

# Evaluating Fall Monarch Butterfly Roadkill Hotspot Incidence and Potential Roadkill Mitigation

## TxDOT Project 0-7022 Project Summary Report

(Task 1)

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22 April 2022

Prepared for

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## PROJECT SUMMARY REPORT

Five continuous years of MaxEnt model projections for fall monarch roadkill in the Texas Central Funnel from 2016 to 2020 agree with simple extrapolations in revealing a biennial cycle of higher roadkill in the even-numbered years of 2016, 2018, and 2020, representing about 2.5% of the monarch overwintering population. In contrast, roadkill represented only 0.8% of the overwintering population in odd-numbered years of 2017 and 2019. Annual MaxEnt monarch roadkill models generally agree in projecting perennial monarch roadkill hotspot regions in both the Texas Central and Coastal Funnels. Spring monarch roadkill was never more than half the fall monarch roadkill seen in odd numbered years and could be less than 10% of that seen in even numbered years. Lepidoptera generally dominated Texas fall and spring arthropod roadkill, except in the spring of 2020 when Hymenoptera and Coleoptera dominated. Roadkill of pierid butterflies, such as the orange sulphur, exceeded that of monarchs in the fall of 2020. Monarchs were generally a minor component of butterfly roadkill in the spring of 2020 and 2021, when orange sulphur roadkill dominated. The most consistent perennial fall monarch roadkill hotspot zones were along IH-10 between Sonora and Sheffield (San Angelo District) and Sanderson Canyon along US-90 (Odessa District) in the Central Funnel, and the Lavaca Bay (Yoakum District), Lyndon B Johnson and John F Kennedy (Corpus Christi District) causeways in the Coastal Funnel. These perennial hotspot zones should be the focus of any trials of direct mitigation to reduce monarch roadkill.

Texas spring roadside milkweeds, which are critical as very high-value monarch nectar resources and primary larval host plants, were dominated by green antelopehorn, antelopehorns, and zizotes milkweeds, with broadleaf milkweed locally common in West Texas. Spring 2021 roadside milkweed densities averaged about 87 per hectare, with milkweeds occurring in 40% of random dispersed transects. Dominant spring high value non-milkweed monarch preferred nectar plants included widely distributed Texas vervain and lemon beebalm, and regional stands of Engelmann daisy and lance leaved coreopsis. Milkweeds and golden crownbeard were the only common very high value monarch spring roadside nectar plants. Monarch preferred spring 2021 nectar plants occurred in about 83 and 87% of the dispersed and random dispersed transects, respectively, with densities averaging around 1,990 and 2,201 nectar plants per hectare. Common fall 2020 roadside monarch preferred nectar plants were Engelmann daisy, Spanish gold, green antelopehorn, heath aster, antelopehorns, and zexmenia in the

Central Funnel, and camphor daisy, seaside goldenrod, climbing milkweed vine, and Texas vervain in the Coastal Funnel. A weak but significant correlation was found between monarch roadkill and counts of milkweed plants in the fall of 2020 and spring of 2021 (but not spring of 2020). This correlation may not be causal, and it could have resulted from monarchs migrating through areas with higher milkweed and nectar plant populations in general.

Four percent of dispersed roadside transects in Texas had monarch larvae in spring 2021, with an average density of 0.02 to 0.06 larvae per plant for the three common milkweed species. A significant but weak correlation was found between roadside monarch larvae per hectare and number of milkweed plants per hectare in both the spring of 2021 and 2020. Combined spring 2017, 2020, and 2021 densities of roadside monarch larvae, monarch roadkill, and milkweeds were generally highest in the northeastern Central Funnel, northern Coastal Funnel and Northeast Texas. These areas should be the focus of habitat enhancement for indirect compensatory monarch roadkill mitigation to increase monarch populations, along with milkweed poor South Texas.

Two specific implementation strategies for mitigation fall monarch roadkill in Texas were detailed and compared for cost effectiveness:

- 1) Direct mitigation through seasonal monarch flight diverter SMAs placed outside the 30 ft clear zone from the roadway that induce migrating monarchs to fly above the traffic, as has been successfully implemented for migratory purple crow butterflies in Taiwan
- 2) Indirect compensatory mitigation through roadside pollinator habitat SMAs placed outside the 30 ft clear zone from the roadway that include protective barrier fencing, planted milkweeds and non-milkweed monarch-preferred nectar plants, and disturbance management.

Seasonal flight diverter SMAs could be implemented during two-week periods of maximum fall migration at five perennial roadkill hotspots, three along draws of IH-10 in the Central Funnel, and two along causeways of the Coastal Funnel. A preliminary 30 year life-cycle cost analysis estimated that flight diverter SMAs may cost \$49-\$262 per adult monarch saved.

Planted pollinator habitat SMAs could be implemented at seven sites that are generally in higher density milkweed areas. Planted pollinator habitat SMAs with 726 milkweeds per acre density cost \$30-\$53 per adult monarch produced over 30 years. Non-planted pollinator habitat SMAs could have lower costs per produced monarch of \$23-\$41 over 30 years if milkweeds increased 83-100% with protection and disturbance management alone. Pollinator habitat SMAs would also be useful for protecting various rare plants, such as the newly proposed endangered prostrate milkweed in South Texas.