

MINE RECLAMATION AND MONARCH BUTTERFLY HABITAT¹

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Abstract

Monarch Butterflies are one of the most recognized creatures of North America, and are renowned for their long-distance seasonal migration and spectacular winter gatherings in Mexico and California. However, researchers and citizen scientists estimate that the Monarch population has declined more than 80% during the past 20 years.

Monarch Butterflies' habitat is anywhere milkweed grows. Milkweeds are required host plants for Monarch Butterfly caterpillars and therefore are a critical component in the Monarch's life cycle. Larvae feed only on milkweed.

The loss of milkweed plants in the Monarch's spring and summer breeding areas across the United States appears to be a significant factor contributing to the reduced number of Monarchs recorded in overwintering sites. Loss of milkweed due to roadside management practices, suburbanization of rural lands (subdivisions, factories, shopping centers, etc.), intensive agriculture and the extensive use of herbicides are certainly factors in this decline. Sustaining the Monarch population will require extensive restoration of milkweeds as well as efforts to protect existing Monarch habitats.

There is no doubt that our landscapes are becoming more fragmented and that there is less and less habitat for Monarchs, pollinators and the wildlife that share the same habitat. This trend will surely continue...unless we step up and do something about it.

This presentation will describe and discuss an opportunity for the abandoned mine land reclamation community to enhance Monarch Butterfly habitat.

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Monarch Butterflies



Figure 1: Monarch Butterfly

William of William & Mary), who was also known as Prince William of Orange, Stadtholder of Holland. It is the State Insect of Illinois, West Virginia, Minnesota Idaho, Vermont, Alabama and Texas.

The Monarch Butterfly (*Danaus plexippus*) may be the most recognized North American creature. It is a large butterfly, whose wings feature an easily identifiable orange and black pattern, with a wingspan of 3½–4 inches. It is possible that Monarchs were given this name because they are so large and majestic. Perhaps the name came from English and Dutch settlers to North America calling them Monarchs because of their coloring, after King William III (the

Monarchs are perhaps best known for their incredible annual southward late-summer/autumn mass migrations (*Flight of the Butterflies* on IMAX, *The Incredible Journey of the Butterflies* on NOVA), from the northeastern and northcentral United States and southern Canada to the mountains of central Mexico, and from western North America to the central coast of California. The butterflies rest for the winter months in large clusters that may contain tens of millions. The eastern Monarch fall migration covers thousands of miles, with a corresponding multi-generational return north. North American Monarchs are the only butterflies that make such a massive journey—up to 3,000 miles.

Monarch Butterflies begin life as eggs about the size of the period at the end of this sentence, and hatch as larvae that eat the milkweed plants on which they were placed. Monarchs are dependent on milkweed plants, which larvae eat nearly exclusively. Fattening larvae become juicy, colorful caterpillars, and then create a hard protective case around them as they enter the pupa stage. They emerge as beautifully colored, black-orange-and-white adults.

Milkweed

Monarch butterfly habitat is anywhere milkweed (*Asclepias spp.*) grows. Milkweeds are required host plants for Monarch butterfly caterpillars and therefore are a critical component in the Monarch's life cycle. Larvae feed only on milkweed. Milkweed is native to all of the lower-48 US states and the eight southern provinces of Canada. Pennsylvania has 11 native species and New Mexico, 24. There are at least 73 species of native milkweeds in the United States. Many of these species are rare, and 21 are threatened and/or endangered. Monarchs utilize about 30 of these species as host plants with some regularity.



Figure 2: Common Milkweed addition, a whole host of insects like beetles, spiders, lady bugs and lacewing use milkweed as their primary food source, or as a major food source.

Common Milkweed (*Asclepias syriaca*) is an important plant because so many species of insects depend on it. Monarch Butterfly larvae, Milkweed Tiger Moth larvae, Milkweed Bugs, and Milkweed Leaf Beetles only eat milkweed, and cannot survive without it. Milkweed nectar contains high amounts of glucose and is sought out by hummingbirds and nectar-eating insects such as bees, butterflies, moths, and beetles. Common Milkweed not only acts as a host plant for Monarchs, but also services up to 75 native pollinator species when in bloom. It's a favorite of bumble bees, honey bees, ants and wasps. In

Besides it being life-support for Monarchs, its flowers have a strong, intriguing fragrance. If you have ever walked along a country road in the Northeast US in late July or early August, you have probably caught a whiff of milkweed in bloom. The smell is very strong and carried by the wind and penetrates the air even without the wind. Even a single blossom radiates a noticeable sweet smell. Stop and smell the milkweed.

Common Milkweed grows up to six feet tall. It has large, broad leaves, usually four to ten inches long, and sometimes has red veins. It is found in fields, gardens, and along roads. Common Milkweed's flowers are pinkish-lavender clusters which often droop. The 50 or so flowers on one flower-head hang loosely and sway in the wind. Fruits are green pods which turn brown before bursting open to let out fluffy seeds. Next to the dandelion, few plants create as much kid's enthusiasm as the milkweed, as its silky seeds that float on the wind when the seed pods split open in the fall.

Milkweed may be toxic to the touch or when taken internally without sufficient preparation. The toxicity of a few milkweed species has resulted in the deaths of grazing, or even hay fed, livestock (horses, cows, sheep), particularly in the West, with the result that all species in the genus *Asclepias* have been branded as toxic and undesirable plants. Most of the cases of livestock poisoning have been attributed to two species, Labriform Milkweed (*A. labriformis*) and Western Whorled Milkweed (*A. subverticillata*). These species are not recommended for either seed collecting or restoration. These two milkweeds are native to New Mexico.

Researchers and citizen scientists estimate that the Monarch population has declined more than 80% during the past 20 years. The loss of milkweed plants in the Monarch's spring and summer breeding areas across the United

States is a significant factor contributing to the reduced number of Monarchs recorded in overwintering sites.

Monarch Population Decline

The Monarch butterfly is perhaps the most recognized, studied, and loved of all of North America’s insects. Children study Monarchs in school. Researchers and citizen scientists track their migration and breeding. Conservationists and government agencies are concerned about threats to breeding, migration, and wintering habitats. The annual migration cycle of the Monarch butterfly has been called an “endangered natural phenomenon”. This species and its migration are dependent upon conservation of habitats in Canada, the United States, and Mexico. Many government agencies, organizations, and individuals across North America are working on projects to conserve Monarch habitats and their migration.

Both eastern and western Monarch populations appear to be declining. The World Wildlife Fund and the Monarch Butterfly Biosphere Reserve “measure” the Monarch population wintering in Mexico each year. Based on these estimates the largest population of Monarchs occurred in 1996-1997 when the colonies covered over 44 acres and contained an estimated one billion butterflies, and the lowest population recorded was in 2013-2014 with 1.7 acres and approximately 33 million Monarchs. The three lowest overwintering populations on record have been recorded in the last three years. A graphic of the Monarch population decline measured in Mexican overwintering sites is shown on Figure 3.

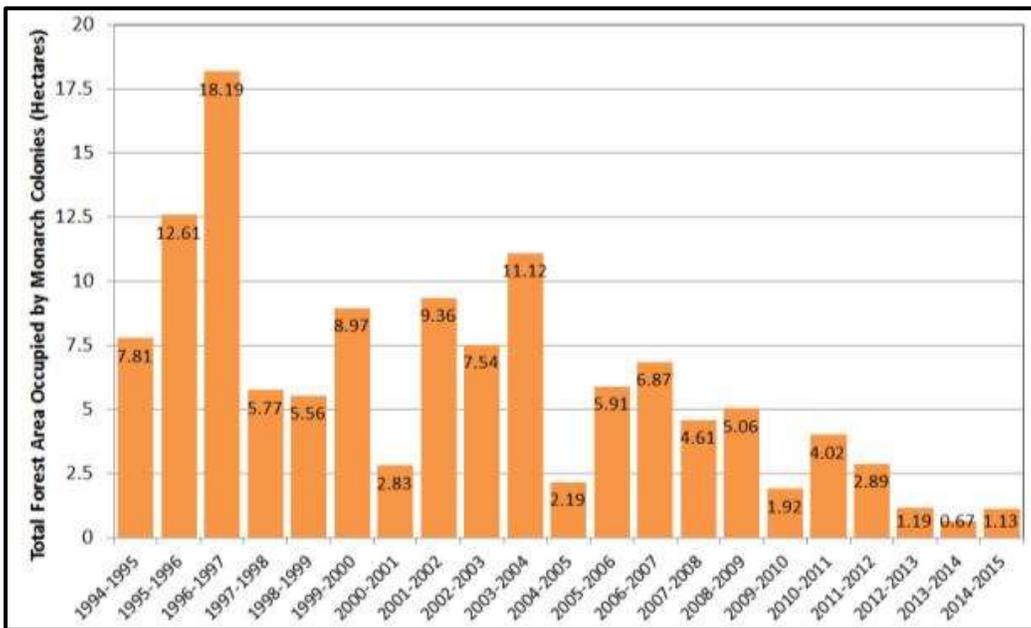


Figure 3: Monarch Populations in Mexican Overwintering Sites

California overwintering site estimates show similar results, for this smaller population. In 1997, over 1.2 million Monarchs were recorded at 101 sites (an average of 12,232 Monarchs per site). In 2014, just 234,731 Monarchs were counted at 185 sites (1,268 Monarchs per site, representing a decline of 81 percent from the 1997 high and a 48 percent decline from the 18-year average).

Loss of Milkweed/Monarch Habitat

The loss of milkweed plants in the Monarch's spring and summer breeding areas across the United States appears to be a significant factor contributing to the reduced number of Monarchs recorded in overwintering sites. Changes in agricultural methods, conversion of grasslands to agriculture, suburbanization of rural lands (subdivisions, factories, shopping centers, etc.), and mowing and pesticide control of roadside vegetation have all have reduced the richness of milkweeds in the landscape.

Changes in Agricultural Methods

No-till farming is a way of growing crops or pasture from year to year without disturbing the soil through tillage. No-till is generally the least intensive form of tillage, and farm operations are made much more efficient.

The idea of modern no-till started in 1943 with Edward Faulkner, author of *Plowman's Folly*, but it wasn't until the development of several chemicals after WWII and in the 1950s, and development of no-till seeders in the 1960s that various researchers and farmers started to try out the idea. 35 percent of U.S. cropland planted to major crops had no-till operations in 2012. The use of no-till has increased over time - 96 million acres in 2012, up from 88 million in 2009, and 3 million in 1972.

No-till farming has been a tremendous step forward for agriculture. However, as it is currently practiced in the U.S., no-till farming might more appropriately be called no-till/chemical agriculture. One of the purposes of tilling is to remove weeds. Many no-till farmers remove weeds with a "burn-down" herbicide such as glyphosate (Roundup[®]) instead of tilling and no-till is often associated with increased chemical use in comparison to traditional methods of crop production. Roundup is known as a broad-spectrum herbicide, because it kills nearly anything green. Beginning in 1996, several crops (corn, soybeans, rice, cotton, etc.) were genetically modified to be resistant to non-selective herbicides. Farmers can control weeds during the entire growing season, leading to additional applications of glyphosate on many fields.

Agricultural fields used to be an important source of milkweed for Monarch caterpillars. Milkweed has historically grown alongside crop plants, and provided abundant food for them. With the introduction of herbicide tolerant crops, management shifted from a till-based approach to the widespread use of

herbicides. This has diminished much of the milkweed growing in agricultural areas, since milkweed can survive some tilling, but cannot survive herbicides.

Loss of Grasslands and Suburbanization of Rural Lands

The US Energy Policy Act of 2005 and the Energy Independence and Security Act of 2007 required increased methanol (biofuels) in gasoline. This methanol mostly comes from corn, and one result of this has been the conversion of 24 million acres of grassland, rangeland, wetlands and shrub lands to crops. These lands have always been significant habitats for milkweed.

Urban sprawl and continuing industrial development are also major factors influencing the decline in quality Monarch habitat. The annual conversion of landscapes in the United States to building sites and the expansion of cities is more than 2 million acres per year. Development consumes about a million acres of farmland a year and the conversion of woodlands and other landscapes to shopping malls, housing and roadways consumes another million acres a year. Overall, the loss of various habitats due to development is some 34 million acres since 1996. Not all of these landscapes contained milkweeds but much of it did at one time.

Loss of Roadside Habitat

Another challenge for the Monarch Butterfly can be found in America's obsession with mowing. We mow our highway right-of-ways several hundred feet from the edge of the pavement. We mow our county and township roadsides to look like putting greens. We mow our residential lawns twice a week, sometimes to the size of football fields. In Douglas Tallamy's book *Bringing Nature Home*, he estimates that in the United States the acreage that has been converted from "wild" to "lawn" would rival an area the size of the state of Illinois! There are also habitat losses due to use of herbicides along roadsides, as well as roadside mowing. Studies have shown that the area from the edge of the road to the edge of the field was about 1% of the total land area in most eastern states, covering more than 10 million acres in the United States. These were significant milkweed and Monarch habitats in the past but it appears that much of this habitat has been lost as well due to these practices.

To help offset the loss of Monarch breeding habitat, the North American Monarch Conservation Plan recommends the planting of regionally-appropriate native milkweed species.

Growing Milkweed

Common Milkweed grows in sandy, clayey, or rocky calcareous soils. It occurs along the banks or flood plains of lakes, ponds, and waterways, in prairies, forest margins, roadsides, and waste places. It is easily propagated by both seed

and rhizome cuttings. Both seedlings and cuttings usually bloom in the second year. Seeds and plants are available from many nurseries. Ernst Seed in Meadville PA currently is producing 3 species of milkweed seed on approximately 120 acres of land: Swamp Milkweed (*A. incarnata*), Common Milkweed, and Butterfly Milkweed (*A. tuberosa*). If planting onto mine land in Pennsylvania, it's recommended to use Common Milkweed on dry sites and Swamp Milkweed on wet sites. If you're planting in a formal garden, don't use Common Milkweed.

There are many guides to growing milkweed (look at the Google), among them are:

- 🐛 Monarch Watch - <http://www.Monarchwatch.org/milkweed/prop.htm> ,
- 🐛 University of Minnesota Monarch Lab <http://Monarchlab.org/biology-and-research/Monarch-rearing/finding-collecting-and-growing-milkweed> , and a big one,
- 🐛 Xerxes Society - <http://www.xerxes.org/milkweeds-a-conservation-practitioners-guide/> (156 pages, 4.3MB).

Propagation from Cuttings

Propagation by cuttings of the tuberous rhizome is easy and reliable. The cuttings should be made when the plant is dormant. Each piece of the rhizome should have at least one bud (they are about two inches apart). Timing of propagation is important. Harvest or divide plants and get the plants in the ground by late fall so they can develop enough root growth to survive the winter. Irrigation the first year will improve survival, and by the second year the root system should be well enough established so plants will survive without irrigation.

Propagation from Seed

Common Milkweed is easily propagated from seed. Collect seeds after the pods have ripened, but before they have split open. The seeds with their tufts are wind dispersed, so be careful when gathering to place in a paper or burlap bag to avoid losing them. Seeds can be directly sown into the ground in the fall. Often the majority of the seed in a given lot of milkweed is dormant. This dormancy typically has not precluded a successful stand establishment when planted in the spring, however the best planting date to maximize the number of plants per pound of seed planted would be in the fall (i.e. October/early November). Planting in the fall will allow the milkweed seed to naturally pass through the cool, moist soil conditions that shift the hormone levels within the dormant seed from preventing germination to permitting germination. When planting milkweed as part of a meadow, very good results have been associated with a planting rate of 0.4 pounds/acre.

Milkweed Management

In general, milkweed grown in their native range and preferred soil type adapt well to no irrigation. Benefits of supplemental fertilizer addition are pretty well unknown, but if soil analyses of nitrogen-phosphorous-potassium show deficiencies, supplements seem to help. Milkweed is tolerant and may benefit from sulfur in the soil, and it seems to like compost.

Common Milkweed is a pioneer plant - a fugitive species - a disturbed habitat specialist - and as such, it is not a good competitor. Therefore, to keep it going, it's best to rough it up a bit. It can be mowed back at the end of the growing season or better - before there is new growth in the spring. Most milkweed species are so specialized they are not particularly good colonizers. In other words, in spite of having windblown seeds, new seedlings usually do not become established unless the conditions are favorable for that species. What this means is that most prairie species do not colonize disturbed areas adjacent to the prairies and woodland species do not move into roadsides or fields. The milkweeds that are good colonizers support the most Monarchs due to their range of habitats and abundance.

Being a good colonizer does not necessarily mean that a plant species is a good competitor for light, space and nutrients. In fact Common Milkweed, by far the best colonizer among milkweeds, tends to be out-competed and disappear as plant succession progresses. Maintaining this species, and several others, requires resetting of the successional stage – a fancy way of saying that to keep these milkweeds from disappearing, one has to adopt a mowing, burning or discing schedule that keeps the plot in an early stage of succession. Many of our reclamation practices that involve compaction keep tree growth from occurring. These practices allow a continuing early-successional stage and allow management without mowing/burning/discing.

Milkweed and Mine Reclamation

So...we've got a plant that is the required host plant for one of America's most recognizable, beautiful and recognizable creatures, and therefore is a critical component in that insect's life cycle. Changes in agricultural methods, intensification of agriculture, development of rural lands and pesticide control of roadside vegetation have all reduced the richness of the plants in the landscape, helping cause a dramatic drop in the Monarch's numbers.

This plant is a pioneer plant - a fugitive species - a disturbed habitat specialist, it grows in sandy, clayey, chalky or rocky soils. It kind of likes sulfur soils. It grows on unreclaimed AML sites. It occurs along roadsides, railroad tracks, bike paths, highway medians, and farm field and forest margins; on vacant land, old fields, small clearings, fence rows and waste places. It is ideal in semi-dry places. It reproduces by seeds, underground stems, and roots, and is easily

propagated by both seed and rhizome cuttings. Seeds and plants are available from many nurseries. It is very recognizable - the plants can be recognized at highway speeds by their distinct form. Seeds can be harvested easily by hand in the fall.



Figure 4: Milkweed on AML sites – Eckley/Delano/Mahanoy City/Centralia

We work in mine reclamation, and our job is to reclaim legacy mining sites to eliminate hazards. Pennsylvania’s Abandoned Mine Reclamation Plan also includes a policy statement that the Commonwealth strongly encourages activities directed to the restoration of the environment in areas degraded by previous coal mining activities. In many of our past and current projects we have added enhancement of wildlife habitat to our missions of reclaiming hazardous abandoned mine features and restoring lands and waters affected by legacy mining.

The OSM Abandoned Mine Land Inventory System (E-AMLIS) reports work done and to be done by an estimation defined by the Government Performance and Reporting Act of 1993 in “GPRA”, or equivalent acres.

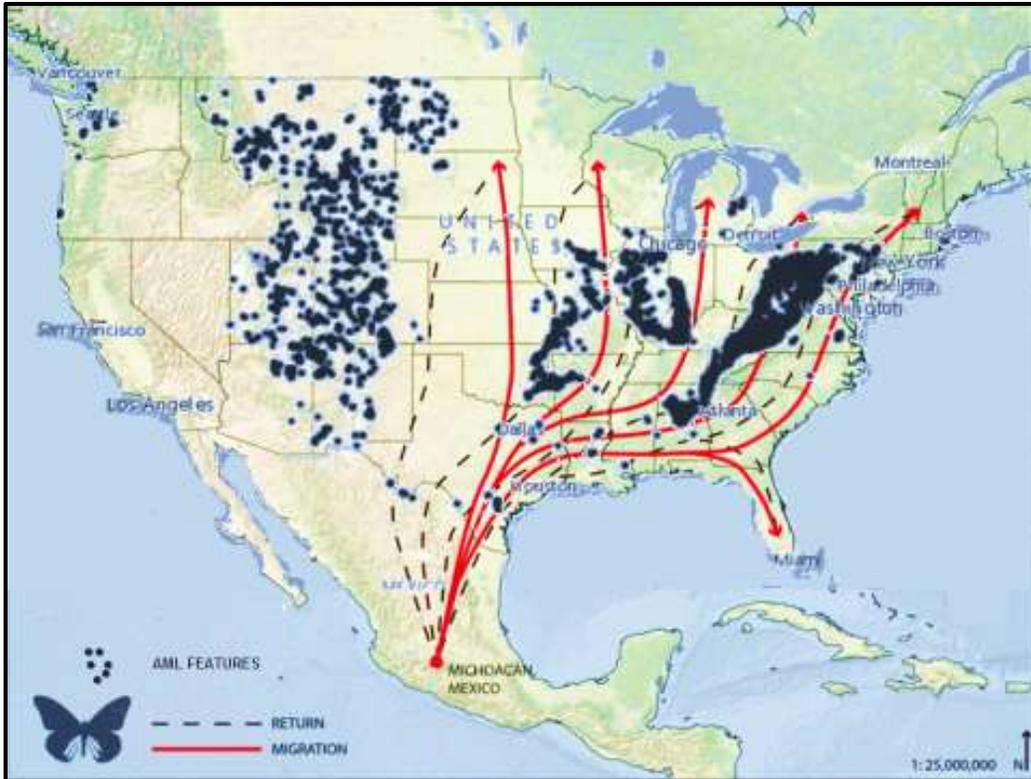


Figure 5: U.S., Showing Monarch Migration Routes and AML Features

The AML programs have reclaimed abandoned mines in the United States since 1980 at a rate of about 12,000 GPRA/year (900 GPRA/year for Pennsylvania). Pennsylvania has 30,000 acres to be reclaimed, and there are some 78,000 acres that might be reclaimed utilizing milkweed in the important Monarch habitat areas of the Cornbelt.

		ABANDONED MINE LAND INVENTORY (in GPRA)										
		PA	IA	IN	IL	KS	MO	KY	ND	OH	"CornBelt"	US
UNFUNDED	30,362	2,580	802	3,017	15,075	3,881	24,779	4,129	23,762	78,025	296,398	
FUNDED	6,988	1,086	35	5,793	228	94	11,809	43	74	19,162	30,171	
COMPLETED	29,797	5,844	6,712	7,236	3,725	4,894	100,516	4,039	14,076	147,042	411,651	

Figure 6: OSMRE Abandoned Mine Inventory as of 4/21/2015 - eAMLIS

Active mine reclamation has even more potential for restoration of butterfly and pollinator habitats, with an estimate of 100,000 acres per year being reclaimed.

Seed mixes are used to restore habitats for wildlife (quail and pheasants), restoration of native vegetation, to reseed construction sites, and rights of way along state and federal highways. Pennsylvania and some other AML programs use milkweed in their wildlife seed mixes, but milkweed is not included in all seed mixes. We should try to include it, except where the post-reclamation land

use is grazing. When using a prepared seed mix, specify one with milkweed in it. By adding milkweed seeds to these mixes it will help to get milkweed reestablished in areas from which it has been eliminated and introduce milkweeds into sites to be re-vegetated.

Milkweed has been used recently in several AML projects that I am aware of; New Mexico - Vermejo Park Ranch, Missouri - Deer Creek II, and Pennsylvania – Newtown South II-2.

New Mexico -Vermejo Park Ranch

Vermejo Park Ranch, near Raton, NM is the largest privately owned contiguous tract of land in the United States, encompassing approximately 900 square miles and six bio-geographic life zones. Several areas of the Ranch were mined in the early 1900s for coal, including the historic mining camps of Brilliant, Koehler and York Canyon. The New Mexico Energy Minerals and Natural Resources Department Mining and Minerals Division has an agreement with the Ranch to work together in reclaiming abandoned mines on the property. The initial project addressed several abandoned coal mines in the Dillon Canyon region.

The New Mexico AML program and Aaron Kauffman, of Southwest Urban Hydrology planted milkweed (Butterfly Milkweed and Showy Milkweed [*A. speciosa*]) at an AML project at Vermejo Park. Seeding took place this past March on a little over 3 acres (Butterfly Milkweed was only spread on about 3/4 of an acre). Apparently the area received good spring precipitation, but I have no other information on how it is doing.

Missouri - Deer Creek II

The Kansas Department of Health and Environment has teamed up with the Kansas Department of Wildlife, Parks and Tourism to do AML work in Southeast Kansas on the Mined Land Wildlife Area. At 14,500 acres, it is one of the biggest pieces of public land in the region. It contains 1,500 acres of surface water and 13,000 acres of land - nearly all of it surface-mined for coal from the 1920s through the mid-1970s.

\$3.5 million is being spent on the Deer Creek pits in Cherokee County. The work involves filling a portion of the pit, which means a loss of 20 surface acres of water, in order to remove a highwall hazard near a roadway. It also will include a new boat ramp and parking area for public access. Those 20 acres will be replaced by the creation of a wetland and a pond adjacent to the pit. “There is habitat gained through these projects,” said David Jenkins, site manager of the Mined Land Wildlife Area. “It definitely will mean improved diversity. We’ll have a little bit of everything there.”

The current site (Deer Creek II) is 142 acres and includes wetlands. The AML Program made contact with Orley R. "Chip" Taylor, Monarch Watch/University of Kansas, on plans for revegetation of the site. The Department purchased and planted one pound each of Butterfly Milkweed and Common Milkweed and ¼ pound of Swamp/Rose Milkweed on the site this year. The Swamp Milkweed was planted by hand in the wetland areas. The others were planted with the forbs. Marlene Spence, from the Surface Mine Section, stated that a walkabout on the Deer Creek project was disappointing as regards milkweed plants, "Hopefully there are some plants out there that I missed."

This spring she purchased some seed from the Kansas Native Plant Society and germinated them inside after a 45 day cold storage. Her plants (also including Green Antelopehorn Milkweed – *A. viridis*), were intended to create a miniature version of the AML site at home. However, the Swamp Milkweed was flooded out by an unusually wet spring that kept her pond shoreline, where it was planted, in a constant flooded state.



Many of the other plants "fell prey to an ornery dog" while in the flats outside getting ready to transplant, but at least one plant in her home garden is now being consumed by a monarch to be. Hopefully the Deer Creek experiment will also "succeed".

Figure 8: Spence's Home Milkweed

Pennsylvania - Newtown South II-2

On a Pennsylvania Department of Environmental Protection Bureau of Abandoned Mine Reclamation (DEP) abandoned mine land reclamation project OSM 54(3649)102.1 Newtown South II-2, working with Pennsylvania Game Commission Southeast District, a game-cover seed mixture of Orchardgrass, Little Bluestem, Yellow Blossom Sweet Clover, White Dutch Clover, Vernal Alfalfa, Canada Wild Rye, Birdsfoot Trefoil, Maximillian's Sunflower, Perennial Sweet Pea, Butterfly Milkweed, and Spring Oats was specified for use on the bulk of the grading areas. All non-wetland areas, nearly 50 acres, were regraded and planted with the mix during construction completed in 2012.

Revegetation results are terrific, and there are lots of bees and butterflies, however in inspecting the project for this presentation, it was observed that NO Butterfly Milkweed was growing, but an abundant amount of Common Milkweed was growing. In specifying for the seed mix, our lack of knowledge about milkweed was displayed. We had specified "Butterfly Milkweed (common or VNS)", and the supplier supplied common. In any case it's doing great and spreading better than the tuberosa would have.



Figure 8: Milkweed at Newtown South

OSMRE and the National Pollinator Strategy

In June 2014, the White House issued a memorandum entitled, “Creating a Federal Strategy to Promote the Health of Honey Bees and Other Pollinators.” This memorandum created a task force composed of numerous departments and agencies to research and expand awareness of pollinator decline, and to develop and implement plans to improve pollinator habitat on managed lands. The Presidential Memorandum was issued in response to declines in certain butterfly and insect pollinator populations. The Task Force was to create a “Strategy to Promote the Health of Honey Bees and Other Pollinators” within 180 days. In May 2015, the Task Force released its strategy, with three ‘overarching’ goals:

1. Reduce Honey Bee colony losses to economically sustainable levels;
2. Increase Monarch Butterfly numbers to protect the annual migration; and
3. Restore or enhance millions of acres of land for pollinators through combined public and private action.

As their part of the Strategy, the US Department of Interior’s Office of Surface Mining Reclamation and Enforcement (OSM) promotes the provision of wildlife habitats through the Appalachian Regional Reforestation Initiative (ARRI), a partnership-based program for the restoration of former mine lands to native forests. In addition to the chestnuts that have been planted on reclaimed mine lands in cooperation with many of the native trees and shrubs ARRI plants, including maples, black cherry, yellow poplar, eastern redbud, various dogwoods, black locust and others are staples for butterflies, honey bees and native pollinators. OSM will continue to promote this program and train state regulatory authorities to promote the use of native tree and ground-cover species, thereby increasing native habitat for the benefit of pollinating species.

OSM will continue to promote habitat on reclaimed minelands through ARRI, with the following goals over the next 2 years (FY2015-2016):

- a) Develop a pollinator species-specific Forestry Reclamation Advisory, which will enhance species selection to be used in reclamation per locality or region (FY2015).
- b) Increase the number of trees planted by 10%.
- c) Increase the number of acres planted in trees and pollinator-friendly species by 10%.
- d) Increase the number of partners engaged in pollinator-friendly species plantings on both active and legacy mine sites.

Pennsylvania – Wildlife Habitats

PADEP has been using a “Deep-Till/Tree Seeding” technique for establishing wildlife habitat and accomplishing forest reclamation on several AML projects. This technique incorporates standard construction methods and equipment utilized for the reclamation of these sites. In these projects, trees from the clearing and grubbing of the grading area create stock for brush barriers, which are placed to create wildlife habitat corridors across the reclaimed meadowlands, and an area 50 feet outward from the brush barrier is ripped with a dozer. Early-successional and some later-successional tree seeds are hydro-seeded or manually broadcast onto the tree-seed area and the area is mulched to hold seed in place and provide moisture retention.

The Xerces Society partners with the native seed industry to produce wildflower seed mixes to provide foraging and nesting resources for a diversity of pollinators. Ernst Conservation Seeds is one of those partners, whose “Pennsylvania Pollinator Conservation Seed Mix” includes high quality native perennial wildflowers that are highly attractive to pollinators, and a native bunch grass that provides nesting habitat for bumble bees and other beneficial insects. Working with Ernst, DEP is working up several “ARRI-Compatible Pollinator/Ground Nesting Bird Mixes” (including Common Milkweed, of course) which should add to the habitat while not competing with the tree growth. Two of these seed mixes are shown in Figures 8 and 9. BAMR will plant several ARRI-compatible pollinator seed mixes on one-acre plots on ARRI/FRA sites and on Deep-Till/Tree-Seed sites this fall and next spring seasons.

OSM and ARRI should consider utilizing “ARRI-Compatible Pollinator/Ground Nesting Bird Mixes,” compatible with Xerces Society “recommended” regional pollinator mixes similar to those DEP is working on with Ernst, as part of their “pollinator species-specific Forestry Reclamation Advisory” development.

ERNST POLLINATOR/GROUND NESTING BIRD MIX			
% of Mix	Latin Name	Common Name	Cultivar/ Ecotype
30	<i>Elymus canadensis</i>	Canada Wildrye	Any
54	<i>Schizachyrium scoparium</i>	Little Bluestem	FIG (PA)
2	<i>Asclepias syriaca</i>	Common Milkweed	PA
1	<i>Aster novae-angliae</i>	New England Aster	PA
1	<i>Desmodium canadense</i>	Showy Tick Trefoil	PA
1	<i>Desmodium paniculatum</i>	Panicled Tick Trefoil	PA
4	<i>Heliopsis helianthoides</i>	Ox-Eye Sunflower	PA
1	<i>Lespedeza frutescens</i>	Shrubby Bushclover	MD
1.5	<i>Monarda fistulosa</i>	Wild Bergamot	FIG (PA)
1	<i>Penstemon digitalis</i>	Tall White Beardtongue	PA
0.3	<i>Pycnanthemum tenuifolium</i>	Narrow Leaved Mountain Mint	PA
3	<i>Rudbeckia hirta</i>	Black Eyed Susan	Any
0.2	<i>Solidago canadensis</i>	Canada Goldenrod	PA

Figure 8: ARRI-Compatible Pollinator/Ground Nesting Bird Mix (1)

ERNST/RMC POLLINATOR/WILDLIFE MIX			
% of Mix	Latin Name	Common Name	Cultivar/ Ecotype
31	<i>Elymus canadensis</i>	Canada Wildrye	Any
37	<i>Schizachyrium scoparium</i>	Little Bluestem	FIG (PA)
14	<i>Andropogon virginicus</i>	Broomsedge	MO
4	<i>Asclepias syriaca</i>	Common Milkweed	PA
0.5	<i>Aster novae-angliae</i>	New England Aster	PA
1	<i>Desmodium canadense</i>	Showy Tick Trefoil	PA
0.5	<i>Desmodium paniculatum</i>	Panicled Tick Trefoil	PA
0.5	<i>Symphotrichum laeve</i>	Smooth Blue Aster	NY
3	<i>Rudbeckia triloba</i>	Browneyed Susan	WV
1	<i>Monarda fistulosa</i>	Wild Bergamot	FIG (PA)
1	<i>Penstemon digitalis</i>	Tall White Beardtongue	PA
2	<i>Solidago juncea</i>	Early Goldenrod	VA
3	<i>Solidago nemoralis</i>	Gray Goldenrod	VA
1	<i>Helenium autumnale</i>	Common Sneezeweed	VA
0.5	<i>Apocynum cannabinum</i>	Indianhemp	PA
1	<i>Pycnanthemum tenuifolium</i>	Slender Mountainmint	PA
0.5	<i>Baptisia australis</i>	Wild Indigo	PA
0.5	<i>Senna marilandica</i>	Maryland Senna	VA/WV
0.5	<i>Zizia aurea</i>	Golden Alexanders	PA
2	<i>Agrostis perennans</i>	Autumn Bentgrass/Albany Pine Bush	NY

Figure 9 ARRI-Compatible Pollinator/Wildlife Mix (2)

Comments/Recommendations – What Can We Do to Help?

- Plant native milkweed. Plant it at home, specify it in your game seed mixes, plant it on with your early-succession reforestation. There are about 4000 seeds/ounce for common milkweed, a bit more for butterfly weed and less for swamp milkweed. Use about a quarter of an ounce (\$2⁰⁰-\$5⁰⁰) per acre in the hope that 100 plants get started. Once established, the plants will send out

rhizomes and will form small clones. Planting in strips as opposed to planting entire plots, is a good way to hyper-disperse the milkweeds and keep costs lower. Milkweed plants are available from several nurseries, and MonarchWatch is offering free (shipping costs only) milkweed plugs for large-scale restoration projects in 2015-2016. For information, their website:

<http://monarchwatch.org/bring-back-the-monarchs/milkweed/free-milkweeds-for-restoration-projects/>

- ✿ Plant nectar plants. The seed mixes in Figures 8 and 9 bloom from early to late in the season and provide nectar (fuel) for migrators as well as habitat and nectar for the stay-at-homes pollinators. Planting costs for these are about \$300⁰⁰ per acre. Regional seed mixes are locally produced in their respective regions by independent farmers, using local eco-type seed wherever possible. The Xerxes Society and the Pollinator Partnership both maintain lists of native plant suppliers that have regional mixes available, and they seem to be very cooperative for special pollinator projects.
- ✿ Avoid pesticides. Pesticides kill monarch in all stages of their life cycle. Avoid spraying for mosquitoes or gypsy moths, or other insects when Monarchs are present.
- ✿ Avoid herbicides. Roundup and many other systemic herbicides kill milkweed. The Penn State Extension's "milkweed control" advice says, "If common milkweed becomes an established problem in field crops, it can be controlled by applying a systemic herbicide while the weed is actively growing. If these chemicals are applied in spring, the milkweed must be at least 12 to 18 inches tall for effective control. A good time to use systemic herbicides on milkweed is early to midsummer when milkweed is in bud. At this stage the plant has used most of its stored energy to produce flowers. Its depleted root system is ready to be fed, and both nutrients and herbicide will quickly translocate from the top growth into the underground parts."
- ✿ Limit mowing. I've already told my wife that if I leave a part of my yard as a butterfly-weed garden, "it's good for the Monarchs!" Talk to property owners that are anticipating property management after reclamation, about ways to reduce or eliminate mowing. If mowing must be done, do it in the late fall, after seed pods ripen, or in the winter, or at least when monarchs aren't using the plants.
- ✿ Individuals can have a significant impact on Monarch and pollinator conservation issues. The reclamation community can have a greater one.

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