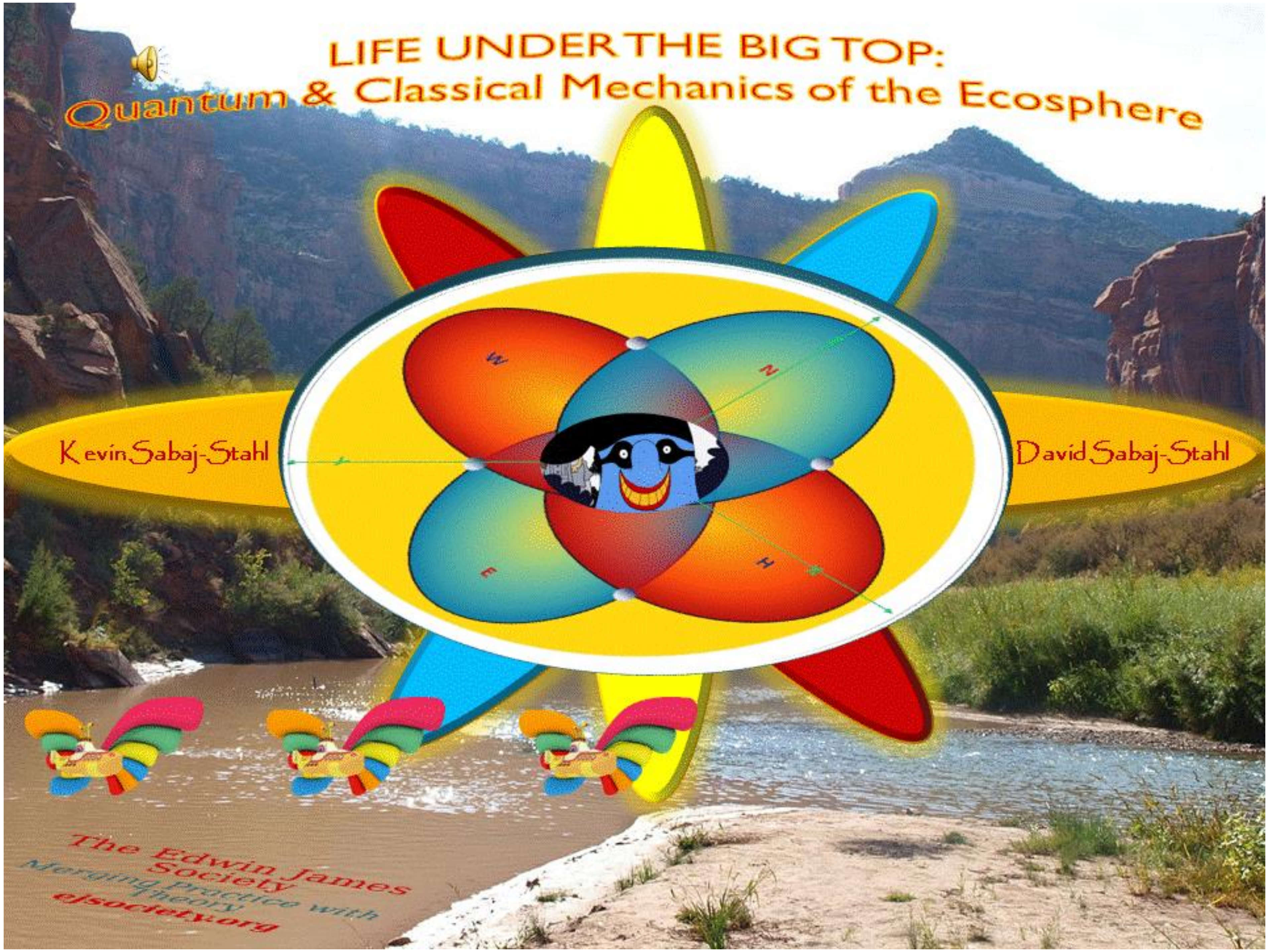

LIFE UNDER THE BIG TOP:
Quantum & Classical Mechanics of the Ecosphere
Kevin Sabaj-Stahl
David Sabaj-Stahl
W
N
E
H
The Edwin James Society
Merging practice with theory
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Quantum & Classical Mechanics of the Ecosphere

INTRODUCTION

The vegetative ecosphere was modeled within the context of quantum & classical mechanics using standard and innovative parametric statistics.

Species-level data were combined to yield percent-cover estimates, with related confidence interval estimates, of ecologically relevant communities: native, exotic, woody & herbaceous.

Interactions of quantum-dependent community structure/ stratification (Sabaj Efficacy Index) with quantum-independent diversity (richness, evenness, dominance & alpha diversity) were probed via simple, logistic & multiple regression.

Creation & application of the refined Quinn Cohesion Index (rQCI) elucidated interactions not readily apparent from regression analyses.

Newtonian unification of quantum-dependent and –independent aspects of the ecosphere were accomplished via creation of Fisher's Disambiguous Coefficent ($\varnothing_F$), yielding the Vegetative Complex Health Index (VCHI).

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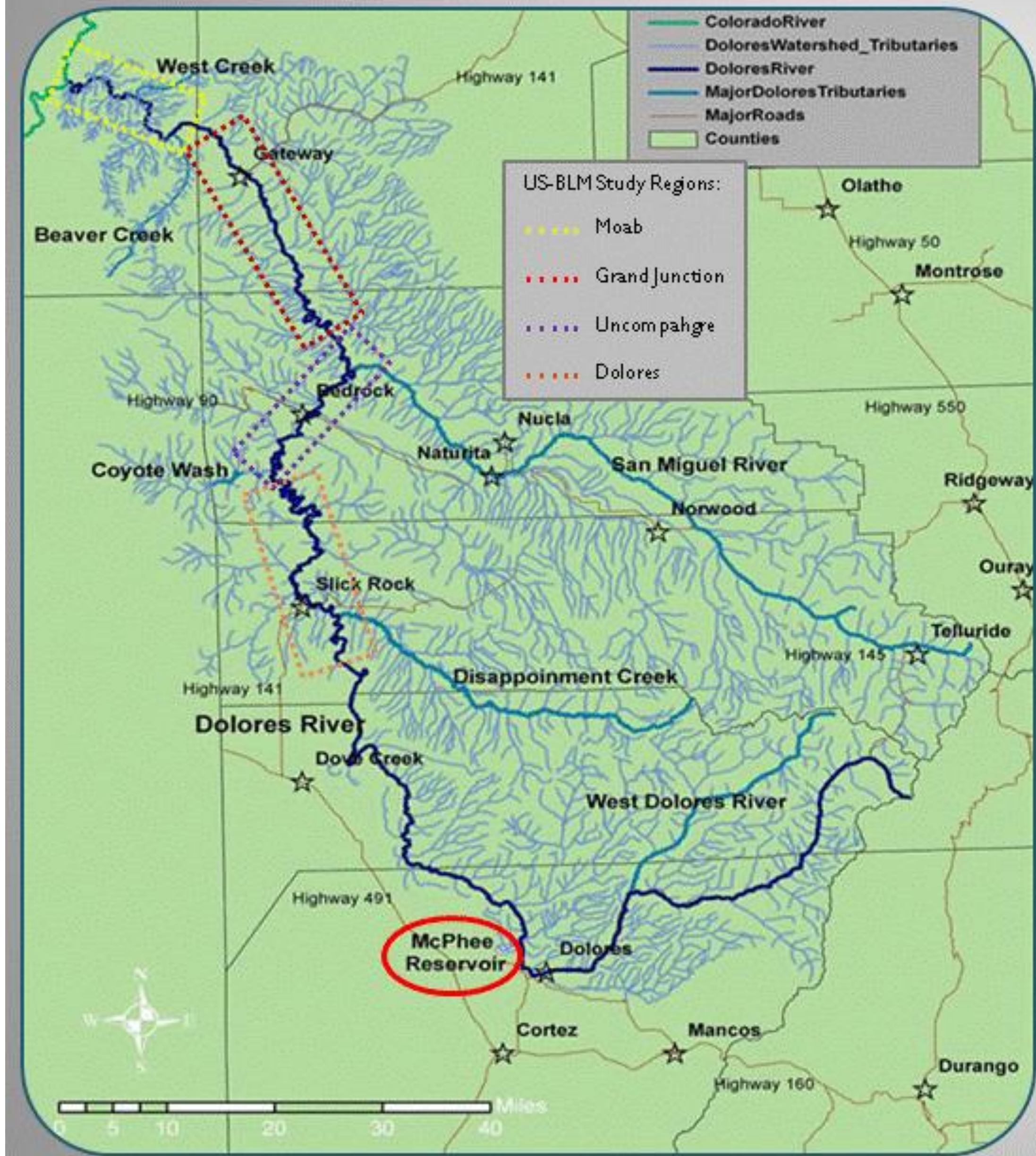

Microhabitats/ Study Sites

Thirty-nine monitoring sites were selected by the Edwin James Society Division of Research, in cooperation with the Dolores River Restoration Partnership, the Tamarisk Coalition and the United States Bureau of Land Management, within riparian corridors of the lower Dolores.

Sites varied with respect to salt cedar stand age, frequency and density.

Sites consisted of 80 x 50 M plots (one square acre) parallel to channel banks.

(Map created by the Dolores River Restoration Partnership).

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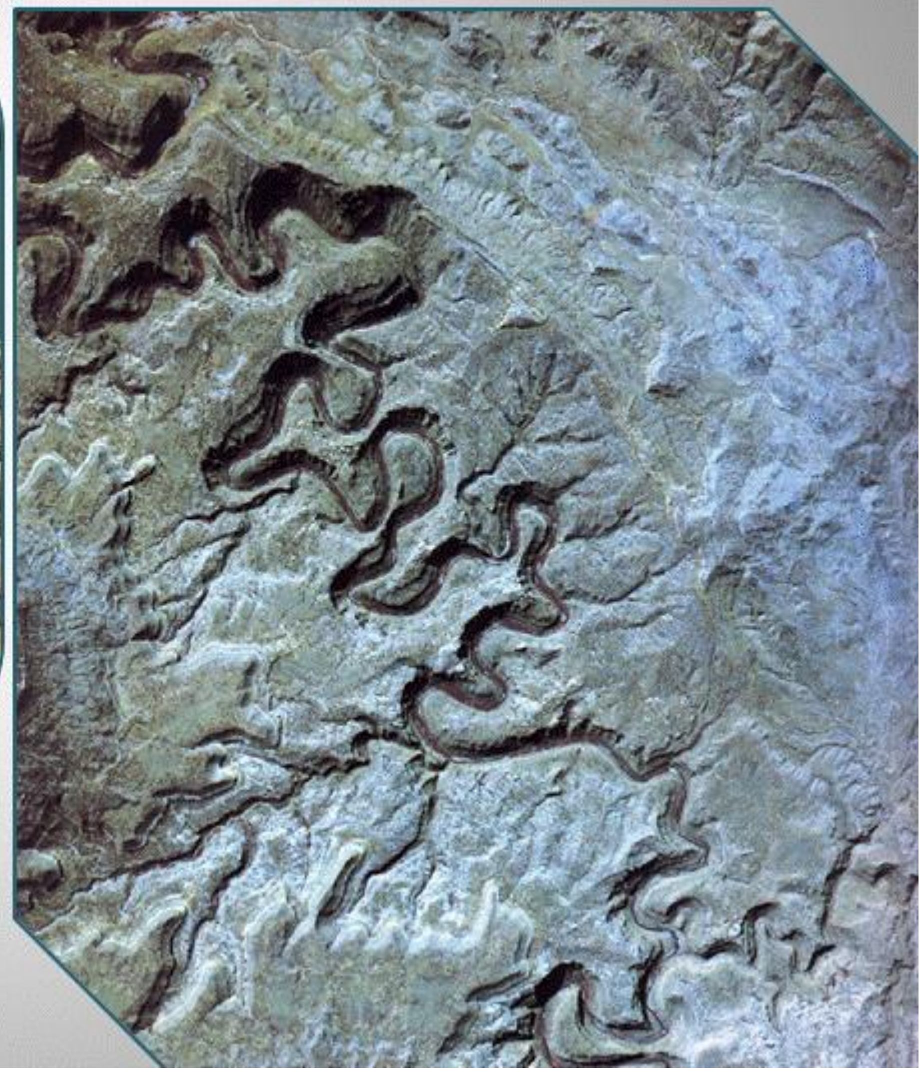
Key Physical Features Defining the Lower Dolores Watershed

Deeply Incised Meanders & Goosenecks
Typify the Watershed

McPhee Impoundment/ Reservoir
Altered Downstream Hydrograph
Removal of 40-50% Surface Water



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Common Site/ Microhabitat Characteristics

EJS/ DRRP Study Area located at
Confluence of Dolores & San Miguel Rivers

Steep Canyon Walls Restricting Breadth
of Riparian Habitat

EJS/ DRRP Study Area located in the
Slick Rock Canyon

Channel Meanderings & Braids Create
Broad Riparian Zones

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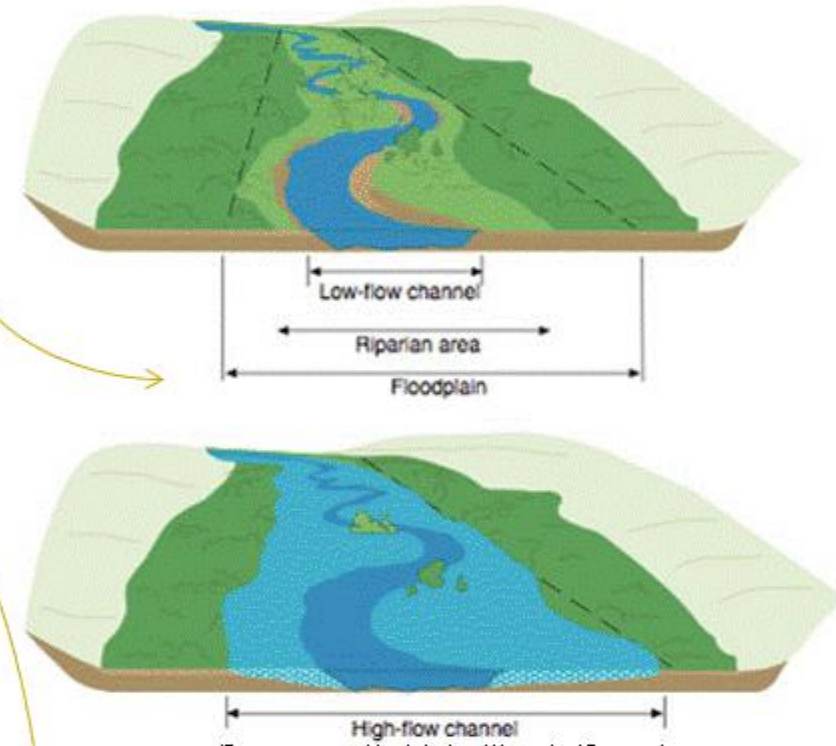
Restoration Speed Bumps

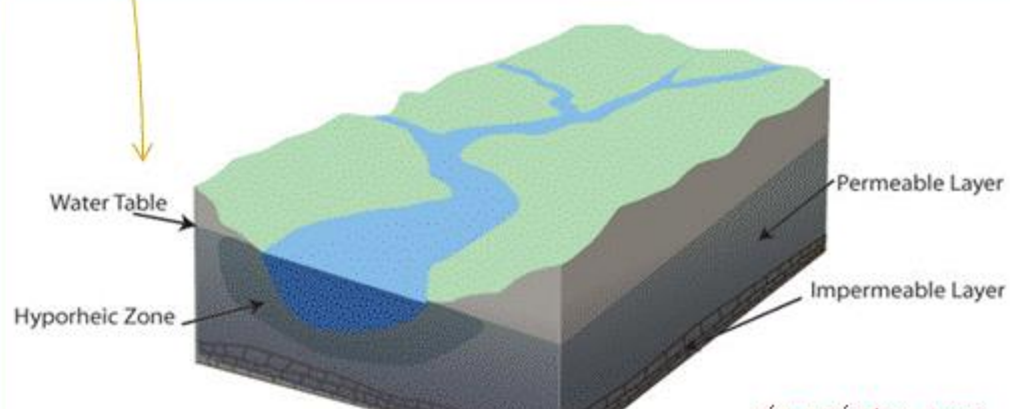
Impoundment + Diversions = Loss of Overbank Flooding.

Restriction of hyporheic zone and reduction of water table imperils many drought-intolerant species.

One invasive (knapweed) replaces another (salt cedar) in spite of restoration efforts.



(Diagram created by Ashokan Watershed Program)



(Diagram created by Minnesota Department of Natural Resources)

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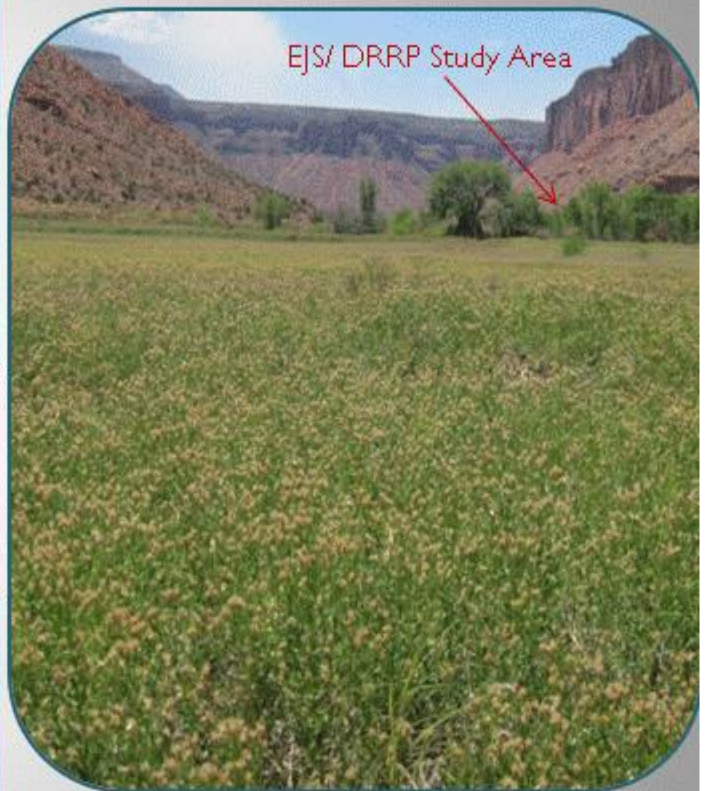
Significant Invasive Species of the Dolores Watershed

Tamarix chinensis (salt cedar)



Acroptilon repens
(Russian knapweed)

Domestic Livestock

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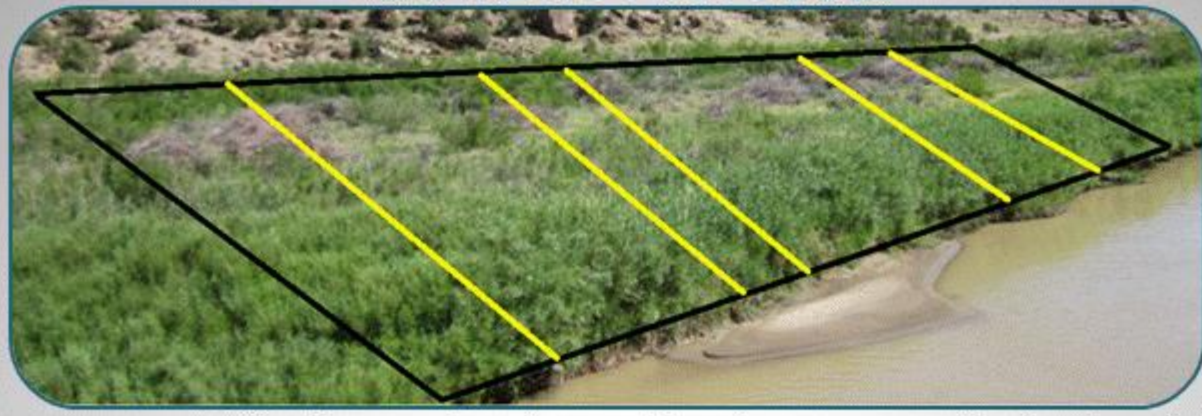
SAMPLING PROTOCOLS



Five, 50 m transects perpendicular to the channel bank were established within 80 x 50 M plots, in a stratified random design, within 16 m intervals, for each microhabitat.

Vegetation was evaluated at ten centimeter intervals along each transect, resulting in 500 points/ transect; 2500 points/ site; and 97,500 points/ study.

Each species intersecting the point was recorded as a single occurrence.

Percent cover of species and community types were estimated for each transect by dividing the number of occurrences along each transect by the total number of points (500) assessed.

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Data Management & Distributional Assessments

Data were initially organized using absolute percent cover estimates in Excel and PAST software packages, on a per species, per transect basis.

Absolute percent cover estimates were arcsine-square root transformed per species, per transect. Transect-level transformations allowed for calculation of means & variances using transformed data.

Community-level (native, exotic, woody & herbaceous) absolute percent cover estimates utilized arcsine-square root transformed species data on a per transect basis, again permitting derivation of means & variances using transformed data.

All variables used for parametric tests were subjected to assessments of the type(s) of frequency distributions they displayed. These distributions were probed for normal, log normal, log series, geometric (negative binomial), broken stick and uniform characteristics.

All distributional tests were performed within the context of 39 samples (i.e., microhabitats).

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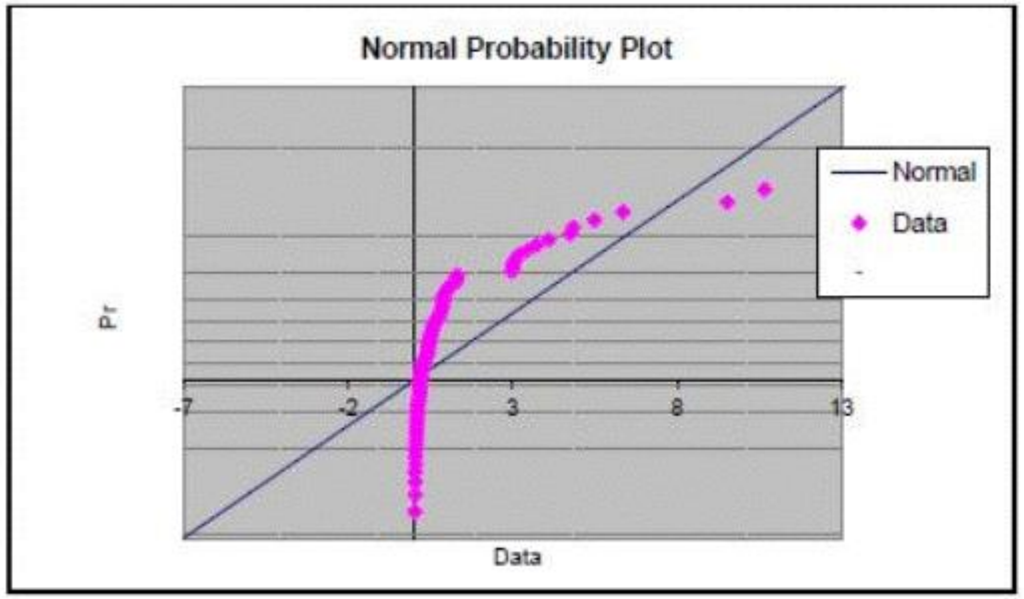
Anderson-Darling Test for Normality of Species Distribution



14.10176	AD test statistic
14.24072	AD* test statistic
<0.0005	P-value

The Anderson-Darling test for normality was performed using arcsine transformed data for all taxa surveyed among the 39 study sites. Absolute, average percent cover of each taxon across all sites was used. The species distribution was not normal.

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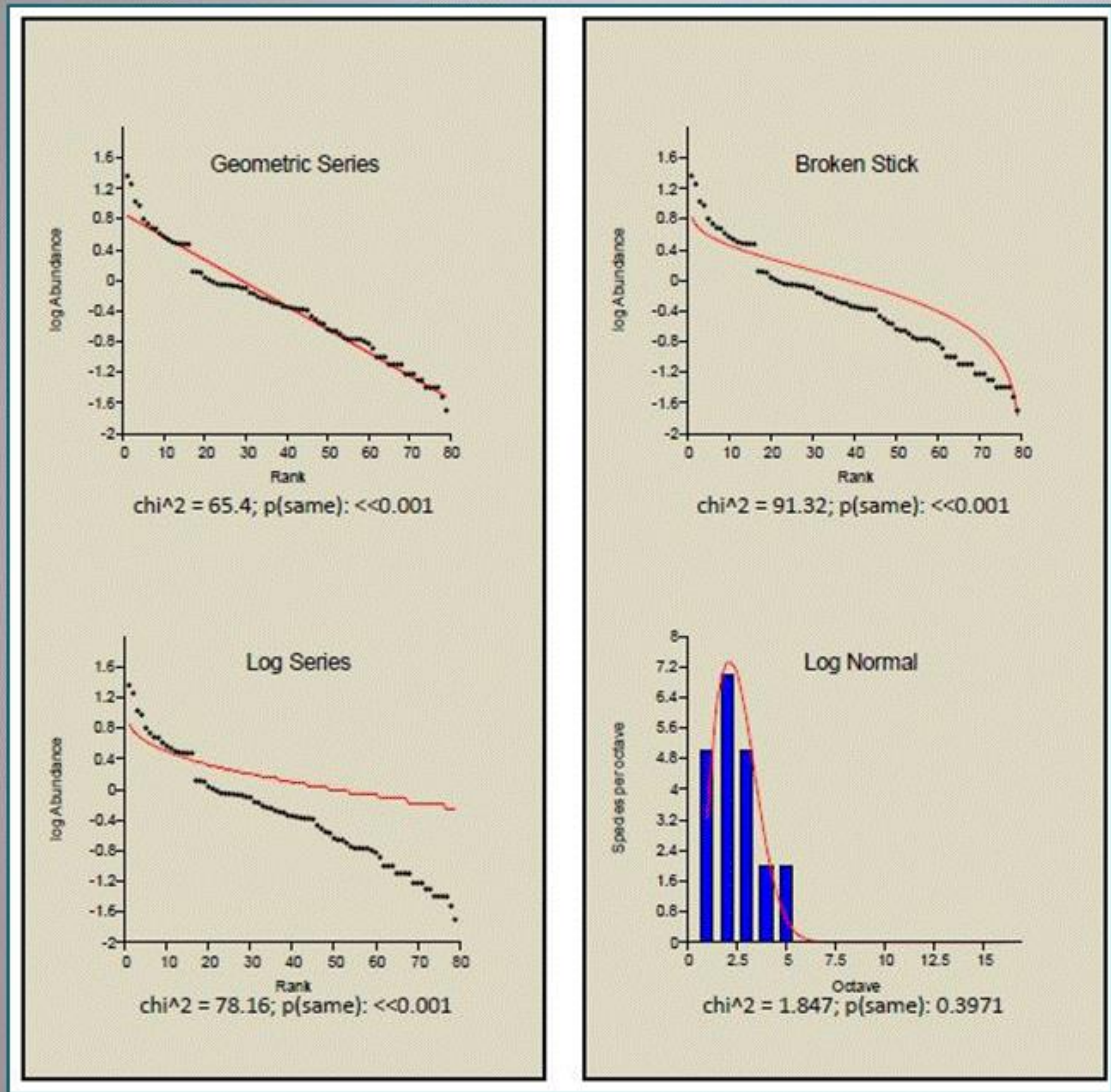

Abundance Models of the Species Distribution

All models were tested using arcsine transformed data for all taxa surveyed among the 39 study sites. Absolute, average percent cover of each taxon across all sites was used. The species distribution was **log normal**.

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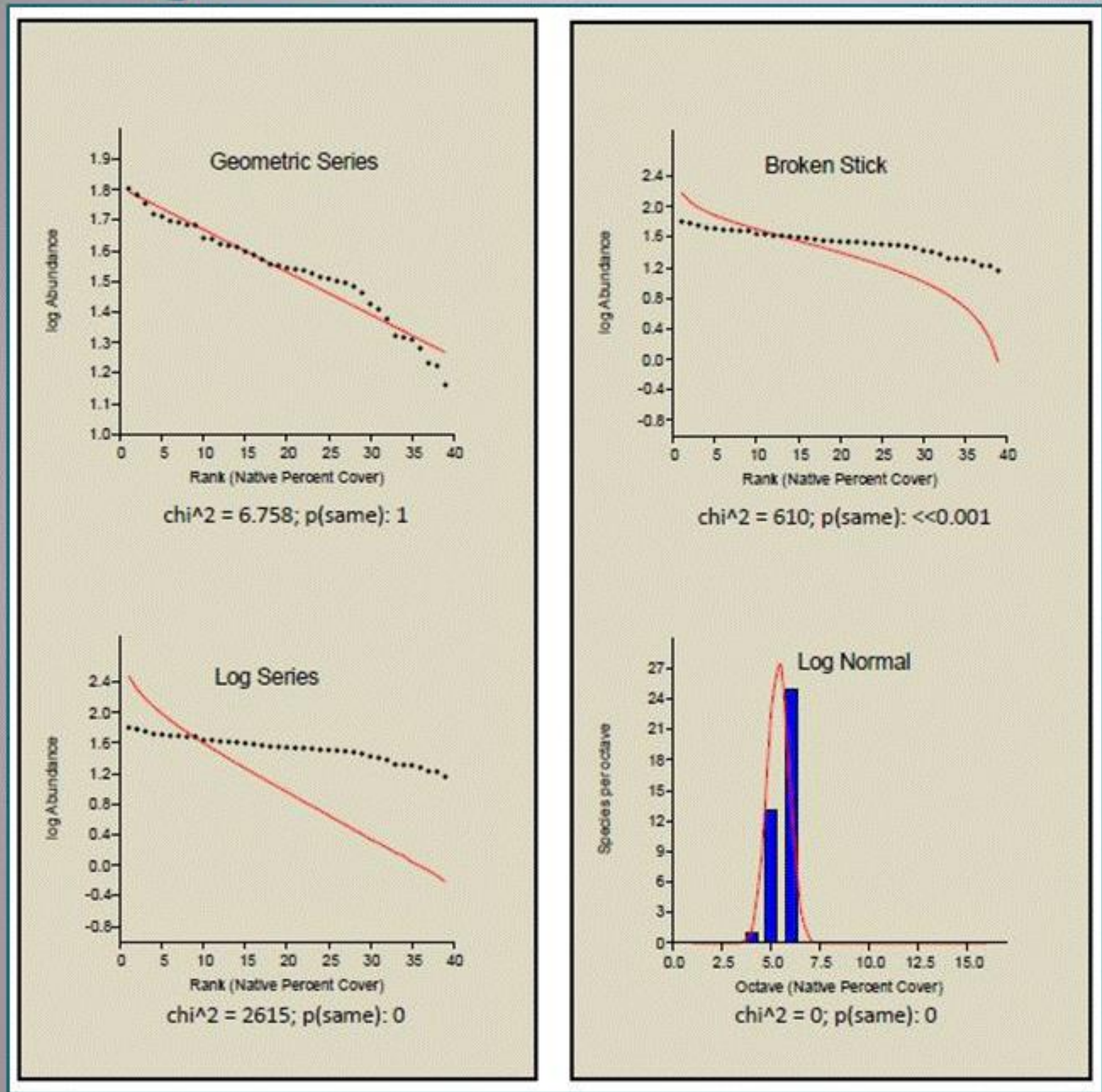

Abundance Models of the Native Community Distribution

All models were tested using arcsine transformed data for all native taxa surveyed among the 39 study sites. Those taxa were summed across all sites to derive native community estimates. The native community distribution was **geometric**.

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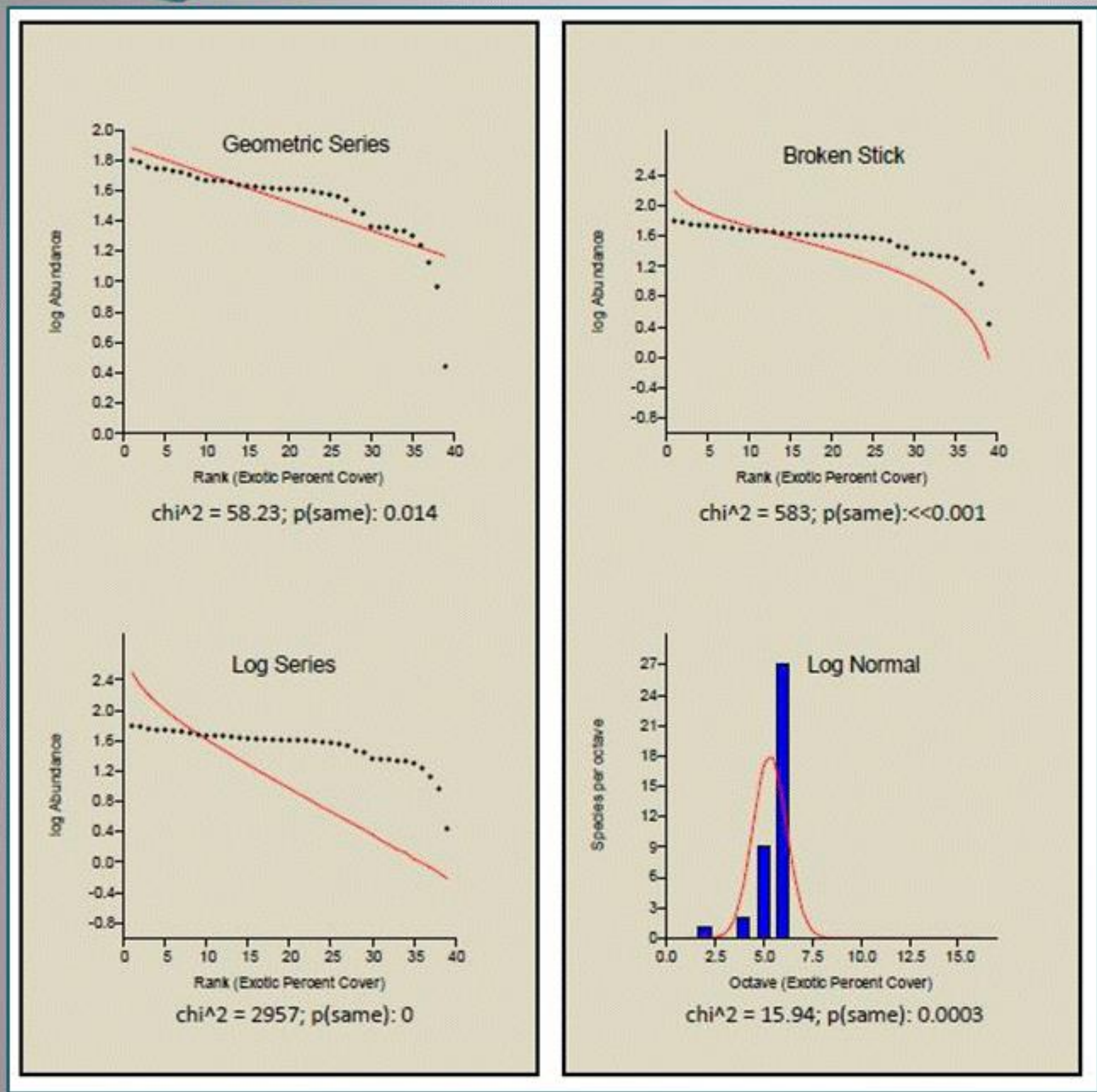

Abundance Models of the Exotic Community Distribution

All models were tested using arcsine transformed data for all exotic taxa surveyed among the 39 study sites. Those taxa were summed across all sites to derive exotic community estimates. The exotic community distribution did not adhere to any particular form, but appeared to approach a geometric distribution.

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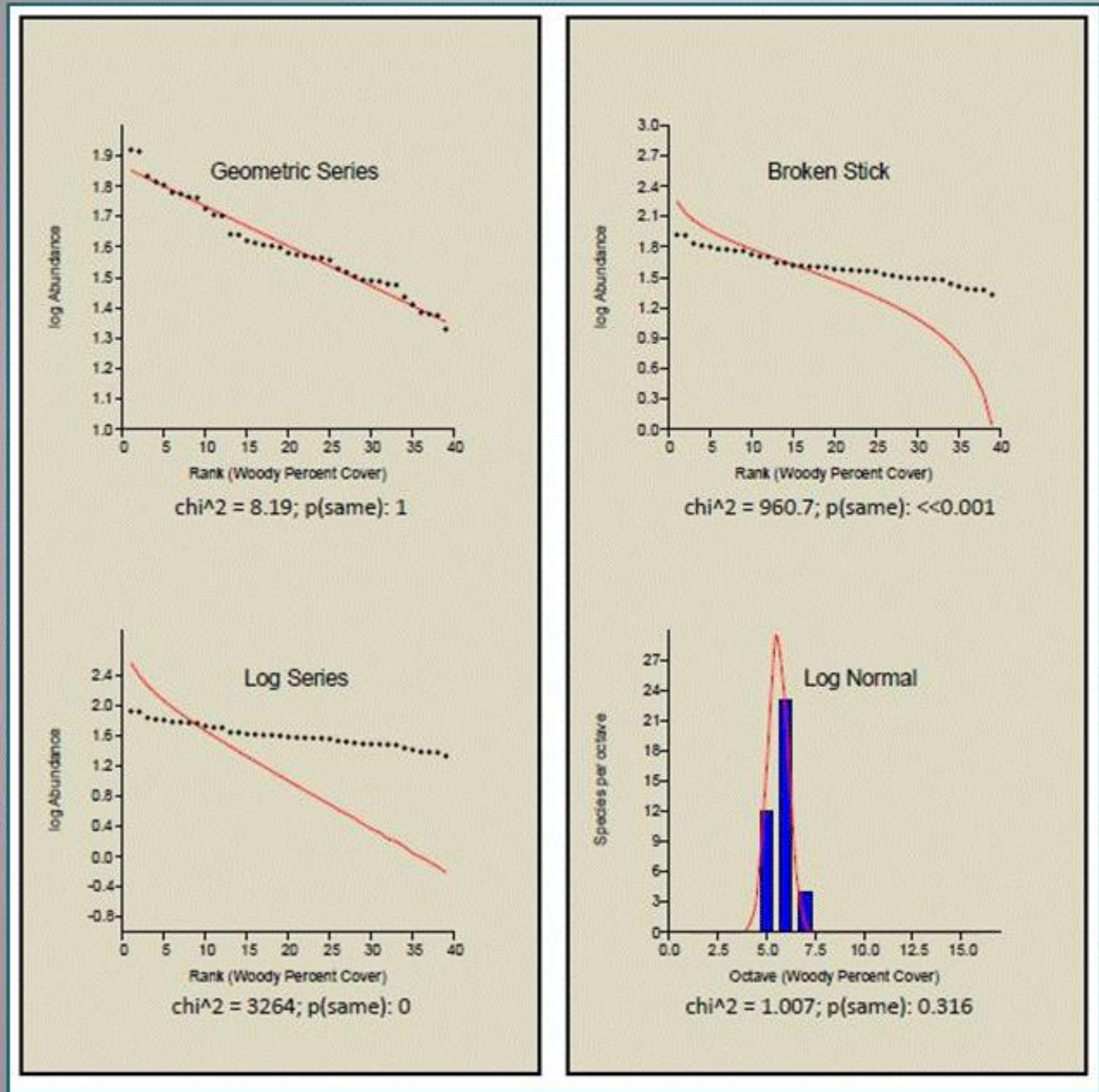

Abundance Models of the Woody Community Distribution

All models were tested using arcsine transformed data for all woody taxa surveyed among the 39 study sites. Those taxa were summed across all sites to derive woody community estimates. The woody community distribution was **geometric and log normal**.

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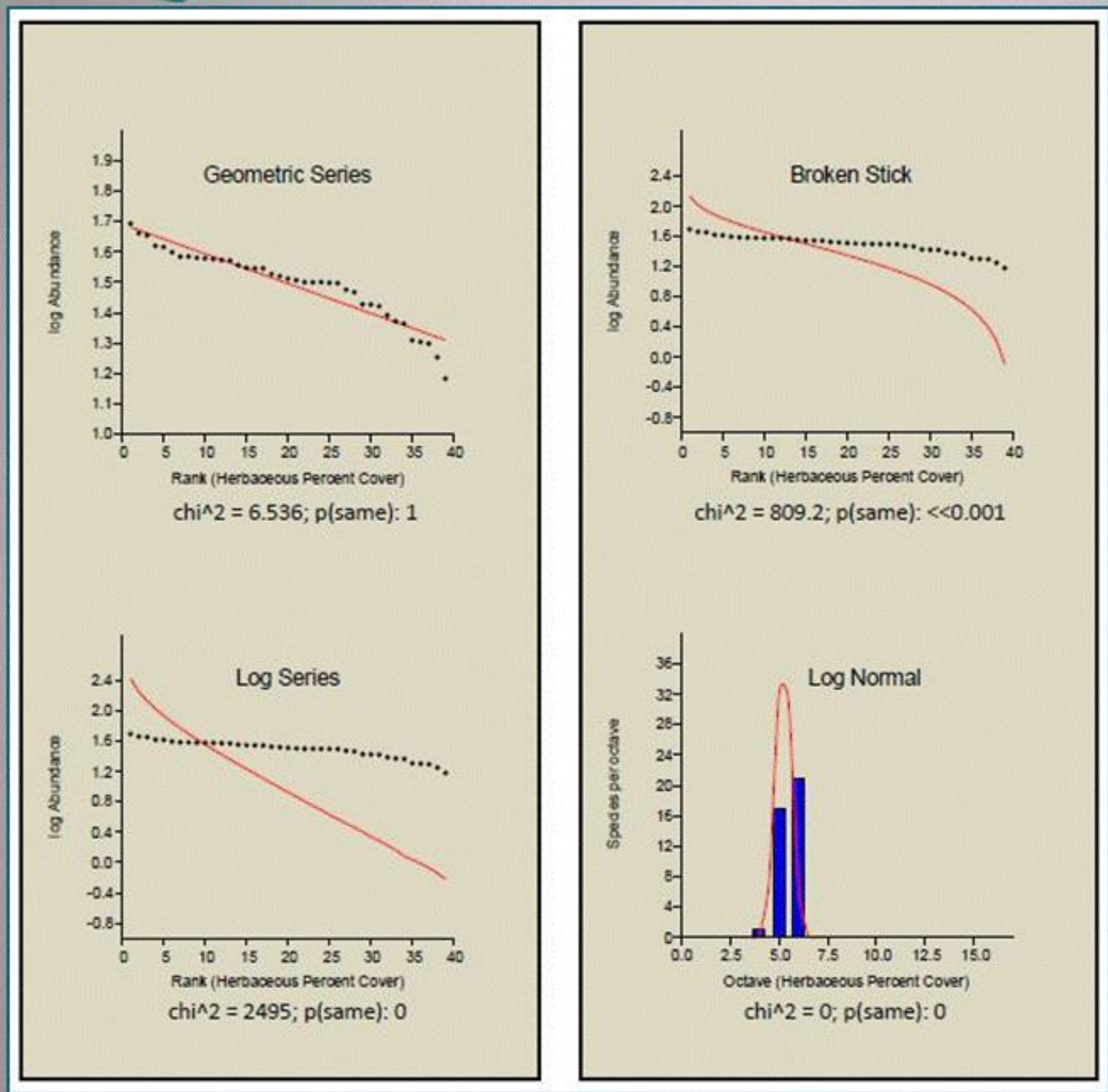

Abundance Models of the Herbaceous Community Distribution

All models were tested using arcsine transformed data for all herbaceous taxa surveyed among the 39 study sites. Those taxa were summed across all sites to derive herbaceous community estimates. The herbaceous community distribution was **geometric**.

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Index	Chi-square	Degrees Freedom	Result
Sabaj Efficacy	7.399	38	Uniform Distribution
Simpson's Dominance	0.557	38	Uniform Distribution
Berger-Parker Dominance	0.784	38	Uniform Distribution
Pielou's J	0.106	38	Uniform Distribution
Evenness (e^H/S)	0.412	38	Uniform Distribution
Margalef's Richness Index	11.528	38	Uniform Distribution
Menhinick's Richness Index	4.077	38	Uniform Distribution
Fogleman's Richness Index	29.577	38	Uniform Distribution
Log Richness	0.586	38	Uniform Distribution
Fisher's Alpha	32.073	38	Uniform Distribution
Shannon's H	1.769	38	Uniform Distribution
Brillouin's Index	1.540	38	Uniform Distribution

Outcomes of Frequency Distribution Assessments

The species distribution was log normal, with two dominant invasive species (salt cedar and knapweed), 13 common species and 64 rare species (all other exotics were rare).

Arcsine-square root transformation of percent cover resulted in increased homoscedasticity as observed per Sabaj Efficacy Index analyses concerning confidence intervals of communities. (Sabaj-Stahl, Whitney, Frank & Clemens 2013. The Theory of Quantum Microbiogeography: Mechanisms of the Priority Site Determination. Echo Efficacy Journal 1(1): 1-77).

Three of four community types (native, woody and herbaceous) exhibited geometric distributions. The woody community distribution was also log normal.

The exotic community frequency distribution did not adhere to any particular form, but appeared to approach a geometric distribution.

Sabaj Efficacy and all elements of alpha diversity (sample-size dependent and independent richness; abundance; dominance; and total diversity) adhered to uniform distributions.

Uniform distributions are appropriate for application of parametric statistics when sufficient sampling causes means & variances to approach those of normal distributions.

Patterns of Diversity per Sampling Regime & Community Stratification

Total diversity, richness & evenness were assessed via SHE analysis. SHE assesses the contributions of richness & evenness to total diversity with increasing sampling effort.

Richness, evenness & total diversity were also assessed relative to community structure/ stratification via the Sabaj Efficacy Index (SEI).

The SEI ranges from zero to one, with community structure increasing the SEI approaches one.

The SEI was defined as the proportion of communities (native, exotic, woody & herbaceous) adhering to 25% confidence interval estimates using point-in time parameter estimates with an alpha of 0.90. (Sabaj-Stahl, Whitney, Frank & Clemens 2013. The Theory of Quantum Microbiogeography: Mechanisms of the Priority Site Determination. Echo Efficacy Journal 1(1): 1-77).

The SEI therefore assesses the tendency of vegetative communities to form uniform bands (i.e., become stratified) parallel to channel banks within riparian habitats.

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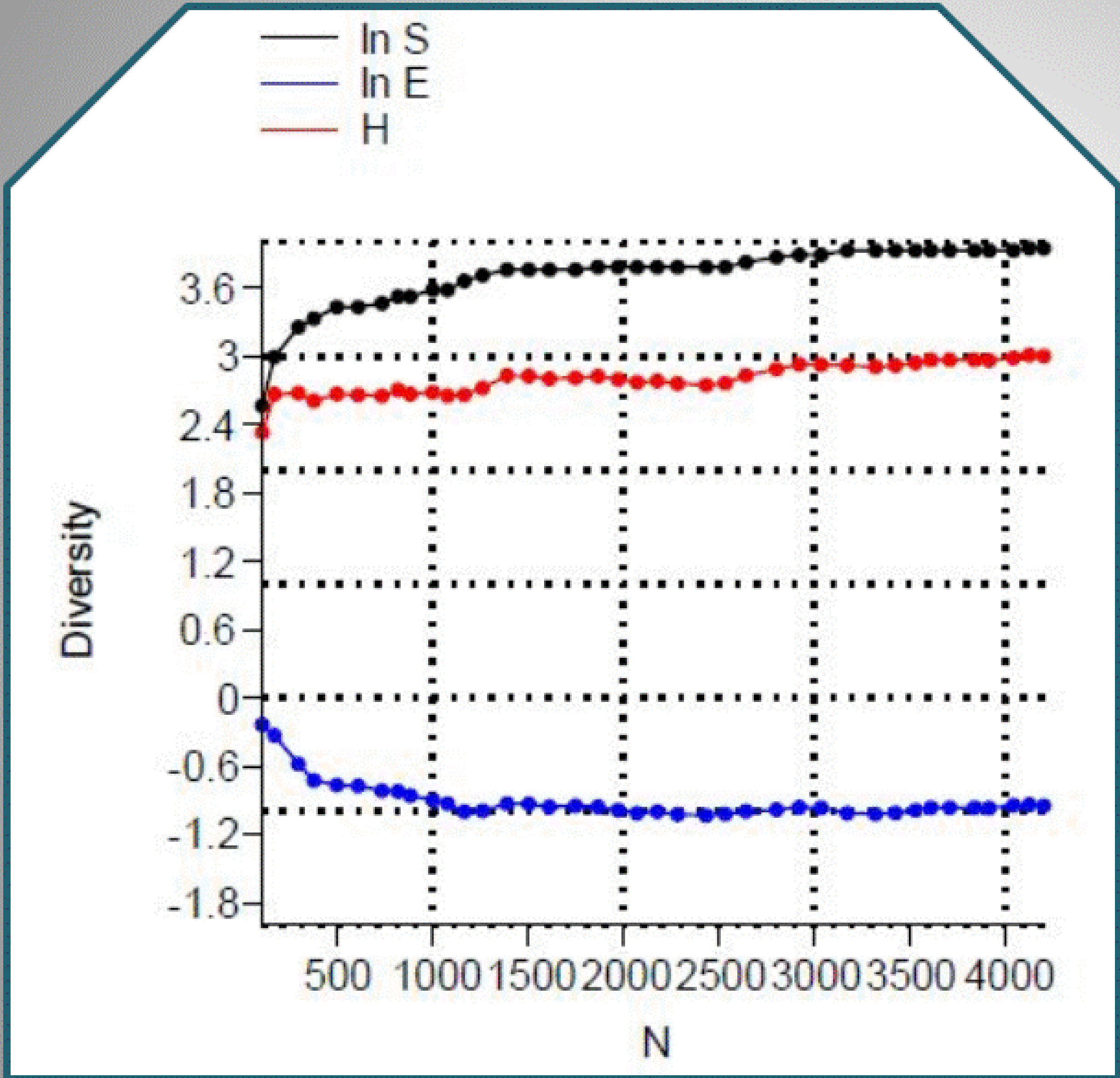

SHE Analysis

SHE analysis was performed using arcsine transformed data for absolute, mean percent cover of all taxa across all sites.

SHE analysis assesses contributions of richness (S) and evenness (E; Pielou J) to changes in Shannon-Wiener diversity (H) with increasing sampling effort.

The pattern was representative of a log-normal distribution.

Evenness plateaued after the sampling of just 12 microhabitats.

Richness & total diversity continued to increase after sampling of 39 sites, but rate of increase subsided after 26 sites.

(Content was reproduced from Sabaj-Stahl, Whitney, Frank & Clemens (2013).

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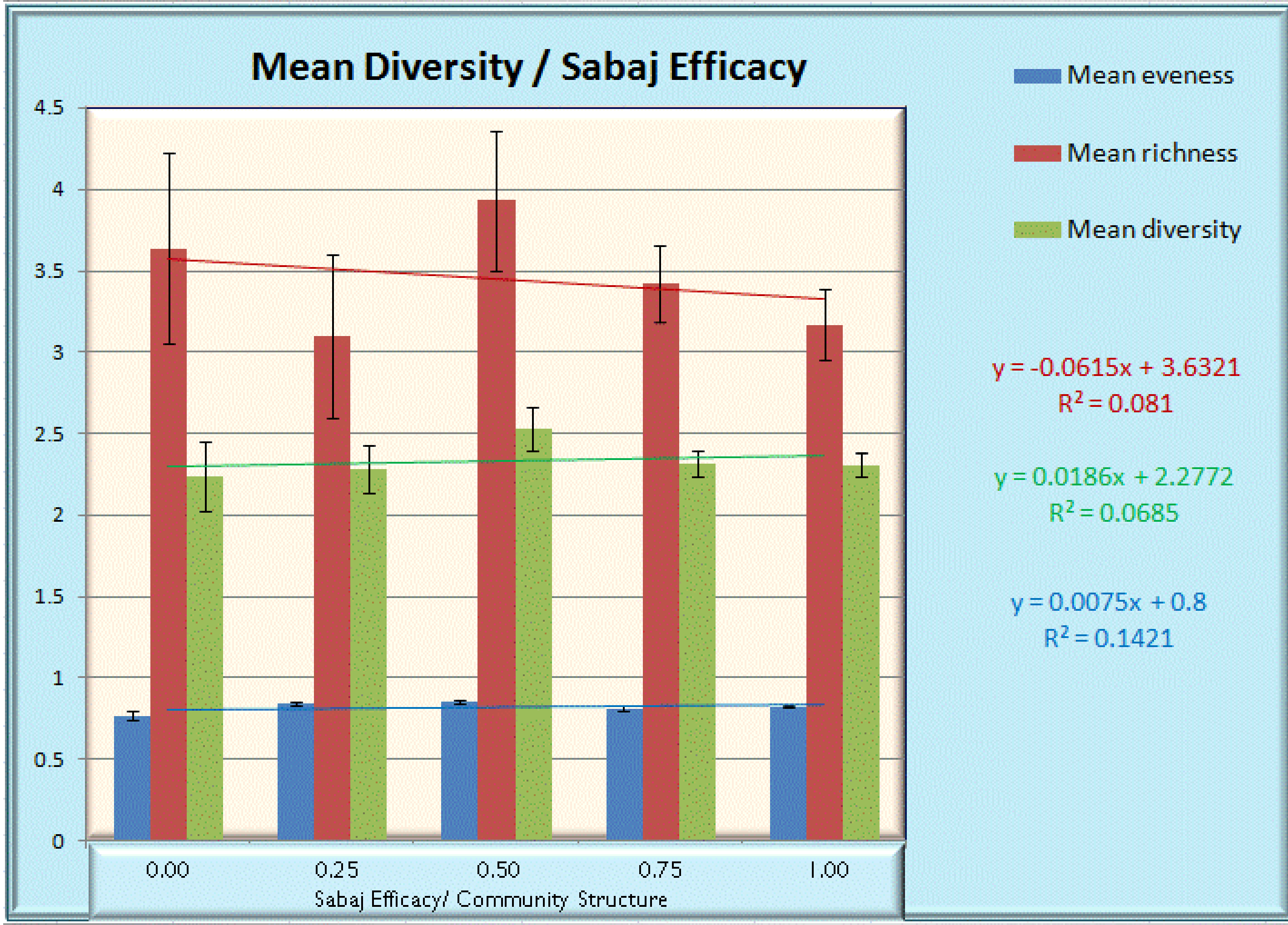

Diversity v. Structure

Assessment of patterns in mean evenness (i.e., Pielou J), richness (Margalef's index) and total diversity (Shannon Weiner) per Sabaj Efficacy Index (SEI) group.

SEI is a measurement of community-level stratification.

Marginal line slopes and small r^2 values indicate an absence of linearity and relatedness between community-level stratification; and evenness, richness & diversity.

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Initial Assessments of Alpha Diversity & Sabaj Efficacy

SHE analysis revealed richness (ln S) and total diversity (H) continued to increase after the sampling of 39 microhabitats. However the rate of increase significantly decreased after the sampling of 26 microhabitats.

Evenness (ln E) plateaued after the sampling of just 12 microhabitats, an important consideration as it concerned the Gehrt-Mueller Priority Site Determination. (Sabaj-Stahl, Whitney, Frank & Clemens 2013. The Theory of Quantum Microbiogeography: Mechanisms of the Priority Site Determination. Echo Efficacy Journal 1(1): 1-77).

The SHE plot was representative of a log normal species distribution and of a community expressing the least evenness.

Evenness and total diversity were essentially unchanged across all Sabaj Efficacy Index categories, indicating independence of community structure from diversity.

Richness fluctuated across Sabaj Efficacy Index categories. However, there was no apparent linear trend, also suggesting potential independence from efficacy.

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A Conundrum & Vexing Paradox

It would seem counter-intuitive that the identical data (species percent cover) used to assess diversity and community-level stratification / structure would result in these variables being *independent of one another*.

That is, it was expected linearity would occur concerning the relationships of community structure with total diversity, evenness & richness.

Specifically, the stratification of communities (i.e., the formation of uniform bands parallel to channel banks) was anticipated to be accompanied by *linear trends* with diversity.

Thus, a paradox of sorts, previously described as the *McIsaac Paradox* (Sabaj-Stahl, Whitney, Frank & Clemens 2013) presents itself:

How can diversity be independent of community structure?

Simple, logistic & multiple regression analyses were applied to further investigate this vexing trend.

Hypotheses:

H_o: $B_1 = 0$. Alpha diversity (total diversity, richness, dominance & abundance) is independent of community structure/ stratification.

H_{a1}: $B_1 \neq 0$. Alpha diversity (total diversity, richness, dominance & abundance) is dependent upon (i.e., correlated with) community structure/ stratification.

H_{a2}: $B_1 < 0$. Alpha diversity (total diversity, richness , dominance& abundance) is directionally dependent upon community structure/ stratification, with diversity decreasing as structure/ stratification increases.

Rationale: The expectation was diversity would decrease as community structure/ stratification increased. Specifically, as more communities came to form uniform bands parallel to channel banks as defined per Sabaj Efficacy, dominance was expected to increase & evenness decrease due to a few species becoming prevalent among those stratified communities. Corresponding decreases in richness, coupled with decreases in evenness, were expected to cause decreases in total diversity as efficacy increased.

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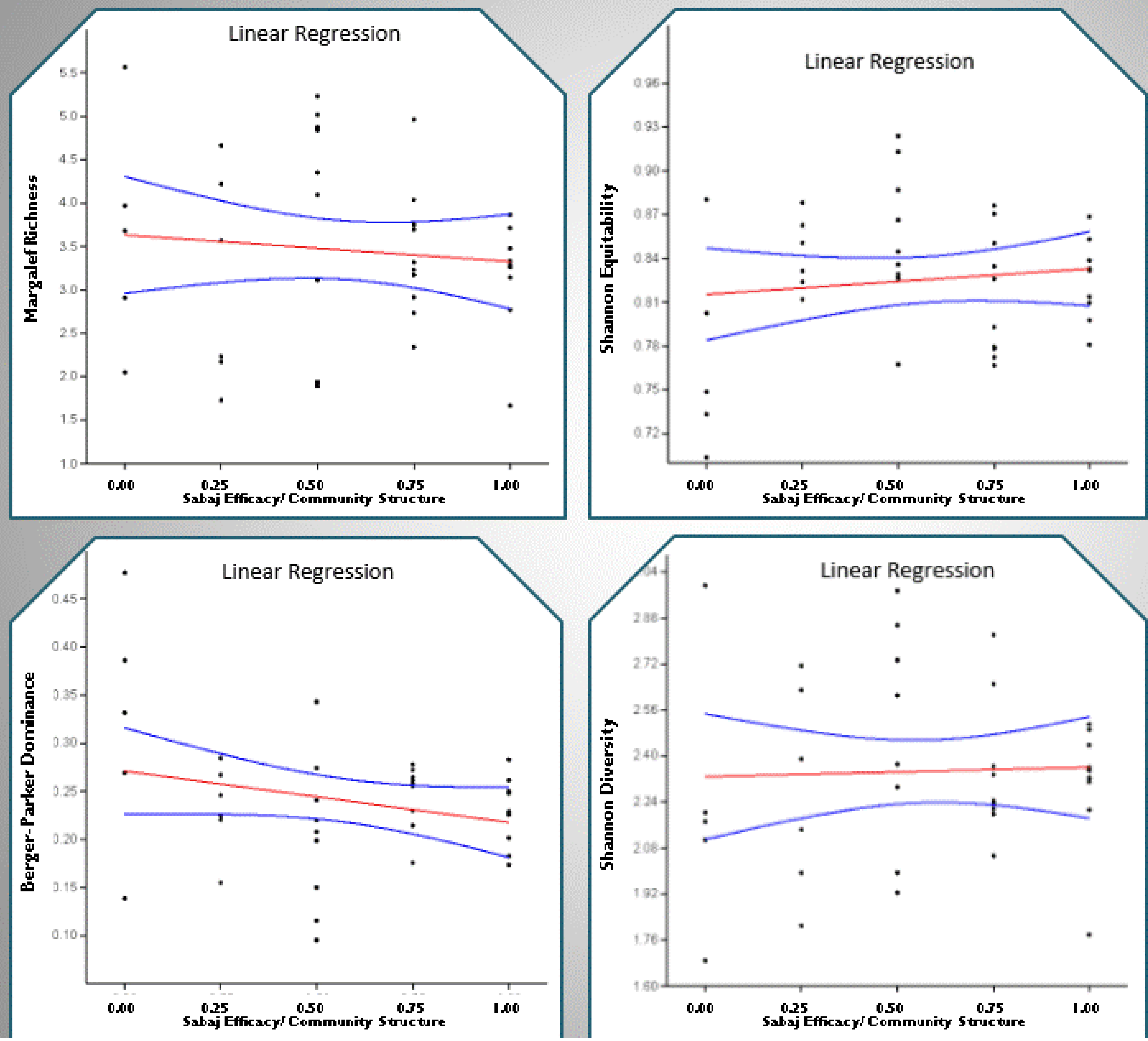

Regression Outcomes

Richness

Slope: -0.306 (-0.396)
r: -0.100 (-0.041)
r^2: 0.010 (0.002)
t_{stat}: -0.612 (-0.252)
p: 0.544 (0.803)
p(a=1): 0.013 (7.965E-08)

Equitability

Slope: 0.018 (0.007)
r: 0.122 (-0.139)
r^2: 0.015 (0.019)
t_{stat}: 0.750 (-0.855)
p: 0.458 (0.398)
p(a=1): 7.73E-33 (2.559E-30)

Dominance

Slope: -0.053 (-0.048)
r: -0.254 (0.144)
r^2: 0.064 (0.021)
t_{stat}: -1.596 (0.884)
p: 0.119 (0.383)
p(a=1): 2.40E-28 (9.392E-07)

Diversity

Slope: 0.032 (-0.016)
r: 0.032 (0.064)
r^2: 0.001 (0.004)
t_{stat}: 0.196 (0.392)
p: 0.846 (0.697)
p(a=1): 6.78E-07 (2.078E-16)

*(red = weighted regression)

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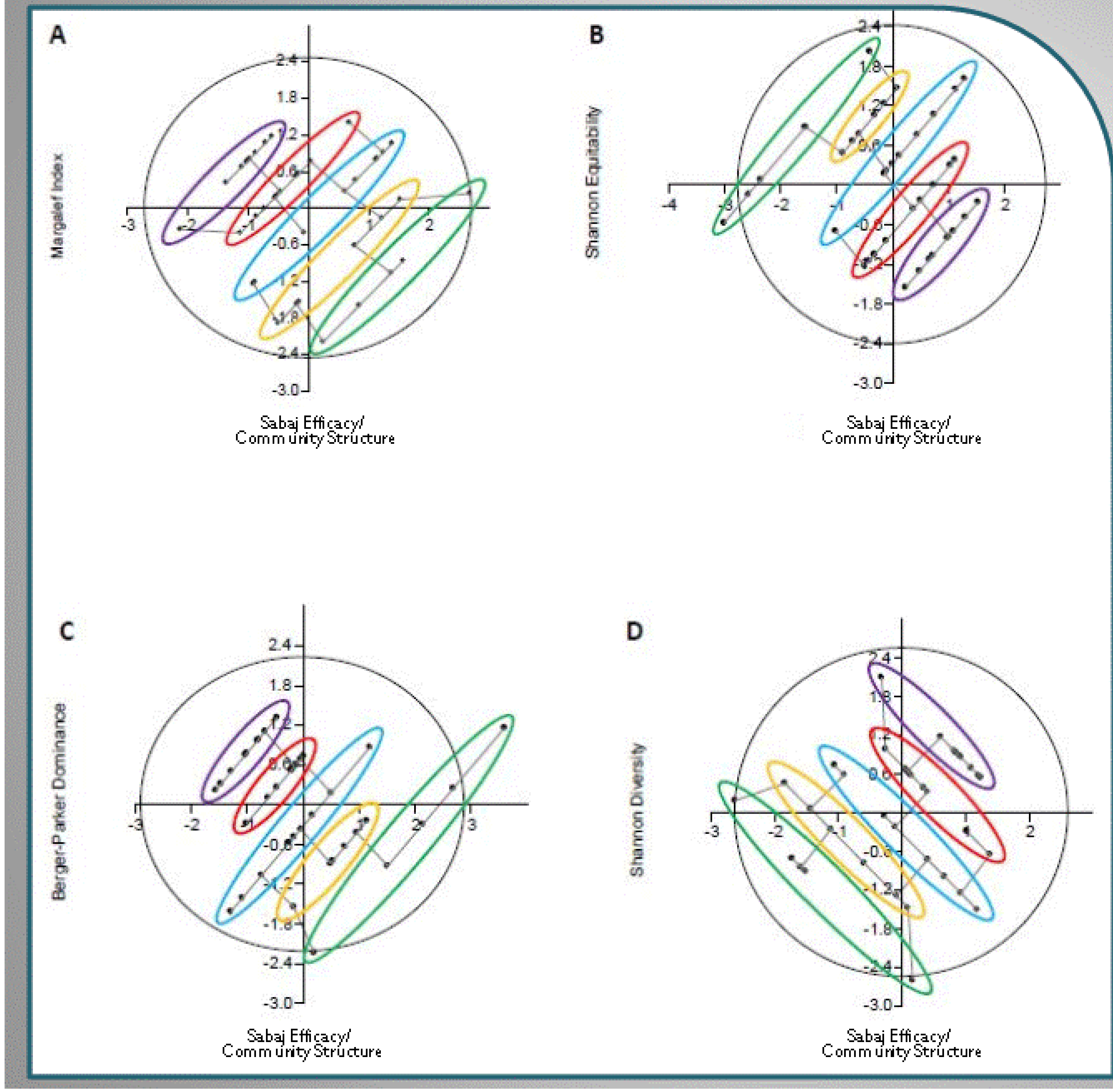

PCA Correlation Matrices of Diversity, Richness, Evenness & Dominance with Sabaj Efficacy.

Arcsine transformed mean percent cover per species were used to derive Sabaj Efficacy and Margalef Richness (A); Shannon Equitability (B); Berger-Parker Dominance (C); and Shannon Diversity (D); per microhabitat.

Although simple regression line slopes suggested no linear relationships between community structure and diversity, PCA scatter plots suggest unequal dispersion of Y upon X, with dispersion decreasing as structure increases.

Furthermore, dispersion is reduced from both tails of the distribution.

Ring Codes

purple:	quarternary structure
red:	tertiary structure
Blue:	secondary structure
Gold:	primary structure
Green:	dimensionless structure

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Interpretation of Simple Regression Outcomes

Reject H_{a1} ($p > 0.05$); $B_1 = 0$. Alpha diversity (total diversity, richness, abundance & dominance) *is* independent of community structure/ stratification, *per the two-tailed t test.*

Accept H_{a2} for richness & dominance; $B_1 \neq 0$ and $B_1 < 0$, *per the one-tailed t test.*

Reject H_{a2} for evenness & total diversity; $B_1 \neq 0$ but $B_1 > 0$, *per the one-tailed t test.*

Simple regression r-values, indicators of the strength/ direction of linear relationships, were universally weak. Line slopes tended toward zero, indicating an absence of linearity.

Simple regression r^2-values, indicators of the percent of variation in *Y* explained by its relationship with *X*, were generally less than 5% (B-P Dominance = 6.4%, two-tailed test).

Pattern analyses of simple and multiple regression scatter plots evidenced an *unequal dispersion* of *Y* upon the independent categories of *X*, thus violating a key assumption of linear regression.

Weighted linear regression outcomes, wherein unequal variances were improved, remained essentially unchanged compared to unweighted simple regression outcomes.

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Interpretation of Multiple Regression Outcomes

Pattern analyses of multiple regression scatter plots evidenced an *unequal dispersion* of *Y* upon the independent categories of *X*. However, those patterns were essentially *unchanged* when using weighted Y values wherein the unequal variances were improved (data not shown).

Pattern analyses of multiple regression scatter plots suggested a trend wherein the means of richness, evenness, dominance & diversity were preserved across Sabaj Efficacy Index categories.

Alternatively, the ranges of these variables were ***curtailed in a two-tailed fashion*** as efficacy increased. *Variance decreased as efficacy increased*. Thus, we observed *directional heteroscedasticity*.

Multiple regression minimum line distances revealed the most efficacious of microhabitats were also the most closely related based upon the variables of diversity and efficacy, displaying the least dispersion/ variance.

Taken together with simple regression outcomes (negligible line slopes, r & r^2 values), conclusions regarding H_{a2} are *highly suspect*.

Thus, any *potential unidirectionality* in the relationships of diversity with efficacy were dismissed. The extremely small p values yielded by *one tailed* t-tests are assumed a result of confidence interval trends occurring across efficacy groups, and not unidirectional trends toward either tail.

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Let's Git Jiggy Wit It!

A higher proportion of the most efficacious microhabitats occur within 95% confidence intervals of simple regression compared to other efficacy groups.

Among eleven diversity indices (total diversity, richness, dominance, abundance) *75%* of the most efficacious sites were constrained within these confidence intervals. ..

A proportion higher than the four lower levels of efficacy.

Confidence intervals for zero efficacy groups were consistently larger than those of the most efficacious groups, yet encompassed only *38%* of microhabitats for that group among the eleven regressions (Sabaj-Stahl, Whitney, Frank & Clemens 2013. The Theory of Quantum Microbiogeography: Mechanisms of the Priority Site Determination. Echo Efficacy Journal 1(1): 1-77).

These trends indicate something beyond the proposed independence of Sabaj Efficacy from alpha diversity explains why the most efficacious sites approximate mean alpha diversity and why mean diversity is conserved across all efficacy groups. The *McIsaac Paradox* continues to perplex… .

It is speculated a bidirectional trend, caused by truncation of the range of diversity from both tails of the distribution as community structure increases, is driven by an innate and elusive force occurring between the variables of diversity and community structure/ stratification.

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The Refined Quinn Cohesion Index

The apparent absence of linearity between diversity and community-level stratification, coupled with reduction in dispersion as microhabitats increased in stratification, prompted analysis of trends concerning dispersion/ variance and confidence intervals.

The refined Quinn Cohesion Index (r-QCI) was derived from the PCA correlation matrices, using only those indices shown to a) have linear relationships with efficacy per simple regression and b) contribute significant information via Akaike Relative Likelihood per logistic regression.
(Sabaj-Stahl, Whitney, Frank & Clemens 2013. The Theory of Quantum Microbiogeography: Mechanisms of the Priority Site Determination. Echo Efficacy Journal 1(1): 1-77).

The r-QCI is an approximation of the *cohesion* occurring between the variables (i.e., alpha diversity and its components, and Sabaj Efficacy) used in simple, logistic & multiple regression.

The index ranges from zero (no cohesion) to one (maximum cohesion). Uniformly distributed variables were used, with the *X*-axis variable (Sabaj Efficacy) discrete and *Y*-axis variables (alpha diversity and its components) continuous.

Data points for the Quinn Quotient were plotted as 3-point, moving averages and then regressed with Sabaj Efficacy to derive the r-QCI.

Derivation of the Quinn Cohesion Index

Sum of no gaps → 4 over 9 (# indices)

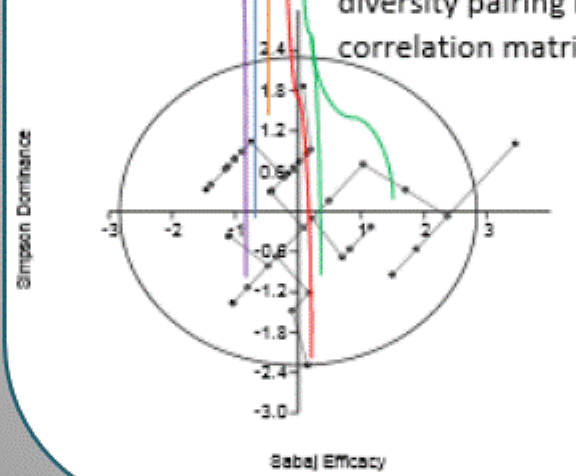
Summary Line Breaks per Efficacy Group:

S.E.	S.D.	S.H.	Ev	Br	Mn	Mr	S.J.	B.P.	L.S.	∑Gaps	Den	Den + 1	Num	QQ
1	1	1	0	1	0	1	0	0	1	5	0.12	1.12	0.44	0.393
0.75	1	1	1	1	1	1	0	0	0	6	0.15	1.15	0.33	0.291
0.5	0	1	2	2	1	2	1	0	2	11	0.27	1.27	0.22	0.175
0.25	2	0	0	0	2	1	0	1	1	7	0.17	1.17	0.44	0.380
0	1	2	1	2	1	1	1	1	2	12	0.29	1.29	0.00	0.000
										41				

5 over 41

0.44 over 1.12

Arrows (left) indicate line breaks per Sabaj Efficacy/ diversity pairing in the PCA correlation matrix.



The Quinn Cohesion Index (QCI) was derived by plotting the Quinn Quotient (y-axis) to Sabaj efficacy (x-axis) as a 3-point, moving average (next slide). *S.E. = Sabaj efficacy; S.D. = Simpson dominance; S.H. = Shannon H; Ev = Evenness (e^H/S); Br = Brillouin index; Mn = Menhinick index; Mr = Margalef index; S.J. = Shannon J; B.P. = Berger-Parker dominance; L.S. = Log richness; Den = Denominator; Num = Numerator; QQ = Quinn Quotient.*

Red circles indicate those indices chosen for r-QCI.

QQ = (∑ (# of efficacy-diversity pairings with no gaps per efficacy group)/ ∑(# of indices assessed)) /(∑(gaps per efficacy-diversity pairing per efficacy group)/∑(gaps for all efficacy-diversity pairings)) + 1.00

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Calculation of the Refined Quinn Quotient & Δ QQ: Orbital Energy States

efficacy	SimpsonD	BP-D	E^H/S	Pielou J	∑ gaps	∑gaps/ total gaps	∑gaps/(total gaps)+1	∑(no gaps)/ #indices	raw QQ	moving av QQ	Δ QQ	mean ΔQQ
1	1	0	0	0	1	0.077	1.077	0.75	0.696	0.609	0.097	0.122
0.75	1	0	1	0	2	0.154	1.154	0.5	0.433	0.512	0.097	0.122
0.5	0	0	2	1	3	0.231	1.231	0.5	0.406	0.415	0.144	0.122
0.25	2	1	0	0	3	0.231	1.231	0.5	0.406	0.271	0.135	0.122
0	1	1	1	1	4	0.308	1.308	0	0.000	0.135	0.135	0.122
Sum					13						0.609	0.61

Legend: efficacy = Sabaj Efficacy/ Community Structure. Dominance indices = Simpson & Berger Parker (BP-D). Evenness Indices = E^H/S & Pielou's J. Raw QQ = Raw Refined Quinn Quotient. Moving Av QQ = 3 Point Moving Average of Refined Quinn Quotient. Δ QQ = Difference Occurring Between Efficacy Levels for the 3 point QQ. Mean Δ QQ = Mean Difference Occurring Between Efficacy Levels for the 3 point QQ.

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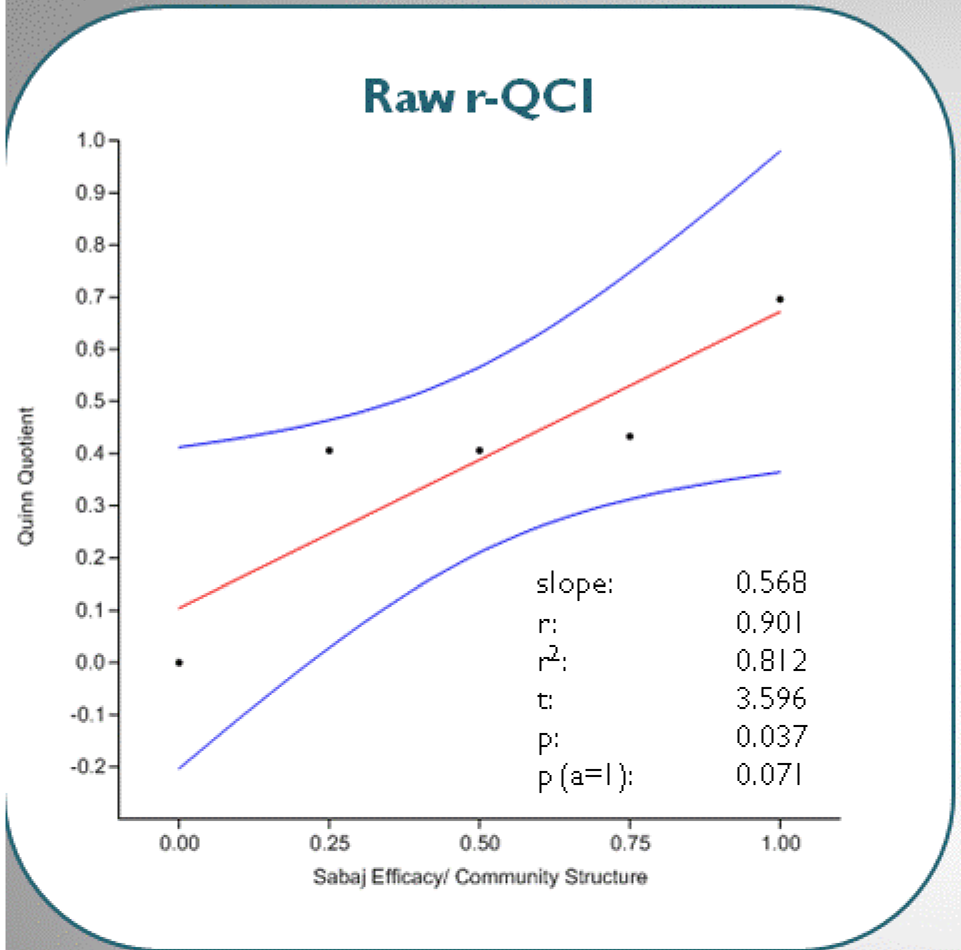
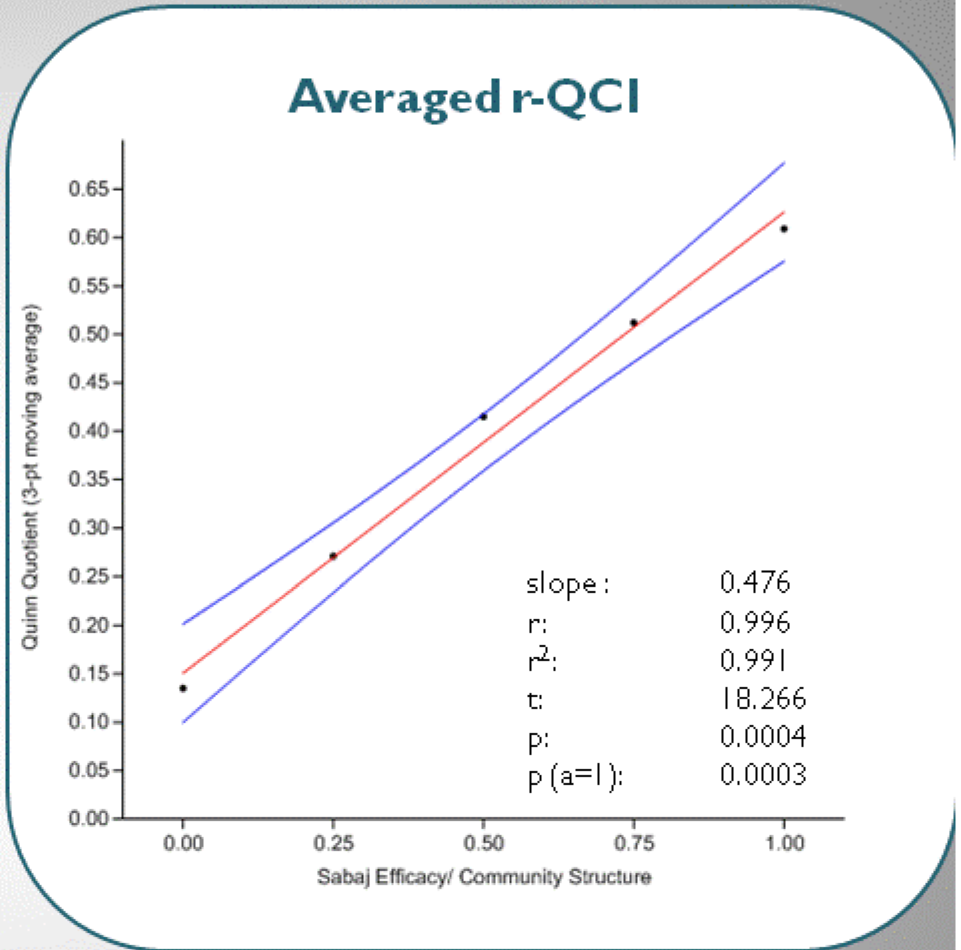


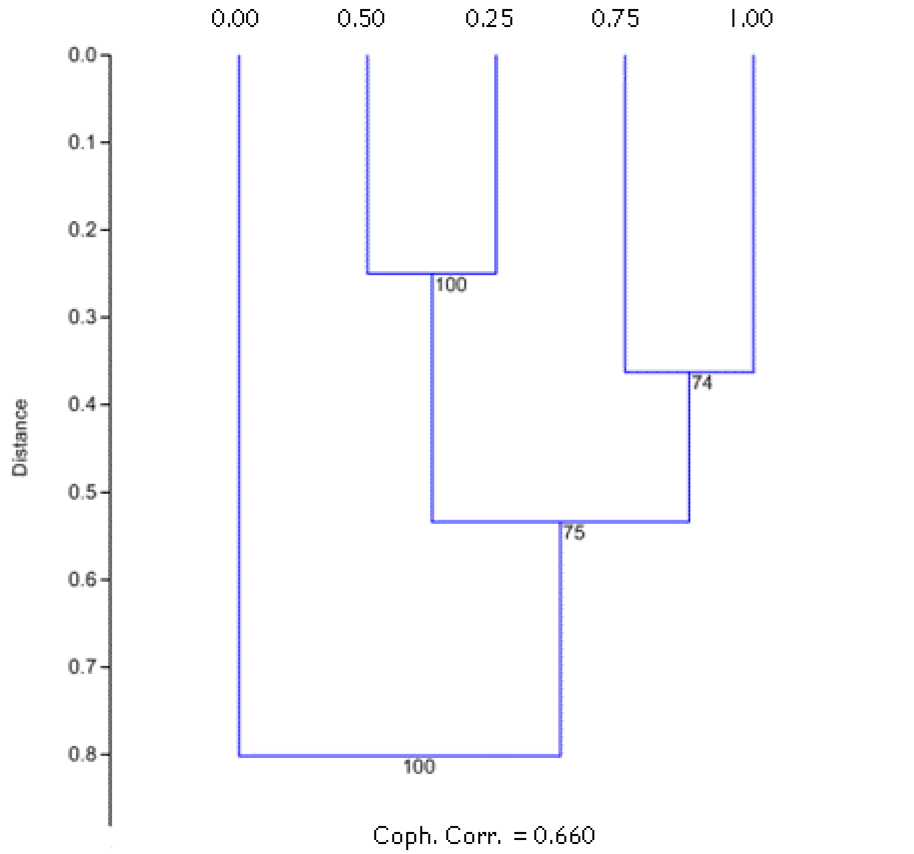


The Quinn Quotient (QQ) for the r-QCI was defined as the proportion of diversity indices with zero line breaks per Sabaj efficacy group / sum of diversity indices selected per Sabaj Efficacy group in the PCA correlation matrices (i.e., 4); divided by the proportion of the number of line breaks per Sabaj Efficacy/ diversity index pairing to the sum of all line breaks in all PCA correlation matrices plus unity (one).

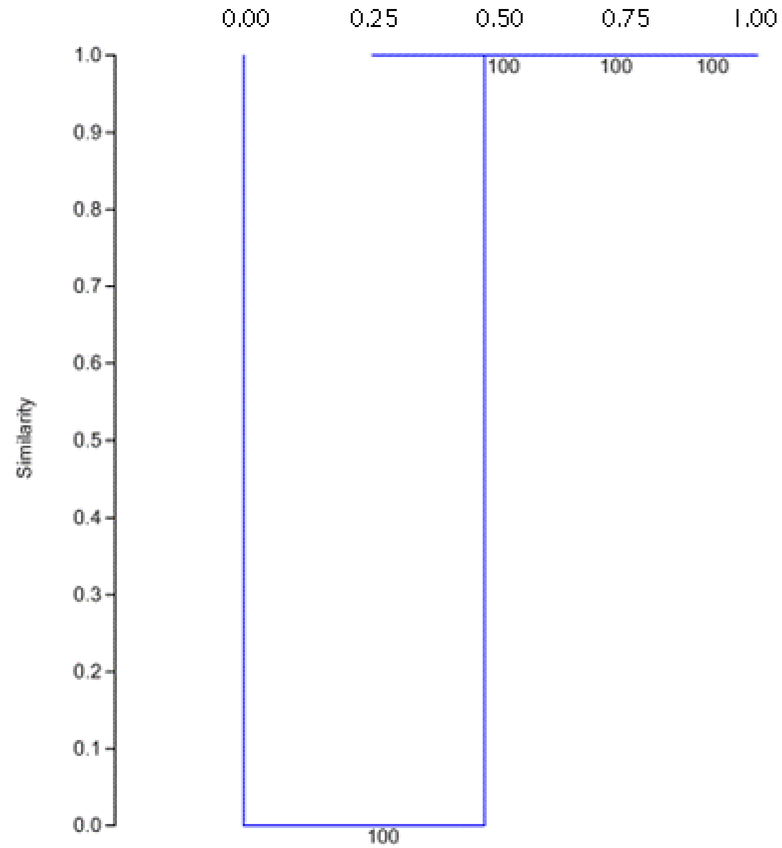
Selection criteria (simple regression + Akaike Relative Likelihood) reduced to four (from nine) the total number of indices assessed for the QQ. The averaged r-QCI is derived by plotting the QQ as a 3-point moving average per efficacy group.

Quantum & Classical Mechanics of the Ecosphere

Euclidean Paired-Group Cluster Analysis



Jaccard Paired-Group Cluster Analysis



Cluster analyses were performed using Sabaj Efficacy (community structure) as the independent (X-axis) variable and the Quinn Quotient as the dependent (Y-axis) variable. Analyses suggest the zero efficacy group (no community level stratification) is least related to the remaining four efficacy/ structure groups. Boot N = 10,000 for both analyses.

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Quantum & Classical Mechanics of the Ecosphere

Quantum Moments

Evenness is uneven in its association with community-level stratification. i.e.; the mean of evenness was conserved across efficacy/ structure, but the range of evenness was not.

Verschränkung, or entanglement, as described by Erwin Schrödinger, was applied "to describe the correlations between two particles that *interact and then separate*, as in the EPR experiment." (Kumar, M., *Quantum*, Icon Books, 2009, p. 313.)

Like the EPR Paradox described by Einstein, Podolsky & Rosen (1935), the *McIsacc Paradox* speculated some unknown phenomenon accounted for the discrepancies observed in the relationship of diversity with community structure/ stratification.

The mean of evenness was preserved across efficacy categories. However, the range of evenness was curtailed in a two-tailed fashion as efficacy increased; i.e., as microhabitats displayed an increasing tendency for the native, exotic, woody & herbaceous communities to become stratified.

This effect accounted for the unequal dispersion of *Y* (alpha diversity and its components) upon the independent categories of *X* (community-level stratification) in regression analyses.

Quantum & Classical Mechanics of the Ecosphere

Quantum Moments Continued…

Quantum entanglement occurs when pairs of particles interact in ways such that the quantum state of each cannot be described independently. A quantum state is said to exist for the system as a whole. Furthermore, entanglement describes the condition wherein particles experience both interaction and separation.

The relationship occurring between efficacy/ structure and diversity can only be understood in terms of the differential associations of evenness with efficacy; i.e., the simultaneous dependence and independence of evenness with efficacy. This effect is analogous to quantum entanglement.

The system is said to exist in a quantum state, as it cannot be understood solely on the basis of dependence or independence of evenness with efficacy/ structure. It can only be understood as a coexistence of both states; of simultaneous dependence and independence. In classical mechanics, such a duality cannot exist.

A duality is therefore established that is analogous to the wave-particle duality of quantum physics. As Einstein lamented upon the paradox of the wave-particle duality, he opined, "It seems as though we must use sometimes the one theory and sometimes the other, while at times we may use either. We have two contradictory pictures of reality; separately neither of them fully explains the phenomena of light, but together they do."

Quantum & Classical Mechanics of the Ecosphere

Quantum Moments Continued…

Additional evidence of the proposed quantum state occurring between evenness & efficacy/ structure was provided by the refined Quinn Cohesion Index (r-QCI). (note: dominance was treated as the compliment of evenness in these analyses)

Averaged r-QCI values elucidated distinct & separate energy states for specific evenness-efficacy/ structural pairings. In fact, as indicated per r-, r^2- and t- values (with associated p value), a nearly perfect linear relationship of these energies was revealed concerning transitions from one specific evenness/ community structure pairing to another.

These relationships were somewhat reminiscent of quantized states of the atom. While no longer considered appropriate for all potential atomic arrangements, Bohr's Model of the atom still accurately describes the quantum state of many atoms (e.g., hydrogen, helium & lithium).

Thus an attempt was made to model the apparent quantized states of the ecosphere within the contexts presented by Niels Bohr, Max Planck & Erwin Schrödinger of the early 20th century.

The specific energies associated with discrete levels of community structure were applied to derive quantum numbers of one through three, representing three levels of community organization/ stratification occurring within microhabitats.

Quantum & Classical Mechanics of the Ecosphere

Quantum Moments Continued…

Interpretation of Refined Quinn Cohesion Outcomes: What is & is not Quantized?

Upon review of the simple regressions of raw r-QCI and averaged r-QCI, taken together with potential dependencies of community structural elements upon one another, there appears to exist but three discrete quantized states, and not four or five.

The three intermediate groups for Sabaj Efficacy (0.25, 0.50 & 0.75); wherein one, two & three communities become stratified within microhabitats, exhibit remarkably similar energy states.

Overwhelmingly, community-level overlap occurred within microhabitats having Sabaj Efficacy ratings of 0.50, 0.75 & 1.00.

Community arrangements display two levels of independence: native from exotic; & woody from herbaceous. However, there exist four levels of overlap/ dependence: native with woody & herbaceous; exotic with woody & herbaceous.

Simple regression of raw r-QCI with Sabaj Efficacy/ community structure indicated there may exist but three discrete quantized states based upon the energies elucidated for Quinn Cohesion.

Quantum & Classical Mechanics of the Ecosphere

Quantum Moments Defined!

Utilizing the trend line produced from the simple regression of the raw Quinn Quotient with Sabaj Efficacy/ community structure, quantized energy states were identified for efficacy groupings of 0.00, 0.25 through 0.75, and 1.00.

efficacy	adjusted r-QCI	absolute ratio	assumed ratio	Quantum #
0.00	0.104	1.00	1.00	1
0.50	0.388	3.73	3.75	2
1.00	0.672	6.46	6.50	3

Adjusted r-QCI is simply the Quinn Quotient value (*Y*-axis) occurring on the trend line for efficacy (*X*-axis) groups of 0.00, 0.50 & 1.00.

The efficacy group of 0.50 was selected to represent the three efficacy groups of 0.25, 0.50 & 0.75; as these three groups exhibited equivalent r-QCI values.

Absolute and assumed (rounded) ratios are displayed in the table for r-QCI. These ratios (1.00:3.75:6.50) represent the Quinn Cohesion energy states assigned to microhabitats based upon their community level stratification.

The less than perfect linear association (i.e., not 1:4:7) of energy states is assumed a result of a loss of 0.25 units of quantized potential energy per leap in quantum number. Quantum leaps appear a function of transitions to levels of independence, not overlap. That is, the transition from 0.00 to 0.25, 0.50 & 0.75 represents one level of independence; from 0 to 1.00 two levels.

Quantum & Classical Mechanics of the Ecosphere

Bohr's Model of the Quantized Atom

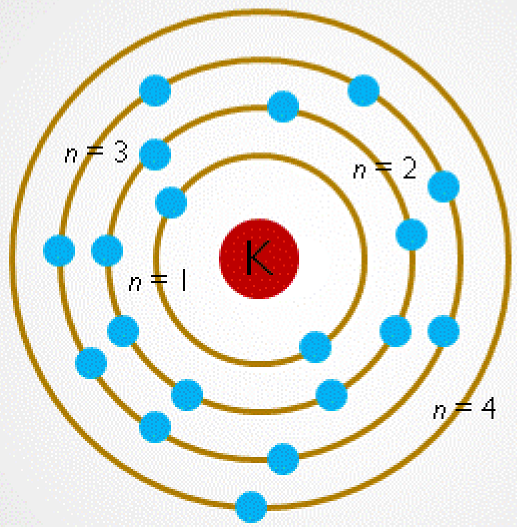
Red Sphere:	Atomic Nucleus
Blue Spheres:	Electrons
Gold Rings:	Electron Orbitals
n:	Quantum Number
K:	Potassium

Quantum theory is based upon the assumption of the variable integer *n*. This was the first application of the quantum number to matter. The larger the value of *n*, the larger the radius of the electron orbit, and the greater the potential energy of the electron.

In the models presented for the quantum state of the ecosphere, microhabitats serve as the equivalent of electrons.

Quantum numbers (one through three) represent all potential states/ combinations of community stratification within microhabitats.

Orbitals, shown as rings and spheres, are the equivalent of electron orbitals. They diverge from atomic in configuration and arrangement in our models to reflect overlap & independence.

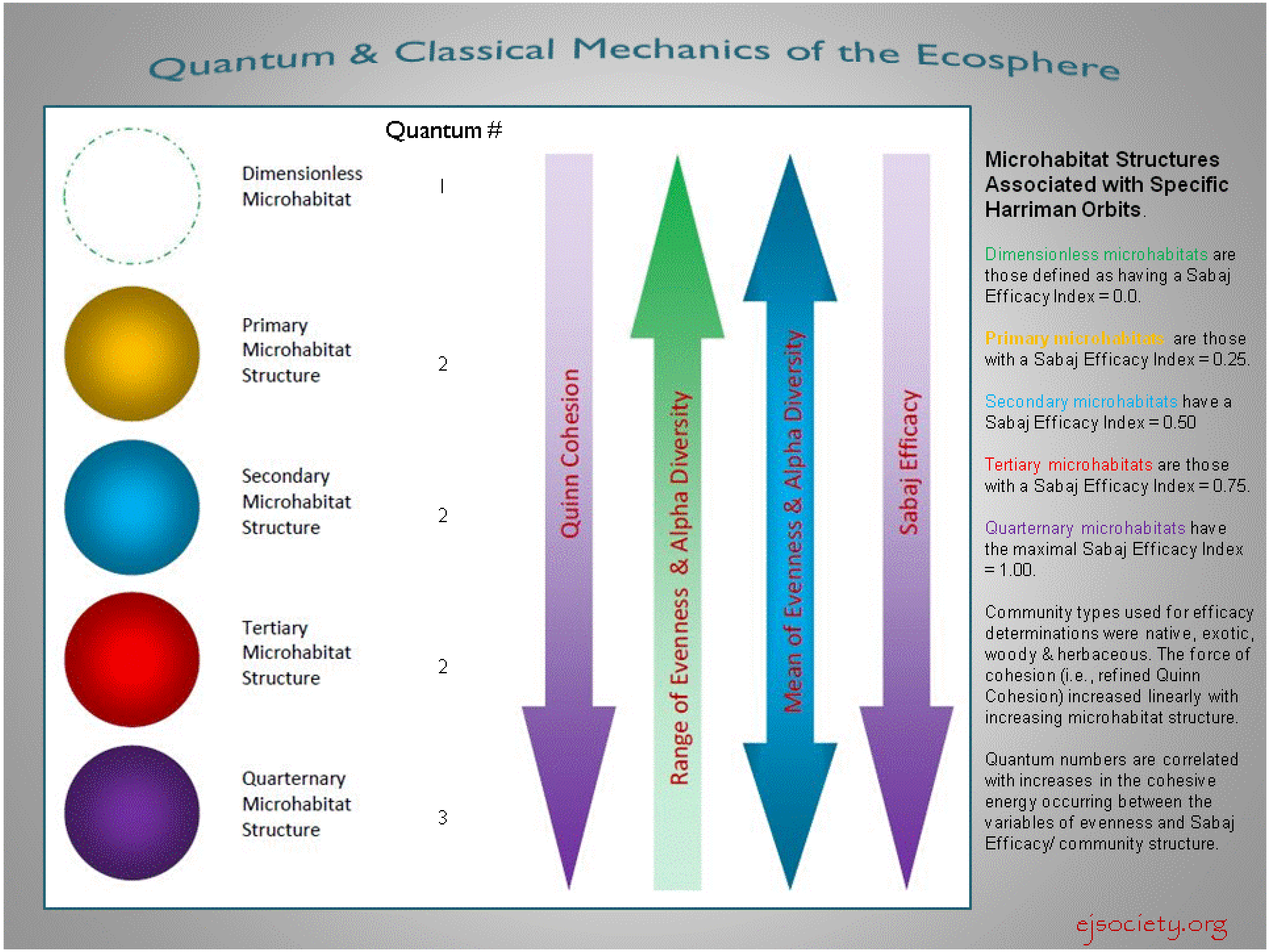


There are discrete energy levels an atom can attain by promoting electrons to higher-energy orbitals. The energy state of an atom is not continuous. Each possible orbital has a discrete energy level. A similar effect, with some modification, was observed for microhabitats per the r-QCI.

As electrons move to orbits of increasing radii, they are in opposition to the force of the positive nucleus, and their potential energy increases.

Analogously, as more communities become stratified within microhabitats, microhabitats occupy additional orbitals. As modeled, each jump a microhabitat experiences per incremental unit of community structure (i.e., quantum number) is accompanied by an expansion of the primary orbital radius.

The analog of the atomic nucleus is the Paulson Particle. It is a hypothetical structure serving as the "Ecologic Qubit," and is equivalent to the computational qubit of quantum computer theory. The Paulson Particle occurs at the intersection of the axes of diversity, structure & cohesion.


Quantum & Classical Mechanics of the Ecosphere
Quantum #
Dimensionless Microhabitat
1
Primary Microhabitat Structure
2
Secondary Microhabitat Structure
2
Tertiary Microhabitat Structure
2
Quarternary Microhabitat Structure
3
Quinn Cohesion
Range of Evenness & Alpha Diversity
Mean of Evenness & Alpha Diversity
Sabaj Efficacy
Microhabitat Structures Associated with Specific Harriman Orbits.
Dimensionless microhabitats are those defined as having a Sabaj Efficacy Index = 0.0.
Primary microhabitats are those with a Sabaj Efficacy Index = 0.25.
Secondary microhabitats have a Sabaj Efficacy Index = 0.50
Tertiary microhabitats are those with a Sabaj Efficacy Index = 0.75.
Quarternary microhabitats have the maximal Sabaj Efficacy Index = 1.00.
Community types used for efficacy determinations were native, exotic, woody & herbaceous. The force of cohesion (i.e., refined Quinn Cohesion) increased linearly with increasing microhabitat structure.
Quantum numbers are correlated with increases in the cohesive energy occurring between the variables of evenness and Sabaj Efficacy/ community structure.
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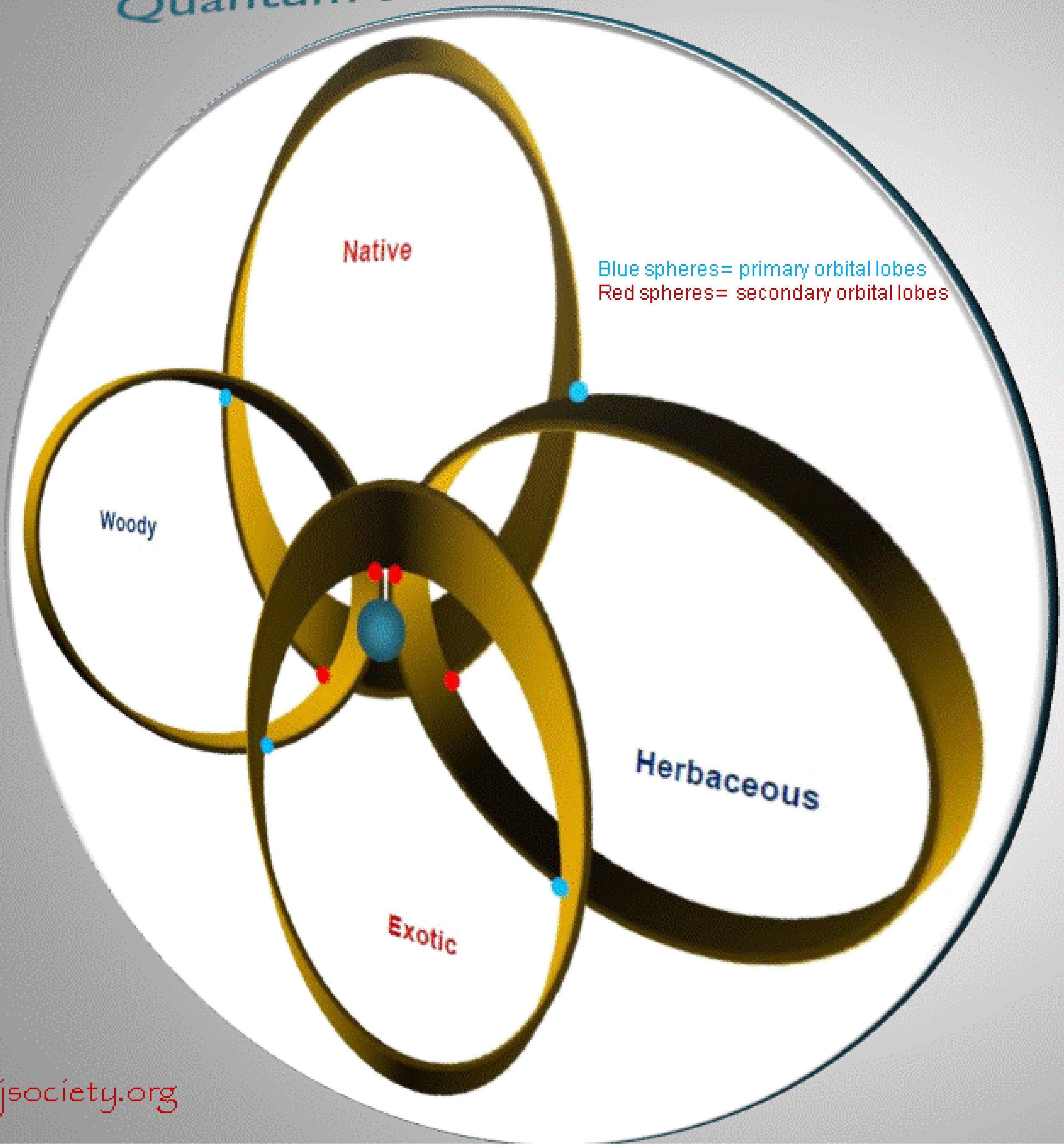
Quantum & Classical Mechanics of the Ecosphere



Harriman Orbital Rings of the Quantum Ecosphere.

Gold rings indicate *primary orbital paths* (the equivalent of atomic S-orbitals) for microhabitats adherent to community efficacy standards for one of four community types (i.e., native, exotic, woody or herbaceous).

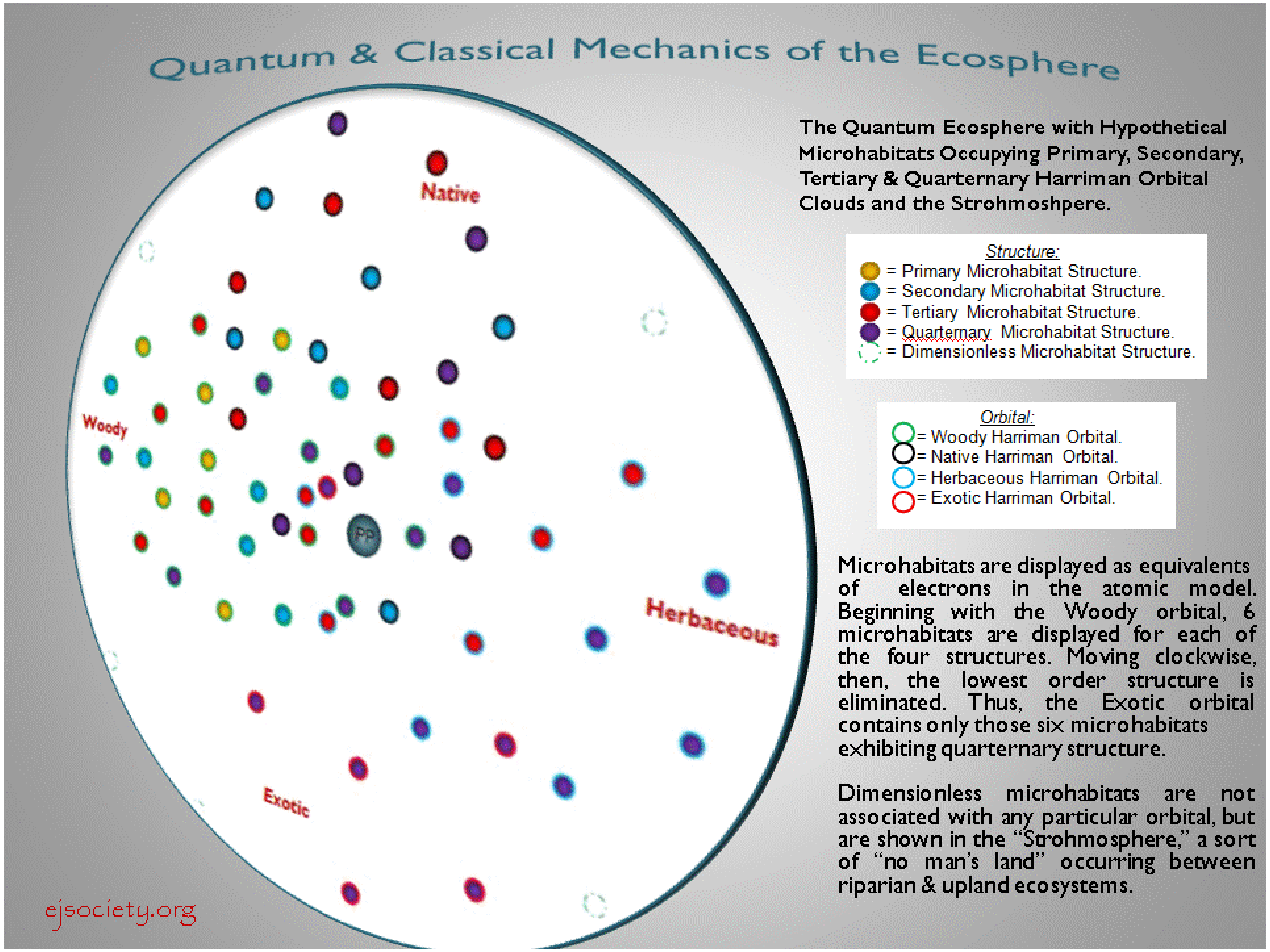
Primary orbital lobes allow for formation of secondary orbital paths (the equivalent of atomic P-orbitals) for microhabitats adherent to community efficacy standards for two of four community types (i.e., secondary structure).

Primary and secondary orbital lobes allow for formation of tertiary orbital paths (the equivalent of atomic SP-hybrid orbitals) for microhabitats adherent to community efficacy standards for three of four community types (i.e., tertiary structure).

Secondary orbital lobes allow for formation of quarternary orbital paths (the equivalent of atomic D-orbitals) for microhabitats adherent to community efficacy standards for four of four community types (i.e., quarternary structure).

The model reflects that native & exotic communities; and woody & herbaceous communities are mutually exclusive of one another.

The Paulson Particle (teal green sphere) represents the confluence of the maximal effects of community-level stratification, range of evenness & alpha diversity, and Quinn Cohesion.


Quantum & Classical Mechanics of the Ecosphere
Native
Woody
Herbaceous
Exotic
PP
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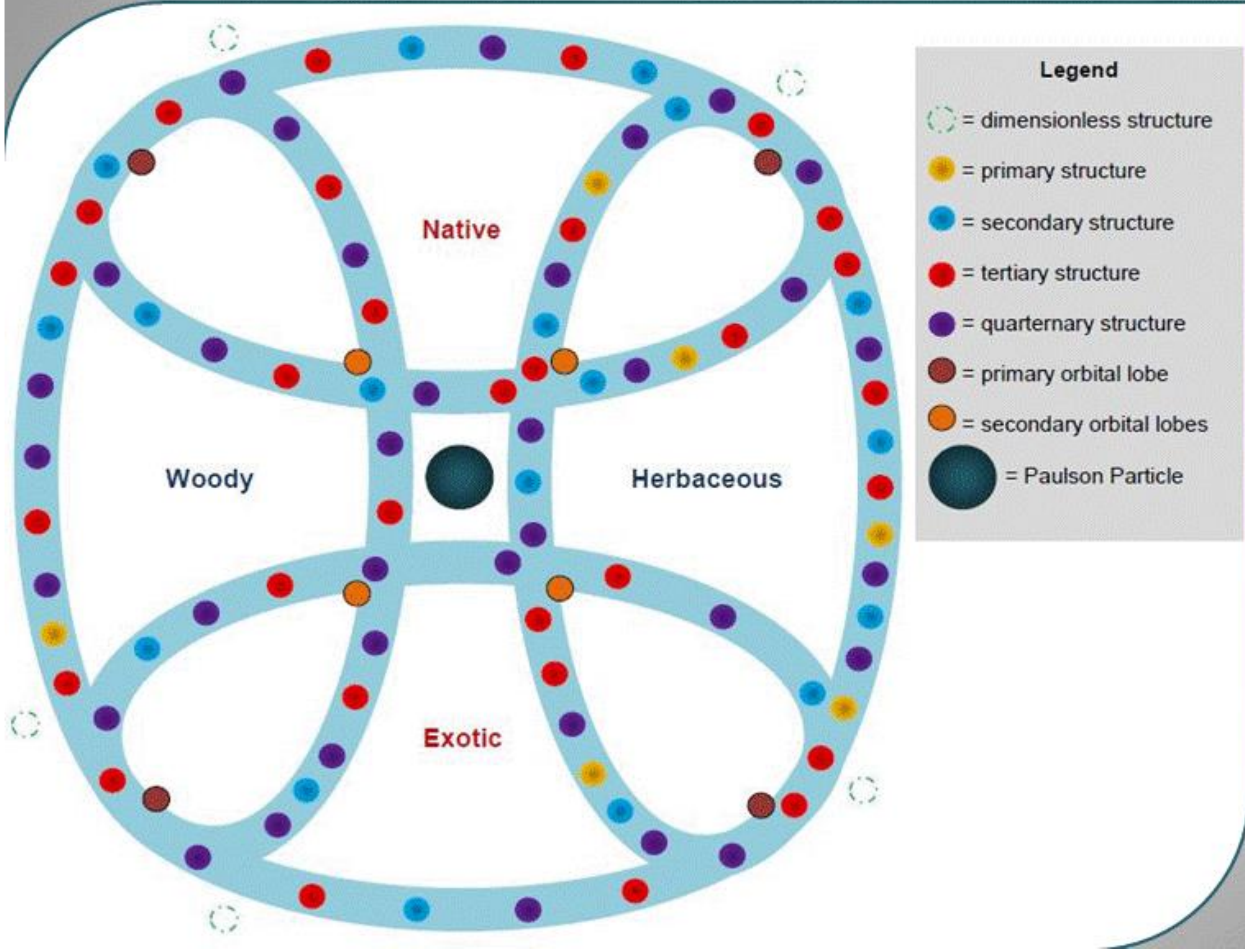
The Quantum Ecosphere with Hypothetical Microhabitats Occupying Primary, Secondary, Tertiary & Quarternary Harriman Orbital Clouds and the Strohmoshpere.
Structure:
= Primary Microhabitat Structure.
= Secondary Microhabitat Structure.
= Tertiary Microhabitat Structure.
= Quarternary Microhabitat Structure.
= Dimensionless Microhabitat Structure.
Orbital:
= Woody Harriman Orbital.
= Native Harriman Orbital.
= Herbaceous Harriman Orbital.
= Exotic Harriman Orbital.
Microhabitats are displayed as equivalents of electrons in the atomic model. Beginning with the Woody orbital, 6 microhabitats are displayed for each of the four structures. Moving clockwise, then, the lowest order structure is eliminated. Thus, the Exotic orbital contains only those six microhabitats exhibiting quarternary structure.
Dimensionless microhabitats are not associated with any particular orbital, but are shown in the "Strohmosphere," a sort of "no man's land" occurring between riparian & upland ecosystems.

Quantum & Classical Mechanics of the Ecosphere

The Lower Dolores Quantum Ecosphere with Primary, Secondary, Tertiary & Quarternary Harriman Orbital Rings and Associated Microhabitats.



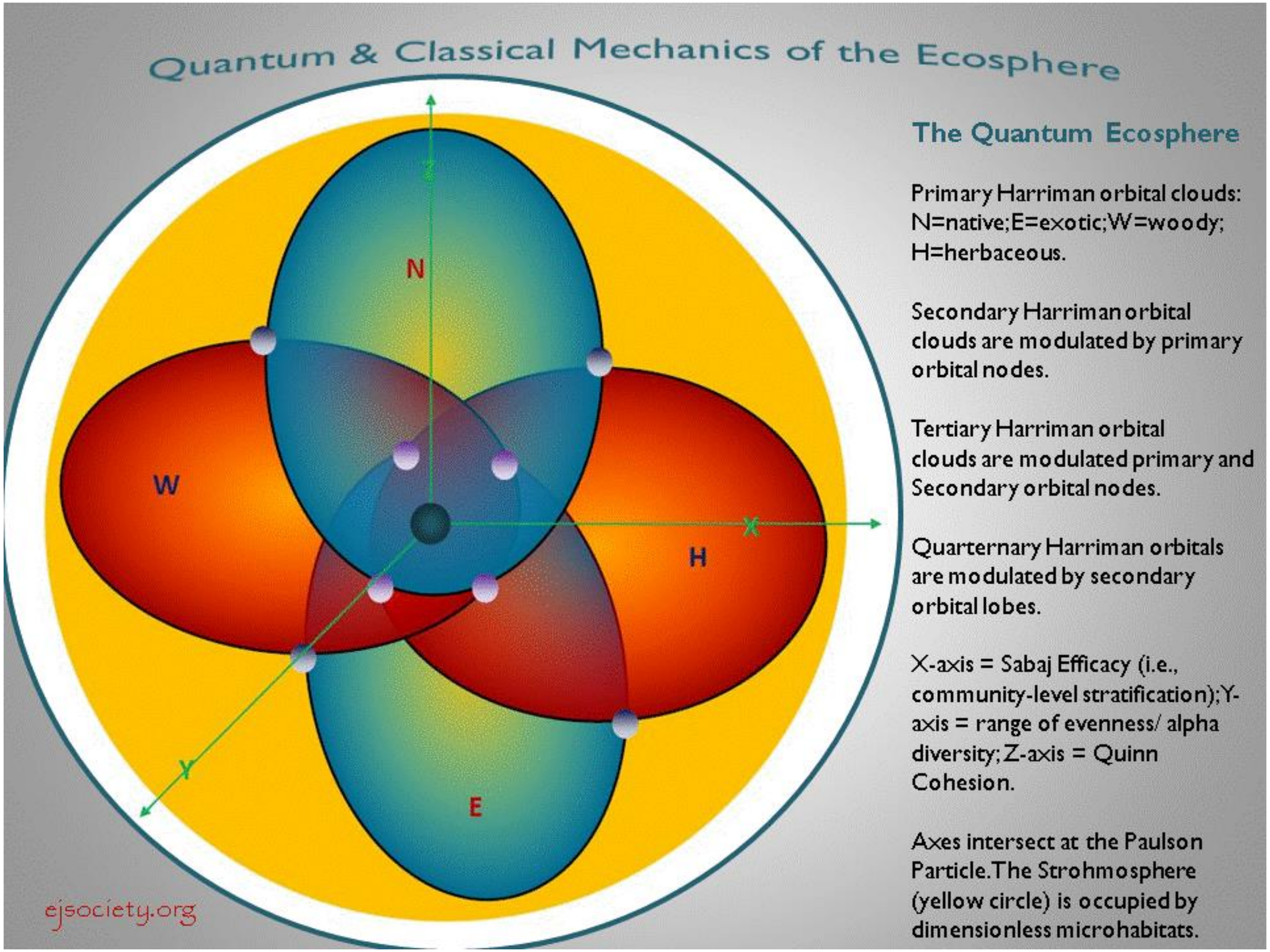
Microhabitats are depicted in their actual frequencies per stratification criteria (i.e., Sabaj Efficacy), per community type, as assessed in the lower Dolores Watershed during the summer of 2010.

The quantum state is reflective of:

a) discrete energies associated with microhabitat structures;

b) discrete microhabitat structures of dimensionless, primary, secondary, tertiary and quarternary ;

c) simultaneous occurrence of given microhabitats in multiple Harriman orbitals (i.e., secondary, tertiary and quarternary microhabitats).


Quantum & Classical Mechanics of the Ecosphere
Z
N
W
X
H
Y
E
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The Quantum Ecosphere
Primary Harriman orbital clouds: N=native; E=exotic; W=woody; H=herbaceous.
Secondary Harriman orbital clouds are modulated by primary orbital nodes.
Tertiary Harriman orbital clouds are modulated primary and Secondary orbital nodes.
Quarternary Harriman orbitals are modulated by secondary orbital lobes.
X-axis = Sabaj Efficacy (i.e., community-level stratification); Y-axis = range of evenness/ alpha diversity; Z-axis = Quinn Cohesion.
Axes intersect at the Paulson Particle. The Strohmosphere (yellow circle) is occupied by dimensionless microhabitats.

The Quantum Ecospheric Model Summary

All models presented were conceptual in nature; none exactly depicts the "real" model.

While the concepts underlying the models were supported by compelling outcomes, with highly significant r-, r^2-, t-test and related p- values; it is not yet apparent what if any *biological significance* (i.e., applicability) resides in the models.

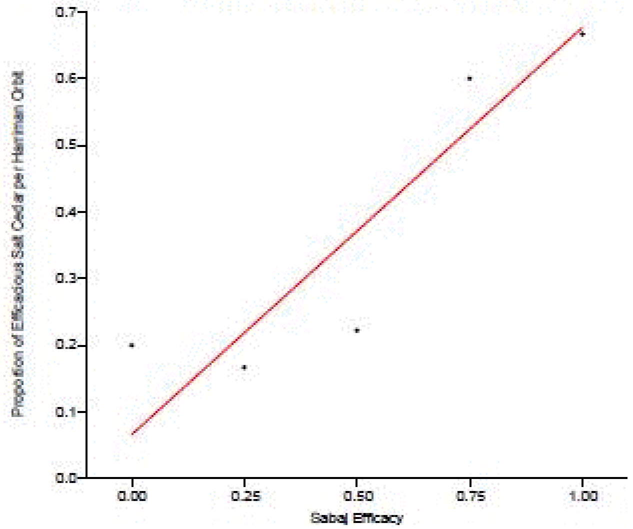
Specifically, while it remains useful to have a means by which to quantify & assess community structure/ stratification- i.e., the formation of uniform bands of vegetative communities parallel to channel banks; independence of mean diversity from community structure might restrict any practical application of these concepts.

That is, if mean diversity fails to show any consistent linear trends related to community structure (as defined), then ecologists might find little use of these concepts as it concerns the study of disturbance, bio-invasion and ecologic restoration.

As richness, abundance and total diversity serve as core measurements related to these processes, it is incumbent to apply the concepts revealed herein in a manner that enables ecologists and land managers to better assess the ecosphere relative to project objectives.

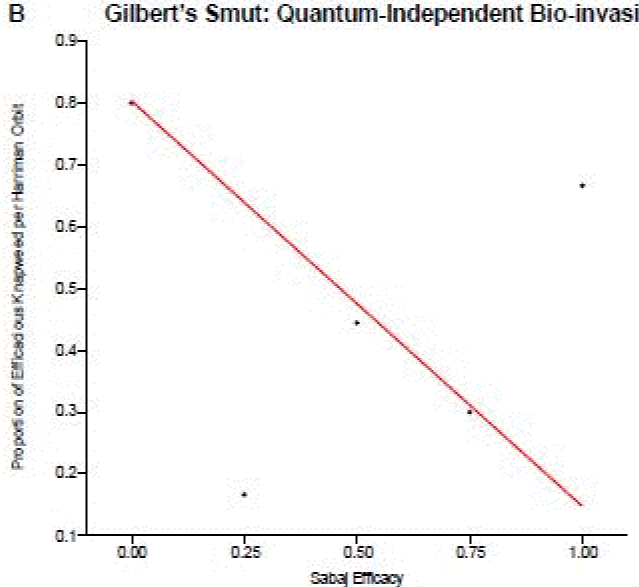
Quantum & Classical Mechanics of the Ecosphere

A Potter's Rot: Quantum-Dependent Bio-invasion



Regression Outcomes:	
Slope:	0.611
Intercept:	0.066
r:	0.895
r^2:	0.802
t:	3.482
p (uncorr):	0.040

B Gilbert's Smut: Quantum-Independent Bio-invasion



Regression Outcomes:	
Slope:	-0.656
Intercept:	0.804
r:	-0.081
r^2:	0.007
t:	-0.141
p (uncorr):	0.897

Orthogonal Regression of Invasive Species Biogeographic Structure with Community Biogeographic Structure.

Invasive species structure was estimated as the proportion of microhabitats within specific Harriman orbitals wherein salt cedar (A) and knapweed (B) adhered to 40% confidence interval limits using point in time parameter estimates. Community structure was defined as before: i.e., as Sabaj Efficacy (using 25% confidence interval limits for the four community assemblages).

Quantum-dependent processes of bio-invasion (dubbed as Potter's Rot, in honor of Cathryne Potter, PhD of Rutgers) presented disease sequelae consistent with community biogeographic structure.

Quantum-independent processes of bio-invasion (dubbed Gilbert's Smut, in honor of Julanna Gilbert, PhD, University of Denver) presented disease sequelae not consistent with community biogeographic structure.

Potter's Rot as an Indicator of Bio-Invasion Mechanisms

Although not assessed within the current study; the ground water table, hyporheic zone and frequency of overbank flooding have been extensively documented as the forces responsible for formation of uniform bands of vegetation parallel to channel banks.

It has also been extensively documented that alterations to these hydrologic regimes via impoundments and diversions are responsible for widespread and ubiquitous bio-invasion of salt cedar in the southwestern US and other regions.

Thus, it was expected salt-cedar bio-invasion would obey the quantum-dependent aspects of community structure within riparian zones.

Salt cedar was found to establish and maintain itself within distinct uniform bands parallel to channel banks. Furthermore, salt cedar stratification consistently occurred within microhabitats where multiple ecologically relevant communities were stratified.

These outcomes provide a reliable and indirect means to assess the processes of bio-invasion within the context of bottom-up hydrologic forces.

Gilbert's Smut as an Indicator of Bio-Invasion Mechanisms

Although not assessed within the current study; livestock grazing regimens and associated soil disturbances have been suspected as a potential causation of knapweed invasion.

However, unlike the consensus concerning hydrology & salt cedar bio-invasion, the community of scholars remains sharply divided in their opinions concerning causes of knapweed bio-invasion.

All 39 of the one-square acre microhabitats assessed with the study were subject to livestock grazing under federal permits. However, a minority of these sites were off-limits to cattle due to surrounding geomorphic characteristics.

Prior to analysis, there was no expectation concerning any potential trends of knapweed bio-invasion relative to community structure.

Unlike salt cedar, knapweed did not establish itself within the riparian zone in a manner consistent with community structure. Ergo, knapweed invasion was deemed quantum-independent and therefore independent of hydrology.

It was considered plausible that a top-down disturbance, such as soil disturbance by cattle, facilitated knapweed invasion.

Community Structure: A Useful Measure of Ecospheric Health?

While community level structure/ stratification, as assessed per the Sabaj Efficacy Index (SEI), appears to have applications concerning overall community dynamics and specific processes of bio-invasion…

… could community structure be integrated with other biometrics to yield a comprehensive & quantitative index for ecosystem health relative to the processes of disturbance, bio-invasion and ecologic restoration?

Analyses demonstrated the mean of diversity (along with means of richness and abundance) was independent of the SEI, indicating quantum independence. However, ranges of these variables were not, and were described within the context of quantum mechanics.

Processes of bio-invasion, as examined per salt cedar and knapweed dynamics, indicate a bifurcation, wherein one was quantum-dependent and the other –independent.

Given these disparities, unification of the variables of community structure, alpha diversity and bio-invasion could become problematic.

Toward a Comprehensive Ecospheric Health Biometric

Of particular concern, community structure as defined prohibits a ranking of study sites on the basis of any quantitative concept of ecosystem health.

While microhabitats absent any stratification (SEI = 0) were likely unhealthy within the context of functional riparian ecosystems, those with maximal stratification (SEI = 1) were stratified for all four community types, including the exotic community.

As such, those microhabitats with the highest of SEI values also displayed significant percent covers of invasive species. This effect precludes an unbiased sorting of microhabitats on the basis of SEI outcomes alone. At best, subjective and qualitative determinations made on a site-by-site basis would be required to grade out overall health on the basis of the SEI.

While the SEI utilizes the very same data as used for diversity estimates (i.e., absolute percent cover estimates of taxa) it does not necessarily reflect any content concerning diversity, given its independence from mean diversity, richness & abundance.

Thus, it was determined the elements of alpha diversity and bio-invasion were necessary in order to generate a biometric truly reflective of ecospheric health.

Quantum & Classical Mechanics of the Ecosphere

The Vegetative Complex Health Index

The VCHI consists of three primary components: *Community Structure, Diversity & Bio-Invasion.*

Community Structure: Defined as the Sabaj Efficacy Index (SEI). Previously, index values of zero through one were utilized. In the VCHI, these index values were converted to rankings of 0, 1, 2, 3 and 4. These rankings correspond to the number of communities (native, exotic, woody & herbaceous) that were stratified within a microhabitat.

Alpha Diversity: Defined as Fisher's Disambiguous Coefficient (FDC) ($\varnothing_F$). The FDC is simply the ratio of Fisher's alpha for a given microhabitat to Fisher's alpha for the ecosystem. Theoretically, $\varnothing_F$ ranges from zero to infinity. In practice, it likely ranges from about 0.1 to 10.

Bio-Invasion: Bio-invasion was assessed using a straight forward and direct ranking metric, the Bio-invasion Rank Index (BRI), ranging from zero to four. Ranks were based upon arcsine-square root transformed, absolute percent cover of invasives, per microhabitat:

0: ≥ 40% invasives; 1: 30-39% invasives; 2: 20-29% invasives; 3: 10-19% invasives; 4: < 10% invasives.

$$VCHI = ((SEI + BRI)/2) * (F\alpha_{site}/F\alpha_{system})$$

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Site	SEI	BIR	Fisher's α	VCHI	Status
GJ1	4	2	4.988	2.61	fair
GJ2	1	2	9.252	2.42	fair
GJ3	4	1	5.933	2.59	fair
GJ4	2	0	2.627	0.46	degraded
GJ5	2	1	6.745	1.76	poor
GJ6	0	1	4.482	0.39	degraded
GJ7	3	0	4.874	1.28	poor
GJ8	3	0	3.428	0.90	degraded
GJ9	0	0	3.001	0.00	degraded
GJ10	3	0	6.054	1.58	poor
MO1	1	0	2.377	0.21	degraded
MO2	2	0	7.751	1.35	poor
MO3	2	2	8.783	3.06	good
MO4	4	2	5.156	2.70	fair
MO5	1	0	7.204	0.63	degraded
MO6	0	0	6.061	0.00	degraded
MO7	1	1	3.156	0.55	degraded
MO8	4	0	6.458	2.25	fair
MO9	0	0	6.848	0.00	degraded
MO10	4	0	2.237	0.78	degraded
UC1	3	0	6.425	1.68	poor
UC2	4	0	4.083	1.42	poor
UC3	3	0	5.105	1.34	poor
UC4	4	3	5.202	3.18	good
UC5	2	3	8.930	3.89	good
UC6	0	2	10.19	1.78	poor
UC7	2	1	9.787	2.56	fair
UC8	2	0	4.886	0.85	degraded
UC9	1	0	5.680	0.50	degraded
UC10	4	0	5.394	1.88	poor
DL1	3	2	4.155	1.81	poor
DL2	3	3	9.347	4.89	excellent
DL3	3	4	4.733	2.89	fair
DL4	2	2	2.723	0.95	degraded
DL5	4	1	5.130	2.24	fair
DL6	3	0	5.285	1.38	poor
DL7	3	4	6.805	4.15	excellent
DL8	2	4	9.197	4.81	excellent
DL9	1	1	3.156	0.55	degraded
System	2.31	1.08	5.734	1.69	poor

Vegetative Complex Health Index Outcomes

$$VCHI = ((SEI + BRI)/2) * Ø_F$$

VCHI Ratings: 0.00-0.99 = degraded; 1.00-1.99 = poor; 2.00-2.99 = fair; 3.00-3.99 = good; ≥4.00 = excellent.

Note that the color codes in the "Site" column correspond to those used previously for the Sabaj Efficacy Index (SEI).

Alternatively, the color codes used in the "Status" column apply to VCHI rankings of degraded (red), poor (yellow), fair (purple), good (blue) and excellent (green).

Notice the manner by which microhabitat groupings form *were not* congruent between the SEI and VCHI.

Those microhabitats receiving VCHI ranks of excellent (DL2, DL7 & DL8) had salt cedar removed by chainsaw just two weeks prior to when all data were collected in the field.

Key Considerations & Distinctions Concerning the SEI & VCHI

The Sabaj Efficacy Index is a discrete index; The Vegetative Complex Health Index is continuous.

The SEI was independent of mean diversity. Associated energies of efficacy/ diversity pairings (low, intermediate & high) evidenced discrete, quantized energies (i.e., Quinn Cohesion).

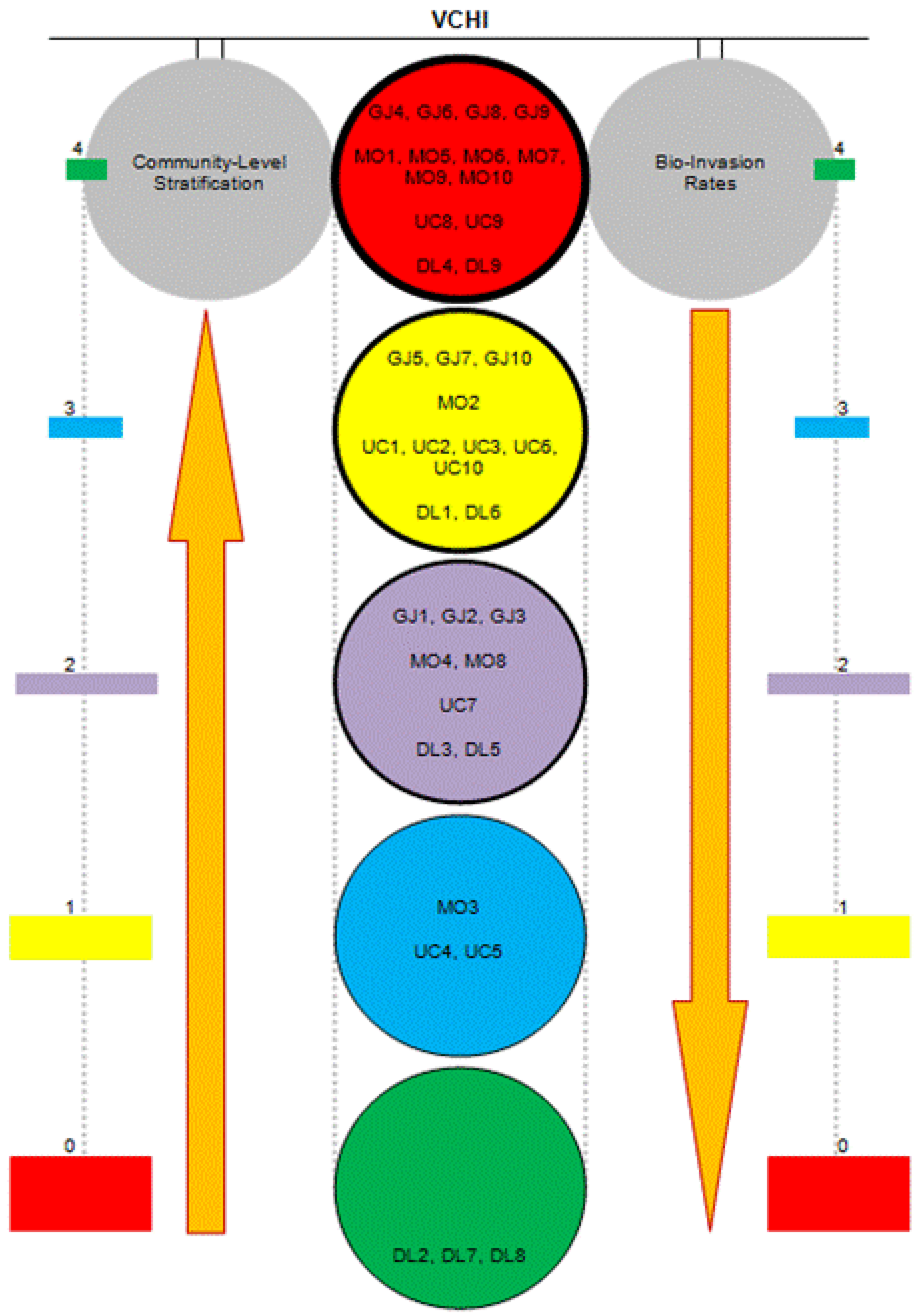
The SEI is a component of the VCHI, along with bio-invasion ranks & diversity components.

As devised, the VCHI appears representative of a classical mechanical system. Furthermore, the VCHI would seem adherent to a classical mechanical, three-pulley system.

The VCHI was predicted to obey the mechanics of a three-pulley system, wherein two pulleys are fixed and the third is free to move.

Specifically, the SEI and BRI serve as the fixed pulleys, microhabitats as the pulley free to move, and alpha diversity as the frictional force acting upon the free pulley. Acceleration of microhabitats is a consequence of the interaction of mass, force & friction.

Within this conceptual model, force is imposed by the SEI and BRI rankings. Friction is imposed by Fisher's Disambiguous Coefficient. Force & friction act upon the mass of microhabitats.



Overall Mechanics of the Vegetative Complex Health Index

The three components of the Vegetative Complex Health Index as revealed per Newtonian (i.e., classical) mechanics via a three pulley system. Community-level stratification (i.e., Sabaj Efficacy) and bio-invasion are shown as fixed pulleys. The chain extending from each has variable weights attached contingent upon SEI and BRI rankings. The pulley that is free to move represents individual microhabitats with associated frictional force (i.e., Fisher's Disambiguous Coefficient). Friction is shown to increase from higher to lower VCHI rankings, however the trend is not universal. The 39 microhabitats studied on the lower Dolores are grouped per VCHI ranking within central pulleys.

Legend:

VCHI = Vegetative Complex Health Index.

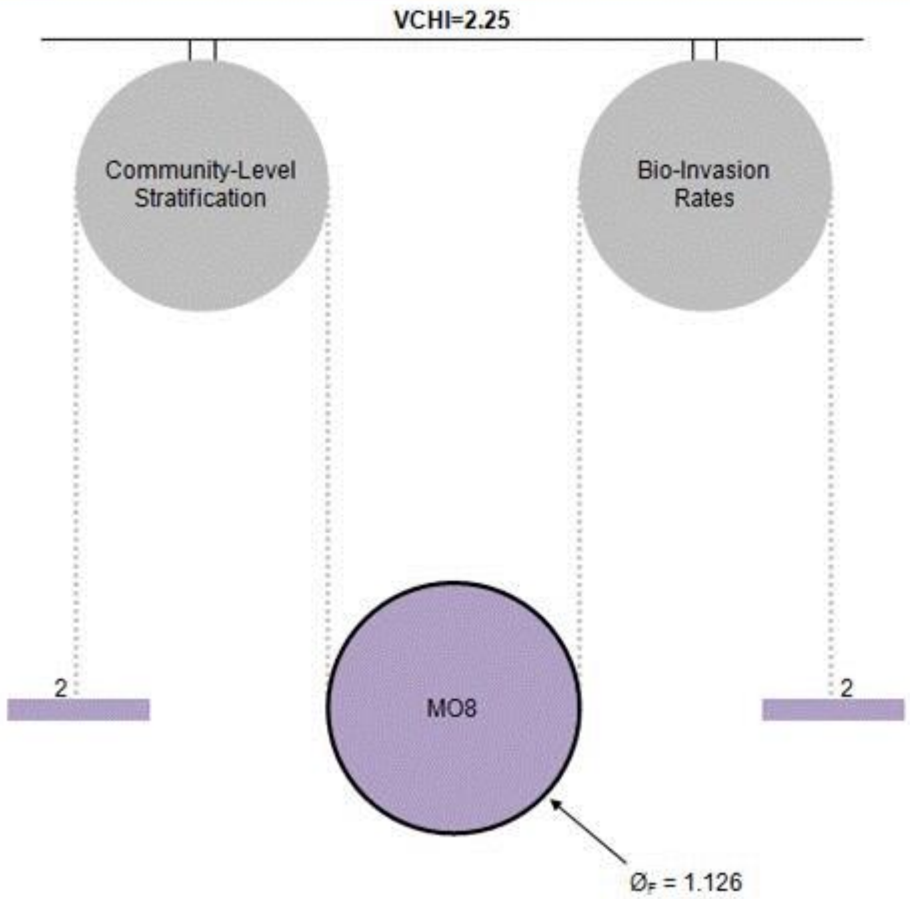
Grey circles = fixed pulleys for community-level stratification (SEI) & bio-invasion (BRI).

Colored bars = relative weights for community-level stratification (SEI) & bio-invasion rankings (BRI) (table 2).

Red, yellow, purple, blue & green circles = pulleys free to move; colors correspond to VCHI rankings of degraded, poor, fair, good & excellent, respectively.

Black outer rings of free pulleys indicate relative force of Fisher's Disambiguous Coefficient ($Ø_F$).

Gold arrows indicate direction of increasing community-level stratification & bio-invasion.



Legend:

VCHI = Vegetative Complex Health Index.

Grey circles = fixed pulleys.

Purple bars = relative weights for community-level stratification (SEI) & bio-invasion (BIR) ratings (table 2).

Purple circle = pulley free to move; color corresponds to VCHI rating of fair (table 2).

Black outer ring of free pulley indicates relative force of Fisher's Disambiguous Coefficient ($Ø_F$).

Dotted grey line = chain attaching to weights & associated with fixed and free pulleys.

Neutral Impacts of Fisher's Disambiguous Coefficient upon Mechanics of the VCHI.

The chain extending from each fixed pulley has relative weights of 2.0 attached per SEI and BRI rankings. The pulley that is free to move represents microhabitat MO8. It has an associated frictional force, $Ø_F$ = 1.126 (i.e., Fisher's Disambiguous Coefficient). Friction is shown to tend toward that of the ecosystem (i.e., 1.00), thus exhibiting neutral effects upon the VCHI ranking.

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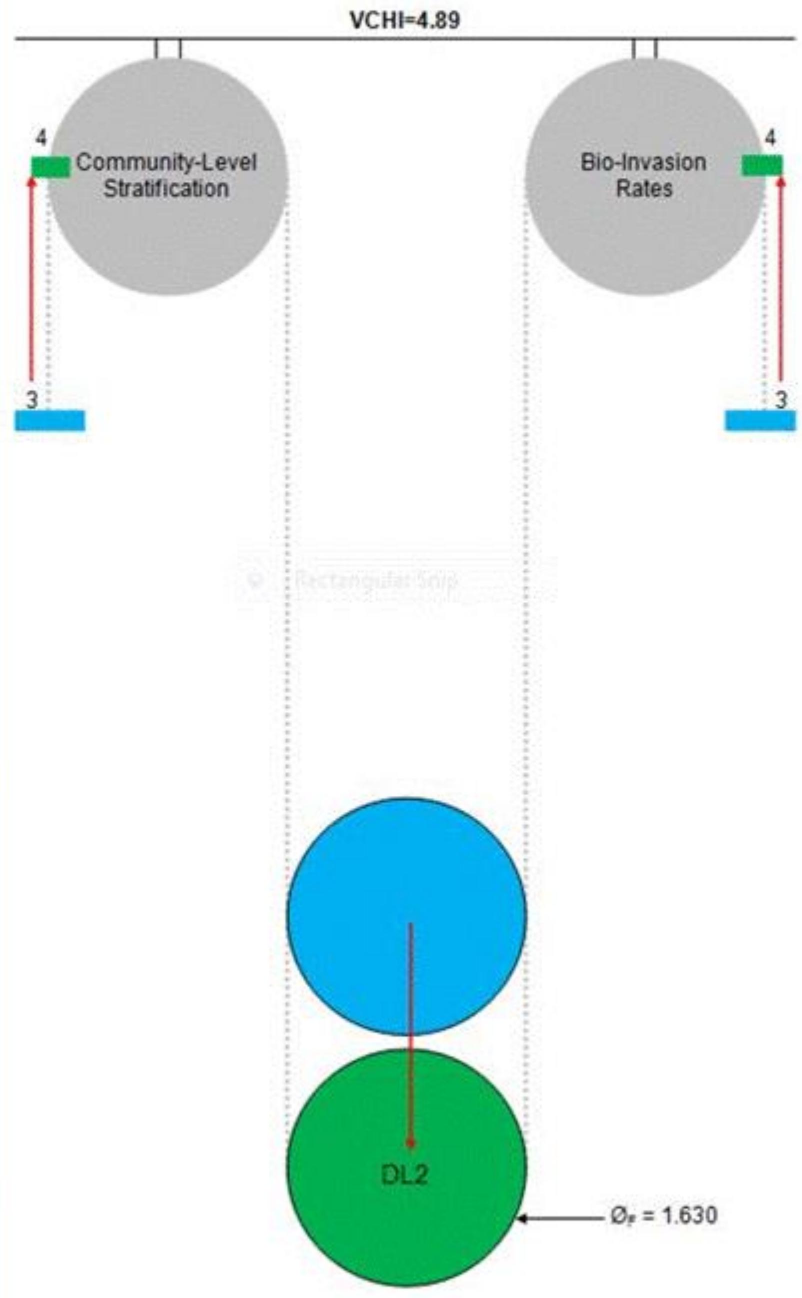

Legend:

VCHI = Vegetative Complex Health Index.

Grey circles = fixed pulleys.

Purple & green bars = relative weights for community-level stratification (SEI) & bio-invasion (BIR) ratings.

Blue & green circles = pulley free to move; colors correspond to VCHI ratings of good & excellent, respectively (table 2).

Black outer ring indicates relative force of Fisher's Disambiguous Coefficient ($Ø_F$).

Dotted grey line = chain attaching to weights and associated with fixed and free pulleys.

Red arrows indicate effects of increased $Ø_F$ (i.e., decreased frictional force) upon chain weights and VCHI rating.

Positive Impacts of Fisher's Disambiguous Coefficient upon Mechanics of the VCHI.

The chain extending from each fixed pulley has relative weights of 3.0 attached per SEI and BRI rankngs. The pulley that is free to move represents microhabitat DL2 with associated frictional force, $Ø_F$ = 1.630 (i.e., Fisher's Disambiguous Coefficient). Friction is shown to be significantly less than that of the ecosystem (i.e., 1.00), thus exhibiting positive effects upon the VCHI ranking, causing it to increase from good to excellent.

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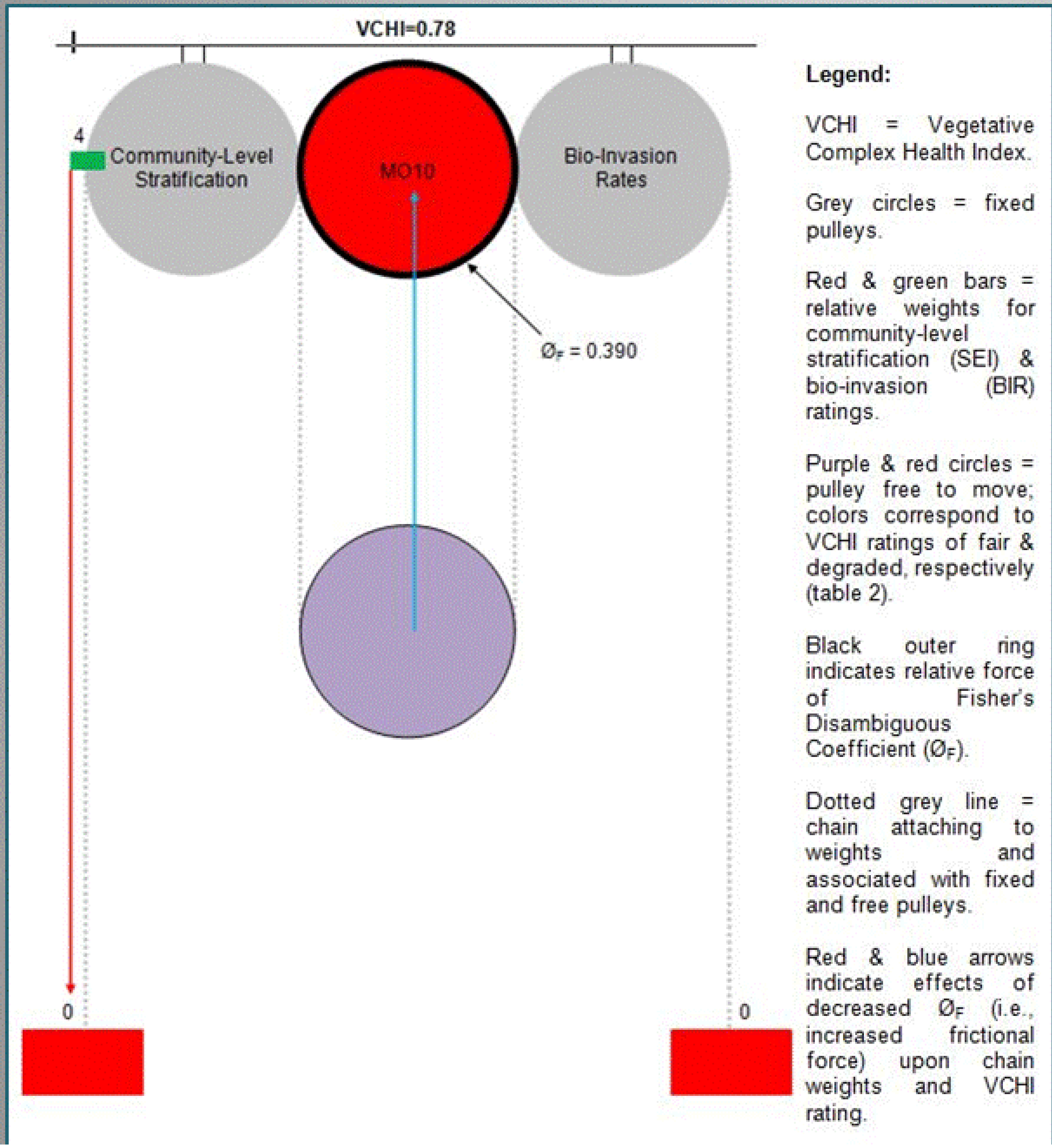

Negative Impacts of Fisher's Disambiguous Coefficient upon Mechanics of the VCHI.

The chain extending from each fixed pulley has relative weights of 4.0 and 0.0 attached per SEI and BRI rankings, respectively. The pulley that is free to move represents microhabitat MO10 with associated frictional force, $\varnothing_F$ = 0.390 (i.e., Fisher's Disambiguous Coefficient). Friction is shown to be significantly greater than that of the ecosystem (i.e., 1.00), thus exhibiting negative effects upon the VCHI ranking, causing it to decrease from fair to degraded.

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Impressions Concerning the Three Pulley System

The models appear to function as anticipated. The definitions of force (community-level stratification and bio-invasion ranks), friction (Fisher's Disambiguous Coefficient) mass (microhabitats) & acceleration function within the rubric of a classical mechanical system having two fixed pulleys and one free to move.

However, concerns remain as to whether the VCHI accomplished the following:

A re-ordering of community structure, such that structure was no longer entirely independent of mean diversity.

Avoidance of including the highest community structure rankings (SEI = 4) among the highest VCHI rankings (good & excellent), as these include significant bands of exotics.

A steady, linear trend evidencing decreases in exotic percent cover as VCHI increases.

A steady, linear trend evidencing increases in richness & total diversity as VCHI increases.

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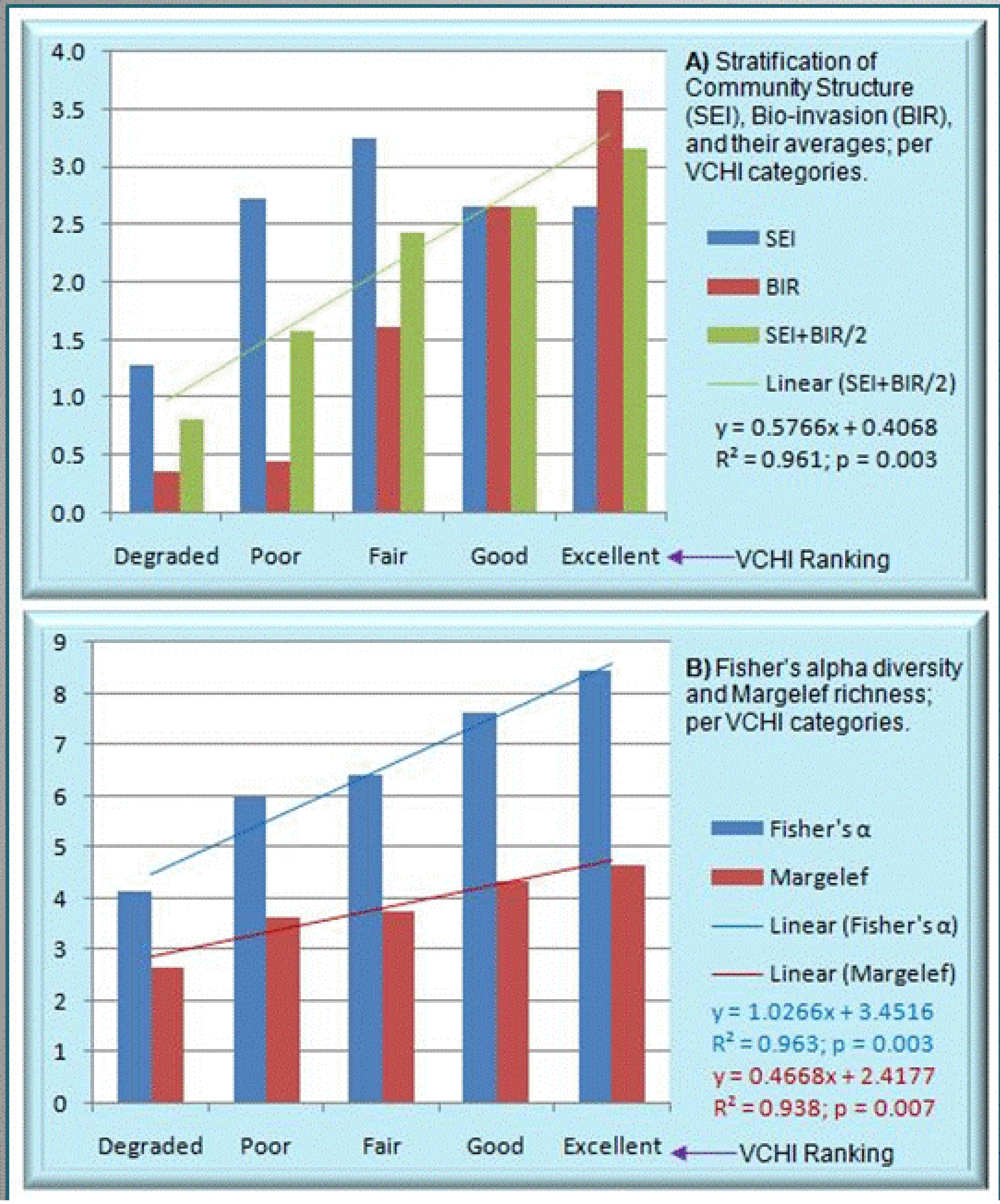

Least Squares Regression of the Average of Community-level Stratification (SEI) and Bio-invasion (BIR) (A); and Fisher's Alpha and Margelef's Richness (B); per Vegetative Complex Health Index (VCHI) Rankings.

Least squares regression revealed highly discrete and predictable linear relationship for the average of SEI + BRI (Y axis) per VCHI ranking (X axis) (panel A).

Similar trends were exhibited for Fisher's alpha and Margelef's richness (panel B).

Note how the re-ordering of microhabitats per the VCHI imparts linearity to total diversity and richness.

Alternatively, these variables were non-linear when they were ordered per SEI alone. However, linearity was observed for the ranks of degraded, poor & fair.

Linearity relative to other variables was accomplished via implementation of Fisher's Disambiguous Coefficient ($Ø_F$) with the Vegetative Complex Health Index.

Vegetative Health Complex Observations

The VCHI Indeed Accomplished all Objectives as Intended!

Bio-invasion rates predictably decreased with high fidelity as the VCHI increased.

Richness & total diversity predictably increased with high fidelity as the VCHI increased.

Community structure/ stratification, as defined per the SEI, was non-linear with the VCHI.

However, community structure/ stratification peaked with the intermediate VCHI rank (fair), then decreased and plateaued with the highest VCHI rankings (good & excellent).

Richness, total diversity & bio-invasion rates obeyed trends consistent with a classical mechanical system. The SEI did not, and was reflective of the outcomes concerning *quantized* energy states.

The VCHI is a first of its kind, new-age biometric obeying the laws of classical mechanics. It provides a comprehensive & quantitative means by which to evaluate the health status of ecosystems relative to disturbance, bio-invasion and ecologic restoration.

Conclusions & Predictions

The relationship of community structure with diversity is quantum in nature. While considerable variability concerning this duality is expected to occur among different community assemblages and ecosystems, the fundamental quantum aspects are expected to persist.

Community structure behaves differently from the concepts of richness, abundance, dominance and alpha diversity. As such, efforts must be undertaken to account for such differences when attempting to interpret ecologic data within the contexts of community structure *and* diversity.

The Vegetative Complex Health Index is one such means to bridge the differences between these variables and arrive at a unified, comprehensive system adherent to the principles of predictive classical mechanics.

The outcomes of the VCHI ought not be judged within the context of short-term ecologic data. While immediate positive impacts were reflected by the index (i.e., removal of salt cedar from three microhabitats,) long term assessments over 50 to 100 years are likely required to assess lasting impacts of disturbance, bio-invasion & restoration events.

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The Science of Quantum Microbiogeography

Dr. David Sabaj-Stahl, DEM and The Edwin James Society have succeeded in establishing the fundamental paradigms of the science of Quantum Microbiogeography.

Quantum Microbiogeography endeavors to elucidate the quantum-dependent & quantum-independent relationships that occur throughout the ecosphere.

Those relationships potentially include comparisons of any and all ecologic variables within a spatio-temporal context.

Quantum Microbiogeography seeks to reveal the fundamental internal mechanisms driving all ecologic processes.

Understanding of these processes shall enable mankind to better preserve & protect our living natural systems.

Application of the knowledge garnered through Quantum Microbiogeography shall enable enhanced stewardship of our ecosphere.

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