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From: The Informally Constituted Monarch Butterfly Scientific Advisory Committee (ICMBSAC):

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To: **Whom it may concern:**

We have collectively drafted the below statement during early February 2005 in order to summarize our concerns over the causes and consequences of this year's low monarch butterfly population overwintering in Mexico, and to make a series of recommendations to mitigate the likely anthropogenic causal factors.

Reduced numbers of monarch butterflies overwintering in Mexico during the 2004-2005 season: evidence, possible causes and recommendations

Included are Table 1 and Figure 1 from the WWF-Mexico Report to CONANP President Ernesto Enkerlin, dated February 2005, received by LPB from EE on 12 February 2005.
(Ver-11 - 17 Feb 2005)

(Note: The above report provides full bibliographical references to annual monarch colony measurements from the 1993-1994 through the 2004-2005 overwintering seasons.)

EVIDENCE

A. The 2004-05 winter butterfly population in Mexico is at an historical low

In the fall of 2004, Sr. Eduardo Rendon of The World Wildlife Fund-Mexico, in collaboration with Sr. Eduardo Ramirez, Director of La Reserva de la Biosfera Mariposa Monarca (MBBR), organized a team of workers to monitor all known overwintering sites of the monarch butterfly in the Transverse Neovolcanic Belt of Mexico. The areas they searched in December 2004 included previously used sites both within and outside of the MBBR. Their data have been summarized in a report (Rendon-Salinas and Galindo-Leal, 2005) that was sent to Dr, Ernesto Enkerlin, Presidente, Comisión Nacional de Áreas Naturales Protegidas (CONANP). These data are included in Table 1 and Figure 1.

The total area occupied by the overwintering butterflies was1.58 to 1.60 ha within the MBBR and 0.59 ha in three colonies outside of the MBBR, for a total 2.19 ha. This is the smallest value recorded in the past twelve overwintering seasons, and, based on largely anecdotal observations, possibly the lowest since the late1970's when annual surveys began (Calvert and Brower, 1986). These low numbers are, as will be shown below, the result of low numbers of monarchs returning to Mexico from the USA and Canada in the fall of 2004. Particularly disturbing is the fact that the three usually large colonies on the Sierra Chincua, Cerro Pelon and Sierra Campanario are all very small this season. The available data base for these twelve overwintering seasons (1993-2005, in Rendon-Salinas and Galindo-Leal, 2005) indicates that the total colony area has fluctuated between the current 2.2 and 21 hectares (Figure 1).

B. The summer 2004 population buildup in the eastern USA and southeastern Canada was low

The Monarch Larva Monitoring Project (MLMP), under the direction of Karen Oberhauser at the University of Minnesota, uses citizen volunteers to collect data on the monarch's breeding population distribution and abundance in the mid-western USA. The study encompasses the area producing an estimated 80% of the fall migratory population of monarch butterflies in eastern North America (Wassenaar and Hobson, 1998; Hobson et al.,1999). The MLMP has collected data on larval populations since 1997. Three of the four lowest year counts during this eight year period occurred in the summers of 2002, 2003 and 2004, with the lowest numbers of larvae recorded in 2004 (Oberhauser et al., in prep.). Why might this be so?

C. The fall 2004 fall migration in the eastern USA and southeastern Canada was low

Extensive reports during the fall of 2004 on the Journey North and Monarch Watch websites, including those of veteran monarch tagger Don Davis in the Toronto region, attested to a very small fall migration through southern Canada and the eastern USA. Monarch Watch's fall

tagging program, under the direction of Orley Taylor at the University of Kansas, includes hundreds of volunteers. In the fall of 2004, they tagged approximately 45,000 monarchs, the lowest number since 1996, the first year that large numbers of monarchs were tagged by Monarch Watch (Taylor, in prep.).

Further evidence of a diminished 2004 fall migration has been produced from two monitoring programs along the Atlantic Coast, in Cape May, New Jersey and in Chincoteague, Virginia. Both areas had the lowest number of fall migrants recorded over the span of the censuses, from 1991-2004 for New Jersey (Walton, Davis and Brower, ms. submitted), and from 1998 -2004 for Virginia (Gibbs, Brower and Davis, in prep.).

WHY IS THE WINTER 2004-05 OVERWINTERING POPULATION SO LOW?

The estimates of colony areas for the winter of 2003-04 were well above average (Figure 1). Monarch populations fluctuate yearly from a combination of factors throughout North America. Some of these are beyond human control, but human factors are also of major importance. The following are what we have discussed at length and what we consider may have been the main factors leading to such a small population estimate for the current 2004-05 winter. We emphasize that research in the future should focus on, and fairly weigh all the possible contributing factors.

A. Winter storm mortality during the 2003-2004 seasons was high

The colony areas that are usually reported are measured between mid-December and mid-January. They reflect the number of fall butterflies that flew from the U.S. and Canada to the wintering areas. The size of the spring migration, however, will be determined both by the size of the migration the previous fall and by the number of butterflies that survive the winter. Storm mortality varies widely from year to year, and when it occurs, it is usually later in the winter. There are two important consequences of this: first, colony measurements made in December may not reflect overwintering success; and second, if there is major mortality, then the numbers migrating north in the spring will be diminished.

The relatively large 2001-02 overwintering population, for example, was estimated to have suffered approximately 80% mortality during and immediately following a severe storm on 12-16 January 2002 (Brower et al., 2004). In 1980-81 the most prolonged storm on record lasted from 12 to 23 January and killed an estimated 42% of the butterflies (Calvert et al., 1983). Storms can occur even later: during the1999-2000 overwintering season, a severe storm occurred on 2-3 March (reported in Taylor, 2000). In 2003-04, storms occurred both on 18 January and 31 January (Rendon and Brower, unpublished data) and may have resulted in mortality exceeding 70% of the population (reported in Taylor 2004).

While we can not know for certain, we agree that it is highly likely that the mortality from these January 2004 storms reduced the numbers of monarchs reaching the southern U.S. breeding areas in March - April. This, in turn may have resulted in a small wave of new first generation butterflies migrating to their northern breeding range. We do know that the number of spring remigrants reaching northern Florida in the spring of 2004 was the lowest observed in several years (Brower et al., in prep.). It is obvious that the buildup of monarchs over the

summer will depend upon the reproductive success and the number of the successive generations produced from April through early September.

B. Weather during the 2004 summer breeding season in the eastern USA and southern Canada was cold and wet

Extensive reports received by Monarch Watch from March-September 2004 suggested that the population buildup in the eastern USA and southeastern Canada was unusually low (Taylor 2004). The summer of 2004 in the mid-western breeding range was the coolest since 1992 (Taylor, 2005). Field and laboratory data as well as Monte Carlo and CLIMEX models indicate that the eastern N.A. monarchs may produce up to five generations in a year with favorable weather conditions, but fewer generations in cold years (Zalucki, 1982; Cockrell, Malcolm and Brower, 1993; Zalucki and Rochester, 1999, 2004; Taylor, 2005). Cold weather hinders population growth by limiting oviposition and by extending generation time, thus limiting the number of generations and truncating exponential growth. Future research needs to establish critical climate monitoring points throughout the breeding range and correlate these data with far more widely obtained monarch population breeding data.

C. Colony mortality is being exacerbated by habitat deterioration of the overwintering sites in Mexico

The condition of the forests in which the monarch colonies overwinter is rapidly deteriorating through small and large scale illegal logging. An extensive literature has definitively documented that opening up of the forest both within or adjacent to the overwintering sites increases exposure of roosting butterflies to wind, wetting and radiational heat loss that increase the numbers that freeze to death. These deleterious effects of forest thinning are exacerbated during winter storms (Alonso-Mejia et al., 1992; Anderson and Brower, 1996; Brower, 1996; 1999a). Monarchs avoid roosting in forests that do not provide the needed climatic conditions, as has been observed in the Chivati-Huacal area where monarchs have not overwintered since major logging occurred in the late 1980's.

Satellite imagery, ground mapping and aerial photography are providing GIS data that document various degrees of logging in three of the prime overwintering areas within the core zone of the Presidentially decreed 2000 Monarch Butterfly Biosphere Reserve (Brower et al., 2002; Ramirez et al., 2003). Illegal logging between 1999 and 2004 in both the buffer and core zones of the Reserve is documented in a report by WWF-Mexico (Galindo -Leal and Honey-Roses, 2004).

Mapping the incursions in relation to the historic locations of overwintering colonies documents that thinning and clearing are not limited to forest areas peripheral to the butterflies' overwintering requirements. Specific habitat areas that were occupied by butterfly colonies over a number of years have now been destroyed (Brower et al., in prep.).

Over the past two years, several members of our Scientific Advisory Committee have witnessed the following deleterious impacts within three of the prime overwintering areas:

1. Sierra Chincua. A January 2004 storm blew down large numbers of trees along the southwestern ridge of the Sierra Chincua. The MBBR staff allowed removal of these trees (salvage logging), and as a collateral result, loggers stripped large portions of the ridge above Arroyo Zapatero of its large living Oyamel and pine trees. This statement is based on direct observations and from a comparison of digital aerial photographs, taken in 1999 and 2002, with Ikonos satellite images taken in 2004 (Ramirez, Brower and Slayback, in prep.). This tree removal has severely exposed the headwaters of Arroyo Zapatero to wind and storm intrusion. This area has hosted overwintering monarchs nearly every winter since the location was first recorded in the 1976-1977 overwintering season (Calvert and Brower, 1986). In addition, the lower reaches of Arroyo Honda - the second of the two main spring remigration canyons on the Sierra Chincua - has been seriously impacted over the past several years by continuous low level logging (Brower, unpublished; Wilson, 2003). Further, the large ridge along the south east side of the Arroyo Honda has been stripped of forest, and a large illegal logging operation along the north side of the Sierra Chincua in 2004 has added numerous major logging tracks and degraded the forest that protects the entire Chincua overwintering areas from northern winds (Honey-Roses and Galindo-Leal, 2004; Ramirez, Brower and Slayback, unpublished).

2. Cerro Pelon. Over the past 7 years the northeast face of the Cerro Pelon range has been stripped of forest and burned, completely destroying several known historic overwintering sites (Anon., 2001; Brower, Ramirez and Slayback, in prep.). In addition, the western edge of Cerro Pelon has been subjected to continuous low level logging that has now degraded several major historical overwintering areas beyond their utility for the monarch butterfly (Brower, Ramirez, and Slayback, in prep.). The one small Cerro Pelon colony this 2004-05 season is located at the top of and adjacent to this degraded area, and is therefore seriously exposed to potential storm damage (Ramirez and Brower, unpublished observations, January 2005). In summary, the entire historical overwintering habitat on Cerro Pelon, except for the southern slopes, has been degraded or destroyed over the past decade.

3. Sierra Campanario. The prime overwintering area that has served as the Rosario ecotourism site (through which the recently built cement stair access leads) has been used by the butterflies predictably since the 1981-1982 overwintering season (Calvert and Brower, 1986). It closely abuts agricultural fields, but until recent years the forest has been relatively dense. A second area (now called Conejos) is at a higher altitude and frequently has hosted an overwintering colony (Brower, unpublished observations). However, the prime ecotourism site was marginally occupied during the 2001-2002 season and not occupied at all by monarchs for the last two overwintering seasons (Rendon, Ramirez and Brower, unpublished observations). We hypothesize that monarchs have abandoned this area because the ongoing culling of trees in the area has opened the forest and created microclimate conditions that the butterflies do not tolerate.

The larger colony has formed nearby in the more intact forest above the Llanos de Conejos in 2001-02, 2003-04 and 2004-05. We hypothesize that the massive mortality from storms in January 2002 and 2004 was at least partially caused by the butterflies being forced to the higher altitude of Conejos, resulting in lower minimal temperatures during the wet and cold storm period.

4. Other sites. World Wildlife Fund-Mexico has documented several additional major illegal logging operations, including one massive operation along the southwestern side of the Sierra Campanario and another along the eastern edge of Chivati-Huacal, adjacent to the tourist access road that leads up the valley from Ocampo to the Rosario ecotourism center (Galindo and Honey-Roses, 2004). Along with the logging operations, Ramirez (2004) has documented an extensive and growing road system that in 2003 extended for 2,213 km within the MBBR. Severe logging is also occurring in and adjacent to several sites outside of the MBBR (research in progress).

D. Summer breeding habitat in the U.S. and Canada is being eliminated by herbicides

The principal larval food plant of the monarch butterfly in eastern North America is the Common Milkweed, *Asclepias syriaca* (Malcolm et al., 1989; 1993) a weedy plant that has been extensively spread by conventional agricultural activities (Brower, 1995). A survey in 2000 in Iowa, Wisconsin and Minnesota concluded that the majority of monarch butterflies are produced on milkweeds growing within agricultural fields (Oberhauser et al. 2001; see also Taylor and Shields, 2000), with fields in the corn belt particularly important (Wassenaar and Hobson, 1998; Hobson et al., 1999; Jesse and Obrycki, 2003). Much of the mid-western breeding habitat is being lost because of changes in U.S. agricultural practices. Adoption of soybean, and to a lesser extent corn, that has been genetically engineered to be resistant to herbicides has been widespread. Herbicides are sprayed in early spring, killing virtually all other emerging plants including *A. syriaca* and myriad potential nectar resources. This was forewarned by Brower (1995, 1999b, 2001) and Taylor (1999, 2004). The scale of this emerging problem is enormous, but as yet unquantified.

E. Herbicides are also eliminating adult nectar resources in the U.S. and Canada

The ability of adult monarch butterflies to obtain nectar from wildflowers during the fall migration is critical to their building up sufficient lipid reserves to survive the winter and remigrate back into the United States the following spring (Masters et al. 1988; Alonso et al, 1997). While the problem has not been addressed quantitatively, herbicide use in combination with GMO crop agriculture is killing off the native wildflower flora on an unprecedented scale throughout the United States and Canada (Brower and Pyle, 2004).

SUMMARY OF OUR CONCERNS

In the absence of habitat deterioration, climate and natural enemies would be the determinants of the butterflies' annual population sizes. The population would build when moderate winters combined with favorable springs and summers, and drop when severe winter storms combined with unfavorable conditions during breeding and migration. In some years, for example, late spring frosts may kill back milkweeds, and hurricanes may displace migrating

monarchs (Brower, 1995). An additional factor is global climate change, predicted to have a negative impact on butterflies wintering in the Oyamel ecosystem (Oberhauser and Peterson, 2003). The effects of climate change on breeding and migration are currently being modeled (Batalden, Oberhauser and Petersen, in prep.).

Climatic factors are beyond human control, but the striking decline in monarch numbers this 2004-2005 overwintering season underscores the need to do all that is possible to minimize the negative impact of human activities on monarch populations. Monarchs have proven resilient to many environmental stresses, but the ongoing deterioration and loss of habitat in Mexico, the United States and Canada has the potential to drive the population below a level from which it can recover. Putting this another way, we submit that the cumulative and interactive effects of habitat degradation by humans and of stochastic extreme climate events may, in the near future, bring the current large scale monarch migratory phenomenon to the point of collapse. We hope we are wrong in this assessment, but we feel that it would be irresponsible for us not to express our consensus.

We are playing butterfly roulette, gambling that breeding success will allow the monarch population to recover from the combined effects of natural and anthropogenic mortality. Major recovery seems to have occurred after the winter storms of 2000-01, but not after the storms of 2001-02 *or* 2003-04 (Figure 1). The United States lost its gamble with both the passenger pigeon and the Rocky Mountain locust (Wilcove, 1999; Lockwood 2004). Degradation of the overwintering habitat in Mexico by the multiplicity of effects of illegal logging, and destruction of the summer breeding habitats by current agricultural practices in the United States and Canada, need mitigation if the phenomenal migration biology of the monarch butterfly is to survive.

We are of the unanimous opinion that the most pressing need is to protect the forests within the Core Zone of the MBBR in Mexico from further logging.

RECOMMENDATIONS TO AMELIORATE THE INTERNATIONAL PROBLEMS

We recommend that the following steps be taken by appropriate government, scientific, educational and conservation organizations in Canada, the United States and Mexico:

1. Ensure that effective and widespread enforcement against illegal logging in the monarch butterfly overwintering areas in Mexico continues throughout the entire year, not only during the butterfly tourism season.

2. Establish a program for standardized early spring measurement of Mexico colony areas, in addition to the existing mid-winter measurements. The mid-winter measurements reflect breeding and fall migration success, but do not assess overwintering mortality. Measurements made during the first two weeks of March would reflect winter mortality, and provide an estimate of the size of the spring remigrant population. More extensive monitoring throughout the breeding range in the U.S. and Canada is also needed.

3. Modify the current Monarch Butterfly Biosphere Reserve management guidelines for both the Core and Buffer Zones in light of recent years' experiences. In addition to the aforementioned problems, we are concerned about salvage logging, the negative impacts of ecotourism, livestock grazing and the diversion of water out of the MBBR.

4. Develop an official document of concern to the manufacturers of herbicides and GMO crops and to government regulatory bodies, recommending specific measures to protect milkweeds and nectar sources of the monarch butterfly in agricultural areas throughout the breeding ranges in the United States and Canada.

5. Develop educational and outreach programs to reduce herbicide spraying of roadsides and agricultural edges, encouraging creation of habitats that will benefit monarch butterflies as well as many other wildlife and plant species.

6. Urge the Canadian authorities to remove all native species of milkweed (*Asclepias*) from their noxious weed lists.

7. Determine the economic and social costs in the States of Michoacan and Mexico, from diminished ecotourism, if degradation of the overwintering habitat in Mexico and the breeding habitat in the United States and Canada continue. The effect of forest clearing on the water supply of local communities should also be determined. Emphasize that the degradation of the overwintering habitat in Mexico and the breeding habitats in the U.S.A. and Canada will negatively affect the ecotourism industry in the States of Michoacan and Mexico.

TABLE 1 AND FIGURE 1

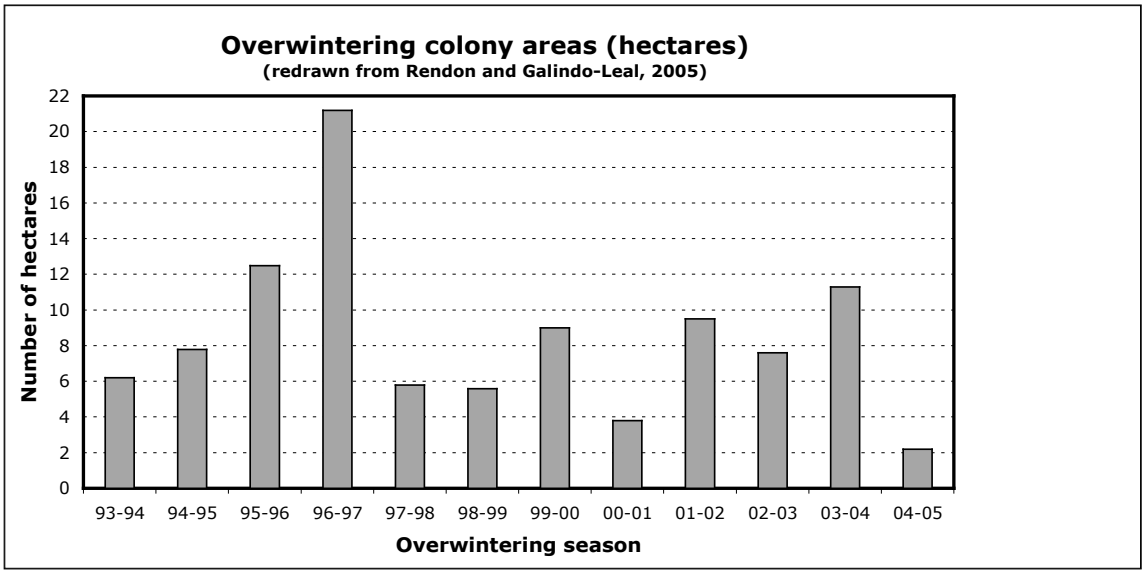
Table 1. Colony area measurements, 2004-05. Data from Rendon and Galindo, WWF Website, LPB received as PDF File on 12 February 2005 from Ernesto Enkerlin. LPB modified the table slightly.

Massif	Note	Site	Date	Total ha	Date	Total ha
Cerro Altimirano		Contepec	6-Dec-04	0.00		
Cerros Chivati-Huacal		Chivati	5-Dec-04	0.00		
San Andreas		San Andreas	14-Dec-04	0.00		
Sierra El Campanario		Las Palomas	2-Dec-04	0.00		
Sierra El Campanario		La Mesa	2-Dec-04	0.00		
Mil Cumbres		Las Palomas	9-Dec-04	0.00		
Sierra Chincua	1	Llanos de los Toros	11-Dec-04	0.20	30-Dec-04	0.36
Sierra El Campanario	2	Conejos 2	7-Dec-04	0.10	21-Dec-04	0.10
Sierra El Campanario	3	Conejos 1	11-Dec-04	1.06	28-Dec-04	0.88
Cerro Pelon	4	Carditos	8-Dec-04	0.24	22-Dec-04	0.24
Palomas		Palomas	12-Dec-04	0.35		
Piedra Herrada	5	Herrada	12-Dec-04	0.14		
San Fco. Oxtotilpan	6	Oxtotilpan	23-Dec-04	0.10		
Total				**2.19**		
Minimum sum				*2.01*		
Maximum sum				*2.35*		
Latest date sum				*2.17*		

Notes:

1. Named Cerro Prieto by Rendon and Galindo; Llanos de los Toros by Brower et al.
2. Named Lomas de Aparicio by Rendon and Galindo; Conejos 2 by Brower et al.
3. Named El Rosario by Rendon and Galindo; Conejos 1 by Brower et al.
4. Named Capulin by Rendon and Galindo; Carditos by Brower et al.
5. Brower et al. shortens to Herrada
6. Brower et al. shortens to Oxtotilpan

Figure 1. Based on the data in Taylor (2002) corrected to 3.83 ha rather than 2.83 ha as given on p. 52 for the 2000- 2001 overwintering season.



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