/16/97	10/17/97	New Orleans, LA	Robin D' Arcangelo	1 d	15 m
SD484	F	Jerry Wiedmann	Painesville, OH	9/28/97	10/5/97	Chesterland, OH	Caitlin Wajahn	7 d	15 m
SY439	M	Gillian Cusack	Dover, NH	10/3/97	10/4/97	Rye, NH	Denise Brown	1 d	13 m
TN230	M	Calvin Cink Baker Univ.	Lawrence, KS	9/21/97	9/25/97	Baldwin City, KS	Eric Blackwood	4 d	13 m
RK470	M	Nancy Lawrence	Warminster, PA	9/13/97	9/16/97	Bucks County, PA	Howard Isaacs	3 d	9 m
RK461	M	Nancy Lawrence	Warminster, PA	9/13/97	9/15/97	Bucks County, PA	Howard Isaacs	2 d	9 m
NZ225	F	Kelli Shrewsbury	Grove City, OH	9/2/97	?	Columbus, OH	Mark Burkhart	?	9 m
NG292	F	Susan Martin Sheridan	Minneapolis, MN	9/17/97	9/18/97	St. Paul, MN	Marcie O' Conner	1 d	8 m
NI914	F	Michelle Prysby U. of Minn.	St. Paul, MN	8/30/97	9/1/97	St. Anthony Village, MN	Alex Steffenson	2 d	8 m
QG604	M	Dan Dickinson	Kansas City, MO	9/15/97	9/16/97	Parkville, MO	Gene Jeske	1 d	8 m
SQ739	M	Linda Ferguson	Pittsburgh, PA	9/17/97	9/19/97	Ross Township, PA	Jane Crompton	2 d	7 m
MY216	M	Robert Mitchell	University Park, MD	9/5/97	9/9/97	Washington, DC	Leeanne & Alfonso Alonso	4 d	6 m
NH918	F	Laura Loppnow	St. Paul, MN	10/8/97	10/11/97	Roseville, MN	Jim Paulley	3 d	5 m
PC825	F	Michael Weissmann Butterfly Pavilion	Westminister, CO	10/7/97	10/7/97	Northglenn, CO	Josh Douglas	1 d	5 m
NT084	M	Kelly Vaughn	Washington, MI	9/29/97	10/4/97	Romeo, MI	Cheryl Smith	5 d	5 m
OR490	M	John Pogacnik	North Perry, OH	8/30/97	9/3/97	Perry, OH	Mike Gerlica	4 d	3 m
PJ381	F	Kathryn Wedge	Neenah, WI	9/4/97	9/6/97	Menasha, WI	Kimberly Peters	2 d	3 m
RK462	M	Nancy Lawrence	Warminster, PA	9/13/97	9/14/97	Hatboro, PA	Johanna Rauscher	1 d	2 m
UB138	M	Alice Kotala	Duncansville, PA	10/28/97	?	Hollidburg, PA	Anonymous	?	2 m
SY570	M	Stacy Adair	Florissant, MO	10/5/97	10/6/97	Hazelwood, MO	Kris Embry	1 d	2 m

Tag No.	Sex	Tagger	Where Tagged	Date Tagged	Date Recovered	Where Recovered	Observed or Reported by	Interval	Est. Distance
NB344	M	Liz Miller	Ames, IA	9/17/97	9/20/97	Ames, IA	Bitzer/Holcroft	3 d	1 m
RO322	?	Justin Wood Southwest J.H.S.	Lawrence, KS?	?	10/17/97	Comstock, TX	Joe & Kathy Labadie	?	?
DZ859	M	John Drummond Shaver's Creek Env. Ctr.	University Park, PA?	?	2/18/98	Pensacola Beach, FL	Alice Bohanen	?	?
071AB	?	Spencer Clarke Maranatha Academy	Shawnee, KS?	?	2/16/98	Victoria, TX	Douglas Cronquist	?	?
LM896	F	Bill Calvert	TX?	?	3/?/98	El Rosario, Mexico	Monarch Prg.	?	?
MM763 <sup>+</sup>	?	Terry Callender Wamego H.S.	Wamego, KS?	?	12/30/96	Anganguero, Mexico	Dale Wynns	?	?

\* These Monarchs were reared under varying conditions and flew distances of 10 miles or greater.

\* This was a 1996 season recovery that was not reported in last year's season summary.

## MONARCH SIZE & MASS

One of our student-scientist projects involves the collection of size and mass data for migrating Monarchs in the fall. Little is known about which Monarchs survive the journey to Mexico and which do not. Maybe individuals representing all size and mass combinations survive equally from their origin in the north to the roosts in Mexico or perhaps individuals of some size and mass groups are more apt to die along the way. If this occurs, samples of Monarchs obtained along the migration should reflect these changes in survivorship. If you are interested in pursuing this project further, see the Student Projects and Bibliography sections of our Web site.

In 1997, thanks to some very determined students and Monarch Watch members, we received data on over 2500 Monarchs! So, as promised, we summarized the data for you and now we have a new challenge for teachers and students alike. The table shows the results of the first year of this study. See if you can answer the following size and mass questions with the data tables provided.

Are there differences between: males and females? reared and wild Monarchs? Monarchs caught in different locations?

Are these differences significant? What might be possible explanations for these differences? What other patterns can you find in these data? 🍌

### Wild Monarchs

Collected By:	FW-F*	FW-M	HW-F	HW-M	Mass-F	Mass-M
Bitzer Ames, IA	51.45 (n=148)	52.23 (n=160)				
Cadogen Clinton, IA	50.96 (n=73)	50.98 (n=125)	34.40 (n=73)	34.28 (n=124)		
Reed Malvern, IA	49.50 (n=16)	50.21 (n=14)	28.69 (n=16)	29.07 (n=14)		
Sammataro Wooster, OH	51.46 (n=13)	52.26 (n=34)	29.15 (n=13)	29.29 (n=34)	0.66 (n=5)	0.77 (n=20)
Mitchell University Park, MD	51.00 (n=2)	50.55 (n=11)				
Gillespie Lee's Summit, MO	47.53 (n=4)	50.40 (n=12)				
Warner Olathe, KS	52.30 (n=41)	52.10 (n=61)	34.20 (n=41)	33.70 (n=61)	.53 (n=68)	.56 (n=85)
Wilson Oak Hill, WV	50.38 (n=8)	49.63 (n=8)	30.00 (n=8)	29.75 (n=8)		
McCord Folly Beach, SC	52.75 (n=402)	53.20 (n=700)				

### Reared Monarchs

Reared By:	FW-F	FW-M	HW-F	HW-M	Mass-F	Mass-M
Rochester Amery, WI	51.25 (n=55)	51.95 (n=66)	29.87 (n=55)	30.12 (n=66)	0.49(n=44)	0.50 (n=48)
Kemp Luzerne, MI					.53 (n=36)	.57 (n=44)
Thoren Neenah, WI	51.83 (n=275)	52.38 (n=308)				
Mitchell University Park, MD	48.74 (n=19)	51.00 (n=8)				
Gillespie Lee's Summit, MO	50.05 (n=2)	46.87 (n=3)				
Warner Olathe, KS	46.60 (n=7)	44.20 (n=5)	30.20 (n=7)	29.4 (n=5)	.45 (n=8)	.46 (n=6)
McCord Folly Beach, SC	50.50 (n=4)	46.50 (n=2)				

\*These data are organized by latitude. All measurements are means with n number of female (F) or male (M) Monarchs measured. Forewing (FW) and Hindwing (HW) measurements are in millimeters and Mass is in grams.

## TAG TEAM UPDATE

Patricia Delmott



Remember this Monarch tagging team from last year's Season Summary? Well, it turns out that their recent tagging efforts really panned out! Patty Delmott and her team tagged 222 Monarchs last fall and two of them were reported in Mexico. The butterflies were tagged on the same day in Melvern, KS and travelled approximately 1335 miles to the roosts in Mexico!

# MONARCH RECORDS

These records were gleaned from the annual reports of the Insect Migration Association, a program run by Fred and Norah Urquhart from 1963-1993, and from the records of Monarch Watch (1992-1997). If we have overlooked an important record or made any mistakes in these reports, please let us know!

## **LONGEST KNOWN FLIGHT: 2880 MILES (4608 KILOMETERS)**

Tagged by Don Davis near Brighton, Ontario, on 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: 18**

Don Davis (Ontario, Canada): 1985 - 1; 1986 - 2; 1990 - 1; 1991 - 10; 1992 - 2; 1994 - 2.

Previous known record was 5, held by Terry Callender and his Wamego High students: 1993 - 1; 1994 - 1; 1996 - 3.

## **ORIGINS OF MONARCHS RECOVERED IN MEXICO**

**MOST WESTERN ORIGIN: MIDLAND, TX (LONGITUDE 102:06:01W)**

**TAGGED BY EMMY ULMSCHEIDER ON OCTOBER 11, 1997**

Previous record was Sharon Springs, KS (longitude 101:45:06W)

Tagged by Erin Townsend on September 25, 1995

**MOST EASTERN ORIGIN:**

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

Tagged by Mark Gretch on September 19, 1995

**MOST NORTHERN ORIGIN: FARGO, ND (LATITUDE 47:03:03N)**

**TAGGED BY GARY BREKKE ON AUGUST 30, 1997**

Previous record was Braham, MN (latitude 45:43:22N)

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

**MOST SOUTHERN ORIGIN:**

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, NEWFOUNDLAND** - 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

## **EARLIEST AND LATEST TAGGING DATES FOR MONARCHS**

### **RECOVERED AT ROOST SITES IN MEXICO:**

#### **NORTH AMERICA**

**14 AUGUST (1994)** - Tagged by Don Davis in Ontario, Canada; Urquhart Tag No. 16274

**15 OCTOBER (1997)** - Tagged by Larry Miller in Abilene, TX; Monarch Watch Tag No. NM097

#### **KANSAS ALONE**

**8 SEPTEMBER (1994)** - Tagged by Terry Callender in Wamego, KS; Monarch Watch Tag No. 835KQ

**4 OCTOBER (1997)** - Tagged by Anita Walker in Rural Cloud Co, KS; Monarch Watch Tag No. RF 698

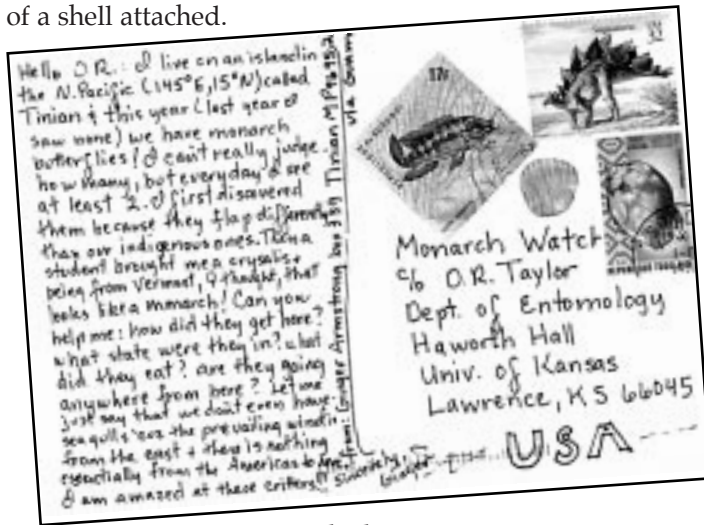
## **TAGGING CAPITAL?**

The students at Wamego High School (Wamego, KS), under the direction of Terry Callender, did it again. During the 1997 season, the Wamego team tagged 11,405 Monarchs! This is an extraordinary effort and is just shy of the record number (12,397) of Monarchs they tagged in 1996. In the five years that Terry's students have participated in Monarch Watch, they have tagged 27,338 Monarchs. Hard work has its rewards and over the years this effort has generated more tag recoveries within the United States (N=19) and Mexico (N=9) than that of any other group. Information generated from this effort, and all other tagging, is being used to answer numerous questions about the Monarch migration. Our thanks to Terry and his students for their contributions to our knowledge of Monarch biology.



# MONARCHS HEAD FOR THE ISLANDS

We receive many interesting letters and cards at Monarch Watch. The following note arrived last November on a handpainted postcard, with some nifty stamps and a piece of a shell attached.



Our response, which was posted to Dplex-L, our Email discussion list, provided an opportunity to discuss some geography, history and Monarch biology.

## GEOGRAPHY:

Tinian is one of a series of islands in the North Pacific. The islands are known as the North Marianas or Micronesia. The most well known islands in the group are Guam and Saipan. This is a U.S. Dependent Area.

## HISTORY:

The Marianas were occupied by the Japanese at the beginning of WWII. Fierce battles were fought to regain these

**FOR MORE INFORMATION ON TINIAN AND THE MARIANAS, POINT YOUR FAVORITE BROWSER TO [WWW.METACRAWLER.COM](http://WWW.METACRAWLER.COM) (OR ANY OTHER "SEARCH ENGINE"). SEARCH FOR "TINIAN" AND YOU'RE BOUND TO HIT UPON QUITE A FEW RESOURCES.**

islands since they could be used as staging areas to carry the war to Japan. In early August 1945, the Enola Gay left the runway on Tinian with the first of two atom bombs destined for Hiroshima and Nagasaki. The bombings shocked Japan, and the world, and brought the Pacific war to a rapid conclusion. Later, some remote islands in the Marianas, and many obsolete ships, were used for atomic testing.

## MONARCHS:

Monarchs evidently reached the Marianas, and many other areas in the Pacific and elsewhere, in the 1890s. This major expansion of the distribution of Monarchs coincided with the development of steam ships and increased rates of trade with remote regions. The steam ships travelled faster than the sailing ships and the theory is that Monarchs as adults, or immatures on cargo, were able to survive long enough to reach new land masses. However, to colonize new areas, the hostplants must have preceded them. Several species of

milkweeds, such as *Asclepias physocarpa/fruticosa* (SEE PHOTOS ON PAGE 17) from South Africa, are now widespread among the Pacific Islands.

For an interesting, and somewhat disputed, account of the expansion of the distribution of Monarchs in the last half of the 19th century see:

*The Columbus hypothesis: An explanation for the dramatic 19th century range expansion of the Monarch butterfly.* Richard I. Vane-Wright in *Biology and Conservation of the Monarch Butterfly* 1993, Natural History Museum of Los Angeles County. pp. 179-188.▼

## GOAT ISLAND ROOST

Last fall we received an interesting letter from Martin Kopacz of Houston, Texas. He reported seeing Monarchs roosting along the Gulf of Mexico in Texas during the winter of 1990. He wrote:

*I crossed the intercoastal canal in a canoe outside Crystal Beach [Texas] to explore a stand of trees off in the distance that I had observed for years...I stumbled into thousands of Monarchs in this stand of trees and stood there in amazement and awe.*

The location of the roost was given as Goat Island, a thin sliver of an island on the north side of the Bolivar Peninsula created a half a century ago by the cutting of the intercoastal canal. This population, if present every year, could explain the appearance of Monarchs in Southern Texas in late February and early March. We are most interested in finding out if these populations still occur in this area. If you have knowledge of a winter roost site in this area, please let us know.

## THE BAHAMAS OR BUST!

On October 25, 1997 a tagged\* Monarch was reported by B. H. Deveaux at Sugar Loaf on San Salvador Island in the Bahamas (approx 24:00:00 N, 74:00:00 W). The Monarch was tagged by Elizabeth Hunter on October 12, 1997 at Cape May Point State Park, New Jersey (38:56:24 N, 74:54:20 W). The straight line distance between these two sites is 1031 miles (1650 km) and the heading is 176.8 - almost due south. Assuming the butterfly was found shortly after it arrived, the average distance covered per day would be 86 miles or more. However, since it is unlikely that the butterfly took a direct route, the per day average may have been more than 100 miles per day! **[Monarchs average 50-70 mi/day during the migration.]**

San Salvador Island is approximately 380 miles (608 km) SE of West Palm Beach, Florida. This island has a unique place in history: San Salvador was the location of the first landfall for Christopher Columbus and his small fleet on their voyage to find a westward passage to the "Indies" in 1492.

\*DR. LINCOLN BROWER TAG NO. SBC 104800

# MONARCH POPULATIONS '97-'98

## SPRING AND SUMMER 1997

The remigration in the spring of 1997 was nothing short of spectacular. The numbers of adults, eggs and larvae reported by observers was truly amazing. The Monarchs also appeared to arrive earlier than usual in many locations. This may have been due to favorable weather but the large number of Monarchs could also have been a factor.

The size of the remigrating population can be important. If the number of Monarchs that recolonize the area east of the Rockies is quite small, it seems logical that some parts of the US and Canada might not be recolonized. There just wouldn't be enough butterflies to reach all of the northern breeding areas. This seems to be the case most years. On the other hand, if there is a superabundance of spring migrants, we might expect Monarchs to not only reach all the breeding areas but to show up in some unusual places. This happened in the spring and summer of 1997.

Recolonization can be thought of as a kind of diffusion problem, a small vs. a large drop of ink in your 10 gallon fish tank - good ol' Brownian movement. The difference is that these molecules have wings and generally head in a northeasterly direction but the effect is pretty much the same. The more dye you add to one end of the tank the better your chances of detecting the dye at the opposite end of the tank. Small numbers of Monarchs may move just as fast and just as far but the chances of detection are less.

Monarchs were reported from the entire range of their milkweed hostplants in 1997. During the summer, Monarchs were seen in good numbers from Saskatchewan to Nova Scotia and throughout the northern states. There were three reports of Monarchs near Saskatoon, Saskatchewan, at least two hundred miles beyond the known northern limit of milkweeds. Although there were a few areas in eastern states where the populations were low, there were no large areas where experienced observers could not find Monarchs. Favorable reports continued throughout the summer leading me to speculate that the fall migration would be extraordinary. It was.

## FALL 1997

Unfortunately, we don't have a good way of obtaining quantitative estimates of the numbers of migrating Monarchs. It's a complicated problem. If it's windy, the Monarchs can be down and out of sight and, if they are using thermals on a perfect September day, they can be flying at altitudes that exceed the limits of a good pair of binoculars. Nevertheless, it's possible to obtain a relative measure of the Monarchs on the move. Dick Walton has done just that at Cape May, New Jersey. Working with volunteers and using a standard survey technique (Pollard transects), Dick has recorded the numbers of Monarchs seen per hour during the fall for the last 6 years. The lowest year was 1992 when only 10.4 Monarchs were observed per hour

and the highest was in 1997 with 106.6. In 1996, a boom year in the midwest, only 58.9 were seen per hour at Cape May. We shouldn't expect point surveys to correlate perfectly with all other sources of information but in general the data from Cape May appears to be representative of the trends in the population. The results in 1997 certainly fit with our expectations based on summer reports.

## LIFT OFF!

On 28 August I witnessed perhaps the largest flight of Monarchs I've ever seen. This was south across the extreme western end of Lake Ontario in southern Ontario at Hamilton. A cold front had passed through overnight and the wind was fairly brisk from the NNW...In the two hours (3-5pm) that I observed before the flight stopped, I estimated that about 120,000 passed. It's quite possible that they started at 10am as conditions were good throughout. If so, more than half a million passed on this single day! Bob Curry, Ancaster, ON [from Leps-L email list]

The question as to whether there is a migration of reproductive Monarchs which occurs before the main migration came up again this fall. In Kansas, it's common, to see some Monarchs moving in a southerly direction in mid August. This occurs even though other Monarchs seem to be resident as indicated by high rates of recapture of tagged individuals. In the first two weeks of August '97, there were two cold fronts that swept across most of the US and even into northern Mexico. Over the following two weeks, we received reports from South Carolina, Georgia to Oklahoma, Texas and even northern Mexico, of the arrival of Monarchs - a month early! These Monarchs appeared to be reproductive since egg laying and even defoliation of milkweeds was observed in some locations. We need to learn more about the southerly movement of Monarchs in early to mid August. This pattern does not fit our preconceived notions about the factors that govern the migration.

## WINTER 1997-'98

What happened to all those fall Monarchs that were seen heading towards Mexico? Did they make it? It's hard to tell. While visiting schools in the Reserve in February with Dr. Sandra Perez, we stopped at El Rosario and solicited opinions from guides and many long time visitors to both El Rosario and Chincua as to the state of the Monarch populations and their numbers relative to previous years. The opinions were mixed. However, no one offered that the populations were above normal and nearly all agreed that there were fewer Monarchs than in the fall/winter of 1996. Bummer. I predicted the best fall migration in 20 years and reports from observers in the fall supported this prediction. At least I thought they did. What happened, if anything? Did we misread the tea leaves and the reports from all the observers throughout the breeding area? Or, is it possible that a large proportion of the Monarchs simply didn't sur-

vive the journey to the overwintering sites? We don't know. Survival during the migration is a subject on which there is no data.

Perhaps many of the Monarchs didn't make it to Mexico or died shortly after their arrival. I visited El Rosario on 14 November. The Monarchs had been arriving for a week or more and the numbers of trees covered with Monarchs was still low (about 40). The number of Monarchs in the air and on the trees was spectacular but as a biologist I couldn't take my eyes off the hundreds, perhaps thousands, of dead and dying Monarchs already scattered on the forest floor. How strange, I thought, to have the biological drive to fly all the way to Mexico only to die within days of arrival. The dying butterflies were thin and appeared to be low on fat reserves. I supposed it was normal for some butterflies to arrive in poor condition. But, were the numbers of arriving butterflies with low fat reserves greater than normal? Again, we don't know. Our ability to explain the dynamics of Monarch populations is still very limited.

The weather during the winter, particularly during December and January, can have a major impact on the Monarch populations. In mid December 1997, a major cold front pushed into central Mexico which caused severe crop damage and killed the native vegetation in many areas. Although there were no reports of widespread deaths of Monarchs due to this cold snap, dead Monarchs, up to two feet deep, were seen under Oyamel trees near the top of the ridge at Chincua. The remainder of the Chincua population, on the southerly and southwestern slopes of the mountain, survived this cold period.

Although it is normally dry during the winters in central Mexico, there is usually some rainfall in the mountains and days and nights are often cloudy. The El Nino weather pattern of '97-'98 was unusually dry. Rain was scarce and cloud cover was minimal throughout the winter. Lack of cloud cover at night resulted in overnight temperatures that were at or below freezing at ground level night after night. In February, we saw evidence at El Rosario that Monarchs caught in the open or on the ground at the end of the day had probably frozen to death. Cold mornings limited the ability of Monarchs to fly to sources of water and water became increasingly difficult to find as the winter progressed. At El Rosario, the lack of water contributed to an unusual redistribution of the Monarchs late in the winter. In late February and March, a large portion of the colony moved downhill to a source of moisture and trees on the property of Anganguero, the adjacent ejido. Much of the tourist traffic destined for El Rosario was diverted to Anganguero to the consternation of many of the El Rosario guides and vendors. This appears to be the first time in memory that the colony resettled in Anganguero.

Winter can be a stressful period and the Monarchs that survive are often in poor condition. The condition of the Monarchs at the end of winter probably determines their ability to remigrate in the spring. Was this a more stressful winter than normal? We don't know. At El Rosario in mid February, the Monarchs seemed to be in good condition.

The wings were not especially worn and the butterflies did not appear to be thin as they do when the fat body is depleted. David Marriott who had a longer opportunity to evaluate the condition of the population in late February and early March, reported that the Monarchs appeared to be in poor condition.

#### MONARCH MONITORING PROJECT

[WWW.CONCORD.ORG/~DICK/MMP97.HTML](http://WWW.CONCORD.ORG/~DICK/MMP97.HTML)

JOURNEY NORTH - [WWW.LEARNER.ORG/JNORTH/](http://WWW.LEARNER.ORG/JNORTH/)

After leaving the overwintering sites, the Monarchs zigzag 600 miles or more through the mountains of Mexico before they reach Texas. Although there is some egg laying on the milkweeds they encounter in the mountains, it is not clear whether surviving offspring in Mexico subsequently move northward. Monarchs are rare or absent from most of northern Mexico during the summer months. During the last two weeks of March the mountains were unusually dry but whether this limited the availability of nectar for the northward migrants is not clear. Many native herbaceous and shrubby plants bloom during this period, even under dry conditions, so nectar limitation may not have been a factor.

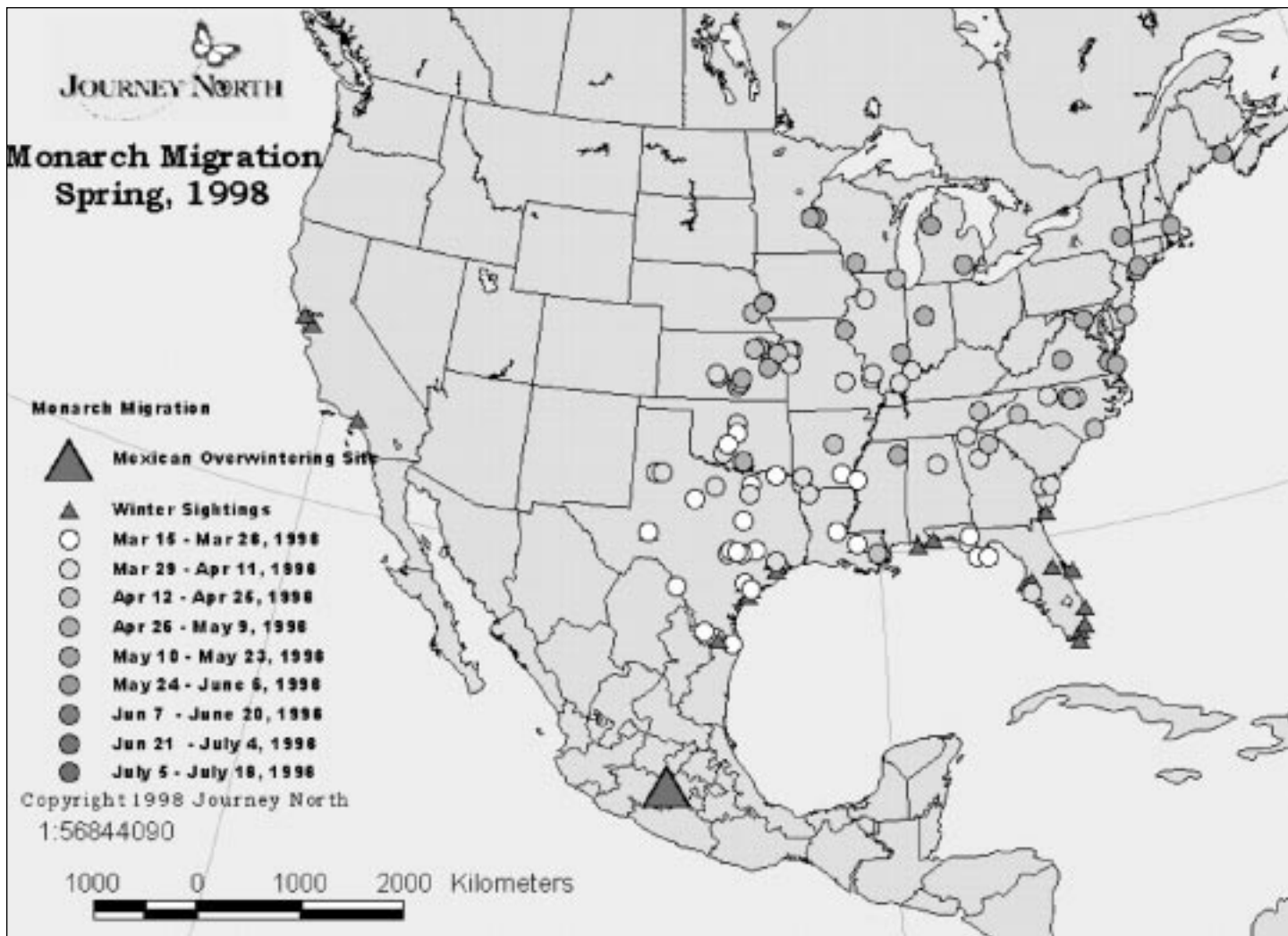
### SPRING 1998

Unlike the spring of 1997, there have been no reports of large numbers of spring Monarchs on the move. The number of sightings has been modest. In April 1997 so many eggs were found on new milkweed shoots that several observers expressed concern the milkweed would be devastated and the Monarch larvae would starve. Neither of these occurred. Predators and parasites evidently harvested many of the "extra" Monarch eggs and larvae.

The pattern of recolonization this spring (PAGE 30) is somewhat different from that recorded over the last 4 years by Journey North. In previous years, the Monarchs expanded through the coastal plain and up the east coast earlier than they advanced into the midwest. This year the numbers of Monarchs moving along the east coast appears to be down and the most rapid movement has occurred in the central midwest. Although the numbers of spring Monarchs appear to be lower this year, their arrival times at new locations are near the long term averages. What does this mean? Are we in for a normal year, a good year or a bad year? At this point, we don't know. A good fall migration followed the spectacular spring migration of last year but this is not always the case. In many years, the number of spring migrants is not a good predictor of the fall population. Why? We're not sure. However, low populations in the fall are strongly associated with droughts and extremely high temperatures. Monarch larvae frequently die when temperatures exceed 95°F and droughts dry out floral sources the adults need for maintenance and egg laying. The milkweeds also suffer under these conditions. My sense is that the most important predictor of the fall migration is the abundance of egg laying females across the northern breeding area from 20 July - 5 August. This hypothesis can be tested with the data generated through Karen Oberhauser's larval monitoring project. ♥



# 1998 SPRING MIGRATION



The Monarch spring migration through 12 May 1998.

Map reproduced with permission from Journey North - [www.learner.org/jnorth](http://www.learner.org/jnorth)

## DID EL NIÑO HAVE AN IMPACT ON MONARCH POPULATIONS?

In the fall I suggested that a good research project for students might be to assess the "The potential effects of El Niño on Monarch populations". This seemed like a cool project to me. There were lots of reasons to expect that the heavy rains and high winds predicted for the California coast and the drier than normal pattern predicted for the overwintering sites in central Mexico could have a significant impact on the Monarch populations. Unfortunately, I didn't hear from anyone on this idea and, as far as I know, no one took the bait. I probably should have done it myself but there just wasn't time. Anyway, here are the predictions I would have made. In California, it seemed likely that the winds and rains expected in January and February would have a substantial negative impact on the Monarchs overwintering at roost sites along the California coast. However, I also expected that the rainfall would promote growth of milkweed and that the surviving Monarchs would enjoy higher than normal reproductive success in the early spring and summer. Well, unless the folks in California aren't telling us something, it doesn't appear that my prediction of high mortality of the overwintering Monarchs due to El Niño effects was realized. A few reports from California in March and April suggest that the spring population is off to a good start. In Mexico, although the weather, as predicted, was drier and colder than normal, large numbers of Monarchs seemed to survive the winter and the sightings of worn and tattered Monarchs in the United States in March and April suggests that a normal recolonization is in progress. No doubt about it, my predictions were wrong. Good. It's good to be wrong because now it becomes more interesting and challenging. The predicted weather patterns for both California and Mexico came true but my predictions did not. This means there are critical facts that I don't know about Monarchs and their overwintering biology. What do you think they might be? Hmmm...

# MONARCH BIBLIOGRAPHY UPDATE

## RECENT POPULAR ARTICLES

Anonymous. Storm kills millions of butterflies: unusual snowstorm and cold temperatures in western Mexico have killed 15-35% of migrating monarch butterflies. 1996. *Facts on File*. 56(2883): 153.

Anonymous. Tragedy in a Mexican forest: a freak snowstorm in south-central Mexico during Jan. 1996, killed millions of migrating monarch butterflies. 1996. *Maclean's*. 109(3): 6.

Anonymous. Winging it to Mexico: Canada and Mexico agree to establish Monarch Butterfly Model Forest in Mexico. 1998. *Maclean's*. 111 (5): 10.

Aridjis, Homero and Lincoln P. Brower. 1996. Twilight of the monarchs: as Mexico's trees disappear, so do the butterflies. *The New York Times*. 145: A15, A27.

Carlson, Shawn. 1997. The amateur scientist: the mysteries of monarch butterflies. *Scientific American*. 277 (3): 91.

Fader, Ellen. 1997. An extraordinary life: the story of a monarch butterfly (book reviews). *The Horn Book Magazine*. 73(3): 344.

Halpern, Sue. 1998. A fragile kingdom: the monarch's 2,000-mile migration ranks among North America's great wonders. But is there enough common ground left in Mexico to assure it a place to land? *Audubon*. 100 (2): 36.

Lanken, Dane. 1998. The nature of monarch butterflies (book reviews). *Canadian Geographic*. 118 (1): 73.

Preston, Julia. 1996. A traveler in danger: snow in Mexico hurts migrating monarch butterflies. *The New York Times*. 145: E2.

Rankin, Bill. 1997. On the track of the monarch butterfly: tracking its migration. *National Wildlife*. 35(3): 46-52.

Taylor, Orley and Brad Williamson. 1996. Monarch migration: monarch butterfly. *The Science Teacher*. 63(5): 26-30.

Teyssier, Jean-Claude. 1998. The Big Picture: Flight Pattern. *Life*. 21 (6): 20-21.

Zimmer, Carl. 1996. The flight of the butterfly: monarch butterfly migration. *Discover*. 17(5): 38-40.

## BOOKS ON MONARCHS

Looking for books on Monarchs? Dana Wilfong (Monarch Watch Program Assistant) found a resource that might be useful to Monarch enthusiasts. The Web site for Amazon books ([www.Amazon.com](http://www.Amazon.com)) has more than 50 titles listed on the topic of "Monarch butterfly." There are also reviews and other useful information (reading level, ISBN#, author, publisher, publication dates, prices, etc.) available for the books they have listed. You can use the site either to get information to help you find books at a bookstore or to place an order online.

## NEW BOOK REVIEWED

### The Nature of Monarch Butterflies: Beauty Takes Flight

Eric S. Grace, Greystone Books. 1997. 114 pp.

Victoria writer Eric Grace here enhances the Monarch's golden reputation with text and, especially, some four dozen fine colour photos on the Monarch's life cycle. He compares its larval stage to its finished glory and marvels at the metamorphosis. "One is an elegant and gregarious beauty with a penchant for courtship and travel, the other, a stay-at-home glutton with voracious habits and a solitary disposition. They seem almost to be two different species..."

Among the book's newer ideas is the interesting notion that the Monarch's range has changed in historic times, from the plains (once flower-strewn, now grain-growing) to more easterly regions (formerly forested but now hosting wildflower meadows). And among the ideas, alas, necessarily repeated are the perils the Monarch faces: threats to the Oyamel fir forests that are its winter lair, and chemical poisons and habitat loss in its northern summer home.

Book review by Dane Lanken in *Canadian Geographic* Jan. - Feb. 1998, page 73.

## RECENT SCIENTIFIC PUBLICATIONS

Alonso M. A., S. E. Rendon, P. E. Montesinos, and L. P. Brower. 1997. Use of lipid reserves by monarch butterflies overwintering in Mexico: implications for conservation. *Ecol. Appl.* 7(3): 934-947.

Dingle, H. and R. Winchell. 1997. Juvenile hormone as a mediator of plasticity in insect life histories. *Archives of Insect Biochemistry and Physiology*. 35(4): 359-373.

Garcia, E. R. and M. E. E. Zamora. 1997. New records of plant-species used by adult monarch butterflies, *Danaus plexippus* L. (Lepidoptera: Nymphalidae: Danainae), during migration in Mexico. *Canadian Entomologist*. 129(2): 375-376.

Leong, K. L. H., M. A. Yoshimura, and H. K. Kaya. 1997. Occurrence of a neogregarine protozoan, *Ophryocystis elektroscirrha* McLaughlin and Myers, in populations of monarch and queen butterflies. *Pan-Pacific Entomologist*. 73(1): 49-51.

Rothschild, M. and G. Bergstrom. 1997. The monarch butterfly caterpillar, *Danaus plexippus*, waves at passing Hymenoptera and jet aircraft: are repellent volatiles released simultaneously? *Phytochemistry*. 45(6): 1139-1144.

Vanholder, B. 1996. The migration of *Danaus plexippus* (L.) during October 1995 in the UK (Lepidoptera: Nymphalidae, Danainae). *Nota Lepidopterologica*. 19(1-2): 129-140.



# THE BEST OF DPLEX

## ARE THE BREEDING WINTER POPULATIONS OF MONARCHS ALONG THE TEXAS COAST NATURAL OR ARTIFICIAL?

Each winter breeding populations of Monarchs are reported from Texas in areas adjacent to the Gulf of Mexico. The only hostplant for the larvae appears to be *Asclepias curassavica*, the tropical or Mexican milkweed. Bill Calvert of the Texas Monarch Watch commented on the origin of *A. curassavica* and the status and significance of the overwintering Monarch populations in Texas.

*A. curassavica* has mysterious origins. Woodson, the expert, writes of this species: "Almost ubiquitous waifs of the tropics and subtropics, frequenting chiefly rather moist places at elevations from near sea level to about 2000 meters: also widely introduced in the tropics of the Old World. Blooming sporadically throughout the year."

The native home of *A. curassavica* is quite conjectural. Linnaeus (the founder of binomial nomenclature) believed that the name *curassavica* was some sort of corruption of Curacao. Woodson's opinion was that *A. curassavica* was from South America.

The point here is that it is not native to Texas, or even to the Gulf Coast of Mexico. To my knowledge all of the native milkweeds in that region senesce during the winter. The Gulf Coast population is then an artificial one, completely dependent on the planting of *A. curassavica* and the few wild escapes.

This of course does not make it any less attractive or interesting, but it suggests two things: 1) that the breeding is an artifact of the widely planted showy and attractive *A. curassavica*, and 2) that it is very limited in extent since not much of the species is established along the coast and during winters with freezes, it dies back to its roots or is killed outright.

Notwithstanding the interest that this coastal population generates, these populations must make only a minuscule contribution to the total Monarch population.

The *A. curassavica*-dependent populations on the Mexican coastal plain are likely much more important to the Monarch population but are still "artificial" since *A. curassavica* is also not native to that region.

## MONARCHS AND OPEN WATER

Each year we receive reports of Monarchs seen flying over open water or approaching landfall from the ocean. The following two accounts are typical but the second led to a discussion by David Gibo of how Monarchs might be responding to coastal wind patterns.

### Sightings of Monarch butterflies along North Carolina and Florida coastlines

In the vicinity of Atlantic Beach (near Morehead City and Beaufort, NC) we frequently observed solitary Monarchs. What struck us as interesting was that none of these butterflies dallied or deviated from their flight path but were heading off in a specific

direction and often out to sea. A number of these butterflies flew to the west along the local shoreline and interior of Bogue Island (a barrier island). Beyond the surf from about 1 to 4 miles off shore the Monarchs were headed more to the southwest, with some heading straight south. Both of these bearings take them out to large expanses of open sea. We also observed two intrepid Monarchs, headed south at about 20 and 45 miles off shore respectively, in the open sea south of Cape Lookout. They were cruising at about 10 - 20 feet above the waves and had no interest in resting on our boat. I do not recall a specific or sustained wind direction, but breezes were generally less than 12 mph and were often angular to the flight path of the butterflies.

- Dan Tyler, Richland, WA

In a report to Journey North, Francis Harvey stated that she had seen about 50 Monarchs flying against the wind as they came in off the ocean on the 15th of March in Panama City Beach, FL - west of Tallahassee.

### The following is a brief abstract of the response by David Gibo, Toronto, Canada

I don't find the sightings unusual because I have made similar sightings on the Outer Banks of North Carolina in the latter weeks of August while on a family vacation.

The probable source of the Monarchs becomes clear when we consider that: (1) migrating (have a preferred direction) and dispersing (no preferred direction) Monarch butterflies both engage in soaring flight; (2) high pressure systems are often ideal air masses for generating thermals; (3) thermals always drift downwind; and (4) when a thermal that has formed over warm land drifts out over a cooler body of water, the supply of warm air feeding into the thermal is cut off and the thermal dissipates.

Is there an adaptive advantage of soaring in thermals near the coast, even at the risk of being drifted out to sea? Perhaps. The sea breeze forms a reasonable dependable source of lift called the sea breeze front. This front is a band of lift paralleling the coastline that is formed when the sea breeze encounters an opposing wind (like the situation on March 15) or forms at the front of the advancing mass of cool air moving inland. This occurs most days from spring through fall and can be used as a highway by soaring animals to travel long distances in relatively straight lines. Lake breeze fronts also form, particularly in the Great Lakes region.

Monarch butterflies may be adapted to exploit this dependable source of lift, or they may simply be exhibiting their normal soaring behavior and are swept up in the lift from the front as soon as it forms. Butterflies that were soaring in thermals further inland would

SOLUTION TO PUZZLE ON PAGE 38





have have been carried S by the N wind and neared the coast just as sea breeze began to move inland. The butterflies would have been swept up by the front could have flown in lift for the rest of the day. Butterflies that started further to the south may have been drifted over the sea and had to fight their way back, but once the sea breeze developed, they too, would have been swept into the front and been able to soar in lift for the rest of the day. Is this an adaptation, or simply their normal soaring program being played out in a favourable environment? I don't know. I do know that it is about as much sophistication we can expect from an insect unless it has senses that we don't know about.

## **MONARCHS STOP OVER IN LAWRENCE, KS AT THE BAKER-HASKELL WETLANDS**

Some years migratory Monarchs stop in Lawrence and other years they pass through in a few days or don't stop at all. In 1997, they more than stopped, they filled the trees and the skies. Here are abstracts of notes Chip Taylor sent to Dplex-L about the Monarchs in Lawrence.

### **10 September**

*Last evening Ken Highfill (local high school teacher and naturalist) reported seeing approximately 2000 Monarchs at the Baker-Haskell wetlands. This evening the numbers of Monarchs at this location were nothing short of extraordinary - perhaps 50,000-100,000. The wetlands are almost a square mile in area on the south side of Lawrence. Scattered through this site are 10's of acres of Bidens and various species of Helianthus (sunflowers) and other composites. The Bidens bloom is spectacular and later than usual this year. The number of Monarchs seen passing through town today appeared to be modest but even two earlier visits to the wetlands did not prepare me for the number of Monarchs we saw coming to roosts at dusk. At noon I estimated that there were about 10,000 Monarchs in the area; in retrospect this appears to have been a gross underestimate.*

*I've been visiting the wetlands during the migration for more than 20 years and the number of Monarchs present this evening exceeded anything I had seen previously at this location. But then, I've never seen such a profusion of Bidens coincident with the arrival of the migrants.*

### **13 September**

*I visited the site three times yesterday and once again this morning. The number of Monarchs is probably closer to 100 than 50 thousand and they are still drifting into the area. There are 100's of small and 10's of large roosts in the wetlands, mostly on the north (lee) side of trees and shrubs. The largest roost probably contained 2000-4000 Monarchs on the morning of the 12th and at least 6 others were found in which the numbers of Monarchs were in excess of 1000. There were many parts of the wetlands which we didn't visit so the number of roosts in the area could be greater.*

The arrival of such a large number of Monarchs attracted several television crews and a modest number of visitors to the wetlands over the next 10 days. The Monarchs began to leave the wetlands on the 14th (Sunday) and most had left the area by the 18th.

The five groups of taggers who visited the wetlands during this interval had no difficulty using all their tags. The data

sheets indicate that 1410 Monarchs collected in the wetlands were tagged. Remarkably, five of these were recovered and of these, three were recovered at El Rosario in Mexico.▼

## **FOLLOW THE MIGRATION**

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.

One of the best sources of weather information for this purpose is Purdue University's Weather Processor Image and Map Archive. This is an extraordinary resource and a curious student can learn more about weather and how to read weather maps in a few minutes than they can from years of watching the weather persons on TV.

Composite images of the weather patterns for the world, in MPEG movie format, can be found at the University of Wisconsin Space Science and Engineering Center site.

Excellent four day forecasts, with temperature and cloud cover maps, are available from CNN.

### **PURDUE WEATHER IMAGE AND MAP ARCHIVE**

**[HTTP://WXP.ATMS.PURDUE.EDU/ARCHIVE/](http://wxp.atms.purdue.edu/archive/)**

### **WISCONSIN SPACE SCIENCE AND ENGINEERING CNTR**

**[WWW.SSEC.WISC.EDU](http://www.ssec.wisc.edu)**

### **CNN WEATHER SITE**

**[WWW.CNN.COM/WEATHER/](http://www.cnn.com/weather/)**

# FREQUENTLY ASKED QUESTIONS

## DO MONARCHS FLY AT NIGHT?

The appearance of Monarchs in England, France and elsewhere in northern Europe in the fall and the sightings of Monarchs arriving on the Florida coastline from the Gulf of Mexico have led some observers to suggest that Monarchs have the ability to fly at night. Crossing the Atlantic, even with the most favorable wind conditions, would appear to require at least three days and crossing the Gulf perhaps two. Do Monarchs fly at night? Strictly speaking, we don't know. There are no credible observations of Monarchs flying beyond dusk. Trans-Atlantic movements can be explained by hitchhiking on ships and the apparent arrival of Monarchs from the Gulf can be explained by Monarchs using off-shore and on-shore winds to move along the coast. In cages, whether indoors or outdoors, migratory Monarchs do not move at night.

## WHY DO MONARCHS ROOST ON THE WEST OR NORTHWEST SIDES OF TREES?

During the past two seasons I have seen perhaps 100-200 roosts in Kansas. The largest roosts are usually on the north and west sides of trees. The west (sometimes slightly NW) facing roosts are usually where the last sun of the day hits the trees. Roosts on the N sides (sometimes even NE) seem to be influenced by strong southerly winds. In these cases, the butterflies appear to be "getting out of the wind". However, we have found many roosts, usually with fewer butterflies, in areas with good overhanging canopies. In the morning, the butterflies with the most protection from the direct rays of the sun (i.e., those with the best canopy and/or on the NW sides of trees) are usually the last to take flight.

## COULD THERE BE SERIOUS CONSEQUENCES OF RELEASING CLASSROOM REARED MONARCHS IN THE EASTERN POPULATION?

We must act responsibly and our actions should have a sound scientific basis. There is more opinion than science on the issue of releases and we need to work towards a better understanding of Monarch populations. For example, we need to establish how all of man's activities - from mowing to the use of insecticides - influence the size and dynamics of the Monarch populations. Nearly all of the habitats occupied by Monarchs are perturbed by human activities on a yearly basis. Some of these perturbations are positive and others are certainly negative. We know almost nothing about how these activities influence Monarchs.

This question can be answered another way. What might it take to have a genetic impact on Monarchs? To answer this question we must know the breeding structure of the population (outbreeding with extensive multiple mating in Monarchs), vagility (mobility - highly mobile) and population size (250-500 million fall migrants), and the amount of genetic input from rearing (i.e., the number of released but-

terflies that survive to reproduce - assuming also that the reared butterflies have deleterious genes that can be passed on). The number of reared Monarchs that are released each fall is probably less than 20,000. This is just a guess but it seems reasonable based on the information we get back from taggers. The proportion of this estimated 20,000 Monarchs that survive to migrate is unknown. Are these releases likely to have an impact on a population with these characteristics? This is a good question but it seems unlikely: there is no precedent for such an effect in the literature. Nevertheless, we should be cautious and under no conditions should we release diseased Monarchs into the natural population.

## DOES THE GENETIC SOURCE OF THE MONARCHS DETERMINE WHETHER THEY WILL MIGRATE?

We don't know. If the Monarchs from each region of the eastern population were somewhat genetically isolated from each other, then there might be such effects. For these conditions to exist, Monarchs from each region would have to return to the same general area each year. There is no evidence that this occurs. More than likely returning Monarchs which originated from the midwest in the fall are scattered on their return across the southern states. Isotope analysis of spring Monarchs will help us answer the question as to whether they return to the same general area. But, we should remember two things about the return: 1) there is considerable mating at the roosts before the butterflies disperse, and 2) return to the northern breeding grounds involves two generations. Both factors would tend to homogenize the genetics of the population. Also, studies to date show that the genetic variability of the fall migratory population does not differ between regions or years.

## IS THE DATE OF RELEASE OF CLASSROOM REARED MONARCHS CRITICAL?

Release time may be critical. Some of the data suggests that, for any one location, the migration window is only three weeks. In other words, unless the migrants are released within three weeks of the time of the arrival of the first migrants to an area, their chances of making it to Mexico are low.

## WHAT IS THE NUMBER ONE PRIORITY IN MONARCH CONSERVATION?

Our number one priority, most will agree, is to preserve the Monarch migration. The overwintering area for Monarchs in Mexico is, as Lincoln Brower, Bill Calvert and others have pointed out, the Achilles heel in the Monarch's annual cycle. Preservation of the critical Oyamel forest is key to the preservation of the Monarch population in eastern North America. Cooperation among the governments of Mexico, the United States and Canada, the local populations in the ejidos, as well as the actions of numerous non-government organizations (NGO's), will be needed to preserve these



areas. To be effective, these efforts will need the support of the public in each country. Fortunately, efforts to educate the public, particularly our children, are increasing. We need to give value to the Monarchs and to the living Oyamel forests in Mexico to preserve the Monarch migration. As we see it, part of our job at Monarch Watch is to give value to the Monarchs through education.

### WHAT IS THE PURPOSE, FUNCTION OR VALUE OF THE MONARCH BUTTERFLY?

The purpose or function question is difficult to address because the statement or question usually is based on a distinct human centered set of values which often have a cultural, economic and religious basis. If we ask what is the functional role of this insect in nature, we can see that it is a herbivore and nectar feeder and hence a pollinator, as well as a food item for many different species. Herbivores often have some limiting effects on the plants they use. Therefore, they may reduce the abundance of these plants thus allowing space and resources for other plant species and these plants support other herbivores and so on. All the interactions among species are thought to contribute to the overall biodiversity of the planet. Thus, the loss of any species to extinction will have an effect on many other species. So, in the broad sense, the Monarch has value in that it is part of the web of life that sustains many species.

### WHAT ARE THE CHANCES OF FINDING A TAGGED MONARCH?

Unfortunately, the prospects of finding tagged Monarchs is quite low. We have done some estimates, admittedly quite crude, but they indicate that if we have a population of 40 thousand tagged Monarchs, the number of Monarchs one person would have to examine before finding one tag would be between 2-15 thousand. The Monarch population heading south can be very large - from 100 million to perhaps a half billion - which makes it very difficult to recover tags by searching. Almost all the recoveries are made by people unfamiliar with our program. Recoveries are chance events, minor miracles - like winning the lottery.

**WANTED:** We need reference copies of the "Insect Migration Studies Annual Report" volumes 1-26, produced by Fred and Norah Urquhart. These materials will be used to assess the patterns of Monarch migration and long term trends in Monarch populations. We will be happy to cover the costs of duplication and postage.

### DO MONARCHS RETURN TO THEIR ORIGIN?

The question as to whether Monarchs, like so many bird species, return to their region of natal origin in the spring, arises several times each year. It seems logical to many observers, including a number of scientists with whom I've discussed this subject, that Monarchs which originated in the midwest in the fall should make some attempt to return to the same general area the following spring. Implicit in their thinking is the notion that somehow the migration must be genetically encoded by region. In other words, it's hard for them to understand how the migration works if

butterflies originating in Connecticut (an east coast population) return instead to the midwest (Kansas, for example). Or, vice versa. Clearly, it is difficult to get away from the bird model and to consider alternatives.

Surprisingly, we don't know the answer to this question. Studies of the genetics of the eastern Monarch populations suggest they are homogeneous, i.e. not regionally partitioned. But, it could also be argued that the genetic analysis used in these studies was not sufficient to answer this question. Similarly, tagging data doesn't help because only eight Monarchs known to, or presumed to, have overwintered in Mexico have been recaptured in the US in the spring and all of these recaptures have been in Texas. To answer this question, we need to obtain samples of spring migrants in areas north and east of Texas and devise a way to analyze these specimens to determine the region of the country from which they originated the previous fall. This sounds like an impossible task but it can be done - with hydrogen isotopes (SEE "HYDROGEN" ON PAGE 9). The preliminary results of the isotope study are so promising that it seems likely we can answer this question by analyzing the wings of the Monarchs for the ratios of hydrogen isotopes.

However, to answer the question we need Monarchs - worn ones - migrants that have probably overwintered in Mexico for the analysis. We do not need large numbers of specimens, only 2-3 per state, for this study. If you have an opportunity to collect a few Monarchs in the spring, we could sure use your help.

The Monarchs can be placed in an envelope on which you have written all the appropriate information - location, date, collector, condition of the specimen - and then placed in a freezer. At a later date the envelopes with the Monarchs can be placed in a crush-resistant container and sent to us. We will forward them on to Canada for the analysis. ♡

## MONARCH LIFE HISTORY

### DEVELOPMENTAL TIME OF IMMATURES AND LONGEVITY OF ADULTS

The following estimates are based on the assumption that the life stages experience temps of 72-82°F.

Egg	3-4 days
Larva	12-16 days
Pupa	9-12 days
Adult	2-6 weeks in summer 7-9 months over winter

### SEASONAL CYCLE

Adult Monarchs migrate northward from the overwintering sites in Mexico in March.

There are 3-5 summer generations from March through August (there is some reproduction in midwestern and southern states in September and October).

Migratory Monarchs, third to fifth generation, emerge mid-August and later (depending on latitude). Those that survive the overwinter period in Mexico move northward in the spring and thus have a lifespan of 7-9 months.



# LETTERS TO MONARCH WATCH

We had the most wonderful experience raising and nurturing our eggs and larvae this fall. I teach in a Title I Program that encompasses grades K through six. To watch the enthusiasm of these young children as they observed firsthand the life cycle of the Monarch Butterfly was tremendously satisfying. I am convinced that the information children take from an experience such as this teaches them to be more observant of their surroundings, to respect life and a certain quietness that enhances their ability to learn.

Thank you for the opportunity to not only tag butterflies but for providing a wonderful chance to share some excitement and knowledge with today's young people. If even one of them is "turned on" to science as a result, it will have been worth all the work!

**Kathy Jewett**  
**Portland, ME**

Implementing Monarchs into my classroom has been one of the best things I've done in all my years of teaching! There are so many things to learn while studying Monarchs! Nothing has ever been easier to integrate into all subject areas and ability levels like Monarchs!

We gained a great amount of knowledge and experienced a tremendous outpouring of interest from other students, teachers and parents.

Thank you so much for sharing your knowledge and interest with us. We appreciate you and your staff for making the Monarch Watch activities and tagging available for us to use in our school.

**Brenda Christian**  
**Hammon Elementary, Hammon, OK**

My students were beside themselves knowing one of the Monarchs was recaptured. I told them that you rely heavily on volunteers

to help you. I teach reading to 4 different grade levels. We had a butterfly party to celebrate ours getting recovered and then we made books about Monarchs and ideas on how to help them. They are so incredibly beautiful, and the ideas and worry about "their" butterflies was so touching. Children are such a great resource [for monarch awareness]!! One mom called me laughing. She said her daughter stopped their little league game to let a monarch pass through the field. She wanted to know what I had done to them! It really isn't me, there is just something so [wonderous] about a creature that fragile and beautiful to accomplish something so grand!

**Lynn Frazier**  
**Columbia, CT**

I just wanted to let you and your staff know what a wonderful experience you created for children and adults alike. I purchased 6 larvae from Monarch Watch to use with a group of kindergartners. Four of the six successfully matured to adults and were tagged and released. The kids couldn't get enough, and thought that the emergence from the pupa was awesome! Thanks again for a wonderful hands on project.

**Michelle Ward**  
**Ames, IA**



**Students at Ascension Catholic School (KS) say farewell to more than 300 tagged Monarchs as local TV camera crews capture the event for a later broadcast.**

*Photo by Jill Wells*

I worked with a number of teachers throughout our district in this project, and they were all filled with tremendous enthusiasm. That also can only do good things for our children and for education in the long run.

It was a wonderful experience, and we hope to be able to participate for years to come.

**Cecelia Peterson**  
**Nettleton Magnet School, Duluth, MN**

This year, I spoke to about 30 different groups of students, ranging from preschool to 5th grade, about Monarch butterflies and the Monarch Watch project. These students reared butterflies from larvae, and in one instance, were even lucky enough to find an egg. Their success rates were commendable, and they were all very excited to find that they will be able to track the migration of the butterflies, and are hoping to find their tag numbers on your Web Site. The teachers of some students have even reported to me that they are not only noticing more butterflies, but are looking for tags on butterflies they see at home, and elsewhere. I find it very encouraging that this project has made them more aware and observant of their surroundings, as well as more interested and excited about doing follow-up research.

You have a wonderful web site! We raised 2 monarchs at home last fall and enjoyed it so much, we are going to do it again. We are going to use this experience (along with tagging) as a school science project this fall. Your web site is very educational and I learned a lot last fall while reading all of your information. Thanks for all of your hard work!

**Barbara Collie**  
**Pfafftown, NC**

I found out about your web page at school today (I'm a teacher) and thought I would check it out. I LOVE it!!! I'm going to bring it up on the computer in my room and let the children look around. I would like to find some milkweed here so we can watch the Monarchs! I've never been exactly sure what milkweed looked like but with the help of you all I think I will be able to find some. Again, I just love this page!

**Susan Gordon**  
**North Carolina**

Just wanted to type you guys a little letter saying "thanks" for all the good information you put out on the internet! I am writing to you from central PA where last summer I planted a butterfly garden in our back yard for our newborn baby girl, Kyra, in hopes that 4 or 5 years from now, as she grows, so will the garden and that her and I can spend quite a few hours through the summer watching butterflies, looking for chrysalis, and even raising and releasing butterflies! I just really wanted to thank all of you who contribute to this website to make it such a great success! Congrats also on the great and increased responses to your tagging efforts.

**Pete Senchyshak**  
**Enola, PA**

Thank you for all of your hard work with Monarch Watch. I read the Monarch Watch List daily and I appreciate your setting that up. I teach 7th grade science and the students really enjoyed participating in Monarch Watch so far this year. We followed the journey of the Monarchs by using the internet. The students had fun catching and tagging the Monarchs. I think they learned a lot.

**Wilson Hunt**  
**Granbury Middle School, Granbury, TX**

I never knew about Monarch Watch until reading through items on your site today! This is so exciting to me because I just contacted a school on the Net who's involved in the Monarch Project. I have pictures containing TONS of pupas, larvae, and butterflies to be released, and the teacher in charge asked me to send some photos. Now that I see that you'll be adding a photo page at some point, I'm psyched! ...and all this time I've been enjoying my own private butterfly project here, not realizing how truly important they are to everyone else, too!

**Jana L. Sheeder**  
**Miami, FL**

My name Michael Cunningham, I'm 7 years old. I'm interested in the Monarch butterfly because there had been so

many around my house. I had even caught one once when it was on my next door neighbor plants. We put it in a jar and made a habitat. The butterfly started to change colors so we released it back into the wild. I want to have more information what is their traveling route. I will be a Monarch butterfly this Halloween.

**Michael Cunningham**

My family and I have chosen your organization to help us honor our deceased mother's birthday. We lost our mother to a long battle with cancer in May of 1995. One of the things she enjoyed most in nature was butterflies. She especially loved Monarch butterflies. Among her many talents, she was an amateur artist. She painted a beautiful Monarch butterfly that now hangs in our home. Because of her love for butterflies we thought it would be fitting to make a donation to an organization dedicated to the preservation of Monarch butterflies and their habitats. Thank you for accepting this donation in honor of our much loved and missed mother, Eileen V. Kenick.

**Kathy Rose**  
**Lancaster, PA**

My second grade class loved this experience. The amount of knowledge we gained was unbelievable.

My students' parents have also joined on the bandwagon. They are now planning to work on expanding our butterfly garden in our nature center. They will also be building a picket fence around the butterfly garden so that we can plant climbing plants. We have plans for a butterfly planting day where all second grade students from both elementary buildings on our site will bring a plant for the butterfly garden. (That's approximately 150 students). We even have parents interested in putting in their own butterfly gardens now.

Now that the first year is behind us, we already have plans for next year. A couple of parents are buying butterfly nets for our classroom for Christmas gifts to be used by next year's students.

Thank you so much for providing us this experience. We look forward to tagging for you again next year.

**Vickie Dykhuizen and her second grade class**  
**Franklin, IN**

## MONARCH PUBLICITY

Did you know that Monarchs and kids attract cameras and reporters? We have proof. Each year Monarch Watchers send us 10's of newspaper accounts with coverage of their Monarch projects. Monarchs and children are a very positive story which, when combined with biology of the Monarch and the concern for the overwintering sites, helps to educate the public about our interest in maintaining Monarch populations. This is good publicity for the schools, the teachers, and the children as well. Next September, when the Monarch fun begins, call your newspaper or local television station and educate the public about your schools and the Monarchs.

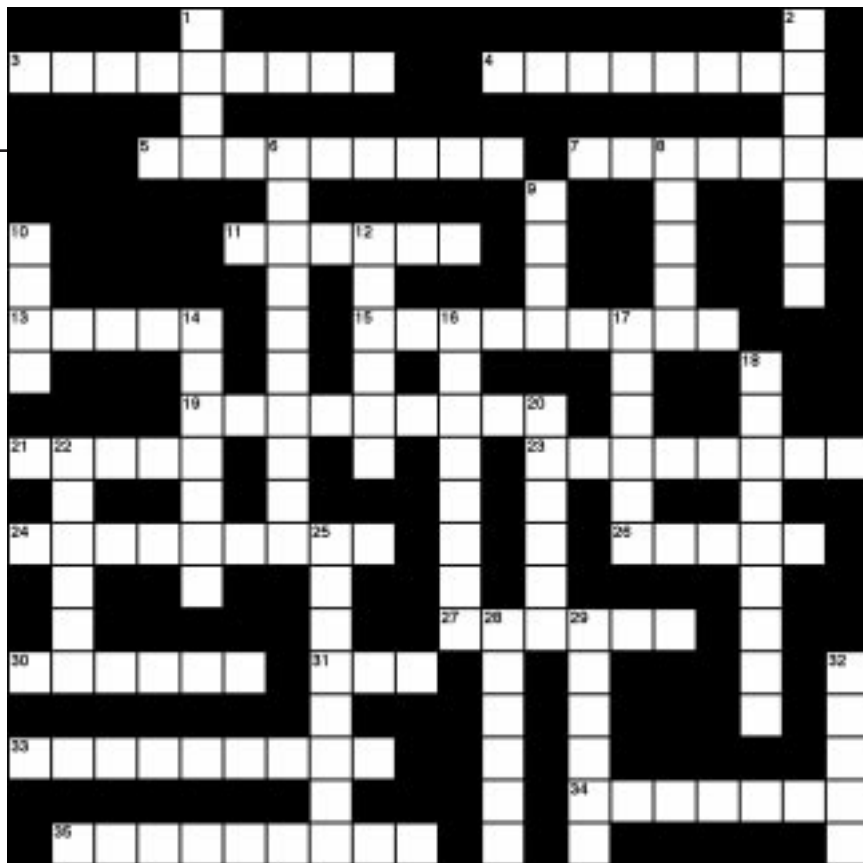
# MONARCH FUN AND GAMES

## TEST YOUR MONARCH VOCABULARY

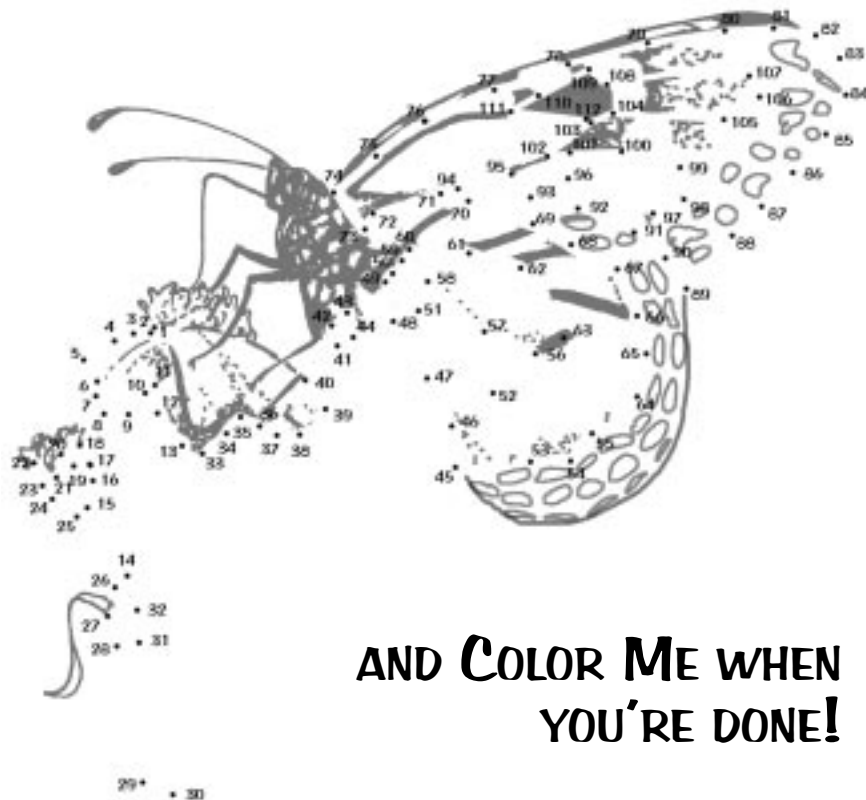
(SOLUTION ON PAGE 32)

### Across

- 3 - Monarch species name.
- 4 - Monarch Watch's "logopillar".
- 5 - Insect blood.
- 7 - Insect skin.
- 11 - Adult butterfly food.
- 13 - A caterpillar.
- 15 - Units that make up a compound eye.
- 19 - Fleishy filaments.
- 21 - Infective stage of bacteria or protozoans.
- 23 - Appendages at the tip of an adult male Monarch's abdomen.
- 24 - Silk-producing organ.
- 26 - Insect hairs.
- 27 - Tags should be applied to this cell.
- 30 - Place where Monarchs overwinter.
- 31 - Insects have \_\_\_\_\_ legs.
- 33 - Tachinid flies are \_\_\_\_\_.
- 34 - Light receptor on top of the head.
- 35 - External openings for breathing.



## CONNECT THE DOTS...



AND COLOR ME WHEN YOU'RE DONE!

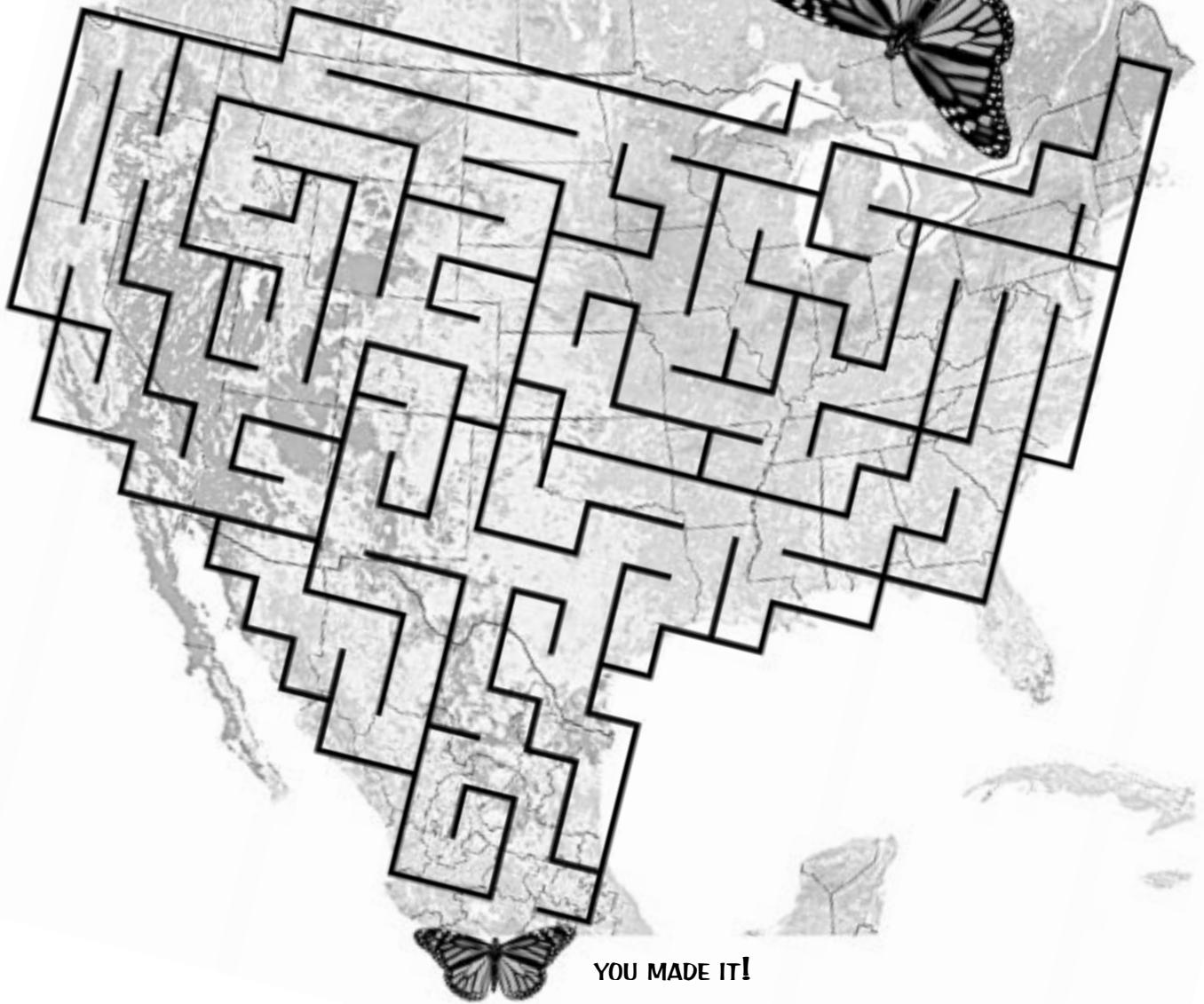
### Down

- 1 - Monarch larvae develop through \_\_\_\_\_ instars.
- 2 - Monarch larvae have five pairs of these.
- 6 - Monarchs do this in Mexico.
- 8 - Insect feet.
- 9 - To shed the skin.
- 10 - Mouthpart bearing sense organs.
- 12 - Wings are attached to a butterfly's \_\_\_\_\_.
- 14 - Sense organs projecting from the head (sing.).
- 16 - Monarch larvae food.
- 17 - \_\_\_\_\_ plexippus.
- 18 - Pupae hang from a silk pad by this.
- 20 - Monarchs have orange ones and black ones.
- 22 - Monarch larvae do this before becoming butterflies.
- 25 - First thing a Monarch larvae eats after hatching.
- 28 - Monarch larvae eat the most during the fifth \_\_\_\_\_.
- 29 - Moth pupae are enclosed in one.
- 32 - Caterpillar poop.



# HELP THE MONARCH MIGRATE TO MEXICO!

START HERE



YOU MADE IT!

## BUTTERFLY LIFE CYCLE SONG

### "Butterfly Cycle"

Hatch, hatch little egg,  
I'm so very small.  
Teeny tiny caterpillar,  
You can't see me at all.

Crawl, caterpillar, crawl,  
Munching on a leaf.  
Crawling, munching, crawling, munching,  
Eat and eat and eat.

Form, form chrysalis,  
I'm a different shape;  
Hanging by a silken thread  
Until I can escape.

*Tune: Row, Row, Row Your Boat*

Rest, rest, chrysalis  
While I change inside;  
Now at last my time has come  
To be a butterfly.

Stretch, stretch, pretty wings,  
It's a special day;  
Soon they will be strong enough  
For me to fly away.

Fly, fly, butterfly,  
Fly from flower to tree;  
Find a place to lay my eggs  
So they can grow like me.

© Suzy Gazlay  
SingingSci@aol.com

# NEWS OF THE WEB

Greetings from Monarch Watch's Webmaster! If you've been visiting us online for some time now, you know our site has gone through a number changes - not without some (hopefully minor) growing pains. We're continually looking for ways to improve the site and make your visits both educational and fun. To that end, we love to hear what you think about the Monarch Watch site and welcome your comments, kudos and criticisms. Feel free to drop me a line anytime!

**Jim Lovett**  
**jlovett@ukans.edu**

## NEW DOMAIN NAME

Since Monarch Watch went online almost five years ago, we've changed our address several times. This was not always by choice and for awhile we became "lost in cyberspace." Now that we have registered our own domain name, this shouldn't ever happen again - you'll always be able to find us at [www.MonarchWatch.org](http://www.MonarchWatch.org).

## SEARCH ME!

We've added search capabilities to our site so that web-surfers can quickly and easily find what they're looking for on our site. The search page will soon be accessible from any page of the Monarch Watch site, but for now there is a search link in the "What's New" section of the home page. In order to perform a search, simply:

1. type in the keyword(s) that you are interested in (we provide several examples to get you started).
2. select match "all" or "any" Use match "all" if you are looking for something specific (only pages that include *all* of the keywords will be "found") and match "any" for a more general search (to find pages that include *any* of the keywords).
3. select "long" or "short" format, depending on how you want the search results displayed. Long format will include a brief description of the Web page and a link to it, whereas short format will only provide a link to each page.

Give it a try and let us know what you think!

## ADOBE ACROBAT PDFs

Portable Document Format (PDF) files are an excellent way of distributing documents on the Web. Without using too much doublespeak, PDF files are based on Adobe's PostScript language which basically describes the layout of graphics and text on a page. The great thing about this is that no matter what kind of computer system you have, a PDF file will look and print out exactly like the "original" document. We currently use only a handful of PDF files on our site, but we plan to use this format more extensively in the coming months and years. The *Monarchs in the Classroom* curricular guides will be included on our CD-ROM as well as on the Web, both in PDF format. Many other sites use this format as well, so it's a good idea to become comfortable with these files.

All you need in order to take advantage of PDFs is Adobe's FREE Acrobat Reader software. This small program is distributed on many CDs that come with computer magazines and is also available for download from Adobe's Web site, as well as many others.

**HEY, IT'S FREE! DOWNLOAD THE LATEST VERSION OF THE ACROBAT READER (3.01) FROM ADOBE'S SITE AT [WWW.ADOBE.COM/PRODINDEX/ACROBAT/READSTEP.HTML](http://WWW.ADOBE.COM/PRODINDEX/ACROBAT/READSTEP.HTML) OR FROM [WWW.BROWSERS.COM](http://WWW.BROWSERS.COM), YOUR ONE-STOP SHOP FOR THE LATEST (AND USUALLY FREE) INTERNET TOOLS.**

## THE FUTURE

In addition to the "Monarch Watchers" section (where your Monarch experiences, photos, etc. are showcased), we'd really like to create a teacher's resource section. This could include tips and tricks for rearing Monarchs and basically anything and everything that has to do with using Monarchs in the classroom (curricular ideas, games, projects, etc.). We're doing as much as we can to accomplish this, but we need more input and feedback from all the educators out there. If you have some ideas you'd like to share, please let us know!♥

## MONICA THE MONARCH



Shalynn Benz, a 6th grader at Byram School in Byram, NJ, created a Web page entitled "Monica the Monarch". Shalynn's Web page focuses on how to raise Monarch butterflies using great images of her Monarch butterfly, Monica. She also provides tips on rearing and text on the journey that Monica will take to Mexico. Shalynn has received questions via Email from other students and gives the answers on the Web. "Monica the Monarch" has also earned several awards such as USA Today's Hot Site of the Week (October 17 - 19, 1997), National Wildlife Federation's Cool Web site of the Month (November 1997), and Yahoo!igans! Cool Web Site of the Week (November 3, 1997). Great job, Shalynn!! You can visit Shalynn (and Monica) at:

**[www2.cybernex.net/~dbenz/monarch.htm](http://www2.cybernex.net/~dbenz/monarch.htm)**

# REGIONAL COORDINATORS

The following is a list of the 1998 coordinators and how they can be contacted. If you live within a region covered by a coordinator, you should send your orders for memberships and additional tags to them and they will send you these materials in August. Please do this as soon as possible (before July 1st) so the regional coordinators know how many tags to order from us. However, if you wish to order other items from Monarch Watch in addition to your membership, you should send your request directly to us. This will save you some postage and be less confusing.

## ARKANSAS

Jim Edson  
Univ. of Arkansas at Monticello  
Division of Math & Sciences  
Monticello, AR 71656-3480  
1.870.460.1966  
Edson@uamont.edu  
Make your check payable to:  
Arkansas Monarch Watch

## INDIANA

Donald B. Fisher, President  
Central IN Butterfly Club  
6356 N. Kingsley Dr.  
Indianapolis, IN 46220-2184  
1.317.475.9770  
Make your check payable to:  
Central IN Butterfly Club

## KENTUCKY

Laura Lang  
KY Dept. of Fish & Wildlife  
No. 1 Game Farm Rd.  
Frankfort, KY 40601  
Llang@mail.state.ky.us

Sondra Cabell  
Audubon State Park  
P.O. Box 576  
3100 US 41 North  
Henderson, KY 42420  
1.502.826.4424

## MASSACHUSETTS

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M C E T  
1 Kendall Square  
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Fred@mcet.edu

## MICHIGAN

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

## MINNESOTA

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



Dan Newbauer  
Richardson Nature Center  
8737 E. Bush Lake Rd.  
Bloomington, MN 55438  
1.612.941.7993

## MISSISSIPPI

Joy Anderson  
Horticulture Agent  
DeSoto County  
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Hernando, MS 38632  
Desoto@ces.msstate.edu

## NEW YORK

Chantal Speglevin  
Rye Nature Center  
P.O. Box 435  
Rye, NY 10580  
1.914.967.5150

## NORTH CAROLINA

Mike Dunn  
NC Museum of Natural Science  
P.O. Box 29555  
Raleigh, NC 27626  
1.919.733.7450

## OHIO

Julie Clemens  
2258 Lamberton Rd.  
Cleveland, OH 44118  
1.216.371.4373

## OKLAHOMA

Bob Melton  
Putnam City Schools  
5401 NW 40th  
OK City, OK 73122-3398  
1.405.495.5200 x 284  
bmelton@ionet.net  
Make your check payable to: OSTA

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

## PENNSYLVANIA

Jerry Zeidler  
HC 64, Box 278  
Trout Run, PA 17771  
1.717.435.4506

## TENNESSEE

Dawn Flaggs  
907 Greenway Dr.  
Collierville, TN 38017

## TEXAS

Bill Calvert - Coordinator  
Melanie Pavlas - For Tag Orders  
Nongame & Urban Program  
TX Parks & Wildlife  
4200 Smith School Road  
Austin, TX 78744  
1.512.389.4464  
1.800.468.9719 - TX Monarch Hotline

## WEST VIRGINIA

Terry Kerns  
SWOOPE  
Rt. 6, Box 211  
Fairmont, WV 26554  
1.800.931.9318

## CANADA

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



# 1998 MONARCH WATCH PROGRAMS

## TAGGING MEMBERSHIPS IN 1998

The annual membership fee is now \$12, which helps defray some of the cost of the materials and postage. Monarch Watch members receive: a tagging kit which contains 24 self-adhesive tags as well as detailed instructions in a short pre-migration newsletter (sent in August) and a 30+ page Season Summary newsletter (sent the following May). If you plan on tagging more than 24 Monarchs, additional 96-tag sheets are also available to members.

**ALL TAG ORDERS FOR THE 1998 SEASON MUST BE RECEIVED BY OCTOBER 10, 1998.**

If you wish to become a member of 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 not require any 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.

## 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; a Monarch life cycle poster that illustrates the magnificent transformation of the Monarch from egg to adult and includes the approximate 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)

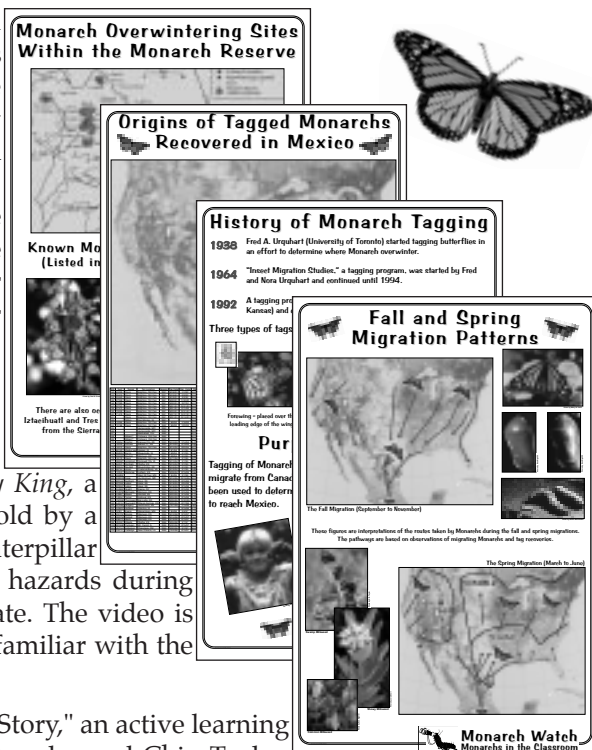
**PLEASE NOTE: WE DO NOT SHIP TAGS OR MONARCHS TO AREAS WEST OF THE ROCKY MOUNTAINS. ALSO, DUE TO HIGH SHIPPING COSTS AND THE NEED FOR PERMITS, MONARCH WATCH WILL NO LONGER BE ABLE TO SEND REARING KITS TO CANADA. HOWEVER, IF YOU CONTACT US, WE WILL BE GLAD TO DIRECT YOU TO SIMILAR PROGRAMS IN YOUR AREA.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



# NEW FROM MONARCH WATCH

## POSTERS!

Monarch Watch has developed four new educational posters that depict various aspects of the Monarch Migration: 1) History and Purpose of Monarch Tagging; 2) Fall and Spring Migration Patterns; 3) Origins of Tagged Monarchs Recovered in Mexico; and 4) Monarch Overwintering Sites Within the Monarch Reserve. These 24"x36" full-color laminated posters are identical to the ones that are being displayed at two sites near the roosting areas in Mexico. All four posters are available in English, Spanish and French versions. See our Web site for previews and descriptions.



## THE BUTTERFLY KING/GULLIVER'S STORY

VHS 20 minutes / 32-page booklet / \$13.00 (incl S&H)

Monarch Watch and Monarchs in the Classroom present *The Butterfly King*, a wonderful story that describes the life history of the Monarch - as told by a caterpillar as he progresses from one life stage to the next. The caterpillar encounters many biological and man-made hazards during its short life. The text is scientifically accurate. The video is appropriate for K-5 but also for anyone not familiar with the life history of the Monarch.

We have bundled this video with "Gulliver's Story," an active learning exercise for grades 2-4 written by Marilyn Ruggles and Chip Taylor.

Gulliver's Story is also available on our Web site and incorporates illustrations from the "Monarchs in the Classroom" curricular materials developed by Karen Oberhauser and her associates at the University of Minnesota. The video provides a visual counterpoint to Gulliver's Story which should facilitate the active learning we are promoting.

## THE MONARCH: A BUTTERFLY BEYOND BORDERS

VHS 47 minutes / ISBN: 1-56029-730-1 / \$35.00 (incl S&H)

Bullfrog Films is the U. S. distributor of the exceptional film *The Monarch: A Butterfly Beyond Borders*, produced and directed by Michael Simpson and David Springbett of Asterisk Productions Ltd. of Victoria, B. C. This film has yet to be shown in the United States. *The Monarch* provides the most up-to-date treatment of the dilemmas we face in trying to maintain Monarch populations and their spectacular migration. The footage obtained at the Monarch overwintering sites in Mexico is truly spectacular. The perspectives of a number of Monarch researchers, notably Lincoln Brower, are featured throughout the film. Here at Monarch Watch we played a small role by assisting with the filming of the immature stages.

We are allowed to distribute this film on the condition that it is sold for personal use only; therefore, we cannot accept institutional checks or purchase orders for this item. If you are interested in purchasing the film for public viewing, you should contact Bullfrog Films at: 1.800.543.3764 - or - bullfrog@igc.org

## VIDEOS!

## A CHRYSALIS TREE



Two aspects of Monarch biology that are awe-inspiring to children and adults alike are chrysalis formation (pupation) and emergence (eclosion) of the adult from the chrysalis. How can we allow everyone to observe these magnificent transformations? The following is a suggestion (slightly modified) from Sarah Dalton, a professional naturalist at Blendon Woods Metro Park in NE Columbus, Ohio.

Gather some branches (1/4-1/2 inch diameter), tie them together to form a tripod and use a flat piece of wood or styrofoam as the base. It helps if some of the side branches are horizontal. Place this structure on stones or similar objects in a large pan and add water, leaving a small, dry platform at the base of the "tree". The "moat" keeps the larvae from wandering off. Once this structure is assembled, you can add large Monarch larvae that have stopped feeding and have begun to wander before hanging to pupate. The larvae will crawl up the branches, spin their silken pads and hang in a J shape from the branches, making it easy to observe both pupation and emergence. Small labels with the date of pupation may be attached to the branches next to the hardened chrysalides to show the age of each Monarch. The jade chrysalides and the emerging butterflies make this tree a beautiful and educational display!

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# 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.

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