

# Studiul speciilor invazive și al schimbărilor climatice utilizând metode GIS

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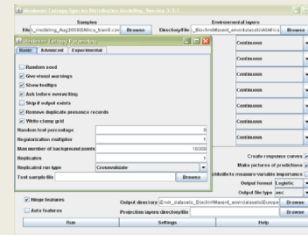
# Cercetare: Modificari ale biodiversitatii



Specii invazive  
Schimbari climatice  
Schimbari ale habitatelor



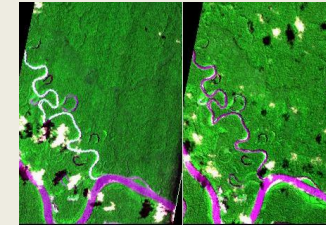
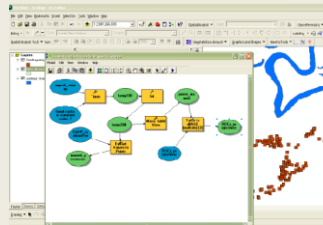
## Metode



Empirical Modeling  
GIS  
Remote Sensing

## Scala studiilor

Larga  
Regionala  
Locala



# Distributia geografica a speciilor

## Surse de informatie

- Observatii (monitoring) – datele pot fi arhivate:
  - Specimene in colectii (muzee, herbarii)
  - Publicatii, monografii, etc.
  - Baze de date

# Digitizarea si accesul la informatie

**Table 2.**

Examples of repositories for Life Sciences data.

Repository	Type of Life Sciences Data	location
AlgaeBase	algae names and references	<a href="http://www.algaebase.org/">http://www.algaebase.org/</a>
ArrayExpress	microarray	<a href="http://www.ebi.ac.uk/arrayexpress/">http://www.ebi.ac.uk/arrayexpress/</a>
Australia National Data Service	general research data	<a href="http://www.ands.org.au/">http://www.ands.org.au/</a>
ConceptWiki	concepts	<a href="http://conceptwiki.org/index.php/Main%20Page">http://conceptwiki.org/index.php/Main%20Page</a>
CSIRO	fisheries catch	<a href="http://www.marine.csiro.au/datacentre/">http://www.marine.csiro.au/datacentre/</a>
Data.gov	natural resources data	<a href="http://www.data.gov/">http://www.data.gov/</a>
Diptera database	Dipteran information	<a href="http://www.sel.barc.usda.gov/diptera/biosys.htm">http://www.sel.barc.usda.gov/diptera/biosys.htm</a>
EMAGE	gene expression	<a href="http://www.emouseatlas.org/emage/">http://www.emouseatlas.org/emage/</a>
ENA	gene sequences	<a href="http://www.ebi.ac.uk/ena/">http://www.ebi.ac.uk/ena/</a>
Ensembl	genomes	<a href="http://uswest.ensembl.org/index.html">http://uswest.ensembl.org/index.html</a>
Euregene	renal genome	<a href="http://www.euregene.org/">http://www.euregene.org/</a>
Eurexpress	transcriptome	
EURODEER	movement of roe deer	
FishBase	fish information	
<b>GBIF</b>	<b>occurrences</b>	
GenBank	gene sequences	
GEO	microarray	
GNI	names	

Thessen and Patterson (2011)  
*ZooKeys*

INBIO	Costa Rican biodiversity	<a href="http://www.inbio.ac.cr/es/default.html">http://www.inbio.ac.cr/es/default.html</a>
INSPIRE	spatial	<a href="http://inspire.jrc.ec.europa.eu/index.cfm">http://inspire.jrc.ec.europa.eu/index.cfm</a>
KEGG	genes	<a href="http://www.genome.jp/kegg/">http://www.genome.jp/kegg/</a>
Life Sciences Data Archive NASA	effects of space on humans	<a href="http://lsda.jsc.nasa.gov/">http://lsda.jsc.nasa.gov/</a>
MassBank	mass spectra	<a href="http://www.massbank.jp/index.html?lang=en">http://www.massbank.jp/index.html?lang=en</a>
MGI	mouse	<a href="http://www.informatics.jax.org/">http://www.informatics.jax.org/</a>
MorphBank	images	<a href="http://www.morphbank.net/">http://www.morphbank.net/</a>
<b>OBIS</b>	<b>occurrences</b>	<a href="http://www.iobis.org/">http://www.iobis.org/</a>
OMIM	human genes and phenotypes	<a href="http://www.ncbi.nlm.nih.gov/omim">http://www.ncbi.nlm.nih.gov/omim</a>
PDB	molecule structure	<a href="http://www.pdb.org/pdb/home/home.do">http://www.pdb.org/pdb/home/home.do</a>
PRIDE	proteomics	<a href="http://www.ebi.ac.uk/pride/">http://www.ebi.ac.uk/pride/</a>
PubMed	citations	<a href="http://www.ncbi.nlm.nih.gov/pubmed/">http://www.ncbi.nlm.nih.gov/pubmed/</a>
Stanford Microarray Database	microarray	<a href="http://smd.stanford.edu/">http://smd.stanford.edu/</a>
tair	Arabidopsis molecular biology	<a href="http://www.arabidopsis.org/">http://www.arabidopsis.org/</a>
TOPP	animal tagging	<a href="http://www.topp.org/topp_census">http://www.topp.org/topp_census</a>
TreeBase	phylogenetic trees	<a href="http://www.treebase.org/">http://www.treebase.org/</a>
<b>TROPICOS</b>	<b>plant specimens</b>	<a href="http://www.tropicos.org/">http://www.tropicos.org/</a>
UniProt	protein sequence and function	<a href="http://www.uniprot.org/">http://www.uniprot.org/</a>
WILDSPACE	life history information	<a href="http://wildspace.ec.gc.ca/more-e.html">http://wildspace.ec.gc.ca/more-e.html</a>
WRAM	wireless remote animal monitoring	<a href="http://www-wram.slu.se/">http://www-wram.slu.se/</a>

# Digitizarea si accesul la informatie

## Muzee si herbarii

- Arhivare pe termen lung
- In intreaga lume: cateva miliarde de specimene
- Informatie valoroasa
  - Schimbari in distributia speciilor
  - Extirpari/Disparitii
  - Specii invazive


# Digitizarea si accesul la informatie

## Muzee si herbarii

- Accesul nelimitat la datele specimenelor

VertNet: 80 milioane (peste 70 de institutii participante)

Tropico  arden)

GBI 

Home Names Specimens References Projects Images More Tools

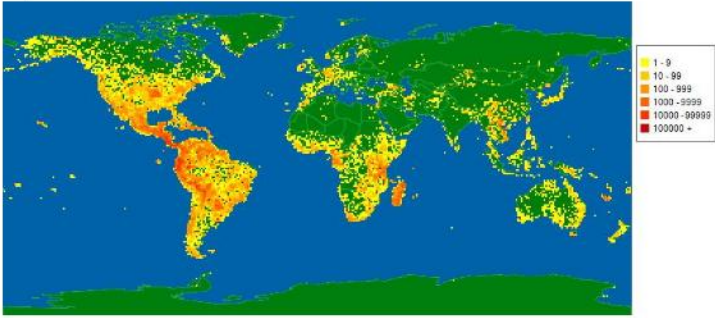
Tropicos® was originally created for internal research but has since been made available to the world's scientific community. All of the nomenclatural, bibliographic, and specimen data accumulated in MBG's electronic databases during the past 25 years are publicly available here. This system has over 1.2 million scientific names and 4.0 million specimen records.

Quick Name Search

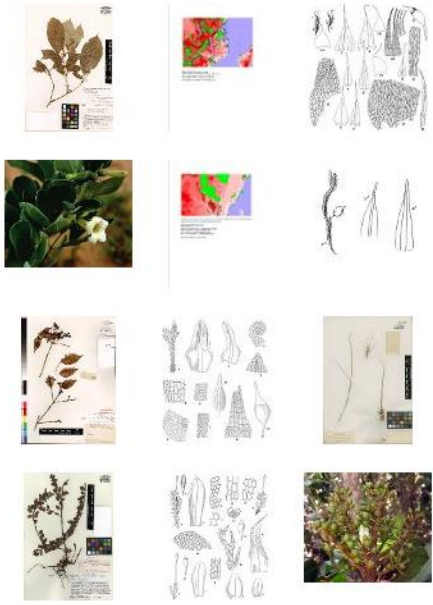
Common Name

News Links Stats Heat Map Country Map

This map shows the density of Tropicos specimen records that have coordinates. Click the image to see a larger version and to explore specimens at particular degree square.



Click an image for detailed information:



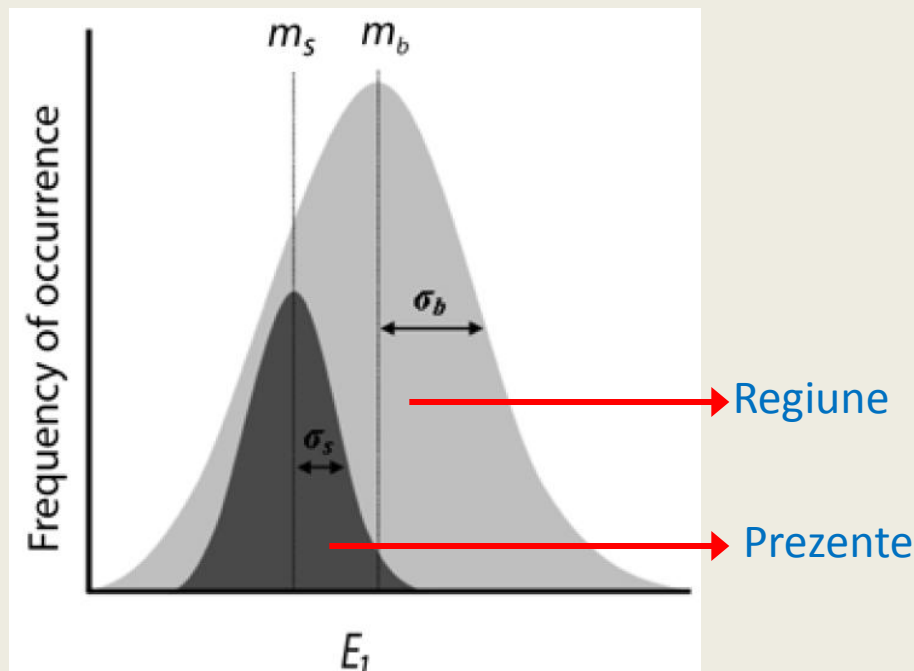
# Digitizarea si accesul la informatie

## Muzee si herbarii

- Arhivare pe termen lung
- In intreaga lume: cateva miliarde de specimene
- Informatie valoroasa
  - Schimbari in distributia speciilor
  - Extirpari/Disparitii
  - Specii invazive
- Accesul nelimitat la datele specimenelor
- **Cercetarea determinata de existenta datelor: extrapolare**

# Programe (open source) pentru analiza datelor de biodiversitate

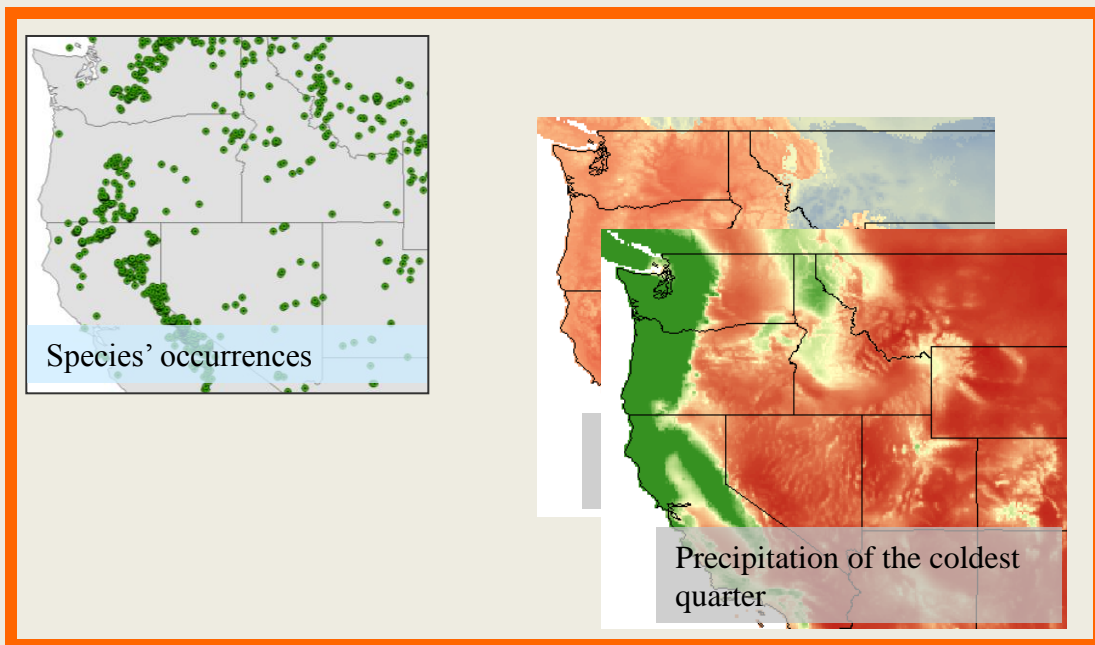
- Influentate de accesul fara precedent la date de biodiversitate
- In paralel cu accesul la baze de date SIG
- Lipsa de informatie inlocuita cu corelatii ale **datelor de prezenta** cu **conditiile climatice**
- Comparatii intre prezente si restul regiunii (sau absente)



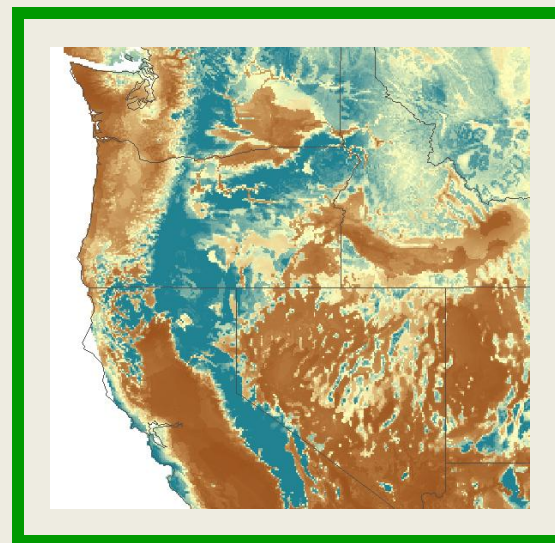


# Programe (open source) pentru analiza datelor de biodiversitate

Date de prezenta & date de mediu → nisa → distributie potentiala



Constructia modelului  
Domeniul ecologic

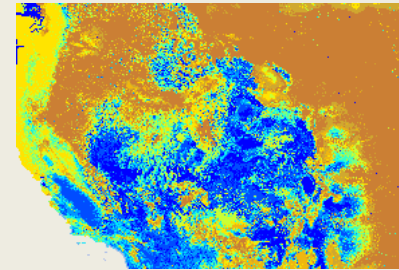
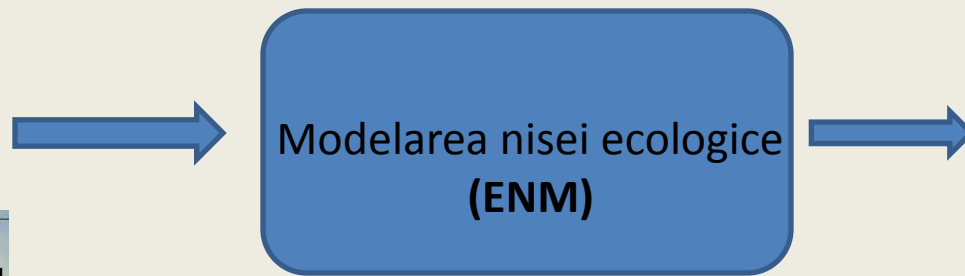
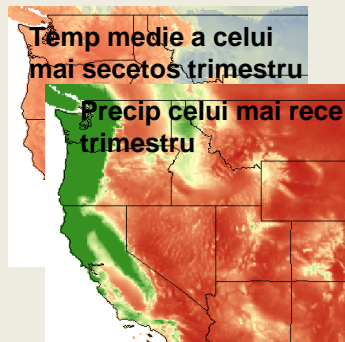
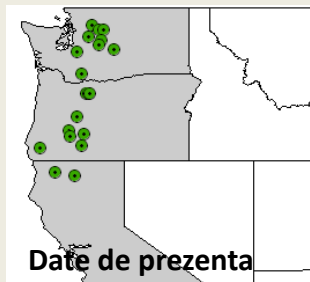


Domeniul geografic

# Programe (open source) pentru analiza datelor de biodiversitate

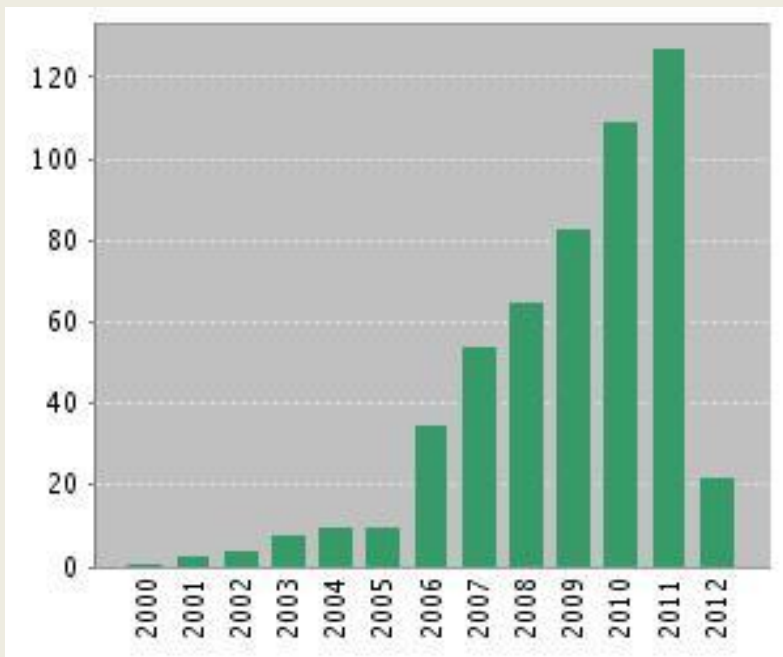
Modelarea nisei ecologice (Ecological niche modeling – ENM): cauta asociatii intre

- (1) Datele cunoscute de prezenta ale speciei
- (2) Variablele de mediu care descriu spatiul ecologic

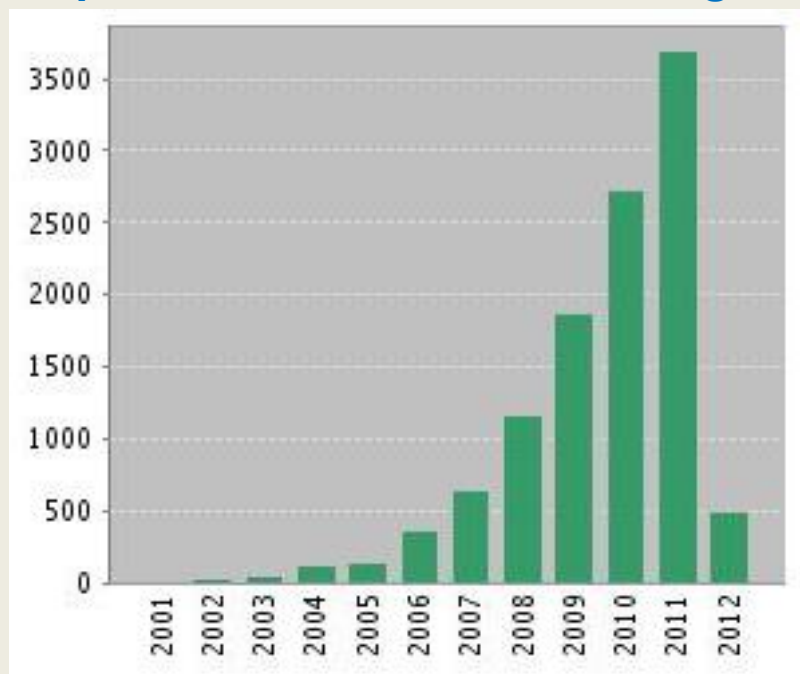


# Programe (open source) pentru analiza datelor de biodiversitate

Articole cu “ecological niche modeling” sau “species distribution modeling”



Citatii ale articolelor cu “ecological niche modeling” sau “species distribution modeling”



Cel mai citat articol (Locul 1): Elith et al. 2006. Novel methods improve prediction of species' distributions from occurrence data. *Ecography*

Locul 2: Phillips et al. 2006. Maximum entropy modeling of species geographic distributions. *Ecological Modelling*

# Programe (open source) pentru ENM

- Maxent – maximum entropy algorithm
- Altele: ENFA, GARP
- Platforme multi-algoritm: openModeller, ModEco

## De ce ENM?

- Pentru a intelege relatiile intre specii si factorii abiotici (inferenta ecologica)
- Pentru a interpola prezenta speciilor (“fill in gaps”)
- Pentru a extrapola prezenta speciilor (proiectie)

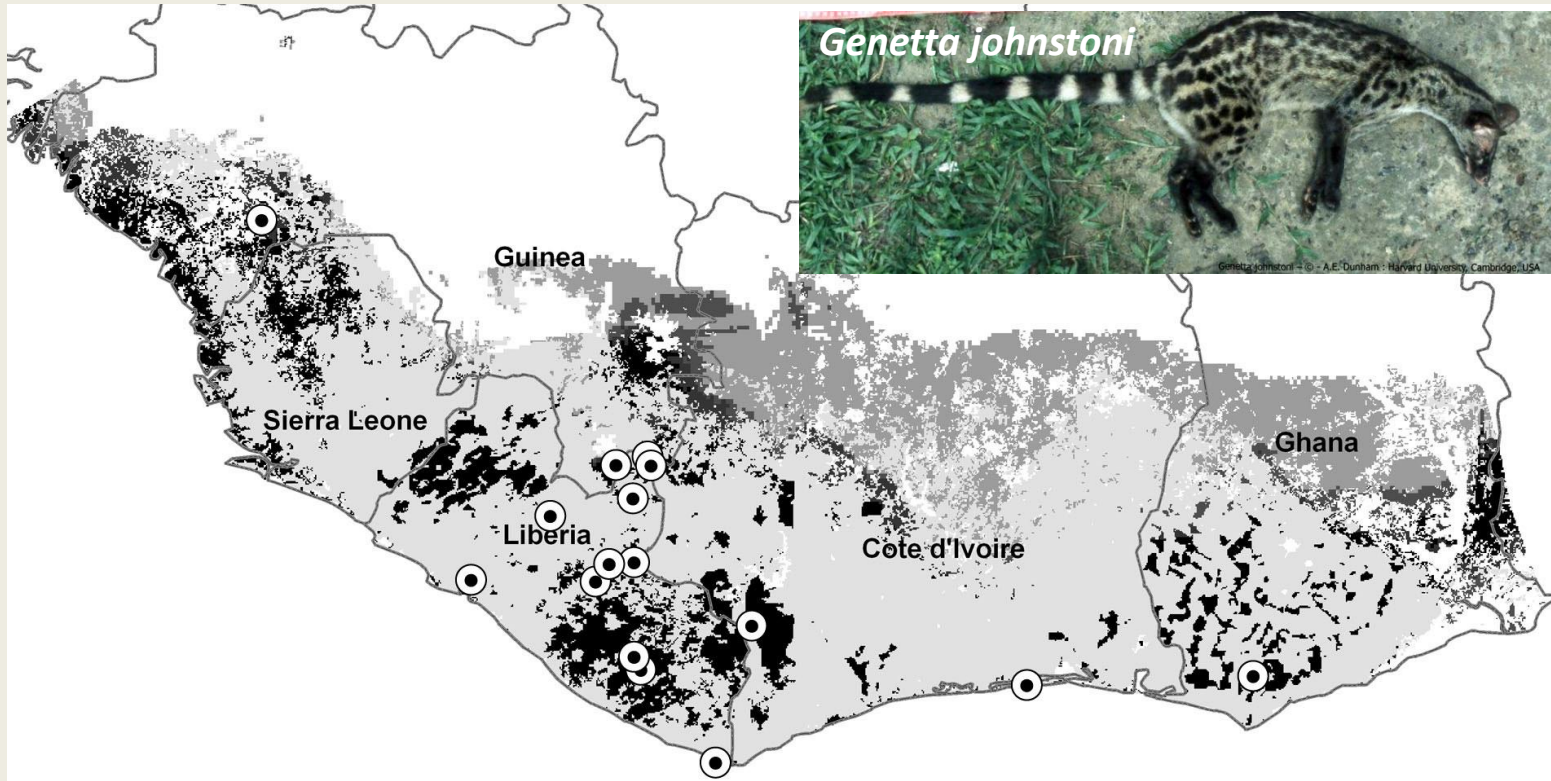
## Aplicatii ENM:

- **Conservarea biodiversitatii**
- **Distributia potentiala a speciilor invazive**
- **Efectul schimbarilor climatice asupra distributiei speciilor**
- Ecologia bolilor
- Restaurare ecologica (re-introduceri de specii)
- Paleo-distributii (filogeografie)
- Evolutia niselor ecologice
- etc

# Aplicatii: Conservarea Biodiversitatii

**Interpolare:** inferente in zonele lipsite de informatie privind distributia speciilor

- Proiectia modelelor de nisa ecologica in **accesii regiune folosita pentru construirea modelelor**

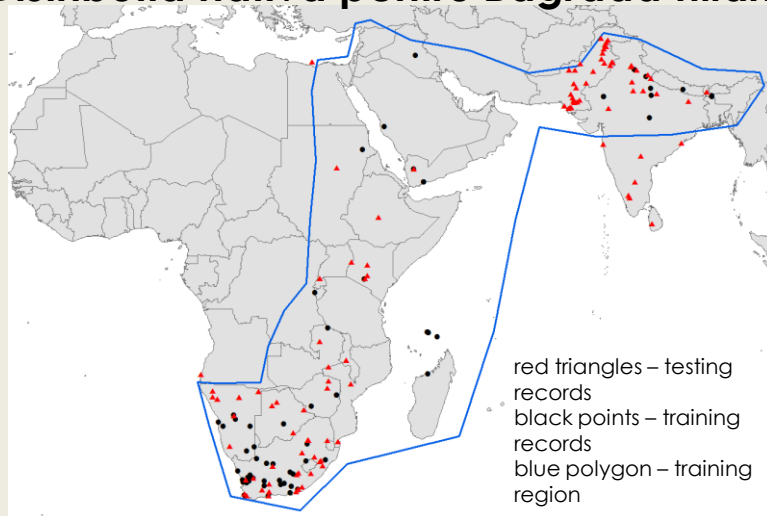


# Aplicatii: Specii invazive

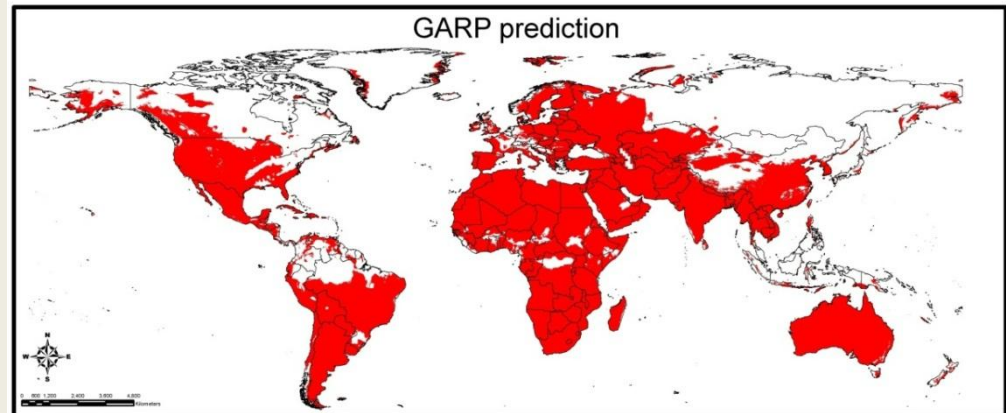
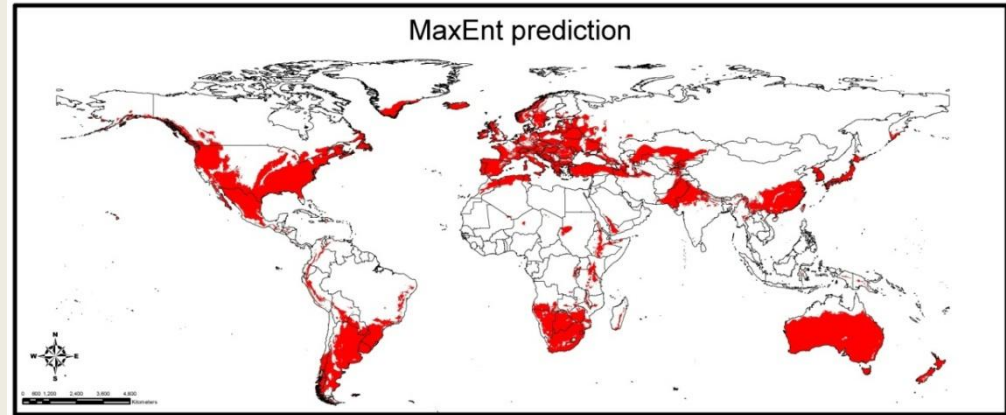
**Extrapolare:** predictii privind distributia potentiala a speciilor exotice

- Proiectia modelelor de nisa ecologica in **regiuni geografice noi**

Distributia nativa pentru *Bagrada hilaris*



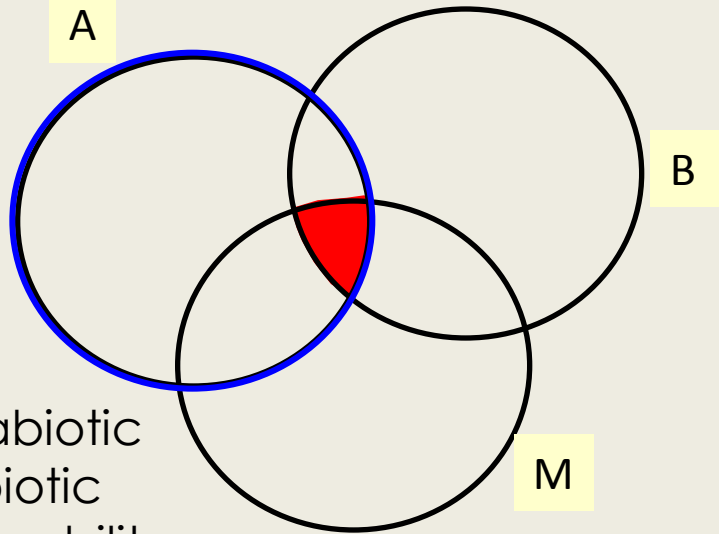
Distributia potentiala pentru *Bagrada hilaris*



Papes & Gherghel *in prep.*

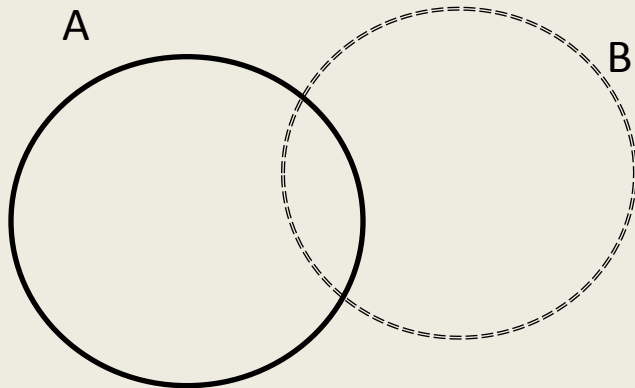
# Aplicatii: Specii invazive

Specia in regiunea nativa

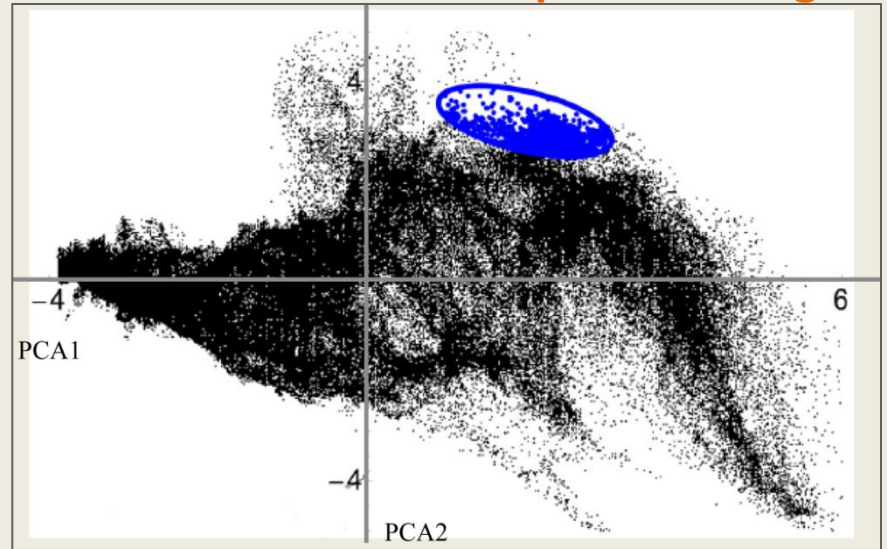


A abiotic  
B biotic  
M mobility

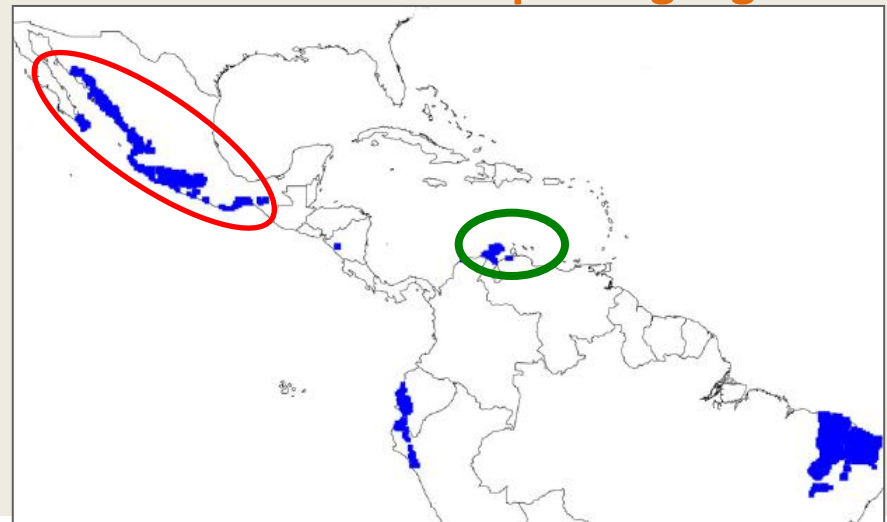
Specia in regiunea invaziva



Spatiu ecologic



Spatiu geografic





# Predictii ale distributiei potentiale a speciilor invazive

## Probleme

- Date incomplete
- Evenimente noi
- Capacitatea de dispersie mediata antropogenic

## Oportunitati

- Re-pozitionarea nisei (Niche shift)
- Evolutie rapida (adaptare)
- Interactiuni biotice

# Aplicatii: Efectele schimbarilor climatice asupra biodiversitatii

**Extrapolare:** modificarea distributiilor datorita schimbarilor climatice

- Proiectia nisei ecologice pe **date climatice noi (scenarii ale climatului in viitor)**

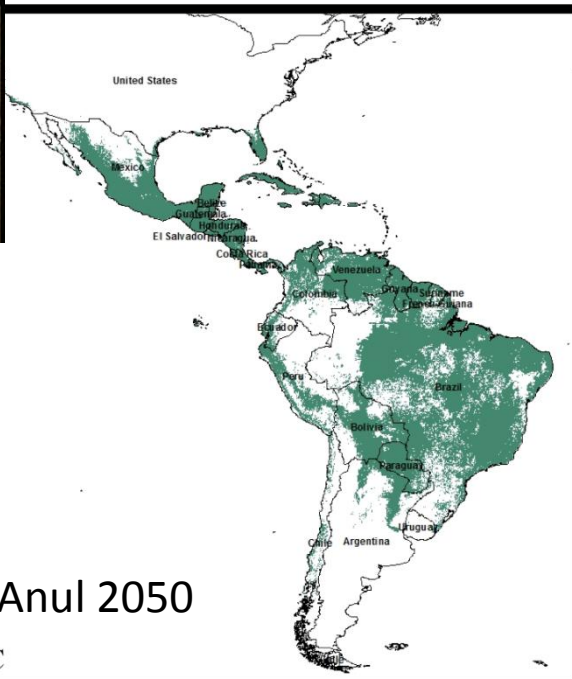


*Desmodus rotundus*



Prezent

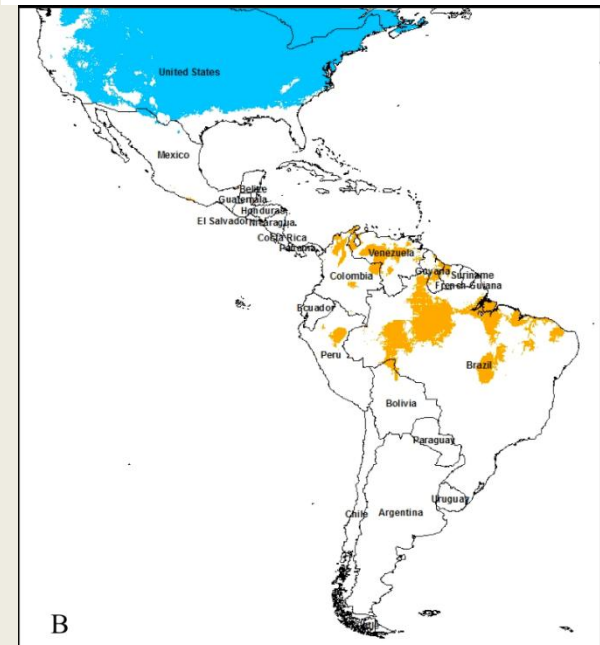
A



Anul 2050

C

Factorii cei mai diferiti (2050)  
Albastru: Sezonalitatea T.  
Auriu:  $T_{medie}$  trimestrul rece

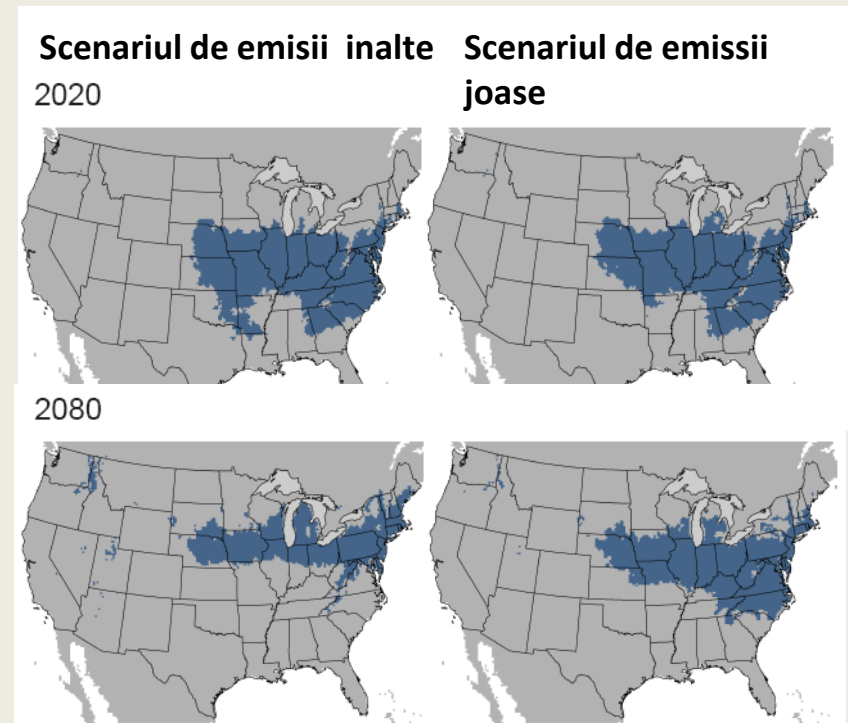
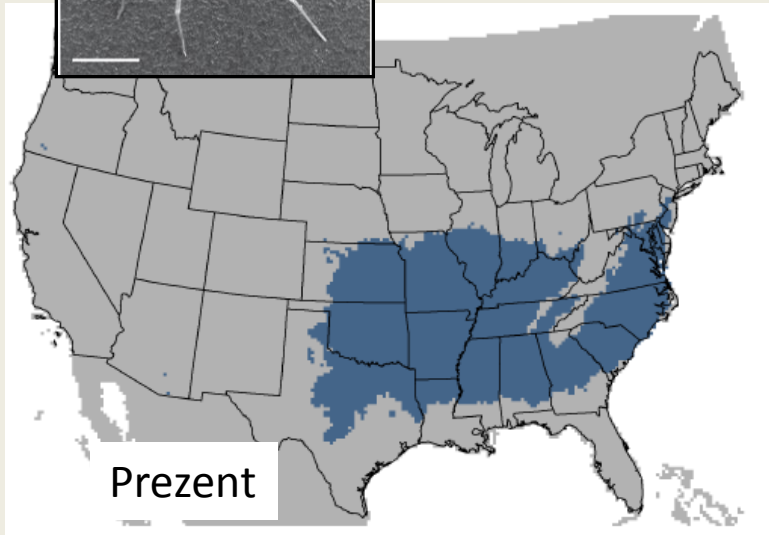


B

# Aplicatii: Efectele schimbarilor climatice asupra biodiversitatii

**Extrapolare:** modificarea distributiilor datorita schimbarilor climatice

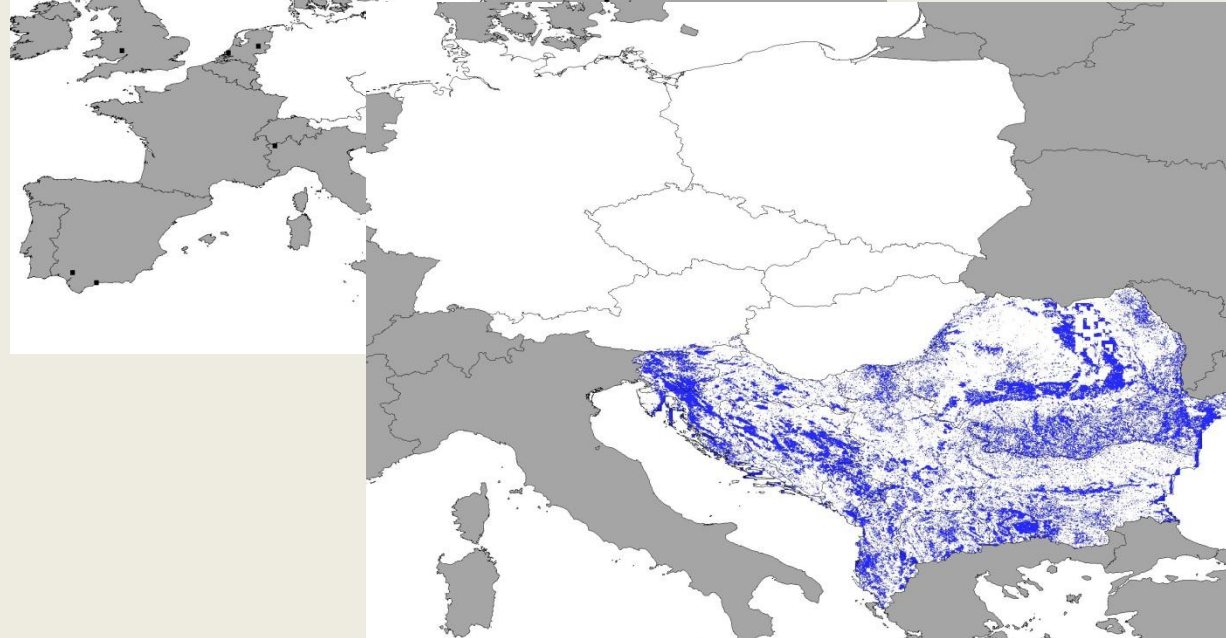
- Proiectia nisei ecologice pe **date climatice noi (scenarii ale climatului in viitor)**



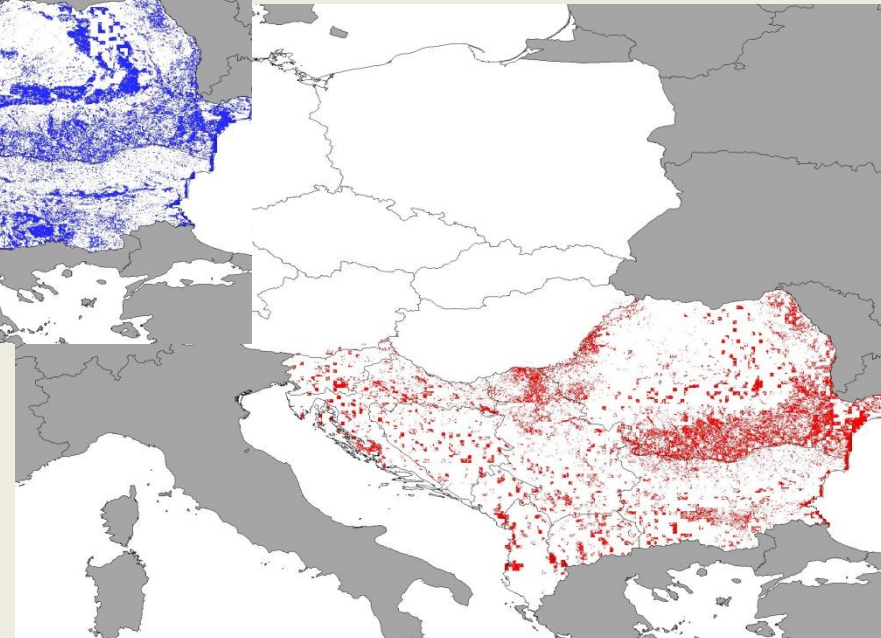
# Interpolare + Extrapolare: Protejarea biodiversitatii in prezenta schimbarilor climatice



Date de prezenta pentru *Aquila clanga*

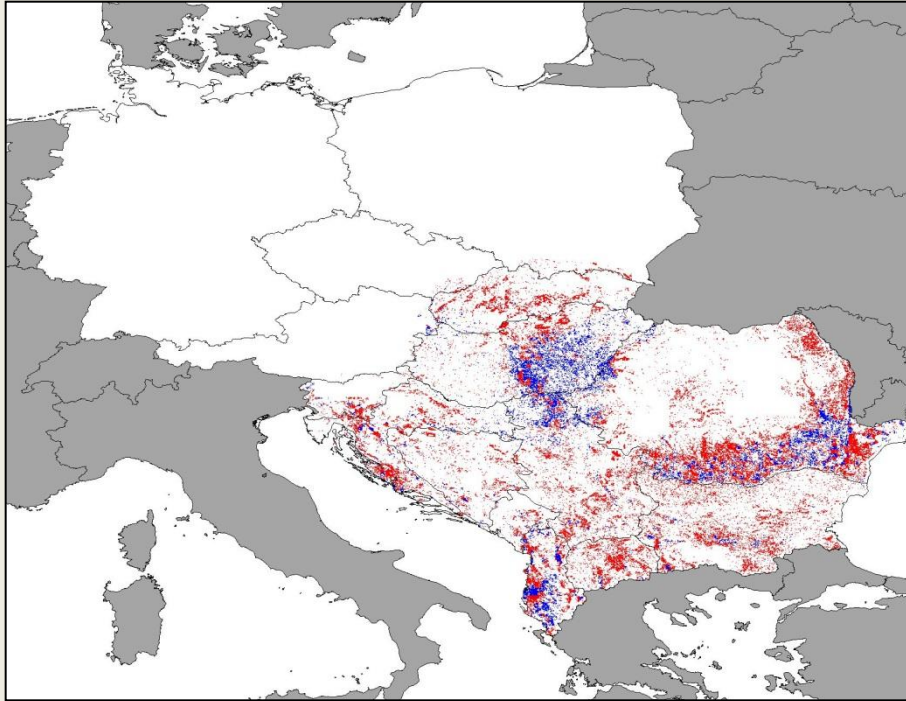


Distributia potentiala (prezent)

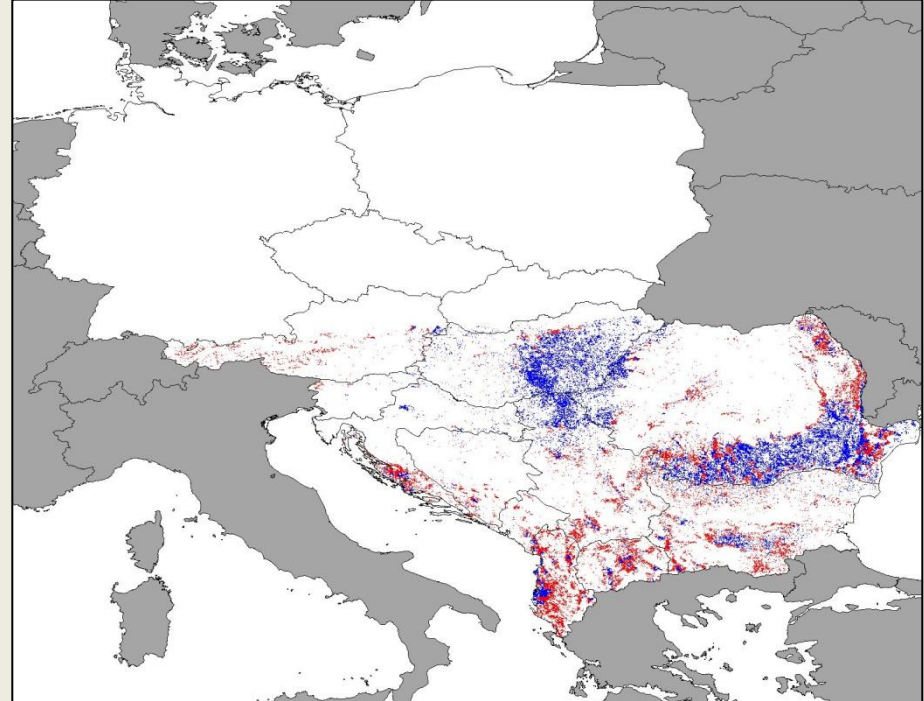


Distributia potentiala (viitor)

*Accipiter brevipes*

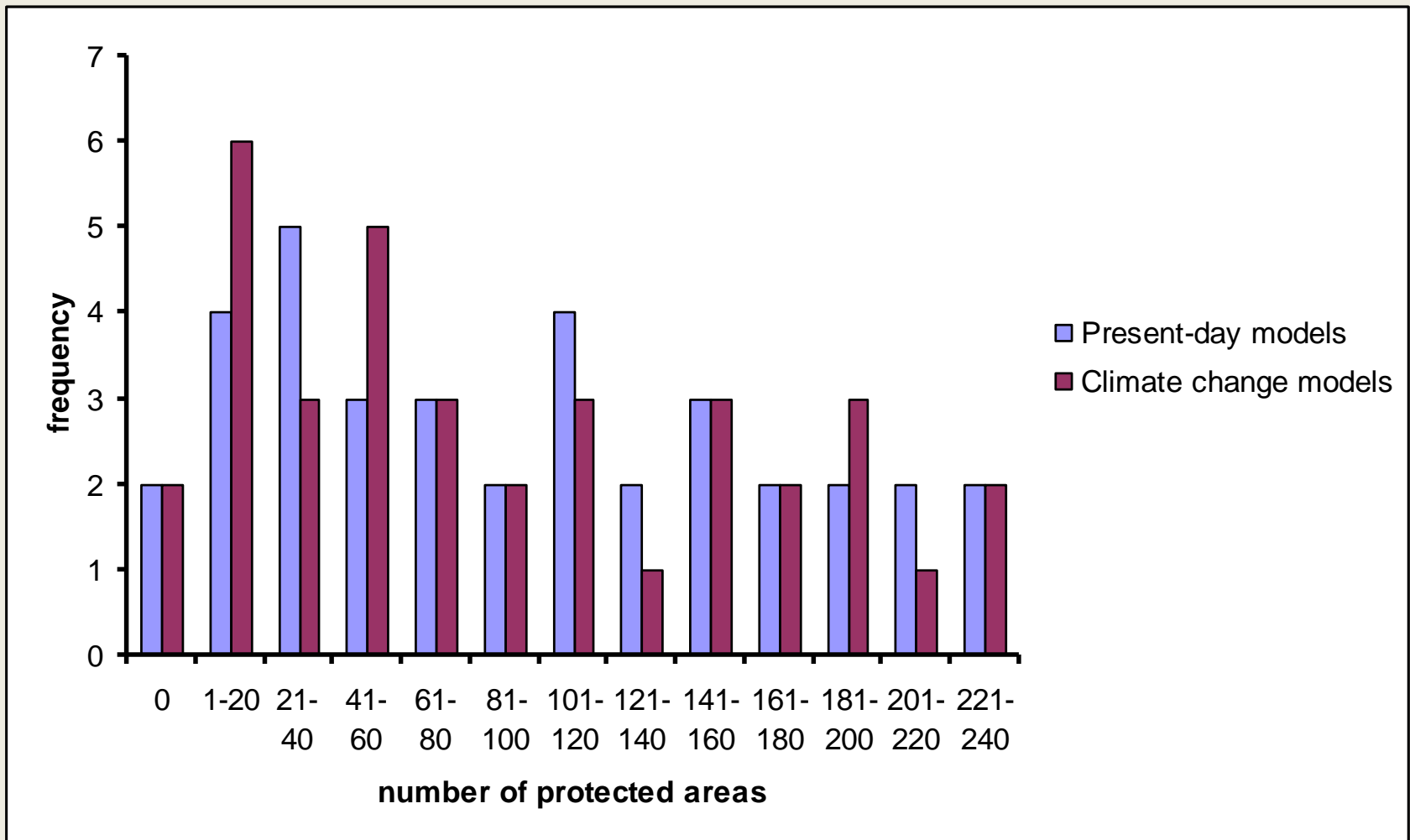


*Alectoris graeca*

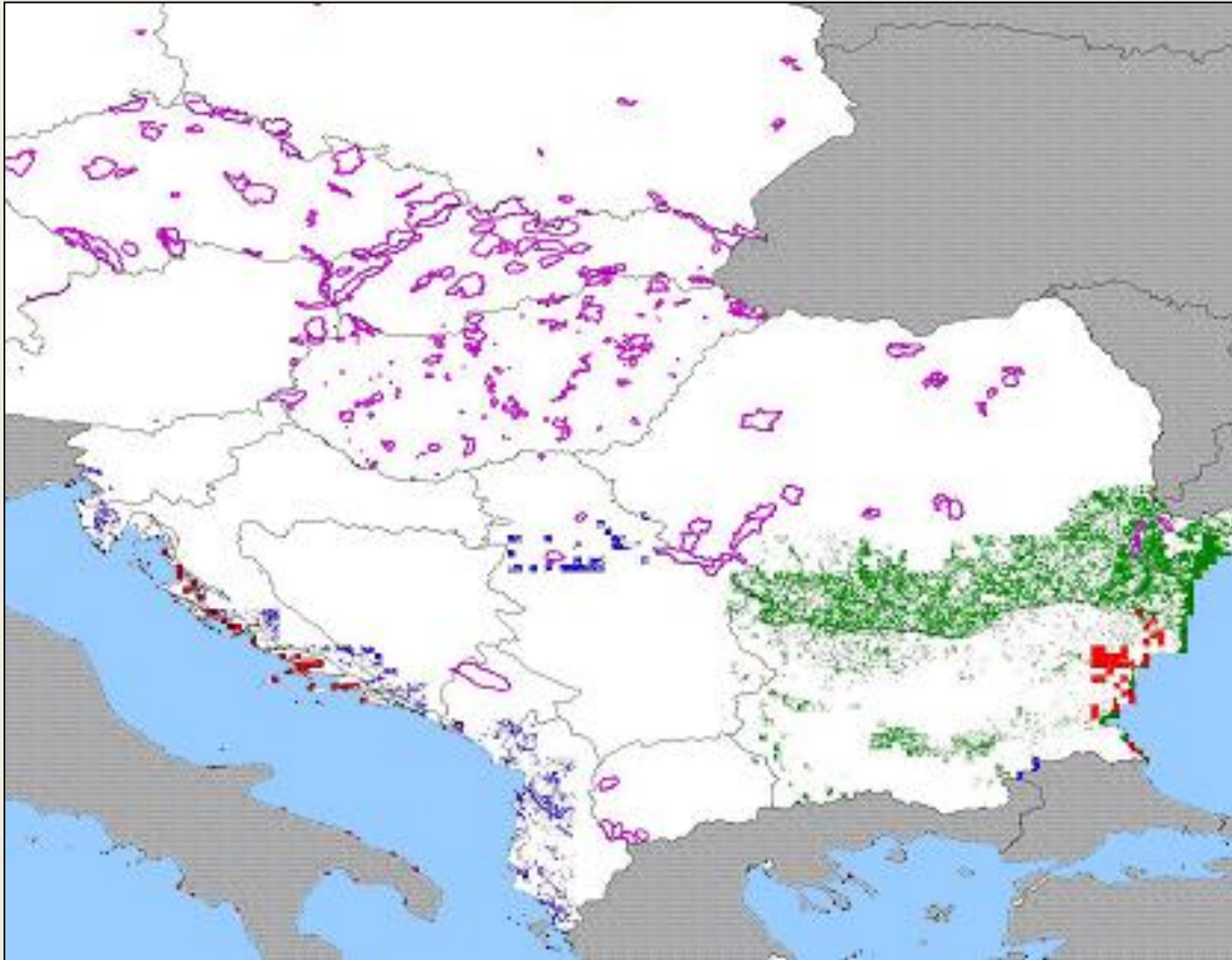


# Interpolare + Extrapolare: Protejarea biodiversitatii in prezenta schimbarilor climatice

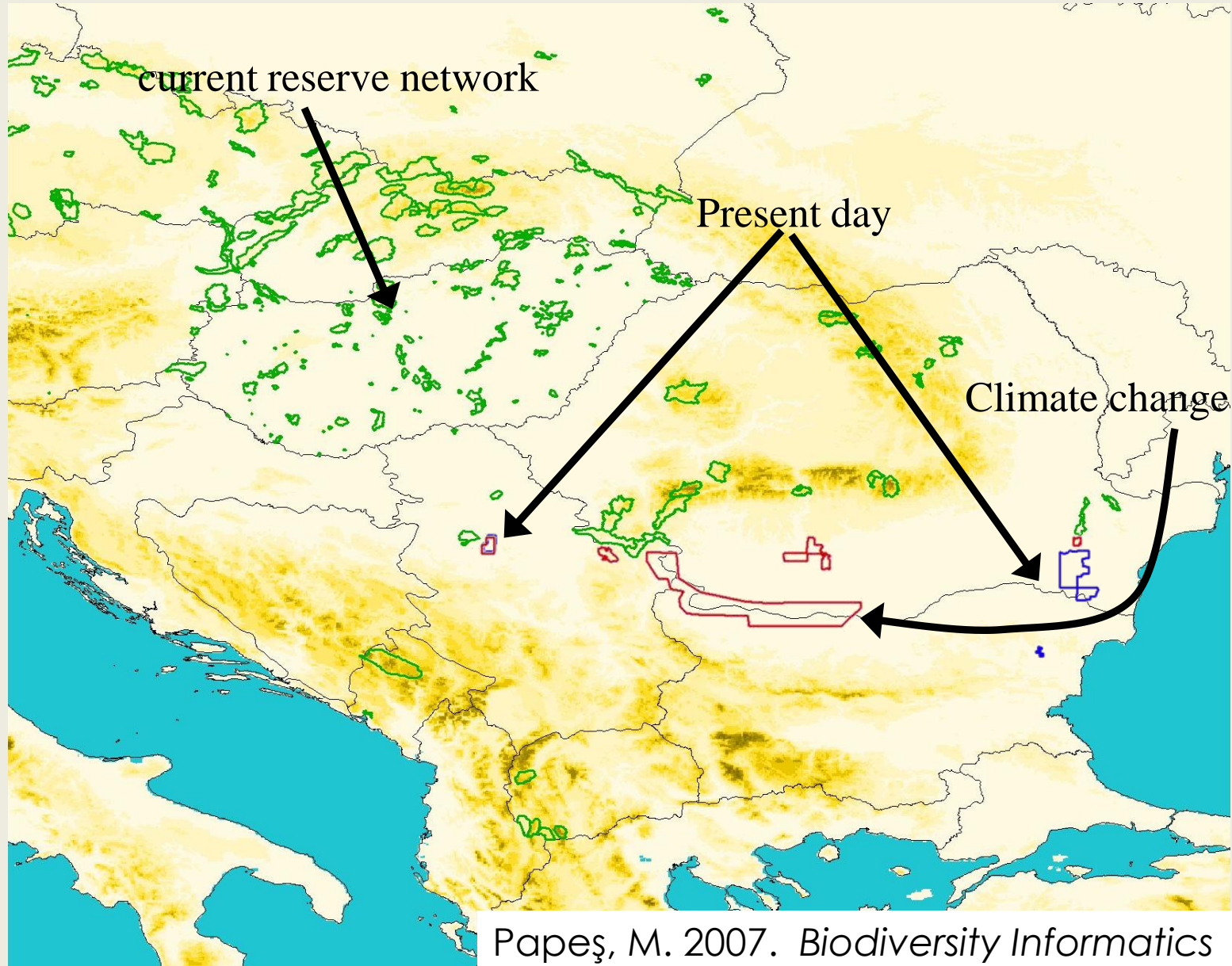
Reprezentarea a 36 de specii in sistemul ariilor protejate



**Falco eleonora** si **Hippolais olivetorum** – nici o arie protejata;  
**Branta ruficollis** – o arie protejata



Prioritizarea ariilor pe baza distribuțiilor potențiale în prezent și viitor (schimbări climatice) a 36 de specii de păsări în pericol în Europa Centrală și de Est





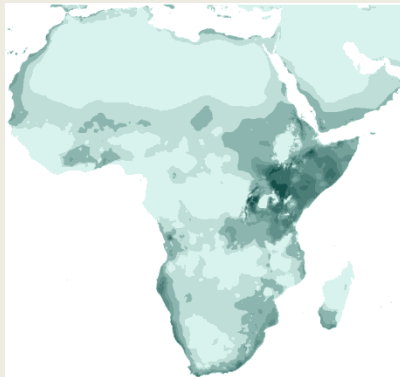
# Programe pentru analiza datelor de biodiversitate

## Consideratii:

- Dualitatea spatiului geografic-ecologic
- Definitia utilizatorului privind arealul speciei
- Folosirea corecta a programelor

## Probleme metodologice

- Date pentru testarea modelelor
- Testarea modelelor in spatiul geografic
- Interpretarea modelelor



# Sumar

- Progrese in digitizarea si accesul la informatiile de biodiversitate
- Posibilitatea studiilor la scala larga
- Dezvoltarea rapida a programelor pentru analiza datelor de biodiversitate
- Numeroase aplicatii
- Evitati problemele metodologice!