

# Captive Breeding and Releasing Monarchs

Are we helping or hurting monarchs by releasing large numbers of captive-reared individuals? Across the country, people purchase monarchs for release at weddings, funerals, and other celebrations; and to raise in classrooms and other educational settings<sup>1</sup>. Following news of the dramatic decline in monarch numbers, some people are rearing large numbers of monarchs in backyard operations or obtaining them from commercial breeders or other organizations and releasing them with the goal of supplementing local populations. While raising and releasing small numbers of monarchs can offer important scientific and educational opportunities and foster a connection to nature, we believe that releasing commercially produced and continuously mass-reared individuals is unlikely to benefit monarchs, and could actually hurt them, as a result of mass rearing conditions that promote crowding and disease spread, or cause the loss of genetic diversity or adaptation to captive rearing conditions. Large-scale captive rearing and subsequent release can also limit the ability of monitoring programs to understand natural population dynamics. For these reasons, we recommend against large-scale captive rearing of monarchs for release into the wild, and we summarize the potential impacts below.

## 1. Negative effects of mass rearing conditions

Mass production of monarchs makes it easy to transmit disease. Monarchs are susceptible to diseases that can be transmitted among larvae<sup>2</sup>. There are no requirements that commercial breeders or others who raise captive monarchs follow specific disease-prevention protocols, nor are there agencies that routinely test captive stock for diseases<sup>3</sup>. In our research labs, we raise several hundred or more monarchs per year for scientific purposes, house them singly or at low densities in hospital-like sterile conditions, and shut down our rearing practices annually for deep cleaning. Even under these conditions, it is hard to keep pathogens in check, and we periodically experience disease outbreaks. It is relatively easy to screen for the most common monarch pathogen, *Ophycystis elektroscirrha* (OE), but doing so requires constant vigilance. A decade ago<sup>4</sup>, and more recently in 2013, several of the authors of this document found that many purchased monarchs from commercial growers were heavily infected with OE.

Additionally, unknown pathogens occasionally affect monarchs in our labs (suspected *Serratia*, *Nosema*, and nuclear and cytoplasmic polyhedrosis viruses); these pathogens often kill 30% or more of our monarchs. Three of us have been rearing monarchs from wild material for over two decades, and these die-offs in our study animals only started in 2004–05. Because it began independently in our laboratories at the same time that we noticed increased releases of commercially bred and other captive-reared monarchs, we wonder if the causative pathogens could be traced to these releases, as has been suggested in bumble bees. There is evidence that the dissemination of commercially bought, captive-reared bumble bees used to pollinate glasshouse tomatoes and open-field crops has helped spread the pathogen *Nosema bombi* into wild bumble bee populations in North America, and this appears to have caused catastrophic declines in four native bumble bees (*Bombus terricola*, *B. affinis*, *B. franklini*, and *B. occidentalis*) in the wild<sup>5,6</sup>.

Although the impact of releasing commercially bred monarchs into the environment has not been well studied, the potential exists for population declines of wild monarchs through the following mechanisms: 1) a build-up of higher levels of pathogens in commercial breeding facilities that are then spread to wild monarchs; 2) more virulent strains of pathogens evolving in commercial breeding facilities that infect wild monarchs; or 3) the introduction of novel strains of pathogens to regions where they would not naturally occur, due to the shipment of monarchs. These potential risks have been considered for bumble bees<sup>7</sup>, and it is reasonable to assume that the same risks exist between commercially bred monarch butterflies and their wild counterparts.

There is also concern that monarchs reared in captivity might be less fit than those that grow outside in a natural environment. A recent study found that reared monarchs were significantly smaller and less likely to be recovered in the Mexican overwintering grounds than their wild counterparts<sup>8</sup>. Smaller monarchs live shorter lives as adults and smaller females lay fewer eggs. In addition, if monarchs are reared at high densities they can become stressed and injured<sup>9,10</sup>.

## **2. Genetic consequences: Adaptation to captive conditions and loss of genetic diversity**

We also are concerned with the potential genetic consequences of breeding and releasing monarchs; breeding closely related individuals can lead to the negative fitness effects of inbreeding<sup>11</sup>. While we don't know if breeders work to maintain genetic diversity, if commercial breeders or other monarch growers use small numbers of monarchs in their initial captive population, and if they continue to breed related individuals over successive generations, then many of the monarchs they release would be closely related. Furthermore, breeders often share monarch lineages (often referred to as "stock") with each other, meaning that even the monarchs coming from different facilities can be related.

Studies in species ranging from fruit flies to fish show that animals can genetically adapt to captive conditions in as short as one or two generations<sup>12</sup>. Conditions experienced in captivity can differ greatly from those in the wild in terms of temperature, moisture, light intensity, day length, food sources, density, presence vs. absence of predators, and more. When this happens, researchers see a high frequency of genetic traits that would be harmful or result in a lower survival rate for these individuals and their offspring if they are released into the wild. The more generations that are continuously raised in captivity, the more extreme this effect becomes.

## **3. Negative effects on scientific research**

To better understand and protect the monarch, researchers and citizen scientists carefully track the size, migration, and geographic range of the monarch population. When captive-reared monarchs are released in places and times when they are rare or not naturally present, it confounds our ability to document the real state of the wild monarch population for several reasons.

- 1) Large-scale releases in places where wild monarchs are already present can bias monitoring and make the population seem artificially large.

- 2) Releases at times and locations where monarchs are not present lead to false measures of monarchs' "occupancy" of the landscape. Because we know that releases occur, this could alternatively lead scientists to disregard observations that are actually real. For example, a monarch observed and photographed in April 2015 in Minnesota was reported to Journey North. This observation was subsequently removed from the Journey North database because of its extreme earliness at the location, and the chance that it could have been captive-reared and released. However, it may have been a very early migrant, and could thus help us understand impacts of weather and climate on monarch migration.

- 3) Collection of monarchs from one area, subsequent mass breeding, and translocation to other areas could distort estimates of genetic diversity and gene flow in wild monarchs<sup>3,13</sup>. Releases that occur during times of the year when natural monarch abundance is low (such as in early spring), have unusually large influences on monarch ecology and genetics. The study of monarch biogeography, especially in western North America, is still in its infancy, and many important questions critical to monarch conservation are still largely

unanswered. Releasing monarchs into the landscape without marking or monitoring interferes with our ability to answer those questions.

For all of these reasons, we do not support the release of purchased or mass-reared monarchs. It is our collective judgment that purchasing and releasing monarchs, or rearing and releasing excessive numbers, could do more harm than good.

We realize that rearing on small scales can offer benefits for education, outreach, connecting with nature, and citizen science. Members of the public who choose to bring in small numbers of wild-collected monarch eggs and larvae for personal enjoyment, outreach, or to participate in citizen science projects are encouraged to follow [protocols for safe rearing](#) and collect data on their reared monarchs for programs such as the [Monarch Larva Monitoring Project](#) and [Monarch Health](#). All rearing of monarchs should be undertaken with extreme care, restricted to a single generation annually if the butterflies will be released, and carried out using safe rearing practices and vigilant monitoring for health and disease. Individuals who care about monarchs and who wish to contribute to monarch conservation are encouraged to participate in citizen science monitoring and habitat restoration projects, and to support natural habitats with diverse ecological communities where monarch populations can be self-sustaining.

Sonia Altizer  
Monarch Health  
Odum School of Ecology  
University of Georgia

Lincoln Brower  
Department of Biology  
Sweet Briar College

Elizabeth Howard  
Journey North

David James  
Department of Entomology  
Washington State University

Sarina Jepsen  
The Xerces Society for Invertebrate Conservation

Eva Lewandowski  
Conservation Biology Graduate Program  
University of Minnesota

Gail Morris  
Southwest Monarch Study

Kelly Nail  
Conservation Biology Graduate Program  
University of Minnesota

Karen Oberhauser  
Monarch Larva Monitoring Project  
Department of Fisheries, Wildlife and Conservation Biology  
University of Minnesota

Robert Pyle  
Northwest Lepidoptera Society

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