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Reference Site Selection for the National Wetland Condition Assessment:
Integrating Best Professional Judgment and Objective Selection Criteria

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What is Reference?

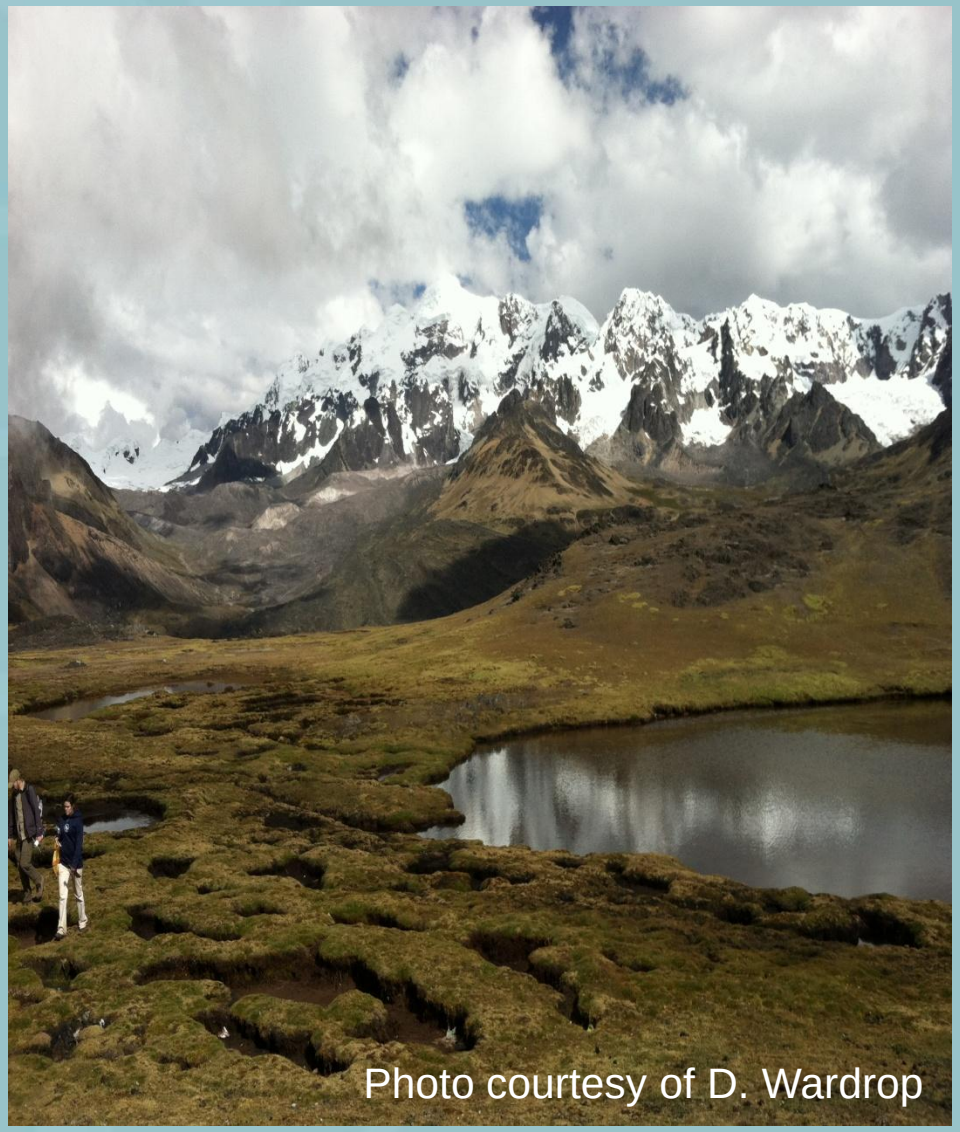
Minimally Disturbed Condition – site condition in the absence of significant human disturbance (e.g., "natural," "pristine" or "undisturbed")

Least Disturbed Condition – found in conjunction with the best available physical, chemical and biological habitat conditions given today's state of the landscape – defined by a set of explicit criteria to which all reference sites must adhere

SEE: Stoddard, J. L., D. P. Larsen, C. P. Hawkins, P. K. Johnson, and R. H. Norris. 2006. Setting expectations for the ecological condition of streams: the concept of reference condition. Ecological Applications **16:1267-1276.**

Reference Sites Used To:

- Define condition categories
- Develop condition indices
- Develop predictive models



Goal of Reference Approach

Improve reference site selection by developing a quantitative process for the National Aquatic Resource Surveys (NARS)

In past surveys, selection of reference sites by BPJ has not been efficient (a high percentage of them have turned out to be non-reference)

Example: 60% of 142 BPJ reference sites sampled in National Wadeable Stream survey were not used as reference in analysis after post-sampling screening

NWCA Reference Sites:

Assumptions:

- Reference Sites represent examples of the least disturbed ecological condition and the associated functional capacity of wetland types in a particular setting (e.g., ecoregion)
- NWCA protocols adequately capture the natural range of variability in wetland condition
- Wetlands in relatively undisturbed condition provide a frame of reference against which to compare assessment results

Sources of Reference Sites

1. Recommended (BPJ) sites
2. Selected from sampled sites

NWCA Candidate Reference Sites:

- BPJ candidate sites were provided to EPA by:
  - States
  - National Estuarine Research Reserve System
  - National Park Service
  - U.S. FWS National Wildlife Refuge System
  - U.S. Forest Service
- 1,141 candidate sites were screened/evaluated

150 candidate sites passed the screens AND provided the required number of sites for NWCA wetland types per ecoregion

Candidate Reference Sites Screening Process:

Step 1: Basic Screen

- Is the wetland type part of the NWCA target population?
- Is the Assessment Area "sample-able" (i.e., <10% of the area contains water >1 m deep, has standing water or soft substrate that is unsafe or impossible to sample effectively, and/or is upland)?
- Is the site accessible (within 10-km of a road or trail)?
- Is the site greater than 1-km away from a probability survey site?

Candidate Reference Sites Screening Process:

Step 2: Landscape Screen

GIS landcover data and aerial photos of the 1-km buffer around candidate sites are evaluated for presence of anthropogenic impact

*Landscape Scr*een: Anthropogenic Impact

Score	Impact	Anthropogenic Impact
0	None	No visual evidence
1	Low	Disturbance feature is present, but only appears to impact a small (<10%) portion of the candidate assessment area
2	Medium	Disturbance feature appears to impact 10-25% of the candidate assessment area
3	High	Disturbance feature appears to impact >25% of the candidate assessment area

Aerial photos of a 1-km radius around the candidate reference site were for each of the following anthropogenic activities:

- Hydrologic modifications
- Forestry activities
- Agricultural Development
- Recreational Development
- Residential and Urban Development
- Industrial Development

Landscape Screen: Presence of Roads

Score	Impact	Presence of Roads
0	None	No visual evidence
1	Low	Visual evidence of trails only
2	Medium	Visual evidence of non-paved roads only
3	High	Visual evidence of paved roads

Using aerial photos of the 1-km radius around the candidate reference site were scored according to presence/absence of road structures according to the table above

Landscape Screen: Distance to Disturbance

Score	Impact	Distance to Disturbance
0	None	> 1 km
1	Low	200 m – 1 km
2	Medium	140 m – 200 m
3	High	< 140 m

Using the table above, candidate reference sites were scored according to the distance from the center point of the assessment area to the following disturbances (if present):

- Anthropogenic ditching or channels
- Paved or non-paved roads
- Edge of human disturbance (from anthropogenic impact info)

Example 1:

Sampled? **NO**

Step 1:

AA sampleable?	No
NWCA wetland type?	Yes
Accessible?	Yes
Proximity?	Yes

Step 2: (score)

A. Anthropogenic Impact
   1. Hydro modifications? n/a
   2. Forestry? n/a
   3. Agricultural Devm't n/a
   4. Recreational Devm't n/a
   5. Residential/Urban n/a
   6. Industrial Devm't n/a

B. Presence of Roads? n/a

C. Distance to Disturbance
   1. Ditch/Channels? n/a
   2. Roads? n/a
   3. Anthr. Impact (from A.) n/a

Example 2:

Sampled? **NO**

Step 1:

AA sampleable?	Yes
NWCA wetland type?	Yes
Accessible?	Yes
Proximity?	Yes

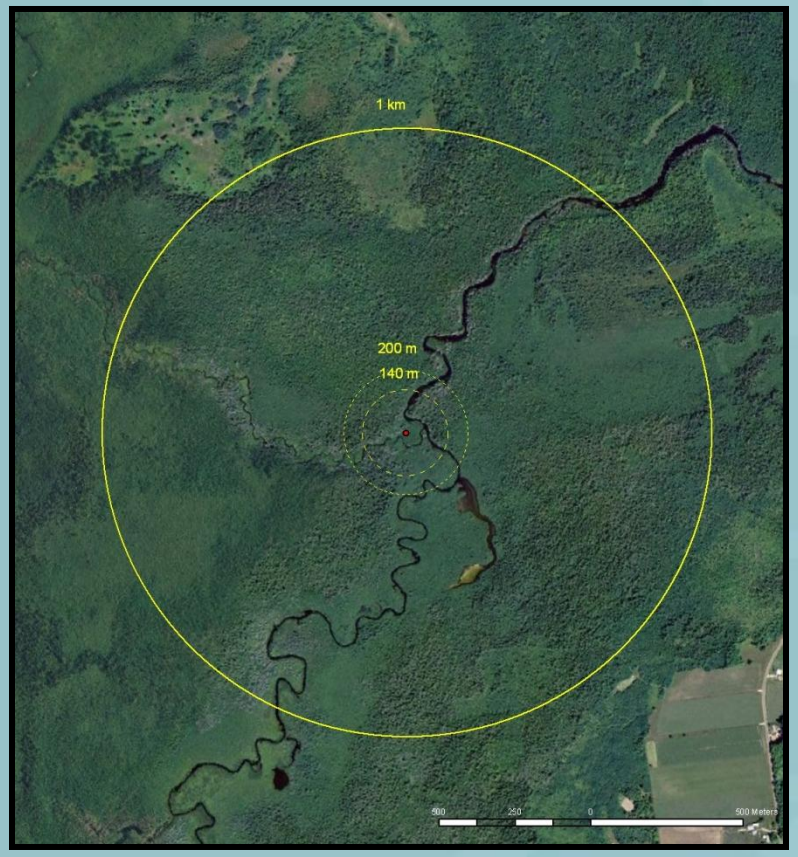
Step 2: (score)

A. Anthropogenic Impact
   1. Hydro modifications? 0
   2. Forestry? 0
   3. Agricultural Devm't 3
   4. Recreational Devm't 0
   5. Residential/Urban 0
   6. Industrial Devm't 1

B. Presence of Roads? 3

C. Distance to Disturbance
   1. Ditch/Channels? 0
   2. Roads? 2
   3. Anthr. Impact (from A.) 2

Example 3:



Sampled? YES

Step 1:

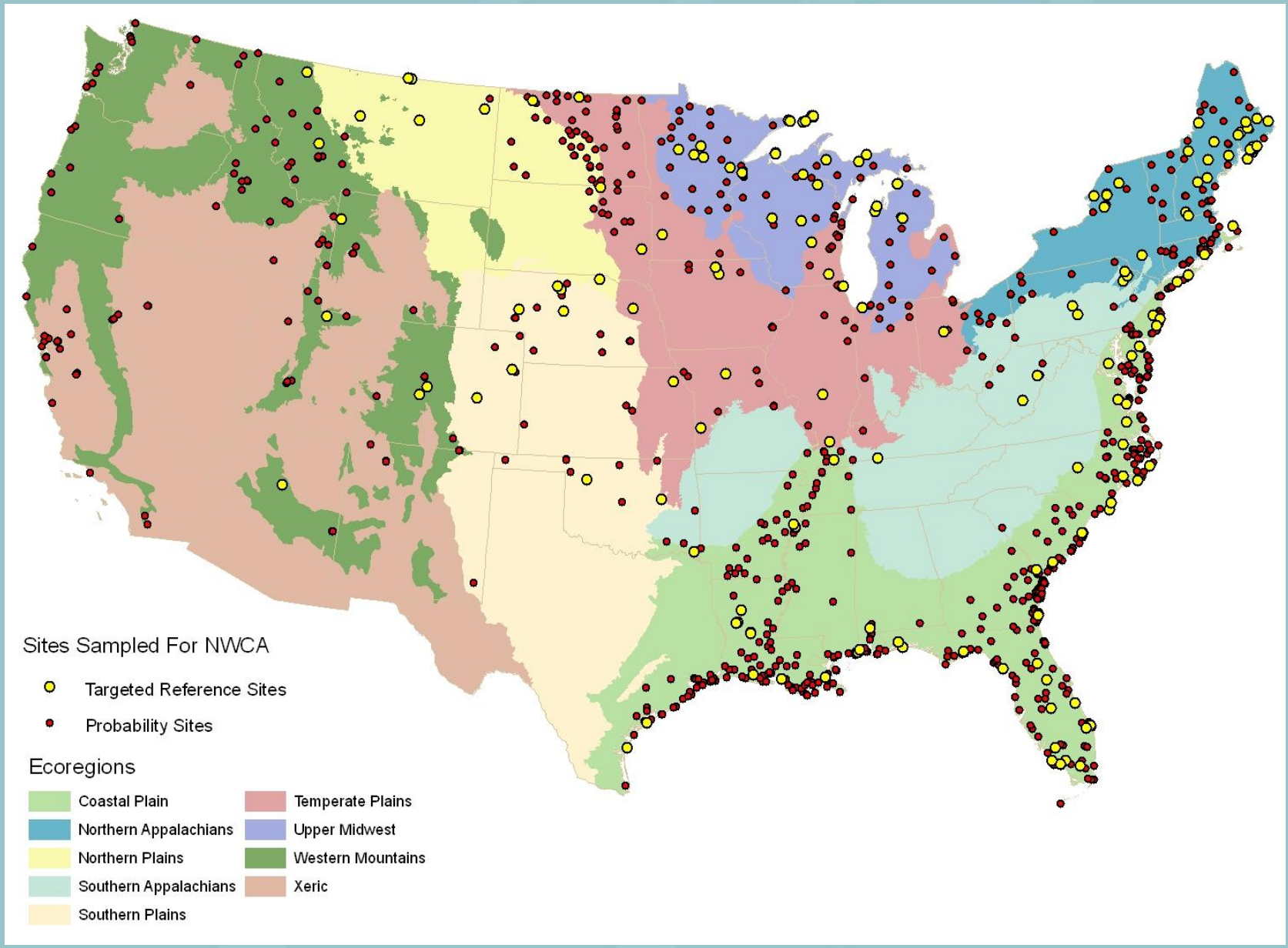
AA sampleable?	Yes
Common wetland type?	Yes
Accessible?	Yes
Proximity?	Yes

Step 2: (score)

A. Anthropogenic Impact
   1. Hydro modifications? 0
   2. Forestry? 0
   3. Agricultural Devm't 0
   4. Recreational Devm't 0
   5. Residential/Urban 0
   6. Industrial Devm't 0

B. Presence of Roads? 0

C. Distance to Disturbance
   1. Ditch/Channels? 0
   2. Roads? 0
   3. Anthr. Impact (from A.) 0


Sites Sampled For NWCA
Targeted Reference Sites
Probability Sites
Ecoregions
Coastal Plain
Northern Appalachians
Northern Plains
Southern Appalachians
Southern Plains
Temperate Plains
Upper Midwest
Western Mountains
Xeric

Post-Sampling Screening of Sites Sampled

I. Compile available stressor indicator information to be used as screening variables and develop a first filter from ecoregion-specific screening criteria

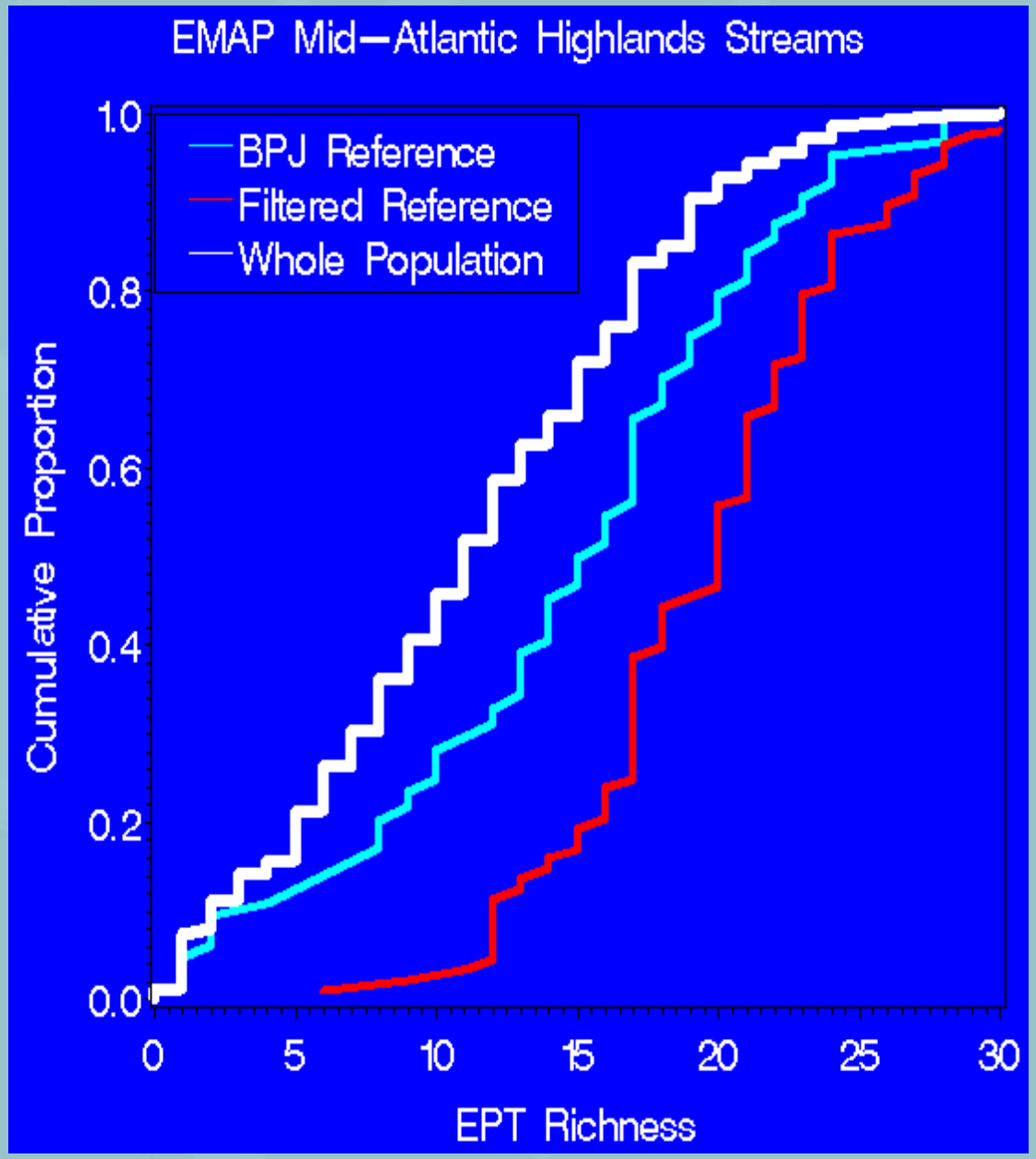
II. Digitize watersheds for sites passing Filter I and develop a second filter of GIS watershed land cover and road density information

III. Use aerial photos to examine the buffer of sites passing Filters I and II and finalize the reference population

NEW – Use of modeling approach to remove the natural variability from individual metric scores for reference sites; results in a measure of metric variability adjusted for natural environmental gradients

Screening:

- Produced a set of Reference Sites with higher Condition Index scores than the BPJ sites
- Decreased number of sites in poor biological condition
- Resulted in a much more rigorous definition of “reference”



Courtesy of Alan Herlihy

Summary:

- **Estimating reference condition provides a baseline from which to compare data from other survey sites impacted by human activities.**
- **Reference condition represents the least impacted conditions and does not necessarily equate to totally pristine conditions.**
- **Handpicked reference sites for dominant wetland types within each ecoregion were identified and evaluated. Sites that passed the desk-top evaluation were sampled using standard NWCA protocols.**
- **Both handpicked reference sites and the probability sites are evaluated post-sampling to create the final reference population.**