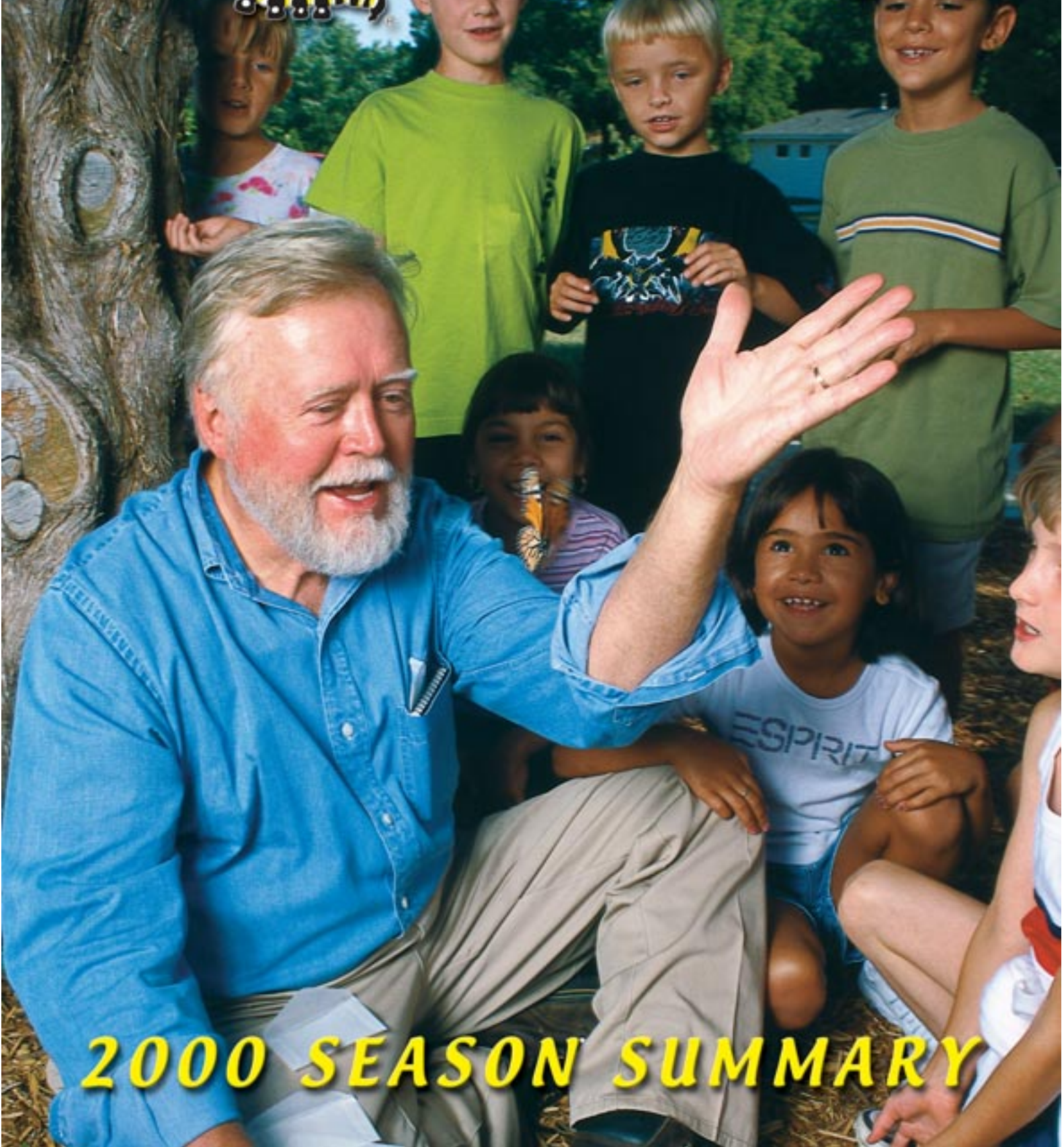




MONARCH WATCH



2000 SEASON SUMMARY

2000 SEASON SUMMARY

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HOW TO REACH MONARCH WATCH	BACK COVER

Monarch Watch is a cooperative network of students, teachers, volunteers, and researchers dedicated to the study of the biology of the monarch butterfly, *Danans 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 monarch's spectacular fall migration.

The project is directed by Dr. Orley R. "Chip" Taylor (Entomology Program, University of Kansas).



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 all the staff and students at KU who so ably assist with the day-to-day activities of this program - Jim Lovett, Dana Wilfong, Cathy Walters, and the entire Critter Crew.

A big thank you to everyone who contributed to this year's Season Summary, including Janis Lentz for her writing; Cara Weeks for her wonderful illustrations; and Shannon Seider and Larry Gibbs for their excellent work as our resident t-shirt models ;-)

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

On the cover: Kathy Davis' 2nd grade class from Hillcrest Elementary watches in awe as Monarch Watch Director Dr. Orley Taylor demonstrates how to catch, tag, and release a monarch. Photo by Earl Richardson.

This publication is funded by tagging memberships, tax-deductible contributions to Monarch Watch and a grant from the Kansas Department of Fish and Wildlife. This year's summary was authored and prepared by Orley R. Taylor (Entomology Program, University of Kansas) and three prodigiously talented individuals - Jim Lovett, Dana Wilfong and Cathy Walters. © 2001 by Monarch Watch. All rights reserved.

INTRODUCTION

Monarch Watch Turns Ten

It was ten years ago this summer that we planted the seed of what was to become Monarch Watch. Every journey starts with a single step as the saying goes. By the time Brad Williamson walked into my office in the summer of 1992 to “catch up on things” I had already taken several steps on this journey but it was Brad who was the catalyst that really led to the development of Monarch Watch. Brad was teaching science at Olathe East High School in nearby Olathe, KS at the time. In the distant past Brad had taken one of my courses and he darkened my door from time to time to keep in touch. As I recall on this occasion, we discussed my interest in monarchs, their value as a study organism in my graduate professional development course, and the evidence, albeit very fragmentary, that the monarch population was low. At the time, the tagging program run by Fred and Norah Urquhart of the University of Toronto was in decline and it seemed unlikely that the data from the program would ever be analyzed. We discussed the possibility of starting a tagging program in Kansas but I was skeptical since I didn’t see how we could get the num-

ber of volunteers quickly enough to make a go of such a program. Brad said “let’s get the teachers and students involved”. He assured me that teachers and students would be excellent partners who could provide high quality data. I remained skeptical but we decided to pursue the idea of recruiting a large number of citizens as well as teachers and students to tag monarchs in the fall of 1992. Brad agreed to print the tags using his computer and I arranged to have a press release sent out through the



University to urge volunteers to tag monarchs. The response to the newspaper accounts that followed the press release was overwhelming and we were answering the phone and printing and shipping tags as fast as we possibly could in September and early October. The response to the program from the teachers was overwhelmingly positive

and I recognized the great value of involving students in collaborative science. We continued to grow for several years and a subsequent collaboration with Karen Obehauser provided a better foundation for Monarch Watch and led to the development of



A few participants in the monarch meeting from Mexico have lunch together. (l-r) Eligio García-Serrano, Eduardo Rendón-Salinas, Eneida Montesinos, and Roberto Solís. Photo by Chip Taylor.

Monarchs in the Classroom.

I recently ran into Brad. He has taken time off from teaching to write a high school biology text. He hasn’t changed much in ten years and he’s still full of ideas and lots of “you know what you should do” advice. Over the years I’ve managed to dodge most of Brad’s suggestions of how I should spend my time and money but I’m glad I took his advice on this occasion. Thanks Brad!

Monarch Population Dynamics Meeting

The big event of the year for Monarch Watch was the Monarch Population Dynamics Meeting we hosted on the University of Kansas campus in May. This meeting was co-sponsored by Karen Oberhauser of Monarchs in the Classroom and the Monarch Butterfly Sanctuary Foundation. It was eighteen months from conception to implementation of the meeting and we were pleased with the outcome. A summary of the meeting is on **page 55**.

Adopt-a-Classroom

In January we loaded the van again with Adopt-a-Classroom materials contributed by many of our members and schools and headed for the communities in the vicinity of the monarch overwintering sites in Michoacán, Mexico. It was another great trip with new adventures



Ryan (age 2) releases a tagged monarch in Fergus Falls, Minnesota with a little help from Dad (Don Viger). Photo contributed by Paul Viger.

and more schools. A brief summary of the trip can be found on **page 26**. The complete Adopt-a-Classroom annual report is available on our web site at www.MonarchWatch.org.

Monarch News

The overwintering population in Mexico was lower in 2000-2001 than in any previous season in which the sizes of the overwintering colonies have been measured. The reasons for the lower population are discussed on **page 14** and the consequences for tag recoveries and estimates of the size of the fall population are discussed on **pages 5 and 11**. Tag recoveries (**page 32**) at the overwintering sites were extremely low, suggesting that the mortality during the migration was higher than usual. In the Seasonal Populations section (**page 6**) you will find an update of the spring migration. In spite of a poor start, monarchs appear to be making a good comeback, and the prospects for fall are better than they appeared to be a few months ago. An account of the misreported pesticide spraying at the overwintering sites as well as the late winter storm that killed monarchs in the more easterly colonies is on **pages 16 and 19**.

More on Transgenics

This past year I participated in four meetings to discuss the latest research on the potential impact of pollen from Bt corn on monarch larvae. A synopsis of some of the research is found on

page 8. Fortunately, Bt corn doesn't appear to be the threat we once feared it might become. However, transgenic corn and soybeans that are resistant to herbicides are still a concern since the use of herbicides in the fields with these plants could significantly reduce the availability of milkweeds in the agricultural landscape.

Deforestation in Mexico

The big news early last fall was the announcement of the study (sponsored by World Wildlife Fund Mexico) of the rates of deforestation within the Monarch Reserve. This study provides the first hard evidence of the changing conditions of the forests used by monarchs during the winter months. Lincoln Brower, et al. have provided a summary of this study on **page 52**.

This announcement was followed by a decree from the outgoing Mexican President Ernesto Zedillo which added 40,159 hectares to the protected area.

In this Issue

As you can see, it has been another dramatic year for those of us interested in monarchs. Perhaps somebody should write a book. In fact, it's been done. In Sue Halpern's *Four Wings and a Prayer*, (Pantheon Books, reviewed on **page 18**) you will find a compelling account of the passions and personalities of the scientists and amateurs who devote their energies to the study of monarchs.

Throughout this volume you will find our usual features plus some new ones including: Challenges to Students (**page 28**), Featured Teachers (**page 20**), Featured Milkweeds (**page 22**), Monarch Crusaders (**page 24**), and various boxes designed to inform, educate, and enlighten you about monarchs.



Chivatí is a severely deforested area near the monarch overwintering sites. This site was formerly a major roosting site for monarchs. Photo by Jim Lovett.

Funding

Monarch Watch continues to be financially challenged. We are just scraping by and are still looking for corporate or foundation support. Due to a shortfall in income we are attempting to enlarge our base of support through collaborative arrangements with other organizations (**page 62**). We will also reduce our staff but will make every effort to maintain our service to our members. We will keep you informed of our progress through the Monarch Watch Email Update (**page 62**) and the email discussion lists Dplex-L and MonEd (**page 62**).

Personnel - My Thanks

Monarch Watch has functioned well over the last several years because I have an excellent full-time staff of Jim Lovett, Dana Wilfong and Cathy Walters. I wish to thank them all for the hard work, long hours, care, and integrity they have given to this enterprise we call Monarch Watch. This has become their program as much as it's been mine, and their advice and wisdom has been extremely important in all phases of the program. They are really a team. It is likely that all three will leave the program in the coming year to seek other opportunities. Dana will leave in late July and will start veterinary school in August. Dana has kept us all on track and focused by asking the hard questions. Thank you Dana and good luck with animals, large and small.

Orley R. "Chip" Taylor
Director, Monarch Watch

Each year it becomes more difficult to choose among the possible items to include in this annual summary. We apologize if your favorite topic has not been covered. We welcome your suggestions for inclusion in the summary for 2001.

MONARCH POPULATIONS

by Chip Taylor

In each Season Summary and Premigration Newsletter, I provide a qualitative assessment of the condition of the monarch population in eastern North America. These assessments are based on reports received from our email discussion list (Dplex-L), emails, faxes, phone calls, letters, and my personal experience. I wish to emphasize that the assessments are qualitative. Quantitative data on population sizes, as well as birth and death rates throughout the year, are needed to establish the annual dynamics for this species. Development of a sound environmental policy to sustain monarch populations will depend on our ability to distinguish between natural mortality and that related to human effects on the environment.

Winter 1999-2000

Monarchs began to arrive at the overwintering sites in Mexico during the last few days of October - right on time for the 1 November "Day of the Dead" celebrations in Mexico. By all accounts the winter was mild in Mexico and there were no reports of winter kill due to severe winter storms. It was a dry winter but not as dry as the 1997-1998 El Niño winter. Although water sources dried up and dust levels increased as the season advanced, creating concerns about the impact of tourism on the Sanctuaries and the monarchs (1999 Season Summary, **page 43**), the population seemed to get through the winter in relatively good condition. Curiously, there was a shift in the proportion of the monarchs at the main colonies this past winter. Eligio García, who measures the size of the colonies, reported that the colony at El Rosario measured 3.78 hectares or 42% of the population of all colonies combined. This was an increase from 2.12 hectares (33%) in 1998. While

El Rosario increased, the size of the colony at Chincua decreased to 0.92 hectares from 1.96, leading to speculation about the impact of tourism on the



A monarch feeding on tropical milkweed.

Photo by Jim Lovett.

quality of this site. The two colonies are usually similar in size so the 4:1 ratio (3.78/0.92) this year was unusual. Generally, the colonies at El Rosario and Chincua represent 60-70% of the total overwintering population but this year only 52% of the monarchs overwintered at these two sites. How monarchs select overwintering sites is not known. The importance of characteristics of the forest habitat and the influence of proximate factors, such as weather or disturbance, is unclear. Continued monitoring of the overwintering populations is needed to establish the factors that determine yearly differences in the use of the overwintering locations.

Spring 2000

Monarchs were off to the best start since the spring of 1997. Modest numbers of monarchs were reported in Texas in late February. Despite the extremely dry conditions in much of the state and an abundance of fire ants in many locations, monarchs appeared to have reproduced with sufficient success to produce the wave of first generation adults which swept northward to colo-

nize the northern part of the milkweed habitat.

However, there is an ominous sign of drought in the Corn Belt, the heartland of monarch reproduction. As of mid-May the drought covered most of the Corn Belt; according to the isotope work of Wassenaar and Hobson (1998), this area accounts for 50% of the monarchs that reach the overwintering sites in Mexico. Weekly updates on soil moisture conditions throughout the United States are available online at enso.unl.edu/monitor.

A few years ago it was easy to dismiss long-range weather predictions, they simply weren't very reliable. The present weather models are much more accurate, so these forecasts are of real concern.

Fall 2000

As anticipated, the fall population was smaller than in 1999. Large numbers of fall migrants were reported only from the eastern Dakotas, Minnesota, western Wisconsin, and northern Iowa. Throughout the remainder of the range the number of fall migrants was low and in large areas of the northeast monarch numbers were extremely low. At Cape May, the census managed by Dick Walton produced 30.58 monarchs per hour for the eight-week migration season. This was the third lowest number of monarchs recorded since this program began in 1991. For detailed information, visit the program's site at:

www.concord.org/~dick/mon.html

In spite of the lower number of migrating butterflies, approximately 70,000 butterflies were tagged by Monarch Watch participants. Again, this suggests that the number tagged is related to the weather conditions. Tagging seems to be most effective when large numbers of monarchs are kept from migrating by inclement weather. Under these conditions clustered or nectar feeding monarchs are available to tag-

gers for longer periods.

In most parts of the country the migration proceeded at the normal pace and was generally quite predictable. The exception was Texas where large numbers (100's of thousands, perhaps millions) of monarchs were delayed late into October in south Texas by cool, wet conditions caused by a large Pacific frontal system that lingered over the state for at least two weeks. These butterflies were roughly 650-750 miles and three weeks away from the overwintering sites on 27-30 October 2000. If they made it, they were among the late arrivals.

Winter 2000-2001

Late in the fall, I predicted that the overwintering population would be 60-70 million butterflies. This prediction was based on reports from numerous observers and many taggers. The previous year my estimate had been fairly close but I was wrong this year. The population was much smaller than I expected. Each year Eligio García counts the number of trees and measures the acreage occupied by monarchs at all the known overwintering colonies. The monarch colonies this year were smaller than any previous year, measuring only 2.83 hectares. At roughly 10 million butterflies per hectare, this translates to 28.3 million butterflies in the overwintering population. This is a significant drop from the 96-108 million in

1999 or even the 55.5+ million of the previous low year (1998).

Although the number of butterflies was low, the condition of the butterflies seemed to be good when we visited El Rosario and Chincua in January. The weather and moisture conditions had been favorable and Eligio indicated that mortality had been quite low in the early part of the season.

By early February, cold weather and exposure at San Andres, a monarch colony outside of the reserves, had evidently killed a large portion of the monarchs. The forest on this mountain has been illegally logged and partially burned. The area occupied by the monarchs in San Andres was described as significantly degraded. In November an estimated one million butterflies had taken up residence at this degraded site but by January the monitoring team estimated that 300,000 of the butterflies had died. A month later no living butterflies were found at this location; all that remained were dead butterflies that littered an area of 10,000 square yards. Whether the butterflies remaining in January survived by moving to another portion of the forest is unknown.

A second catastrophic event killed large numbers of monarchs in several of the easternmost colonies. On the evening of 2 March, a severe rain, snow, and ice storm accompanied by high winds, took down trees, destroyed houses, and killed large numbers of monarchs at Cerro Pelon, Herrada (Los Saucos) and Palomas. Again, it is not clear how many monarchs were lost as the result



A monarch tagged during the University of Kansas Audubon Society's tagging day September, 2000. Photo by Chip Taylor.

of this storm. These colonies were small this year and according to Bill Calvert only twenty trees were occupied by monarchs at Herrada. Even though these colonies usually constitute less than 10% of the total population, the loss at these sites is significant at a time when the overall population is low. The same storm deposited a substantial amount of snow at El Rosario and Chincua but the butterflies survived well and only 7% of the population died as a result of this storm. Rumors that the monarch deaths at San Andres were due to intentional spraying by loggers have been refuted (page 15) and similar accusations by local residents at another colony have not been confirmed.

Spring 2001

A critical factor in the build-up of the monarch population each year is the number of female monarchs returning from Mexico each spring. These females lay eggs on milkweed as they move northward and the success of this reproductive effort determines the number of monarchs that move from the southern states in May to colonize the northern portion of the breeding range in May and June. The number of female monarchs returning north this spring (4.9 million, see box page 42) was lower than any year since at least 1992. Approximately five million females seems like a good number but it represents only one-third to one-half the number of females that normally move



Monarchs roosting at El Rosario, Michoacán, Mexico.

Photo by Jim Lovett.

into Texas in the spring.

What do low numbers of spring females mean for the fall migration? This question is hard to answer because we can't predict the conditions in the breeding habitats throughout the summer. However, there does seem to be a general trend. In most years, it appears that returning females give rise to 6-20 females in the fall population although this clearly was not the case last year (see "Replacement Rates" **page 42**).

In March and April the population did not appear to be off to a good start. This was an unusually cold, wet spring in Texas and monarchs were 10-14 days behind their average arrival dates as they moved north. They were a month behind in eastern Kansas.

Illustration by Cara Weeks.



Fortunately, in spite of the delays, the rains of the previous fall, winter, and early spring in Texas provided excellent conditions for milkweed and nectar resources for the breeding monarchs. Each year the key to the rest of the season often seems to be the reproductive success of the first generation. This year the reproduction seems to have been better than usual. Good numbers of monarchs had been seen moving northward through eastern Kansas in mid-May and this movement continued into June. More importantly, monarchs arrived in the northern states in mid-May and substantial numbers of eggs were reported in a number of locations.

Prospects for Fall 2001

Overall, it appears that the population has made a good recovery in spite of the low numbers of females that survived to reproduce this spring in the southern states. The overwintering population will certainly be greater in 2001-2002 than that of last year (28.3 million); even so, it seems unlikely that the overwintering population will exceed 60 million monarchs.

Reports from many areas of the central midwest indicate normal to above normal monarch populations for mid July. These observations extend from Manitoba to southern Ontario and from South Dakota to Indiana. In Minnesota (16-17 July) I located large patches of common milkweed in bloom along the Mississippi River. Each morning hundreds of monarchs that had emerged the previous day were observed sunning themselves and nectaring on the flowers at this location. In other Minnesota locations it was relatively easy to find eggs on milkweeds. If these observations are an indication of the general condition of the population in the upper midwest, the population originating from this region should be above normal.

It is usually more difficult to get an idea of the size of the population in the eastern states. Each year we receive many emails from observers in eastern states, complaining that there are no monarchs in their area - whether or not there is a deficiency in monarchs in the east this year is not clear. Observers from New Jersey, New York, and Maine reported finding eggs without much difficulty in mid July. This is the appropriate time to see an increase in egg laying. In most of the northern portion of the breeding range, eggs laid from 15 July to 5 August give rise to the majority of adults that become migratory in late August and September. To assess the eastern prospects we need a much more comprehensive survey of eggs and adults during this critical period.

Last fall drought conditions and exceedingly high temperatures prevailed during the early and mid portions of the migration in the midwest. These conditions may have contributed to the lower recovery rate of tags in 2000. There is no drought this year and soil moisture is normal to above normal for most of the country. If these conditions continue, fall flowers will be abundant during the migration, which may enable a higher proportion of the migratory population to reach the overwintering sites in Mexico this year. ■

Larval Monitoring: We're looking for Volunteers!

The Monarch Larval Monitoring Project is a research project based at the University of Minnesota, Department of Ecology, Evolution, and Behavior. The coordinators are Michelle Prysby and Karen Oberhauser. This is a citizen science project. Volunteers from the general public collect data on monarch and milkweed populations in their areas, and share those data with the coordinating scientists and with each other. The overarching goal of this project is to better understand how and why monarch populations vary in time and space, with a focus on monarch distribution and abundance during their breeding season in North America. Over 150 volunteers have participated since the project began in 1997, and the project continues to grow.

We are recruiting more volunteers. To participate, read through the directions on the Monarch Lab Web site and send an e-mail with your name and mailing address to prys0004@tc.umn.edu.

Monarch Larval Monitoring Project

[www.monarchlab.umn.edu/
MP/mp.html](http://www.monarchlab.umn.edu/MP/mp.html)



Photo by Jim Lovett.

TRANSGENICS AND MONARCHS

by Chip Taylor

When the controversy surrounding Bt corn first arose in May of 1999, I was invited by the industry technology group to lend expertise to an assessment of the possible impact of Bt corn pollen on monarch butterflies. One of my first suggestions was that the distribution and abundance of milkweeds within cornfields be examined along with the use of these plants by monarchs. This proposal was not funded. At the time the emphasis was on the distribution of milkweeds and Bt pollen shadows adjacent to the cornfields, not the milkweed within the cornfield. The assumption seemed to be that there were few milkweeds within cornfields and that these would not be used by monarchs. It may have also been that the industry didn't want to learn that monarchs used milkweeds within cornfields since this portion of the habitat was certain to have the highest concentrations of Bt pollen per milkweed leaf. Subsequent research has not only shown that milkweed occurs within cornfields but that corn may be one of the best of the various monarch/milkweed habitats.

Interestingly, the GIS analysis of monarch habitats that was funded by industry (Taylor and Shields 2000 and the 1999 Season Summary) suggests that 90% of the monarchs originate from agricultural landscapes that contain milkweeds. Put another way there simply isn't enough roadside habitat (1-3% per state) or natural areas to account for the number of monarchs produced in the northern states and southern Canada each year. Clearly, this means that agricultural practices that maintain or diminish milkweed could have a potentially strong impact on monarch populations. We understood this intuitively when the Bt corn issue started but now

we have numbers that can be used to give scale to this situation. If milkweed contaminated corn is one of the best habitats for monarchs, we need to know how much of this habitat exists in the main monarch breeding areas. Our estimate is that corn constitutes 18.3% of the effective breeding habitat for the monarch as we now understand it. If corn yields more monarchs per acre than other habitat, and this may be the case, then this habitat is more important than measures of acreage indicate. Again, this means that how corn is managed either in terms of varieties planted

Fortunately, milkweeds appear to be relatively tolerant of Roundup®, the principal herbicide used in these applications. The plants die back when sprayed but often put up new shoots that may in fact be more attractive to monarchs for egg laying than the older growth. However, we really don't know the proportion of the plants that survive this treatment or if they die after repeated treatments. Long term studies of milkweed survival in fields planted with herbicide-resistant varieties are greatly needed.

Bt corn as a monarch issue is dying even though some of the major questions have not been satisfactorily answered. Briefly, there are five major reasons pollen from Bt corn appears to be less threatening than it was initially. First, Event 176, the corn hybrid engineered to express the Bt toxin in the pollen, has been withdrawn from use. The pollen from this variety was an effective insecticide. In tests in our lab, low pollen concentrations killed monarch larvae quite effectively and more dramatically than reported in the original paper by John Losey. Second, the pollen from Mon 810 and Bt 11 hybrids (which are the two predominant



*Common milkweed (*Asclepias syriaca*) growing in a soybean field. It is not known whether or not herbicide use on herbicide resistant crops will harm milkweed populations.*

Photo by Chip Taylor.

or weed control could have an impact on monarchs. Bringing agricultural management into the picture puts the focus on Bt corn as well as corn and soybeans that have been genetically modified for resistance to herbicides.

The herbicide-resistant plants may pose a greater threat to monarchs than Bt corn but so little attention has been given to the use of these varieties that we have no idea as to whether this is a realistic concern. Yet, the potential seems real since the herbicide resistant varieties are intended to be used with herbicides, rather than mechanical weed control, as a means of controlling weeds and reducing costs. Milkweeds are one of the targets of this weed control.

Bt corn types on the market at this time) contains low quantities of the Bt toxin. Third, toxicity tests in the laboratory show that to kill larvae they need to be exposed to higher concentrations of pollen than is normally found in the field. In fact, the concentrations of pollen on milkweed leaves even within cornfields seldom reach the threshold where an effect might be expected. Fourth, models of the overlap of the shedding of corn pollen (anthesis) and the occurrence of eggs and early instars of monarchs shows that the overlap occurs primarily in the northern half of the Corn Belt and not the southern half. Fifth, field tests have failed to show that larvae are significantly impacted by milk-

weed leaves dusted with Bt pollen.

The latter result is a bit unsettling to some of the field biologists who suspect Bt pollen has an impact but their methods simply fail to show it. They have a point. The field tests require following the survival of large cohorts of monarch larvae by searching for them every day. Finding larvae can be problematic; they disappear rapidly and at such a high rate that it seems everything eats them. On the other hand, they might still be present but difficult to find. Under these conditions it is hard to attribute mortality to Bt corn pollen. In the future, tests might involve an enclosure system that allows natural pollen deposition followed by monarch oviposition or adding of eggs to the enclosure. Subsequently the system would be closed to provide better control of parasites and predators. Control enclosures

with non-Bt corn would also be used and the total numbers of monarchs emerging in each enclosure (with several replicates of each) could be used as a measure of the net impact of the treatment. The potential criticism of this approach is that it would tend to reduce natural removal of pollen from leaf surfaces due to wind or rain. Nevertheless, a system of this type appears to be needed since predation and parasitism may be obscuring the impact of Bt toxins on monarch larvae. One might ask if such tests will ever be conducted. The answer is probably not. These tests would require a substantial investment and at the moment the justification for such an effort is weak. There is no longer a smoking gun to suggest a strong impact on monarchs by the present Bt toxins from Bt 11 and Mon 810.

As with most research endeavors,

there are many unanswered questions. Some of these questions were mentioned in the 1999 Season Summary. The question that is most nagging has to do with the impact of Bt pollen on the rate of development of monarch larvae. Delayed development of larvae fed sublethal doses of Bt pollen has been found by several investigators. What does this mean? Is the monarch's size, longevity, capacity to migrate or reproduce compromised if it feeds on Bt pollen? The bottom line is more research is needed to establish the impact of Bt corn pollen on monarchs.

Reference

Taylor, O.R. and J. Shields. 2000. The summer breeding habitat of monarch butterflies in eastern North America. Unpublished report prepared for the Environmental Protection Agency.

Monarch Watch 2000 in Central Park

On a beautiful fall day in September a crowd of "Monarch Watchers" gathered in New York's Central Park to send dozens of monarch butterflies on their way to Mexico. Attendees tagged monarchs and enjoyed the music of a mariachi band as costumed children performed traditional Mexican dances.

Although the event was light-hearted, the message conveyed by speakers was a serious one: the monarch's overwintering habitat is in danger and needs to be preserved. Monarch experts Dr. Orley R. "Chip" Taylor (Director of Monarch Watch) and Dr. Lincoln P. Brower (Sweet Briar College), as well as officials from the Mexican government and World Wildlife Fund, described the urgent situation at the overwintering sites of the Monarch butterfly in Mexico. Monarch Watch 2000 in Central Park was a great success, providing an opportunity to educate the public about monarchs and habitat conservation.

This event was sponsored in part by MasterVision, a Manhattan-based film production company. For more information about the event please visit

www.mastervision.com/mw2000

Top: Monarchs on display in front of a mariachi band at Monarch Watch 2000 in Central Park.

Bottom: Dr. Lincoln Brower of Sweetbriar College speaks about deforestation in Mexico. Photos by Chip Taylor.



HABITAT RESTORATION

Restoring Milkweed and Monarch Habitats

One of the easiest places to find milkweed when searching for monarch eggs or larvae is along roadsides. The number of milkweeds found during such searches is highly variable. In many areas there are no milkweeds while other sites nearby contain good stands. The basis for this variability usually isn't apparent but in many areas the diversity of vegetation along roadsides is probably related to management. Intensely managed areas, those that are mowed more than twice a year and in which herbicides have been used to reduce woody and broadleaf vegetation, tend to have low diversity and virtually no milkweed.

Many people are beginning to question the wisdom of intense roadside management. Safety and aesthetics are the primary reasons given by state Departments of Transportation (DOTs) for such management practices. Visibility of oncoming traffic and the ability to see and anticipate wildlife that might be crossing a road are certainly valid issues but these considerations can be accommodated while maintaining highly diverse roadsides. Aesthetics seem to be as important as safety since the public frequently complains if roadside vegetation isn't short and "neat". Clearly, the public is not aware of the value of a diverse roadside habitat. This is also the case with the engineers and managers in most DOTs. To change the mentality and the management of our roadsides we need to educate the public about the value of this habitat.

Although road margins only constitute 1-3% of the land area in each of the states east of the Rockies (except Texas), these landscapes constitute an important natural resource (Taylor and Shields 2000). In areas where farming and other land use is extensive, these lands represent a disproportionate share of the habitat available for ground nesting birds (including quail and pheasants),

small mammals, native plants, uncommon pollinators, other beneficial insects, and monarch butterflies. In addition, when well vegetated, these areas reduce the rate of runoff of pollutants from the roads into the drainages and subsequently the streams and rivers. Also, well managed and highly diverse margins rich in flowers and native grasses, are of greater value and interest than long uniform strips of grass.

Even if we can't convince DOTs of the biological value of road margins, we should be able to persuade them to change their management based on economics alone. At present, it costs \$17-40 per year to manage each acre of roadside. In the mid-west many counties spend 40-50 thousand per year to kill noxious weeds most of which would be out-competed and absent if the roadsides were allowed to develop into rich communities of native forbs and grasses. By reducing the rate of mowing and limiting herbicide use to only those cases where it is necessary for safety or to eliminate aggressive invading plants, money would be saved and the diversity and abundance of life in these zones would increase. As energy costs increase over the next few years, it should be easier to make the economic argument. Changes in management can be combined with efforts to identify and protect unique plant communities, to restore native species, including less common milkweeds, and to educate the public.

How much will changes in roadside management improve monarch habitat and the number of monarchs? This is impossible to answer at this time but these improvements will be needed just to offset increasing rates of urbanization and changes in agriculture which reduce milkweeds and nectar sources.

Monarch Habitat Restoration

Last year under the title "Milkweed Restoration" we printed a letter from

David King from the North Carolina Department of Transportation about the Department's attempt to create monarch habitat by planting milkweeds and nectar plants along roadsides. Recently, I wrote David to inquire about the success of this effort. The following is David's response.

Dear Chip:

Good to hear from you again. I am happy to report that we (NCDOT) have extended our Monarch Butterfly Program for 2001, a little wiser from the experiences gained during our initial year with this program in 2000. A tremendous amount of interest and positive public reaction was generated with the inception of this program. You may want to see some of the things we've done with the program by checking out our website at www.doh.dot.state.nc.us/operations (click on Roadside Environmental Unit, then Monarch Butterfly Program).

I was personally not satisfied with our success in establishing milkweed last year. Having not been given the green light to proceed with the program until early spring of 2000, I believe we planted too late and in most cases where there was too much competition. For 2001 we did a much better job in site selection and we applied either a non-selective, non-residual herbicide or a fumigant to each site prior to planting. All of the planting was accomplished in late fall and early winter. We hope and expect to see much better stands of milkweed in 2001 as a result of these improved methods.

Due in part to the highly favorable public response, we were authorized to expand our program for 2001. We have doubled the acreage planted in swamp and common milkweed and tripled the acreage planted in butterfly weed. We now have approximately 40 acres of Asclepias planting sites in 25 counties across North Carolina. We also planted approximately 1.5 acres each of common and swamp milkweed on our native wildflower farm which we manage for the purpose of growing and harvesting seed to be used in our wildflower program. We hope to be able to produce our own milkweed seed in order to further the Monarch Butterfly Program

[continued on page 13]

MONARCH POPULATION SIZE

Each of the last two years I've used the tag recovery data to estimate the size of the fall migratory population and the proportion of the population that survives the migration to reach the overwintering sites. Because the estimates cannot be obtained via the usual mark and recapture formula (the Lincoln Peterson index), I have used an indirect approach, one that brackets the various parameters, such as search effort, to work toward a best estimate of the size of the population. With this new approach, outlined below, I estimated that the size of the fall 2000 migratory population was 106 million and the overwintering population was 28.3 million monarchs. There were many assumptions in the previous efforts but overall I was satisfied that the approximations for 1998 (182 million) and 1999 (252 million), were fairly realistic. But, we will examine them again in light of the population crash in 2000 using a slightly different projection.

Estimated Population Parameters

The estimate for population size is based on the following parameters, all of which are estimates themselves:

1. total area occupied by monarchs at all overwintering sites (2.83 hectares);
2. number of monarchs (density) per hectare (10 million based on Bill Calvert's recent analysis);
3. proportion of the total area represented by the monarchs at El Rosario (1.17/2.83 hectares = 41%);
4. total number of monarchs tagged (79,882); and
5. percentage of tags and monarchs lost from the viewing area at the colonies during the overwintering period (20%). This assumption is different from that used over the past two years (50% loss during overwintering).

Size of the Overwintering Population

The total area occupied by monarchs this past winter was estimated by Eligio García Serrano (Reserva de la Biosférica Mariposa Monarca) to be 2.83 hectares (1 hectare = 2.2 acres). If we use the Calvert estimate of 10 million/hectare, the estimate for the overwintering population is 28.3 million monarchs. The population at El Rosario occupied 1.17 hectares (about 41% of the total) and therefore had approximately 11.7 million monarchs early in November/December 2000.

Number of Monarchs Tagged

During the fall of 2000, we issued approximately 250,000 tags but only a portion of these were used. There are three ways to estimate the number of monarchs tagged. The most direct method is to use the returned datasheets. We average the number of records per page (with several sub-samples) and multiply this by the total number of pages of records (determined by weight). A less direct method is to look at tagging and recovery records from people who tagged large numbers of monarchs and estimate the number tagged based on recoveries in Mexico. A third method is simply to add the estimated number of unreturned data sheets to the estimated number of returned data sheets. The first method yields an estimate of 73,577 monarchs tagged. This year the second method yielded a rate of one recovery per 425.35 monarchs tagged; therefore, 172 monarchs recovered in Mexico leads to an estimate of 73,160 monarchs tagged in 2000. The estimate derived from the number of returned combined with unreturned data sheets is 79,882 monarchs tagged. This is the most realistic estimate and the one I will use for these calculations.

Survival of Tagged Monarchs

If we tagged 79,882 monarchs, and these monarchs arrived at random at all of the colonies, as suggested from the isotope study (Wassenaar and Hobson 1998), and El Rosario contained 41% of all the overwintering monarchs, the maximum number of tagged monarchs at El Rosario would be 32,751. However, some unknown portion of the monarchs does not survive the journey. Using the overall sizes of the overwintering populations for the last three years, and specifically the numbers known for El Rosario, the principal site where tags are recovered, I have constructed a table showing potential fall populations over a range of survivorship scenarios (**Table 1**). The first column shows the number of monarchs that would have to start the migration at specific levels of mortality for each year. The second column shows the hypothetical number of monarchs headed for El Rosario adjusted for the proportion of the population at El Rosario each year. The 4th through 7th columns represent the potential number of tags headed for El Rosario, the number of untagged butterflies per tag, the number of tags reaching El Rosario, and the number of tags at risk of being found under the assumption that somewhere around 20% of the butterflies die or move away from the overwintering sites where they can't be located. The first thing to notice is that the mortality during the migration for the last three years must exceed 75% (25% survival) for the fall population to be larger than 362 million. This provides a perspective on the upper limits for the size of the fall population. Secondly, observe the estimated number of tags reaching El Rosario and the potential number at risk in columns 5 and 6. The numbers are remarkably close due to the fact that a similar number of monarchs are tagged each fall and that similar proportions (.36, .42,

.41) of the monarchs choose to overwinter at El Rosario each year. Before we apply the information in this table to the population issue, let's consider another factor.

Search Effort

We don't know the amount of search effort (number of person hours) involved to find 160 tags at El Rosario. Previously we estimated that it requires guides 1-3 hours of searching for each tag. We discussed this estimate with guides at El Rosario in January and they confirmed that they recover a tag for every 2-4 hours of searching. Unfortunately, we don't know how many butterflies they scan to achieve this rate of recovery.

All the butterflies cannot be viewed to see if they are tagged due to their positions in trees; therefore, we have to make some additional assumptions about the average number of butterflies viewed to recover a tag or the percentage of the population viewed by those seeking tags. The return per unit effort concept applies to the recovery of tags. How many butterflies would you scan without finding a tag before you gave up the search? Or, stated another way, how often would you have to find a tag to keep searching? The answer depends on the motivation of the individual searcher. Nevertheless, it seems unlikely that many tags would be recovered if tags were as few as 1/10,000 or less.

After working out the math, it seems likely that only 6-12% of the population is viewed to make the recoveries each year. Last year I used 9% viewed as the basis for adjusting the population estimates.

Size of the Migratory Population

How many monarchs were in the fall migratory population in 2000? Let's assume, as we did last year, that to recover 160 tags, 9% of the population was viewed. The calculation is as follows: 11.7 million (starting population at El Rosario) x .8 (proportion left after 20% tag loss) x .09 (proportion viewed)

= 842,400; $842,400/160 = 5265$ untagged monarchs per tag. Comparing 5265 with the estimates in column five of Table 1. shows that this figure is similar to the 5716 estimate for 25% survivorship. Extrapolating from this estimate suggests that if 9% were viewed, the survivorship was 26% and the estimated size of the fall population was 109 million. This is pretty neat but the weakness is that we don't really know the percentage of the population that was viewed. Nevertheless, look what happens if survival was only 12.5%: over 22,800 butterflies would have to be examined to find a tag and if 50% survived, we would have expected a higher recovery rate than for either 1998 or 1999 since the ratio of tagged to untagged monarchs would have been more favorable by a factor of 2-3. It is also interesting to note that under this scenario approximately 10% (160/1638) of the tags at risk were recovered.

Let's re-examine the estimates for 1998 and 1999. These estimates were based on an estimate of 12 million monarchs per hectare, an assumption that only 50% of the monarchs arriving at the overwintering sites were viewable by the guides through the winter months, and that roughly 9% of the population had been viewed through the season. These estimates yielded 182 million for 1998 and 252 million for 1999. This new approach yields a different percent survival of the fall migrants from the 33% in 1998 and 43% in 1999 given in the 1999 season summary. The new percent survival is 30.5% for 1998 and 36% for 1999.

If we plug these estimates into Table 1 and interpolate the data in a similar manner, we create **Table 2**.

In 1998 400 tags, at 6867 monarchs per tag, were recovered from El Rosario in a population of 16 million at the time of recovery. This means that 17.2% of the population, rather than 9%, was viewed to make these recoveries. Similarly, for 1999, with 597 recoveries, the estimate is that 16.1% of the popu-

lation was viewed. These are interesting figures but the numbers of butterflies per tag seems high.

Let's see what happens if we use a population estimate that is 20% smaller and larger for each year:

if 20% smaller we create **Table 3**;

if 20% larger we create **Table 4**.

As you can see, using a lower estimate has the effect of increasing the survival during the migration and it increases the number of tagged butterflies reaching El Rosario. More importantly, it decreases the number of monarchs that need to be viewed for each tag recovered. The higher estimate has the opposite effects, decreasing survival during the migration and increasing the number of monarchs guides need to scan for each recovery.

If we compare the 20% lower figures with the projections made last year for 1998 and 1999, they actually look more realistic than the earlier figures. Overall, this approach appears to be more useful than the method used the last two years, and is certainly more straightforward.

An underlying assumption of all these calculations has been that tagged butterflies survive the migration to Mexico at the same rate as untagged monarchs. Whether this is true or not is uncertain but the proportion of tagged butterflies that survive the trip is certainly high. If tagged butterflies are less likely to survive the trip, the effect would be to increase the proportion of untagged to tagged monarchs requiring a higher search rate to recover the same number of tags. In the following, I have decreased the number of potential tags headed for El Rosario by 20% for 1998. This shows the potential effects of tag loss and handling which might increase mortality of tagged monarchs.

As you can see, 20% loss of tags or tagged monarchs (**Table 5**) does not change the dynamics of the estimation substantially.

If you have been following these accounts, you might have observed that my estimates for the size of the fall

Table 1. Potential fall monarch populations.

Survival	Fall Pop. Size (millions)	Pop. headed for El Rosario* (millions)	Tags headed for El Rosario	Monarchs per Tag	Tags Reaching El Rosario	Tags at Risk 20% Less**
100%						
2000	28.30	11.70	32,751	357	32,751	26,201
1999	90.50	37.80	30,878	1,224	30,878	24,702
1998	55.50	20.00	26,496	755	26,496	21,197
75%						
2000	37.70	15.60	24,563	635	18,425	14,740
1999	120.60	50.40	23,159	2,176	17,371	13,897
1998	74.00	26.70	19,872	1,344	14,881	11,905
50%						
2000	56.60	23.40	16,376	1,429	8,188	6,550
1999	181.00	75.60	15,439	4,897	7,719	6,175
1998	111.00	40.00	13,248	3,019	6,625	5,300
25%						
2000	113.20	46.80	8,188	5,716	2,047	1,638
1999	362.00	151.20	7,720	19,585	1,930	1,544
1998	222.00	80.00	6,624	12,077	1,656	1,325
12.5%						
2000	226.40	93.60	4,094	22,863	512	407
1999	724.00	302.40	3,860	78,342	482	386
1998	444.00	160.00	3,312	48,309	414	331
6.25%						
2000	452.80	187.20	2,047	91,450	128	102
1999	1448.00	604.80	1,930	313,368	121	97
1998	888.00	320.00	1,656	193,237	103	82

Table 2. Potential fall monarch populations.

A	B	C	D	E	F	G	H	I
1998	30.50%	182	65.5	9,539	6,867	2,912	2,330	17.2% / 400
1999	36.00%	252	105.8	12,969	8,158	4,633	3,707	16.1% / 597

Table 3. If 20% smaller.

A	B	C	D	E	F	G	H	I
1998	38.10%	145.6	52.4	10,095	5,191	3,853	3,082	13% / 400
1999	44.80%	201.8	84.8	13,831	6,131	6,165	4,932	12.1% / 597

Table 4. If 20% larger.

A	B	C	D	E	F	G	H	I
1998	24.40%	227.5	81.9	6,359	12,879	1,553	1,242	32.2% / 400
1999	28.70%	315	132.3	8,862	14,895	2,538	2,030	29.4% / 597

Table 5. 20% loss of tags.

A	B	C	D	E	F	G	H	I
1998	38.10%	145.6	52.4	8,076	6,488	3,083	2,466	16.2% / 400

Key for Tables 2-5. A: Year; B: Survival; C: Fall Population size (in millions), D: Population at El Rosario (in millions), E: Number of tags at El Rosario, F: Monarchs per tag, G: Tags Reaching El Rosario, H: Tags at Risk (20% less), I: viewed/recoveries.

migration are downsized each year. I don't claim to know the number of monarchs in the fall populations each of the last three years but my estimates are valuable in that they give us a perspective on the differences among years. Furthermore, they clearly indicate that the migratory population is smaller than many monarch biologists had realized. As these estimates become more refined, they can be used to assess the relative productivity of various milkweed/monarch habitats.

In summary, the estimate for the migratory population of 2000 was 106 million (26% survival) and the revised estimates for 1998 and 1999 are 146 million (38% survival) and 202 million (45% survival).

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"Habitat" continued from page 10

in the future.

*Thanks for your interest in our efforts. We have gained a lot of valuable information from Monarch Watch. I look forward to hearing more about the North American Pollinator Protection Campaign.**

David King, NCDOT
Roadside Environmental Unit

**I am also part of a campaign to educate the public about the value of pollinators. Methods and policies to protect monarch and pollinator habitats are complimentary.*

Connecting the DOTs: The Prairie Passage

The Prairie Passage is a proposed 2000-mile highway corridor through the Great Plains from Mexico to Canada. The main objective of this six-state effort is to showcase, protect, and restore the cultural and natural heritage within the Tall Grass Prairie.

The Prairie Passage is a collaborative effort of the Departments of Transportation (DOTs) of Minnesota, Iowa, Missouri, Kansas, Oklahoma, and Texas and the Federal Highway Administration. The project runs along or near Interstate 35 essentially through the center of the original tall grass prairie of the central United States. Interestingly, it is along this route that tagged monarchs have the highest recovery rate. Initiated in 1992, the project is now taking shape after a long period of identifying routes, prairie sites, seed sources, and preparing management plans to enhance and restore the vegetation.

When the Prairie Passage is completed, motorists will see educational signs and will be able to visit demonstration areas along the highways.



The Prairie Passage. Participating states include Texas, Oklahoma, Kansas, Missouri, Iowa, and Minnesota.

Adopted from a KDOT brochure.

Why did the monarch population decline in 2000?

The overwintering population declined from 96-108 million in 1999 to 28.3 million in 2000. The previous low for the last 10 years was 55-66 million in 1998. Why were the numbers lower in 2000 and how can we explain these swings in the size of the population? There is no quantitative data to support answers to these questions, so we can only speculate and point out possible causes.

There were severe spring droughts in Texas in 1998 and 2000 and in both years the subsequent winter populations were lower than the previous year. Such droughts could affect the reproductive success of arriving spring migrants in several ways: 1) limited access to nectar and therefore energy and water resources could decrease the life span of the adults; 2) the leaves of drought-stressed plants might not provide adequate nutrition; 3) drought-stressed plants produce less foliage reducing the surface area for hunting predators such as fire ants and possibly leading to greater losses of monarch larvae due to predation; and 4) milkweed growth could be constrained by the lack of soil moisture. The latter is probably the least important of these four since most milkweeds use the stored energy and water in their root systems to initiate new growth.

In addition to the spring drought in Texas, the first generation monarchs that moved north from Texas in May encountered a widespread drought in the southern portion of the Corn Belt. This may have further limited population build-up. As the summer progressed it became apparent that relatively few monarchs colonized the northeastern portion of the country. Rainfall and cooler temperatures in the northeast were so prevalent through much of the summer that it may have been difficult for females to lay eggs again limiting population growth. In Vermont there were reports of extremely late production (late September/early October) of monarchs perhaps a consequence of the inability of females to lay eggs within the normal time frame or delayed development due to low late season temperatures.

The conditions during the migration south may also have been more stressful than normal. As the migration progressed through the middle of the country in late summer, the butterflies encountered many days when the temperatures exceeded 100°F. Due to the extended drought, flowers and therefore nectar and water were scarce over large areas of the Midwest and Texas. However, September rains provided substantial bloom for the butterflies moving through south Texas in October. The majority of the late migrants were probably killed by an early hard freeze (6-8 October) in the central Midwest. The affect of high temperatures and low nectar availability on the survival of the monarchs is not known but it would be surprising if these factors did not contribute to the mortality of the migrating butterflies. The low recovery rate of tagged monarchs for the past winter is consistent with high mortality during the migration. A related discussion can be found on **page 11** ("Monarch Population Size").

PESTICIDES KILL MONARCHS

Pesticides Kill Monarchs in MN

Spraying to control mosquitoes is common in many areas of the country and especially in the upper mid-west, the heartland of monarch reproduction. Mosquito control is only supposed to kill mosquitoes. However, many non-target species die as well. Most of these are small and inconspicuous and we generally aren't aware of them. These collateral deaths are ignored and no one asks what the consequences might be for birds and other organisms that feed on such insects. Clearly, non-target species are affected by such spraying.

The Mankato Free Press published three articles about a monarch kill in Gaylord, MN a town of 2000 residents about twenty miles from Mankato, MN. The town was sprayed with Permethrin (Biomist) late in the day on 23 August and dying monarchs were observed that evening and the following morning. The townspeople immediately linked the monarch deaths to the spraying, but the city officials were skeptical and even claimed that the pesticides could not have caused the monarch deaths. Analysis of dead monarchs by the Minnesota Department of Agriculture showed the monarchs contained enough

pesticide to have killed them, but concluded that the pesticide was not misused even though the pesticide concentration was higher than allowed for this type of application.

each latitude when the altitude angle of the sun reaches 56 degrees and peaking when the angle reaches 52 degrees, we now have the basis for advising authorities and spray applicators as to when

The following are related articles available on the Mankato Free Press website:

www.mankatofreepress.com/archives/2000/000826/story1.html

www.mankatofreepress.com/archives/2000/001104/story1.html

www.mankatofreepress.com/archives/2001/010127/story2.html

www.mankatofreepress.com/archives/2001/010629/story2.html

Our thanks to Lisa Tite of Mankato, MN for bringing this story to our attention and to Mike Quinn or posting the AP story to the email discussion list Dplex-L.

How to prevent another Gaylord, MN monarch kill.

How common are events such as the Gaylord monarch kill? We don't know. It is possible that there are many lesser monarch kills that are unrecognized or unreported. The issue is less about how many monarchs are lost to pesticides each year than what we can do to minimize such events.

Fortunately, there are a few things we can do. Because the fall migration has a predictable time course, beginning at

they might expect the maximum number of monarchs to be in their area. Accordingly, this summer, in anticipation of the fall migration, we will issue a press release addressed to all State Departments of Agriculture, municipalities, and pesticide applicators. We will attempt to make them aware of the presence of monarchs and will advise against spraying pesticides during the peak of the migration, referring them to our website to check those dates for their area. The city of Gaylord has resolved the spraying issue for the fall of 2001. They will be targeting certain areas where the mosquitoes breed instead of spraying citywide. For more information, please read the articles available on the Mankato Free Press website at the addresses above. ■

Alert for Ontario Taggers

The following information came to us via Dplex-L, our email discussion list, from Don Davis in Toronto, Ontario regarding the need for permits to tag Monarchs in Ontario.

For the information of those tagging monarch butterflies in Ontario, you will require a Wildlife Scientific Collector's Permit. I am posting, below, the letter I received today. This Permit is required because monarch butterflies (and other large and colorful [butterfly] species, such as swallowtails) were given protected status last year under our new Fish and Wildlife Conservation Act. I've also inquired as to how some of the many questions and concerns raised by the Ontario entomological community have been responded to. For example, what about the school teacher who would like to rear a few monarchs in their classroom?

It is indeed unfortunate that our legislators did not have the foresight to add these procedures to the Act as regulations that could easily be modified or changed, as opposed to putting them directly into the Act, which now has to be changed by the Legislature. While MNR officials say that there is nothing that can be done about the present situation and the newly passed Act will not be changed for, say, five years, others say that if the entomological community and others complain and advocate effectively to our elected legislators, changes will be made sooner than later.

[To obtain a permit, Ontario taggers should contact: Wilma Miyasaki, Wildlife in Captivity Biologist, Wildlife Section, Fish & Wildlife Branch, Ontario Ministry of Natural Resources, Box 7000, Peterborough, Ontario K9J 8M5 Phone 705-755-1999, Fax 705-755-1900, Email wilma.miyasaki@mnr.gov.on.ca]

WHAT HAPPENED LAST WINTER?

What happened at the overwintering sites last winter? Is it true that millions of monarchs were sprayed by loggers and that more were killed in a snow storm? These questions won't go away. They arrive in emails and pop up in casual conversations with people who know I have an interest in monarchs. I don't really know what happened at the overwintering colonies last winter. No one does. There is no one monitoring all of the colonies all of the time. All that we can do is sort through the contradictory accounts in the news media, the endless speculation in email discussion lists, and official reports. The following is a brief account of the chronology of events known to me.

The first indication of a winter kill came from an email received late on 5 March from Jeff White. Jeff's account was surprising but not alarming since he described what is now known to be a typical snowfall and monarch recovery scenario.

Hello Monarch Watch,

I don't know if word has reached you that there was a one-in-18 year snow storm in central Mexico last Friday night (2 March) and that the reserves around Angangueo had 15 cm of wet snow.

We went to El Rosario on Friday and mostly saw butterflies hanging in clusters as it was cool and somewhat rainy.

Saturday AM we drove up to Sierra Chincua. We were among the first to enter the reserve and reached the butterflies around noon when the sun was just starting to peek through. Trees had fallen along the roads and trail. Where the butterflies were, we saw several downed branches -- at least one with butterflies on it. We didn't do a formal survey but my impression was that the snow had relatively little effect on the butterflies, especially those still in trees. As the sun came out (1:00 PM-ish), the butterflies started to fly about. The local forests have received an extra shot of moisture, and contrary to what you might expect, it was

probably warmer the night of the snowstorm than it will be over the next few days...

Best regards,

*Jeff White, CIMMYT
Texcoco, Edo. Mexico, Mexico*

This was followed by messages posted to Dplex by Mike Quinn on the morning of 7 March. The first message was a Reuters account from Mexico City written by Eizabeth Fullerton. In this message, Homero Aridjis, President of the Group of 100, a major conservation group in Mexico, claimed that perhaps 22 million monarchs had been killed by pesticides applied by loggers at San Andres and Las Palomas, the westernmost monarch colonies, in the previous two weeks. Aridjis linked the actions of the loggers to the report on the rate of deforestation that was followed by the new Presidential decree which extended the areas included in the monarch reserves. "The wings of the butterflies found inert on the ground had a strange luster and there was a smell of pesticide and petrol in the sanctuaries," he said. This sounds like a first hand account but Aridjis did not visit the site. Joel Rodriguez an official of Profepa, a government environmental watchdog agency, was quoted as saying the mortality might simply have been due to cold weather. Exactly when the monarchs were killed was not clear and this led to some confusion when additional reports of the effects of the storm began to arrive. The second story appeared in the newspaper El Norte (Monterrey). The story was entitled "Denuncian la muerte de miles de Monarcas" or "Denunciation of the deaths of millions of monarchs". This story repeated the essence of the first account except that the Profepa statement strongly asserted that the butterflies had died from the cold.

Two hours after Mike Quinn's email the following arrived from David Marriott:

Dear Chip and Lincoln,

Please post the following information on Dplex and to other concerned individuals:

Last Friday night and early Saturday morning there was a fierce storm that hit the mountains near Valle de Bravo and Capulin. Very strong winds over 100 kilometers per hour, with snow and ice, destroyed many homes and trees. The highway between Toluca and Valle de Bravo was closed all day Saturday. I have never seen anything like it. It looked like a total disaster zone. Snow and ice levels reached 8,000 feet.

I met the Secretary of Ecology of the State of Mexico, the Director of Administration to the Funacomm group, the president of Valle de Bravo, and other important people during a meeting at the bottom of the La Herrada monarch sanctuary in Los Sauces. Things do not look good. The Secretary of Ecology had tears in her eyes and the local people were praying. It was a very sad moment...

Near Angangueo, the storm was not too bad. On Sunday, the snow was .12 meters at Chincua and -8°C. Snow level at El Rosario was 7-10 cm. with a temperature of -4°C. Mortality rate was about 7%. I fear that the mortality rate at La Herrada and Cerro Pelon is very high but I will not know until Wednesday or Thursday...

Sincerely,

David F. Marriott

Executive Director, The Monarch Program

To the best of my knowledge there was no subsequent assessment of the storm related mortality at Herrada and Cerro Pelon but both colonies were quite small early in the winter according to Eligio García. It should be mentioned that Herrada and Pelon are in the eastern group of colonies and that San Andreas and Las Palomas are about sixty miles to the west. The main colonies, El Rosario and Chincua, are in the middle.

On the 8th, Lincoln Brower forwarded a long email for Dplex. This message represented extensive discussions Lincoln had with his colleagues, especially Monica Missrie, from World

Wildlife Fund Mexico. I will quote one section of this message.

Monarch butterfly scientist Lincoln Brower is concerned that there is a possibility that the report of reputed insecticidal spraying of the monarch butterflies[at] San Andrés and San Isidro Las Palomas overwintering colonies in Mexico may be based on an incorrect interpretation of natural mortality caused by the prolonged wet and cold winter that has characterized the butterfly overwintering area this season.

We know from our extensive research over the past 20 years at several of the overwintering sites, that monarchs can be killed in very large numbers by winter storms and, particularly, by the very cold clear nights that can follow these storms. We have found several inches of dead butterflies packed together on the forest floor after severe storms. Most of the butterflies have large reserves of fat in their bodies, and after they are killed, the fat gradually leaks out into their wings. As a result, their wings become saturated with fat and have a dark greasy appearance. This could easily lead an inexperienced observer to come to the false conclusion that they had been killed by spraying...they could have died of natural causes.

These comments were somewhat reassuring. However, on the evening of the 9th, Lincoln received a call from David Marriott from Valle de Bravo. David left a message that he had been told by ejidatarios that the Cerro Pelon Sanctuary had also been sprayed in late December 2000 and that the spray had killed 75% of the colony. This was followed by a lengthy, detailed and seemingly credible account by Homero Aridjis purporting to provide evidence of pesticide spraying at San Andres. The article contained numerous statements such as: "Loggers have been carrying away bags and bags of dead butterflies and now very few remain as evidence that there were millions of them in the forest", as well as vivid accounts of dead butterflies and a condemnation of logging and the justice system that seems to protect them. The report called for an investigation of the monarch deaths and of the logging in the region. Nevertheless, the report contains the

following quote:

According to the PROFEPA office in Michoacan, local biologist Xiomara Mora claims that "the butterflies froze to death, due to climate conditions registered in December" (rains, continuous low temperatures). Other circumstances that contributed to the butterfly deaths in San Andres are: The forest where the colony is situated is of very young trees with very unstable climate conditions. Nearby is an area that suffered a severe fire in 1998.

Numerous newspaper articles appeared about this time and most emphasized the uncertainties as to whether the monarch deaths were due to weather conditions or spraying.

On 12 March a Reuters report from Mexico City quoted a statement issued by Profepa "that a scientific analysis of 300 butterfly corpses from the Cerro San Andres sanctuary in central Michoacan state showed no trace of toxic substances from pesticides." Unfortunately, the actual data, methods, and other details needed to validate such test results were not posted to the Profepa web site. Again, Profepa maintained that the butterflies had died from the cold as they had in all previous reports.

The most comprehensive press account of the monarch kill at San Andres appeared in a Reuter's article of 29 March titled "What killed Mexico's Monarch butterflies". I drew attention to the article in a message to Dplex but we were unable to get permission to post the article on the web site.

The article provided an insight as to how the San Andres story started. In February, Rodolfo Fuentes, the cultural director in the nearby town of Maravatío climbed San Andres to show the butterflies to visitors. Instead of the living colony that had been there a few weeks before, he found a mass of dead butterflies covering an area some 50 x 200 yards. Nearby there were fresh signs of logging. Subsequently, Fuentes and other officials in Maravatío contacted the Group of One Hundred about their observations and concerns about the

loggers and spraying and this led to the publicity that drew attention to the deaths of the monarchs at this colony.

The stories led to an investigation by Profepa, and included the analysis of samples of dead butterflies for pesticide residues and the conditions at the colony site selected by the butterflies in which to overwinter. The forest was found to be composed of young trees with little canopy and poor protection for the butterflies. The forest had been badly degraded by both deforestation and a recent fire. These conditions along with cold weather in January, combined to kill about one third of the colony (300,000 monarchs). The other two thirds of the colony evidently moved to another unknown site.

Roberto Solis, Director of the Monarch Biosphere Reserve, was quoted as follows:

They did not die from pesticides, nor did the cold alone kill them. A set of climatic conditions including destruction of the forest in that area killed them.

On 1 April a brief Reuters account described Profepa's crackdown on illegal logging in the vicinity of San Andres in late March. At that time Profepa discussed and mapped a protection plan with local officials, property owners, the environment ministry, and the military. The plan calls for more inspection of the forest reserve, reforestation, and protection from wildfires.

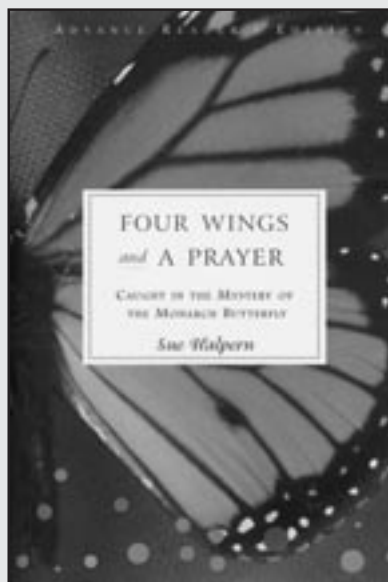
There were several additional press reports after 1 April but none of them added anything new to the story.

What did we learn from this story and how can it help us in the future?

I think we've learned again what we already know. Passions about monarchs, logging, land use, land ownership, and individual and community rights run deep. Suspicions of the actions and motives of others frequently lead to rumors, exaggerations and fabrications. Once these views become public it becomes extraordinarily difficult to sort out the facts since the press accounts are more noteworthy for their misrepresen-

[continued on page 54]

Four Wings and a Prayer



Four Wings and A Prayer: Caught in the Mystery of the Monarch Butterfly a book review by Dana Wilfong

In her new book, *Four Wings and a Prayer*, Sue Halpern brings to life the scientists, researchers, and everyday people who dedicate their time to the study of monarch butterflies. Sue's story is presented as a travel log which begins prior to the 1997 monarch conference in Morelia, Mexico and ends with a flight in Dr. David Gibo's glider in Ontario, Canada. The narrative constitutes a report of the people and places encountered as Sue pursues the mystery and wonder of the monarch migration. Sue has a knack for asking the right questions and is unerring in her portrayal of the personalities and passions of each of her subjects. In this book you will meet all of the important players including Dr. Fred and Norah Urquhart, and the late Kenneth Brugger all of whom were instrumental in locating the overwintering sites in Mexico. You will also get to know the quiet, self-effacing Dr. Bill Calvert, the scientist who has more experience at the overwintering sites than anyone else and Dr. Lincoln Brower who has made a career of studying monarchs and promoting conservation of the overwintering sites in Mexico. Sue also introduces you to the views of others including Dr. Chip Taylor, director of Monarch Watch;

Dr. Sandra Perez, who spent time studying monarch orientation; Dr. David Gibo, who is interested in the flight tactics of the monarch; Dr. Karen Oberhauser along with Dr. Sonia Altizer and Liz Goehring, who use monarchs to teach teachers about science; and Dick Walton, who directs the Monarch Monitoring Project each fall in Cape May, NJ. In addition to the researchers, Sue talks to other monarch enthusiasts including Terry Callender, a teacher at Wamego, KS high school, who has inspired extraordinary tagging efforts by his students, and the ejidatario (Mexican landowner) Dimas Salazaar. The philosophy, attitudes, and motivations of Paul Cherubini, a long-time critic of monarch conservation efforts makes for fascinating reading. If you ever wanted to get to know the people who study monarchs - their personalities, politics, and passions - this book is a must. *Four Wings and a Prayer* is available through the Monarch Watch Amazon Portal at www.MonarchWatch.org - see [page 62](#) for more information.



Above: Dr. Bill Calvert, Texas Parks & Wildlife, Austin, Texas.

Right: Dr. David Gibo, University of Toronto, Toronto, Ontario, CANADA.

Photos by Chip Taylor.



Left: Dr. Sonia Altizer, Emory University, Atlanta, Georgia.

Photo by Chip Taylor.

Below: The late Kenneth Brugger. Photo contributed by Katharine Carroll.



CATASTROPHIC MORTALITY

Very little is known about the dynamics of the birth and death processes in the monarch population. The value of this information became apparent when the death of a large number of monarchs due to the late season snow and ice storm (2-3 March) in Mexico raised a number of questions about the importance of such catastrophic mortality to the overall dynamics of the monarch population. Since extremes in the weather are part of the environmental background in which monarchs evolved, it is a normal event even if it only occurs occasionally. In general, species which experience high death rates (particularly those which are periodically decimated by natural disasters) have high birth rates and therefore, the capacity to recover their numbers when conditions return to normal. The monarch fits this pattern. Female monarchs have the capacity to produce 400 or more eggs in their lifetime; when conditions are favorable, enough immatures survive to the adult stage to replace and even increase the population.

If this is the case, do we really need to worry about catastrophic mortality in monarchs? (Biologists call this "density independent mortality" since the mortality is due to extrinsic events that are unrelated to the density of the population.) In environments that are relatively stable over long periods, catastrophic mortality could depress a population although we would expect it to recover in a relatively short time. There are many examples of this pattern in the biological literature. But what might happen to the recovery time if the environment is degraded in a manner that contributes to even higher rates of mortality when the extreme condition occurs? Surely the recovery time would be longer. This scenario may apply to monarchs. If the forest in the overwintering areas is being degraded and this degradation leads to higher than normal attrition of the overwintering monarchs and even higher

mortality in snow, ice or freezing rain storms, then the time needed for the population to recover after catastrophic mortality should increase. We don't know this to be the case for monarchs since our knowledge of the population dynamics of this species is too incomplete to assess this possibility. Nevertheless, it is a concern. If the number of overwintering colonies is reduced due to deforestation, the vulnerability of the population to catastrophic mortality is likely to increase. Biologically this will be the equivalent of putting all the eggs in one basket and sooner or later catastrophic mortality at the remaining colonies could result in a substantial reduction of the population. Measures of the mortality of monarchs in forests of differing qualities are needed to determine the relationship of mortality to the integrity of the forest. These data are needed to establish the most favorable conditions for overwintering monarchs.

There is another issue to consider: Is catastrophic mortality due to spraying of insecticides different from mortality due to natural events? No, although the former is preventable. From the standpoint of the population, both sources of mortality reduce the population, which will

decrease the birth rate in subsequent generations. The number of generations affected by such reductions is unknown and is an attribute of the population cycle we need to evaluate. It is not difficult to imagine that severe catastrophic mortality combined with human-assisted mortality at the overwintering sites followed by unfavorable conditions for breeding could depress the population for two or more seasons. It is worth noting that the lowest overwintering population in the last six years occurred in 1998 - 1999 and followed the extremely dry El Niño winter of 1997/1998 and the severe drought in Texas in the spring of 1998. Dry conditions in the winter could have increased the mortality of the adults and drought in Texas could have reduced the reproductive success of those that moved north in the spring. The most important factor that determines the size of the fall migratory population is probably the number of offspring derived from eggs laid by returning females in the southern states. These offspring move north and lay eggs on milkweed in the northern states and Canada. If insufficient numbers of these monarchs reach northern areas in May and June, fall populations are usually small. ■



Photos courtesy of Jeff White, Papalotla, Mexico.

Incidentally, the name "Papalotla" means "place of the butterflies."

Most of these monarchs appear to have survived the late-season snowstorm at Sierra Chincua in March 2001.



FEATURED TEACHERS

Teaching is one of the most under-appreciated professions, yet teachers are responsible for molding and educating generations of young people. Many teachers teach beyond the curriculum and incorporate history, geography, art, languages, and other topics. They serve as excellent mentors and role models for their students. Each year we honor teachers who do a wonderful job of using monarchs in their classroom to make science more engaging for their students. This year we are featuring high school Biology teachers **Paula Donham** and **Karyl McLean**. We'd like to thank them and all other teachers who make learning interesting and enjoyable.

year to teach and inspire students. She has been teaching for eight years. She spent the most recent three years at Olathe East High School where she currently teaches sophomore and AP Biology. Next year, she will add Department Chair of the Science Department to her list of responsibilities.



Students work together to tag monarchs and record data.

Photo contributed by Paula Donham.



Paula tagging monarchs in the field.

Photo contributed by Paula Donham.

Paula Donham didn't begin her career as a teacher. She left a lucrative position as Director of Product Development for Business Men's Assurance to follow her first dream of becoming a teacher. This move illustrates her dedication to the teaching profession. Paula received a Bachelor's Degree in Biology from the University of Missouri at Kansas City and a Master's Degree in Education from the University of Kansas. For her Master's thesis, Paula wrote about using a butterfly garden thematically throughout the

Paula comments on using monarchs in her classroom:

I use monarchs as a thread through the fall semester to raise interest and motivation levels as we learn and polish some of the more basic science skills and concepts. What better way to polish observation skills than sending students out to collect monarchs in the fall?...Observing a live organism is something the students rarely do close-up and personal, and this experience offers not only unique discussion opportunities, but a chance to appreciate

nature in a new way.

Once the students bring the monarchs in we start a process of examining, categorizing and tagging butterflies. A select group of healthy ones (mostly females) we keep in a breeding cage. I find checking the butterflies for Ophryocystis [a common monarch parasite] an opportunity to improve the students' microscope skills and it's a perfect "teachable moment" to discuss sexually transmitted diseases with the students from a fresh angle. They are surprised to find that this risky aspect of reproductive behavior applies to organisms other than humans. This gives me an opportunity to discuss how high risk and high energy requiring reproduction is — this is an important discussion to have with teenagers and yet one teens usually approach with a closed mind. The monarchs give me a new angle to discuss an age-old problem.

One of Paula's students carries a tent full of tagged monarchs waiting to be released.
Photo contributed by Paula Donham.



Paula was honored recently by one of her students, Kristen White, who was chosen as a Kansas State Governor's Scholar and was told she could invite her most influential teacher to the ceremony. She chose Paula.

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“Getting senior students interested in field biology” has been one of **Karyl McLean**’s long-time goals. She has been teaching for twenty-three years in Florida, Virginia, and mostly Fredonia, NY. She received her Bachelor’s and Master’s degrees in Biology Education from the State University of New York at Fredonia. She has a husband and two grown children who are also certified biology teachers. Her interest in field biology inspired her to develop a senior level “Topics in Biology” class at Fredonia High School where she teaches now. Each quarter covers a different topic: entomology, herpetology, mammalogy, and ornithology.

In addition to the hands-on fieldwork required to collect and prepare representatives from twelve different insect orders, students work collaboratively to capture and tag as many migrating monarchs as possible. Karyl was featured in the winter 2000-2001 quarterly publica-

tion of the Roger Tory Peterson Institute of Natural History, called the “Guide”. The article emphasized the way in which Karyl incorporates Monarch Watch tagging into her classes. During the fall of 1999, her students tagged 500 butterflies and of those, three were recovered in Mexico. She and her students also managed to tag 250 monarchs during the slow 2000 tagging season. Karyl’s students have a wonderful opportunity in Fredonia to capture the monarchs as they finish their long trip across Lake Erie. The students use goldenrod fields near the lake as their tagging grounds because the monarchs literally drop out of the sky to refuel there after their long flight. In many cases, students’ siblings and parents all get hooked on these tagging expeditions.

Karyl explains the impact monarchs have on her students:

The most amazing thing for me, during this entomology unit, is to watch these supposedly sophisticated 18 year-olds come “unglued” the first time they net a monarch, or catch a cicada, or find a caddisfly larva case or a dragonfly nymph in the pond we visit. After they become aware of the insect life around them, they actually begin to see it everywhere. I know that I have done my job when they report nightmares that have included both insects and Mrs. [McLean]. As seniors, [students] embrace the excitement of seeing biology in action in the fields and forests around them. Once these children get a taste of nature, there is very little encouraging that needs to be done.

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Our many thanks go out to both Paula and Karyl for their hard work to make a difference in their students lives. We congratulate you both on your successes as wonderful role models for students and teachers alike. ■



Karyl McLean’s Topics in Biology class celebrates the recapture of a monarch butterfly tagged on September 12th in Fredonia, NY and recovered in El Rosario, Mexico on January 14th. Students, from front left: Jackie Berner, Colleen McDonald, Brooke Antolini, Eileen Marutiak; from back left: Pete Shampoe, Colleen Murphy, Stacey Szocki, Lisa Micelli, Samad Khan, and Karen McIntyre.

Photo by Karyl McLean.

:: Cake says: “I made it to Mexico!” with the tag # 816 GT on the butterfly. ::

FEATURED MILKWEEDS

Asclepias hirtella (Pennell) Woodson, prairie milkweed is a perennial forb with linear to lance-shaped leaves. Conspicuously covered in short, soft hairs, *A. hirtella* can be found in sandy prairies and marshy areas of Iowa, Missouri, eastern Kansas, and eastern Oklahoma. This species appears to be able to survive modest levels of soil disturbance and is not limited to native habitats. It flowers from May to September. The flowers resemble a display of fireworks with their purple-tinged florets.

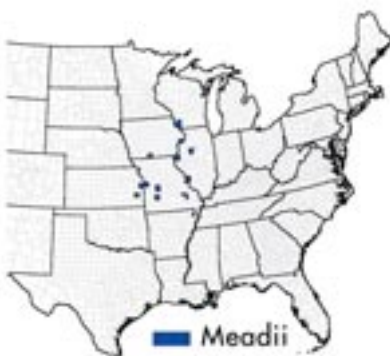
Flowers are significant in plant identification because flowers are intricate structures with many features that can be assessed, counted, and measured. Affinities among closely related species can be shown because floral morphology is conservative. Leaves and stems have features shared across many groups and lack unique combinations of features for species identification.

Members of *Asclepias* have an additional floral whorl of what are called hoods. These hoods often enclose struc-

tures important in milkweed identification called horns (modified filaments of the anthers). Notice that *A. hirtella* is entirely lacking horns. *A. hirtella* is grouped with *A. viridiflora*, *A. asperula*, and *A. viridis* all of which are species which share this feature.



The shaded areas of these maps represent counties where *A. hirtella* (above) and *A. meadii* (below) have been reported.



Asclepias meadii (Torr ex A. Gray), Mead's milkweed is a rare perennial usually with two or three pairs of hairless, lance-shaped leaves. This milkweed is most easily recognized when it produces a single nodding umbel of beautiful, waxy, yellow-green flowers late May through June. This species is found only in native prairies.

The U.S. Fish & Wildlife Service officially listed *A. meadii* as "Threatened" in 1988. Though historical records indicate this species has always been rare (Woodson, 1941), loss of native prairies diminished its chance for survival. Roughly one hundred fifty populations of *A. meadii* are currently known to exist; most of these populations are

located in eastern Kansas, Missouri and Iowa. A number of populations have been lost to the plow and urbanization in recent years.

Many areas in which Mead's milkweed grows are often unsuitable for plowing and have been used instead as hay meadows. The perennial nature of Mead's milkweed has allowed it to survive annual mowings for generations. Unfortunately, most hay meadows are mowed before the seeds mature and as a consequence, *A. meadii* may experience a decline in genetic variation. This species has proven difficult to propagate. Studies suggest that periodic prescribed burnings between September and April stimulate sexual reproduction in Mead's milkweed, and could be significant in conserving this species. ■



Asclepias hirtella - Prairie Milkweed



Asclepias meadii - Mead's Milkweed



DANA'S FAREWELL

by Dana Wilfong

"Hurry, it's poopating" my three-year-old niece Maggie squealed pointing to the monarch larva hanging in "J" formation. So my nephew and father moved breakfast into the sunroom where my mom had placed her monarch cage on the table. It was filled with milkweed leaves and the large larvae I brought to display at her garden show (which was selected to be on the tour because of her milkweed plants). Maggie was right, the monarch was pupating. All four of us sat in amazement as the larva's skin split and the fresh pupa did its "wiggle dance" to shed its old skin.

The fact that my young niece and nephew's all know the "proper" names for the monarch throughout its life cycle illustrates the effect that my last four years as a Monarch Watch program assistant has had on my life. My interest in monarchs has been infectious to all those I know and love; from my mother, who is now a regional coordinator for Monarch Watch, to my grandfather, who takes me on tours of his farm to show me all the different milkweed species he's found, to my fiancé's mother who now orders monarchs from Monarch Watch every year to use in her sixth-grade classroom. Virtually every person in my family has been touched by what I do. My youngest sister even worked for Monarch Watch while she was a student at the University of Kansas.

A conversation I had with a woman at my mother's garden show summed it up. "You have the coolest job" she commented. I agreed "Yes I do!" To which she added "Much better than sitting at a computer screen all day." I couldn't help but laugh, because I actually do sit at a computer screen all day. It's the passion you put into your work that makes the job. I have truly enjoyed the last four

years working with Chip, Jim, Cathy, Stephanie, all the students we've had in the lab, and all the friends I've made along the way. I can only hope that I will be so lucky in my next big endeavor. Thanks Monarch Watch for a great experience! ■



Left and above: Richard and Nancy Wilfong with their grandchildren Maggie and Jeffery at their home that was featured on a garden tour for their milkweeds and butterfly garden.

Photos by Kimberly Plake.



MONARCH CRUSADERS

In February we received a request from *American Girl* magazine for a young girl whom they could feature in a section in which they give recognition to animal crusaders. We asked for nominations through Dplex-L and received many letters on behalf of worthy Monarch Crusaders. *American Girl* selected Isabel Nuesse for their feature but we felt that the other nominees deserved recognition as well - so, here is our group of Monarch Crusaders. We wish to thank them all for their efforts on behalf of Monarchs.



Though only ten years old, **Sarah Ketelhut** has spent three years passionately pursuing her interests in monarchs. At age seven, she encouraged her parents to "pilgrimage" up and down the state of California to visit many of the monarchs' overwintering areas to see for herself the magnificence of the overwintering phenomenon. After meeting with Ro Vaccaro, the "Butterfly Lady," in Pacific Grove, she was hooked.

The following year, Sarah again traveled up and down the state of California to many of the overwintering areas in preparation for a science fair project

that assessed whether the migration was an endangered phenomenon. Her meetings with scientists and professors such as David Marriott and his crew at the Monarch Program, Dennis Frey, Kingston Leong, and Michael Yoshimura of Cal Poly left her with a desire to devote herself to protecting the monarch, and the overwintering migration. Through her project, she educated many others about the necessity of protecting the monarch, and grew seedlings and passed out milkweed seeds all around her hometown.

This year, in addition to participating in the Thanksgiving Butterfly counts, she has talked to local officials about the necessity of protecting overwintering areas, and has raised hundreds of monarchs from eggs, has hand-fed them when it was too rainy to release, and has scoured the state for milkweed when her plants wouldn't sustain the large numbers of caterpillars. A number of her released butterflies have returned to her yard to lay eggs, thus starting the marvelous process all over again!

Sarah's devotion has inspired many people to take a new look at the monarch, and to join in the dialogue regarding protection of coastal California overwintering areas.

Submitted by Marcella Ketelhut

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Valerie Tite (age 10) has been helping her mother Lisa collect milkweed and raise caterpillars to butterflies nearly all her life. In the last two years she has assisted with tagging, data collecting, and she has taught her family about monarchs by doing research on the Monarch Watch web site. Each fall she has volunteered to teach her classmates about the monarch life cycle and the tagging program, and has arranged to have her mother introduce caterpillars, chrysalids and butterflies to her classmates. She brought her teachers "Monarchs in the Classroom" literature, and the school she attended last year is



now using this curriculum to introduce students to monarchs. Valerie worked with her mother to raise monarchs in the summer months. She collected and cleaned milkweed for the caterpillars, repotted milkweed and nectar source flowers, kept the flight cage clean and maintained nectar for the butterflies. Last summer Valerie and her mother raised nearly 300 butterflies that were tagged and released at a butterfly garden dedication and memorial service in memory of a student who had been killed in a tragic accident. Valerie has developed a lifelong love of monarchs and wants to help conserve monarchs and their habitat. Next year she intends to get her own tagging membership with Monarch Watch, so she and her mother can be a mother-daughter tag team!

Submitted by Lisa Tite

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Rachel Kaufmann (age 9) became a butterfly enthusiast several years ago after receiving a gift of a butterfly net and an identification book. Now Rachel's favorite outdoor activity is the identification of butterflies. With net and book in hand she has become very adept at gently capturing these beautiful creatures. After close observation and

identification they are carefully released. In 1999 she used this skill to collect and tag monarchs with her mother for Monarch Watch. She really enjoyed participating in the tagging program and was very excited to receive a certificate from Monarch Watch last year indicating that one of her tagged monarchs had been recovered in Mexico.



Rachel and her mother Jayne work hard to attract butterflies to their yard.

She has helped her mom plant host and nectar plants for monarchs and other butterflies. Many butterfly species have visited the yard but they have been particularly successful in attracting black swallowtails by planting fennel, parsley, and dill. In the summer, Rachel delights in counting the number of these colorful caterpillars on the plants. Occasionally, if she looks carefully, she even finds chrysalises hidden in the garden. Rachel is learning a great deal about butterflies and the plants they utilize.

Submitted by Jayne Boyer

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Tara Clancy and **Olya Pavlova** are eighth graders at Ordean Middle School in Duluth, MN. During the summer and fall of 2000, they participated in a 2-week Monarch Research Institute where they learned about monarch biology, ecology, behavior, and conservation. Working with their teacher, Annette Strom, and scientists from the University of Minnesota, they designed



and completed an original experimental study of the effects of lawn chemicals on milkweed and the survival of monarch larvae. They also led fellow students in monitoring the abundance of monarch larvae on milkweeds as volunteers in a nationwide citizen science project run by Michelle Prysby of the University of Minnesota. These young ladies showed their intelligence, interest, leadership, and enthusiasm through all phases of these projects. They truly have been star monarch 'crusaders'!

Submitted by Michelle Solensky

Challenges to Students Winners

Monarchs may contain magnetite, a magnetic material that is thought to be associated with magnetic orientation in a number of organisms. Last year we asked students to design an experiment to determine whether or not Monarchs have magnetic material. Here is a report from Christy McCoy's students:

We are two fifth graders at DeSoto Intermediate School in DeSoto, Iowa. We wanted to find out if monarch butterflies really had magnetite in their bodies. In November, we did an experiment from the Summer 2000 publication of Monarch Watch, Challenges to Students. We ground up seven monarch bodies until they were as fine as dust. We poured 50 mL of acetone in a petri dish with the ground monarchs. Then we stirred it with a glass rod and examined the mixture under a dissecting microscope with a light. We raised the petri dish on blocks so the magnet could slide under. Next we slid a magnet under the dish so we could see if the monarch pieces moved with the magnet. We saw the particles move with the magnet!!!! We concluded that they had magnetite in their bodies.

We wanted to do a control experiment to prove (test) our hypothesis. We did the exact same experiment using twenty corn borer beetles, because they were small. We slid the magnet under the petri dish. When we were examining the particles with the magnet underneath the dish, the particles did not move. We concluded that corn borer beetles do not have magnetite in their bodies like monarchs do.

Rachel Edge and Ben Scott, Desoto Intermediate School



Great job and congratulations to the fifth grade class at De Soto Intermediate School!
This year's "Challenges to Students" appears on page 18.

ADOPT-A-CLASSROOM UPDATE

by Janis Lentz

In January 2001, I traveled once again to Mexico with Monarch Watch as part of Adopt-a-Classroom. We delivered math and science kits, textbooks, and school supplies. Joining us this year on school visits were Director Alejandro Pulido Pedraza and Maestro Eugenio Salazar Sanchez who helped us locate schools and introduced us to teachers and administrators.

I was especially interested in elementary level curriculum. Before we left, the teachers presented me with a set of 4th grade books to take back and share with my students. In addition, they served as guides to the natural surroundings, helping me understand more about the wildlife population in the forests around Ocampo.

They teased me endlessly about one little mistake in my Spanish. I tried to blame it on the altitude, but they only laughed. We found a common ground in humor, in our love for children, and in our devotion to education.

Connecting with students and teachers outside the classroom was one of the

most enjoyable aspects of this year's trip. We sat with four children on the steps outside of Escuela Profr. Jose Palomares Quiroz as they waited for school to start. We chatted with them, played with their toy animals, and listened and smiled as they told us stories about the games they were playing.

In the school at Laguna Verde, I shared a snack with a young girl

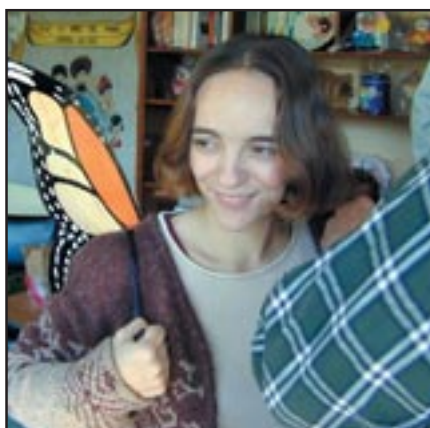
who offered me a crispy wafer topped with shredded raw cabbage, cheese, tomato, and a very spicy sauce. It was delicious!

On our visit to Jardin de Niños Joaquín Fernández de Lizardi, I had an opportunity to speak with administrators and parents

who described how their students participated in the parade to honor the monarchs. The principal showed me a pair of cardboard wings which Cathy agreed to model so I could have a picture to take back to my students so we could make our own in class.

I was honored to be part of the Monarch Watch crew when we were invited to a teacher's home. We sat around the diningroom table drinking coffee and having a lively conversation about our jobs and our families and children.

With Sra. Colin, I walked through a patch of forest as she pointed out seeds and plants her students use for art projects. She handed me leaves to



taste and taught me names of plants in Spanish.

When I returned to Texas, I turned over our Adopt-a-Classroom project to a group of my 5th grade students. Chrysta and Karrie visited each classroom in our school, first teaching the other students about monarchs and then returning to collect school supplies at the end of the year. Adam helped sort the supplies and put them in boxes. When I began working with Adopt-a-Classroom, I received an email from Chuck Saffris, a monarch enthusiast from Des Moines, Iowa, who had served for several years as a writing mentor for my students. It was his hope that someday we would be able to take not only discarded school supplies but new items as well. This year, we collected over 200 small boxes of new crayons to supplement the used supplies which my students will send to students in the Monarch Reserves. Adopt-a-Classroom remains a powerful student to student effort, enriching lives on both sides of the border. ■

Top right: Janis sits with students in front of Escuela "Francisco I. Madero".

Photo by Chip Taylor.

Center: Cathy models a pair of butterfly wings given to Janis by the principal at Jardin de Niños Joaquín Fernández de Lizardi. *Photo by Dana Wilfong.*

Bottom left: Playing with our new friends on the steps outside of Escuela Profr. Jose Palomares Quiroz.

Photo by Jim Lovett.

Thanks 3M!

Monarch Watch would like to thank 3M for their generous contribution of \$7,500 to our tagging program. This money will be used to help pay for the manufacture and distribution of this year's tagging kits. 3M technology is used in the tags we distribute. Their adhesive and polypropylene label stock enable us to make lightweight self-adhesive tags that work so well that some participants brag that they've used them to repair Monarch wings. Thanks for the much-needed assistance 3M!

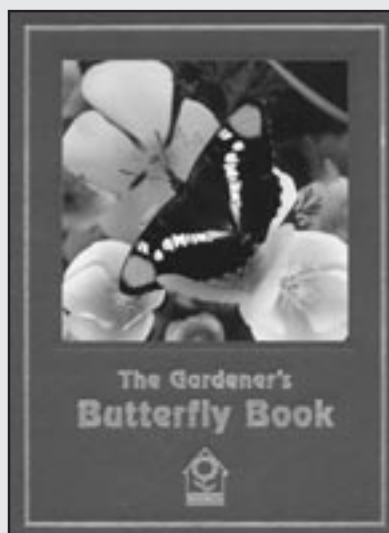


A tagged monarch nectars on Mexican sunflower (Tithonia).

Photo by Paul B. Southerland.

The Gardener's Butterfly Book by Alan Branhagen*

Are you interested in butterfly gardening and would you like to know how to increase the number of species visiting your garden at school or at home? Do you wish you could identify all the



butterflies that you see in your yard? If so, Alan Branhagen, Director of Horticulture at Powell Gardens** east of Kansas City, has written a book of great value - *The Gardener's Butterfly Book*. In this book, Alan blends his training in landscape architecture, his great knowledge of butterfly nectar and host plants, and his detailed knowledge of the most common butterflies seen in gardens. The book has an easy to use design and layout. The photographs throughout the book are excellent and the butterflies are pictured larger than life-size making it easy to identify each species.

The book is organized in three chapters, butterfly gardening regions, gardening tips, and accounts and pictures of 120 butterfly species. The general characteristics of each region are described along with the butterfly species likely to be found there. Lists of nectar and host plants along with gardening tips are provided for each region. The "how to" gardening section

is very general and readers might want to locate additional horticultural information elsewhere. The real strength of this book lies in species identification. The species accounts include excellent photos, common and scientific names, a general description of garden habitat, status, and identification of adult and immatures. You will also find range maps and tips on how to attract many of the species.

This is an excellent book for the beginning butterfly gardener or teacher working with students on school gardens.

*2001, National Home Gardening Club, Minnetonka, MN pp. 208. ISBN 1-58159-099-7

**Powell Gardens hosts a major butterfly festival each August. For more information on this festival see the "What's Happening" section of the Powell Gardens website at

www.powellgardens.org

Monarch enthusiast publishes story for kids!

Long-time tagger Steve Rich used monarchs in his imaginative story "The Migration of Monty Stevens". The short story about three monarchs and their adventures on the way to Mexico was part of an integrated science student book published by the University of Alabama Center for Communication and Educational Technology. Steve's story is featured in the "Cycles" component of a four-book series for grade six. The story begins with a monarch named Monty raised in a classroom then tagged, and released. Monty and his travelling companions experience all the trials and tribulations migrating monarchs might face. The story focuses on the heroic autumn migration monarchs make to Mexico without having been there before. Much of the text is based on fact but Steve also exercises a little creative license. For example, in his story a blue jay feels remorse about taking a bite out of a monarch's wing and then carries the monarch to Mexico on its back. Nevertheless, the idea that the migration is a difficult trip with many pitfalls is conveyed to those who read this creative tale.

CHALLENGES TO STUDENTS

Questions, questions, questions! There seems to be an infinite number of questions about monarchs and many of these questions can serve as the basis for independent research by students or class projects. Each year we suggest a number of experiments or lines of research for students. These ideas are always new to us, so we don't know how the investigations will turn out. This isn't cookbook science, it's the real thing and that's what makes it fun and challenging. In the paragraphs to follow you will find an outline of an idea or an experiment. It's not a blueprint or recipe, only a guideline. My suggestion is that you take these ideas, modify them, adapt them to your situation and make them your own. If you do these projects, please let us know how they turn out!

Is your monarch "magnetic"?

We posed this question in last year's "Challenges". Christy McCoy's fifth grade class at DeSoto Intermediate School in DeSoto, Iowa were intrigued by the question and followed the guidelines we suggested (1999 Season Summary, **page 23**). The method required finding a dead monarch, drying it thoroughly and then suspending the finely ground monarch in a beaker containing acetone. Minor problems with the methods were resolved by a few phone calls to Monarch Watch and once these issues were dealt with the class was able to show that particles moved in the suspension when a magnet was passed beneath the beaker. This is evidence for the presence of magnetic material. But, where did it come from? Was it present in the monarch when it emerged or is the magnetic material the result of contamination by contact with metallic objects? How would we find out?

If we want to establish whether the magnetic material is unique to the monarch and is not due to some source

of contamination, we have to rear them and test them under conditions in which they have no contact with metallic objects throughout their rearing and handling. I'm sure you can all figure out a way to do this. However, you should be aware that because you touch metallic objects frequently, such as door handles, that your hands are a potential source of contamination.

Contamination with metallic material is subtle and can come through the air in the form of contaminants from coal-fired power plants or contact with metallic objects. To show the subtle nature of such contamination, place a clean piece of white paper (about the size of a 3x5" card) in a beaker and burn it completely to ash. Please do this under a fume hood or in a safe place. Handle the paper with non-metallic instruments at all times. Once the ash has formed, crush it to a fine powder with a glass rod, add the acetone and pass a magnet below the suspension while viewing through a dissecting scope. If you see particles move, then again there is evidence for magnetic material. In this case, the magnetic material was acquired in the manufacturing process. However, if your paper is "clean", then take another piece of the same size and rub it with some material containing iron. Then burn and test this sample as you did the first one. You should see moving particles when a magnet is applied. I have no idea how free of magnetic materials various paper samples might be. If some show contamination, this could be a project in itself.

Getting back to the butterflies - now that we know monarchs have magnetic material, we want to know why they have it. Do monarchs use the magnetic material as part of their navigational system or is it just there? We can't really answer this question directly at this time but we can get some evidence relevant to this issue by looking for magnetic material in other migratory and non-migratory insects. Each spring and early

summer the following butterfly species move into the northern states from the south. Most of these migrate south in the fall as well, but little is known of these migrations. The question is, do these migratory species also have magnetic material and how do they compare with non-migratory species?

Fritillaries

Euptoieta claudia - Variegated Fritillary

Hairstreaks

Strymon melinus - Gray Hairstreak

Milkweed Butterflies

Danaus gilippus - Queen

Snouts

Libytheana carinenta - American Snout

Sulphurs

Colias eurytheme - Orange Sulphur

Eurema lisa - Little Yellow

Eurema nicippe - Sleepy Orange

Phoebis sennae - Cloudless Sulphur

Swallowtails

Battus philenor - Pipevine Swallowtail

True Brush-foots

Junonia coenia - Common Buckeye

Polygonia interrogationis - Question Mark

Vanessa atalanta - Red Admiral

Vanessa cardui - Painted Lady

Vanessa virginiensis - American Lady

If you are unfamiliar with these species, most are pictured in butterfly books or you can find them on Paul Opler's USGS website:

"Butterflies of North America"

**[www.npwrc.usgs.gov/
resource/distr/lepid/
bflyusa/bflyusa.htm](http://www.npwrc.usgs.gov/resource/distr/lepid/bflyusa/bflyusa.htm)**

Is Black Swallow-wort (Dog Strangle Vine)* a trap plant for monarchs?

Black swallow-wort, *Cynanchum nigrum*, is an introduced species in the milkweed family, Asclepiadaceae. This is a twining species introduced from Europe late in the last century presently ranging from Kansas and Nebraska east to Maine where it appears to be replacing native vegetation. This species has become well established in the northeast and is a noteworthy pest. If you search for black swallow-wort on the Internet, you will find several web sites dedicated to telling you how to rid your property of this plant. Black swallow-wort is also of interest because it may be a trap plant for monarchs, that is, one on which the females will lay eggs due to the chemical similarity of the plant to other milkweeds but on which, for various unknown reasons, the monarch larvae cannot mature. Placing eggs in the wrong place could reduce the reproductive success of the population. Last spring monarch enthusiast, Gary Stell, observed about thirty monarch eggs on *C. nigrum* in upstate New York but was unable to establish whether the monarch larvae fed on this plant. The obvious question is - "Is black swallow-wort a suitable host for monarch butterflies?" Sounds like an easy question to answer and it may be, but we need to be cautious.

Monarch larvae will sometimes feed on cut foliage of plants that they are unable to use when intact. Such seems to be the case with *Asclepias sullivantii*. Monarchs will oviposit on the blossoms of this relatively common tall grass prairie milkweed but the larvae disappear from the plants in the third instar. Damage to the foliage is virtually absent and the only way to rear monarchs on this species is to remove the leaves from the plants. *A. sullivantii* produces profuse quantities of latex, which may be sufficient to deter the larvae from feeding on the leaves. In effect, *A. sullivantii* has the



Black swallow-wort, *Cynanchum nigrum* has small, dark purple flowers. Photo by Gary Stell.

attributes of a "trap plant" and it is a native species, although one with a relatively limited range.

Knowing this, how should we go about testing to see if monarchs can be reared on Black Swallow-wort? Clearly, we have to rear the monarchs on intact plants and we need controls. One way to do this is to place larvae or eggs in sleeves that cover the plants. The sleeves should eliminate complications caused by predators and parasites. Simple sleeves can be made from 5-gallon paint strainers that can be purchased from many paint stores.

The larger question is why do female butterflies make mistakes in their choice of host plants? In other words, why hasn't selection eliminated this type of behavior? Could it be that the chemosensitive means by which females select plants is specific to the milkweed family but not specific enough to exclude species which are unfit for larvae?

**There is confusion as to whether there are one or two species of invaders. Dog strangle vine is sometimes known as Louis' swallow-wort (*Cynanchum louiseae*) and is considered to be a separate species from Black swallow-wort (*Cynanchum nigrum*). Another scientific name for Black swallow-wort is *Vincetoxicum nigrum*.*

How do predators and parasites of mon- archs find their prey?

Did you know that about 98% of the monarch eggs, larvae, and pupae are eaten by some other critter before they reach the adult stage? Eggs and first and second instar larvae disappear at a rapid rate and most of these are probably eaten by ants, mites, lady-bug adults and larvae, and other insects that glean leaf surfaces for prey. Larger larvae are attacked by stink bugs, ambush bugs, earwigs, paper wasps, yellow jackets, and tachinid flies. The latter search out larvae that are third instar or older and lay eggs inside their bodies. The fly larva reaches maturity at the time of pupation, or just after, and then emerges from the monarch to form a puparium in the ground. The paper wasps and yellow jackets bite the larvae, chew them up and take all but the head capsule and some of the skin back to their nest to feed their young. Every creature has to be good at what it does



With its deadly beak, this wheel bug (*Arilus cristatus*) is a dreaded enemy of many insects such as this monarch pupa. The wheel bug uses its beak to pierce and ingest its prey. Photo by Jacalyn Loyd Goetz.

and to be a good parasite or predator they have to be able to find their prey. The question is how do they do it – smell, vision, simply searching, or is learning involved? Let's concentrate on the use of olfaction (smell). If smell is used to locate prey, are the predators using the smell of the hostplants, the frass (feces) of the larvae, or the larvae themselves.

Here is a suggestion to determine how prey are found. First we need to design a trap that will collect the predators and parasites (PPs) and we need to present our "prey" in a manner so that they can't be seen by the PPs. To do this let's first try circular tube cages of about 12-15 inches made of black window screen. These should be placed over planted or potted milkweeds such that the screen has no gaps at ground level. Above the tube, suspend an inverted funnel made of the same type of screen. The funnel should be at least 3 inches wider than the diameter of the tube and should be positioned so that the funnel overlaps but does not touch the end of the tube. The idea is that if the PPs enter the tube by crawling up the side they will go up into the funnel to escape. To collect the PPs cut a hole in the end of the funnel and place an inverted jar with a hole punched in the lid over the

hole in the funnel. The PPs will go into the jar and you can make counts of those captured per unit time. To adequately test the smell concept you will need at least two cages for each of the following: plants alone, plants with frass alone, and plants with larvae (4th and 5th instar larvae would be best). If the design suggested above needs modification - let us know what works best.

Why do monarchs "choose" to pupate where they do?

After completing their feeding, monarchs tend to wander off their host plants in search of a suitable place to pupate. In the field pupae aren't found that frequently and when they are found they are often under broad leaves amongst other vegetation. Why do they choose these places to pupate? A priori we might hypothesize that the larvae are avoiding light while looking for a rough and relatively horizontal place upon which they can spin the silken mat from which the pupa will hang. An alternative hypothesis is that the larvae simply wander until they are ready to pupate and that no selection is involved.

Since we suspect that light might be involved in the larva's choice of sites, we need to control for this factor. Therefore, we need an arena - one made of a large cardboard cylinder will do. The color on the inside of the cylinder should be uniform. A cool-white light for the arena is suspended above the center of the cylinder. The test apparatus consists of a vertical dowel (at least thirty inches in height) placed in some sort of base (like a wooden block, Styrofoam, or florist foam). Place the apparatus in an aluminum pie pan and then place the aluminum pie pan into a larger container which will serve as a moat. This container is filled with water so that it comes up to the edge of the pie pan. The moat will confine the wandering larvae to the apparatus and the larvae will climb up the dowel. To give them choices, design "leaves" that can be added as contrasting pairs to the dowel at intervals of every ten inches.

The simplest test is to make white and black leaves. Be sure to make the leaves of materials that are ridged and rough enough so that the larvae will spin their mats on the underside of the leaves.

When you conduct this test make sure to use larvae that are just starting to wander. They are usually distinguished by the tendency to go to the top of your rearing container and also by a degree of shortening and puffiness around the forelegs. How many larvae would you have to test? In a two-choice test such as this you should probably use at least 20 larvae (they don't all have to be run at once). However, if another choice is added (e.g., height), a larger sample size would be required to distinguish their preferences. Once you have worked out a routine and have determined whether there is a leaf or height preference, you might modify the leaves or the inside of the cylinder to test other hypotheses.

Other Questions for Students to Investigate

What can a larva see and how far can they see it? (Hint: You might try using an arena with vertical stripes).

How far do most larvae wander before choosing a pupation site? (Hint: A suspended horizontal hula hoop might be useful).

Do amino acids and other nutrients in nectar improve egg laying and longevity in monarchs? (Hint: A good comparison would be Gatorade and Gatorade with pollen added.)

Do larvae grow faster in the sun or the shade?

What is the microclimate of a leaf? How does it vary throughout the day?

What can a larva do to avoid overheating or to avoid predators?

Do latex and hairiness of milkweed leaves inhibit larval feeding?

Good luck with your experiments and please send us your reports!

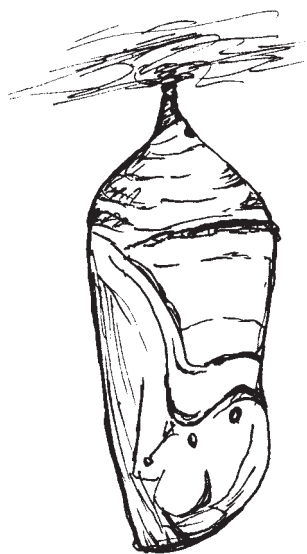
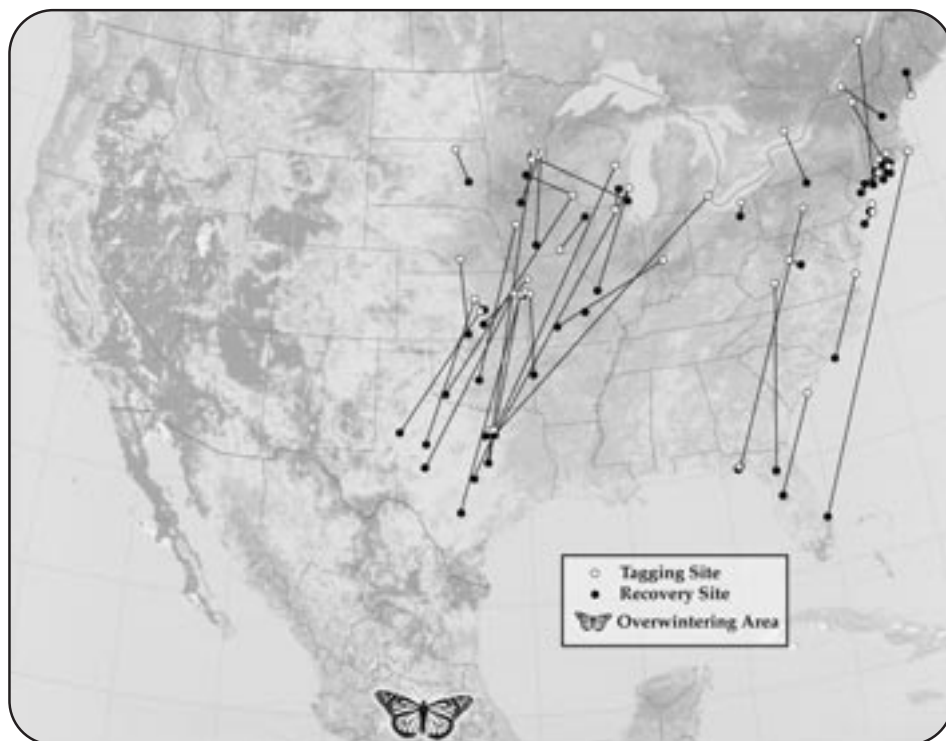


Illustration by Cara Weeks.

2000 MONARCH RECOVERY MAPS

RECOVERIES WITHIN THE UNITED STATES AND CANADA



This map represents monarchs (N=56) tagged in 2000 and recovered at distances of 10 miles or greater within the United States and Canada. Recoveries lacking complete data are excluded (N=11).

See complete recovery data on page 32.

ORIGINS OF TAGGED MONARCHS RECOVERED IN MEXICO

This map represents monarchs (N=213) tagged in the United States, Canada, and Mexico recovered at the overwintering sites in Mexico during the winter of 2000-2001 (or previously unreported). Recoveries lacking complete data are excluded (N=16).

Tagged in 2000: 161
 *Tagged in 1999: 44
 *Tagged in 1998: 4
 *Tagged in 1997: 3

*Previously unreported or recently acquired from local residents.

See complete recovery data on page 32.



2000 SEASON TAG RECOVERIES

This is a summary of tagged Monarchs recovered during the 2000-2001 season, listed by distance traveled. Due to space limitations, only Monarchs that traveled at least 10 miles are included here. A more complete data set may be found on our Web site. Recovery maps for the United States and Mexico generated using these data appear on **page 31**.

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

NUMBER OF MONARCH WATCH TAGGING KITS SENT OUT	~1800
NUMBER OF MONARCH WATCH TAGS DISTRIBUTED	250,000
ESTIMATED NUMBER OF MONARCHS TAGGED (BASED ON RETURNED DATA SHEETS)	63-79,000
NUMBER OF MONARCH WATCH TAGS RECOVERED WITHIN THE UNITED STATES AND CANADA	56
NUMBER OF MONARCH WATCH TAGS RECOVERED IN MEXICO	229
TOTAL NEW MONARCH WATCH RECOVERIES REPORTED IN THE 2000 SEASON SUMMARY	296

Tag No.	Tagger	Tag City, State	Tag Date	Report Date	Report Location	Reporter	Miles
613PZ	Ian Morris	Old Lyme, CT	09/24/00	01/26/01	El Rosario, MICH, MX	Paul Cherubini	2222
486KF*	Donald Davis	Darlington, ONT	09/12/99	01/07/01	El Rosario, MICH, MX	Javier García Dominguez	2090
067GA*	Matthew Douglas	Douglas Lake, MI	08/20/00	01/07/01	El Rosario, MICH, MX	Javier García Dominguez	1995
154JR	Denise Gibbs	Chincoteague, VA	09/25/99	03/09/01	Cerro Pelon, MEXICO, MX	David Marriott	1969
017MS	Maryann Frazier	Cresson, PA	09/01/99	12/01/00	El Rosario, MICH, MX	Cathy Wertz	1927
505JA	Bill Kraly	Lapeer, MI	08/30/99	03/09/01	Cerro Pelon, MEXICO, MX	David Marriott	1906
341TN	Mark Garland	Fisherman Island, VA	10/03/00	01/26/01	El Rosario, MICH, MX	Paul Cherubini	1901
384LZ	Julie Clemens	Kirtland, OH	09/14/99	03/09/01	Cerro Pelon, MEXICO, MX	David Marriott	1892
945QU*	Virginia Living Museum	Newport News, VA	09/25/00	02/28/01	El Rosario, MICH, MX	Bill Calvert	1873
709TX	Joanne Muzzin	Redford Twp, MI	08/30/00	?	El Rosario, MICH, MX	José Luis Alvarez Alcala	1858
861UC	Bonnie Pfeffer	Clitherall, MN	08/24/00	03/07/01	El Rosario, MICH, MX	Marsha Bonicatto	1856
650UT*	Prairie Wetlands Learning Center	Fergus Falls, MN	08/24/00	03/27/01	El Rosario, MICH, MX	Nancy Greig	1853
639UT	Prairie Wetlands Learning Center	Fergus Falls, MN	08/19/00	?	El Rosario, MICH, MX	José Luis Alvarez Alcala	1853
725UC	Linda Boe	Ashby, MN	08/26/00	02/01/01	El Rosario, MICH, MX	James & Teresa Gallion	1842
172SP	Paul Viger	Campbell, MN	08/19/00	02/01/01	El Rosario, MICH, MX	James & Teresa Gallion	1838
924WO	Sandy O'Brien	Glenwood, MN	09/10/00	01/07/01	El Rosario, MICH, MX	Martin Mondragón	1816
839WO	Sandy O'Brien	Glenwood, MN	08/26/00	02/28/01	El Rosario, MICH, MX	David Marriott	1816
205RE	Bill Dailey	Oak Harbor, OH	09/17/00	01/07/01	El Rosario, MICH, MX	Juan Carlos Gonzalez	1814
155UT	Audre Ross	Morris, MN	09/05/00	02/28/01	El Rosario, MICH, MX	David Marriott	1807
355RJ	Tom Baweja	Wayland, MI	08/31/00	01/07/01	El Rosario, MICH, MX	Amado Mondragón García	1804
087TS	Patricia Kowal	Maple Grove, MN	09/11/00	01/26/01	El Rosario, MICH, MX	Paul Cherubini	1800
342SP	Paula Feller	Aberdeen, SD	09/04/00	03/09/01	Cerro Pelon, MEXICO, MX	David Marriott	1800
920LQ	Alexandri Ferrante	Middlefield, OH	09/12/99	12/01/00	El Rosario, MICH, MX	Cathy Wertz	1796
815XM	Mattie Ernst	St. Paul, MN	08/30/00	02/28/01	El Rosario, MICH, MX	David Marriott	1794
957FF	Sue Bauer	Minneapolis, MN	09/27/99	01/07/01	El Rosario, MICH, MX	Javier García Dominguez	1793
421UC	Mattie Ernst	West St. Paul, MN	08/23/00	03/14/01	El Rosario, MICH, MX	Bill Calvert	1791
443FC	Dodge Nature Center	West St. Paul, MN	08/28/99	01/14/01	El Rosario, MICH, MX	Abe Lackow	1791
290FZ	Farmington Elementary	Cannon Falls, MN	08/31/99	03/09/01	Cerro Pelon, MEXICO, MX	David Marriott	1783
424JC	Dan Newbauer	Victoria, MN	09/11/99	01/07/01	El Rosario, MICH, MX	Javier García Dominguez	1781
669RM	Raymond Sullivan	Wauwatosa, WI	08/31/00	03/09/01	Cerro Pelon, MEXICO, MX	David Marriott	1780
330WG	Susan Borkin	Shorewood, WI	08/28/00	03/01/01	El Rosario, MICH, MX	Bill Calvert	1771
513FZ	Farmington Elementary	Cannon Falls, MN	08/31/99	01/07/01	El Rosario, MICH, MX	Javier García Dominguez	1768
179FA	Farmington Elementary	Cannon Falls, MN	08/20/99	01/07/01	El Rosario, MICH, MX	Javier García Dominguez	1768
345TX	Lesla Wende	Lima, OH	09/21/00	03/27/01	El Rosario, MICH, MX	Nancy Greig	1742
311TX	Lesla Wende	Lima, OH	09/14/00	03/04/01	El Rosario, MICH, MX	Dave Williams	1742
233YT	Kris Gesner	Lewisburg, WV	09/13/00	01/26/01	El Rosario, MICH, MX	Paul Cherubini	1731
303QW	Laurie Mc Kean	Raleigh, NC	09/26/00	01/07/01	El Rosario, MICH, MX	Javier García Dominguez	1726
692RL	Lee Zieke Lee	Burr Oak, IA	09/10/00	01/07/01	El Rosario, MICH, MX	Salvador Soto	1714
481HN	Chris Larson	Decorah, IA	08/28/99	01/07/01	El Rosario, MICH, MX	Eliseo Guardino Martinez	1705
831JB	Richard Wagoner	Cresco, IA	09/08/99	01/07/01	El Rosario, MICH, MX	Javier García Dominguez	1704
419RW	Jim, Linette, Grant & Lucas Langhus	Monona, IA	08/30/00	01/12/01	El Rosario, MICH, MX	Javier García Dominguez	1696
302RW	Jim, Linette, Grant & Lucas Langhus	Monona, IA	08/22/00	01/01/01	El Rosario, MICH, MX	Bill Calvert	1696
060RX	Jim, Linette, Grant & Lucas Langhus	Monona, IA	09/08/00	03/01/01	El Rosario, MICH, MX	Bill Calvert	1696
771RW	Jim, Linette, Grant & Lucas Langhus	Monona, IA	09/09/00	03/01/01	El Rosario, MICH, MX	Bill Calvert	1696

Tag No.	Tagger	Tag City, State	Tag Date	Report Date	Report Location	Reporter	Miles
489RW	Jim, Linette, Grant & Lucas Langhus	Monona, IA	08/27/00	01/26/01	El Rosario, MICH, MX	Paul Cherubini	1696
096RX	Jim, Linette, Grant & Lucas Langhus	Monona, IA	09/08/00	?	El Rosario, MICH, MX	José Luis Alvarez Alcala	1696
288RQ	Lisa Ralls	Lake Mills, IA	08/30/00	03/27/01	El Rosario, MICH, MX	Nancy Greig	1686
941WM*	Amy Cooper	Batavia, IL	08/31/00	?	El Rosario, MICH, MX	José Luis Alvarez Alcala	1686
181HK	Todd Von Ehwegen	Mason City, IA	08/31/00	01/26/01	El Rosario, MICH, MX	Paul Cherubini	1673
896JT	Stacey Newbrough	Tripoli, IA	09/09/99	12/05/00	El Rosario, MICH, MX	Jean Apgar	1665
401RR	Garnetta Snyder	Tripoli, IA	09/04/00	?	El Rosario, MICH, MX	José Luis Alvarez Alcala	1665
380NG	Monica Beitzel	Mt. Carroll, IL	09/10/99	01/07/01	El Rosario, MICH, MX	Javier García Dominguez	1663
254WS	Juliene Bramer	Greene, IA	09/10/00	02/28/01	El Rosario, MICH, MX	David Marriott	1662
237HU	Lana Kullander	Sioux Falls, SD	08/30/99	01/07/01	El Rosario, MICH, MX	Javier García Dominguez	1662
725TT	Lana Kullander	Sioux Falls, SD	09/02/00	01/01/01	El Rosario, MICH, MX	Bill Calvert	1662
979YL	Outdoor Campus	Sioux Falls, SD	09/15/00	01/07/01	El Rosario, MICH, MX	Javier García Dominguez	1662
299YM	Outdoor Campus	Sioux Falls, SD	09/15/00	01/12/01	El Rosario, MICH, MX	Javier García Dominguez	1662
606YM	Outdoor Campus	Sioux Falls, SD	09/06/00	01/12/01	El Rosario, MICH, MX	Javier García Dominguez	1662
486YM	Outdoor Campus	Sioux Falls, SD	?	01/12/01	El Rosario, MICH, MX	Martin Mondragón	1662
426HS	Outdoor Campus	Sioux Falls, SD	?	02/01/01	El Rosario, MICH, MX	James & Teresa Gallion	1662
515HT	Outdoor Campus	Sioux Falls, SD	09/01/99	03/01/01	Sierra Chincua, MICH, MX	Bill Calvert	1662
619YM	Outdoor Campus	Sioux Falls, SD	09/06/00	01/26/01	El Rosario, MICH, MX	Paul Cherubini	1662
413WH	Outdoor Campus	Sioux Falls, SD	08/31/00	02/28/01	El Rosario, MICH, MX	David Marriott	1662
469YM	Outdoor Campus	Sioux Falls, SD	09/06/00	02/28/01	El Rosario, MICH, MX	David Marriott	1662
945UT	Rebecca & John Olsen	Sioux Falls, SD	09/02/00	?	El Rosario, MICH, MX	José Luis Alvarez Alcala	1662
899WG	Outdoor Campus	Rowena, SD	08/28/00	03/27/01	El Rosario, MICH, MX	Nancy Greig	1661
771WH	Outdoor Campus	Tea, SD	08/30/00	01/07/01	El Rosario, MICH, MX	Remedios de Jesús	1654
399WH	Outdoor Campus	Tea, SD	08/30/00	?	El Rosario, MICH, MX	José Luis Alvarez Alcala	1654
756WH	Outdoor Campus	Tea, SD	08/30/00	?	El Rosario, MICH, MX	José Luis Alvarez Alcala	1654
221SP	Mary Petrik	Ethan, SD	09/05/00	01/26/01	El Rosario, MICH, MX	Paul Cherubini	1654
585LU	Margaret Bausman	Thomson, IL	09/14/99	01/07/01	El Rosario, MICH, MX	Javier García Dominguez	1651
508NA	Mark Roberts	Goose Lake, IA	09/22/99	01/07/01	El Rosario, MICH, MX	Javier García Dominguez	1646
816XP	Julie Yarolim	Maquoketa, IA	09/10/00	03/05/01	El Rosario, MICH, MX	Bill Calvert	1646
688WH	Bob Buller	Lennox, SD	08/31/00	03/01/01	Sierra Chincua, MICH, MX	Bill Calvert	1643
507WF	John Williams	Cedar Falls, IA	09/09/00	03/01/01	El Rosario, MICH, MX	Bill Calvert	1643
485RS	Mickey Johnson	Waterloo, IA	09/11/00	02/28/01	El Rosario, MICH, MX	David Marriott	1643
381OX	Dennis Herrick	Mt. Vernon, IA	09/25/99	03/09/01	Cerro Pelon, MEXICO, MX	David Marriott	1637
519RS	Marian McNabb	Linn Grove, IA	09/10/00	03/01/01	El Rosario, MICH, MX	Bill Calvert	1631
436UA	Mary Ann Schanze	Grand Mound, IA	09/13/00	01/26/01	El Rosario, MICH, MX	Paul Cherubini	1631
911YL	Outdoor Campus	Center, SD	09/06/00	02/28/01	El Rosario, MICH, MX	David Marriott	1631
861NA	Mark Roberts	Calamus, IA	09/10/99	01/07/01	El Rosario, MICH, MX	Javier García Dominguez	1629
129RL	Carol Groen	Grundy Center, IA	09/04/00	02/28/01	El Rosario, MICH, MX	David Marriott	1628
284JT*	David Schanze	Long Grove, IA	09/23/99	02/02/01	El Rosario, MICH, MX	Cathy Wertz	1625
555NA	Mark Roberts	Calamus, IA	09/10/99	01/31/01	Sierra Chincua, MICH, MX	Harold Gillespie	1625
957RQ	Cathy Irvine	Dysart, IA	09/12/00	02/11/01	El Rosario, MICH, MX	Gaye Shrack	1623
935RO*	Cheryl Brooks	East Moline, IL	09/01/00	01/26/01	El Rosario, MICH, MX	Paul Cherubini	1616
745WI	JoAnn Whitmore	Milan, IL	09/13/00	?	El Rosario, MICH, MX	José Luis Alvarez Alcala	1609
798WE	Marshall County Conservation Board	Marshalltown, IA	08/31/00	01/07/01	El Rosario, MICH, MX	Remedios de Jesús	1604
707ZR	Marshall County Conservation Board	Marshalltown, IA	09/21/00	01/26/01	El Rosario, MICH, MX	Paul Cherubini	1604
994WE	Marshall County Conservation Board	Marshalltown, IA	09/12/00	03/05/01	El Rosario, MICH, MX	Bill Calvert	1604
534MY	Marge Middaugh	Glidden, IA	09/06/00	03/09/01	Cerro Pelon, MEXICO, MX	David Marriott	1596
012RT	Dawn Chapman	Sioux City, IA	09/01/00	03/27/01	El Rosario, MICH, MX	Nancy Greig	1593
480XP	Royce Bitzer	Ames, IA	09/10/00	01/12/01	El Rosario, MICH, MX	Javier García Dominguez	1592
468XP	Royce Bitzer	Ames, IA	09/05/00	?	El Rosario, MICH, MX	José Luis Alvarez Alcala	1592
730WO	Dawn Chapman	Sergeant Bluff, IA	09/01/00	02/28/01	El Rosario, MICH, MX	David Marriott	1587
406KZ	Deb Williams	Huxley, IA	09/10/99	01/07/01	El Rosario, MICH, MX	Javier García Dominguez	1584
447RT	Aaron Hershberger	Carroll, IA	09/06/00	03/01/01	El Rosario, MICH, MX	Bill Calvert	1579
081OJ*	Kyle Harrigan	Altoona, IA	09/21/99	01/07/01	El Rosario, MICH, MX	Javier García Dominguez	1570
326SM	Jeff Meyer	Clearwater, NE	08/30/00	02/28/01	El Rosario, MICH, MX	David Marriott	1559
963IN	Dale Mundil	Oakland, NE	09/09/99	01/07/01	El Rosario, MICH, MX	Javier García Dominguez	1547
070SZ	Dale Mundil	Oakland, NE	09/13/00	01/07/01	El Rosario, MICH, MX	Eliseo Guardino Martinez	1547
008SZ	Kirk Eriksen	Oakland, NE	09/11/00	02/25/01	El Rosario, MICH, MX	Peter Korb	1547
214SM	Sarah Ahrens	Oakland, NE	09/11/00	02/25/01	El Rosario, MICH, MX	Peter Korb	1547
708RP	Andria Cossolotto	Atlantic, IA	09/06/00	03/04/01	La Herrada, MEXICO, MX	David Marriott	1532
672UR	April Pollmann	Drakesville, IA	09/28/00	03/01/01	El Rosario, MICH, MX	Bill Calvert	1531
773RP	Andria Cossolotto	Oakland, IA	09/09/00	02/01/01	El Rosario, MICH, MX	James & Teresa Gallion	1522
BW720	Mike Williams	North Bend, NE	08/06/00	02/01/01	El Rosario, MICH, MX	James & Teresa Gallion	1519
856YP	Mike Williams	North Bend, NE	09/07/00	01/26/01	El Rosario, MICH, MX	Paul Cherubini	1519
116HM	Nancy Hubbard	Council Bluffs, IA	09/09/99	01/07/01	El Rosario, MICH, MX	Javier García Dominguez	1512
DO620	Beverly Sedlacek	Omaha, NE	09/11/00	01/07/01	El Rosario, MICH, MX	Remedios de Jesús	1512
747RT	Nancy Hubbard	Council Bluffs, IA	09/12/00	02/28/01	El Rosario, MICH, MX	David Marriott	1512

Tag No.	Tagger	Tag City, State	Tag Date	Report Date	Report Location	Reporter	Miles
282SZ	Juliette Wheeler	Omaha, NE	09/09/00	?	El Rosario, MICH, MX	José Luis Alvarez Alcala	1512
963UI	Ken Staroska	Omaha, NE	09/10/00	03/01/01	Sierra Chincua, MICH, MX	Bill Calvert	1508
010JU	Kathleen Tack	Malvern, IA	09/17/99	01/07/01	El Rosario, MICH, MX	Javier García Dominguez	1500
350JS	Rosemary Thornton	Lincoln, NE	09/23/99	12/01/00	El Rosario, MICH, MX	Cathy Wertz	1476
037IB	Linden Trial	Martinsville, MO	09/21/99	01/07/01	El Rosario, MICH, MX	Javier García Dominguez	1473
667UU	Jan Tell	Grand Island, NE	09/08/00	02/01/01	El Rosario, MICH, MX	James & Teresa Gallion	1472
650UU	Jan Tell	Grand Island, NE	09/08/00	01/26/01	El Rosario, MICH, MX	Paul Cherubini	1472
327TW	Amy Newman	Geneva, KY	09/17/00	03/27/01	El Rosario, MICH, MX	Nancy Greig	1465
313XH	Jane Koch	Hastings, NE	09/12/00	02/28/01	El Rosario, MICH, MX	David Marriott	1449
279XH	Jane Koch	Hastings, NE	09/12/00	03/15/01	El Rosario, MICH, MX	Ashley Gottula	1449
758WK	Hebron Taggers	Hebron, NE	09/20/00	02/25/01	El Rosario, MICH, MX	Dorothy Davis	1425
604WP	Gerald Axelbaum	Gray Summit, MO	09/11/00	02/28/01	El Rosario, MICH, MX	David Marriott	1419
249IA	Dan Dickinson	Kansas City, MO	09/24/99	02/10/01	El Rosario, MICH, MX	Anne Stanaway	1387
CJ173	Cara McReak	Wamego, KS	09/17/98	03/09/01	Cerro Pelon, MEXICO, MX	David Marriott	1385
052XZ	Jacalyn Goetz	Overland Park, KS	09/19/00	01/26/01	El Rosario, MICH, MX	Paul Cherubini	1371
763YH	Terry Callender	Wamego, KS	09/13/00	01/07/01	El Rosario, MICH, MX	Rogelio Martinez	1370
SZ941	Heather Niedfeldt	Wamego, KS	09/16/97	01/12/01	El Rosario, MICH, MX	Javier García Dominguez	1370
820YI	Scott Pittenger	Wamego, KS	09/14/00	02/01/01	El Rosario, MICH, MX	James & Teresa Gallion	1370
594YG	Melissa Sackrider	Wamego, KS	09/12/00	03/01/01	El Rosario, MICH, MX	Bill Calvert	1370
692YH	Luke Evans	Wamego, KS	09/13/00	01/26/01	El Rosario, MICH, MX	Paul Cherubini	1370
668YG	Melissa Sackrider	Wamego, KS	09/12/00	01/26/01	El Rosario, MICH, MX	Paul Cherubini	1370
409YG	Ambrozia Williams	Wamego, KS	09/12/00	03/14/01	El Rosario, MICH, MX	Bill Calvert	1370
003YI	Ambrozia Williams	Wamego, KS	09/14/00	02/28/01	El Rosario, MICH, MX	David Marriott	1370
599YG	Melissa Sackrider	Wamego, KS	09/12/00	?	El Rosario, MICH, MX	José Luis Alvarez Alcala	1370
230YH	Weston Kline	Wamego, KS	09/13/00	?	El Rosario, MICH, MX	José Luis Alvarez Alcala	1370
366YI	Curtis Odgen	Wamego, KS	09/14/00	?	El Rosario, MICH, MX	José Luis Alvarez Alcala	1370
229SU	Randy Warner	Olathe, KS	09/19/00	02/28/01	El Rosario, MICH, MX	David Marriott	1367
670XD	Stephanie Simonson	Olathe, KS	09/25/00	02/02/01	El Rosario, MICH, MX	Peter Korb	1367
109NC	Kelly Barth & Lisa Grossman	Lawrence, KS	09/11/00	12/05/00	El Rosario, MICH, MX	Lee Maher	1366
UQ640	Kathy Davis	Lawrence, KS	09/29/97	01/26/01	El Rosario, MICH, MX	Paul Cherubini	1366
746PC	Danny Umscheid	Lawrence, KS	09/29/00	03/05/01	El Rosario, MICH, MX	Bill Calvert	1366
525PS	Jennifer Kissinger	Lawrence, KS	09/29/00	02/28/01	El Rosario, MICH, MX	David Marriott	1366
131WJ	Calvin Cink	Lawrence, KS	09/25/00	?	El Rosario, MICH, MX	José Luis Alvarez Alcala	1366
281ST	Roseanne Smith	Lawrence, KS	09/22/00	03/07/01	El Rosario, MICH, MX	Dave Williams	1366
835IA	Stephanie Darnell	Gardner, KS	09/26/99	12/05/00	El Rosario, MICH, MX	Patricia Klein	1361
031LW*	Emily Piper	Carbondale, KS	09/22/99	01/14/01	El Rosario, MICH, MX	Paul & Jacki Richey	1351
025XG	John Wachholz	Salina, KS	09/21/00	03/27/01	El Rosario, MICH, MX	Nancy Greig	1332
RF793	Tanner Dabignon	Hays, KS	10/08/97	01/12/01	El Rosario, MICH, MX	Javier García Dominguez	1328
972UG	Shannon Sander	Hays, KS	09/17/00	01/12/01	El Rosario, MICH, MX	Javier García Dominguez	1328
382XE	Lauren Harrell	Reading, KS	09/24/00	02/01/01	El Rosario, MICH, MX	James & Teresa Gallion	1328
877UG	Kristin Psannienstiel	Hays, KS	09/18/00	03/05/01	El Rosario, MICH, MX	Bill Calvert	1328
XP946	Andrew Heerman	Emporia area, KS	?	03/01/01	Sierra Chincua, MICH, MX	Bill Calvert	1313
319XF	Loretta Snelling	Marion, KS	09/13/00	02/28/01	El Rosario, MICH, MX	David Marriott	1305
311XF	Loretta Snelling	Marion, KS	09/13/00	03/01/01	Sierra Chincua, MICH, MX	Bill Calvert	1301
932XR	Michael Craig	Mc Pherson, KS	09/14/00	01/07/01	El Rosario, MICH, MX	Javier García Dominguez	1301
955XR	Michael Craig	Mc Pherson, KS	09/14/00	03/01/01	El Rosario, MICH, MX	Bill Calvert	1301
924SW	Kelly Jost	Goessel, KS	09/13/00	01/26/01	El Rosario, MICH, MX	Paul Cherubini	1295
180JC	Dani Fensky	Moundridge, KS	09/11/00	01/07/01	El Rosario, MICH, MX	Ortino Guzman	1291
621JH	Stephanie Berquist	Moundridge, KS	09/11/00	01/26/01	El Rosario, MICH, MX	Paul Cherubini	1291
DZ548	Michael Carpenter	Moundridge, KS	09/11/00	01/26/01	El Rosario, MICH, MX	Paul Cherubini	1291
500KU	Kristen Schrag	Moundridge, KS	09/11/00	01/28/01	El Rosario, MICH, MX	Paul Cherubini	1291
631JH	Jason Hunt	Moundridge, KS	09/11/00	03/01/01	El Rosario, MICH, MX	Bill Calvert	1291
150IZ*	Lucas Stuckey	Moundridge, KS	09/11/00	02/28/01	El Rosario, MICH, MX	David Marriott	1291
954IU	Lucas Stuckey	Moundridge, KS	09/11/00	02/27/01	El Rosario, MICH, MX	Bonnie Chase	1291
ED040	Kyle Neufeld	Moundridge, KS	09/11/00	02/28/01	El Rosario, MICH, MX	David Marriott	1291
DZ574	Michael Carpenter	Moundridge, KS	09/11/00	01/14/01	El Rosario, MICH, MX	Abe Lackow	1291
650ML	Evan Fast	Hesston, KS	09/14/00	03/01/01	El Rosario, MICH, MX	Bill Calvert	1287
547XF	Karen Fulk	Hesston, KS	09/12/00	01/26/01	El Rosario, MICH, MX	Paul Cherubini	1287
AU663	Karen Fulk	Hesston, KS	09/17/98	02/28/01	El Rosario, MICH, MX	David Marriott	1287
568JE	Heath Doane	Moundridge, KS	09/11/00	01/31/01	Sierra Chincua, MICH, MX	Barbara Brummer	1286
488XS	Pam Martin	St. John, KS	09/12/00	?	El Rosario, MICH, MX	José Luis Alvarez Alcala	1269
520XS	Pam Martin	St. John, KS	09/17/00	?	El Rosario, MICH, MX	José Luis Alvarez Alcala	1269
514WN	Darrell Terbush	Valley Center, KS	09/19/00	03/27/01	El Rosario, MICH, MX	Nancy Greig	1267
620XX	Karen Koch	Wichita, KS	09/22/00	01/26/01	El Rosario, MICH, MX	Paul Cherubini	1257
XT827	Carol Parker	Pratt, KS	09/30/98	01/07/01	El Rosario, MICH, MX	Javier García Dominguez	1245
883ZN	Anthony-Harper School	Anthony, KS	09/19/00	01/12/01	El Rosario, MICH, MX	Javier García Dominguez	1215
836ZN	Tawnia Misak	Anthony, KS	09/17/00	02/01/01	El Rosario, MICH, MX	James & Teresa Gallion	1215

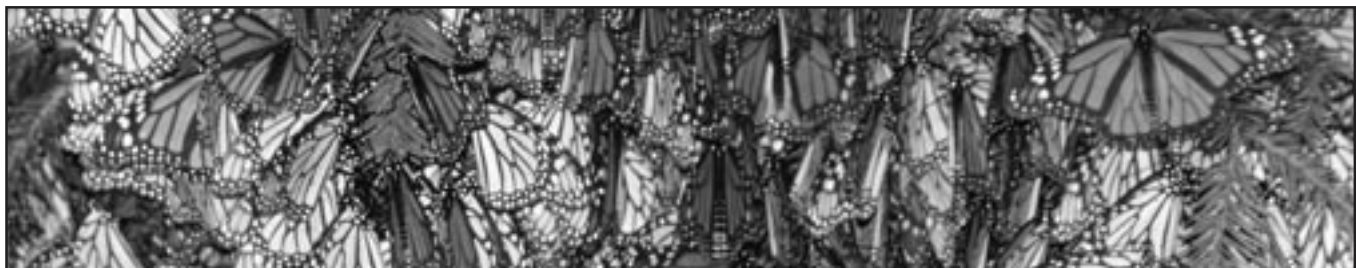
Tag No.	Tagger	Tag City, State	Tag Date	Report Date	Report Location	Reporter	Miles
744ZN	Kara Fadenrecht	Anthony, KS	09/20/00	01/26/01	El Rosario, MICH, MX	Paul Cherubini	1215
774ZN	Bret Walker	Anthony, KS	09/19/00	01/26/01	El Rosario, MICH, MX	Paul Cherubini	1215
866ZN	Joseph Morgan	Anthony, KS	09/19/00	01/28/01	El Rosario, MICH, MX	Paul Cherubini	1215
959ZN	Emily Aldis	Anthony, KS	09/19/00	02/25/01	El Rosario, MICH, MX	Peter Korb	1215
941PO*	Pat & Ed Mc Donald	North Little Rock, AR	10/08/00	03/01/01	El Rosario, MICH, MX	Bill Calvert	1151
301TC*	Pat Mc Donald	North Little Rock, AR	09/26/00	01/27/01	Sierra Chincua, MICH, MX	Paul Cherubini	1151
744TC	Carol Bricker	Fort Smith, AR	10/03/00	01/07/01	El Rosario, MICH, MX	Ruben García García	1143
739TC	Carol Bricker	Fort Smith, AR	10/03/00	?	Sierra Chincua, MICH, MX	Bill Calvert	1139
162PU	Tricia Sheppard	Dartmouth, MA	10/02/00	11/03/00	Port St Lucie, FL	Robert Stevens	1122
226TE	Marilyn Stellman	Oklahoma City, OK	09/20/00	03/01/01	El Rosario, MICH, MX	Bill Calvert	1105
045XJ	Scott Martin	Oklahoma City, OK	?	02/11/01	El Rosario, Mexico	June Parker	1105
039XJ	Scott Martin	Oklahoma City, OK	?	01/07/01	El Rosario, Mexico	Ortino Guzman	1105
457ID*	Pat & Walter Reif	Norman, OK	09/16/00	03/09/01	Cerro Pelon, MEXICO, MX	David Marriott	1105
491PO	Jim Edson	Monticello, AR	09/30/00	03/27/01	El Rosario, MICH, MX	Nancy Greig	1098
809TF	Hannah Christian	Elk City, OK	09/16/00	03/05/01	El Rosario, MICH, MX	Bill Calvert	1088
614RH	Dana Wloch	Southgate, MI	09/19/00	10/13/00	Addison, TX	Bob Adams	981
849ZT	Karl Halder	Carrollton, TX	10/11/00	03/01/01	La Herrada, MEXICO, MX	Bill Calvert	969
792LW	Bob Adams	Addison, TX	10/05/99	01/07/01	El Rosario, MICH, MX	Javier García Dominguez	943
379SI	Lisa tite	Chaska, MN	08/30/00	10/01/00	Waco, TX	Christy Klausung	934
895ZK	David Powell	Fort Worth, TX	10/12/00	01/26/01	El Rosario, MICH, MX	Paul Cherubini	923
368TG	Jane Borland	Arlington, TX	10/11/00	01/31/01	Sierra Chincua, MICH, MX	Barbara Brummer	917
350US*	Judy Thoren	Neenah, WI	08/31/00	10/25/00	Irving, TX	David Myers	905
586IT	Julia Baker	Abilene, TX	10/04/00	01/07/01	El Rosario, MICH, MX	Javier García Dominguez	884
372KS	Gary Musgrove	Abilene, TX	10/09/99	01/07/01	El Rosario, MICH, MX	Javier García Dominguez	884
789KR	Gary Musgrove	Abilene, TX	10/09/99	12/05/00	El Rosario, MICH, MX	Jean Apgar	884
021KS	Gary Musgrove	Abilene, TX	10/14/99	01/15/01	El Rosario, MICH, MX	Gene Petrik	884
202IU	Paul Mangum	Midland, TX	10/28/99	03/09/01	Cerro Pelon, MEXICO, MX	David Marriott	878
464YJ	Linda Rogers	Fairfield, TX	10/13/00	03/01/01	El Rosario, MICH, MX	Bill Calvert	872
346WG	Susan Borkin	Shorewood, WI	09/14/00	11/15/00	Dallas, TX	Jon Brooks	859
992QB	Maryann Frazier	Oley, PA	09/23/00	10/11/00	St marks, FL	Richard Rubino	849
832YJ	Bruce Backlund	San Angelo, TX	09/23/00	01/07/01	El Rosario, MICH, MX	José Serafin Cruz	814
813YJ	Bruce Backlund	San Angelo, TX	09/24/00	03/05/01	El Rosario, MICH, MX	Bill Calvert	814
666RW	Jim, Linette, Grant & Lucas Langhus	Monona, IA	09/06/00	09/27/00	Altus, OK	Scott Plato	719
289XD	Prasant Desai	Olathe, KS	09/21/00	10/31/00	San Antonio, TX	Gail Brennan	683
245SO	Bea Harrison	Del Rio, TX	10/14/00	03/01/01	El Rosario, MICH, MX	Bill Calvert	673
ER333	Glenda Overfelt	Del Rio, TX	10/29/98	02/28/01	El Rosario, MICH, MX	David Marriott	673
257ZL	David Larson	Del Rio, TX	10/01/00	03/27/01	El Rosario, MICH, MX	Nancy Greig	673
216ZL	David Larson	Del Rio, TX	10/01/00	02/28/01	El Rosario, MICH, MX	David Marriott	673
340ZL	David Larson	Del Rio, TX	10/04/00	02/28/01	El Rosario, MICH, MX	David Marriott	673
427XL	Randy Laurence	Quemado, TX	11/02/00	?	El Rosario, MICH, MX	José Luis Alvarez Alcala	643
611WL	Carol Cullar	Carrizo Springs, TX	11/01/00	02/28/01	El Rosario, MICH, MX	David Marriott	614
374SU	Colen Smalley	Lawrence, KS	09/19/00	11/11/00	San Angelo, TX	Steven Hoelscher	596
206YT	Kris Gesner	Lewisburg, WV	09/19/00	10/13/00	Gainesville, FL	Wes Marbut	571
474PS*	Cheryl Natt	Eden Prairie, MN	09/11/00	10/01/00	Cherryville, MO	Autumn Pospeshil	496
801XA	Dave Bowman	Carroll, IA	09/06/00	09/13/00	Norman, OK	Owens-Powell & Associates	491
914XF	John Wachholz	Salina, KS	09/18/00	10/12/00	Sweetwater, TX	Carly Johnson	465
814SL	Kelly Jost	Goessel, KS	09/05/00	09/16/00	O' Donnell, TX	Alan Barrett	443
473NW	Sonia Ortiz	Monterrey, MEXICO	10/28/99	01/07/01	El Rosario, MICH, MX	Javier García Dominguez	416
484NW	Sonia Ortiz	Monterrey, MEXICO	10/28/99	01/07/01	El Rosario, MICH, MX	Javier García Dominguez	416
780PR*	SPSNQ	Charlesbourg, QUE	09/03/00	09/20/00	Milford, CT	Richard Julian	398
024RC*	Vicki Dietz	Clayton, IN	09/11/00	10/02/00	Marshfield, MO	Dennis & Carol Kautzmann	382
590SA	Adeline Carlsen	Waukesha, WI	08/26/00	09/14/00	St Louis, MO	Michael Wooten	320
685QH	Brad Jaynes	Folly Beach, SC	10/29/00	12/28/00	Brooksville, FL	Scott	320
031ZJ*	Terry Vick	Minneapolis, MN	10/10/00	10/20/00	Bristol, WI	Catherine Morris	309
248ZN	Deborah Vega	St. Paul, MN	10/10/00	10/31/00	Osceola, IA	Karen Spick	272
654TN	Mark Garland	Kiptopeke, VA	10/19/00	10/26/00	Oak Island, NC	Cindy Grimm	252
579ZC	Nancy Smith	Essex Junction, VT	08/18/00	09/26/00	Sagaponack, NY	David Dakers III	250
176SS*	Kelly Gillespie	Lee's Summit, MO	10/03/00	10/22/00	Ft Smith, AR	Seth Brock	245
155XH	Jane Koch	Hastings, NE	09/12/00	09/20/00	Harper, KS	Larry Campbell	229
523PC*	Norma Snow	West Hartford, CT	09/08/00	09/30/00	Ocean View, NJ	Monique James	207
860YE	Leah Connery	Plattsburg, MO	09/10/00	09/25/00	Wichita, KS	Frieda Kieffer	203
920ZR	Ann Feitl	White Bear Lake, MN	10/13/00	11/15/00	West Bend, IA	Dan & Amy Classen	162
706YN	Rene Boutin	Chambly, QUE	09/30/00	10/14/00	Franklin, NH	Richard Tarbin	159
722XY	Donald Davis	Brighton, ONT	09/17/00	09/27/00	Wellsboro, PA	A. Price	159
878ZS	Shannon Ellis	Addison, TX	10/03/00	10/13/00	Briggs, TX	James & Nance Stearman	156
386RW	Jim, Linette, Grant & Lucas Langhus	Monona, IA	08/27/00	09/09/00	Mankato, MN	Judy Cousins	151
333RU	Janice Gray	Savannah, IA	09/06/00	10/03/00	Preston, IA	Robert Meyer	145

Tag No.	Tagger	Tag City, State	Tag Date	Report Date	Report Location	Reporter	Miles
347UW	Robbie Marshall	Old Saybrook, CT	09/25/00	09/30/00	Sewaren, NJ	Jean Gall	111
644QD*	James Kupcho	Lavallette, NJ	09/16/00	?	Center Moriches, NY	Rich & Kathryn Hoffman	88
871WL	Mary Claffey	West Hartford, CT	09/21/00	11/13/00	Massapequa, NY	Edward Stuchbury	85
082PX	Lakotah Farrell	Pemaquid, ME	08/22/00	09/01/00	Newport, ME	Michael Turner	65
253PY**	Chris Higley	Willington, CT	09/12/00	09/21/00	Milford, CT	Richard Julian	61
922XU	Harold Benecke	Belvidere, IL	09/18/00	08/15/00	Oconomowoc, WI	Nicole Duchow	61
461PY	Richard Julian	Milford, CT	09/18/00	09/21/00	New York City, NY	John Kada	60
915XF	John Wachholz	Salina, KS	09/18/00	09/22/00	Marion, KS	M. Wilcox	46
077WZ	Julie Clemens	Penitentiary Glen, OH	09/29/00	10/25/00	Norton, OH	The Lawrence Family	44
303PY	Chris Higley	Willington, CT	09/16/00	09/19/00	Waterford, CT	Paula Cymbala	39
916YK	Paula Waggy	Franklin, WV	09/25/00	10/14/00	Grottoes, VA	Lisa Osgood	38
253PY**	Richard Julian	Milford, CT	09/21/00	09/24/00	Center Moriches, NY	Kevin Mc Keen	32
350PY	Richard Julian	Milford, CT	10/03/00	10/06/00	Cutchogue, NY	Karen Blair	32
472PY	Richard Julian	Milford, CT	09/20/00	09/24/00	Mastic, NY	Jerry Crossley	31
877WB	Richard Rubino	St. Marks, FL	10/11/00	10/11/00	Alligator Point, FL	Roy du Verger	22
394SP	Paula Feller	Aberdeen, SD	09/12/00	09/14/00	Ferney, SD	Scott Bahr	21
047ZU*	Jenny Singleton	Grapevine, TX	10/21/00	10/25/00	Fort Worth, TX	Poul Bjergager	20
589SS	Dan Dickinson	Kansas City, MO	09/29/00	10/01/00	Leawood, KS	Laura Elcock	15
682SD	Teresa Root	Deephaven, MN	10/09/00	10/13/00	Minneapolis, MN	Anonymous	13
475UW	Robbie Marshall	Old Saybrook, CT	10/03/00	10/14/00	Killingworth, CT	Taylor French	11
841ZY	Mary Ann Manaresi	Beach Haven, NJ	?	?	Long Beach, NJ	Sandy & Morgan Ginyras	10
098ZP	Mary Ann Manaresi	Beach Haven, NJ	?	10/13/00	Long Beach, NJ	Michael Holtz	10
180XC	Ann Mock	Maple Grove, MN	09/28/00	10/01/00	Wayzata, MN	Megan Krentsa	10
926JA	Matthew Douglas	Grand Rapids, MI?	?	08/06/00	Midland, MI	Doug Cross	?
002OB	?	?	?	10/11/00	St Marks, FL	Richard Rubino	?
NF105	Lolita Cox	St. Paul, MN?	?	10/13/00	Cannon Falls, MN	Rick & Dawn Anderson	?
116QP	Janet Coffey	Stillwell, KS?	?	10/15/00	Leawood, KS	Reinigs	?
888ZE	Roni Caffrey	Hesston, KS?	?	10/02/00	Hesston, KS	Curt Buller	?
014QP	Alicia Walsh	Stillwell, KS?	?	09/16/00	Lawrence, KS	Caitlyn Tilden	?
732LU	Randy Fyler	Lawrence, KS?	?	09/23/00	Lawrence, KS	Alexis Powell	?
ZQ898	Doug Cross	Putnam County, WV?	?	09/25/00	Winfield, WV	David Smith	?
646YN	Rene Boutin	Chambly, QUE?	?	10/25/00	Granville, MA	Annmari Clendenin	?
027JN	Dianna Haywood	Dunnville, ONT?	?	01/07/01	El Rosario, MICH, MX	Javier García Dominguez	?
989US	Audre Ross	Morris, MN?	?	01/26/01	El Rosario, MICH, MX	Paul Cherubini	?
326UT	Audre Ross	Morris, MN?	?	01/12/01	El Rosario, MICH, MX	Javier García Dominguez	?
421FF	Judith Borer	Hopkins, MN?	?	12/01/00	El Rosario, MICH, MX	Cathy Wertz	?
927YO	Susan Jahn	Des Moines, IA?	?	02/01/01	El Rosario, MICH, MX	James & Teresa Gallion	?
184XJ	John Stacey	Oklahoma City, OK?	?	02/01/01	El Rosario, MICH, MX	James & Teresa Gallion	?
003YK	Pam Backlund	San Angelo, TX?	?	03/14/01	El Rosario, MICH, MX	Bill Calvert	?
159YM	Outdoor Campus	Sioux Falls, SD?	?	?	El Rosario, MICH, MX	Bill Calvert	?
151YM	Outdoor Campus	Sioux Falls, SD?	?	02/28/01	El Rosario, MICH, MX	David Marriott	?
025TD	Jill Sullins	Edmond, OK?	?	?	El Rosario, MICH, MX	José Luis Alvarez Alcala	?
235IS	Randy Laurence	Quemado, TX?	?	01/07/01	El Rosario, MICH, MX	Javier García Dominguez	?
495JK	Harlen Aschen	Port Lavaca, TX?	?	02/11/01	El Rosario, MICH, MX	Gloria Tryon	?
474SL	Maureen Beaudet	Prairie Village, KS?	?	?	Prairie Village, KS	Annie Ortin	?
611PF	Greg Munson	Rochester, MN?	?	?	Dyersburg, TN	Madison Reed	?
260PG	Greg Munson	Rochester, MN?	?	02/01/01	El Rosario, MICH, MX	James & Teresa Gallion	?
175PG	Greg Munson	Rochester, MN?	?	02/28/01	El Rosario, MICH, MX	David Marriott	?
295PG	Greg Munson	Rochester, MN?	?	01/26/01	El Rosario, MICH, MX	Paul Cherubini	?
438JW	Greg Munson	Rochester, MN?	?	01/07/01	El Rosario, MICH, MX	Javier García Dominguez	?

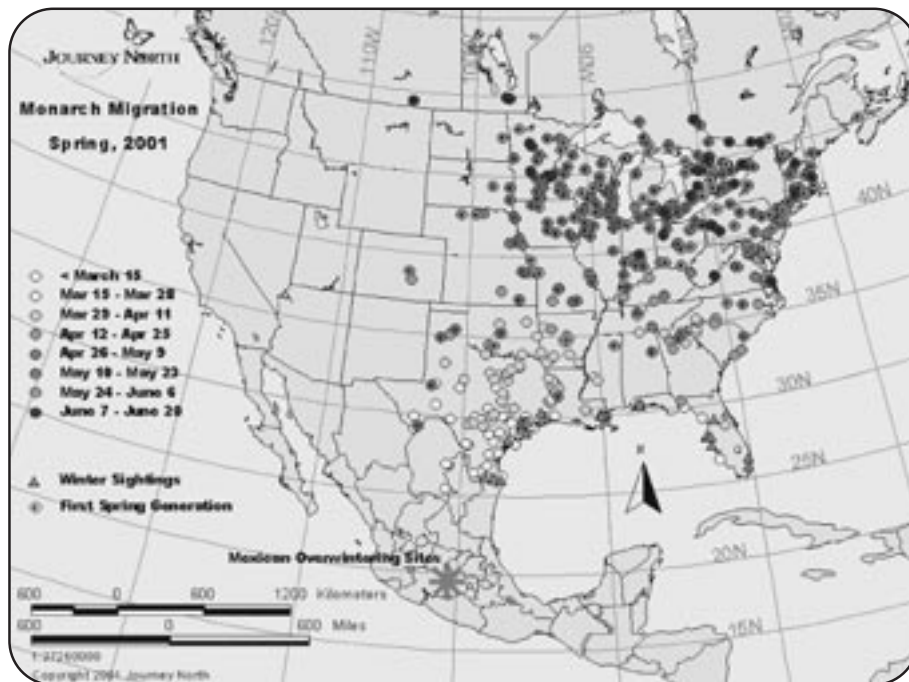
The following are updates to recoveries that appeared in the 1999 Season Summary.

947LG	Jim Edson	Monticello, AR	09/30/99	01/26/00	El Rosario, MICH, MX	Cherubini	1098
859LN	Jim Edson	Monticello, AR	?	01/28/00	El Rosario, MICH, MX	Cherubini	1098
678NG	Kelly Gillespie	Lee's Summit, MO	10/01/99	2/00	El Rosario, MICH, MX	Calvert	1367

* These monarchs were reared under various conditions; ** This monarch was recovered in two separate locations; ? in the Tag Location field denotes unreturned data sheets. Locations given indicate where the tags were sent, NOT actual tag sites.



OTHER RECOVERIES AND REPORTS



The Monarch Spring Migration through 20 June 2001.

Map reproduced with permission from Journey North (www.learner.org/jnorth)

The following are additional recoveries and updated records reported to Monarch Watch during the 2000 tagging season. Please note that the tags listed below are not Monarch Watch tags (see footnote).

Tag No.	Tag*	Tagger	Tag City, State	Tag Date	Report Date	Report Location	Reporter	Miles
124906	B	Brower	?	?	Fall 2000	Wilmington, NC	Heather Seagroves	?
110967	B	Brower	?	?	1-7-2001	El Rosario, MX	Javier Garcia Dominguez	?
183796	B	Michael O'Brien	Cape May Point, NJ	9-17-2000	9-26-2000	MD	Sharon Johnson	?
100858	B	Brower	?	?	?	El Rosario, MX	Jose Luis Alvarez Alcala	?
1367**	?	?	?	?	Feb-01	El Rosario, MX	Peter Korb	?
198283	B	Louise Zemaitis	Cape May Point, NJ	9/28, 2001	Feb-01	El Rosario, MX	William Calvert	?
40056	U	Urquhart	Grand Manan Island, New Brunswick	8-19-2000	3-9-2001	Cerro Pelon, MX	David marriott	2595

* B=Lincoln Brower Tag, U=Fred Urquhart Tag; ** Orange rectangular tag 3 digits; 13 and the last digit looked like a 6 but was worn.

Monarch Records (last updated 4/13/01)

The following are unique records for the 2000 tagging season. For all other monarch records see any of our previous Season Summaries. If we have overlooked an important record or made any mistakes in these reports, please let us know!

Longest Known Flight for a monarch recovered in Mexico: Urquhart tag # 40056 was tagged in Grand Manan Island, New Brunswick Canada on 8/19/2000. It was Recovered in Cerro Pelon, Mexico on 3/9/2001 by David Marriott. This monarch traveled 2,595 miles.

First monarch recovered in two separate locations: 253 PY was originally tagged on 12 September 2000 in Willington, CT. It was then reported alive on 21 September 2000 in Milford, CT (61mi SW). This same monarch was found dead in Center Moriches, NY (32mi S-SE) on 24 September 2000.

First monarch recovered that was tagged as a mating pair: For the first time, a tagged monarch that was part of a mated pair was recovered some distance from its release location. Monarch 379 SI (a female) was tagged in Chaska, MN on 8/30/00. It was found dead on 10/1/00 in Waco, TX. 934 mi S-SW

States east of the Rocky Mountains without recovered monarchs in Mexico: Alabama, Delaware, Montana, New Hampshire, New Mexico, Rhode Island, South Carolina, Wyoming

MONARCH GENETIC STRUCTURE

by Chip Taylor

The following text is a summary of evidence that relates to the genetic structure of the monarch population in North America. This text is based on published data and what I feel are reasonable interpretations of what we know about monarch biology.

Introduction

Most populations of plants and animals vary in phenology, morphology, behavior, and other features throughout their geographic range. If the regional differences are consistent and appear to have a genetic basis, geographic subunits of the population are often recognized as sub species. The differences between the subunits of the populations presumably arise because of limitations of dispersal and therefore gene flow. Selection acting on local populations enhances survival under the specific conditions experienced by these portions of the species gene pool resulting in the observed differences. On the other hand, if gene flow is substantial, selection for adaptations to local conditions can be swamped out with the result that no differentiation is observed. The gene flow or rate of movement of reproductive individuals among geographic subunits of the population is the key. Most population geneticists agree that if only 1% (and some say much less) of the reproductive individuals move among geographic subunits each generation this is sufficient to override selection that favors adaptation to local conditions.

How does this apply to monarchs?

As a migratory species, we might expect that monarchs would show little if any regional differentiation. Yet, it has been argued that the monarch population west of the Rockies may be genetically distinct (Brower et al., 1995). In fact, our lack of knowledge of the

amount of gene flow between western and eastern populations has been the basis for federal regulations that restrict shipments of monarchs across the Rockies. Some states are adopting similar policies, evidently on the assumption that monarchs originating from outside their states are (or might be) different from their local population.

To examine the genetic structure of the monarch population and gene flow in general terms, I will review the seasonal dynamics of migration, dispersal, and reproduction. Most of the following discussion involves the monarch population east of the Rockies but the basic biology is similar for both regions.

Spring Migration: Range Expansion

Each year eastern North America is re-colonized by two generations of monarchs - the overwintering monarchs and their progeny. The monarchs east of the Rockies overwinter in the Transvolcanic range west of Mexico City in the states of Michoacán and Mexico. These butterflies become sexually active and begin moving north in late February with the majority moving north in early March. As females move northward, they seek milkweeds on which to lay eggs. Some eggs are laid as the butterflies advance through Mexico but most are laid on milkweeds in the southern states. Many females disperse their eggs over great distances - perhaps a thousand miles. Most die before they reach the latitudes of the summer breeding range (37-50°N). In March and April developmental rates of

the monarch immatures vary from 26-45 days on a more or less South to North gradient. This means that in rare cases, newly emerged adults that have matured from the first eggs may overlap their dying mothers and their younger siblings as they move northward. As shown by Malcolm et al., (1993) it is the offspring of these returning migrants that colonize the summer breeding range again laying eggs en route as they move northward. The striking feature of this pattern is that the offspring are scattered in a manner that would not favor regional population differentiation.

The pattern of spring colonization as recorded each year by Journey North (www.learner.org/jnorth) suggests that the returning population spreads out over the countryside as permitted by the prevailing weather conditions. Recolonization appears to be influenced by the position of the jet stream over the midwest. During springs when the jet stream is low over the midwest, the monarchs shift east and may reach higher latitudes in the east than they do in the midwest on the same dates. If the jet stream is to the north with strong high pressure in the central part of the country, the monarchs move rapidly into the midwest. Again, the variability in the recolonization pattern from year to year argues against regional differentiation. It

Monarch Gender

The gender of the monarch to be is determined at the moment of fertilization of the egg. In Lepidoptera, the male is the homogametic sex which is the scientists way of saying that the male has two x chromosomes rather than an XY (heterogametic) as in humans and most vertebrates, except birds in which the males are also XX. However, though heterogametic, females are frequently XO in Lepidoptera since a Y sex chromosome is missing in many species. Because the males are homogametic all the sperm contain an X chromosome. However, females produce eggs which have either an X or an O. Those eggs with the O combine with the X of the male to form an embryo that develops into a female monarch while those eggs with the X combine with an X from a sperm to form a male.

should also be noted that because of the patterns of movement and the mortality en route it is unlikely that overwintering females return to the location of their natal origin.

Summer Breeding Range

The monarch summer breeding range spans 37-50° N latitude. Although there are a few pockets of monarch production from June to September along the coasts and in the mountains below 37°, the numbers are too small to contribute significantly to the population. Evidently high temperatures and a lack of host plants account for the absence of summer production in the southern states. Evidence is beginning to accumulate for a pre-migration migration of reproductive monarchs in August and September that recolonize the southern states. The progeny of these monarchs may also join the migration if they emerge before the end of October. The size of this cohort is unknown but the number of individuals is probably related to the prevailing temperatures and moisture at the time, with moderate to cool conditions being most favorable. This recolonization emphasizes the dynamic nature of movement during the breeding season.

Local Breeding

Currently, there is some disagreement as to whether monarchs continue to move the entire breeding season or whether they become resident for one to two generations before migrating south again in the late summer. Brower (1996) has proposed that monarchs move continuously with a kind of annual clock that advances one degree per day. While it is possible that some portion of the population is on the move during the summer months it is also possible that monarchs become resident for a period (6-12 weeks) at some latitudes. In eastern Kansas we have yet to see directional flight by monarchs from late June to early August. The butterflies seen moving south in mid August (10th-20th) may be part of the pre-migration migration

mentioned above and these butterflies could be originating from the states to the north. Locally, it appears that butterflies are resident from roughly 21 June



until the arrival of the first migrants from the north around 10 September (>11 weeks). Evidence of non-migratory behavior and low dispersal in the summer months comes from mark and recapture studies, release experiments and from measures of the genetic variability of the populations. Mark and recapture and studies in the summer months (Taylor, pers. obs., Zalucki, pers. com.) suggest that monarchs stay in one area and have relatively low dispersal since high proportions of the marked monarchs are recaptured. In contrast, the spring recapture numbers (Knight et al., 1999) are extremely low suggesting that most monarchs move out of the area where they were marked. Release studies in Kansas in late August and early September show that the local reproductive butterflies lack any focal direction - in other words, when released they go in all possible directions (Perez and Taylor, unpublished). In contrast, non-reproductive fall migrants (7-14 days later) head in a SW (210-220°) direction (Perez, et al. 1998).

Genetic evidence is also consistent with non-migration and low vagility in the summer months. Monarchs maintain a high degree of overall genetic het-

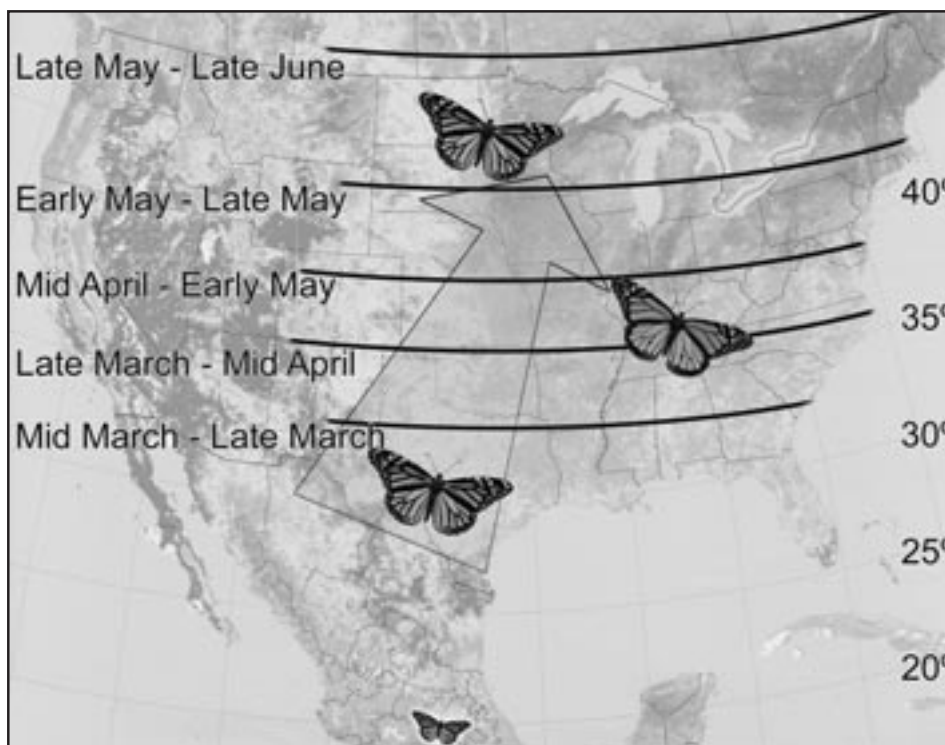
erozygosity as a population (Eanes and Koehn, 1978). However, during the fall migration there are fewer heterozygotes than expected for a randomly breeding population. This is known as a Wahlund effect. The deficiency of heterozygotes is considered to be evidence of inbreeding in subpopulations during the summer months and the fall population therefore represents an aggregation of these subunits.

The fall migration begins in late August (around the 20th) in the most northern latitudes. By the 25th, the monarchs are starting to migrate at 45°N (e.g., St Paul, MN). The migration picks up new monarchs as it moves south. The migratory butterflies are almost entirely non-reproductive and it doesn't appear that reproductive monarchs join the migration. However, not all individuals are able to sustain a non-reproductive condition, especially in hot weather, and some become reproductive during the migration. It is not clear whether these butterflies become local or keep moving with the main body of the migration - probably the former. With the possible exception of Florida, such reproduction is a dead end and does not contribute to the population because the offspring are seasonally too late to join the migration. It follows that there is strong selection not to become reproductive during the migration. Therefore, the release of reproductive monarchs in the during the migratory period will have no impact on the population.

Genetic analysis of the fall population shows the same gene frequencies throughout the area east of the Rockies from year to year (Eanes 1978,1979, Eanes and Koehn 1978). These results indicate that any inbreeding that occurred in the summer generations is swamped out by the mixing of the fall migrants.

But where do the monarchs come from that converge at a given sampling point? We are not sure. However, it seems likely that in Kansas only a small number of the monarchs observed and/or tagged there actually originate in

the state. Most of the September monarchs seen in Kansas probably originated from states to the north and east - but how far east? We probably get butterflies from Wisconsin; but what about Michigan and points further east? We don't know; unfortunately, the number of recoveries of tagged monarchs within the United



The spring monarch migration and recolonization of the United States and Canada showing approximate dates of arrival by latitude.

States is too low to do a proper analysis for the midwest. On the east coast the tagging records indicate that butterflies caught along the Connecticut/New York shoreline appear to come from New England, the Maritimes, Quebec, and even Ontario. Evidently, some monarchs are blown to, or take, a course to the southeast from the Toronto area.

The fall migrants have headings or migratory vectors that are expected for each region (Rogg, et al 1999). These results suggest that monarchs have a sense of latitude and longitude. We now know that this sense of location is acquired from local information. It is the same kind of information we have with respect to the daily rhythm. If we are transported half way around the world, we suffer from jet lag and it takes several days for our body to re-adjust to the new photoperiod. Monarchs have the same problem. They are blown off course frequently and if they are to get to Mexico, they have to be able to adjust to the local conditions in a manner that allows them to set a new direction based on the location they now find themselves in. Our data show that monarchs make these adjustments (Perez and Taylor, unpub data). This suggests that

if we move migratory monarchs anywhere in the eastern United States their biochemistry will be adjusted in a way that will allow them to take a new heading. However, moving such migrants, either by weather fronts or humans, is not without cost. The tagging data shows that monarchs released further from Mexico have a reduced probability of reaching the overwintering sites. Each mile of the migration is full of hazards which apparently take their toll. In three of the last four years one out of every 65-100 butterflies tagged in Kansas was recovered in Mexico but in the northeast 200-400 tagged butterflies were required to have one recovered at the overwintering sites.

Monarchs first arrive in the Transvolcanic range during the last days of October. It takes about five weeks for all the butterflies to reach the overwintering sites. The monarchs first cluster on the trees along the ridge tops. Progressively, these loose assemblages form into the well-known overwintering colonies. Most of the colonies form on southwest facing slopes and slowly move downhill during the winter months. Using stable isotopic analysis, Wassenaar and Hobson (1998) showed

that the colonies are composed of monarchs from all areas of the eastern United States and Canada. None of the colonies were found to contain a predominance of monarchs from a particular region of the breeding habitat. In other words, the population is thoroughly mixed at the overwintering sites.

Mating at and North of Overwintering Sites

Monarchs begin to break diapause and become sexually active in mid-February. Small males predominate in the first matings. These males have the smallest mass and most reduced fat bodies and appear to have almost no chance of migrating north. Once the hormones kick in, these males court and mate with females. Curiously, these males mate with a disproportionate number of the larger females in the population (Van Hook 1993). This result seems puzzling but, since we can duplicate this outcome in the laboratory, it probably means that the large females are simply unable to escape from the small, persistent males because they lack the maneuverability to do so (Taylor, unpub. data). Because of the composition of the population at the overwintering sites and because mat-

ing appears to be related to condition rather than origin, the mating is random and the population can be characterized as panmictic. As mentioned above, few if any of the overwintering females return to the regions of their origin.

Males Move North and Mating Continues

We now know that males move north in good numbers along with the ovipositing females. Mating occurs en route and females reaching the end of their life have usually mated more than four times. The multiple paternity of the progeny from nearly every female contributes to the genetic diversity of the population. Every aspect of the fall movement, as well as overwintering, followed by the spring mating and migration favors outbreeding which maximizes the variability in the population. It is only during the midsummer and late summer generations that there appears to be evidence of inbreeding.

The Bottom Line

The eastern monarch population has all the attributes of a large panmictic, randomly mating, and highly vagil population from the Rockies to the east coast and from the Maritimes to Florida. The evidence suggests that there are no regional differences and no sub-populations in a genetic sense in the eastern monarch population. Because of the size of the eastern population (100-400 million each fall), and the panmictic nature of the breeding and migratory system, releases of monarchs in the area east of the Rockies are unlikely to have any impact on the population.

Monarchs West of the Rockies

Are the monarch populations west of the Rockies genetically distinct? The answer is that we don't know. Although there is no genetic evidence that suggests that eastern and western monarchs are genetically distinct populations, the possibility remains that the amount of gene flow between the two populations is so low that some differentiation may

have occurred that has eluded us. This reasoning was the foundation for the paper by Brower et al., (1995) which serves as the basis for the current USDA-APHIS regulation prohibiting the shipment of monarchs across the Rockies. Part of the argument is that the lack of genetic evidence for differences between these populations (Brower and Boyce, 1991) should not be looked on as compelling evidence since relatively few genetic traits have been examined and it's quite possible that key differences simply haven't been discovered. In support, data presented by Altizer and Oberhauser (1999) suggests that there are differences in the populations in their susceptibility to the protozoan *Ophryocystis elektroscirrha*. In contrast, Brower (pers com.) has recently suggested that monarchs periodically recolonize California from Mexico. This speculation is based on observations by ornithologists that migrating birds are blown off course to the west by unusual weather patterns in the spring. Similarly, Pyle (1999) in his book *Chasing Monarchs* presents evidence that intermountain monarchs in the western states appear to enter Mexico along the southeastern Arizona border in the fall. In addition, controversial tag and release experiments by Paul Cherubini (www.swallowtailfarms.com) show that some of the monarchs released west of the Rockies reach the overwintering sites in Mexico. Although these ideas and observations are relevant and are of interest, they do not establish that there is gene flow between eastern and western populations. Undoubtedly, there is some gene flow between these populations. The Rocky Mountains are certainly not an absolute barrier. However, the issue remains: is there sufficient gene flow between these populations to swamp out genetic differences that might have arisen due to local adaptations? Possibly, yes. Nevertheless, given the deficiencies in our knowledge, it seems wise to maintain the current restriction against moving monarchs across the Rocky Mountains.

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Replacement Rate

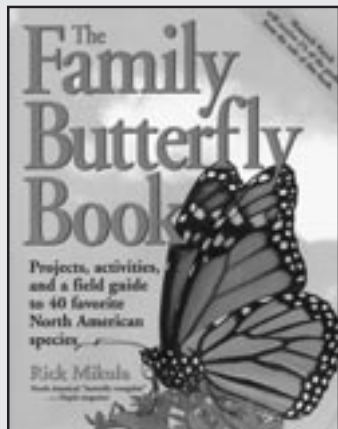
Population dynamics simply refers to the changes in the number of individuals in a population through time. To understand the reasons for changes in population sizes through time, we need to obtain quantitative information on all aspects of the yearly cycle that affect birth and death rates. If birth rates are higher than death rates for a given period, the population increases; if death rates are higher than birth rates, the population declines. Demographers, those who study populations, attempt to identify the factors that cause changes in the birth and death rates and for a given period of study they often speak of net replacement rates. This refers to the net change in the number of females reaching the adult stage per female of the previous generation or season. Males are ignored in these discussions since they don't lay eggs or give birth. The sex-ratio is often not 1:1, in which case it is even more important to know the number of potentially reproducing females.

We are at the beginning of our understanding of monarch population dynamics and we don't really have an adequate grasp of replacement rates at this time. Nevertheless, it may be instructive to outline possible replacement scenarios. We can reject or modify these ideas as more data becomes available.

Let's compare what happened from the winter of 1999-2000 (100 million overwintering monarchs) to the winter of 2000-2001 (28 million monarchs). Clearly, the population declined but what might this mean in terms of replacement rates? As usual, to interpret what might have happened, we have to round up the usual assumptions, some of which are based on data. If the sex-ratio is 1:1 and there is 50% mortality through the winter, then we would expect 25 million females to survive the winter. Of these, a certain number will die as they move north from the overwintering sites. We don't know this percentage, but let's estimate 30% die before laying eggs in the southern United States; this leaves 17.5 million females to colonize the U.S. If the replacement rate was 5 females per female (very low) over the summer, the fall population was 175 million (including males). Yet, if only 28 million arrived at the overwintering sites, only 16% of the fall migratory population survived. This seems low since our previous estimates of survival during the migration, based on the tag recoveries, range from 20-45%. It seems more likely that the fall population was smaller than 175 million. If we assume that 45% of the fall migrants arrived in Mexico (probably a high estimate given the harsh conditions during most of the migration), then the initial fall population was 62 million (males included) and the net replacement rate for the season of 2000 was 1.8 (31/17.5 females). Wow! This is low and it doesn't take much imagination to see what would happen to the population if replacement rates were this low two years in a row.

Although we can't predict the future, we can ask what will happen in the 2001 breeding season given some assumptions about the starting population and replacement rates. Starting with 28 million and assuming a 1:1 sex ratio and 50% winter mortality and 30% loss prior to breeding in the spring in the United States leaves just 4.9 females to start the population in 2001. If after the summer, the net replacement rate is 10 females/female, the fall population would be 98 million (males included) and if 45% of these survive the fall migration, the population in the winter of 2001-2002 would be 44.1 million. As you can see from these projections (and the specific set of assumptions), to have an overwintering population in the range of 60 million or greater, the replacement rate must be higher than 10. In general, if you play around with these assumptions, you will discover that to maintain the same number from year to year, the replacement rate has to be in the range of 6-10 females/female in the breeding season. If they are lower, the population declines and if higher the population will increase. Conjecture like this is easy; the hard part will be to test each of the assumptions in this simple model.

The Family Butterfly Book



From American Coppers to Zebra Longwings, butterflies charm us with their beauty and grace. Rick Mikula, known as "The Grandfather of Butterfly Farming", connects us with these magnificent creatures in "The Family Butterfly Book". With terms, tips, and brilliant color photos, this one hundred sixty-six page book provides guidance for anyone who wants to identify and raise butterflies. Also included are fifteen projects and activities and an illustrated field guide to forty North American butterfly species. This is an ideal book for students, teachers and families who want to explore the magnificent world of butterflies.

To order a copy, you can visit Rick Mikula's website at www.butterflywebsite.com. Monarch Watch will receive 2% of the profits from the sale of this book. It is also available through the Monarch Watch Amazon Portal at www.MonarchWatch.org. See [page 62](#) for more information.

NSTA NATIONAL CONVENTION

Reaching new teachers and spreading the word about using monarchs in education is an important goal for Monarch Watch. This spring we attended the National Science Teachers Association (NSTA) conference to do just that. The 2001 NSTA conference was held from 22-25 March at The America's Center in St. Louis, MO.

Our booth featured live monarchs in a display cage borrowed from Paula Donham of Olathe East High School in Olathe, KS, larvae on plants and artificial diet, and a display of our promotional items, posters, and books. Although our booth was modest compared to those of the many large corporations at the meeting, the word that we had live monarchs spread quickly and we had a crowd of people around us most of the time. We usually had four or five Monarch Watch employees or volunteers at the booth at any one time and we were almost always busy talking to people who stopped by. We encouraged visitors to the booth to sign up for a drawing and include their email for our new Monarch Watch Update by email. We began sending out this email in June and hope to continue the update on a monthly basis to all of our Monarch Watch participants with email. There are currently more than 5000 subscribers to

this update and the list is growing every day. To learn how to join see **page 62**.

We were greatly aided at the convention by volunteers who were kind enough to give of their time so that we could more effectively communicate with the teachers at the convention. Our volunteers included: Janis Lentz, Nancy Wilfong, Jackie Goetz, Suzette Slocomb, and Monarch Watch staffers Dana Wilfong, Jim Lovett, and Chip Taylor. A special thank you goes out to Richard and Nancy Wilfong, Dana's parents, who housed and fed the Monarch Watch crew during the convention and loaned supplies for the booth.

Long-time Monarch Watchers Cyrene Slegona (Cornish Elementary School, Cornish, ME), Suzette Slocomb (I.C.E. Center School District #58 in Kansas City, MO), and Carmen Tharp (Cabot High School, Cabot, AR), all gave presentations at the NSTA conference about monarchs. Cyrene presented her unique science program supported by funds from Toyota as part of the Toyota TAPESTRY Share-a-Thon. Suzette



spoke about "Metamorphosis: Nature's Magic Act". Carmen presented on "The Outdoor Classroom! Adopt a Stream and Tag a Butterfly". During the course of the convention many teachers who've been affiliated with Monarch Watch came by to say hello. We were delighted to meet these Monarch Watch participants in person.

The NSTA conference was a big success and we estimate that 1200 visitors stopped by our booth during the four day conference. We signed up over 300 people to the Monarch Watch Email Update List, distributed our information to many more teachers, sold lots of books, videos, and posters, and were able to put faces with the names of some of our most loyal participants. ■

Top right: Our monarch display cage attracted a lot of curious onlookers; Bottom left: Our display booth, a.k.a. Monarch Watch headquarters for the duration of the show; Bottom right: Janis Lentz shows a young visitor how to tag monarchs. Photos by Jim Lovett.



HURRICANES AND MONARCHS

Are monarchs carried on hurricanes to Europe?

Believe it or not, 1999 was a big year for monarchs in the British Isles! In late September and October there were 441 sightings of monarchs representing an estimated 300 individuals in Ireland, Scotland, and southwest England (Tunmore 2000). These sightings occurred in the days following two major storm tracks across the North Atlantic, Hurricane Floyd, which swept up the east coast of the United States and across the Atlantic from 17-22 September, and an unnamed storm which followed from 26 September to 1 October (Davey 2000). In his article, Tunmore lists the records, the manner of data collection, the history of monarchs in England and the weather conditions during the influx. The records show that the number of sightings peaked the third day after each of the weather fronts hit the British Isles. In his brief note Davey assumes that to traverse the Atlantic: the monarchs were wind and not human assisted; they flew non-stop at five mph; and they oriented their flight downwind. Davey shows the track taken by Hurricane Floyd and from this track it would appear that to reach the British Isles the monarchs were airborne for five days! Even if it was only three days - wow! Why wow? Because I don't think three to five days of sustained, even passive, flight covering a distance of 3,000 miles is consistent with what we know about monarchs. So, I'm skeptical and here are my reasons:

1. Monarchs are not known to fly at night;
2. The glide ratio (3:1) for monarchs is such that to stay airborne, monarchs would have to use powered flight frequently or be lifted constantly by the action of the winds;

3. They don't have the energetic capacity for active flight for such periods;

4. Monarchs were not recorded in England until 1876, a curious fact given the British interest in natural history and the frequency of trans-Atlantic hurricanes over the centuries;

5. Many of the sightings in the past have been close to ports;

6. The surface temperatures of the North Atlantic ranged from 4-16°C during the critical period; and

7. Rainfall during these storms would seem to preclude flight by monarchs much of the time.

An alternative hypothesis is that monarchs swept to sea off the east coast of the United States during these storms took refuge on ships, leaving the ships three to five days later as they approached the western coasts of the British Isles especially the main port of Liverpool. The first steamships began to cross the Atlantic in 1840 and by the 1870's nearly all sail powered craft had been replaced by faster steamships which were able to cross the Atlantic in a week rather than months. This might explain why monarchs were not observed in England until 1876. Currently, passage from New York to coastal England takes seven to ten days and the amount of traffic is substantial. We have heard several accounts of sightings of monarchs landing on ships at sea off the east coast of the United States in the fall. Inland in the United States, monarchs crossing large cool bodies of water frequently land on sailboats during the fall migration. If the air over the water is too cool, monarchs appear to have difficulty sustaining flight and many drown. The temperature at the boundary layer at the surface of the North Atlantic as well as that of the air mass above are critical to the ability of the monarch to sustain even passive flight for a sustained period. We need to

know these conditions before we even conditionally accept the idea that monarchs are transported across the Atlantic unaided by humans.

A search of internet sites shows that the sea surface temperatures between Newfoundland and the English coast ranged from 4-16°C during the period in question. Although the air mass above the sea was certainly warmer due to its tropical origin, if monarchs encountered air colder than 10°C (50°F) it is unlikely they could sustain even passive flight.

The origins of the monarchs is an interesting question. The track of Floyd shows that it followed the coast line north from the Carolinas through New England and then moved sharply to the northeast through the interior of New Brunswick crossing through Newfoundland and almost due east to the British Isles. Records from Dick Walton's Cape May New Jersey monitoring project show that for the week prior to the hurricane (through the 14th) the number of monarchs at Cape May was low (17/census hour). In the following week the counts exceeded 100 per hour. Therefore, it seems likely that most of the monarchs were still north of New Jersey as the hurricane passed through the area on the 16th. As the hurricane moved north, it diminished in strength and was downgraded to the status of a tropical storm with winds of 65 mph once it reached 39°N (Cape May). As the storm passed, rainfall was heavy and New York City received six inches of rain. If monarchs were swept to sea in this storm, it had to be between periods of rainfall during daylight hours. The most likely source for the monarchs would seem to be coastal New England and especially Maine. For the second storm, the point of origin for the monarchs would have been further south.

Students, especially potential meteorologists, might pursue the questions I've raised a bit further by checking out the weather conditions, particularly the daytime temperatures and rainfall as

Floyd passed northward along the east coast of the United States. Further checks on ship traffic might also be productive. Additional information on the sea surface temperatures along the transatlantic route as well as temperatures, wind speed and circulation of hurricane and tropical storm Floyd would be of interest. The following resources could serve as a starting point for such an investigation:

The storm track of hurricane Floyd - esip.gmu.edu/siesip/orbit3D/html/track_floyd.html

Sea surface temperatures - rs.gso.uri.edu/avhrr-archive/archive.html

General information on hurricanes - www.1ststeps.org/Science/hurricanes.htm

Dick Walton's Cape May New Jersey monitoring project - www.concord.org/~dick/mmp99.html

Davey, Peter. 2000. Backtrack for the 1999 Monarch *Danaus plexippus* (Linn.) Influx. *Atropos* 9:17-18.

Tunmore, Mark. 2000. The 1999 Monarch *Danaus plexippus* (Linn.) Influx into the British Isles. *Atropos* 9:4-16.

My thanks to Jane Ruffin of Rosemont, PA for bringing these articles to my attention. ■

Winning the Monarch Lottery

The odds have changed just when we thought we had it all figured out. In 1998, 1/200 tagged monarchs were recovered in Mexico but in 1999 the odds of having one of your tagged monarchs recovered were 1/130. This past season the bottom fell out and the odds were longer - about 1 recovery for every 464 tagged. This is quite a change and it may mean that a higher proportion of the monarchs died during the migration than in previous years (see "Population Estimates" **page 11**).

The estimated recovery rate is dependent on a number of factors. A partial analysis from past years shows that recovery rates are highest in the central corridor from Minnesota through Texas. If we assume that the distribution of taggers and tagging did not differ substantially among years, we can ask what else might have affected the outcome.

The recovery rate is sensitive to our assessment of the number of butterflies tagged. There are a number of ways to arrive at this estimate (see "Population Estimates"). The following is an attempt to refine the recovery rate with the use of different estimations of the number of butterflies tagged.

Estimated tag recovery rates.

1998: 412 recoveries at all sites • 1/159 (412/65,500) returned data sheets only • 1/175 (412/72,050) combined returned and non-returned data sheets.

1999: 643 recoveries at all sites • 1/98 (643/62,788) returned data sheets only • 1/114 (643/73,519) combined returned and non-returned data sheets.

2000: 172 recoveries at all sites • 1/428 (172/73,577) returned data sheets only • 1/464 (172/79,557) combined returned and non-returned data sheets.

Most of the tags are recovered at El Rosario; the following is a brief summary of the relative sizes of the populations at El Rosario to the total overwintering monarch population.

In 2000 El Rosario was 1.17 hectares or 41% of the total population and had 160 recoveries or 1/73,125.

In 1999 El Rosario was 3.78 hectares or 42% of the total and had 597 recoveries or 1/63,400.

In 1998 El Rosario was 2.0 hectares or 36% of the total and had 402 recoveries or 1/49,751.

Possible reasons for fewer tags recovered per number of monarchs tagged in 2000 include the following:

1. The location of the butterflies in the forest was not as conducive to tag recovery - this may be relevant since the colony at El Rosario was located in a less accessible area of the forest;
2. There were fewer visitors which means there were fewer guide-days at the colonies and therefore, lower search effort - this may have been a factor early in the season;
3. A smaller portion of the tagged butterflies died during the winter and the living butterflies with tags were too high in the trees to be accessible;
4. The proportion of tagged monarchs that survived the migration was less relative to total population size than in previous years - this seems probable; and
5. There was a greater loss of tags before the monarchs arrived at the overwintering sites due to the quality of the adhesive or other factors - there was no evidence of greater tag loss in 2000.

Will the odds change next year? You can bet on it!

PROMO & EDUCATIONAL ITEMS

There are several way to order Monarch Watch items. We have recently implemented secure online shopping at “Gulliver’s Gift Shop” (see **page 62** for details) and you can still mail or fax in your order to us.

Please note: due to the lack of substantial funding and the fact that our overnight shipping costs have nearly tripled without warning we are forced to increase the prices of our educational and promotional items. Up-to-date pricing information and current order forms are always available on our web-site at **www.MonarchWatch.org**. If you have any questions about this, please feel free to contact us (see back cover) anytime.

Memberships

The **2002 Membership (\$25)** includes a welcome kit, all Monarch Watch mailings (including the Premigration Newsletter, Season Summary, and Adopt-a-Classroom Annual Report).

The **2002 Tagging Membership (\$25)** includes the materials described

above and a Tagging Kit that includes 25 tags, instructions, and a data sheet.

Additional **25-tag (\$2)** or **500-tag (\$32)** sets are available to those who purchase a Tagging Membership.

Promotional and Educational Items

Monarch Rearing Kit (\$32) This kit contains sixteen 3-5 day-old monarch larvae which must be transferred to milkweed plants to feed. Pupation will occur in 10-12 days and adults will emerge 10-14 days after pupation. These butterflies can be used for classroom instruction, student projects or to start a classroom breeding population. Instructions are included.

Millennium Butterfly Garden Kit (\$30) This kit consists of 25 seed packets (about 100 seeds each) of annuals and perennials which are known butterfly nectar plants and/or host plants for butterfly larvae. Also included is a 24-page gardening guide (available separately as well, see below) which describes how to plant and care for each species

and provides information on designing and maintaining your butterfly garden.

Butterfly Gardening Guide (\$4) This 24-page gardening guide (included in the Millennium Butterfly Garden Kit, see above) describes how to plant and care for a number of of annuals and perennials which are known butterfly nectar plants and/or host plants for butterfly larvae. It also provides information on designing and maintaining your butterfly garden.

Milkweed Seeds (\$12) Individual packets of five varieties of milkweed: common, swamp, tropical, showy, and butterfly weed - an instruction sheet is included to get you started. (~100 seeds/pack, varieties may vary)

Monarch Magic! Butterfly Activities and Nature Discoveries (\$15) More than 100 stunning full-color photos with easy to follow text let you experience the Monarch’s complete life cycle and spectacular migration. Lots of fun activities and projects! Ages 4-12, 96pp.





Monarch Watch's "Butterfly Condo"

My Monarch Journal (\$10; \$12) This book will guide you in raising Monarchs and allow you to record your experiences. It's filled with more than 150 beautiful photos that illustrate the Monarch's transformation from egg to larva to pupa to adult. The 52-page Parent-Teacher Edition builds upon the Student Edition (32pp).

The Butterfly King Video (\$15) The life history of the Monarch, as told by a caterpillar as he progresses from one life stage to the next. Bundled with this video is "Gulliver's Story" an active learning exercise for grades 2-4. 20 min.

The Monarch: A Butterfly Beyond Borders Video (\$35) This is the most up-to-date treatment of the dilemmas we face in trying to maintain monarch populations and their migration in eastern North America. The footage obtained at the monarch overwintering sites is truly spectacular. Licensed for home use only. 47 min.

Educational Posters (\$10; \$15) There are now six educational posters available from Monarch Watch! All posters are printed in full-color and laminated.

Four posters depict various aspects of the monarch migration. These 24" x 36" posters are available in English, Spanish and French.

The Monarch Annual Cycle poster depicts the annual cycle of the Eastern North American monarch population. It is available in two sizes: 24" x 36" or 18" x 24"

The 18" x 22" Life Cycle poster illustrates the transformation of the monarch from egg to adult and includes the approximate age at each stage.

Migration T-shirt (\$17) This 100% cotton T-shirt is printed on both sides in black and brilliant monarch orange with lots of migrating monarchs! Adult sizes M, L, XL and XXL.

Adult Monarch Watch Logo T-shirt (\$17) This 100% cotton T-shirt features Gulliver on the upper left chest and two large monarch butterflies on the back. Adult sizes M, L and XL.

Youth Monarch Watcher T-shirt (\$13) This 100% cotton T-shirt features Gulliver and "I'm a Monarch Watcher!" on the front and two large monarch butterflies on the back. Youth sizes S and L.

Season Summary (\$5) This publication is available in the spring/summer following the tagging season and contains tag recovery data, tips and ideas for teachers and students, observations on Monarch populations, new information on monarch biology and a whole lot more! Summaries from previous tagging seasons (1997-2000) are also available while they last.

Butterfly Nectar Kit (\$5) This kit includes 1 clear plastic feeding dish, 1 feeding scrubber, and nectar mix (ingredients you wouldn't normally find in your kitchen). Makes 1 liter of nectar and will not ferment.

Game of Monarch Life (\$18) Learn about the life cycle and migration of monarch butterflies in this challenging board game. Large laminated game board, dice, playing pieces, challenge cards and instructions included.

Gulliver Pin (\$5) This 1" metal pin features our "logopillar" Gulliver and an adult monarch.

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

Butterfly Condo (\$50) This 24" x 24" x 28" white mesh and clear plastic collapsible tent is perfect for raising and observing monarchs or other insects at home or in the classroom.

Contributions

Monarch Watch relies on the sale of promotional items and donations for funding. We do not rely on grants or federal funding. To recruit taggers, the tagging kit fee is kept low; so low, in fact, that it doesn't cover the cost of the tagging program. The sale of promotional items helps to cover the remaining costs of the tagging program. However, Monarch Watch needs your contributions to successfully direct and expand the Adopt-a-Classroom program, the development of educational materials and projects, as well as the tag recovery effort.

A contribution in the amount of \$100 or more to any of the following funds entitles you to a premium. For more information or to contribute to any of these funds, please use the enclosed contribution and order form.



Chip Taylor showing a tag recovered by one of the guides at El Rosario, Michoacán, Mexico. Photo by Dana Wilfong.



One of the more than 30 rural schools near the Monarch Reserve that Monarch Watch visited and delivered supplies to on our 2001 Adopt-a-Classroom trip in January. Photo by Jim Lovett.

Monarch Watch Adopt-a-Classroom Fund We have pledged to provide educational resources to the communities (ejidos) in the vicinity of the overwintering areas in Mexico. The schools within the Monarch Reserve are simple, cinder block buildings. The classrooms are crowded with crude, uncomfortable desks. Most have poor lighting and some have no electricity. While basic textbooks are supplied by the Mexican government, workbooks, writing materials, even paper and pencils are scarce. Library resources and supplemental teaching aids - a requirement for teaching math and science concepts effectively - are also lacking in these schools.

Providing these children with a better education will enable them to make informed decisions. With the help of several teachers, we have designed a basic math and science kit (in Spanish), which includes many hands-on activities appropriate for the classrooms in Mexico. Each kit costs \$100 and we need your help raising funds for their purchase and delivery.

Monarch Watch Education Fund Monarch Watch is always working to create new educational materials and projects. However, our income barely covers the daily expenses of operation, so very little remains for development. Many projects are unfinished due to lack of funding. Among these are an interac-

tive CD-ROM, an activity guide, and a roadside vegetation management project. Donations to the Monarch Watch Education Fund will facilitate the completion of these and other projects.

Monarch Watch Tag Recovery Fund

Monarch Watch taggers have enjoyed record numbers of recoveries in Mexico during the last two tagging seasons. The increased recovery rate is due to the 50 peso (~US\$5) reward that Monarch Watch offers the Mexican guides at the reserve for each recovered tag. Each season, Monarch Watch pays thousands of dollars for this valuable information. We have created a Tag Recovery Fund for those who wish to assist with the purchase of these tags.

Thank you for your support!

Monarch Watch would like to thank all those who made contributions to our program this past year. Contributors of \$100 or more are listed below. Please notify us with corrections or updates to our list.

Tag Recovery Fund

Roy Beckemeyer, D.L. Bishop, Jim & Teresa Gallion, David Gibo, Pat Hallden-Abberton, George Kustka, Pat McDonald, Laurie McKean, Alexis Powell, Sally Prior, St James Episcopal School, Richard Stadin, Gayle Steffy, Paul Viger, and Randy Warner.

Education Fund

Stephen Esser, Kathleen Ziemer, Jim & Teresa Gallion, Roy Beckemeyer, Nancy Harp, and Paula Iliff.

General Fund

3M, Jay McRoberts, Marlene Grover, Lee Larcheveque, Marian McNabb,

Chip & Toni Taylor, Coevolution Institute, Lincoln Brower, Helen Johnson, Paula Donham and David Gibo.

Adopt-a-Classroom

Carol Armbrust, Sharon Barnett, Roy Beckemeyer, Velma Begley, John Brown, Elizabeth Brown, Rose Brunner, Susan Casker, Sandy Cavanaugh, Rebecca Clemens, Clinton Young Elementary, Joyce Davis, Ken de Waal Malefyt, Nancy Dott, Jan Eversole, Alan Fiero, Joan Folse, Jim & Teresa Gallion, Mary Ginley, Jacalyn Goetz, Sammy Hensel-Hunter, Sharon Howard, Judith Jackson, Anne Kenney, Anne Kenney, Heather Long, Fran Ludwig, Teresa Mallon, Judy Matthews, Jonne McCarron, Pat McDonald, Judy McIntyre, Laurie McKean, Virginia Millard, Paul Milner, Colleen Mitchell, Monarch Research Associates, Barbara Nelson, David Novello, John Obrycki, Pam Owens, Shelia Parker, Mary Pearson, Barbara Plunkett, Quittapahilla Audubon Society, Millie Ramsey, Karen Rieser, Lynn Rosenblatt, WM Rountree, Jr., Betty Sanders, Raven Skydancer, Cyrene Slegona, Robert Small, St. James Episcopal School, Tom Uecker, Victor Volkman, Karen Washburn, Frances Welden, Adrian Wenner, Cathy Wertz, Marsha White, Jessica Winslow, and Gary Zang.

We would also like to thank the following organizations and individuals who donated school supplies:

Centennial Elementary 2nd Graders; Ann Macpherson, Harvey Green Elementary School; Leah McDowell, Haine Elementary; Patty McLeod, Bangor Christian School; Morton School; Bob Melton; Ron Perkins, Educational Innovations, Inc.; Sue Powers, Moyock Elementary; Randi Reed; Lyn Silcock, Glenwood High School; Alice Story, Windsor Hill Elementary; Elaine Winslow; and Union Public Schools. ■

LETTERS TO MONARCH WATCH

I am a third grade teacher at Benjamin Franklin Elementary School in Menomonee Falls, Wisconsin. Last year, I created a large indoor butterfly garden in our school lobby. The entire school became involved in collecting caterpillars, picking vases of nectar flowers and other host plants, and observing the whole metamorphosis process for about three weeks. My students and I have enjoyed the Monarch Watch web site in our computer lab. It's an excellent site and I have recommended it to other teachers and parents. We'll be watching to see if any of our butterflies are identified in this year's count.

Connie Wolf
Menomonee Falls, WI



An indoor Butterfly Garden.

Photo by Connie Wolf.

My two-year-old son and I were walking along the nature trails at the Outdoor Campus in Sertoma Park, which is located along the Big Sioux River in Sioux Falls, South Dakota, when we located one of your butterflies. I caught it for my son to look at and found your sticker on its wing. We released it in the same area where it was found. We would be very interested in finding more about the butterfly we found (i.e. when it was tagged and released, etc...) and we would like to know more about your Monarch Watch project. Ironically, I watched a special on tv about a week ago on monarch butterflies. There was a man who took part in a study like yours involving the tagging of monarch butterflies. I was curious to know if that television special had anything to do with Monarch Watch. As I watched the program I thought to myself, "I wonder what the likeliness is of running across a tagged butterfly? Not very likely, I bet!" And now here I am with one

of your tags [188 WH]. How funny! Anyway, if you would be able to send us any information, we would really appreciate it! Thanks and good luck with your study.

Jennifer Prochniak and Family
Sioux Falls, SD

.....

I am a ten-year-old boy who lives on the coast of Maine. I love insects and especially monarch butterflies. When I grow up I want to be an entomologist, veterinarian or Park Ranger.

We live on the coast of Maine and the butterflies congregate here. At night, you can see them dripping from the spruce trees. In the cool morning air, they fly up to get warm and I love watching them. When they take off to go wherever on their long journey, they look like a swarm of bees heading out over the ocean.

I got some other Cub Scouts to assist me in tagging them. It was fun being out in the warm sun watching them delicately flutter from flower to flower. I used all 125 tags, and next year I am going to send for even more tags because after I used all the tags I saw hundreds more that I hadn't tagged yet. I hope they are all safe somewhere.

In Cub Scouts I not only got my Wildlife badge but my academic pin in Wildlife, and the Conservation badge. Working with the monarchs helped me accomplish some of the requirements. I hope it was a successful year of tagging monarchs. Thank-you for letting me be a part of the tagging.

P.S. I like your website!

Lakotah Farrell
Damariscotta, ME

.....

Just wanted to let you know how fun this was to do! It turned into a family adventure! We can't wait until next year. Thank-you for a wonderful program.

Dee Lahey
Dixon, IL

.....

Here, at long last, is the money, \$445.40, my class raised to donate to Adopt-A-Class! Parents and students at South Shore Charter School are constantly called upon to fundraise to

meet our own needs. Being a Charter School, we do not have access to much of the funding available to traditional public schools. Our community recognizes that our school's needs and shortcomings pale in comparison to the hardship experienced by much of the world's children. We feel that reaching beyond what we want for ourselves, and identifying needs of others is an important life skill and habit for our students to acquire.

Each teacher and Pod chooses a community service project and builds curriculum around it. Pod 4 chose to become more involved with monarchs, milkweed and especially with Adopt-A-Class. I enlarged the pictures of the children in the season summary. This helped my K-2 students relate on a more personal level to the human element. We studied Mexican culture and we talked about, and worked on developing empathy.

The Monarch Watch Site and Season Summary have provided us an incredible resource with a wealth of important information. Thanks to your educational offerings and our participation in Journey North activities, I feel my students have benefited from real life, learning experiences focused in all the disciplines.

To raise money for a contribution, my students and I were excited to come up with two very marketable ideas. The glass globe Christmas ornaments filled with milkweed floss and the Mother's Day Plant sale were both well received. My young entrepreneurs applied and practiced math concepts and other skills as they planned, created, advertised, conducted and totaled up their sales from these projects.

I couldn't begin to list here all of the activities related to monarchs, Mexico, science, and social studies. High on the list of their favorite activities were, of course, raising their monarchs and I should mention the fun we had exploring the principles of flight as we tested out the different butterfly designs included in Dr. David Gibo's article. Roll, pitch and yaw were very popular with the Kindergartners, especially! Thank you for including that and for so much, much more...

Velma Begley, K-2 Pod Teacher
and "The Milkweed Pod"
Cohasset, MA

FREQUENTLY ASKED QUESTIONS

Can I ship my monarchs south when it is too cold to release them here?

Late in the season, people who raise monarchs or find them in the wild, often worry that the butterflies will not be able to survive the cooler temperatures and won't make it to their destination in Mexico. This may be true. As the season progresses past the peak of the migration, the chance that a newly emerged monarch will arrive at the overwintering sites declines. We suggest you release your monarchs as long as the daytime temperatures are high enough to allow flight (a minimum of 60°F) and nighttime temperatures do not regularly drop below freezing. Monarch adults can escape some frosts by roosting high up in the trees along their migration route.

We do not recommend shipping your monarchs to more southern states. A lot



of paperwork is involved to legally ship monarchs across state lines, and you need to have permits from the USDA for each state you plan to ship to. Instructions and an application for a permit (PPQ Form 526) can be obtained from the USDA Web site at www.aphis.usda.gov/ppq/permits/butterflies.htm. It is best to either release these stragglers or keep them in the classroom for instructional purposes. For more information on maintaining monarchs, visit our website.

Why do my monarchs feed on Dill?

Black Swallowtail larvae are often confused with monarch larvae. Monarch



larvae only feed on members of the milkweed family (Asclepiadaceae), while swallowtail larvae feed on members of the carrot family (Apiaceae) including dill, fennel, carrot, parsley, etc. Black swallowtails have green and black stripes with orange spots, whereas monarch larvae have yellow, black, and white stripes. Swallowtail larvae also have a Y-shaped organ called an osmeterium that protrudes from behind their head if they are disturbed. This organ emits a pungent odor to ward off potential enemies (see photos above).

Where can I go to see the migration?

From August through November, migratory monarchs seek roosting areas that provide shelter from the wind and weather. The best places to find these roosting areas are on the north sides of hedgerows and in trees along rivers or

near wetlands. Monarchs use certain areas year after year. The best times to see the clustered butterflies are at dusk and dawn. If you want to find monarchs throughout the day, try locating their favorite nectar sources such as butterfly bush, thistle, aster, goldenrod, and other late season bloomers during the migration.

If you are interested in locating monarchs in your area or need help finding a good place to tag monarchs, try contacting the Monarch Watch regional coordinator for your state to see if they can help. A list of the regional coordinators for Monarch Watch can be found on our website.

Why did my monarch pupa die?

Monarchs, like all other living organisms, are subject to disease, parasites, and developmental problems. The two most common causes of pupal mortality are parasitism by tachinid flies and infections of a neogregarian protozoan (Ophryocystis). A discussion of how to control the protozoan may be found on our website. Bacteria, viruses and exposure to freezing temperatures can also cause pupae to turn black and eventually die.

Four species of tachinid flies can lay their eggs on monarch larvae. The tachinid larva burrows into a monarch larva and eats tissues and fluid from the



monarch's body. The monarch larva lives and continues to grow until the tachinid larva is ready to leave. When the monarch pupates, the fly larva kills its monarch host. You can usually tell if your monarch was parasitized by a tachinid fly by the tell-tale stringy substance trailing from the dead "J"-shaped larva or pupa. If you rear your monarchs in cages, you should be able to find the small brown fly pupa lying on the floor of the cage.

Braconid wasps sometimes parasitize larvae. The female brachonid lays one egg inside the monarch larva. From that egg, as many as 32 genetically identical adults develop. You will know if your pupa has been parasitized if you see gnat-sized wasps in their container or if you notice a hole in the pupa. Parasitism by flies and wasps can be avoided by rearing the larvae indoors or under netting outdoors. For netting, we use five-gallon paint strainers and sleeves made from fine-meshed mosquito netting.

Help! I found an injured (or stranded) monarch, what do I do with it?

If the butterfly is injured, you should try to determine if it is able to fly. If it can fly, release it. If it cannot fly, the best thing you can do for it is take it to a local school or keep it in a cage in your home for its lifespan (about one month). If it is unable to feed, you might consider euthanizing the butterfly. We recommend chilling the butterfly in the refrigerator (in an envelope) for ten to twenty minutes and then placing it in the freezer. This method should slowly shut down the butterflies senses as if entering a dormant stage and humanely puts it to sleep.

If you keep the monarch, feed it a 10% sugar water solution (or our Nectar Kit, Gatorade, or Juicy Juice). To feed the butterfly, place a plastic mesh scouring pad in a shallow cup full of sugar

water. The level of the solution should be near the top of the scouring pad. The feeder is placed near the light source in a cage. Sugar water ferments and should be changed daily. If your butterfly is not feeding, you can gently pick it up (by grasping its closed wings) and place it on the feeding dish. Hold it there until its proboscis unfurls and touches the solution. If your butterfly does not unfurl the proboscis on its own, use a pin or the end of an extended paper clip to unfurl it. After eating the first time, the monarch will not need any further assistance. Your butterfly can be housed in a "food tent" used at picnics in the summertime to keep insects off of food. This mesh tent placed on top of a pizza box would be an adequate home for your butterfly.

Why can't I find monarch larvae in the wild?

Monarch larvae are very good at avoiding detection in the wild, their tactics work well to disguise them against predators. However, there are several tricks that will help you find those sly larvae. Once you find their milkweed host plant, start looking for the dark green frass (droppings) against the light green milkweed leaves. Check the underside of the milkweed leaves and look for leaf damage and leaves that have been "flagged" by later instar monarch larvae. Flagging is the chewing of a notch in a leaf vein, which causes the leaf to droop. This behavior may prevent high



A fifth instar monarch larva on a partially flagged milkweed leaf. Photo by Jim Lovett.



Tussock moth larvae also feed on milkweed. Photo by Jim Lovett.

levels of toxic latex from being ingested while they feed. Eggs and young monarch larvae are almost always found on the underside of the leaves. Females usually only lay a single egg per leaf. Don't be fooled by clusters of yellowish eggs of the Milkweed Tussock Moth, whose larvae also feed on milkweed. The largest monarch larvae usually wander off their host plant when they are ready to pupate. They seek dark protected areas that offer some shelter from the sun and predators. Generally, it is easiest to find monarch larvae in the late summer and more difficult to find them early in the spring and late in the season (after most of the migration has moved through your area). Good luck and happy hunting!

Can I share my tags with people who run out during the tagging season?

Monarch Watch has an immense task of tracking 250,000 tags and collecting datasheets from our taggers. When tags are transferred to others, errors in record keeping are more likely. This is why we ask that you to refrain from sending your unused tags to other people during the tagging season. If you want to help someone who is out of tags, we request that you return full sheets of unused tags to Monarch Watch so that we may reissue them and properly record to whom they've been distributed. Without this information, we are unable to track shared tags when they are recovered. ■

EXPANDED MONARCH RESERVE

Reprinted from the Monarch Butterfly Sanctuary Foundation (MBSF) 2001 Newsletter

An Expanded Monarch Butterfly Special Biosphere Reserve

by Lincoln Brower, Mónica Missrie, Karen Oberhauser, and Elizabeth Howard

A central goal of MBSF is to encourage protection of the forests in which eastern North American monarch butterflies overwinter. Late last year, we took a big step towards that goal, demonstrating that cooperative efforts between conservation organizations, governments and citizens can effect significant change. Here's what happened!

Deforestation Study

Last December, MBSF's Dr. Lincoln Brower submitted a jointly-written manuscript to the journal *Conservation Biology* that represented the culmination of a major international effort. The study documented continued deforestation in and adjacent to five major monarch overwintering sites that had supposedly been protected by a Presidential decree in 1986.

In 1997, Dr. Guillermo Castilleja, then Director of the World Wildlife Fund Mexico, saw the need for objective data to convince the Mexican government of the severity of the deforestation. MBSF offered scientific support and half the salary of a person in the WWF office whose time would be devoted mainly to monarch issues. Mónica Missrie was hired to fill this position, and Missrie and Castilleja assembled a scientific team that included Brower and National University of Mexico scientists Armando Peralta, Jose Lopez, and Luis Bojorquez. The team documented changes in 42,020 hectares (1 hectare (ha) = 2.47 acres) of the forest ecosystem where most North American monarch butterflies overwinter.

Analyses of aerial photographs meas-

ured progressive decline of what had been a nearly continuous high quality forest to a series of smaller fragments of degraded forest (see maps). From 1971 to 1999, 44% of the forest was degraded and the largest patch of high quality forest was reduced in size from 27,115 to 5,827 ha. The annual rate of degradation from 1971-1984 was 1.70%, and increased to 2.41% during the next 15 years. At this rate, less than 10,000 ha of the original high quality forest will remain in 20 years, and less than 4,500 ha in 50 years. A subset of the analysis quantified even more rapid changes in a 6,596 ha area on the Sierra Chincua, Sierra Campanario and Cerro Chivati-Huacal mountains that had been protected by the 1986 presidential decree. The study concluded that the 1986 decree had failed to protect the forests.

A New Decree

A turning point in discussions with the Mexican government occurred in spring 1999 when study authors made a formal presentation of the findings to Dr. Julia Carabias, Secretary of the Environment, Natural Resources and Fisheries Ministry (SEMARNAP). After viewing proof of the extensive changes, Secretary Carabias asked WWF-Mexico to help develop a plan that would serve as the basis for revising the 1986 decree. On 10 November 2000, President Ernesto Zedillo officially announced a new decree expanding the Monarch Butterfly Reserve from 16,100 to 56,259 ha.

The new decree was announced at the Presidential Mansion in Mexico City in a ceremony which began with a speech by Carabias. She described the importance of conserving the forests critical to the monarch's winter survival, and acknowledged that the 1986 decree had proven insufficient and provided few benefits for local inhabitants facing a dilemma they describe as "either we conserve the butterflies or we feed our children." Secretary Carabias thanked Dr. Lincoln

Brower for his years of research and WWF-Mexico for the new plan and for developing an innovative mechanism to compensate landowners. She then thanked William Reilly of WWF-USA for his help in obtaining a five million dollar donation from the Packard Foundation to be administered by the Fondo Mexicano para la Conservación de la Naturaleza (FMCN). To the delight of all, she announced that the federal government would add one million dollars to the fund and that the state governments of Michoacan and Mexico will contribute as well.

Kathryn Fuller, President of WWF-US, thanked President Zedillo for his support of conservation activities in Mexico during his administration and Secretary Carabias for her leadership. She also thanked UNAM, Dr. Brower and the WWF team for helping make this innovative scheme become a reality. Ms. Fuller said the new decree represents a unique opportunity to protect the monarch butterfly.

President Zedillo thanked all the speakers and said that a Land Use Plan has been drafted with the help of the governments of the States of Mexico and Michoacan and SEMARNAP. The President thanked conservation organizations for their help and support during his administration. He stated that the Monarch Butterfly Reserve is an example of how economic and social development can go hand in hand, emphasizing that it was all possible thanks to joint efforts from all sectors of society. He ended by expressing his confidence that the United States and Canada will also protect the butterfly's migratory route in their territories.

A New Conservation Scheme

Economic incentives for local landowners need to be implemented to achieve successful conservation of the new Reserve's forest ecosystem. To this end, WWF and the Fondo Mexicano

para la Conservación de la Naturaleza (FMCN) have established a trust fund to provide money for long-term conservation activities and sustainable forest management by the local communities within the core zone of the new Reserve. As with the deforestation study and the revised decree, Mónica Missrie was instrumental in setting up the details of this trust fund. For the first time in Mexico's history, a conservation fund has been created specifically to offer incentives to local communities affected by the establishment of a protected area, making them integral partners in conservation. This fund will finance the purchase of current logging permits inside the new core area of the Reserve and provide payments for forest conservation activities in the Reserve's Management Program. Payments will be financed with the interest earned from the money donated by the Packard Foundation and the Mexican government, and future donations to the FMCN. The campesinos were part of the process from the beginning; before the decree was promulgated they signed legal agreements with WWF, FMCN and the government accepting the new boundaries and the compensation mechanism.

Although details remain to be worked

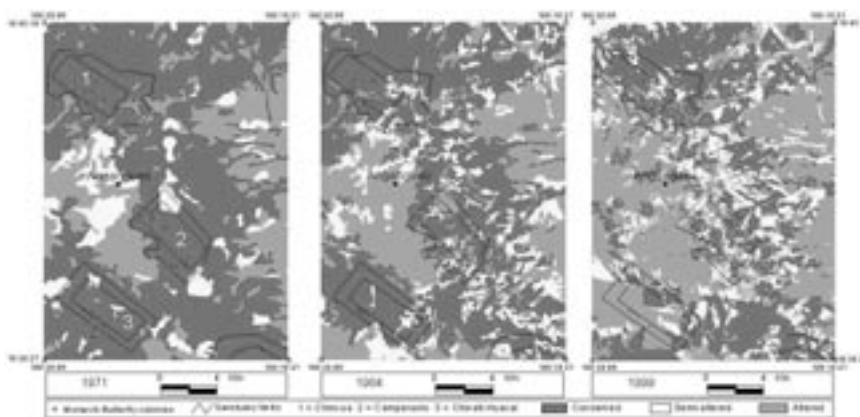
out in setting up the payment structure, the day the legal agreements were signed (October 24, 2000) WWF and FMCN promised the campesinos they would get an advance in December. Each ejido received an invitation, and several checks were distributed on December 26, 2000. The pragmatic complexities of the issues that need to be addressed is illustrated by the fact that some campesinos could not receive their checks because they have no bank accounts; these individuals will be helped as they establish legal mechanisms for receiving payments.

What's Next?

The success of expanded protection for the monarch overwintering sites will depend on several things. Probably most important is the satisfaction of the landowners with the compensation scheme, which will require communication and trust between parties that



New reserve boundaries (above). The small polygons represent the old core and buffer zones of Sierra Chincua, Sierra Campanario, and Chivatí-Hualcal (top to bottom). The inner and outer contiguous polygons are the new core and buffer zones. White dots represent known locations of monarch colonies during the last 20 years.



GIS maps showing forest cover in 42,020 ha. Numbers on the left map indicate 1986 protected area boundaries (core and surrounding buffer zones of 1) Sierra Chincua, 2) Sierra Campanario (Rosario), and 3) Chivatí-Hualcal. The darkest color on the maps represents conserved forest (see legend). From a manuscript in press by "Conservation Biology" titled "Quantitative changes in forest quality in a principal overwintering area of the monarch butterfly in the states of Michoacan and Mexico: 1971 to 1999"; Courtesy of WWF-Mexico, and the authors.

have sometimes been at odds in the past. Commitment to the project on the part of the campesinos will only evolve if they see that a healthy forest ecosystem also benefits them, and MBSF and other organizations are continuing to ensure that this is both apparent and true. In addition, there must be effective enforcement against logging within the oyamel-pine forest ecosystem and restoration of areas that have been degraded, and we will support efforts to assure that these things happen. We are also concerned about the seven other known overwintering areas in the region that were not included for protection under this decree. A major role for MBSF in the future will be monitoring the success of the forest protection, and ultimately helping to increase the size of

the trust fund to extend the reserve. In addition, we hope to help assure the protection and reforestation of the new buffer zone. We anticipate even greater collaboration with WWF-Mexico and other organizations involved in helping to make all of these things reality.

Endnote

MBSF learned early that significant changes in the status of the Monarch Reserve were more likely to succeed if they originated in Mexico. Our support of a position devoted to monarch conservation at WWF-Mexico, a respected and established conservation organization, provide an important impetus to add monarch conservation to their mis-

sion. Together, we have made significant progress toward our goal of protecting the forests in a way that respects and benefits local landowners.

**To view this
article in the
MBSF Newsletter
in color, please
visit them
online at
www.MBSF.org**

"Winter" continued from page 17

tations than they are for their accuracy. It is also clear that it is virtually impossible to obtain accurate and timely information on what is happening or has happened at the more remote monarch colonies since they are visited so few times each year by knowledgeable authorities. In the future, it is my hope that parties dealing with monarch disasters - yes, there will be others - will act with dispatch, discretion, and in consultation with knowledgeable biologists and local authorities.

Chip Taylor
Director, Monarch Watch

Developmental Anomalies and Mutations



Specimen provided by Charlie Cameron. Photo by Jim Lovett.

Male or Female?

If you look closely at the monarch pictured at left you will note that both sexes are represented on the wings of this specimen. The difference extended to the genitalia as well with the male side of the abdomen having a clasper and the female side showing a notch for the gonopore or mating opening. How is this possible? Specimens in which the left half is one sex and the right half is another are known as bilateral gynandromorphs. Some of the best known examples of this condition are found in the Lepidoptera, particularly in species in which the males and females are strikingly different in color and pattern such as the common sulphurs of the genus *Colias*. This condition arises at the

first cell division after fertilization. In this case an egg with an X (sex) chromosome was fertilized by a sperm also carrying an X. However, somehow during replication and cell division one of the new cells did not receive an X and therefore the new cell was XO (female) and all tissues which subsequently developed from this cell became female.

Dark Monarch

The monarch pictured at right shows an excessive deposition of melanin (black) pigment. This could be a genetic mutation controlling color and pattern but it could also be a developmental anomaly in which an environmental stimulus such a cold shock resulted in excessive production and deposition of black pigment.

Photo by Jordan D. Marché II, Ph.D.



POPULATION DYNAMICS MEETING

by Chip Taylor

Monarch experts from the United States, Mexico, Canada, and Australia gathered at the University of Kansas in Lawrence, KS on 20-23 May 2001 to present research on the dynamics of monarch populations.



A group photo showing most of the more than ninety attendees of the first Monarch Population Dynamics Meeting. Photo by Jim Lovett.

Karen Oberhauser and I conceived of and planned this meeting as a result of our interests and training as ecologists and population biologists who are concerned with the long-term continuation of the monarch population in eastern North America. Although we have learned a great deal about monarchs in the last few years, our knowledge of monarch population dynamics is too general, and too qualitative to be used to argue effectively for particular conservation policies. We need quantitative information on the factors that influence the birth rates and death rates of monarchs throughout their annual cycle.

Recent reports of the degradation of the forests at the overwintering sites in Mexico, the possible impact of transgenic crops such as Bt corn on monarch populations, and changes in agricultural practices that may affect the availability of milkweed host plants raise significant concerns about the potential impact of human activities on the dynamics of monarch populations. These concerns coupled with observations of massive swings in the numbers of monarchs observed each year at the overwintering

sites in Mexico (e.g., 210 million in 1996 - 28 million in 2001) beg questions of cause and effect. Clearly, to conserve the monarch migration in eastern North America, we need to be able to distinguish the effect of anthropogenic factors on the population from those attributable to biotic and abiotic (weather related) causes.

Accordingly, the goals of the meeting were: 1) to integrate existing knowledge on monarch population dynamics. 2) to inform conservation organizations and decision-makers of the status of the eastern monarch population. 3) to form collaborations for future research and suggest important research directions. Outcomes of the meeting will include a volume with contributed chapters (edited by Karen Oberhauser, Chip Taylor and Jurgen Hoth); and a summary paper with analysis and recommendations that will be given to government agencies concerned with monarch conservation.

This meeting signals the start of a unique project - namely, an effort to gain an understanding of the annual dynamics of a migratory species with a continental distribution. This will be a major collaborative effort extending over several years involving many scientists and large numbers of citizen scientists. We hope that many of you will contribute to these efforts.

Meeting Summary

We were very pleased at the participation in the meeting, it exceeded our expectations.

There were 31 presentations, 8 poster presentations and over 90 in attendance at the three day conference.

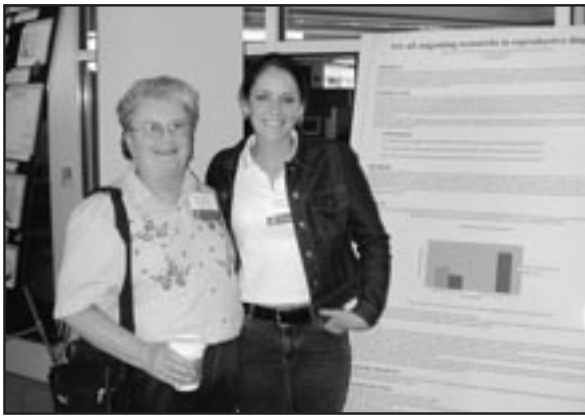
The convention started with a reception on Sunday evening at the Lawrence Holidome, the temporary residence of most of the participants. The meeting was held in Joseph R. Pearson (JRP) Hall at the University of Kansas. After more than a day and a half of talks, we visited two local prairies to see remnants of the monarchs' original habitat and to see milkweed species that are limited to prairies. In all, the participants had a chance to see 12 milkweeds including flowering plants of the rare and endangered *Asclepias meadii*. An evening barbecue followed the visits to the prairie. On the third day of the meeting we broke up into three working groups to summarize what is known and what needs to be learned about monarchs during their annual cycle. The range of topics discussed was broad and included wintering biology, breeding biology and migration as well as education and policy issues. These discussions were aided by Jurgen Hoth, Sandra Perez, and Michelle Solensky who served as moderators for these sessions.

The presentations were grouped into categories as follows:

Overwintering biology and conservation. This section featured the



Hunting for uncommon milkweeds (including *Asclepias meadii* and *A. hirtella* - see "Featured Milkweed" page 22) in the Aikin Prairie east of Lawrence, KS. Photo by Cathy Walters.



Mary Bishop Kennedy and Kristin Duncan alongside Kristin's poster at the meeting. Photo by Jim Lovett.

keynote address by Lincoln Brower on the "Changing states of the forests in the monarch butterfly overwintering areas in Mexico." In this presentation Dr. Brower summarized the recent collaborative effort with his colleagues of World Wildlife Fund Mexico on the progressive degradation of the forests within and surrounding the protected monarch colonies. Other topics included the expansion of the monarch butterfly biosphere reserve (Missrie), overwintering by monarchs in California (Cherubini, Frey, Leong, Manion), biology of overwintering monarchs, and relevant forest dynamics in Mexico (Calvert, Garcia, Keiman, Rendon).

Breeding biology. This topic included information on the genetic structure of monarch populations in Mexico (Montesinos), heritability of mating success in males (Solensky), predation on monarch larvae by paper wasps (Rayor), monitoring of larval densities with the help of citizen scientists (Prysby), larval feeding habits in relation to plant chemistry (Hoevenaer), and the occurrence and use of milkweeds by monarchs in agroecosystems (Jesse, Oberhauser, Obrycki, Pleasants).

Migration. This group of presentations included a summary of the patterns of spring recolonization (Howard), wing wear as an indicator of the origins of spring monarchs (Malcolm), evidence for celestial cues that initiate and maintain the pace of the fall and spring migrations (Taylor, Gibo), monitoring the fall migration at

specific sites (Davis, Gibbs - unable to attend), ecological and geographic factors that influence the monarch migration in Mexico (Solis), and ongoing research on possible genetic differences among monarch populations (Perez).

Integrating and modeling. Speakers covered the transmission and dynamics of a protozoan that affects monarchs

(Altizer), the development of a model of the migration and the rate of growth of monarchs through the breeding season (Feddemma), migration and decline of winter aggregations in Australia (James), and spatial and temporal dynamics of monarchs in Australia (Zalucki).

Regulation. In this section Wayne Wheling discussed the laws and regulations that serve to protect monarchs.

One of the delightful and gratifying aspects of the meeting was the presence of eleven student scientists and their teachers (facilitated by Karen Oberhauser's teacher training grants). These students presented seven posters on such topics as a comparison of fall monarchs from Minnesota and Texas (Borland, Johnson and their students Crumpton, Montes, Tovar, and Watkins), reproductive diapause in migrating monarchs (Kennedy and Duncan), how monarchs find their host plants (Kennedy, Spurgat, and Leach), the effect of malathion on adult and larval monarchs (Petersen and Clancy), the feeding preferences of weevils that infest milkweeds (Petersen and Peterson), the effects of garden chemicals on plants and invertebrates (Strom, Proctor, and Saline), and fluctuations in monarch populations in northern Minnesota (Strom, Proctor, and Saline).

After the meeting we received several inquiries about the location and dates of the next meeting! Although it would be great to have a meeting each year, it takes a great deal of time and money to put these meetings together and we

need a good justification or theme. Nevertheless, as we move forward on projects to provide quantitative information on the dynamics of monarch populations, we will give considerable thought to having smaller meetings to coordinate efforts by citizen scientists.

Funds to support the first Monarch Population Dynamics Meeting were provided by:

Monarch Watch

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Monarchs in the Classroom

• • •

**Monarch Butterfly
Sanctuary Foundation**

• • •

**The National Fish
and Wildlife Foundation**

• • •

**The United States Fish and
Wildlife Service**

• • •

**The University of Kansas
Office of the Provost**

• • •

**The University of Kansas
College of Liberal Arts and Sciences**

• • •

**The University of Kansas
Department of Ecology and
Evolutionary Biology**

• • •

**The University of Kansas
Natural History Museum and
Biodiversity Research Center**

Excellent support for the meeting was provided by Laura Razo and Penny Hodge of the Kansas University Continuing Education program. And, of course, none of this would have been possible without the help of the Monarch Watch staff and students: Jim Lovett, Dana Wilfong, Cathy Walters, Larry Gibbs, and Jennifer Thomas. The program for the Monarch Population Dynamics Meeting may be downloaded as a PDF file from our website at www.MonarchWatch.org and includes abstracts submitted by the monarch experts who spoke at the meeting.



2001 Monarch Meeting Presentations



Overwintering Biology and Conservation

Lincoln Brower (Keynote Address) Changing states of the forests in the monarch butterfly overwintering areas in Mexico
Monica Missrie - The Expansion of the Monarch Butterfly Biosphere Reserve

Dennis Frey - Spatial and temporal pattern of monarch overwintering abundance in western North America

Eligio Garcia - Behavior analysis of the monarch butterflies (*Danaus plexippus* L.) in their overwintering sites in Mexico

Christian Manion - Thanksgiving Counts and Western Population Dynamics

Eduardo Rendón-Salinas - Forest structure, cover and regeneration of the monarch butterfly's overwintering sites in Sierra Chincua, Michoacan, Mexico.

Paul Cherubini - A photo tour of monarch overwintering sites along the California coast.

Kingston Leong - Analysis of California's monarch overwintering habitats using GIS

Andres Keiman - Successional dynamics and self-clearing in the oyamel forest of the Monarch Butterfly Biosphere Reserve

Bill Calvert - Estimates of the population size of monarch overwintering colonies in Mexico

Breeding Biology

Eneida Montesinos - Genetic Structure of migratory and local populations of monarch butterflies in Mexico. Implications for the conservation of the migratory phenomenon.

Michelle Solensky - Heritability of male mating success in monarch butterflies (*Danaus plexippus*)

Laura Jesse - Stability of common milkweed (*Asclepias syriaca*) infestations in cropland and adjacent areas.

Michelle Prysby - Temporal and geographical variation in monarch densities: Using citizen scientists to document monarch population patterns

Karen Oberhauser - The Importance of Agricultural Habitats to Eastern NA Monarchs

John Obrycki - The occurrence and abundance of *Danaus plexippus* L. (Lepidoptera: Danaidae) on *Asclepias syriaca* (Asclepidaceae) in corn agroecosystems.

Linda Rayor - Polistes Wasp Predation on Monarch Caterpillars

John Pleasants - Monarch populations in agricultural fields: possible reasons for oviposition preference and the impact of agricultural practices.

Migration

Elizabeth Howard - Analysis of Spring Monarch Migration Patterns 1997 - 2001

Chip Taylor - A general theory to explain the movement of migrating Monarchs across latitudes: Part I - Migration south

David Gibo - A general theory to explain the movement of migrating Monarchs across latitudes: Part II - Migration north

Andrew Davis - Monarch migration on the Eastern Shore of Virginia: monitoring methods and stopover ecology of fall migrants

Denise Gibbs - An overview of the Chincoteague monarch monitoring project, 1997-2000

Roberto Solis - Factores ecológicos y geográficos de la migración de mariposas monarca (*Danaus plexippus*) en México

Integrating/Modeling

Sonia Altizer - Transmission and population dynamics of the protozoan parasite *Ophryocystis elektroscirrha* in monarch butterflies

Johannes Feddema - Simulating the Migration and Development of the Monarch Butterfly (*Danaus plexippus*)

David James - Monarch Migration and Winter Aggregation in Australia: An Endangered Phenomenon?

Myron Zalucki - Spatial and temporal population dynamics of Monarchs down-under: lessons for North America

Regulation

Wayne Wheling - The role of the United States Department of Agriculture in safeguarding the monarch butterfly

Posters

Ms. Jane Borland, Tiffany Watkins, Trey Crumpton; Ms. Carol Johnson, Brenda Montes, James Tovar - Characteristics of Fall Migratory Monarch Butterflies, *Danaus plexippus*, in Both Minnesota and Texas

Ms. Mary Bishop Kennedy, Kristin Duncan - Are all Migrating Monarchs in Reproductive Diapause?

Ms. Mary Bishop Kennedy, Stephanie Spurgat, Bethany Leach - Do Monarch Larvae Use Visual or Chemical Stimuli to Find Milkweed?

Dr. Ilse Ortabasi - Science Snoops & Backyard Bugs: The Monarch

Ms. Cindy Petersen, Jill Clancy - A Silent Killer

Ms. Cindy Petersen, Sarah Peterson - Danger: Weevils

Ms. Annette Strom, Jenna Proctor, Brittney Saline - Effects of Common Garden Chemicals on Invertebrates

Ms. Annette Strom, Jenna Proctor, Brittney Saline - Population Fluctuations

THE BEST OF DPLEX

Dplex-L (named for *Danaus plexippus*) is one of the email discussion lists for Monarch Watch. We created this list to facilitate reports of sightings, observations of Monarch biology, as well as discussions. This past year the list has been dominated by discussions of points of view of Monarch conservation. The following postings to Dplex-L have been selected because they provide new and or useful information. These notes have been edited.

White Monarchs

10 Apr 2001

I know there are a number of people on this list who are interested in the white form of the Monarch (nivosus) which used to be common on the Hawaiian island of Oahu.

Max Moulds and R. B. Lachlan have just published a paper in the Australian Entomologist reporting the existence of an established population of white Monarchs on the Vanuatuan Island of Aneityum. This is significant because it is the only known established population of white monarchs apart from that in Hawaii. The proportion of the Vanuatu population (around 20% of the total monarch population) is greater than that of Hawaii which had a maximum frequency of approximately 8% (It is now much lower).

The discovery of white monarchs in Vanuatu provides an opportunity for hybridization experiments between the Hawaiian and Vanuatu populations, which may shed light on the origin of the white form. It is hypothesized that white monarchs are a consequence of inbreeding the trait due to isolation.

*The full reference for the paper is: Moulds, M.S. and Lachlan, R.B. (2001). First record of white monarchs, *Danaus plexippus* (L.) form nivosus (Lepidoptera: Nymphalidae). The Australian Entomologist 27: 113-116.*

David G. James

How to Fix Wings

19 Jun 2001

Is there any way a person can fix a butterfly's wings? Would an appropriately sized and

cut out computer label be too heavy to attach to the remaining wing after it's torn?

Suzanna McMahan

19 Jun 2001

A price sticker type label can be used to splice a fore wing. You can make one about 1/2" long and 1/3" wide. Make a duplicate too.

Then use both pieces of paper to splice the wing. A small amount of ordinary rubber cement makes an excellent adhesive to hold everything together- strong yet flexible and waterproof. Allow about 10 minutes to dry. You can hold the butterfly down during the drying with heavy coins.

Repaired butterflies can usually fly reasonably well.

Paul Cherubini

20 Jun 2001

You can fix wings using nail varnish and a splint made from another dead adult's wing. This is a strong fix and the butterfly can fly easily without being lopsided.

Nigel Venters

23 Jun 2001

Elmers white gluenworks better than varnish. It needs to dry competely and then is waterproof. I place wax paper between the wings a dead wing splint on the undersurface of the wing and use a clothes pin to secure the wins together for about 20 Minutes.

John Beck

Tachinid Parasites

A discussion of the possible impact on monarchs of a tachnid fly parasite, *Compsilura concinnata*, introduced to control gypsy moths led Mike Quinn to report a list of tachinids reared from monarchs.

12 Apr 2001

Known Tachinid Parasites of Monarchs. Paul H. Arnaud, Jr. 1978. A host-parasite catalog of North American Tachinidae (Diptera). USDA Misc. Publ. No 1319. 860 pages.

On page 615, Arnaud (1978) lists the fol-

lowing Tachinid fly parasites of the Monarch:

Buquetia obscura, Chaetogaedia monticola, Compsilura concinnata, Eusisyropa virilis, Exorista mella, E. spp., Lespesia archippivora, L. schizurae, L. spp., Madremyia saundersii, Phryxe pecosensis, P. vulgaris*

**According to Chip Taylor, Lespesia archippivora is the "most common and widespread species" of Tachinid to parasitize Monarchs.*

Mike Quinn

[Although *L. archippivora* is a wide spread and common species, given the new information, my statement should be re-examined. --Chip Taylor]



This tachinid fly larva emerged from a fifth instar monarch larva.

Photo by Patti Rose.

Do Danainae Occur in Kenya?

9 Feb 2000

*There are a great number of Danainae in Kenya. The most common one is the *Danaus chrysippus* (The African Queen or the common tiger). Its found practically all over Kenya (yeah, I've seen them even in some really dry parts of the country), and sometimes you can see many of them "socialising" in damp mud patches. It's quite an interesting butterfly, and is known as one of the most polymorphic butterflies. I have seen many other butterflies that mimic this species...I think its quite toxic too, because the roots of Crotalaria (which contain pyrrolizidine alkaloids) make good baits to*

attract these butterflies. Our Kenyan "version" of the American monarch also migrates (though I have never been lucky enough to witness this myself). But the mixed migration in which it participates is nothing as impressive on international standards as the migration of the American Monarch... From the genus 'Danaus', this is the only Danainae I know of that we have in Kenya. Other Danainae are from the genus 'Amauris' - the ones I know of are *Amauris echeria* (Chief) and *Amauris albimaculatus* (Layman). There are lots of other Danainae...you just need to go down to a river bank that's muddy enough and you can see so much Danainae diversity, as well as all those other species that mimic the Danaids.

Smruti Damania
East Africa

Growing milkweeds

23 Oct 2000

I'm sure everyone has their own way of growing perennial milkweeds from seed, but here is what works best for me; I usually get a 100% germination rate:

Collect seedpods in paper grocery bags; fold top of bag down; shake really hard (kids love this part); cut one inch off of a bottom corner of bag; seeds pour out; silky parachutes are contained in bag; use to stuff a small fabric pillow.

Spread seeds out on newspaper; remove and relocate assorted insects (kids really love this part too); discard any damaged or dessicated (embryo will look shriveled) seeds.

Sow seeds in a plastic flat (or in individual pots) of moistened seed-starting mixture (it usually contains little or no soil—mostly vermiculite, peat moss, etc.) Cover seeds with about one-quarter inch of mixture.

Cover flat or pots loosely with plastic bag; store in refrigerator for one month (this is the cold-moist stratification part that mimics nature).

Take from refrigerator; remove plastic; germinate on heating coils under fluorescent lights or in warm sunny spot. Watch grow; dream of Monarchs nectaring and ovipositing on your plants.

I'd advise against using peat pots- the soil contained in them has a tendency to dry out very quickly; I recycle plastic food containers for this purpose.

Denise Gibbs

Wings and Wildflowers Nursery

A Butterfly Park and Monarch Migration Sanctuary

1 Jan 2001

In referenced to monarch 419 RW, Tagged 8-30-00, Male, Monona, IA, on willow. This monarch was tagged in a new butterfly park in Monona created to enhance and preserve a piece of land that the monarchs have roosted in for at least the past 5 years. This butterfly park and prairie restoration project is an Iowa Earth Year 2000 initiative and has received funding from both the Iowa Earth 2000 Grants Program and an Iowa REAP Grant totaling \$46,900. The grants were written indicating that this area is an annual roosting area and that the tagging that has now produced 14 returns in the last 3 years in support of a larger national study. Thanks Monarch Watch and keep up the good work.

Jim Langhus
Monona, IA



Monarchs killed by scissor-tailed flycatchers at J.W. Stewart's home in Uvalde, TX. Photo by Chip Taylor.

Scissor-tailed Flycatchers

2 Nov 2000

I wanted to report that a neighbor from a block away out here in the country 12 mi. north of Eagle Pass came to report that yesterday evening just as the monarchs were clustering in the trees above his garden a flock of scissor-tailed flycatchers numbering about 20-30 birds moved in on the clusters in a "boiling mass" and began taking the monarchs off the trees. He watched them fly to the electric wires behind

the house and "tear the wings off before eating the abdomen." I'm on my way over there now to see how many carcasses I can retrieve. He said he thinks there were about 40 butterflies....

At a wild guess I'd suspect that this the same group of birds observed by J. W. Stewart southeast of Uvalde on Monday through Thursday of this past week. Uvalde is 65 miles northeast of here as the crow (or scissor-tail) flies.

Carol Cullar
Lehmann Research Foundation

Invertebrate Predation

6 Oct 2000

I have just published a paper "Feeding on larvae of *Danaus plexippus* causes mortality in the assassin bug, *Pristhesancus plagipennis*" (The Australian Entomologist 2000. Vol 27: 5-8.). I found that these Australian assassin bugs fed exclusively on monarch larvae, died after 11-20 days after consuming 10 -34 larvae.

Thus, the cardiac glycosides in monarch larvae ARE capable of killing this assassin bug and perhaps other invertebrate predators, although it is unlikely that assassin bugs, praying mantids or other generalist predators in the wild, utilize a diet of ONLY monarch larvae. Whether these invertebrate predators 'learn' to avoid monarch larvae (like birds do) remains to be investigated...

David G. James
Washington State University

Late Summer Monarchs

3 July 2001

Please report all sightings of monarchs seen in August and mid September at latitudes of 38 degrees or less to Monarch Watch. A recent paper by Bill Calvert, personal observations, and numerous previous reports to D-plex suggest that reproductive monarchs begin moving south in early August - effectively recolonizing areas devoid of monarchs from mid May to late summer. We need locations and dates of any sightings below 38 degrees - imagine a line from mid KS to the east coast. These data will be used to test a new theory concerning the migration.

Chip Taylor

MONARCH MONITORING PROJECTS

The number of monarch monitoring projects continues to grow. Five programs have been established to monitor the fall migratory population east of the Rocky Mountains. The first and most well known of these programs was established by Dick Walton and Lincoln Brower at Cape May, New Jersey. This program is supported by a web site at www.concord.org/~dick/mon.html and the observations of the fall populations at Cape May are recorded for each year since 1991. These are very valuable data.

Denise Gibbs and C.J. Meitner, also working with Lincoln Brower, have established monitoring projects at Chincoteague National Wildlife Refuge, specifically Assateague Island, Virginia and the Hiawatha National Forest,

Peninsula Point, Michigan, respectively. Similarly, Dr. Tonya Van Hook, a recent Ph.D. student of Dr. Brower's, established a program at St. Mark's National Wildlife Refuge, Florida. The program at St. Mark's is now under the direction of Richard Rubino. Andrew Davis and Mark Garland of Cornell University have monitored the fall population passing through the southern tip of the Delmarva Peninsula in Virginia for the last three years.

These projects share similar goals. The primary objective in each case is to assess the seasonal abundance of the migratory population. In most cases, captured monarchs are tagged and an effort is made to associate the behavior and flight of the monarchs with physical conditions such as temperature, wind

speed, and direction. In some cases, special attention is given to the nectar and structural resources (trees) used by the monarchs as they move through these locations. The St. Mark's project now includes additional nearby monitoring sites to the west and southeast and a spring monitoring program as well.

As these programs continue, the data will become increasingly valuable and should help give us a better understanding of monarch populations and the physical factors associated with the migration.

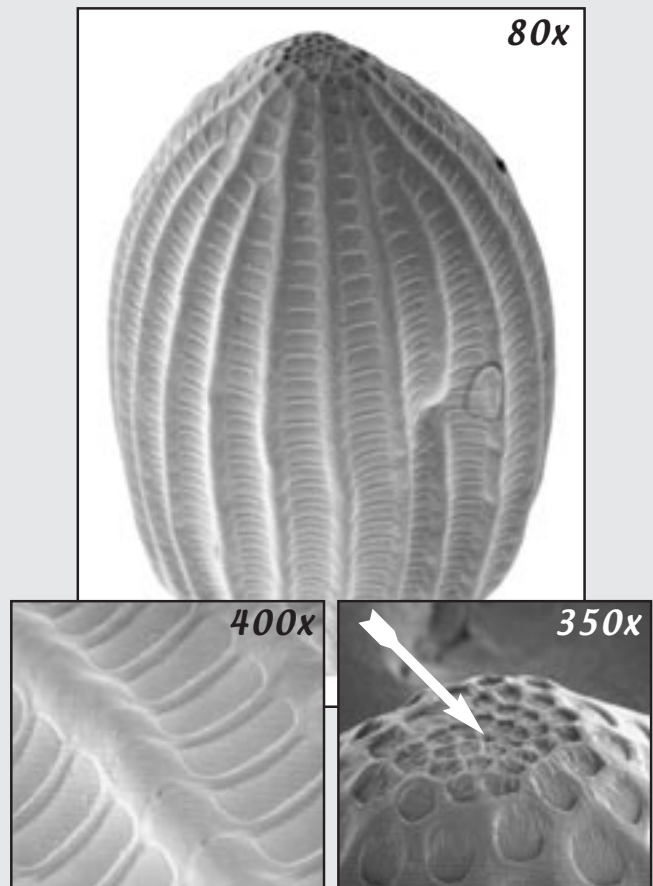
Most of these programs rely on volunteers. If you would like to be of assistance to these researchers, please contact us at Monarch Watch (see back cover) and we will put you in touch with the director of any project. ■

Monarch Eggs

Eggs are covered with a shell (called a *chorion* in insects), so how does sperm enter to fuse with the egg nucleus and form an embryo which develops into a larva?

Females monarchs have four ovarioles in which the eggs develop. Mature eggs, with egg shells completely developed, are held in the ovarioles until egg laying is initiated. Once an egg is laid another egg descends from one of the four ovarioles into the common oviduct where the top of the egg is positioned opposite an excurrent duct from the sperm storage organ (spermatheca). Sperm is released down this duct and some of the sperm enter the pores in the micropyle at the top of the egg and one sperm proceeds to fuse with the nucleus of the egg, a process that initiates the development of an embryo and then a larva. Curiously, female monarchs - as well as those of most other Lepidoptera - carry an already fertilized egg at the end of the common oviduct nearly all of their reproductive lives. The fertilized egg continues to develop even though it is within the female and if a female is unable to lay eggs due to the weather for a day or two, the first egg laid on a subsequent day will be developmentally "older" than all the other eggs produced by the female that day.

Scanning electron micrographs of a monarch egg showing the scalloped surface and the region of the micropyle (arrow) which contains pores through which sperm enters the egg.



SEM images by Jim Lovett, Dana Wilfong, and Cathy Walters.

Syrphid Fly Larvae



*A syrphid fly larva eating aphids within a colony of the oleander aphid (*Aphis nerii*) established on the tropical milkweed (*Asclepias curassavica*). An aphid parasitized by the wasp *Aphidius colemani* is shown by the arrow. Photo by Dana Wilfong.*

The common oleander aphid, *Aphis nerii*, infests many of the milkweed species used by monarchs. This species seems to be particularly common in gardens and within cities. The aphids are yellowish orange in color which may indicate that they are distasteful to predators. Ladybird beetles which feed on soft bodied insects, particularly aphids, do not appear to be especially fond of this species. In general, this species does not appear to be controlled by parasites and predators in gardens. Yet, there are a few species that feed on them and may have some role in controlling the aphid populations.

Syrphids are an abundant and diverse group of flies and the adult flies of some species appear to be mimics of wasps and bees. The adults of many syrphids are flower visitors that play an import role in the pollination of many plants. In some species the larvae feed on the eggs and larvae of other insects, particularly species in which the larvae cannot easily escape.

The “mummified aphid” indicated by the arrow in the above photo had been parasitized by a small wasp known as *Aphidius colemani*. This species is available commercially for the control of numerous aphid species that infest plants within greenhouses and we have used it successfully to control the oleander aphid on the milkweeds we grow in our greenhouse.

For more information on monarch predators, parasites, and diseases, please visit our website at

www.MonarchWatch.org

Video Briefs

Each year we are invited to consult and assist with video productions. Last summer Martha Stewart’s company approached us to make a short video on the monarch migration. The production was taped in September at the peak of the migration at the Baker-Haskell Wetlands on the south side of Lawrence, KS. The piece features tagging by students and teachers assembled by Randy Warner of Frontier Trail Junior High (Olathe, KS) as well as interviews about the migration with Chip Taylor. The production is being edited to incorporate Martha Stewart as the interviewer. The first viewing is scheduled for September. We are grateful to Ann Johnson, who assembled a team in less than eighteen hours to shoot this video. Ann is an award winning videographer who also worked on the Turner production, “Pollinators in Peril”.

Somewhat later in the fall we were contacted by Lori Benson, a producer with the NY Times Science Times/ National Geographic, to assist with a production for a series that will be shown on the new National Geographic channel. This video was shot in October 2000 near Uvalde, Texas where (we were assisted by Carol Culler) and at the overwintering sites in Mexico in January (photos below). Again, I haven’t seen the production but the content appears to emphasize the migration and our attempt to create an interest in monarch butterflies.



NOTES FROM THE WEBMASTER

This past year has seen a lot of exciting changes “behind the scenes” at Monarch Watch and our website is no exception. We hope to make some more visible changes soon! Unfortunately, we do not currently have the resources to implement all of the great ideas that we have for improving our educational offerings online, so we need your feedback to prioritize our “wishlist” of changes we’d like to make this season. If you haven’t already done so, please stop by and fill out our short survey at

www.MonarchWatch.org/sitesurvey

to let us know what you think of our little home on the Web. You can also send your questions, comments, suggestions, and criticisms to us by phone, fax, email, snail mail, etc. - all of our contact information appears on the back cover of this Season Summary. Please feel free to drop us a line anytime - we’d love to hear from you! --Jim

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Monarch Watch Email Update List

In June we decided to create an email list to keep in touch with anyone interested in monarchs and/or Monarch Watch. This Email Update List has been **very** well received and is currently delivered to over 5,000 recipients all over the world - wow! Furthermore, we are adding more than a dozen or so email addresses a day...that's a lot of Monarch Watchers!

If you’d like to receive periodic (usually monthly) updates, visit our website and sign up at

www.MonarchWatch.org/signup

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Gulliver’s Gift Shop

Monarch Watch is pleased to announce our new on-line storefront.

Through a partnership with a company called HomeEarth we are now able to offer our promotional and educational items to you from our own Shop at www.MonarchWatch.org. Just click the link on our homepage to check it out. You’ll find our Monarch Watch items, plus lots of great butterfly books, videos and other nature-related items like bird feeders, bat houses, and such. We are trying this service for 3 reasons. First, you’ve asked for this type of convenience and we want to be responsive to what Monarch Watchers request. Second, we want to show our appreciation for your continuing support by improving the member services we pro-



vide. Finally, we feel that this new service will make it easier for our staff to process the requests for supplies and promotional items so we can spend more time on our mission of monarch education, conservation, and research, and less time on administrative duties.

We ask that you go to our Shop at www.MonarchWatch.org and browse the aisles. If you see something you’d like, get it! Just enter coupon MW-00102 at checkout to get 15% off your first purchase (exp. 3/15/02). Remember that each purchase you make supports our operations and that you’re shopping is safe and secure! Thanks for your help to make this new program a success.

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Amazon.com Portal

Do you shop at Amazon.com? If so, you can designate that a small percent-

age of your purchase amount go to Monarch Watch. Doing this does not affect your purchase price in any way as the 5% “commission” is paid by Amazon.com after your transaction is complete.

There are also several books that Monarch Watch does not keep in stock, but that we can offer via Amazon.com. By purchasing these books through our link to Amazon, Monarch Watch receives 15% of the purchase price.

Complete details about how your Amazon.com purchases can help support Monarch Watch are available at www.MonarchWatch.org/amazon

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CafePress

Thanks to an online service called CafePress we are able to offer t-shirts, mugs, mousepads, baseball caps and more with several different designs. Visit our “store” (link below) to purchase these items and stay tuned for new products and more designs coming soon.

Also, if you have any ideas for these new products (or want to create your own design), please let us know and we will see what we can do :-)

Complete details are available at

www.MonarchWatch.org/cafePress

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MonEd

MonEd (**Monarch Education**) is the name of our new electronic mailing list for educators and students. We have created MonEd as an alternative to Dplex-L, our long-time email discussion list, which has been open to scientists, teachers and the general public. Like all lists, Dplex-L changed over time and was no longer meeting the needs of many of the educators and students interested in monarchs. MonEd is intended to facilitate discussions among educators and students on the biology of monarchs

and how to use monarchs in the classroom and for scientific study. Our intent is to provide a forum in which those interested in monarchs can communicate with each other. To participate in this list you must have an affiliation with a school or educational institution, such as a museum or nature center. Home-schoolers are also welcome. The list will be moderated by Chip Taylor, Director of Monarch Watch and the Monarch Watch staff. A few scientists will be invited to join the list to help answer questions.

Subscribers to the list are urged to report first monarch larvae and eggs seen in the spring on milkweed plants, to provide observations of breeding populations during the summer months, and to report their observations of the fall migration. Much of this information is being used by scientists to establish a database on the dynamics of the monarch population and the migration. Participants might also contribute useful tips and tricks on the use of monarchs in classrooms, rearing monarchs, milkweeds, and butterfly gardening. Monarch Watch will occasionally post announcements of festivals, meetings, and conservation efforts, etc. Newcomers can use the list to track the migration and to learn more about monarchs.

If you wish to also subscribe to Dplex-L, a list in which much of the discussion is by scientists and informed members of the public, you may do so. However, to join MonEd you must be an educator or student as defined above.

To subscribe to MonEd, send an email message with the subject "Add MonEd" to monarch@ku.edu and

include in the body of the message your educational affiliation, name, and email address.

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CyberSurfari 2001

Monarch Watch has once again been invited to participate in the latest educational internet treasure hunt presented by DiscoverySchool.com. This will mark our fourth appearance in these games. To participate, "CyberSurfarians" must first sign up and choose a division in which they will compete (individual, family team, school team, etc.). Then the hunt is on as players race to find the answers to clues given throughout several "CyberStations" - such as DiscoverySchool.com, Adobe.com, NEA.org, and Education-World.com. The clues provided on these sites send players to other "Outpost" sites such as MonarchWatch.org. When the answer is found, a treasure page is displayed and players enter their keycode to receive credit for a successful hunt. There are several ways to win and over \$100,000.00 in cash and prizes are awarded to schools, families and individuals. Contests are held year-round, so if you'd like to join the hunt or would just like more information, surf on over to

www.CyberSurfari.org ■

Contact Updates

The following are updates to lists previously published in the Season Summary. Please refer to our website for a complete listing of Regional Coordinators and/or Monarch Speakers. If you would like your name to be included on these lists, please contact us!

If you have questions about tagging monarchs, or need information on monarchs, you can contact the Regional Coordinator in your area.

If you'd like someone to speak to your class or organization, please feel free to contact a monarch speaker in your area for more information.

Regional Coordinators

Mike Quinn

TPWD, Wildlife Diversity Program
3000 IH35 South Suite 100
Austin, TX 78704
Mqnature@hiline.net

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Monarch Speakers

Donn R. Byrne

1443 Old Hickory Road
Tyler, TX 75703
903-581-7072
No fee

Jackie Goetz, Master Gardener

Johnson County Extension
Johnson County, KS
jlgoetz@yahoo.com
Kansas City area:
honorariums appreciated
913-897-4003

Jim and Teresa Gallion

Walkersville, MD
Jimbo2193@aol.com



Surfing the web? Be sure to stop by these sites to see what's new:

Monarch Watch
www.MonarchWatch.org

Journey North
www.learner.org/jnorth

Tactics and Vectors
www.TacticsAndVectors.org

Gulliver's Gift Shop
Shop.MonarchWatch.org

Monarchs in the Classroom
www.MonarchLab.umn.edu

Monarch Monitoring Project
www.concord.org/~dick/mon.html

MONARCH WATCHER OUTREACH

Many Monarch Watch members have developed their own outreach programs to educate people in their areas about the goals and objectives of our program. It is always gratifying to hear of these activities and to assist whenever we can in public education about monarchs. Our correspondence suggests that there may be as many as 50 Monarch Watchers who assist teachers in classrooms, conduct workshops, develop public exhibits, volunteer at nature centers and maintain exhibits at fairs and garden shows. We often learn about these events second hand and usually after the fact. If you are engaged in these activities, please let us know. We might be able to draw attention to your event or put you in contact with teachers or groups who request assistance.



Left: Teresa is still busy, even as the day winds down and "butterfly bedtime" approaches.

Right: Teresa and Jim show off a tagged monarch.

Far right: The Gallions' "Got Milkweed?" bumperstickers were a big hit, I'm sure!



The Great Frederick Fair, 16-22 September 2001, Frederick, MD.

Congratulations to **Teresa and Jim Gallion** for their extraordinary exhibit and educational booth which they maintained for 10 hours a day at the Great Frederick Fair. The exhibit featured a large (8'x8'x8') cage containing adult monarchs as well as monarchs emerging from pupae. All the monarchs were reared from eggs laid on milkweeds in their garden. Many of the monarchs were tagged and released as part of the demonstration. The fair was well attended and Teresa and Jim estimate that at least 10,000 people stopped at their booth during the fair. The Gallions are Master Gardeners and National Wildlife Fund Habitat Steward volunteers. They have extended their stewardship to milkweeds as well as monarchs and they actively promote planting milkweeds in gardens.

Got Milkweed ?

Monarch butterflies depend on milkweed for survival

"Butterfly Symposium" at Oak Grove Primary, Prairieville, LA - May 2001.

Judy McIntyre, a teacher at Oak Grove, helped the gifted program students coordinate an event to educate the community about butterflies and butterfly gardening. Poster presentations by each student and educational videos were part of the display. Hundreds of butterfly host plants such as verbena, passion flowers, and zinnias were grown by students to be given away.



This special group of students took the initiative to sell popcorn and face painting to raise money. Over 150 people attended the event and \$100.00 was raised, which was donated to the Adopt-a-Classroom program. Thank-you to all of the K-4 students for your help in making this event a success!



FOR THE KIDS (IN ALL OF US)

S R O L Y A T P I H C R A N O M I M A P U P
 P W R P R O L E G S E O N E Y S E K Q S G G
 O E E R A T C E N T I L A G U C C E E A R S
 R R V J T A D B A R O N O P O A A L T O I S
 E C I I S R B R A V N L P N L R C C H C I K
 S R L M N S G S E E O I I B E A H C S S I C
 L E L L I I O R T M X U H T R R T O O E N A
 L T U O M R W N O E M E P I Y A B H S L S T
 E T G V L I A T L B M O P S W O P D R A E E
 C I Q E N L N P U O D S A H R R A G E C C R
 L R T T A E S T L I P L C P O N N N T S T P
 A C E T K U T Y P H I R O M A I O I L E X I
 C R E M A E M E M S A M A W D F I R A S S L
 S X G N R P L I K N M T I I E R S A W U M L
 I A A F H L L C O A E L L G O A O O Y A A A
 D D L V E K L M T M F G N O N S L S H P N R
 X Y K M W A W I V O G A S B O S C N T A D V
 A S A E S W D O N E R T O C I X E M A I I A
 R Y E P W I N G S O S E P I R T S H C D B T
 O D E C A R D E N O L I D E S B O C E L L I
 H R E T S A M E R C N G L N E M O D B A E R
 T T L O M A D O P T A C L A S S R O O M S L

Find the most words, win a Monarch Watch poster!

So, you think you've got what it takes to find all of the words and phrases in our little puzzle? Go ahead, give it your best shot and then head on over to www.MonarchWatch.org/puzzle to tell us who you are and submit your word list for a chance to win.

The words and phrases in this puzzle are all related to monarchs and/or Monarch Watch - in fact, they all appear somewhere on our website at www.MonarchWatch.org (hint, hint ;-). Words may be found horizontally, vertically, or diagonally as well as forwards or backwards. Singular and plural forms count as a single word. There are *at least* fifty words and/or phrases to be found.

Entries will be accepted until December 31st, 2001 and the winner will be chosen based on the number of valid words/phrases submitted. In the event of a tie, a random drawing will be made to determine the winning entry. The winner will be notified via email and will receive the Monarch Watch poster of their choice. **Good Luck!**



OTHER MONARCH PUBLICATIONS

Monarch Butterfly Sanctuary Foundation 2001 Newsletter

The Monarch Butterfly Sanctuary Foundation's (MBSF) main goal is to encourage the protection of the Oyamel fir forests in Central Mexico where the eastern monarch butterfly population overwinters. Their 2001 Newsletter details their recent victory in this effort, expanding the reserve. Monarch Watch was so excited about their efforts that we reprinted the article in this volume on **page 52**. In addition to this recent victory, the newsletter details other MBSF conservation efforts including issuing research grants for Mexican researchers, supporting small enterprise efforts by the Mexican landowners from printing t-shirts to making baskets. The work of two other monarch conservation organizations (the La Cruz Habitat Protection Project and Alternare) is also detailed in this volume.

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The Monarch Quarterly

The Monarch Quarterly, formerly *Monarch News*, is now published in January, April, July and October by the Monarch Program. Last October marked the final publication of their monthly newsletter *Monarch News*. The



Monarch Monitor is now being sent out monthly and is a one-page update on all monarch-related stories. By publishing a larger quarterly newsletter, the Monarch Program is able to add more articles and include color photos. A painted lady butterfly made it on the cover of the Spring 2001. The Painted Lady butterfly is another migratory butterfly, whose migration is often confusing for people who think they are monarchs. Congratulations to the Monarch Program - your quarterly looks great!

If you would like to become a member of the Monarch Program, dues are \$30, payable to Monarch Program, PO Box 178671, San Diego, CA, 92117. For more information, visit the resource section of the Monarch Watch website at www.MonarchWatch.org/resource

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Texas Monarch Watch Monitoring Packet

The Texas Monarch Watch is a volunteer monitoring project sponsored by the Wildlife Diversity Program of Texas Parks and Wildlife. The focus of this publication is to get the word out about monarchs and to recruit Texas monarch spotters. Spotters are asked to phone their sightings into the Texas Monarch Hotline at 1-800-468-9719. Besides recruiting new members, this monitoring packet includes information on the basic biology and life cycle of monarchs, as well as sections on distinguishing monarchs from their look-alikes, how to find the sometimes elusive monarchs, and identifying milkweed species. To learn more about Texas Monarch Watch visit their website at

www.tpwd.state.tx.us/monarch

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Monarch News from Peninsula Point

The Monarch Butterfly Project is a cooperative project between the Forest

Service, Hiawatha National Forest, and The Great Monarch Chase. C.J. Meitner started it when reports flooded into the Michigan Forest Service office about monarchs gathering at Peninsula Point on the tip of the Stonington Peninsula. C.J. spent over a year gathering data on the monarch butterfly and compiled it all into a report for the Forest Service. The result of Meitner's efforts brought about the Monarch Butterfly Project which strives to monitor Monarch reproduction and migration, conserve the Monarch habitat in the area, and educate the public about Monarchs and their migration. Meitner's monitoring involves tagging Monarchs as well as conducting counts of larvae and adults in the area. The Monarch Butterfly Project's second newsletter "Monarch News from Peninsula Point" came out in January 2000 and contains the results of their monitoring efforts for 2000. To learn more about the Monarch Butterfly Project, contact C. J. Meitner at 906-630-5188 or 906-474-6442.

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Monarchs in the Classroom 2001 Newsletter

Monarchs in the Classroom is an educational program that encourages teachers to incorporate monarchs into their curriculum. The 2001 Newsletter for Monarchs in the Classroom gives you all the information necessary to do just that. In this newsletter, you will find personal accounts from teachers who use monarchs in their classrooms, participated in Karen Oberhauser's teacher workshops, and visited the overwintering sites with monarch researcher Bill Calvert. In addition, this issue features a section on educational gardening, tips for teaching with monarchs, and the 2000 Monarch Fair. You can learn more about Monarchs in the Classroom by visiting their website at

www.monarchlab.umn.edu

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Schultz, S., et al. 2000. Science- A Deadly Pollen. *U.S. News & World Report*. 129(9): 6.

Your Data are Important!

Send us your tired, worn, messy, scribbled, or tattered data sheets. We don't care what they look like or how many monarchs you tagged - we just need your data sheets! Please send them to us as soon as you have completed your tagging. If you don't send them in, it costs us time and money to track you down and find out where and when you tagged them. As you know, we use the data from the tagging to estimate the size and mortality of the fall monarch population. This analysis is sensitive to the number of monarchs tagged as well as the number recovered in Mexico. If your data sheets are not returned, we have to guess at the number of monarchs that were tagged but for which we have no data. Similarly, for some analyses of the data, we have to disregard records of tagged monarchs found in Mexico if the data are incomplete. It's disappointing not to be able to use these records and we seem to be slipping a bit each year from 97% complete records for tagged monarchs in 1998, to 95% in 1999, and to 92% in 2000. The tagging program is producing some remarkable data and providing perspectives about the biology of monarchs we didn't envision when we started the program. Please help us maintain the high quality of the program by sending your data at the season's end. **Thanks!**



Adopt-a-Classroom Trip to Mexico • January 2001

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. Here's how to do this:

Snail Mail: Monarch Watch • University of Kansas • Department of Entomology • 1200 Sunnyside Avenue • Lawrence, KS 66045

Email: monarch@ku.edu

Online: www.MonarchWatch.org

Fax: 1-785-864-5321

Telephone: 1-785-864-4441

Toll-Free: 1-888-TAGGING (within the U.S. only)

Dplex-L Email Discussion List: visit www.MonarchWatch.org/dplex

MonEd Email Discussion List: visit www.MonarchWatch.org/moned

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