Agriculture Habitat, ChesLen Preserve

Brief Climate Change Vulnerability Assessment for the Natural Lands Climate Adaptation Project

This document represents a brief evaluation of climate change vulnerability for agriculture habitat in the Natural Lands' ChesLen Preserve in Chester County, Pennsylvania. The following information was based on expert input provided in fall 2022 as well as sources from the scientific literature.

Habitat Description

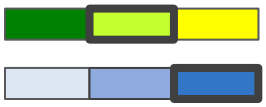
ChesLen Preserve, located in Chester County, PA was historically used for cattle, sod, and mushroom farming, but the agricultural land in the preserve (~437 acres) is now used to cultivate row crops such as corn and soybeans as well as hay (*1–3*). These fields are predominately located in the northwest quadrant of the preserve, and are interspersed with small forested areas and other grasslands (*1*). Grasslands also often border the fields, where they serve as hay sources in addition to providing essential pollinator and bird habitat (*2*). The agricultural areas within the preserve have 1.9 miles of unnamed tributaries to the West Branch Brandywine Creek that run through them (*2*). They are generally considered to be prime farmland or farmland of statewide importance (*2*).

Herbaceous plants commonly found within the cultivated fields and surrounding grasslands include Indian hemp (*Apocynum cannabinum*), common milkweed (*Asclepias syriaca*), foxtail (*Setaria spp.*), smartweed (*Polygonum pensylvanicum*), and winter wheat (*Triticum aestivum*). Invasive poison hemlock (*Conium maculatum*) has also been identified in these areas (*2*).

Key Climate Vulnerabilities

Moderate Vulnerability

High Confidence



Vulnerability is evaluated by considering the habitat's sensitivity and exposure to various climate and non-climate stressors as well as the habitat's adaptive capacity or ability to cope with these stressors with minimal disruption. The overall vulnerability of the habitat is ranked on a scale from low vulnerability (dark green) to high vulnerability (yellow). The confidence in the vulnerability ranking's accuracy is similarly ranked on a scale from low (light blue) to high (dark blue).

Sensitivity & Exposure

Sensitivity *is a measure of whether and how a habitat is likely to be affected by a given change in climate and climate-driven factors, changes in disturbance regimes, and non-climate stressors. By contrast,* ***exposure*** *is a measure of how much change in these factors a resource is likely to experience. Sensitivity and exposure are combined here for a score representing climate change impact, with high (yellow) impact scores corresponding to increased vulnerability and low (dark green) scores suggesting a habitat is less vulnerable to climate change.*

Potential impacts of projected climate changes on this habitat may include:

- Longer growing seasons as a result of warming temperatures could cause shifts in species' timing of reproductive maturation and will likely result in greater growth and productivity of

crops during these periods if crops are able to receive the amount of water and nutrients they need to survive (*4*, *5*). However, as temperatures rise, corn crops may suffer reduced yields due to stress caused by hot summers and the potential of pests like corn earworms (*Helicoverpa zea*) to damage crops (*4*).

- The anticipated decrease in snow coverage and frozen soil during the winter months, as a result of increased winter temperatures, may have an impact on a range of agricultural processes, such as the breakdown of organic matter, the cycling of nutrients, and the initiation of the growth cycle (*5*, *6*). Soybean crops are expected to increase in yield due to decreased frost during the growing season (*4*).
- Projected increases in drought during summer and fall months (*4*) could lead to decreased crop yield and crop quality for rain-fed crops, such as corn and hay (*7*).
- Increased flooding could lead to delayed planting and harvesting, reduced early-season production, and increased crop leaf and root disease (*7*). Prolonged inundation of fields can also increase the possibility of soil compaction and threaten soil quality due to the use of machinery in the flooded fields (*5*, *7*).
- Soybean rust caused by the pathogen *Phakopsora pachyrhizi* is not currently a threat but is likely to move north into the northeastern United States as temperatures increase and could be a future threat to ChesLen's agricultural fields (*5*). Soybean rust causes defoliation of soybean plants and ultimately leads to large crop yield losses.
- Instances of heavy rain can have negative effects on crop productivity due to reduced nutrient uptake by crop roots and lower availability of nitrogen in soils through leaching. This can lead to waterlogging which has been associated with decreased soybean crop yields (*8*).

The agricultural lands within the ChesLen preserve may also be vulnerable to non-climate stressors that increase the presence of pollutants and poisons in the system and introduce pests, pathogens, and invasive species into the habitat. Stressors that could degrade the agricultural areas directly (e.g., recreational use) could also make the habitat more vulnerable to the impacts of climate change.

Adaptive Capacity

Adaptive capacity *is the ability of a habitat to accommodate or cope with climate change impacts with minimal disruption. High adaptive capacity (dark green) corresponds to lower overall climate change vulnerability, while low adaptive capacity (yellow) means that the habitat will be less likely to cope with the adverse effects of climate change, thus increasing the vulnerability of the habitat.*

Intrinsic (i.e., inherent characteristics) and extrinsic (i.e., management potential) factors that enhance or undermine the ability of agricultural areas to cope with climate impacts include:

Intrinsic Factors

- ▲ High structural and functional integrity (*3*)
- ▲ Fairly continuous agricultural areas within the preserve, which are largely buffered from stressors outside of the preserve by forested habitat (*3*)
- ▼ Low diversity of component species and functional groups (*3*)
- ▼ Invasive and problematic species present in the preserve's agricultural areas as well as existing roads and trails may act as barriers

to species dispersal or movement across the landscape (*3*)

Extrinsic Factors

- ▲ Agricultural use is already being managed in a way that minimizes impact on natural resources (e.g., farmers must follow a conservation plan) (*3*)
- ▲ Portions of the agricultural fields are under USDA Natural Resources Conservation Service Conservation Reserve Enhancement Program contracts (*2*, *3*)
- ▲ High public value for the preserve as a whole, largely due to its aesthetic value
- ▲ Species selection and planting practices can be altered as temperature increase and climate changes (*3*)
- ▼ There is some desire to remove agricultural lands from Natural Lands preserves altogether or dramatically decrease the acreage that is currently being farmed (*3*)
- ▼ Potential damage to equipment as the result of extreme storms and flooding could impact management capacity (*3*)
- ▼ There is currently no irrigation system in the agricultural areas of ChesLen preserve, which could be detrimental to crops during drought events (*3*)

Recommended Citation

EcoAdapt. 2023. Agriculture, ChesLen Preserve: Climate Change Vulnerability Assessment Summary for the Natural Lands Climate Adaptation Project. Version 1.0. EcoAdapt, Bainbridge Island, WA.

Further information on the Natural Lands Climate Adaptation Project is available on the project page (https://ecoadapt.org/goto/Natural-Lands).

Literature Cited

1. C. Steckel, “Embreeville property vegetation survey” (Botanical Inventory; Natural Lands, 2007).
2. Natural Lands, “Natural Resources Stewardship Plan for ChesLen Preserve” (Natural Lands, Media, PA, 2020).
3. Natural Lands Stakeholders, Vulnerability assessment worksheet input (2022).
4. ICF, “Pennsylvania Climate Impacts Assessment 2021” (ICF, Fairfax, VA, 2021), (available at https://www.dep.pa.gov/Citizens/climate/Pages/impacts.aspx).
5. D. Tobin, M. Janowiak, D. Hollinger, H. Skinner, C. Swanston, R. Steele, R. Radhakrishna, A. Chatrchyan, “Northeast and northern forests regional climate hub assessment of climate change vulnerability and adaptation and mitigation strategies” (USDA Northeast Climate Hub, 2015), , doi:10.32747/2015.6965350.ch.
6. L. Rustad, J. Campbell, J. S. Dukes, T. Huntington, K. Fallon Lambert, J. Mohan, Nicholas. Rodenhouse, “Changing climate, changing forests: The impacts of climate change on forests of the northeastern United States and eastern Canada” (NRS-GTR-99, U.S. Department of Agriculture, Forest Service, Northern Research Station, Newtown Square, PA, 2012), p. NRS-GTR-99, , doi:10.2737/NRS-GTR-99.
7. D. W. Wolfe, J. Comstock, A. Lakso, L. Chase, W. Fry, C. Petzoldt, R. Leichenko, P. Vancura, “Chapter 7: Agriculture *in* Responding to climate change in New York State: the ClimAID integrated assessment for

effective climate change adaptation" (Technical Report, New York State Energy Research and Development Authority (NYSERDA), Albany, New York, 2011), pp. 217–254.

8. G. Kaur, G. Singh, P. P. Motavalli, K. A. Nelson, J. M. Orlowski, B. R. Golden, Impacts and management strategies for crop production in waterlogged or flooded soils: A review. *Agronomy Journal*. **112**, 1475–1501 (2020).