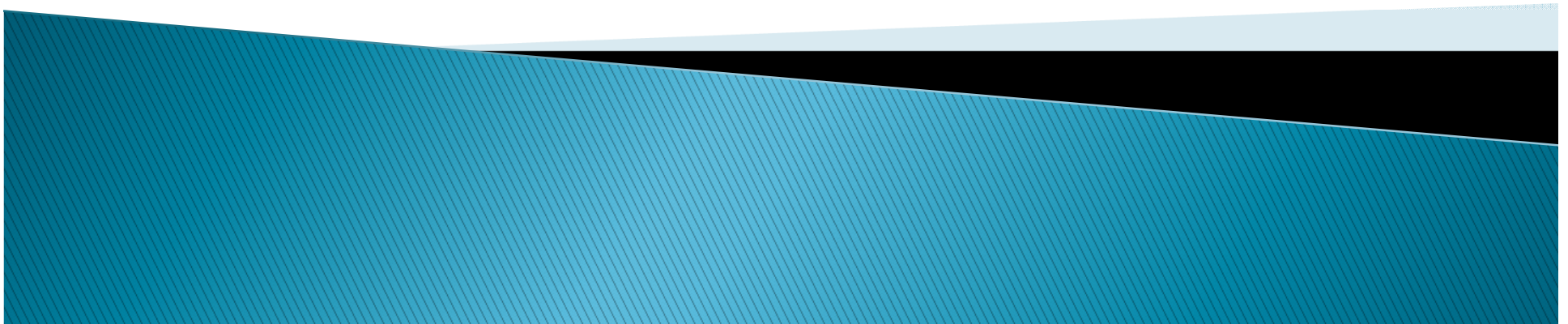


*Reference sites and reference
condition for Biological Condition
Gradient (BCG) development*

Portland
1 May, 2012



Collaborators

Name	Organization
Will Bouchard	Minnesota PCA
Kayla Bowe	Red Lake Band of Chippewa, DNR
Joel Chirhart	Minnesota PCA
Jeffrey Dimick	U. Wisconsin Stevens Point
Mike Feist	Minnesota PCA
John Genet	Minnesota PCA
Jeroen Gerritsen	Tetra Tech, Inc.
Kevin Goodwin	Michigan DNRE
Ed Hammer	U.S. EPA Region 5
Kari Hedin	Fond du Lac Band of Lk. Superior Chippewa
Daniel Helwig	Minnesota PCA
Benjamin Lundeen	Minnesota PCA

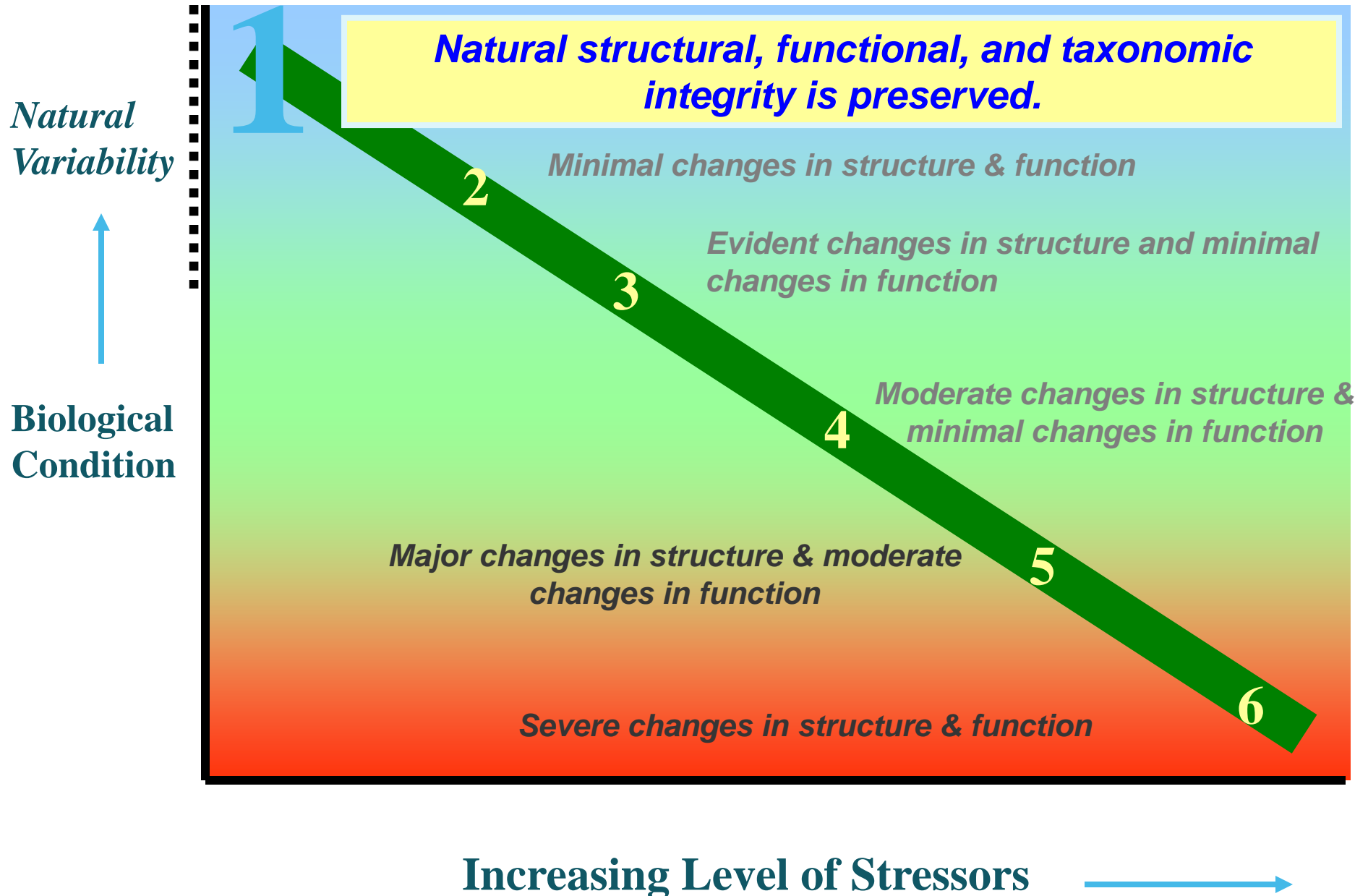
Name	Organization
Michael Miller	Wisconsin DNR
Scott Niemela	Minnesota PCA
Betsy Nightingale	U.S. EPA Region 5
Stephanie Ogren	Little River Band of Ottawa Indians
John Sandberg	Minnesota PCA
Kurt Schmude	U. Wisconsin Superior
Nancy Schuldt	Fond du Lac Band of Lk. Superior Chippewa
James Snitgen	Oneida Nation
Jen Stamp	Tetra Tech, Inc.
Kevin Stroom	Minnesota PCA
Lizhu Wang	Michigan DNRE
Chris Yoder	Midwest Biodiversity Inst.

The Biological Condition Gradient

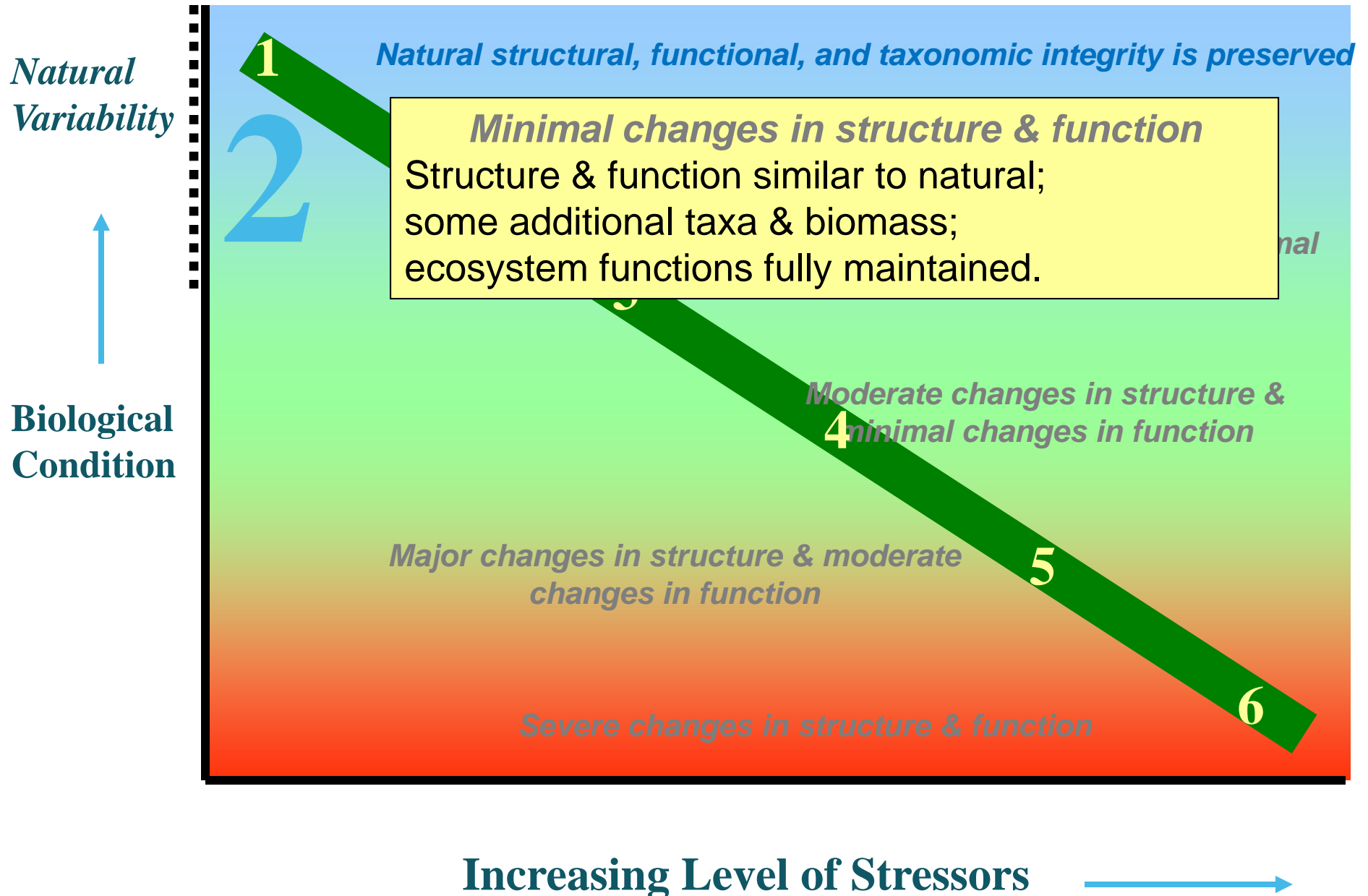
- ▶ Conceptual model of ecological knowledge and theory to describe changes with increasing stress
- ▶ Practical application/calibration uses combination of empirical information and professional judgment and experience
- ▶ *Can professional judgment help inform descriptions of minimally disturbed aquatic communities?*



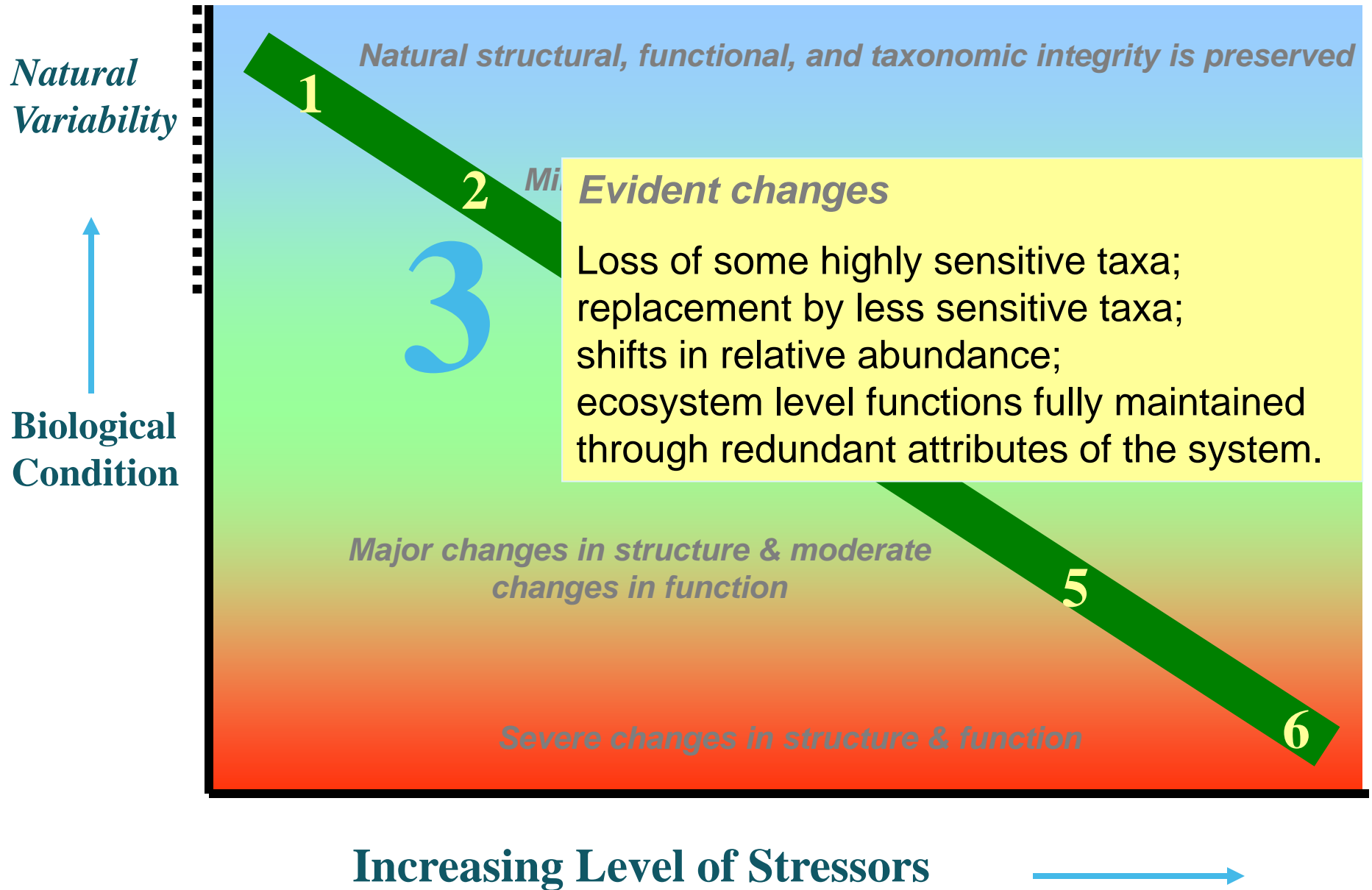
The Biological Condition Gradient



The Biological Condition Gradient



The Biological Condition Gradient



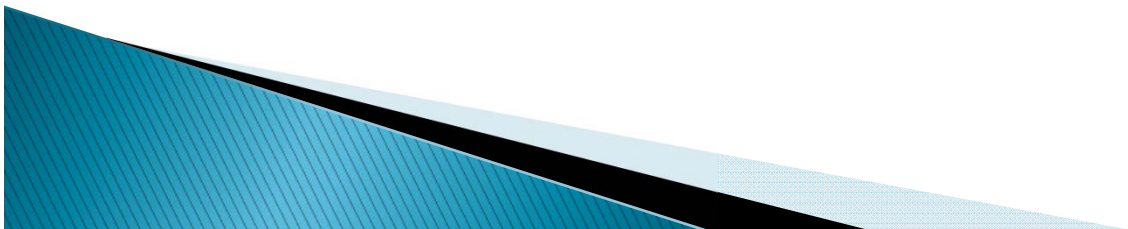
BCG Calibration

- ▶ Classification
- ▶ Identify stressor gradient
- ▶ **Define expectations**
- ▶ Identify attributes and metrics
- ▶ Develop rules for assigning sites (decision criteria)



Define Expectations: Describe undisturbed

- ▶ Best sites (reference) are not necessarily undisturbed!
- ▶ Capture critical information for decisions



Maine best: Minimally disturbed



JUL 29 2003

Connecticut, New Jersey best: Least disturbed



21. 10. 2002

Wisconsin/Minnesota Driftless Area best: Least disturbed



Minnesota (wetland) best: Minimally disturbed



Example:

Minnesota Disturbance Index

- ▶ 8 metrics, score 0–81:
 - Agricultural land use
 - Urban land use
 - Animal units (feed lots)
 - Point sources
 - Watershed riparian disturbance
 - Site riparian disturbance
 - Watershed channelization
 - Site channelization
- ▶ Metric scores modified by proximity, slope, other considerations
- ▶ Site-specific factors not considered



Upper Midwest BCG development

- ▶ Panels of fish, invertebrate experts examined stream samples
- ▶ Panels assigned taxa to BCG attributes
- ▶ Identity of stream and disturbance score hidden from panel
- ▶ Panel assigned consensus BCG levels to each sample



Stream Classes (MN)

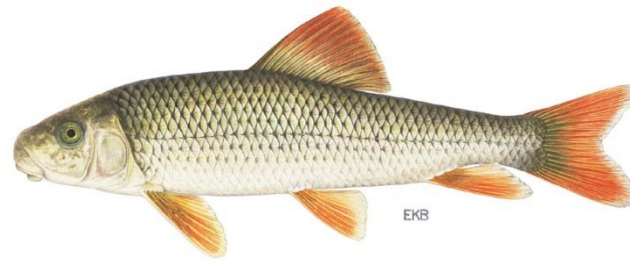
- ▶ Northern Forest Rivers
- ▶ Southern rivers
- ▶ Northern Forest Riffle–Run
- ▶ Northern Forest Glide–Pool
- ▶ Southern Riffle–Run
- ▶ Southern Hardwood Glide–Pool
- ▶ Prairie Glide–Pool
- ▶ Northern Coolwater
- ▶ Southern Coldwater (karst)
- ▶ Northern Forest Rivers
- ▶ Prairie Rivers
- ▶ Northern Wadeable Streams
- ▶ Northern Headwaters
- ▶ Southern Wadeable Streams
- ▶ Southern Headwaters
- ▶ Wetland Streams
- ▶ Northern Coolwater
- ▶ Southern Coldwater (karst)

Invertebrates

Fish

Identify attributes and metrics fish

**Attribute 1 taxa:
Rare or endemic
(river spp)**



greater redhorse



American eel



Identify attributes and metrics fish

Attribute 2 taxa: most sensitive; the first
to disappear



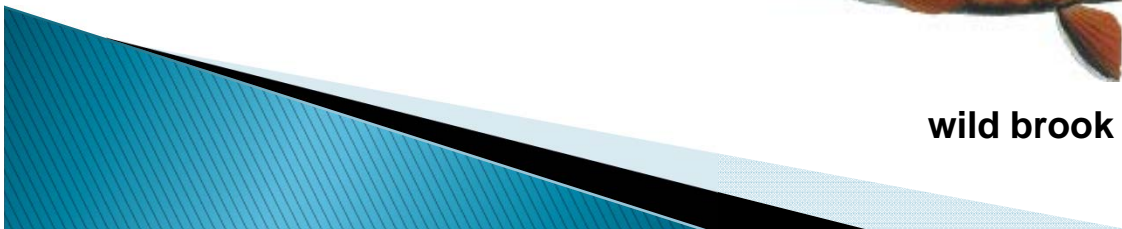
slimy sculpin



Northern brook lamprey



wild brook trout



Identify attributes and metrics fish

Attribute 3 taxa: Intermediate sensitive



burbot



Hornyhead chub



Northern redbelly dace



BCG Level 1 site

St. Croix River

- 26 species
- Dominated by sensitive spp
- Rare spp present

Species	N	Attribute
gilt darter	8	1
greater redhorse	2	1
lake sturgeon	1	1
burbot	114	3
chestnut lamprey	1	3
hornyhead chub	3	3
lamprey ammocoete	61	3
logperch	17	3
northern hogsucker	8	3
rock bass	23	3
shorthead redhorse	72	3
slenderhead darter	39	3
smallmouth bass	12	3
blackside darter	3	4
bluegill	17	4
common shiner	11	4
johnny darter	96	4
northern pike	2	4
spotfin shiner	5	4
tadpole madtom	6	4
walleye	2	4
white sucker	19	4
yellow perch	5	4
creek chub	1	5
bluntnose minnow	2	5a
central mudminnow	5	5a

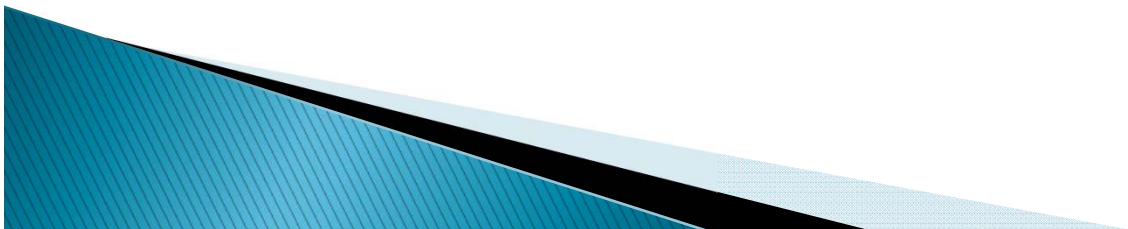
Problematic species



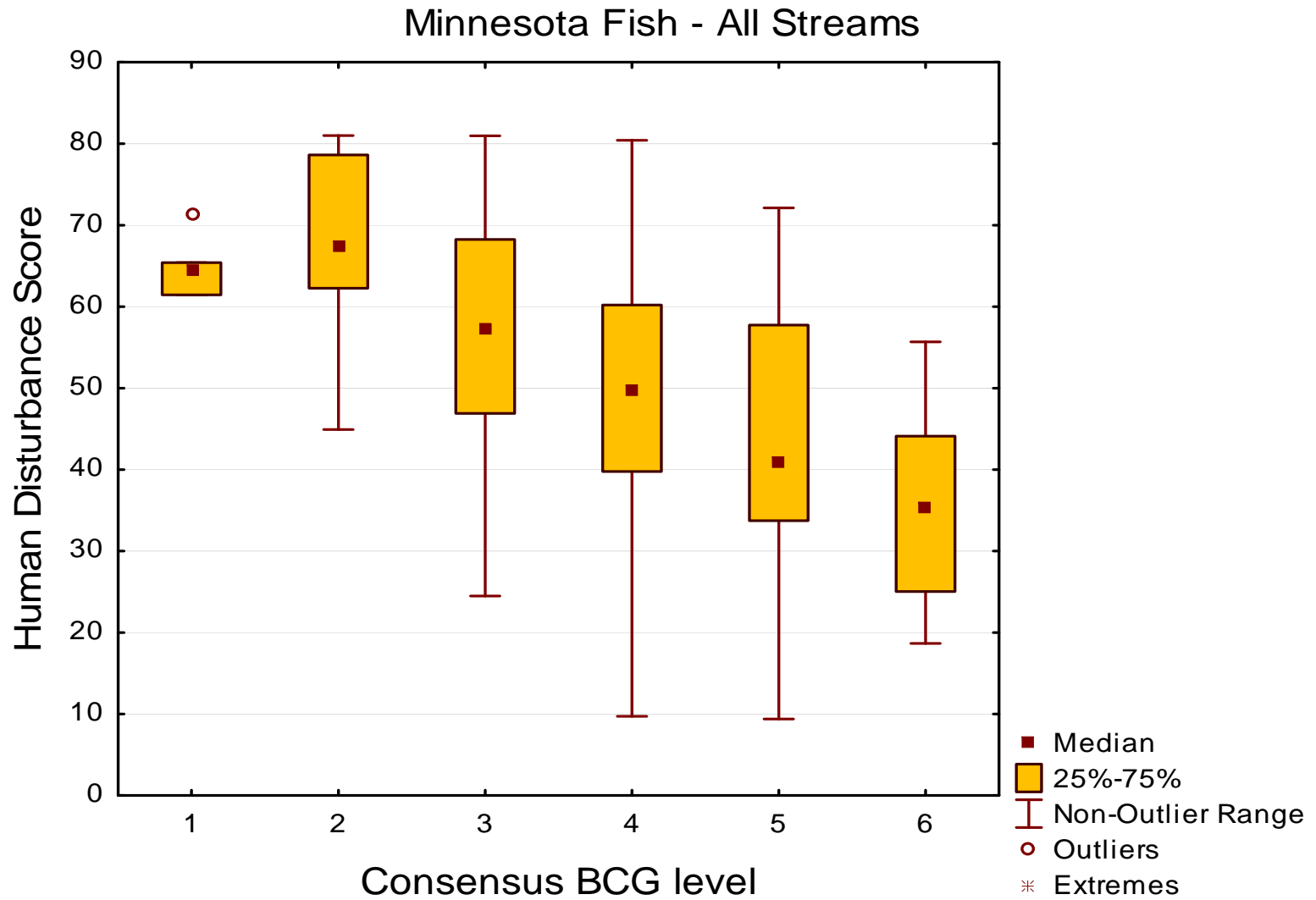
nonnative trout



really cool bugs

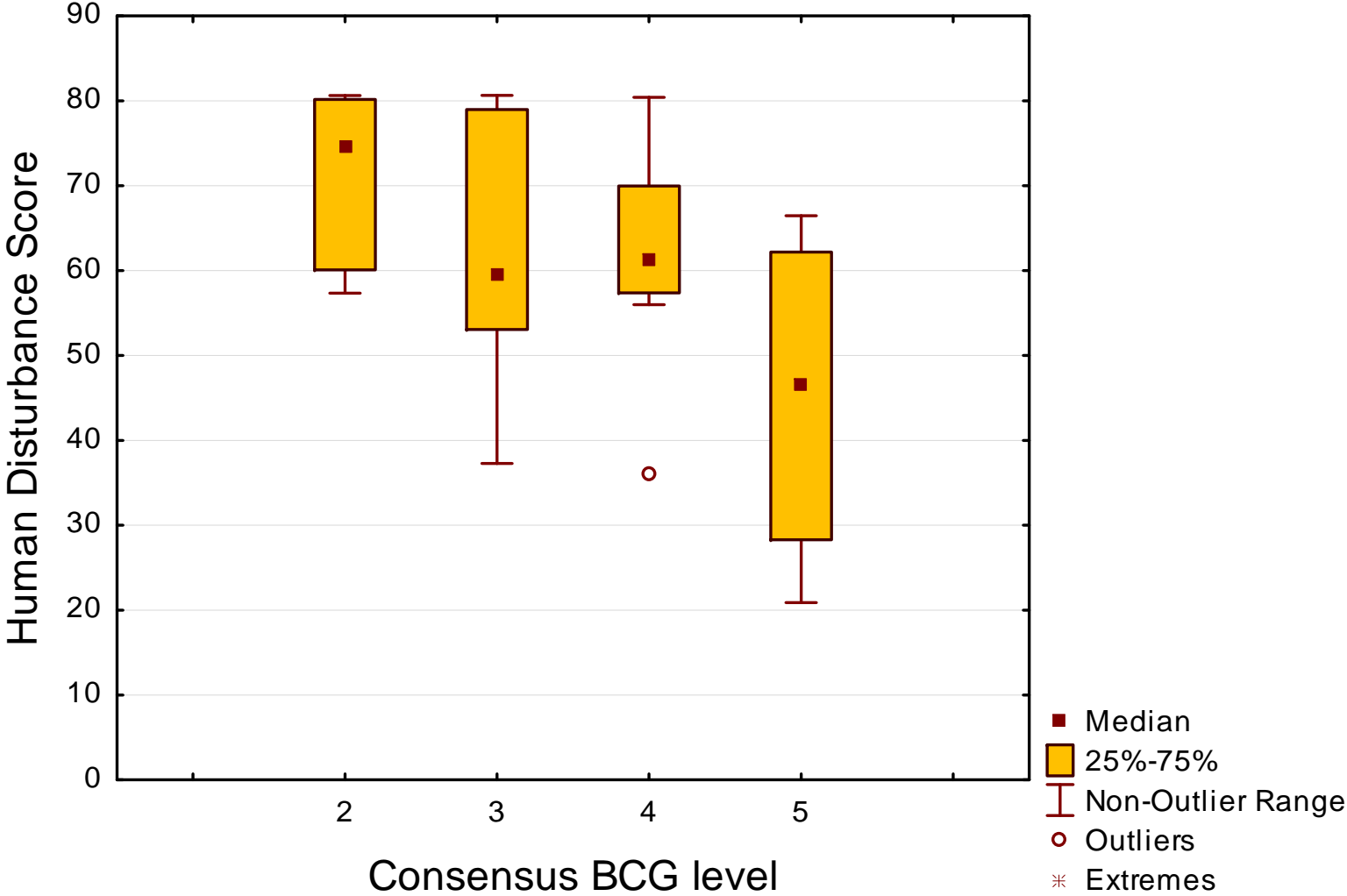


Panel BCG decisions and the Disturbance Gradient



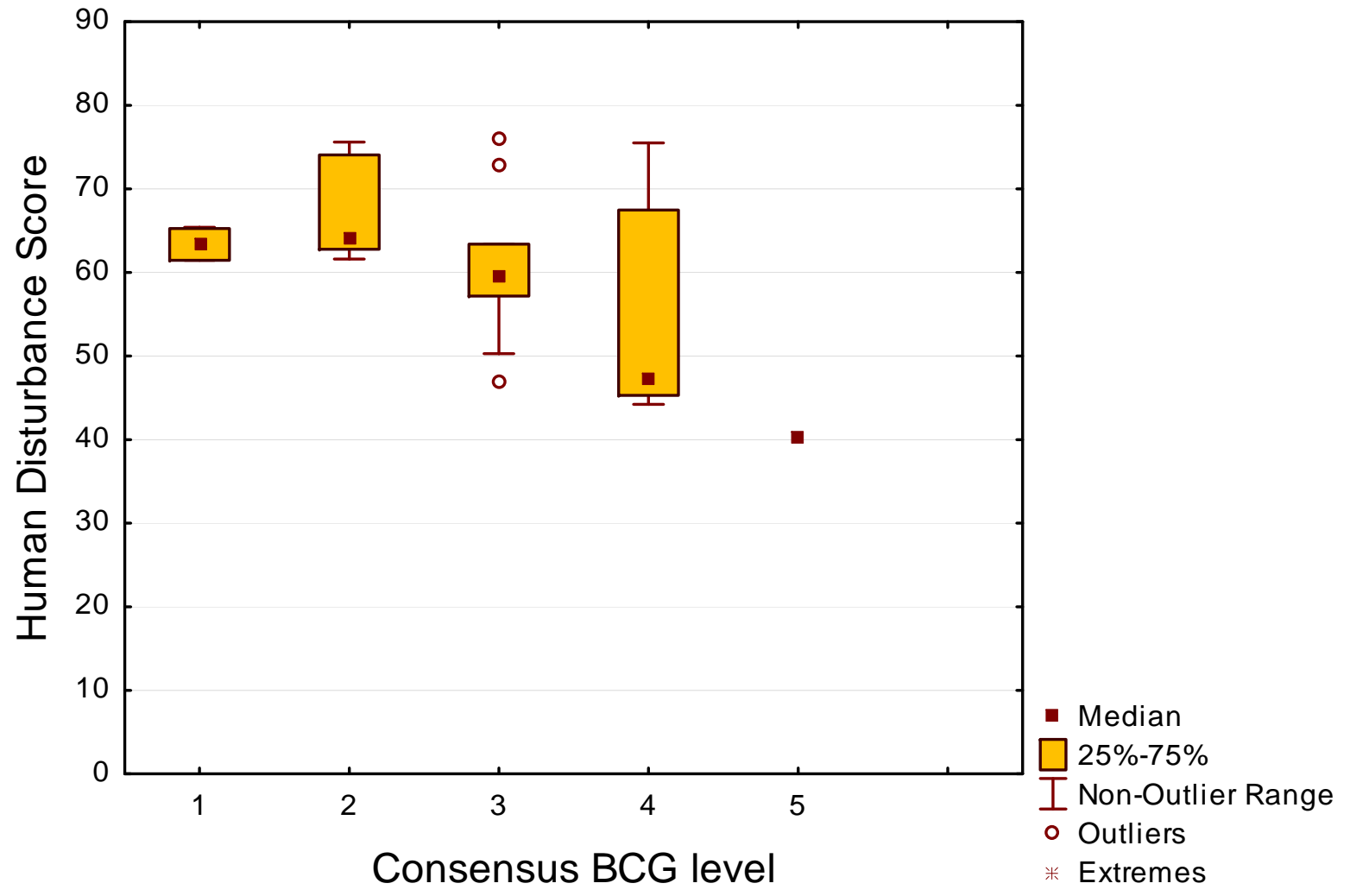
Northern Wadeable Streams

Fish



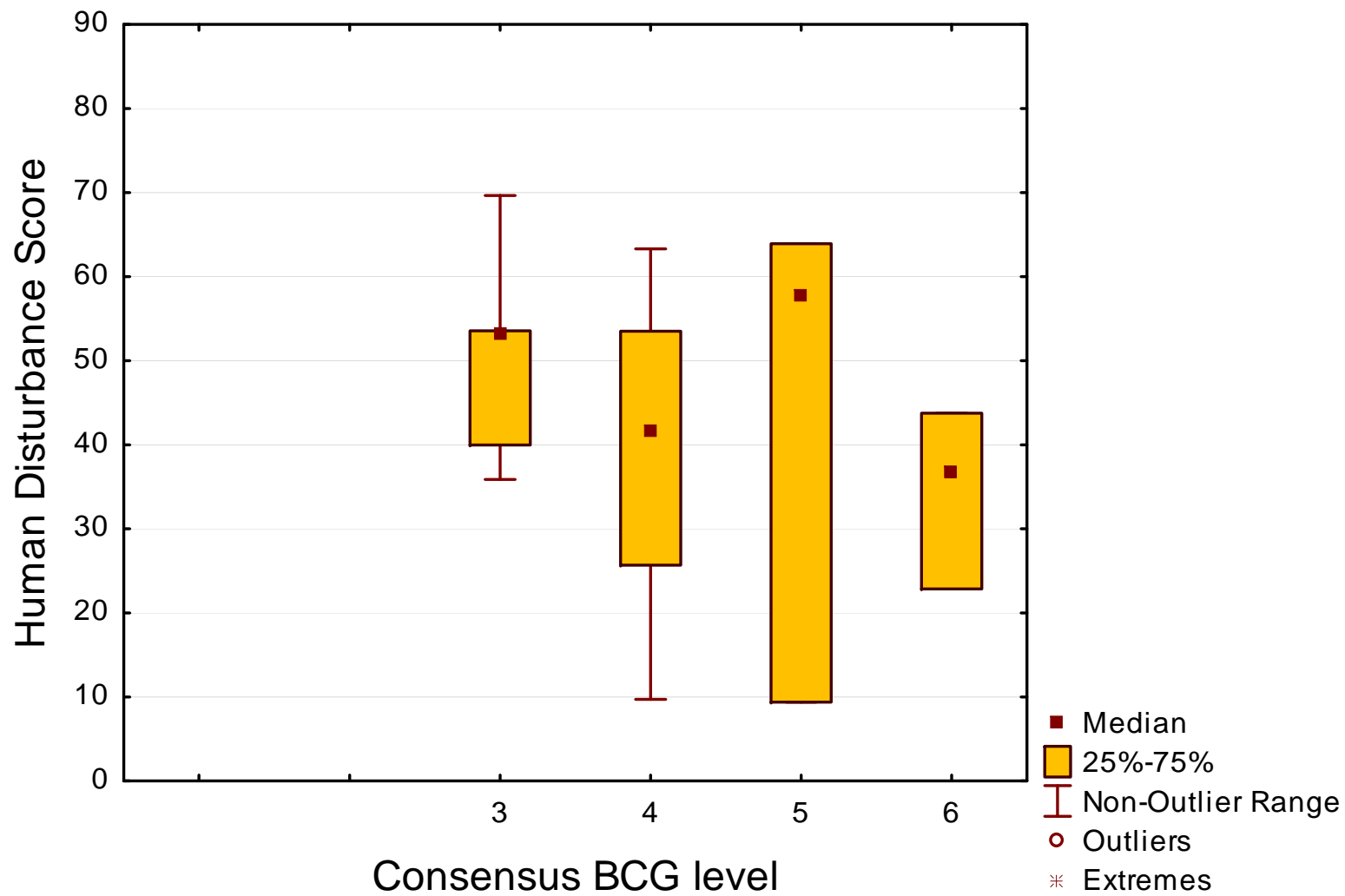
Northern Forest Rivers

Fish



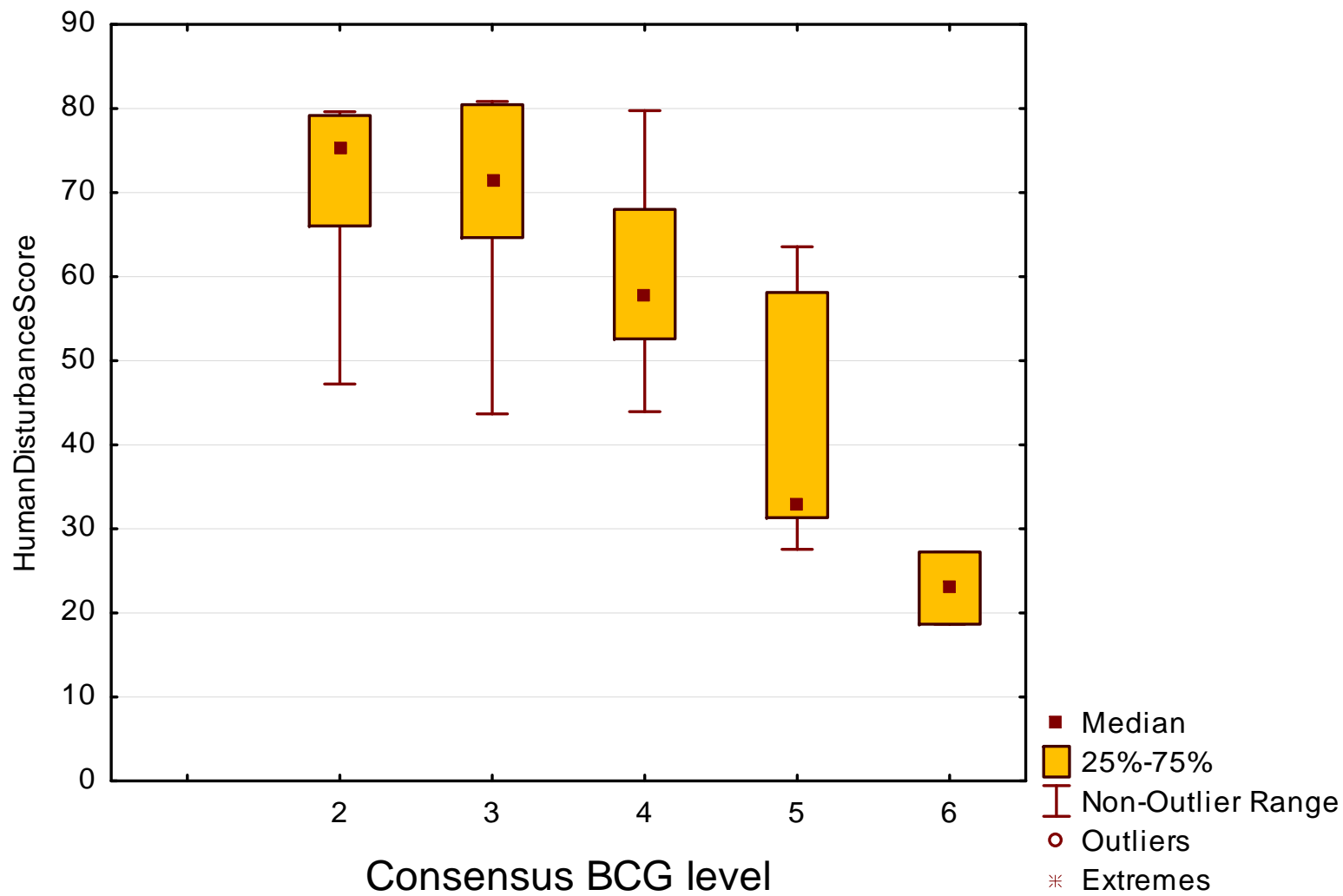
Southern Headwater Streams

Fish



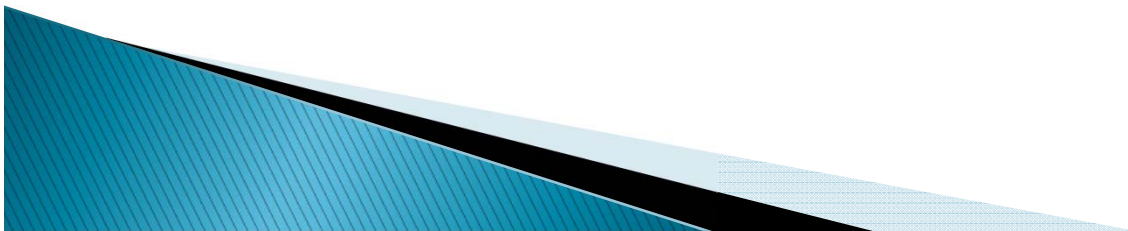
Wetland Dominated Streams

Fish



Lessons – assemblages

- ▶ Fish:
 - historical observations
 - museum collections, archeology
 - historic distributions of spp. generally known
- ▶ Invertebrates:
 - museum collections
 - historical distributions not generally known.
 - Mussels: middens, if documented



Lessons Learned – reference

- ▶ Professional experience informs expectations
- ▶ Reference sites provide ground truth
- ▶ Professional experience bolsters expectations for (nonexistent) minimally disturbed
 - Based on ecological considerations, not a particular data set
 - not dependent on statistical comparison to specific reference set
- ▶ Classification is critical!



