Cambios temporales en comunidades de aves en sistemas manejados
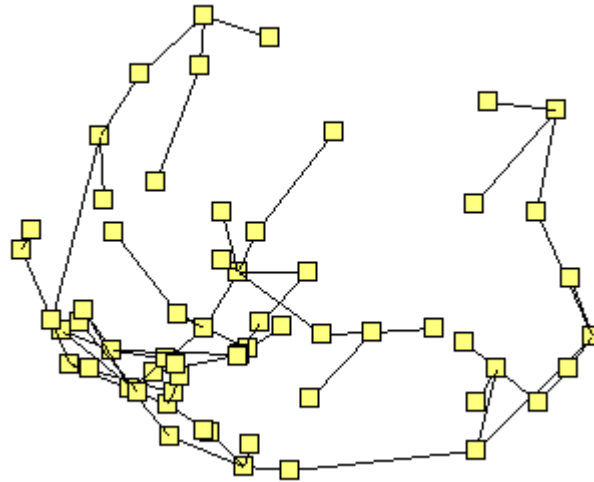
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QEco: A tool for analysis of ecological communities

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WHAT IS QEco?

QEco is an open source software for the analysis of ecological communities whose algorithms are taken from libraries compiled in the statistical software R.

It provides a single environment that facilitates the use of specialized techniques to evaluate, explore and confirm hypotheses of interest in ecology and conservation biology, biogeography, ecology of communities, among other fields of ecology. It can be used for the analysis of ecological communities with educational and / or scientific purposes.

https://sites.google.com/site/qecosite/

Functionality of version 1.0

Comparison functions

❏ ADONIS (Permutation multivariate analysis of variance using distance matrices)
❏ ANOSIM (Similarity analysis)
❏ Beta-dispersion (Multivariate homogeneity of group's dispersions variances)
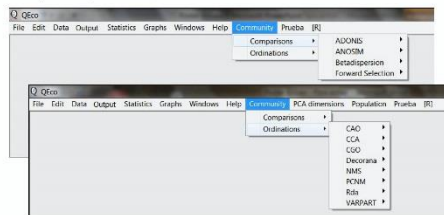❏ Forward selection (Forward selection with multivariate response using permutation under reduced model)

Ordination functions

> Unconstrained
❏ Decorana (Detrended correspondence analysis and basic reciprocal averaging)
❏ NMS (Non-metric multidimensional scaling)
❏ PCNM (Principal coordinates of neighbour matrices)
> Constrained
❏ CCA (Partial or Constrained Correspondence analysis)
❏ CGO (Constrained gaussian ordination)
❏ Rda (Redundancy analysis)
❏ VARPART (Partition the variation of community matrix by 2, 3 or 4 explanatory matrices)

These routines allow to answer research questions in ecological communities such as

does the ecological community under study present an organization pattern?
what factors determine the composition and species turnover of the community?
what scales are given to these assembly processes?
what is environmental or spatial tolerance of the species?

FUNCTIONALITY – AN EXAMPLE

Problem

Evaluate the relative importance of environmental and spatial features in the beta diversity of a community of mites - available in library vegan (Oksanen *et al.*. 2013)-.
The observations correspond to plots (70).

Brachy	PHTH	...	PLAG2	Trimalc2	SubsDens	WatrCont	Substrate	Shrub	Topo	x	y
17	5		0	0	39,18	350,15	Sphagn1	Few	Hummock	0,2	0,1
2	7		0	0	54,99	434,81	Litter	Few	Hummock	1	0,1
5	4		0	0	80,59	266,78	Interface	Many	Blanket	2	1,3
36	7		1	0	35,59	134,13	Sphagn3	Many	Blanket	2,4	1,9
...	...	...	...	...	...	...	...	...	...	...	...
6	0		1	0	51,47	488,55	Sphagn4	Many	Hummock	0,8	3,9
20	1		0	0	38,17	403,32	Sphagn2	Many	Blanket	1,8	4,5
38	0		0	0	36,44	387,3	Sphagn2	Few	Blanket	0,6	5,3
8	0		0	9	31,46	514,85	Sphagn1	None	Blanket	1,6	8,9

Community of mites (variables 1 to 35) Relative abundance of 35 species of mites (species composition)

Environmental Variables (variables 36 to 40)
SubsDens: Density Substrate
WatCont: water content in the substrate
Substrate: Type of substrate (six categorical levels)
Shrub: shrub density (three categorical levels)
Topo: microtopography (two categorical levels)

Spatial variables (variables 41 and 42)

1. Explore the association between environmental variables and the community of mites. Identify redundant and irrelevant variables.

Forward Selection
It allows to enter predictor variable one by one into a multiple regression model (univariate or multivariate) and evaluates the importance of each one in the model based on a retention criteria. The hypothesis tests are evaluated by permutations.

Redundancy Analysis (Rda)
A multiple regression extension which allows to restrict response variables in the space of predictors variable across principal component.

2. Explore the association between environmental variables and the community of mites.

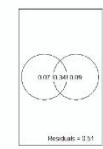**PCNM (Spatial Eigenfunction and Principal Coordinate Analysis)**
Moran Index for the significant coordinates (in spatial terms)
It detects and quantifies spatial patterns over a wide range of scales, breaking the spatial variables (geographic coordinates) in a truncated matrix of Euclidean distances, and in axes of ordination based on principal coordinates analysis.

3. Analyze the variance partition considering the environmental and spatial variables.

VarPart (Partition the variation of community matrix by 2, 3 or 4 explanatory variables)
Method to evaluate the relative importance of 2, 3 or 4 sets of explanatory variables on a response variable set. It is based on a partial redundancy analysis and an extension of partial regressions.
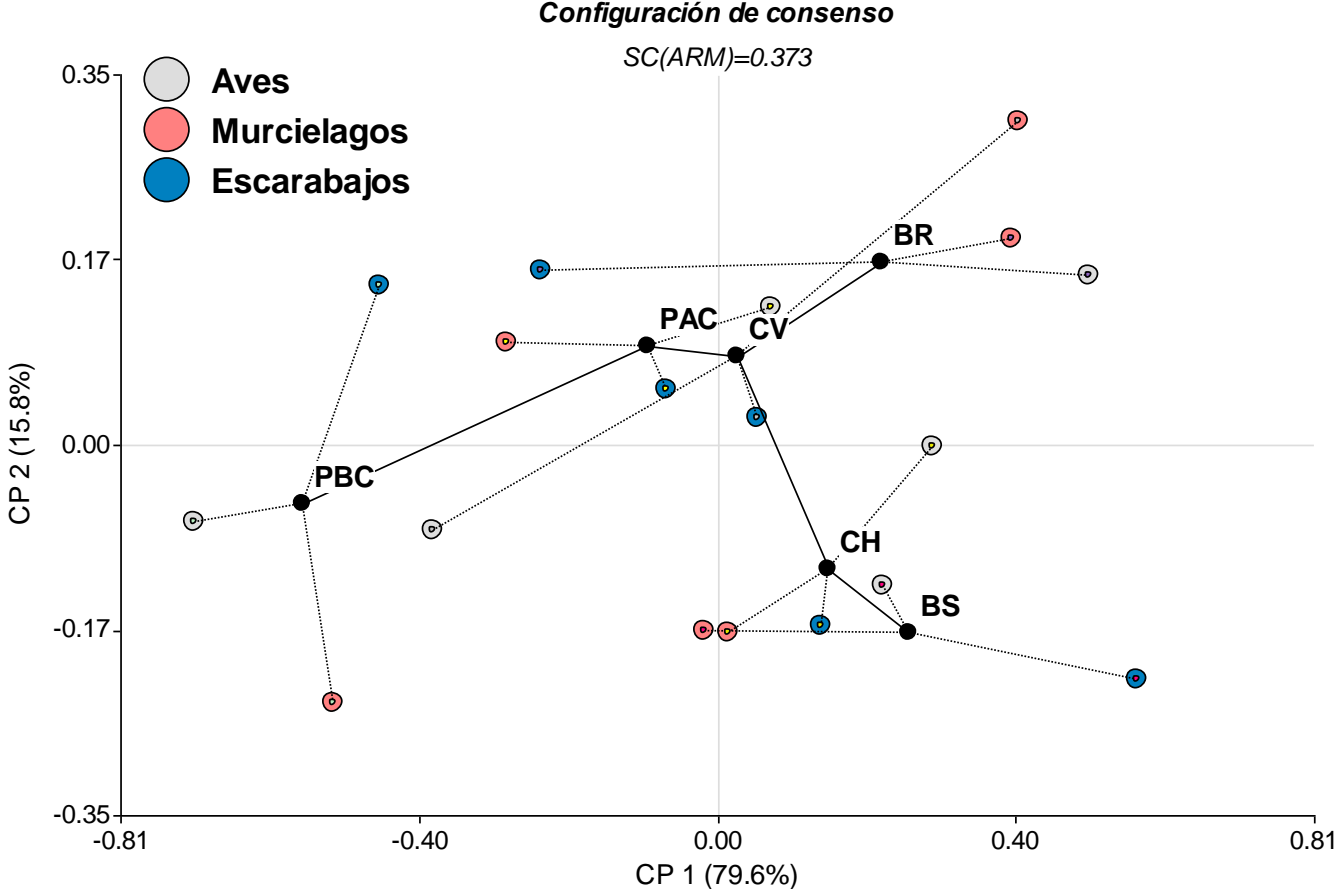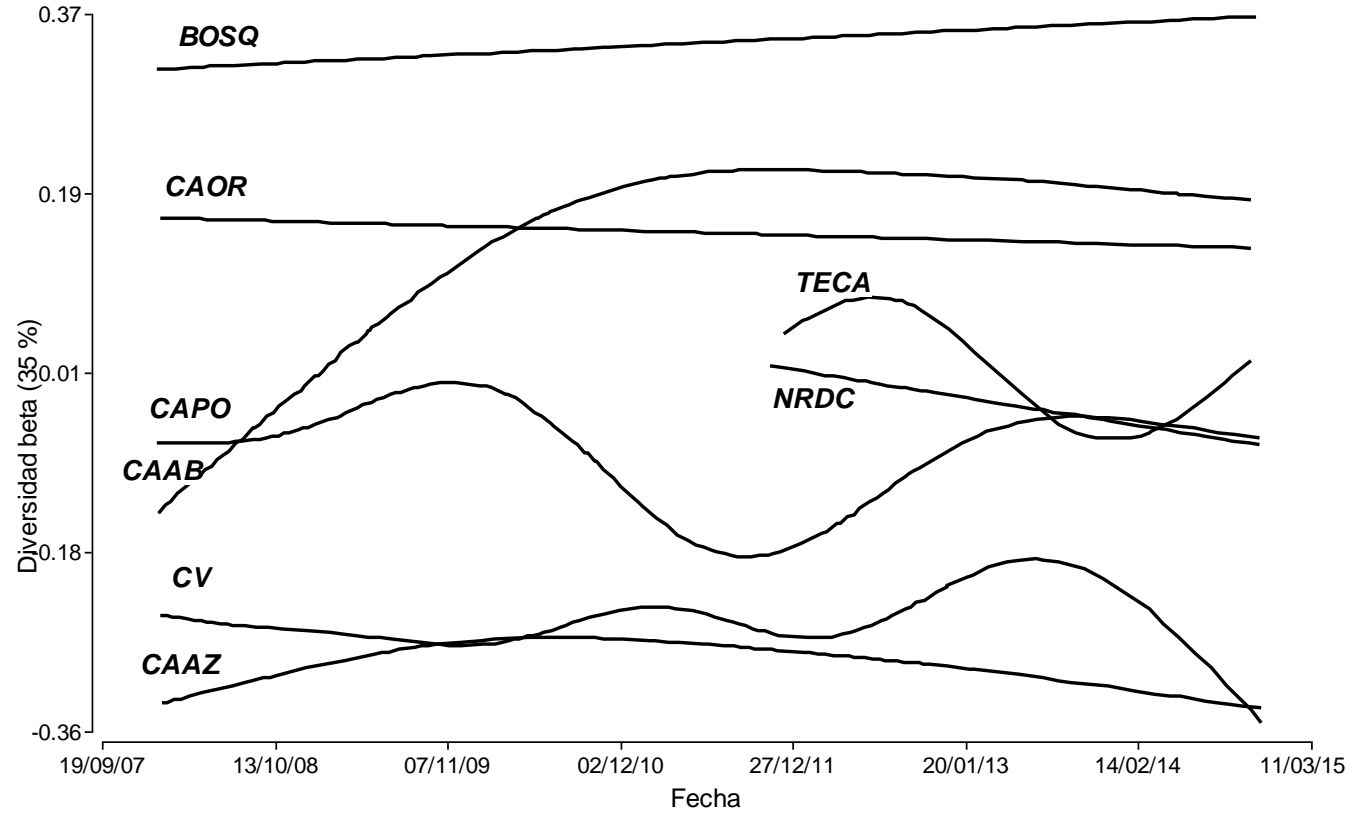
Output

FUTURE WORK

Routines to include in the next version

❏ Characterization of communities
   Diversity/Dominance indices
   Accumulation curves
   Indicator species
❏ Restricted and partial ordination analysis
   dbRDA (Redundancy analysis dissimiliarity matrices)
   Partial correlograms
   CAO (Restricted additive ordination)
   Regression trees or classification (Varpart-Tree)
❏ Univariate methods
   Generalized additive models (GAM)
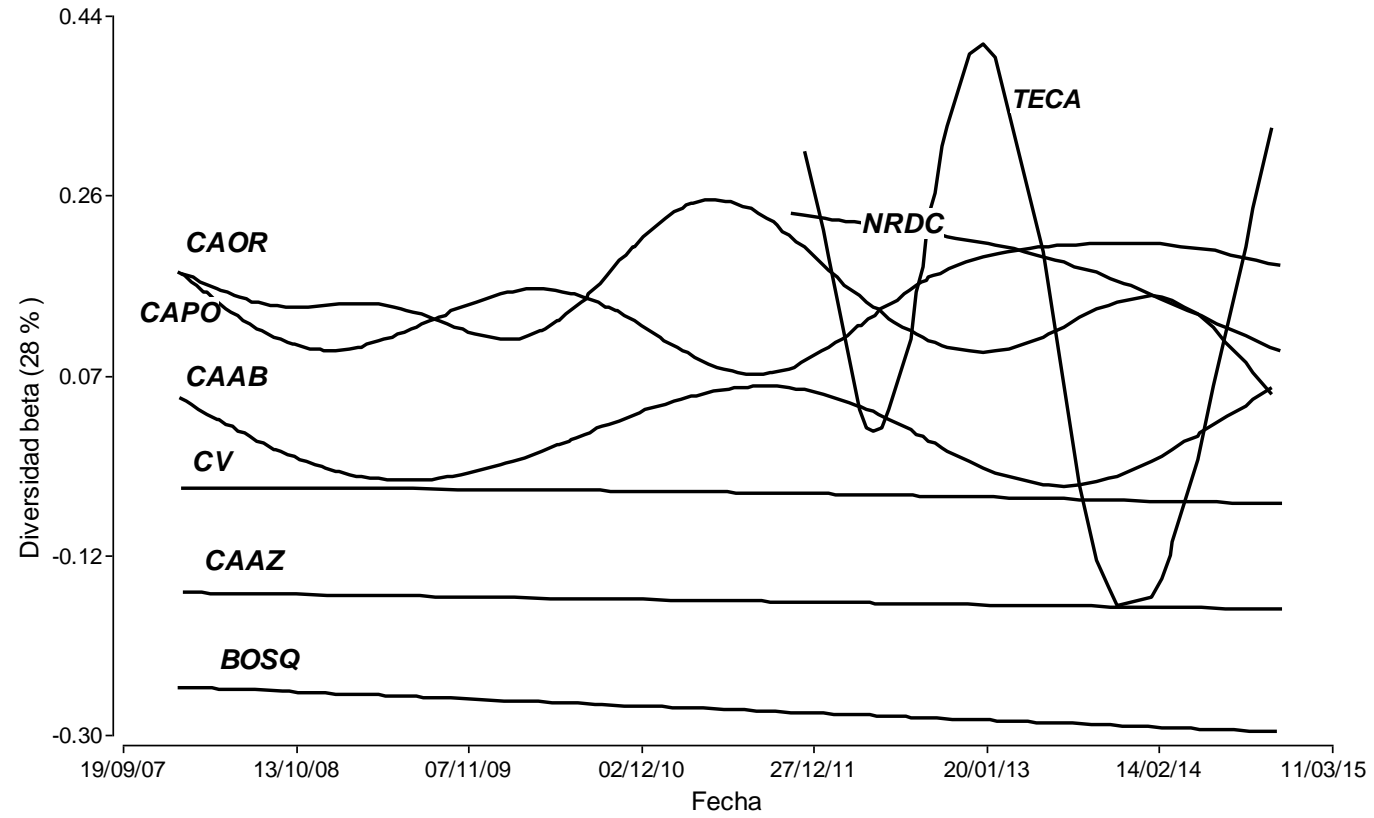   Generalized additive models zero-inflated (mixture model GAM).

BIBLIOGRAPHY

Borcard, D.; Legendre, P.; Drapeau, P. (1992). Partialling out the spatial component of ecological variation. Ecology. 73: 1045–1055.

Legendre, P.; Legendre, L. (2012). Numerical ecology. 3rd English edition. Elsevier Science BV, Amsterdam.

Legendre, P.; Gallagher, E. D. (2001). Ecologically meaningful transformations for ordination of species data. Oecologia, 129: 271–280.

Oksanen, J.; Blanchet, F.G.; Kindt, R.; Legendre, P.; Minchin, P. R.; O'Hara, R. B.; Simpson, G. L.; Solymos, M.; Stevens, R. H.; Wagner, E. (2013). Community Ecology Package (Package vegan). Disponible en: http://vegan.r-forge.r-project.org/

Oksanen, J. (2013). Multivariate Analysis of Ecological Communities in R: vegan tutorial. Disponible en línea: http://cc.oulu.fi/~jarioksa/opetus/metodi/vegantutor.pdf

Peres-Neto, P.; Lendrdre, P.; Dray, S.; Borcard, D. (2006). Variation partitioning of species data matrices: estimation and comparison of fractions. Ecology, 87: 2614–2625.

Congruencia

Configuración de consenso

SC(ARM)=0.373

Cambios temporales

¿Qué monitorear?