

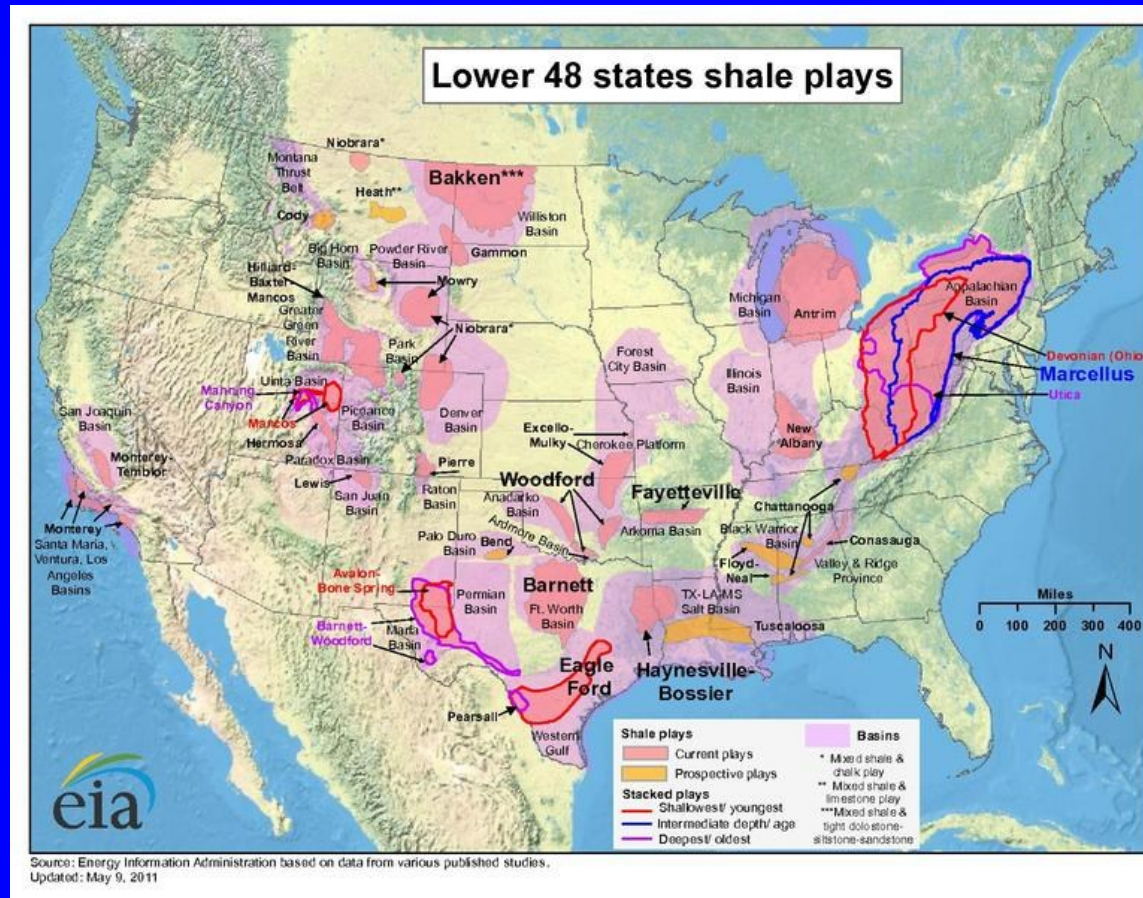
Ecological Risks of Shale Gas Development

M. Brittingham, Discussant

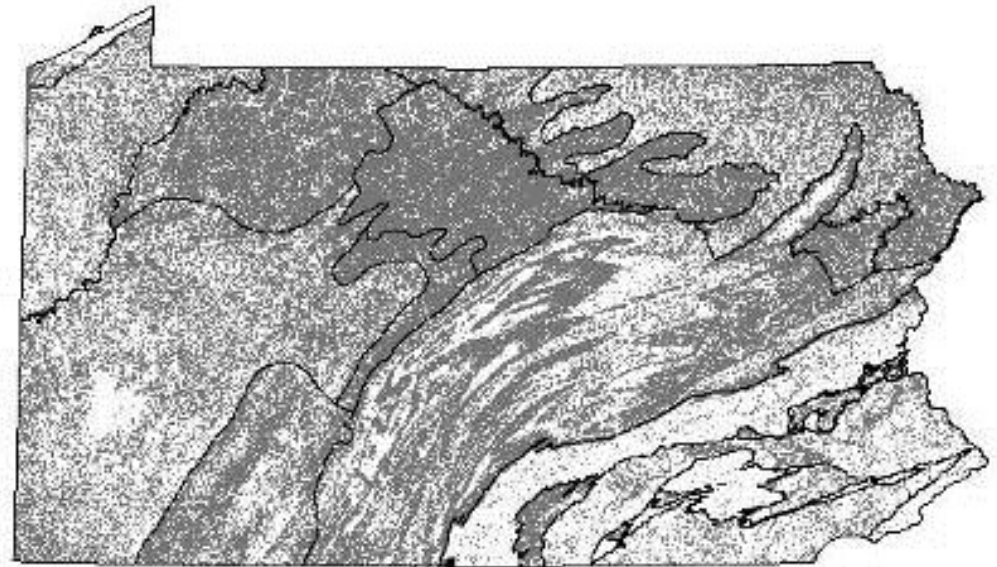
With P. Drohan and D. Mortensen

Department of Ecosystem Science and Management

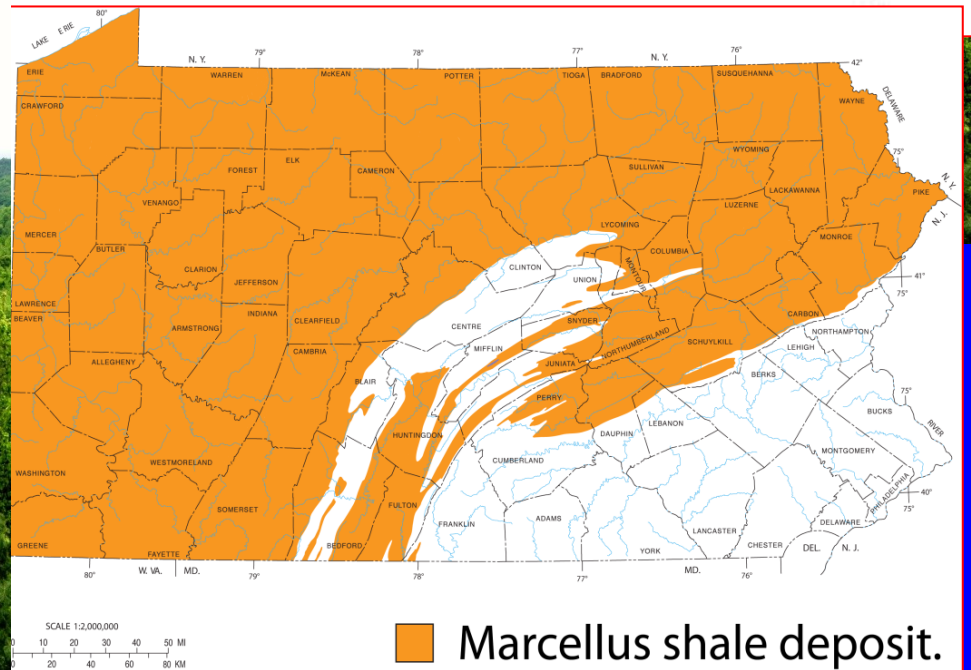
Penn State University



The overlap
between core forest
and the Marcellus
shale results in high
vulnerability for this
habitat



50 0 50 100 Kilometers



Core forest habitat has high ecological value and is particularly important for forest interior/ area sensitive songbirds.



Gas well development changes the landscape



Landscape effects differ between shallow and deep (unconventional/shale) development

Shallow



Deep



Shallow



Deep



The pad footprint averages 1 ha (2.47 acres)

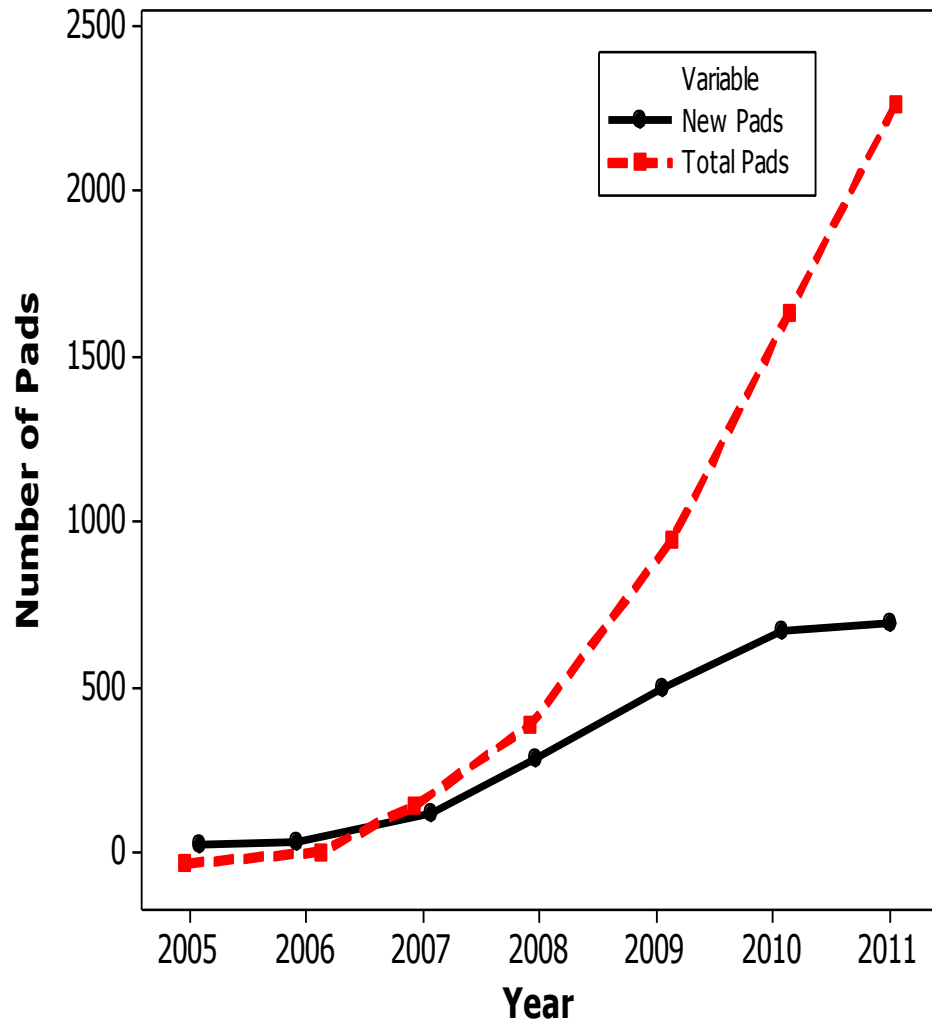
Pad+ local disturbance= 2.7 ha (6.7 acres)

Range = 0.1- 19 ha (0.25-49.4 acres)

Drohan and Brittingham 2012



Numbers of pads developed is a good indication of landscape change



>2350 pads
built in PA
2005-2011

48 % of pads are in farmland and 52% in forest lands

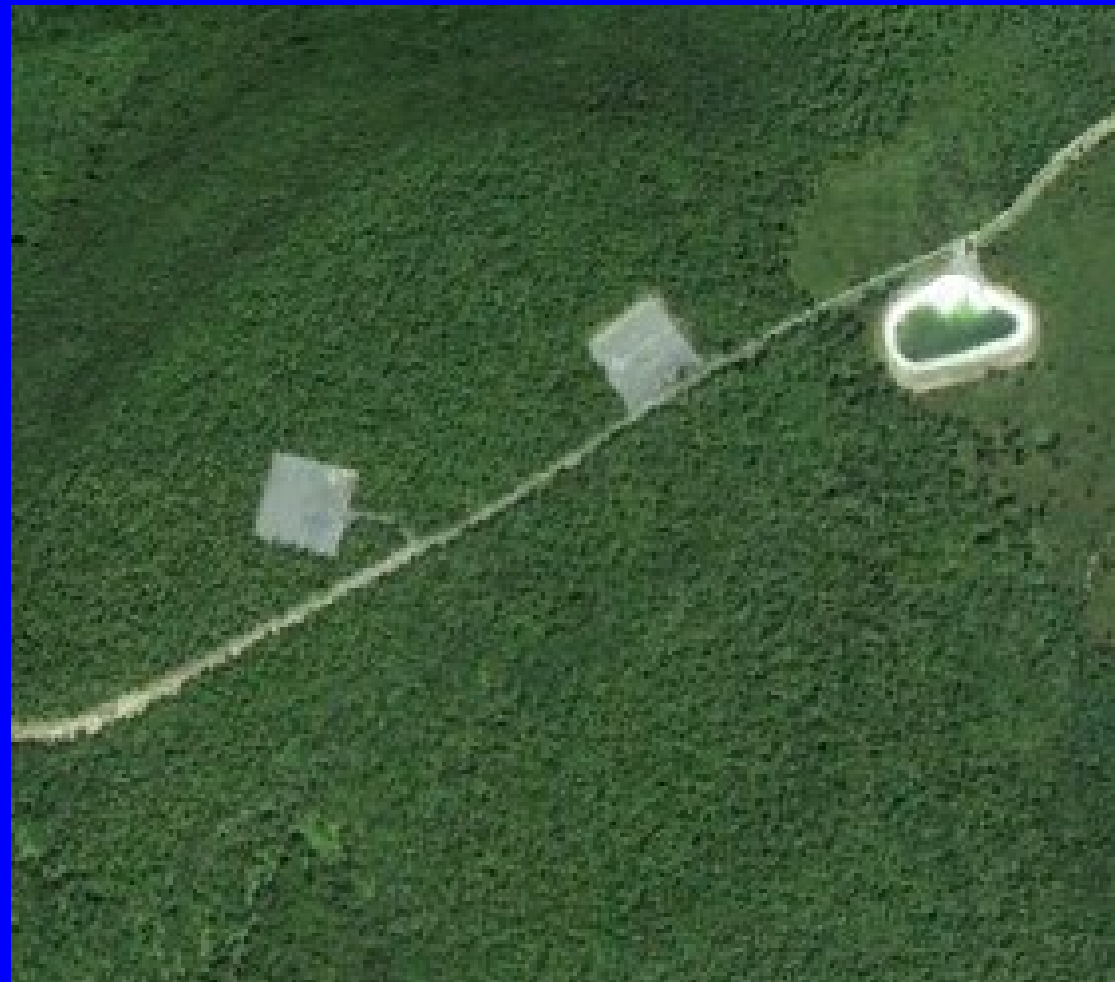


Approximately 25% of wells are going into core forest (forest > 100 m from pre-existing opening or edge) Drohan et al. 2012

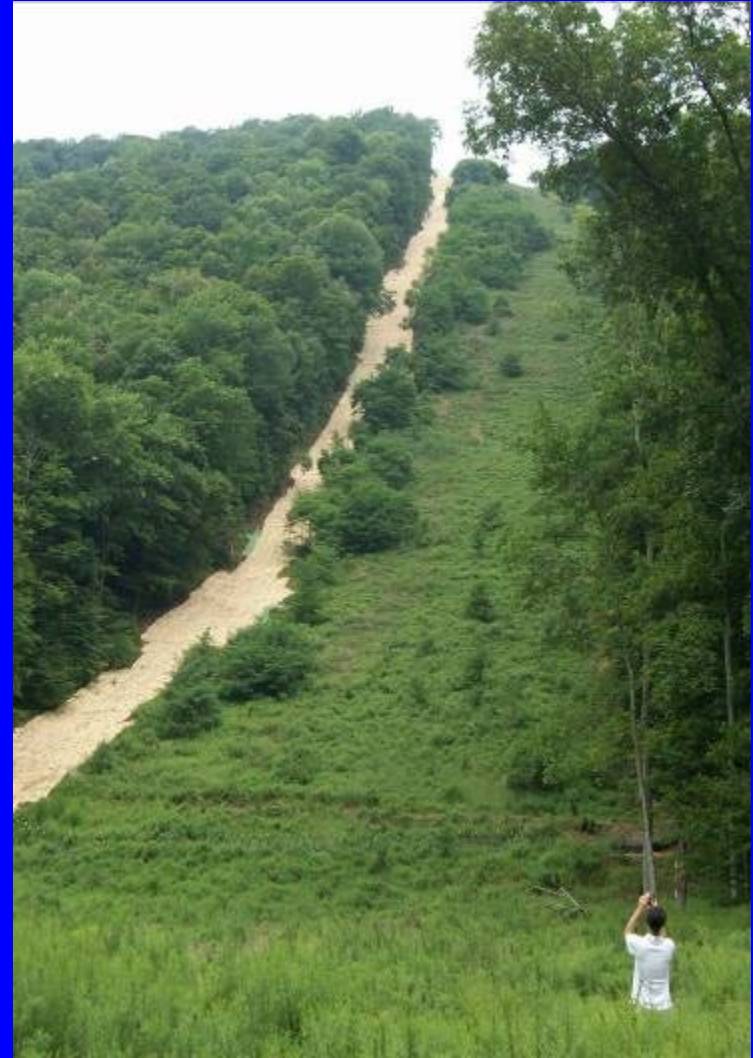
25% in core forest

25% in edge forest (< 100 m from an edge)

2% in woodlots



Pipelines and roads create linear corridors and will probably have a larger ecological effect than the pads themselves



Pipeline
Corridors may
act as
barriers to
dispersal for
some species



Spotted Salamander



And as
avenues
for invasion
for others

Brown-headed Cowbird



D. Daniels

Wolf predation on woodland caribou increased near linear corridors such as pipelines, seismic lines and roads - Alberta Canada

James and Stuart-Smith 2000



Width of seismic line influenced whether it was a boundary or part of the territory

Seismic lines 8 m wide acted as territory boundaries

Low impact (2-3 m) seismic lines were incorporated into territory

Bayne et al. 2005



Ovenbird

D. Daniels

Bradford County Gathering Lines - Johnson et al. 2011

2.65 km per pad
(1.65 miles)

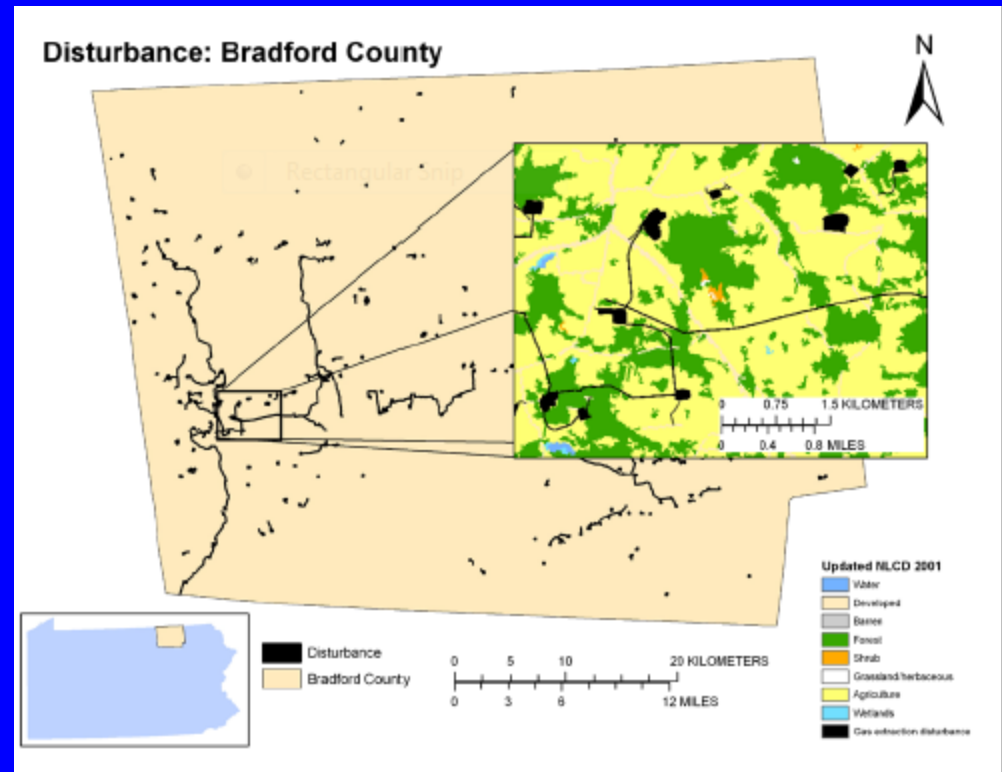
16,093-40,233 km
new gathering lines
predicted at build
out (10,000 –
25,000 miles)



Landscape consequences of natural gas extraction- Bradford County, PA

Pipeline construction is major contributor to forest loss

Loss of core forest is 2 times loss of overall forest



New and expanded roads and heavy truck traffic reduce habitat quality for most wildlife. Many studies showing effects of roads on wildlife and response of wildlife to roads including avoidance, increased mortality and altered species composition



Northrop and Wittemyer
2012 Ecology Letters gives
overview of energy related
studies

Habitat Fragmentation is a result of gas exploration and development and is a primary concern

Change in species composition and abundance (winners and losers)

Spread of invasive species

Disturbance to sensitive habitats

Negative effects on biological diversity and ecosystem functions



Species composition differed with well abundance and proximity to wells

Barton, Fronk, Brittingham - Preliminary results of ongoing work

- Forest interior species declined
- Human-associated species increased
- Early successional species showed no pattern



New pads, pipelines and roads act as corridors for Invasive Species

Barlow, Mortensen, Drohan, & Hayes (In prep)

- 60 % of surveyed pads had invasive plants
- Invasion dependent upon:
 - Regional invasive plant pressure
 - Degree of forest fragmentation
 - Type of road: gravel worse
 - Land-use history
 - Proximity to different disturbance types



Disturbance of Sensitive Habitats



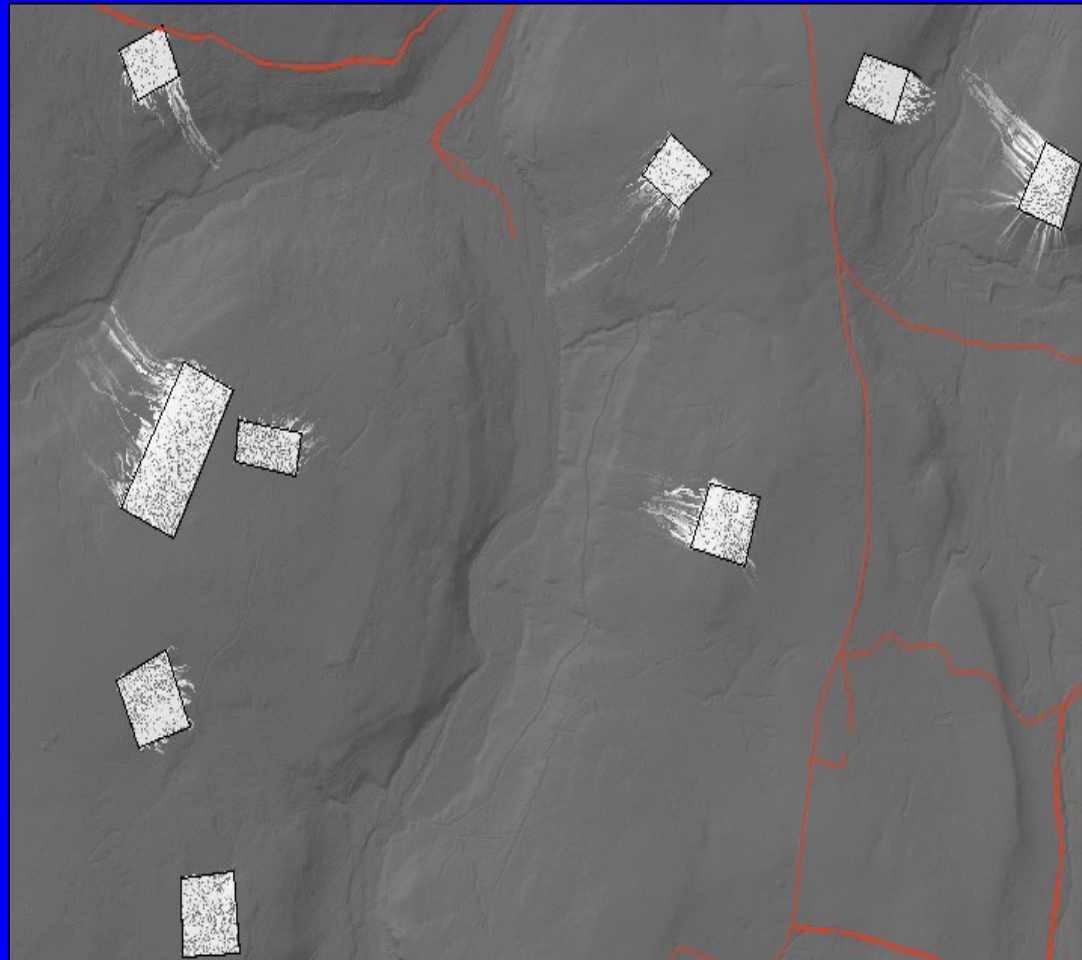
There is evidence of hydrologic capture associated with shale-gas roads and pad development resulting in some areas becoming wetter and some drier. (Drohan

Hydric soil change

Wetland hydroperiod change

Surface runoff change

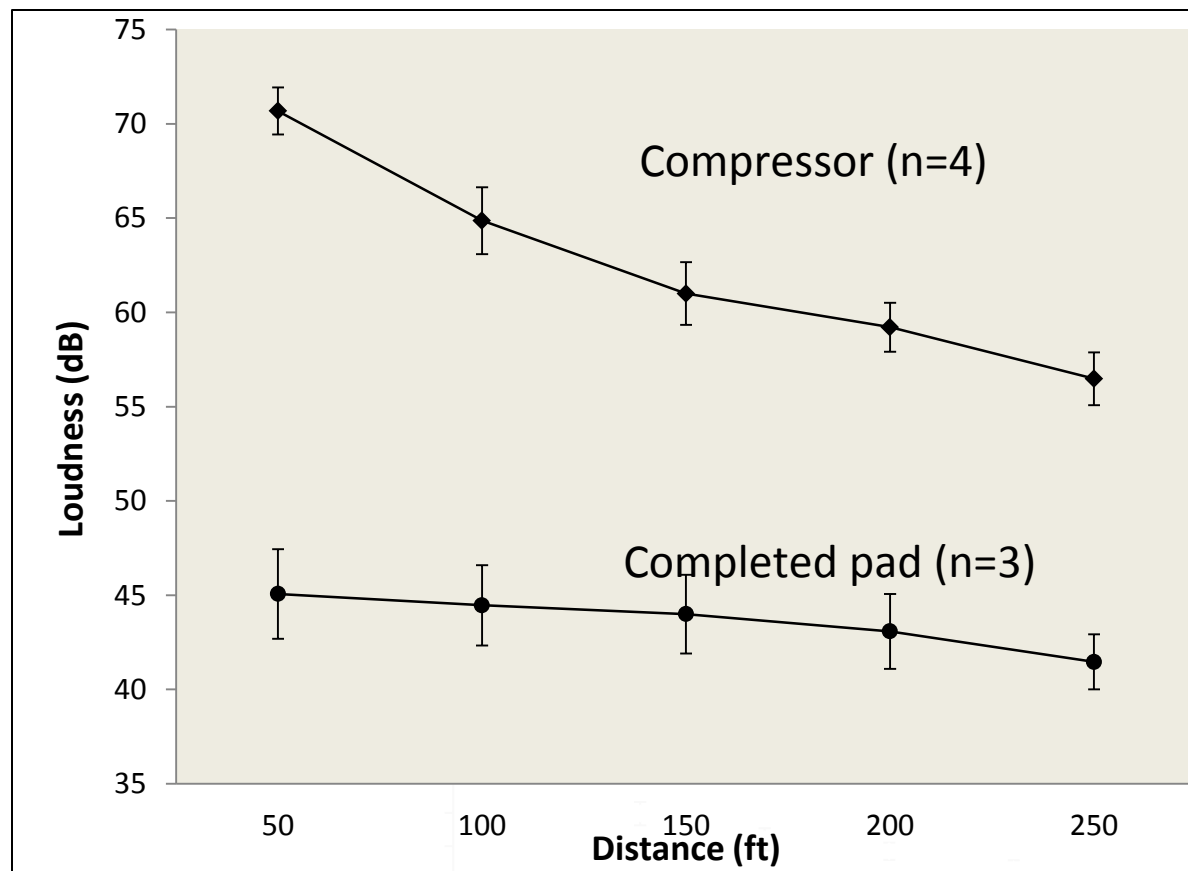
Potential change to amphibian migratory or breeding habitat



Noise and Light Pollution associated with pad development and drilling may have local site-specific impacts but probably not long-term effects



Compressors
are a long-
term source
of noise



Sound is important for communicating and noise from compressors can affect this process



D. Daniels

Songbird density declined with noise, pairing success declined with noise, young males got noisy territories (Bayne, Habib, and Boutin 2008, Habib, Bayne, and Boutin 2007)

No research on effects on amphibians

Noise from compressors has been documented to affect species richness and community structure resulting in changes in reproductive success with consequences to ecological services such as seed dispersal and pollination

(Francis et al. 2009, 2011, 2012)



Concern over effects on species with small populations or limited distributions. Many of these are target of direct management or mitigation



In Pennsylvania, 93% of pads are on private land - Drohan et al. 2012

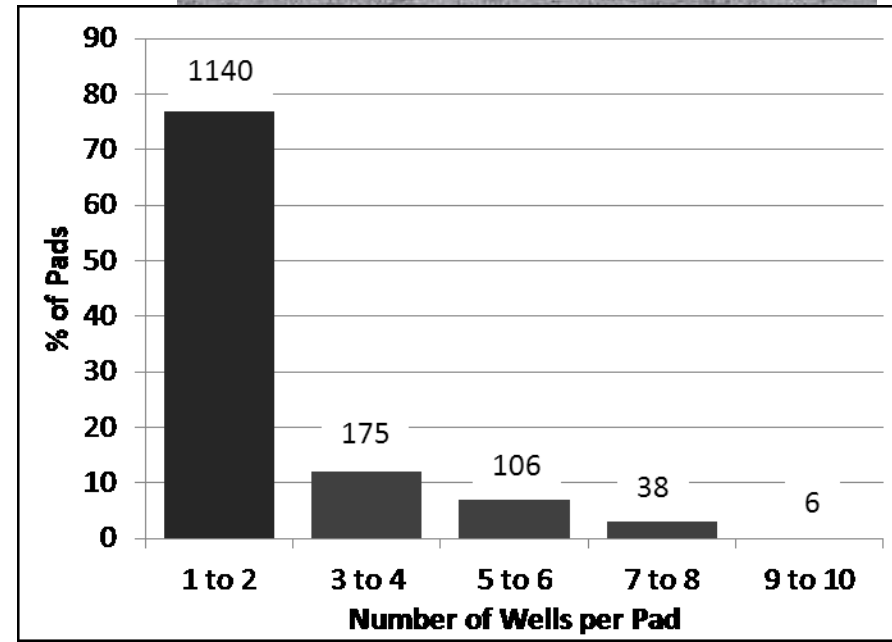
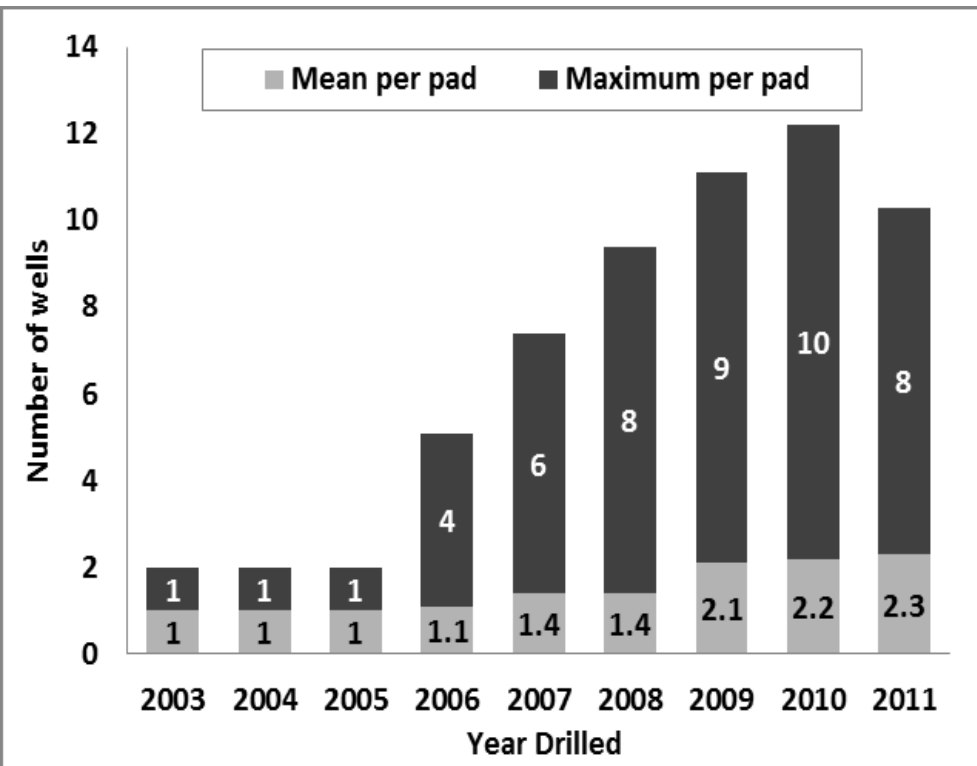
- Private landowners lack planning and management resources available on public land
- Lack of planning oversight or control
- Surface owner often is not mineral owner
- Increased risk and uncertainty



Over 75% of pads have only 1-2 wells per pad (Drohan et al. 2012)

n=2,931 wells and 1465 pads

Mean = 2.3 wells per pad



Restoration potential and timing is a big unknown

In PA, 16% of pads reclaimed, 84% not reclaimed

Most reclamation is to grass cover or clover not to shrub cover or trees



Research Needs

Thresholds of change for different species and groups of species

Mechanisms underlying species responses

Restoration methods and potential

Electronic Field Guide-<http://marcellusfieldguide.org/>

Marcellus Shale: Home - Windows Internet Explorer

http://www.marcellusfieldguide.org/

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PENNSTATE

MARCELLUS SHALE

Electronic Field Guide

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Welcome

The development of Marcellus Shale natural gas resources presents Pennsylvania's landscapes and citizens with many opportunities and challenges. This guide is meant to help in forging ahead with the best possible options for Pennsylvania's future. In this guide, you will find options for assistance in land management at all stages of infrastructure development. The guide does not take sides on the issue of Marcellus exploration and encompasses advice for all parties involved. Only by working together will we ensure that Pennsylvania's future is strong and its wildlands and wildlife are protected as best as possible.


This guide can be used in multiple ways. The guide's sections are reflective of the most frequent questions asked by landowners and managers, and gas industry employees. A reader using the guide can access information from any level using the menu on the left, or via the directory trail across the top of the page. The guide is also accessible from "Smart Phones" and similar devices.

New to the topic?


Share Experiences




How are landscapes changing?



On-site Management Practices



Restoration Questions



Penn State Cooperative Extension Penn State College Of Agricultural Sciences CEI

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