CHAPTER 1

The King of North America

What surprised me was how cold it was. Here we were less than 20 degrees north of the Equator—well within the Tropics—but as we trekked across the meadows and pastures toward the track that would lead up to the site at Sierra Chincua, we walked through the man-made fog of our own exhaled breath. Yesterday morning, as we had climbed the stairs at El Rosario, it had actually been down to freezing but this morning was warmer by a scant few degrees. Still, there was an abundance of easily recognized wildflowers—senecio, lupine and sage—and maidenhair ferns, too. They, also, were not at all what I expected to see.

We stopped partway up the soon-to-be-dusty track for a group photo, a dozen and a half intrepid explorers, some who came along to simply see before it disappeared, others to satisfy their curiosity, the rest of us to renew some half-remembered sense of wonder. Of course, it was the elevation that made it feel this cold. My brain knew this, but my brain and my heart seemed to be on different planets. The elevation was also obviously responsible for the recognizably temperate floral elements. The question that kept running, over and over, in my mind was "why?"

Why here? What possessed such a seemingly fragile creature as a Monarch butterfly to undertake the long perilous journey across unknown, untravelled distances to this *place? None of the butterflies had been here before, yet those that survived the journey all found their way here. From places as far away as central Ontario, the Adirondacks, and the corn belt and prairies of the upper Midwest, they came and congregated here in the mountains of the Transverse Neovolcanic Belt, the* Sierra Volcanica Transversal, *of central Mexico. It was cold here. Of course, that in itself was part of the answer. The other half, however, was that it wasn't too cold here. This is just one of the many contradictions that make the Monarch butterfly—the King of North American butterflies—so enigmatic and unusual…*

Iconic of all butterflies and a symbol of the North American Free Trade Act signed between Canada, the United States and Mexico, the migratory Monarch is probably the most familiar and well known butterfly in the world.

What's In A Name?

The Monarch butterfly is probably the most familiar and well known butterfly in much of the world. Brightly colored in a contrasting quilt of fiery orange patches with white- or orange-spotted black wing edges and black lines following the main veins of the wings, it is almost instantly recognizable. The familiarity of this audacious insect is reinforced by its common use in advertising, as a symbolic icon of all butterflies, and its selection as the official state insect of several U.S. and Mexican states. It is also a symbol of NAFTA, the tri-national North American Free Trade Act signed by Canada, the United States and Mexico during the late 20th century, an agreement that is wonderfully underscored by the natural distribution and migration of the eastern North American Monarch across the three countries.

Why would I call the Monarch butterfly, *Danaus plexippus*, the "King of North America?" Obviously its common name provides part of the answer, but there's more to this name than meets the eye. Gary Noel Ross, self-proclaimed "butterfly evangelist" and a great lover of all butterflies, once asked of the Monarch, "what's in a name?" Taking cues from renowned Monarch biologist and migration researcher Fred Urquhart, author and dedicated butterfly conservationist Robert Pyle and one of Dr. Urquhart's most stalwart, longtime migration taggers, Don Davis, Dr. Ross describes how the earliest European settlers of Canada and the United States, largely protestants seeking an escape from religious prosecution, were "impressed by the sight of such a magnificent butterfly" and named it—for its familiar orange and black color—after a well-loved prince of Holland who later became king of England, William of Orange. My own maternal grandmother often called them "King Billys" rather than "Monarchs," and this is likely the ultimate source of the common name.

The regal roots of this story run even deeper, because this particular King also has a "royal family" consisting of some relatives—the Queen, *Danaus gilippus*, and the Soldier, *Danaus erisimus*—and some courtiers including the very similar but quite unrelated Viceroy, *Limenitis archippus*. Note, even, the similarity of the Latin species names of these royal butterflies, a potential source of confusion to the novice. According to Chris Durden, Curator of the Invertebrate Collection at the Texas Memorial Museum in Austin, the scientific name *Danaus* is derived from a latinized form of the Greek *Danaos*, a historic figure

who is purported to have led his people from Egypt to Greece, while *plexippus* was a mythological hunter killed by his own nephew. In other places our Monarch may be called the Wanderer, or simply the Milkweed Butterfly, but here in its native North America it truly is royalty.

The Royal Family Tree

The "royal family" of the Monarch, Queen and Soldier (but not including the oft-times mimetic, but quite unrelated, Viceroy) are milkweed butterflies, unusual members of an almost exclusively tropical and sub-tropical group of butterflies. The Danainae, regardless of whether they are considered as a subfamily of the much larger Nymphalidae (a family with multiple origins that includes as many as one-third of all butterflies, some 6,400–7,200 species) or as a subfamily of the Danaidae (a family that would only include them with the Ithominae and Tellervinae, or about seven percent of the Nymphalidae), consist of nine to eleven genera (*Amauris*, *Anetia*, *Danaus*, *Euploea*, *Lycorea*, *Idea*, *Ideopsis*, *Parantica*, *Tirumala*, and the relatively recently established monogeneric *Protoploea* and *Tiradelphe*) comprising around 160 species (*See table below*).

The subfamily Danainae is unified by a number of common characteristics that are not shared by most other butterflies. The caterpillars have smooth, brightly colored exoskeletons with pairs of tubercles or fleshy tentacles on two

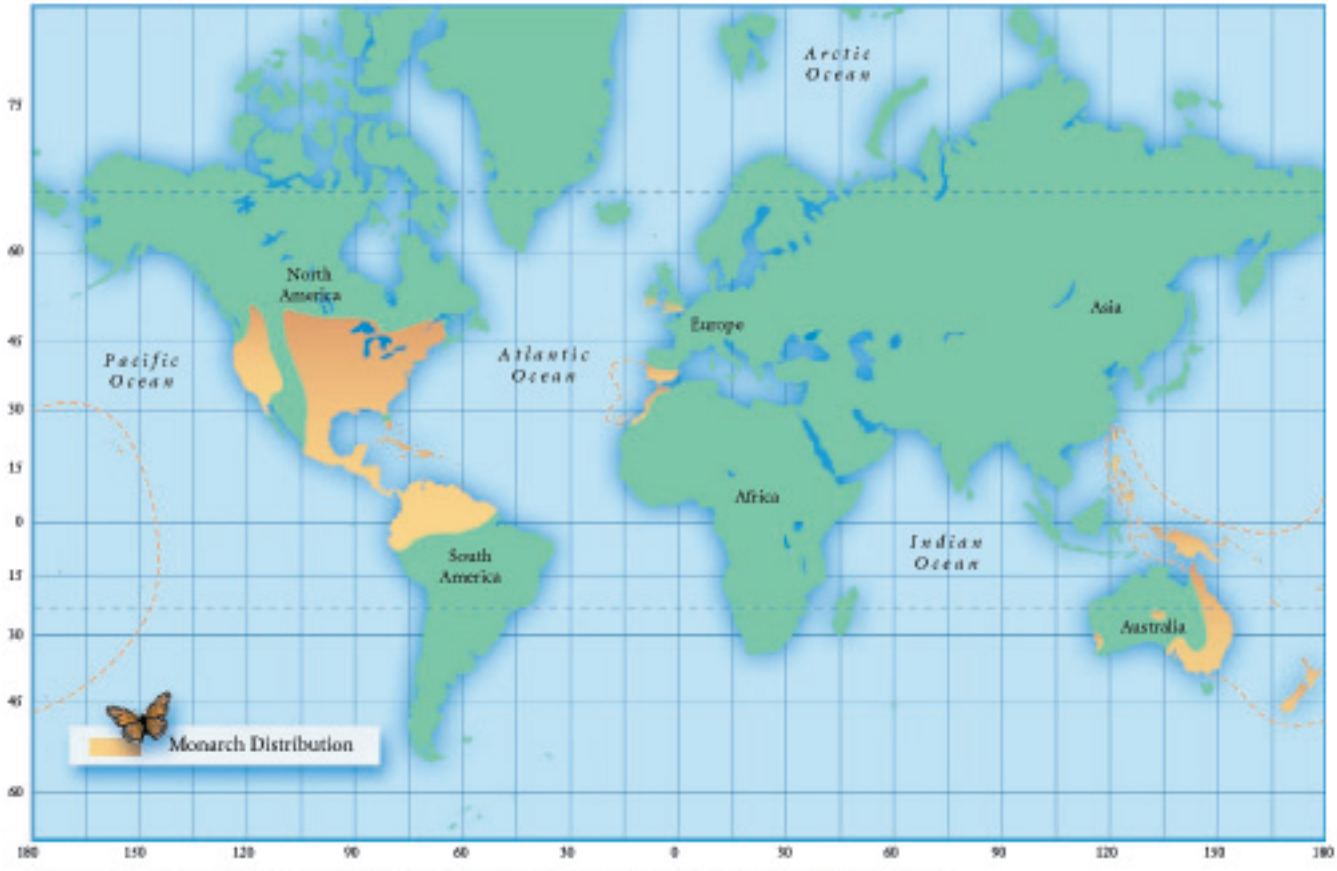
The Subfamily Danainae (after Ackery and Vane-Wright, 1984)

Tribe	Sub-Tribe	Genus	No. of Species
Danaini	Amaurina	*Parantica*	38
		Ideopsis	8
		Amauris	15
	Danaina	*Tirumala*	9
		Danaus	11
		Tiradelphe	1
Euploeini	Euploeina	*Euploea*	54
		Idea	12
		Protoploea	1
	Itunina	*Lycorea*	3
		Anetia	5
		Total	157

*The Royal Family, clockwise from top: the Monarch (*Danaus plexippus*), Queen (*Danaus gilippus*), the mimetic but unrelated Viceroy (*Limenitis archippus*), African Wanderer (*Danaus chrysippus*) and Soldier (*Danaus erisimus*). There are more than 160 species of milkweed butterflies worldwide but the Monarch is most well-traveled—and most famous.*

to eleven body segments, and feed on the dogbane and milkweed plant families (Apocynaceae and Asclepiadaceae) although almost one-third of the subfamily (much of the tribe Euploeini) are also known to feed on the mulberry family (Moraceae). Adults are all boldly patterned, often in brown, orange, yellow and black, but some are strikingly marked in black and white or blue and black. All males possess abdominal hairpencils, scent-disseminating organs that can be extruded from the tip of the abdomen, while females share a unique foreleg tarsus that is clubbed and has four segments.

Almost 80 percent of Danaines are only found in the Oriental or Australasian zoogeographic zones, or realms, with a further 13 percent being found exclusively in Africa (the Ethiopian realm). In fact, the Americas, that is the Nearctic and Neotropical realms together, only have some 14 species, less



The worldwide distribution of the Monarch, Danaus plexippus. *The Monarch is found in five of the six recognized zoogeographic regions or realms for butterflies and moths.*

than nine percent of milkweed butterflies. Intriguingly, while three species are relatively widespread (and account for why the above percentages do not add up to 100) only the native American Monarch, the aptly named Wanderer of its old world populations, is found in five of the six realms.

In their book *Milkweed Butterflies: Their Cladistics and Biology*, Philip Ackery and Dick Vane-Wright further subdivide the genus *Danaus*, of which the Monarch is a species, into three seemingly well-delineated subgenera, *Danaus (Danaus)*, *Danaus (Salatura)* and *Danaus (Anosia)*. The subgenus *Salatura* contains four species (*D. ismare, D. genutia, D. affinis* and *D. melanippus*) that are exclusively Oriental and Australasian in distribution while the subgenus *Anosia* also contains four species (*D. erisimus* [the Soldier], *D. plexaure*, *D. gilippus* [the Queen] and *D. chrysippus*, the African Monarch or Wanderer) that are either American (Nearctic/Neotropical) or in the singular case of *D. chrysippus*, African (Ethiopian) in origin, although *D. chrysippus* is also now found throughout much of the Oriental and Australasian realms.

The subgenus *Danaus*, however, is exclusively American (Nearctic/Neotropical) and consists of the three remaining species, *D. cleophile*, the relatively rare Jamaican Monarch found only on the Caribbean islands of Jamaica and Hispaniola, the putatively separate species *D. erippus* of South America, found south of the Amazon Basin, and *D. plexippus*, the Central and North American Monarch. Unlike even its near relatives, the Monarch is now found in a wide variety of places, including its native Central and South America north of the Amazon Basin and the islands of the Caribbean, Hawaii, most of the larger islands of the Pacific including the Galapagos, Norfolk, the Solomon Islands, the Philippines and Taiwan, New Zealand and Australia, and is now also common in the eastern Atlantic—the Canary Islands, Madeira, southern mainland Europe and northwest Africa.

Milkweed butterflies are generally large, slow flyers that often glide on their expansive, outstretched wings for considerable amounts of time. Their caterpillars feed on plants with well-documented defensive compounds (cardenolides, or cardiac glycosides) that are sequestered and retained in the body and wings through the adult butterfly stage. Together with their bold colors and patterns, these defenses make them aposematic, or warningly colored, allowing them to avoid predators while flying or gliding in plain sight. Many Danaines also roost communally and are known to migrate short distances in some numbers. The Monarch, however, takes these traits to entirely new levels.

Life Cycle of the Monarch

Most researchers agree that the Monarch is a singularly unusual Danaine butterfly. It shares the southern portion of its eventual range with the Queen and the Soldier, which, although they may also be somewhat migratory (for example, the Queen was found through an impressive number of states in northeastern North America in 2001), rarely attain the population densities or expansive geographic range common in the Monarch. Intriguingly, the biology and ecology of the immature stages—eggs, caterpillars or larvae, and pupae or chrysalides—are very similar, as is their dependence on milkweeds, the importance of certain nectar sources to adults, and their bold, aposematic lifestyle. These similarities notwithstanding, the Monarch differs in enough important traits to be considered quite "unusual."

Monarchs lay their eggs singly, usually on the upper leaves of the tender shoots of milkweed plants. Pale yellow or ivory when laid, the eggs darken to a gray-black as the caterpillar develops inside the egg, typically over three to eight days.

Eggs

Monarchs lay their eggs singly (as opposed to in clusters), generally on the upper leaves of a tender shoot of a milkweed (genus *Asclepias*) or sometimes a milkweed vine (genera *Cynanchum*, *Matelea* and *Sarcostemma*), all in the plant family Asclepiadaceae. There are approximately 110 species of milkweeds in North America, although not all species are used as host plants, and some species are preferred over others (or others are not suitable and avoided). Consequently, host use varies substantially.

Another significant factor affecting host plant use and suitability is the geographic and seasonal distribution of milkweeds. Milkweeds do not persist when temperatures are too cold or too hot, consequently there are no host plants available during the winter and milkweed distribution is limited by the length of the growing season in the northern parts of its range (presently above about 52°N latitude). However, during the summer the southern latitudes (below about 38°N) are also too hot for native milkweeds so plants are rarely found outside of the spring and fall.

The eggs themselves are pale yellow or ivory when laid but darken to a dark gray-black, with the development of the caterpillar inside the egg, over three to eight days depending on temperature. They are taller than they are wide, flattened on the bottom where they are attached to the plant but with an apical point on the top, and have many vertical, faceted ridges.

The Caterpillar or Larva

Monarch caterpillars bear only two pairs of fleshy, non-poisonous "tentacles," tubercles or filaments on the second thoracic (metathorax) and eighth abdominal segments. The Queen, the Soldier and the African Monarch each possess a third pair of these appendages on the second abdominal segment, which makes it possible to easily identify Monarch caterpillars to species. These appendages are probably anti-predator devices since they contain body fluids, are mobile and can be waved about when the caterpillar is disturbed. The Monarch's minimum complement of these tubercles, placed on opposite ends of the body, likely also serve to confuse predators about which end of the body is the head and which is the tail.

Monarch caterpillars change from pale gray-white when freshly hatched to being brightly colored with alternating, complete, transverse bands of yellow and white on a black background. The yellow "bands" on the Queen and on the African Monarch, however, are incomplete and broken into "dashes" that do not completely encircle the body. The bright coloration, or aposematism, of these caterpillars is also an anti-predator strategy that advertises the fact that they not only feed on plants that contain noxious substances but that they have incorporated those compounds into their own bodies.

Monarch caterpillars prefer the top leaves of their host plant and are behaviorally "wired" to be negatively geotactic (they prefer moving upward against gravity) and positively phototactic (they also move toward light). The combination of these traits ensure that the caterpillars are highly visible so that their brilliant, aposematic coloration has the largest impact on potential predators. Further defensive characteristics of the caterpillars include their behavior of curling up and dropping off of their host plant when mildly stimulated and their ability to "foam at the mouth," regurgitating a cardenolide and ketone-laced foam from their mouths when they are continuously and strongly stimulated.

Monarch caterpillars grow quickly. In only 10 to 14 days, depending on temperature, the caterpillar will grow to more than 3,000 times its hatching weight. Caterpillars grow through five larval instars (periods between molts or shedding of their exoskeletal "skin," as seen here).

When caterpillar growth is complete, they usually leave their host plant to find a place to pupate. The prepupal stage has a characteristic "J" shape because the pupa or chrysalid will hang free, upside down.

Caterpillar growth and development is prodigious. Depending on temperature, a typical Monarch caterpillar proceeds through five larval instars (the periods between successive molts or shedding of their exoskeletal "skin") in 10 to 14 days, although it may take up to 40 days if temperatures are below 10°C (50°F). Within this two-week period caterpillars will grow from being about 2 mm (1/16 in.) long to being more than 3,000 times their hatching weight. One interesting characteristic of Monarch caterpillars is their penchant for basking in direct sunlight, a behavior that may reduce the duration of the caterpillar stage by enabling the caterpillar to raise its body temperature up to 8°C (46°F) above the ambient air temperature, thus allowing it to increase its metabolic rate.

*The pupa hardens into a brilliant green chrysalis with metallic gold spots (*top left*). Depending on temperature, light and humidity, the pupal stage lasts from 9 to 15 days, after which the chrysalis will change color, darkening before turning translucent a few hours before the butterfly is ready to emerge (*top right*). An intake of air is used to expand and split open the chrysalis, allowing the butterfly to eclose, or emerge (*bottom*).*

The Chrysalis or Pupa

Upon completion of the growth that characterizes the caterpillar stage, mediated by hormone balances, the caterpillar almost always leaves its host plant and crawls around to locate a place where it can pupate. It spins a silk pad attached to a branch or some other substrate, meshes its anal prolegs—hydrostatic leg-like appendages on its last abdominal segment that terminate in a pad of crochets or small hooks, not unlike the hook side of a strip of Velcro™—in the pad and hangs free, upside-down, in a characteristic "J" shape. It rests in this position for some time before the last larval skin splits along the top of the thorax (near the base of the "J") and the caterpillar shakes and gyrates to loosen the skin from the emerging pupal case or chrysalis. Before the old caterpillar skin is shaken completely off, the pupal cremaster, a special hook-like appendage, is securely fastened into the silk pad.

The Monarch chrysalis is a brilliant, but deceptively cryptic, green color with a line of metallic gold spots on a black background about two-thirds of the way up (at the junction of the abdomen and thorax) and a few gold and yellow spots at various places around the body. The function of these "gold spots" is not fully understood although some research has suggested that they may serve some organizing function promoting wing pigment development. Unlike some of its near relatives there is no color morphism in the pupa—that is, the chrysalis is always green—although an orange-colored recessive mutation has recently been described that further reinforces the Monarch's Danaine ancestry. Depending on factors such as temperature, light and humidity, the pupal stage lasts from 9 to 15 days, on average.

The Imago or Adult

Most milkweed butterflies are quite large and the Monarch is no exception. Their large size has a significant effect on their biology and no doubt contributes greatly to our perception and familiarity with them. Large wings with a relatively small body mass provide a high lift-to-drag ratio, aerodynamically speaking, that allows the Monarch to soar and glide for considerable distances—a very useful trait in a migratory species. Still, for all of their size, their wings are surprisingly flexible and Stephen Dalton's groundbreaking high-speed flash photos of a Monarch showed just how flexible they could be—capturing the wings as they seemingly "cup" the air, greatly increasing the efficiency of powered flight. The Monarch's large size also buffers

Adult Monarchs often cling to their old chrysalis for a few hours while their wings harden and they fuse the two halves of their proboscis. The brilliant orange and black color warns of the noxious compounds that they ingested as caterpillars feeding on their milkweed host plants. This aposematic warning coloration provides protection from predators that have learned to associate the color with the bad taste.

their thermoregulatory capability, or their ability to gain or shed heat, and they have developed behaviors such as "shivering" and anti-basking body orientation to respond to the effect that their large size has on their gain or loss of heat.

The fuel for the flight of the vast majority of butterflies is the sugar-rich nectar of flowers, and Monarchs have developed intriguing ways to convert and store these energetically needed carbohydrates as lipids (fats) in "fat bodies" within their abdomens. Of course, they also have the ability to re-convert these fats back into useable flight energy, another useful adaptation for both their migratory habit and their need to survive long periods of inactivity. Another useful feature of the conversion of sugars to fats for storage is that it increases body mass, thus lowering their lift-to-drag ratio and contributing to their "flight trim," or their efficiency as fliers. They've even developed ways to offset the use and loss of these lipids during migration by drinking and storing water to maintain their flight trim.

The use of noxious, cardenolide-containing milkweed host plants and the storage of these compounds in the Monarch's body are advertised by their brilliant orange and black coloration. Since the Queen and the Soldier also feed on milkweeds, they also advertise their unpalatability to predators in orange-brown and black patterns. Together, these butterflies are said to mimic each other to present a "united" color pattern that will "train" their vertebrate predators (birds and lizards) to avoid them. (*See "Monarchs and Mimicry" on page 14.*) This "co-mimicry" is called Müllerian mimicry after the researcher that suggested the hypothesis.

One final characteristic, the Monarch's unusual courtship and mating behavior, deserves mention. All male Danaine butterflies actively seek compounds known as pyrrolizidine alkaloids (PAs for short) from certain plants and nectar sources to produce sex pheromones. Males use these pheromones to "entice" females to cease flying and be receptive to mating. The pheromones are manufactured in glands in "alar spots" or pockets on the hindwings and are broadcast with hairpencils, extrudable brush-like organs from the tip of the abdomen that the males insert into their alar pockets to coat with pheromones. While Monarchs have alar pockets and hairpencils, visit PA-containing plants, and could court females in much the same manner as male Queen butterflies do, they largely choose not to but use coercive mating tactics instead.

Male Monarchs are larger than females, an unusual arrangement among butterflies where the female, who usually carries more mass in eggs and flight

MONARCHS AND MIMICRY

If we consider Müllerian mimicry's notion of shared pattern for protection, it makes sense that there might be "cheaters" who, even though they are not protected by any sequestered plant poisons, could be avoided by predators if they resembled a noxious "model." This "model-mimic" idea—where a palatable and unprotected butterfly can gain protection from predators simply by resembling a butterfly that advertises its chemical protection and unpalatability—was first proposed by Henry W. Bates after his observations of butterflies in the Tropics and has come to be known as Batesian mimicry.

The Monarch/Queen and the Viceroy have long been considered the "classic" example of this kind of model-mimic system. The Viceroy's appearance varies with its co-occurrence with either the Monarch or the Queen, and it was long believed that the Viceroy, which feeds on willow and poplar, was not protected by plant poisons. However, relatively recent research has shown that at some times and in some places the Viceroy is, in fact, just as unpalatable to birds as the Monarch or Queen. In other words, the Viceroy changes from being a Müllerian mimic of the Monarch and/or the Queen (unpalatable and chemically "protected") to being a Batesian mimic (palatable and unprotected) depending on the specific model species, their relative abundances and seasonality, the geographic location and the larval host plant of the Viceroy.

A further wrinkle comes from the variation in the presence, concentration and quality of the cardenolides or cardiac glycosides among Monarch host plants. Some species, such as the common milkweed (*Asclepias syriaca*), have low amounts of generally poor-quality cardenolides, offering little protection to the butterflies. However, enough individual Monarchs feed on other species—such as the green or spider milkweed (*A. viridis*) or the antelope horn milkweed (*A. asperula*)—that contain much higher levels of these poisonous compounds that a mimetic phenomenon, first described in Monarchs and dubbed "automimicry," occurs. As you might suspect, automimicry is an extreme form of Batesian mimicry in which highly protected individuals that have incorporated high concentrations of less palatable cardenolides within their bodies afford protection to more palatable, or less noxious, individuals within the same species.

The relatively rare "white Monarch" (Danaus plexippus form *nivosus), a genetic form with grey-white scales replacing the usual orange, bears a striking resemblance to some related* Idea *species of the Australasian realm. However, other than in Hawaii, White Monarchs rarely survive for long. This pale Monarch was photographed in Florida.*

muscles to support the larger wings needed to carry her, is generally larger than the male. Male Monarchs use their size and mass advantage to aggressively "attack" and subdue other Monarchs, grappling in the air and falling to the ground, where they attempt to mate. If successful in obtaining a copulation the male will carry the female to a shrub or tree to finish mating. An intriguing side issue of this tactic is that smaller males are often the target of attacks by larger males and male-male interactions among Monarchs are relatively common.

Origins

The Danaines are essentially tropical butterflies. Why then does the eastern North American Monarch travel each summer to higher latitudes, then return south each winter? Why do they choose to roost together and why roost in the mountains of central Mexico instead of the coastal rainforests? When did this annual migration begin? Unfortunately, no one knows the true answers to these questions, although there are some pretty good theories, and some corroborative evidence from other butterflies, including closely related species and details of what the Monarch does in other places. In any case, all of these questions lead, in one way or another, to the larval host plants, the milkweeds.

There are more than 100 species of milkweeds in Central and North America, although not all of them are entirely suitable as host plants. The most relevant fact about the native milkweeds of North America is that they are all seasonal; they die or rest through unseasonable conditions when it is either too cold and dry or too hot and dry to grow and flower. Host plant availability to the Monarch, therefore, is limited by the seasonality of milkweeds. There are no plants for caterpillars to feed on when it is dry and either too cold (winter in the north) or too hot (high summer in the south). But this is also true, at least in the winters of the northern United States and Canada, for most kinds of butterfly host plants. Why do most temperate species of butterflies overwinter, usually in immature stages (eggs, caterpillars or chrysalides), while Monarchs migrate away from the loss of their host plants?

For insight into a possible answer to this question we need to return to the Monarch family tree. It turns out that most of the Danaine butterflies have seasonal migratory tendencies, albeit on a much smaller scale than Monarchs, and many also roost together in overnight or seasonal roosts. For example, a num-

ber of *Idea* species are known to migrate to suitable habitats during wet and dry seasons in the Oriental realm and roost communally. Similarly, *Anetia briarea* individuals aggregate in roosts in the montane regions of the Dominican Republic. So the ancestors and relatives of the Monarch were already capable of escaping temperature extremes and, most importantly, the dry conditions in which their milkweed host plants perished by migrating to another area and hibernating in roosts. However, while this provides a possible *raison d'etre* for the southward migration, it doesn't explain the northward return.

For this we need to again consider their milkweed host plants. Milkweeds are, as their very name suggests, weeds that grow well under somewhat marginal conditions (although it's important to note that Monarchs seek out the plants that are in the very best condition because these will provide for the faster growth and best survival of the caterpillars). During the winter months, almost as far south as the Texas-Mexico border, there are very few milkweeds growing but as conditions get warmer and wetter the perennial species begin to regrow from their roots and the seeds of annual and perennial species alike germinate. This trend continues northward as the seasonal change from winter through spring progresses. (*See "Milkweeds and Migration" on page 42.*) It shouldn't come as any surprise that the breakup of the overwintering roosts in central Mexico coincides with the return of the milkweed to the southern United States. The Monarch "migration" north is, perhaps, better considered a recurring range expansion wherein the butterflies, over a couple of generations, gradually recolonize the entire range of available milkweeds.

Populations or Population?

Throughout this book I will be almost exclusively discussing the eastern population of North American Monarchs. I don't mean to slight the western populations, and the reader should realize that almost everything that I discuss in this book, from problems to population trends to Monarch biology, applies equally well to the western population, but I am far more familiar with the eastern population, it has a much larger range and population sizes are also much larger than its western counterpart. However, there are some additional differences, and even some controversy about whether there are one or two populations of Monarchs in North America.

One of the major differences between the eastern and western populations is that overwintering by the western butterflies is as diffuse as that by the eastern butterflies is concentrated. There are almost 400 known roosting sites along the Pacific coast of California in the United States (and even some non-coastal roosts near Death Valley) and Baja California in northwestern Mexico for the western population, while there are fewer than 20 consistently used roosting sites for the eastern population in central Mexico.

Despite this difference, the population size of the eastern population is much, much larger. One or two of the California roosts may reach as many as one hundred thousand Monarchs but most are much smaller and none approach the 20 to 30 million butterflies that may be found in some of the larger Mexican roosts. The total western population is at least an order of magnitude less than the eastern population.

The western roosts are also not as stereotypical as those of the eastern population, with roosts forming in a wide variety of tree species including pines, palms, oaks and the non-native *Eucalyptus.* It has been suggested that the planting of *Eucalyptus* trees has greatly increased the numbers of roosts available and caused the overwintering population to become fragmented and more susceptible to endangerment. Habitat loss through competition with man for coastal real estate is the single largest threat facing the western Monarch population at the roost sites.

Differences in population size and roost number aside, there are also a great number of similarities between the two populations. Both repopulate a breeding range and migrate to overwintering grounds in the fall. Both choose roost sites with moderate climates that buffer the extremes of severe cold and provide the proper moisture balance to sustain them. Both populations experience reproductive dormancy, that is they delay maturation and mating, and mate before colony breakup occurs in the spring, and so on.

Finally, while it has been widely held that the populations have always been entirely separate, recent thought is that the populations do share individuals from time to time and that there is a flow of genes from one population to the other and back again. Only a few years ago a number of Monarch biologists pleaded with the public to avoid “interpopulational transfers” of Monarchs from one population to the other, concerned that the movement of pathogens and parasites along with the butterflies could have a devastating effect on a susceptible uninfected population.

Recently, however, it has been suggested that in exceptional years the eastern population has “rescued” the western population through a large influx of eastern Monarchs migrating northwest instead of northeast. It is also probable, supported by some tag recoveries and the observations of Robert Pyle in his book *Chasing Monarchs* that some western Monarchs end up at the central Mexican overwintering sites rather than the coastal California roosts. While it is likely that some individuals from the two populations cross the Rocky Mountains, how much mixing or gene flow there is between the populations is unknown.