

**PENNSYLVANIA CLIMATE CHANGE ADAPTATION STRATEGY
NATURAL RESOURCES WORKING GROUP**

MAY 25, 2010 (10:00 am to 2:00 pm)

College of Forest Resources, Room 107, Penn State University, State College, PA

Attendees:

- Co-Chair Sally Just, Director, Office of Conservation Science, DCNR, sjust@state.pa.us
- Co-Chair Nels Johnson, Director of Conservation Programs, The Nature Conservancy, njohnson@tnc.org
- Doug Austen, DCNR, dougausten@state.pa.us
- Dave Day, PFBC, davday@state.pa.us
- Jim Apgar, USFS – Allegheny NF, japgar@fs.fed.us
- Doug Wolfgang, PA Dept of Ag, dowolfgang@state.pa.us
- Robert Witmer, DCNR-BOF, rowitmer@state.pa.us
- Mary Ann Furedi, WPC, mfuredi@paconserve.org
- Greg Czarnecki, WRCP, gczarnecki@state.pa.us
- Kim Hoover, DEP, khoover@state.pa.us
- Paul Roth, DCNR, paroth@state.pa.us
- Jack Williams, PA Trout Unlimited, jwilliams@clarion.edu
- Ashley Walter, PA Dept of Ag, aswalter@state.pa.us
- Paul Lyskava, PA Forest Products Association, plyskava@paforestproducts.org
- Kathy Patnode, USFWS, Kathleen_patnode@fws.gov
- Tyler Wagner, USGS, txw19@psu.edu
- Duane Diefenbach, USGS, ddiefenbach@psu.edu
- Thomas Hall, DCNR-BOF, Forest Pest Management, thall@state.pa.us
- Diane Husic, Moravian College, dhusic@moravian.edu
- Stephanie Livelsberger, DCNR-BSP, slivelsberger@state.pa.us
- Jim Thorne, NLT, jthorne@natlands.org
- Tamara Gagnolet, TNC, tgagnolet@tnc.org
- Erica Smithwick, PSU/Geography, smithwick@psu.edu

OVERVIEW OF PENNSYLVANIA CLIMATE CHANGE ADAPTATION PROCESS – Sally Just, DCNR

Statewide Adaptation Process, part of the PA Climate Change Action Plan

- Two co-chairs for four working groups
 1. Natural Resources
 2. Public Health and Safety
 3. Infrastructure
 4. Tourism and Outdoor Recreation
- Workgroups will engage in meetings to address the following issues:
 1. Key areas for vulnerability and risk
 2. Practical actions for immediate and strategic implementation
 3. Current efforts underway
 4. Missing information
 5. Opportunities for collaboration

March 2011 – completion of workgroups' findings and presentation

OVERVIEW OF CLIMATE CHANGE IMPACTS ON PENNSYLVANIA NATURAL RESOURCES – Erica Smithwick, Geography Department, Penn State University

Adaptation = “adjustment in natural or human systems to a new or changing environment that exploits beneficial opportunities or moderates negative effects”

Involves: projection of potential impacts from science, scale of impacts and response

Includes: building adaptive capacity; transforming capacity into action

Building adaptive capacity

- Communicating climate change info
- Building awareness of potential impacts
- Maintaining well-being
- Protecting property and land
- Exploiting new opportunities

Adapting to the impacts of climate change

1. Identify current and future climate changes relevant to the system
2. Assess vulnerability and risk to system
3. Develop adaptation strategy using risk-based prioritization schemes
4. Identify opportunities for co-benefits and synergies across sectors
5. Implement adaptation options
6. Monitor and re-evaluate implemented adaptation options

Climate projections

Model agreement for precipitation

Annual predictions – most models agree that there will be increase in precipitation in PA

Less agreement in PA for growing season

Fewer snow-covered days per month

More sure about temp increases than precipitation increases

It is likely that PA’s precipitation will become more extreme, with longer dry periods & greater precip intensity

Summary:

- Getting warmer (0.65 to 0.75 C per decade) especially in winter
- Increase in growing season (1 week); decrease in frost
- Increase in annual precipitation and heavy rain events (9.5mm) but droughts too

Vulnerabilities and risks

- Species composition and ranges
- Disturbance regimes
- Growth rates and phenology
- Insect/disease dynamics
- Hydrology and earlier peak discharge
- Interactive factors: fragmentation, invasive species, nitrogen deposition

Climate niche space is changing and may exclude some species in the future

Novel climate envelopes – we don’t know what species will be there

Evidence of latitudinal and upslope migrations:

Latitudinal migrations – mean latitude of seedlings is farther north than mature trees

Upslope migration

Shifts in biomes: Pennsylvania is the ecotone boundary in the predicted shifts

Shifts in forest types: maple/beech/birch moving north and getting replaced by oak species and some pine species moving in

Adaptation strategies

- Resistance
- Resilience
- Facilitation

Conservation Actions

- “coarse-filter” approach
 - o Expand reserves that lack adequate environmental heterogeneity
- Focus on future desired forest functions, rather than species
- Prioritize climate refuges; buffer small reserves
- Maintain high biodiversity to promote resiliency
- Manage forests for multi-species, multi-ages
- Genetic diversity

Conservation Networks

- Link to climate-proof networks – link isolated habitat that is within new suitable climate zone to the nearest climate-proof network
- Increase colonizing capacity
- Optimize sustainable networks in climate refugia

Restoration

- Mitigation (increase carbon storage)
- Build resiliency
- To what?
 - o Historic ranges of variability still relevant?
 - o Focus on function/service/natural capital?
 - o Manage for future species/functions?

Success must include assessment of effectiveness, efficiency, equity, legitimacy

- Recognize heterogeneity in capacity, benefits, objectives
- Ensure actions do not adversely affect others (minimize negative downstream effects)
- Be careful not to amplify conflicts

Scale-specific criteria

- International/national/state/county/household
 - o Implement and evaluate at relevant scale
- Cross-scale interactions

Q & A for Erica:

- How does nitrogen deposition play into climate change impacts?
- Do you think it's more likely that resilience approach will work best at landscape scale? We've already tried the resistance approach without much success

- Need to consider soil ecology as well as what is happening at surface; also need to look at insects and disease and how those adapt more rapidly to climate change
- Climate change is just one stress to consider in landscape management; how do we decide where to focus our energies? Resource allocation issue – how to inform managers? Erica’s response: prioritization of our efforts is key. Focus on areas with compound interactions - where you have a land use interacting with strong climate change effect. Trouble to get human decisions into climate change modeling – ecologists/climatologists need to collaborate with social scientists

PRIORITY RISKS AND VULNERABILITIES – Sub-Groups

Participants at the May 25 workshop formed sub-groups for **forests**, **freshwater**, **agriculture**, and **wildlife/plants**. Each subgroup developed a list of important risks and vulnerabilities for their natural resource area (see Attachment 1 for a complete list from each sub-group). The sub-groups then selected several **priority risks/vulnerabilities**, as summarized below.

FORESTS

- Interactions of ecological stressors - invasive species, wind and ice damage, altered fire regime, etc.
- Disease/pest outbreaks - new pathogens and pests, more severe outbreaks of existing pests and pathogens
- Connectivity - isolation of forest blocks and patches that prevents species movement between habitats

FRESHWATER

- Thermal change to aquatic systems – loss of cold water and trout habitat
- Altered hydrology – flashier system and increased erosion (streams)
- Riparian corridor condition – forest composition changes driven by stressors exacerbated by climate change such as invasive species
- Groundwater (springs)recharge - reductions due to flashier rainfall and drought that could:
 - o Impact stream flow on many groundwater influenced systems
 - o Confounded by human water withdrawal that will exacerbate groundwater loss
- Flow changes that affect life cycle of inverts, fish, etc.
 - o ex: emergences of inverts and fish feeding, spawning, nest integrity, juvenile rearing

AGRICULTURE

- Increased need for water – heat stress increases water demand for crops and livestock
- Changes in agricultural production – both type and level
 - o Ex: decrease in dairy; increase in hog/livestock farming; longer growing season
- Pest / invasive species management
 - o Herbicides and pesticides needed to manage – what other effects will those have?

WILDLIFE/PLANTS

- Species/ habitat vulnerability – declining viability of species and habitats as climate and stressors change
- Community composition – shift in habitat composition affects viability of rare species

- Food chain disruption – shift in climate conditions, and related shifts in habitat composition, plant phenology, and stressors, lead to unpredictable changes in food availability
- Native species displaced by exotic species – native species, which are often habitat specialists and sensitive to changes in climate and habitat conditions, are replaced by non-native species, which are typically habitat generalists adapted to a wider range of climate and habitat conditions
- Genetic diversity – genetic diversity narrows as marginal populations are extirpated.

The entire group then reviewed the sub-group risk and vulnerability lists and identified those that were common to several of the sub-groups. These will be reviewed at the next Natural Resources Working Group meeting in August.

CROSS-CUTTING

- Shifts in habitat or agricultural species composition that change function and value
- Interactions of disturbances (e.g. fire, storms, pests, pathogens)
- Interactions of stressors (e.g. pest, pathogens, drought, floods)
- Movement / connectivity
- Hydrologic alterations
- Genetic diversity

PRIORITIZATION CRITERIA - Nels Johnson, The Nature Conservancy

The full Natural Resources Working Group discussed criteria that could be used to prioritize strategies and actions, which will be the focus of the next working group meeting in August.

- From our list of priorities, what actions will move us the furthest in the short term? Versus things that will take a long time and require a lot of resources
- We need to make sure that the final report states things in very easy terms that the general public can understand. We also need to keep in mind that some terms (e.g. movement, connectivity) can mean different things to different people, so we need to be specific in our wording.
- efficiency / cost-benefit – greatest benefit for resources expended
- tractable (logistics, \$\$, existing data)
 - o practicality
 - o co-benefits
 - o synergy with public thought – greater connection with people – broad understanding
 - find a way to communicate with public and gain support
 - use examples of things that are important to people (ex: cold water fisheries, dairy vs. livestock farming)
 - o utilize existing datasets identifying critical / at-risk areas (ex: high elevation bogs),
 - o building on existing capacity
 - o protect existing capacity (minimize losses – hold on to what you have before it's gone)
- temporal criteria
 - o immediate investment for long-term benefit
 - o current impacts (immediacy) – adaptation for extreme events
 - o immediate actions to mitigate changes

- broader scale than Pennsylvania (ex: anticipate issues that are likely to arrive in Pennsylvania) – proactive management
- spatial criteria
- need to match space and time dimensions in a particular location
- culturally and historically significant species, etc.
- economic impact of vulnerability/risk (ex: loss from pests/pathogens)
- realize that we can only save some things – let the losers go and focus on the winners

Risks and Vulnerabilities Identified by Each Sub-Group

FORESTS

Priorities:

- Interactions of stressors
- Disease/pest outbreaks
- Connectivity

Full List:

- Invasive species (3 dots)
- Old growth forests
- Large log products
- Connectivity (4 dots)
- Black cherry
- Wetlands
- Disease/pest outbreaks (5 dots)
- Forest soils (2 dots)
- Natural/suitable regenerations
- Fire
- Drought
- Effects of ozone
- Interactions of stressors (6 dots)
- Calcium deficiencies
- Nitrogen deposition
- Large woody debris
- Carbon sequestration
- Leading/trailing edges of range (2 dots)
- Early/late frosts
- Extreme weather events (1 dot)
- Unfragmented reserves (1 dot)
- Economic decision making of land owners (3 dots)
- Interaction w/ land use legacies (1 dot)
- Migration of species – southern and western
- Deforestation
 - o Development
 - o Biofuels
 - o Agriculture
 - o Alternative energy
- Fiber versus food land uses
- Temporal response capacity (2 dots)
- Public buy-in (2 dots)
- \$ to respond (2 dots)
- Loss of coppice regenerated forests
- Recreational opportunities (1 dot)
- Marcellus Shale
- Loss of/changing services
- Changing inputs for urban forests → cost of management
- Communication of values of forests
- Meaning of native?
- Increased urban wild space
- Genetics research
- Adapting to changing market forces
- Local control of forests

FRESHWATER

Priorities:

- Thermal change to aquatic systems – loss of cold water and trout habitat
- Altered hydrology – flashier system and increased erosion (streams)
- Forest composition changes affect health of riparian corridors
- Groundwater (springs) – recharge reduced due to flashier rainfall and drought
 - o Impact stream flow on many groundwater influenced systems
 - o Confounded by human water withdrawal that will exacerbate groundwater loss
- Flow impacts on life cycle of inverts, fish, etc.
 - o ex: emergences of inverts and fish feeding, spawning, nest integrity, juvenile rearing

Others:

- Impact on lake temps, stratification and loss or change of lake habitat
- Change in wetland temporal cycle coupled with life=cycle of animals may be interrupted/alterd
- Changed fauna – loss of coldwater species – possible increase in cool and warm water
- Invasive species and disease
- Nutrient input altered due to increased erosion and soil loss
- Temperature changes on phenology of birds, insect hatches / emergence
- Large scale ocean changes will impact anadromous /catadromous species – shad, striped bass, eel

AGRICULTURE

Priorities:

- Increased need for water
- Changes in agricultural production – both type and level
 - o Ex: decrease in dairy; increase in hog; longer growing season
- Pest / invasive management
 - o Herbicides and pesticides needed to manage – what other effects will those have?

Original list:

- Drought/adaptation
- Invasives
- Pests (increased/new)
- Pest control
- Economics
- Intensive livestock
- Land use change (ag → ag)
- Methane emissions
- Increased nutrients/runoff
- Best management practices
- Soil carbon management

WILDLIFE/PLANTS

Priorities:

- Species / habitat vulnerability
- Community composition
- Food chain perturbation
- Native (extinction)→ Exotic
- Genetic diversity

Others:

- Diseases
- Insect pests
- Species biodiversity
- Migration / re-establishment
- Life history
 - o Specialists
 - o Habitat requirements
- Physiology
- Soil health
- Ranges
 - o Narrow
 - o Extent
 - o Distribution
- Urbanization – climate interaction
- Wetland loss
- Lack of fire adaptation