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EcoBase: a repository solution to gather and communicate information from EwE models

Mathieu Colléter, Audrey Valls, Jérôme Guitton, Morissette Lyne, Francisco Arreguín- Sánchez, Villy Christensen, Didier D. Gascuel, Daniel Pauly

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ECOBASE: A REPOSITORY SOLUTION
TO GATHER AND COMMUNICATE
INFORMATION FROM EWE MODELS

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A Research Report from the Fisheries Centre at UBC

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DIRECTOR'S FOREWORD

It is now clear that research addressed at a large scale can allow for new insights on complex phenomena taking place in the global ocean. Ecological studies are more and more based on data-driven methodologies that rely on pre-existing datasets. However, open-access, digital and cross-disciplinary datasets are still uncommon for ecology. In the face of the global overexploitation of marine resources and rapid degradation of ecosystem integrity, new research tools are required to tackle these issues and enable new powerful, interdisciplinary research capabilities. We have, in fisheries research generally, and at the Fisheries Centre in particular, broad experience with fisheries data collection, and analysis of food web aspects of ecosystem dynamics.

With this report titled *EcoBase: a repository solution to gather and communicate information from EwE models*, Colléter and colleagues have made a big effort at collecting information from all existing ecosystem models worldwide, built using the Ecopath with Ecosim (EwE) approach. EwE is the world's most widely used ecological modeling approach, and its development is led by Fisheries Centre researchers, including, Villy Christensen, Daniel Pauly and Carl Walters. A new accomplishment is now achieved with the EcoBase project initiated by the Ecopath Research and Development Consortium (ERDC) and carried out by the authors of this report. The ERDC was initiated at the Fisheries Centre in October 2011, and formally established in Edinburgh, Scotland, in May 2012. It contributes to creating synergies and partnerships between scientists in aquatic ecology, and promotes the EwE modeling approach.

The main goals of EcoBase are to (i) gather published EwE models; (ii) communicate on EwE modeling research; (iii) facilitate meta-analyses based on EwE models. EcoBase is meant to be a comprehensive, open-access, digital repository where EwE models are made discoverable, accessible and reusable by the scientific community. The structure, capabilities and current state of the EcoBase models repository are described in further details in this report. This represents new opportunities for research and trans-disciplinary analyses, including, trophic functioning, fisheries impact or economic aspects, for which I commend the authors.

U. R. Sumaila,
Director,
Fisheries Centre, UBC.

ECOBASE: A REPOSITORY SOLUTION TO GATHER AND COMMUNICATE INFORMATION FROM EWE MODELS¹

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INTRODUCTION

Data sharing in ecology

The Life Sciences have reached a new era, that of the “Big New Biology” (Thessen and Patterson 2011). Ecology is following the same pathway, and has turned into a data-intensive science (Kelling *et al.* 2009; Michener and Jones 2012). Ecological studies are more and more based on data-driven methodologies, relying on pre-existing large datasets and allowing for new insights on complex or underlying phenomena at global scales (Christensen *et al.* 2009). We are facing environmental degradation world-wide, and research has to be conducted at a large or global scale to tackle these issues. However, open-access, digital and cross-disciplinary datasets are still lacking for ecology to actually join the other historical “Big” sciences, such as astronomy (Thessen and Patterson 2011). The main reason for this relates to sociological and technological challenges with data sharing (Reichman *et al.* 2011; Thessen and Patterson 2011; Hampton *et al.* 2013).

Even if it is now clear that “large integrated datasets can potentially provide a much deeper understanding of both nature and society and open up many new avenues of research” (Science Staff 2011), data sharing too often remains individual scientists’ responsibility. In fact, sharing data is not a tradition in ecology (Pauly 1995; Reichman *et al.* 2011), yet it is a required principle for independent verification, as well as reuse (Vision 2010). Most of the time, biological data are not being collected with reuse in mind and are then published in a narrative or summarized style in scientific articles (Vision 2010; Thessen and Patterson 2011). The actual data are meant to be provided in online supplements or upon individual requests sent to the authors, but these options have been demonstrated unreliable (Vision 2010). Thus, several authors acknowledged that new practices are needed to make data sharing fully part of the culture in Life Sciences (Vision 2010; Reichman *et al.* 2011; Thessen and Patterson 2011; Dalglish *et al.* 2012; Hampton *et al.* 2013). The two critical stages at which practices have to be improved to allow for data sharing are the very first one, the collection of the data, and the very last one, the publication of the data. Another challenge is the simple loss of data (e.g., hard-copies, computer files in outmoded format), which can be met – at least in part – by extensive data sharing (Zeller *et al.* 2005).

The open-access principle of sharing information online for free has been increasingly applied to publications but much less to data, due to issues of recognition, technical support and sense of data ownership (Vision 2010; Thessen and Patterson 2011). Nevertheless, authors demonstrated that published papers making available their data are cited more frequently (Piwowar *et al.* 2007), and incentives for digitization of non-digital materials through the use of metadata and repositories have been growing (Thessen and Patterson 2011). A popular example in aquatic ecology is the FishBase database (www.fishbase.org). As stated by Thessen and Patterson (2011), repositories that “provide standardization, atomization and quality control services facilitate the [discovery, storage and] reuse of data and will play a stronger role in data-intensive science”. Since May 2007, the INSPIRE Directive established an Infrastructure for Spatial Information in the European Community to support environmental policies. The Directive notably requires that common Implementing Rules are adopted to ensure discoverability, compatibility and usability principles for spatial data to be shared among the Member States of the European Union (inspire.jrc.ec.europa.eu/index.cfm).

¹ Cite as: Colléter, M., Valls, A., Guitton, J., Morissette, L., Arreguín-Sánchez, F., Christensen, V., Gascuel, D. and Pauly, D. (2013) EcoBase: a repository solution to gather and communicate information from Ewe models. Fisheries Centre Research Report 21(1). Fisheries Centre, University of British Columbia, Canada (ISSN 1198-6727).

Ecopath with Ecosim (EwE)² models, a data source on marine ecosystems

Facing the challenges described above, the Ecopath Research and Development Consortium (ERDC) initiated the project of an Ecopath with Ecosim (EwE) models repository, which led to EcoBase, which we developed with the intention of making published models discoverable, accessible and reusable to the scientific community. The main goals of EcoBase are to (i) gather published EwE models; (ii) communicate on EwE modeling research; (iii) facilitate meta-analyses based on EwE models.

EwE is based on ECOPATH, a trophic web model initially developed by Dr. Jeffrey Polovina in the early 1980s. In ECOPATH, the modeled ecosystem was partitioned into groups of similar species and estimates of biomass, diet, production and food consumption were provided (Polovina 1984). The original version has then been developed further, notably by Drs. Daniel Pauly, Villy Christensen and Carl Walters from the UBC Fisheries Centre, and several versions have successively been proposed over the past 30 years. The latest released version of EwE (version 6.3, released on November 25, 2012) consists of a suite of three main routines: (i) Ecopath, a static, mass-balanced snapshot of the ecosystem food-web; (ii) Ecosim, a time-dynamic simulation module for exploring fisheries management or climate change scenarii; (iii) Ecospace, a spatial and temporal dynamic module primarily designed for exploring impact and placement of marine protected areas (Christensen and Pauly 1992; Walters *et al.* 1999; Pauly *et al.* 2000; Christensen and Walters 2004; Walters and Christensen 2007; Walters *et al.* 2008; Walters *et al.* 2010). In addition, a suite of modules or plug-ins have also been developed and added to the EwE package, such as EcoTroph, which is a representation of the biomass distribution across trophic levels in the ecosystem (Gascuel 2005; Gascuel *et al.* 2008; Gascuel and Pauly 2009; Gascuel *et al.* 2009; Gascuel *et al.* 2011). Details on the core principles and equations of EwE can be found in the references cited above as well as in the EwE6 user guide available online (Christensen *et al.* 2008). Since October 2011, the ERDC has been in charge of the research, development and sustainability of the EwE approach and software.

The EwE software is user-friendly, free (under the terms of the GNU General Public License) and downloadable online (www.ecopath.org). EwE can be seen as a tool-box offering a wide range of different tools and thus allowing analyses of various ecological phenomena. These are certainly the main reasons why it has been applied to hundreds of (aquatic) ecosystems worldwide. Several meta-analyses based on EwE models have been published (Table 1).

Some of these models focused on specific ecological questions, such as ecosystems flow characteristics (Christensen and Pauly 1993), ecosystem maturity (Christensen 1995), relations between stability and complexity (Pérez-España and Arreguín-Sánchez 1999) or stability and maturity (Pérez-España and Arreguín-Sánchez 2001), fish biomass predictions (Christensen *et al.* 2003b), ecosystem impacts of MSY policies from single-species assessment (Walters *et al.* 2005), the concept of alternative attractors (Feng *et al.* 2006) or the keystone species concept (Libralato *et al.* 2006), trophic flow kinetics (Gascuel *et al.* 2008), ecosystem effects of fishing on primary production and transfer efficiency (Libralato *et al.* 2008) or of selected marine protected areas (Le Quesne *et al.* 2008), top-down and bottom-up dynamics (Arreguín-Sánchez 2011), or metabolic scaling regularity (Salcido-Guevara *et al.* 2012). Others focused on ecosystems of particular interest, such as the South China Sea (Pauly and Christensen 1993; Christensen *et al.* 2003a), the Gulf of Mexico (Pauly *et al.* 1999; Vidal-Hernandez and Pauly 2004), the Gulf of California (Lluch-Cota *et al.* 2010) or the Mediterranean Sea (Coll and Libralato 2012). Finally, few meta-analyses were dedicated to a particular species or taxon, like jellyfish (Pauly *et al.* 2009) or squids (Coll *et al.* 2012). However, these meta-analyses were based on different individual datasets. To our knowledge, no comprehensive, open-access, digital collection of EwE models published worldwide has been made, and that is what EcoBase is meant to be.

EcoBase, an information repository

The EcoBase project seeks to gather information obtained from all the ecosystem models built using the EwE approach, which have been published worldwide in scientific journals, technical reports or theses. All models have already been referenced, but not all of them have been made available in EcoBase yet. We hope that the capabilities and perspectives of the EcoBase project described in this report will encourage more modelers to make their models fully available. EcoBase is not, strictly speaking, a database but an information repository, the distinction between the two being important, but generally overlooked (Thessen and Patterson 2011). Indeed, EwE models integrate several types of data: descriptive data on species abundance, diet composition and catch; computed data on species production, consumption and ecotrophic efficiency as well as ecosystem properties; and simulation data on species biomass trends after applying alternate scenarios. These data are required to build a model and run scenarios, and they are often only partly provided by the authors in the corresponding publications. There are also many cases where

² Strictly speaking, ECOPATH models correspond to models developed before the Ecosim implementation, and EwE models to models developed with Ecopath with Ecosim. We retroactively renamed all models as EwE models, even if EcoBase does not account for Ecosim data yet.

details on the data and parameters used to build the model are provided in supplementary materials, which are not always easily accessible.

Besides, each EwE model is also associated with a particular ecosystem with specific characteristics (e.g. location, area), as well as a corresponding publication (identified by its authors, year, reference type, etc.). The former information represents critical metadata when one wants to conduct a meta-analysis. However, detailed information on the modeled ecosystems is not systematically provided by the modelers. In EcoBase, we built a framework where all critical metadata may be stored, in a standardized and granular fashion, so that they can be reused as criteria based on which models can be selected for future meta-analyses. Thus, we hope that EcoBase would also serve authors as a template of the required information which should be provided when publishing a model. In the long term, EcoBase is meant to be used by ecosystem modelers worldwide as a platform where to (i) look for published EwE models; (ii) select and access models of interest to one's research work; (iii) download other's models as well as upload one's own models. Overall, EcoBase will provide an online repository where to make your own model discoverable, accessible and reusable to the scientific community, as soon as it is published. We believe EcoBase may thus contribute to create synergies and partnership between scientists in aquatic ecology.

Table 1. List of published meta-analyses based on EwE models

| Reference | Research question/topic | Location | Number of models |
|--|--|--------------------|------------------|
| Christensen and Pauly 1993 | Ecosystems flow characteristics | - | 41 |
| Christensen 1995 | Ecosystem maturity | - | 41 |
| Perez-España and Arreguín-Sánchez 1999 | Relation between complexity and stability | - | 4 |
| Perez-España and Arreguín-Sánchez 2001 | Relation between maturity and stability | - | 14 |
| Christensen <i>et al.</i> 2003a | Fish biomass predictions | North Atlantic | 23 |
| Christensen <i>et al.</i> 2003b | Fish biomass predictions | South China Sea | 16 |
| Walters <i>et al.</i> 2005 | Ecosystem impacts of MSY policies from single-species assessment | - | 11 |
| Feng <i>et al.</i> 2006 | Concept of alternative attractors | - | 36 |
| Libralato <i>et al.</i> 2006 | Keystone species concept | - | 33 |
| Gascuel <i>et al.</i> 2008 | Trophic flow kinetics | - | 55 |
| Libralato <i>et al.</i> 2008 | Ecosystem effects of fishing on primary production and transfer efficiency | - | 91 |
| Le Quesne <i>et al.</i> 2008 | Ecosystem effects of marine protected areas | - | 5 |
| Pauly <i>et al.</i> 2009 | Role of jellyfish in ecosystems | - | 23 |
| Lluch-Cota <i>et al.</i> 2010 | | Gulf of California | 12 |
| Arreguín-Sánchez 2011 | Top-down and bottom-up dynamics | - | 13 |
| Coll and Libralato 2012 | | Mediterranean Sea | 40 |
| Coll <i>et al.</i> 2012 | Role of squid in ecosystems | - | 75 |
| Salcido-Guevara <i>et al.</i> 2012 | Metabolic scaling regularity | - | 98 |

ECOBASE DESCRIPTION

History

Sharing data among EwE developers has been a persistent dream, and a models depository was implemented on the ecopath website (www.ecopath.org). However, only a small fraction of the published models were included on the web-page, and the structure was not in place for extensive data sharing. That is the reason why the idea of creating a new models repository has been growing since the creation of the Ecopath Research and Development Consortium (ERDC). The EcoBase project itself started with the PhD project of Mathieu Colléter, which consists in a meta-analysis of EwE models focusing on the trophic functioning of aquatic ecosystems. An oral presentation was made during the last Ecopath Consortium meeting (Colléter *et al.* 2012). Colléter and colleagues first gathered EwE models from two existing databases:

- Dr. Lyne Morissette developed Excel sheets for 178 EwE models, and listed the total number of EwE models developed to date (393 models (Morissette 2007)). She collected some metadata (publication year, reference, ecosystem type, area, modeled period, Ecosim model developed), as well as detailed data on each of the 178 EwE models (main inputs and outputs);
- Drs. Luís Antonio Salcido-Guevara and Francisco Arreguín-Sánchez developed an Access database, called ECOMOD, accounting for 153 models. This database was initiated during the INCOFISH project (INCOFISH 2006), and expanded later on as part of Dr. Salcido-Guevara PhD project (Salcido-Guevara 2006). The database integrated several metadata (publication info, geographic location, country, FAO area, LME, ecosystem type, etc.), functional groups, and all input and output data (basic parameterization and network analysis). All models were updated to EwE version 5.1 and verified in respect to associated publications.

The first step was then to compare and merge both sets of EwE models into one single database supported by PostgreSQL to create a data server. Making the same data available all over the world from a single database is the first step for information sharing. The main challenge was to define a database structure accounting for all compatibility and identification issues. Notably, we double-checked for duplicates and made sure that versions of similar EwE models inherited from both collections were actually identical. Indeed, some models had been modified to be balanced if they were not, whereas others were still not balanced. However, most of the time, all the modifications had been recorded and the collections proved to be very valuable materials. The two existing databases both integrated the great collection of documentation and files listed in the ecopath website. After matching, we obtained a list of about 200 unique models. Then, a third contribution was added to EcoBase: Dr. Villy Christensen and his team had gathered a collection of 233 EwE models, with their associated publications. Some metadata about the person through whom the model was given and the few modifications made had also been recorded. This collection was compared and merged as well to the previous list. We obtained an additional list of 132 unique additional models after comparison. Several authors have also sent their models directly for incorporation in the repository. Finally, since the inherited collections were not up-to-date with the most recent EwE models published, Audrey Valls and Mathieu Colléter conducted a literature review and ended up with a list of 99 recent (or previously missing) models, to be added to the list. Thus, we ended up with a list of 425 unique models and 494 models in total (including duplicates). A list of the EwE models registered and referenced in EcoBase is provided in Appendix 1 (with details on the model location, period, country, author, facilitator and reference, and indexes by author and country).

Software and access

Several database management systems were available to develop our information repository. We chose to use the PostgreSQL software. PostgreSQL is a professional relational database management system. It is a free software, and sources are available (www.postgresql.org). All its technical capabilities make it a robust and widely used management system. It notably has graphical interfaces to manage tables, libraries for various programming languages, and drivers for the Microsoft Open Database Connectivity (ODBC) application programming interface (API) enabling connections with several softwares. The database server is currently hosted on a development server at Agrocampus Ouest (Rennes, France) and accessible everywhere in the world (with access authorization).

Currently, access to the repository is possible through various interfaces such as: pgAdmin “the most popular and feature rich Open Source administration and development platform for PostgreSQL, the most advanced Open Source database in the world” (www.pgadmin.org), any Internet server, or Microsoft Access (office.microsoft.com/en-ca/access) through ODBC connections. All the different ways to access the repository are currently restricted with user logins and passwords, managed by the database administrators (DBAs). Full access to the repository is restricted to expert users (EUs) only. However, a large number of web services may become accessible to general users (GUs) (see section 2).

Structure of the repository

General structure

EcoBase comprises numerous tables encompassing all Ecopath data and various metadata. The architecture of the repository relies on one main table called 'models_list'. This table is used to declare all encoded models by assigning a unique number to each one, declared as a primary key: the 'model_number' variable. A primary key is a special relational database table column (or combination of columns) designated to uniquely identify all table records. It must contain a unique value for each row of data and no null values. The 'model_number' primary key enables a complete identification of each single model and linkages to other tables comprising the other data. Along with 'models_list', four other tables ('references_tables', 'models_details', 'fishery_fleets and 'import_like_groups') are used to declare the four other primary keys needed to create the linked tables (Figure 1). All five tables enable the creation of a series of tables used to store all the other data. We differentiated three categories of data stored in EcoBase.

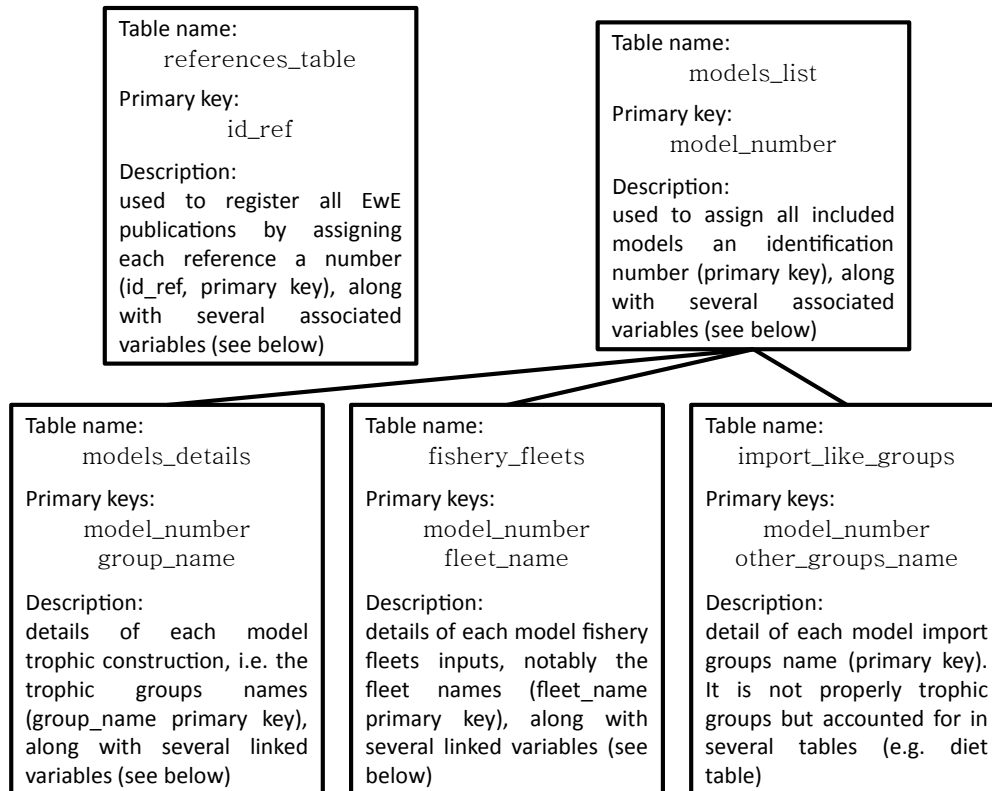
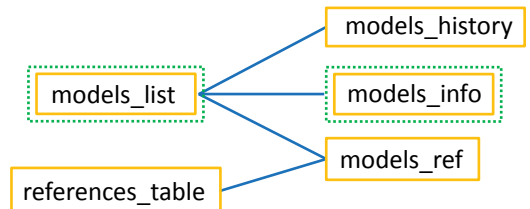


Figure 1. Basic diagram of the five main tables of the PostgreSQL EcoBase repository (name of the tables, associated primary keys and a short description).

Model metadata

A first objective of our approach was to store metadata on EwE models. These data are necessary for a complete identification of each model and to provide information not directly included in EwE data, such as the location of the ecosystem, the objectives and history of the model or its contributors. The definition of metadata was based on potential needs for conducting meta-analyses, and key points identified by merging the three existing databases of EwE models. All metadata were stored in five tables (Figure 2). We created three additional tables linked with 'models_list': 'models_history', 'models_info' and 'models_ref' (also linked with 'references_table'). Jointly, these tables enable a complete storage of all metadata and models quality criteria. A comprehensive list and detailed description of all the models' metadata fields is available in Appendix 2.



- 'models_list' enables the storage of several model parameters, such as the models name, author, units, the use of several routines or plug-ins (e.g. Ecosim, Ecospace, EcoTracer, EcoTroph), and other criteria of particular interest.

Figure 2. Relation diagram of the five metadata tables (orange solid contours indicate tables containing metadata, green dotted ones tables containing EwE inputs).

- ‘models_history’ includes information on the history of the model: through whom the model was obtained? ; is it balanced? ; is it referenced? ; has it been modified and by whom? Additionally, by merging several contributions, we included comments made at different stages by the different involved researchers.
- ‘models_info’ informs on the model itself and the modeled ecosystem. The table stores the model period, area, location, and geographic extent (see Appendix 3). We used Postgis extensions for Postgres which add spatial capabilities to the database. These libraries enable numerous spatial functions, like the computation of areas, distances, or intersections. The table also comprises several environmental variables, such as the ecosystem type or zone. We proposed a-priori classification of models by ecosystem types, and we distinguished 12 types: channel/strait, bay/fjord, coastal lagoon, coral reef, continental shelf (200m depth), ocean, river, estuary, reservoir, lake, beach, and terrestrial. We also defined three ecosystem zones: tropical, temperate and polar.
- ‘models_ref’ links the models to the associated references contained in ‘references_table’, and enables their classification by importance.

Model inputs

We also stored the descriptive data required to build EwE models, here called ‘model inputs’. Several tables have been designed to store these data (Figure 3). The names of the tables and fields have been designed to enable an easy understanding, and to create a homogeneous database with condensed information. All tables rely on the ‘models_list’ table and the three main associated tables ‘models_details’, ‘fishery_fleets’ and ‘import_like_groups’. This ensures referential integrity of EcoBase (e.g., if a model is suppressed from models_list, then all associated records are suppressed too). The repository has been designed to store all the input data coming from EwE version 6.3, also accounting for additional routines like the Taxonomy or Pedigree (Figure 4). An exhaustive list and detailed description of all models’ inputs fields is available in Appendix 2.

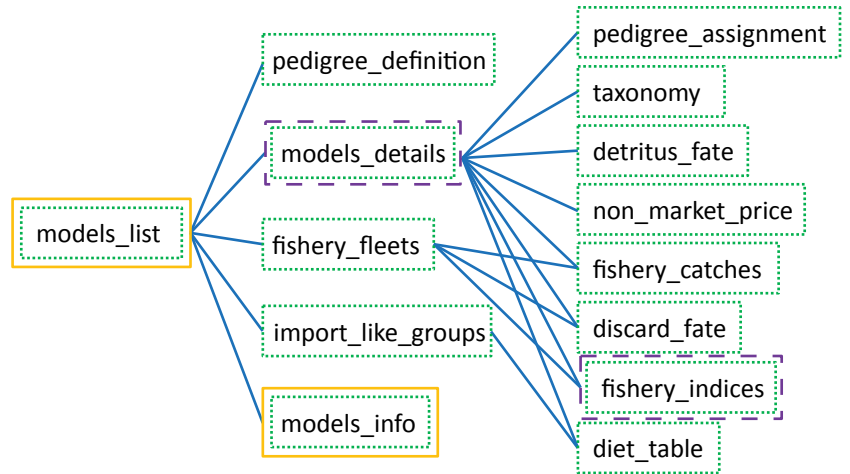


Figure 3. Relation diagram of the EwE input tables (orange solid contours indicate tables containing metadata, green dotted ones tables containing EwE inputs, and purple dashed ones tables containing EwE outputs).

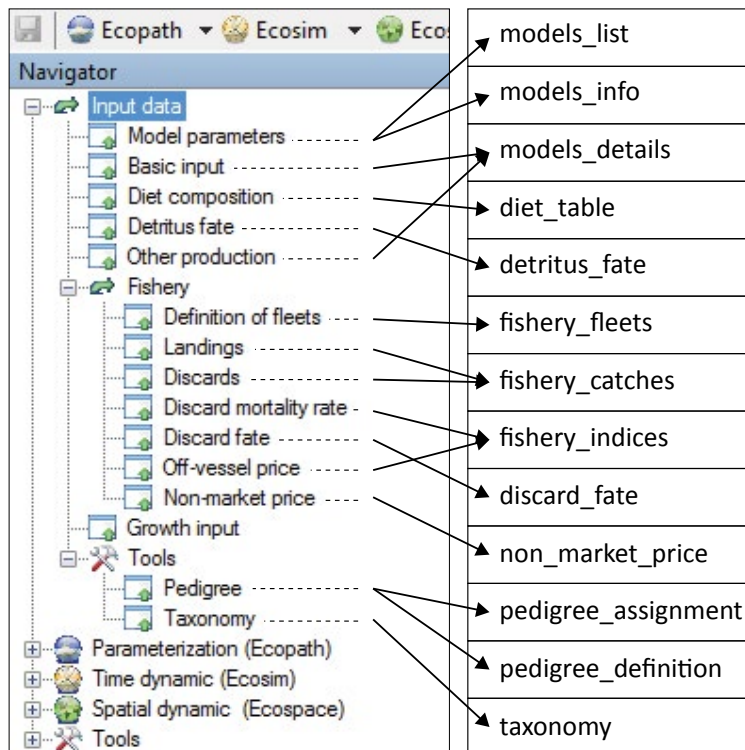


Figure 4. Snapshot of EwE software navigator for input data, and correspondence with EcoBase tables.

Model outputs (Ecopath)

For the purpose of our analyses, we decided to store as well in EcoBase the computed data obtained from EwE models (the Ecopath routine only), here called ‘model outputs’. In fact, several outputs are needed to perform meta-analyses or run EwE plug-ins, such as EcoTroph. Again, several tables have been designed to store these data (Figure 5). As we did for the ‘model inputs’, the tables and fields names have been chosen to simplify the usage and structure of EcoBase. The referential integrity is guaranteed by relations between tables and the use of the four main tables: ‘models_list’, ‘models_details’, ‘fishery_fleets’ and ‘import_like_groups’.

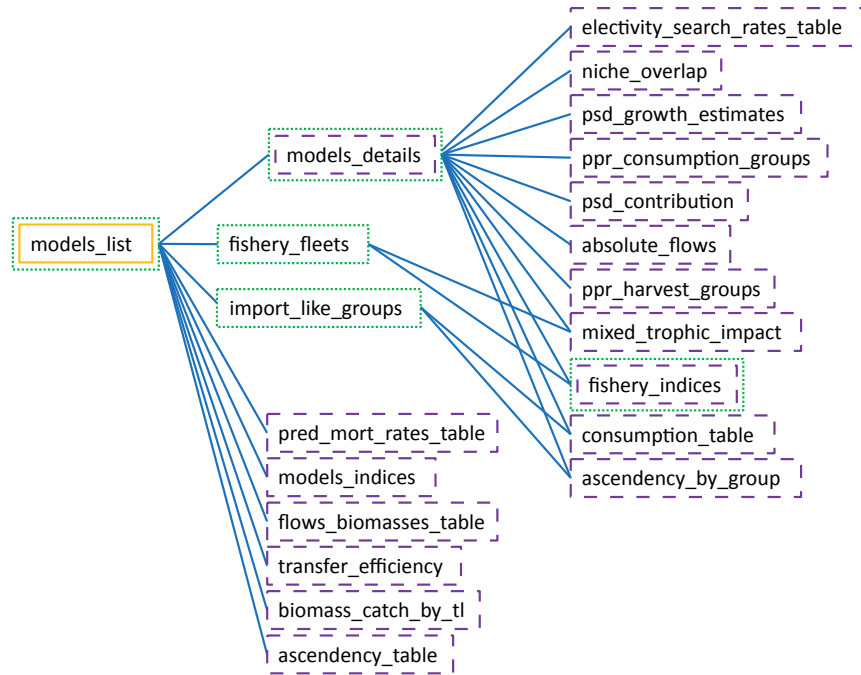


Figure 5. Relation diagram of the EwE input tables (orange solid contours indicate tables containing metadata, green dotted ones tables containing EwE inputs, and purple dashed ones tables containing EwE outputs).

The repository has been designed to store output data coming from EwE version 6.3 (Figures 6 and 7). We decided not to consider the Fishery Quantity and Value tables and the Relative Flows table as they are easily computable with included data. Details of the Cycle and Pathways module are not yet accounted for, due to the large amount of data this would have required, and neither are the Ecosim Network Analysis and Value Chain modules. The architecture of EcoBase can still evolve to include new data and fulfill new needs expressed by the EwE community. A complete list and full description of all the models’ outputs fields is available in Appendix 2.

In conclusion, EcoBase has been designed to store almost all data coming from EwE version 6.3, also accounting for several relevant modules, such as the Taxonomy, Particle Size Distribution and Pedigree. Additional metadata may also be stored, such as the geographic coordinates (spatial extent of the model, see Appendix 3). Model quality criteria were also added for selection and meta-analyses. The entire structure of EcoBase can be summarized using a relations diagram (Figure 8). We strongly believe that the format we chose is suitable not only for our particular use, but also for a global use by any EwE modelers and fisheries scientists.

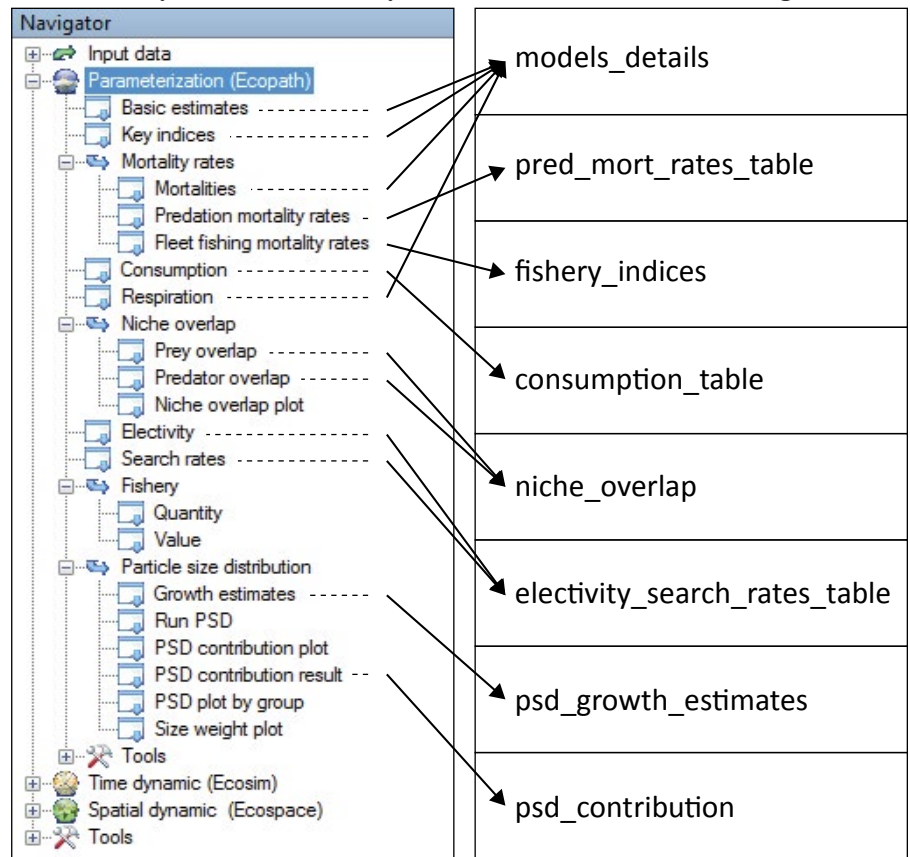


Figure 6. Snapshot of EwE software navigator for input data, and correspondence with EcoBase tables.

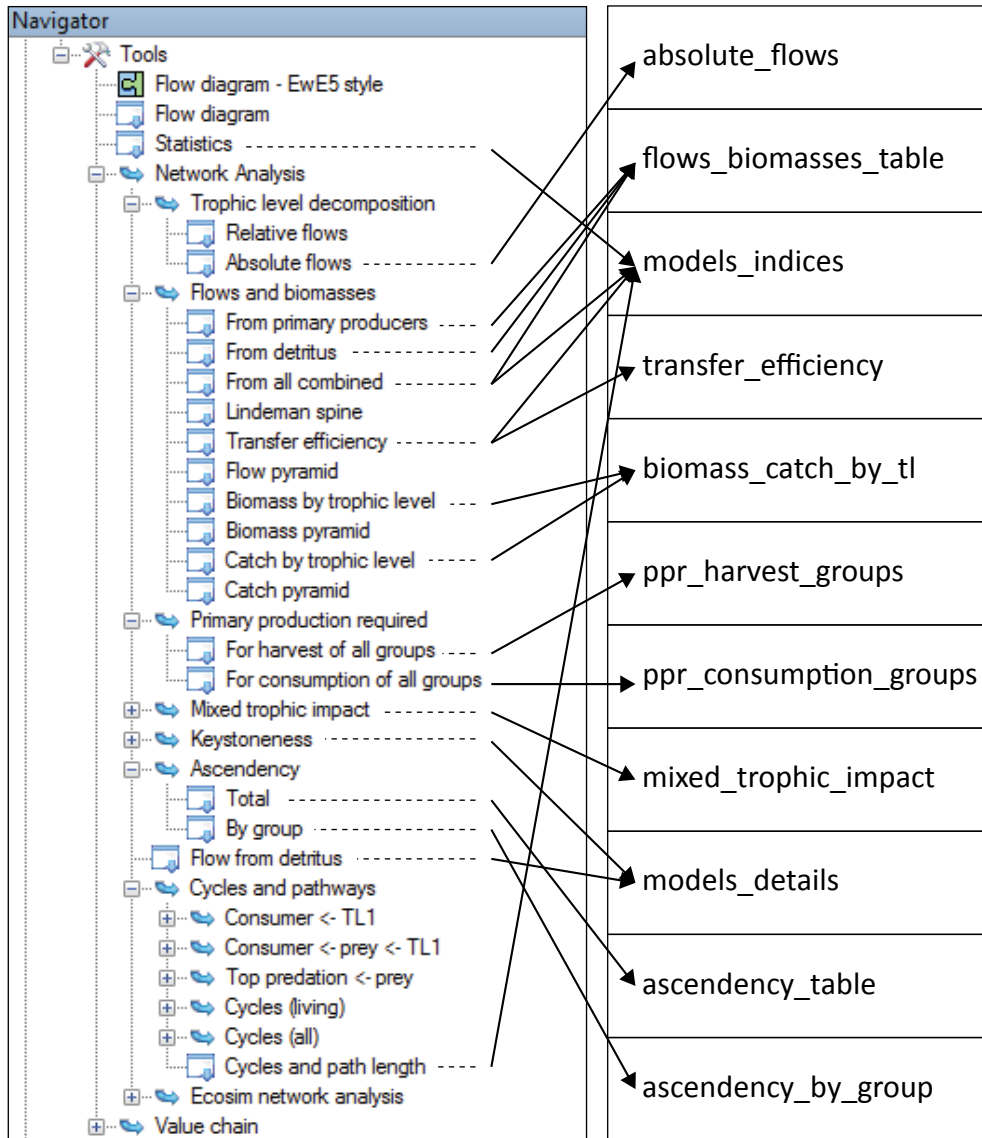


Figure 7. Snapshot of EwE software navigator for Network analysis output data, and correspondence with EcoBase tables.

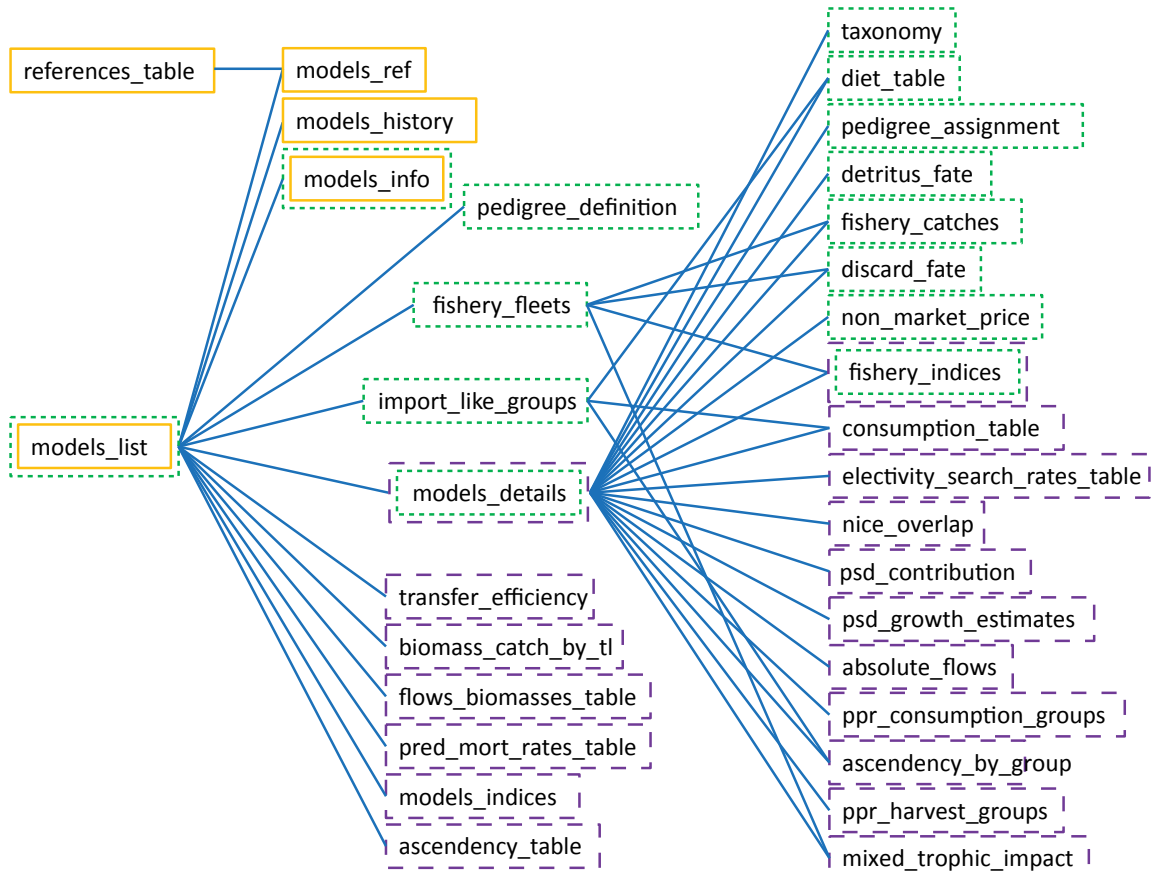


Figure 8. Diagram of tables relations (orange solid contours indicate tables containing metadata, green dotted ones tables containing EwE inputs, and purple dashed ones tables containing EwE outputs).

ECOBASE CAPABILITIES

Overview

After presenting the repository software and structure, we introduce in this section the possible usages of EcoBase and detail functionalities associated to the different users categories: the general users, and the developers including the database administrators (DBAs) and the expert users. The PostgreSQL Relational Database Management System (RDBMS) and the structure we developed enable powerful capabilities to share services linked with the database content. As for the database administrators, the EcoBase RDBMS and structure present interesting capabilities such as: a control of the access, centralized modifications, and a unique information source. Database administrators as well as expert users can directly use the database to manage structure and access, or perform analyses. Such powerful capabilities cannot logically be given to everybody. General users need more elaborated and controlled pathways to access data, via web services (Figure 9). Once users' needs are expressed, we have to deal with three main issues: (i) how to organize the database feeding; (ii) how to disseminate the data; (iii) which services to set up.

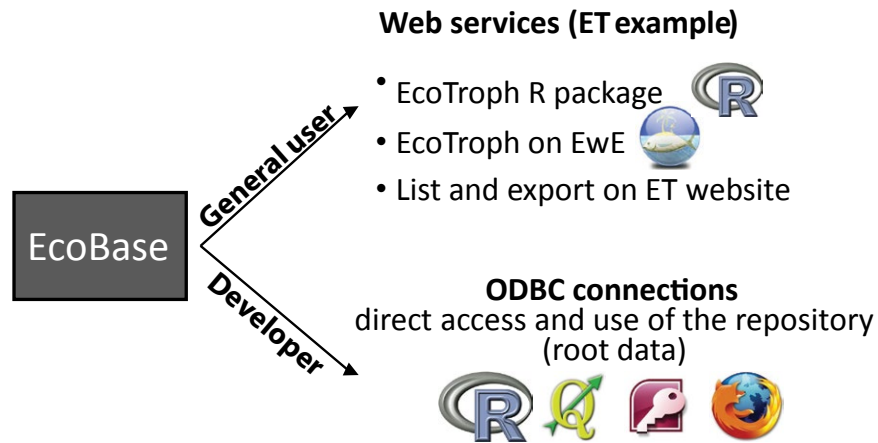


Figure 9. PostgreSQL formats user's functionalities.

For general users

A great number of web services responding to the general users' expectations are possible using EwE models data loaded in EcoBase and metadata added for each model. Examples detailed below focus on web services already developed and related to the EcoTroph approach, which give an interesting overview of the potential capabilities of EcoBase.

- **EcoTroph R package:** An EcoTroph R package has been developed enabling an independent use of the EcoTroph model (Coll ter *et al.* 2013). This package contains EcoTroph functions but also a 'read.ecopath.model' function. This function enables the loading of data needed for EcoTroph analyses from each model in EcoBase with a granted access. EcoTroph users are given the possibility to analyze any Ecopath model available in the EcoBase models repository.
- **EwE EcoTroph plug-in:** A new functionality of the EwE EcoTroph plug-in is a linkage with EcoBase. EcoTroph inputs can be loaded in three different ways: from the model loaded in EwE, from an external .xml file, or from EcoBase via a web service which lists each model in EcoBase with a granted access and downloads the selected one (Figure 10).

A list of available EwE models stored in the repository and a short description of each of them is displayed on the EcoTroph website (sirs.agrocampus-ouest.fr/EcoTroph/). Users have the possibility to select a model, obtain additional information and see a map of the spatial extent of the model (see Appendix 3). Data needed for EcoTroph are also downloadable from this interface for each model in EcoBase with a granted access (Figure 11). The web service is yet limited (search by name or on a map if the geographic extent of the model is known), but advanced search capabilities could be easily developed using the models metadata.

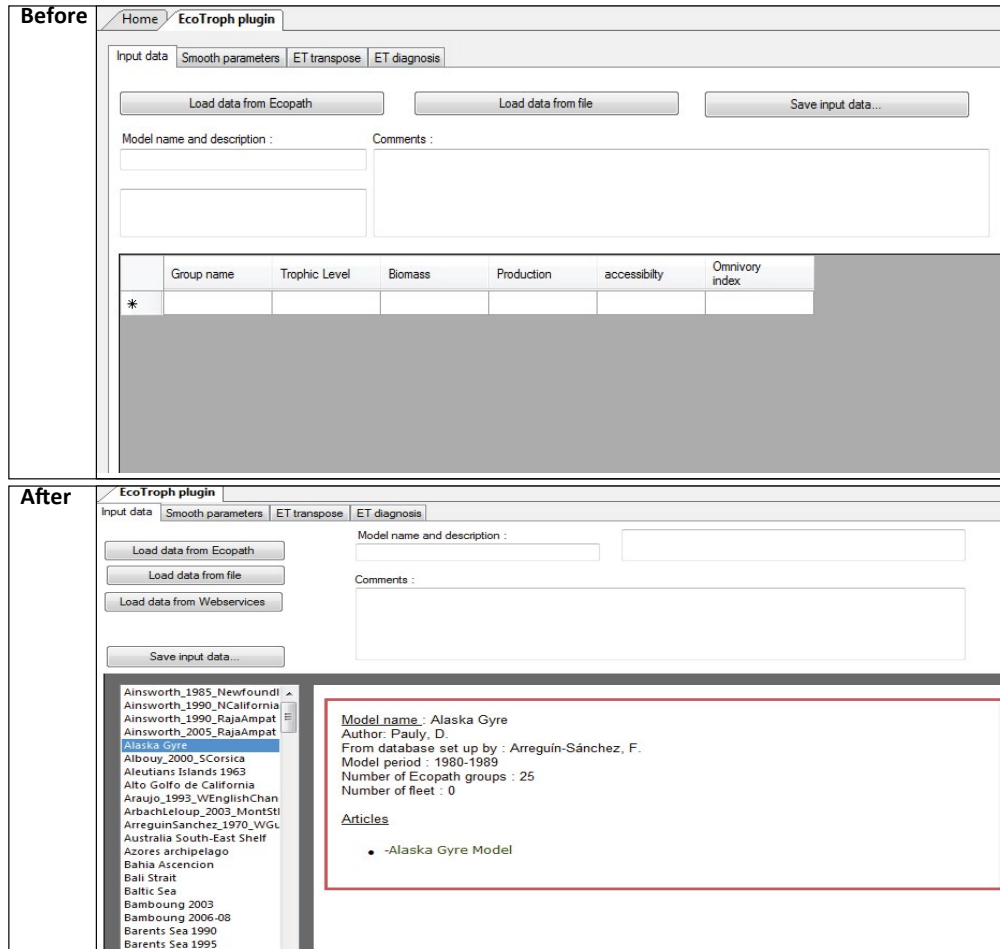



Figure 10. Snapshot of the EwE EcoTroph plug-in before and after the implementation of the EcoBase web service.



An EcoTroph modelling package for


Home

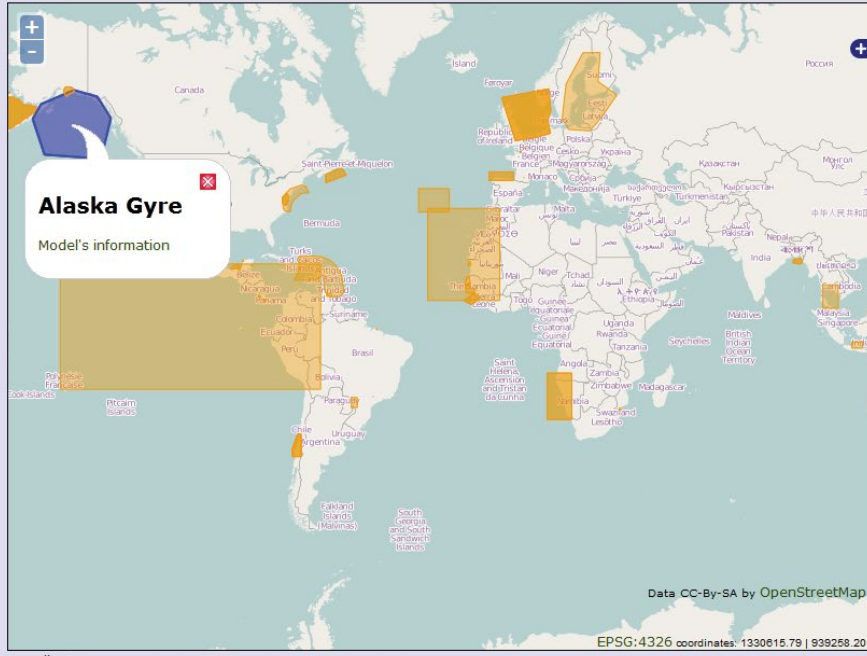
Download

Documentation

Examples

EcoBase





Data CC-BY-SA by OpenStreetMap
EPSG:4326 coordinates: 1330615.79 | 939258.20

coordinate

- 0 - Ainsworth_1985_Newfoundland, Author : Ainsworth, C.H., Model period : 1985-1985
- 1 - Ainsworth_1990_RajaAmpat, Author : Ainsworth, C.H., Model period : 1990-1990
- 2 - Ainsworth_2005_RajaAmpat, Author : Ainsworth, C.H., Model period : 2005-2005
- 3 - Alaska Gyre, Author : Pauly, D., Model period : 1980-1989
- 4 - Albouy_2000_BSNR_Corsica, Author : Albouy, C., Model period : 2000-2001
- 5 - Aleutian Islands 1963, Author : Guénette, S., Model period : 1963-1963
- 6 - Alta Golfo de California, Author : Morales, J., Model period :

Figure 11. Snapshot of the EwE models list available on the ET website.

For developers only

EcoBase presents great capabilities for developers (including database administrators and expert users). First, a full control of the access to root data (tables and structure) is possible through security features of PostgreSQL (controlled by login, password, IP). Expert users who want to connect directly to the database need a user login and a password controlled by database administrators. There is also the possibility to manage different rights to users (data consulting only, data editing, etc.). Expert users can access to the complete database through the use of ODBC connections or the web interface, with clearly defined access rights allocated by database administrators. This opens new capabilities for expert users, notably statistical analyses using R and the package RODBC (cran.r-project.org/web/packages/RODBC/index.html) (or Rpgsql for Linux users), or spatial outputs using GIS tools. The great amount of data and the easy access through R is an open gate to large and reproducible analyses. However, these expert users' capabilities do not constitute the standard way to use the database, since it is often the less controlled and more CPU time-consuming. Thus, the number of expert users should be limited to ensure that standard services will always be available for general users.

In conclusion, EcoBase constitutes a unique source of information where modifications and usages are centralized and manageable. Access is possible all over the world, freely and easily. The repository can be managed by several database administrators at different places, and enables the set-up of a developers' community. Data access is fully controlled by database administrators through the use of clearly defined rights to the associated expert users, and web services for general users. A great number of web services answering general users' expectations are possible using EwE models data loaded in EcoBase and metadata added for each model. Provided examples concentrate on EcoTroph use, but give an interesting overview of capabilities. Direct interactions with the EwE software are possible, as external uses to provide additional information.

EcoBASE: CURRENT STATE AND FUTURE DEVELOPMENTS

Current state of EcoBase

As presented in the sections above, the core structure of EcoBase is in place but not all the fields have been encoded yet. Thus, in its current state, the models repository is not completed. The first phase of encoding focused on metadata. An exhaustive inventory of all published EwE models was completed and a final list of models in EcoBase was established. For all listed models, available information on metadata was then collected from the original publications describing the models and encoding of all fields consisting in metadata was completed. However, few actual data has been encoded in EcoBase yet. 494 EwE models are currently referenced in the EcoBase repository of which 425 are unique (see Appendix 1). Table 2 shows a detailed assessment of the current data availability, by table and for all referenced models. Data used by the EcoTroph routines have been encoded by Mathieu Colléter, as part of his PhD project, for models included in the Morissette and Arreguín-Sánchez databases. The completion of encoding will constitute the second phase of the project. EcoBase structure enables encoding of all input or output data from any referenced Ecopath models. EcoBase originally focused on the Ecopath routine of EwE models, so that no Ecosim time series or Ecospace maps can be stored in the database in its current state. Also, EwE scenarios are a type of data highly dependent on the context in which they were generated, putting restrictions on their potential reuse.

Table 2. Data availability for all referenced models in EcoBase (May 2013)

| Table | Data type | Data availability |
|-------------------------------|------------------|---|
| absolute_flows | Output | Empty |
| ascendency_by_group | Output | Column 'Throughput' available for models initially assembled by L. Morissette and F. Arreguín-Sánchez |
| ascendency_table | Output | Empty |
| biomass_catch_by_tl | Output | Empty |
| consumption_table | Output | Empty |
| detritus_fate | Input | Available for one model (test) |
| diet_table | Input | Available for one model (test) |
| discard_fate | Input | Available for one model (test) |
| electivity_search_rates_table | Output | Empty |
| fishery_catches | Input | Available for models assembled by L. Morissette and F. Arreguín-Sánchez |
| fishery_fleets | Input | Available for models assembled by L. Morissette and F. Arreguín-Sánchez |
| fishery_indices | Input / Output | Available for one model (test) |
| flows_biomasses_table | Output | Empty |
| mixed_trophic_impact | Output | Empty |
| models_details | Input / Output | Available for models assembled by L. Morissette and F. Arreguín-Sánchez |
| models_history | Metadata | Available for all models |
| models_indices | Output | Available for models assembled by L. Morissette and F. Arreguín-Sánchez |
| models_info | Metadata / Input | Available for all models |
| models_list | Metadata / Input | Available for all models |
| models_ref | Metadata | Available for all models |
| niche_overlap | Output | Empty |
| non_market_price | Input | Available for one model (test) |
| other_groups | Input | Available for models assembled by L. Morissette and F. Arreguín-Sánchez |
| pedigree_assignment | Input | Empty |
| pedigree_definition | Input | Empty |
| ppr_consumption_groups | Output | Empty |
| ppr_harvest_groups | Output | Empty |
| pred_mort_rates_table | Output | Empty |
| psd_contribution | Output | Empty |
| psd_growth_estimates | Output | Empty |
| references_table | Metadata | Available for all recorded references |
| taxonomy | Input | Empty |
| transfer_efficiency | Output | Empty |

Future improvements of EcoBase

EcoBase is an on-going project and many features are still to be improved to make it a more powerful and efficient tool. Table 3 shows a report card of EcoBase, which summarizes the key features already implemented, or still to be implemented, and estimates the degree of completion of each feature. Future improvements should notably focus on data encoding, linkages between EcoBase and the EwE software and database access policy. Also, users should not be allowed to encode outputs which are not consistent with the inputs. Maintenance of EcoBase in the long-term is probably the most critical aspect to ensure a long life span of the repository, facing issues such as migration to new technologies or updating.

Table 3. Report card of EcoBase

| Feature | Grade | Comment |
|--------------------------------|-------|---|
| 1. Structure | A | Structure is in place for storing metadata and Ecopath inputs/outputs data. Note: no Ecosim or Ecospace data considered yet. |
| 2. Metadata | A | Metadata encoding is completed and metadata are accessible and usable. Remaining missing metadata was not provided in the references. |
| 3. Data | D | Data encoding is not completed and data are not accessible or usable. Requires completion of items 4 and 5. |
| 4. Links with the EwE software | C | No link between EcoBase and the EwE software is currently available, but feasible to develop such linkages. Several options are under consideration. |
| 5. Open-access | C | Several options are under consideration. Requires a consensus within the ERDC. |
| 6. Website and web services | B | Website partially completed: some functionalities already implemented such as models browser; some still missing such as fill-in forms for adding models. |
| 7. Short-term maintenance | A | Mathieu Colléter and Jérôme Guitton are in charge of the maintenance in the short term. |
| 8. Long-term maintenance | D | Modalities of the maintenance in the long-term still have to be defined. |

Projects possibly involving EcoBase

As mentioned in the introduction, only a few meta-analyses based on a large collection of EwE models have been published. EcoBase creates new opportunities for various types of meta-analyses, involving larger datasets, at broader scales. The repository notably provides standardized and atomized metadata, which may be used as selection criteria. By applying a scoring method on these criteria, a list of models of potential interest may be obtained. The pool of selected models may then be reused to conduct meta-analyses. Also, the ODBC connections and web services enable direct links between EcoBase and popular statistical softwares such as R (www.r-project.org/), which allows for statistical analyses to be easily and quickly run. Besides, new mapping tools for EwE models are available in EcoBase and may be used to get new insights on EwE-based research worldwide (see Appendix 3). Table 4 shows a list of researchers who are members of on-going projects using EcoBase, or who have expressed strong interest in using the models repository. The list is not meant to be exhaustive and should grow as EcoBase is enhanced.

Table 4. List of on-going and potential projects involving EcoBase

| Researcher | Interest | Project status |
|--|--|--|
| Mathieu Colléter (UBC/Agrocampus Ouest) | Trophic functioning meta-analysis (TE, Kinetic) and EcoTroph use | On-going PhD thesis |
| Audrey Valls (UBC, Nereus Program) | Index of Keystoneness; Diet composition | On-going PhD thesis |
| Sylvie Guénette (EcOceans) | Trophic role of small pelagics | Interests expressed |
| James Watson (Nereus Program) | Particle size distributions | Interests expressed |
| Deng Palomares (UBC, FishBase) | Links EcoBase-FishBase | Interests expressed |
| Jérôme Guitton (Agrocampus Ouest) | Links EcoBase-EwE | Starting project |
| Jérémy Lobry (IRSTEA) | Meta-analysis of EwE models of estuaries | Interests expressed |
| Jean Guillard, Orlanne Anneville and Jérémy Lobry (INRA/IRSTEA) | Meta-analysis of EwE models of lakes (Alpes) | Interests expressed (PhD thesis) |
| James Simons (CCS-TAMU-CC) | Linking EcoBase with the Gulf of Mexico trophic database | Interests expressed (GoMexSI project) |
| Francisco Arreguín-Sánchez (IPN-CICIMAR) | | |
| Luis Salcido-Guevara (IPN-CICIMAR) | Supply-demand balance of trophic networks | On-going research |
| Francisco Arreguín-Sánchez (IPN-CICIMAR) | Ecosystem functional indicators | On-going research |
| Monica Ruiz-Barreiro (IPN-CICIMAR) | Exergy: application to management and conservation | Interests expressed (PhD thesis) |

Links with the Ecopath Research and Development Consortium

Building a models repository was an initiative of the Ecopath Research and Development Consortium (ERDC), and EcoBase is an outcome of this initiative. The EcoBase project was instigated with two main phases in mind. Phase 1 consisted in establishing an up-to-date and comprehensive list of published Ecopath models and making the models discoverable through an online repository. Phase 1 notably involved: (i) merging three pre-existing lists of Ecopath models, gathered by Francisco Arreguín-Sánchez, Lyne Morissette and Villy Christensen; (ii) selecting published Ecopath models only and identifying their associated references (citations); (iii) collecting metadata about the published Ecopath models, when provided in the associated references (see Appendix 1). Phase 1 has been done as part of Mathieu Colléter and Audrey Valls' PhD theses and is now completed. We believe it will be valuable to anyone willing to conduct meta-analyses of Ecopath models.

Phase 2 is meant to be taken over by the ERDC, under the coordination of the Models Repository Working Group. The ERDC was initiated in Vancouver, Canada, in October 2011, and formally established in Edinburgh, Scotland, in May 2012. It is “a global, cooperative network focused on the research, development and sustainability of the EwE approach and software, its information basis, and complementary activities and capabilities”. Its objective is “to contribute to the sustainability of living resources and ecosystems by developing, applying, teaching, and promoting modeling and analytical tools, with a focus on the EwE modeling approach” (www.ecopath.org/consortium). Phase 2 will consist in making accessible to and reusable by the EwE community all the Ecopath models which are currently discoverable in EcoBase. We believe that open-access has to become the way of thinking in ecology and we built the EcoBase repository with this idea in mind. Thus, we hope that the ERDC will encourage the EwE community to take that route as well.

CONCLUSIONS

This report constituted for us a great opportunity to present the on-going EcoBase project. The EcoBase models repository is meant to make published EwE models discoverable, accessible and reusable, and thus to enhance the promotion of EwE-based approaches and meta-analyses in marine ecosystem modeling. It has been designed to meet global scientific challenges, such as data sharing, gathering and dissemination. We merged three existing EwE models databases into a new models repository enabling more powerful capabilities. The architecture of EcoBase is meant to correspond to the EwE software structure (version 6.3) and collect all the data required for conducting meta-analyses and ensuring models identification. We integrated a large amount of metadata on the models origin, structure, and history, as well as the modeled ecosystems traits. Moreover, the PostgreSQL format enables new capabilities for data sharing and access control. The structure of the repository is flexible, and the database administrators have a full control on users' access. Thus, different user profiles are configurable through the use of web services. We have already developed interesting examples of web services linked with the EcoTroph approach, and there are possibilities for more if new users are willing to develop their own tools in the future.

This report represents the completion of the phase 1 of the EcoBase project. We developed the models repository as part of the ERDC initiative to move forward in EwE modeling. We hope EcoBase will offer new functionalities to the EwE community and bring new perspectives within the ERDC. The phase 2 of the EcoBase project is meant to be taken over by the members of the Models Repository Working Group, under the coordination of the ERDC. We would like to encourage them to develop new linkages between EwE and EcoBase, which could help encoding all missing data in EcoBase as well as developing new web services for EwE modelers. We envision the EcoBase project as a new opportunity for strengthening the EwE community via a shared online tool, and offering new capabilities for EwE research and communication.

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APPENDIX 1. LIST OF EwE MODELS REGISTERED AND REFERENCED IN EcoBASE (LIST OF THE MODELS, THE ASSOCIATED REFERENCES AND INDEXES BY AUTHOR AND BY COUNTRY)

Appendix Table A1. List of the EwE models

| Number | Location | Period | Country | Author | Facilitator | References |
|--------|---|-----------|--|-------------------------|----------------|------------|
| 7 | Azores archipelago | 1997-1997 | Portugal | Guénette, S. | Morissette, L. | 8 |
| 12 | Bay of Bengal | 1984-1986 | Bangladesh | Mustafa, M.G. | Morissette, L. | 12 |
| 13 | Bay of Biscay | 1970-1970 | France | Ainsworth, C.H. | Morissette, L. | 13 |
| 14 | Bay of Biscay | 1998-1998 | France | Ainsworth, C.H. | Morissette, L. | 13 |
| 22 | Cantabrian Sea | 1994-1994 | Spain | Sánchez, F. | Morissette, L. | 23 |
| 24 | Caribbean Islands | 1986-1986 | Not affiliated | Melgo, J.L. | Morissette, L. | 24 |
| 25 | Celestun lagoon | 1986-1986 | Mexico | Vega-Cendejas, M.E. | Morissette, L. | 25 |
| 27 | Celestun lagoon | 1986-1986 | Mexico | Vega-Cendejas, M.E. | Morissette, L. | 25 |
| 28 | Atlantic Ocean, central | 1950-1950 | Not affiliated | Vasconcellos, M. | Morissette, L. | 27 |
| 29 | Atlantic Ocean, central | 1998-1999 | Not affiliated | Vasconcellos, M. | Morissette, L. | 27 |
| 30 | Central Chile | 1992-1992 | Chile | Neira, S. | Morissette, L. | 28 |
| 33 | Pacific Ocean, central | 1990-1998 | Not affiliated | Cox, S.P. | Morissette, L. | 31 |
| 34 | Chesapeake Bay | 1950-1950 | United States of America | Christensen, V. | Morissette, L. | 32,479 |
| 35 | Chesapeake Bay | 2002-2002 | United States of America | Christensen, V. | Morissette, L. | 32 |
| 36 | Mexican Caribbean | 1990-1990 | Mexico | Alvarez-Hernández, J.H. | Morissette, L. | 33 |
| 40 | Nova-Scotia, Eastern | 1980-1985 | Canada | Bundy, A. | Morissette, L. | 34,35 |
| 41 | Nova-Scotia, Eastern | 1995-2000 | Canada | Bundy, A. | Morissette, L. | 35,34 |
| 42 | Pacific Ocean, Eastern tropical | 1993-1997 | Not affiliated | Olson, R.J. | Morissette, L. | 36,37,459 |
| 43 | English Channel | 1973-1973 | U.K. of Great Britain and Northern Ireland | Stanford, R. | Morissette, L. | 38 |
| 44 | English Channel | 1995-1995 | U.K. of Great Britain and Northern Ireland | Stanford, R. | Morissette, L. | 38 |
| 46 | Faroe Islands | 1997-1997 | Faroe Islands | Zeller, D. | Morissette, L. | 435,41,40 |
| 48 | Floreana Island | 2000-2001 | Ecuador | Okey, T.A. | Morissette, L. | 43 |
| 49 | Gambia, continental shelf | 1986-1986 | Gambia | Mendy, A.N. | Morissette, L. | 44 |
| 50 | Gambia, continental shelf | 1992-1992 | Gambia | Mendy, A.N. | Morissette, L. | 45 |
| 51 | Gambia, continental shelf | 1995-1995 | Gambia | Mendy, A.N. | Morissette, L. | 45 |
| 52 | Gironde estuary | 1991-1998 | France | Lobry, J. | Morissette, L. | 478,46 |
| 53 | Gulf Dulce | 1993-1994 | Costa Rica | Wolff, M. | Morissette, L. | 47 |
| 54 | GBR, Northern | 1993-1994 | Australia | Gribble, N.A. | Morissette, L. | 49,48 |
| 55 | Large area off Guinea | 1985-1985 | Guinea | Guénette, S. | Morissette, L. | 50 |
| 56 | Large area off Guinea | 1998-1998 | Guinea | Guénette, S. | Morissette, L. | 50 |
| 57 | Guinea-Bissau continental shelf | 1990-1992 | Guinea-Bissau | Amorim, P. | Morissette, L. | 51 |
| 58 | Gulf of Mexico | 1980-1989 | Mexico | Browder, J.A. | Morissette, L. | 52 |
| 60 | Gulf of Thailand | 1997-1997 | Thailand | Vibunpant, S. | Morissette, L. | 54,56,55 |
| 66 | Icelandic marine ecosystem (ICES area Va) | 1997-1997 | Iceland | Mendy, A.N. | Morissette, L. | 60 |
| 67 | Icelandic shelf | 1997-1997 | Iceland | Mendy, A.N. | Morissette, L. | 61 |
| 68 | Icelandic shelf | 1997-1997 | Iceland | Samb, B. | Morissette, L. | 62 |
| 71 | Lagoon Chiku | 1997-1997 | China | Lin, H.-J. | Morissette, L. | 65 |
| 72 | Lagoon of Venice | 1994-1994 | Italy | Carre, S. | Morissette, L. | 66 |
| 73 | Manila, Laguna de Bay | 1950-1950 | Philippines | Delos Reyes, M.R. | Morissette, L. | 67,68 |
| 74 | Manila, Laguna de Bay | 1980-1980 | Philippines | Delos Reyes, M.R. | Morissette, L. | 67,68 |

Appendix Table A1. Continued

| Number | Location | Period | Country | Author | Facilitator | References |
|--------|---|-----------|--------------------------|----------------------------|----------------|------------|
| 76 | Lake Awassa | 2003-2004 | Ethiopia | Fetahi, T. | Morissette, L. | 452,69 |
| 81 | Lake Malawi | 1977-1996 | Malawi | Nsiku, E. | Morissette, L. | 74 |
| 86 | Lake Victoria | 1985-1986 | Kenya | Moreau, J. | Morissette, L. | 78 |
| 92 | Loyalty Islands, Uvea Atoll | 1991-1992 | New Caledonia | Bozec, Y.M. | Morissette, L. | 81 |
| 93 | Veracruz, Mandinga lagoon | 1982-1983 | Mexico | De La Cruz-Aguero, G. | Morissette, L. | 82 |
| 95 | Canary Islands, Maspalomas lagoon | 1993-1994 | Spain | Moreno, T. | Morissette, L. | 84 |
| 96 | Mauritania EEZ | 1987-1987 | Mauritania | Ould Taleb Ould Sidi, M.M. | Morissette, L. | 85 |
| 97 | Mauritania EEZ | 1998-1998 | Mauritania | Ould Taleb Ould Sidi, M.M. | Morissette, L. | 85 |
| 98 | Bank Arguin | 1988-1998 | Mauritania | Ould Taleb Ould Sidi, M.M. | Morissette, L. | 86 |
| 99 | Middle Atlantic Bight | 1995-1998 | United States of America | Okey, T.A. | Morissette, L. | 87 |
| 103 | Moorea, Fringing reef of Tiahura | 1971-1989 | French Polynesia | Arias-González, J.E. | Morissette, L. | 89 |
| 104 | Atlantic coast of Morocco | 1985-1986 | Morocco | Stanford, R. | Morissette, L. | 90 |
| 105 | Newfoundland | 1900-1905 | Canada | Pitcher, T.J. | Morissette, L. | 95 |
| 106 | Newfoundland | 1985-1987 | Canada | Bundy, A. | Morissette, L. | 92,93 |
| 107 | Newfoundland | 1985-1987 | Canada | Heymans, S.J.J. | Morissette, L. | 94,91 |
| 108 | Newfoundland | 1995-1997 | Canada | Heymans, S.J.J. | Morissette, L. | 91,94 |
| 110 | Newfoundland | 1994-1995 | Canada | Pitcher, T.J. | Morissette, L. | 91 |
| 111 | Atlantic Ocean, central | 1950-1950 | Not affiliated | Vasconcellos, M. | Morissette, L. | 27 |
| 112 | Atlantic Ocean, central | 1997-1998 | Not affiliated | Vasconcellos, M. | Morissette, L. | 27 |
| 113 | Caete estuary | 1970-1990 | Brazil | Wolff, M. | Morissette, L. | 96 |
| 114 | North Sea | 1970-1970 | Not affiliated | Beattie, A. | Morissette, L. | 97 |
| 115 | Benguela, Northern | 1956-1956 | Namibia | Heymans, S.J.J. | Morissette, L. | 101,100 |
| 116 | Gulf of St Lawrence, Northern | 1985-1987 | Canada | Morissette, L. | Morissette, L. | 103 |
| 117 | Gulf of St Lawrence, Northern | 1994-1996 | Canada | Savenkoff, C. | Morissette, L. | 104 |
| 118 | Africa, Northwestern | 1987-1987 | Not affiliated | Morissette, L. | Morissette, L. | 105 |
| 119 | Orbetello lagoon | 1996-1996 | Italy | Brando, V.E. | Morissette, L. | 106 |
| 120 | Venice, Pallude della Rosa | 1994-1994 | Italy | Carrer, S. | Morissette, L. | 107 |
| 124 | Peruvian upwelling ecosystem | 1973-1979 | Peru | Jarre-Teichmann, A. | Morissette, L. | 108 |
| 125 | Ria Formosa reservoir | 1996-1997 | Portugal | Gamito, S. | Morissette, L. | 109 |
| 126 | British Columbia, Rivers Inlet | 1951-1955 | Canada | Watkinson, S. | Morissette, L. | 110 |
| 127 | British Columbia, Rivers Inlet | 1991-1995 | Canada | Watkinson, S. | Morissette, L. | 110 |
| 129 | San Miguel Bay | 1992-1994 | Philippines | Bundy, A. | Morissette, L. | 112 |
| 130 | Leyte, San Pedro Bay | 1994-1995 | Philippines | Campos, W.L. | Morissette, L. | 113 |
| 131 | Gulf of Mexico, Terminos lagoon | | Mexico | Rivera-Arriaga, E. | Morissette, L. | 114 |
| 132 | Normandy, Seine estuary | 1995-1995 | France | Rybarczyk, H. | Morissette, L. | 115 |
| 133 | Senegambian continental shelf | 1990-1990 | Senegal, Gambia | Samb, B. | Morissette, L. | 116,117 |
| 134 | Pacific Ocean, central | 1990-1998 | Not affiliated | Kitchell, J.F. | Morissette, L. | 118 |
| 135 | Shelf and slope waters off Sierra Leone | 1964-1964 | Sierra Leone | Heymans, S.J.J. | Morissette, L. | 119 |
| 136 | Shelf and slope waters off Sierra Leone | 1978-1978 | Sierra Leone | Heymans, S.J.J. | Morissette, L. | 119 |
| 137 | Shelf and slope waters off Sierra Leone | 1990-1990 | Sierra Leone | Heymans, S.J.J. | Morissette, L. | 119 |
| 140 | Brazil Bight, Southern | 1998-1999 | Brazil | Gasalla, M.A. | Morissette, L. | 121 |
| 141 | Brazil Bight, Southern | 1998-1999 | Brazil | Gasalla, M.A. | Morissette, L. | 121 |
| 143 | South Orkneys, South Georgia | 1990-2000 | Antarctica | Bredesen, E.L. | Morissette, L. | 122 |

Appendix Table A1. Continued

| Number | Location | Period | Country | Author | Facilitator | References |
|--------|---|-----------|--|-----------------------|----------------------|------------|
| 144 | Brazil, Southern | 1950-1994 | Brazil | Vasconcellos, M. | Morissette, L. | 123 |
| 145 | Gulf of St Lawrence, Southern | 1985-1987 | Canada | Savenkoff, C. | Morissette, L. | 124 |
| 146 | Gulf of St Lawrence, Southern | 1994-1996 | Canada | Savenkoff, C. | Morissette, L. | 124 |
| 147 | Southwest Coast of India | 1994-1996 | India | Vivekanandan, E. | Morissette, L. | 125 |
| 149 | Gulf of Mexico, Seagrass in St Marks | 1994-1994 | United States of America | Christian, R.R. | Morissette, L. | 127 |
| 151 | Subantarctic plateau of New Zealand | | New Zealand | Bradford-Grievé, J.M. | Morissette, L. | 129 |
| 154 | Gulf of Mexico, Tampamachoco lagoon | | Mexico | Rosado-Solórzano, R. | Morissette, L. | 133 |
| 155 | Terengganu coast | 1984-1985 | Malaysia | Liew, H.C. | Morissette, L. | 134 |
| 157 | Thames, Sonning | 1966-1972 | U.K. of Great Britain and Northern Ireland | Mathews, C.P. | Morissette, L. | 136 |
| 158 | Tongoy Bay | 1978-1989 | Chile | Wolff, M. | Morissette, L. | 137 |
| 163 | Gulf of Salamanca | 1997-1997 | Colombia | Duarte, L.O. | Morissette, L. | 142,141 |
| 168 | Greenland, Western | 1997-1997 | Greenland | Pedersen, S.A. | Morissette, L. | 145 |
| 169 | Peninsula Malaysia, Western | 1987-1991 | Malaysia | Man, A. | Morissette, L. | 146 |
| 173 | Florida shelf, Western | 2000-2000 | United States of America | Okey, T.A. | Morissette, L. | 148 |
| 174 | West Greenland shrimp grounds | 1991-1992 | Greenland | Pedersen, S.A. | Morissette, L. | 149 |
| 175 | Bering Sea, Western | 1981-1990 | Russian Federation | Aydin, K.Y. | Morissette, L. | 150 |
| 176 | English Channel, Western | 1994-1994 | France, U.K. of Great Britain and Northern Ireland | Araújo, J.N. | Morissette, L. | 151,152 |
| 179 | Sine Saloum estuary, Bolong de Bamboung | 2003-2003 | Senegal | Colléter, M. | Colléter, M. | 155 |
| 180 | Sine Saloum estuary, Bolong de Bamboung | 2006-2008 | Senegal | Colléter, M. | Colléter, M. | 155 |
| 181 | Gulf of Alaska | 1980-1989 | Canada | Pauly, D. | Arreguín-Sánchez, F. | 156 |
| 182 | Bering Sea, Eastern | 1955-1960 | Not affiliated | Trites, A.W. | Arreguín-Sánchez, F. | 15 |
| 183 | Bering Sea, Eastern | 1979-1985 | Not affiliated | Trites, A.W. | Arreguín-Sánchez, F. | 15 |
| 184 | Weddel Sea, Eastern | 1983-1993 | Antarctica | Jarre-Teichmann, A. | Arreguín-Sánchez, F. | 7 |
| 185 | GBR, Northern | 1993-1994 | Australia | Gribble, N.A. | Arreguín-Sánchez, F. | 48,49 |
| 186 | GBR, Central | | Australia | Tudman, P.D. | Arreguín-Sánchez, F. | 157 |
| 187 | GBR, Northern | 1993-1994 | Australia | Gribble, N.A. | Arreguín-Sánchez, F. | 49,48 |
| 188 | Baltic Sea | 1974-1974 | Sweden | Harvey, C.J. | Arreguín-Sánchez, F. | 11 |
| 189 | Caete estuary | 1970-1990 | Brazil | Wolff, M. | Arreguín-Sánchez, F. | 96 |
| 190 | State of Sao Paulo, Broa reservoir | | Brazil | Angelini, R. | Arreguín-Sánchez, F. | 158 |
| 191 | Brazil Bight, Southern | 1998-1999 | Brazil | Gasalla, M.A. | Arreguín-Sánchez, F. | 121 |
| 192 | Brunei Darussalam | 1989-1990 | Brunei Darussalam | Silvestre, G. | Arreguín-Sánchez, F. | 17 |
| 193 | Lake Tanganyika | 1980-1983 | Burundi | Moreau, J. | Arreguín-Sánchez, F. | 77 |
| 194 | British Columbia, Northern | 1750-1750 | Canada | Ainsworth, C.H. | Arreguín-Sánchez, F. | 159 |
| 195 | British Columbia, Northern | 1900-1900 | Canada | Ainsworth, C.H. | Arreguín-Sánchez, F. | 159 |
| 196 | British Columbia, Northern | 1950-1950 | Canada | Ainsworth, C.H. | Arreguín-Sánchez, F. | 159 |
| 197 | British Columbia, Northern | 2000-2000 | Canada | Ainsworth, C.H. | Arreguín-Sánchez, F. | 159 |
| 198 | British Columbia, Rivers Inlet | 1951-1955 | Canada | Watkinson, S. | Arreguín-Sánchez, F. | 110 |
| 199 | British Columbia, Rivers Inlet | 1991-1995 | Canada | Watkinson, S. | Arreguín-Sánchez, F. | 110 |
| 200 | Lake Ontario | 1991-1991 | Canada | Halfon, E. | Arreguín-Sánchez, F. | 76 |
| 201 | Newfoundland | 1450-1450 | Canada | Pitcher, T.J. | Arreguín-Sánchez, F. | 95 |
| 202 | Newfoundland | 1900-1905 | Canada | Pitcher, T.J. | Arreguín-Sánchez, F. | 95 |
| 203 | Newfoundland | 1985-1987 | Canada | Pitcher, T.J. | Arreguín-Sánchez, F. | 91 |
| 204 | Newfoundland | 1995-1997 | Canada | Pitcher, T.J. | Arreguín-Sánchez, F. | 91 |

Appendix Table A1. Continued

| Number | Location | Period | Country | Author | Facilitator | References |
|--------|---|-----------|--|--------------------------|----------------------|------------|
| 205 | Gulf of St Lawrence, Northern | 1985-1987 | Canada | Morissette, L. | Arreguin-Sánchez, F. | 103 |
| 206 | Canary Islands, Maspalomas lagoon | 1993-1994 | Spain | Moreno, T. | Arreguin-Sánchez, F. | 84 |
| 207 | Central Chile | 1992-1992 | Chile | Neira, S. | Arreguin-Sánchez, F. | 28 |
| 208 | Central Chile | 1998-1998 | Chile | Neira, S. | Arreguin-Sánchez, F. | 28 |
| 209 | Tongoy Bay | 1978-1989 | Chile | Wolff, M. | Arreguin-Sánchez, F. | 137 |
| 210 | Bohai Sea | 1982-1983 | China | Tong, L. | Arreguin-Sánchez, F. | 16 |
| 211 | Gulf of Salamanca | 1997-1997 | Colombia | Duarte, L.O. | Arreguin-Sánchez, F. | 142,141 |
| 212 | Gulf of Nicoya | | Costa Rica | Wolff, M. | Arreguin-Sánchez, F. | 53 |
| 213 | Gulf Dulce | 1993-1994 | Costa Rica | Wolff, M. | Arreguin-Sánchez, F. | 47 |
| 214 | Thames, Sonning | 1966-1972 | U.K. of Great Britain and Northern Ireland | Mathews, C.P. | Arreguin-Sánchez, F. | 136 |
| 215 | Lake Awassa | 2003-2004 | Ethiopia | Fetahi, T. | Arreguin-Sánchez, F. | 452,69 |
| 216 | Bay of Somme | 1998-1998 | France | Rybarczyk, H. | Arreguin-Sánchez, F. | 14 |
| 217 | Etang de Thau | 1980-1989 | France | Palomares, M.L.D. | Arreguin-Sánchez, F. | 39 |
| 218 | Gironde estuary | 1991-1998 | France | Lobry, J. | Arreguin-Sánchez, F. | 46,478 |
| 219 | Massif Central, Lake Ayardat | 1990-1992 | France | Reyes-Marchant, P. | Arreguin-Sánchez, F. | 42 |
| 220 | Normandy, Seine estuary | 1995-1995 | France | Rybarczyk, H. | Arreguin-Sánchez, F. | 115 |
| 221 | Garonne river, Toulouse | 1990-1991 | France | Palomares, M.L.D. | Arreguin-Sánchez, F. | 160 |
| 222 | Moorea, Barrier reef of Tiahura | 1971-1989 | French Polynesia | Arias-González, J.E. | Arreguin-Sánchez, F. | 89 |
| 223 | Moorea, Fringing reef of Tiahura | 1971-1989 | French Polynesia | Arias-González, J.E. | Arreguin-Sánchez, F. | 89 |
| 224 | Sakumo lagoon | 1971-1971 | Ghana | Pauly, D. | Arreguin-Sánchez, F. | 111 |
| 225 | West Greenland shrimp grounds | 1991-1992 | Greenland | Pedersen, S.A. | Arreguin-Sánchez, F. | 149 |
| 226 | Icelandic marine ecosystem (ICES area Va) | 1997-1997 | Iceland | Mendy, A.N. | Arreguin-Sánchez, F. | 61 |
| 227 | Icelandic shelf | 1950-1950 | Iceland | Buchary, E.A. | Arreguin-Sánchez, F. | 59 |
| 228 | Icelandic shelf | 1997-1997 | Iceland | Samb, B. | Arreguin-Sánchez, F. | 62 |
| 229 | Lake Veli | 1980-1980 | India | Aravindan, C.M. | Arreguin-Sánchez, F. | 143 |
| 230 | Lake Kinneret | 1980-1989 | Israel | Walline, P.D. | Arreguin-Sánchez, F. | 73 |
| 231 | Lagoon of Venice | 1994-1994 | Italy | Carrer, S. | Arreguin-Sánchez, F. | 66 |
| 232 | Orbetello lagoon | 1996-1996 | Italy | Brando, V.E. | Arreguin-Sánchez, F. | 106 |
| 233 | Lake Turkana | 1973-1973 | Kenya | Kolding, J. | Arreguin-Sánchez, F. | 138 |
| 234 | Lake Turkana | 1987-1987 | Kenya | Kolding, J. | Arreguin-Sánchez, F. | 138 |
| 235 | Lake Victoria | 1971-1972 | Kenya | Moreau, J. | Arreguin-Sánchez, F. | 79 |
| 236 | Lake Malawi | 1979-1981 | Malawi | Degnbol, P. | Arreguin-Sánchez, F. | 75 |
| 237 | Terengganu coast | 1984-1985 | Malaysia | Liew, H.C. | Arreguin-Sánchez, F. | 134 |
| 238 | Gulf of California, La Paz Bay | 1992-1998 | Mexico | Arreguin-Sánchez, F. | Arreguin-Sánchez, F. | 161 |
| 239 | Gulf of California, Central | 1978-1979 | Mexico | Arreguin-Sánchez, F. | Arreguin-Sánchez, F. | 30,29 |
| 240 | Gulf of Mexico, Sonda de Campeche | 1988-1994 | Mexico | Manickchand-Heileman, S. | Arreguin-Sánchez, F. | 21,120 |
| 241 | Huizache-Caimanero lagoon | 1984-1986 | Mexico | Zetina-Rejón, M.J. | Arreguin-Sánchez, F. | 58 |
| 242 | Alto Golfo de California | | Mexico | Morales-Zárate, M.V. | Arreguin-Sánchez, F. | 6 |
| 243 | Gulf of Mexico, Terminos lagoon | | Mexico | Manickchand-Heileman, S. | Arreguin-Sánchez, F. | 135 |
| 244 | Veracruz, Mandinga lagoon | 1982-1983 | Mexico | De La Cruz-Aguero, G. | Arreguin-Sánchez, F. | 82 |
| 245 | Gulf of Mexico, Tampamachoco lagoon | | Mexico | Rosado-Solórzano, R. | Arreguin-Sánchez, F. | 133 |
| 246 | Celestun lagoon | | Mexico | Chávez, E.A. | Arreguin-Sánchez, F. | 26 |
| 247 | Celestun lagoon | 1986-1986 | Mexico | Vega-Cendejas, M.E. | Arreguin-Sánchez, F. | 25 |

Appendix Table A1. Continued

| Number | Location | Period | Country | Author | Facilitator | References |
|--------|--------------------------------------|-----------|--|--------------------------|--------------------------------------|-------------|
| 248 | Maputo Bay | 1972-1985 | Mozambique | De Paula E Silva, R. | Arreguin-Sánchez, F. | 83 |
| 249 | Loyalty Islands, Uvea Atoll | 1991-1992 | New Caledonia | Bozec, Y.M. | Arreguin-Sánchez, F. | 81 |
| 250 | Subantarctic Plateau New Zealand | | New Zealand | Bradford-Grieve, J.M. | Arreguin-Sánchez, F. | 129 |
| 251 | North Sea | 1981-1981 | Not affiliated | Christensen, V. | Arreguin-Sánchez, F. | 98 |
| 252 | Aleutian Islands | 1963-1963 | United States of America | Guénette, S. | Arreguin-Sánchez, F.; Morissette, L. | 5, 4 |
| 253 | Pacific Ocean, central | 1990-1998 | Not affiliated | Cox, S.P. | Arreguin-Sánchez, F. | 31 |
| 254 | Pacific Ocean, central | 1990-1998 | Not affiliated | Kitchell, J.F. | Arreguin-Sánchez, F. | 118 |
| 255 | Manila, Laguna de Bay | 1820-1820 | Philippines | Delos Reyes, M.R. | Arreguin-Sánchez, F. | 68,67 |
| 256 | Manila, Laguna de Bay | 1920-1920 | Philippines | Delos Reyes, M.R. | Arreguin-Sánchez, F. | 68,67 |
| 257 | Manila, Laguna de Bay | 1950-1950 | Philippines | Delos Reyes, M.R. | Arreguin-Sánchez, F. | 67,68 |
| 258 | Manila, Laguna de Bay | 1968-1968 | Philippines | Delos Reyes, M.R. | Arreguin-Sánchez, F. | 68,67 |
| 259 | Manila, Laguna de Bay | 1980-1980 | Philippines | Delos Reyes, M.R. | Arreguin-Sánchez, F. | 67,68 |
| 260 | Manila, Laguna de Bay | 1990-1990 | Philippines | Delos Reyes, M.R. | Arreguin-Sánchez, F. | 67,68 |
| 261 | Santiago Island, Bolinao coral reef | 1990-1990 | Philippines | Alifio, P.M. | Arreguin-Sánchez, F. | 162 |
| 262 | South Orkneys, South Georgia | 1990-2000 | Antarctica | Bredesen, E.L. | Arreguin-Sánchez, F. | 122 |
| 263 | Benguela, Northern | | Namibia | Heymans, S.J.J. | Arreguin-Sánchez, F. | 102 |
| 264 | Cantabrian Sea | 1994-1994 | Spain | Sánchez, F. | Arreguin-Sánchez, F. | 23 |
| 265 | Parakrama Samudra reservoir | 1970-1980 | Sri Lanka | Moreau, J. | Arreguin-Sánchez, F. | 126 |
| 266 | Kuosheng Bay | 1998-2001 | China | Lin, H.-J. | Arreguin-Sánchez, F. | 64 |
| 267 | Lagoon Chiku | 1997-1997 | China | Lin, H.-J. | Arreguin-Sánchez, F. | 65 |
| 268 | Gulf of Paria | | Trinidad and Tobago, Venezuela | Manickchand-Heileman, S. | Arreguin-Sánchez, F. | 163 |
| 269 | Looe Key | 1980-1989 | United States of America | McCormick Venier, J. | Arreguin-Sánchez, F. | 80 |
| 270 | Lake George | 1970-1979 | Uganda | Moreau, J. | Arreguin-Sánchez, F. | 71 |
| 271 | English Channel | 1973-1973 | U.K. of Great Britain and Northern Ireland | Stanford, R. | Arreguin-Sánchez, F. | 38 |
| 272 | English Channel | 1995-1995 | U.K. of Great Britain and Northern Ireland | Stanford, R. | Arreguin-Sánchez, F. | 38 |
| 273 | Monterey Bay | 1989-1991 | United States of America | Olivieri, R.A. | Arreguin-Sánchez, F. | 88 |
| 274 | Gulf of Mexico, Seagrass in St Marks | 1994-1994 | United States of America | Christian, R.R. | Arreguin-Sánchez, F. | 127 |
| 275 | Florida shelf, Western | 2000-2000 | United States of America | Okey, T.A. | Arreguin-Sánchez, F. | 148 |
| 276 | Bering Sea, Eastern | 1979-1985 | United States of America | Aydin, K.Y. | Arreguin-Sánchez, F. | 150 |
| 277 | Bering Sea, Western | 1981-1990 | Russian Federation | Aydin, K.Y. | Arreguin-Sánchez, F. | 150 |
| 279 | Prince William Sound | 1994-1996 | United States of America | Okey, T.A. | Arreguin-Sánchez, F.; Morissette, L. | 1, 2 |
| 280 | Prince William Sound | 1980-1989 | United States of America | Dalsgaard, J. | Arreguin-Sánchez, F. | 3 |
| 282 | Venezuela shelf | 1988-1988 | Venezuela | Mendoza, J.J. | Arreguin-Sánchez, F. | 144 |
| 283 | Lake Chad | 1970-1972 | Chad | Palomares, M.L.D. | Arreguin-Sánchez, F. | 70 |
| 284 | Lake Kariba | 1980-1980 | Zimbabwe | Machena, C. | Arreguin-Sánchez, F. | 72 |
| 285 | San Miguel Bay | 1992-1994 | Philippines | Bundy, A. | Arreguin-Sánchez, F. | 112 |
| 286 | Ria Formosa reservoir | 1996-1997 | Portugal | Gamito, S. | Arreguin-Sánchez, F. | 109 |
| 287 | Mexican Caribbean | 1990-1990 | Mexico | Alvarez-Hernández, J.H. | Arreguin-Sánchez, F. | 33 |
| 288 | Celestun lagoon | 1992-1994 | Mexico | Vega-Cendejas, M.E. | Arreguin-Sánchez, F. | 25 |
| 289 | Gulf of Mexico, Terminos lagoon | | Mexico | Rivera-Arriaga, E. | Arreguin-Sánchez, F. | 114 |
| 290 | Bahia La Ascension | 1989-1995 | Mexico | Vidal, L. | Arreguin-Sánchez, F. | 9 |
| 291 | Campeche Sound | 1988-1994 | Mexico | Zetina-Rejón, M.J. | Arreguin-Sánchez, F. | 19,20,21,22 |

Appendix Table A1. Continued

| Number | Location | Period | Country | Author | Facilitator | References |
|--------|---|-----------|--|-----------------------|----------------------|-------------|
| 292 | Brazil, Southern | 1950-1994 | Brazil | Vasconcellos, M. | Arreguín-Sánchez, F. | 123 |
| 293 | North Sea | 1881-1890 | Not affiliated | Mackinson, S. | Arreguín-Sánchez, F. | 99 |
| 294 | Barents Sea | 1990-1990 | Russian Federation | Blanchard, J.L. | Arreguín-Sánchez, F. | 57 |
| 295 | Barents Sea | 1995-1995 | Russian Federation | Blanchard, J.L. | Arreguín-Sánchez, F. | 57 |
| 296 | West Scotland | 2000-2004 | U.K. of Great Britain and Northern Ireland | Haggan, N. | Arreguín-Sánchez, F. | 164 |
| 297 | English Channel, Western | 1994-1994 | France, U.K. of Great Britain and Northern Ireland | Araújo, J.N. | Arreguín-Sánchez, F. | 151,152 |
| 298 | Paraná River Floodplain | 1992-1995 | Brazil | Angelini, R. | Arreguín-Sánchez, F. | 140 |
| 299 | Venice, Pallude della Rosa | 1994-1994 | Italy | Carrer, S. | Arreguín-Sánchez, F. | 107 |
| 300 | Bay of Bengal | 1984-1986 | Bangladesh | Mustafa, M.G. | Arreguín-Sánchez, F. | 12 |
| 301 | Southwest coast of India | 1994-1996 | India | Vivekanandan, E. | Arreguín-Sánchez, F. | 125 |
| 302 | North Coast of Central Java | 1979-1979 | Indonesia | Nurhakim, S. | Arreguín-Sánchez, F. | 165 |
| 303 | Peninsula Malaysia, Western | 1987-1991 | Malaysia | Man, A. | Arreguín-Sánchez, F. | 146 |
| 304 | Sarawak, Western | 1972-1972 | Malaysia | Garces, L.R. | Arreguín-Sánchez, F. | 147 |
| 305 | Sabah, Western | 1972-1972 | Malaysia | Garces, L.R. | Arreguín-Sánchez, F. | 147 |
| 306 | Leyte, San Pedro Bay | 1994-1995 | Philippines | Campos, W.L. | Arreguín-Sánchez, F. | 113 |
| 307 | Jalisco and Colima | 1995-1996 | Mexico | Galván-Piña, V.H. | Arreguín-Sánchez, F. | 63 |
| 308 | Lake Kinneret | 1980-1989 | Israel | Walline, P.D. | Arreguín-Sánchez, F. | 73 |
| 309 | Lake Tanganyika | 1974-1976 | Burundi | Moreau, J. | Arreguín-Sánchez, F. | 77 |
| 310 | Lake Tanganyika | 1980-1983 | Burundi | Moreau, J. | Arreguín-Sánchez, F. | 77 |
| 311 | Peruvian upwelling ecosystem | 1953-1959 | Peru | Jarre-Teichmann, A. | Arreguín-Sánchez, F. | 108 |
| 312 | Peruvian upwelling ecosystem | 1960-1969 | Peru | Jarre-Teichmann, A. | Arreguín-Sánchez, F. | 108 |
| 314 | Gulf of Mexico | 1980-1989 | Mexico | Browder, J.A. | Arreguín-Sánchez, F. | 52 |
| 315 | Lake George | 1970-1979 | Uganda | Moreau, J. | Arreguín-Sánchez, F. | 71 |
| 316 | Lake Kariba | 1980-1980 | Zimbabwe | Machena, C. | Arreguín-Sánchez, F. | 72 |
| 317 | Gulf of Mexico, Southwestern | 1970-1979 | Mexico | Arreguín-Sánchez, F. | Arreguín-Sánchez, F. | 153 |
| 318 | Gulf of Mexico, Tamiagua | 1980-1989 | Mexico | Abarca-Arenas, L.G. | Arreguín-Sánchez, F. | 130 |
| 320 | Gulf of Mexico, Yucatan | 1987-1987 | Mexico | Arreguín-Sánchez, F. | Arreguín-Sánchez, F. | 154 |
| 321 | Lake Victoria | 1971-1972 | Kenya | Moreau, J. | Arreguín-Sánchez, F. | 79 |
| 322 | Lake Victoria | 1985-1986 | Kenya | Moreau, J. | Arreguín-Sánchez, F. | 79 |
| 323 | Campeche Bank | 1985-1990 | Mexico | Vega-Cendejas, M.E. | Arreguín-Sánchez, F. | 18 |
| 324 | British Virgin Islands | 1960-1999 | British Virgin Islands | Opitz, S. | Arreguín-Sánchez, F. | 139 |
| 325 | Gulf of California, Southern | 1994-1997 | Mexico | Salcido-Guavara, L.A. | Arreguín-Sánchez, F. | 166 |
| 327 | Brazil, Southern | 1950-1994 | Brazil | Vasconcellos, M. | Arreguín-Sánchez, F. | 123 |
| 328 | Strait of Georgia | 1950-1950 | Canada | Martell, S.J.D. | Arreguín-Sánchez, F. | 128 |
| 329 | Bali Strait | 1990-1999 | Indonesia | Buchary, E.A. | Arreguín-Sánchez, F. | 10 |
| 330 | Lake Malawi | 1977-1996 | Malawi | Nsiku, E. | Arreguín-Sánchez, F. | 74 |
| 331 | Lake Victoria | 1985-1986 | Kenya | Moreau, J. | Arreguín-Sánchez, F. | 78 |
| 332 | Barents Sea | 1990-1990 | Russian Federation | Blanchard, J.L. | Arreguín-Sánchez, F. | 57 |
| 333 | Barents Sea | 1995-1995 | Russian Federation | Blanchard, J.L. | Arreguín-Sánchez, F. | 57 |
| 335 | Bay of Biscay | 1994-2005 | France | Lassalle, G. | Arreguín-Sánchez, F. | 171,170 |
| 400 | Raja Ampat | 1990-1990 | Indonesia | Ainsworth, C.H. | Christensen, V. | 301,300 |
| 401 | Raja Ampat | 2005-2005 | Indonesia | Ainsworth, C.H. | Christensen, V. | 509,301,300 |
| 402 | Bonifacio Strait Natural Reserve, Corsica | 2000-2001 | France | Albouy, C. | Albouy, C. | 304 |

Appendix Table A1. Continued

| Number | Location | Period | Country | Author | Facilitator | References |
|--------|---|-----------|--|---------------------------|-----------------|-------------|
| 403 | Western English Channel | 1993-1995 | France, U.K. of Great Britain and Northern Ireland | Araújo, J.N. | Christensen, V. | 151 |
| 404 | Celestun lagoon | | Mexico | Arreguin-Sánchez, F. | Christensen, V. | 153 |
| 405 | Australian North West Shelf | 1986-1991 | Australia | Bulman, C. | Christensen, V. | 308 |
| 406 | East Bass Strait | 1994-1994 | Australia | Bulman, C. | Christensen, V. | 310 |
| 407 | Tasmanian Seamounts Marine Reserve | 1992-1996 | Australia | Bulman, C. | Christensen, V. | 309 |
| 408 | China Sea, Beibu Gulf | 1997-1999 | China, Viet Nam | Chen, Z. | Christensen, V. | 439,313 |
| 409 | China Sea, Beibu Gulf | 1997-1999 | China, Viet Nam | Chen, Z. | Christensen, V. | 439,312 |
| 410 | N South China Sea | 1970-1970 | China, Viet Nam | Cheung, W.W.L. | Christensen, V. | 314 |
| 411 | Falkland Islands (Islas Malvinas) | 1990-1990 | Falkland Islands (Malvinas) | Cheung, W.W.L. | Christensen, V. | 315 |
| 412 | Gulf of Thailand | 1963-1963 | Thailand | Christensen, V. | Christensen, V. | 56 |
| 413 | North Sea | | Not affiliated | Christensen, V. | Christensen, V. | 317 |
| 414 | West coast of Peninsular Malaysia | 1970-1970 | Malaysia | Christensen, V. | Christensen, V. | 318 |
| 415 | SW coast of Vietnam | 1993-1995 | Viet Nam | Christensen, V. | Christensen, V. | 318 |
| 417 | Baja California Sur | 1970-1970 | Mexico | Christensen, V. | Christensen, V. | 320,441 |
| 418 | Catalan Sea, Southern | 1994-1994 | Spain | Cisneros-Montemayor, A.M. | Christensen, V. | 321 |
| 419 | Northern and Central Adriatic Sea | 1990-1990 | Italy, Slovenia, Croatia | Coll, M. | Christensen, V. | 322 |
| 420 | Catalan Sea, Southern | 1978-1980 | Spain | Coll, M. | Christensen, V. | 323 |
| 421 | NC Adriatic Sea | 1975-1975 | Italy, Slovenia, Croatia | Coll, M. | Christensen, V. | 324,453 |
| 422 | Antarctic Peninsula | | Antarctica | Cornejo-Donoso, J. | Christensen, V. | 325 |
| 423 | La Guajira, N Colombian coast | 1995-2000 | Colombia | Criales-Hernández, M.I. | Christensen, V. | 521,443,326 |
| 424 | Black Sea | 1960-1960 | Not affiliated | Daskalov, G.M. | Christensen, V. | 327 |
| 425 | Gulf of California, La Paz Bay + La Ventana Bay | 1990-2001 | Mexico | Díaz-Urbe, J.G. | Christensen, V. | 329 |
| 426 | Norwegian and Barents Sea | 1997-1997 | Norway, Russian Federation | Dommasnes, A. | Christensen, V. | 330 |
| 427 | Antarctic Peninsula | | Antarctica | Erfan, A. | Christensen, V. | 331 |
| 428 | Central North Pacific | | Not affiliated | Essington, T.E. | Christensen, V. | 332 |
| 429 | Sorford and Ullsfjord, Troms County | 1993-1996 | Norway | Falk-Petersen, J. | Christensen, V. | 333 |
| 430 | East Brazil Large Marine Ecosystem | 1970-1970 | Brazil | Freire, K.M. | Christensen, V. | 336 |
| 431 | Port Phillip Bay | 1994-1995 | Australia | Fulton, E. | Christensen, V. | 337,520 |
| 433 | Black Sea | 1955-1965 | Not affiliated | Gucu, A. | Christensen, V. | 341 |
| 434 | Black Sea | 1980-1980 | Not affiliated | Gucu, A. | Christensen, V. | 341 |
| 435 | Black Sea | 1990-1990 | Not affiliated | Gucu, A. | Christensen, V. | 341 |
| 436 | WC Tropical Pacific Ocean | 1990-2001 | Not affiliated | Godinot, O. | Christensen, V. | 339 |
| 437 | Lingayen Gulf, NW Philippine coast | | Philippines | Guarin, F.Y. | Christensen, V. | 376,340 |
| 438 | SE Alaska | 1963-1963 | United States of America | Guénette, S. | Christensen, V. | 4 |
| 439 | Peruvian coast | | Peru | Guénette, S. | Christensen, V. | 343 |
| 440 | Guinean coast | 2004-2004 | Guinea | Guénette, S. | Christensen, V. | 338 |
| 441 | Sri Lanka coast | 2000-2000 | Sri Lanka | Haputhantri, S. | Christensen, V. | 344 |
| 442 | WC Aleutian Islands | 1963-1963 | United States of America | Heymans, S.J.J. | Christensen, V. | 346 |
| 443 | Rockall Trough and its seamounts, Scotland | 1974-1974 | U.K. of Great Britain and Northern Ireland | Heymans, S.J.J. | Christensen, V. | 465,347 |
| 444 | Gulf of Maine and Georges Banks | 1977-1986 | United States of America | Heymans, S.J.J. | Christensen, V. | 345 |
| 445 | East China Sea | 1997-2000 | China, Japan | Jiang, H. | Christensen, V. | 348 |
| 446 | Hudson Bay | 1970-1970 | Canada | Hoover, C. | Christensen, V. | 351,350,462 |
| 447 | Antarctica | | Antarctica | Hoover, C. | Christensen, V. | 349 |

Appendix Table A1. Continued

| Number | Location | Period | Country | Author | Facilitator | References |
|--------|--|-----------|---|-------------------|-----------------|-------------|
| 448 | Irish Sea | 1973-1973 | Ireland, U.K. of Great Britain and Northern Ireland | Lees, K. | Christensen, V. | 354 |
| 449 | Mont St Michel Bay | 2003-2003 | France | Arbach Leloup, F. | Christensen, V. | 355 |
| 450 | East of California, Northern | 1990-2000 | Mexico | Lercari, D. | Christensen, V. | 356 |
| 451 | East China Sea | 2000-2000 | China, Republic of Korea, Japan | Li, Y. | Christensen, V. | 357 |
| 452 | Miramare Natural Marine Reserve, Gulf of Trieste, Adriatic Sea | 2000-2003 | Italy | Libralato, S. | Christensen, V. | 358 |
| 453 | Tapong Bay, SW Taiwan | 1999-2001 | China | Lin, H.-J. | Christensen, V. | 359 |
| 454 | Nanwan Bay, Kenting National Park, S Taiwan | 2001-2003 | China | Liu, P.-J. | Christensen, V. | 360 |
| 455 | Aranci Bay, NE Sardinian coast | 2004-2007 | Italy | Diaz-López, B. | Christensen, V. | 328 |
| 457 | North Sea | 1991-1991 | Not affiliated | Mackinson, S. | Christensen, V. | 362 |
| 458 | Strait of Georgia | | Canada | Mackinson, S. | Christensen, V. | 361 |
| 459 | Lesser Antilles Pelagic Ecosystem | 2001-2005 | Not affiliated | Mohammed, E. | Christensen, V. | 364 |
| 460 | Grenada and the Grenadines | 1999-1999 | Grenada | Mohammed, E. | Christensen, V. | 363 |
| 461 | West coast of Scotland | 2000-2004 | U.K. of Great Britain and Northern Ireland | Morissette, L. | Christensen, V. | 367 |
| 462 | Gulf of St Lawrence, Northern | 1995-1995 | Canada | Morissette, L. | Christensen, V. | 366 |
| 463 | Gulf of St Lawrence, Northern | 1985-1987 | Canada | Morissette, L. | Christensen, V. | 365,366 |
| 464 | Baltic Sea, Schlei Fjord | | Germany | Nauen, C. | Christensen, V. | 368,319 |
| 465 | Albatross Bay, Gulf of Carpentaria | 1986-1992 | Australia | Okey, T.A. | Christensen, V. | 370 |
| 466 | Gulf of Carpentaria | 1990-1990 | Australia | Okey, T.A. | Christensen, V. | 371 |
| 467 | South Atlantic Bight | 1995-1998 | United States of America | Okey, T.A. | Christensen, V. | 372 |
| 468 | Black Sea | 1980-1980 | Not affiliated | Orek, H. | Christensen, V. | 373 |
| 469 | South China Sea | | Not affiliated | Pauly, D. | Christensen, V. | 376 |
| 470 | Southern BC Shelf | | Canada | Pauly, D. | Christensen, V. | 375 |
| 471 | Mejillones Peninsula, Antofagasta | 1999-2002 | Chile | Pavés, H.J. | Christensen, V. | 377 |
| 472 | Te Tapuwae o Rongokako Marine Reserve | 2000-2003 | New Zealand | Pinkerton, M. | Christensen, V. | 378 |
| 473 | Bay of Calvi | | France | Pinnegar, J.K. | Christensen, V. | 379 |
| 474 | NE Ionian Sea | 1964-1964 | Greece | Piroddi, C. | Christensen, V. | 380 |
| 475 | NE Ionian Sea | 2007-2007 | Greece | Piroddi, C. | Christensen, V. | 381 |
| 476 | French Frigate Shoals, NW Hawaiian Archipelago | | United States of America | Polovina, J.J. | Christensen, V. | 382 |
| 477 | Strait of Georgia | 1950-1950 | Canada | Preikshot, D.B. | Christensen, V. | 383 |
| 478 | BC Shelf | 1950-1950 | Canada | Preikshot, D.B. | Christensen, V. | 383 |
| 479 | NE Pacific Ocean | 1950-1950 | Canada, United States of America | Preikshot, D.B. | Christensen, V. | 383 |
| 480 | Kerguelen Islands | 1987-1988 | French Southern and Antarctic Territories | Pruvost, P. | Christensen, V. | 384 |
| 481 | Sao Sebastiao Channel | | Brazil | Rocha, G.R. | Christensen, V. | 385 |
| 482 | C Gulf of California | 1980-1980 | Mexico | Rosas-Luis, R. | Christensen, V. | 386 |
| 483 | C Gulf of California | 2002-2002 | Mexico | Rosas-Luis, R. | Christensen, V. | 386 |
| 484 | Oregon Coast, inner shelf | 2000-2002 | United States of America | Ruzicka, J.J. | Christensen, V. | 387 |
| 485 | S Benguela | 1978-1978 | South Africa | Shannon, L. | Christensen, V. | 522,390,389 |
| 486 | Cape Verde Archipelago | 1981-1985 | Cape Verde | Stobberup, K.A. | Christensen, V. | 391 |
| 487 | Northern Humboldt Current Ecosystem | 1995-1996 | Peru | Tam, J. | Christensen, V. | 392 |
| 488 | Northern Humboldt Current Ecosystem | 1997-1998 | Peru | Tam, J. | Christensen, V. | 392 |
| 489 | Sechura Bay | 1996-1996 | Peru | Taylor, M.H. | Christensen, V. | 393 |
| 490 | Independence Bay | 1996-1996 | Peru | Taylor, M.H. | Christensen, V. | 394 |
| 491 | Gulf of Riga | 1990-1990 | Lithuania | Tomczak, M.T. | Christensen, V. | 396 |

Appendix Table A1. Continued

| Number | Location | Period | Country | Author | Facilitator | References |
|--------|---|-----------|--|----------------------|------------------|-------------|
| 492 | Lithuanian Coast | 1990-1990 | Lithuania | Tomczak, M.T. | Christensen, V. | 396 |
| 493 | Parnu Bay | 1990-1990 | Estonia | Tomczak, M.T. | Christensen, V. | 396 |
| 494 | Puck Bay | 1990-1990 | Poland | Tomczak, M.T. | Christensen, V. | 396 |
| 495 | N Aegean Sea | 2003-2006 | Greece,Turkey | Tsagarakis, K. | Christensen, V. | 397 |
| 496 | Eritrean Red Sea coast | 1998-1998 | Eritrea | Tsehaye, I. | Christensen, V. | 398 |
| 497 | Port-Cros Archipelago | 1998-2008 | France | Valls, A. | Christensen, V. | 399 |
| 498 | S Brazilian Shelf | | Brazil | Velasco, G. | Christensen, V. | 402,400,401 |
| 499 | Kaloko-Honokohau, Honolulu | 2005-2005 | United States of America | Wabnitz, C.C. | Christensen, V. | 403,516 |
| 500 | N Benguela | 1600-1600 | Angola | Watermeyer, K. | Christensen, V. | 406 |
| 501 | N Benguela | 1900-1900 | Angola | Watermeyer, K. | Christensen, V. | 406 |
| 502 | N Benguela | 1967-1967 | Angola | Watermeyer, K. | Christensen, V. | 406 |
| 503 | N Benguela | 1990-1990 | Angola | Watermeyer, K. | Christensen, V. | 406 |
| 504 | S Benguela | 1600-1600 | Namibia,South Africa | Watermeyer, K. | Christensen, V. | 407 |
| 505 | S Benguela | 1900-1900 | Namibia,South Africa | Watermeyer, K. | Christensen, V. | 407 |
| 506 | S Benguela | 1960-1960 | Namibia,South Africa | Watermeyer, K. | Christensen, V. | 407 |
| 507 | Gulf of Maine | 1980-1980 | United States of America | Zhang, Y. | Christensen, V. | 409 |
| 508 | Gulf of Maine | 1990-1990 | United States of America | Zhang, Y. | Christensen, V. | 409 |
| 509 | Congo | 2005-2007 | Democratic Republic of the Congo | Bongu, M.M. | Christensen, V. | 307 |
| 510 | Sao Tome and Principe | 1999-2006 | Sao Tome and Principe | Castro, A. | Christensen, V. | 311 |
| 511 | Benin | 2005-2005 | Benin | Flogbe, E.D. | Christensen, V. | 335 |
| 512 | Sierra Leone | 2006-2007 | Sierra Leone | Kargbo, V.H. | Christensen, V. | 352 |
| 513 | Liberia | 1995-2007 | Liberia | Kay, D.W. | Christensen, V. | 353 |
| 514 | Gabon | 2005-2005 | Gabon | Ogandagas, C. | Christensen, V. | 369 |
| 515 | Ghana | 2005-2008 | Ghana | Osei, S.V. | Christensen, V. | 374 |
| 516 | Togo | 1990-2009 | Togo | Sedzro, K.M. | Christensen, V. | 388 |
| 517 | Nigeria | 1995-2007 | Nigeria | Williams, A.B. | Christensen, V. | 408 |
| 518 | Grand Banks of Newfoundland | 1985-1985 | Canada | Ainsworth, C.H. | Christensen, V. | 303 |
| 519 | Northern Californian Current | | United States of America | Walters, C.J. | Christensen, V. | 405 |
| 520 | Gulf of Mexico | | Mexico, United States of America | Walters, C.J. | Christensen, V. | 404,405 |
| 521 | Northern Californian Current | | United States of America | Field, J.C. | Christensen, V. | 302,334 |
| 522 | Catalan Sea | 2009-2009 | Spain | Tecchio, S. | Christensen, V. | 395 |
| 523 | Angola | 1986-1986 | Angola | Angelini, R. | Only publication | 424 |
| 524 | Parangipettai, southeast coast of India | 2004-2005 | India | Antony, P.J. | Only publication | 425 |
| 525 | NAFO Division 4X (western Scotian Shelf + Bay of Fundy) | 1970-1970 | Canada | Araújo, J.N. | Only publication | 427,437 |
| 526 | Western English Channel | 1973-1973 | France, U.K. of Great Britain and Northern Ireland | Araújo, J.N. | Only publication | 428 |
| 527 | Bay of Fundy | 1995-2000 | Canada | Araújo, J.N. | Only publication | 426 |
| 528 | NAFO Division 4X (western Scotian Shelf + Bay of Fundy) | 1995-2000 | Canada | Araújo, J.N. | Only publication | 426 |
| 529 | Western Scotian Shelf | 1995-2000 | Canada | Araújo, J.N. | Only publication | 426 |
| 530 | Alacranes Reef, Campeche Bank | | Mexico | Arias-González, J.E. | Only publication | 430 |
| 531 | Boca Paila, N Sian Ka'an Biosphere Reserve | | Mexico | Arias-González, J.E. | Only publication | 429 |
| 532 | Mahahual | | Mexico | Arias-González, J.E. | Only publication | 429 |
| 533 | Tampalam, S Sian Ka'an Biosphere Reserve | | Mexico | Arias-González, J.E. | Only publication | 429 |

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| Number | Location | Period | Country | Author | Facilitator | References |
|--------|--|-----------|---------------------------------|-----------------------|------------------|-------------|
| 534 | Gulf of Alaska | | United States of America | Aydin, K.Y. | Only publication | 431,455,456 |
| 535 | Gulf of Lions | 2000-2009 | France | Bănar, D. | Only publication | 432 |
| 536 | Northern Adriatic Sea | 1996-1998 | Italy,Slovenia,Croatia | Barausse, A. | Only publication | 433 |
| 537 | Santa Pola Bay | 2001-2007 | Spain | Bayle-Sempere, J.T. | Only publication | 434 |
| 538 | Java Sea | 1974-1979 | Indonesia | Buchary, E.A. | Only publication | 436 |
| 539 | Sea of Okhotsk | 1980-1980 | Russian Federation,Japan | Chaikina, N. | Only publication | 438 |
| 540 | East China Sea | 2000-2000 | China | Cheng, J. | Only publication | 440 |
| 541 | South Catalan Sea, Balearic Sea | 1978-1978 | Spain | Coll, M. | Only publication | 442 |
| 542 | Breton Sound Estuary | 1986-1990 | United States of America | de Mutsert, K. | Only publication | 444,445 |
| 543 | Northern and Central Gulf of California | 1980-1980 | Mexico | Díaz-Uribe, J.G. | Only publication | 446 |
| 544 | Lake Victoria | 1977-1977 | United Republic of Tanzania | Downing, A.S. | Only publication | 447 |
| 545 | Lake Victoria | 1987-1987 | United Republic of Tanzania | Downing, A.S. | Only publication | 447 |
| 546 | Lake Victoria | 2005-2005 | United Republic of Tanzania | Downing, A.S. | Only publication | 447 |
| 547 | Pearl River Estuary | 1981-1981 | China | Duan, L.J. | Only publication | 449 |
| 548 | Pearl River Delta | 1997-1999 | China | Duan, L.J. | Only publication | 448 |
| 549 | Pearl River Estuary | 1998-1998 | China | Duan, L.J. | Only publication | 449 |
| 550 | West coast of Vancouver Island | | Canada | Espinosa-Romero, M.J. | Only publication | 450 |
| 551 | Kelavarapalli reservoir, Hosur Taluk | | India | Feroz Khan, M. | Only publication | 451 |
| 552 | Delaware Bay | 1966-1966 | United States of America | Frisk, M.G. | Only publication | 454 |
| 553 | Eastern Great Australian Bight | 1991-1991 | Australia | Goldsworthy, S.D. | Only publication | 457 |
| 554 | Eastern Tuna and Billfish Fishery | 2004-2007 | Australia | Griffiths, S.P. | Only publication | 458,459 |
| 555 | Namyang reservoir | 2007-2007 | Republic of Korea | Han, J.-H. | Only publication | 460 |
| 556 | Puget Sound Central Basin | 2000-2000 | United States of America | Harvey, C.J. | Only publication | 461 |
| 557 | Antarctic Peninsula | 1978-1978 | Antarctica | Hoover, C. | Only publication | 463 |
| 558 | Lake Toya | 1992-2004 | Japan | Hossain, M.M. | Only publication | 464 |
| 559 | Lake Gehu | 1986-1989 | China | Jia, P. | Only publication | 466 |
| 560 | East China Sea | 1997-2000 | China,Republic of Korea,Japan | Jiang, H. | Only publication | 348,468 |
| 561 | SE Australian continental shelf | 1915-1915 | Australia | Klaer, N.L. | Only publication | 469 |
| 562 | SE Australian continental shelf | 1961-1961 | Australia | Klaer, N.L. | Only publication | 469 |
| 563 | Lake Huron | 1981-1981 | Canada,United States of America | Langseth, B.J. | Only publication | 470 |
| 564 | Lake Michigan | 1987-1987 | Canada,United States of America | Langseth, B.J. | Only publication | 470 |
| 565 | Bay of Biscay | 1994-2005 | France,Spain | Lassalle, G. | Only publication | 170,171 |
| 566 | Eastern Bering Sea | 1979-1985 | United States of America | Lee, S.I. | Only publication | 473 |
| 567 | Arachania, sandy beach | | Uruguay | Lercari, D. | Only publication | 474 |
| 568 | Barra del Chuy, sandy beach | | Uruguay | Lercari, D. | Only publication | 474 |
| 569 | Strait of Georgia | 2005-2005 | Canada | Li, L. | Only publication | 476 |
| 570 | Northern Central Adriatic Sea | 1990-1990 | Italy,Slovenia,Croatia | Libralato, S. | Only publication | 358 |
| 571 | Miramare Natural Marine Reserve, Gulf of Trieste | 2000-2003 | Italy | Libralato, S. | Only publication | 358 |
| 572 | Lake Qiandaohu | 2004-2004 | China | Liu, Q.-G. | Only publication | 477 |
| 573 | Laguna de Rocha | 2003-2006 | Uruguay | Milessi, A.C. | Only publication | 480 |
| 574 | Arabian Sea | 1999-2001 | India | Mohamed, K.S. | Only publication | 481 |
| 575 | Lancaster Sound region | 1980-1980 | Canada | Mohammed, E. | Only publication | 483 |
| 576 | Bahia Tortugas, Baja California | 2006-2008 | Mexico | Morales-Zárate, M.V. | Only publication | 484 |

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| Number | Location | Period | Country | Author | Facilitator | References |
|--------|---|-----------|--|--------------------|------------------|------------|
| 577 | Lake Victoria | | Kenya | Moreau, J. | Only publication | 78 |
| 578 | Greek Ionian Sea | 1998-2006 | Greece | Moutopoulos, D.K. | Only publication | 486 |
| 579 | Southeastern Brazilian Bight | 2001-2001 | Brazil | Nascimento, M.C. | Only publication | 487 |
| 580 | Southern Humboldt upwelling system off central Chile | 1970-1970 | Chile | Neira, S. | Only publication | 488 |
| 581 | Baltic Sea | | Not affiliated | Niranan, S. | Only publication | 489 |
| 582 | Great South Bay, Long Island | 1880-1880 | United States of America | Nuttall, M.A. | Only publication | 490 |
| 583 | Great South Bay, Long Island | 1930-1930 | United States of America | Nuttall, M.A. | Only publication | 490 |
| 584 | Great South Bay, Long Island | 1980-1980 | United States of America | Nuttall, M.A. | Only publication | 490 |
| 585 | Great South Bay, Long Island | 2000-2000 | United States of America | Nuttall, M.A. | Only publication | 490 |
| 586 | Barren Ground habitat, Mejillones Peninsula | 2004-2007 | Chile | Ortiz, M. | Only publication | 492 |
| 587 | Lessonia trabeculata habitat, Mejillones Peninsula | 2004-2007 | Chile | Ortiz, M. | Only publication | 492 |
| 588 | Macrocystis integrifolia habitat, Mejillones Peninsula | 2004-2007 | Chile | Ortiz, M. | Only publication | 492 |
| 590 | La Rinconada Marine Reserve, Antofagasta Bay | | Chile | Ortiz, M. | Only publication | 493 |
| 591 | Puerto Aldea, southern Tongoy Bay | | Chile | Ortiz, M. | Only publication | 496,495 |
| 592 | Mud habitat, Puerto Aldea, southern Tongoy Bay | | Chile | Ortiz, M. | Only publication | 491,495 |
| 593 | Sand habitat, Puerto Aldea, southern Tongoy Bay | | Chile | Ortiz, M. | Only publication | 495,496 |
| 594 | Sand-gravel habitat, Puerto Aldea, southern Tongoy Bay | | Chile | Ortiz, M. | Only publication | 495,496 |
| 595 | Seagrass habitat, Puerto Aldea, southern Tongoy Bay | | Chile | Ortiz, M. | Only publication | 495,496 |
| 596 | Wyra reservoir | 1995-1996 | India | Panikkar, P. | Only publication | 497 |
| 597 | Wyra reservoir | 2002-2003 | India | Panikkar, P. | Only publication | 497 |
| 598 | Eutrophic area, south arm of Mondego Estuary | 1991-1997 | Portugal | Patricio, J. | Only publication | 498 |
| 599 | Intermediate area, south arm of Mondego Estuary | 1991-1997 | Portugal | Patricio, J. | Only publication | 498 |
| 600 | Meadows area, south arm of Mondego Estuary | 1991-1997 | Portugal | Patricio, J. | Only publication | 498 |
| 601 | Gulf of Mexico | | Mexico, United States of America, Cuba | Pauly, D. | Only publication | 499 |
| 602 | Sørflord | 1993-1996 | Norway | Pedersen, T. | Only publication | 500 |
| 603 | Discovery Bay | 1999-2001 | Jamaica | Persad, G. | Only publication | 501 |
| 604 | Mekong Delta | 2002-2004 | Viet Nam | Phong, L.T. | Only publication | 502 |
| 605 | Bolivar Channel, Galapagos | 2004-2008 | Ecuador | Ruiz, D.J. | Only publication | 518,503 |
| 606 | Northern California Current | 2003-2007 | United States of America | Ruzicka, J.J. | Only publication | 504 |
| 607 | Gwaii Haanas National Marine Conservation Area, Queen Charlotte Islands | | Canada | Salomon, A.K. | Only publication | 505 |
| 608 | Baltic Proper, Baltic Sea | 1974-1974 | Not affiliated | Tomczak, M.T. | Only publication | 506 |
| 609 | Lake Ayamé | 1995-1996 | Côte d'Ivoire | Traore, A. | Only publication | 507 |
| 610 | Bay of Bengal | 1991-2007 | Bangladesh | Ullah, M.H. | Only publication | 508 |
| 611 | Ebrie lagoon | 1980-1981 | Côte d'Ivoire | Villanueva, M.C.S. | Only publication | 511,514 |
| 612 | Sine Saloum Estuary | 1991-1992 | Senegal | Villanueva, M.C.S. | Only publication | 511,512 |
| 613 | Bagré reservoir | 1997-1998 | Burkina Faso | Villanueva, M.C.S. | Only publication | 513 |
| 614 | Gambie Estuary | 2000-2002 | Gambia | Villanueva, M.C.S. | Only publication | 511 |
| 615 | Lake Nokoue | 2000-2001 | Benin | Villanueva, M.C.S. | Only publication | 511,514 |
| 616 | Lake Kivu | 2002-2003 | Democratic Republic of the Congo, Rwanda | Villanueva, M.C.S. | Only publication | 515 |
| 617 | Northern Hangzhou Bay | 2006-2007 | China | Xu, S. | Only publication | 519 |
| 618 | La Rinconada Marine Reserve SS1, Antofagasta Bay | 2005-2007 | Chile | Ortiz, M. | Only publication | 494 |

Appendix Table A1. Continued

| Number | Location | Period | Country | Author | Facilitator | References |
|--------|--|-----------|---------------------------------------|----------------|------------------|------------|
| 619 | La Rinconada Marine Reserve SS2, Antofagasta Bay | 2005-2007 | Chile | Ortiz, M. | Only publication | 494 |
| 620 | N South China Sea | 2000-2000 | China,Viet Nam | Cheung, W.W.L. | Only publication | 314 |
| 622 | S Gulf of St Lawrence | 1995-1995 | Canada | Morissette, L. | Only publication | 366 |
| 623 | S Gulf of St Lawrence | 1985-1985 | Canada | Morissette, L. | Only publication | 366 |
| 624 | Sao Sebastiao Inner Shelf | | Brazil | Rocha, G.R. | Only publication | 385 |
| 625 | Independence Bay | 1998-1998 | Peru | Taylor, M.H. | Only publication | 394 |
| 626 | Curonian Lagoon, Baltic Sea | 1990-1990 | Lithuania | Tomczak, M.T. | Only publication | 396 |
| 628 | North Sea | 1973-1973 | Not affiliated | Mackinson, S. | Only publication | 362 |
| 629 | Pearl River Estuary | 1981-1981 | China | Wang, Y. | Only publication | 449,517 |
| 630 | Arabian Sea, SW India | 1999-2001 | India | Mohamed, K.S. | Only publication | 481,482 |
| 631 | Gulf of Mexico | | Mexico, United States of America,Cuba | Vidal, L. | Only publication | 510,499 |
| 725 | Guinea continental shelf | 2004-2004 | Guinea | Gascuel, D. | Gascuel, D. | 523 |
| 726 | Guinea continental shelf | 1985-1985 | Guinea | Gascuel, D. | Gascuel, D. | 523 |

Appendix Table A2. List of the associated references.

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| Number | Full reference |
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Appendix Table A2. Continued

| Number | Full reference |
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| New Zealand | 250, 472, 151 |
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| Norway | 602, 429, 426 |
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| Republic of Korea | 555, 451, 560 |
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| Uganda | 270, 315 |
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| Albouy, C. | 402 |
| Aliño, P.M. | 261 |
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| Amorim, P. | 57 |
| Angelini, R. | 190,523,298 |
| Antony, P.J. | 524 |
| Araújo, J.N. | 528,403,525,529,297,627,526,176,527 |
| Aravindan, C.M. | 229 |
| Arbach Leloup, F. | 449 |
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| Arreguín-Sánchez, F. | 238,404,239,320,317 |
| Aydin, K.Y. | 276,534,277,175 |
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| Bozec, Y.M. | 249,92 |
| Bradford-Grieve, J.M. | 250,151 |
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| Bredesen, E.L. | 143,262 |
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| Buchary, E.A. | 227,538,329 |
| Bulman, C. | 407,406,405 |
| Bundy, A. | 40,41,285,106,129 |
| Campos, W.L. | 306,130 |
| Carrer, S. | 72,120,231,299 |
| Castro, A. | 510 |
| Chaikina, N. | 539 |
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| Cheng, J. | 540 |
| Chen, Z. | 409,408 |
| Cheung, W.W.L. | 620,410,411 |
| Christensen, V. | 412,413,414,415,35,34,621,251 |
| Christian, R.R. | 274,149 |
| Cisneros-Montemayor, A.M. | 417 |
| Colléter, M. | 180,179 |
| Coll, M. | 419,420,421,541,418 |
| Cornejo-Donoso, J. | 422 |
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| Dalsgaard, J. | 280 |
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| Delos Reyes, M.R. | 260,256,258,259,73,257,74,255 |
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| Díaz-López, B. | 455 |
| Díaz-Uribe, J.G. | 543,425 |
| Dommasnes, A. | 426 |
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| Duan, L.J. | 547,548,549 |
| Duarte, L.O. | 163,211 |
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| Espinosa-Romero, M.J. | 550 |
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| Fetahi, T. | 215,76 |
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| Freire, K.M. | 430 |
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| Gasalla, M.A. | 191,141,140 |
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| Godinot, O. | 436 |
| Goldsworthy, S.D. | 553 |
| Gribble, N.A. | 54,185,187 |
| Griffiths, S.P. | 554 |
| Guarin, F.Y. | 437 |
| Gucu, A. | 435,433,434 |
| Guénette, S. | 440,252,56,7,55,438,439 |
| Haggan, N. | 296 |
| Halfon, E. | 200 |
| Han, J.-H. | 555 |
| Haputhantri, S. | 441 |
| Harvey, C.J. | 188,556 |
| Heymans, S.J.J. | 137,444,443,442,115,107,136,108,263,135 |
| Hoover, C. | 446,557,447 |
| Hossain, M.M. | 558 |
| Jarre-Teichmann, A. | 312,124,184,311 |
| Jiang, H. | 560,445 |
| Jia, P. | 559 |
| Kargbo, V.H. | 512 |
| Kay, D.W. | 513 |
| Kitchell, J.F. | 254,134 |
| Klaer, N.L. | 562,561 |
| Kolding, J. | 234,233 |
| Langseth, B.J. | 563,564 |
| Lassalle, G. | 565,335 |
| Lee, S.I. | 566 |
| Lees, K. | 448 |
| Lercari, D. | 450,568,567 |
| Libralato, S. | 571,570,452 |
| Liew, H.C. | 237,155 |
| Li, L. | 569 |
| Lin, H.-J. | 266,71,453,267 |
| Liu, P.-J. | 454 |
| Liu, Q.-G. | 572 |
| Li, Y. | 451 |
| Lobry, J. | 52,218 |
| Machena, C. | 284,316 |
| Mackinson, S. | 457,293,628,458 |
| Man, A. | 303,169 |
| Manickchand-Heileman, S. | 240,268,243 |
| Martell, S.J.D. | 328 |
| Mathews, C.P. | 214,157 |
| McCormick Venier, J. | 269 |
| Melgo, J.L. | 24 |
| Mendoza, J.J. | 282 |
| Mendy, A.N. | 49,50,226,67,51,66 |
| Milessi, A.C. | 573 |
| Mohamed, K.S. | 574,630 |
| Mohammed, E. | 575,459,460 |
| Morales-Zárate, M.V. | 242,576 |
| Moreau, J. | 270,310,577,265,322,321,309,86,193,315,331,235 |
| Moreno, T. | 95,206 |
| Morissette, L. | 116,623,622,461,118,205,462,463 |
| Moutopoulos, D.K. | 578 |
| Mustafa, M.G. | 12,300 |
| Nascimento, M.C. | 579 |
| Nauen, C. | 464 |
| Neira, S. | 208,580,30,207 |
| Niiranen, S. | 581 |
| Nsiku, E. | 330,81 |
| Nurhakim, S. | 302 |
| Nuttall, M.A. | 582,584,583,585 |
| Ogandagas, C. | 514 |
| Okey, T.A. | 48,99,173,279,466,467,465,275 |
| Olivieri, R.A. | 273 |
| Olson, R.J. | 42 |
| Opitz, S. | 324 |

Appendix Table A4. Continued

| Author | Reference number |
|----------------------------|---|
| Orek, H. | 468 |
| Ortiz, M. | 587,595,594,593,592,591,590,588,586,618,619 |
| Osei, S.V. | 515 |
| Ould Taleb Ould Sidi, M.M. | 97,96,98 |
| Palomares, M.L.D. | 217,283,221 |
| Panikkar, P. | 596,597 |
| Patricio, J. | 599,598,600 |
| Pauly, D. | 181,469,470,601,224 |
| Pavés, H.J. | 471 |
| Pedersen, S.A. | 168,225,174 |
| Pedersen, T. | 602 |
| Persad, G. | 603 |
| Phong, L.T. | 604 |
| Pinkerton, M. | 472 |
| Pinnegar, J.K. | 473 |
| Piroddi, C. | 475,474 |
| Pitcher, T.J. | 204,202,203,110,201,105 |
| Polovina, J.J. | 476 |
| Preikshot, D.B. | 479,478,477 |
| Pruvost, P. | 480 |
| Reyes-Marchant, P. | 219 |
| Rivera-Arriaga, E. | 131,289 |
| Rocha, G.R. | 481,624 |
| Rosado-Solórzano, R. | 245,154 |
| Rosas-Luis, R. | 482,483 |
| Ruiz, D.J. | 605 |
| Ruzicka, J.J. | 606,484 |
| Rybarczyk, H. | 220,132,216 |
| Salcido-Guavara, L.A. | 325 |
| Salomon, A.K. | 607 |
| Samb, B. | 228,68,133 |
| Sánchez, F. | 264,22 |
| Savenkoff, C. | 145,146,117 |
| Sedzro, K.M. | 516 |
| Shannon, L. | 485 |
| Silvestre, G. | 192 |
| Stanford, R. | 44,104,271,272,43 |
| Stobberup, K.A. | 486 |
| Tam, J. | 487,488 |
| Taylor, M.H. | 490,489,625 |
| Tecchio, S. | 522 |
| Tomczak, M.T. | 491,494,492,626,493,608 |
| Tong, L. | 210 |
| Traore, A. | 609 |
| Trites, A.W. | 183,182 |
| Tsagarakis, K. | 495 |
| Tsehay, I. | 496 |
| Tudman, P.D. | 186 |
| Ullah, M.H. | 610 |
| Valls, A. | 497 |
| Vasconcellos, M. | 292,112,144,111,28,327,29 |
| Vega-Cendejas, M.E. | 323,27,247,288,25 |
| Velasco, G. | 498 |
| Vibunpant, S. | 60 |
| Vidal, L. | 631,290 |
| Villanueva, M.C.S. | 612,614,613,611,616,615 |
| Vivekanandan, E. | 301,147 |
| Wabnitz, C.C. | 499 |
| Walline, P.D. | 308,230 |
| Walters, C.J. | 520,519 |
| Wang, Y. | 629 |
| Watermeyer, K. | 506,504,503,502,501,500,505 |
| Watkinson, S. | 198,199,126,127 |
| Williams, A.B. | 517 |
| Wolff, M. | 212,209,189,53,158,113,213 |
| Xu, S. | 617 |
| Zeller, D. | 46 |
| Zetina-Rejón, M.J. | 291,241 |
| Zhang, Y. | 508,507 |

APPENDIX 2. ECOBASE NOMENCLATURE: LIST OF FIELDS BY TABLE (VARIABLES IN BOLD TYPE CORRESPOND TO TABLES' PRIMARY KEYS, AND DATA SOURCES ARE GIVEN FOR METADATA TABLES).

Appendix Table A5. Details of the 'absolute_flows' table

| Variable | Type | Definition |
|---------------------|------------------------|---|
| model_number | Bigint | Number of the model in the DB (models_list) |
| group_name | character varying(255) | Name of the trophic group (models_details) |
| tl_classes | character varying(255) | Trophic level class (I, II, III...) |
| abs_fl_value | double precision | Absolute flows by trophic level value |

Appendix Table A6. Details of the 'ascendency_by_group' table

| Variable | Type | Definition |
|---------------------|------------------------|---|
| model_number | bigint | Number of the model in the DB (models_list) |
| group_name | character varying(250) | Name of the trophic group (models_details) |
| ascendency | double precision | Ascendency by group value |
| overhead | double precision | Overhead by group value |
| information | double precision | Information by group value |
| throughput | double precision | Throughput by group value |

Appendix Table A7. Details of the 'ascendency_table' table

| Variable | Type | Definition |
|-----------------------|------------------------|---|
| model_number | bigint | Number of the model in the DB (models_list) |
| line_classes | character varying(255) | Total ascendency source (Import, Internal flow...) |
| column_classes | character varying(255) | Total ascendency class (Ascendency (flowbits), Overhead (flowbits)) |
| asc_tab_value | double precision | Total ascendency value |

Appendix Table A8. Details of the 'biomass_catch_by_tl' table

| Variable | Type | Definition |
|------------------------|------------------------|---|
| model_number | bigint | Number of the model in the DB (models_list) |
| tl_classes | character varying(255) | Trophic level class (I, II, III...) |
| biomass_classes | character varying(255) | Biomass/Catch class (Living, Detritus, Total, Non-hidden) |
| biomass_value | double precision | Biomass by trophic level value |
| catch_value | double precision | Catch by trophic level value |

Appendix Table A9. Details of the 'consumption_table' table

| Variable | Type | Definition |
|----------------------------|------------------------|--|
| model_number | bigint | Number of the model in the DB (models_list) |
| prey_group_name | character varying(255) | Name of the prey group (models_details + other_groups) |
| predator_group_name | character varying(255) | Name of the predator group (models_details) |
| consumption_value | double precision | Consumption value |

Appendix Table A10. Details of the 'detritus_fate' table

| Variable | Type | Definition |
|----------------------------|------------------------|---|
| model_number | bigint | Number of the model in the DB (models_list) |
| group_name | character varying(255) | Name of the source trophic group (models_details) |
| detritus_group_name | character varying(255) | Name of the fate Detritus group (models_details) |
| det_fate_value | double precision | Detritus fate value |

Appendix Table A11. Details of the 'diet_table' table

| Variable | Type | Definition |
|----------------------------|------------------------|--|
| model_number | bigint | Number of the model in the DB (models_list) |
| prey_group_name | character varying(255) | Name of the prey group (models_details + other_groups) |
| predator_group_name | character varying(255) | Name of the predator group (models_details) |
| diet_value | double precision | Diet table value |

Appendix Table A12. Details of the ‘discard_fate’ table

| Variable | Type | Definition |
|---------------------|------------------------|--|
| model_number | bigint | Number of the model in the DB (models_list) |
| fleet_name | character varying(255) | Name of the fleet (fishery_fleets) |
| detritus_group_name | character varying(255) | Name of the fate Detritus group (models_details) |
| discard_fate_value | double precision | Discard fate value |

Appendix Table A13. Details of the ‘electivity_search_rates_table’ table

| Variable | Type | Definition |
|---------------------|------------------------|---|
| model_number | bigint | Number of the model in the DB (models_list) |
| prey_group_name | character varying(255) | Name of the prey group (models_details) |
| predator_group_name | character varying(255) | Name of the predator group (models_details) |
| electivity_value | double precision | Electivity value |
| search_rates_value | double precision | Search rate value |

Appendix Table A14. Details of the ‘fishery catches’ table

| Variable | Type | Definition |
|--------------|------------------------|---|
| model_number | bigint | Number of the model in the DB (models_list) |
| fleet_name | character varying(255) | Name of the fleet (fishery_fleets) |
| group_name | character varying(255) | Name of the trophic group (models_details) |
| catch_type | character varying(255) | Type of catch (landings or discards) |
| catch_value | double precision | Catch value |

Appendix Table A15. Details of the ‘fishery_fleets’ table

| Variable | Type | Definition |
|----------------------|------------------------|---|
| model_number | bigint | Number of the model in the DB (models_list) |
| fleet_name | character varying(255) | Name of the fleet (fishery_fleets) |
| fixed_cost | double precision | Fixed cost value (in %) |
| effort_related_cost | double precision | Effort related cost value (in %) |
| sailing_related_cost | double precision | Sailing related cost value (in %) |
| profit | double precision | Profit value (in %) |
| total_value | double precision | Total value (in %) |

Appendix Table A16. Details of the ‘fishery_indices’ table

| Variable | Type | Definition |
|-------------------------|------------------------|---|
| model_number | bigint | Number of the model in the DB (models_list) |
| fleet_name | character varying(255) | Name of the fleet (fishery_fleets) |
| group_name | character varying(255) | Name of the trophic group (models_details) |
| discard_mort_rate | double precision | Discard mortality rate value |
| off_vessel_price | double precision | Off-vessel price value |
| fleet_fishing_mort_rate | double precision | Fleet fishing mortality rate value |

Appendix Table A17. Details of the ‘flows_biomasses_table’ table

| Variable | Type | Definition |
|---------------------|------------------------|---|
| model_number | bigint | Number of the model in the DB (models_list) |
| tl_classes | character varying(255) | Trophic level class (I, II, III...) |
| fl_classes | character varying(255) | Flows and biomasses class (Import, Consumption by predators...) |
| from_pp_value | double precision | Flows and biomasses from primary producers value |
| from_det_value | double precision | Flows and biomasses from detritus value |
| from_all_comb_value | double precision | Flows and biomasses from all combined value |

Appendix Table A18. Details of the ‘mixed_trophic_impact’ table

| Variable | Type | Definition |
|----------------------|------------------------|--|
| model_number | bigint | Number of the model in the DB (models_list) |
| impacting_group_name | character varying(255) | Impacting group name (models_details + fishery_fleets) |
| impacted_group_name | character varying(255) | Impacted group name (models_details + fishery_fleets) |
| mti_value | double precision | Mixed trophic impact value |

Appendix Table A19. Details of the 'models_details' table

| Variable | Type | Definition |
|-----------------------------|------------------------|--|
| model_number | bigint | Number of the model in the DB (models_list) |
| group_name | character varying(255) | Name of the trophic group |
| tl | double precision | Trophic level |
| habitat_area | double precision | Habitat area (fraction) |
| biomass_habitat_area | double precision | Biomass in habitat area |
| b_hab_area_input | boolean | Biomass in habitat area input? (TRUE/FALSE) |
| biomass | double precision | Biomass |
| pb | double precision | Production on biomass ratio |
| pb_input | boolean | Production on biomass ratio input? (TRUE/FALSE) |
| qb | double precision | Consumption on biomass ratio |
| qb_input | boolean | Consumption on biomass ratio input? (TRUE/FALSE) |
| ee | double precision | Ecotrophic efficiency |
| ee_input | boolean | Ecotrophic efficiency input? (TRUE/FALSE) |
| other_mortality_input_value | double precision | Other mortality (input value) |
| pq | double precision | Production on consumption ratio |
| pq_input | boolean | Production on consumption ratio input? (TRUE/FALSE) |
| uq | double precision | Unassimilated consumption on consumption ratio |
| detritus_import | double precision | Detritus import |
| consumer | boolean | Consumer group? (TRUE/FALSE) |
| producer | boolean | Producer group? (TRUE/FALSE) |
| detritus | boolean | Detritus group? (TRUE/FALSE) |
| part_prod_from_pp | double precision | Part of production from primary producer |
| multi_stanza_group_name | character varying(255) | Multi-stanza group name |
| stanza_age | double precision | Stanza age (in months) |
| immigration | double precision | Immigration (input value) |
| emigration | double precision | Emigration (input value) |
| emigration_rate | double precision | Emigration rate (input value) |
| biom_acc | double precision | Biomass accumulation |
| biom_acc_input | boolean | Biomass accumulation input? (TRUE/FALSE) |
| biom_acc_rate | double precision | Biomass accumulation rate |
| biom_acc_rate_input | boolean | Biomass accumulation rate input? (TRUE/FALSE) |
| a_in_lw | double precision | Parameter 'a' value in length-weight relation |
| b_in_lw | double precision | Parameter 'b' value in length-weight relation |
| l_at_infinity | double precision | Length at infinity |
| w_at_infinity | double precision | Weight at infinity |
| k_in_vbfg | double precision | Parameter 'K' value in Von Bertalanffy growth function |
| t0_in_vbfg | double precision | Parameter 't ₀ ' value in Von Bertalanffy growth function |
| age_first_capture | double precision | Age of first capture |
| max_age | double precision | Maximum age |
| net_migration | double precision | Net migration |
| flow_to_det | double precision | Flow to detritus |
| net_efficiency | double precision | Net efficiency |
| oi | double precision | Omnivory index |
| fishing_mort_rate | double precision | Fishing mortality rate |
| pred_mort_rate | double precision | Predation mortality rate |
| net_migration_rate | double precision | Net migration rate |
| other_mort_rate | double precision | Other mortality rate |
| respiration | double precision | Respiration |
| assimilation | double precision | Assimilation |
| ks_index_1 | double precision | Keystone index |
| ks_index_2 | double precision | Keystone index #2 |
| rel_tot_impact | double precision | Relative total impact |
| flow_from_det | double precision | Flow from detritus |

Appendix Table A20. Details of the 'models_history' table

| Variable | Type | Definition | Source |
|----------------------|------------------------|---|-------------|
| model_number | bigint | Number of the model in the DB (models_list) | database |
| available | boolean | Is the model recorded in the DB? (TRUE/FALSE) | database |
| referenced | boolean | Is the reference recorded in the DB? (TRUE/FALSE) | database |
| asked | boolean | If not available, did we ask for the model? (TRUE/FALSE) | database |
| facilitator | character varying(500) | Person through whom the model was given | database |
| facilitator_contact | character varying(500) | E-mail address of the facilitator | database |
| balanced | boolean | Is the Ecopath model balanced? (TRUE/FALSE) | database |
| modified | boolean | Has the model been modified? (TRUE/FALSE) | database |
| modifier | character varying(500) | If modified=TRUE, person who modified the model | database |
| modifier_contact | character varying(500) | E-mail address of the modifier | database |
| match_paper_b | boolean | Do model biomass values correspond to reference values? (TRUE/FALSE) | model/paper |
| difference_b | character varying(250) | If not, importance of the difference (low,medium,high) | model/paper |
| match_paper_dc | boolean | Do model diet values correspond to reference values? (TRUE/FALSE) | model/paper |
| difference_dc | character varying(250) | If not, importance of the difference (low,medium,high) | model/paper |
| match_paper_ee | boolean | Do model EE values correspond to reference values? (TRUE/FALSE) | model/paper |
| difference_ee | character varying(250) | If not, importance of the difference (low,medium,high) | model/paper |
| match_paper_pb | boolean | Do model P/B values correspond to reference values? (TRUE/FALSE) | model/paper |
| difference_pb | character varying(250) | If not, importance of the difference (low,medium,high) | model/paper |
| match_paper_qb | boolean | Do model Q/B values correspond to reference values? (TRUE/FALSE) | model/paper |
| difference_qb | character varying(250) | If not, importance of the difference (low,medium,high) | model/paper |
| match_paper_y | boolean | Do model catch values correspond to reference values? (TRUE/FALSE) | model/paper |
| difference_y | character varying(250) | If not, importance of the difference (low,medium,high) | model/paper |
| ewe_version_database | character varying(255) | Version of EwE in which the model has been stored in the DB | model/paper |
| ewe_version_original | character varying(255) | Version of EwE in which the model has been built by its author, as cited in the paper | paper |
| villy_remarks | text | Any remark from Villy Christensen on the model | database |
| paco_model_remarks | text | Any remark from Francisco Arreguín-Sánchez when opening and processing the model (balance procedure, problems, comparison with reference) | database |
| paco_remarks | text | Any additional remark from Francisco Arreguín-Sánchez on the model | database |
| mathieu_problem | text | Summary remarks from Mathieu Colléter when merging all databases | database |
| mathieu_usable | boolean | Is the model usable for Mathieu Colléter meta-analysis purposes? (personal use) | database |

Appendix Table A21. Details of the 'models_indices' table

| Variable | Type | Definition |
|---|------------------|---|
| model_number | bigint | Number of the model in the DB (models_list) |
| sum_all_consumption | double precision | Sum of all consumption |
| sum_all_exports | double precision | Sum of all exports |
| sum_all_resp_flows | double precision | Sum of all respiratory flows |
| sum_all_flows_into_det | double precision | Sum of all flows into detritus |
| total_system_throughput | double precision | Total system throughput |
| sum_all_prod | double precision | Sum of all production |
| mean_tl_catch | double precision | Mean trophic level of the catch |
| gross_efficiency | double precision | Gross efficiency (catch/net p.p.) |
| input_total_net_pp | double precision | Input total net primary production |
| calculated_total_net_pp | double precision | Calculated total net primary production |
| unaccounted_pp | double precision | Unaccounted primary production |
| pp_resp_ratio | double precision | Total primary production/total respiration |
| net_system_prod | double precision | Net system production |
| pp_biomass_ratio | double precision | Total primary production/total biomass |
| biomass_throughput_ratio | double precision | Total biomass/total throughput |
| total_biomass_exclud_det | double precision | Total biomass (excluding detritus) |
| total_catch | double precision | Total catch |
| connectance_index | double precision | Connectance Index |
| system_omnivory_index | double precision | System Omnivory Index |
| total_market_value | double precision | Total market value |
| total_shadow_value | double precision | Total shadow value |
| total_value | double precision | Total value |
| total_fixed_cost | double precision | Total fixed cost |
| total_variable_cost | double precision | Total variable cost |
| total_cost | double precision | Total cost |
| profit | double precision | Profit |
| pedigree_index | double precision | Ecopath pedigree index |
| measure_fit_t | double precision | Measure of fit, t* |
| flows_biomasses_throughput_extracted_break_cycles | double precision | Flows and biomasses from all combined extracted to break cycles |
| flows_biomasses_throughput_input_tl_ii | double precision | Flows and biomasses from all combined: Input TL II+ (not in throughput) |
| prop_flow_origin_det | double precision | Proportion of total flow originating from detritus |
| te_from_pp | double precision | Transfer efficiency from primary producer (calculated as geometric mean for TL II-IV) |
| te_from_det | double precision | Transfer efficiency from detritus (calculated as geometric mean for TL II-IV) |
| te_total | double precision | Total transfer efficiency (calculated as geometric mean for TL II-IV) |
| throughput_cycled_exclud_det | double precision | Throughput cycled (excluding detritus) |
| pred_cycling_index | double precision | Predatory cycling index |
| throughput_cycled_includ_det | double precision | Throughput cycled (including detritus) |
| finn_cycling_index | double precision | Finn's cycling index |
| finn_mean_path_leng | double precision | Finn's mean path length |
| finn_straight_through_path_length_without_det | double precision | Finn's straight-through path length (without detritus) |
| finn_straight_through_path_length_with_det | double precision | Finn's straight-through path length (with detritus) |

Appendix Table A22. Details of the 'models_info' table

| Variable | Type | Definition | Source |
|-------------------------|------------------------|--|-------------------|
| model_number | bigint | Number of the model in the DB (models_list) | database |
| model_year_start | smallint | Start year of the modeled period | model input/paper |
| model_year_end | smallint | End year of the modeled period | model input/paper |
| sibling_model | boolean | Are there several historical versions of the model? (TRUE/FALSE) | database |
| sibling_code | character varying(255) | Model number(s) of sibling(s) (if several, noted as 195_196) | database |
| area | double precision | Modeled area (km2) | model input/paper |
| model_location | character varying(255) | Model location | model input/paper |
| country | character varying(255) | Country (if the model can be related to one (or several) country) | model input/paper |
| fao_area | character varying(255) | FAO area in which the model is included (if several, noted as 61_71) | database |
| lme | character varying(255) | Large Marine Ecosystem in which the model is included (if several, noted as 27_28) | database |
| coordinates_north | text | Northern coordinate (in decimal degrees) | model input |
| coordinates_south | text | Southern coordinate (in decimal degrees) | model input |
| coordinates_east | text | Eastern coordinate (in decimal degrees) | model input |
| coordinates_west | text | Western coordinate (in decimal degrees) | model input |
| geographic_extent | text | Spatial polygon of the model (in decimal degrees) | database |
| geom | geometry | Calculated geometric column (from geographic_extent) enabling mapping of the models | database |
| overlapping_model | boolean | Are there several spatial versions of the model? (TRUE/FALSE) | database |
| overlapping_code | character varying(255) | Model number(s) of overlapping model(s) (if several, noted as 195_196) | database |
| temperature_min | double precision | Minimum sea surface temperature (SST) of the ecosystem on the modeled time period | paper |
| temperature_max | double precision | Maximum SST of the ecosystem on the modeled time period | paper |
| temperature_mean | double precision | Mean SST of the ecosystem on the modeled time period | paper |
| depth_min | double precision | Minimum depth of the modeled ecosystem | paper |
| depth_max | double precision | Maximum depth of the modeled ecosystem | paper |
| depth_mean | double precision | Mean depth of the modeled ecosystem | paper |
| salinity_min | double precision | Minimum water salinity of the ecosystem on the modeled time period | paper |
| salinity_max | double precision | Maximum water salinity of the ecosystem on the modeled time period | paper |
| salinity_mean | double precision | Mean water salinity of the ecosystem on the modeled time period | paper |
| oxygen_min | double precision | Minimum water oxygen rate of the ecosystem on the modeled time period | paper |
| oxygen_max | double precision | Maximum water oxygen rate of the ecosystem on the modeled time period | paper |
| oxygen_mean | double precision | Mean water oxygen rate of the ecosystem on the modeled time period | paper |
| primary_production | double precision | Mean primary production of the ecosystem on the modeled time period | paper |
| sediment_structure | character varying(255) | Sediment structure of the ecosystem | paper |
| ecosystem_zone | character varying(255) | Model ecosystem zone (tropical, temperate or polar) | paper |
| ecosystem_type | character varying(255) | Model ecosystem type (channel/strait, bay/fjord, coastal lagoon, coral reef, continental shelf (< 200m depth), ocean, river, estuary, beach, reservoir, lake, terrestrial) | paper |
| mathieu_ecosyst_type | character varying(255) | Model ecosystem type (Mathieu Coll  ter's classification) | database |
| paco_ecosyst_type | text | Model ecosystem type (Paco Arregu  n-S  nchez's classification) | database |
| paco_other_ecosyst_type | text | Model other ecosystem type (Paco Arregu  n-S  nchez's classification) | database |
| paco_other_ecosyst_uses | boolean | Other modeled ecosystem uses? (Paco Arregu  n-S  nchez's info, TRUE/FALSE) | database |
| paco_describe_uses | text | What for other use (Paco Arregu  n-S  nchez's info) | database |
| whole_food_web | boolean | Is the entire food web accounted for in the model? (TRUE/FALSE) | paper |
| mpa | boolean | Is the modeled ecosystem under any protection? (TRUE/FALSE) | paper |

Appendix Table A23. Details of the 'models_list' table

| Variable | Type | Definition | Source |
|--------------------------|------------------------|--|----------------------|
| model_number | bigserial | Number of the model in the DB | database |
| model_name | character varying(255) | Name of the model | model input/database |
| description | text | Description of the model | model input |
| author | character varying(255) | 1st author name | paper |
| author_contact | character varying(500) | 1st author e-mail address | paper |
| relevant_decimal_digits | smallint | Number of relevant decimal digits | model input |
| group_digits | boolean | Group digits? (TRUE/FALSE) | model input |
| monetary_units | character varying(255) | Monetary unit of the model | model input/paper |
| currency_units | character varying(255) | Currency unit of the model | model input/paper |
| time_units | character varying(255) | Time unit of the model | model input/paper |
| include_psd_calculations | boolean | Includes particle size distribution (PSD) calculations? (TRUE/FALSE) | model input |
| ecospace | boolean | Is the Ecospace routine used? (TRUE/FALSE) | paper/model |
| ecosim | boolean | Is the Ecosim routine used? (TRUE/FALSE) | paper/model |
| ecopath | boolean | Is the Ecopath routine used? (TRUE/FALSE) | paper/model |
| ecotracer | boolean | Is the Ecotracer routine used? (TRUE/FALSE) | paper/model |
| ecotroph | boolean | Is the EcoTroph routine used? (TRUE/FALSE) | paper |
| keystone_analysis | boolean | Has a keystone analysis been done? (TRUE/FALSE) | paper/model |
| species_info | boolean | Is the list of species for each functional group available? (TRUE/FALSE) | paper |
| species_of_interest | boolean | Has the model been built to study a particular species/group? (TRUE/FALSE) | paper |
| stanza_groups | boolean | Are there any stanzas in the model? (TRUE/FALSE) | model input/paper |
| species_of_interest_name | character varying(255) | If species_of_interest=TRUE, name of species/group of particular interest | paper |
| number_groups | smallint | Number of functional groups included in the model | paper/model |
| fisheries | boolean | Was the model built to study fisheries? (TRUE/FALSE) | paper |
| aquaculture | boolean | Was the model built to study aquaculture? (TRUE/FALSE) | paper |
| environment_variability | boolean | Was the model built to study environmental variability? (TRUE/FALSE) | paper |
| ecosyst_functioning | boolean | Was the model built to study global ecosystem functioning? (TRUE/FALSE) | paper |
| pollution | boolean | Was the model built to study pollution? (TRUE/FALSE) | paper |

Appendix Table A24. Details of the 'models_ref' table

| Variable | Type | Definition |
|----------------|---------|--|
| model_number | bigint | Number of the model in the DB (models_list) |
| id_ref | bigint | Number of the reference in the DB (references_table) |
| ref_importance | integer | Importance of the reference (if several: 1, 2...) |

Appendix Table A25. Details of the 'niche_overlap' table

| Variable | Type | Definition |
|--------------------|------------------------|---|
| model_number | bigint | Number of the model in the DB (models_list) |
| group_name | character varying(255) | Name of the trophic group (models_details) |
| column_group_name | character varying(255) | Name of the trophic group (models_details) |
| prey_overlap_value | double precision | Prey overlap value |
| pred_overlap_value | double precision | Predator overlap value |

Appendix Table A26. Details of the 'non_market_price' table

| Variable | Type | Definition |
|--------------|------------------------|---|
| model_number | bigint | Number of the model in the DB (models_list) |
| group_name | character varying(255) | Name of the trophic group (models_details) |
| price_value | double precision | Non-market price value |

Appendix Table A27. Details of the 'other_groups' table

| Variable | Type | Definition |
|-------------------|------------------------|---|
| model_number | bigint | Number of the model in the DB (models_list) |
| other_groups_name | character varying(255) | Name of the other groups |
| other_groups_type | character varying(255) | Other groups type (notably import) |

Appendix Table A28. Details of the 'pedigree_assignment' table

| Variable | Type | Definition |
|-----------------|------------------------|---|
| model_number | bigint | Number of the model in the DB (models_list) |
| group_name | character varying(255) | Name of the trophic group (models_details) |
| variable | character varying(255) | Concerned variable |
| definition_name | character varying(255) | Pedigree classification name |

Appendix Table A29. Details of the 'pedigree_definition' table

| Variable | Type | Definition |
|-----------------|------------------------|--|
| model_number | bigint | Number of the model in the DB (models_list) |
| variable | character varying(255) | Name of the variable (Biomass in habitat area, P/B...) |
| definition_name | character varying(255) | Name of the Pedigree classification |
| index_value | double precision | Index value |
| conf_interv | double precision | Confidence interval (+/-%) |

Appendix Table A30. Details of the 'ppr_consumption_groups' table

| Variable | Type | Definition |
|--------------------|------------------------|--|
| model_number | bigint | Number of the model in the DB (models_list) |
| group_name | character varying(255) | Name of the trophic group (models_details) |
| paths_number | double precision | Number of paths |
| ppr_pp | double precision | Primary production required (PPR) from primary producers |
| ppr_det | double precision | PPR from detritus |
| ppr | double precision | Total PPR for consumption |
| consumption | double precision | Consumption |
| ppr_cons_ratio | double precision | PPR on consumption ratio |
| ppr_totpp_ratio | double precision | PPR on total primary production ratio |
| ppr_ubiomass_ratio | double precision | PPR on biomass unit ratio |

Appendix Table A31. Details of the 'ppr_harvest_groups' table

| Variable | Type | Definition |
|------------------|------------------------|--|
| model_number | bigint | Number of the model in the DB (models_list) |
| group_name | character varying(255) | Name of the trophic group (models_details) |
| paths_number | double precision | Number of paths |
| ppr_pp | double precision | Primary production required (PPR) from primary producers |
| ppr_det | double precision | PPR from detritus |
| ppr | double precision | Total PPR for harvest |
| catch | double precision | Catch |
| ppr_catch_ratio | double precision | PPR on catch ratio |
| ppr_totpp_ratio | double precision | PPR on total primary production ratio |
| ppr_ucatch_ratio | double precision | PPR on catch unit ratio |

Appendix Table A32. Details of the 'pred_mort_rates_table' table

| Variable | Type | Definition |
|---------------------|------------------------|---|
| model_number | bigint | Number of the model in the DB (models_list) |
| prey_group_name | character varying(255) | Name of the prey group (models_details) |
| predator_group_name | character varying(255) | Name of the predator group (models_details) |
| pmr_value | double precision | Predation mortality rate value |

Appendix Table A33. Details of the 'psd_contribution' table

| Variable | Type | Definition |
|---------------|------------------------|---|
| model_number | bigint | Number of the model in the DB (models_list) |
| group_name | character varying(255) | Name of the trophic group (models_details) |
| weight_class | character varying(255) | Name of the weight class |
| contrib_value | double precision | Contribution value |

Appendix Table A34. Details of the 'psd_growth_estimates' table

| Variable | Type | Definition |
|-------------------|------------------------|--|
| model_number | bigint | Number of the model in the DB (models_list) |
| group_name | character varying(255) | Name of the trophic group (models_details) |
| a_in_lw | double precision | Parameter 'a' value in length-weight relation |
| b_in_lw | double precision | Parameter 'b' value in length-weight relation |
| l_at_infinity | double precision | Length at infinity |
| w_at_infinity | double precision | Weight at infinity |
| k_in_vbgf | double precision | Parameter 'K' value in Von Bertalanffy growth function |
| t0_in_vbgf | double precision | Parameter 't ₀ ' value in Von Bertalanffy growth function |
| age_first_capture | double precision | Age of first capture |
| max_age | double precision | Maximum age |

Appendix Table A35. Details of the 'references_table' table

| Variable | Type | Definition |
|------------|---------|--|
| id_ref | integer | Number of the reference in the DB |
| xml_ref | xml | Reference in xml format |
| pdf | boolean | Is the reference available online in pdf format? (TRUE/FALSE) |
| supplement | boolean | Does the reference contain supplementary materials? (TRUE/FALSE) |

Appendix Table A36. Details of the 'taxonomy' table

| Variable | Type | Definition |
|---------------------|------------------------|--|
| model_number | bigint | Number of the model in the DB (models_list) |
| group_name | character varying(255) | Name of the trophic group (models_details) |
| subgroup_name | character varying(255) | Name of the subgroup name, i.e. species name |
| prop_of_biomass | double precision | Proportion of biomass |
| genus | character varying(255) | Genus name |
| species | character varying(255) | Species name |
| family_name | character varying(255) | Family name |
| order_name | character varying(255) | Order name |
| class_name | character varying(255) | Class name |
| phylum_name | character varying(255) | Phylum name |
| organism | character varying(255) | Organism name |
| ecology | character varying(255) | Ecology |
| occurrence_status | character varying(255) | Occurrence status |
| prop_of_biomass2 | double precision | Proportion of biomass |
| prop_of_catch | double precision | Proportion of catch |
| iucn_conserv_status | character varying(255) | IUCN conservation status |
| vuln_index | double precision | Vulnerability index |
| mean_length | double precision | Mean length |
| max_length | double precision | Maximum length |
| mean_weight | double precision | Mean weight |
| mean_life_span | double precision | Mean life span |

Appendix Table A37. Details of the 'transfer_efficiency' table

| Variable | Type | Definition |
|----------------|------------------------|--|
| model_number | bigint | Number of the model in the DB (models_list) |
| transf_classes | character varying(255) | Transfer efficiency source class (Producer, Detritus, All flows) |
| tl_classes | character varying(255) | Trophic level class (I, II, III...) |
| te_tab_value | double precision | Transfer efficiency value |

APPENDIX 3. METHOD FOR THE GEO-LOCALIZATION OF EwE MODELS

We decided to include a precise spatial polygon for each EwE model. This representation relies mainly on publications information, and has been developed for several uses. It relies on the specification of spatial coordinates in the 'geographic_extent' field of the 'models_info' table. This field is treated within the database to furnish a geographic object usable in GIS software. We use spatial capabilities of the Postgres/Postgis database object. The geometry type enables us to store more than only numeric or text objects, but also spatial ones. Import of the data can be made as text (it should be KML files) or as shapefiles. Spatial coordinates can correspond to a specific point or a polygon (2D), e.g. '-33,41,0 -33,35,0 -23,35,0 -23,41,0 -33,41,0' corresponding to a square covering the area modeled by Guénette and Morato (2001; see Figure A1).¹ Once data are loaded, several functions dedicated to this data type are usable: area, distance, projections, intersection, union calculations, and transformation as shape or kml.

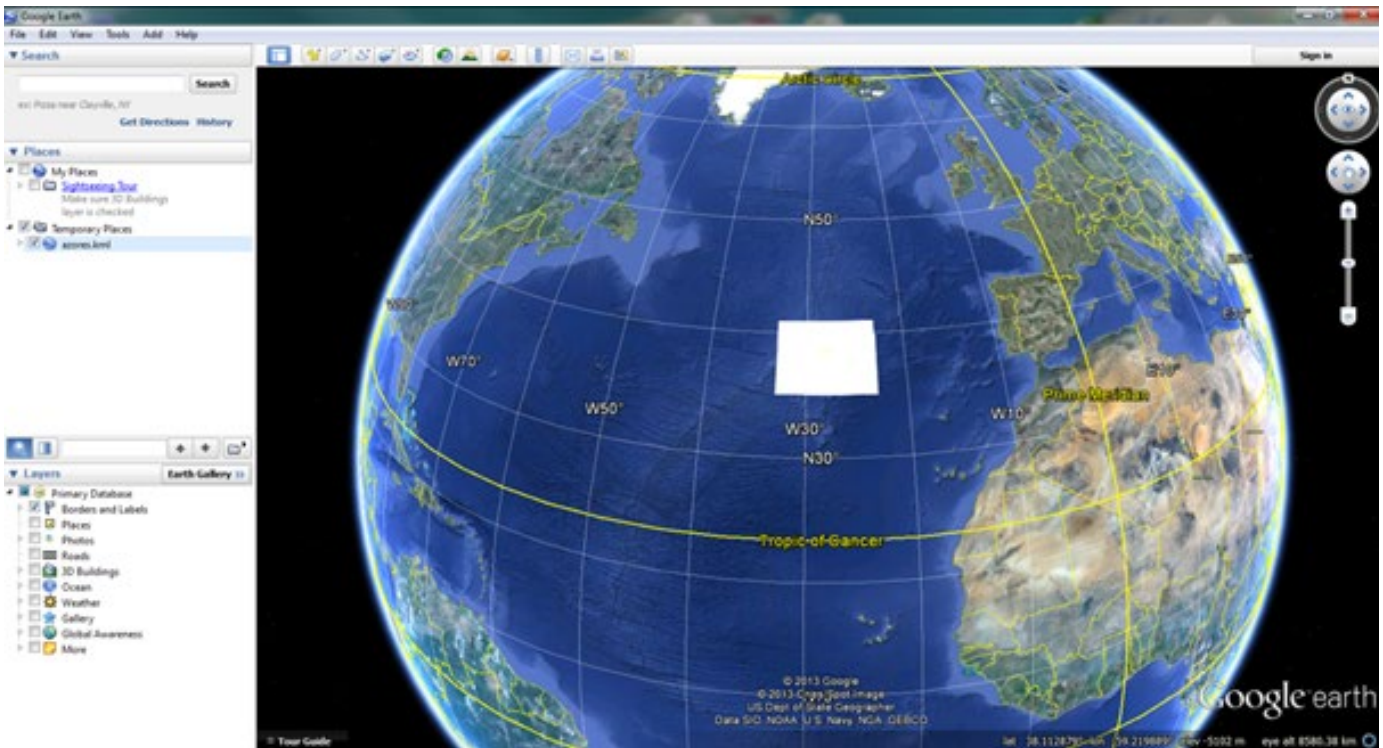


Figure A1. Google Earth representation of the spatial polygon allocated to Azores EwE model.

¹ Guénette S and Morato T (2001) The Azores Archipelago, 1997. pp. 241-270 In Zeller D, Watson R and Pauly D (eds.), Fisheries Impacts on North Atlantic Ecosystems: Models and Analyses. Fisheries Centre Research Reports 9 (4). The Fisheries Centre, University of British Columbia, Vancouver, Canada.