Modelação espacial da distribuição de espécies invasoras: O uso de diferentes variáveis ambientais/antropogénicas e previsão de possíveis impactos das alterações climáticas.

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MARE

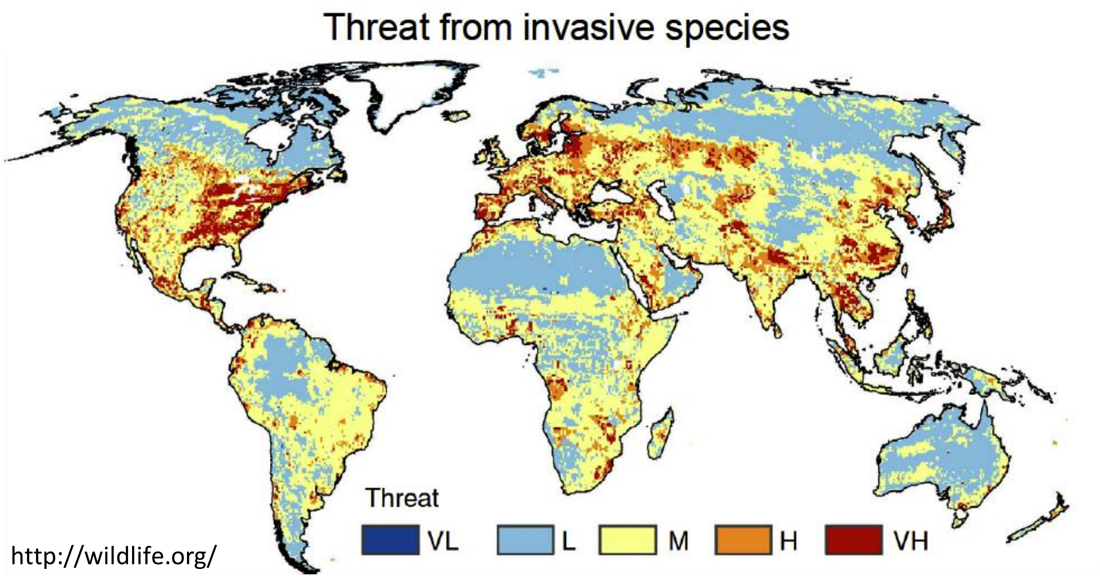
UNIVERSIDADE DE ÉVORA

Jornadas Internacionales
"Especies Exóticas Invasoras: problemática y herramientas de gestión, control y erradicación"
Cáceres, 20 e 21 de Março de 2018

Anualmente o custo associado à presença de espécies invasoras na União Europeia é:

12 biliões de euros

E estes custos continuam a aumentar !



http://wildlife.org/

Será que?

- O uso de diferentes variáveis (topográficas, climáticas e antropogénicas) influencia a adequabilidade de habitat?

amêijoa asiática (*Corbicula fluminea*)

tartaruga da Flórida (*Trachemys scripta elegans*)

- Esta metodologia é eficaz para prever impactos das mudanças climáticas usando diferentes cenários climáticos futuros?

Corbicula fluminea

- Originária da Ásia (introduzida por emigrantes chineses) ; Europa(1981)
- Dispersão: correntes, barcos, aves aquáticas, peixes, transporte de areia ou comércio.
- Efeitos negativos: fitoplancton (macrófitas), modificação do substrato e ciclo de matéria orgânica. Afecta estruturas de captação , distribuição e retenção de água.

Trachemys scripta elegans

- Originária dos Estados Unidos e México.
- Principal meio de introdução – Comércio (aquários, como animal de estimação).
- Compete com espécies nativas, perturba ninhos de aves, pode predar girinos. Vector de transmissão de estirpes de *Salmonella* – impactos na saúde humana

Modelos de distribuição/ modelação de nicho ecológico

➢Utilizados para determinar o potencial de dispersão de espécies ou mapear a adequabilidade de habitat.

➢Podem ajudar a tomar medidas adequadas, direccionando recursos mais eficientemente.

➢Tem-se vindo a combinar o uso de modelos matemáticos isolados em análises do tipo ensemble combinando previsões de modelos individuais num meta modelo.

➢Estes parecem aumentar a capacidade de previsão dos modelos individuais.

➢Podem ser utilizados para prever/modelar os efeitos das alterações climáticas e consequentemente alterações nas áreas de dispersão de espécies.

Variáveis climáticas vs topográficas

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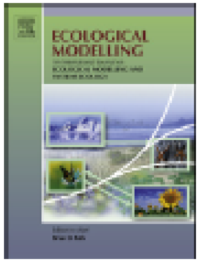


Predicting global habitat suitability for *Corbicula fluminea* using species distribution models: The importance of different environmental datasets

CrossMark

M. Gama[a,*], D. Crespo[b], M. Dolbeth[b,c], P. Anastácio[a]

- 412 localizações geográficas
- 4 variáveis bioclimáticas

BIO1 = Annual Mean Temperature

BIO10 = Mean Temperature of Warmest Quarter

BIO11 = Mean Temperature of Coldest Quarter

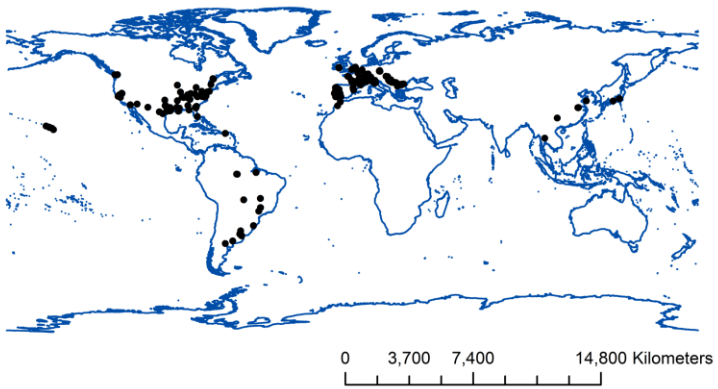
BIO12 = Annual Precipitation

- 3 variáveis topográficas

Altitude

Declive

Cti - compound topographical index



- 3 combinações de dados

- **corbiculaTOPO**

Altitude
Declive
Cti

- **corbiculaCLIM**

BIO1
BIO10
BIO11
BIO12

- **corbiculaMIX**

Altitude
Declive
Cti
BIO1
BIO10
BIO11
BIO12

9 algoritmos no BIOMOD2

SRE (surface range envelop or BIOCLIM)

CTA (classification tree analysis),

RF (random forest for classification and regression)

MARS (multivariate adaptive regression spline)

FDA (Flexible discriminant analysis)

GLM (generalized linear models)

GAM (generalized additive models)

GBM (generalized boosted regression models)

ANN (artificial neural networks)

Ensemble

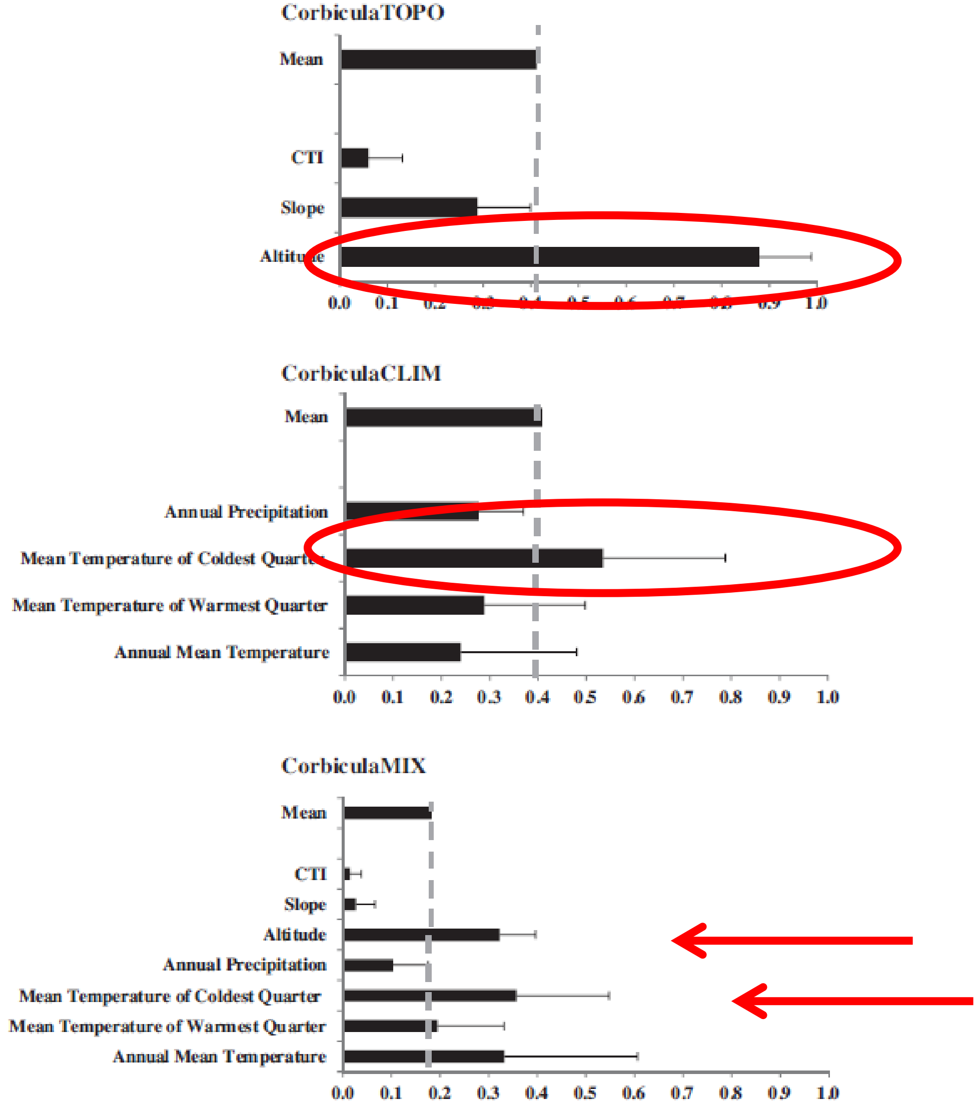


Fig. 2. Mean value of relative importance of the environmental variables used to predict the distribution of *Corbicula fluminea* obtained from nine different modeling algorithms with corresponding standard deviation values. Gray line – mean relative importance. *CorbiculaMIX*, *CorbiculaCLIM* and *CorbiculaTOPO* correspond to different environmental datasets.

Table 2
Sensitivity and specificity calculated for the different environmental datasets *CorbiculaTOPO*, *CorbiculaCLIM* and *CorbiculaMIX*. Percentage (%) of suitable and unsuitable terrestrial areas calculated after binary map resampling based on a specificity and sensitivity approach.

TSS	Sensitivity	Specificity	Unsuitable (%)	Suitable (%)
CorbiculaTOPO	95.57	99.35	98.1	1.9
Corbicula CLIM	94.60	96.50	92.8	7.2
CorbiculaMIX	97.78	95.30	93.8	6.2

Performance semelhante entre CorbiculaMIX e CorbiculaCLIM.

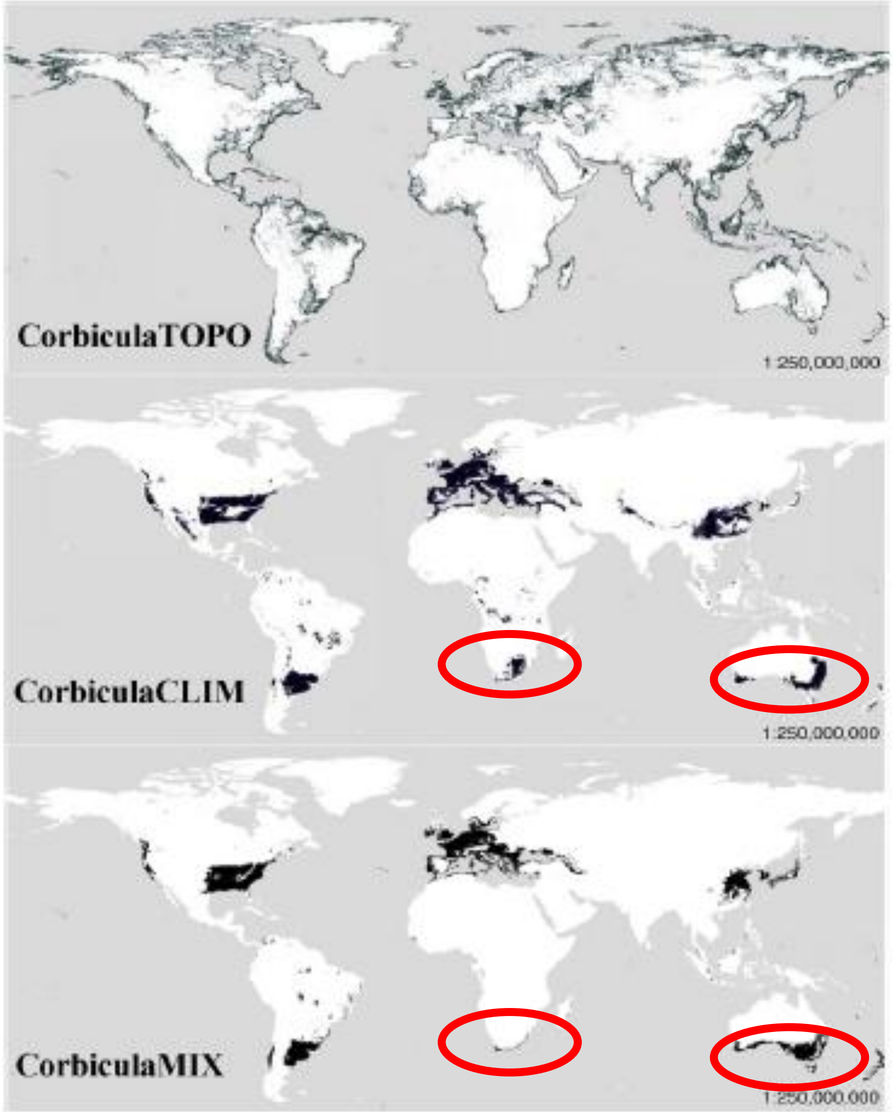


Fig. 3. Binary maps (suitable–unsuitable areas) of predicted worldwide distribution of *C. fluminea* in the three different environmental datasets: *CorbiculaTOPO*, *CorbiculaCLIM* and *CorbiculaMIX*. Black means suitable.

Projeção do impacto das alterações climáticas

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RESEARCH ARTICLE

Ensemble forecasting of *Corbicula fluminea* worldwide distribution: Projections of the impact of climate change

Mafalda Gama[1] | Daniel Crespo[2] | Marina Dolbeth[3] | Pedro Manuel Anastácio[1]

Aquatic Conserv: Mar Freshw Ecosyst. 2017;27:675–684. wileyonlinelibrary.com/journal/aqc | 675

- 412 localizações geográficas de ocorrência
- 8 variáveis bioclimáticas

BIO1 = Annual Mean Temperature

BIO5 = Max Temperature of Warmest Month

BIO6 = Min Temperature of Coldest Month

BIO8 = Mean Temperature of Wettest Quarter

BIO9 = Mean Temperature of Driest Quarter

BIO10 = Mean Temperature of Warmest Quarter

BIO11 = Mean Temperature of Coldest Quarter

BIO12 = Annual Precipitation

- Modelos climáticos globais (GCM) projecções -IPSL-CM5, IPSL Earth system model (5º relatório do IPCC)

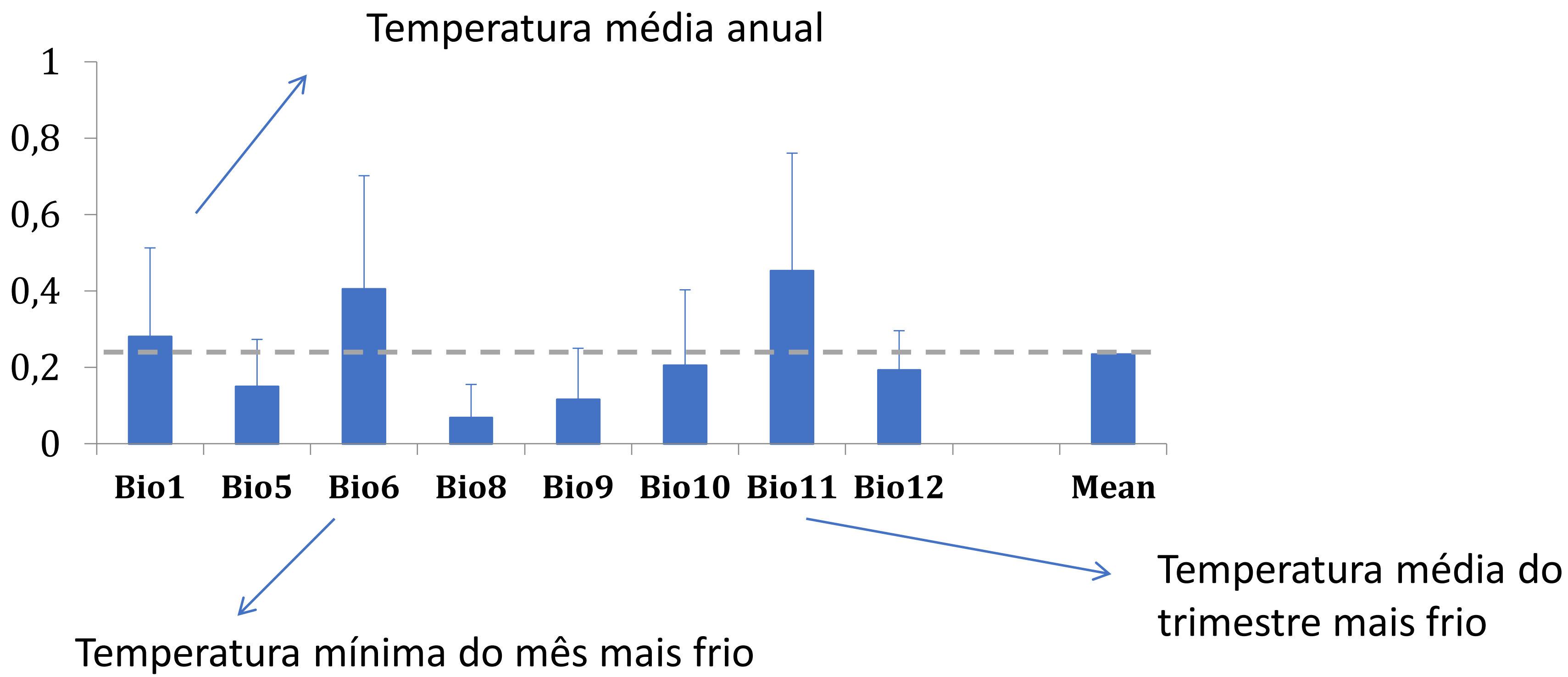
  Condições actuais (1950–2000)

  2050 (média 2041-2060)

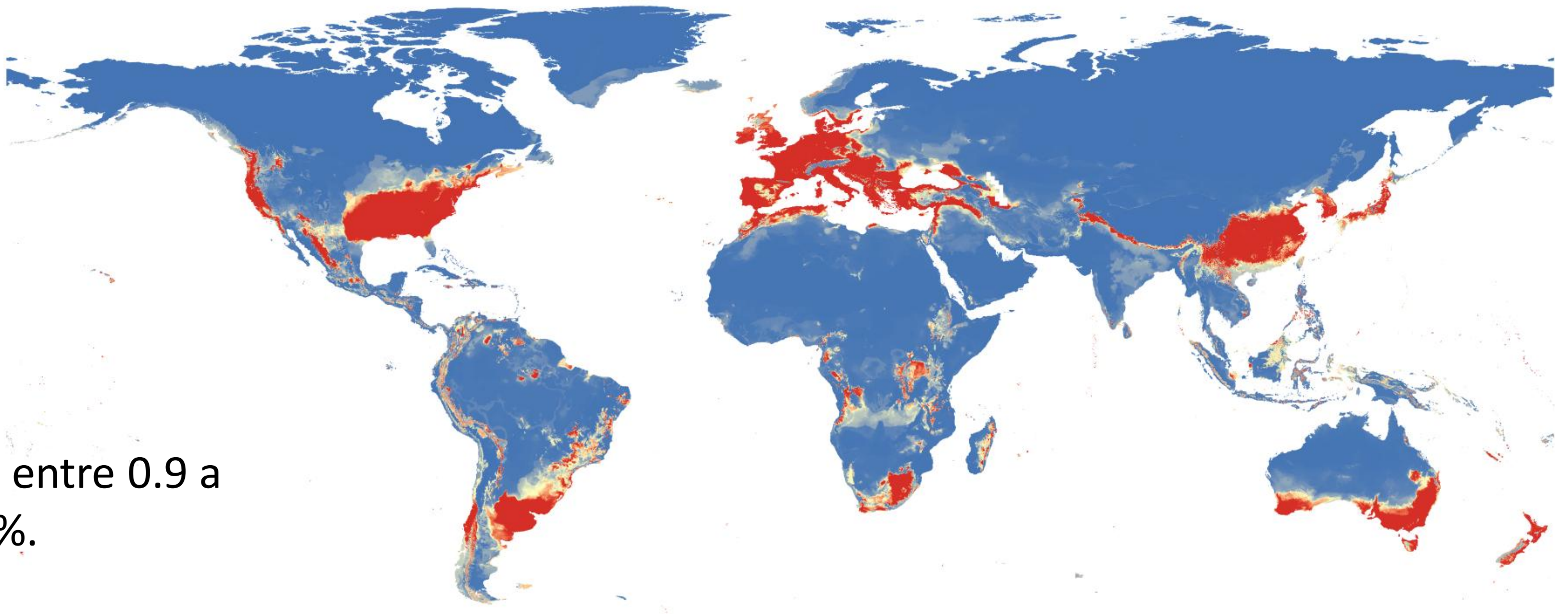
  2070 (média 2061-2080)

- 4 cenários crescentes de emissões de gases (RCPs): RCP2.6 (rcp26), RCP4.5 (rcp45), RCP6 (rcp60), e RCP8.5 (rcp85)

Importância das variáveis ambientais



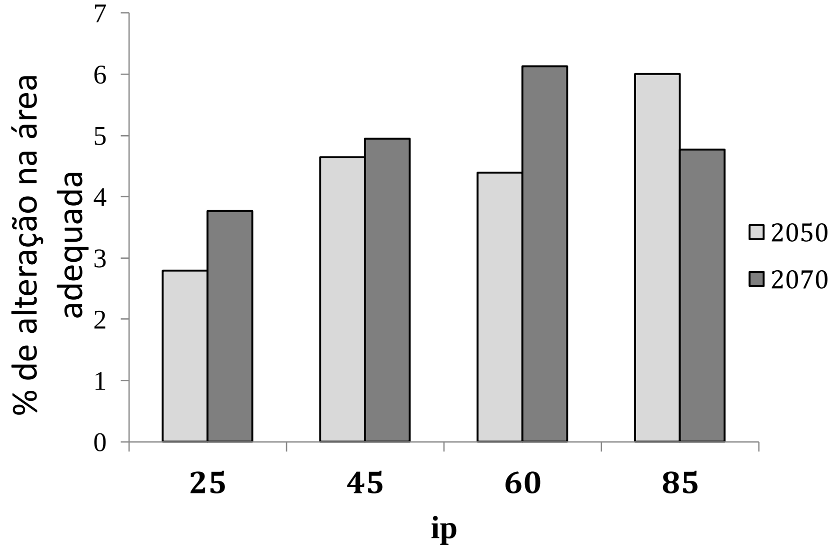
Adequabilidade de habitat nas condições actuais



varia entre 0.9 a
99.7%.

Habitat adequado

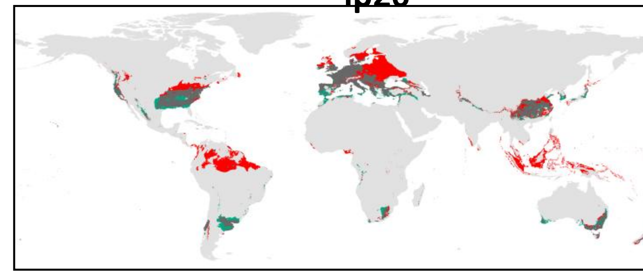
			Não Adequado	Adequado
Actual			93.4	6.6
2050	**ip**	26	90.6	9.4
		45	88.8	11.2
		60	89.0	11.0
		85	87.4	12.6
2070	**ip**	26	89.6	10.4
		45	88.4	11.6
		60	87.3	12.7
		85	88.6	11.4



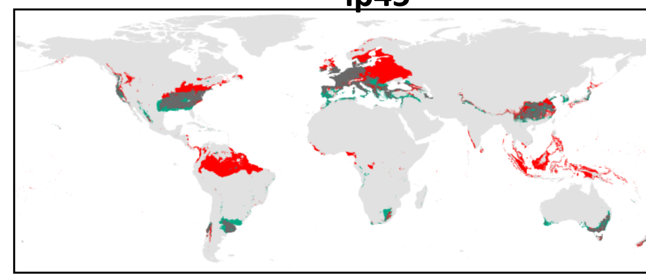
2070

Actual

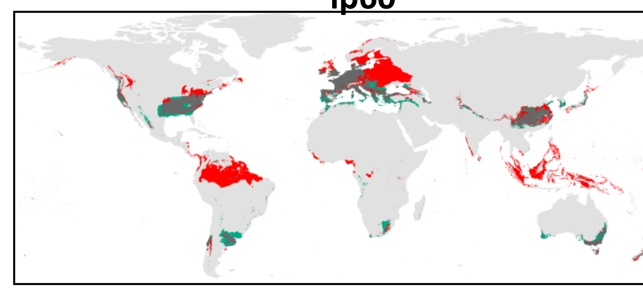
ip26



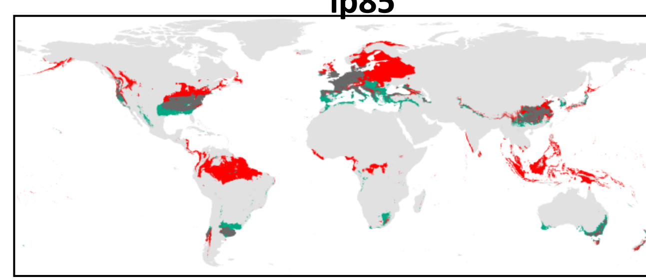
ip45

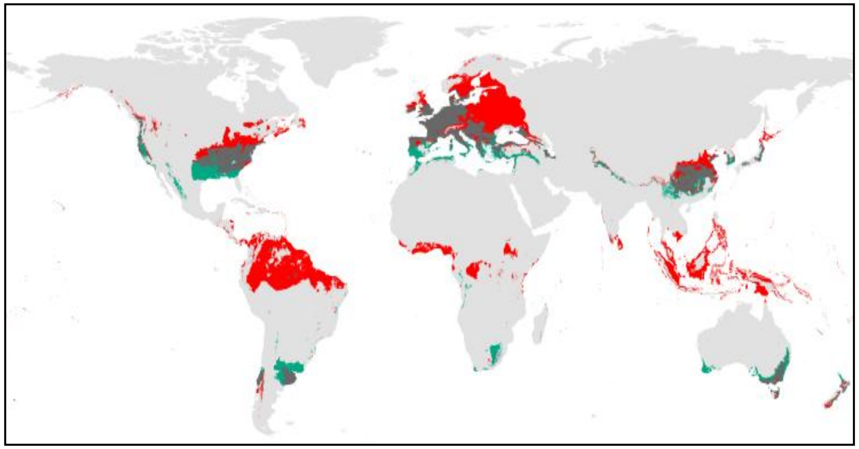


ip60



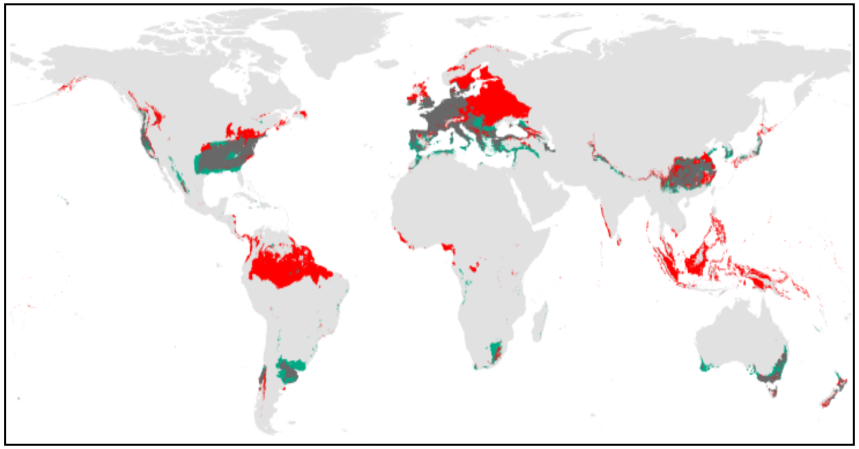
ip85





2050 ip85

+6%



2070 ip60

+6.1%

Adicionar variáveis antropogénicas

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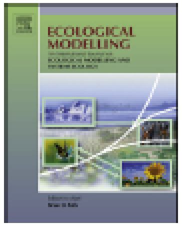

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The effect of reproductive occurrences and human descriptors on invasive pet distribution modelling: *Trachemys scripta elegans* in the Iberian Peninsula

Filipe Banha*, Mafalda Gama, Pedro Manuel Anastácio

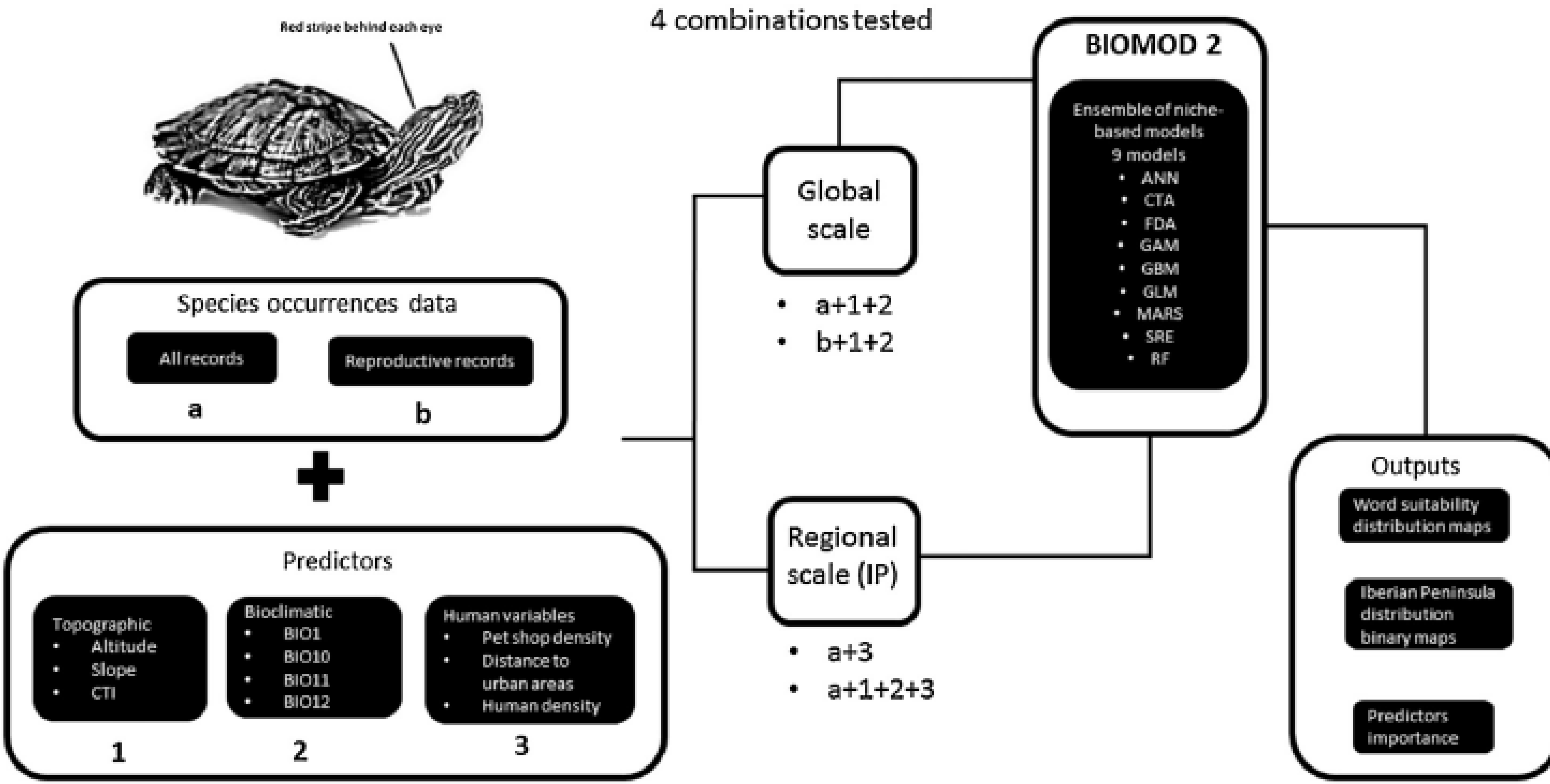

Fig. 1. Conceptual diagram of the study.

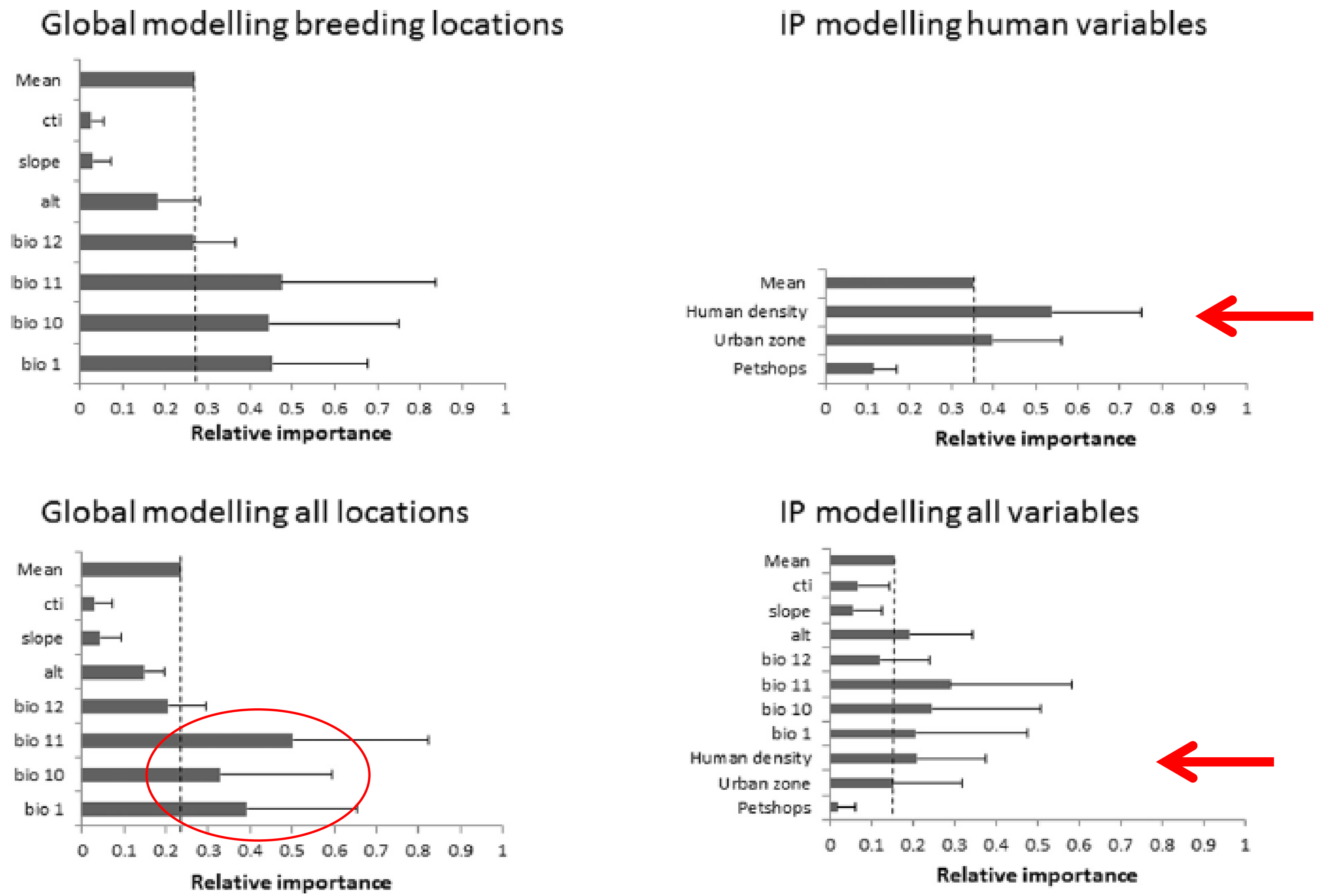

Fig. 2. Mean value and relative importance of the environmental and human predictor variables for *Trachemys scripta elegans* distribution modelling. Dotted line – mean relative importance: a) worldwide breeding occurrences using environmental variables only, b) worldwide occurrences using environmental variables only, c) Iberian Peninsula occurrences using human and environmental variables, d) Iberian Peninsula occurrences using human variables only. The climatic variables included were: BIO1 – Annual Mean Temperature, BIO10 – Mean Temperature of Warmest Quarter, BIO11 – Mean Temperature of Coldest Quarter and BIO12 – Annual Precipitation. The human variables included were: Pet shops – kernel density raster reflecting the pet shops density, urban areas – raster reflecting distance to urban areas land cover, human density – raster with human density raster (people/ha).

Table 2
Sensitivity and specificity calculated for the different environmental datasets: a) worldwide breeding locations using environmental variables only; b) worldwide occurrences using environmental variables only; c) Iberian Peninsula occurrences using human and environmental variables; d) Iberian Peninsula occurrences using human variables only. Percentage of suitable and unsuitable terrestrial areas calculated after binary map resampling based on a specificity and sensitivity approach.

TSS	Sensitivity	Specificity	Global		Iberian peninsula	
			Unsuitable (%)	Suitable (%)	Unsuitable (%)	Suitable (%)
a) worldwide breeding locations	97.87	91.58	89.5	10.5	41.3	58.7
b) worldwide occurrences	96.12	89.32	86.5	13.5	5.1	94.9
c) Iberian Peninsula occurrences using human and environmental variables	92.75	98.36	–	–	95.9	4.1
d) Iberian Peninsula occurrences using human variables only	98.98	78.45	–	–	73.7	26.3

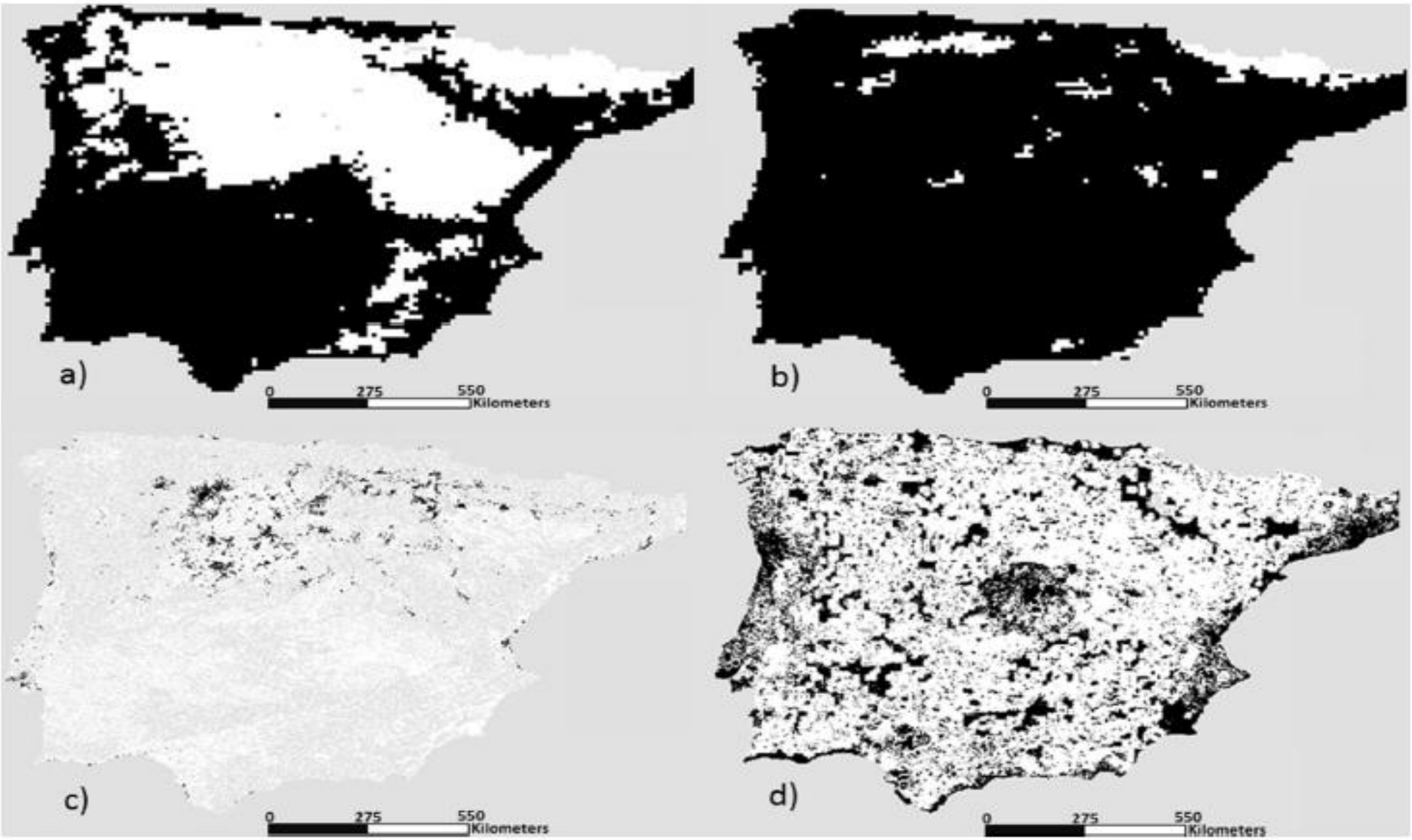

Fig. 3. Binary maps (suitable-unsuitable areas) of predicted Iberian Peninsula distribution of *Trachemys scripta elegans* using four different datasets: a) worldwide breeding occurrences, using environmental variables only, b) worldwide occurrences, using environmental variables only, c) Iberian Peninsula occurrences using human and environmental variables, d) Iberian Peninsula occurrences using human variables only. Black means suitable.

Os NBMs podem fornecer informações importantes sobre a ameaça combinada de mudanças climáticas e distribuição de espécies invasoras.

O uso de meta modelos pode ajudar a tomar decisões informadas sobre gestão de recursos para monitorizar, controlar e minimizar impactos negativos da presença de espécies invasoras e proteger espécies vulneráveis.

Obrigada pela atenção!

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