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# Integration of newly developed models, tools and indices on the portal (M36)

STATUS: FINAL

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Call and Contract: FP7-ENV-2008-1  
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Co-ordinator: Leibniz-Institute of Freshwater Ecology and Inland Fisheries at Forschungsverbund Berlin e.V., Germany  
Partners: RBINS, Royal Belgian Institute of Natural Sciences, Belgium  
BOKU, Universität für Bodenkultur Wien, Austria  
ICLARM, International Center for Living Aquatic Resources Management, Malaysia  
IRD, Institut de Recherche pour le Développement, France  
UDE, Universität Duisburg-Essen, Germany  
IUCN, International Union for Conservation of Nature, Switzerland  
UOXF.AC, Oxford University, UK  
UB, Universitat de Barcelona, Spain  
UFZ, Helmholtz Zentrum für Umweltforschung, Germany  
UCL, University College of London, UK  
UCBL, Université Claude Bernard - Lyon 1, France  
UPS, Université Paul Sabatier- Toulouse 3, France  
ECOLOGIC, Ecologic GmbH Institut für Internationale und Europäische Umweltpolitik, Germany  
EC-ERC, Commission of the European Communities - Directorate General Joint Research Centre, Italy  
UD, University of Debrecin, Hungary  
NRM, Naturhistoriska riksmuseet, Sweden  
FIN, FishBase Information and Research Group, Inc.

This project is supported by funding from the specific programme 'Cooperation', theme 'Environment (including Climate Change)' under the 7th Research Framework Programme of the European Union.



## BIOFRESH

Biodiversity of Freshwater Ecosystems: Status, Trends, Pressures, and Conservation Priorities



Project no. 226874

Large scale collaborative project

Report on models, tools, and indices integrated to the BioFresh portal

Deliverable number	D1.4
Deliverable name	Report on Integration of newly developed models, tools and indices on the portal
WP no.	WP 1
Lead Beneficiary (full name and Acronym)	ICLARM
Nature	DB: Part of an information system
Delivery date from Annex I (proj. month)	M36
Delivered	yes
Actual forecast delivery date	2012-10-31
Comments	This report is a global synthesis of the activities in WP1 for integration of data and tools in the BioFresh portal. This is the first progress report. This report is also linked to the Tasks 4.2, 5.2 and 6.2 of WPs 4, 5 and 6 (D4.2; 5.2 and 6.2) that are consolidated into one separated report.

Project funded by the European Commission within the Seventh Framework Programme Dissemination Level		
PU	Public	✓
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

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In case the report consists of the delivery of materials (guidelines, manuscripts, etc)

Delivery name	Delivery name	From Partner	To Partner
BioFresh Portal (part of)	Integrated data and tools	All partners + external sources	All partners

## Introduction

This report on models, tools, and indices integrated to the BioFresh portal is the first (M36) of two reports on this topic. The current report is an initial report detailing the current status of the work, while the final report (M51) will give a complete overview of the finalised products. It covers progress on the tasks 1.4 and 1.5 regarding the integration of results and development of new models, tools and indices from partners, and from external sources. Except for the visualization tool and AquaMaps, which are part of the WP1, the results are extracted from the Work Packages 4 to 7.

The progress of the efforts concerning data and tools that should be integrated or linked is consolidated in a separate report covering D4.2, D5.2 and D6.2. Hence the present document reports the **current status of integration** and not the (progress of the) content of databases or the development of the tools. Several data and tools will be integrated with the ongoing development of the Atlas (T5.5 and D5.5), e.g., a number of comparative and predictive freshwater biodiversity models resulting from the tasks T4.5/5.5/6.5.

## Statistics summary

About 20 tools are integrated in or linked from the BioFresh portal. The list is available at: <http://data.freshwaterbiodiversity.eu/tools.html>.

About 50 shapefiles are linked from the BioFresh portal, which covers an important part of what is currently available on or helpful for freshwater studies at global scale. The list is available at: <http://data.freshwaterbiodiversity.eu/shapefiles.html>.

Both are listed as screen shots in annexes as a reporting milestone.

## Integrated and/or linked

Most of the tools have their own websites that are currently under progress or still maintained. Their integration was then reconsidered. The BioFresh portal links to these original websites with some explanations.

Suggestion: It should be discussed if the portal could provide dedicated webservices to these tools to be used in their native website, rather than trying to duplicate them in the portal.

However, the BioFresh portal should be seen as a possible repository for still useful tools that could not be maintained anymore by their original projects or owners.

Suggestion: Some documentation for their possible future integration should be available by the end of BioFresh to the portal developers.

## Overview of integration in the portal

### General visualization and GIS tools (T1.4)

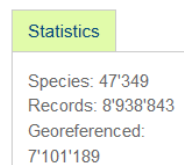


Fig. 1. The current statistics displayed in the portal about integrated occurrences data.

As occurrence data are considered as the core dataset of the portal (Fig. 1 for current statistics), the search functionalities for accessing them were included directly at the bottom of the home page of the portal (Fig. 2).

### Search species and occurrence data

Start typing a scientific name (e.g. Alligator), select a species from the autocomplete list and hit search or click the random button to view an example species. Have a look at the [search tips](#) for more information.

The figure displays two search interfaces. The top interface, titled 'Simple Taxon Search', features a 'Species Name' input field, a 'Random' button, and a 'Search' button. The bottom interface, titled 'Simple Occurrence Search', includes an 'Advanced occurrence search' section with 'Taxon Options' (FADA group dropdown, Scientific name input) and 'Geographic Options' (Continent dropdown, FADA region dropdown), along with a 'Search' button.

Fig. 2. Examples of search functionalities in the portal home page: simple taxon search on the left; advanced occurrence search on the right.

A special effort was made to integrate or mainly link around 50 shapefiles for various geographical and environmental data (see list <<http://data.freshwaterbiodiversity.eu/shapefiles.html>>). Although the page presents mainly links, each shapefile has been backed up for security in the portal, just in case if the original source would become unavailable.

### Models and Tools pages

The listing of tools, models and shapefiles on the data portal allows us to quickly add any relevant resources we come across. An important tool that we will add shortly is for instance the WISER methods database <<http://www.wiser.eu/results/method-database/>> detailing national assessment methods used to classify the ecological status of rivers, lakes, coastal and transitional waters from different EU member states.

### AquaMaps (T1.5)

The concept and model for the Freshwater AquaMaps was refined and finalized (final selection of environmental parameters). The methodology to integrate AquaMaps was developed, and some maps results were integrated in the portal as reported in D1.3. See an example for the beaver on figure 3.

Batch processing will be resumed in the near future and the final implementation of the Freshwater AquaMaps with tools on the AquaMaps website at <<http://www.aquamaps.org/>> and mapping options on the BioFresh data portal will be completed by July 2013.

Note that for the beaver example, if one compares the AquaMaps with the one available in the IUCN RedList website (Fig. 4), notwithstanding some adjustments in the southern part of Europe, AquaMaps shows where the beaver could be distributed in absence of human impact, while the IUCN shows where the beaver is actually currently distributed to the best knowledge of specialists.

**Suggestion:** viewing the two maps at the same time might be an interesting new tool for conservationists to drive conservation plans; further statistical tools could be also developed to measure how much the two maps are

different. We have AquaMaps as an example, but it could be a map resulting from any other model, the principle being to compare the result from a model, with a map “manually-made” by specialists.

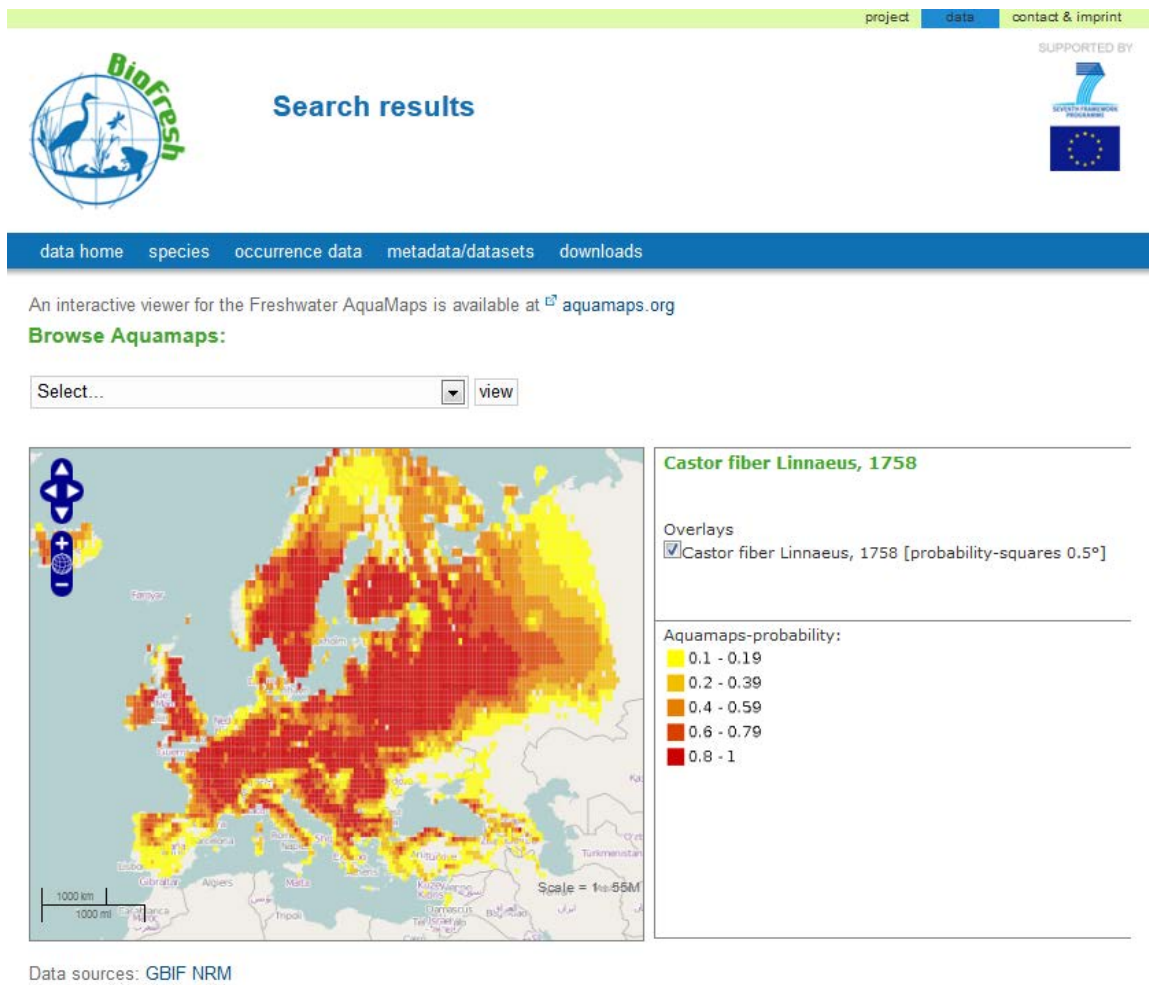


Fig. 3. AquaMaps for the beaver within the BioFresh portal.



Fig. 4. IUCN RedList map for the beaver (<<http://maps.iucnredlist.org/map.html?id=4007>>). Version 2012-2.

### European Fish Index (EFI+) (T1.5)

The on-line tool resides on a dedicated web page <<http://efi-plus.boku.ac.at/software/index.php>> (Fig. 5). It is linked from the BioFresh portal. The integration of the tool could be done if the current website would not be maintained anymore.

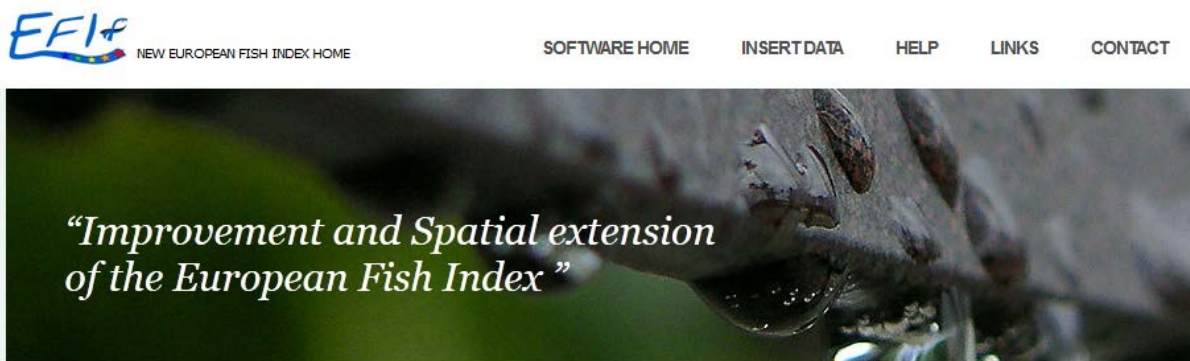


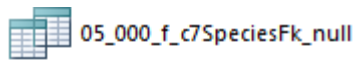
Fig. 5. European Fish Index home page linked from the BioFresh portal.

### Index of Biodiversity Vulnerability (T1.5)

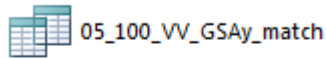
The establishment of CVI was delayed. However, interactive options for the CVI visualisation tool are currently under discussion, and the results and tool will be integrated as soon as the index is finalised.

### Tools for taxonomic quality control (T2.2)

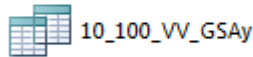
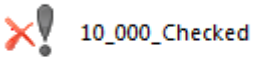
Following an evaluation of the resources needed to adapt a names matching tool for use within BioFresh, we concluded that adding this functionality –which was not foreseen in the DoW- would not be realistic within the timeframe of the BioFresh project. Rather, we will search how to exploit the tools developed by other parallel European projects such as 4D4Life <<http://www.4d4life.org/>>, i4Life <<http://www.i4life.eu/>>, and EU-Brazil OpenBio <<http://www.eubrazilopenbio.eu/>>. Matching tools are or about to be available before the end of BioFresh, and the portal will redirect to these tools, which are enough for the majority of ecological studies.



Just for fishes, a complete suite of about 100 queries was developed (Fig. 6)



It is not integrated in the portal yet. It is detailed but complex and requires good skills in fish taxonomy and nomenclature. ICLARM and RBINS will discuss how far it is possible to integrate it, or to propose it as a case-by-case service.



The tool is modular enough to be further adapted to the FADA list containing other taxonomic group, although some customization are always to be expected.

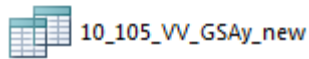
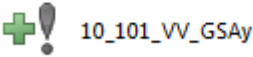


Fig. 6. Start of the list of ~100 queries of the taxonomic matching tool for fishes.

### Biodiversity matrix (T4.4)

Due to the delay in the availability of the HydroSHEDS/HydroBASIN layers necessary for the construction of the biodiversity matrix (BioMatrix), the integration of the complete BioMatrix is postponed to March 2013, especially in the atlas. But individual species layers will be made available for integration in the data portal as they are available.

### Global Freshwater Biodiversity Atlas (T5.5)

An elaborate example of the on-line global freshwater biodiversity atlas has been worked out by IGB and discussed in detail during a meeting early November 2012. A first on-line editorial board meeting is scheduled for December 2012 and will mark the start of the active mobilisation of maps and model results for integration. The majority of the outputs from the modelling work described here will eventually be integrated in the on-line atlas rather than on the data portal itself.



## Annexes

### Lists of shapefiles and tools available from the BioFresh portal at the end of the second period (31<sup>st</sup> October 2012)

#### Shapefiles

[project](#) [data](#) [contact & imprint](#)



## Data portal

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[data home](#) [species](#) [occurrence data](#) [metadata/datasets](#) [downloads](#)

Help

- ↳ Support BioFresh
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  - Submit Data
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  - Submit via IPT
  - Submit via own IPT
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- ↳ Quality control
  - GBIF data
  - suspect coordinates
  - zoo/aquarium/farm
  - fossil
- ↳ Search Tips
- ↳ Roadmap

### A selection of useful shapefiles in freshwater biodiversity research

#### Geographic region and country shapefiles

- TDWG Geographic Region Level 1-4: Continent, regions, provinces and countries
  - Shapefiles matching the TDWG-standards for geographic regions ("World Geographical Scheme for Recording Plant Distributions"). It identifies geographic units worldwide in a four-level hierarchy, incorporating continents, regions, provinces and countries.
  - More info: [abstract at NHM](#), [pdf at TDWG](#), [info on downloads at KEW](#), [info on downloads at EDIT](#)
  - **Level 1: Continents** - direct download link: [at KEW](#), [at EDIT](#)
  - **Level 2: Regions** - direct download link: [at KEW](#), [at EDIT](#)
  - **Level 3: Botanical countries** - direct download link: [at KEW](#), [at EDIT](#)
  - **Level 4: Basic recording units** - direct download link: [at KEW](#), [at EDIT](#)
- Countries
  - Countries of the world
  - More info: [info on download at EDIT](#)
  - Direct download link: [at EDIT](#), [at DIVA-GIS](#)
- Grids
  - Regular equal-area units at different scales. UTM squares, latitudinal squares and icosahedric triangles
  - Download links: [at EDIT](#)
- FADA-regions
  - Fada faunistic regions: AfroTropical, ANTarctic, AUstralasian, NeArctic, NeoTropical, Oriental(Indomalaya), PACific(Oceania), PalaeArctic
  - Download link: [.zip](#)

Statistics

Species: 47'349  
Records: 8'938'843  
Georeferenced: 7'101'189



BioFresh Data  
**biofreshdata**

biofreshdata Finally, we got the new version of [bit.ly/hXAmRi](#) running! check out the updates search interface and initial download capabilities  
27 days ago · [reply](#) · [retweet](#) · [favorite](#)

biofreshdata We are currently updating the data portal, so please be patient until it's up and running again  
34 days ago · [reply](#) · [retweet](#) · [favorite](#)

biofreshproject The #BioFresh BioMatrix due for launch in Oct is slated to save fw scientists an enormous

Join the conversation

## Hydrographic regions

- Global Lakes and Wetlands Database (GLWD)
  - The Global Lakes and Wetlands Database (GLWD); Lehner, B. and P. Döll (2004): Development and validation of a global database of lakes, reservoirs and wetlands. Journal of Hydrology 296/1-4: 1-22. Three levels are included, two are available as polygon shapefiles and one as a grid;
  - Level 1: Largest Lakes and Reservoirs
  - Level 2: Other Lakes and Reservoirs
  - Level 3: Level 1 + Level 2 + Extra Info (as grid)
  - More info: [page on spatial data at WWF](#), [pdf at WWF](#)
  - Download info: [at WWF](#) (requires contact details for downloading)
- Freshwater Ecoregions of the World
  - Freshwater Ecoregions of the World, (FEOW) provides a new global biogeographic regionalization of the Earth's freshwater biodiversity.
  - More info: [link to main FEOW website](#)
  - Direct download link: [at FEOW](#) - [Other downloads at FEOW](#)
- European ecoregions for rivers and lakes according to Illies
  - More info: [map at EEA](#)
  - Download info: [at EEA](#)
- GIWA Large Marine Ecosystem/Basin Delineation
  - Global International Waters Assessment's Terrestrial WaterSheds and Large Marine Ecosystems, a medium resolution WS delineation based on terrestrial modifications to the NOAA-URI Large Marine Ecosystems.
  - More info: [at FAO](#)
  - Direct download link: [at FAO](#)
- WRI Major Watersheds of the World Delineation
  - WRIBASIN: Watersheds of the World published by the World Resources Institute, a cleaned version of this watershed delineation enhanced to include WRI's original publication attributes.
  - More info: [at FAO](#)
  - Direct download link: [at FAO](#)
- Rivers
  - Data on rivers at country level from [DIVA-GIS](#)
  - Concatenated world shapefiles for rivers available on request
- Waterbodies
  - Data on waterbodies at country level from [DIVA-GIS](#)
  - Concatenated world shapefiles for waterbodies available on request
- Other spatial data on hydrographic regions
  - [HydroSHEDS](#): Hydrological data and maps based on Shuttle Elevation Derivatives at multiple Scales
  - Watershed shapefiles [at FAO](#)
- European Catchment Characterisation and Modelling - CCM River and Catchment Database, version 2.1 (CCM2)
  - More info and download link: [at JRC](#)

### Terrestrial ecoregions

- Baily ecoregion scheme for the continents
  - Ecoregions of the Continents characterizes global potential natural vegetation at approximately 1/2-degree resolution. The dataset is based on a Russian vegetation map (Gerasimov, 1964), updated by the US Fish and Wildlife Service (Robert C. Bailey) and reprojected to geodetic coordinates at the World Conservation Monitoring Center, England.
  - More info and download link: [↗](#) at NGDC
  - Detailed info for the U.S.: [↗](#) at US forrest services

### Climatic regions

- Climatic regions according to the Köppen-Geiger climate classification
  - More info: [↗](#) on Wikipedia, [↗](#) on the Updated world map of the Köppen-Geiger climate classification
  - Direct download link: [↗](#) at EDIT
- More climate data
  - [↗](#) WorldClim - Global Climate Data
  - Download links: [↗](#) at WorldClim

### Miscellanea

- Natura2000
  - Natura 2000 data - the European network of protected sites
  - More info: [↗](#) at EEA
  - Direct download link: [↗](#) at EEA
- Anthropogenic Biomes
  - More info: [↗](#) at SEDAC. Downloads available as GeoTiff or ESRI Grids.
- The Last of the Wild
  - The Last of the Wild data collection includes the Human Influence Index (HII) grids, Human Footprint grids, and The Last of the Wild vector data.
  - More info: [↗](#) at SEDAC. Downloads available as shapefiles.

### Other spatial data lists

- [Databases](#) and [GIS downloads](#) at EDIT
- [at DIVA-GIS](#)
- [at the EDEN project](#)

### Spatial environmental datasets

- Global Ecosystems Database (GED)
  - Collection of spatial datasets on ecosystem features.
  - More info: [at NOAA](#)
- HYDRO1k Elevation Derivative Database
  - HYDRO1k is a geographic database developed at the U.S. Geological Survey's Center for Earth Resources Observation and Science (EROS) to provide comprehensive and consistent global coverage of topographically derived data sets, including streams, drainage basins and ancillary layers derived from the USGS' 30 arc-second digital elevation model of the world ([GTOPO30](#)).
  - More info: [at USGS](#)
- Atlas of the Biosphere
  - The Atlas of the Biosphere is a product of the [Center for Sustainability and the Global Environment \(SAGE\)](#) and provides spatial data in 4 different categories: Humans, Land Use, Ecosystems, and Water Resources.
  - More info: [at SAGE](#)
- Climate Change Data - GCM
  - Datasets part of the International Centre for Tropical Agriculture ([CIAT](#)) climate change downscaled data, developed in the Decision and Policy Analysis (DAPA) program. The data have been originally downloaded from the [IPCC data portal](#) and re-processed using an spline interpolation algorithm of the anomalies and the current distribution of climates from the [WorldClim database](#) developed by Hijmans et al. (2005).
  - More info: [at ccafs-climate](#)
- Global land cover at GEO-Wiki
  - The Geo-Wiki Project is a global network of volunteers who wish to help improve the quality of global land cover maps.
  - More info: [at GEO-Wiki](#)
- CGIAR-CSI Datasets - Consortium for Spatial Information
  - Digital Elevation Data: [at cgiar](#)
  - Global Potential Evapo-Transpiration (Global-PET) and Aridity Index (Global-Aridity): [at cgiar](#)
  - Global High-Resolution Soil-Water Balance: [at cgiar](#)
- MODIS Land Cover Data
  - Collection 5 Land Cover product (MOD12Q1)
  - More info: [at BU](#)

## Tools

data home
species
occurrence data
metadata/datasets
downloads

Help

**Support BioFresh**

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- How to Contribute?
- Submit Metadata
- Submit Data
- Data Paper

**Submit Data**

- Collaboration with freshwater journals
- Procedure
- Submit Spreadsheet
- Submit via IPT
- Submit via own IPT

**Data Policy**

- Guiding Principles
- Recommendations
- Data Paper
- User Agreement
- Citation
- Provider Agreement
- Definitions

**Quality control**

- GBIF data
- suspect coordinates
- zoo/aquarium/farm
- fossil

**Search Tips**

**Roadmap**

### A selection of useful tools in freshwater biodiversity research

The aim of this page is to bundle the tools used and developed in the framework of the BioFresh-project.

**BioFresh-tools**


- **EFI+** (Improvement and Spatial extension of the European Fish Index)
  - The EFI+-tool (Improvement and Spatial extension of the European Fish Index) allows assessing the ecological status of rivers in accordance with the EU Water Framework Directive. The tool is based on the European Fish Index (EFI) developed within the FAME and EFI+ project as a standardized fish-based assessment method applicable across a wide range of European rivers. The EFI employs a number of environmental descriptors (see [documentation on the data input matrix](#)) to predict biological reference conditions and quantifies the deviation from reference conditions on a statistical basis.
  - More info: [documentation page](#), [pdf manual](#)
  - On-line tool: [at BOKU](#)
- More to come...
  - BioFresh will be developing tools such as the Climate Vulnerability Index and Key Biodiversity Areas.

**Freshwater AquaMaps**

- **AquaMaps for Europe**
  - Freshwater AquaMaps is an approach to generating model-based, large-scale predictions of freshwater species and is based on a methodology, which was originally developed for marine mammals. Models for the freshwater AquaMaps are constructed from estimates of the environmental tolerance of a given species with respect to elevation, temperature, soil pH, soil moisture, soil carbon, precipitation and the Compound Topographic Index (a wetness index) and occurrence data available through FishBase and GBIF. Maps show the colour-coded relative likelihood of a species to occur in a global grid of half-degree latitude/longitude cell dimensions, which corresponds to about 50 km near the equator.
  - Predictions are generated by matching habitat usage of species, termed environmental envelopes, against local environmental conditions to determine the relative suitability of specific geographic areas for a given species. Knowledge of species' distributions within FishBase, FAO areas or bounding boxes is also used to exclude potentially suitable habitats in which the species is not known to occur.
  - Environmental parameter layers and drainage basins based on the Pfaffstetter system have been established for European freshwater fishes, amphibians, and mammals. Parameters were tested by calculating their relative contribution to the predicted distribution patterns for different organisms. Predicted ranges have been tested against IUCN shapefile boundaries based on known distributions. AquaMaps is relatively insensitive to gaps in occurrence data and uses presence only for calculation of ranges.
  - The European AquaMaps are currently available for a dozen of freshwater species and will be produced for a wider range of species in the near future. These maps can be consulted at:
    - European AquaMaps at [aquamaps.org](#)
    - AquaMaps integration in the [BioFresh-portal](#)
    - More background information on AquaMaps in general is available at [aquamaps.org](#)

Statistics

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BioFresh Data  
**biofreshdata**

biofreshdata Finally, we got the new version of [bit.ly/hXAmRi](#) running! check out the updates search interface and initial download capabilities  
27 days ago · reply · retweet · favorite

biofreshdata We are currently updating the data portal, so please be patient until it's up and running again  
34 days ago · reply · retweet · favorite

biofreshproject The #BioFresh BioMatrix due for launch in Oct is slated to save fw scientists an enormous

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### Ecological assessment tools

- Assessing the ecological quality of rivers - ASTERICS
  - ASTERICS (version 3.1.1) calculates the ecological status of rivers based on benthic invertebrate taxa lists. The assessment fulfills the demands of the WFD. The German Assessment System PERLODES is part of the software.
  - More info: [at fliessgewaesserbewertung.de](http://at.fliessgewaesserbewertung.de)
  - On-line tool: [at fliessgewaesserbewertung.de](http://at.fliessgewaesserbewertung.de)
- Taxa Entry Tool
  - Tool to produce a standardized taxalist for Macrophytes, Fish, Phytoplankton or Diatoms.
  - On-line tool: [at freshwater ecology.info](http://at.freshwaterecology.info)

### Literature analysis tools

- Eco-Evidence
  - Eco Evidence is a unique tool for performing systematic literature review. It allows users to document and extract causes and effects and their response direction in a standardized manner. As such, the tool helps users to perform a systematic review of the scientific literature focussing on a specific cause-and-effect hypothesis. Eco Evidence consist of an online database and a desktop application for data analysis.
  - On-line database tool: [at eWater Toolkit](#) (access is registration based)
  - More info: on the desktop analyser software (Windows) [at eWater Toolkit](#)

## R-packages and modeling tools used within the project

- R software
  - R is a powerful, free cross-platform environment for statistical computing and graphics. This software is required to use the packages mentioned below.
  - More info: [at r-project](#)
  - Download software: [at one of the cran-mirrors](#)
- Biomod
  - BIOMOD is R-package for ensemble forecasting of species distributions, enabling the treatment of a range of methodological uncertainties in models and the examination of species-environment relationships.
  - More info: [at R-forge](#)
  - Download package: install using the command  
`install.packages("BIOMOD",repos="http://r-forge.r-project.org")`
- spdep
  - Spatial dependence: weighting schemes, statistics and models
  - More info: [at cran](#)
  - Download package: install using the command  
`install.packages("spdep",repos="http://cran.r-project.org")`
- spatstat
  - An R library for spatial statistics
  - More info: [at spatstat](#)
  - Download package: [at cran](#) or install using the command  
`install.packages("spatstat",repos="http://cran.r-project.org")`
- gbm
  - Generalized Boosted Regression Models. gbm package, found in Elith, J, J. R. Leathwick and T. Hastie. 2008. A working guide to boosted regression trees. *Journal of Animal Ecology*. 77: 802-813.
  - More info: [pdf manual at cran](#)
  - Download package: [at cran](#) or install using the command  
`install.packages("gbm",repos="http://cran.r-project.org")`
- vegan
  - Vegan: R functions for vegetation ecologists. Useful tool for vegetation/community analysis. Contains the major ordination methods, dissimilarity indices and tools for biodiversity, species richness and abundance analysis.
  - More info: [at OULU](#), [pdf tutorial at OULU](#), [pdf reference manual at cran](#)
  - Download package: [at R-forge](#) or install using the command  
`install.packages("vegan",repos="http://r-forge.r-project.org")`

### Other (spatial) modeling tools

- Maxent
  - Maxent software for species habitat modeling. Software based on the maximum-entropy approach for species habitat modeling.
  - More info and download form: [at princeton](#)
- Spatial Analysis in Macroecology (SAM)
  - SAM (Spatial Analysis in Macroecology) is a Windows program designed as a package of tools for spatial statistical analysis, mainly for applications in Surface Pattern Spatial Analysis.
  - More info: [at ufg](#), [pdf article](#)
  - Download form: [at ufg](#)
- Geospatial Modelling Environment
  - GME is an analysis and modeling environment for geospatial analysis that is designed to facilitate rigorous analysis of geospatial data. Windows program requiring the statistical software R and ESRI ArcGIS to drive geospatial analyses.
  - More info: [at spatialecology.com](#)
  - Download page: [at spatialecology.com](#)

### On-line GIS tools

- Earthpoint Excel to KML
  - Simple on-line tool to convert coordinates in Excel to a KML-file which can be viewed in Google Earth
  - More info and on-line tool: [at earthpoint.us](#)
- The World Coordinate Converter
  - A tool to convert geodetic coordinates in a wide range of reference systems
  - More info and on-line tool: [at twcc.free.fr](#)

### Open source GIS tools

- Quantum GIS
  - User friendly Open Source Geographic Information System (GIS)
  - More info: [at qgis](#)
- GRASS GIS
  - Geographic Resources Analysis Support System. Commonly referred to as GRASS, this is free Geographic Information System (GIS) software used for geospatial data management and analysis, image processing, graphics/maps production, spatial modeling, and visualization.
  - More info: [at fbk](#)
- PostGIS
  - Geographic object support for [PostgreSQL](#) databases
  - More info: [at refractions](#)