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# Global Freshwater Atlas and Freshwater Biodiversity Models (M51)

STATUS: FINAL VERSION

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# BIOFRESH

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

Project no. 226874

Large scale collaborative project

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| 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 file name | From Partner | To Partner |
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## Global Freshwater Biodiversity Atlas

### *Introduction*

This report covering the deliverable D5.5 "Global Freshwater Biodiversity Atlas" describes the results of the development of the Atlas website and the interactive web mapping interface, the setup of web map services, the background and capacities of the Atlas and its integration in the BioFresh information platform (http://www.freshwaterbiodiversity.eu/). Information is given on the installation and activities of the editorial board for the Atlas, the establishment of partnerships with stakeholders and dissemination activities undertaken prior to and after the official launch of the Atlas during the "Water Lives" science-policy symposium on 29th January 2014 in Brussels (http://waterlives.eu/).

The aim for the Global Freshwater Biodiversity Atlas (http://atlas.freshwaterbiodiversity.eu/) is to develop a comprehensive online information platform, presenting spatial information and species distribution patterns relating to freshwater biodiversity in a visually appealing and dynamic format. Seen as a resource for better, evidenced-based decision making relating to water policy, science and management, it is an open-access and interactive gateway to provide information for policy-makers, water managers, scientists and the interested public.

Not only will the Atlas contain all spatially related BioFresh outcomes from the scientific work packages, moreover it is intended as a nucleus for further development and collaboration in the freshwater biodiversity community and is being developed in a collaborative effort as stakeholders are invited to contribute actively. The Atlas is an open-access resource for scientists and resource managers to share visualizations of their spatial data with a broad community of users and it provides access to freshwater biodiversity related maps and spatial data at global, continental and regional scales.

Dynamic online maps in the Atlas are presented in an interactive web map interface and accompanied by short articles with contextual background information as well as links to relevant publications, map data download options and important primary data sources (e.g. contained in the BioFresh data portal or repository or other open access archives). The content is offered under a Creative Commons license, permitting users to reuse maps and articles within the specified terms, while offering correct citation as indicated on the map.

### *Integration of Maps in the Atlas*

Currently, 23 maps are published on-line and 22 are in preparation or requested. The focus after the end of BioFresh is on further processing new maps, both from project partners as well as from external sources. Results from the modelling work carried out in the framework of BioFresh, which resulted in spatial data and maps, were integrated or are planned for integration in the Global Freshwater Biodiversity Atlas (see the report D4.7 for further details).

**Table 1: Integration of scientific results from BioFresh in the Atlas**

| chapter | map title | status |
|---|---|---|
| 1.1.1 | Global Diversity Patterns in Freshwater Systems | published |
| 1.1.2 | Global Distribution of Freshwater Dependent Amphibians | published |
| 1.1.3 | Global Freshwater Fish Species Richness | published |
| 1.2.1 | Freshwater Fish Extinction Rates due to Water Availability Loss from Climate Change | published |
| 1.2.3 | Forecasts of *Salmo trutta* distribution in European basins | published |
| 2.5.1 | Global Inundation Map (GLIN) | published |
| 2.6.1 | The Groundwater Habitat Map of Europe | published |
| 3.4.1 | Global Waterfall Database (HydroFALLS) | published |
| 4.1.2 | Threats to Freshwater Biodiversity and Rural Livelihoods in Sub-Saharan Africa | published |
| 4.3.1 | Freshwater Biodiversity and Protected Areas in Africa: a Gap Analysis | published |

| | | |
|---|---|---|
| 4.6.1 | Freshwater Species Data: Increasing Knowledge on Biodiversity in Sub-Saharan Africa | published |
| 1 | Homogenization patterns of the world's freshwater fish faunas | under preparation |
| 4 | European Key Biodiversity Areas | under preparation |
| 1 | Odonata diversity in Africa | under preparation |
| 1 | Global patterns of median body size of freshwater fish assemblages | under preparation |
| 1 | Global diversity of subterranean fishes | under preparation |
| 1 | Global Biodiversity of Freshwater Shrimp | under preparation |
| 2 | Global map of HydroBASINS | under preparation |
| 1 | Global diversity of Freshwater Turtles | under preparation |
| 1 | Climate change impacts on European Plecoptera | under preparation |
| 1 | Climate change impacts on European Trichoptera | under preparation |
| 4 | Global Database of Biological Field Stations | under preparation |
| 1 | Potential of Biogeographical Maps to Project Current and Future Distribution Patterns of Freshwater Species in Germany | planned/available |
| 3 | BioFresh review paper (Drivers and stressors of freshwater biodiversity patterns across different ecosystems and scales) | planned/available |
| 1 | BioMatrix | planned/partly available |
| 1 | Patterns of freshwater fish in the Danube, Elbe and Ebro | planned/not yet available |
| 1 | Impact of climate change on fish assemblages in European rivers | planned/not yet available |
| 1 | Biodiversity patterns of European Ephemeroptera, Plecoptera, Trichoptera on a ecoregional scale | planned/not yet available |
| 1 | European Groundwater Species Richness | planned/not yet available |
| 4 | European Climate Vulnerability Index | planned/not yet available |

### Global Database of Biological Field Stations

Parallel to the development of the Atlas, a global database of biological field stations was compiled, and the map of field stations is being prepared for inclusion in the Atlas.
Biological field stations are an important resource for place-based scientific research. The global database was established through an extensive web research and contains amongst others information on the station's research domains (terrestrial, freshwater, marine), their location, year of establishment, and affiliates.

### *Atlas webpage and integration in the BioFresh platform*

The website was set up using an open source content management system (Joomla), applying the same technology and design as the whole BioFresh information platform and being linked to from its start page and dropdown menu. Information and articles for each map are managed in a catalogue system, which allows an easy and fast expansion and update of the content as new maps and data become available.
General information on the Atlas can be found on a Frequently Asked Questions page (http://atlas.freshwaterbiodiversity.eu/index.php/manuals/frequently-asked-questions).

The main sections of the Atlas website are "Explore", "Maps" and "Contribute" (see Figure 1).

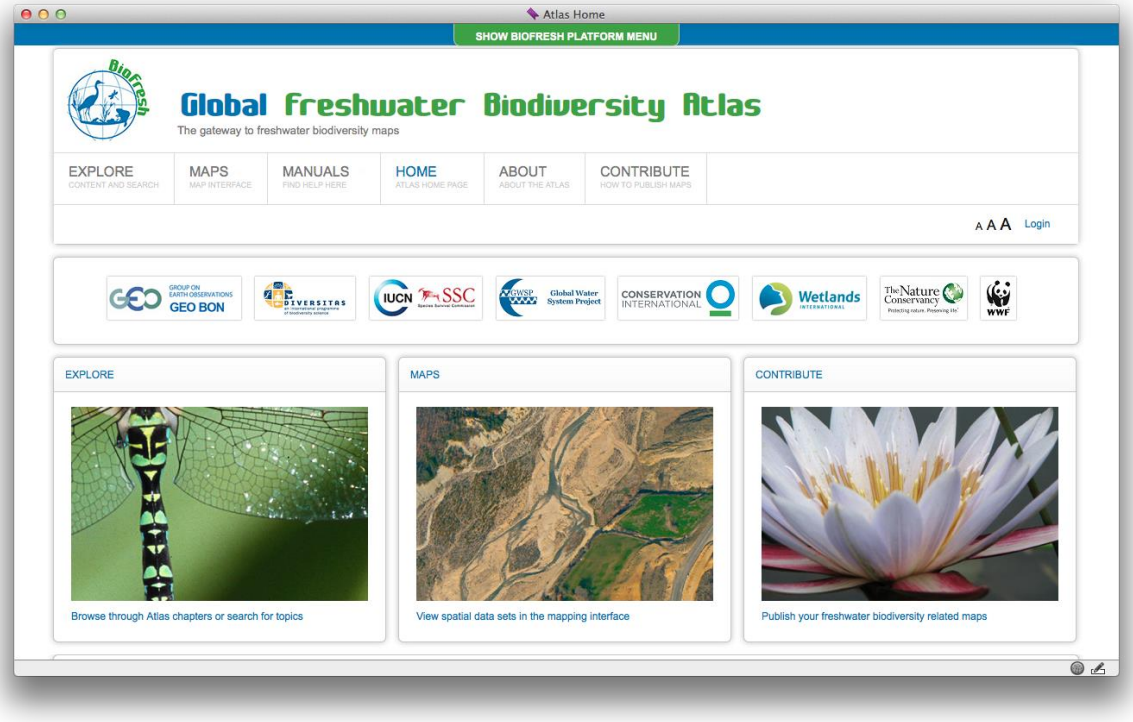


**Figure 1**: **Screenshot of the Global Freshwater Biodiversity Atlas homepage**

### "Explore" section

The "Explore" section (http://atlas.freshwaterbiodiversity.eu/index.php/explore, see Figure 2) presents the maps structured in a book-like fashion, allowing easy browsing through the four thematic chapters, on:

1) Patterns of freshwater biodiversity;

2) Freshwater resources and ecosystems;
3) Pressures on freshwater systems;
4) Conservation and management.

Additionally maps can be discovered via key words presented in a tag cloud, a drop-down chapter selection box or a full-text search box. Each map is presented on an overview page providing information on its source, the article authors etc. and linking to this map in the interactive web map interface. Detailed information on how to use the "Explore" pages can be found in the manuals section provided on the Atlas website (http://atlas.freshwaterbiodiversity.eu/index.php/manuals/exploring-the-maps).

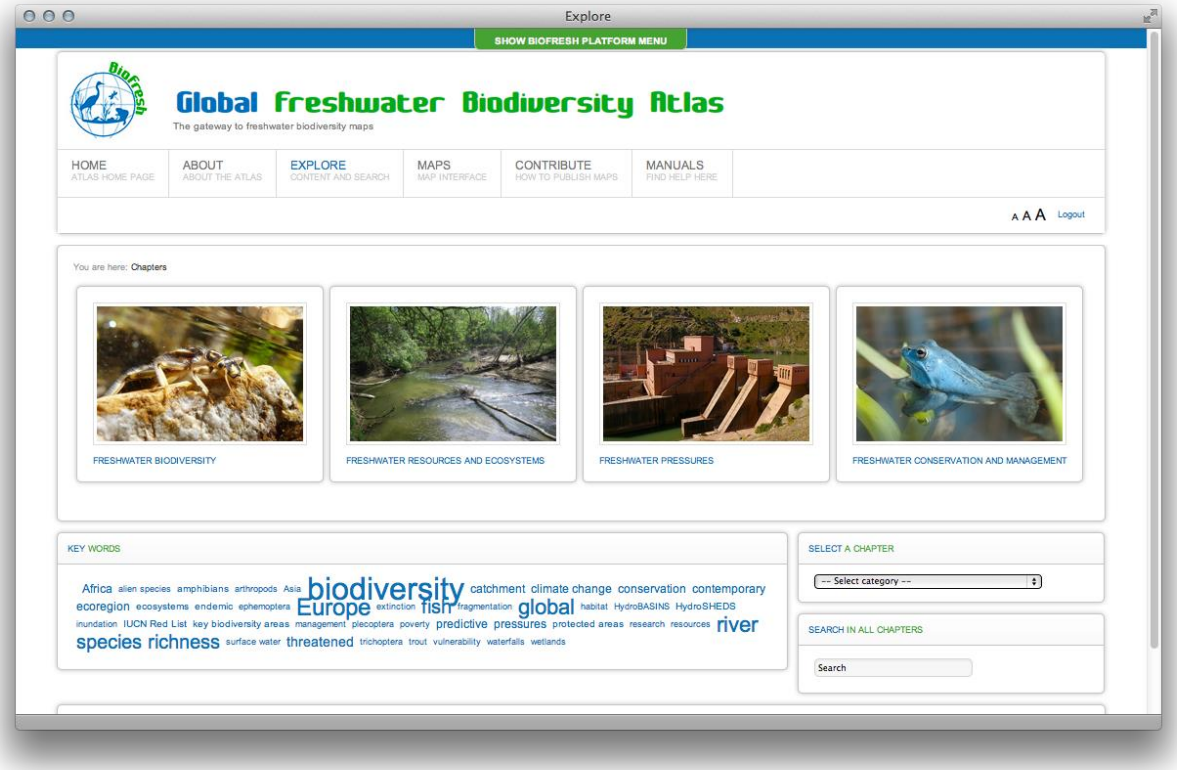


**Figure 2: Screenshot of the "Explore" section**

## "Map" section

The "Map" section links directly to the interactive web map interface, which can be viewed in a smaller, embedded version (http://atlas.freshwaterbiodiversity.eu/index.php/maps) or a full-screen version with advanced functionalities (http://atlas.freshwaterbiodiversity.eu/atlasApp/full/, see Figure 3). It was programmed using up-to-date open source JavaScript libraries (ExtJS4, GeoExt2 and OpenLayers 2.12) and its source code is deposited in an online version control repository (https://bitbucket.org/IGB-Berlin/biofresh-atlas/), which can be accessed on request. Furthermore a style package was created to adopt the design of the BioFresh platform for the Atlas map interface.
The interface presents information in boxes such as "Navigation" and "Source/Citation" on the left hand side and the main window with the map and article tabs on the right hand side. The "Navigation" box features the chapter tree, which allows users to switch between the chapters and maps easily, a base layer and map layer switcher, and a map caption and legend for the displayed map. The "Source/Citation" box contains information on the contributing institutions, indication of map data

sources, links to related scientific publications, information on the map and article license and a citation for the displayed map.

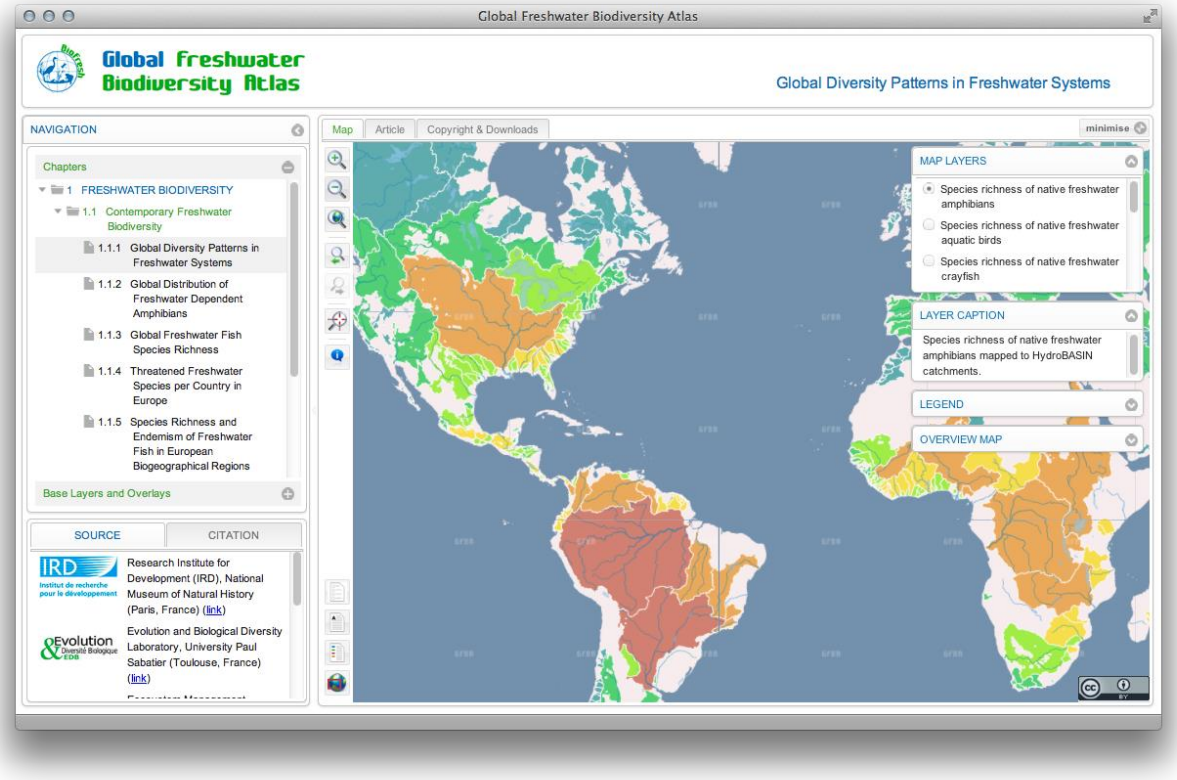


**Figure 3: Map view of the interactive web map interface**

The interactive map in the "Map" tab allows navigating and zooming within maps and displaying information on individual map features in pop-up windows. The displayed map contains one or more thematic layers, which can be chosen in the map layers switcher.
In the full-screen version, the map layer switcher, map caption, legend and overview map are displayed on the right hand side on top of the map area.
The map article is displayed in an additional tab containing information on the authors, related scientific publications, an introduction followed by a short description of the methods used in creating the map or dataset, and a short description of the map content (see Figure 4). Additionally references for mentioned scientific publications and geographic base layers, acknowledgements and contact information for the authors are given. An optional tab can be displayed for an extended description of methods used in development of the map, and another tab provides information on data download, citation and licenses.

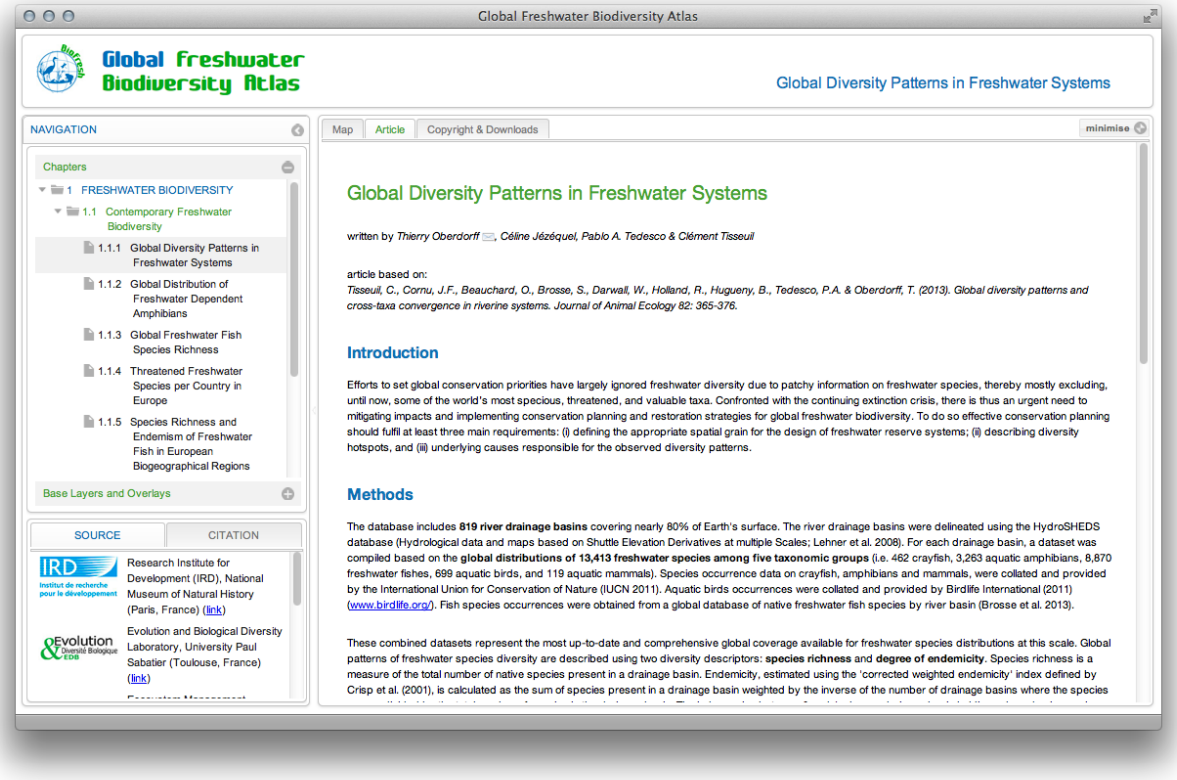


**Figure 4: Screenshot of the Article view**

Detailed information on the capabilities of the web map interface and how to use it can be found in a guide in the manuals section (http://atlas.freshwaterbiodiversity.eu/index.php/manuals/using-the-map-interface).

### "Contribute" section

The "Contribute" section (http://atlas.freshwaterbiodiversity.eu/index.php/contribute) is intended to assist potential map contributors in the steps needed to contribute to the Atlas. Detailed "author guidelines" can be downloaded in PDF format (http://atlas.freshwaterbiodiversity.eu/images/atlas/pdf/GFBA_guidelines.pdf), which contain comprehensive information on how to provide maps and articles, information on the CC-BY license and options for offering map data for download. Also contact information for the Atlas editors is given (atlas@freshwaterbiodiversity.eu).

### *Overview of technical infrastructure*

In addition to the website and web map interface a geospatial server and database were set up at IGB as part of the spatial data infrastructure for the Atlas (see Figure 5). Map data are stored in a shapefile repository or a spatially enabled database (PostgreSQL with spatial extension PostGIS) and map layers are set up as web map services (WMS) using the open source geospatial server software "GeoServer" (http://geoserver.igb-berlin.de/geoserver/web/). These WMS can be displayed in the atlas as well as in external web applications. Map data can potentially be downloaded from the Atlas GeoServer in various formats; this will be implemented on the Atlas website for map layers without access restriction.
Additionally WMS from external sources can be integrated into the Atlas. An example for this is the inclusion of the European Alien Species Information Network (EASIN) maps (http://atlas.freshwaterbiodiversity.eu/index.php/explore/item/69-european-freshwater-alien-species),

and it is taken into consideration for further map layers from International Union for Conservation of Nature (IUCN), the European Environmental Agency (EEA) and other potential web map service providers.

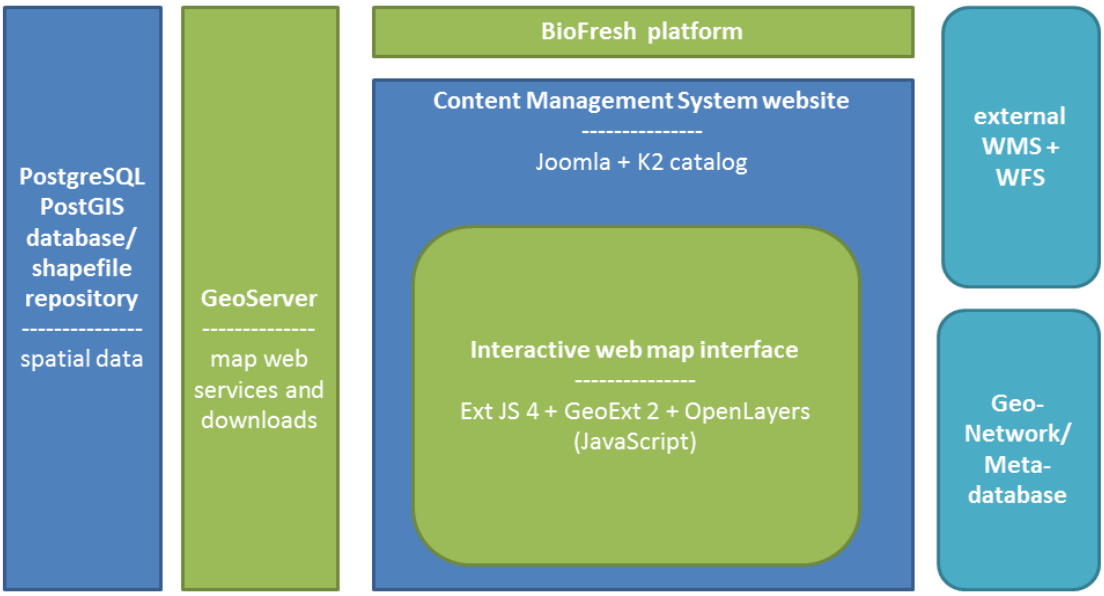


**Figure 5: Overview of technical components**

### *Atlas Editorial Board*

An editorial board for the Atlas was established in March 2012 during the annual project meeting in Oxford, with 17 members from 12 BioFresh partner institutions (http://atlas.freshwaterbiodiversity.eu/index.php/about-the-atlas/atlas-editorial-board). A first board meeting via Skype conference was scheduled for December 2012 and was followed by monthly Skype meetings to discuss proposed maps, texts and other editorial issues. The minutes of the meetings are available from the BioFresh intranet.

The main responsibilities of the editorial board members are to search for new maps, contact data/map holders, request map data, texts and articles and review the received articles. Furthermore they assisted in the creation of author guidelines, manuals, partner invitation letters, press releases and discussed strategic questions on the development of the atlas content and interface.

To facilitate the collaboration during the preparation of new maps a Trello Board (https://trello.com/b/lukRRHug/biofresh-atlas) was set up (see Figure 6). Editorial board members can propose new maps for inclusion into the Atlas on the Trello board, which are then discussed and voted upon by all members. The board is also used to document the different work steps to be taken and keep track of the progress made for each map.

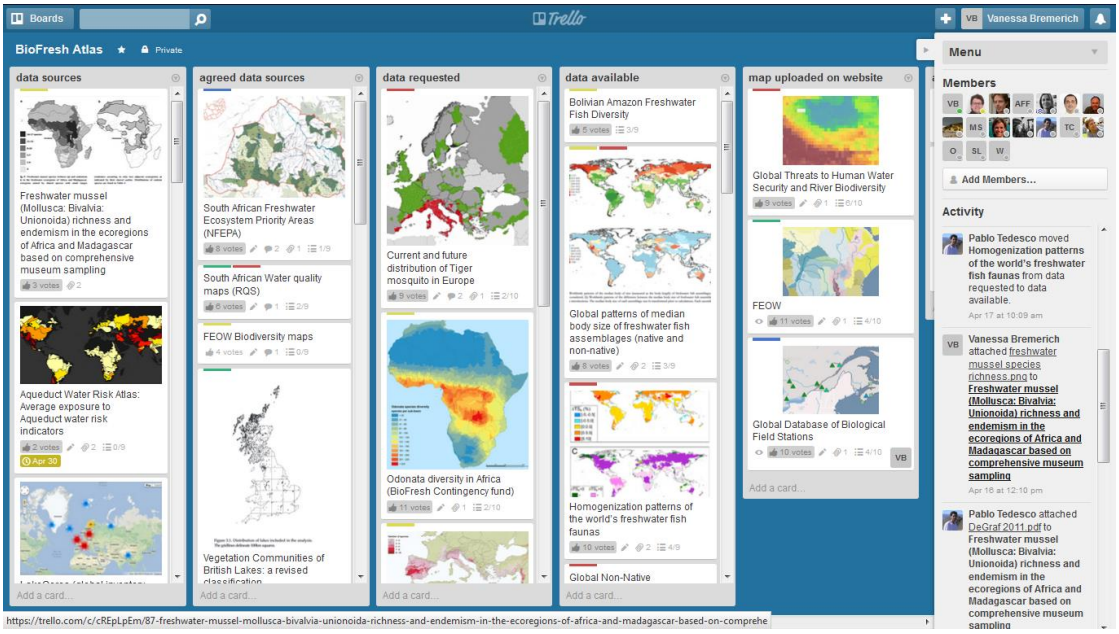


**Figure 6: Trello Board page for the Atlas Editorial Board**

In the final meeting of the editorial board in April 2014 most of the members agreed to stay on the board after the official end of BioFresh, providing continuity of work on the Atlas content. The board will also actively try to recruit new members.

### *Partner agreements*

As discussed in 2011 at the BioFresh stakeholder meeting in Montserrat, international organisations active in the field of freshwater biodiversity conservation and research were invited to become official partners of the Atlas. This initiative was undertaken to emphasise the collaborative nature of the Atlas project, to widen the audience of the Atlas through the dissemination channels of these partners and open up opportunities for future collaboration.

With the completion of the Atlas website beta version representatives of the following organisations received and accepted our invitation in December 2013: Group on Earth Observations Biodiversity Observation Network (GEO BON), DIVERSITAS, IUCN, the Global Water System Project (GWSP), Conservation International (CI), Wetlands International, The Nature Conservancy and the World Wildlife Fund (WWF).

These organisations were invited to review the beta version of the Atlas and to provide feedback, to contribute maps and to join the Editorial Board. They also were asked to support and promote the Atlas through their professional networks and (if applicable) through provision of material for inclusion into the Atlas. The logos of these partners were then displayed prominently on the Atlas start page and a separate page dedicated to the partners (http://atlas.freshwaterbiodiversity.eu/index.php/about-the-atlas/partners, see Figure 7). It is planned to add more information about the partner organisations on this page, and construct a similar page with information on institutions contributing maps to the Atlas.


**Figure 7: Atlas partner logos**

### *Dissemination and press review*

The Atlas was officially launched and presented to the public during the "Water Lives" science-policy symposium on 29th January 2014 in Brussels.

Prior to the launch a press release, containing information on the Atlas and statements from editorial board members was sent to all Atlas partners, and circulated through the networks of BioFresh members, posted on the BioFresh blog, promoted on Twitter, and translated from English to Spanish, French and German. The press release was quickly picked up on news websites, and in social media, leading to a high initial interest and visitor rates on the Atlas website.

All known published press mentions are collected on an internal page of the Atlas website accessible to editorial board members (access can be provided on request, http://atlas.freshwaterbiodiversity.eu/index.php/eb-press). In total 117 posts were registered, with 43 original articles or direct postings of the press release, and 74 follow-up press mentions derived from the original postings. Examples of original articles and interviews are listed below:

- Huffington Post guest blog post, 6 February 2014, "IUCN Releases First Online Global Freshwater Biodiversity Atlas" (http://www.huffingtonpost.com/charles-knapp-phd/iucn-releases-first-onlin_b_4740620.html)
- SciDevNet interview, 12 February 2014, "Freshwater atlas to help nations conserve biodiversity" (http://www.scidev.net/global/biodiversity/news/freshwater-atlas-to-help-nations-conserve-biodiversity.html)
- Geoawesomeness blog, 23 February 2014, "GIS on nature watch: First online Global Freshwater Biodiversity Atlas" (http://geoawesomeness.com/gis-nature-watch-first-online-global-freshwater-biodiversity-atlas/)
- ESA 2014. Dispatches. Frontiers in Ecology and the Environment 12: 92–96, March 2014, "New atlas reveals freshwater biodiversity worldwide" (http://www.esajournals.org/doi/full/10.1890/1540-9295-12.2.92)

Additionally the "Maps in Action" (http://research.freshwaterbiodiversity.eu/index.php/teaching-engagement/maps-in-action) series highlights selected policy relevant maps and helps to bring these maps to the attention of policy makers and the public.

### *Visitor statistics after Launch*

In the three months following the launch (until April 30th) 14,532 visits to the Atlas website were registered (each IP address counted once per day) (see Figure 8). This corresponds to approximately 4800 visits per month.

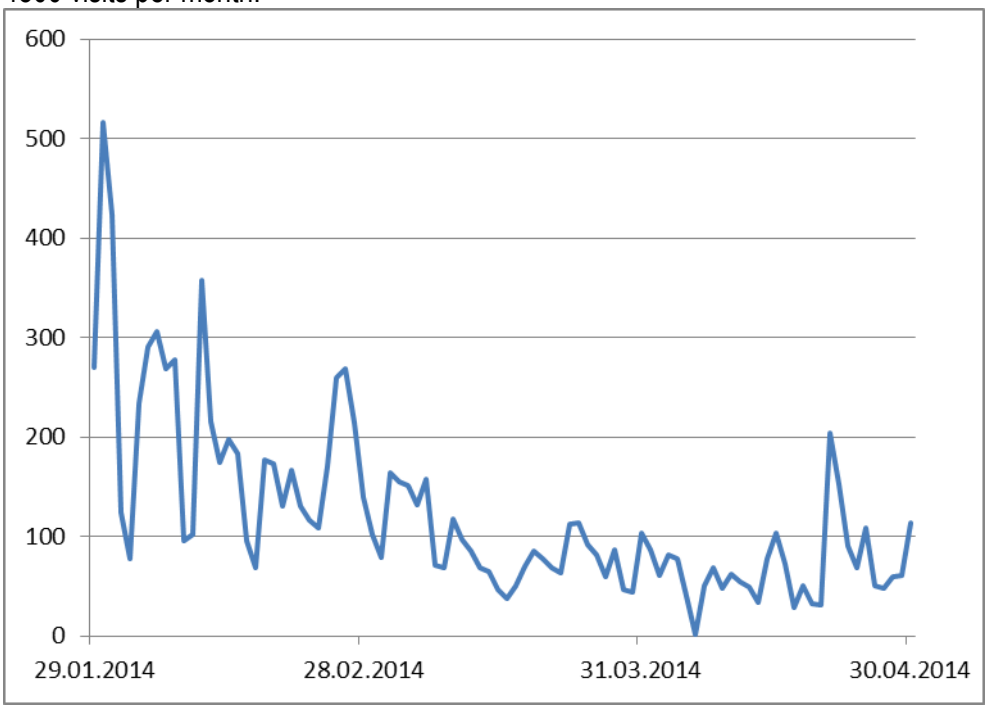


**Figure 8: Atlas visits per day (each IP address counted once a day)**

Most visits were registered coming from the United States, followed by Germany, Spain, and France, in total from 139 countries of the world (see Table 2).

**Table 2: Atlas visits per country in the first 3 months (rank 1-15)**

| rank | country | count |
|---|---|---|
| **1** | United States | 2587 |
| **2** | Germany | 1018 |
| **3** | Spain | 1005 |
| **4** | France | 853 |
| **5** | The Netherlands | 505 |
| **6** | United Kingdom | 489 |
| **7** | Austria | 384 |
| **8** | Portugal | 349 |
| **9** | Brazil | 335 |
| **10** | India | 224 |
| **11** | Switzerland | 219 |
| **12** | Italy | 216 |
| **13** | Canada | 208 |
| **14** | Australia | 171 |
| **15** | Sweden | 145 |
| **total** | | **14,532** |

***Future steps after the end of the project***

For the time after BioFresh IGB will provide funding to maintain and further develop the Atlas. Also most of the editorial board members are committed to devote a certain amount of time for the future of the Atlas.

The refinement of the web map interface elements, adding supplementary functionality (e.g. print template for maps and articles, ability to change layer opacity, ability to add layers directly from GeoServer to allow users to freely combine available layers with each map, upgrade feature info popups to display more information for each map layer, browse maps in map interface filtered by keywords) is planned. Spatial data without access restrictions will be made available for download; alternatively a link to a website offering the data for download will be provided. Metadata for the downloadable geodata may be stored on the Atlas webpage and for some datasets as well in the BioFresh metadatabase, or alternatively in an instance of GeoNetwork OpenSource spatial metadata catalogue, that would then be set up for the Atlas.

Key BioFresh products still to be integrated are among others the biodiversity matrix, the climate vulnerability index (CVI) and the key biodiversity areas (KBAs).

Furthermore plans exist to develop an advanced GeoPortal, linking the BioFresh data portal and the Atlas, allowing users to combine occurrence search results from the data portal with any map layers from the Atlas.

A second dissemination campaign is planned for autumn 2014, as well as the set-up of a “News” section on the Atlas website with an RSS feed. New maps will also be featured on the BioFresh blog (http://biofreshblog.com/, now renamed Freshwater blog) and Twitter (@biofreshatlas).