CNR, Rome, 27-29 May 2019

LifeWatch ERIC Scientific Community Meeting

The LifeWatch alien species showcase: from workflows to the virtual research environment

Paolo Colangelo

National Research Council

Research Institute on Terrestrial Ecosystems

LifeWatch ITALIA

The LifeWatch Alien Species Showcase

Habitat vulnerability to Alien Species Invasion

The **Biodiversity LifeWatch database** contains both native and alien species distributed within Eunis habitats along the Italian peninsula.

The LW Alien Species showcase

- Invasion biology often focus on single alien taxon or group of related species (i.e. genera, family, orders)
- The availability of large database (i.e. LW database) allows to **test generalized invasion patters in a macroecological framework**

Identify emergent patterns regarding the potential drivers of alien species occurence in freshwater/marine/terrestrial sites

What is the susceptibility of EUNIS habitat to invasion?

What are the main factors that determine the increase of the probability of a site to be invaded?

Data gathering and quality control

Data source: biodiversity surveys (published or unpublished papers, reports, notes,…)

Data cleaning by local/national experts

Taxonomic reliability
Taxonomic consistency
Alien /Native trait assignment

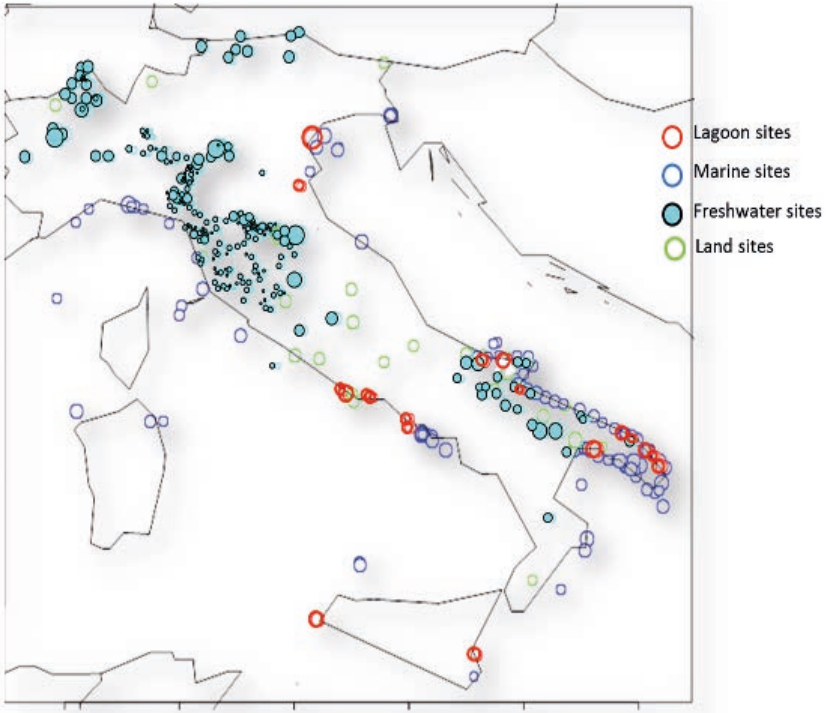
www.faunaitalia.it/checklist/ www.eunis.org omnidia.free.fr

www.marinespecies.org www.ittiofauna.org www.fishbase.org

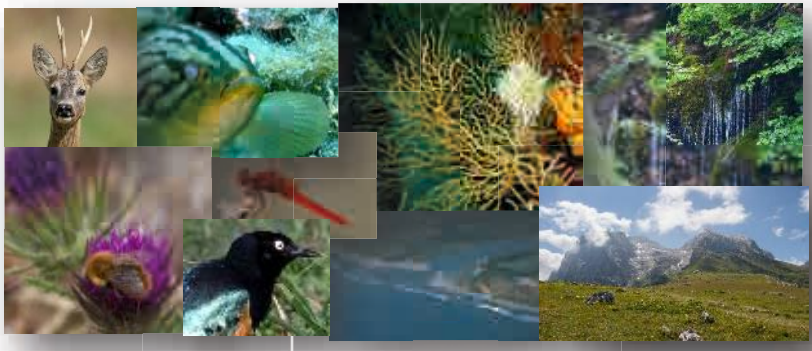
www.faunaeur.org www.algaebase.org scientific publications

A large taxonomic, habitat and geographic coverage

34386 TOTAL OBSERVATIONS
12406 SPECIES
563 SITES
42 PHYLA
36 HABITATS (EUNIS LEVEL 2)
40 YEARS OF OBSERVATIONS



The **LifeWatch Biodiversity database** contains both native and alien species distributed within Eunis habitats along the Italian peninsula.

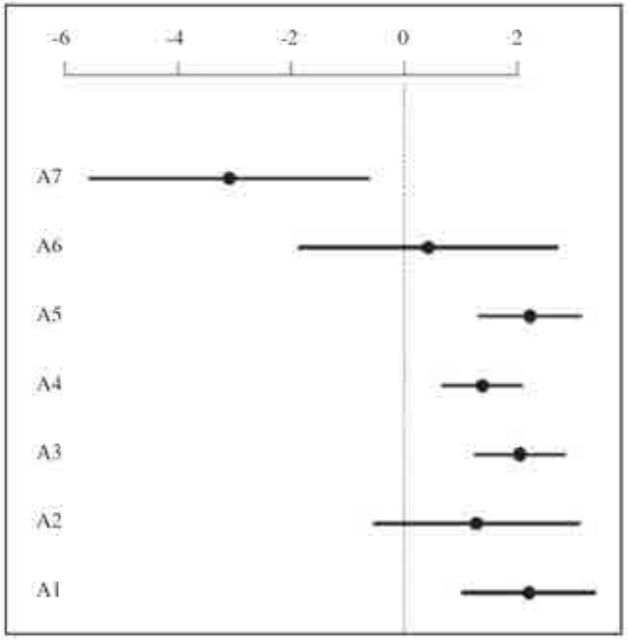


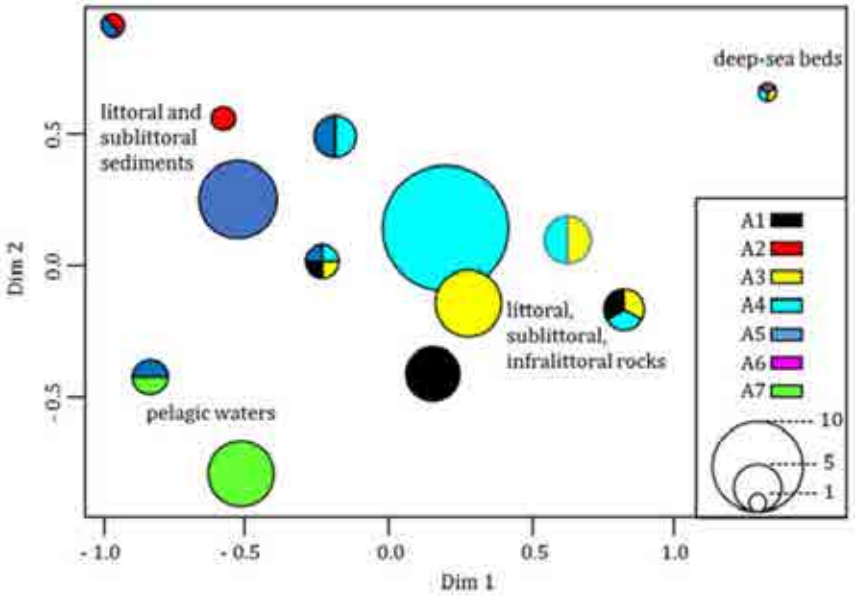
The database was used to test and describe generalized invasion patters

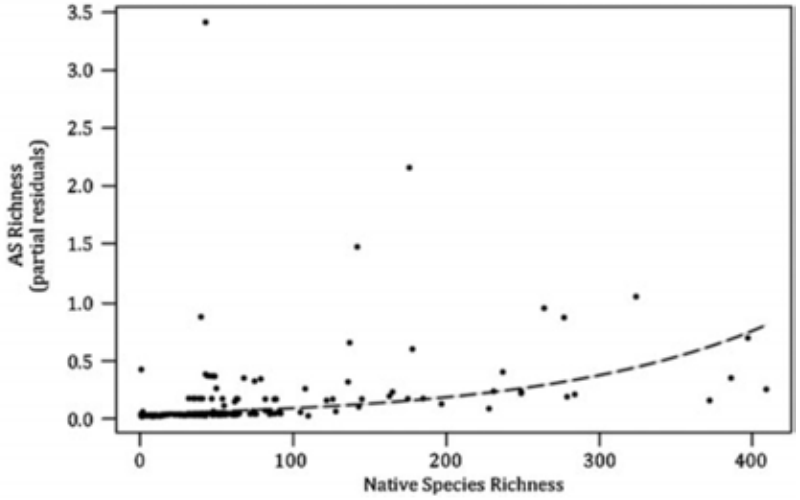
AQUATIC CONSERVATION
Marine and Freshwater Ecosystems

Ecosystem vulnerability to alien and invasive species: a case study on marine habitats along the Italian coast

GIUSEPPE CORRIERO[a], CATALDO PIERRI[a,*], STEFANO ACCORONI[k], GIORGIO ALABISO[c], GIORGIO BAVESTRELLO[d], ENRICO BARBONE[e], MAURO BASTIANINI[f], ANNA MARIA BAZZONI[b], FABRIZIO BERNARDI AUBRY[f], FERDINANDO BOERO[h], MARIA CRISTINA BUIA[g], MARINA CABRINI[f], ELISA CAMATTI[f], FRINE CARDONE[a], BRUNO CATALETTO[i], RICCARDO CATTANEO VIETTI[d], ESTER CECERE[e], TAMARA CIBIC[i], PAOLO COLANGELO[j], ALESSANDRA DE OLAZABAL[l], GIANFRANCO D'ONGHIA[a], STEFANIA FINOTTO[f], NICOLA FIORE[b], DANIELA FORNASARO[i], SIMONETTA FRASCHETTI[b], MARIA CRISTINA GAMBI[g], ADRIANA GIANGRANDE[b], CINZIA GRAVILI[b], ROSANNA GUGLIELMO[g], CATERINA LONGO[a], MAURIZIO LORENTI[g], ANTONELLA LUGLIÈ[h], PORZIA MAIORANO[a], MARIA GRAZIA MAZZOCCHI[g], MARIA MERCURIO[a], FRANCESCO MASTROTOTARO[a], MICHELE MISTRI[i], MARINA MONTI[i], CRISTINA MUNARI[i], LUIGI MUSCO[m], CARLOTTA NONNIS-MARZANO[a], BACHISIO MARIO PADEDDA[h], FRANCESCO PAOLO PATTI[g], ANTONELLA PETROCELLI[e], STEFANO PIRAINO[b], GIUSEPPE PORTACCI[e], ALESSANDRA PUGNETTI[f], SILVIA PULINA[h], TIZIANA ROMAGNOLI[k], ILARIA ROSATI[b], DIANA SARNO[g], CECILIA TEODORA SATTA[h], NICOLA SECHI[b], STEFANO SCHIAPARELLI[d], BEATRICE SCIPIONE[g], LETIZIA SION[a], ANTONIO TERLIZZI[b], VALENTINA TIRELLI[i], CECILIA TOTTI[k], ANGELO TURSI[a], NICOLA UNGARO[c], ADRIANA ZINGONE[g], VALERIO ZUPO[g] and ALBERTO BASSET[h]





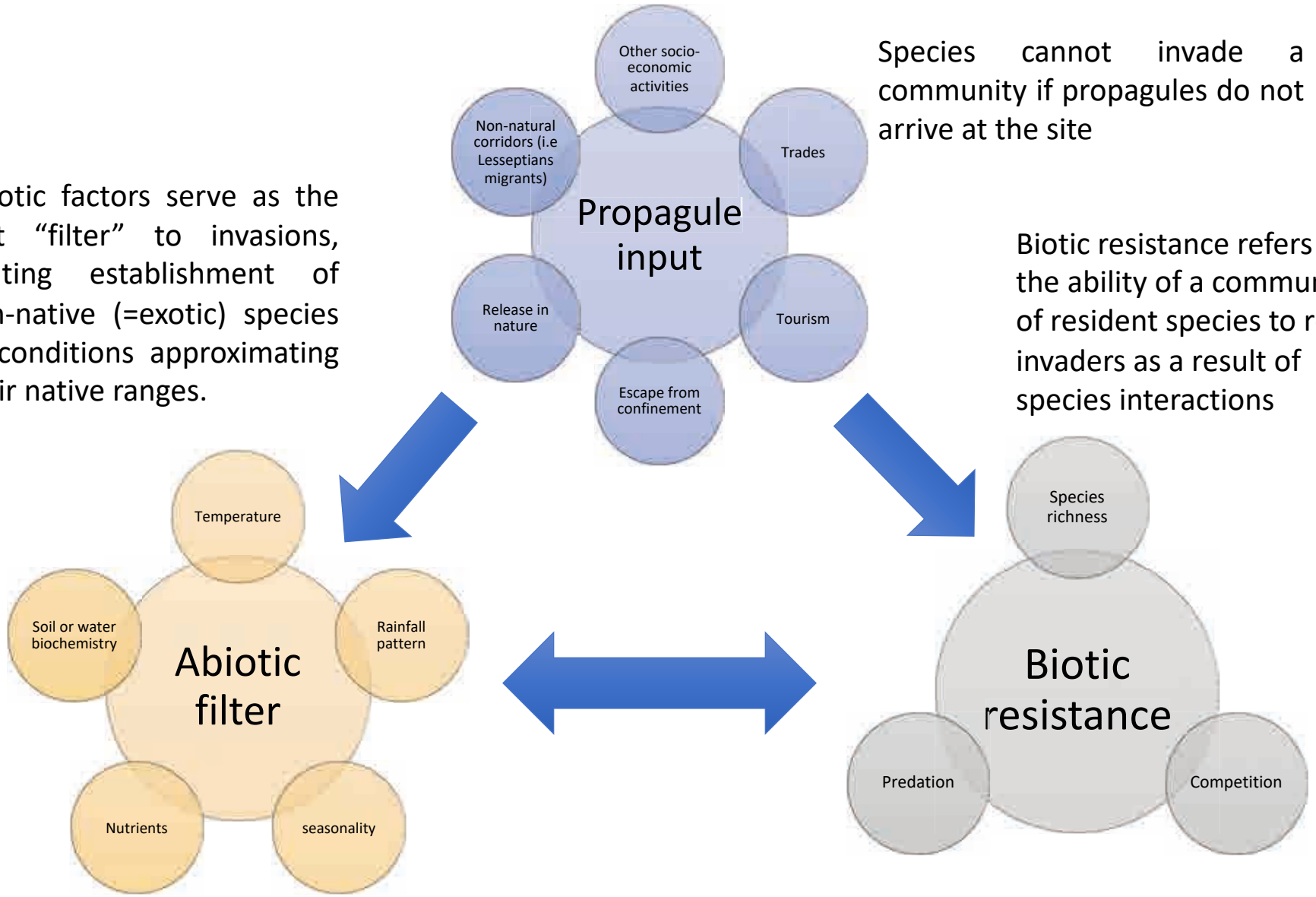


The Propagule, Abiotic, Biotic framework

Species cannot invade a community if propagules do not arrive at the site

Abiotic factors serve as the first "filter" to invasions, limiting establishment of non-native (=exotic) species to conditions approximating their native ranges.

Biotic resistance refers to the ability of a community of resident species to repel invaders as a result of species interactions

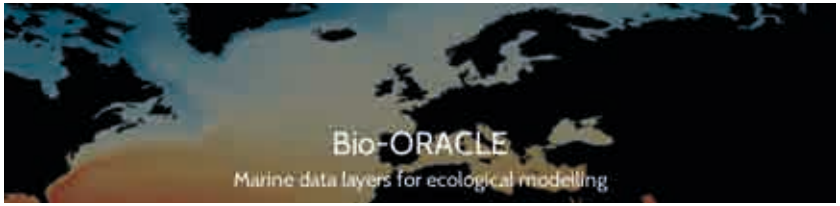


Data integration

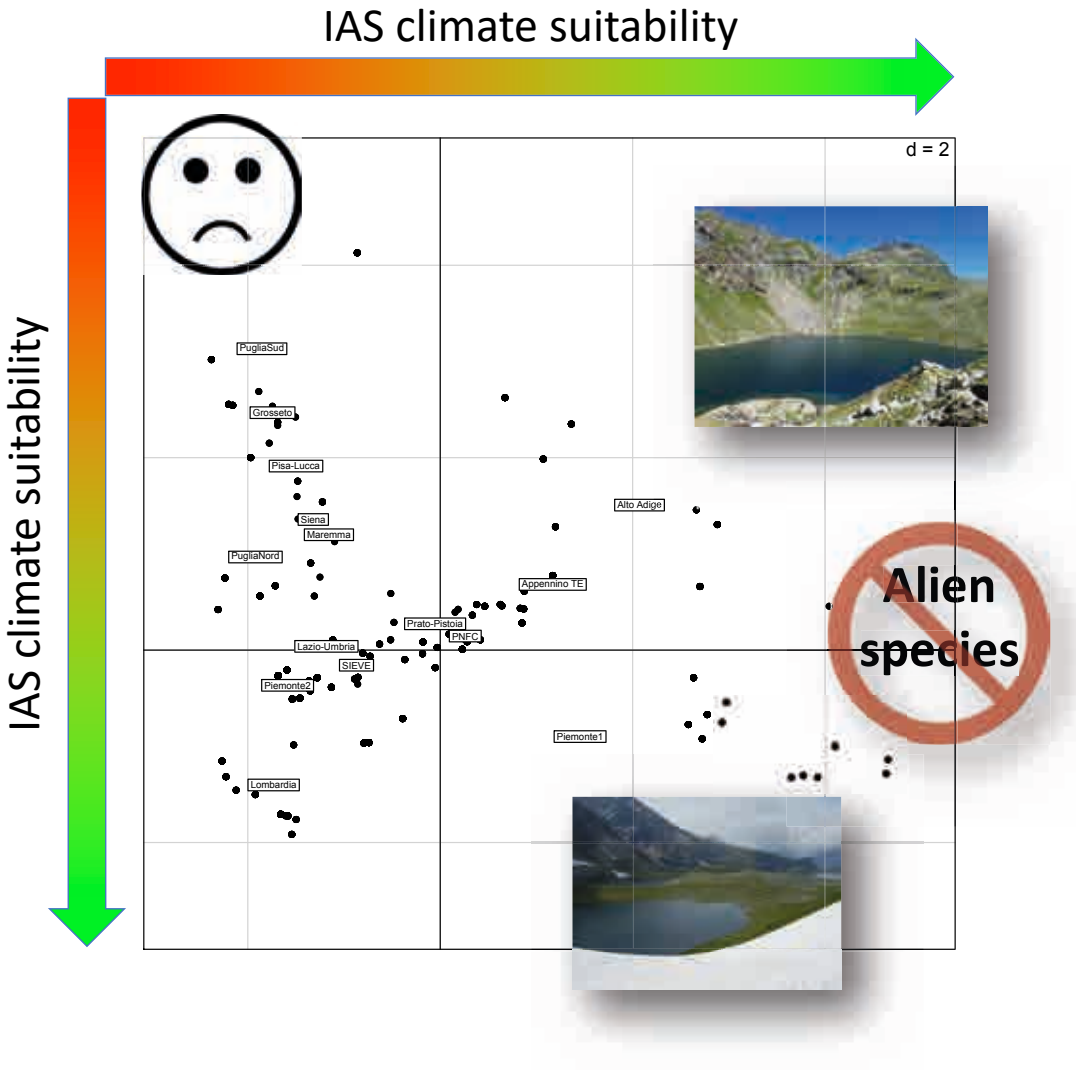
Data of occurrence were integrated with an array of bioclimatic and abiotic variables

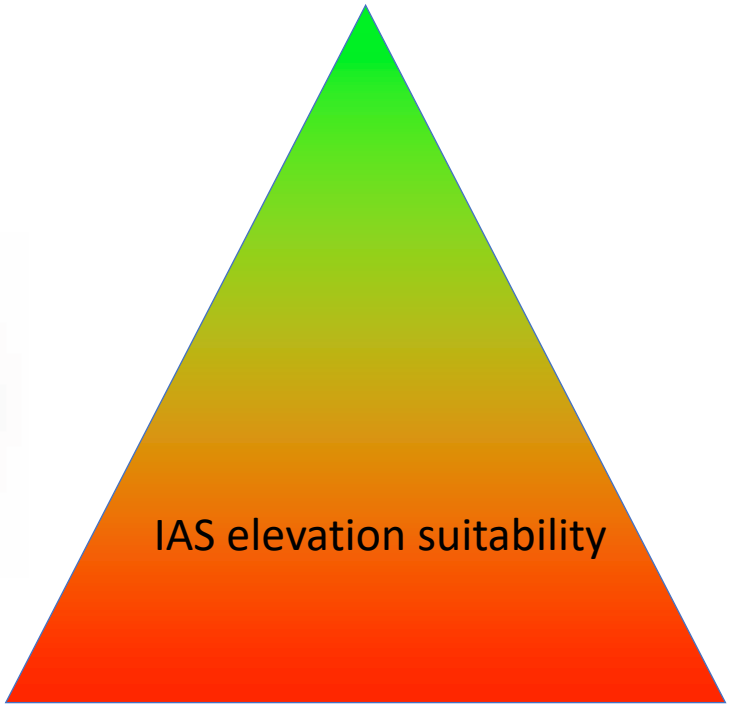
- Annual Mean Temperature
- Mean Diurnal Temp. Range
- Isothermality
- Temperature Seasonality
- Max Temperature of Warmest Month
- Min Temperature of Coldest Month
- Temperature Annual Range
- Mean Temperature of Wettest Quarter
- Mean Temperature of Driest Quarter
- Mean Temperature of Warmest Quarter
- Mean Temperature of Coldest Quarter
- Annual Precipitation
- Precipitation of Wettest Month
- Precipitation of Driest Month
- Precipitation Seasonality
- Precipitation of Wettest Quarter
- Precipitation of Driest Quarter
- Precipitation of Warmest Quarter
- Precipitation of Coldest Quarter

- Surface Chlorophyll-a Concentration (ChlA)
- Annual Sea Surface Temperature 2009-2013
- Distance (in min) from large cities
- Distance (in km) from large harbors
- Pathways and vectors
- Anthropic pressure
- Max length of a species (in mm)
- Min salinity (PSU)
- Mean salinity (PSU)
- Max salinity (PSU)



Abiotic factor: the role of climate and geography





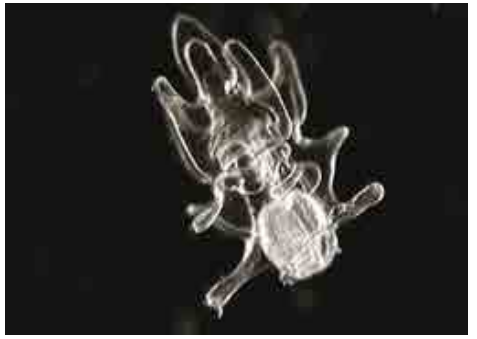
Biotic resistance

Propagule pressure

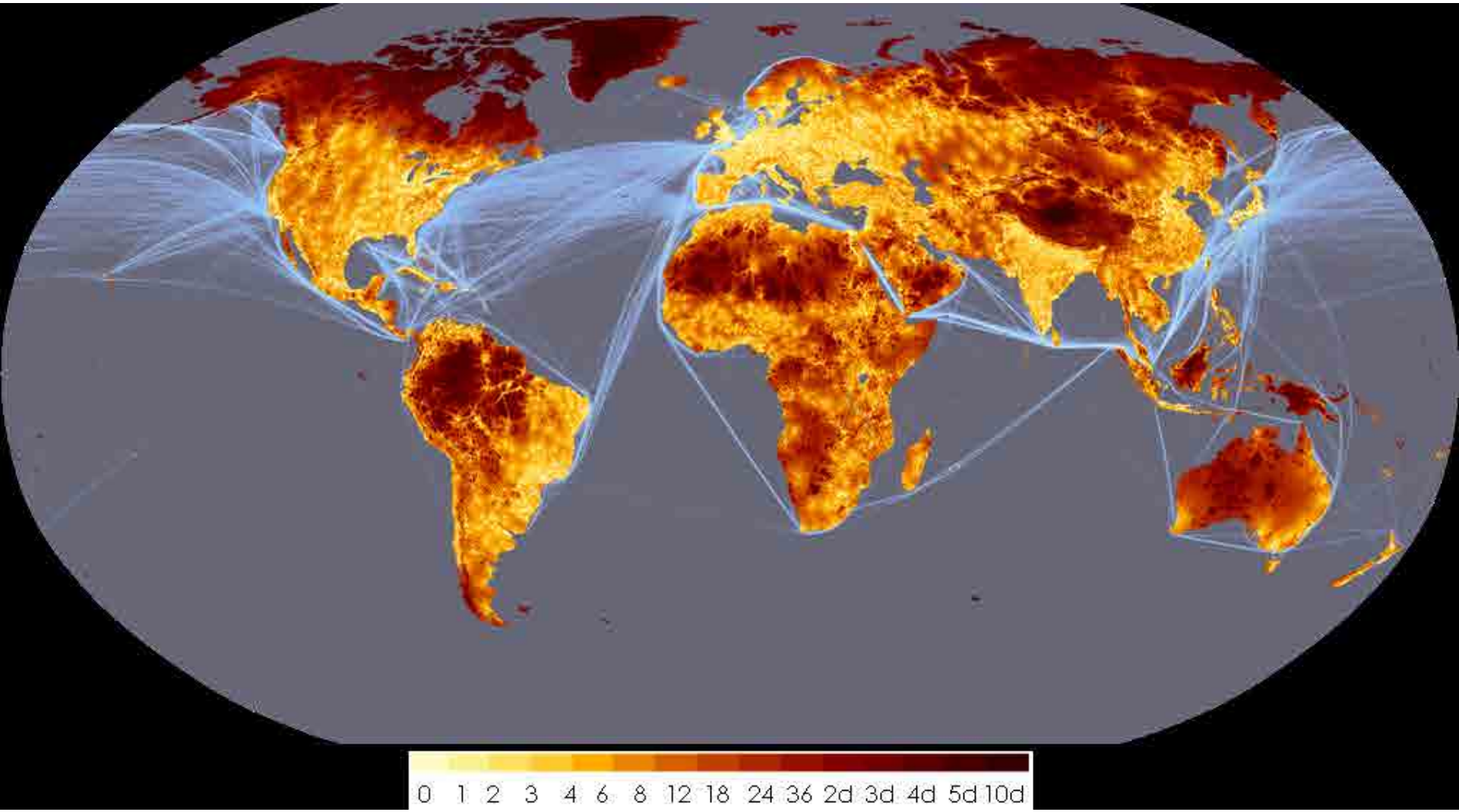
Voluntary introduction

Escape from confinement

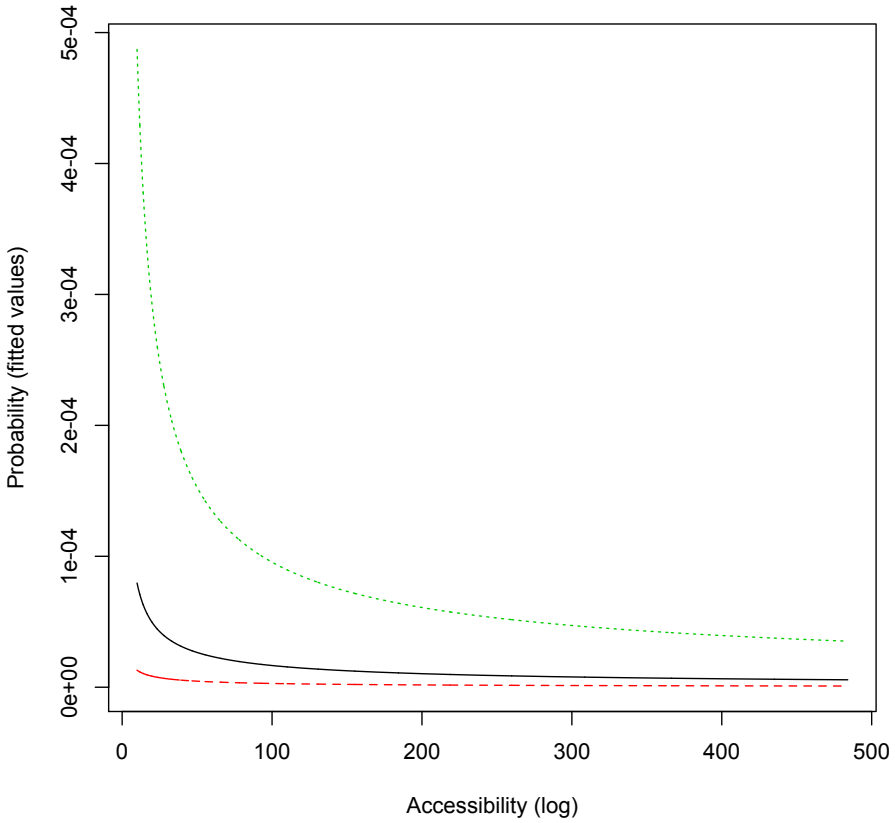
Involuntary introduction

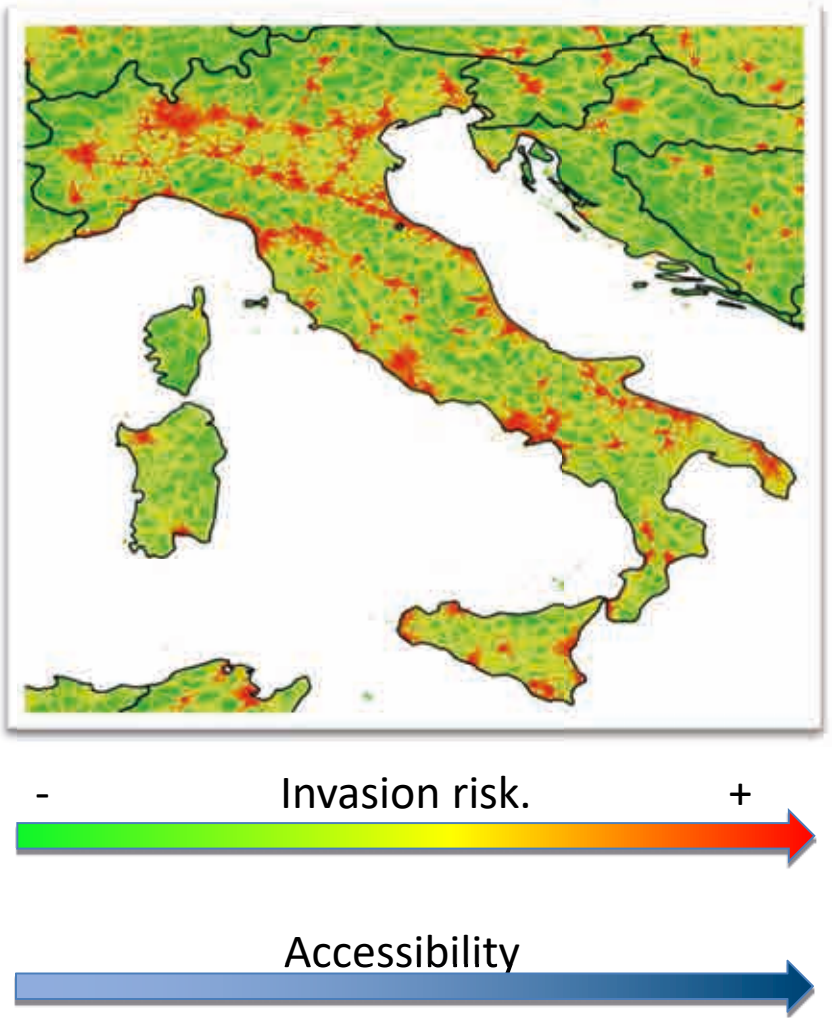


Propagule pressure

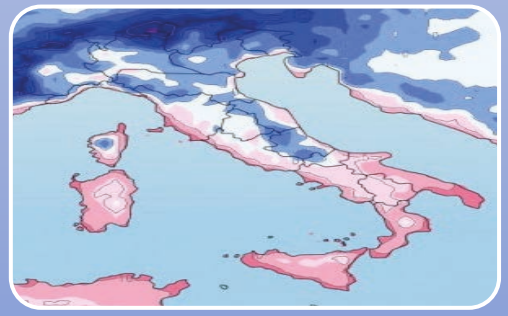


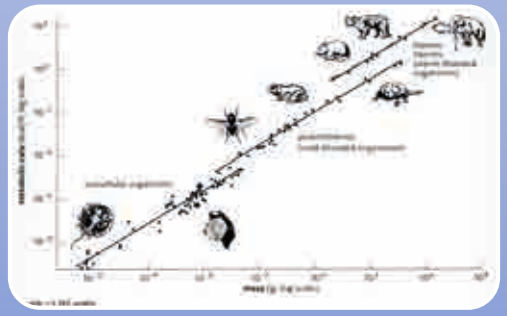
Propagule pressure is proportional with human accessibility





Invasion drivers





Pressure

Accessibility

time in minutes to reach the closest town with at least 50000 inhabitants

Abiotic

Climate:

- Mean annual temperature & diurnal range
- Annual precipitation
- Precipitation &temperature stagionality

Geographic location:

- Latitude
- longitude

Biotic

Species richness

Body Size

- maximum body size was estimated for each species and then averaged by family

Aquatic Invasions (2017) Volume 12, Issue 3: 299–309
DOI: https://doi.org/10.3391/ai.2017.12.3.04
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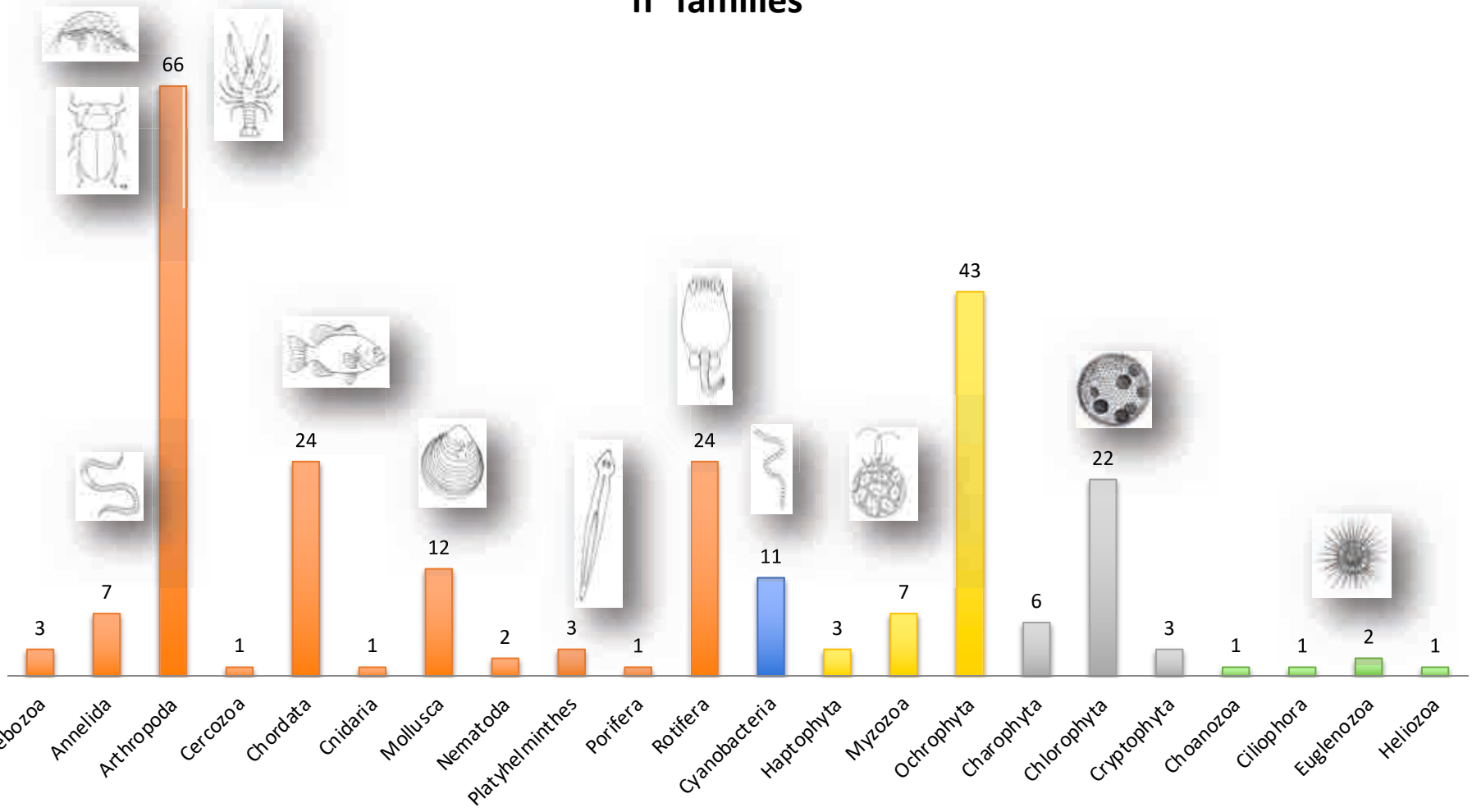
Special Issue: Invasive Species in Inland Waters
Research Article

Alien species in Italian freshwater ecosystems: a macroecological assessment of invasion drivers

Paolo Colangelo[1,14,*], Diego Fontaneto[1], Aldo Marchetto[1], Alessandro Ludovisi[2], Alberto Basset[3,14], Luca Bartolozzi[4,14], Isabella Bertani[5], Alessandro Campanaro[6], Antonella Cattaneo[7], Fabio Cianferoni[8,14], Giuseppe Corriero[9,14], Gentile Francesco Ficetola[9,10], Francesco Nonnis-Marzano[11], Cataldo Pierri[8,14], Giampaolo Rossetti[12], Ilaria Rosati[13,14] and Angela Boggero[1,14]

n° families



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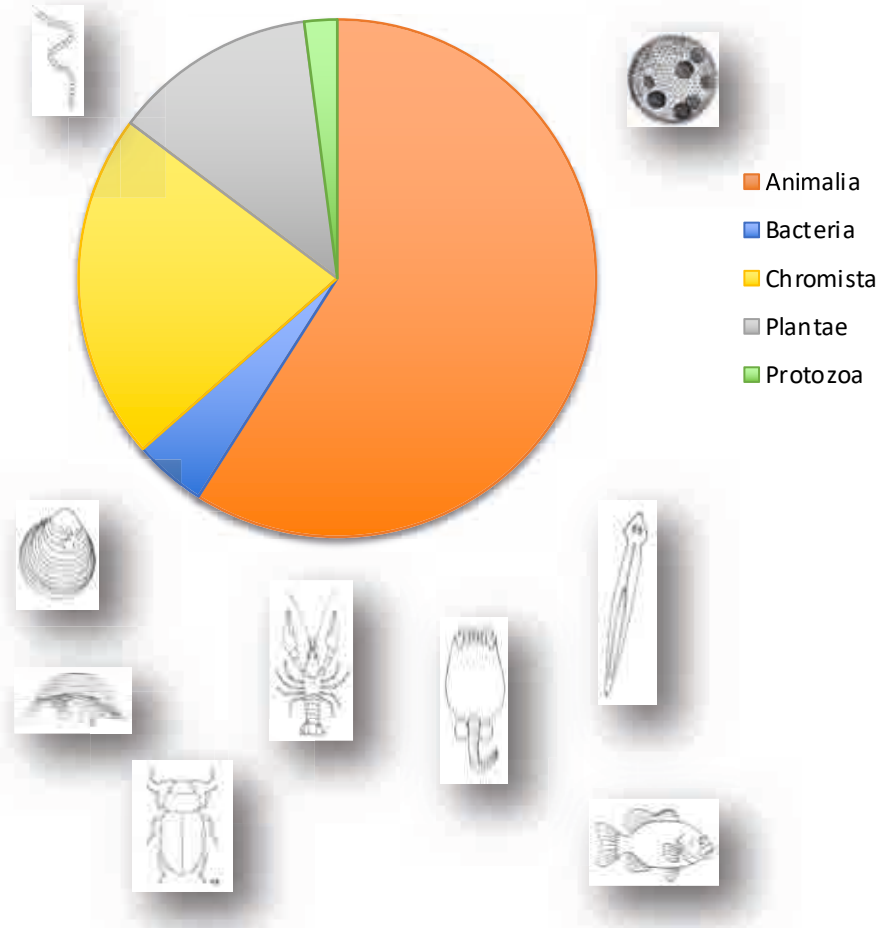
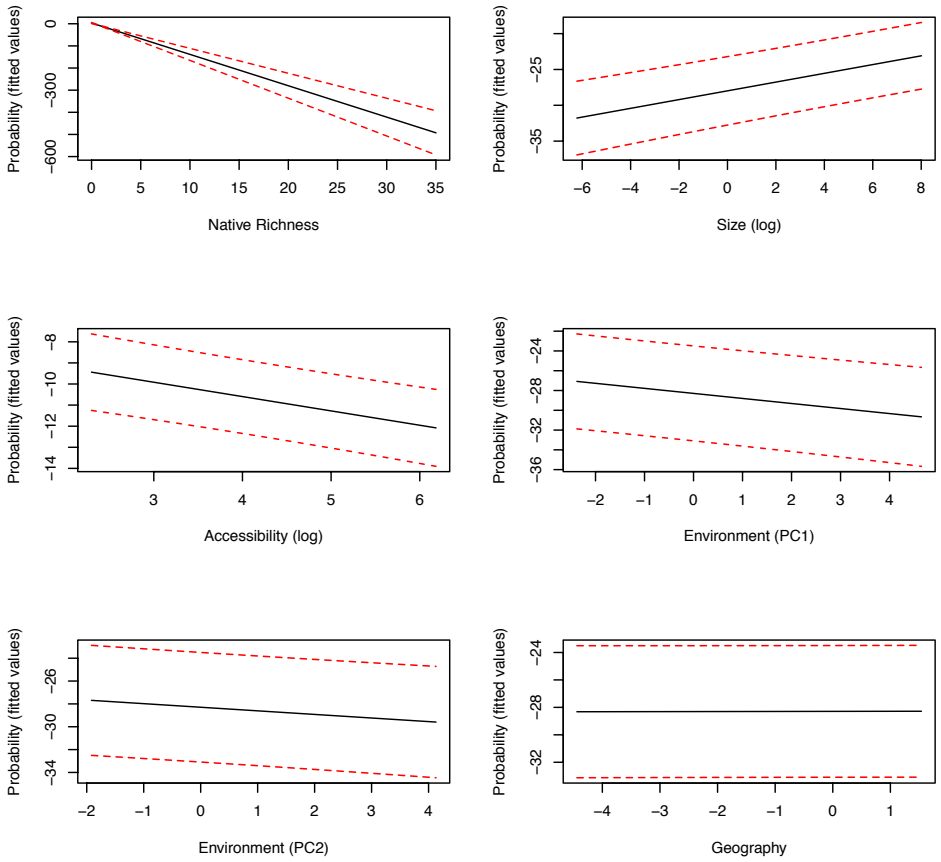


Average model: probability of AS occurence



Contents lists available at ScienceDirect

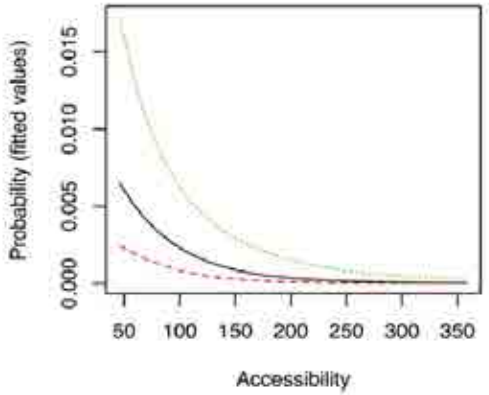
Ecological Indicators

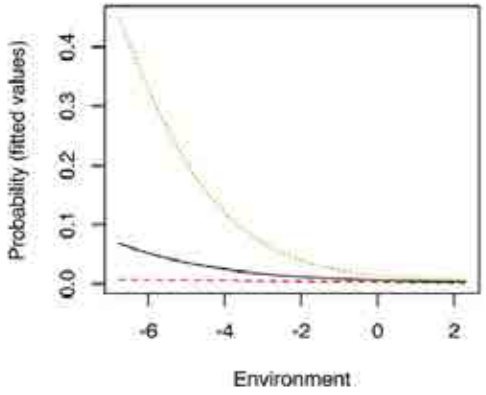
journal homepage: www.elsevier.com/locate/ecolind

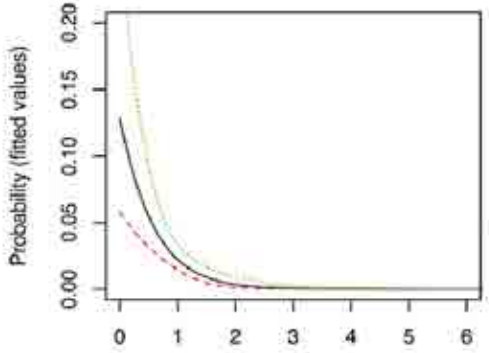
Original Articles

Plant invasions in Italy: An integrative approach using the European LifeWatch infrastructure database

Marco Malavasi[a,*], Alicia Teresa Rosario Acosta[b], Maria Laura Carranza[c], Luca Bartolozzi[d,o], Alberto Basset[e,o], Mauro Bassignana[f], Alessandro Campanaro[g], Roberto Canullo[h], Francesca Carruggio[i], Viviana Cavallaro[i,j], Fabio Cianferoni[d,o], Claudia Cindolo[k], Cristiana Cocciuffa[k], Giuseppe Corriero[l,o], Francesco Saverio D'Amico[i,j], Luigi Forte[i,j], Michele Freppaz[i], Francesca Mantino[i], Giorgio Matteucci[m,o], Cataldo Pierri[b,o], Angela Stanisci[c], Paolo Colangelo[n,o]

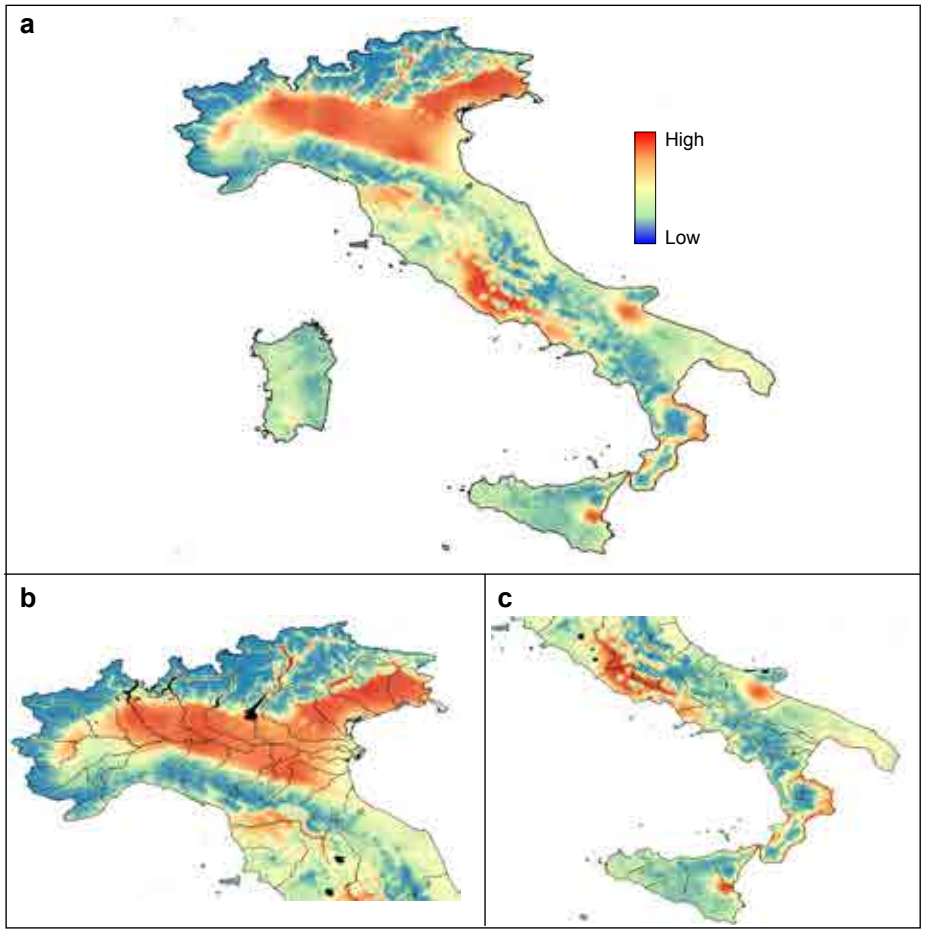






	Estimate	Std Error	z value	Pr(>|z|)
Intercept	0.05052	1.28333	0.039	0.9686
P (Accessibility)	-0.01931	0.00884	-2.184	0.0289
A (Environment)	-0.38132	0.29641	-1.286	0.1983
B (Native richness)	-1.86734	0.80888	-2.308	0.0210

Is it possible to model invasion risk?



If invasibility is a property of sites, if we have a good number of sites to train a model we can extrapolate invasion risk over larger areas

LifeWatch VRE

Virtual Labs

Resources & Services / Catalogue of Virtual Labs

Alien and Invasive Species VRE

The LifeWatch Alien Species Virtual Research Environment (AS-VRE) has been built and equipped in order to developing systems that support the scientist's work for experimental researches on alien species arrival and spread into different types of ecosystems (aquatic and terrestrial). The AS-VRE is an example of the types of scientific studies that researchers on biodiversity and AS could undertake.

Would you like to know more about the Alien Species VRE, its services, get in contact with its coordination team, access the training resources, view the related publications and the showcases? Visit our dedicated minisite.

AS-VRE minisite ← Back

Search

gg/mm/aaaa

Text

Select Category

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Category

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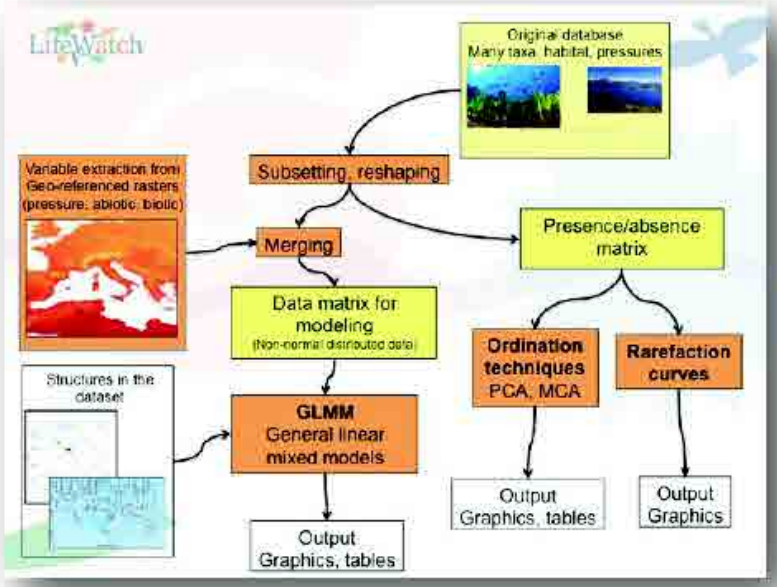
From R to Taverna




```
library(shiny)
library(maps)
library(raster)

shinyServer(function(input, output, session) {

  Data <- reactive({
inFile<-input$file
    if (is.null(inFile)) {
      return(NULL)
    } else {
      dc-read.csv(inFile$datapath)
d
    }
  })


  observe({
    data <-Data()
    updateSelectInput(session, "x", choices = names(data))
    updateSelectInput(session, "y", choices = names(data))
  })
```

Taverna service oriented scientific workflow

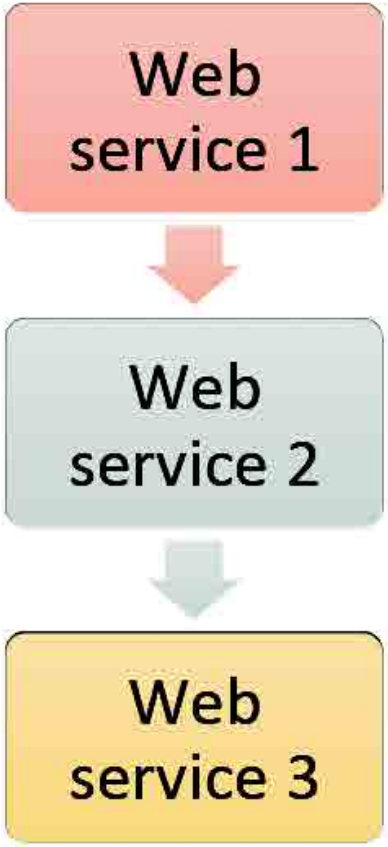
Implement R scripts via Rshell and Rserve.

Connect R scripts with other services

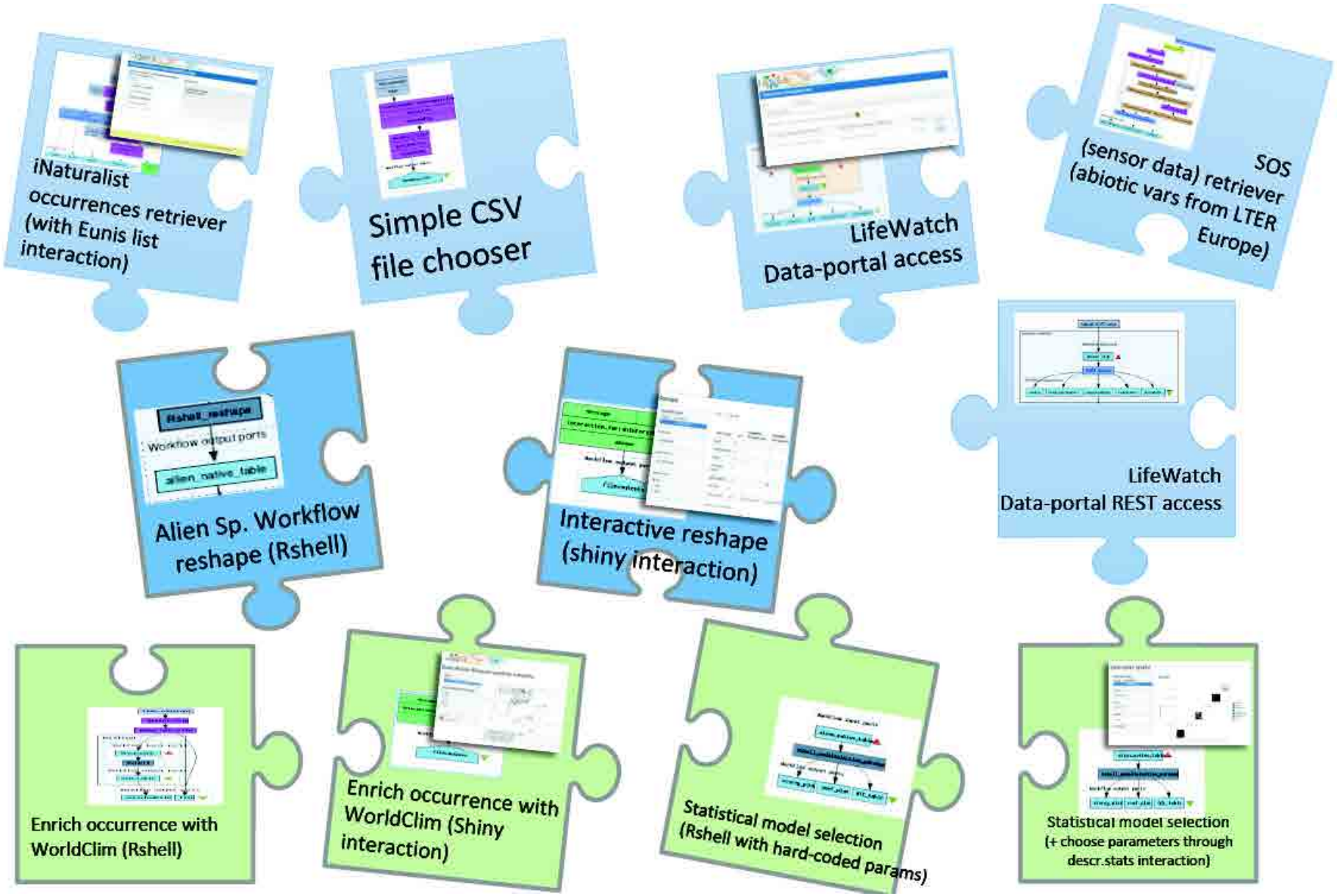
Orchestrating web services

Taverna

Galaxy PROJECT

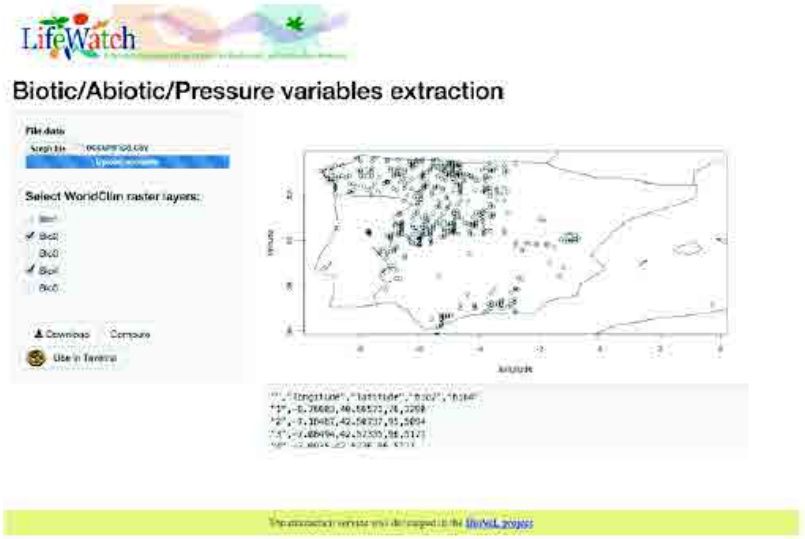


Different solutions possible, but be aware always to the researchers sensibility…


iNaturalist occurrences retriever (with Eunis list interaction)
Simple CSV file chooser
LifeWatch Data-portal access
SOS (sensor data) retriever (abiotic vars from LTER Europe)
Alien Sp. Workflow reshape (Rshell)
Interactive reshape (shiny interaction)
LifeWatch Data-portal REST access
Enrich occurrence with WorldClim (Rshell)
Enrich occurrence with WorldClim (Shiny interaction)
Statistical model selection (Rshell with hard-coded params)
Statistical model selection (+ choose parameters through descr.stats interaction)

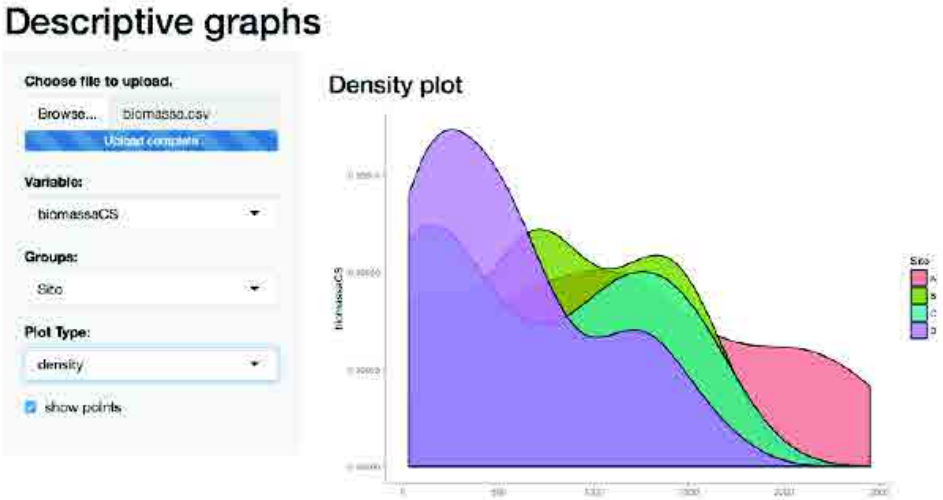
Enhancing the agent-user interaction

- Progresses: reusable web-application interaction services with **advanced interactivity** and **processing**
- **Taverna aware** *Shiny (R) applications*

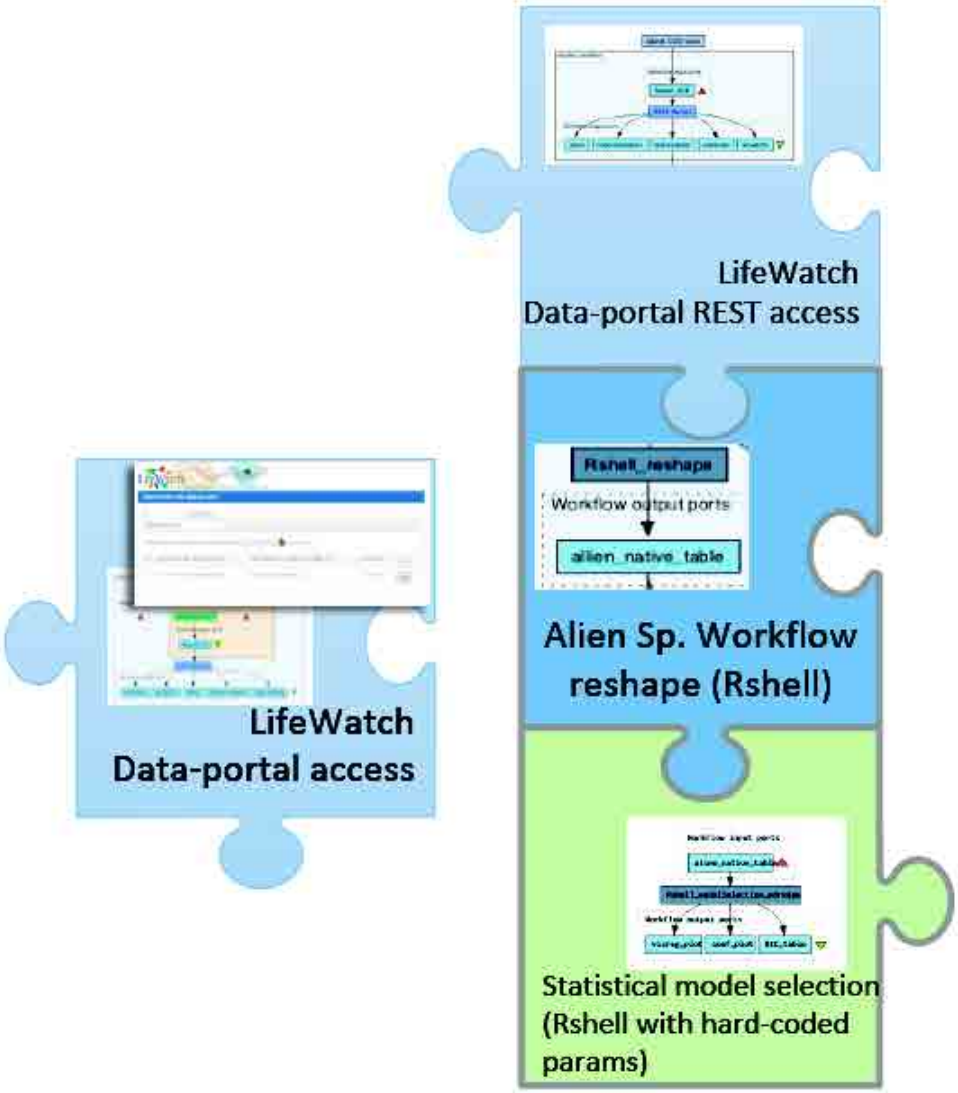


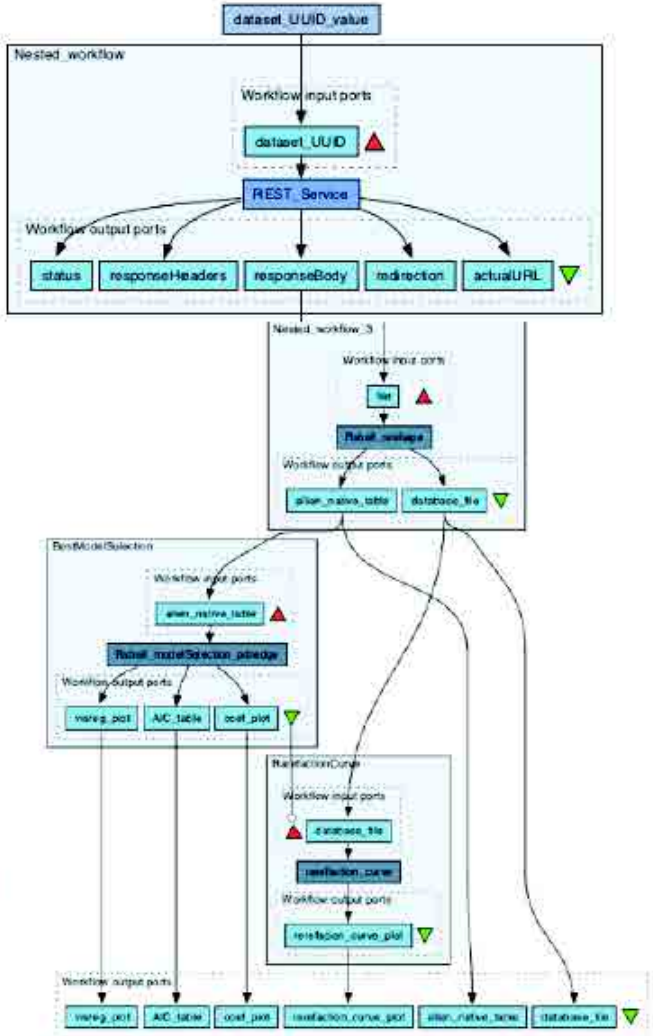
Some example:

- Enrich species occurrence with abiotic data from WorldClim
- Choices of parameter through *descriptive statistics*
- Dynamically reshape data



Re-combination

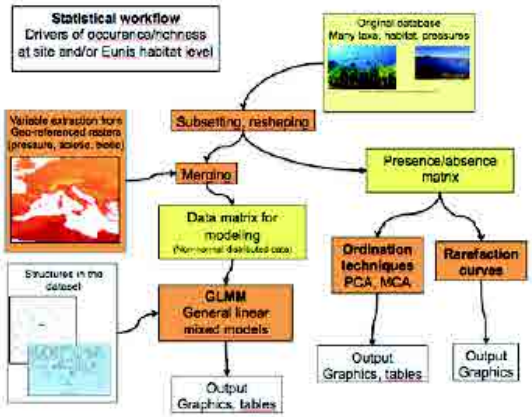


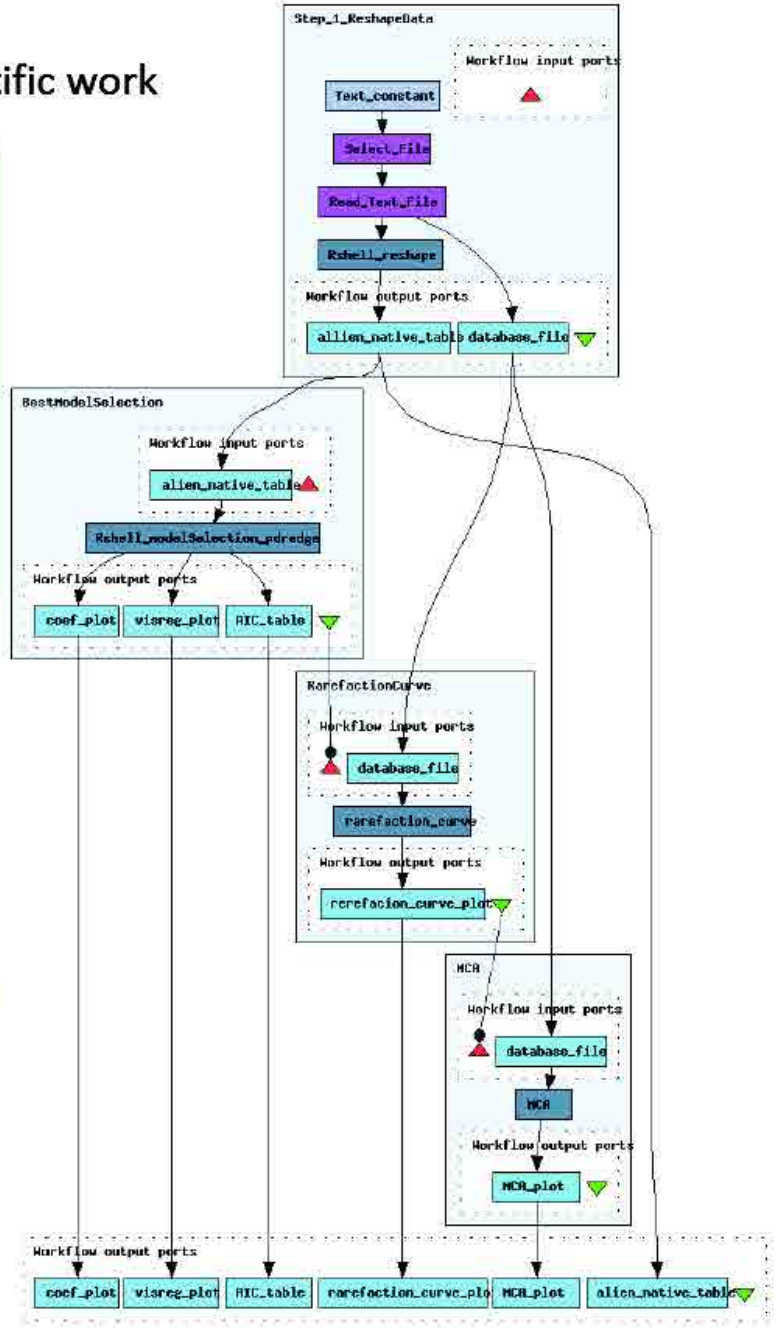


The workflow as a runnable formalization of scientific work

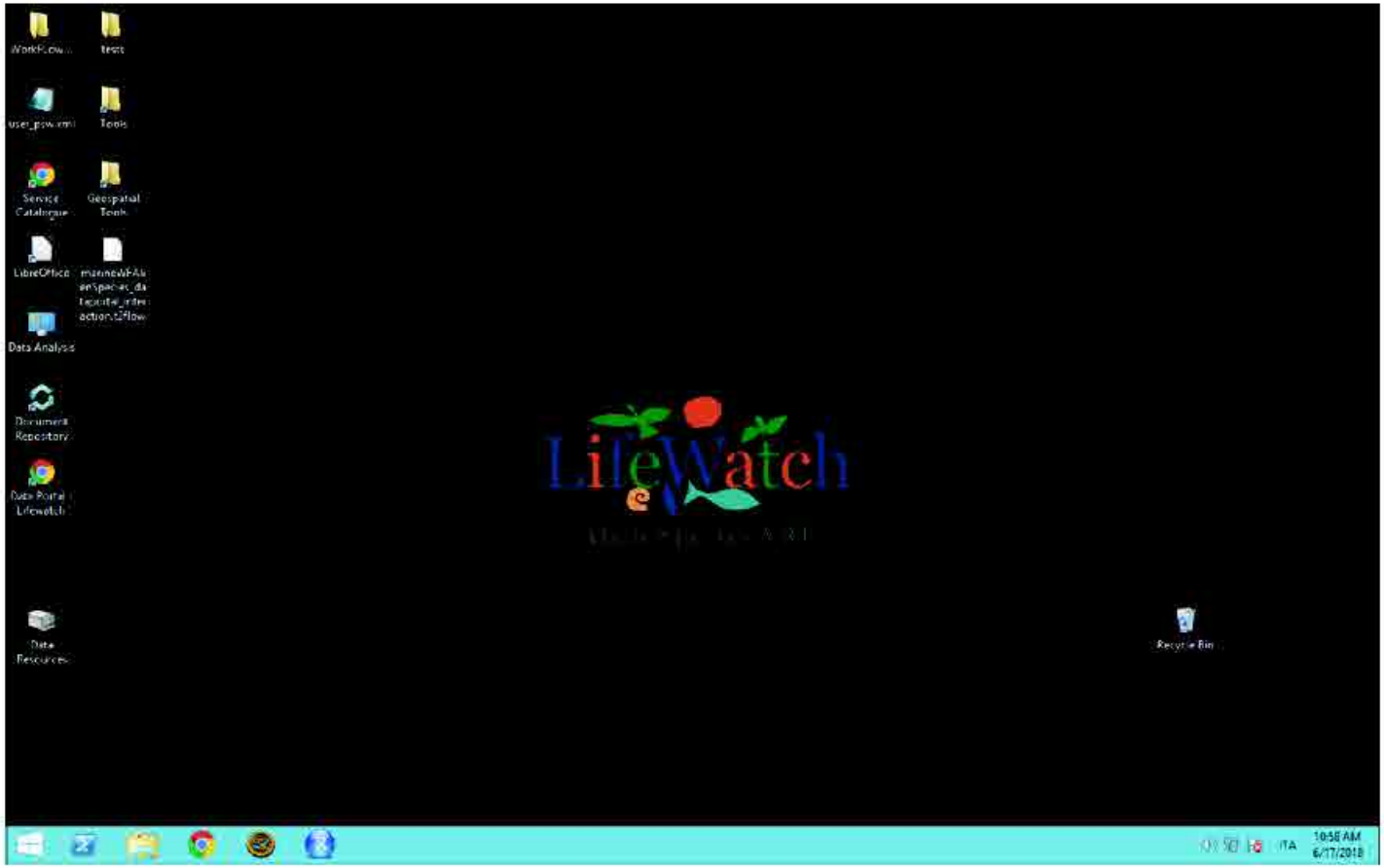
Taverna workflow system

- Composed by "services" (remote and local) – configurable assignment to agents
- Workflow execution: data driven (plus control links)
- Nested workflows





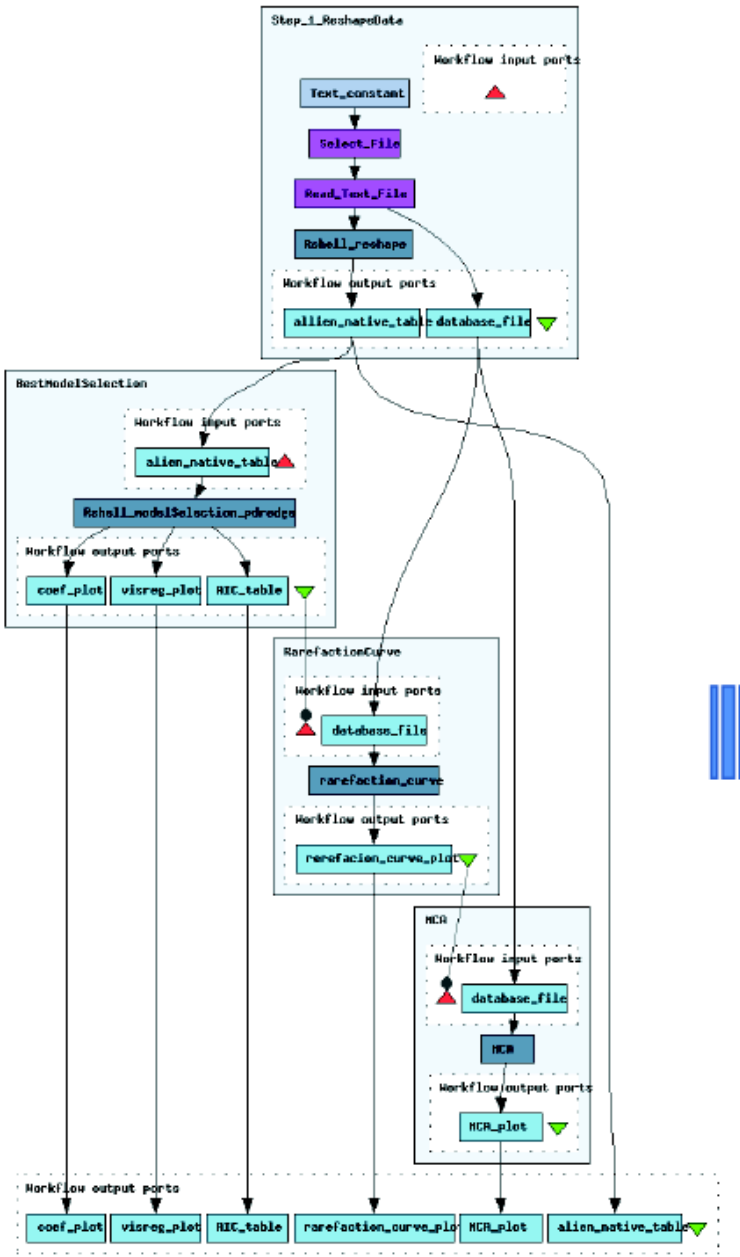
Example workflow: alien species

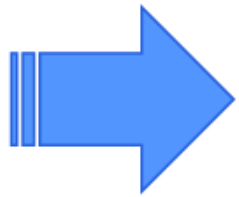


- Possibility to replicate the AS showcase analysis
- Possibility to use new data that are stored in the LW dataportal
- Allow some degree of workflow manipulation

- Needs to develop new app or web services
- Authentication with multiple users on the same project is triky
- Taverna is not for all

Complex workflows and researchers…





VREs in biodiversity domains

VREs have the potential to benefit research in all disciplines at all stages of research?

Web of Science
Showing 155 records for TOPIC: ("virtual research environment*")

Barriers to the use of VREs

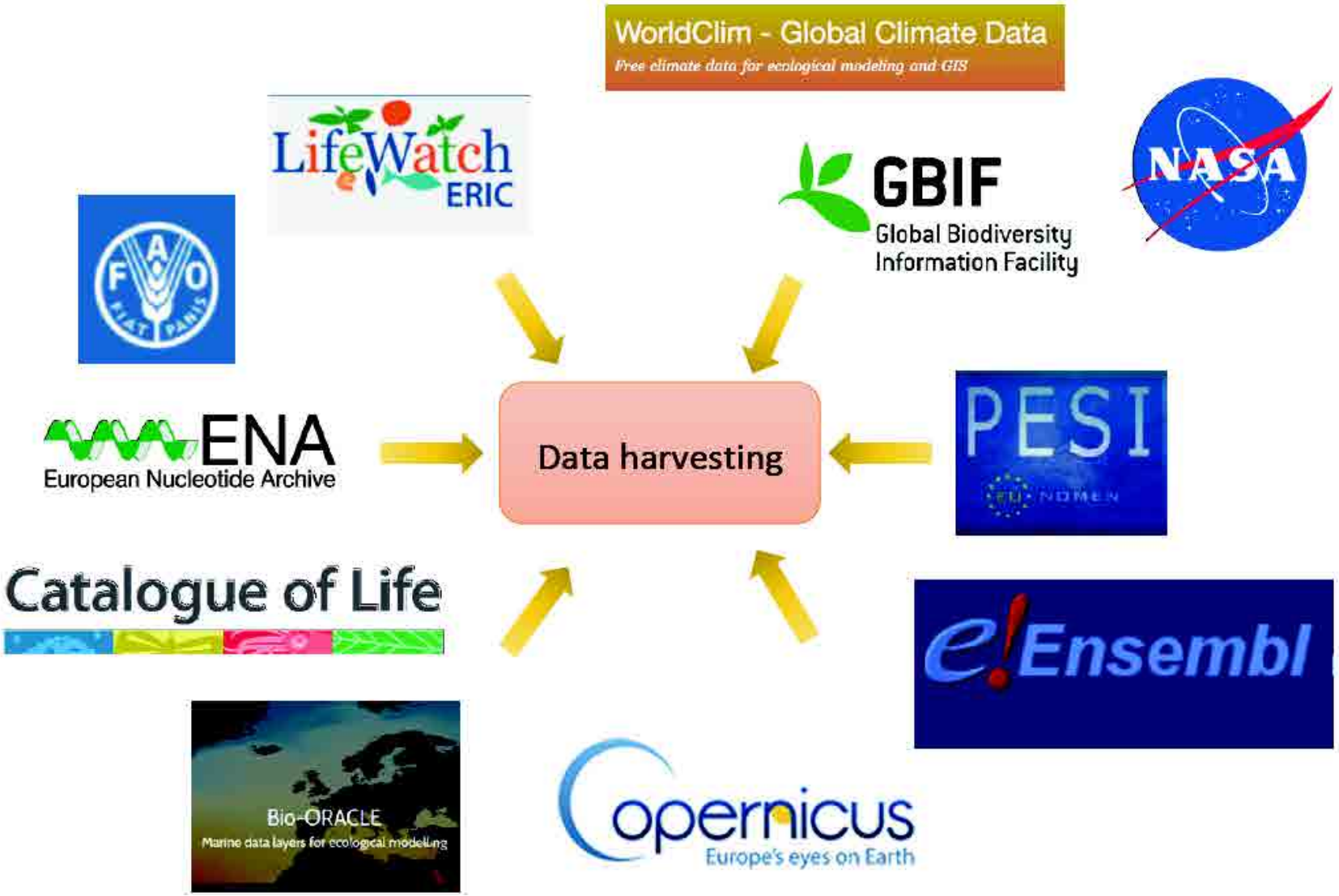
- "...the majority of these systems (VREs) are not yet fully integrated into standard practices, tools and research protocols used by real life communities of practice."
- "This reluctance to migrate from traditional and consolidated research practices and facilities to the innovative ones promoted by VREs is among the most difficult barriers affecting the entire VRE domain."

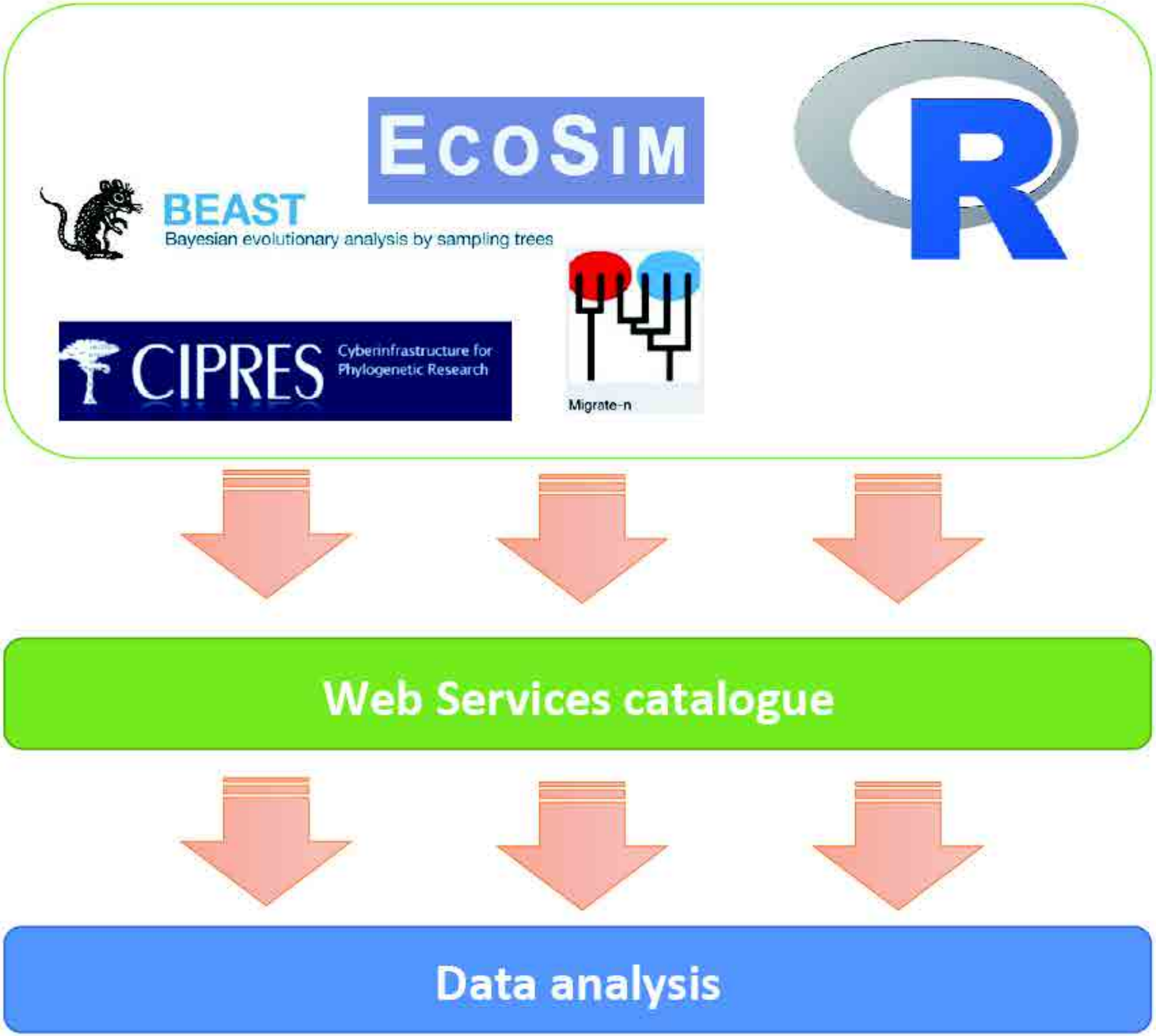
Candela et al. (2013). Virtual Research Environments: An Overview and a Research Agenda. Data Science Journal. 12, pp.GRDI75–GRDI81

technology not reliable:	8
too difficult to use:	14
does not suit our research practice:	11
not enough technical support:	22
not enough institutional support for training etc.:	20
user community too small:	15
security/trust issues:	11
other:	36

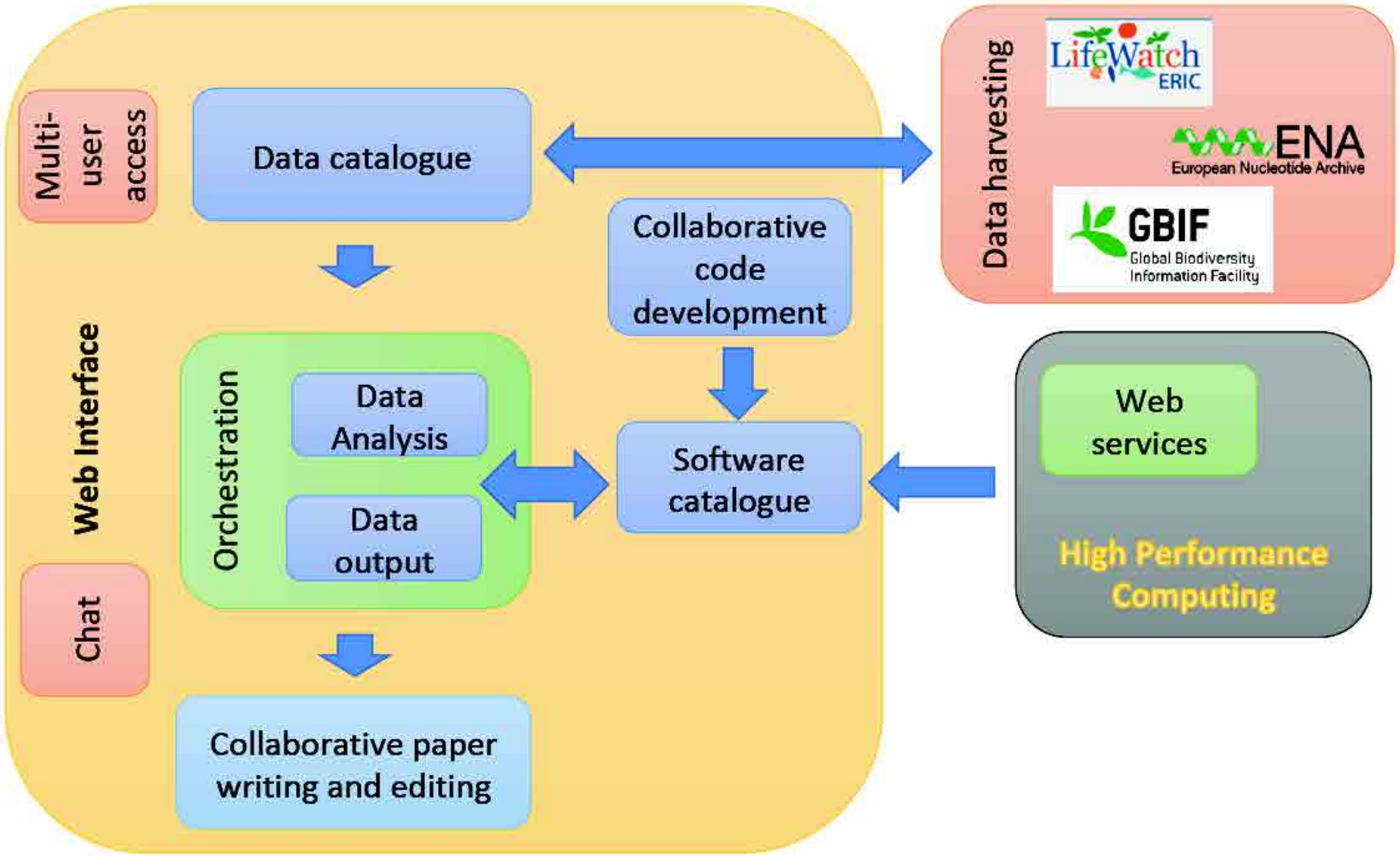
Carusi & Reimer, 2010. . Virtual Research Environment Collaborative Landscape Study. JISC

Access to biodiversity data




EcoSim
BEAST
Bayesian evolutionary analysis by sampling trees
R
CIPRES
Cyberinfrastructure for Phylogenetic Research
Migrate-n
Web Services catalogue
Data analysis

VRE-LW architecture



Open questions

What biodiversity researchers would like to found in a VRE?

1. Access to a wide range of biodiversity data (data catalogues)?
2. High computing capacity (HPC clusters)?
3. Access to software validated by the scientific community?
4. A collaborative environment?
5. User friendly interface, accessible via web technologies?
6. Other?