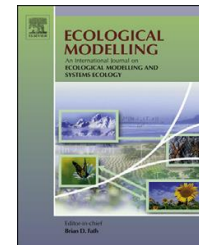# Combinaciones ambientales "periféricas y novedosas" y superficies de respuesta de los modelos

Andrés Lira-Noriega

Constraints on interpretation of ecological niche models by limited environmental ranges on calibration areas

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ARTICLE INFO
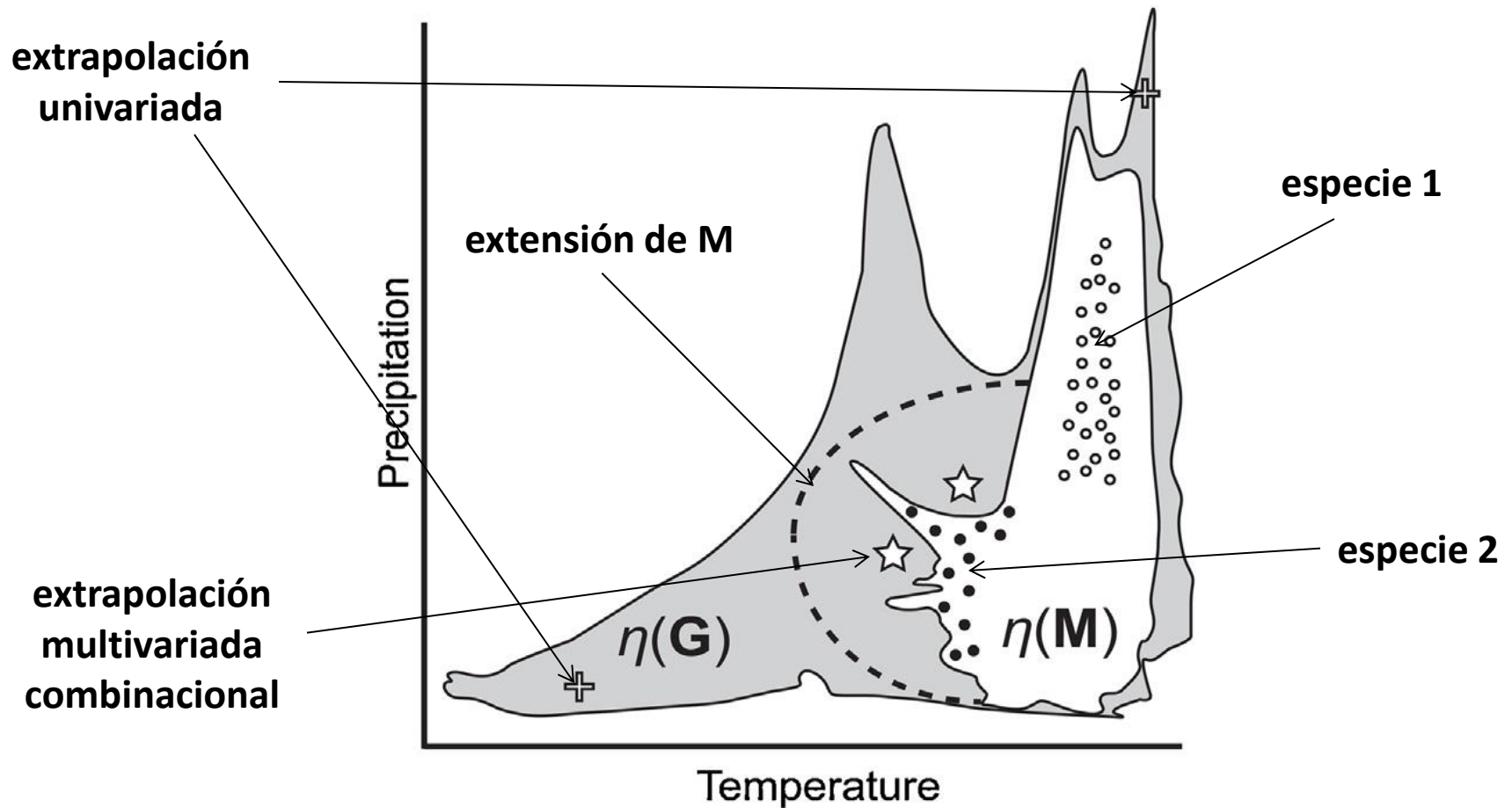
ABSTRACT

Correlational models of species' ecological niches are commonly used to transfer model rules onto other sets of conditions to evaluate species' distributional potential. As with any model fitting exercise, however, interpretation of model predictions outside the range of the independent variables on which models were calibrated is perilous, herein denoted as strict extrapolation to distinguish from extrapolation onto novel combinations of variables. We use novel visualization techniques to characterize model response surfaces for several niche modeling algorithms for a virtual species (wherein the truth is known) and for two transfer-based studies published by one of our group. All modeling algorithms for each species showed strict extrapolation, such that biologically unrealistic response surfaces were reconstructed. We discuss the implications of these results for calibration and interpretation of niche models and analysis of ecological niche evolution. We present Mobility-Oriented Parity (MOP), a modification and extension of the Multivariate Environmental Similarity Surface (MESS) metric currently in use, as a means of both quantifying environmental similarity between calibration and transfer regions and highlighting regions in geographic space where strict extrapolation occurs.
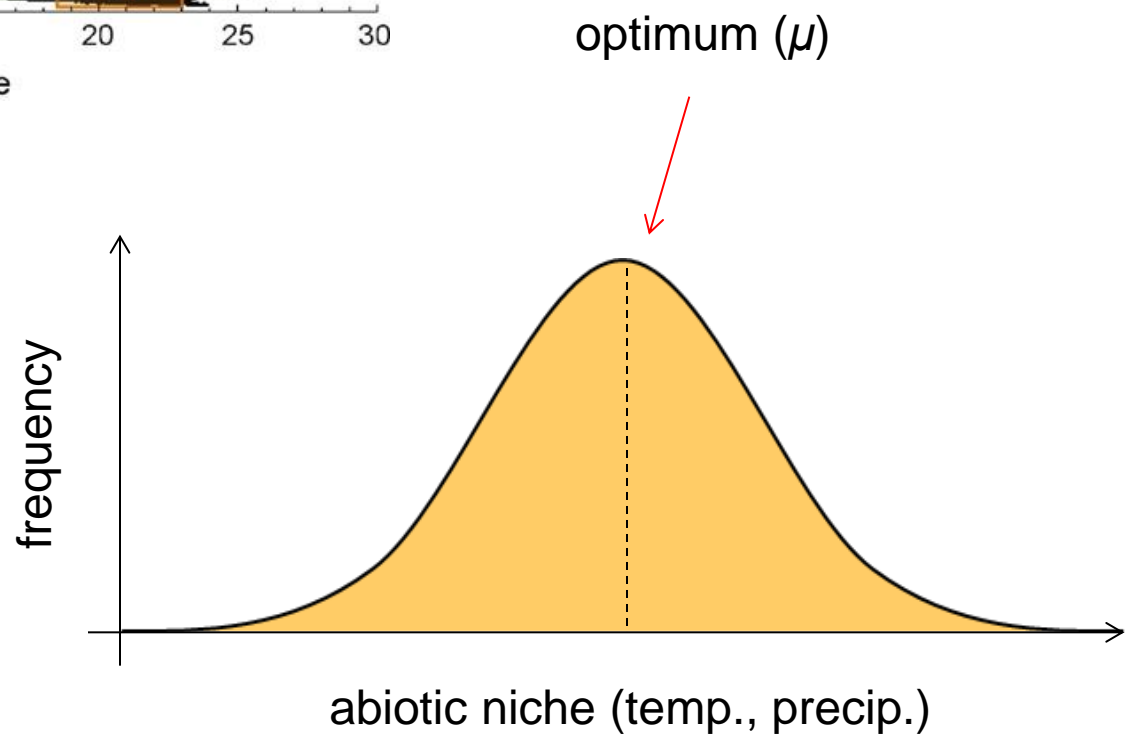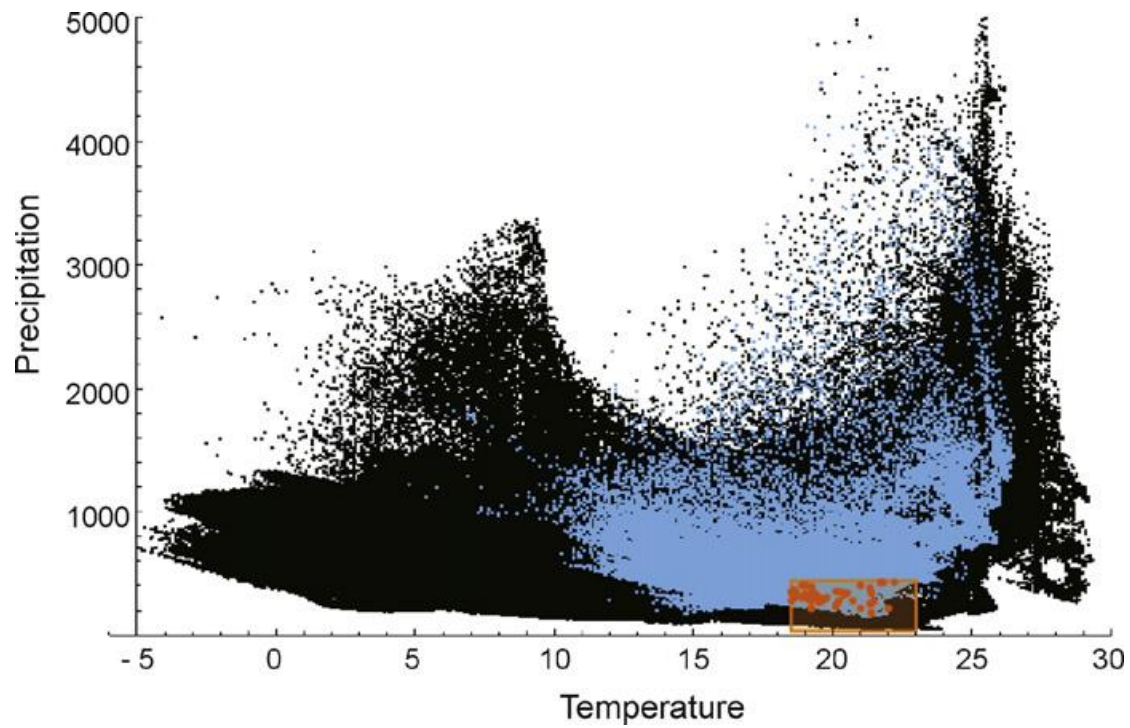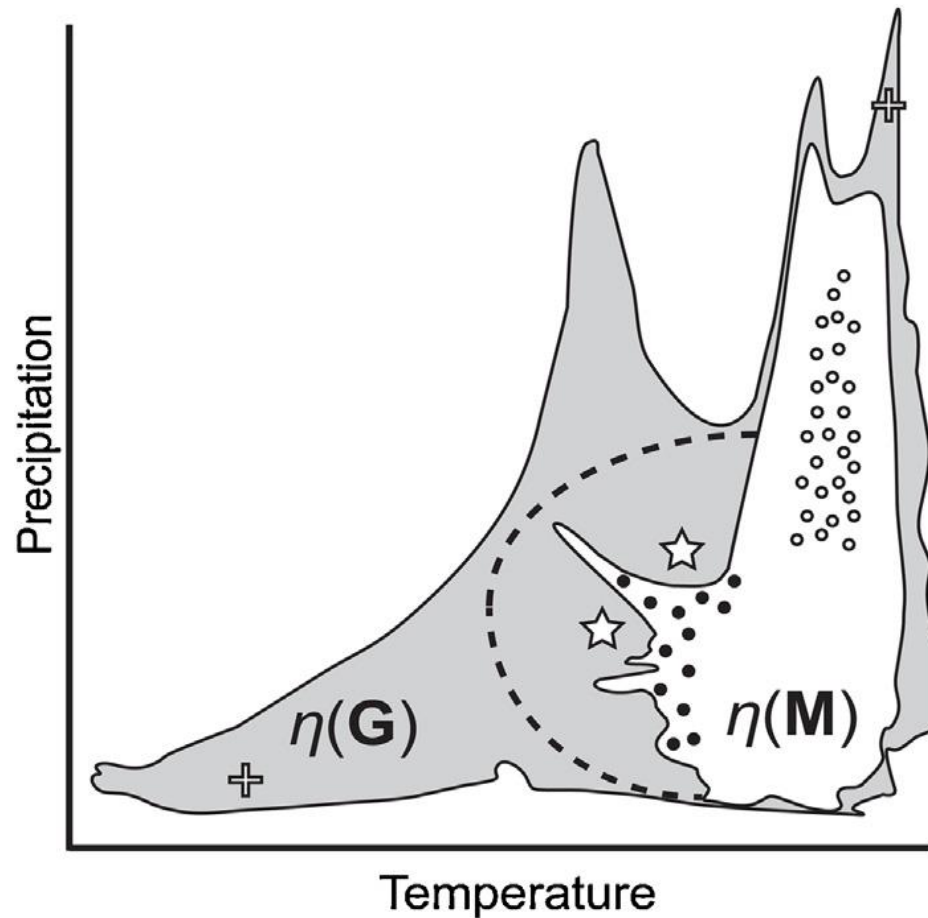
Precipitation

Temperature

optimum (μ)

frequency
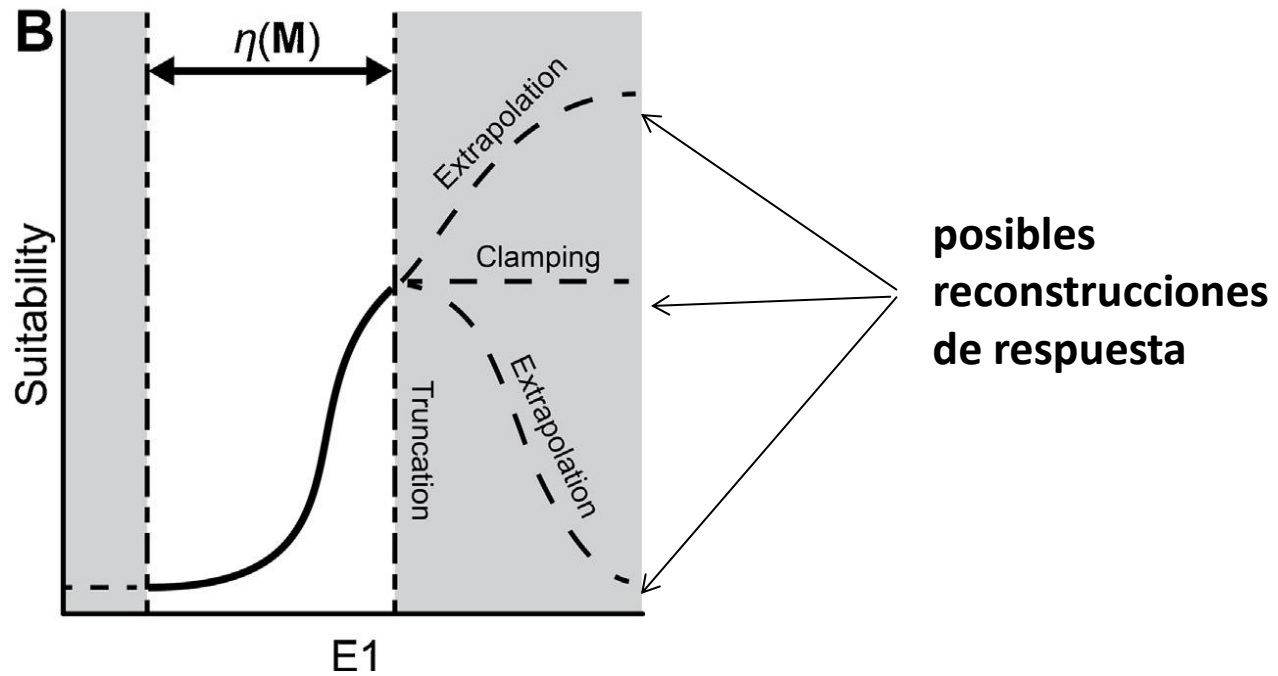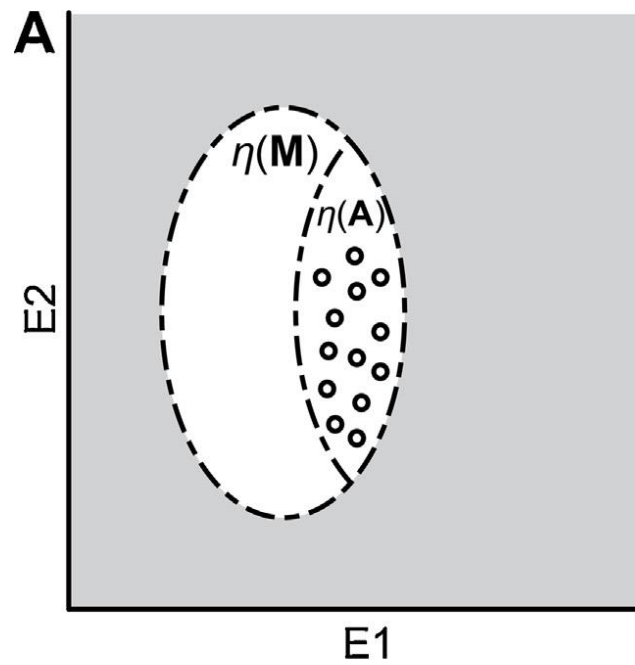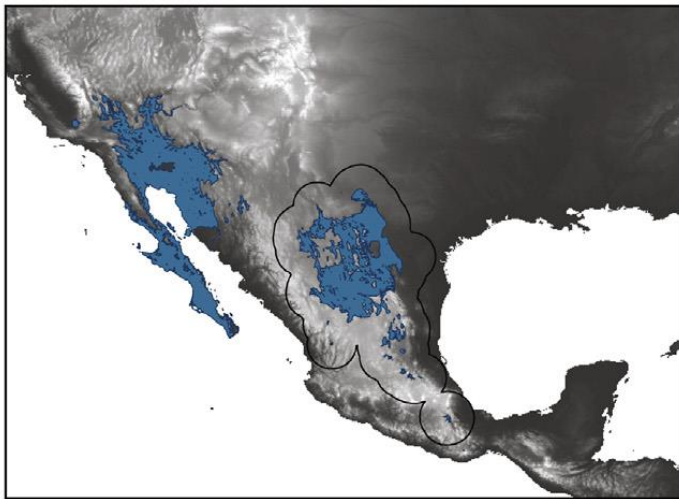
abiotic niche (temp., precip.)

Fig. 1. Illustration of situations regarding suitable and accessible areas in environmental space. Environments represented across some area of interest (projection area) are depicted in gray shading; environments associated with **M** are depicted in the white area. Stars indicate areas of combinational extrapolation from **M**, crosses indicate areas of strict extrapolation. Known occurrences for two example species are shown—one as open circles, the other as filled circles. Dashed line indicates possible (**M**) designed to avoid extrapolation problems for filled circle species.
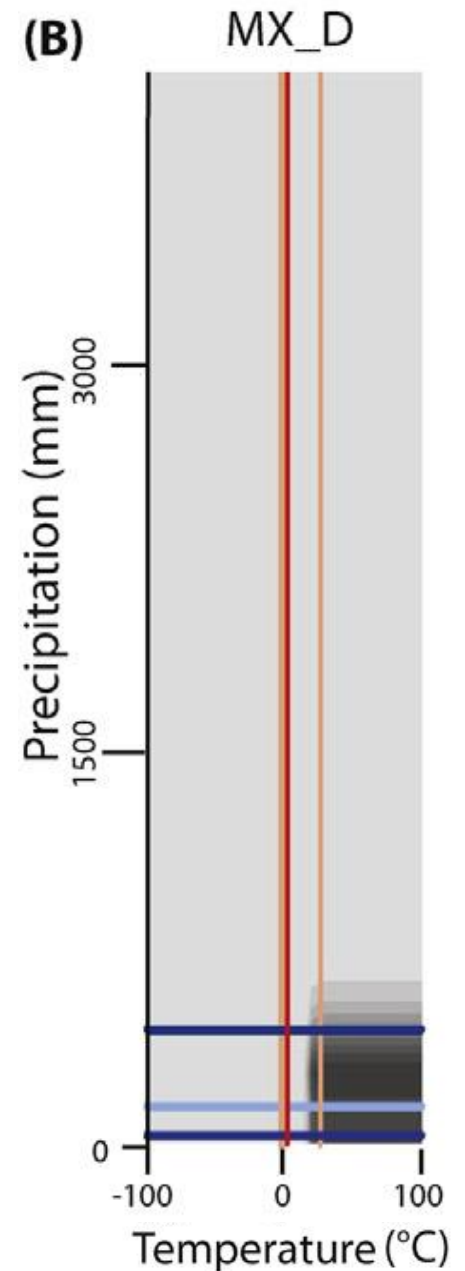
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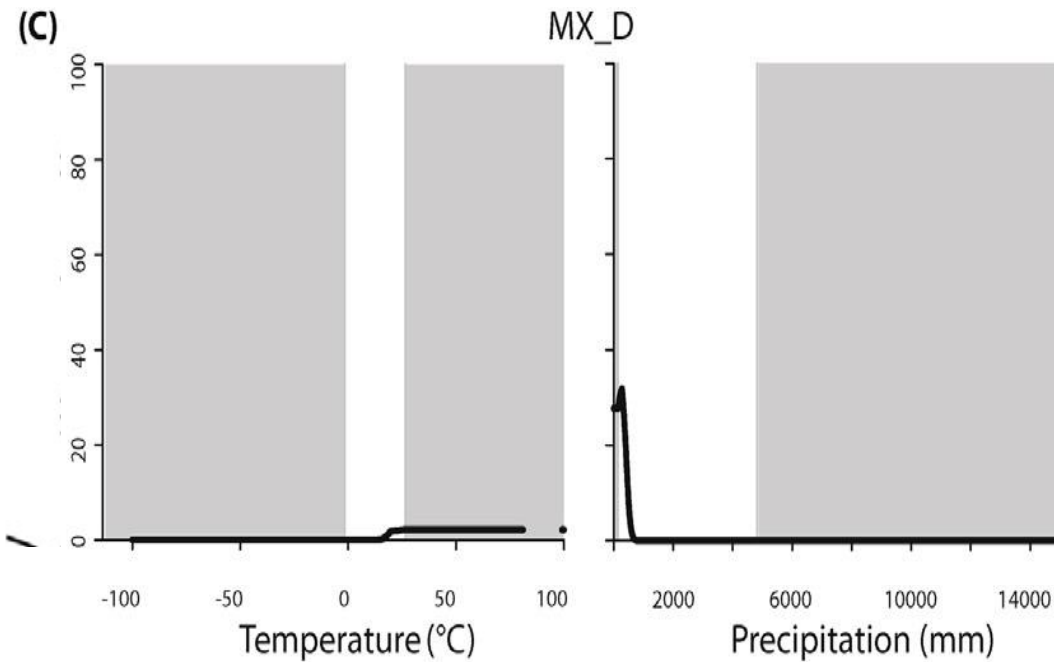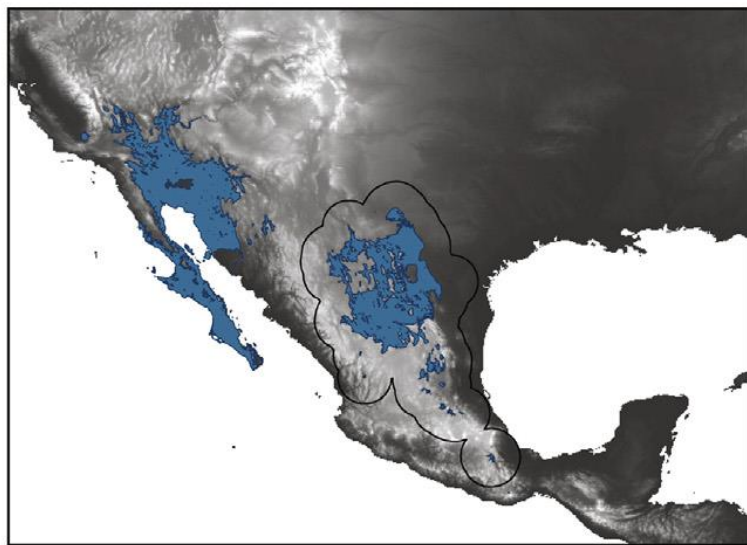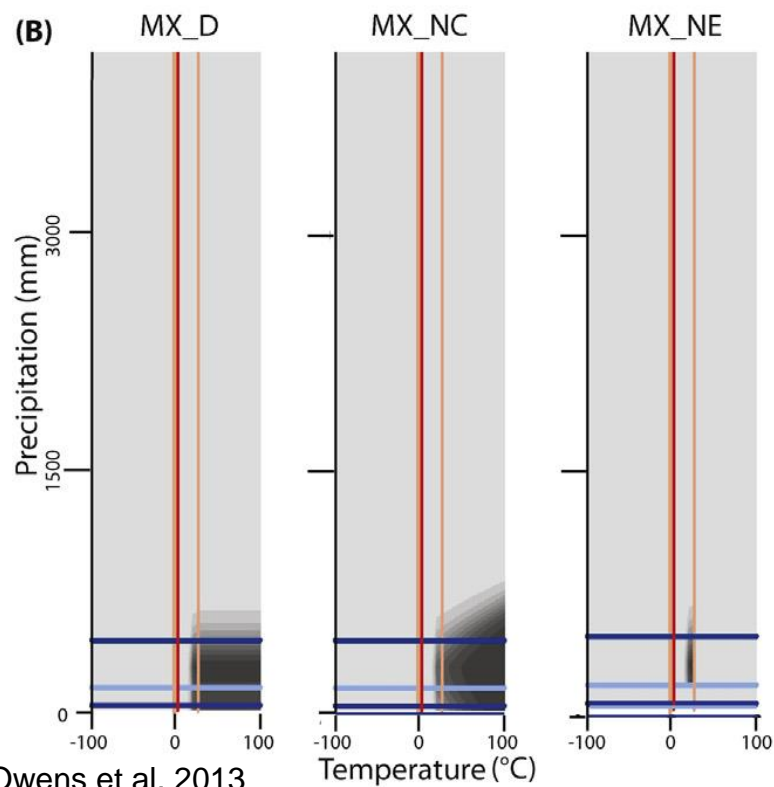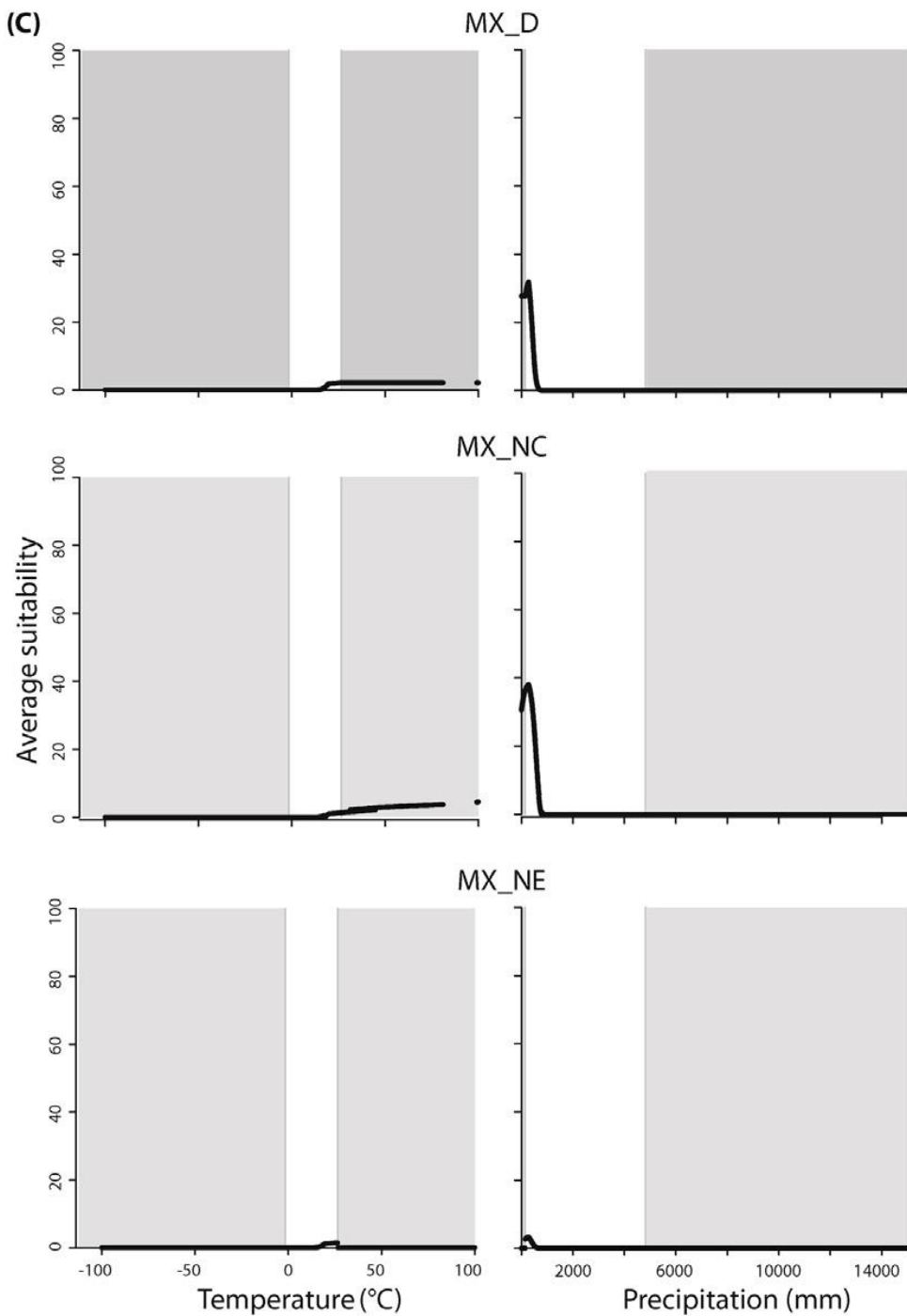
A

B

$\eta(\mathbf{M})$

$\eta(\mathbf{A})$

E2

E1

Suitability

Extrapolation

Clamping

Truncation

Extrapolation

posibles
reconstrucciones
de respuesta

E1

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(A)

(B) superficies de respuesta (oscuro = alta favorabilidad)
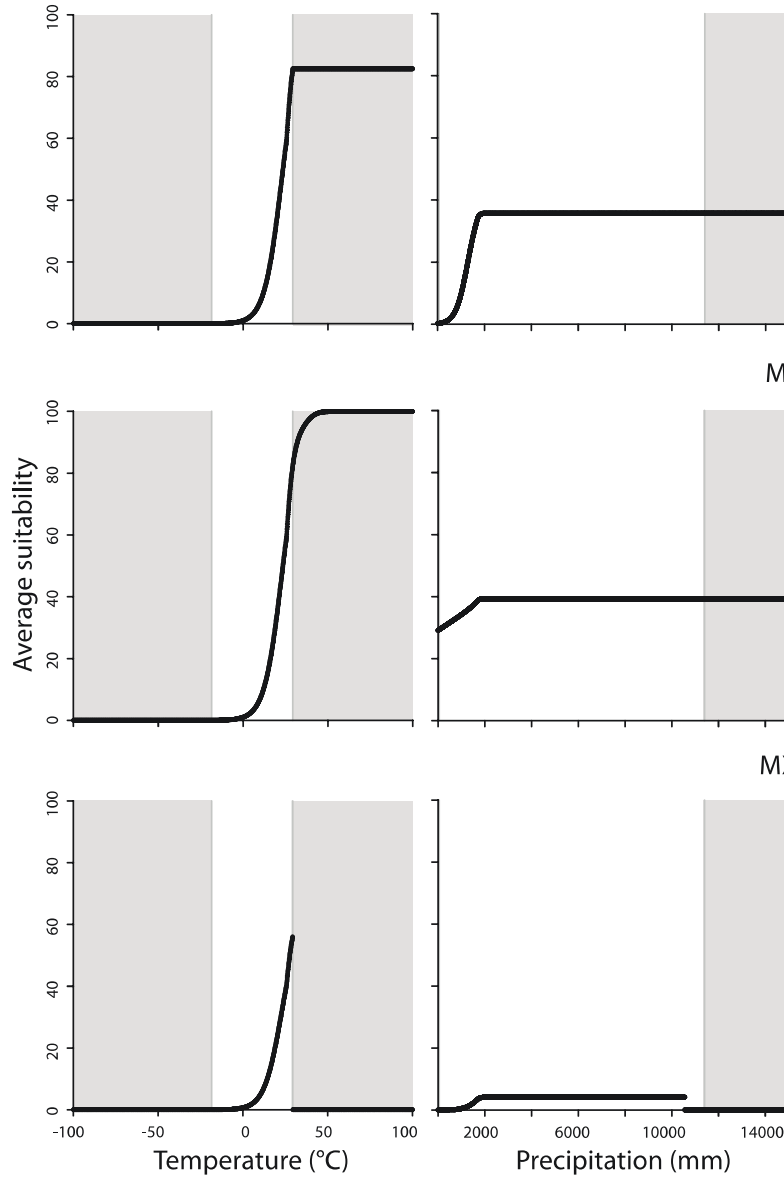
(B) MX_D

(C) curvas de favorabilidad

(C) MX_D

(A)

(B)

MX_D   MX_NC   MX_NE

Precipitation (mm)

Temperature (°C)

(C)

MX_D

MX_NC

MX_NE

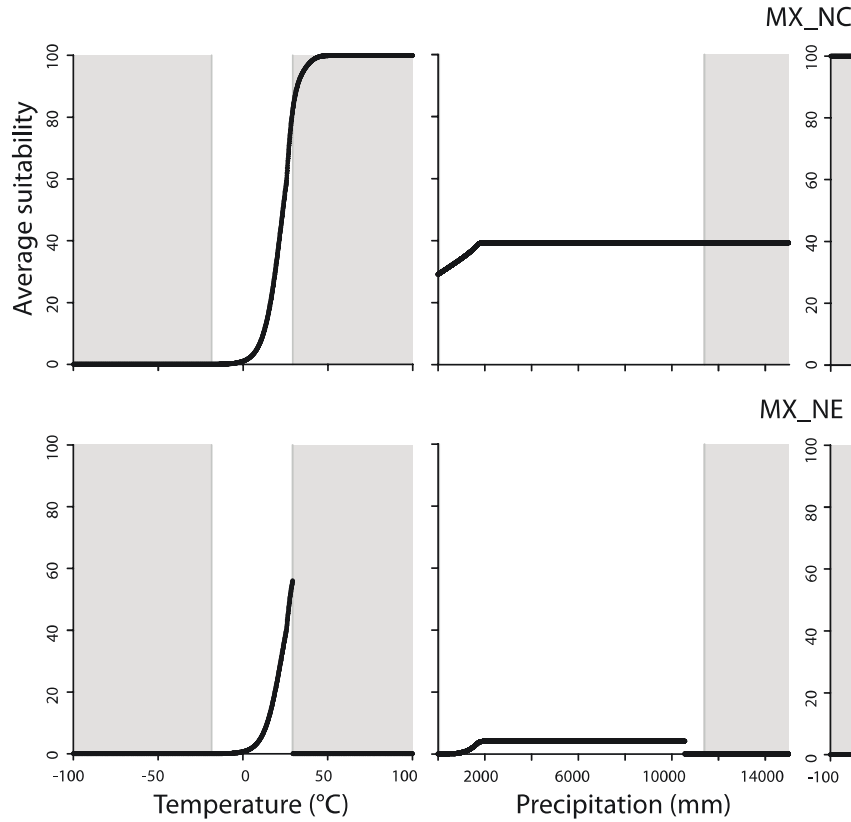Average suitability

Temperature (°C)   Precipitation (mm)

mosca de la fruta — *Bactrocera invadens*

mosquito — *Anopheles gambiae*

MX_D
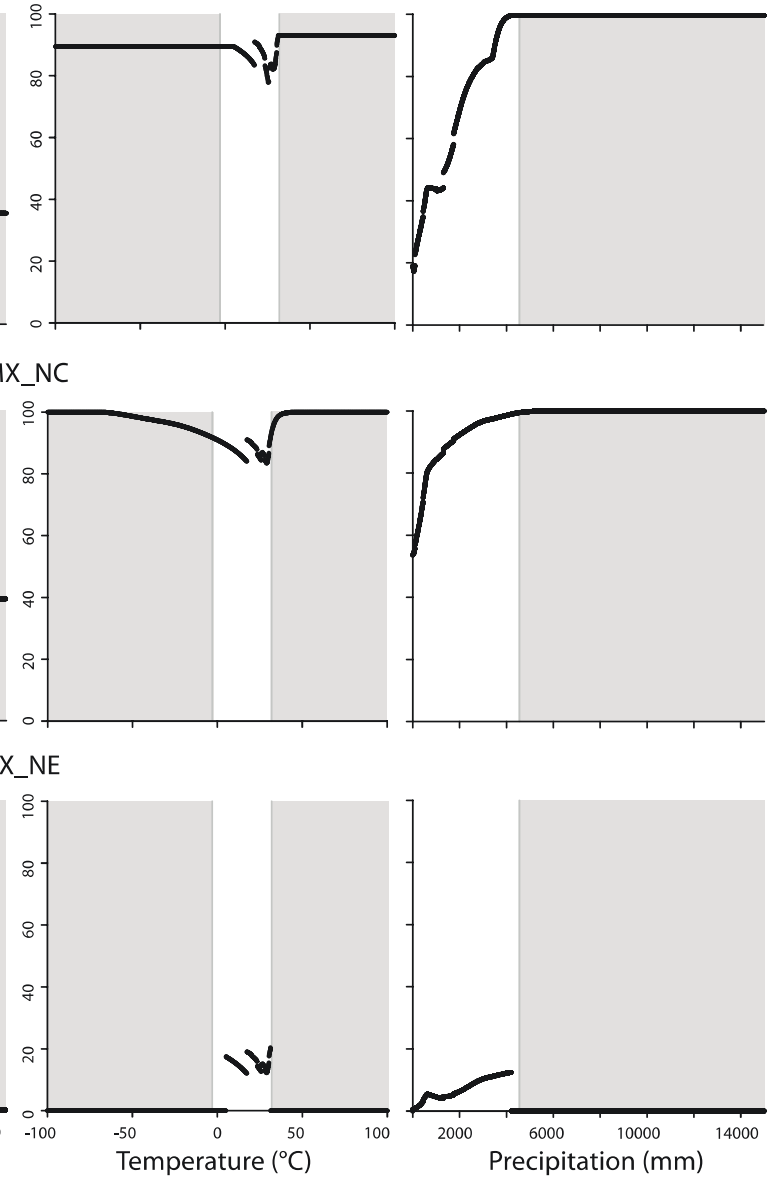
MX_NC

MX_NE

Average suitability

Temperature (°C)

Precipitation (mm)

Temperature (°C)

Precipitation (mm)
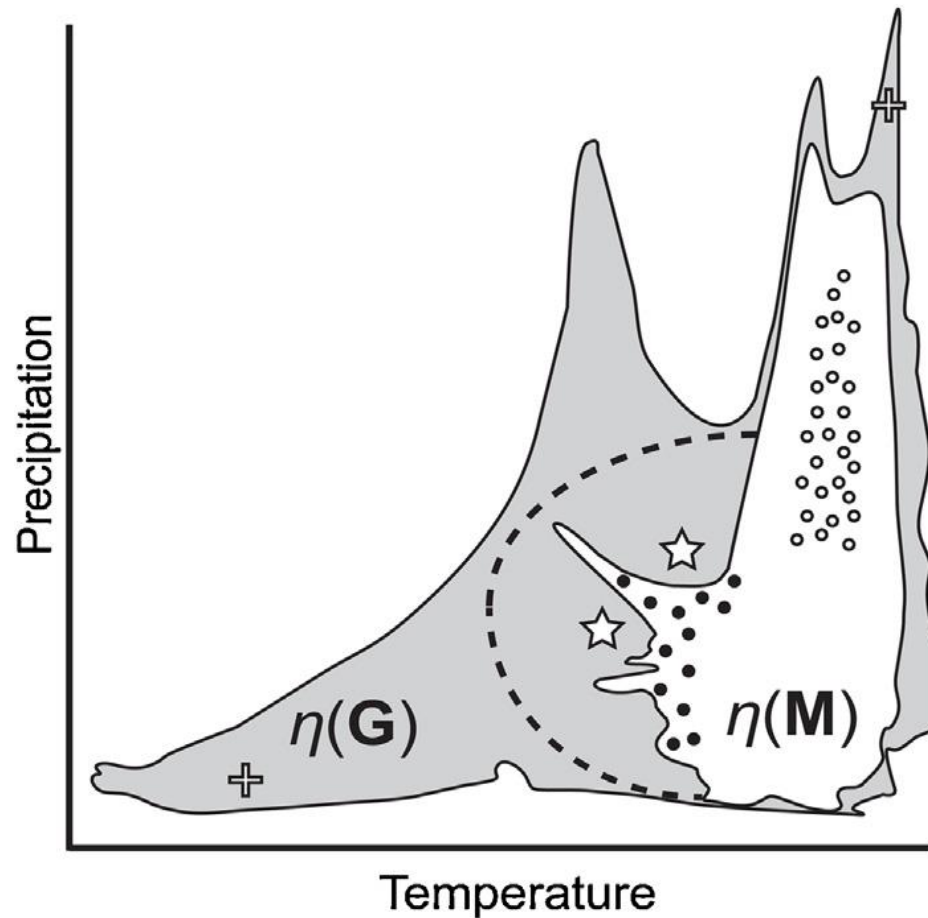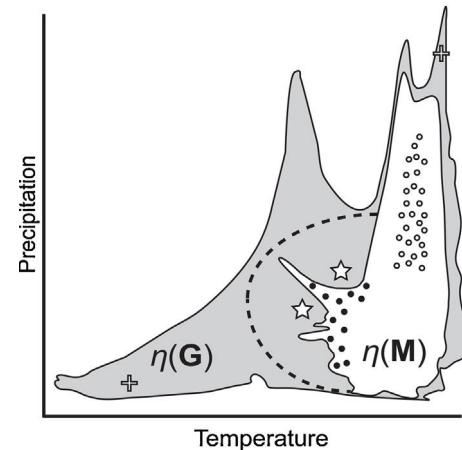
Fig. 1. Illustration of situations regarding suitable and accessible areas in environmental space. Environments represented across some area of interest (projection area) are depicted in gray shading; environments associated with **M** are depicted in the white area. Stars indicate areas of combinational extrapolation from **M**, crosses indicate areas of strict extrapolation. Known occurrences for two example species are shown—one as open circles, the other as filled circles. Dashed line indicates possible (**M**) designed to avoid extrapolation problems for filled circle species.

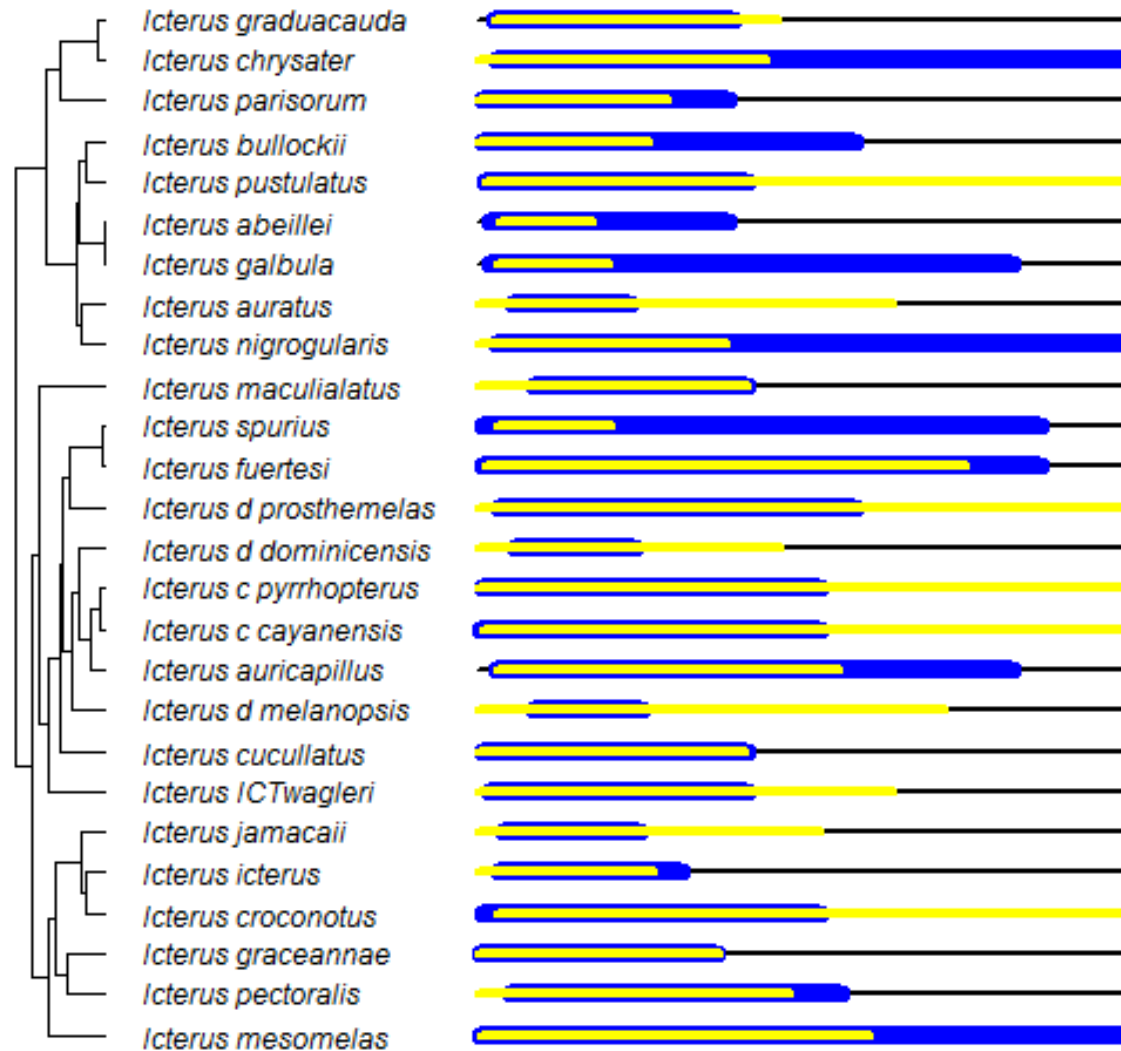# Mobility-Oriented Parity (MOP): comparing $\eta(\textbf{\textit{M}})$ to $\eta(\textbf{\textit{G}})$
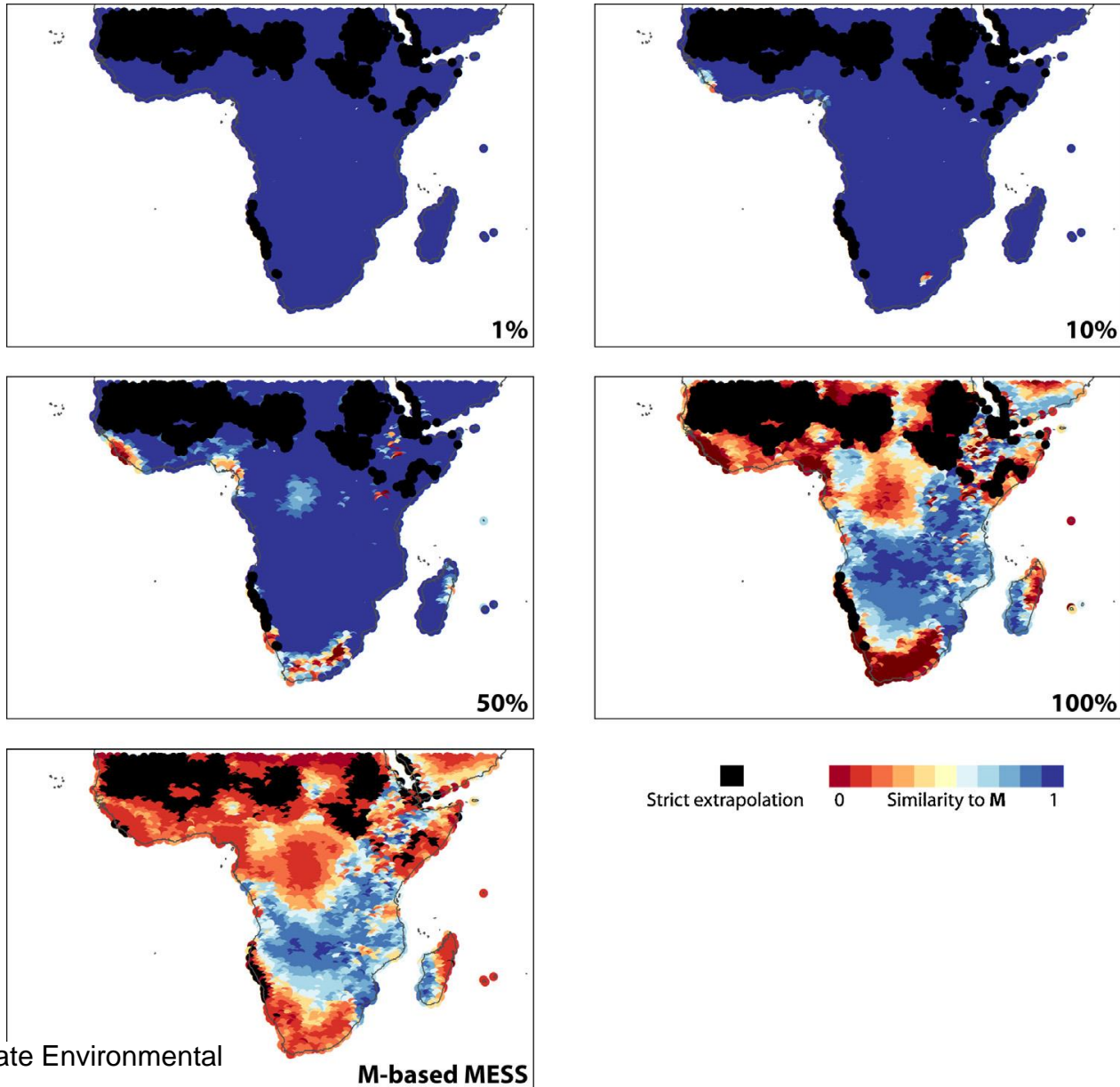
Multivariate Environmental
Similarity Surface (MESS)

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Evolución de nicho

Rangos de variables