**(ii) The current major sources of biodiversity data and information; (iii) The main biodiversity data, information and knowledge gaps.**

The plethora of repositories and databases and programs already existing for gathering information about biodiversity and related environmental variables, is an evidence of both 1) increasing interest and efforts of the international research community and related governments towards a global collaboration for the creation of a concerted framework; 2) lack of coordination and established structure with relative emerging issues.

The main incongruences evident in such information is probable redundancy, spatial/temporal scales that could not be comparable, lack of global standardization and high margin for improvement of metadata and ancillary data. A possible strategy would be to choose few of the main existing ones as reference for future global compilation, and make all the smaller and, in some cases, more specialized ones, fully interoperable, both in terms of standards and usable format. This approach would allow to satisfy more general/global needs but also more detailed/localized ones without imposing a hierarchy.

The multiplication of information sources, along with the need of applying state of the art knowledge, technology and processing tools to deal with them, diminish considerably the sharing and applicative potential of such information both for research and decision making.

Therefore, following the need to create easy access to easy processing tools, processing platforms and users’ trainings have to be further implemented. This tools should include, but not limited to, the application and integration of focus-targeted models and analyses, to avoid too general outputs, unsuitable for end-users needs like regional or local integrated ecosystem assessments for managing and conservation of natural resources or to comply with precise policy requirements.

On the socioeconomic point of view, it will be very valuable to add to biodiversity data also the corresponding pressures and direct and indirect impacts, for instance by region, for species and habitats, generated by both anthropogenic activities and consequences of climate change. This information would be much more appealing for stakeholders like governments and environmental managers who need to go through the cost/benefit analysis phase for decision making. On the other hand, such socio-economic valuations can highlight lack of resources or information for certain regions or species/habitats and therefore be a guidance to improve the collection and processing of biodiversity data.

Another aspect to consider in the present biodiversity information landscape is the lack of clarity among actual databases and repositories, programs and networks. We already have several main international databases and repositories that are fed by multiple projects and programs. Nonetheless, there are more than 200 programs globally and half of them do not have an official repository. Of this half, only 30% provide free access to their data, for the other ones a special request to access the data is needed.

MBON community already has operational systems that can deliver indicators of trends in at least plankton (including HAB and CPR), coral reefs, and rocky reefs and could do the same for coastal sediment fauna, rocky seashores and fishery related data. Main metrics could be changes (turnover) in species richness and abundance, and gain/loss of indicator species (e.g. threatened, introduced, harmful, keystone.

**Policy needs**

**Research needs**

Fig. 1: Integrated cyclical biodiversity data process

## List of major biodiversity-related data repositories

* OBIS <https://obis.org/> data repository and platform, biodiversity
* GBIF <https://www.gbif.org/> data repository and platform, biodiversity
* Sealifebase <https://sealifebase.se/search.php> sea life data
* Fishbase <https://fishbase.in/search.php> fish data
* Algaebase <https://www.algaebase.org/> algae data
* NCBI <https://www.ncbi.nlm.nih.gov/> genetic diversity repository
* Reeflifesurvey <https://reeflifesurvey.com/> citizen science
* iNaturalist <https://www.inaturalist.org/> citizen science
* INPN espèces [https://determinobs.fr/#/](https://determinobs.fr/%22%20%5Cl%20%22/) citizen science
* Ebird <https://ebird.org/home> citizen science
* Ecotaxa <https://ecotaxa.obs-vlfr.fr/> plankton diversity
* GMED <http://gmed.auckland.ac.nz/> environmental data repository
* Movebank <https://www.movebank.org/cms/movebank-main> animal tracking data and platform
* Seadatanet <https://www.seadatanet.org/> biodiversity & environmental data and platform for European territories
* PANGAEA <https://doi.pangaea.de/> Data Publisher for Earth & Environmental Science
* EMODNET <https://www.emodnet.eu/en> biodiversity & environmental data for European territories
* AODN <https://portal.aodn.org.au/> biodiversity & environmental data for Australian territories
* DOSI <https://www.dosi-project.org/> deep ocean diversity, pressures, impacts
* INPN <https://inpn.mnhn.fr/accueil/index?lg=en> biodiversity data for French territories
* DASSH <https://www.dassh.ac.uk/> UK biodiversity repository
* UNEP-WCMC <https://www.unep-wcmc.org/> mangroves, seagrass, corals
* Aquamaps <https://www.aquamaps.org/main/home.php> platform for SDM
* Copernicus <https://marine.copernicus.eu/> remote sensed and modeling EOV and indicators data and platform
* WORMS <http://marinespecies.org/> taxonomic repository
* OSPAR: <https://odims.ospar.org/> data repository and platform, biodiversity, environmental and pressures data
* Ocean Health Index <http://www.oceanhealthindex.org/> data repository and platform, biodiversity, environmental and pressures data
* Wallace <https://wallaceecomod.github.io/> platform for SDM models
* Bluebridge <https://bluebridge-vres.eu/> platform
* Bluecloud <https://www.blue-cloud.org/> platform and data
* Lifewatch <https://www.lifewatch.eu/> platform
* Bccvl <http://bccvl.org.au/> biodiversity modeling platform
* D4science <https://www.d4science.org/> platform
* Wildlife <http://eo4wildlife.eu/node/543> platform for tracking data of marine megafauna
* Darwincore <https://dwc.tdwg.org/> biological data standard
* ERDDAP <https://coastwatch.pfeg.noaa.gov/erddap/index.html> data processing tool

## Main European repositories

* + - <https://water.europa.eu/marine> marine data repository and platform for several topics.
		- [EMODnet (European Marine Observation and Data Network)](http://www.emodnet.eu/) Network of organisations supported by the EU’s integrated maritime policy that make European marine data available as interoperable data layers and data products.
		- [CMEMS (Copernicus Marine Environment Monitoring Service)](http://marine.copernicus.eu/) Copernicus, previously known as GMES (Global Monitoring for Environment and Security), is the European Programme for the establishment of a European capacity for Earth Observation. Its marine component is the CMEMS, that provides regular and systematic reference information on the physical state, variability and dynamics of the ocean and marine ecosystems for the global ocean and the European regional seas.
		- [ICES (International Council for the Exploration of the Sea)](http://www.ices.dk/marine-data/data-portals/Pages/default.aspx) Through the ICES data portals, users can access and download data on biodiversity, contaminants, fish surveys, oceanographic data and underwater noise, among others.
		- [OSPAR ODIMS (Data & Information Management System)](https://odims.ospar.org/) Through ODIMS, OSPAR makes accessible a lot of data, metadata
		- [HELCOM Map and Data Service (HELCOM MADS)](http://maps.helcom.fi/website/mapservice/) Geospatial data relevant for HELCOM work from status assessments to shipping density maps. The HELCOM Map and Data service contains various functionalities for viewing datasets, for example, identify features and attribute table functionalities.
		- [InfoMapNode](http://infomapnode.info-rac.org/) The geoportal for sharing geospatial data and maps within the Barcelona Convention
		- [EAS (European Atlas of the Seas)](https://ec.europa.eu/maritimeaffairs/atlas_en) The Atlas has been created by DG-MARE and it provides access to over 100 web services with up-to-date information on marine knowledge, protected areas, fisheries and blue growth.
		- [JRC-MSFD Competence Centre- EMIS-R Marine Analyst](https://mcc.jrc.ec.europa.eu/main/dev.py?N=simple&O=410&titre_page=EMIS-R%2520Marine%2520Analyst) The EMIS-R Marine Analyst is a R-tool dedicated to the environmental assessment of marine areas as Marine Protected Areas (MPAs) and political assessment units. It provides a wide range of information as maps and statistics on the selected marine areas
		- [EEA section: Habitats Directive- Conservation status of habitat types and species](https://www.eea.europa.eu/data-and-maps/data/article-17-database-habitats-directive-92-43-eec-1) Tabular data as reported by Member States for the 2007-2012 period, as well as GIS files of species and habitats distribution.
		- [EEA section: Birds Directive- Status and trends of bird populations](https://www.eea.europa.eu/data-and-maps/data/article-12-database-birds-directive-2009-147-ec) Tabular data as reported by Member States for the 2008-2012 period, as well as GIS files of species distribution.
		- [EEA Natura 2000 viewer](http://natura2000.eea.europa.eu/) This map viewer  allows searching for sites by site code or name, by species or habitats types. It also shows species distribution (as reported by EU Member States under Art. 12 Birds Directive or Art. 17 Habitats Directive) and habitats distribution (as reported by EU Member States under Art. 17 Habitats Directive
		- [EEA section: WISE WFD reference spatial data sets](https://www.eea.europa.eu/data-and-maps/data/wise-wfd-spatial-2) GIS files of the river basin districts, river basin district sub-units, surface water bodies, groundwater bodies and monitoring sites used in the first and second River Basin Management Plans (RBMP).
		- [EEA section: WISE Water Framework Directive Database](https://www.eea.europa.eu/data-and-maps/data/wise-wfd-spatial-3) Data from the 1st and 2nd River Basin Management Plans reported by EU Members States, Norway and the United Kingdom according to article 13 of the Water Framework Directive (WFD).
		- [EEA section: Marine LitterWatch](https://www.eea.europa.eu/themes/coast_sea/marine-litterwatch) Data on marine litter collected by different organisations (communities) via the Marine LitterWatch app or entered
		- [EEA section: Urban Waste Water Treatment Directive reported data](https://www.eea.europa.eu/data-and-maps/data/waterbase-uwwtd-urban-waste-water-treatment-directive-6) The dataset contains data selected from the reporting of Member States as part of the UWWTD implementation.
		- [EEA Spatial Data Infrastructure (SDI) catalogue](https://sdi.eea.europa.eu/) Discovery tool where some European reference datasets relevant for the marine environment are described and downloaded
		- [EEA Discomap](https://discomap.eea.europa.eu/) EEA's map services server that allows access to a lot of different thematic maps.

## List of major biodiversity-related programs

* MBON <https://marinebon.org/> network and links to data
* GOOS <http://ioc-goos.org/> EOV, EBV, network, links to data
* OTN <http://oceantrackingnetwork.org/> network, acoustic data repository and tools
* CPR <http://globalcpr.org/> plankton monitoring, links to data
* AMT [www.amt-uk.org](http://www.amt-uk.org) plankton monitoring, links to data
* Tara Oceans <https://oceans.taraexpeditions.org/en/> plankton, microbes, corals
* LTER <https://lternet.edu/> US monitoring network, links to data
* iLTER <https://www.ilter.network/> international monitoring network, links to data
* DOSI <https://www.dosi-project.org/> deep ocean diversity, pressures, impacts
* TOOP <http://www.topp.org/> tagging of pelagic predators
* Oceanscape <https://oceanscape.org/> network
* <https://geoblueplanet.org/> network
* <https://marinegeo.si.edu/> network
* <https://www.oceanbestpractices.org/> network
* <https://gcrmn.net/> coral reefs monitoring network

## List of major databases and programs as reported in reviews

Bingham H, Doudin M, Weatherdon L, Despot-Belmonte K, Wetzel F, Groom Q, Lewis E, Regan E, Appeltans W, Güntsch A, Mergen P, Agosti D, Penev L, Hoffmann A, Saarenmaa H, Geller G, Kim K, Kim H, Archambeau A, Häuser C, Schmeller D, Geijzendorffer I, García Camacho A, Guerra C, Robertson T, Runnel V, Valland N, Martin C (2017) The Biodiversity Informatics Landscape: Elements, Connections and Opportunities. Research Ideas and Outcomes 3: e14059. <https://doi.org/10.3897/rio.3.e14059>

Table 1.

|  |  |
| --- | --- |
| Short Name | Long Name |
| Amphibian Species of the World | Amphibian Species of the World |
| AmphibiaWeb | AmphibiaWeb |
| AquaMaps | AquaMaps |
| Arctos | Arctos |
| ARPHA | ARPHA Writing Tool |
| Barcode of Life | International Barcode of Life |
| BHL | Biodiversity Heritage Library |
| BioCASE | Biological Collection Access Service |
| Biodiversity Literature Repository | Biodiversity Literature Repository |
| BIP | Biodiversity Indicators Partnership |
| BISE | Biodiversity Information System for Europe |
| CABI ISC | Centre for Agriculture and Biosciences International: Invasive Species Compendium |
| CITES Appendices | Convention on International Trade in Endangered Species of Wild Fauna and Flora Appendices |
| CITES Checklist | Convention on International Trade in Endangered Species of Wild Fauna and Flora Checklist |
| CITES Trade Database | Convention on International Trade in Endangered Species of Wild Fauna and Flora Trade Database |
| COL | Catalogue of Life |
| DAISIE | Delivering Alien Invasive Species Inventories for Europe |
| DEIMS | Dynamic Ecological Information Management System |
| DOPA | Digital Observatory for Protected Areas |
| EBSA | Ecologically or Biologically Significant Marine Areas |
| EMODnet Portal | European Marine Observation and Data Network Portal |
| EnvThes | Environmental Thesaurus |
| EOL | Encyclopedia Of Life |
| ERMS | European Register of Marine Species |
| EU Biodiversity Strategy | EU Biodiversity Strategy to 2020 |
| Euro+Med PlantBase | Euro+Med PlantBase |
| EUNIS | European Nature Information System |
| EurOBIS | European node of Ocean Biogeographic Information System |
| European Biodiversity Portal | European Biodiversity Portal |
| Fauna Europaea | Fauna Europaea |
| FishBase | FishBase |
| GBIF | Global Biodiversity Information Facility |
| GEOSS Portal | Global Earth Observation System of Systems Portal |
| GFN | Global Footprint Network |
| GFW | Global Forest Watch |
| GISD | Global Invasive Species Database |
| GISIN | Global Invasive Species Information Network |
| GRIIS | Global Register of Introduced and Invasive Species |
| ICoMM - Microbis Portal | International Census of Marine Microbes - Microbis Portal |
| ILTER | International Long Term Ecological Research |
| iNaturalist | iNaturalist |
| Index Fungorum | Index Fungorum |
| IPBES | Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services |
| ITIS | Integrated Taxonomic Information System |
| KBA | Key Biodiversity Areas |
| KNB | Knowledge Network for Biocomplexity |
| Lifewatch Geoportal | Lifewatch Geoportal |
| Living Planet Index | Living Planet Index |
| MOL | Map of Life |
| MPAtlas | MPAtlas |
| MycoBank | MycoBank |
| Natura 2000 | Natura 2000 Network Viewer |
| OBIS | Ocean Biogeographic Information System |
| OBIS SEAMAP | Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations |
| ODV | Ocean Data Viewer |
| OHI | Ocean Health Index |
| OTN Data Portal | Ocean Tracking Network Data Portal |
| PESI Portal | Pan-European Species Directories Infrastructure |
| Plazi | Plazi |
| PlutoF | PlutoF |
| Protected Planet | Protected Planet |
| Red List | International Union for Conservation of Nature Red List of Threatened Species |
| SAU | Sea Around Us |
| SDGs | Sustainable Development Goals |
| SeaLifeBase | SeaLifeBase |
| Species 2000 | Species 2000 |
| Species+ | Species+ |
| SWOT | State of the World's Sea Turtles |
| Symbiota | Symbiota |
| UN Strategic Plan for Biodiversity | United Nations Strategic Plan for Biodiversity 2011-2020 |
| UTIS | Unified Taxonomic Information Service |
| VertNet | VertNet |
| WoRMS | World Register of Marine Species |
| WPI | Wildlife Picture Index |

Costello M.J. et al. (2017) Methods for the Study of Marine Biodiversity. In: Walters M., Scholes R. (eds) The GEO Handbook on Biodiversity Observation Networks. Springer, Cham. <https://doi.org/10.1007/978-3-319-27288-7_6>.

