NETN Freshwater Wetland Monitoring, QC, and Minimum Detectable Differences

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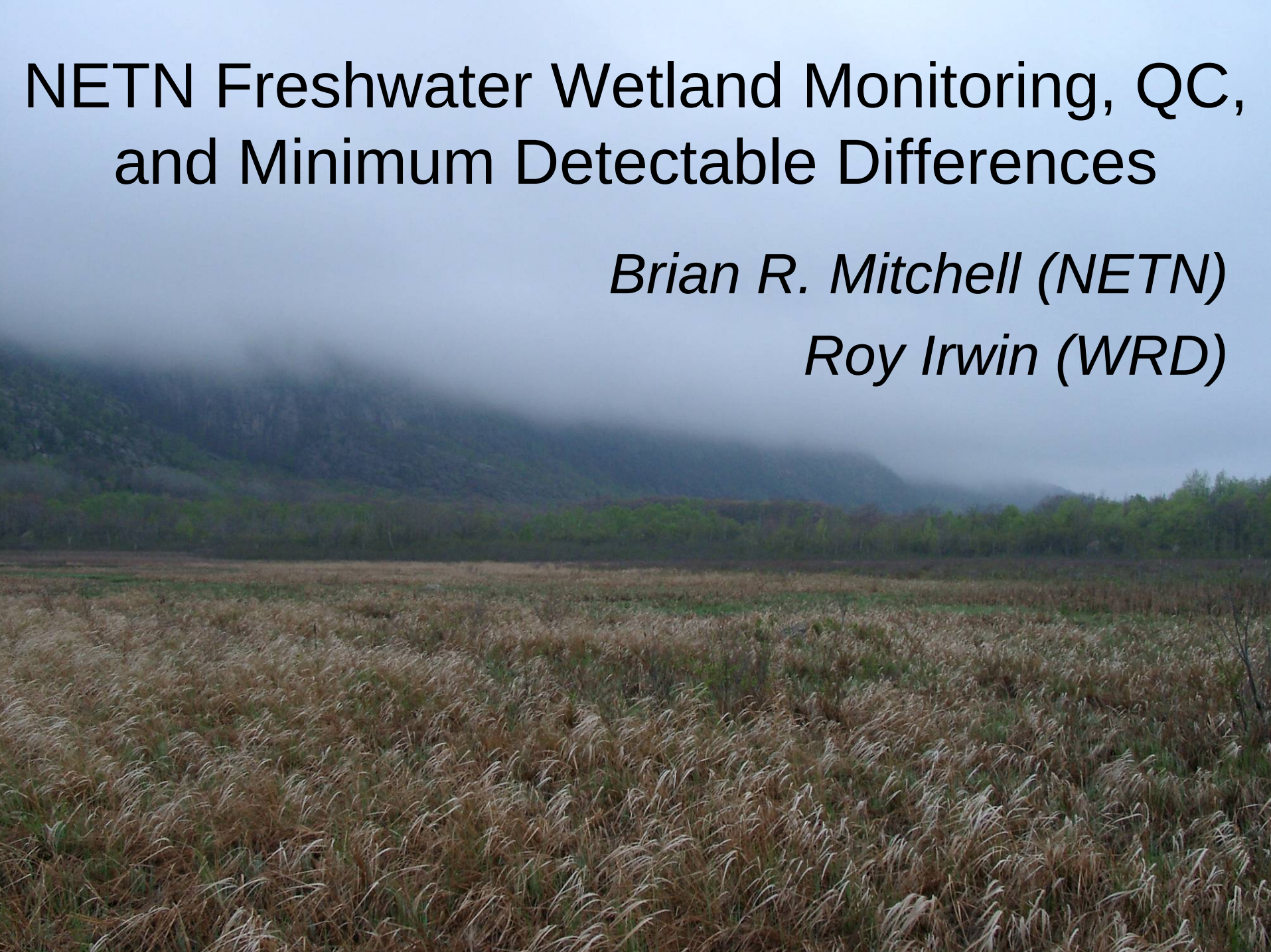
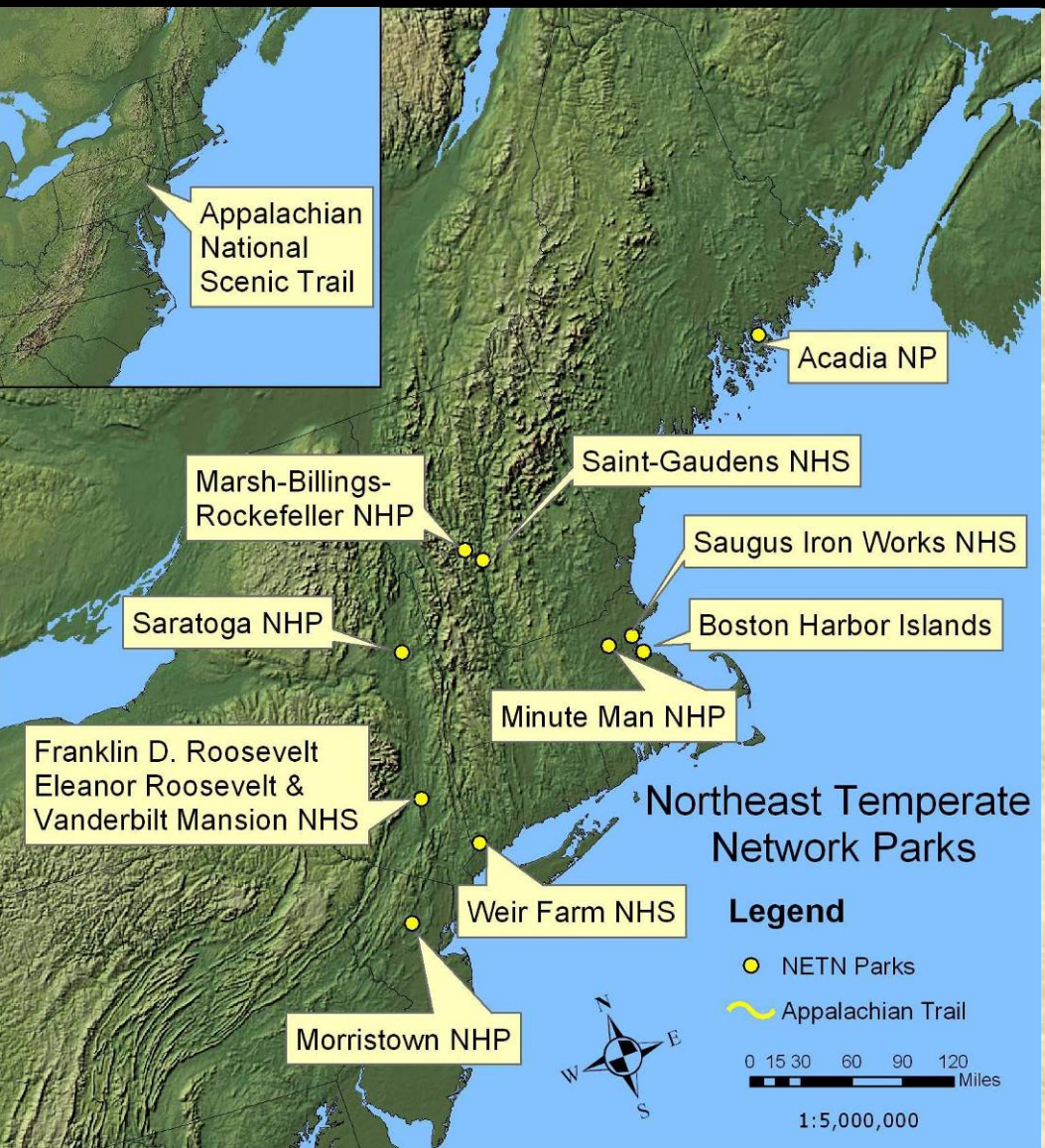


Inventory & Monitoring Program
Northeast Temperate Network



Northeast Temperate Network

Vital Signs Monitoring Plan

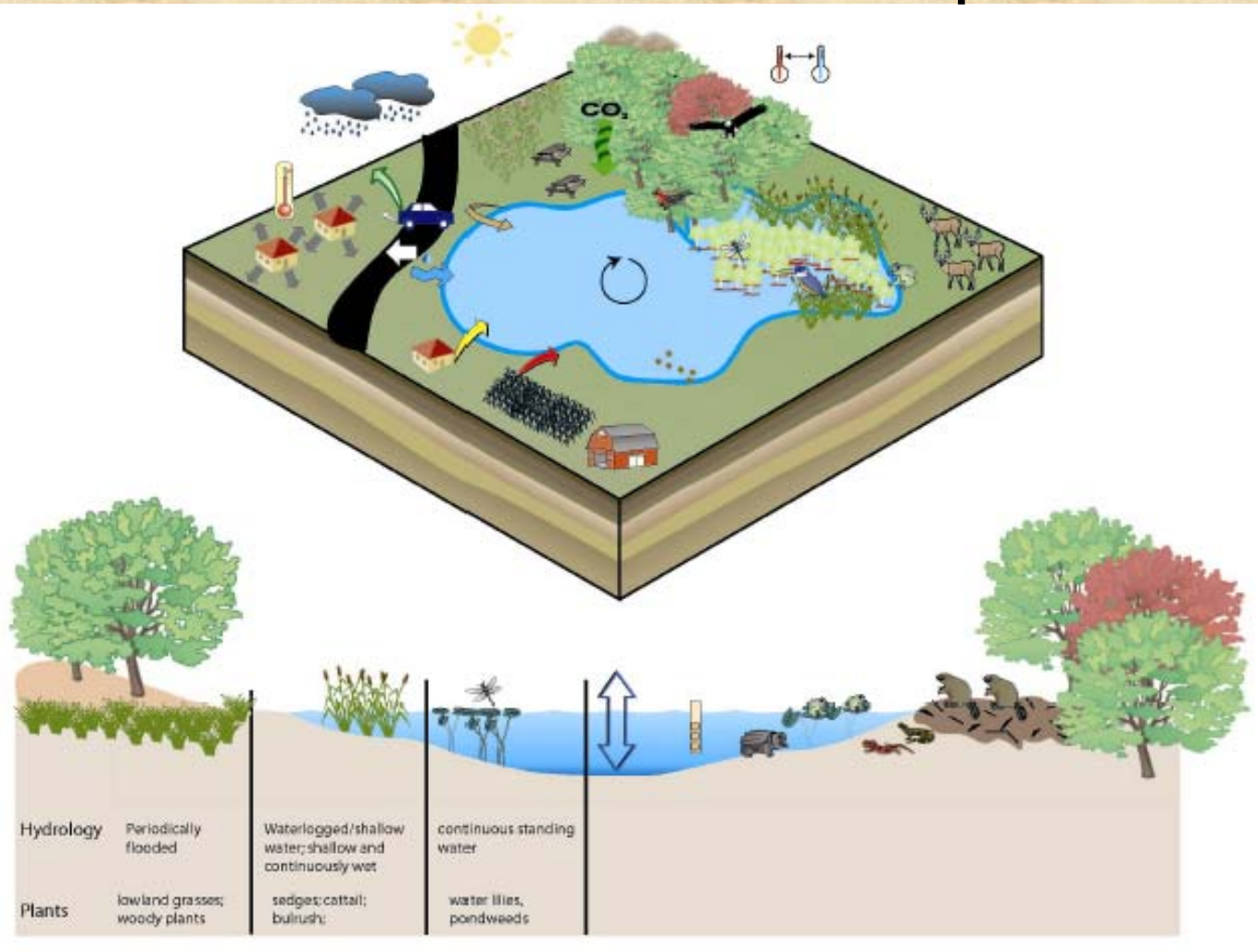
Protocols:

- Forest Health
- Lakes and Streams
- Forest/Grassland Birds
- Wetlands
- Rocky Intertidal
- Coastal Birds

Inventory & Monitoring Program
Northeast Temperate Network

Park	Wetland Acres	Number Emergent	Number Forested
Acadia	2,590	299	84
Boston Harbor Islands	31	--	--
Marsh-Billings-Rockefeller	5	0	4
Minute Man	200	15	24
Morristown	22	0	8
Roosevelt-Vanderbilt	72	21	18
Saint-Gaudens	18	1	1
Saugus Iron Works	5	1	0
Saratoga	175	29	20
Weir Farm	3	4	3

Wetland Conceptual Model



Documents current understanding

Identifies important characteristics, processes, and stresses

Facilitates metric selection

Approaches to Wetland Monitoring

Extensive (NatureServe)

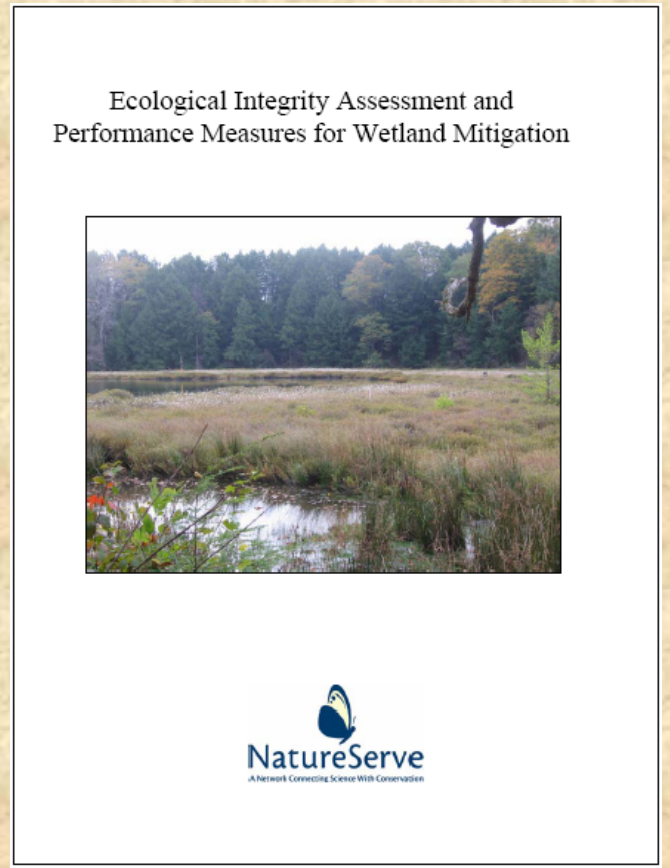
- Rapid assessment
- Semi-quantitative or qualitative metrics
- Many wetland types
- CRAM, ORAM, EPA, and NatureServe

Approaches to Wetland Monitoring

Intensive (USGS)

- More time per wetland
- Quantitative metrics
- Single wetland type
- Based on USGS research at ACAD

Extensive Wetland Program



EPA Wetland Assessment Project

- Faber-Langendoen et al., 2006
- http://www.cnhp.colostate.edu/reports.html
- Ecological integrity assessments for a variety of systems

Address gap in NETN intensive program

- Expand beyond emergent wetlands
- Develop metrics and thresholds for assessing ecological integrity

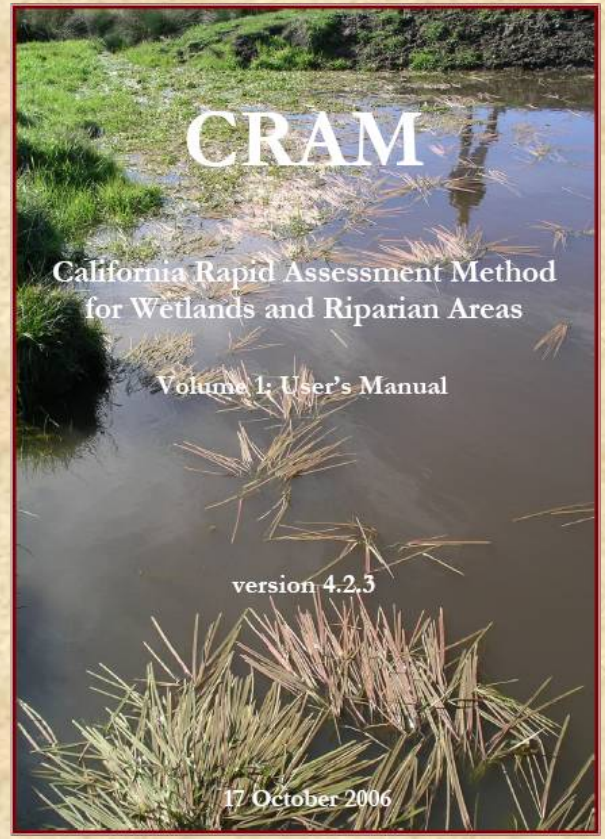
Extensive Wetland Program

Sampling Design

- Spatial
  - ACAD: Census or random sample
  - Other parks: Census
  - Exclude: Low quality and no management interest
- Temporal
  - 5 to 10 year rotation

Extensive Wetland Program

Metric Selection



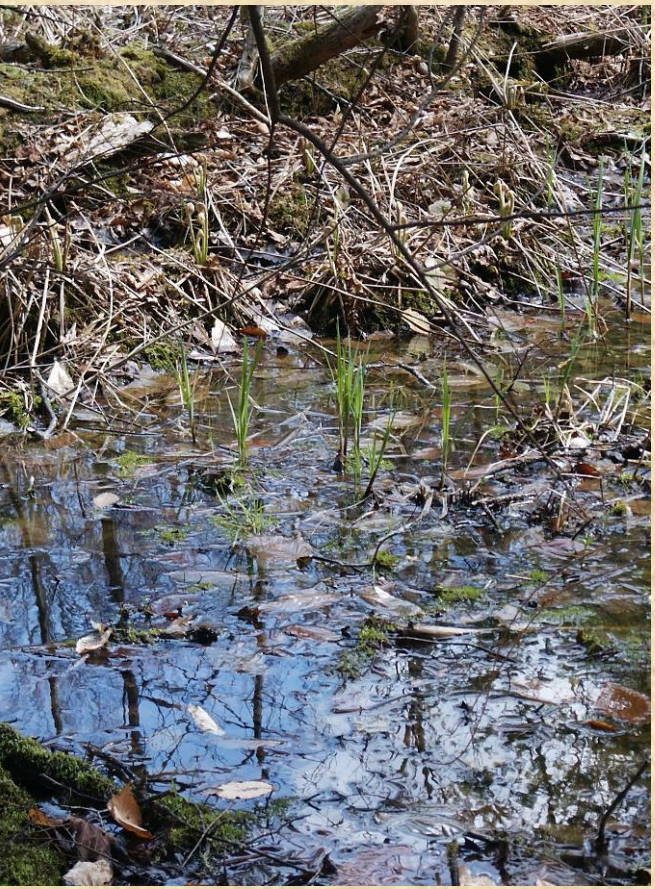
- Ecological Relevance
  - Landscape Context (e.g., connectivity)
  - Biota (e.g., vegetation structure)
  - Hydrology (e.g., hydroperiod)
  - Physico-chemical (e.g., soil disturbance)
- Feasibility
- Response Variability

Extensive Wetland Program

Quality assurance and control (QA/QC) options

- Detailed SOPs
- Thorough training
- Duplicate assessments (5% to 10%)
- Power analyses for more quantitative metrics
- Overlap with intensive sites for metric calibration

Intensive Wetland Program



ACAD wetlands project

- USGS (Neckles and Guntenspergen)
- Focus on anthropogenic stressors
- Emergent to forested wetlands
- Identify indicators of wetland function

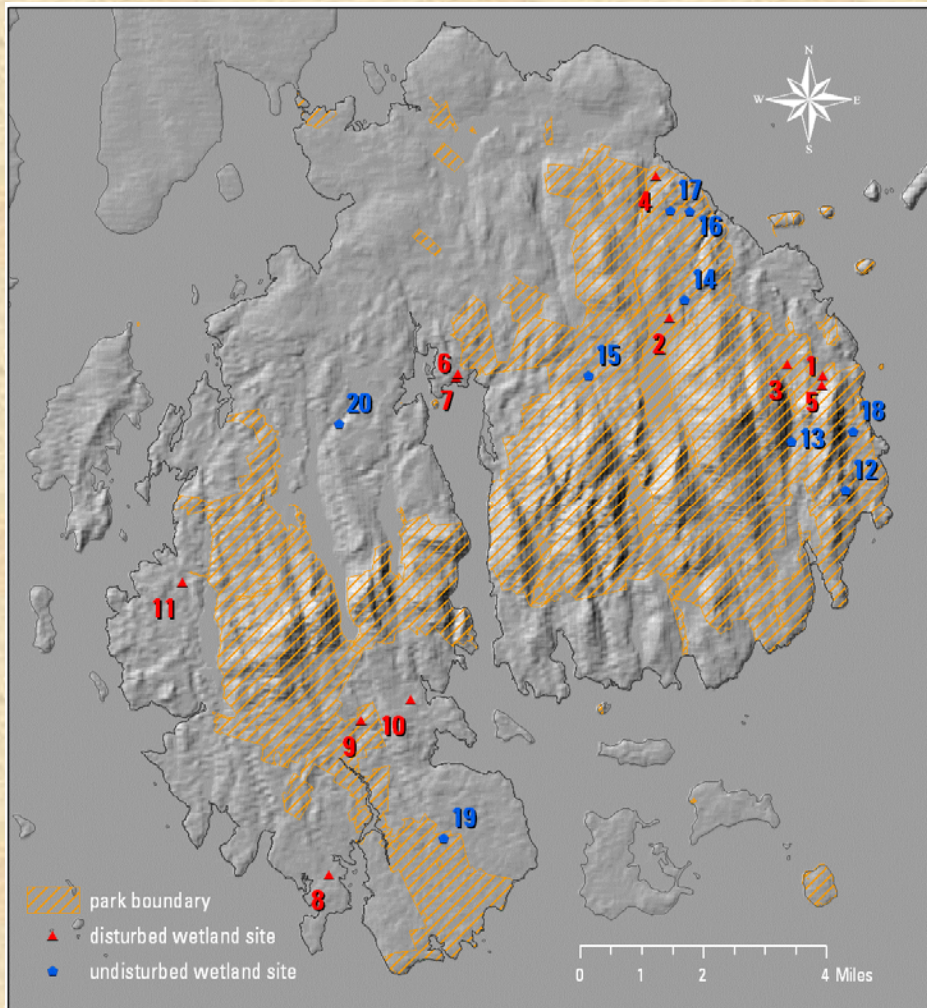
NETN protocol

- USGS was asked to extend scope to entire network

Intensive Wetland Program

Pilot Study Design

- 2000 – 2001
- 20 emergent wetlands
  - 11 disturbed
  - 9 undisturbed
- Weekly to alternate week sampling for most metrics
- Nutrients sampled twice per season



Intensive Wetland Program

Pilot Study Metrics

- Water chemistry (e.g., conductivity, pH)
- Nutrients (e.g., ammonia, phosphate)
- Vegetation species (species richness)
- Hydrology (e.g., groundwater depth)

Intensive Wetland Program

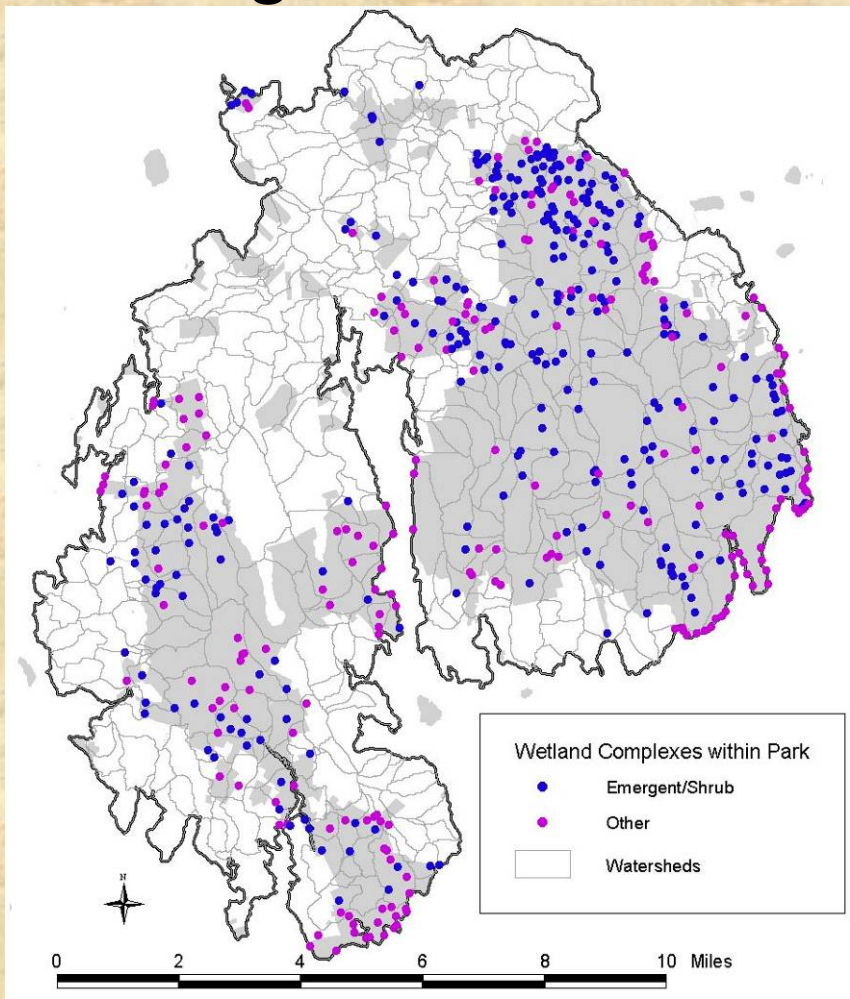
Pilot Study Results

- Subset of metrics was distinct between disturbed and undisturbed emergent wetlands
  - GW and SW specific conductance and pH
  - Species richness
  - Tested metrics in follow-up study (8 sites)
- Follow-up study in deciduous forested wetlands
  - 16 wetlands (8 disturbed, 8 undisturbed)
  - None of the metrics were distinct

Intensive Wetland Program

Sampling Design (ACAD)

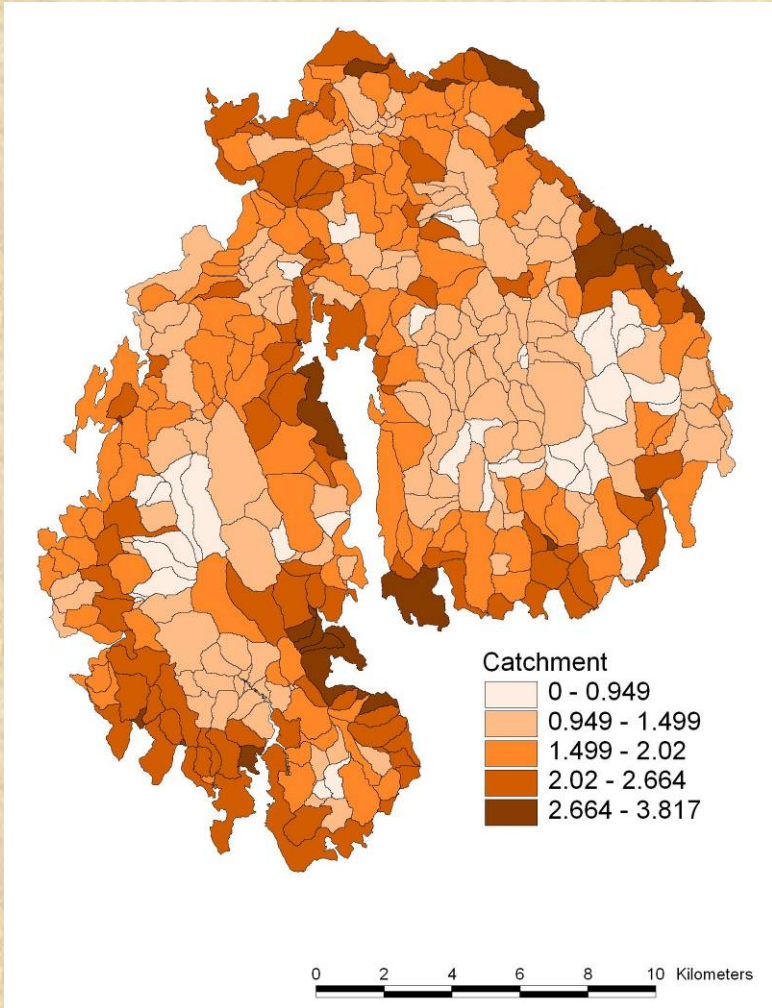
- Target Population
  - Herbaceous emergent wetlands
    - < 50% sphagnum
    - < 25% low shrub
  - Geographically limited to main portion of Acadia (Mount Desert Island)



Intensive Wetland Program

Sampling Design (ACAD)

- Spatial
  - Stratified by geography (E / W)
  - Stratified by stressor gradient
    - Based on % ag, % urban, pop density, road density, and % impervious for accumulated catchment
  - Random selection of wetlands within 6 strata



Intensive Wetland Program

Strata & geographic distribution		1	2	3	4
	n	***24***	***24***	***24***	***24***
Ref: 3 east/1 west Undist: 3 east/1 west Dist: 3 east/1 west	***12***	X	X	X	X
Ref: 3 east/1 west Undist: 3 east/1 west Dist: 3 east/1 west	***12***	X			
Ref: 3 east/1 west Undist: 4 east/0 west Dist: 2 east/2 west	***12***		X		
Ref: 3 east/1 west Undist: 3 east/1 west Dist: 3 east/1 west	***12***			X	
Ref: 3 east/1 west Undist: 4 east/0 west Dist: 2 east/2 west	***12***				X

Sampling Design (ACAD)

- Temporal
  - 60 total wetlands
  - 24 per year
  - 12 every year
  - 48 on 4 year rotation

Intensive Wetland Program

Metrics

- Ground and surface water specific conductivity, pH, and water level
  - 3 wells per wetland
  - May, July, and September
- Plant species richness
  - August / September

Intensive Wetland Program – QA/QC

Quality Assurance and Control (QA/QC)

- Documentation, training, and calibration
- Quality control samples to document quality objectives

Indicator	Measurement increment	Accuracy goal	Precision goal	Completeness goal
Groundwater level	1 mm	±5 mm	±5 mm	90%
Surface water level	1 mm	NA	±5 mm	100%
Conductivity ≤100 µs/cm >100 µs/cm	1 µs/cm	 ±5% ±3%	 ±5% ±3%	90%
Temperature	0.1 °C	±0.3°C	±0.3°C	90%
pH	0.01 pH unit	±0.1 pH units	±0.1 pH units	90%
Vegetation	observation	NA	±5%	100%

Intensive Wetland Program – QA/QC

Groundwater level

- Calibrate with reference well before each round of field work
- Triplicate GW measurements every 10th well

Surface water level

- Duplicate measurement every 3rd or 4th site

Intensive Wetland Program – QA/QC

Conductivity, temperature, and pH

- Calibrate against reference standards before each round
- Triplicate measurements every 2nd site (cond and temp) or 10th sample (pH)

Vegetation

- Use only skilled botanists
- Maintain reference collection
- Concurrent or replicate sampling at 10% of sites

Intensive Wetland Program – MDDs

Minimum detectable differences

- What is the minimum difference between two sampling intervals that can be detected in 12, 24 or 60 wetlands, with a power of 0.8 and a 0.05 chance of a Type I error?
- Calculator at http://www.statsalive.com/resources.html

Metric	Mean	SD/Mean (CV)	MDD 12 - / +	MDD 24 - / +	MDD 60 - / +
GW Conductivity	303	0.32	34% / 51%	24% / 32%	16% / 19%
GW pH	5.73	0.03	4% / 4%	3% / 3%	2% / 2%
SW Conductivity	186	0.28	30% / 43%	22% / 27%	14% / 16%
SW pH	5.62	0.03	4% / 4%	3% / 3%	2% / 2%
Sphagnum cover	0.18	0.46	46% / 84%	33% / 49%	22% / 28%