Preface

In 2006, Natural Lands Trust, Continental Conservation, and Botanical Inventory completed the first phase of ecological assessment of Lehigh Gap Wildlife Refuge (LGWR) for the Wildlife Information Center, now known as Lehigh Gap Nature Center (LGNC). This assessment concentrated on plants and plant communities and also included light-trapped insects and lichens. While a valuable tool and partial baseline study of the Refuge, many more taxa and conditions remained to be studied to develop a more complete baseline assessment for use in management of habitats and biodiversity on the Refuge and to inform decisions regarding educational, research and recreational programs and activities on the refuge.

In 2007, LGNC succeeded in obtaining grant funding from the Wild Resource Conservation Program to continue the assessment process to fill in the gaps remaining in the first assessment. Additional funding from several other sources complemented the WRCP funding to help complete the assessment. In addition, vast numbers of volunteer, internship, and academic partner hours were contributed to complete the studies in this assessment. Our academic partnerships made the work possible.

This assessment covers a broad range of physical and biotic factors, establishes a baseline for ongoing monitoring, and resulted in a network of academic and agency partners that can continue research at the Refuge. It is also a very important study because of its location on the Kittatinny Ridge, which is of statewide and regional importance ecologically, especially in a world with a changing climate.

With regard to the ecological community, Aldo Leopold wrote[1] "To keep every cog and wheel is the first rule of intelligent tinkering." It is difficult to manage an ecosystem if you don't know what its components and interactions are. We now know many of the "cogs and wheels" of the ecosystems and communities of Lehigh Gap Wildlife Refuge, and have a pretty good idea of some that are missing from the system as well. This assessment will help us be intelligent tinkerers.

DK

A note about names. The Wildlife Information Center, Inc. is the official IRS and PA Charities Bureau name of the 501(c)(3) nonprofit organization that purchased the land that became known as Lehigh Gap Wildlife Refuge, a privately owned 750-acre reserve on the Kittatinny Ridge at Lehigh Gap. After operating the Refuge and its successful ecological reclamation program, the Wildlife Information Center registered to officially do business as Lehigh Gap Nature Center. Thus, the organization that operates the Lehigh Gap Wildlife Refuge (the land) is the Lehigh Gap Nature Center (the organization).

[1] Leopold, Aldo. 1949. *A Sand County Almanac, With Essays on Conservation from Round River*. Oxford University Press, London.

Executive Summary

Over the past six years, the Lehigh Gap Nature Center (LGNC) have undertaken the task of producing a comprehensive ecological assessment of Lehigh Gap Wildlife Refuge (LGWR) because part of the Refuge is encompassed by the Palmerton Superfund site, and also because it is on the ecologically important Kittatinny Ridge. The first phase of the assessment was published in 2007 and has led to significant progress (see Chapter 11) in addressing the resource challenges and threats outlined in the document.

Upon completion of the first phase of the ecological assessment, the LGNC procured funding for a phase two of the assessment, with the objectives of: 1) filling in gaps from the first assessment with regard to the baseline ecological conditions of LGWR, 2) gathering information about the ecological interactions occurring in both the restoration area and other habitats of the Refuge, and 3) using the information obtained to develop monitoring protocols to allow adaptive management of the resources at LGWR.

In this phase of the assessment, the following studies and inventories were performed, greatly enhancing our understanding of the biota, physical conditions, and ecological interactions of the refuge:

- Inventories of mammals (Ch. 3); reptiles and amphibians (Ch. 4); birds (Ch. 5); flying, crawling, and aquatic insects, including special surveys of bees, butterflies, odonatans, and aquatic macroinvertebrates (Ch. 6); and soil microorganisms (Ch. 7). We also added to the inventory of plants from Part I of the assessment (Ch. 8), and are working on a bioacoustics survey of the Refuge (Ch. 9).

- Ecological studies (Ch. 9) of:
  - Succession in the grassland revegetation area and of the Prairie Warbler Trail scrub habitat
  - Total plant cover in the re-vegetation zone
  - Metal uptake and risk assessment in the remediation area
  - Food web and herbivory in the grassland area
  - Habitat changes and disturbances throughout the refuge

- Studies of the physical conditions of the Refuge (Ch. 10) including:
  - Soil metal levels
  - Ground and surface water metal levels
  - Microclimate

As of December 2010, 23 species of mammals have been observed at the Refuge. The Carnegie Museum of Natural History has range distribution maps for each county in Pennsylvania. From their records, a total of 51 species have been documented in Carbon and Lehigh Counties combined. Thus, over 40% of these have been observed at the LGWR.

Interestingly, porcupines have been documented at the Refuge but are not noted in the Carnegie Museum's range maps for this area of the state.

Over 50% of the species of reptiles and amphibians ("herps") documented for Carbon and Lehigh Counties by the Pennsylvania Herpetological Society have been observed at the Refuge. To date, 164 bird species have been reported, and since the establishment of the grasslands, new species are not only seen at the Refuge, but are breeding at the site.

Extensive insect surveys have been conducted at the Refuge (for both Part I and II of the ecological assessment) and, to date, the compiled total of species is 851. Many of the insect surveys and research projects have significant educational components for the public and many of the findings have relevance beyond the LGWR.

Current studies of soil microbes (bacteria and mycorrhizal fungi) show recovery from previous reports from the 1970's. These organisms are important for soil quality, decomposition of organic matter, and plant growth since some of them play roles in nutrient availability and uptake and can help to confer metal tolerance.

The LGNC has continued to monitor invasive plant species as well as early successional plants. Some of these take up the metal contaminants from the soil, presenting new management questions for the site. Significant progress has been made in terms of habitat enhancement and the native plant/habitat gardens are important educational tools at the Refuge.

A number of abiotic conditions (physical parameters) have been studied including the distribution and persistence of the metal contaminants in the soil, seeps and springs at the LGWR. Weather stations have been installed to allow a number of future studies, including analysis of microclimates at the Refuge and long-term climate change monitoring.

Chapter 11 summarizes the way in which hazards identified in Part I of the assessment have been addressed. The LGNC has worked on the majority of the recommendations from Part I of the assessment and this progress is also summarized in Chapter 11. Finally, based on the findings of the two phases of the assessment and the work done as a result of the recommendations of the first phase, a new set of recommendations has been formulated and put forth in the conclusion of this phase of the assessment (Ch. 12). The major recommendations of the report include:

- Maintain up-to-date species inventories and fill in gaps for taxa not surveyed.

- Continue monitoring efforts of succession, grassland enhancement, herbivory, and impacts of climate change.

- Maintain the network of researchers, including professional and citizen scientists to continue the valuable research occurring at LGNC and initiate new studies as warranted by monitoring and evaluation.

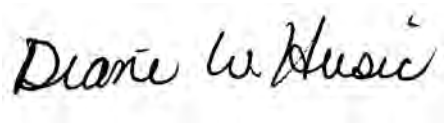
- Determine the desired trajectory of succession in the grassland revegetation area and manage accordingly.

- Continue managing the Refuge with protection of resources as highest priority but allowing research, educational, and recreational uses which do not degrade the resources.

- Acquire additional appropriate land parcels as funding permits to protect the resources of the Refuge and enhance other uses.

While no ecological assessment can be totally complete, the broad range of taxa studied, the wide range of physical factors studied, and the ecological interactions investigated in the two phases of this assessment give the LGNC an excellent picture of the ecology, physical environment, and organisms present at LGWR at this time. It will serve us well in the future to inform management decisions and set the parameters for future research.

Dan Kunkle, Executive Director, Lehigh Gap Nature Center



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