LINKING SALAMANDER OCCURRENCE TO HYDROLOGY

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PROJECT OVERVIEW:

• USEPA Grant to Study Physical Hydrology To Better Understand Deep Aquifer Recharge Potential (Funded 2006 – 2007 data collection; reporting in-progress).

• Supplemental “Pilot Study” To Correlate Salamander Occurrence To Hydrology Gradients in Sparsely-Developed Headwaters Catchment (Begun 2008).
INCENTIVES TO ADJUST MUNICIPAL LAND MANAGEMENT STRATEGY

• Northeastern Bucks County is situated between Philadelphia and New York City and land development pressure has intensified.

• Potable water is supplied primarily by groundwater.

• Septic waste management occurs via Individual Subsurface Sewage Disposal Systems (ISSDS).

• Effective management of natural resources is vital for rural character and scenery to persevere.
GEOLOGIC SETTING:

- Diabase *Terrane* ► Jurassic-age sill intruded into sedimentary host rock of Triassic - Jurassic Newark Supergroup (Brunswick & Lockatong).

- Igneous Diabase ► dense, fine-grained, fracture-resistant; weathers to produce rounded boulders and swelling clay (montmorillonite)-rich soils.

- Coffman Hill Diabase ► 80 to 570 feet thick, prominent oval-shaped landform 3.8 mile x 5 mile surrounded by halo of hornfels-dominated metamorphism.
A Rapp Creek waterfall descends from the Coffman Hill Diabase at contact with host rock.
HYDROLOGIC SETTING:

• Rapp Creek ► 7.4 mi² Exceptional Value (EV) status watershed in the Wild & Scenic portion of Delaware River watershed.

• Study Area ► Wetland and low-order tributary network in second-growth deciduous forest.

• Stream Flow Regime ► Flashy response to rain events; primarily intermittent from May - October.
HYDROLOGIC MODEL:

- Surface and shallow groundwater flowpaths dominate.
- Deep aquifer recharge potential <10% annual input.
- Deep aquifer recharge occurs late autumn to early spring.
- Stream networks exhibit “flashy” response to rainfall.
- Wetlands develop at/below break in slope due to intersection of flowpaths and poorly-drained soils.
- Not much functional difference between wetlands and uplands.
Ground Water Level Time Series
State Game Lands 56
Nockamixon Township, Bucks County, Pennsylvania

Rising Water Level Limbs

Water Budget Result: Deep aquifer recharge occurs when ET demand is low.
We observed apparent “hot spots” for salamander activity in relation to GSI discharges.

Sub-adult northern red salamander
CAN SALAMANDERS SERVE AS A BIOLOGICAL RESPONSE INDICATOR OF HUMAN LAND USE?

• Jurisdictional wetland determination provides certain land use restrictions.

• Upgraded watershed status confers protections for designated uses and water quality.

• EV designation mandates that water quality shall be maintained (anti-degradation) and protected.

• Salamanders represent a possible surrogate biometric to monitor environmental quality (sensitive, varying life history requirements, range of preferred habitats).
STUDY APPROACH:

• Establish survey plots/areas that correspond to 3 categories along a hydrology gradient
  • Intermittent
  • Perennial
  • GSI Discharge

• Standardize search effort and repeat every 2-4 weeks (3 events completed to date).
STUDY AREA:

- Intermittent
- GSI Discharge
- Perennial
Intermittent Areas

Left: Typical spring flow status (non-rain). Right: Staff gauge upstream after forest canopy development.
Left: Typical spring flow status (non-rain). Right: Staff gauge showing summer “base flow”.

GSI Discharge Areas
Perennial Areas

Left and Right: Typical spring views (non-rain).
Profile:
Terrestrial all life stages; oviposit summer; eggs placed in damp settings beneath objects; female may guard eggs; prefer forests.

Redback (adult) – *Plethodon cinereus*
Profile:
Terrestrial as adults, aquatic as larvae; oviposit generally summer; eggs in recesses in streams/seeps; prefer headwaters and springs.

Northern Spring (sub-adult) – *Gyrinophilus p. prophyriticus*
Profile:
Terrestrial as adults, aquatic as larvae; oviposit generally spring to summer; eggs in flowing water; prefer forested stream margins.

Northern Two-Lined (adult) – *Eurycea bislineata*
Profile:
Terrestrial as adults, aquatic as larvae; oviposit generally fall to spring; eggs in headwater streams/seeps; prefer headwater margins and springs.

Northern Red (adult) – *Pseudotriton r. ruber*
Profile:
Terrestrial as adults, aquatic as larvae; oviposit generally late spring to summer; eggs placed near aquatic sites; prefer forested stream margins.

Northern Dusky (adult) – *Desmognathus f. fuscus*
ABUNDANCE/RICHNESS vs. HYDROLOGY

Abundance and Richness - 3 Events

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<th>Date</th>
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Count

 dared
Abundance
Richness

Legend:
- Red: Abundance
- Blue: Richness
SPECIES OCCURRENCE vs. HYDROLOGY

Species Counts - 3 Events

0 5 10 15 20 25 30 35 40 45
Count

I GSI P I GSI P I GSI P
14-Mar 11-Apr 30-Apr

Redback Northern Spring Northern Two-lined Northern Red Northern Dusky
Based on Probable Response to Hydrologic Gradients, Salamanders Appear to be Worthy of Further Study for Use as Biometric Indicators of Watershed Integrity.
Thank You
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