

Chapter 1

Introduction



Introduction

LGNC history and mission

The Wildlife Information Center (WIC) was founded in 1986, primarily as a research and advocacy organization. In 1998, a leadership change and a subsequent strategic planning process, funded by the William Penn Foundation, resulted in a re-defined mission with an emphasis on conservation, education, and research for the sake of wildlife and people. Capacity building and development of the Board of Directors became high priorities, and acquisition of land for a community nature and environmental education center became a major emphasis. The Board members' dream of owning land became a reality when they launched a bold initiative to purchase over 750 acres of land on the Kittatinny Ridge (Blue Mountain) in eastern Pennsylvania.



The Lehigh Gap

With the acquisition of land at Lehigh Gap, the Center's work became focused geographically at that location, prompting the Board of Directors to register the name "Lehigh Gap Nature Center" (LGNC) as an official name by which the organization can do business.

The land has been set aside as a wildlife refuge and is referred to as the Lehigh Gap Wildlife Refuge (LGWR or the Refuge).

The images on the following pages include 1) a panoramic photograph of the LGWR property along the north face of the Kittatinny Ridge stretching from the Lehigh Gap to the Northeast Extension of the PA Turnpike (Interstate 476); 2) a GoogleEarth® image of the property; and 3) a map of the property parcel prepared for the 2007 Lehigh Gap Wildlife Refuge Ecological Assessment (Part I) by the Natural Lands Trust.¹



Location of the Lehigh Gap Wildlife Refuge (Map generated for the 2007 Ecological Assessment by the Natural Lands Trust.)

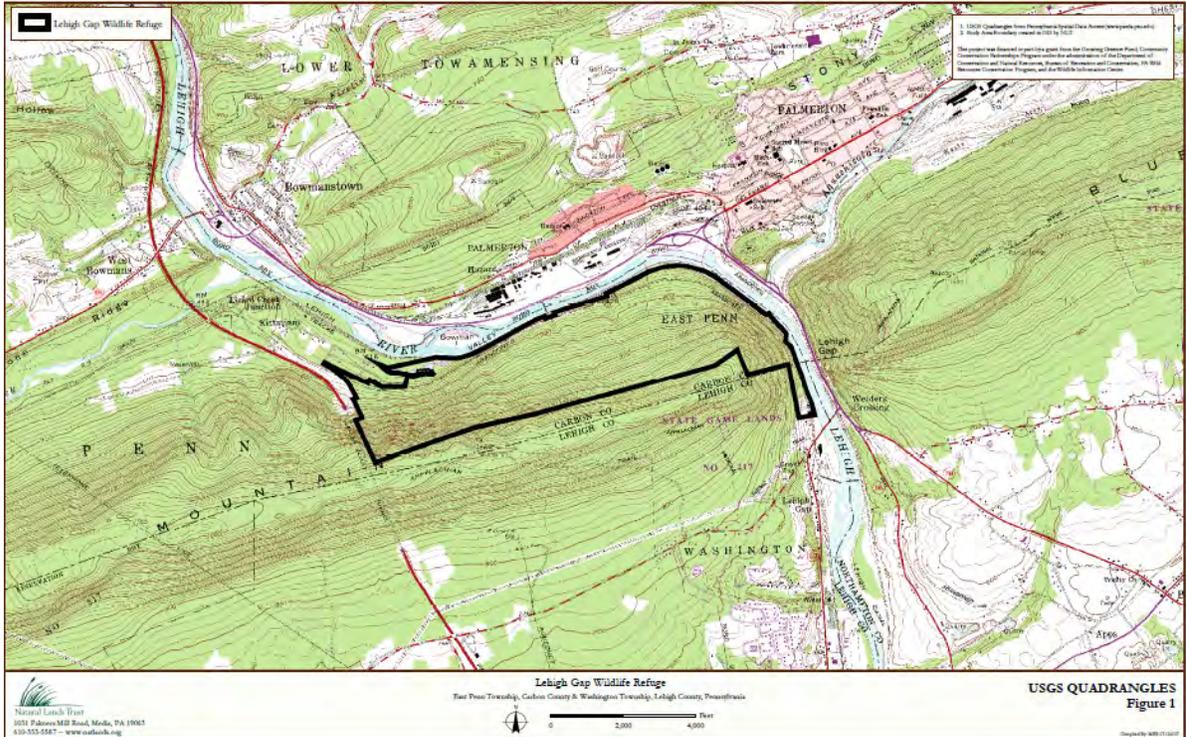
¹ Available at <http://lgnc.org/wp/wp-content/uploads/2009/06/lgnc-ecological-assessment.pdf>.



A view of the LGWR property (the north face of the Kittatinny Ridge)



A GoogleEarth® image of the LGWR property showing the Lehigh River to the east and north of the property.



The LGWR property parcel outlined in black

What makes this particular land acquisition and story unusual is that some of the acquired property was badly damaged by air pollution from zinc smelter plants in the area that had operated between 1898 and 1980. The mountainside was largely devoid of vegetation, the topsoil had eroded away, the ground was highly contaminated with heavy metals (zinc, lead, cadmium and arsenic), and, as such, the area couldn't support other forms of wildlife. In fact, about one half of the property is on the National Priorities List as part of the Palmerton Superfund Site and, at the time of purchase, was in need of complete ecological restoration. Thus, LGNC became involved with the U.S. Environmental Protection Agency (EPA) program ongoing at the site. Upon advice of some consultants and friends

of the LGNC, attempts to re-vegetate the site using with native (mostly warm-season) grasses began in 2003. The grasses are tolerant of heavy metals in the soil, do not significantly take up the metals, have deep root systems to help reduce erosion and can gradually build topsoil. Details of this reseeded and re-vegetation process have been described elsewhere.²

Using innovative restoration methods, a functioning ecosystem has been restored on the barren landscape in less than 5 years. Valuable grassland habitat is being established on nearly 400 acres of mountainside that was devoid of vegetation for half a century.

² For instance, see the series of articles at <http://lgnc.org/conservation>.



A portion of the LGWR property in 2003 prior to seeding with native grasses in the original test plot areas. Notice the severe erosion along the former LNE rail bed.



The same area of the LGWR property in 2008 after the seeding process.

In addition to the restoration area, there are a variety of other healthy habitats on the Refuge. These include a 2.5-mile riparian zone along the Lehigh River, forested slopes, vernal pools and other wetlands, ponds, seeps and springs, hemlocks, and a pitch pine/hairgrass savanna of statewide significance (R. Latham, personal communication, 2005) along the top of the Kittatinny near Lehigh Gap³. The property has been established as a

³ See also 2007 LGWR Ecological Assessment -- Part I; available at <http://lgnc.org/wp/wp-content/uploads/2009/06/lgnc-ecological-assessment.pdf>.

wildlife refuge, open to the public for passive recreation and educational opportunities.

The demonstrated ability to both return functioning ecosystems to the formerly barren area and use the project as the focal point of a wide range of education efforts propelled the Center into yet a new era. A capital campaign was launched to raise funds for infrastructure and facilities improvements that will enhance the capabilities of the LGNC with regard to education programming, visitor services, and passive recreation at the nature center. Groundbreaking for a new visitor and education center took place July 24, 2009 and the building was officially opened to the public on July 16, 2010.



The new LGNC visitor and education center

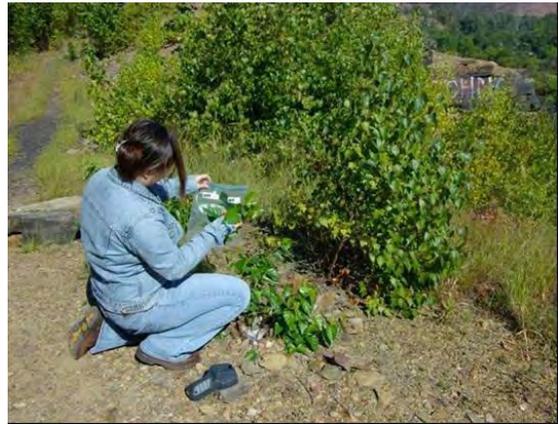
Education is Central in the LGNC Mission. The Lehigh Gap Environmental Education Partnership was initiated in late 2004, in which the LGNC works with the local school districts to develop K-12 curriculum involving the LGNC staff and volunteers and use of the Refuge. The key objective is to deliver environmental education to students in a way that is meaningful and consistent throughout the students' K-12 career. It is expected that this program will result in high achievement on the Environment and Ecology portion of the Pennsylvania System of Student Assessment tests, and preparedness for life beyond school. Over 2,000 students were served during the past year in the education programs.



Besides K-12 educational opportunities, students from nine different colleges participated in class trips, presentations, or research opportunities at the LGWR property. Over the past six years, LGNC has provided paid internships in ecology and wildlife research for 18 students providing unique real world learning experiences that illustrate the intersections between science and policy in this revitalization project.

Academic research partners at Moravian College, Lehigh Carbon

Community College, Kutztown University, Lehigh University, and the University of Pennsylvania have already incorporated Lehigh Gap Wildlife Refuge into their curriculum as a case study, field laboratory activity, or research opportunity. A future goal is to develop an ecological field station at the site in collaboration with our network of researchers and academic institutions.



In addition to programs for students, a strong program of teacher workshops has been developed in to help train teachers in ecology and environmental issues. Elementary and middle school teachers are now responsible for teaching these subjects in Pennsylvania, with their students accountable on state tests. These workshops have been developed and are taught in conjunction

with Moravian College, where the teachers can opt for academic credit for the courses in addition to gaining Act 48 continuing education credit through the Pennsylvania Department of Education.



The Lehigh Gap Environmental Education Partnership is just one part of a highly regarded environmental education program. The LGNC has been approved as an Educational Improvement Organization by the Commonwealth of Pennsylvania, and, as such, qualifies for business donations that can be used in the Education Improvement Tax Credits program. The educational programs include: Young Ecologists Summer Camp, Wonderful World of Wildlife reading program, Lehigh Gap Naturalists Club, field trips, programs in classrooms, an internship program, adult and family-oriented public programs and workshops, and teacher training.



The Lehigh Gap Naturalists Club



The members of the Naturalist Club are participating in two national projects: a) Monarch Watch butterfly migration tracking program⁴ through the University of Kansas and b) a native bee survey with the U.S. Geological Survey and the Smithsonian Institution. The club was recently featured in Audubon magazine, a national publication.⁵



⁴ See <http://www.monarchwatch.org/>.

⁵ See

<http://audubonmagazine.org/citizenScience/citizenscience0905.html>).

An important aspect of the public education component of the LGNC mission is to honor the importance of the history of the region. The value of the industries that built the region and were the foundation of the Industrial Revolution in the United States is recognized – despite the environmental damage that may have resulted from the industrial processes. This philosophy is consistent with the opinions expressed by Daniel Bluestone in a chapter entitled “Toxic Sites as Places of Culture and Memory: Adaptive Management for Citizenship” from a book published after the 25th anniversary of the Superfund legislation. He notes the need to both “engage industrial sites historically” and “cultivate a politics of place to encourage site stewardship”.⁶ So rather than covering up the history along with the contaminants, the historical significance should be landmarked and celebrated as new stories of ecological resilience and the value of the new uses (such as recreation) at the once contaminated site are told.



A second emphasis is research. Research, of course, overlaps with education and has become a prominent part of the LGNC program. More than 70 researchers – including high school students, college undergraduates, Ph.D. students, academic professionals, and government scientists – have been

⁶ Macey, G.P. and J.Z. Cannon, 2007. Reclaiming the Land: Rethinking Superfund Institutions, Methods and Practices. Springer Press.

involved with some kind of research work at LGWR. To date, two roundtables have been convened to strengthen this research network and explore potential collaborations. The last roundtable in May 2009 was attended by 40 people. Many of these individuals contributed to the work reported on in this assessment.

The most significant research partnerships have been with Moravian College and Lehigh University. The LGNC has hosted 10 undergraduate research students from Moravian under the guidance of Professors Diane Husic and Frank Kuserk. Both of these professors also utilize the site for field studies for a variety of classes and Husic co-taught a conservation biology class with LGNC director Dan Kunkle based, in part, on the conservation and restoration work at Lehigh Gap. Another half dozen graduate and undergraduate interns from Lehigh University have done research work at LGWR and Professor Bruce Hargreaves has set up a microclimate monitoring network that will support future ecological research.



Meredith Wright presenting her research at the State Capitol in Harrisburg

A fourth and critical emphasis in the mission of the LGNC is conservation.

Because of the importance of the Refuge from a biodiversity standpoint given the diminishing amount of open space in the eastern United States, especially grassland habitat, it is imperative that the Refuge be managed in an ecologically sound manner. Ideally, the Lehigh Gap Wildlife Refuge will become an exemplary model of protected and well-managed lands along the Kittatinny Ridge. The site is also unique in that it has undergone remarkable transformation from a denuded, highly contaminated site to a grassland habitat which now supports a range of wildlife. The restoration work has gone beyond reducing the environmental and human health risk or allowing the contaminated land to be reused for another industrial site. As such, it is also a model for restoration work at other Superfund and Brownfield sites.



There are not many comparable projects to what has occurred at the LGWR site; thus, the future of how this site will continue to respond is somewhat of an unknown – i.e. it is an experiment-in-progress for restoration work, land management, and conservation. Extensive literature reviews have turned up few clues as to how to manage such a site. Signs of succession, the appearance of invasive

species, and changes in wildlife species that use the site as a stopover or breeding ground are already evident. Thus, the LGNC conservation efforts will, by necessity, include short- and long-term monitoring and adaptive management approaches based on the best information available at a given point in time. Thorough ecological assessments not only provide critical “baseline” information for proper management of the Refuge at this early stage of the restoration process, but also important information about the Kittatinny Ridge, an area of statewide significance as both a valuable natural resource and as part of the state’s largest Important Bird Area.



The Kittatinny is world famous as a leading line for raptor migration, but it is also a major stopover habitat for migrating songbirds, and a dispersal corridor for vertebrates and plants. It provides a number of ecosystem services such as water filtration and groundwater recharge, and the forests along the slopes serve as significant carbon sinks. Audubon Pennsylvania has designated the Kittatinny as an Important Bird Area, and PA Department of Conservation of Natural Resources has designated it as a high priority corridor for land acquisition and conservation. The DCNR also helps

fund the Kittatinny Coalition (of which the nature center is a charter member), whose role it is to advocate and plan for protection of the ridge. In addition, the Lehigh River was designated DCNR's River of the Year in 2007. Thus, this project has not only statewide, but also national and global significance, especially with relation to the migrating songbirds and raptors that are currently in decline.



The Kittatinny Ridge is part of the watershed for both the Delaware and Susquehanna River drainages, and, as such, is important to drinking water and water quality for more than half of Pennsylvania's residents. This project directly affects the water quality of the Lehigh River, and subsequently the people of Lehigh, Northampton and Bucks Counties, and the city of Philadelphia.



Given the risk of contaminant run-off or leaching from the Superfund site, it is important to continually monitor the water quality in 1) the seeps and springs at the Refuge; 2) the section of the Lehigh River that runs adjacent to the Refuge and through the Lehigh Gap; and 3) of ponds on the western end of the property. This is being done by determining metal levels in water samples, evaluating the diversity of aquatic macroinvertebrates, and conducting periodic surveys of biodiversity in and around the river, ponds and wetland areas.



During the period of which this assessment was being conducted, it became clear that future conservation on the Kittatinny Ridge would need to take climate change into consideration. From climate change modeling and impact studies, there is significant evidence that the ridge will play an important role in climate change adaptation as a migration corridor for a wide range of species – both along the corridor of the ridge *per se* and for altitudinal and south-to-north slope

shifts of species seeking cooler environments. The climate change models from the National Oceanic and Atmospheric Administration show that the ridge will likely experience significant warming over the next several decades, although the changes will be less dramatic than regions south of the mountain. According to the Union of Concerned Scientists report entitled *Climate Change Impacts and Solutions for Pennsylvania*, conditions may become unsuitable for many of the important hardwood tree species in Pennsylvania such as black cherry, sugar maple and American Beech.⁷ This, in turn, negatively impacts critical habitat for key resident and migratory bird species. The importance of the Kittatinny Ridge as a corridor for climate migrants and the need for ecological monitoring was noted numerous times during meetings of the PA Climate Change Adaptation Working Group on Natural Resources.⁸ Despite the importance of the ridge in climate change resilience and adaptation, relatively little is being done to monitor phenology along the ridge in Pennsylvania.

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This assessment is vital to developing monitoring protocols and to inform

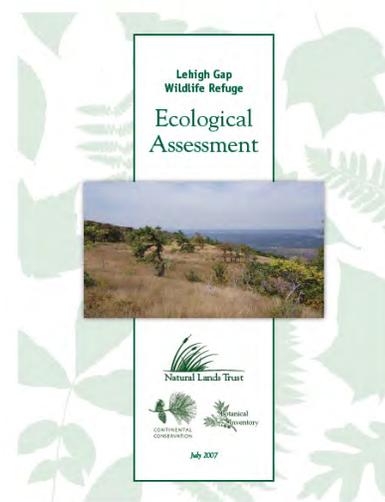
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<sup>7</sup> 2008. Climate Change Union of Concerned Scientists Report in Pennsylvania: Impacts and Solutions for the Keystone State. [http://www.ucsusa.org/global\\_warming/science\\_and\\_impacts/impacts/climate-change-pa.html](http://www.ucsusa.org/global_warming/science_and_impacts/impacts/climate-change-pa.html).

<sup>8</sup> For information on the PA Climate Change Adaptation working group, see <http://www.dcnr.state.pa.us/conservationscience/climatechange/index.htm>. The complete report on climate change adaptation for PA will be released by DEP in January 2011.

management of this critical and unique site, especially with the rapidly expanding use of the site for recreation and education. These protocols and the restoration project have vast implications for other natural areas and restoration projects throughout the state and beyond. Given that ecological restoration is a relatively new field and there is relatively little in the scientific literature about rehabilitating Superfund sites to wildlife refuges, the restoration work at Lehigh Gap is regarded as a series of scientific experiments, which need to be carefully documented and continually monitored.

## Ecological Assessment – Part I



In 2005, the initial ecological assessment of the LGWR property was undertaken with funding from the Growing Greener Fund, Community Conservation Partnerships Program under the administration of the Pennsylvania Department of Conservation and Natural Resources, Bureau of Recreation and Conservation Pennsylvania Wild Resource Conservation Program, and Wildlife

Information Center. The project was coordinated by the Natural Lands Trust (out of Media, PA) in conjunction with Continental Conservation and Botanical Inventory, along with a number of other specialists and scientists.<sup>9</sup>



The 2005-06 ecological assessment provided detailed information about Lehigh Gap Wildlife Refuge that will prove invaluable in management of the Refuge. This is the description of the assessment as described in the grant proposal:

*The proposal (Steckel 2005) calls for a two-year study, including a total ecological inventory of the entire property in year one, with a second year of intensive study of hotspots identified in the year one inventory. The main goals and objectives of the assessment are to:*

*1) Survey the extant plant communities, their component species (including any animal species*

*of special concern), and current state of health.*

*2) Catalog the current stewardship issues and provide general recommendations designed to protect and enhance native plant communities, facilitate educational opportunities and minimize impacts of proposed recreational uses.*

*The results of the project will include GIS mapping and ecological analysis, with recommendations for management of the refuge. We expect this to become part of our Master Site Plan, the guiding document that will allow us to manage this internationally important resource with the best stewardship possible.*

The assessment succeeded in accomplishing these objectives and exceeded them; during the scope of the project, two other major groups were assessed: light-trapped insects (primarily moths) and lichens. This data provided insight into the ecological health and state of recovery of the restoration zone. Four plants of special concern were found, including perhaps the largest population of wild bleeding heart (*Dicentra eximia*) in the state. Other Pennsylvania endangered or threatened species include two *Carex* sedges, and southern wild senns (*Senna marilandica*).

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<sup>9</sup> See complete list in Latham, R. E., D. B. Steckel, H. M. Harper, C. Steckel and M. Boatright, 2007. Lehigh Gap Wildlife Refuge Ecological Assessment; available at <http://lgnc.org/wp/wp-content/uploads/2009/06/lgnc-ecological-assessment.pdf>.



*Dicentra eximia*

A grassland/savanna of statewide significance was also discovered on the Refuge and adjoining National Park Service and PA State Game Lands and is likely the largest natural, native grassland in the state, according to ecologist Roger Latham (personal communication, 2005).

The ponds/wetlands/vernal pool complex at the base of the ridge next to the Lehigh River were determined to also be an area of great significance because of its importance to a variety of unique species, including river otters, and two of the endangered plant species.



Of particular importance, Part I of the LGWR Ecological Assessment made a

series of recommendations related to stewardship, educational and recreational opportunities and future research.

## **The Ecological Assessment – Part II**

The primary goals for this second phase of the LGWR Ecological Assessment were:

- To complete the baseline assessment of the LGWR property and biodiversity;
- To establish protocols for ongoing monitoring to inform decision-making and allow adaptive management of the natural resources of the Refuge; and
- To follow-up on stewardship issues and recommendations from the first assessment.

In spite of the value of the Natural Lands Trust assessment report and the fact that it exceeded the objectives for data collection and analysis, the baseline assessment is still incomplete. The NLT report provided excellent baseline information and maps for plant communities, moths, lichens, and physical features of the Refuge. It also included some preliminary data on insect populations (primarily moths). In Part II, information has been gathered on various vertebrates groups (birds, mammals, amphibians and reptiles); native bee and other insect populations; ecological interactions, especially with regard to the restoration area and the uptake and effects of heavy metals by plants; and the physical

environment of the Refuge including microclimate and water quality. A number of studies have been designed and implemented and preliminary data collected; most of these will be longitudinal studies spanning many years.

The monitoring protocols established during these two parts of the assessment studies provide the framework for ongoing ecological monitoring that will continue well into the future. These protocols include establishment of permanent test plots for succession monitoring, studies of herbivore pressure, and habitat enhancement experiments. The biodiversity studies also outline the protocols and schedules for future assessments that will be used for comparisons to the baseline data and inform subsequent management decisions about the resources of the Refuge.

### **Objectives for Phase II of the LGWR Ecological Assessment**

There were three overarching questions that were intended to be addressed in this assessment:

1) ***What is the baseline ecological condition of all the diverse habitats of the Lehigh Gap Wildlife Refuge?*** Baseline data had already been established for plant communities, plant species, night flying insects, and lichens and produced some GIS mapping of plant communities, stewardship features and hazards, and trails. In this assessment, the intention was to assess the status of various

vertebrate and invertebrate animal groups, selected microorganisms, and microclimate, and adding GIS maps to the existing collection.

2) ***What are the ecological interactions that are occurring that impact both the restoration area and other habitats on the Refuge?*** There are numerous questions to be answered concerning invasive species detection and management; the physical environment and of the interactions of plants and metals; and succession and habitat enhancement efforts.

3) ***How can the information learned in the assessment be used to set up monitoring protocols to allow for adaptive management of the Refuge's habitats and to manage the ecological restoration processes in the grassland restoration area of the Refuge?*** These protocols should be designed to be flexible, to ensure protection and enhancement of biodiversity on the Refuge, and to monitor the fate of and risks associated with the contaminants that remain onsite. The revitalization work and adaptive management plans that are developed should be useful as models for rehabilitation and monitoring at other sites as well.

A detailed list of proposed research questions was included in the original proposal to the Wild Resource Conservation Program of the PA DCNR. Most of the things on list have been accomplished and are discussed in this report. The LGNC also took advantage of some opportunities that came along

over the past two years, and as is typically the case in science, some things took longer than expected so are still works in progress or else the projects didn't develop as expected. Furthermore, new questions arose, such as consideration of the impact of climate change on the management efforts at the LGWR site and along the Kittatinny Ridge in general.

