

## V. Biological Resources

### Background

There are several currents in landscape ecology which are relevant to the planning and design of urban greenways. The most fundamental has to do with the extent to which landscape heterogeneity (mix of habitats and land uses) is encouraged at various scales, and how biological resources are assessed. A landscape ecology model provides a useful way of understanding the issue of multiple-scaled and interactive ecosystems in fragmented, urbanized regions. Landscape ecology has been defined as a study of the interactions and fluxes of energy, mineral nutrients, and species among clustered stands or ecosystems (Forman, 1981). This defines a landscape system with several working scales: alpha (within habitat or vegetation community), beta (between habitat), gamma (bioregional or watershed), and delta (biome) (Noss, 1983; Naveh, 1994).

At NMR an example of an alpha-scale habitat is the **mid-successional woodland** along older slag slopes (**see Section V-b**). The beta-scale could be considered environments such as open brownfields and dense urban development. The complex of alpha and beta environments combine to form the gamma-scale system—Pittsburgh's bioregion—and the combined watersheds of the Allegheny, Monongahela, and Ohio Rivers might be considered Pittsburgh's delta ecosystem. Beyond this scale, geological regions assume even larger proportions; NMR functions as a tiny part of the Allegheny Plateau, which itself is a sub-component of the Stable Interior region (primarily layered sedimentary rocks) stretching from upstate New York to New Mexico (**see Section III-a1**).

The usefulness of this landscape ecology model becomes apparent when assessing biological resources at NMR in light of objectives of ecosystems integrity, **biodiversity**, and sustainability. When the pattern and interconnectedness of ecosystems are assessed, one can begin to understand how patchy, poorly-linked habitats show less species diversity, tolerate stresses poorly, and reveal dysfunctional natural processes.

A final important ecological process involves the dispersal and containment of genetic resources. The health of a population of organisms is dependent on the wide exchange of genetic material since it is through the sharing of chromosomes within a species that resiliency is achieved. It is in this realm that NMR presents its greatest degree of isolation and disconnection. One of the important outcomes of this study will be to propose ways in which ecological fragmentation can be reversed in order to facilitate genetic diversity and species resiliency (**see Section VII**).

For planning purposes, the NMR project area can be organized into an assortment of individual, but overlapped and linked, ecosystems. This approach is consistent with trends in ecology over the last few decades that have seen a shift away from the stable-holistic model of static and



An aerial view of the slag dump looking towards I-376.

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**mid-successional woodland:** disturbed landscape which is developing from an initial growth of early pioneer species, to a vegetation which may be more typical of the region

**biodiversity:** the different plants, animals and organisms in a given area



Hop tree (*Ptelea trifoliata*)

community-oriented assemblages of organisms to an ecosystems continuum model that stresses an individualistic, competitive, and largely functional ecology displaying a complex continuum of processes as part of often indistinct ecosystems (Barbour, 1995; Tamminga, 1997).

Each ecosystem in NMR presents a range of ecological attributes that say something of their ecological integrity. Some are isolated, some well-connected; some are small, some large; some are buffered, some unbuffered; some are degraded internally, some are relatively pristine; some are high in biodiversity, some extremely simplified. Coupled to the location and categorization of ecosystems within NMR is the relationship that the stream valley has to its adjacent exterior ecosystems and to the Pittsburgh bioregion in general. Finally, NMR can be assessed for its function (past, present, and future) as an ecological greenway corridor for biological resources within an urban environment.

Assessment of the biological resources at NMR focused on two key indicator groups, the **vascular** plants and insects. Plants and insects typically comprise over 90 percent of the biotic diversity in most ecosystems, and at NMR plants and insects may comprise an even higher percentage, given a **depauperate** vertebrate fauna. Due to their dominance in most ecosystems, plants and insects are valuable tools for environmental assessment, including water quality and the general health of ecosystems. Plants are often used as **biotic indicators** because they are immobile and thus are impacted by even subtle changes in **abiotic factors**. Insects, due to sheer diversity and habitat-specific lifeways, are one of the best groups of animals for use as biological indicators in both terrestrial and aquatic systems.

Although the biodiversity profile of NMR has changed substantially since the turn of the century, preliminary studies, especially studies of vascular plants and selected lineages of **arthropods**, indicate significant remnant populations of **native species** still existing in the watershed. Paradoxically, changing conditions at NMR created new habitats which have enabled native species, previously not found in the watershed, to colonize this area. For example, hop tree (*Ptelea trifoliata*), which has a conservation status of threatened in Pennsylvania, did not grow historically at NMR, but today occurs along the base of slag slopes, areas similar to the more **xeric habitats** typical of this plant (**see Section V-c**). In addition, a number of grass-associated species of native cutworm moths, unusual in or absent from forest habitats, have become abundant on or near the slag habitats (including *Agrotis gladaria*, *Agrotis venerabilis*, *Euxoa* (*Euxoa*) *bostoniensis*, and *Euxoa* (*Euxoa*) *obeliscoides*).

Given these shifts in the biota of the NMR watershed, both in terms of its historical past and potential future rehabilitation as different habitat types, one of the objectives of this project was to determine what ecological communities are possible within a severely degraded urban watershed and to propose rehabilitation potentials for this degraded urban environment (**see Section VII**).

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**vascular plants:** plants with specialized systems for conducting tissue; these are the most common plants in the terrestrial environments

**depauperate:** falling short of natural development, lower than would be expected

**biotic indicators:** signs or indicators of life

**abiotic factors:** non-living factors

**arthropods:** invertebrate animals like insects, spiders, etc. that have jointed bodies and limbs

**native species:** plants and animals that are indigenous, originating and growing in a region

**xeric habitats:** environments which are characterized by small amounts of moisture

## General Methods

Studies of the vascular plants and terrestrial insects at NMR were conducted by botanists and entomologists from the Carnegie Museum of Natural History (CMNH) using a rigorous protocol of specimen-based documentation (see below for specific research methods). The collection of vouchers (=specimen-based documentation) is an essential component of any responsible biotic inventory. For groups of organisms - including many plants and insect species - that are not easily identified, or even described, the preservation of vouchers as part of current studies provides the basis for future biodiversity assessments. Professional and scientifically useful preservation of vouchers is required (1) to render ongoing investigations credible, (2) to provide context for current studies as systematic or biological discoveries are made in the future, and (3) to provide an indication of past diversity as expertise develops to identify groups of organisms which have not yet been studied.

An intensive survey of selected lineages of terrestrial insects and vascular plants was conducted at four study sites within the NMR area. These sites were picked to represent the diversity of habitat types found within the overall conservation area. Three of the sites were located along the valley floor and the wooded areas adjacent to it, and the fourth site was located on the top of the slag heap itself. This provided a comparison of the flora and invertebrate fauna of a range of habitats from relatively less disturbed to totally unnatural conditions. Sites were located in a secondary forest patch, a wetland, on a small floodplain of NMR in a **riparian forest**, and on an open slag slope (**See Table V-1 and Map V-1**)

**Site 1.** The secondary forest site was located southeast of the main gravel walking trail in a secondary forest patch with a semi-shrubby understory. This area is relatively less disturbed with a variety of trees, including American elm (*Ulmus americana*), sassafras (*Sassafras albidum*), sugar maple (*Acer saccharum*), ash (*Fraxinus* sp.), and spicebush (*Lindera benzoin*). Common non-native plants at the site include garlic mustard (*Alliaria petiolata*) and Amur honeysuckle (*Lonicera maackii*). The soil is rich, but well-drained, as the site was located on the lower portion of a hillside.

**Site 2.** The wetland site was located east of the main walking trail and south of a path leading to the creek itself at the small wetlands discussed in Section IV-b (refer to **Map V-2**). The site was in a low area, which remained slightly damp even during the driest parts of the summer. Vegetation in the area includes both **facultative and obligate wetland species** such as cattails (*Typha angustifolia*), sensitive fern (*Onoclea sensibilis*), and various species of sedges (*Carex* spp. and *Scirpus* spp.) Nearby trees include cottonwood (*Populus deltoides*), sycamore (*Platanus occidentalis*), and staghorn sumac (*Rhus typhina*).

**Site 3.** The riparian forest site was located in the bottoms on the west bank of NMR at the point at which the creek changes from a southerly to a westerly flow direction. The soil is a rich clay composition in the wooded part of the site, almost mucky in places, and changes to sand

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**riparian forest:** plants and trees growing along a body of water

**facultative wetland species:** would indicate plant species which may occur in wetlands but may also survive in more upland environments

**obligate wetland species:** indicate plant materials which are uniquely suited to survive only in wetland conditions

and stones along the stream. The site was subject to flooding during high water events, and although traps were set above the projected waterline, they were flooded during several heavy rains. Dominant trees in the floodplain include silver maple (*Acer saccharinum*), American elm, and the introduced Siberian elm (*Ulmus pumila*).

**Site 4.** Chosen as a comparison site, the slag slope location was just below the top of the slag heap at the edge overlooking the stream, just south of I-376 and the Squirrel Hill Tunnel. The site **substrate** was composed entirely of slag, and the woody plants were primarily a mixture of staghorn sumac and tree-of-heaven (*Ailanthus altissima*).

Precise latitude and longitude coordinates for each site were determined using a hand-held global positioning system (**GPS**) unit (Magellan Trailblazer XL), and altitude was determined using both the GPS unit and a hand-held **barometric altimeter**. Field measurements of latitude, longitude, and altitude were confirmed using the United States Geological Survey (USGS) 7.5 minute, 1:24,000 topographic map for the Pittsburgh East Quadrangle.

In addition to the intensive study of vascular plants and terrestrial insects, data on the biological resources at NMR were gathered from a variety of sources, including an historical work on the ecology of Frick Park (Black, 1947), specimens in the CMNH collections, and more recent observations of the mammals, birds, amphibians, and reptiles in the area.

#### **Deposition and Access to Specimen Data**

All plant and insect specimens collected during this project are deposited at CMNH and are the property of CMNH. As appropriate, information on insects and plants are available for transfer to the Pennsylvania Natural Diversity Inventory (PNDI). Future access to all preserved specimens of insects and plants resulting from this survey, and their associated data, is the right of the Pittsburgh Department of City Planning and the Pennsylvania Department of Conservation and Natural Resources with suitable compensation for preparation and identification of specimens requiring extraction from bulk sample residues stored at CMNH and in accordance with CMNH data release policy.

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**substrate:** the layer beneath surface soil

**GPS:** Global Positioning System, a hand-held tool which communicates with satellites to tell the user his/her position on the earth in longitude and latitude

**barometric altimeter:** hand-held tool which uses air pressure to analyze the relative height of the user/tool in its position, above sea level

**geology:** the science of rocks and soils

**hydrogeology:** the science of interaction between soils and moisture

**hydrology:** the movement of water across a landscape

**physiography:** the science of land forms

**floristic patterns:** the patterns of growth and interrelationships between plant communities

## **V-a. Wildlife**

### **Background**

Several urban areas across North America have defined their bioregion as a prelude to understanding the setting of site-specific initiatives. Such an exercise has yet to be fully conducted in the Pittsburgh area; however, the Allegheny County greenways map (ACPD, 1995, p.3) begins to show the network of natural spaces and corridors remaining in the city and surrounding Allegheny County. Other bioregional mapping efforts have taken a multi-layered approach to generating a definable bioregion: **geology, hydrogeology, hydrology/watersheds, physiography, wildlife, floristic patterns**, soils, and cultural heritage expressed in landscape-level patterns. All of these spatial variables can be synthesized into a single bioregional representation of the greater Pittsburgh area. The process of generating and applying bioregional

characterizations often reveals opportunities for a regional-scale system of linked and enhanced remnant natural features and the associated biological resources.

Although a bioregional map of Pittsburgh does not yet exist, it is clear that the biological resources of NMR are linked to other natural areas within the region. While NMR does not contain large areas of habitat suitable for wildlife, the valley does exhibit linear patterns of **successional vegetation (see Section V-b)**. These remnant patches combined with the stream suggest that NMR functions as an ecological corridor between Frick Park and the Monongahela River. For example, the stream serves as a conduit for the down-gradient flow of materials, nutrients, and microorganisms. Small mammals, white-tailed deer, birds, and invertebrates pass up and down the valley. The NMR/Frick Park deer herd moves seasonally as well, using the forest interior of the park as a wintering yard and spreading south into the valley and laterally along the well-wooded north slope of the Monongahela River during the warmer seasons. The Monongahela itself provides a larger ecological corridor for aquatic and avian species. As a major valley flyway, it funnels both nesting and migratory birds near the mouth of NMR. Near the mouth of NMR, the oak-hickory slopes along the north bank of the Monongahela River also serve as a species-conducting linear greenway. Terrestrial and aquatic wildlife are discussed below in the context of NMR as an ecological corridor within the Pittsburgh bioregion.

## V-a1. Terrestrial Wildlife

### V-a1a. Terrestrial Wildlife: Vertebrates

#### Methods

Information on vertebrate species at NMR is from three sources: (1) historical records, primarily Black (1947) and specimens deposited in the CMNH vertebrate collections; (2) Frick Park records; and (3) sight records by project participants and others who use this area for recreational wildlife-viewing.

#### Discussion

A total of **240** species of vertebrates have been observed in the Nine Mile Run watershed area, including **189** birds, **22** species of mammals, and **29** species of amphibians and reptiles (**see Appendices V-1 to V-3** for species lists). The vertebrate species occurring at NMR are typical for this bioregion and the habitats represented at NMR. Two species of mammals introduced in Pennsylvania, house mouse and Norway rat, which are associated with human-dominated ecosystems, occur in the watershed. Although aesthetically pleasing in terms of wildlife enjoyment, white-tailed deer at NMR may pose a serious threat to vegetation through over-browsing, and the population should be monitored.

### V-a1b. Terrestrial Wildlife: Invertebrates

#### Methods

Field Sampling: At each of the four study sites, a specific light trap location was selected. Each light trap consisted of a 15-watt blacklight positioned above a metal funnel on top of a standard 5-gallon plastic bucket with power provided by a 12-volt battery. On days when rain was



NMR slag slopes



Frick Park Valley



Deer and wild turkey are regularly sighted at NMR, this fawn was photographed on the slag plateau.

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**successional vegetation:** the natural replacement of plant species in an orderly sequence of development



an interceptor trap

a potential problem, a plastic tarp was installed above the light trap location to protect the trap from precipitation. These traps were used to collect nocturnal flying insects, especially Lepidoptera (e.g., moths). Hand-collection of various insects using aerial nets, beating sheets, and collecting jars occurred at all study sites during each collecting episode.

In addition to light traps and hand-collecting, a tent-intercept trap and a series of 10 pitfall traps were installed at two sites (woodland and floodplain sites) for the duration of the study. An intercept trap consists of a mesh fabric, 2-m high, tent-shaped structure positioned above a pool of saturated salt water (NaCl) held in a plastic liner directly under the tent. The peak of each tent was sprayed weekly with a dilute pyrethrum solution. Insects entering the tent and naturally moving upward toward the peak were subsequently affected by the **pyrethrum** compound and dropped into the pool where they were preserved until collected during weekly site visits. These traps were used to continuously capture the **diurnal flying insect** fauna. Pitfall traps were positioned and maintained throughout the season to sample surface-crawling insects. Each pitfall trap consists of two cups, a connecting baffle, and rain covers.

Nineteen trips were made to the sites on a weekly basis, beginning on 30 June 1997 and continuing through the first frosts on 6 November 1997. CMNH staff entomologists (principal field worker, Robert Andrew; assisted by Walter Zanol, Timothy Tomon, David Koenig, and Robert Davidson) conducted the survey. Each visit consisted of a blacklight setup trip in the afternoon of the first day and a retrieval trip in the morning of the second day. Coupled with retrieval of the light traps was the collection of samples from intercept and pitfall traps and a period of hand collection of insects in the field. Environmental data and other information about each trap site and trapping event were recorded on a standard field form. These data included collector, date, time, weather conditions, and notes on equipment problems. Light trap samples were carefully moved from the trap bucket to plastic bags and were stored frozen at CMNH prior to sorting and preparation. Intercept and pitfall samples were strained, rinsed, and preserved in 80 percent ethanol. Hand-collected specimens were stored in glassine envelopes or preserved in 80 percent ethanol as appropriate for the taxon in question.

Sample Processing and Specimen Identification: Light trap samples were retained in freezers at CMNH until sorting took place. Samples were thawed to room temperature, then carefully sorted by Dr. John E. Rawlins, a CMNH entomologist who is an expert on world Lepidoptera, following a strategy to optimize diversity information. Every Lepidoptera specimen in all samples was examined individually and retained according to a sorting protocol which (1) assures documentation of occurrence for every species in every sample, (2) strongly registers the difference between one specimen and two or more, and (3) less rigorously reflects total abundance by the presence of three or more vouchers. In general, this protocol produces a set of vouchers that reflects abundance of species in a sample. It is precise at low levels of occurrence and becomes less so as abundance increases. This method

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**pyrethrum:** an insecticide consisting of the chemicals from the dried heads of several Old World chrysanthemums

**diurnal insects:** insects that are active during the daytime

is both practical and essential, as many thousands of specimens were captured and examined such that the size and diversity of samples would overwhelm the sorter if precise counting was attempted. The many variables influencing effectiveness of light trap catches are unpredictable and thus precise sample counting is not only expensive in terms of time, but is not likely to yield information of much utility, either for within-species comparisons, and especially for between-species comparisons.

Samples taken by other collecting methods (intercept traps, pitfall traps, hand-collecting) were also selectively sorted following the same general protocol in order to remove all specimens of several targeted lineages of insects for this study and of potential future comparative value for understanding disturbed ecosystems. In particular, beetles (Coleoptera) in the families Carabidae, Silphidae, and Cerambycidae were comprehensively extracted from samples, as were flies in the families Sarcophagidae, Tabanidae, and Tipulidae. A number of other species were documented in other families of Coleoptera and Diptera, but no attempt was made to voucher every species in every sample as was done for the Macrolepidoptera and the non-lepidopterous families listed above. Material not prepared for this study is retained in 80 percent ethanol in the CMNH Invertebrate Residue Collection. CMNH staff entomologists and preparators processed the samples collected according to strict standards of pinning, point-mounting, and labelling to ensure specimen conservation.

Authoritative identifications of insect specimens was provided by staff and associates of the Section of Invertebrate Zoology, CMNH, as follows: John E. Rawlins (Lepidoptera: all families plus other miscellaneous insect families); Robert L. Davidson (Coleoptera: primarily Carabidae); Chen W. Young (Diptera: Tipulidae); and Robert A. Androw (Coleoptera: Cerambycidae and Silphidae).

## Discussion

A number of ecologically diverse lineages of insects were comprehensively assessed from the samples taken. All species observed in those lineages are listed in **Appendix V-4**. It is important to emphasize that this survey focused on adults specimens, and that only half of the season was sampled with collecting beginning in late June. Many species with adults occurring in spring and early summer species are **univoltine** and their presence or absence at NMR cannot be determined based on this study. With this sampling restriction in mind, it is possible to summarize the terrestrial fauna based on adult occurrence records from mid-summer through fall.

In general, the insect fauna was as expected for disturbed secondary forests associated with fields and open areas near a stream. Compared to similar undisturbed habitats elsewhere in the Pittsburgh bioregion, the following summary points on the terrestrial insect fauna may be noted: (1) species richness (= number of species) was reduced in each of the major insect groups studied, (2) numbers of individuals captured for most (but not all) species were reduced, and (3) a number of species considered unusual in the bioregion were present at densities greater than expected, especially introduced taxa and species associated with

xeric habitats and grasses. Most notably, aquatic species occur in low numbers in light trap samples, with groups such as Trichoptera (caddisflies), Plecoptera (stoneflies), Dytiscidae (diving beetles), and Hydrophilidae (water scavenger beetles) particularly being low in number. Attempts to hand collect aquatic insects were generally unproductive. Familiar insects such as water striders (Gerridae in the order Heteroptera) were rarely observed, and no indication of a thriving insect fauna in the stream was observed. Despite this, the number of Trichoptera species documented as adults exceeded the number recorded as larvae in the stream by Mirani (1997)

The following comments on representative insect lineages will illustrate and sustain the faunistic generalizations above. While the majority of beetles collected at NMR were common, widespread species, the diversity in some families was higher than expected considering the disturbed nature of NMR habitats. Most of the Cerambycidae (long-horned beetles) have wood-boring larvae with generalist diet breadth including many families and genera of woody plants. A few, such as *Megacyllene robiniae* in black locust (*Robinia pseudoacacia*) and *Tetraopes tetrophthalmus* in common milkweed (*Asclepias* spp.), are obligate borers of their hosts. Less common species, such as *Clytoleptus albofasciatus* in grape (*Vitis* spp.) and *Astyliidius parvus* were collected several times. In contrast, the family Silphidae (carrion beetles) was poorly represented in all trap samples. The only two species collected were *Nicrophorus orbicollis* and *Nicrophorus tomentosus*, both abundant throughout Pennsylvania.

An interesting species of Scarabaeidae, *Onthophagus taurus*, was collected in the intercept at the riparian forest site (Site 3). The species was introduced into the United States in the late 1980s from Africa and was only recently recorded from Pennsylvania.

The group of beetles most frequently used as ecological indicator species are ground beetles (Carabidae), and therefore the carabids were exhaustively studied. This ecologically diverse family is represented at NMR by a relatively depauperate fauna. The number of individual carabid specimens collected was much lower than expected, as was the total number of species. However, eight species were new records for Pennsylvania, and three of these were not previously known north of South Carolina or Washington D.C. Most species documented were characteristic of fields, open areas and disturbed habitats, and there was no species restricted in association to forested or woodland systems. The fauna is dominated by a species of *Cyclotrachelus convivus*, *Platynus hypolithos*, and *Trichotichnus vulpeculus*, all generalists of open areas. Large series of *Bembidion* affine (from wet places) and *Lebia viridis* (on vegetation) were taken, the latter in association with a metallic green flea beetle (Chrysomelidae: Alticinae), undoubtedly its host.

Crane flies (Tipulidae) represent a large family of flies with very diverse habitat associations. The larvae are ecologically important as decomposers of stream debris, fallen leaves, rotting logs, and other organic detritus. The crane fly fauna of NMR represents a mixture of

species expected for a dry woodland with a small stream, although overall species richness is lower than expected and only a few species were abundant. The occurrence of *Epiphragma solatrix* indicates moist decaying wood available for the larval stages. Other common dry woodland species are *Tipula* (*Lunatipula*) *duplex*, *Nephrotoma ferruginea* and the late fall species, *Cladura flavoferruginea*. *Pedicia* (*Tricyphona*) *inconstans* is an aquatic carnivorous species and the larvae require clean cold streams or saturated springy hillsides above a watercourse. Its presence at NMR is notable in terms of water quality.

All families of larger nocturnal Lepidoptera (nocturnal Macrolepidoptera or "larger moths") were assessed exhaustively, and when compared to other systems studied intensively in western Pennsylvania, these moth lineages show reduced species richness and reduced population density for most (but not all) species. Faunal composition is also shifted toward taxa unexpected for woodland or riparian habitats, especially introduced species and those associated with open, xerophytic, or "barrens-like" natural communities.

The presence of many species of Lepidoptera with larvae (caterpillars) restricted to feeding on a single genus, or even a single species, of host plant, provides rather thorough indication of the vegetation as confirmed by botanical studies. A few of the many moth examples with such restricted diets include *Zale horrida* on arrow-wood (*Viburnum* spp.), *Mellilla xanthometata* on honey-locust (*Gleditsia triacanthos*), *Paectes oculatrix* on poison ivy (*Toxicodendron radicans*), *Schinia trifascia* on eupatorium (*Eupatorium* spp.), *Achatodes zeae* on elderberry (*Sambucus*), *Spragueia leo* on morning glory (*Convolvulaceae*), *Eumorpha pandorus* and the primarily diurnal *Harrisina americana* on grapes, *Epiglaea decliva* on cherry (*Prunus* spp.), *Ellida caniplaga* on basswood (*Tilia americana*), *Scoliopteryx libatrix* on willows (*Salix* spp.), and *Basilodes pepita* on flowers and nascent infructescences of wingstem (*Verbesina alternifolia*) to name only a few. Of greater interest is the presence of herbivorous species known to be restricted to a single larval food plant, but for which that **host plant** was not documented by botanical efforts. For example, the presence of *Semiothisa quadrinotaria* is certain indication of buckeye (*Aesculus* spp.) at NMR despite that host plant genus remaining unrecorded by the present botanical survey. It is therefore predicted that one or more buckeye trees will eventually be found growing at NMR or in adjacent habitats.

In contrast to the above, several species of Lepidoptera were absent, despite having their hostplants represented by established populations in the sampling area. For example, large stands of hops (*Humulus*) were not associated with notable populations of the host-restricted moth *Hypena humuli*. Bristly locust (*Robinia hispida*) growing at the site may support a population of the rare and monophagous inchworm, *Heliomata infulata*, but adults of this attractive moth are active before the sampling period of this study and additional fieldwork is required to document its presence.

The invasive plant species at NMR are associated with monophagous herbivores that have established invasive populations of their own. Some are exotic species feeding on exotic host plants, such as the



Poison Ivy Moth (*Eutelia Pulcurrewa*)



Rosy Maple Moth (*Drycampa rubicunda*)

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**host plant:** a plant/food source which an insect has adapted to.

European moth *Calophasia lunula*, introduced from Mediterranean regions into Canada and New England to control populations of the European weed, butter-and-eggs (*Linaria biennis*). In some cases, an invasive exotic plant species is sustaining populations of native moth species that have caterpillars feeding on the same genus or family of plants. This is the case with our attractive native moth *Nerice bidentata* that is feeding on both introduced and native species of elms at NMR. More obvious is the colorful orange moth, *Atteva punctella* (*Ailanthus* webworm), a native species feeding at NMR exclusively on invasive tree-of-heaven. Before introduction of tree-of-heaven, the species fed on other New World Simaroubaceae farther south and were not found in Pennsylvania.

The small wetland at Site 2 contained a number of moth species characteristic of wetlands and wet soil habitats, including *Amolita fessa* associated with soft-leaved wetlands grasses, and various species of owlet moths (Noctuidae) with larvae boring in large stemmed herbaceous species, such as *Luperina passer* in dock (*Rumex* spp.), *Papaipema impecuniosa* boring in stems of composites (*Aster* and *Helenium*), and *Papaipema baptisiae* boring in stems of a wide variety of large-stemmed herbs, including wetlands plants as well as dry habitat species such as dogbane (*Apocynum*).

The xeric, well-drained habitats on the slag slope are not historically represented at NMR, nor do they occur extensively in the Pittsburgh bioregion. It is significant to note the presence of abundant populations of several moth species associated with such systems. These species are rare or missing in the other habitat types at NMR, and in general are unusual in the Pittsburgh bioregion. The most conspicuous of these taxa are several cutworm moths with larvae feeding on various grasses and associated with open dry to xeric habitats. They include *Agrotis gladiaria*, *Euxoa* (*Euxoa*) *bostoniensis*, and *Euxoa* (*Euxoa*) *obeliscoides*. Less restricted but still unusual in the NMR region are other cutworms, *Euxoa* (*Longivesica*) *messoria*, *Agrotis venerabilis*, and *Feltia jaculifera* on grasses. A number of specimens of *Abagrotis cupida* were taken, although the highly similar *Abagrotis brunneipennis* and *Abagrotis anchocelioides* were not recorded. A rare undescribed species of *Abagrotis* with earlier adult flight periods is possible in the Pittsburgh area, but will require sampling in June to confirm.

Several species of moths documented at NMR in this study are unexpected or have unusual habits and, therefore, deserve special comment. These include the stiriine noctuid moth *Plagiomimicus pityochromus* that feeds only on the seeds of ragweed (*Ambrosia*), and is known in western Pennsylvania from very few specimens. It occurs at the secondary forest site (Site 1). *Dysodia oculatana*, a member of the strange moth family Thyrididae, was seen in surprising numbers at all sites on NMR and especially on the slag slope. Known from only a few specimens from this region, the species reportedly feeds as a caterpillar on beans and other herbaceous legumes, but the actual host at NMR remains unknown. Finally, the unusual parasitic moth *Fulgoraacia exigua* was found as both adults and larvae in the secondary forest site. The species is the only North American member of the family

Epipyropidae and is the only true Lepidoptera in North America to be parasitic on other insects, feeding on the abdominal secretions of fulgoroid planthoppers. Two larvae were found attached to abdomens of a planthopper taken in light traps. Diversity indices and similarity values between sites were calculated. Despite overall insect diversity being low at each site (alpha diversity within a given habitat), between-site diversity was relatively high (beta diversity or between habitat diversity) for sampling stations only separated by a few hundred feet. Many species were recorded from only one or two sites. At all sites both species diversity and the number of individuals were low compared to undisturbed habitats elsewhere in the Pittsburgh bioregion. However, considering the disturbance history of NMR, a comparatively diverse reservoir of species is present, and with beta diversity levels high, populations of many species could grow rapidly through reproduction of existing individuals as opposed to waiting for more serendipitous recolonization of such species by dispersing individuals from outside the system. As a result, populations of many species, including ones with relatively narrow or restricted ecological requirements (stenotopic species), are likely to expand rapidly should habitat changes favor them in the future.

Each of the four insect trapping stations had a characteristic fauna:

Site 1, the secondary forest was the most productive site in number and diversity of moth species. However, the intercept and pitfall traps at this site produced relatively few specimens of ground beetles, carrion beetles, and other non-Lepidoptera.

Site 2, the wetland, produced an intermediate number of specimens and species from light trap samples and was the site most affected by weather conditions, especially low evening temperatures.

Site 3, the riparian forest, yielded diverse light trap catches, but not at the level of Site 1. In contrast, intercept and pitfall trap samples at this site were larger and more diverse than those in the secondary forest. Ground beetles were quite numerous and relatively diverse.

The light trap at Site 4, the slag slope, documented fewer total specimens of nocturnal Lepidoptera than the upland forest or riparian forest sites, but catch size was more stable than at the other sites. Being elevated above the stream, this site was consistently warmer later into the evening, providing longer periods of insect activity and therefore increased probability of capture in the light trap. Site 4 was also the first to be warmed in the morning and insect activity was greater much earlier than at the other sites. Species diversity here also seemed more consistent, although lower than at the other sites.

## V-a.2. Aquatic Wildlife

Comparisons between **pristine reference streams** and degraded streams have resulted in indicators of stream ecology integrity in a manner similar to landscape ecology. Many species, especially some

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**pristine reference stream:** a stream in a watershed which is relatively untouched by development or agriculture. Stream conditions in a pristine environment would include: clear, fresh water, well-supplied with oxygen and nutrient-rich organic detritus, and stable base flows supporting a variety of aquatic animals and plants.



Common Snapping Turtle from NMR

**macroinvertebrates** and amphibians, are reliable indicators of water quality. Highly oxygenated, cool waters with relatively stable base flows and few pollutants will accommodate sensitive species not found in highly impacted streams. While some of the more resilient macroinvertebrates are still found in the stream (**see Section V-a.2.2**). A number of sightings of other riparian creatures, such as the Belted Kingfisher near the creek's mouth, suggest that a semblance of ecological integrity still remains within and alongside NMR, despite decades of chemical, biological, and physical assault.

#### **V-a2a. Aquatic Wildlife: Vertebrates**

In addition to the Belted Kingfisher mentioned above, several other species of birds associated with riparian habitats have been observed at NMR.

Several species of amphibians and reptiles associated with aquatic habitats have been found historically in the NMR watershed, primarily in Fern Hollow. These include five species of frogs (Green Frog, Mountain Chorus Frog, Northern Leopard Frog, Pickerel Frog, and Wood Frog); five species of salamanders (Longtail Salamander, Northern Dusky Salamander, Northern Spring Salamander, Northern Two-lined Salamander, and Spotted Salamander); three species of snakes (Northern Water Snake, Eastern Ribbon Snake, and Queen Snake); and the Common Snapping Turtle. Several individuals of an unidentified species of fish were sighted in the stream below Commercial Avenue during 1997. The only aquatic mammal observed within the watershed was an immature beaver seen in the stream in 1997, in addition to evidence of beaver activity.

#### **V-a2b. Aquatic Wildlife: Invertebrates**

##### **Benthic Studies** (excerpted from Mirani, 1997)

Recent studies of **benthic macroinvertebrates** of NMR and Fern Hollow show similar results to previous studies of these streams. Both streams support a variety of organisms, but in low numbers. Downstream of Fern Hollow, the water quality of NMR seems to exhibit some improvement, possibly due to the confluence with Fern Hollow. Relative conditions of the two streams do not seem to have changed drastically in the past 10 years or more. While NMR is inhabited by pollution-tolerant organisms, Fern Hollow is dominated by clean-water scuds (*Gammarus minus*) and supports a limited colony of caddisflies (*Neophylax* sp., *Rhyacophila* sp.). **See also Appendix V-5**.

##### **Adult Aquatic Invertebrates**

Incidental to the detailed study of terrestrial arthropods in NMR, adults of various aquatic insect groups were collected. Of interest is the documentation of several genera of Trichoptera in addition to those noted as larvae by Mirani (1997). This suggests a more diverse and biologically variable aquatic fauna than previously thought in NMR. This impression is supported by the collection of *Pedicia* (*Tricyphona*) *inconstans*, an aquatic carnivorous crane fly with larvae requiring clean cold streams or saturated spring hillsides above a water course.

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**macroinvertebrates:** insects which are visible with the human eye; in this context it refers to creatures which live during some part of their life cycle amongst the mud and detritus in streams

**benthic study:** an analysis of bottom dwelling insects

**benthic macroinvertebrates:** organisms with no spinal column that live at the bottom of a body of water

## V-b. Vegetation

### Methods

Field Sampling: The vegetation surrounding the light trap station at all four study sites was quantified using Adjacent Vegetation Analysis (AVA), a protocol developed at CMNH and used in comparable surveys. All woody plants equal to, or greater than, 1 cm diameter at breast height (dbh) and located within a 25 m radius of each light trap were identified and their dbh measured and distance from the light trap recorded. Notes were made on the **herbaceous vegetation** also occurring within this radius throughout the growing season.

Two transects (**see Table V-1, Map V-1**) were installed to allow comparison of vegetation growth on the slag slopes versus a natural shale slope. Transect 1 (T1) started on the slag plateau and descended the SSE-facing slag slopes, including areas with regrowth and open slag, and ended at the streambed. Transect 2 (T2) started in an oak-maple woods on the opposite side of NMR and descended a NNW-facing shale slope, also ending at the streambed. Both transects consisted of a series of 10 m quadrats in which all woody plants equal to, or greater than, 1 cm dbh were identified and recorded for the quadrat along with their dbh. Notes were also made on the herbaceous vegetation occurring within each quadrat.

In addition to AVA and transects, general collections were made of vascular plants throughout the area of NMR below Commercial Avenue. During 1997, CMNH botanists made a total of 16 visits to NMR for fieldwork from 19 June to 29 October. All major habitats within the area below Commercial Avenue were surveyed and all plant species encountered were documented with voucher specimens (291 vouchers total). Specimens were collected and processed using standard botanical techniques of field pressing, with subsequent drying of specimens occurring at CMNH.

Mapping of the vegetation was done by Ken Tamminga, Assistant Professor of Landscape Architecture, through exhaustive on-site survey of the watershed area as well as use of aerial photographs.

Sample Processing and Specimen Identification: All plant specimens collected at NMR were labelled and prepared by CMNH staff in accordance with strict **herbarium** standards using archival paper and labels. Authoritative identifications of plant specimens was done primarily by Dr. Sue Thompson, Assistant Curator of Botany, CMNH. Confirmation of some identifications will be sought from external experts in specific taxonomic groups, if necessary.

### Discussion

General Vegetation: The NMR watershed is presently a severely degraded system, unlikely to be restored to its original condition, but clearly a candidate for rehabilitation and/or remediation to another type of more natural habitat. Prior to degradation, the biodiversity of NMR was typical of similar wooded watersheds in western Pennsylvania. Two-hundred years ago, NMR's terrestrial environment would have consisted of a mixed oak-hickory (*Quercus-Carya*) association on the plateau and dryer side slopes, with northern hardwoods and hemlock

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**herbaceous vegetation:** vegetation which has little or no woody tissue and persists for a single growing season

**herbarium:** a collection of dried plant specimens usually mounted and systematically arranged for reference

(*Tsuga canadensis*) mixed in on the cool northern slopes. Typical riparian areas along such wooded stream valleys might have included floodplain forests dominated by trees such as American elm, sycamore, silver maple, and boxelder (*Acer negundo*). Specimens in the CMNH herbarium indicate that NMR historically contained populations of three plant species presently considered to be of conservation concern in Pennsylvania and one additional species presently a candidate for listing (**see Section V-c**).

Besides irregular fire events and blowdowns, the original forests of NMR would have largely exhibited interior habitat characteristics: closed-canopied, multi-layered, and accommodating a diversity of habitat-specialist species, free from the "edge effects" typical of fragmented habitats found today throughout the Pittsburgh region. It has been estimated that the eastern **deciduous forest** had 80 percent continuous forest cover by mature and old-growth (over 100 years old) trees and a 20 percent cover of successional vegetation or unforested lands (Riley and Mohr, 1994). The stream itself would have been pristine compared to current conditions—clear, fresh, well-supplied with oxygen and nutrient-rich organic detritus, and with stable base flows—and would have supported a variety of aquatic animals and plants.

As development in this area progressed, both terrestrial and aquatic ecosystems at NMR were heavily impacted, and the vegetation changed drastically. The dumping of millions of tons of slag, which ended in the 1970s, essentially eliminated the stream valley and associated riparian forests and wetlands, and changed the surrounding slopes from wooded hillsides to giant slag piles. The NMR watershed today contains a mosaic of vegetation types, heavily influenced by the activities of man over many decades, including remnants of native vegetation types to areas heavily invaded by exotic species to slag almost completely devoid of plant growth.

Two overall vegetation types occur today in NMR: upland vegetation communities and lowland/riparian vegetation communities (**Table V-2, Map V-2, vegetation map and key to vegetation map**). There are seven basic community types of upland vegetation ranging from open slag slope to secondary forest and areas of planted evergreens, and three different types of riparian vegetation. These vegetation communities are not discrete and distinct entities with fixed boundaries, and many areas intermediate between different types occur at NMR. All vegetation communities at NMR contain a mixture of both exotic and native plants, although in different proportions. Many of the plant species at NMR are introduced from Europe and Eurasia, but a substantial proportion are species that are native to this area, including many native "weedy" species. The native weed species play an important role in normal **successional growth** and include species, such as staghorn sumac and black locust (*Robinia pseudoacacia*), that colonize open areas. In areas of NMR, these plants compete with introduced successional species, such as the tree-of-heaven, which can even grow through cracks in sidewalks! (See also section on Invasive Species).

**deciduous forest:** forests of trees with leaves that fall off at the end of the growing season

**successional growth:** the natural replacement of plant species in an orderly sequence of development

Relatively undisturbed secondary forest areas contain native hardwoods, including tulip-tree (*Liriodendron tulipifera*), basswood (*Tilia americana*), various species of oaks, American elm, sassafras, sugar maple, and ash as well as a mixture of introduced (e.g., garlic mustard and Amur honeysuckle) and native species (e.g., mayapple (*Podophyllum peltatum*) and spicebush) in the understory and forest floor.

The dynamics of this mixture must be monitored to maintain this vegetation type within NMR. Non-forested upland vegetation communities include meadows and the more open slag slopes.

Vegetation on the open slag areas consists primarily of a few species of woody plants (staghorn sumac and tree-of-heaven) and little else. Early meadows occur on the slag plateau and elsewhere at NMR, and contain a sparse mixture of early successional herbs (e.g., sweet-clover (*Melilotus alba* and *M. officinalis*)) and grasses (e.g., foxtail barley (*Hordeum jubatum*)). As meadows become more established, perennial herbs, including asters (*Aster* spp.), goldenrods (*Solidago* spp.), and sweetpea (*Lathyrus latifolius*), become more dominant. Meadows grade into woodlands, especially in some areas on the slag slopes, as early successional tree species, such as poplars and staghorn sumac, start to grow.



Honeysuckle (*Lonicera* spp.)

Wetlands at NMR include both facultative and obligate wetland species such as cattails, sensitive fern, and various species of sedges (*Carex* spp. and *Scirpus* spp.). Trees fringing these wetlands include cottonwood, sycamore, staghorn sumac as well as introduced shrubs, such as Amur honeysuckle. Dominant trees in the floodplain riparian forest include silver maple, American elm, and the introduced Siberian elm.

Invasive Species: An exotic species of plant or animal is one that was introduced, either intentionally or unintentionally, by human endeavor into a locality where it previously did not occur (SER, 1994). Introduced plant species form an important part of our environment, contributing immensely to agriculture, horticulture, landscaping, and soil stabilization. But among the thousands of plant species introduced to North America, approximately 10 percent display unexpected aggressive growth tendencies, resulting in real threats to native ecosystems (Blossey, 1997). These invasive plants typically exhibit (1) highly successful seed dispersal, germination, and colonization; (2) rapid growth and maturity; (3) prolific seed production; (4) rampant spread; (5) ability to outcompete native species; and (6) high cost to remove and control (Miller, 1994).

Disturbed sites such as NMR provide a haven for invasive plants. These species have left behind the natural controls (usually insects) that kept them in check in their native habitats in favor of compromised urban environments. Some, such as the common dandelion (*Taraxacum officinale*) or ox-eye daisy (*Chrysanthemum leucanthemum*), have over time become integrated into the flora of Pittsburgh's urban watersheds. These can be considered "naturalized" and, although newcomers to an ecosystem with a long natural history, can be tolerated and even appreciated in an urban watershed such as NMR.

Other plant species are of greater concern, for they have proven that



Tree-of-heaven (*Ailanthus*)



Garlic mustard (*Alliaria officinalis*)

they can out-compete and displace indigenous vegetation. None is more evident at NMR than honeysuckle. As with most other species successful in invading disturbed ecosystems, dense thickets of honeysuckle can modify ecosystem structure and functions to their exclusive advantage (Luken et al., 1997). Other invasive species at NMR include tree-of-heaven, garlic mustard, giant knotweed (*Polygonum sachalinense*) and Japanese knotweed also known as Mexican bamboo (*Polygonum cuspidatum*), and multiflora rose (*Rosa multiflora*). Populations of these species at NMR are extensive and control of these plants is addressed in Section VII. Following is an overview of existing and potential invasive species of primary concern.

Several species of honeysuckle were introduced to the eastern U.S. in the late 1890s as horticultural shrubs and vines and for wildlife habitat improvement. Plants are present throughout the study area and are clearly associated with areas of disturbed soil and fill situations. The species of primary concern are Japanese honeysuckle (*L. japonica*), a vine form, and Amur honeysuckle, an upright shrub. Species of honeysuckle can freely hybridize (Williams, 1995), and some **hybridization** may have occurred with closely related species such as Tartarian honeysuckle (*L. tatarica*) and Morrow's honeysuckle (*L. morrowii*), both of which are present throughout the NMR watershed as common ornamental shrubs. Morrow's honeysuckle is of special concern because it is able to invade wetter riparian areas.

Honeysuckle often out-competes native plants due to earlier leaf expansion and later fall leaf retention. Large thickets of honeysuckle interfere with the life cycles of many native woody and herbaceous plants. These stands can alter habitats by decreasing light availability and depleting soil moisture and nutrients. Some honeysuckle species are likely allelopathic, releasing chemicals into the soil that inhibit the growth of other plant species (Converse, 1995). Fruits are consumed and passed by many birds, which makes effective control difficult (Williams, 1995).

Tree-of-heaven is a fast growing tree of Chinese origin and is ubiquitous in urban areas, including Pittsburgh. It is a prolific seed producer, a persistent stump and root sprouter, and an aggressive competitor with respect to surrounding vegetation. Tree-of-heaven occurs primarily in disturbed areas, but can also invade undisturbed habitats. It is found throughout NMR, from the most isolated slag slope locations to shady riparian environments. A high degree of shade tolerance gives tree-of-heaven a competitive edge over other plant species. The production of toxic chemicals may also explain the success of this plant, helping to limit natural succession in tree-of-heaven stands (Hoshovsky, 1995). Tree-of-heaven presents an interesting dilemma in disturbed areas such as NMR—a tree that grows where little else can, thus sometimes providing just the foothold needed for other species to colonize vs. a tree that can outcompete many other early successional native species.

Garlic mustard, a biennial herb of European origin, is unusual among invasive species in that it is also shade tolerant and spreads readily

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**hybridization:** a reproductive process where different species of plants combine to produce a third species which is a genetic mixture of the first two.

under forest canopy, especially in moist sites such as riparian woodlands. It is found at NMR especially in wooded areas, but occurs in scattered patches throughout the site. A prime local example is the woodland study area, where garlic mustard is found both in the understory and in full light settings near the trail. This resilient species is very aggressive in disturbed soil, forming a dense monoculture and displacing native herbs. Spring seedlings can attain densities of 20,000 seedlings/m<sup>2</sup> (Blossey, 1997). The mode of dispersal is unknown, but believed to be influenced by white-tailed deer populations, where trampling exposes soil and allows seeds to germinate. Human trampling and alteration of light conditions achieve the same affect.

Japanese knotweed and giant knotweed are two related and often confused species of Asian perennial herbs, which both occur at NMR. While little is known about the geographic distribution of giant knotweed in North America, Japanese knotweed has spread throughout the eastern U.S. and Great Lakes area. In some areas of Pennsylvania, it forms large **monospecific stands** along forested floodplains. Small stands of both species are established throughout NMR, including on the slag slopes as well as in riparian habitats. A vigorous patch is located just downgradient from the CMU trailer in an area of disturbed soil. Although plants produce viable seeds, they are dispersed mostly through the spread of **rhizome** fragments (Seiger, 1995).

Multiflora rose is an adaptable, thorny shrub attaining a height between 10- 23 m. This Asian rose has arching stems that form impenetrable clumps up to 6 m in width, choking out native plants. Long planted for wildlife food and erosion control, it has become a major pest in fallow field and bottomland clearings throughout the United States, and is officially listed as a noxious weed in Pennsylvania. Although decidedly less ubiquitous at NMR than honeysuckle, multiflora rose is found scattered throughout the more open riparian slopes of NMR, especially in the old field area downstream of the soccer fields. It can spread clonally outward from established clumps, but seems to be dispersed largely through consumption and subsequent deposition of seeds by songbirds.

Other invasive species grow at NMR, but have not yet become major problems. Crown vetch (*Coronilla varia*), introduced into the area during I-376 reconstruction, is present near the trailer on Commercial Avenue and has become somewhat aggressive. Kudzu (*Pueraria lobata*), which is listed as a noxious weed in Pennsylvania, is a hugely invasive vine, especially in the south, smothering large trees as it clambers for light; a small patch occurs above the Squirrel Hill Tunnel. Canada thistle (*Cirsium arvense*), another Pennsylvania noxious weed, has also been spotted at NMR, but does not appear to be spreading at present. Dame's rocket (*Hesperis matronalis*) is considered to be a potentially troublesome species elsewhere in Pennsylvania (Tamminga, 1997), and frequently occurs along stream margins. Several grasses may also be potential threats, including smooth brome (*Bromus inermis*) and Kentucky bluegrass (*Poa pratensis*). Additional fieldwork is required to determine the extent and impact of invasive forbs and grasses at NMR.

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**monospecific stand:** a single plant species which out-competes and crowds out all others

**rhizome:** underground stems which produce shoots aboveground and roots below

## Community Input

*A letter to DCNR steering committee member  
Jack Solomon*

Dear Jack,

I am writing to you about the ornithological value of Frick Park. In short, I consider Frick Park to be the premier spring migrant "trap" in all of Pennsylvania. I say this as one who has birded extensively and intensively in every corner of the Commonwealth.

The major attraction for birders is the spring warbler flight through Frick Park. There are 36 species of warblers that occur regularly in Pennsylvania, and every single one of them has been seen in Frick Park. All but two of them (Prothonotary Warbler and Connecticut Warbler) occur annually in the park. On a good day in May, it is possible to see nearly 30 species of warblers. Some of the more common species (Yellow-rumped Warbler, Black-throated Green Warbler, Blackburnian Warbler, Chestnut-sided Warbler, and Black-and-white Warbler) routinely number in the high double digits. On exceptional days, it is possible to see well over a thousand individual warblers in the park.

In recent years, Frick Park has become increasingly popular with birders. On a typical morning in May, one will encounter a dozen or more birders—including visitors from the suburbs and beyond. A visit to Frick Park is a must for anyone seriously contemplating a May "Big Day" in southwestern Pennsylvania. That's because, quite simply, there is no better place in Pennsylvania for finding large numbers of nearly all the warbler species. It is not surprising that Frick Park is a popular site for outings sponsored by the Audubon Society of Pennsylvania. In fact, when the American Ornithologists' Union met in Pittsburgh in 1988, Frick Park was chosen as the location for the morning field trips. Dozens of the best ornithologists on the planet visited the park, and they were well pleased with the park's offerings of everything from Yellow-throated Warblers to Olive-sided Flycatchers.

When I first started birding in Frick Park, as a teenager, I was mesmerized by the great abundance and diversity of warblers that would stream through the park every spring. But I also assumed that similar spectacles were staged in every comparable forest fragment throughout the region. I have since learned that, to the contrary, Frick Park is exceptional, and nearly unique, in comparison with similar forest tracts in the region. I believe I am appropriately credentialed to offer this assessment, having served for years as the Allegheny County

(continue to next page)

A discussion of aggressive invasive plants would not be complete without mention of several native species. Boxelder and wild grapes as well as other native species possess the ability to form fairly exclusive monocultures that thrive in disturbed environments.

## V-c. PNDI Species

The Pennsylvania Natural Diversity Inventory (PNDI), established in 1980, is a comprehensive inventory and database of significant natural areas as well as plant and animal species of conservation concern in Pennsylvania. PNDI focuses on elements of special concern due to uniqueness or rareness in Pennsylvania, and monitors plants, animals, geologic landmarks, natural communities, and other natural features. Plant and animal species are assigned rankings based primarily on the number of extant populations within the state. Although these rankings differ slightly among organisms, the basic categories are (1) extirpated (extinct in Pennsylvania); (2) endangered (in danger of becoming extinct in the state); (3) threatened (may become endangered if critical habitat is not maintained); and (4) rare (uncommon due to restricted geographic areas or occurring in low numbers throughout Pennsylvania).

### Plants

Two PNDI species presently are found in the NMR watershed, and NMR has historically contained populations of four additional species of conservation concern, including three currently listed in PNDI and one candidate species.

An extensive population of hop-tree (*Ptelea trifoliata*), which is listed as threatened in Pennsylvania, grows at the base and along the lower edge of slag slopes at NMR. Hop-trees did not grow historically at NMR and were first documented in this area in 1991. Although hop-trees are found throughout most of North America, populations are localized, resulting in listing as a species of conservation concern in many areas. Hop-tree is an excellent colonizer and is often found in open areas, such as sand dunes along the Great Lakes. Trees are extremely shade intolerant, and individuals in partial shade show a marked reduction, or absence, of flowering and fruiting (Ambrose et al., 1985). At NMR, hop-trees grow along the base of slag slopes, especially along Old Browns Hill Road, in areas similar to the drier natural habitats typical of this species, as well as on the shale slopes near the mouth of the run. Trees at NMR exhibited abundant flowering and fruiting, and seedlings and saplings were present. The success of hop-trees at NMR is likely due to the porous nature of the slag substrate and the open habitat in those areas. Standard PNDI Site Survey and Special Plant forms were completed for this population and have been submitted to PNDI.

Fringe-tree (*Chionanthus virginicus*), recommended this year for listing as threatened by the Pennsylvania Biological Survey (PABS), is another species which did not occur historically at NMR. One individual was documented growing on a bluff along the Monongahela River near the mouth of NMR in 1991. The general range of fringe-tree is to the east and south, but other sites are known from Allegheny County. Plants are found mainly in moist open woods and along edges. The species is also cultivated for its fragrant flowers (Cooperrider, 1995), and the tree along

the Monongahela River may represent a plant naturalized from cultivation. Appropriate habitat at NMR needs to be searched for additional plants, and a natural status at NMR verified.

Historical records exist in the CMNH herbarium for populations at NMR for four additional PNDI-listed or candidate species: (1) passion-flower (*Passiflora lutea*), endangered; (2) American gromwell (*Lithospermum latifolium*), endangered; (3) blue false-indigo (*Baptisia australis*), recommended this year as a potential endangered species; and (4) white trout-lily (*Erythronium albidum*), recommended this year as a candidate for listing as rare.

Passion-flower and blue false-indigo were collected near the mouth of NMR in 1909; American gromwell was found in the area in the 1890s, and white trout-lily was last collected at NMR in 1908—all dates prior to slag dumping in the valley. Passion-flower is at the edge of its range in Pennsylvania, and in other areas is often found along roadside woods and hedgerows (Clancy, 1993). American gromwell occurs in dry woods and thickets and on limestone slopes; its range in Pennsylvania is limited to the southwestern corner (Rhoads and Klein, 1993).

Blue false-indigo prefers clay soil (Kosnik et al., 1996) and has been observed in open woods, river banks, and sandy floodplains in Pennsylvania (Rhoads and Klein, 1993). It grows mainly in the eastern United States, but has been found as far southwest as Texas. In Pennsylvania, the species is native to western counties and has been introduced to some of the eastern counties (Rhoads and Klein, 1993).

White trout-lily is a herbaceous perennial spring plant in many deciduous forests. The flowers and fruit mature in the spring and plants wither by early summer, and thus are visible only for a short period each year (Kaul, 1989). Plants are found in wooded areas, low moist ground, and also along streams and floodplains. White trout-lily is among the widest ranging of the eastern North American trout-lilies, occurring as far south as Texas and as far west as Nebraska. The species can withstand stress, and is often the first to return to previously overgrown woods after burning or mechanical clearing of underbrush (Swink and Wilhelm, 1994).

Despite previous searches in the area for passion-flower and American gromwell by staff of the Western Pennsylvania Conservancy and the extensive botanical fieldwork during this project, no populations of these two species have been found recently at NMR. No specific searches have been conducted for white trout-lily and blue false-indigo, but neither species was found during the botanical fieldwork for this project. Since fieldwork for this project did not start until late June, which is after white trout-lily has completed its seasonal cycle, additional fieldwork is needed.

### **Vertebrates**

Five PNDI-listed species of birds have been sighted since 1970 in the NMR watershed: Bald Eagle (endangered), Common Snipe (threatened), Olive-sided Flycatcher (presently listed as

Editor for the journal, *Pennsylvania Birds*, and more recently as the Philadelphia County Editor of that journal. I am also the state coordinator for the North American Migration Count, and I am always impressed by Allegheny County's haul—much of which comes right out of Frick Park.

Sincerely yours,

Ted Floyd



There is a small slope wetland on the slag property.

extirpated in Pennsylvania), Osprey (endangered), and Yellow-bellied Flycatcher (threatened). In addition, five "Candidate at Risk" (species particularly vulnerable to exploitation or environmental modification) have been seen in this region: American Coot (historical record only), Blue Grosbeak, Pied-billed Grebe (historical record only), Summer Tanager, and Swainson's Thrush. Three "Candidate Rare" (species which occur in restricted areas or habitats or in low numbers) are also known from NMR: Common Barn Owl (historical record only), Northern Harrier, and Prothonotary Warbler. Another four species, which presently have no legal status but are under study for future listing, are also known from NMR either historically (American Bittern) or from more recent records (Black-crowned Night-heron, Great Blue Heron, and Virginia Rail). Of all these species, only the Summer Tanager is known to have bred in the area (up until 1982), and the Great Blue Heron probably had breeding populations at least in the nearby vicinity.

There are no records or sightings of PNDI-listed mammals, amphibians, reptiles, or fish in the NMR area.

### **Invertebrates**

Knowledge of the presence and abundance of most invertebrates in Pennsylvania is extremely limited. The most diverse lineage of invertebrates are insects, and precise information on the conservation status for most species other than butterflies, dragonflies, damselflies, and a few beetles is not available. As a result, PNDI ratings are conjectural for most terrestrial species and the best information on conservation status depends on the impressions of regional specialists of which there are few. Although a few species of insects thought to be relatively rare or unusual in the Pittsburgh region were documented during this study, no officially-listed PNDI invertebrate species were documented.

## **V-d. Important Habitats**

Site investigations and background studies reveal a number of important habitats, representing almost all areas of the valley and adjacent uplands. While additional work to acquire baseline data is needed to identify the extent of some of these resources, there is sufficient data to suggest that the following areas be noted as important habitats and be managed accordingly. Six categories of important habitat have been identified and are discussed below.

**Wetlands** Two wetland areas have been preliminarily identified (**see Section IV-b**) within NMR. Their importance stems from a number of interrelated issues and characteristics:

- they are apparently unique to the NMR watershed, which is in a larger urban area that has no mapped wetlands according to the National Wetlands Inventory;
- they serve vital hydrological, biogeochemical, and habitat functions that are in extremely short supply in the valley;

- they provide a repository for plant and animal species that occur nowhere else in the study area, for example, hydrophytes such as sedges and other obligate wetland species;

- they are small and only tenuously connected to the landscape context; they are surrounded by fairly degraded landscapes and human activities (paths, ballfields, etc.) rendering them prone to further stress; and

- they can provide richly contrasting educational and experiential opportunities if carefully managed and accessed.



Successional growth on slag.

Additional research is required to assess hydrological and biological parameters of these sites, to delineate their boundaries in a more accurate manner, and to ensure their protection in terms of hydrological supply and biological and soil resources. With the upstream wetland, in particular, there is ample opportunity for remedial work and control of invasive species.

**Slag Plateaus and Slopes.** Slag may seem a rather unlikely candidate for important habitat, but is discussed here for several reasons. Biotic colonization of the almost impossibly severe surfaces of the slag slopes and plateaus presents an important brownfield research opportunity. Life forms from warmseason grasses to nonindigenous vegetation to macroinvertebrates to microorganisms to birds, herptiles, and small mammals all contribute to a surprisingly complex web of life. The slag represents a superb lesson for the public in urban ecology; themes include survival, succession, nutrient cycling, and the human role among others that are sometimes only subtly apparent. For example, the fact that hop-trees, a threatened species in other areas of Pennsylvania, grows at NMR because of the slag presents a useful teaching tool about the complicated interrelationships among organisms and the effects of substrate on biodiversity. Early successional species that make up much of the slag's most important constituents can provide a ready source of seeds and propagules to promote managed succession (**see Section VII, Restoration**). While much of the plateau and slag slope area is slated for development and accelerated succession, respectively, some examples should be retained for research and educational purposes.

**Remnant Secondary Forests** These areas (**see Map V-2**) are relatively scarce within the greenway proper, but are more abundant in Frick Park and along the Monongahela River. Secondary forests provide many values, particularly forest interior habitat, the production of organic material which feeds ecosystems, **downgradient hydrological buffering**, and microclimate amelioration.

These **mesic stands** may provide a ready source of seeds and **propagules** of local origin—an important consideration in revegetation strategies. These secondary forests are some indication of what existed prior to clearance, and they hold great interpretive potential as offspring of denser, grander old growth forests in inspiring the challenge of ecological regeneration throughout the valley. All remnant upland

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**downgradient hydrological buffering:** protection of downhill slopes due to uphill forest cover

**mesic stands:** stands of trees which are characterized by a moderate amount of soil moisture and good drainage

**propagules:** a plant which will produce roots and grow without seed

forests not slated for residential development should be protected and managed for enhanced ecological integrity. Invasive species, clearing, and dumping are current threats.

One of the most important roles of these secondary forest patches is in providing **interior habitat**, which is critical in maintaining populations of many organisms, especially birds. Although the present study at NMR focused on plants and insects, another widely-used indicator of the integrity of forest interior habitat correlates habitat patch size and shape with bird species that require minimum areas for successful breeding. As the patch size and corresponding interior increase, habitat specialists are more likely to be found. These are usually species that are declining due to habitat fragmentation resulting from urbanization or land clearing and include indicator species such as **neo-tropical migrants** (e.g. warblers) and neo-temperate migrants (e.g., Red-shouldered Hawk), and resident species (e.g., Pileated Woodpecker).

This approach is so well-developed as to be quite reliably predictive. Under certain threshold sizes, area-sensitive interior species are not likely to breed successfully. As the size of forested interior area decreases, edge habitat and developed landscape increase. Instead of warblers, one is more likely to find species associated with successional and scrubby vegetation, such as House Sparrow, Catbird, Brown Thrashers, and the parasitic Cow Bird—all species that, relative to pre-contact conditions, are superabundant in settled landscapes.

**Table V-3** shows key habitat threshold sizes, determined in previous studies by avian biologists, with possible associated bird species (Riley and Mohr, 1994; Moorhead, 1995) and corresponding habitats in and adjacent to NMR. This type of spatial overview analysis is useful since it suggests that a strategic approach to revegetation could bolster interior habitats (and associated species) which are increasingly rare in the Pittsburgh area. As importantly, it would also undoubtedly reverse the decades-old trend toward diminished biodiversity at NMR.

Frick Park could be expected to act as a local refugia for interior bird species; it is also likely to contain breeding populations of interior-nesting neotropical migrants. Frick Park also serves a similar function for small mammals and herptofauna. The mapping of forest interior habitat (**Map V-d, Forest Interior Map**) clearly shows that while total upland forest cover in Frick Park is almost 370 acres (150 ha), the actual interior habitat in the single meta-woodland is approximately 87 acres (35 ha), less than 25 percent the total coverage.

NMR south of I-376 contains virtually no forest interior habitat. In fact, of the approximately 158 acres (64 ha) of upland forest vegetation in total, only a tiny 0.1 acre core has been identified as having any potential as interior habitat. However, a number of small patches do attain the micro-woodland scale in which moderately area-sensitive bird species may be expected to nest. All the other patches of early successional woody vegetation and old field habitat support habitat generalist bird species that are ubiquitous throughout the greater Pittsburgh area.

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**interior habitat:** natural habitat of woods which are surrounded on all sides by significant stands of timber.

**neo-tropical migrants:** bird species which migrate from tropical climates to temperate climates.

**ha:** hectare, 2.47 acres

Many researchers point out the importance of context in determining minimum woodland size requirements. For example, the number of area-sensitive species within woodlands and the rate of increase of forest interior birds in larger woodlands were highest in an area that had the most overall forest cover on the landscape, about 30 percent (Freemark and Collins, 1992). Related to this is the importance of proximity. NMR has excellent proximity not only to the significant secondary forests of Frick Park, but also the flanking slopes of the Monongahela River and several large forest patches extant across Browns Hill Road in Calvary Cemetery and along Rivermonth Drive (See **Map V-d**).

Thus, although NMR exhibits extreme patchiness, it is nested within an urban region that is decidedly more wooded than most other North American cities. This would suggest that revegetation efforts in NMR and Frick Park are likely to result in an increased number of vertebrate species because of the ability to "borrow" biodiversity from adjacent wooded patches.

### **Aquatic Habitats**

NMR has been the focus of previous research on the effects of urbanization on small urban streams. Benthic organism and water quality studies provide valuable clues to trends, ecological tolerances, and critical thresholds of biodiversity. Two contrasting types of habitats can be identified, highly degraded and relatively pristine. The former is worthy of much attention, with attendant short- and long-term goals for rehabilitation and restoration. The latter exist in short stream reaches on site, natural substrates, shale ledges, several well-developed meanders, a few deeper pools, and some very interesting sandbars showing natural selection.

### **Remnant Riparian Forests (See Map IV-b)**

While in very short supply, there are several sites both up and down stream of Forward Avenue which accommodate fairly important remnant riparian forests. These are small floodplain flats spared of slag dumping. Disturbed soil regimes, stormflow litter, and invasives species, however, contribute to their current state of serious degradation. Nevertheless, forested floodplains—once a ubiquitous part of the Nine Mile Run system—must be considered important vestiges of the past, and valuable as in situ reference sites for wider restoration efforts. Their role in stormwater uptake, habitat, erosion control, nutrient cycling, and educational opportunities should be recognized and strengthened. Some of the more unusual terrestrial species of insects at NMR are associated with these riparian habitats, such as the large long-horned beetle (*Prionus laticollis*), which has larvae boring in the roots of mature trees associated with undisturbed bottomland forest.

### **Rock Outcroppings**

There are a number of interesting geological features along NMR that should be included as important habitats. Natural and man-made shale cuts exist in good supply along the upper reaches of the stream, as well as several large exposures along the midreaches of the stream and along the jeep trail. They are a source of high-profile educational



Shale outcropping with Basswood trees. There are four shale outcrops along NMR, two in Frick Park, and two along the slag-dump property.

opportunities, harkening to past eons that formed the foundation for current ecosystem functions and cultural utilization of the local area. While more work is required on the specific ecologies at work on these very sensitive features, there are some intriguing species of native plants, including wild hydrangea (*Hydrangea arborescens*) and rattlesnake root (*Prenanthes altissima*), associated with these rock outcrops. The presence of adults of the crane fly (*Limonia* (*Geranomyia*) *communis*) also indicates habitats with hygopetric association such as rocky margins of streams with vertical cliffs where the surface is continually wet and covered with algal growth.

**Table V—CMNH transects and radius**

1	Secondary forest	40-25-26 N 79-54-21 W	245 m	Secondary forest near meadows	Light trap, pit-falls, intercept, AVA, plants
2	Wetland	40-25-27 N 79-54-24 W	235 m	Small wetland in dis-turbed woodland	Light trap, AVA, plants
3	Riparian Frst	40-25-26 N 79-54-28 W	230 m	Disturbed forest on floodplain near stream	Light trap, pit-falls, intercept, AVA, plants
4	Slag Slope	40-25-30 N 79-54-33 W	285 m	Extremely disturbed scrub on slag slope	Light trap, AVA, plants
	Transect 1	79-54-40 W 40-25-19 N	225-290 m	Wooded and open SSE-facing slag slope	Quadrat data for plants only
	Transect 2	40-25-25 N 79-54-32 W	225 _ 265 m	Wooded NNW-facing shale slope	Quadrat data for plants only

**Table V-a.—Remnant Secondary Forests**

Patch Type / Size	Possible Breeding Bird Species	Representative Areas in NMR (see Map V-d)
Meta-Woodland (100-400 ha or 250-1000 ac)	highly area-sensitive species (e.g. Pileated Woodpecker, Northern Waterthrush, Canada Warbler)	Frick Park main woodland (107 ha), marginally meta-scale due to convoluted shape and frequent gaps.
Meso-Woodlands (30-100 ha or 75-250 ac)	area-sensitive species (e.g. Veery, Wood Thrush, Scarlet Tanager, many warblers)	Frick Park main woodland
Micro-Woodlands (4-30 ha or 10-75 ac)	generalist and moderately area-sensitive species (e.g. Yellow-bellied Sapsucker, Gray Catbird, Red-eyed Vireo, some warblers, possibly Scarlet Tanager)	several in Fern Hollow/Frick Park; 4 or 5 stands in NMR south of Hwy. 376.
Wooded Patches under (4 ha or 10 ac)	generalist “field-and-edge species”, permanent residents, short distance migrants (e.g. Gray Catbird, Cowbird, Robin, Gold Finch)	a number of scattered examples in NMR south of Hwy. 376.
Early-Successional Patches (loosely scattered trees, shrubs and forbs)	generalist and edge species (e.g. White-throated and House Sparrow, Brown Thrasher, Cowbird, Mockingbird, Blue Jay, Cardinal, Robin, Gold Finch)	many scattered examples in NMR south of Hwy. 376.