

All Hail the King: Monarch butterflies in Mexico – Canada Migration

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Introduction



Figure 1. The monarch butterfly. (Pixabay, 2015).

Monarch butterfly populations have significantly decreased, threatening the stability of the species. Monarch butterflies make the multi-generational migration south towards Mexico from eastern U.S. and southern Canada, and reach central Mexico beginning early November. Genetically modified crops, specifically transgenic corn pollen, have a negative effect on the nursery habitat of monarchs. The loss of milkweed habitat, the loss of forests from illegal logging, and climate change are some of the main drivers for the massive drop in monarch populations. We will address the major issues of this problem and the existing governance, and propose possible solutions.

Framing the Problem

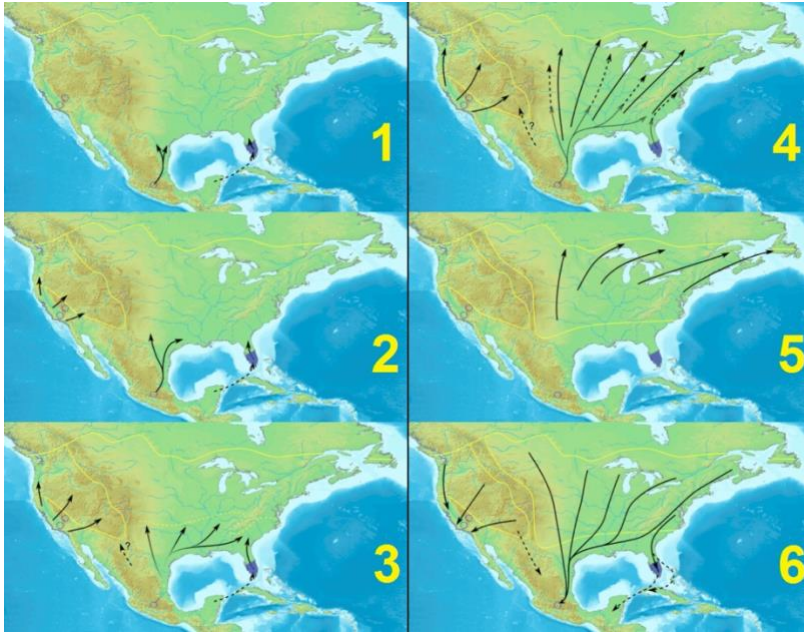
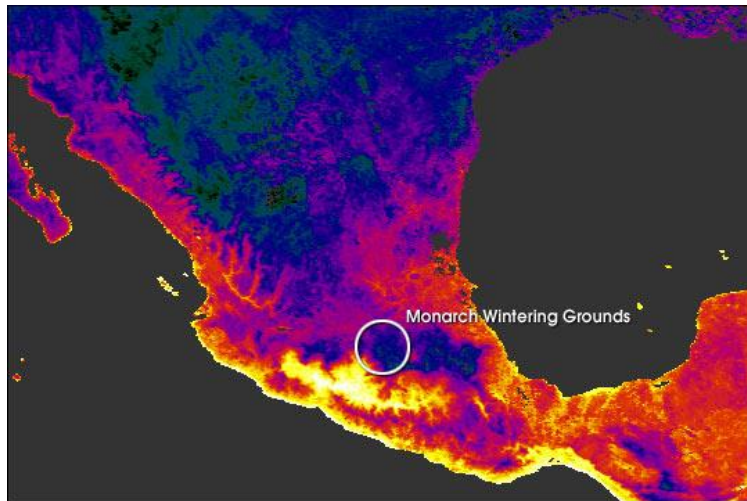
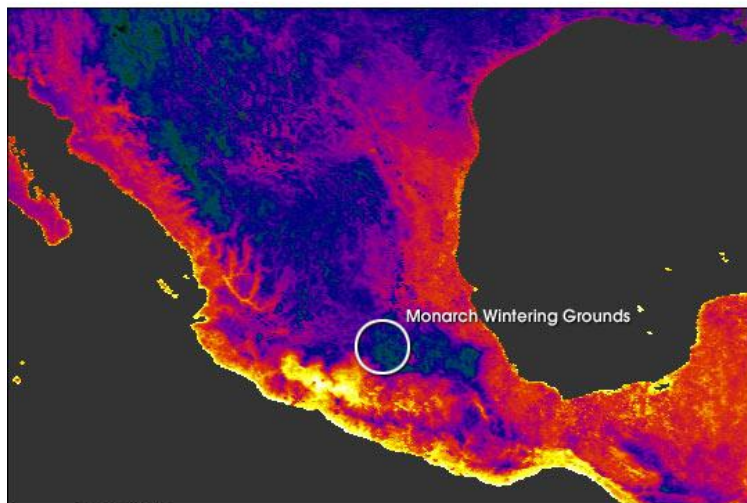


Figure 2. Monarch butterfly migration from central Mexico to southern Canada. (Wikimedia Commons, 2011).

The situation is a wicked problem because the stakeholders such as communities, government and private sectors of Mexico, the U.S. and Canada have different legislation for monarch butterflies and milkweed population (Ewins, 2015), and scientific knowledge of how human activity affects the migrational phenomenon of the monarch butterfly is limited. Private sectors such as agriculture and logging would have the most impact, followed by the government, then the communities. Private sectors, most prominently agricultural, use pesticides to prevent pests and increase production; however these pesticides are harming milkweed populations. Pesticide use, coupled with the planting of genetically modified (GM) food such as maize and soya in the U.S. Midwest, caused the loss of milkweed and as a result, monarch populations declined by 81% from 1999 to 2010 (Pleasants & Oberhauser, 2013). Logging is also highly detrimental to monarch habitat.



January 11-20, 2001



January 11-20, 2002

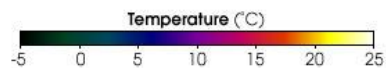


Figure 3. The increase in cooler temperatures, displayed by blue and green pixels, wiped out approximately 80 percent of monarch wintering grounds nesting habitat from 2001 to 2002 in central Mexico (Simmons, 2009).

The Monarch Butterfly Biosphere Reserve has been highly degraded in Mexico, mainly by deforestation from illegal logging and from drought, pests, lightning, and landslides (Fears, 2015). Finally, communities and the demand for certain products they generate causes degradation in monarch habitat. The public's reliance on herbicide can be counteracted by support for organic farming or education about the importance of milkweed to monarch butterflies.

Governance Framework

Monarchs face threats at all parts of their migrational cycle. The governments of Canada, Mexico, and the United States ultimately have the most power to make a large impact on conservation, but NGOs and locals, especially in Mexico, have the power of sheer numbers

and more versatility. Farmers could play a role, but due to the nature of the agricultural sector in the United States and Canada, the choice of using pesticides is often made for them.

The United States has the most work to do on the federal level while states and NGOs are making considerable progress. The US has no federal protection for monarchs, but California has Assembly Bill #1671 that protects monarch butterfly overwintering habitat, and the state voted to buy overwintering habitat (Commission for Environmental Cooperation, 2008). The Monarch Joint Venture is perhaps the most ambitious project in the United States addressing monarch conservation. It consists of federal and state agencies, NGOs, and academic programs in the lower 48 states. The group is partnered with several other organizations, many of which are federal, and all reports are available for free on their website (Monarch Joint Venture, 2015). Pesticide legislation is the weak point of the United States, as it has the weakest maximum residue limit for 21 food and pesticide combinations. In addition, the process required for approving new pesticides is not always followed (Boyd, 2006), for which the government has yet to answer. The United States also has the Lacey Act, which was updated in 2008 and prohibits the sale, import, export, and transportation of illegal lumber. Penalties such as prison sentences are possible, although accountability is lacking, as Lumber Liquidators was the first felony conviction, and only came into existence recently. One major flaw is that suspicion has to be raised based on the information provided, which could be challenging if lumber is declared incorrectly (Illegal Logging Portal, n.d.). Due to the vast majority of threats to monarchs being contained within North America, global agreements do not exist. For example, the Convention on International Trade in Endangered Species of Wild Fauna and Flora is a global agreement but is not concerned with the monarch butterfly (US Fish and Wildlife Service, n.d.). Only two regional agreements on the conservation of monarchs exist. The North American Monarch Conservation Plan, an in-depth action plan for the whole continent, was created in 2007, although from expert input only. The plan outlines several potential actions and is easily accessible for free online, but there is no mention of holding each of the countries accountable, and almost none of the suggested actions include communication with the locals (Commission for Environmental Cooperation, 2008). The other large-scale agreement is the International Network of Monarch Butterfly Reserves created in 1995 that sets aside thirteen areas in North America as monarch sanctuaries (Figure 5). The protected areas are contained within park boundaries in all three countries (Commission for Environmental Cooperation, 2008). The low number of large-scale agreements means that each country must take responsibility for issues within its borders, which leads to a lack of accountability and transparency, since there are no sanctions or investigations conducted by other countries.

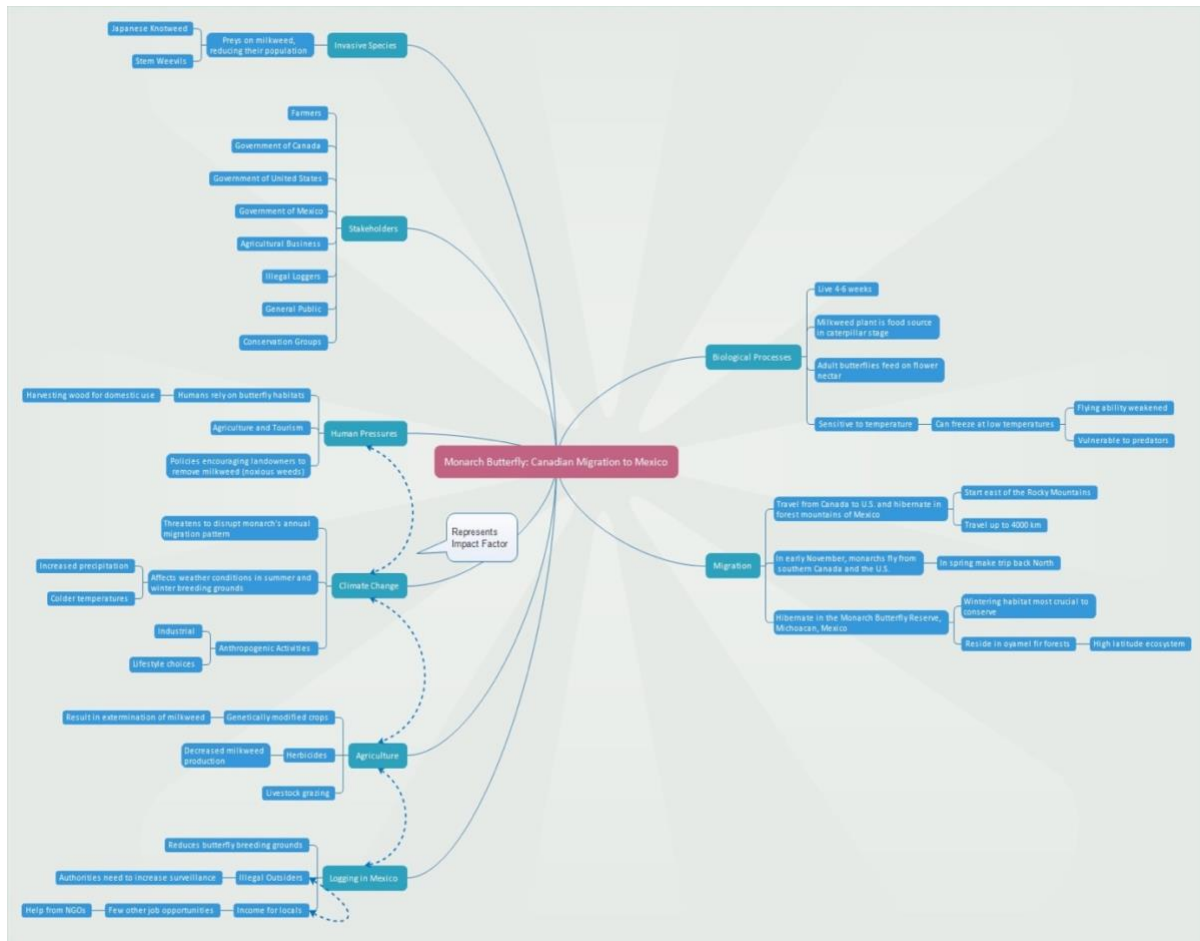


Figure 4. On the right side of the map, under the header Biological Processes, information regarding the monarch's characteristics is included to aid the understanding of the importance of milkweed protection. The monarch's migration path is also included to show the key areas that need to be protected and preserved. On the left side of the map, the four topics consist of: Human Pressures, Climate Change, Agriculture, Invasive Species and Illegal Logging. All of these factors need to be addressed with the cooperation of the three governments in Canada, the U.S., and Mexico.

Canada plays a lesser role in monarch butterfly conservation, although this is largely due to the monarch's range barely penetrating Canadian borders. Still, the monarch butterfly is listed as a species of special concern under the Species at Risk Act, but protection can only occur on federal lands. In addition, the Conservative government weakened enforcement capabilities, reducing the accountability of the government. However, Ontario plays an important role in protecting monarch habitat. The provincial government passed the Fish and Wildlife Conservation Act in 1997, which requires special permits to conduct research on monarchs (Commission for Environmental Cooperation, 2008), but could be a barrier to conservation. Canada is worse than the United States in terms of pesticide legislation, having the worst maximum residue limits for 24 combinations of food and pesticides. Similar to the United States, Canada also permits the use of numerous pesticides that have been banned in other industrialized countries (Boyd, 2006). Ontario is once again a leader in this regard, as recent legislation restricts the use of neonicotinoids, a group of pesticides known to be toxic to monarchs. The new legislation currently requires that all sellers of neonicotinoids

submit an annual report of sales and acquire a license. In 2016, farmers will only be allowed to use neonicotinoids on half of their crops, unless they can prove they have a pest issue. In 2017, neonicotinoids will be banned completely, unless a farmer can prove they have an insect problem, sign a declaration, and take a pest management course. While this new legislation sounds promising, farmers were never consulted, and enforcement will likely be lacking (Atkins, 2015). A final issue that Canada must address is the status of milkweed as a noxious weed. Ontario recently removed common milkweed from the list of noxious weeds, but Manitoba and Quebec still have it listed, which promotes removal by citizens and means it can be restricted by local authorities (Cowbrough, 2014).



Figure 5. Monarch reserves (non-MBBR) in North America (Commission for Environmental Cooperation, 2008).

The problem is quite different in Mexico, the main destination of winter migration for monarchs. The federal government started setting aside land for monarch conservation in 1980, with a decree that was not specific and only mattered during winter. In 1986, the area became well defined and in 2000, the size was greatly increased. One of the main problems is that the federal government barely considered the locals, who relied heavily on logging due to few other job opportunities. Treating them as an unnecessary obstacle, logging permits were stripped (Commission for Environmental Cooperation, 2008). Through the work of NGOs, the Monarch Butterfly Conservation Fund was set up to reward communities that reduced deforestation in their area to close to zero. A regional forum was set up in 2004 to allow communities to express their concerns. Though deforestation in the area never halted, recently it has been found that 96% of deforestation in protected areas occurs within the area of one community (World Wildlife Fund, 2016). However, some communities have complained about armed outsiders illegally logging the area, who not only destroy the area, but also cause the communities affected to lose their share of the conservation fund. The Mexican government has yet to take action, which has resulted in some communities confronting the illegal loggers themselves, putting many lives at risk (O'Connor and Booth, 2011). In Mexico, the government has failed to be accountable, transparent, or include citizen participation in their decisions. Instead, multiple NGOs are attempting to empower the locals.

Overall, governance regarding the monarch is quite inadequate. Due to few international agreements, accountability for all three governments is almost non-existent. While NGOs have been both transparent and encouraged citizen participation, the governments of each country need to become more involved. Canada and the US need to work on being more accountable, while the Mexican government needs to recognize monarch conservation as a pressing issue and ensure locals are communicated with during the decision making process.

Looking Forward

The decline of Monarch butterflies is a complex problem to manage. Any management strategy should first determine clear goals, within realistic timeframes, to ensure that the impacts of any mitigation attempts are considered. In the case of the monarch, we want to have aims based at growing populations to support a sustainable future. For this to happen, it is important to stimulate collaboration and discussion between groups to identify common goals and find where discrepancies in values may arise. Creating a forum in which scientific knowledge can be discussed alongside stakeholder views is the first step in identifying a viable solution. From this, it can be determined what actions will be most beneficial for monarchs, whilst having the least drastic effects on key stakeholders.

To increase monarch survival over short time scales, action should be taken by the public to reinstate milkweed. Non-profit groups and government organizations provide sufficient information on how replanting efforts can be carried out to support monarchs (National Wildlife Federation, 2015). Simplest among these is for the public to provide new habitat for butterflies by planting native milkweed species on private property. This requires very little input from stakeholders, as seeds are accessible to most people along the migratory route (Monarch Joint Venture, 2015). If the newly planted species were non-invasive, this would increase viable monarch habitat with little impact on the environment or the key values of other stakeholders such as farmers and loggers. Planting should also be implicated at a community level, where schools and other public spaces could be planted with milkweed. Despite few foreseeable negative impacts of these changes, it should be noted that possible outcomes could be different. For instance, were too many of the wrong species of milkweed to be planted, there could be a detrimental effect on biodiversity and other species may be negatively impacted by poisonous milkweed (Cowbough, 2014).

While much of the monarch's symbolism comes from its importance as an indicator of ecosystem health, it is also a nostalgic reminder of the potential that future generations may grow up without experiencing the wonder of the monarch migration (Fears, 2015). For this reason, public outreach, in schools especially, should be encouraged. Education about the plight of the monarch can foster interest in their preservation and lead to sustainable initiatives, such as planting milkweed (Rabic, 2015). The need to preserve current monarch habitat to prevent further decline can be emphasized by educating people about the significance of milkweed in the monarch life cycle. These small-scale public initiatives cannot be deemed sufficient to sustain monarch populations, but are an important step to ensure that butterflies will be around to enjoy the benefits of changes to government policy that will be slower to take effect.

The next step in solving the monarch decline should be taken at a local government or state level. State legislation has the ability to contribute larger areas of public space for monarch habitat (National Wildlife Federation, 2009). Already we are seeing states adopting this

technique. For example in New Jersey, government land around sewers and roadways is being planted with milkweed (State of New Jersey, 2014). These initiatives should be adopted by all states on the migration route and should be introduced relatively quickly to provide refuge for beleaguered butterflies. The larger size of these areas does create some problems, as implementing such measures requires funding and is initially time-intensive. Areas outside of farmland may still be affected by the use of pesticides (Atkins, 2015), so the management and regulation of these boundary zones could cause tension between farmers and conservationists. However, this is a viable option for rebuilding monarch populations to sustainable levels, without major impacts and changes for stakeholders to deal with.



Figure 6. Application of an identification tag to a monarch butterfly as part of an observatory program in Cape May (Wikimedia Commons, 2008).

In order to truly understand the state of the monarch butterfly decline, more research is still required. Monitoring populations (Figure 6) should continue in order to make educated decisions and support changes in policy and management (Commission for Environmental Cooperation, 2008). These changes could alleviate current pressures we see facing monarchs and lead to new conservation targets and international agreements. It will also allow collaboration between key stakeholders to be better informed, and help find a reasonable level for a new stable state in monarch populations.

In Mexico, where overwintering habitat is being degraded by illegal logging (Vidal & Rendón-Salinas, 2014), stronger government legislation and action is needed to protect the monarch's winter home. In the Monarch Butterfly Biosphere Reserve (MBBR), logging is still occurring, unopposed by government forces. Those community groups that have tried to safeguard monarch habitat are putting their own lives at risk in the face of armed resistance by illegal loggers (O'Connor & Booth, 2011). These people and areas should be afforded stronger government protection if monarch wintering grounds are to recover from logging practices. Extending the MBBR based on metapopulation ecology to contain more areas of monarch habitat is also important to provide protection for butterfly populations wintering outside the current boundaries.

If the monarch is to survive for generations to come, stronger legislation needs to be introduced to control the use of pesticides and reduce their negative effects on monarch

habitat. In the United States and Canada, the discussion must be had to strengthen pesticide regulations to equal those in other developed nations (Boyd, 2006). Understandably creating policy like this takes time, as all the various stakeholders, including farmers, agribusiness, conservation groups and policy makers, need to be heard. The fallout from tighter regulations may include outbreaks of other weed species or reduced crop yields (Monsanto, 2014), which must be weighed against the positive effects for butterflies. Urgency is recommended so that changes in policy that take place in the next five to ten years, can have positive effects while the monarch populations are still able to recover. These discussions should consider adding monarchs to protected species lists and creating more monarch reserves and sanctuaries across all three countries (Commission for Environmental Cooperation, 2008). Both of these are important actions in ensuring that monarch populations can thrive in the future.

Resources

Peer Reviewed Articles

Antinori, C., & Rausser, G. (2007). Collective choice and community forestry management in Mexico: An empirical analysis. *The Journal of Development Studies*, 43(3), 512–536. Retrieved from: <http://www-tandfonline-com.ezproxy.library.ubc.ca/doi/pdf/10.1080/00220380701204471>

This article is peer-reviewed, and is about various decision-making strategies that are likely to produce better results, as evaluated by both rule conformance and ecological condition. The authors collected the opinions of locals through a survey and also interviewed several people from different groups such as foresters and community leaders. Survey data was then compared to the condition of the local environment. This study will help develop a better understanding of the social issues of logging. One problem with this study is that surveys can easily be riddled with false information, and so can interviews.

Fargione, M. (2015). Invasive species add to monarch butterfly's woes. *Poughkeepsie Journal*. Retrieved from: <http://www.poughkeepsiejournal.com/story/tech/science/environment/2015/07/30/cary-institute-invasive-species-monarch-butterfly-nature/30878593/>

Fischer, S. J., Williams, E. H., Brower, L. P., & Palmiotto, P. A. (2015). Enhancing Monarch Butterfly Reproduction by Mowing Fields of Common Milkweed. *American Midland Naturalist*, 173(2), 229–240. Retrieved from: <http://doi.org/http://dx.doi.org/10.1674/amid-173-02-229-240.1>

Flockhart, D. T., Pichancourt, J., Norris D. R. & Martin T. G. (2015). Unravelling the annual cycle in a migratory animal: breeding-season habitat loss drives population declines of monarch butterflies. *Journal of Animal Ecology*, 84, 155–165. doi: 10.1111/1365-2656.12253

This is a peer reviewed journal article where the authors look at the consequences of perturbations on monarch butterfly habitat and analyze the effects using population viability models. The results of this study show that a loss of breeding habitat has the most significant effect on monarch mortality, so these findings is very applicable to our case

study. We think that these outcomes can be trusted only to a certain degree, because numerical models can only account for a limited number of variables. However the input variables and methods for this research appear to be very good, as other relevant works have cited these findings. The authors have strong academic affiliations and the publication is well known, which increases the credibility of this paper.

Gowler, C. D., Leon, K. E., Hunter, M. D., & de Roode, J. C. (2015). Secondary Defense Chemicals in Milkweed Reduce Parasite Infection in Monarch Butterflies, *Danaus plexippus*. *Journal of Chemical Ecology*, 41(6), 520–523. Retrieved from: <http://doi.org/http://dx.doi.org/10.1007/s10886-015-0586-6>

Hartzler, R. G. (2010). Reduction in common milkweed (*Asclepias syriaca*) occurrence in Iowa cropland from 1999 to 2009. *Crop Protection*, 29, 1542-1544. doi:10.1016/j.cropro.2010.07.018

This communication addresses the loss of milkweed in Iowa using comparative data taken across a ten year interval from cropland and roadside sites. The author concludes that milkweed has declined in almost all cropland due to the use of glyphosate resistant engineered crops, while populations have increased along road ways. This data was collected from over 700 sites in 1999 and shows a decline of approximately 90% of milkweed in agricultural fields by 2009. The sites were selected randomly from across Iowa so the reliability of this data could be called into question. However, this is a trend that appears to be occurring in many monarch habitats, so the causes determined in this paper may be significant for other regions. This information is at the center of this study, so we believe it is an important and ultimately accurate source of data because of the author's other work in this field and strong academic credibility.

Oberhauser, K., & Peterson, A. T. (2003). Modeling current and future potential wintering distributions of eastern North American monarch butterflies. *Proceedings of the National Academy of Sciences of the United States of America*, 100(24), 14063–14068. Retrieved from: <http://doi.org/10.1073/pnas.2331584100>

O'Brien, D. (2012). Trapping Weevils and Saving Monarchs. *Agricultural Research*, 60(9), 17–17.

Once there were millions of passenger pigeons too. (1997). *Alternatives Journal*, 23(4), 5. Retrieved from: <http://search.proquest.com.ezproxy.library.ubc.ca/docview/218772316?accountid=14656>

Pleasants, J. M., & Oberhauser, K. S. (2013). Milkweed loss in agricultural fields because of herbicide use: effect on the monarch butterfly population. *Insect Conservation and Diversity*, 6(2), 135–144. Retrieved from: <http://doi.org/http://dx.doi.org/10.1111/j.1752-4598.2012.00196.x>

This paper investigates whether the loss of milkweed has contributed to the decline in Monarch populations across Midwest agricultural sites, as a result of the introduction of genetically modified crops. It is a peer reviewed journal article and is often cited in other related works. All the information is well referenced including the methodology. The authors display their affiliation with major academic institutions and it is published in a pertinent academic journal. The methods for gathering the data are scientific and account for different

variables across a range of temporal and spatial scales. We believe the findings of this study to be reliable and of high relevance to our topic.

Sears, M. K., Hellmich, R. L., Stanley-Horn, D. E., Oberhauser, K. S., Pleasants, J. M., Mattila, H. R. ... Dively, G. P. (2001). Impact of bt corn pollen on monarch butterfly populations: A risk assessment. *Proceedings of the National Academy of Sciences of the United States of America*, 98(21), 11937-11942. doi:10.1073/pnas.211329998

A meta analysis of a collaborative research done in several U.S. states and in Canada to develop a formal risk assessment of the impact of *Bt* corn on monarch butterfly populations. The 2-year study suggests that the impact of *Bt* corn pollen from current commercial hybrids on monarch butterfly populations is negligible. Shows the spatial or temporal ability for exposure by monarch larvae to pollen in cornfields. To conduct the research, four essential components were used: hazard identification, nature of dose response to a toxin, probability of exposure to an effective dose, and characterization of risk. Sears et al. considered risk as a function of exposure and addressed four main questions: the density of *Bt* pollen on milkweed leaves representing a threat to larvae, the proportion of *Bt* pollen exceeding the toxicity for larvae, the proportion of monarch populations that use milkweed near a cornfield, and the degree of overlap between the flowering of corn and larval stages of the monarch.

Vidal, O. and Rendón-Salinas, E. (2014) . Dynamics and trends of overwintering colonies of the monarch butterflies in Mexico. *Biological Conservation* 180, 165–175. doi: 10.1016/j.biocon.2014.09.041

Zalucki, M. P., Parry, H. R., & Zalucki J. M. (2015). Movement and egg laying in Monarchs: To move or not to move, that is the equation. *Austral Ecology (not yet Published in Volume)*. doi:10.1111/aec.12285

This journal article investigates the spatial and temporal components of insect movement, in particular that of the monarch butterfly. It addresses how monarchs move between milkweed habitat and creates models for important insights into how monarch ecosystems function. The authors have proved their authority in this field with numerous prior studies and their work has been cited not only in this study but in others as well. We believe the conclusions are worthy of our attention as they relate to the loss of milkweed and reduction of egg laying by monarchs. This study is also very recent and has not yet been published in a volume, which may degrade its credibility slightly, but provides up to date information.

Government Documentation

Commission for Environmental Cooperation. (2008). *North American Monarch Conservation Plan*. Retrieved from: <http://www3.cec.org/islandora/en/item/2350-north-american-monarch-conservation-plan-en.pdf>

This report was prepared to set goals for monarch butterfly preservation. It provides an overview of the current and historical context of monarch populations and dynamics as well as plans for conservation and proposed actions required for safeguarding monarchs. It addresses the need for a multinational approach and is published in three languages to provide a platform for further investigation. This document is well researched and collaboratively organized to ensure quality and the extensive reference list covers sources from a wide range of backgrounds. We believe the framework required for such a document demands that experts critically review it prior to publication, so we are confident the

information is reliable for our research. Reviewing it has helped us gain a stronger understanding of the circumstances and needs of monarch butterflies.

COSEWIC. (2010). *COSEWIC assessment and status report on the Monarch Danaus plexippus in Canada*. Committee on the Status of Endangered Wildlife in Canada. Retrieved from: http://www.sararegistry.gc.ca/virtual_sara/files/cosewic/sr_Monarch_0810_e.pdf

Under the Committee on the Status of Endangered Wildlife in Canada, the monarch butterfly has a status of special concern. There is a summary of the species information, distribution, habitat, biology, population sizes and trends, and limiting factors and threats. The monarch butterfly receives protection under the Fish and Wildlife Conservation Act. The distribution of the monarch butterfly is shown in a map of Canada and aerial photos demonstrate loss of forests in core habitats.

Government of Canada. (2015). *Species profile*. Species at Risk Public Registry. Retrieved from: http://www.registrelep.gc.ca/species/speciesDetails_e.cfm?sid=294

Health Canada. (2012). *Maximum residue limits for pesticides*. Retrieved from: <http://pr-rp.hc-sc.gc.ca/mrl-lrm/index-eng.php>

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State of New Jersey. (2014). *216th Legislature. Milkweed for Monarchs*. Retrieved from: http://www.njleg.state.nj.us/2014/Bills/A3500/3352_11.HTM

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United States Department of Health and Human Services. (2015). *FDA's Role in Regulating Safety of GE Foods*. Retrieved from: <http://www.fda.gov/ForConsumers/ConsumerUpdates/ucm352067.htm>

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U.S. Fish & Wildlife Service. (n.d.). *Monarch Butterfly*. Retrieved from: <http://www.fws.gov/international/animals/monarch-butterfly.html>

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Atkins, E. (2015). Ontario restricts use of pesticides blamed for decline of bee populations. *The Globe and Mail*. Retrieved from: <http://www.theglobeandmail.com/report-on-business/ontario-unveils-first-restrictions-on-class-of-pesticides/article24874268/>

Augestein, S. (2014). *Declining Monarch butterflies begin 3,000 mile trek to Mexico, N.J. legislators bills plan to welcome them*. Retrieved from: http://www.nj.com/cape-may-county/index.ssf/2014/09/declining_monarch_butterflies_beginning_3000-mile_trek_to_mexico_nj_legislator_plans_bills_to_welcom.html

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Efforts to save the monarch. (2015). *Tribune*. Guelph, Ont., Canada. Retrieved from: [http://search.proquest.com/docview/1708743549/abstract/6622F9D8CE924B2DPQ/14White, N. J. \(2014, April 4\).](http://search.proquest.com/docview/1708743549/abstract/6622F9D8CE924B2DPQ/14White, N. J. (2014, April 4).)

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Fears, D. (2015). The monarch massacre: Nearly a billion butterflies have vanished. *Washington Post*. Retrieved from: <http://www.washingtonpost.com/news/energy-environment/wp/2015/02/09/the-monarch-massacre-nearly-a-billion-butterflies-have-vanished/>

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Ewins, P. (2015). Monarch butterfly population recovering but still at its lowest in years. *WWF Canada*. Retrieved from: <http://blog.wwf.ca/blog/2015/01/28/monarch-butterfly-population-recovering-still-lowest-years/>

Illegal Logging Portal. (n.d.). *US Lacey Act*. Retrieved from: <http://www.illegal-logging.info/topics/us-lacey-act>

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