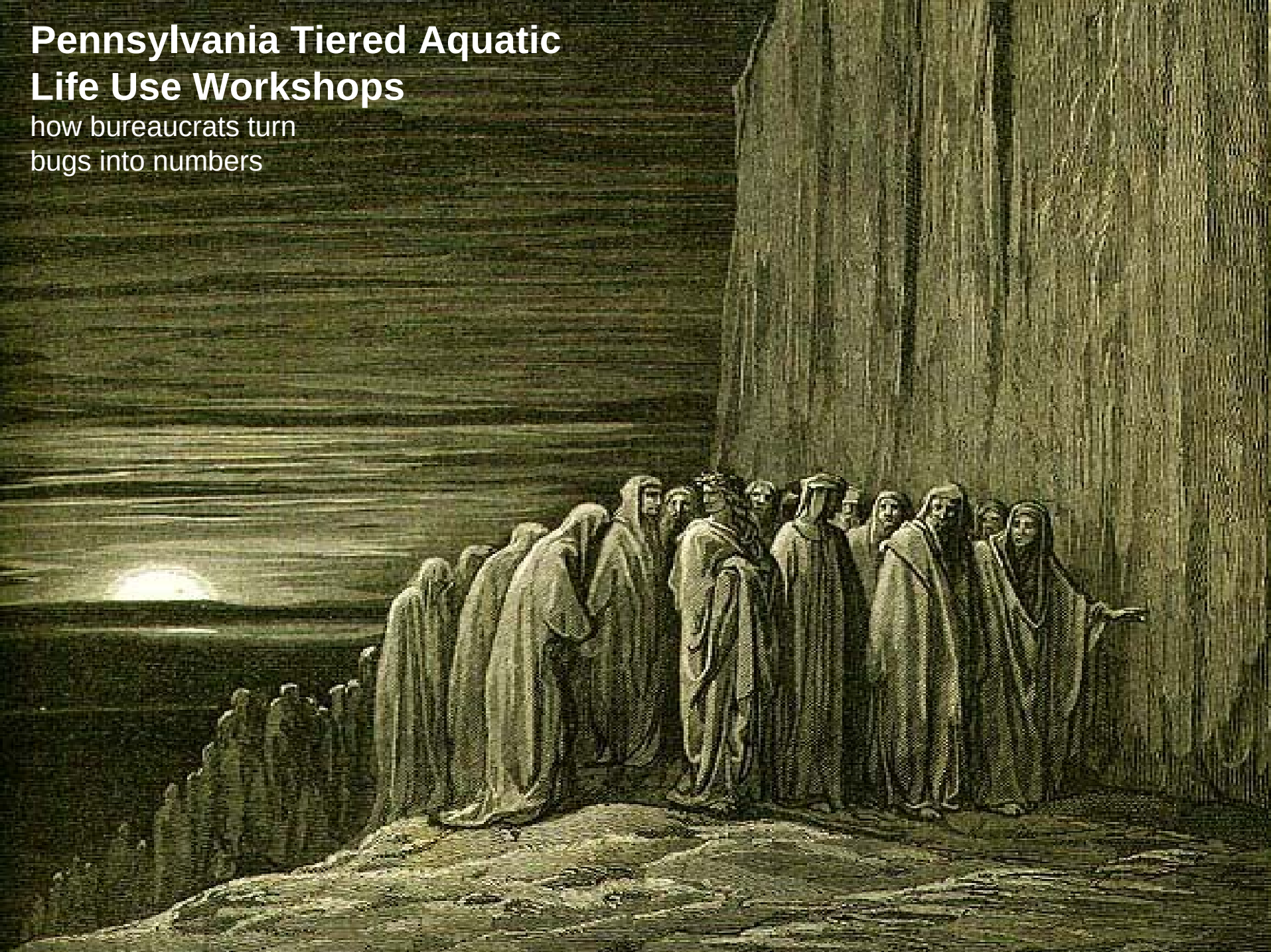
Pennsylvania Tiered Aquatic Life Use Workshops

how bureaucrats turn bugs into numbers



Pennsylvania Tiered Aquatic Life Use Workshops

how bureaucrats turn
bugs into numbers

Bug pictures taken by **Gary Kenderes** and organized by **Rick Spear**

August 8 – 9, 2006
PA TALU workshop

IDENTIFICATION OF THE BIOLOGICAL CONDITION GRADIENT FOR FREESTONE (NON-CALCAREOUS) STREAMS OF PENNSYLVANIA

Prepared for:

U.S. EPA Office of Science and Technology
Susan Jackson, Work Assignment Manager

U.S. EPA, Region 3
Maggie Passmore

Pennsylvania Department of Environmental Protection
Rod Kime

Prepared by:

Jeroen Gerritsen
Ben Jessup

Tetra Tech, Inc.
400 Red Brook Boulevard, Suite 200
Owings Mills, MD 21117

February 2007

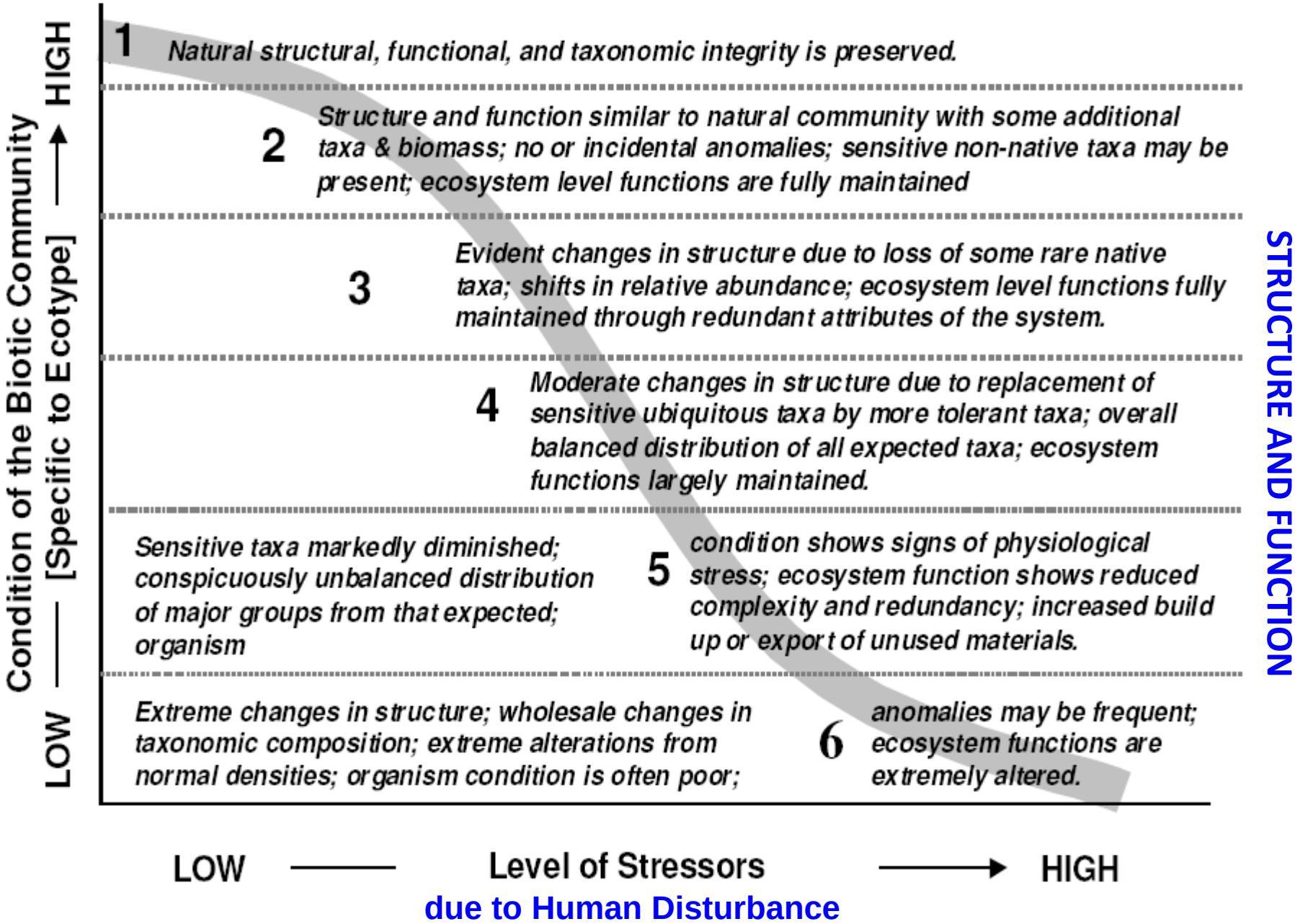


FIGURE 1-1. Conceptual model of the Biological Condition Gradient.

Ecological Attributes	Biological Condition Gradient Tiers					
	1 Natural or native condition	2 Minimal changes in the structure of the biotic community and minimal changes in ecosystem function	3 Evident changes in structure of the biotic community and minimal changes in ecosystem function	4 Moderate changes in structure of the biotic community and minimal changes in ecosystem function	5 Major changes in structure of the biotic community and moderate changes in ecosystem function	6 Severe changes in structure of the biotic community and major loss of ecosystem function
	Native structural, functional and taxonomic integrity is preserved; ecosystem function is preserved within the range of natural variability	Virtually all native taxa are maintained with some changes in biomass and/or abundance; ecosystem functions are fully maintained within the range of natural variability	Some changes in structure due to loss of some rare native taxa; shifts in relative abundance of taxa but Sensitive-ubiquitous taxa are common and abundant; ecosystem functions are fully maintained through redundant attributes of the system	Moderate changes in structure due to replacement of some Sensitive-ubiquitous taxa by more tolerant taxa, but reproducing populations of some Sensitive taxa are maintained; overall balanced distribution of all expected major groups; ecosystem functions largely maintained through redundant attributes	Sensitive taxa are markedly diminished; conspicuously unbalanced distribution of major groups from that expected; organism condition shows signs of physiological stress; system function shows reduced complexity and redundancy; increased build-up or export of unused materials	Extreme changes in structure; wholesale changes in taxonomic composition; extreme alterations from normal densities and distributions; organism condition is often poor; ecosystem functions are severely altered

I Historically documented, sensitive, long-lived or regionally endemic taxa	As predicted for natural occurrence except for global extinctions	As predicted for natural occurrence except for global extinctions	Some may be absent due to global extinction or local extirpation	Some may be absent due to global, regional or local extirpation	Usually absent	Absent
II Sensitive-rare taxa	As predicted for natural occurrence, with at most minor changes from natural densities	Virtually all are maintained with some changes in densities	Some loss, with replacement by functionally equivalent Sensitive-ubiquitous taxa	May be markedly diminished	Absent	Absent
III Sensitive-ubiquitous taxa	As predicted for natural occurrence, with at most minor changes from natural densities	Present and may be increasingly abundant	Common and abundant; relative abundance greater than Sensitive-rare, taxa	Present with reproducing populations maintained; some replacement by functionally equivalent taxa of intermediate tolerance.	Frequently absent or markedly diminished	Absent
IV Taxa of intermediate tolerance	As predicted for natural occurrence, with at most minor changes from natural densities	As naturally present with slight increases in abundance	Often evident increases in abundance	Common and often abundant; relative abundance may be greater than Sensitive-ubiquitous taxa	Often exhibit excessive dominance	May occur in extremely high OR extremely low densities; richness of all taxa is low
V Tolerant taxa	As naturally occur, with at most minor changes from natural densities	As naturally present with slight increases in abundance	May be increases in abundance of functionally diverse tolerant taxa	May be common but do not exhibit significant dominance	Often occur in high densities and may be dominant	Usually comprise the majority of the assemblage; often extreme departures from normal densities (high or low)

VI Non-native or intentionally introduced taxa	Non-native taxa, if present, do not displace native taxa or alter native structural or functional integrity	Non-native taxa may be present, but occurrence has a non-detrimental effect on native taxa	Sensitive or intentionally introduced non-native taxa may dominate some assemblages (e.g. fish or macrophytes)	Some replacement of sensitive non-native taxa with functionally diverse assemblage of non-native taxa of intermediate tolerance	Some assemblages (e.g., fish or macrophytes) are dominated by tolerant non-native taxa	Often dominant; may be the only representative of some assemblages (e.g., plants, fish, bivalves)
VII Organism Condition (especially of long-lived organisms)	Any anomalies are consistent with naturally occurring incidence and characteristics	Any anomalies are consistent with naturally occurring incidence and characteristics	Anomalies are infrequent	Incidence of anomalies may be slightly higher than expected	Biomass may be reduced; anomalies increasingly common	Long-lived taxa may be absent; Biomass reduced; anomalies common and serious; minimal reproduction except for extremely tolerant groups
VIII Ecosystem Functions	All are maintained within the natural range of variability	All are maintained within the natural range of variability	Virtually all are maintained through functionally redundant system attributes; minimal increase in export except at high storm flows	Virtually all are maintained through functionally redundant system attributes though there is evidence of loss of efficiency (e.g., increased export or decreased import)	There is apparent loss of some ecosystem functions manifested as increased export or decreased import of some resources, and changes in energy exchange rates (e.g., P/R; decomposition)	Most functions show extensive and persistent disruption

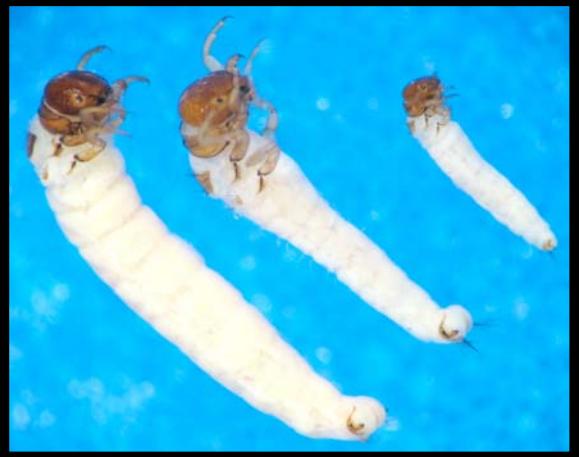
don’t really measure

FFG?

IX Spatial and temporal extent of detrimental effects	N/A A natural disturbance regime is maintained	Limited to small pockets and short duration	Limited to the reach scale and/or limited to within a season	Mild detrimental effects may be detectable beyond the reach scale and may include more than one season	Detrimental effects extend far beyond the reach scale leaving only a few islands of adequate conditions; effect extends across multiple seasons	Detrimental effects may eliminate all refugia and colonization sources within the catchment and affect multiple seasons
X Ecosystem connectance	System is highly connected in space and time, at least annually	Ecosystem connectance is unimpaired	Slight loss of connectance but there are adequate local recolonization sources	Some loss of connectance but colonization sources and refugia exist within the catchment	Significant loss of ecosystem connectance is evident; recolonization sources do not exist for some taxa	Complete loss of ecosystem connectance in at least one dimension (i.e., longitudinal, lateral, vertical, or temporal) lowers reproductive success of most groups; frequent failures in reproduction & recruitment

landscape level?

landscape level?



Microsoft Excel - APP_D_TALU PA Wrkshp 20061004.xls

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H18 fx Baetidae

1,221 total taxa

52

	Count of ID Lev	Pct of Samples	BCG Attribu	FinalID	Comment	IDLEVEL	HILS_of_IDl	Phylum	Class	Order	Family (Tribe)	Genus	Species	CODI	Fi ID Le
10	2	0	x	Ephemeroptera		Ephemeroptera		Arthrop	Insecta	Ephemeroptera				1E+09	Or
12	100	7	2	Ameletus		Ameletus	0	Arthrop	Insecta	Ephemeroptera	Ameletidae	Ameletus		1E+09	Ge
13	3	0	x	Siphlonuridae		Siphlonuridae	7	Arthrop	Insecta	Ephemeroptera	Siphlonuridae			1E+09	Fa
14	3	0	x	Siphlonisca		Siphlonisca	7	Arthrop	Insecta	Ephemeroptera	Siphlonuridae	Siphlonisca		1E+09	Ge
15	2	0	x	Siphlonurus		Siphlonurus	7	Arthrop	Insecta	Ephemeroptera	Siphlonuridae	Siphlonurus		1E+09	Ge
18	56	4	3	Baetidae		Baetidae	6	Arthrop	Insecta	Ephemeroptera	Baetidae			1E+09	Fa
19	431	29	3	Acentrella		Acentrella	4	Arthrop	Insecta	Ephemeroptera	Baetidae	Acentrella		1E+09	Ge
20	64	4	3	Acerpenna		Acerpenna	6	Arthrop	Insecta	Ephemeroptera	Baetidae	Acerpenna		1E+09	Ge
21	944	63	4	Baetis		Baetis	6	Arthrop	Insecta	Ephemeroptera	Baetidae	Baetis		1E+09	Ge
23	1	0	4	Callibaetis		Callibaetis	9	Arthrop	Insecta	Ephemeroptera	Baetidae	Callibaetis		1E+09	Ge
24	35	2	2	Centroptilum		Centroptilum	2	Arthrop	Insecta	Ephemeroptera	Baetidae	Centroptilum		1E+09	Ge
25	14	1	3	Cloeon		Cloeon	4	Arthrop	Insecta	Ephemeroptera	Baetidae	Cloeon		1E+09	Ge
26	6	0	x	Diphetor		Diphetor	6	Arthrop	Insecta	Ephemeroptera	Baetidae	Diphetor		1E+09	Ge
28	1	0	x	Labiobaetis		Labiobaetis	2	Arthrop	Insecta	Ephemeroptera	Baetidae	Labiobaetis		1E+09	Ge
29	2	0	x	Procloeon		Procloeon	6	Arthrop	Insecta	Ephemeroptera	Baetidae	Procloeon		1E+09	Ge
30	56	4	3	Heterocloeon		Heterocloeon	2	Arthrop	Insecta	Ephemeroptera	Baetidae	Heterocloeon		1E+09	Ge
31	17	1	x	Plauditus		Plauditus	4	Arthrop	Insecta	Ephemeroptera	Baetidae	Plauditus		1E+09	Ge
33	511	34	3	Isonychia		Isonychia	3	Arthrop	Insecta	Ephemeroptera	Oligoneuriidae	Isonychia		1E+09	Ge
34	147	10	x	Heptageniidae		Heptageniidae	3	Arthrop	Insecta	Ephemeroptera	Heptageniidae			1E+09	Fa
35	675	45	2	Epeorus		Epeorus	0	Arthrop	Insecta	Ephemeroptera	Heptageniidae	Epeorus		1E+09	Ge
36	69	5	2	Heptagenia		Heptagenia	4	Arthrop	Insecta	Ephemeroptera	Heptageniidae	Heptagenia		1E+09	Ge
37	247	16	2	Leucrocuta	disagreemen	Leucrocuta	1	Arthrop	Insecta	Ephemeroptera	Heptageniidae	Leucrocuta		1E+09	Ge

StatusPage / Map / Attendees / MasterTaxaList / Sample_Info / DistGradInfo / Sample_Bugs / A_001 / A_002 / A_003 / A_004 / A_0(

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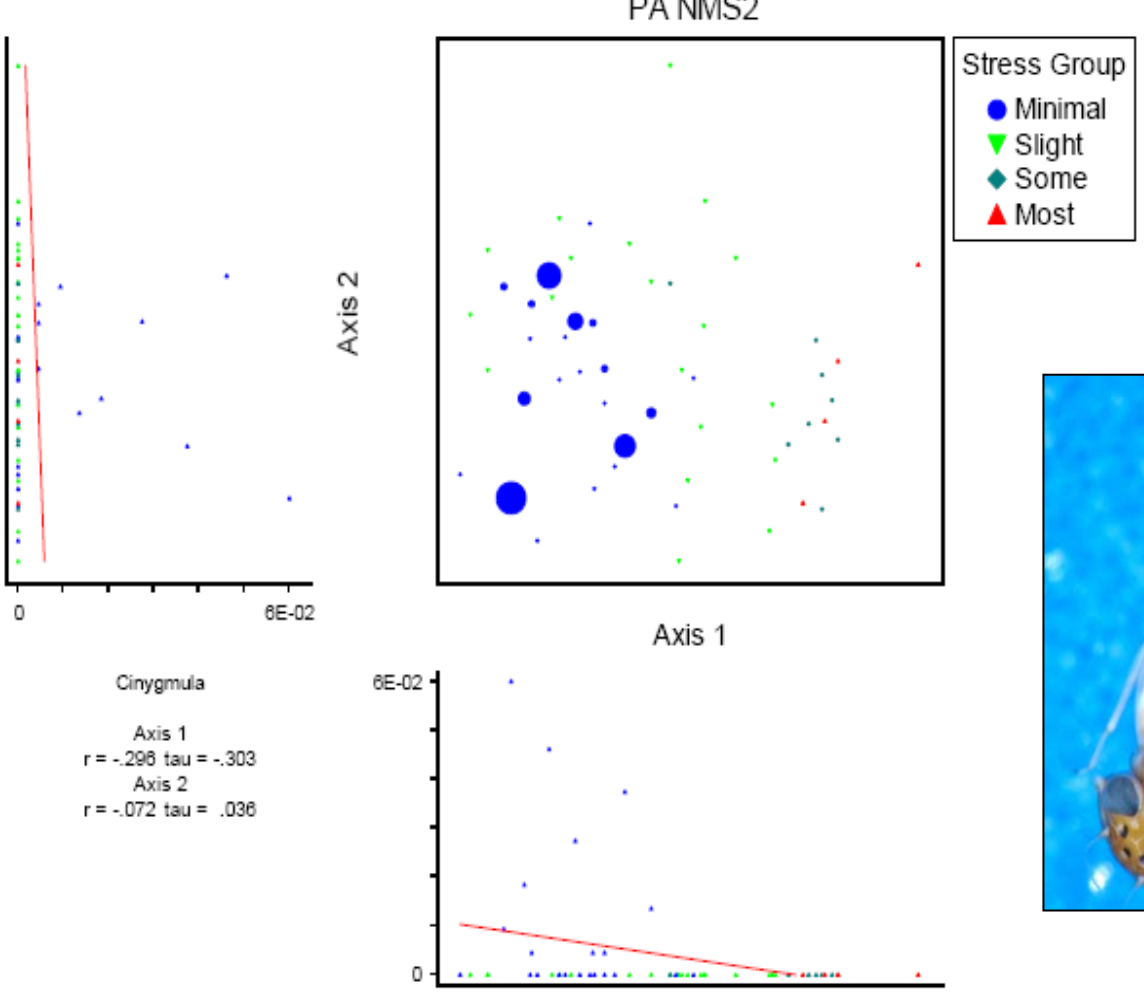

Figure 4. Occurrence and relative abundance of *Cynigmula* in ordination space. The large plot with large symbols is the NMS ordination plot, with size of the symbols indicating relative abundance of *Cynigmula*. The 2 smaller scatterplots to the left and below the large plot are relative abundance of *Cynigmula* on each of the ordination axes. Correlation coefficients for *Cynigmula* relative abundance are shown for each axis: r is the Pearson correlation coefficient; tau is the Spearman rank-order correlation coefficient. Note that *Cynigmula* is most abundant at low (left-hand) values of Axis 1, but has no relationship with Axis 2. This is also reflected in the correlation coefficients. In this figure, Axis 1 defines the stressor gradient, with least stressed sites occurring to the left of axis 1. *Cynigmula* occurs exclusively in least-stressed sites (blue), and is never dominant (maximum relative abundance 6%). *Cynigmula* is an example of a typical Attribute II taxon (highly sensitive).

Table 1. Breakdown of macroinvertebrate taxa by attribute group.

Ecological Attribute	Number of taxa	Example Taxa
I Endemic, rare	1	*Litobrancha* (Ephemeroptera: Ephemeridae)
II Highly Sensitive	35	*Cynigmula*, *Drunella*, *Pteronarcys*, *Isoperla*, *Diplectrona*, *Rhyacophila*
III Intermediate Sensitive	50	*Oulimnius*, *Hexatoma*, *Ephemerella*, *Nigronia*, *Lanthus*, *Leuctra*, *Neophylax*
IV Intermediate Tolerant, (Indifferent)	44	*Naididae*, *Gammarus*, *Optioservus*, *Chimarra*, *Cheumatopsyche*
V Tolerant	17	Tubificidae, *Stenelmis*, Chironomidae
VI Exotic, Invasive	1	*Corbicula*
x unassigned	17	

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Example 1. Sample spreadsheet reviewed by PA biologists.

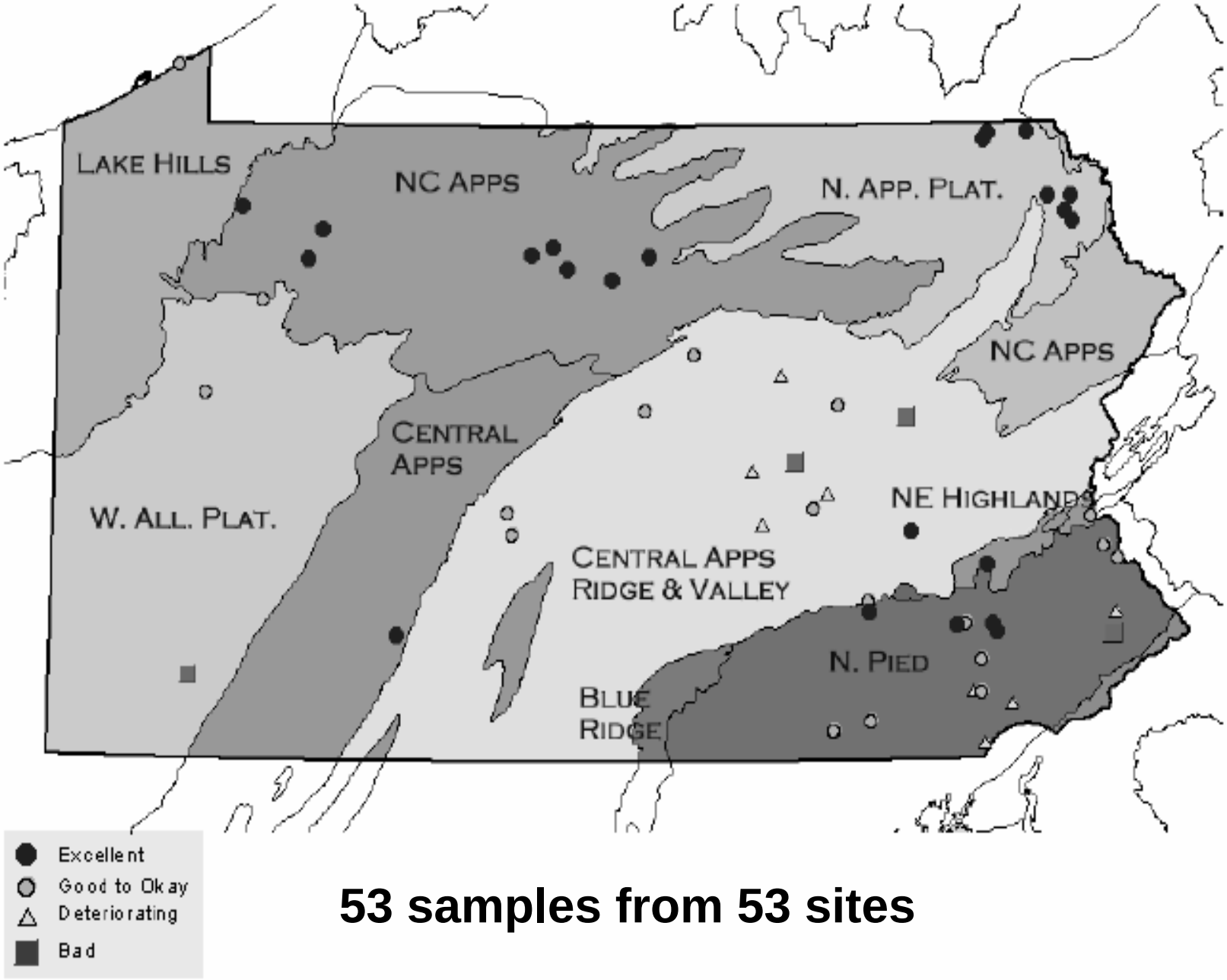
StationID	20020515-1635-CAM	Assigned Tier	Reasoning	Group Tier
TALUSampID	003	1.6	enter text here	1.5952
CollectDate	2002-05-15	Group	A	
BCG Attr.	Taxa	Individuals	Taxa	Individuals
1	0	0	0	0
2	13	111	22	179
3	9	68		
4	5	21	8	38
5	3	17		
6	0	0	0	0
x	2	2	2	2
Total	*32*	*219*		

BCG Attr.	FinalID	Individuals	Order	Family (Tribe)
4	Baetis	8	Ephemeroptera	Baetidae
2	Epeorus	52	Ephemeroptera	Heptageniidae
4	Stenacron	1	Ephemeroptera	Heptageniidae
3	Stenonema	1	Ephemeroptera	Heptageniidae
2	Cinygmula	13	Ephemeroptera	Heptageniidae
2	Drunella	8	Ephemeroptera	Ephemerellidae
3	Ephemerella	5	Ephemeroptera	Ephemerellidae
2	Habrophlebiodes	2	Ephemeroptera	Leptophlebiidae
2	Paraleptophlebia	2	Ephemeroptera	Leptophlebiidae
3	Lanthus	1	Odonata	Gomphidae
2	Pteronarcys	13	Plecoptera	Pteronarcidae
3	Amphinemura	14	Plecoptera	Nemouridae
3	Leuctra	21	Plecoptera	Leuctridae
2	Isoperla	1	Plecoptera	Perlodidae
2	Suwallia	3	Plecoptera	Chloroperlidae
3	Sweltsa	4	Plecoptera	Chloroperlidae
2	Dolophilodes	1	Trichoptera	Philopotamidae
2	Parapsyche	2	Trichoptera	Hydropsychidae
2	Diplectrona	1	Trichoptera	Hydropsychidae
2	Rhyacophila	8	Trichoptera	Rhyacophilidae
2	Lepidostoma	5	Trichoptera	Lepidostomatidae
3	Neophylax	11	Trichoptera	Uenoidae
4	Chelifera	6	Diptera	Empididae
x	Oreogeton	1	Diptera	Empididae
4	Dicranota	2	Diptera	Tipulidae
3	Hexatoma	1	Diptera	Tipulidae
3	Prosimulium	10	Diptera	Simuliidae
4	Simulium	4	Diptera	Simuliidae
5	Chironomidae	15	Diptera	Chironomidae
5	Gyraulus	1	Basommatophora	Planorbidae
5	Oligochaeta	1	Haplotaxida	
x	Stygonectes	1	Amphipoda	Crangonyctidae

Example 2. Sample spreadsheet reviewed by PA biologists.

StationID	20031030-1400-AAK	Assigned Tier	Reasoning	Group Tier
TALUSampID	047	5.8	enter text here	5.7619
Collection Date	2003-10-30	Group	A	
BCG Attribute	Taxa	Individuals	Taxa	Individuals
1	0	0	0	0
2	0	0	1	1
3	1	1		
4	4	128	9	196
5	5	68		
6	0	0	0	0
x	0	0	0	0
Total	*10*	*197*		

BCG Attribute	FinalID	Individuals	Order	Family (Tribe)
4	Cheumatopsyche	14	Trichoptera	Hydropsychidae
4	Hydropsyche	104	Trichoptera	Hydropsychidae
3	Glossosoma	1	Trichoptera	Glossosomatidae
4	Tipula	7	Diptera	Tipulidae
5	Chironomidae	7	Diptera	Chironomidae
5	Physidae	2	Basommatophora	Physidae
4	Sphaerium	3	Veneroida	Pisidiidae
5	Hirudinea	14		
5	Oligochaeta	23	Haplotaxida	
5	Caecidotea	22	Isopoda	Asellidae



53 samples from 53 sites

Figure 3. Distribution of calibration data set across Pennsylvania, showing ecoregions.

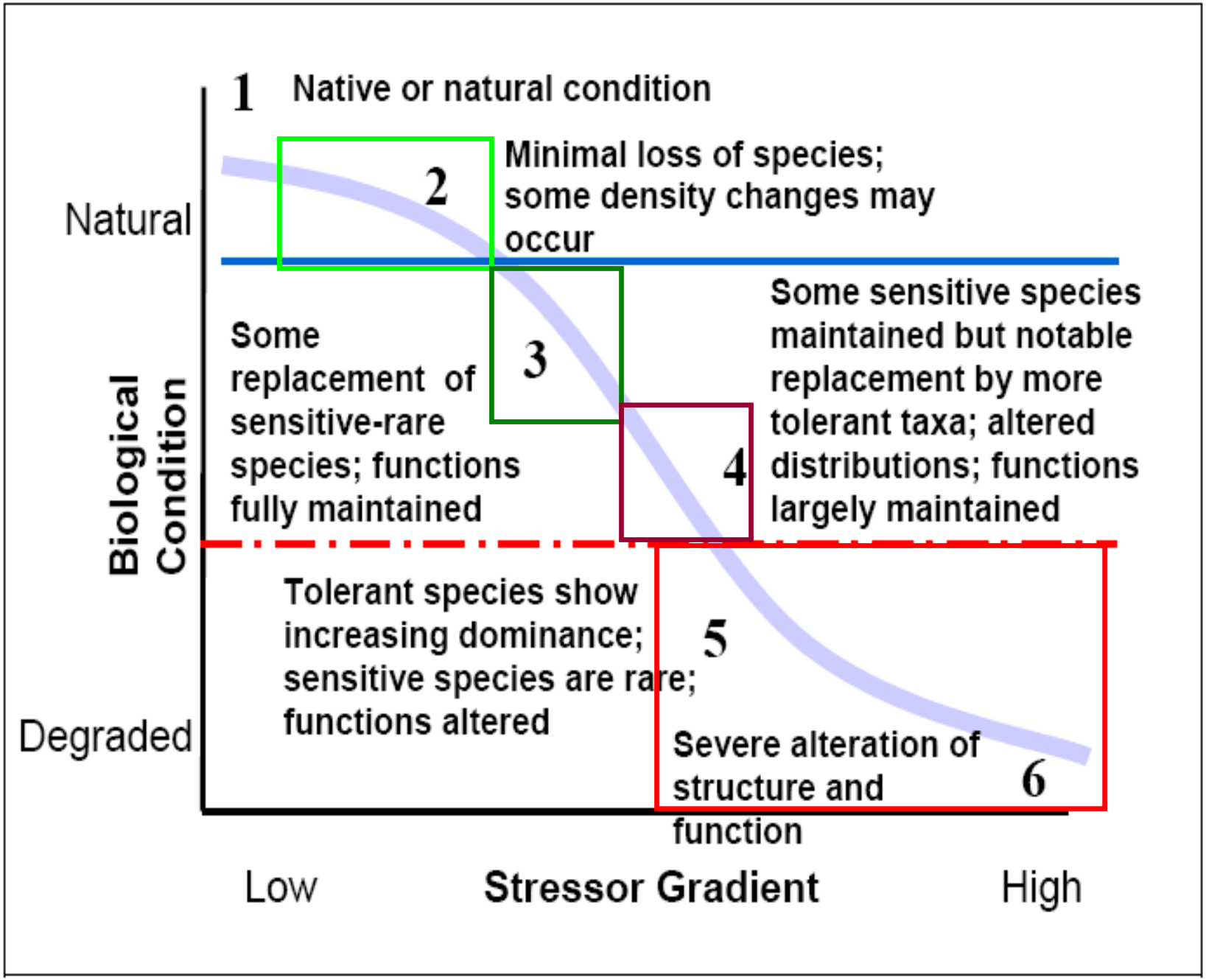
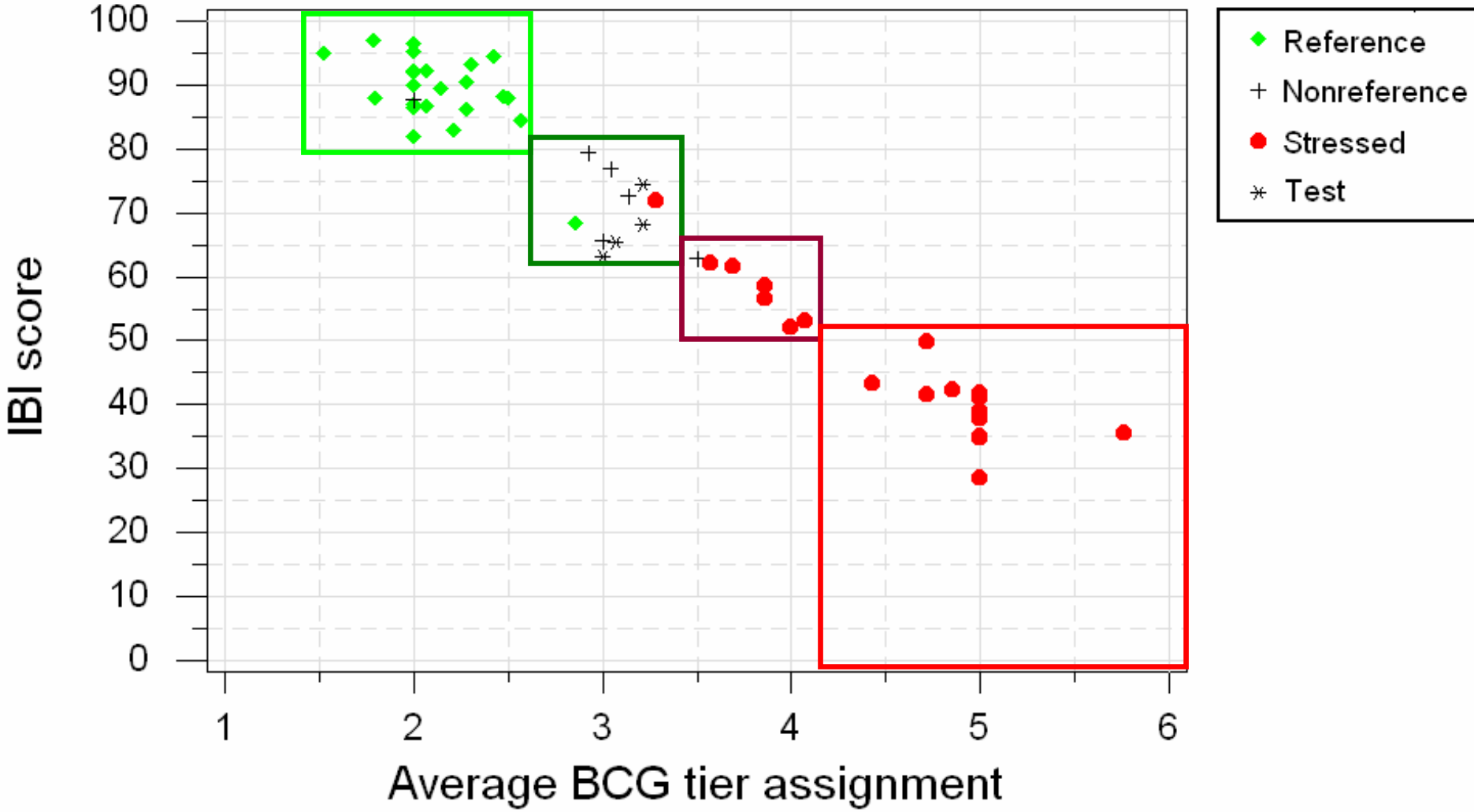
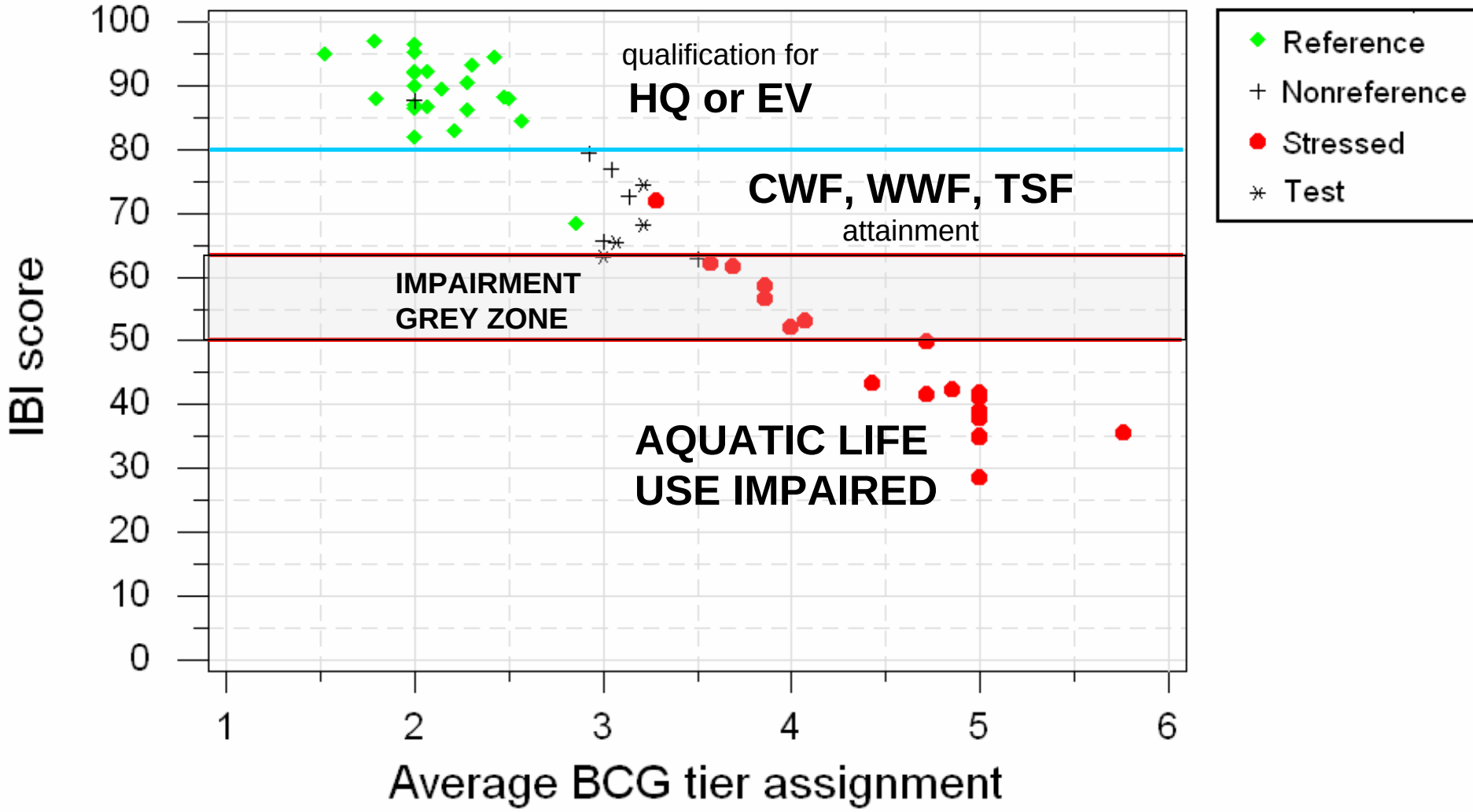


Figure 16. The Biological Condition Gradient – a conceptual model depicting stages of biological condition responses to an increasing stressor gradient – *adapted from Davies and Jackson 2006.*


IBI score
100
90
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
Average BCG tier assignment
Reference
Nonreference
Stressed
Test


qualification for
HQ or EV
CWF, WWF, TSF
attainment
IMPAIRMENT
GREY ZONE
AQUATIC LIFE
USE IMPAIRED
IBI score
Average BCG tier assignment
Reference
Nonreference
Stressed
Test
100
90
80
70
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10
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1
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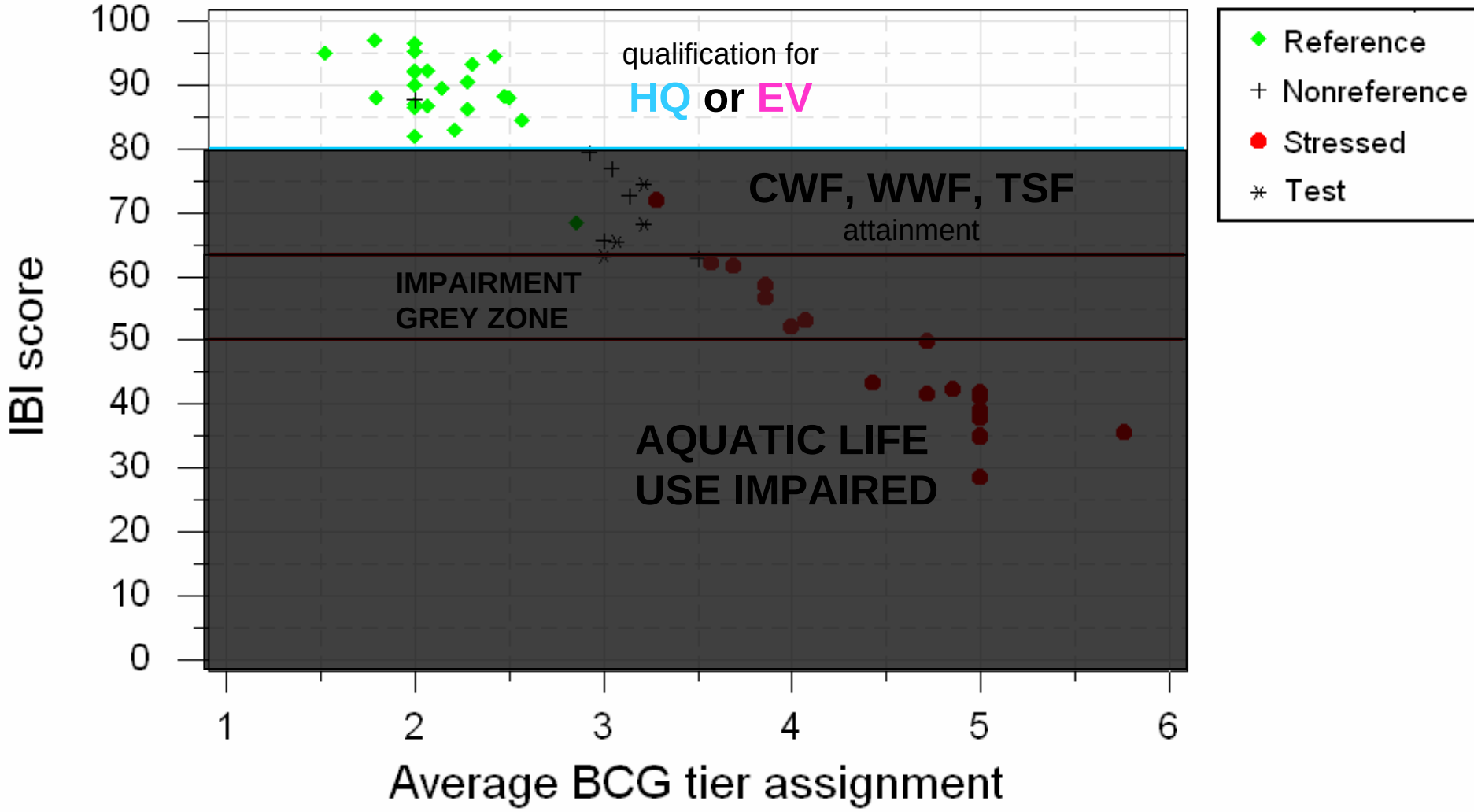
August 22 – 23, 2007
PA TALU workshop



Description of BCG Attribute values used at August 2007 TALU workshop

I. <u>Extremely Sensitive and Extremely Rare, Historically-documented, Long-lived, or Regionally-endemic Taxa</u>:

refers to taxa that are extremely sensitive to anthropogenic disturbance, naturally occur in extremely low numbers relative to total population density, and usually make up a very small relative proportion of richness. These taxa are extremely rare to encounter in conventional samples and are generally encountered in less than 20% of DEP 6 D-frame kick, 200 organism sub-samples. These taxa are almost always the first taxa observed to be lost from a community under anthropogenic stress. These taxa are often habitat specialists (i.e., can only live in very specific habitat conditions).

This attribute also includes taxa that are known to have been supported in a waterbody or region prior to enactment of the Clean Water Act, according to historical records compiled by state or federal agencies or published scientific literature. Sensitive or regionally endemic taxa have restricted, geographically isolated distribution patterns (occurring only in a locale as opposed to a region), often due to unique life history requirements. They may be long-lived, late maturing, low fecundity, limited mobility, or require a mutualist relation with other species. May be among listed endangered/threatened or special concern species. Predictability of occurrence is often low, therefore, requiring documented observation. Recorded occurrence may be highly dependent on sample methods, site selection and level of effort.

Description of BCG Attribute values used at August 2007 TALU workshop

II. <u>Highly Sensitive and Somewhat Rare Taxa</u>:

taxa that are highly sensitive to anthropogenic disturbance and naturally occur in low numbers relative to total population density, but may make up large relative proportion of richness. They may be ubiquitous in occurrence or may be restricted to certain microhabitats, but because of low density, recorded occurrence is dependent on sample effort. Often stenothermic (having a narrow range of thermal tolerance) or cold-water obligates; they are commonly k-strategists (populations maintained at a fairly constant level; slower development; longer life-span). They may have specialized food resource needs or feeding strategies and are generally intolerant to significant alteration of the physical or chemical environment; is often the first taxa observed to be lost from a community.

Description of BCG Attribute values used at August 2007 TALU workshop

III. <u>Sensitive and Common Taxa</u>:

taxa that are sensitive to anthropogenic stress and are ordinarily common and abundant in natural communities when conventional sample methods are used. They often have a broader range of thermal tolerance than BCG Attribute I and II taxa. These are taxa that naturally occur in greater densities than BCG Attribute I and II taxa, often comprise a substantial portion of natural communities, and that often exhibit negative response (loss of population, richness) at mild levels of anthropogenic stress.

Taxonomic Order	Taxa Name	August 2006 Attribute	August 2007 Attribute
Diptera	Blepharicera	2	1
	Twinnia	2	x (not found in PA)
Ephemeroptera	Cinygmula	2	1
	Nixe	2	*** 1
	Diphetor	x	2
	Anthopotamus	3	*** 2
	Ephoron	3	*** 2
Hemiptera	Neoplea	2	x (not found in PA)
Odonata	Lanthus	3	2
Trichoptera	Adicrophleps	2	1
	Goera	2	1
	Heteroplectron	2	1
	Odontoceridae	2	1
	Palaeagapetus	2	1
	Parapsyche	2	1
	Psilotreta	2	1
	Theliopsyche	2	1
	Wormaldia	2	1
	Agarodes	3	*** 1
	Protoptila	3	*** 1
	Apatania	3	2
	Hydatophylax	3	2
	Lype	3	2
	Molanna	3	2
	Psychomyia	3	2
	Ptilostomis	3	2
	Ceraclea	3	*** 2
	Mystacides	3	*** 2
	all Phryganeidae (except Ptilostomis)	3	x (not found in PA)

++ Tolerant of abandoned mine drainage

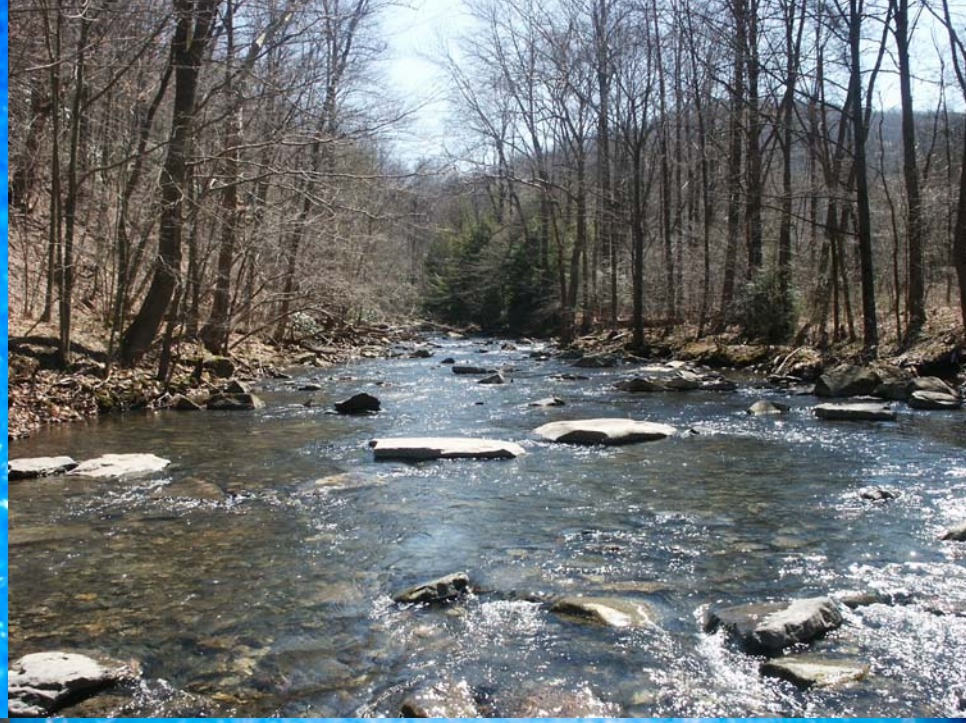
*** Usually only found in larger streams, warmer water environments, or non-riffle habitats

Taxonomic Order	Taxa Name	August 2006 Attribute	August 2007 Attribute
Plecoptera	Alloperla	2	1
	Isogenoides	2	1
	Malirekus	2	1
	Nemoura	2	1
	Ostrocerca	2	++ 1
	Peltoperla	2	1
	Pteronarcys	2	1
	Rasvena	2	1
	Remenus	2	1
	Shipsa	2	1
	Soyedina	2	++ 1
	Suwallia	2	1
	Taenionema	2	1
	Tallaperla	2	1
	Yugus	2	1
	Paraleuctra	3	1
	Cultus	2	*** 1
	Neoperla	2	*** 1
	Helopicus	3	*** 1
	Oemopteryx	3	2
	Paracapnia	3	2

++ Tolerant of abandoned mine drainage

*** Usually only found in larger streams, warmer water environments, or non-riffle habitats

Ephemerella
II or III



Acroneuria
II or III

Epeorus
II or III

ID Level	Individuals	Order	Family (Tribe)	BCG Attribute	Hilsenhof	FFG
Acentrella	10	Ephemeroptera	Baetidae	3	4	SC
Heptageniidae	1	Ephemeroptera	Heptageniidae	---	3	SC
Drunella	33	Ephemeroptera	Ephemerellidae	2	1	SC
Ephemerella	18	Ephemeroptera	Ephemerellidae	3	1	CG
Stylogomphus	1	Odonata	Gomphidae	4	4	PR
Amphinemura	30	Plecoptera	Nemouridae	3	3	SH
Acroneuria	17	Plecoptera	Perlidae	3	0	PR
Isoperla	1	Plecoptera	Perlodidae	2	2	PR
Haploperla	1	Plecoptera	Chloroperlidae	3	0	PR
Sweltsa	9	Plecoptera	Chloroperlidae	3	0	PR
Nigronia	2	Megaloptera	Corydalidae	3	2	PR
Dolophilodes	1	Trichoptera	Philopotamidae	2	0	FC
Polycentropus	2	Trichoptera	Polycentropodidae	4	6	FC
Diplectrona	30	Trichoptera	Hydropsychidae	2	0	FC
Cheumatopsyche	1	Trichoptera	Hydropsychidae	4	6	FC
Hydropsyche	3	Trichoptera	Hydropsychidae	4	5	FC
Rhyacophila	13	Trichoptera	Rhyacophilidae	2	1	PR
Psephenus	1	Coleoptera	Psephenidae	4	4	SC
Optioservus	21	Coleoptera	Elmidae	4	4	SC
Oulimnius	4	Coleoptera	Elmidae	3	5	SC
Anchytarsus	1	Coleoptera	Ptilodactylidae	3	5	SH
Tipula	1	Diptera	Tipulidae	4	4	SH
Chironomidae	13	Diptera	Chironomidae	5	6	CG
Oligochaeta	3	Haplotaxida		5	10	CG

Sample Date	BCG Attribute	Taxa	Individuals	Taxa	Individuals
23 April 2002	1	0	0	0	0
	2	5	78	14	170
	3	9	92		
	4	7	30	9	46
	5	2	16		
	6	0	0	0	0
	---	1	1	1	1
	Total	**24**	**217**	**24**	**217**

Metric	Value
EPT Taxa Richness	15
Total Taxa Richness	24
Shannon Diversity Index	2.58
Hilsenhof Index	2.14
Beck's Index #3	23
Percent Intolerant Individuals	91.2
Percent EPT Individuals	78.3
Mayfly Taxa Richness	4
Percent Mayfly Individuals	28.6
Stonefly Taxa Richness	5
Percent Stonefly Individuals	26.7
Caddisfly Taxa Richness	6
Percent Caddisfly Individuals	23.0
Percent Chironomid Individuals	6.0

ID Level	Individuals	Order	Family (Tribe)	BCG Attribute	Hilsenhof	FFG
Acentrella	10	Ephemeroptera	Baetidae	3	4	SC
Heptageniidae	1	Ephemeroptera	Heptageniidae	---	3	SC
Drunella	33	Ephemeroptera	Ephemerellidae	2	1	SC
Ephemerella	18	Ephemeroptera	Ephemerellidae	3	1	CG
Stylogomphus	1	Odonata	Gomphidae	4	4	PR
Amphinemura	30	Plecoptera	Nemouridae	3	3	SH
Acroneuria	17	Plecoptera	Perlidae	3	0	PR
Isoperla	1	Plecoptera	Perlodidae	2	2	PR
Haploperla	1	Plecoptera	Chloroperlidae	3	0	PR
Sweltsa	9	Plecoptera	Chloroperlidae	3	0	PR
Nigronia	2	Megaloptera	Corydalidae	3	2	PR
Dolophilodes	1	Trichoptera	Philopotamidae	2	0	FC
Polycentropus	2	Trichoptera	Polycentropodidae	4	6	FC
Diplectrona	30	Trichoptera	Hydropsychidae	2	0	FC
Cheumatopsyche	1	Trichoptera	Hydropsychidae	4	6	FC
Hydropsyche	3	Trichoptera	Hydropsychidae	4	5	FC
Rhyacophila	13	Trichoptera	Rhyacophilidae	2	1	PR
Psephenus	1	Coleoptera	Psephenidae	4	4	SC
Optioservus	21	Coleoptera	Elmidae	4	4	SC
Oulimnius	4	Coleoptera	Elmidae	3	5	SC
Anchytarsus	1	Coleoptera	Ptilodactylidae	3	5	SH
Tipula	1	Diptera	Tipulidae	4	4	SH
Chironomidae	13	Diptera	Chironomidae	5	6	CG
Oligochaeta	3	Haplotaxida		5	10	CG

Sample Date	BCG Attribute	Taxa	Individuals	Taxa	Individuals
23 April 2002	1	0	0	0	0
	2	5	78	14	170
	3	9	92		
	4	7	30	9	46
	5	2	16		
	6	0	0	0	0
	---	1	1	1	1
	Total	**24**	**217**	**24**	**217**

Metric	Value
EPT Taxa Richness	15
Total Taxa Richness	24
Shannon Diversity Index	2.58
Hilsenhof Index	2.14
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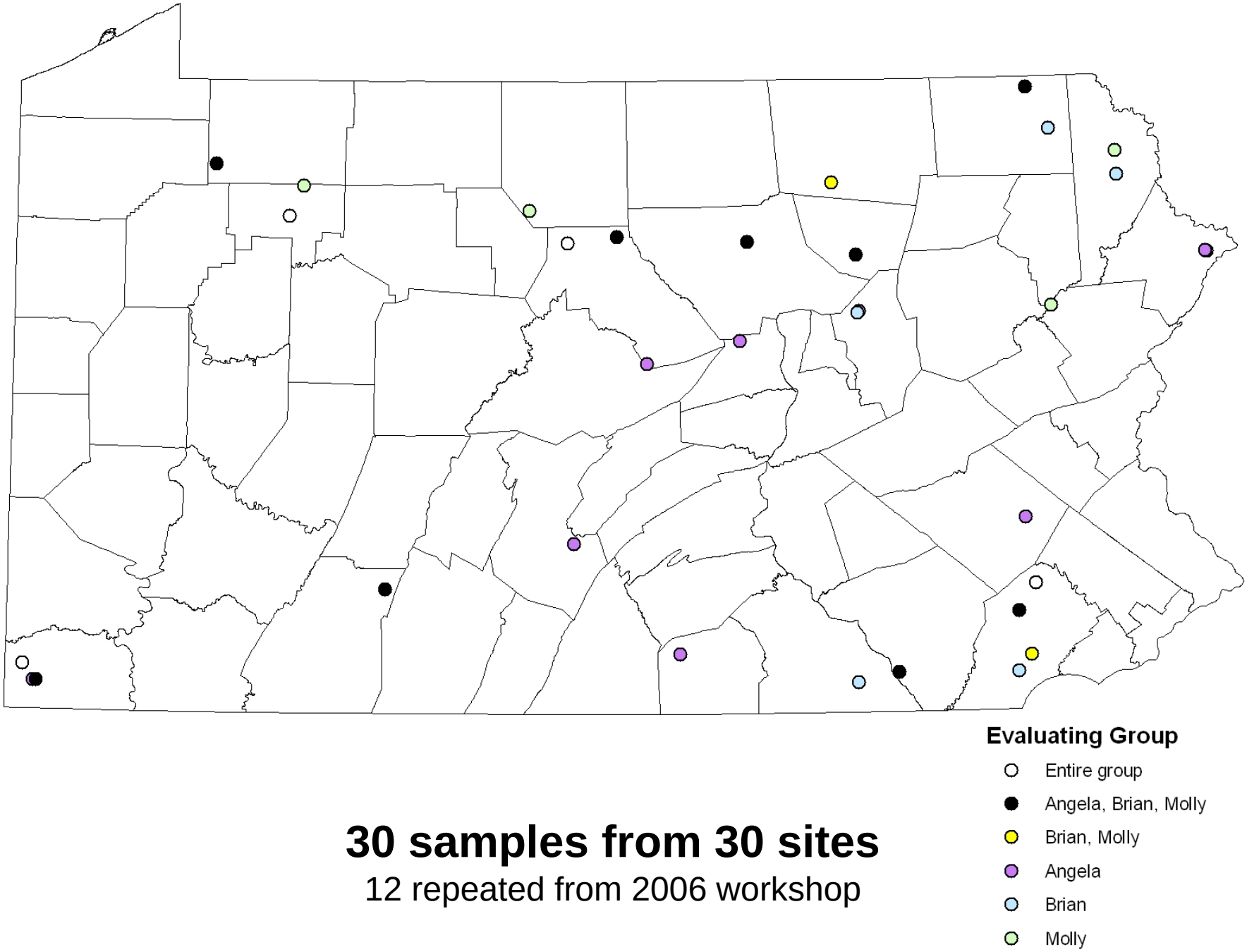
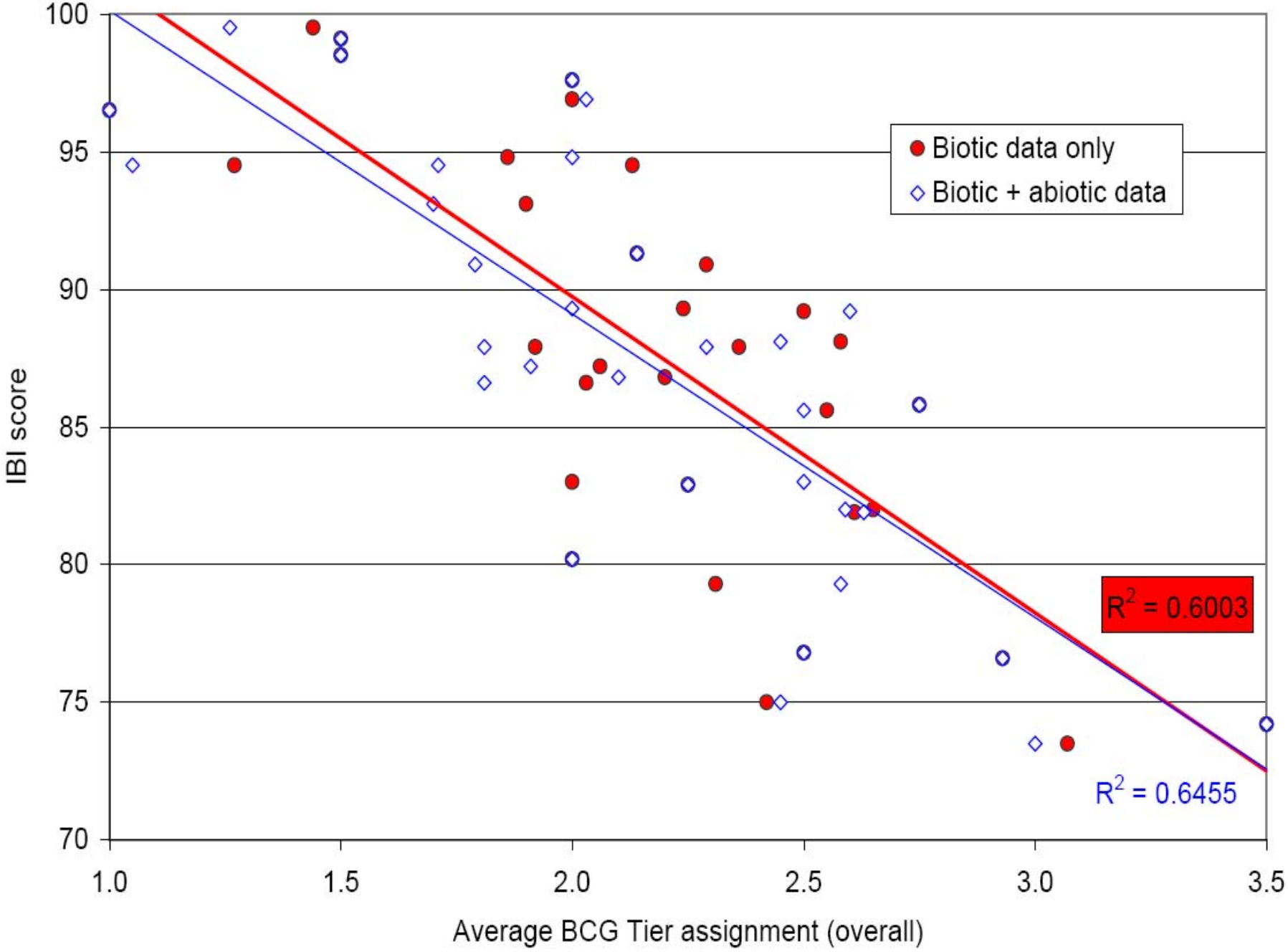
Percent Stonefly Individuals	26.7
Caddisfly Taxa Richness	6
Percent Caddisfly Individuals	23.0
Percent Chironomid Individuals	6.0

Station ID	20020423-1200-GLW
Stream Name	Tucquan Creek
IBI score	79.3
IBI conditon	Non-reference
Drainage Area (square miles)	6.2
% water	0.00
% developed	0.36
% barren	0.03
% forested	41.66
% agricultural	57.26
% wetland	0.57
DEP Region	Southcentral
County	Lancaster
Basin	Susquehanna River
HUC 8	Lower Susquehanna
HUC 12	Susquehanna River - Muddy Creek
Ecoregion I	Eastern Temperate Forests
Ecoregion II	Southeastern USA Plains
Ecoregion III	Northern Piedmont
Ecoregion IV	Piedmont Uplands
Physiographic Province	Piedmont
Physiographic Section	Piedmont Upland
Elevation (meters above sea level)	136
Slope class	High gradient
Strahler order	2
Instream Cover	16
Epifaunal Substrate	16
Embeddedness	15
Velocity/Depth Regimes	11
Channel Alteration	17
Sediment Deposition	15
Frequency of Riffles	18
Channel Flow Status	16
Condition of Banks	16
Bank Vegetative Protection	16
Grazing or Other Disruptive Pressure	17
Riparian Vegetative Zone Width	16
Total Habitat	189
pH (field)	7.06
Temperatue (°C, field)	15.67
Conductivity (umhos, field)	211
Dissolved Oxygen (mg/L, field)	9.65
Total Alkalinity (mg/L as $CaCO_3$, field)	---
Total Dissolved Solids (mg/L, field)	138
Nitrate-Nitrogen (mg/L, lab)	8.12
Total Phosphorus (mg/L, lab)	0.029
pH (lab)	7.2
Total Alkalinity (mg/L as $CaCO_3$, lab)	22
Total Organic Carbon (mg/L, lab)	0.9
Chloride (mg/L, lab)	16.1
Sulfate (mg/L, lab)	14.1
Total Iron (ug/L, lab)	307



30 samples from 30 sites

12 repeated from 2006 workshop


100
95
90
85
80
75
70
IBI score
1.0
1.5
2.0
2.5
3.0
3.5
Average BCG Tier assignment (overall)
Biotic data only
Biotic + abiotic data
R2 = 0.6003
R2 = 0.6455

BCG Attribute Value	Taxa Richness Rule	Proportional Taxa Rule	Relative Abundance Rule
I	≥ 3 or 0	≥ 0 ?	> 0% ?
II	≥ 6	≥ 0.15	≥ 10%
III	?	?	≥ 20% and ≤ 60%
IV	≤ 12 ?	≤ 0.33	≤ 40%
V	≤ 3 ?	≤ 0.10	≤ 25%
VI	0	0	0
I + II	≥ 8	≥ 0.20	≥ 15%
I + II + III	≥ 18	≥ 0.60	≥ 45%
II + III	≥ 15?	≥ 0.50 ?	≥ 45%
III + IV	?	≤ 0.75	≤ 75% ?
IV + V	?	≤ 0.40	≤ 50%
(I + II + III) – (IV + V)	≥ 9		

HQ / EV Discriminant Model Development Parameters & Thresholds

1. IBI Score of 80 or more. The site also must meet all HQ standards.
2. Total Habitat Score > 190
3. Instream Habitat >60, Instream Cover, Epifaunal Substrate, Embeddedness, Sediment Deposition
4. Riparian Habitat > 45, Condition of Banks, Bank Vegetative Protection, Riparian Vegetative Zone Width
5. % Forest > 70 %
6. % Urban < 5%
7. Indicator Taxa >5

The **“Rules”** to select EV
Rules 3 & 4 require some BPJ

1. Must Score > 80 IBI to be Special Protection and be EV.
2. Fails no Thresholds should be EV.
3. Fails 1 Thresholds should probably be EV.
4. Fails 2 Thresholds without a reasonable explanation the site should not be EV.
5. Fails 3 or more Thresholds the site must not be EV.

EV Model Threshold and Rule Decision Making Process

(Yellow Violates Thresholds)

How would you designate the use for each site?

>80	**>190**	**>60**	**>45**	**>70%**	**<5%**	**>5**	**Rule**	
IBI	HabTotal	InStrHab	RipHab	%Forest	%Urban	IndTaxa	**Use**	New Use Comments
95.3	211	71	54	99.8	0.0	7	**EV**	0 Threshold
83.8	217	72	54	99.3	0.0	8	**EV**	0 Threshold
90.5	196	66	47	76.1	0.1	**5**	**EV**	1 Threshold
87.4	202	68	50	80.1	**10.6**	7	**HQ**	1 Threshold, %Urban high ?
80.3	**183**	**60**	**44**	**49.8**	0.0	**4**	**HQ**	>80, 4 Thresholds
89.3	**173**	65	**39**	85.0	0.1	9	**EV**	2 Thresholds, low Flow =10
87.9	**185**	68	**40**	84.8	0.1	**5**	**HQ**	3 Thresholds, >80
81.2	**188**	**54**	55	**60.3**	0.1	8	**HQ**	3 Thresholds, >80
85.8	208	69	48	**66.8**	0.4	10	**HQ**	1 Threshold, high row crops
84.2	197	62	54	89.3	0.3	**4**	**EV**	1 Threshold

May 15 – 16, 2008
PA TALU workshop

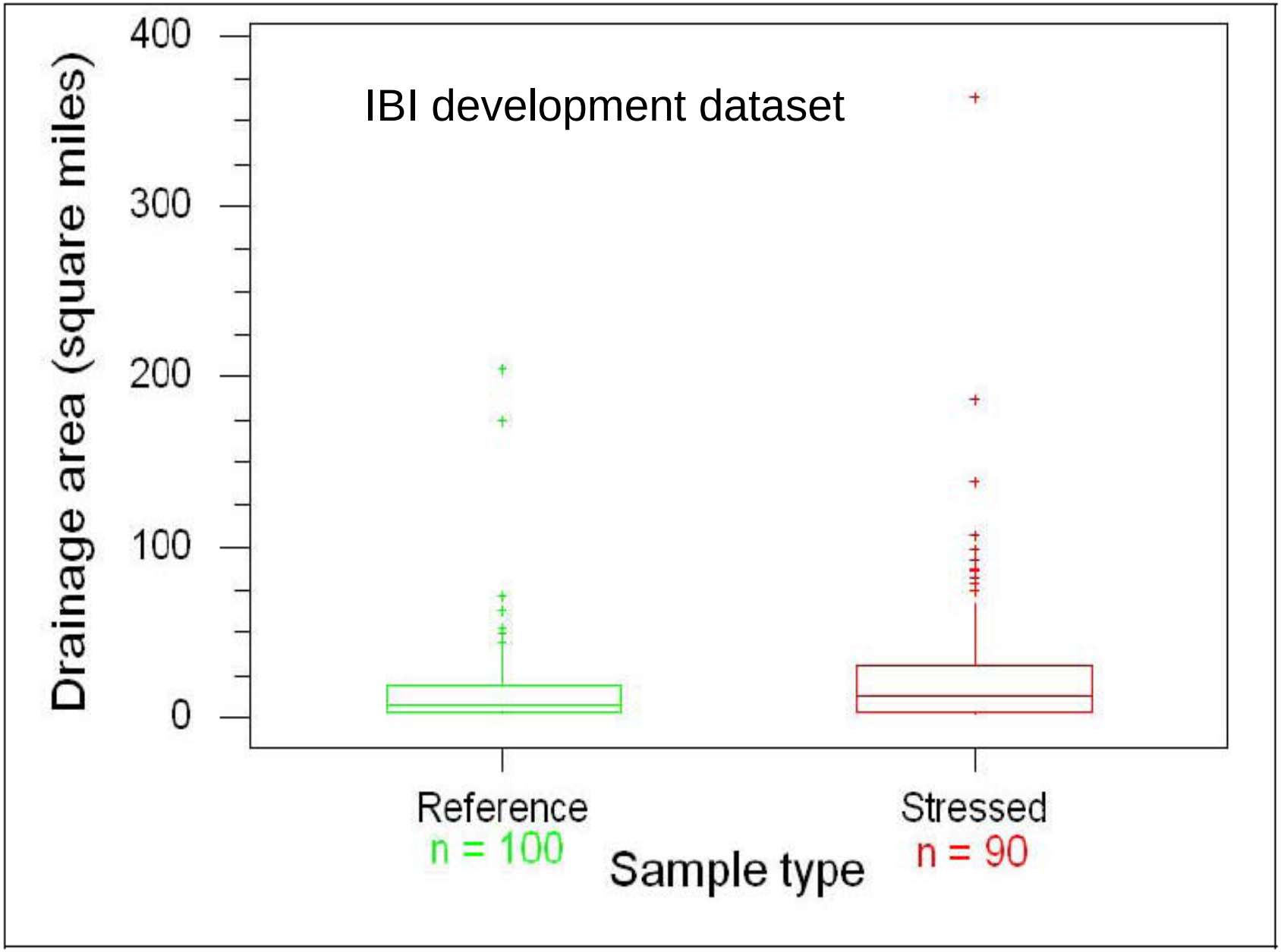
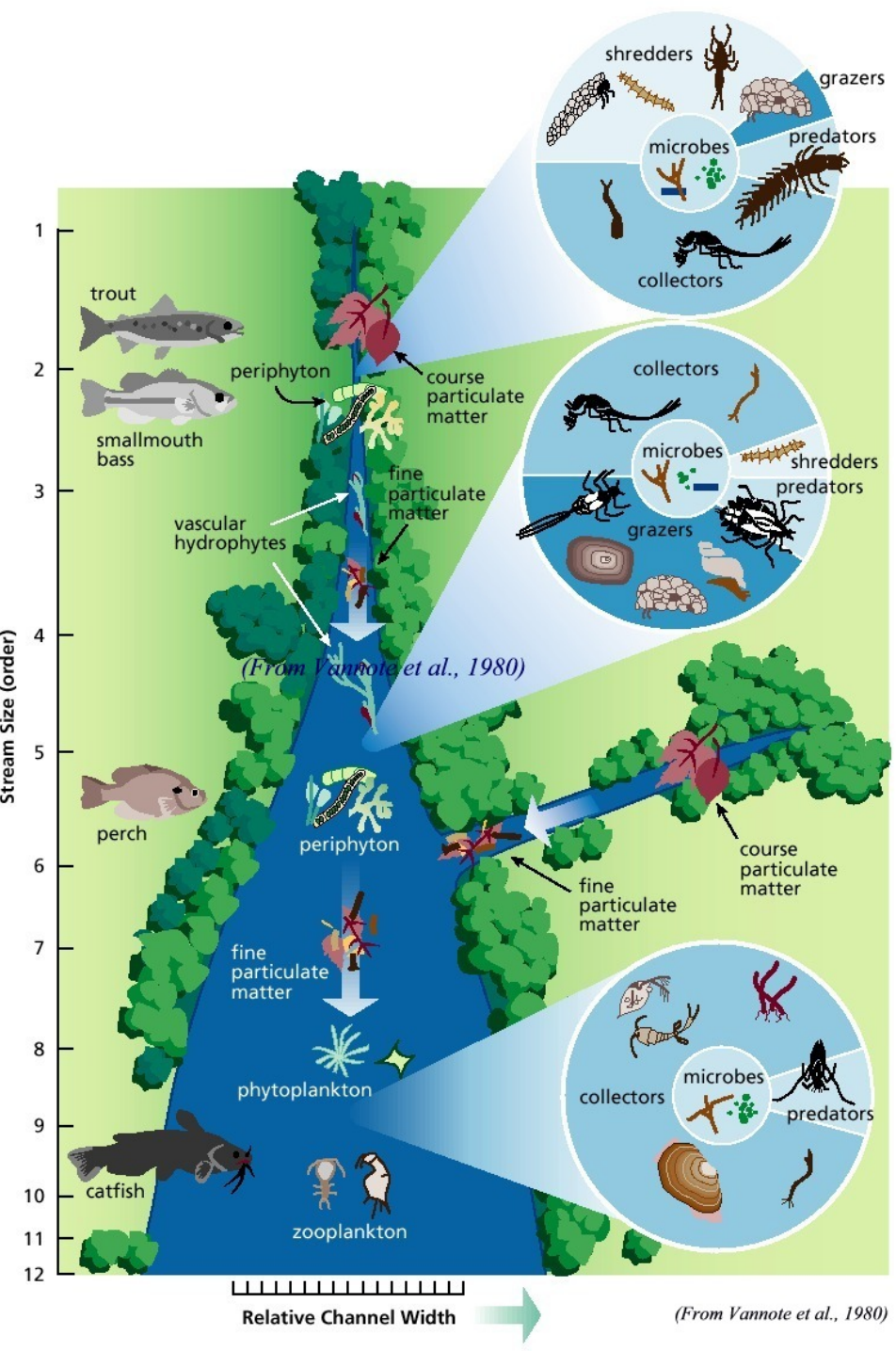
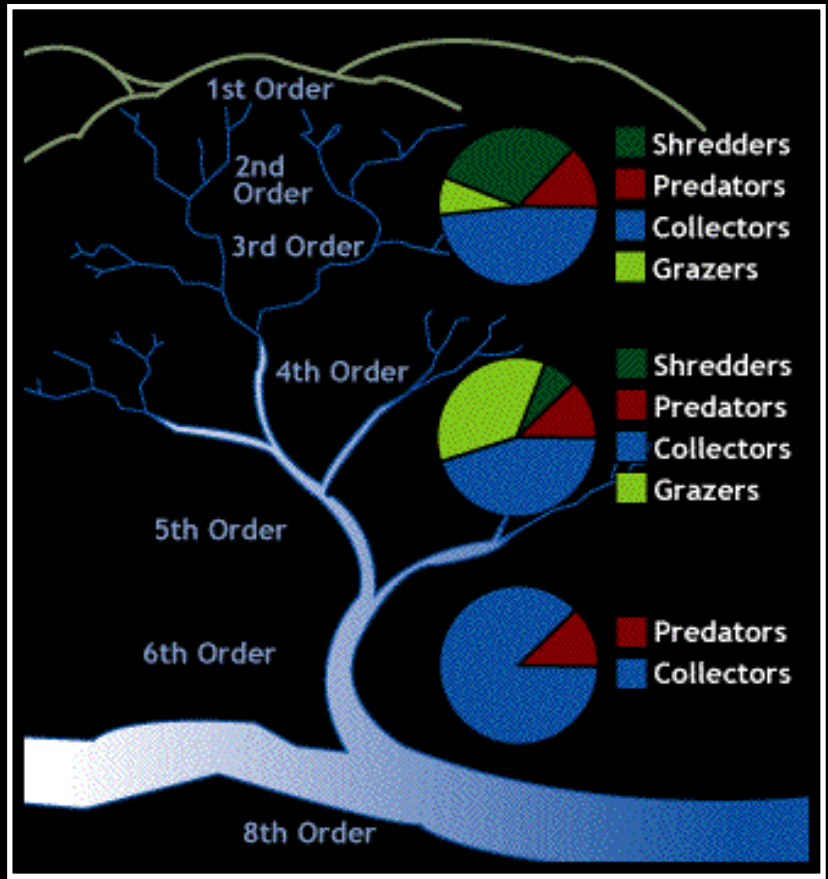
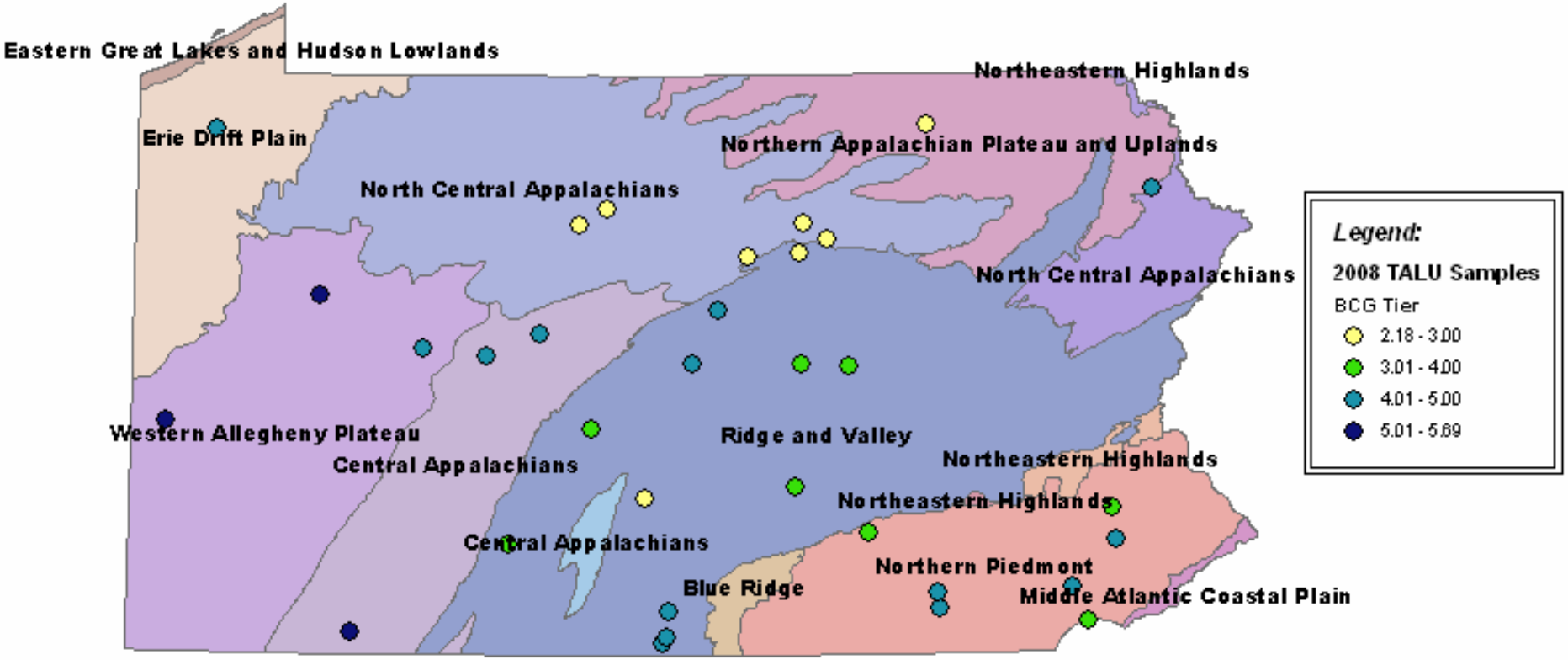


Figure 4. Drainage area for reference and stressed samples with drainage area data (not all samples had accompanying drainage area data).


shredders
grazers
microbes
predators
collectors
trout
periphyton
course particulate matter
smallmouth bass
collectors
microbes
shredders
predators
grazers
fine particulate matter
vascular hydrophytes
(From Vannote et al., 1980)
perch
periphyton
course particulate matter
fine particulate matter
fine particulate matter
phytoplankton
collectors
microbes
predators
catfish
zooplankton
Stream Size (order)
1
2
3
4
5
6
7
8
9
10
11
12
Relative Channel Width
(From Vannote et al., 1980)

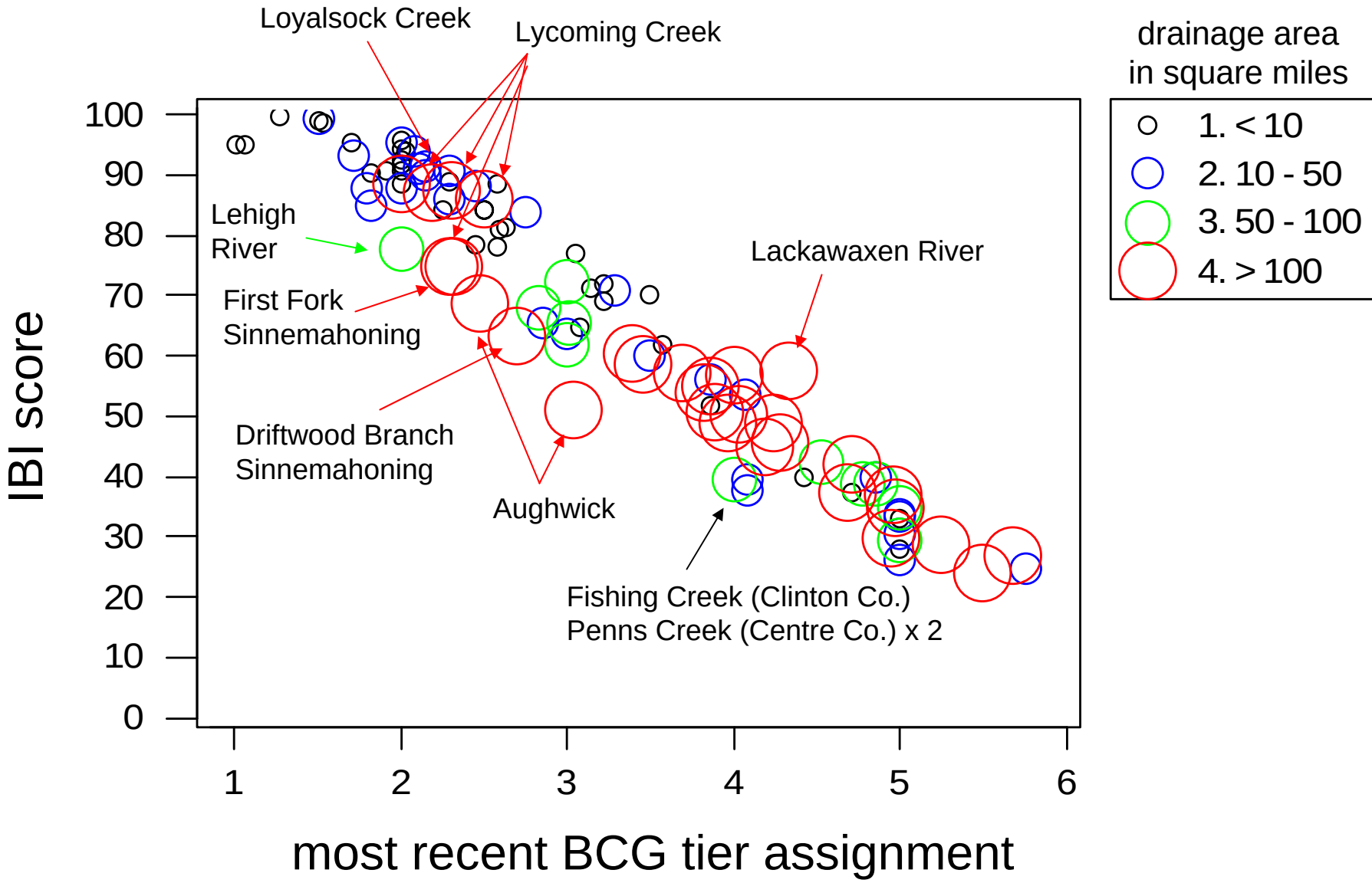

1st Order
2nd Order
3rd Order
4th Order
5th Order
6th Order
8th Order
Shredders
Predators
Collectors
Grazers
Shredders
Predators
Collectors
Grazers
Predators
Collectors

2008 TALU Samples
BCG Tier & Ecoregions



34 samples from 29 sites

none from 2006 or 2007 workshops

2006 + 2007 + 2008 TALU results

105 samples from 99 sites