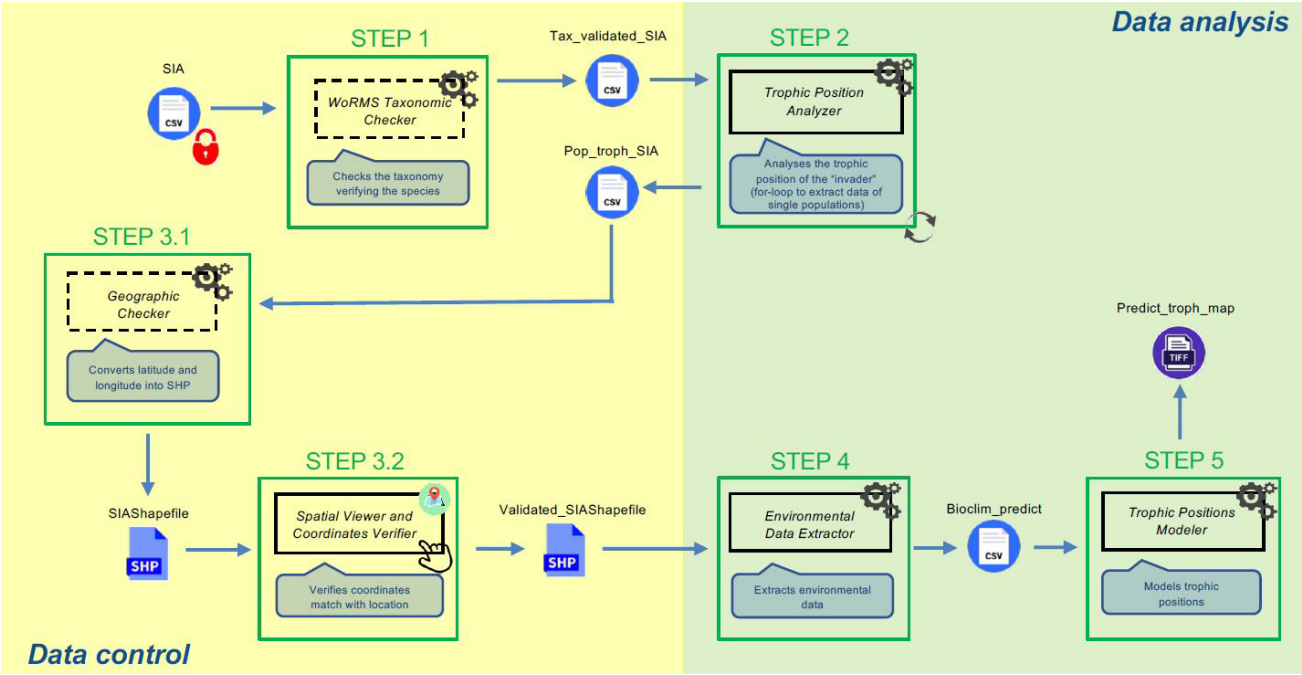
Functional Biogeography Workflow



Training Guide

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Background

The analytical workflow on "Functional biogeography of alien species", along with other analytical workflows and services developed in Tesseract, was conceived to address scientific questions on the ecological processes following the introduction of alien species.

Modelling tools to study the ecological responses to alien species introduction rely on correlations between environmental variables and geo-located species records and, therefore, to the analysis of the environmental drivers determining species adaptation, establishment and expansion within introduced habitats. Modelling approaches should also consider the responses of the native communities and quantify the ecological changes within those autochthonous communities using relevant variables for each ecological aspect considered.

The analytical workflow on "Functional biogeography of alien species" was then proposed to evaluate and measure the impact of alien species on native communities by studying changes in functional traits (i. e. trophic position of the invader) and seek associations between those changes and environmental variables that could influence post-invasion shifts of the invader trophic positions. Such analyses could also help users in making predictions of the most threatened communities or habitats in the context of expected environmental changes driven by the climate change and to determine those biogeographical contexts where biological invasions could have severe deleterious effects on native communities.

The scientific questions that this analytical workflow aims to address are:

1. Can the ecological impact of alien and invasive species be predicted using satellite-derived bioclimatic variables?
2. Can the ecological impact of alien and invasive species be predicted in a changing climatic scenario?
3. Do post-invasion shifts occur in the trophic position of invasive crustacean species?
4. If any, which are the main bioclimatic drivers of these shifts, and will their contribution change under different climate change scenarios?

Introduction

This training focuses on the workflow developed by LifeWatch ERIC in Tesseract for a case study on omnivorous crustaceans.

The workflow analyses the trophic position of invasive crustaceans and aims at finding correlations between the invader trophic positions and the environmental variables for the locations included in the input dataset. This workflow operates as an analytical pipeline using isotopic data of invasive species and their potential prey within the invaded food-webs.

The Functional Biogeography workflow in Tesseract combines specific services to:

1. check the species taxonomy,
2. calculate the trophic position of invasive species,

3. evaluate the accuracy of the geographic locations included in the input dataset,
4. extract accessible abiotic data from environmental monitoring agencies (i.e. Copernicus), and
5. use statistical models to find environmental predictors influencing the trophic position of the invaders.

This means that members of the scientific community and stakeholders, but also citizen scientists, students and even beginners with little scientific and computational knowledge, could use this analytical workflow to estimate the trophic position of invasive species and produce prediction maps (Fig. 1) to model trophic position variations based on an array of environmental variables.

This workflow relies on R scripts and uses different R packages (see services factsheets in "The Analytical Workflow and Services" section for details) for the analyses. The workflow can be run using custom input datasets provided by the users and it is flexible to different taxonomic groups and habitats (marine, freshwater and terrestrial). To run the entire workflow successfully, the input dataset must be provided by the user in a certain format and it should include specific variables needed for the analyses (check fact sheets for more details).

The expected outcomes of the workflow are:

1. a complete database specifying the trophic positions of native and invasive species across different locations;
2. a predictive map of invasive species occurrences and their estimated trophic position correlated with environmental gradients (Fig. 1).

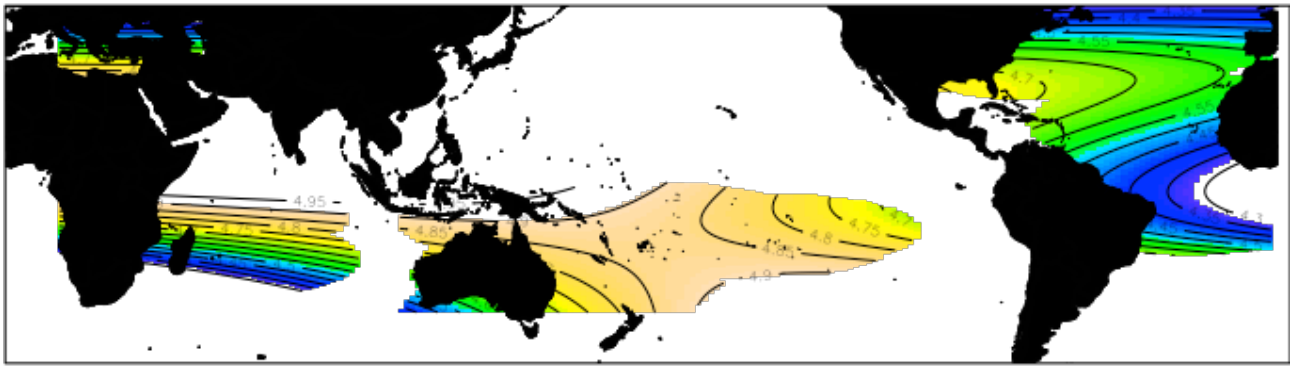

Figure 1. Predictive map of the Atlantic blue crab (*Callinectes sapidus*). The color gradient reflects the scale of the trophic position of the blue crab (orange to blue = from the lowest to the highest trophic position).

Learning Objectives

After this training the user will be able to:

1. Examine the technical requirements of the workflow's services;
2. Process the services included in the workflow;
3. Run the workflow successfully;
4. Identify and troubleshoot problems that may arise while running the workflow.

Training Materials

In this training the user will be guided through the workflow steps and ICT services developed in the Tesseract Virtual Research Environment of LifeWatch ERIC.

To do so, on this platform, the user will find the following training material:

1. A guide that illustrates how to read the workflow's diagram and explains the symbols used therein (PDF doc);
2. A manual with general information to access and navigate the Tesseract platform. You will be able to move between the document's sections by clicking on items on the table of contents (PDF doc);
3. A step-by-step demonstration on how to run the workflow services (video resource);
4. A series of factsheets (one for each service) that illustrate the technical requirements of each service/step (PDF doc);
5. A number of additional resources in case you would like to deepen your knowledge on the case study for which this workflow was developed. In particular, you will find:
    - A link to additional information on the validation case, including an open knowledge map (LifeWatch website);
    - A scientific presentation of the case study (video resource);
    - A section where you can post your comments and/or questions for the workflow developers (forum style).