National Biological Assessment and Criteria Workshop

Advancing State and Tribal Programs

Coeur d'Alene, Idaho
31 March – 4 April, 2003

WET 101

Monitoring to Determine Aquatic Life Use Support

Presented by:
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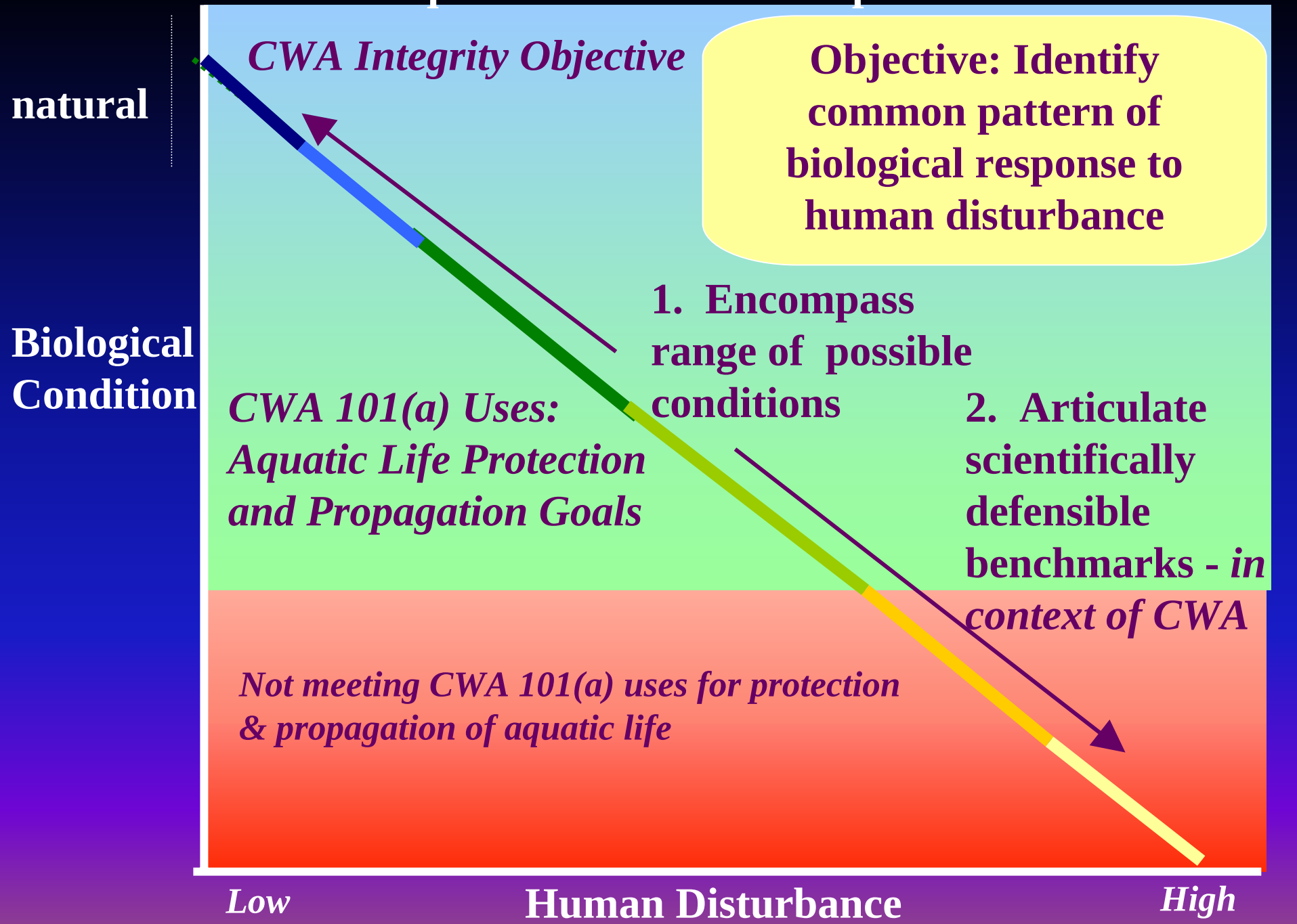
Purpose of Tiered Aquatic Life Use Framework

Nationally consistent approach for:

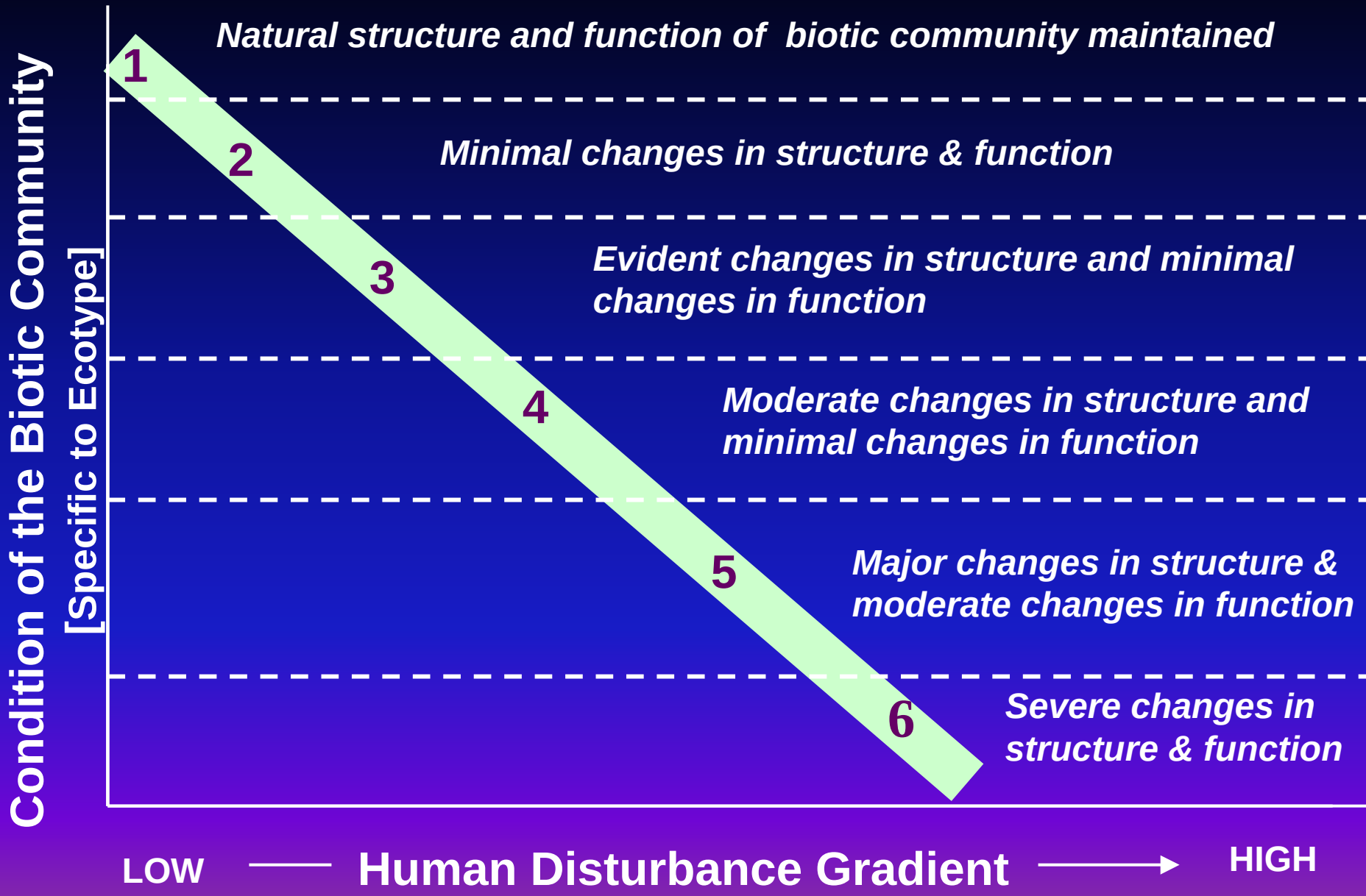
- **protection for excellent quality waters**
- **achievable goals for incremental restoration**
- **scientifically defensible benchmarks**
- **common framework for communication & evaluation - public, stakeholders, across political boundaries**

Tiered Aquatic Life Uses: Conceptual Framework



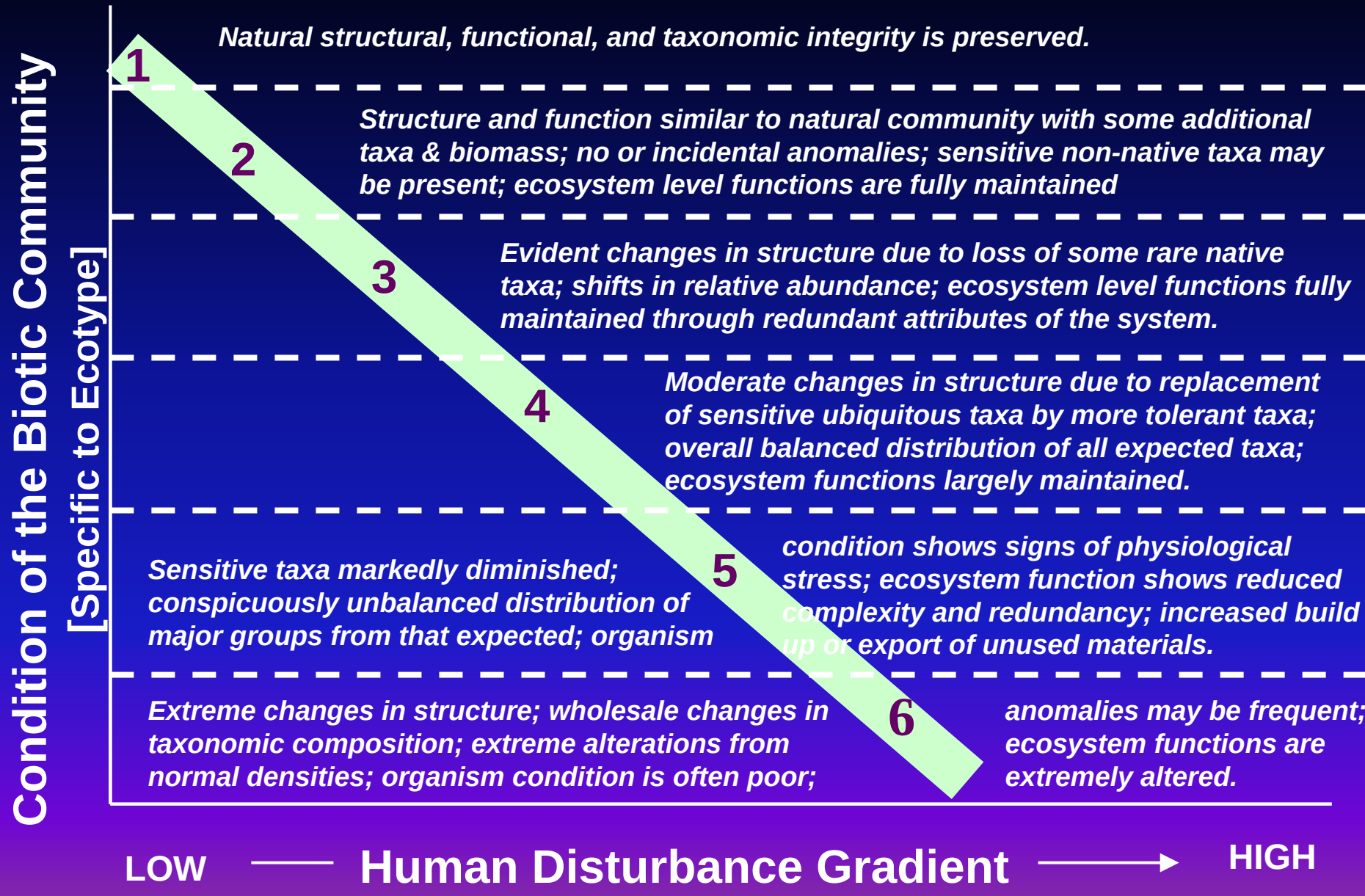
Tiered Aquatic Life Use Conceptual Model: Draft Biological Tiers -1

(10/22 draft)



Tiered Aquatic Life Use Conceptual Model: Draft Biological Tiers -2

(10/22 draft)



Tiers:
Defined in 4 Levels of Detail

1. General Description
2. Conceptual Description
3. Detailed Description
4. Example Scenarios

Issues Integrated into TALU Framework

- What are Tiers' Benchmarks
- Method of Defining Criteria
- Method of Defining Reference Condition
- Different Expectations for Different Classes of Habitats
  - Expected Condition
  - Sensitivity of Response to Human Disturbance
- Global and Regional Extirpation of Species
- Biological versus Physical and Chemical Integrity
- Structural versus Functional Integrity
- Distinguishing "Stressors" from Human Activities

Transferability to Wetlands

- Common responses of ecosystems to human disturbance
  - Replacement of sensitive taxa with tolerant taxa
  - Change in relative abundance before loose species
  - Function preserved with moderate stress via functional redundancy of taxa
- Large number of attributes with different responses to stressors
  - Algae, plants, inverts, megafauna, water chemistry, soil chemistry, hydrology, etc.
- Functional and structural assessment part of tradition (HGM & IBI approaches)

Tiers:
Defined in 4 Levels of Detail

1. General Description
2. Conceptual Description
3. Detailed Description (example)
4. Example Scenarios

Selected Plant Attributes

- **Sensitive, native taxa**
- **Tolerant, native taxa**
- **Non-native (tolerant) taxa**
- **Invasive taxa**
- **Landscape Spatial Heterogeneity (zonation and patch mosaic of different plant types)**
- **Critical Life Support Function - (submerged and emergent plant area, height, fractal dimension, open space, patchiness)**
- **Production/Respiration Ratios**
- **Other Plant Functions (nutrient retention, etc.)**
- **Spatial and Temporal Extent of Anthropogenic Effect**
- **Ecosystem Connectance**

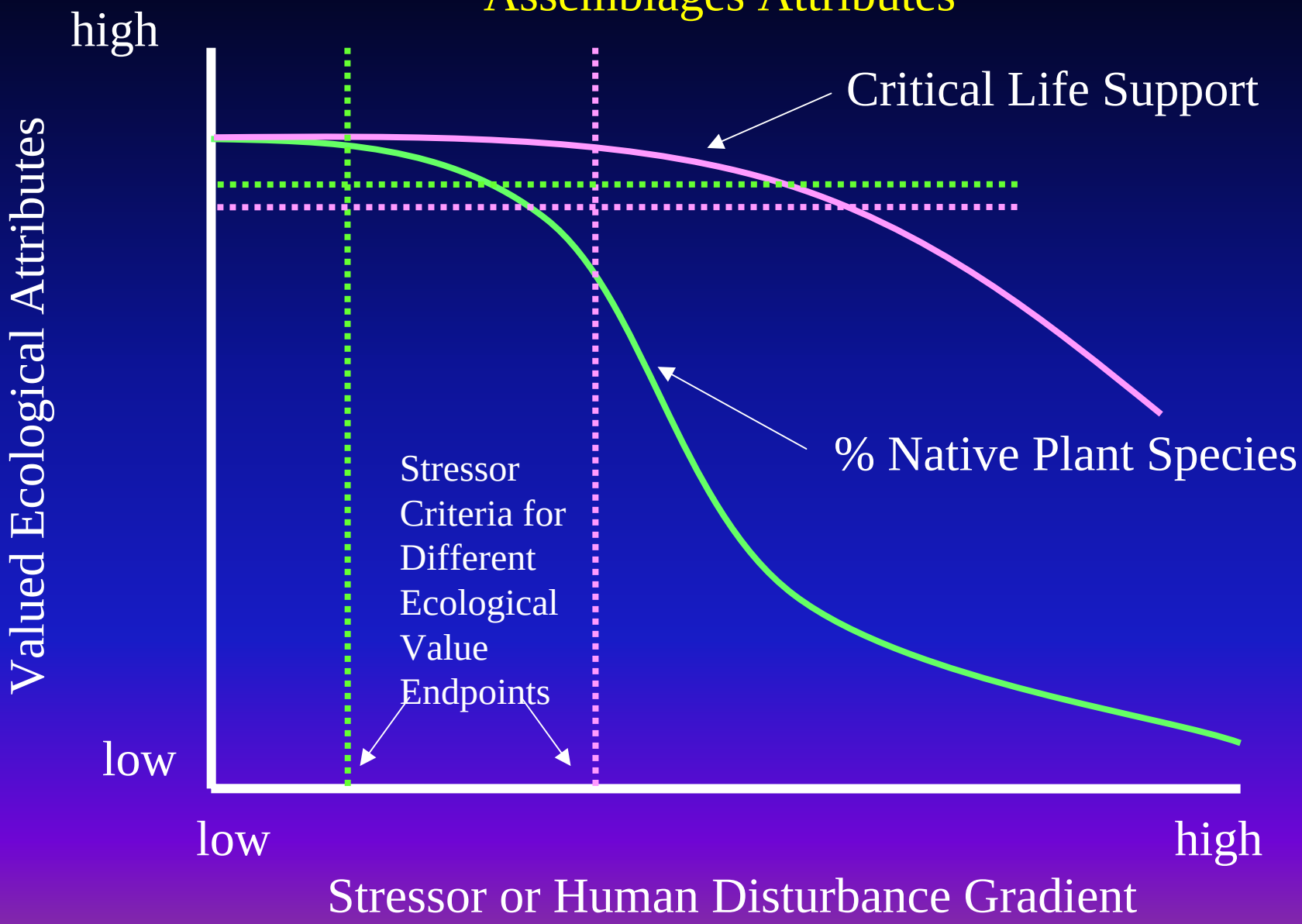
Attribute/Metric	1	2	3			
Sensitive, native taxa	As predicted for natural occurrence, with at most minor changes from natural densities. All expected species present except those lost at global scale	As predicted for natural occurrence, with at most minor changes from natural densities. All expected species present except those lost at regional scale	Some loss of taxa, with replacement by functionally (?) equivalent tolerant taxa	May be markedly diminished	Rare	Absent
Tolerant, native taxa	As naturally occur, with at most minor changes from natural relative abundances	As naturally present with slight increases in abundance	Evident increases in abundance	May be common but do not exhibit significant dominance	Can occur in high densities and can be dominant	May comprise the majority of the assemblage; often extreme departures from normal densities (high or low)
Non-native (tolerant) taxa	Non-native taxa, if present, are rare and have non-detrimental effect on native taxa	May be present, but occurrence has a non-detrimental effect on native taxa	Some replacement of sensitive native taxa with non-native taxa	Non-native taxa common, but not dominant	Can occur in high densities and can be dominant	May comprise the majority of the assemblage
Invasive taxa	None	Rare	Can be present	Can be common	Can be abundant	Can be dominant
Landscape Spatial Heterogeneity (zonation and patch mosaic of different plant types)	Maintained as natural	Maintained as natural	Slightly altered from natural (e.g., patch size has changed or some zones have diminished in size as others expand)	Moderately Altered from natural	Major Alterations	Severe Alterations
Critical Life Support Function - (submerged and emergent plant area, height, fractal dimension, open space, patchiness)	Fully Maintained, e.g., open water habitat as naturally occurs	Fully Maintained	Fully Maintained	Slightly Maintained, e.g., open water habitat slightly altered from naturally occurring	Partially Maintained, e.g., open water habitat is substantially changed from naturally occurring	Not Maintained, e.g. open water habitat is gone and vertical habitat greatly altered
Production/Respiration Ratios	As natural	May be slightly elevated	May be moderately higher than natural	May be significantly higher than natural	May be imbalanced temporally or spatially to cause mild oxygen depletion	May be highly imbalanced to cause severe oxygen depletion
Spatial and Temporal Extent of Anthropogenic Effect	N/A	Limited to short durations (a season), small wetlands, or portions of large wetlands	Limited to short durations (a season), small wetlands, or portions of large wetlands	Mild detrimental effects may be detectable in larger areas and longer durations	Detrimental effects extensive and leaving only a few regional refugia of adequate conditions; effect extends across multiple seasons	Detrimental effects may eliminate all refugia and colonization sources within the region for years
Ecosystem Connectance	System is highly connected in space and time to other wetlands with similar species.	Ecosystem connectance and dispersal is unimpaired.	Slight loss of connectance and dispersal, but there are adequate local recolonization	Some loss of connectance but colonization sources and refugia exist within the	Significant loss of ecosystem connectance is evident; recolonization	Complete loss of ecosystem connectance may occur and lower reproductive

See Handout WET101_07

Plant Attributes along BioAxis

BioAxis Level	Sensitive, native taxa
1	As predicted for natural occurrence, with at most minor changes from natural densities. All expected species present except those lost at global scale
2	As predicted for natural occurrence, with at most minor changes from natural densities. All expected species present except those lost at regional scale
3	Some loss of taxa, with replacement by functionally (?) equivalent tolerant taxa
4	May be markedly diminished
5	Rare
6	Absent

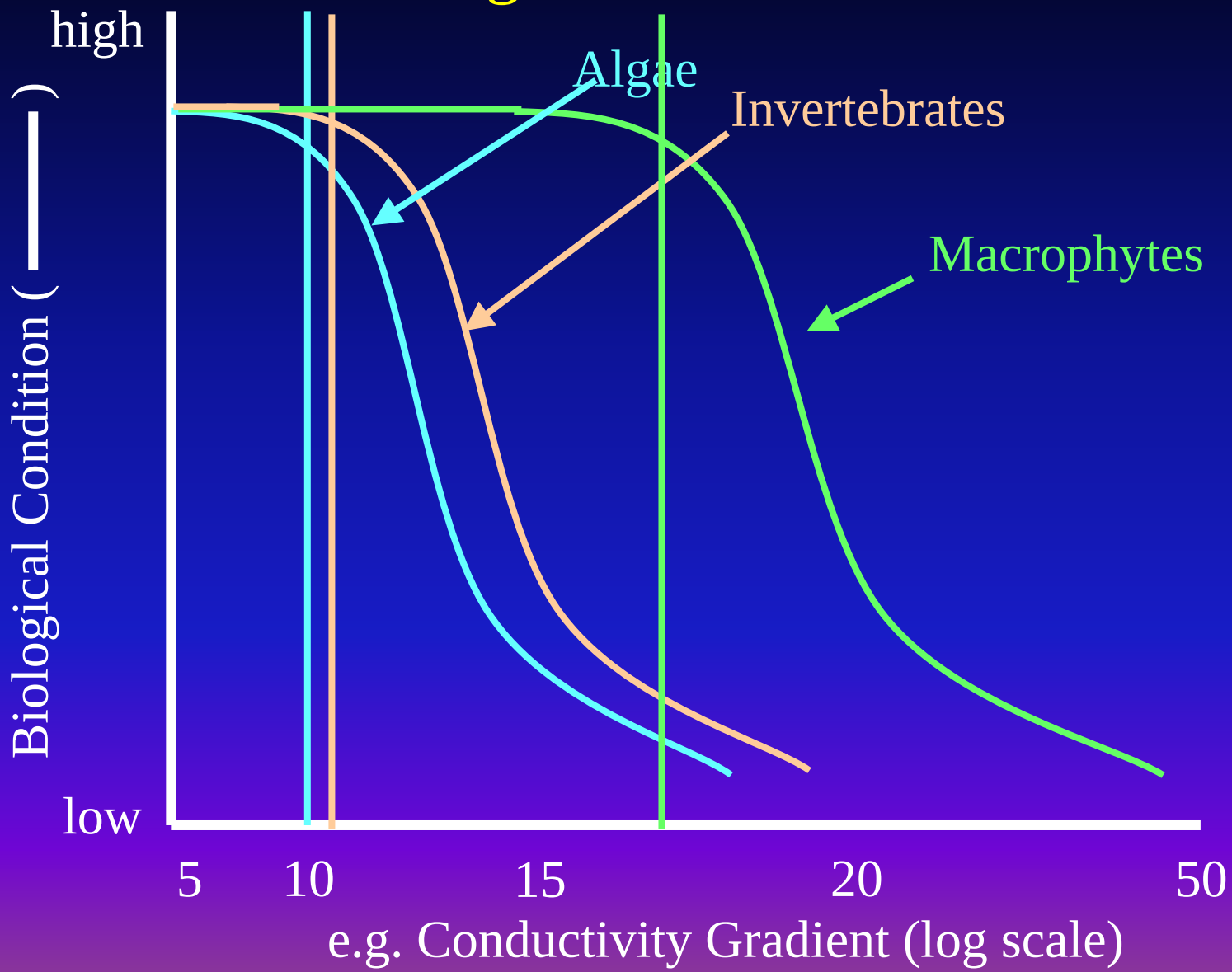
Tiered Uses Based on Differing Response of Plant Assemblages Attributes



Differing Responses of Valued Ecological Attributes in Wetlands

- Within Assemblage Attributes (FQAI vs. % Native Taxa)
- Among Assemblages (Plants vs. Inverts and Algae)
- Between Structural vs. Functional Attributes

Tiered Criteria Based on Different Valued Ecological Attributes: MRW



Developing Tiered Uses & Criteria:
Integrating Issues into a Common Framework

- Common framework – 101, 303, 305, & 404
  - Standardizes approach
  - Increases transferability & comparability of results
- Multiple approaches for setting criteria:
  - Non-reference, reference, modeling and stressor-response approach
- Scientifically defensible criteria
- Defining reference condition (Pristine versus Best Attainable)
- Responses vary among types (classes) of wetlands
- Ecological and Comparative Assessments

Conclusions

- Consensus Agreement
  - Tiered ALUS was a useful concept
  - "Ecological Integrity" – support of native species and most ecological function
    - ***Structure and function similar to natural community with some additional taxa & biomass; no or incidental anomalies; sensitive non-native taxa may be present; ecosystem level functions are fully maintained***
  - Could relate 305 (b), 303(d), 404, etc.....

Conclusions, continued

- Consensus Agreement
  - Common Benchmarks
  - Plant and Invertebrate Scenarios Useful
  - Relatively Easy to Assign Ranks in Data Exercise
  - >Challenge in Streams to Assign Actual Value (e.g., 1-2-3-4 versus 2-4-5-6)

Conclusions, continued

- Issues of Concern
  - Language associated with faster change in function than structure
  - Need more “function”
  - What constitutes system that does not support fish, shellfish, and wildlife... The interim goal of the CWA
    - 5 = Sensitive taxa markedly diminished; conspicuously unbalanced distribution of major groups from that expected; organism condition shows signs of physiological stress; ecosystem function shows reduced complexity and redundancy; increased build up or export of unused materials.

Part 2
Applying TALU concepts to Ohio wetland data

John Mack, Ohio EPA

Regulatory background

- 1990 – U.S. EPA mandated states include water quality standards for wetlands
- 1996-1998 – Ohio EPA initiates rule development process and formal regulatory negotiation stakeholder group
- May 1998 – Ohio adopted initial wetland water quality standards and wetland antidegradation rule

Ohio's Wetland Water Quality Standards (WWQS) Program

- Current elements of the program in OAC Rules 3745-1-50 to 54:
  - narrative criteria
  - chemical criteria
  - "wetland" designated use
  - antidegradation rule
  - Procedural rules OAC Chapter 3745-32
  - Method to categorize wetlands (ORAM)

Current Elements in Ohio's Wetland Program

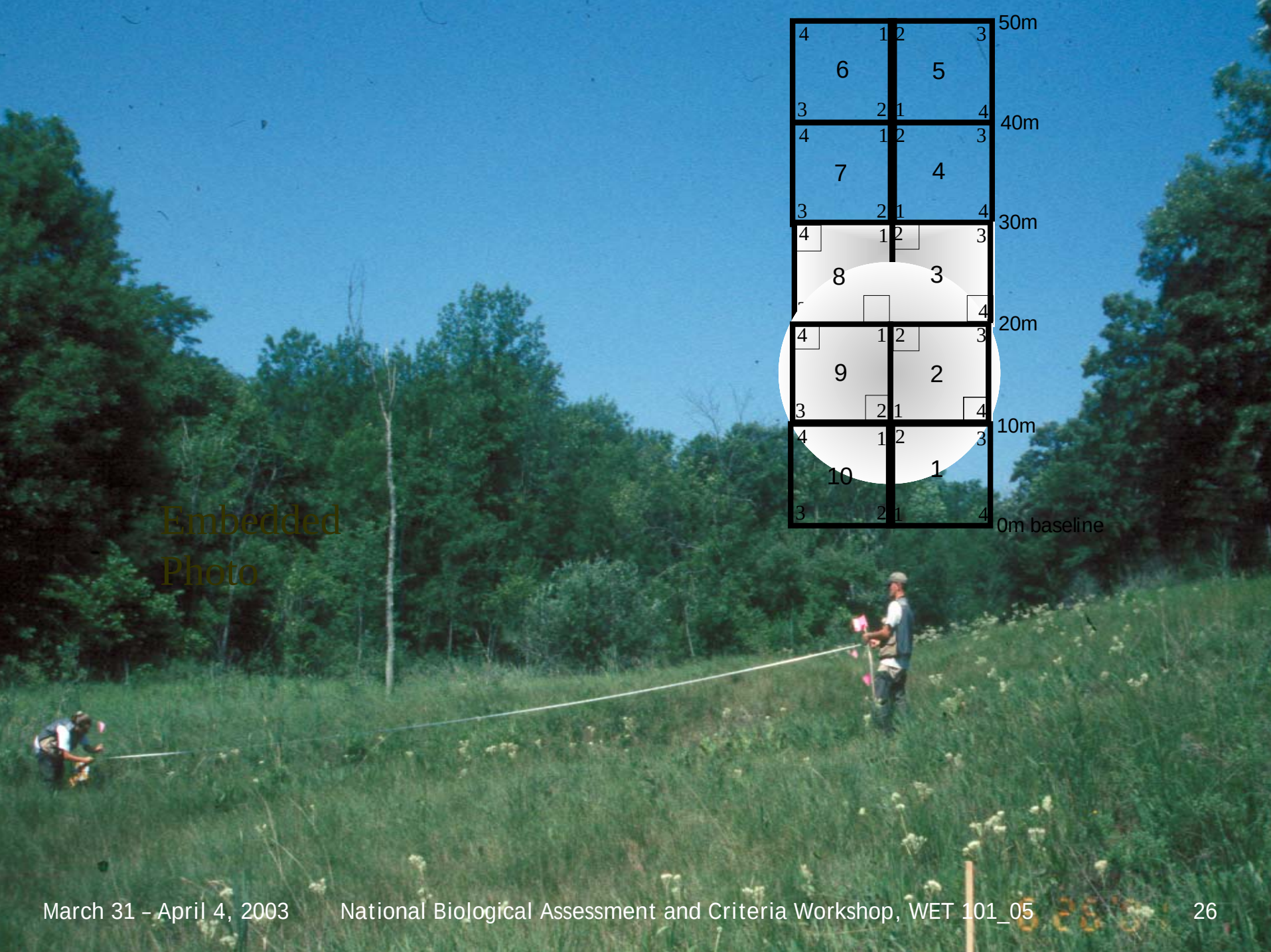
- Wetland water quality standards
  - narrative criteria and chemical criteria
  - "wetland" designated use
  - antidegradation rule
- Section 401 Certification Program
- Rapid Assessment Method for Wetlands
- Numeric biological criteria using vascular plants, amphibians, and macroinvertebrates
- Standardized mitigation wetland monitoring protocols and performance standards
- Watershed-level wetland condition assessment

Summary of numbers of sites by major hydrogeomorphic and plant community classes. Sites in parentheses sampled in 2001-2002 and data not reported here.

Hydrogeomorphic Classes	N	Plant Community Classes	N
isolated depression	59 (21)	sphagnum bog communities	6 (2)
riparian mainstem depression	8 (12)	calcareous fen communities	6 (4)
riparian headwater depression	8 (5)	mixed emergent marshes	23 (26)
slope	8 (9)	sedge-grass communities	3 (10)
fringing	2	shrub swamps	21 (9)
impoundment (beaver, human)	2 (10)	swamp forests	29 (20)
coastal	1 (12)		
riverine	0 (2)		
TOTAL	**88 (159)**	**TOTAL**	**88 (159)**

Sampling methods

- plot based sampling method
- combines aspects of releves and transects and quadrats
- flexible multipurpose method for diverse plant communities
- Peet et al. (1998)
- locate plots in areas most representative of plant community of interest
- minimize environmental heterogeneity


6
5
7
4
8
3
9
2
10
1
50m
40m
30m
20m
10m
0m baseline
Embedded
Photo

Parameters measured

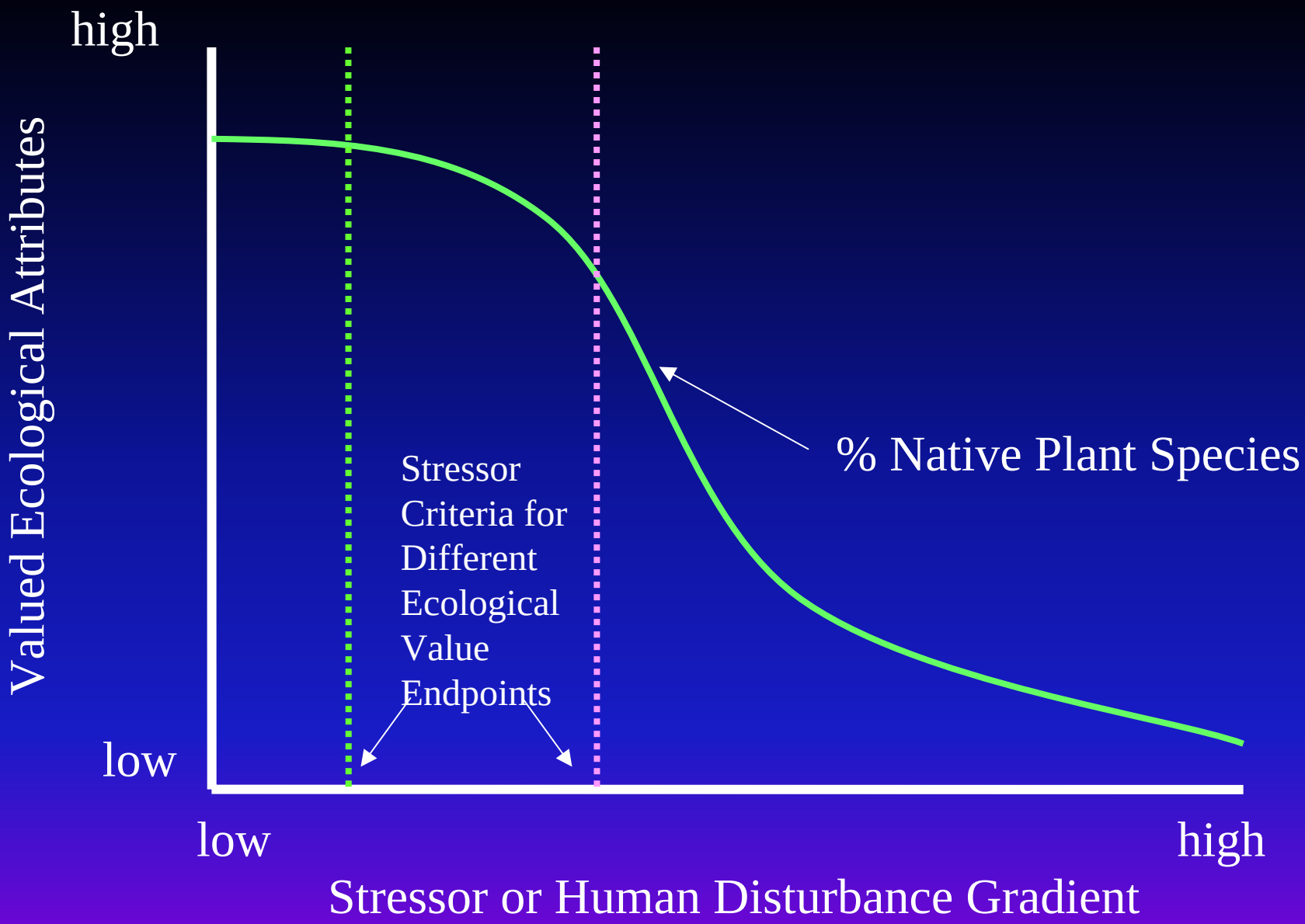
- presence/absence (~2500 vouchers collected 1996-2002, avg ~16 per plot)
- % cover herb and shrub stratum
- stem density and basal area shrub and tree stratum (shrub and forest only)
- standing biomass (emergent only)
- soil nutrients
- water chemistry
- physical parameters: water depth, depth to saturated soils, coarse woody debris, hummocks and tussocks, standing dead, etc.

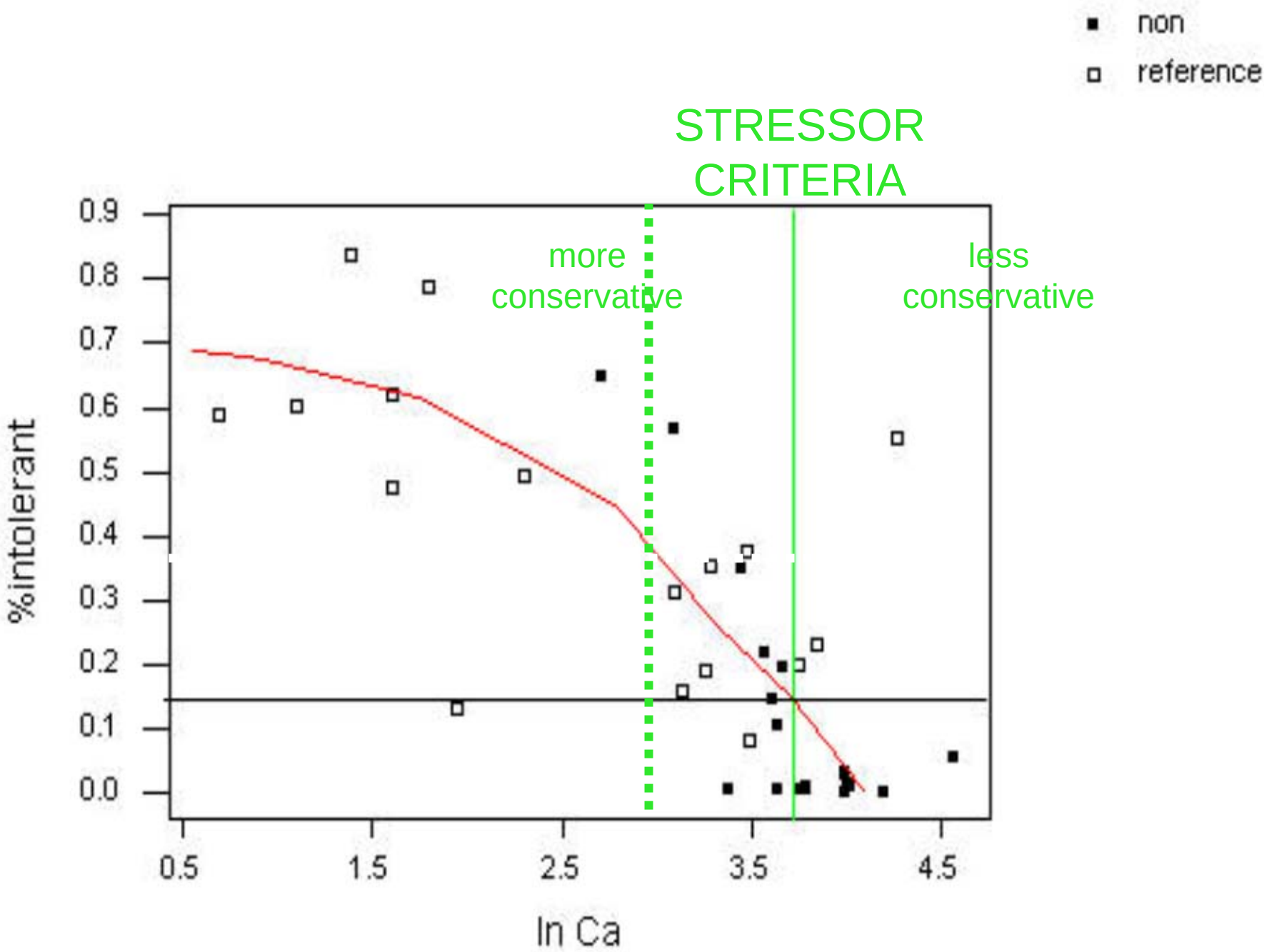
Semi-qualitative disturbance gradient

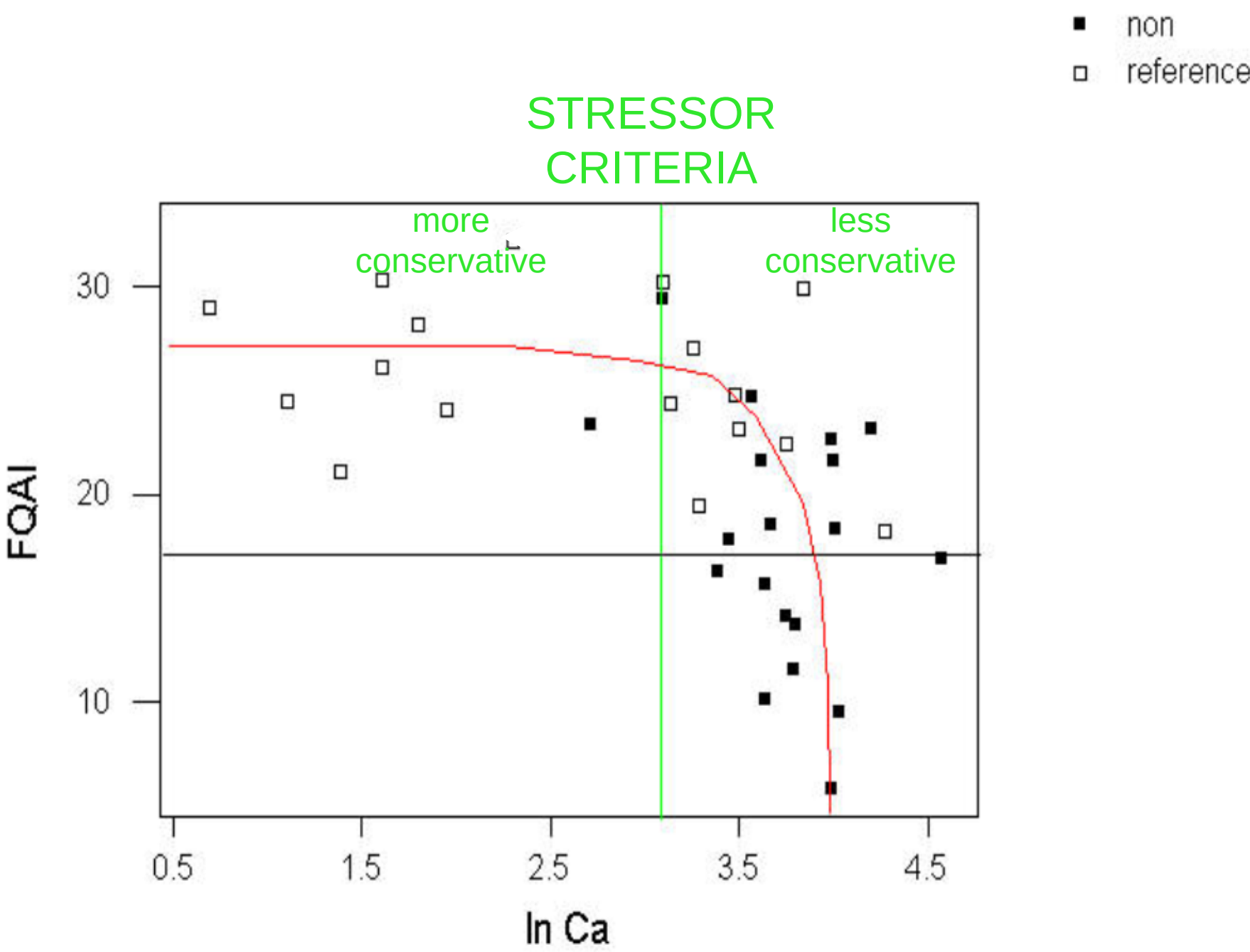
- buffer width
- intensity of surrounding land use
- intactness of natural hydrology
  - ditch, tile, fill, grade, stormwater, etc.
- intactness of substrates
  - farming, off-road vehicles, grazing, sedimentation, etc.
- intactness of natural habitat
  - farming, clearcutting, nutrient entrichment, etc.

Using plant attributes to establish stressor criteria

- type of dose-response relationship
  - linear
  - "shallowly" curvilinear
  - threshold
- each type has different utility in determining acceptable level of stress on system


high
Valued Ecological Attributes
low
Stressor Criteria for Different Ecological Value Endpoints
% Native Plant Species
low
high
Stressor or Human Disturbance Gradient


non
reference
STRESSOR CRITERIA
more conservative
less conservative
%intolerant
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
0.5
1.5
2.5
3.5
4.5
ln Ca


non
reference
STRESSOR
CRITERIA
more
conservative
less
conservative
FQAI
30
20
10
0.5
1.5
2.5
3.5
4.5
ln Ca

Preliminary Wetland TALUs

- Envision 4 and perhaps ultimately 5-6 tiered system
- LQWLH – limited quality wetland habitat
  - possibly split into low and very low
- RWLH – restorable wetland habitat
- WLH – wetland habitat
- SWLH – superior wetland habitat
  - possibly split into high and very high

Modifiers

- Add modifiers for dominant plant community and landscape position (HGM)
- Multiple purposes for modifiers
- Wetland's have different functions and values based on type
- Important for IBI development and application to classify by type
- Tracking impacts
- Implementing and assessing mitigation and restoration

Modifiers cont.

Plant community wetland use designation modifiers

Use code	specific use designation
Ia	Swamp forest
Ib	Vernal pool
Ic	Forest seeps
Id	Tamarack-hardwood bog
IIa	Mixed shrub swamp
IIb	Buttonbush swamp
IIc	Alder swamp
IId	Tall shrub bog
IIe	Tall shrub fen
IIIa	Marshes (includes submergent, floating-leaved, mixed emergent, and cattail)
IIIb	Sedge-grass communities (includes wet prairies, sedge meadows, and seep fens)
IIIc	Riverine marsh communities (includes submergent, floating-leaved, mixed emergent and various intermixed shrub communities
IIId	Fens (includes cinquefoil-fens, tamarack fens, arbor vitae fens)
IIIe	Bogs (includes sphagnum bogs, leatherleaf bogs, but not tamarack-hardwood bogs (Ic) or tall shrub bogs (IId)
IV	Coastal marshes

Landscape position use designation modifier

(1) riparian headwater depression
(2) riparian mainstem, depression
(3) isolated depression
(4) lacustrine
(5) human impoundment
(6) beaver impoundment

Special use modifiers

Special wetland use designations.

subscript	special uses	description
A	recreation	wetlands with known recreational uses including hunting, fishing, birdwatching, etc. that are publicly available
B	education	wetlands with known educational uses, e.g. nature centers, schools, etc.
C	fish reproduction habitat	wetlands that provide important reproductive habitat for fish
D	bird habitat	wetlands that provide important breeding and nonbreeding habitat for birds
E	flood storage	wetlands located in landscape positions such that they have flood retention functions
F	water quality improvement	wetlands located in landscape positions such that they can perform water quality improvement functions for streams, lakes, or other wetlands

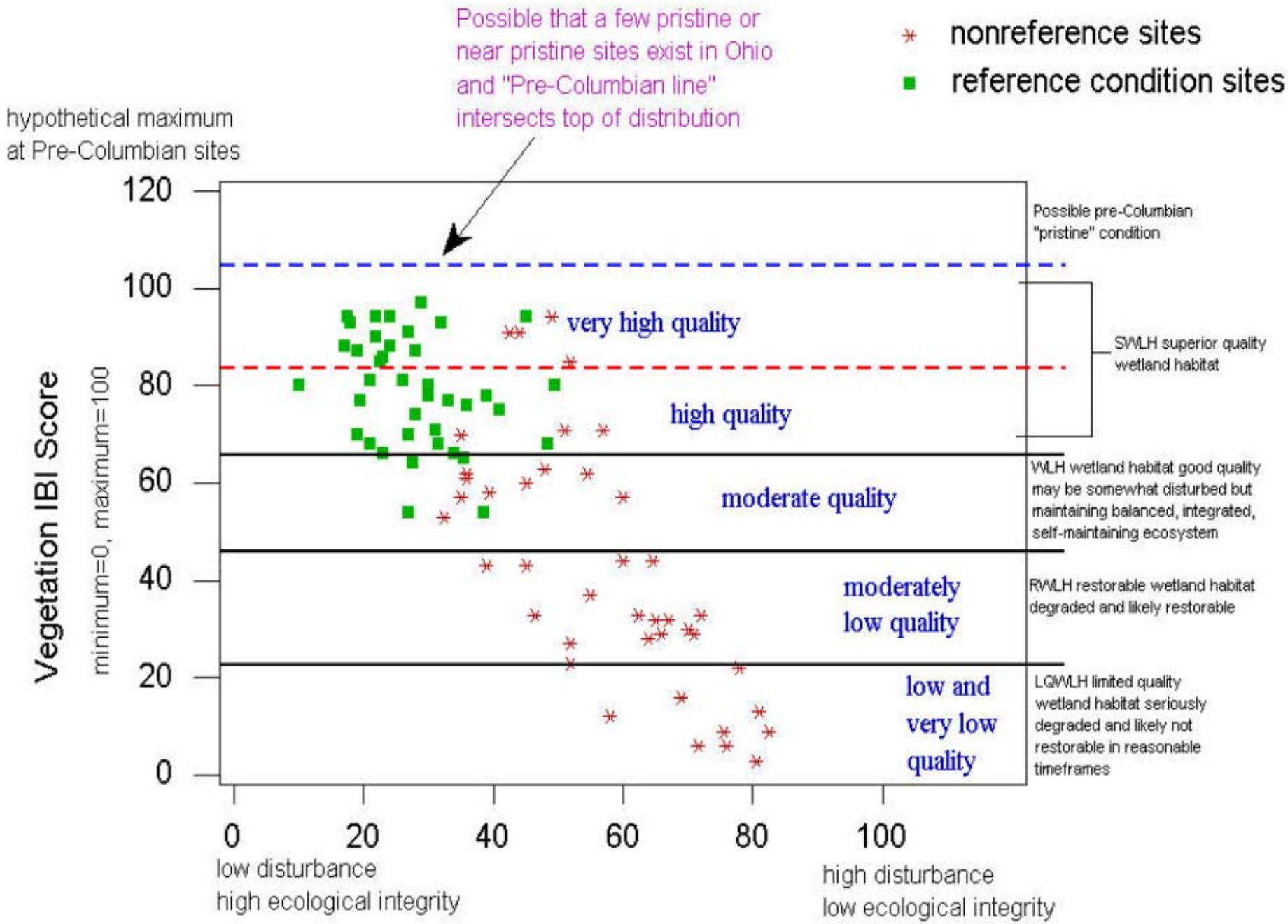
Example

- Pumpkin ash (*Fraxinus profunda*) swamp in nature preserve
- Vegetation IBI score = 81 = SWLH range
- Plant community/landscape position = Ia3 (swamp forest-isolated depression)
- Educational uses as nature preserve
- Wetland TALU = SWLP-$Ia3_B$, where SWLH=means Superior Wetland Habitat, Ia3=Isolated Swamp Forest, and the $subscript_B$=education use.

Preliminary Wetland TALUs

Pilot numeric biological criteria for wetlands based on Vegetation IBI breakpoints for specific plant communities and landscape positions. "tbd"=to be developed.

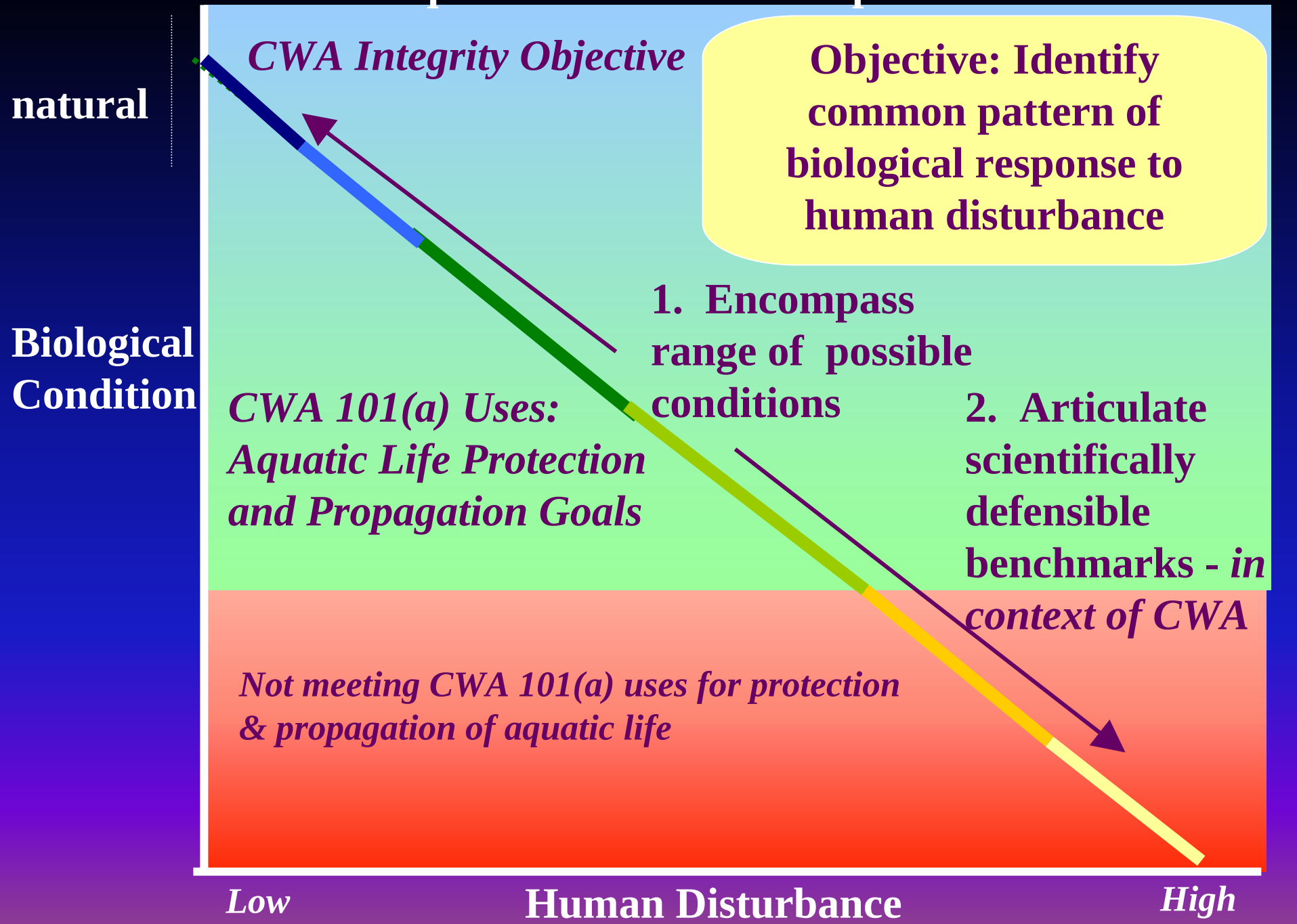
Landscape position	plant community	specific use code(s)	LQWLH	RWLH	WLH	SWLH
Riparian mainstem depressions	swamp forests shrub swamps	Ia2, IIa2, IIb2, IIc2	0-16	17-33	34-50	51-100
All landscape positions except riparian mainstem depressions	swamp forests vernal pool shrub swamp	all use codes except Ia2, IIa2, IIb2, IIc2	0-22	23-45	46-66	67-100
All landscape positions except coastal and riverine	marshes	IIIa-ECBP	0-16	17-33	34-50	51-100
		IIIa-EOLP	0-20	21-41	42-62	63-100
All landscape positions	bog fen sedge-grass	Id, IId, IIe, IIIb, IIId, IIIe	0-23	24-47	48-71	72-100
Coastal	all	all use codes	tbd	tbd	tbd	tbd
Riverine	all	n/a	tbd	tbd	tbd	tbd


Possible that a few pristine or near pristine sites exist in Ohio and "Pre-Columbian line" intersects top of distribution
nonreference sites
reference condition sites
hypothetical maximum at Pre-Columbian sites
Vegetation IBI Score
minimum=0, maximum=100
120
100
80
60
40
20
0
very high quality
high quality
moderate quality
moderately low quality
low and very low quality
Possible pre-Columbian "pristine" condition
SWLH superior quality wetland habitat
WLH wetland habitat good quality may be somewhat disturbed but maintaining balanced, integrated, self-maintaining ecosystem
RWLH restorable wetland habitat degraded and likely restorable
LQWLH limited quality wetland habitat seriously degraded and likely not restorable in reasonable timeframes
0
20
40
60
80
100
low disturbance
high ecological integrity
high disturbance
low ecological integrity

Conclusions from the Ohio Case Study

- **Plants are robust indicator taxa group**
- **TALU concepts can be applied to actual wetland plant data**
- **Landscape position (HGM class) and dominant plant community affect structure and function of wetlands and should be included in any wetland TALU system**

Tiered Aquatic Life Uses: Conceptual Framework



Ecological Integrity for Waters

CWA Goal	Biological	Physical	Chemical	Cultural
	fauna/flora	hydro, geo	biogeochem	socio-econ
Integrity				
Interim				
Impairment				
	x-axis Human Disturbance Gradient			