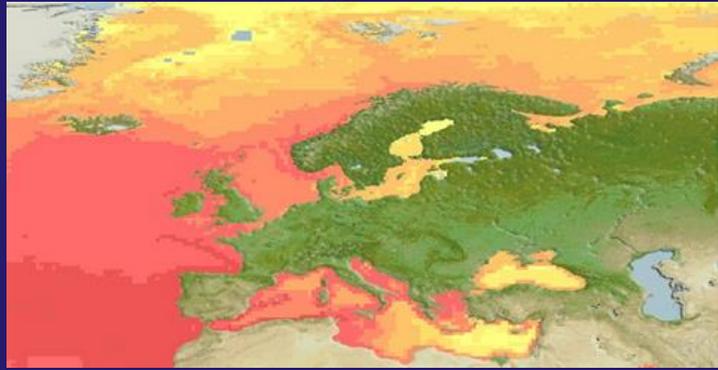# AquaMaps for
EU BON

DECISION-SUPPORT TOOL

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Overview

AquaMaps is an approach to generating model-based, large-scale predictions of where aquatic species occur naturally. The modelling approach uses species occurrence data coupled with expert knowledge to estimate species tolerances for environmental factors that can be used as predictors of species presence (e.g., depth, sea temperature, and salinity for marine species, and net primary production, soil carbon, elevation for freshwater species). Predictions, expressed as probabilities of species occurrence, are generated by matching species tolerances (environmental envelopes) against local environmental conditions to determine the relative suitability of an area for a species (Fig. 1). These probabilities are illustrated through color-coded species range maps in half-degree latitude and longitude cell resolution.

The AquaMaps for EU BON has two main interfaces. Marine AquaMaps features standardized distribution maps for over 1,032 European fishes and marine mammals, while Freshwater AquaMaps features maps for 173 species (including 33 fishes and 140 non-fish species). These interfaces allow users to search, view and explore species maps. Experts are able to review, modify and approve maps.

Environmental envelope type modeling approach
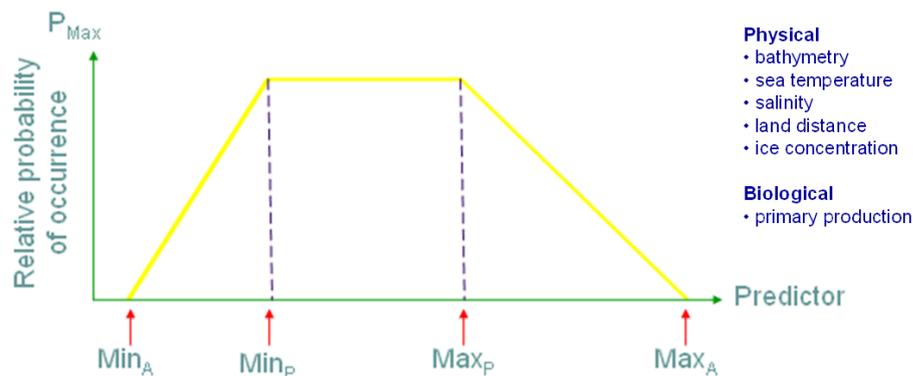
$$P_c = P_{bathymetry_c} \times P_{temperature_c} \times P_{salinity_c} \times P_{primary\ production_c} \times P_{ice\ concentration_c} \times P_{land\ distance_c}$$

Figure 1. Model of a species-specific environmental envelope. A species will have an envelope for each of the environmental parameters used to predict its occurrence. In AquaMaps, the probability that a species is present is uniformly highest (P=1.00) where mean environmental conditions fall within the preferred parameter range of the species (MinP to MaxP). If environmental conditions fall outside this range, the probability of occurrence decrease linearly towards the species' absolute minimum or maximum parameter thresholds (MinA or MaxA), and is set to zero (P=0.00) beyond these absolute thresholds. The overall probability of species occurrence in a cell (Pc) is the product of the probabilities of the environmental parameters considered for the species.

Expected advantages

1. **Addresses biases from occurrence data:** Uses FishBase and SeaLifeBase to prevent inclusion of misidentified species. Incorporates expert information on species' habitat preferences to counter sampling bias. Applies species distributions within FAO areas, bounding boxes or drainage basins to exclude potentially suitable habitat in which a species is not known to occur;
2. **Easy species search:** Call species maps using either a common or scientific name, or select from a checklist (e.g., by country or large marine ecosystem);
3. **Interactive species maps:** Explore maps covering a species' predicted natural range (1) in the current period, (2) by the year 2100 (based on IPCC A2 emission scenario), (3) in all suitable habitats outside of a species' currently known natural range, as well as (4) a map of geo-referenced occurrences of the species. Multi-species maps (e.g., biodiversity) are also available;
4. **Editable/Reviewed maps:** Includes a Create-Your-Own-Map tool that allows a user to view and change mapping parameters and settings, and to regenerate a new map applying changes made. Maps reviewed and edited by experts or through verification against known distribution are also available;
5. **Downloadable data:** Predicted probabilities of species occurrence (native range) can be exported in csv format.

Applicability

AquaMaps for EU BON is an online interface that will be publicly accessible through the European Biodiversity Portal. Development is ongoing through the prototype of a Visualization and Decision Support Interface at http://www.aquamaps.org/eubon/home.php. The map data will be updated following the AquaMaps production run in 2016. Inclusion of range maps as species probability layers in GeoCAT through CartoDB is being considered.

For regular users, searching, exploring and downloading of maps and the associated data are the expected common usage for AquaMaps for EU BON. The interfaces are user-friendly, making it easy use and perform these applications. However, Marine AquaMaps offers more search options compared with Freshwater AquaMaps (Fig.2).

For more advanced users, map editing and regeneration can be done through the Create-Your Own-Map (CYOM) tool. If a user is an expert, arrangements can be made to include their expert-reviewed/edited maps in AquaMaps for EU BON. The data required to use the CYOM to edit/correct a species' map would include:

1. Ecological data (marine AquaMaps): depth range or habitat description (proxy to depth range); bounding box coordinates for species' known natural range; FAO areas (standardized large geographical fishing areas used by the Food and Agriculture Organization) where native/endemic; feeding and breeding environment (neritic, oceanic, pelagic, demersal, etc.)
2. Ecological data (freshwater/terrestrial AquaMaps): ecosystems or watershed basins allocations within species' known natural range; FAO areas where native/endemic
3. Geo-referenced species occurrence data

Potential users

The target users of this online interface are students, researchers, conservation planners, and non-government organizations.
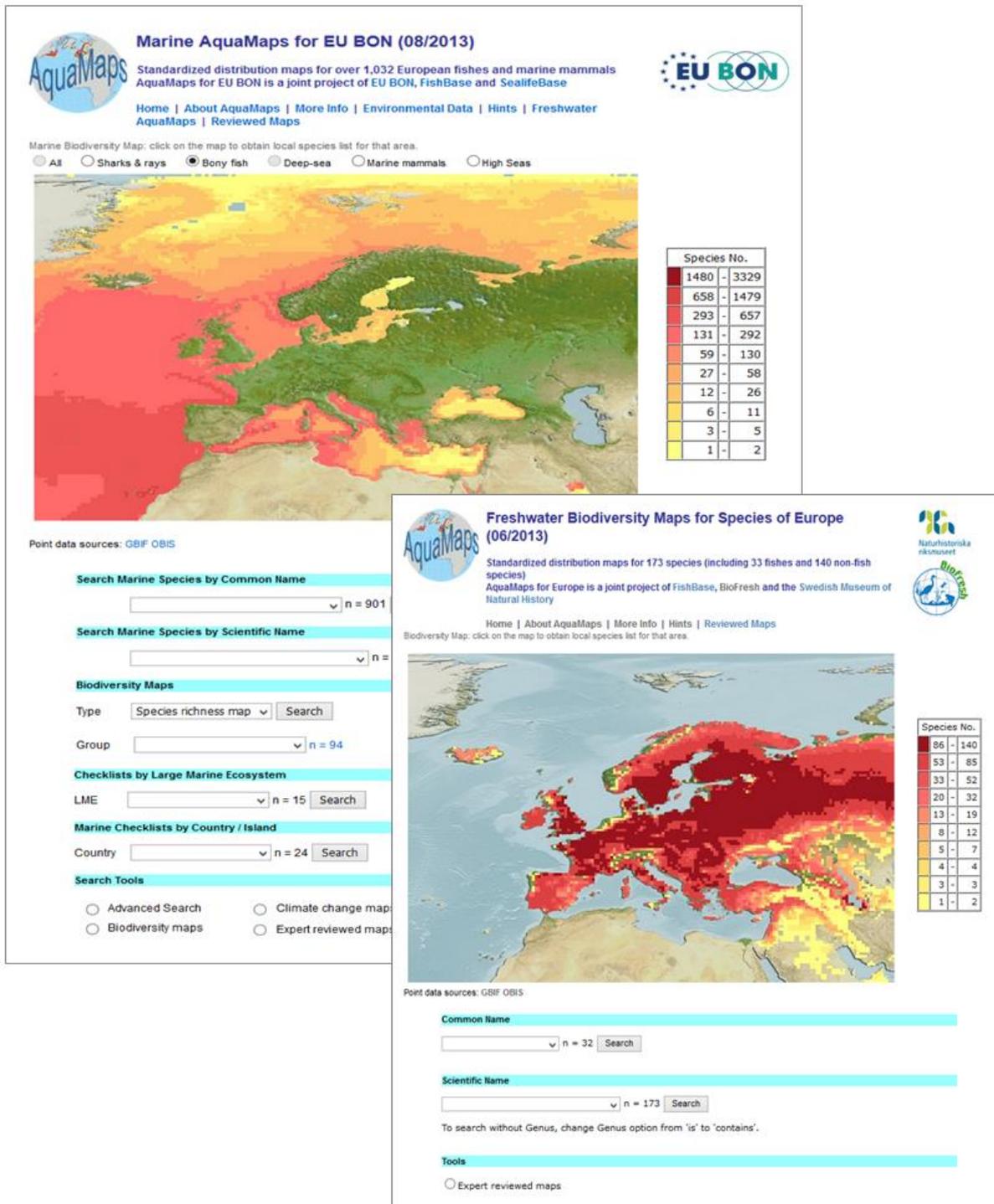
Figure 2. Marine AquaMaps and Freshwater AquaMaps interfaces. The Marine AquaMaps search page offers searches for common name, scientific name, biodiversity maps, checklists by Large Marine Ecosystem (LME) or country, climate change maps, expert-reviewed maps, and advanced searches. Freshwater AquaMaps only offers searches for common names and scientific name and expert-reviewed maps at this time.