LIFEWATCH

E–SCIENCE AND TECHNOLOGY INFRASTRUCTURE
FOR BIODIVERSITY DATA AND OBSERVATORIES

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CONTENTS

CONTACT: Wouter Los <los@science.uva.nl>
WWW.lifewatch.eu

1. INTRODUCTION

The ESFRI identified in its document Opportunities for New Research Infrastructure the crucial need to strengthen biodiversity research in Europe. LIFE*WATCH* demonstrates not only the need but also the feasibility of building this kind of robust infrastructure, and is presented to the ESFRI and the European Commission.

An integrated approach, supported by member states, will be presented in this proposal. Initially submitted by the Netherlands, it was prepared with the combined expertise and experience of the following networks:

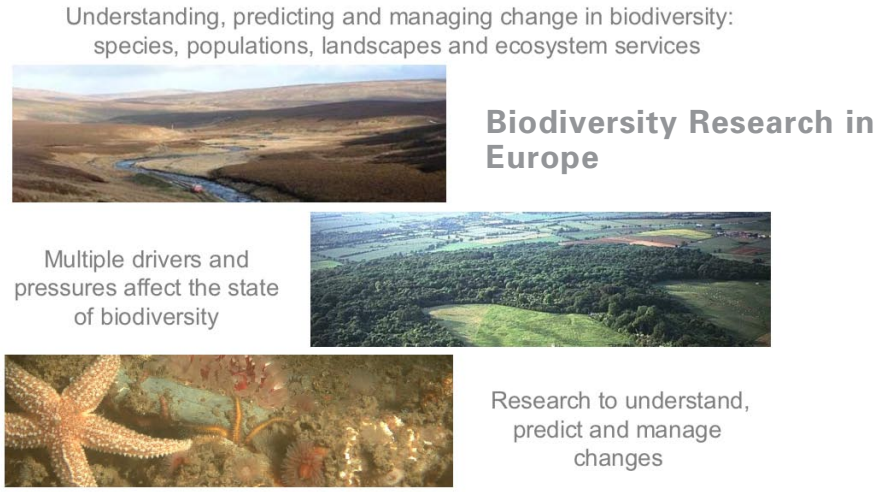
Network of Excellence, Terrestrial Biodiversity – ALTER-Net
Network of Excellence, European Distributed Institute of Taxonomy – EDIT
Network of Excellence, Marine Biodiversity and Ecosystem Functioning – MarBEF
Network of Excellence, Marine Genomics Europe - MGE
Infrastructure network SYNTHESYS
European Network for Biodiversity Information – ENBI
Biological Collection Access Service for Europe – BioCASE

+ LOGO MARINE GENOMICS

2. SHORT DESCRIPTION

2.1 WHAT IS AT STAKE?

It is increasingly important that Europe develops novel approaches to understand and manage our living environment, allowing for the development of reliable and science-based management strategies. We can move closer to this goal by making available and sharing electronic data on biodiversity records. But the current availability of Earth habitat observations and species-level and ecosystem biodiversity data is poor. This is particularly true with respect to co-ordination and data sharing among countries, organisations and disciplines, and meeting the needs of sustainable development. There are large spatial and temporal gaps in data coverage. This denies large-scale analytical and modelling developments that benefit of these resources. The Global Biodiversity Information Facility has made much progress in providing access to interoperable databases, but has to rely on the data-providers. Moreover, there is an eroding observational infrastructure and inadequate long-term data archiving. Targeted collective action is a feasible solution to these issues. Initiatives are already underway in the area of remote Earth observations, in Europe with GMES, and at the global level with GEOSS (see par. 7.3). It is now urgent we complement this with an infrastructure providing ground-level and sea-level observations about ecosystems, species-level biodiversity and the genetic variability of its components. For this, we must guarantee the usability of data collected as an ongoing activity as well as mobilising relevant 'legacy data' not yet available in electronic form.



The infrastructure required for research and management of Europe's biodiversity must address the basic gaps in existing knowledge. In particular, it must address the lack of long-term data required to monitor the effects of climate change and other anthropogenic drivers on different scales. These data have to come from direct observation, existing monitoring programmes and large-scale biological and geological collections. Users need an infrastructure that allows them to suggest targeted new data or specific experimental set-ups. This is necessary for scientific progress, and will also benefit growth in sustainable development, ecosystem-based land use planning, agriculture or biotechnological innovation. Progress in other parts of the world has highlighted the need for Europe to accelerate its efforts. The LIFE*WATCH* project is acutely relevant at the European level and is also of pan-European interest.

2.2. OUTLINE OF THE NEW RESEARCH INFRASTRUCTURE

The research infrastructure proposed by LIFE*WATCH* will contribute a European component to the GEOSS 10-year implementation plan, in particular (i) enabling global, multi-system information capabilities for biodiversity conservation, and (ii) improving the coverage, quality and availability of essential information from the in situ networks and improving the integration of in situ and satellite data. LIFE*WATCH* will be unique in its scope and approach, but will complement other initiatives around the globe, e.g. NEON (USA), to provide 'A web of sites and sensors taking the Earth's pulse'. It will therefore be a central component of the European contribution to GEOSS, complementing its remote Earth observation data. This proposal will secure the essential infrastructure and information systems necessary to collate existing data on biodiversity and distribute this information with analytical and modelling capabilities to the scientific community and to other users in the public, commerce and policy sectors. It will link and co-ordinate data from existing long-term monitoring sites, collections and data repositories. While data capture itself will be a national task, the new infrastructure provides technologies to accelerate this, to integrate data and make databases interoperable, creating a virtual laboratory environment encouraging analysis, modelling and experimentation.

The components are categorised as follows:
- infrastructure networks for data generation and data processing
- facilities for data integration and interoperability (and scientific domain interaction)
- virtual laboratories to encourage use of a range of analytical and modelling tools
- Service Centre to provide special services for European and national policies, and research opportunities for young scientists

LIFE*WATCH* will construct and bring into operation the facilities, hardware and software and governance structures necessary to create the interoperable system. It will reflect the complex and multidisciplinary problems scientists face when collaborating in virtual organisations.

2.3 USER GROUPS

LIFE*WATCH* is an open access infrastructure. The user groups will come from the scientific community. Tens of thousands of researchers will benefit from access, either by physical access or by exploiting the new digital services. The LIFE*WATCH* Service Centre will use eLearning techniques to further the application of data and services. Management will specifically promote use by young researchers, since this group is expected to develop innovative ways of using the infrastructure's facilities. A special competitive fellowship programme will stimulate and foster bright young researchers to explore such developments.

There are also wider user groups that will benefit. Since biodiversity contributes significantly to the economic and quality-of-life interests of society, information and knowledge is essential for managing our natural environment in a sustainable way. Changes in biodiversity are having serious effects on the capability of European ecosystems to provide essential services. This in turn will affect the quality of life of European citizens and social and economic aspects of sustainable development. LIFE*WATCH* will contribute to providing the data, information and knowledge required to address this issue. In addition, the new infrastructure will offer new facilities for biodiversity information and analytical capabilities for specific market and user group demands, and will develop and offer expert services and products that in return will also create new markets.

3. AMBITIONS

The ambitions for the new infrastructure are high, but realistic. The challenge is to bring together existing components (species-level and ecosystem-level data, data integration facilities, online analytical and modelling tools) and add scientific value for the next generation infrastructure. It is not a matter of just merging the components, but to organise and manage them in a setting that allows for advanced data mining and knowledge development. Rather than the traditional reductionist approach based on limited or estimated data sets, this next generation infrastructure will boost scientific development that at present mostly only lives in theory and cannot escape the blue-print phase.

More specifically, the ambitions are:

OPENING UP NEW OPPORTUNITIES FOR RESEARCH

Establishing the LIFE*WATCH* infrastructure will be a large leap forward to bring together the capacities of data generation, data interoperability and data mining for the different levels of biodiversity. It will for the first time provide a basic infrastructure for monitoring changes in Europe's biodiversity at the appropriate scales. It will allow modellers to finally use a database of sufficient size. Acceleration and integration of data will bring biodiversity mapping to a higher level. Changes on ecological or geological time-scales will help identify biodiversity hot spots and their vulnerability. Comparative data mining can allow for interlinking different levels of biodiversity and the study of mechanisms behind common patterns. Recognising patterns in specific combinations of genes, functions, species and ecosystems under specific external conditions will promote innovation in, for example, managing biological resources or in biotechnology.

SERVICES TO SOCIETY

Changes in biodiversity arising from modernday life are now having serious effects on the capability of European ecosystems to provide essential services. This in turn will affect the quality of life of European citizens and social and economic aspects of sustainable development. The LIFE*WATCH* facilities will provide data and knowledge to underpin biodiversity and ecosystem research, and ensure decision makers at national and European levels are aware of the effects of their choices and can adapt appropriately to the environmental changes over the next 50 years. LIFE*WATCH* should be able to underpin the understanding and managing of the extent, causes and consequences of biodiversity loss and ecosystem change.

DATA INTEGRATION FROM DIFFERENT SCIENTIFIC DOMAINS

European biodiversity is a valuable resource that can only be properly managed at the European and sometimes global level. LIFE*WATCH* will provide a common management structure to secure data provision. Using eScience in Europe, we can address issues through networked collaborations in a Grid environment to allow for large scale distributed data storage and high performance computing.

VALUE ADDED NETWORKING

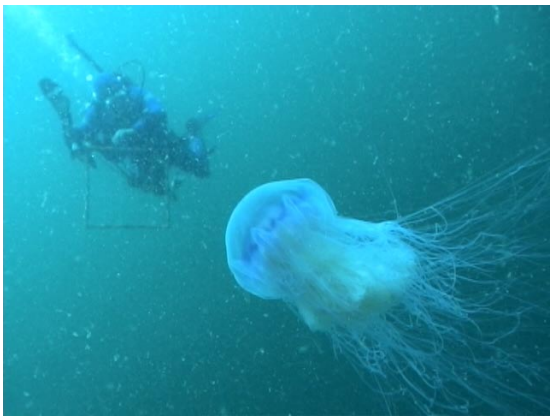
LIFE*WATCH* will bring together networks of the best possible expertise in a lasting co-operation. These include FP5 networks of ENBI (European Network for Biodiversity Information) and BioCASE (Biological Collection Access Service for Europe). Also, in FP6 the collections infrastructure network SYNTHESYS, MarBEF for marine biodiversity, ALTER-Net for terrestrial biodiversity and EDIT for taxonomy. Together these networks group the major players in the biodiversity research in Europe.

4. SCIENCE CASE

Biodiversity is the variety of life on Earth, encompassing plant, animal and microbial species, the genes they contain and the habitats in which they live. Earth is a living planet and the role of biodiversity is now increasingly understood and recognised. At the same time, biodiversity on land and in the oceans is rapidly declining and we are facing what is now commonly called the sixth extinction crisis since life began more than three billion years ago. Common drivers for this decline are linked to human population and economic growth and include exploitation of species, changing land use, global climate change and distribution shifts of species. What is needed is a much more integrated approach to understand and predict biodiversity dynamics and to support scientifically sound ecosystem and nature conservation management policies across Europe. But we also need to provide such knowledge and expertise for the developing and mega-biodiverse countries. This is essential to allow for sustainable exploitation of the natural resources, and to continue to benefit from the goods and services provided by these resources.
Below is an overview of different research areas that will benefit from the LIFE*WATCH* infrastructure, and thus provide the challenge to meet the related demands from the scientific community.

DISCOVERY OF BIODIVERSITY

In this century, where planetary exploration is becoming normal practice, it is remarkable that some biodiversity is still unknown. This not only holds for species-level biodiversity (especially for microbes and in the marine environment), but also our understanding at the ecosystem level. Species discovery and ecosystem dynamics (in time and space) need new approaches to information integration and knowledge development. Such development will contribute to provide reliable species identifications and to classify species and ecosystems as per their biological relations, functional properties, evolutionary or ecological history.



BIODIVERSITY PATTERNS – MAPPING HOT SPOTS

We lack comparable information about biodiversity hotspots. We should aim to be able to compare different hotspots by spatial levels, representative taxa and local dynamics and vulnerabilities. Improvements to this will be tested in various places with a variety of approaches. Ecological niche modelling is directed at the prediction of actual distribution of biodiversity, based on estimates of the dimensions of potential ecological niches of the components (species). Species ranges are hypothesised by extrapolations of collection or observed localities of presence. Other approaches also take into account the value of genetic components by introducing phylogenetic weighting in biodiversity mapping. Large-scale and reliable information is essential here.

BIODIVERSITY PROCESSES – MONITORING CHANGES

A large obstacle in biodiversity research is the absence of adequate long-term and comparable time series of biodiversity changes. Monitoring changes in Europe's biodiversity at an

appropriate scale is essential to understand and predict processes. Standards and 'best practice' approaches are one part of the solution. Data collection, processing, fusion and representation is another. This is a scientific effort in itself, but it will result in a wealth of data sources for new scientific knowledge.

Studying pressures on biodiversity

LINKING TO REMOTE EARTH OBSERVATION DATA

The possibilities of using plane or satellite observations to estimate biodiversity are well known. They can be validated by ground measurements, through well-defined networks of standard measurement sites over at least a decadal time scale such as online data assimilation in complex models. Although Earth observation data are now being used in this way, progress is hampered by the lack of comparable and easily available in situ data. By building on existing networks and facilities and making use of recent advances in distributed data systems, the creation of a biodiversity observation network in Europe is feasible and timely.

SYSTEMS BIOLOGY

Comparative data mining in large data sets from the different (genetic, population, species and ecosystem) levels of biodiversity allows us to identify patterns between these levels and provides evidence for the mechanisms behind them. Biocomplexity can be studied in alternative systems of combinations of genes, functions, species and ecosystems, together with external abiotic factors. One challenge is to expand systems biology up to the ecosystem level, and by taking into account the multi-state dynamics of relations and interactions between different (spatial, temporal and hierarchical) states of biodiversity. Another one is to bridge the gap between morphology or function with (developmental) genetics. Knowledge of the genetic basis of morphological or functional development opens up a whole field for targeted biotechnological modifications (e.g. in horticulture).

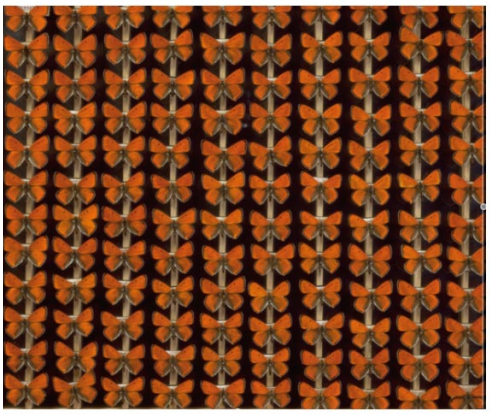
NATURE CONSERVATION AND MANAGEMENT

The previous science cases will help underpin the scientific basis of nature conservation and nature management. Data and knowledge about the characteristics of spatial distributions, changes at different time scales, and the associated multi-state dynamics, may provide a more solid basis for making decisions. Implementation of the decisions and monitoring their effects becomes more reliable. LIFE*WATCH* has a role in contributing to these efforts.

DATA CHALLENGES FOR THE LIFE*WATCH* INFRASTRUCTURE

Major problems in evaluating the magnitude and importance of changes to our biodiversity include the lack of primary biodiversity data coherently available in electronic form, the lack of adequate reference systems on present and past biodiversity, and adequate observation

systems for identifying the causes of change and quantifying the effects of this change on key ecosystem services. Furthermore, new species continue to be described at a near linear rate. The explosion of taxonomic information is very difficult to handle but not impossible if good use is made of the parallel explosion in information technologies.
A similar problem exists for the observation of biodiversity at the proper temporal and spatial scales. In Europe, many measurements of ecosystem health used in monitoring programmes are based on the evaluation of species richness and abundance. These measurements are often local or national, the data collected independently and maintained in unconnected databases, if at all, without control of their coherence with other such databases. Therefore their value is limited to local purposes. Once brought together their value will increase greatly.



Very large data sets

BIODIVERSITY E-SCIENCE

Biodiversity research can benefit greatly from very rich data sources. The growth of methods and technologies for data generation and data processing, challenges for data integration or interoperability, and data mining or other analytical and modelling developments, help feed a new scientific domain. Biodiversity eScience is a scientific domain addressing the challenges of data sharing, methodology and technology development, computational innovation and working in virtual organisations. The sheer scale of the LIFE*WATCH* infrastructure will pose new challenges to biodiversity informatics, e.g. in the development or adaptation of analytical tools, the information flows from data providers to analytical services and their users, the feedback mechanisms needed to maintain and improve data quality, the need for rapid access in a distributed data environment, the use of eLearning for training, and so on.
The perspectives of Grid-enabled working practices are clear. These are tasks that can be implemented in the LIFE*WATCH* infrastructure programme, in partnership with the appropriate informatics communities.

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5. TALENT CASE

The collective experience of LIFE*WATCH*-supporting components ensures that scientific user groups will benefit. Tens of thousands of researchers at the pan-European level, but also globally, will benefit from access, either in a physical sense or by exploiting the new digital services.

Access to the digital services will include:
- Information retrieval, both directly by individual researchers or by machine-machine interactions allowing for value-added data combinations for specific uses.
- Experimenting by combining data sets with analytical or modelling tools facilitated by Grid-enabled work flows.
- Requests for targeted data and/or analytical/modelling tools that are not part of regular services. This may imply joint research projects to generate such data or to develop the required tools.

It is important scientists develop innovative ways to benefit from LIFE*WATCH* facilities, since this will promote new uses and subsequently knowledge discovery. Optimisation of the infrastructure will be enhanced by a variety of supporting measures with respect to training and capacity building. International symposia and working groups will invite top scientists to share advancements and develop new applications. The management will specifically promote the use by young researchers, since this group is expected to be a source of original ways for performing research at the infrastructure's facilities. A special competitive fellowship programme will stimulate and foster bright young researchers to explore such developments. The LIFE*WATCH* Service Centre will be in charge of optimising access and use of the facility with special attention again to research opportunities for young scientists.

6. INNOVATION CASE AND IMPACT TO SOCIETY

The proposed research infrastructure is a revolutionary development and will provide key innovative possibilities for various user groups.

The construction plan for LIFE*WATCH* is ambitious and costly, but also timely and feasible. The time is right to act, since science and society need the infrastructure's capabilities. Europe cannot wait for other continents to take the lead.
There are a number of possibilities arising from the new initiative, and these have been highlighted in paragraph 4 (Science case, p4).

But the infrastructure itself is also innovative with its new provisions for:
- direct links to sites in key ecosystems for quantifying the cause-effect relationships driving changes in biodiversity and ecosystems services
- the development and deployment of data-based models (combining site and collections data) for forecasting the impacts of environmental changes and cross-sectoral policies on biodiversity and ecosystem services
- instrumented sites with comprehensive environmental data, providing the European research community with multi-functional research platforms for inter-disciplinary research on biodiversity, ecosystem processes and ecosystem services

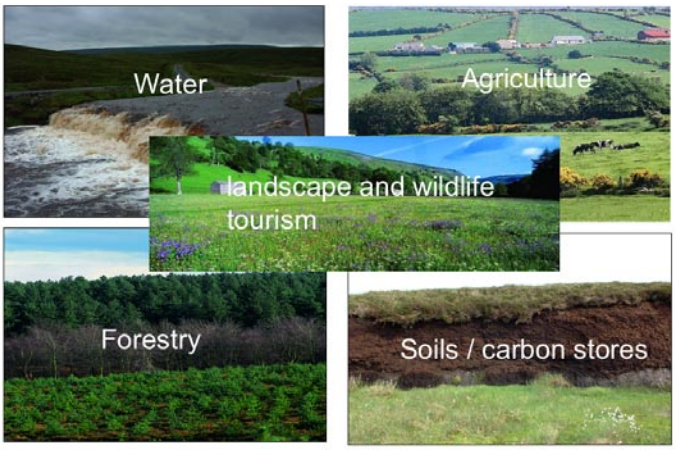
Biodiversity knowledge contributes significantly to the economic and quality-of-life interests of society.

Information and communication technologies offer new, unprecedented opportunities to manage and analyse biodiversity information for specific market and user-group demands, and to develop and offer expert services and products that in return also create new markets. It will be a fast-growing economic sector in the coming decades. Clients are varied, and include both public and private sectors.

Promising markets include:
- Land use planning, environmental assessment and environmental monitoring.
  For example, controlled timber logging, cultivation, fisheries, building and other construction facilities.
- Nature conservation and management.
  This sector is evolving professionally, (and often as SMEs) in a global market.
- Agriculture, trade, health and safety.
  Economically important organisms, either positive (food, pollinators, natural enemies, building material), or negative (pest organisms or health threats) can be identified and managed when reliable information and expertise about natural processes are available or generated at short term. The market is large, and still open for further controlled economic expansion.
- Natural products, pharmaceuticals, biotechnology.
  In the search for new products or more efficient production, the still largely unknown biodiversity is expected to provide new resources for economic development. An example is the enormous diversity of (exotic) marine organisms with important secondary metabolites or genes.
- Overseas development and capacity building.
  The collections, data and expertise about biodiversity are concentrated in the northern hemisphere, particularly in Europe. Data sharing and transfer of expertise is essential for the future welfare of our planet.

It is increasingly important to develop novel approaches to understand and sustainably manage our environment so that spatial requirements for human activities and for protecting the natural environment are balanced.

Understanding and managing changes in biodiversity is crucial for the sustainable development and exploitation of Europe's resources in relation to climate change and global change in general. Some of the impacts of climate change such as changing precipitation patterns, droughts and fires, frequency and intensity of storms, sea level rise, acidification of the oceans and so on will inevitably lead to changing species distributions and migration of whole biogeographical zones to the north. The rate of such changes is known already for a number of well-studied groups such as birds and butterflies or forests and agricultural crops but not for many others, including most marine populations, many pests and parasites and invading species. Changes in biodiversity are having serious effects on the capability of European ecosystems to provide essential services. This in turn will affect the quality of life of European citizens and social and economic aspects of sustainable development. The data, information and knowledge required to address this issue are scattered and incomplete. In particular, the long-term data required to understand the response of ecological systems to social, economic and global changes are rarely available and the lack of spatial comparability of data across Europe and its adjacent seas severely inhibit our capacity to develop cost-effective European-scale policy responses.
In addition, by providing access to in and ex situ data, LIFE*WATCH* will contribute directly to the social benefits delivered by the GEOSS programme. These include: mitigation and adaptation to climate change, management and protection of terrestrial, coastal and marine ecosystems, supporting sustainable agriculture and combating desertification, and monitoring and conserving biodiversity.



Ecosystem services

7. PARNERSHIP CASE

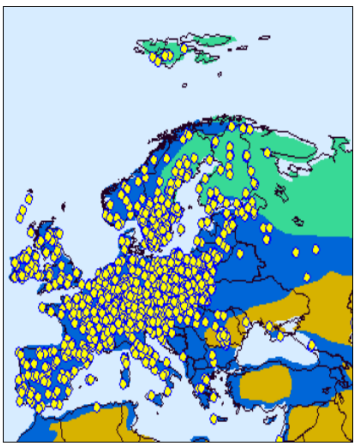
7.1 THE NEW RESEARCH INFRASTRUCTURE BUILDS UPON LARGE EU NETWORKS

In FP5 and 6, a number of large EU research networks prepared the building blocks for a new infrastructure. The partnership of these networks will facilitate plans for establishing the new research infrastructure and will provide added value from their combined expertise and experience. Support for the LIFE*WATCH* infrastructure has been voiced by organisations participating in the current FP6 NoEs including:

– terrestrial and freshwater sites – 24 organisations in 17 European countries
– marine sites – 78 organisations in 22 European countries
– major taxonomic data collections – 26 organisations in 13 European countries

NETWORK OF EXCELLENCE ALTER-NET

The ALTER-Net partnership is developing a design for the terrestrial and freshwater component of LIFE*WATCH*. This will include specification of research questions and outputs, data requirements, definition of measurements, protocols and sampling design, a framework for data and information management, criteria and specification for Long-Term Ecosystem Research (LTER) sites, and criteria and specification for Long-Term Socio-Environmental Research (LTSER) sites. In addition ALTER-Net is developing partnerships between research organisations and with national stakeholders required to support the long-term operation of the infrastructure. Formal governance arrangements are currently being developed through the activities of the ALTER-Net Network of Excellence. This will include negotiations with national governments in order to secure national funding and support for the infrastructure proposals.



Terrestrial LTER sites

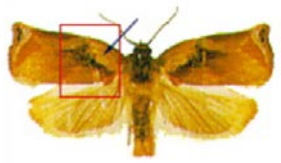
Substantial progress has already being made towards the development of a European Network of LTER sites (www.lter-europe.ceh.ac.uk/index.htm). Thirteen European countries now have formal, nationally supported LTER networks and five more should be established over the next year. ALTER-Net is also developing innovative approaches to science communications, mainly through the development of links with the European Network of Science Centres (ECSITE) and the establishment of an International Press Centre for Biodiversity (IPCB). ECSITE is a network of science visitor centres in 25 European countries that currently receive in excess of 30,000,000 visitors per year and provides a unique platform for research on attitudes and understanding related to biodiversity and ecosystems. ALTER-Net is also collaborating widely with other international programmes to ensure compatibility with systems across Europe (e.g. GBIF) and globally (e.g. with the US programmes of LTER, NEON and SEEK).

NETWORK OF EXCELLENCE EDIT

EDIT brings together the leading taxonomic institutions in Europe, to make both existing and newly created taxonomic knowledge better accessible for biodiversity and ecosystem

research and users. With North American and Russian partners, it is a worldwide leading network. This network of excellence encourages lasting integration of the most important European taxonomic institutions, from which other institutions and taxonomists can integrate their activities. EDIT was an initiative of the Consortium of European Taxonomic Facilities (CETAF), but aims to have a wider global impact.
Among the major objectives are the reduction of fragmentation and the transformation of taxonomy into an integrated science through interoperability of databases held by EDIT participants, and creation of the cybertaxonomy tools allowing both qualitative and quantitative improvement in delivery of taxonomic knowledge. EDIT will address these significant problems of information and management of knowledge in a rapidly changing field, and contribute significantly to international initiatives and programmes such as GBIF and Species 2000.

The issues addressed by EDIT are structural: governance and management, providing a suitable IT environment, the development of new tools and encouraging taxonomists to work as one across European (and other) institutions. In addition, EDIT has a forum for stakeholders and end-users for taxonomy in biodiversity and ecosystem research. The EDIT network will contribute significantly to both the scientific basis and capacity for biodiversity conservation provided by the LIFE*WATCH* infrastructure. This will be enhanced by MarBEF and ALTER-Net direct links and data, established with a community of providers and users larger than EDIT resources.



Collection reference material for pest insect control

NETWORK OF EXCELLENCE MARBEF

The network of excellence MarBEF (Marine Biodiversity and Ecosystem Functioning) integrates research efforts by forming a dedicated group of marine scientists and institutes and creating a virtual European institute. The institute has a long-term research programme and dedicated links with industry and the public at large. This involves co-ordination of research, training, exchange and outreach activities in several relevant fields of science, including marine ecology and biogeochemistry, fisheries biology, taxonomy and socio-economic sciences. Integration of research also supports the legal obligations of the EU and its member states and associated states for the Convention for Biological Diversity, the OSPAR and Barcelona conventions as well as several EU directives (Bird Directive, Habitat Directive, Water Framework Directive). The network improves links with the large and growing number of industries depending on the sustainable use and exploitation of marine biodiversity, including tourism, fisheries and aquaculture and new industries exploring and commercialising marine genetic and chemical products.

Marine references and focal sites

The MarBEF research programme addresses the following issues:

1. *Developing a better understanding of marine biodiversity and ecosystem functioning.*
   Integration of two complementary approaches aimed at developing our ability to assess and forecast changes in marine biodiversity and the effect of such change on the continuing provision of ecosystem services and products. The first approach is structural: the analysis of spatial and temporal patterns in marine biodiversity at all scales from seascapes to genes, and the factors that generate them. The second is functional: to generate the theory that will enable us to model marine ecosystems, to predict how they will change, and to test the relationships between biodiversity and ecosystem functioning.

2. *Understanding and minimising the negative impacts of human activities.*
   Human activities impact all marine ecosystems, but we have limited understanding of the mechanisms involved. MarBEF develops the research base required to advance our understanding of marine ecosystems at all scales.

3. *Ensuring sustainable management of natural resources and marine ecosystems as well as the protection of genetic resources.*
   Sustainable exploitation of the marine environment requires informed and science-based management. The focus of MarBEF's research programme is the provision and strengthening of that science base for management of living resources, coastal zone management and water quality.

NETWORK OF EXCELLENCE MARINE GENOMICS EUROPE

The major goal of "Marine Genomics Europe" (MGE) Network of Excellence is to reshape European Research in marine biology by networking groups and hence permitting the necessary critical mass in scientific expertise and technological resources to become a leading force in Marine Genomics. In this way, MGE aims to promote, develop and spread a better understanding of the functioning of marine ecosystems and the biology of marine organisms throughout the European Union. Our long-term target is to establish a durable European network capable of implementing high-throughput genomic approaches in the field of marine biology.

INFRASTRUCTURE NETWORK SYNTHESYS

This integrated infrastructure initiative is based in Europe and offers physical access to the earth and life science collections (comprising more than half the world's natural history specimens). In addition it provides analytical facilities and taxonomic expertise at 20 collections-based institutions organised in 11 national Taxonomic Facilities (TAFs). More than 26,000 visitor days will be provided over 60 months. This expertise in managing a proposal application process for visiting researchers, as well as the coaching and support, are important components for the development of LIFE*WATCH* services. In addition, SYNTHESYS is, via Networking Activities, improving both physical and virtual access to the infrastructure.

The main issues addressed are:

- complementarity to bring together information on the strengths of each institution's collections and expertise, leading to a co-ordinated European development plan
- standards for the long-term preservation and access to the collections, and to assess the collections to identify priorities for improvement through mechanisms such as training courses
- co-ordination of the development of collection databases across Europe and to create an integrated, distributed European collection database system
- review of new collections (such as tissue samples for molecular study) to establish common policies and methodologies

– introduction of new analytical methods and techniques from other disciplines (such as CT), and assessment of how they might be applied in systematics and other natural history studies

BIOCASE NETWORK

The 5th FP research project BioCASE (a Biological Collection Access Service for Europe) implemented both a technical infrastructure and an organisational network giving access to European natural history collections and observations. The BioCASE has continued its endeavours after the conclusion of the project phase (Jan 2005) by means of activities of the 35 partners and by further development of the network through SYNTHESYS and ENBI. This will be carried forth to become an integral part of the EDIT taxonomic backbone infrastructure. BioCASE today offers a system of 31 national nodes throughout Europe providing meta-information about thousands of European collections. It includes an access system to specimen-level information encompassing millions of records, which is firmly integrated into the Global Biodiversity Information Facility and acts as a European node for those countries that have not already joined GBIF.

Digitized herbarium specimen

THE EUROPEAN NETWORK FOR BIODIVERSITY INFORMATION (ENBI)

ENBI, as the European contribution to GBIF, concentrates on databases at the European scale, and on activities that need co-operation at the European scale. ENBI also addresses the potential of tools to apply the biodiversity data as such, or in combination with other categories of data. In addition, ENBI gives special attention to the market of end-users and to the processes to develop specific products and services. ENBI maintains a network of 65 partner institutes with communication platforms, dissemination mechanisms of new developments, and co-ordination with the activities of other stakeholder networks, such as the European Community Clearing-House Mechanism.

More specifically, the scope of activities includes:

1. *Co-ordinating activities.*
   Strategies for sustainability and continuity of the network activities by developing a European approach, building on member states and other EU project initiatives. Prioritising biodiversity information, information management and applications that require a common approach and are more efficiently managed at the European scale.
2. *Maintenance, enhancement and presentation of biodiversity databases.*
   Promotion of routines and mechanisms to update, validate and ensure sustainability of biodiversity databases at a European scale, which are not expected to be maintained at the national level. Identification of gaps in knowledge and information, and strategies to solve these. Avoidance of duplication of efforts.
3. *Data integration, interoperability and analysis.*
   Identification of new emerging technologies and trends to anticipate and organise a critical mass of European efforts. Exploring the opportunities of Grid-based developments. Inventories of biodiversity database analysing software systems and the identification of common (exchangeable) approaches.

4. *User needs: products and e-services.*
   Establishment of communication platforms to support the development of common procedures to meet end-user priorities with respect to high-quality products and e-services. Development of dictionaries of biodiversity terminology in different European languages, to be integrated in existing machine translation services.

7.2 PARTICIPATING ORGANISATIONS AND SUPPORT FROM MEMBER STATES

This proposal is supported by the main scientific European networks in biodiversity research as mentioned in paragraph 7.1. These networks cover many if not all the leading institutes in Europe.

This plan was presented by The Netherlands to the ESFRI Biodiversity and Environment Expert Group. Several member state institutes are engaged in research projects directly contributing to the LIFE*WATCH* infrastructure. These are, for example, projects that design biodiversity information processing and modelling in the GRID-environment, in the UK (Reading, Cardiff) the BD-World project, and in The Netherlands (Amsterdam) the EcoGRID project.

7.3 RELATED STRATEGIC PARTNERS

DIVERSITAS

Diversitas, as an international framework for biodiversity science, has the mission to promote an integrative biodiversity science, linking biological, ecological and social disciplines in an effort to produce socially relevant new knowledge, and to provide the scientific basis for the conservation and sustainable use of biodiversity.
The bioDISCOVERY core project of the DIVERSITASprogramme is defined around three major goals: the assessment, monitoring and prediction of the change of biodiversity. It will provide knowledge on the status of the resource biodiversity. It will also increase our ability to measure the change of biodiversity, to understand the underlying processes and to partly predict future changes. These are important contribution required also to asses the impacts of biodiversity change on the delivery of ecological and economic services and to develop knowledge and to guide policy and decision making that support the sustainable use and management of biodiversity. Info: www.diversitas-international.org.

GBIF

The Global Biodiversity Information facility (GBIF) is an international organisation established in 2001 with the mission to make the world's biodiversity data freely and universally available via the Internet. (www.gbif.org and www.gbif.net). It currently has a prototype portal connecting nearly 100 million biodiversity records that adhere to the interoperable standards for data sharing. It presently has a membership of 46 countries, one economy and 31 international organisations.
The biodiversity data now concentrate on specimen, observation and species-level information.

The work programme consists of four components:
– data access and interoperability
– electronic catalogue of names
– digitisation of collection and observation data
– outreach and capacity building

GMES

The European Commission and the European Space Agency for the Global Monitoring for Environment and Security (GMES) aims to design and establish by 2008 a European capacity for a variety of mainly Earth observation (EO) sources by satellites or other airborne

observatories. (www.gmes.info). Their challenge is to cope with the various time-periods and geographic levels. GMES is involved in the development of INSPIRE, an EU initiative to establish an infrastructure for spatial information in Europe that will help make spatial or geographical information more accessible and interoperable for a wide range of purposes supporting sustainable development. (inspire.jrc.it/home.html)

GEOSS

The Global Earth Observation System of Systems (GEOSS) is a global initiative to advance scientific and societal benefits. (www.epa.gov/geoss/index.html). For information needs common to many benefit areas, GEOSS will facilitate the development and provision of common products such as maps of topography, bathymetry, river systems, infrastructure, land cover and land use, and a geodetic reference frame for Earth observation. Interpretation and use of Earth observations require information on drivers and consequences of change, including georeferenced socio-economic data and indicators. Implementing GEOSS will unify many disparate biodiversity-observing systems at the global level and create a platform to integrate biodiversity data with other types of information. Taxonomic and spatial gaps will be filled, and the pace of information collection and dissemination will be increased.

7.4 EUROPEAN PLATFORM FOR BIODIVERSITY RESEARCH STRATEGY (EPBRS)

Outputs from this project will be directly relevant to policy needs identified through the activities of the European Platform for Biodiversity Research Strategy (EPBRS). This is a joint research/policy group in which national representatives from most European countries identify the research required for the EC to meet its obligations as a Party to the Convention on Biological Diversity. This project will provide the infrastructure required to deliver the agreed EPBRS research goals, which have in turn been identified in relation to the main policy requirements of the EU and member states. Of particular relevance to EPBRS are issues concerning co-ordination of research, institutional arrangements, data management, common data standards and quality assurance procedures.

8. TECHNICAL CASE

Although data generation and data management facilities are currently scattered and exist in different scientific communities, the technical plan for the new infrastructure is to apply an integrated approach from the very onset.

This holds for the following categories:
– governance and management
– infrastructure networks and instrumentation for data generation and data processing
– facilities for data integration and interoperability (and scientific domain interaction)
– virtual laboratories to utilise a range of analytical and modelling tools
– Service Centre to provide special services for European and national policies, but also to provide research opportunities for young scientists

The components of the LIFE*WATCH* infrastructure have been designed, developed and tested in various national European and international projects with the partnerships as outlined in paragraph 7. Although the integration of these components in the proposed infrastructure is a new challenge, the preparations so far indicate plans are sufficiently mature.

8.1 GOVERNANCE AND MANAGEMENT

Many stakeholder communities are directly involved in data acquisition, delivery and interpretation of LIFE*WATCH*. Their involvement and responsibility is crucial for providing reliable services, but can be in conflict with the requirement to establish a clear governance and management structure. This is not unusual for large-scale infrastructures, but is especially true for distributed and virtual facilities such as LIFE*WATCH*.

It is planned to organise the governance structure with the following bodies:
– LIFE*WATCH* board, with representatives of each financially contributing country. This board appoints the management and oversees the operations of the infrastructure.
– LIFE*WATCH* council, with representatives of the major scientific networks concerned (see paragraph 7.1).
– The provider's and user's platform, with representatives of the interested European countries.

The LIFE*WATCH* management is responsible for designing the infrastructure strategies and plans, the operations and is responsible to the LIFE*WATCH* board. See further in paragraph 9.

8.2 INFRASTRUCTURE NETWORKS AND INSTRUMENTATION FOR DATA GENERATION AND DATA PROCESSING

MARINE OBSERVATORIES

A network of marine biodiversity observatories in Europe is being built based on properly networked existing sites. These sites (www.pml.ac.uk/biomare/site.htm) are either field sites, supported by research institutes, or the EU-BIOMARE network covering Europe's shores from Svalbard to the Canary Islands and the Azores in the Atlantic to Turkey in the Mediterranean. They can also be monitoring stations operated by national governments. Continued data collection and assimilation to maintain and update these long-term data series is essential. In the Network of Excellence MarBEF, the BIOMARE network is now being extended to include deep-sea sites, both pelagic (CPR) and benthic.

Besides supporting scientific research on long-term and large-scale patterns and changes in biodiversity, the BIOMARE network intends to increase observational efforts by focusing on a limited number of biological, chemical and physical variables that should be measured using standardised methodology over a large area and over a long time period. These include the use of underwater measuring equipment on buoys or bottom stations and online

communication of data through satellites. When protocols can be agreed on the European (and international) level, this will greatly increase our observational capacity without much additional financial input. These efforts will also be linked to the global Census of Marine Life (www.coml.org) and its Ocean Biogeography Information System (OBIS) (www.iobis.org).

Besides the BIOMARE network, which has been designed for biodiversity research, an already partly operational network of seafloor observatories (submitted EU project) includes biological parameters. Seafloor observatories may provide continuous, long-term, multidisciplinary and time-referenced monitoring from coastal areas to deep sea. They may overcome limitations of traditional ship-based expeditions for data and samples gathering, allow the study of multiple, interrelated processes over time scales ranging from seconds to decades, allow near real-time or real-time communication of scientific data and advance research in the ocean (and earth) sciences addressing socially important issues.

The potential of airborne and satellite remote sensing for marine biodiversity observation has become very clear. Also other new technologies are being developed, for instance underwater listening curtains to track the movement of tagged fish, bird, turtle and mammal species, new sonar technology allowing fish populations to be traced tens of kilometres around sound sources, new visualisation technology for the oceans and others. Such developments will result in new partnerships for LIFE*WATCH*.

TERRESTRIAL OBSERVATORIES

LIFE*WATCH* will establish a network of Instrumented Long-Term field (LTER) sites collecting data from harmonised observational programmes and experiments combined with distributed data centres, linked to synthesis and interpretation centres for the generation of high-level information products for policy applications. Such networks have been prepared in various EU projects and are now being consolidated in the Network of Excellence ALTER-Net.

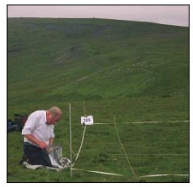
A European Network of in situ long-term ecosystem monitoring sites will identify and quantify the causal relationship between the drivers of environmental change and their impacts on biodiversity and ecosystems and the services they provide to society. Data from such sites will be used in conjunction with Earth observation data, to provide the assessment and forecasting capability needed to support future environmental policy, planning and resource management decisions on biodiversity.

The field site network around the European LTER network will consist of about 100-150, sites largely based on existing facilities organised at national level. The network will be developed to provide representative coverage of the main ecosystem and landscape types and to address a wide range of contemporary and emerging environmental issues (including

biodiversity loss, land use change and water quality, carbon budgets, spread of alien species, climate change impacts on ecosystem services, environmental change and human health). The establishment and operational costs of the network will be reduced by making best use of existing sites and organisational structures, although in some regions new sites will be needed. The use of existing sites will also give access to long-term datasets for the assessment of baselines and natural variability and trend detection. In addition, a sub-set of these sites will be established as larger scale (regional) multi-functional research platforms (Long-Term Socio-Environmental Research, LTSER, sites) in which the data to enable the relationship between natural and socio-economic processes affecting biodiversity will be collected.

Biodiversity Observations






Data collected from sites are managed through a smaller network of interoperable data centres capable of delivering data and information to European and global research communities. With respect to distributed access and interoperability, the European infrastructure developed in the GBIF context offers a ready-to-use platform, which needs to be adapted to the specific needs of the data centres. This offers the possibility to greatly extend the scope of primary data available to researchers by including the natural history collections and recording communities into the common infrastructure, both providing input of solid taxonomic capabilities to the ecological community and access to current distribution and functional data to systematists.

These components are being brought together as part of the strategic plan to develop a European terrestrial Biodiversity Observation and Research Network (BORN), as part of the P6 Network of Excellence on A Long-Term Biodiversity, Ecosystem and Awareness Research Network (ALTER-Net).

BIOLOGICAL / GEOLOGICAL COLLECTIONS AND TAXONOMIC DATA REPOSITORIES

Biological collections represent the diversity of nature in a critical selection of specimens, which reflect the existing or past (genetic) variation of species in space and time, from geological to anthropological dimensions. Geological collections complement this with specimens that document the evolving abiotic environment of our planet. These collections enable us to reconstruct Earth's history, understand the present and forecast the future. This information profoundly, and increasingly, affects our understanding and exploitation of life. Great strides forward have been made with respect to contributing data on specimens in natural history collections and observation data held by species observation recording organisations and floristic or faunistic mapping schemes. The Global Biodiversity Information Facility unites advanced informatics tools and strategies for global standardisation, networking

and common open access to such primary data with the reconciliation and co-ordination process among stakeholders providing such information. European projects such as BioCASE, EuroCAT (building on ERMS, Fauna Europaea, and Euro+Med Plantbase), ENBI and SYNTHESYS NA have, in close collaboration, contributed significantly towards GBIF's global aims and have at the same time created a model infrastructure that can be used on the European as well as national levels. This includes implemented protocols for distributed data access, data exchange standards (developed in collaboration with TDWG) and a comprehensive data portal strategy. Such data processing can be expanded to the broader scope of observational data. The prime target remains to overcome the inadequate degree of data mobilisation, i.e. digitisation and standardisation of specimen and data collections, and participation of institutions holding such data. This will be followed by the implementation of data quality assurance measures. Part of this task is to maintain and regularly update authoritative species lists for the European biodiversity, and also for parts of the global biodiversity if the basic expertise is only available in Europe.

Scientific collections are large-scale facilities

LIFE*WATCH* will realise the full potential of taxonomic and collection-based information by bringing the institutions that support taxonomic research and biological collections together in a comprehensive network, allowing integration and availability of the various kinds of biodiversity information. LIFE*WATCH* will also link observations data collected from marine and terrestrial environments with the vast amount of data in physical collections. Such facilities exist in no other place, thus providing analysis of the evolution of biodiversity rooted in the past. Indeed, much of the information of collections was obtained prior to modern development and constitutes an irreplaceable record of past biodiversity. Collections are the most lasting data source on changing landscapes and patterns of species distributions. Because taxonomy has been founded and developed in Europe, the EU taxonomic institutions grouped in the Consortium of European Taxonomic Facilities (CETAF) hold the most comprehensive body of specimens and associated taxonomic literature, research and expertise in the world. BioCASE and SYNTHESYS Networking Activities provide the models and protocols that make this information, of which only less than five per cent is digitised so far, readily accessible and interoperable with environmental data. The contribution of EDIT is not only to co-ordinate such policies for taxonomic research and expertise and to make the information in the collections available, but to prepare the Internet platform allowing for collaborative creation of new knowledge and correlative improvement of the availability of new taxonomic data.

8.3 FACILITIES FOR DATA INTEGRATION AND INTEROPERABILITY

Direct observation includes the use of satellites and planes. These are connected with a grid of ground observatories covering Europe for measuring a series of standardised and quality-controlled biological variables coupled to physical – including geological and chemical observations. The existing technical protocols developed by BioCASE and integrated into the GBIF infrastructure allow access and retrieval of complex data in the form of XML documents from widely distributed data sources. Data standards and processing facilities have to be developed or improved to link the information from different sources, ranging from collection records to observatory data on terrestrial and marine biodiversity. Information structures and services providing the linking elements such as species, localities and environmental parameters, as well as data and quality/usability standards, are evolving rapidly. In the taxonomic arena, LIFE*WATCH* would provide a European GBIF component which, focussing on the biodiversity in Europe, provides the services needed to use taxonomic information as an effective tool for broad information clustering. The other primary component, spatial information, has to be developed in close adherence to INSPIRE, making biodiversity information an integral part of the European spatial information infrastructure. Data quality and usability standards, and also semantic definitions of information components, have to be driven in global co-operation, for example by supporting the standardisation processes in GEOSS and TDWG.

8.4 VIRTUAL LABORATORIES

The wealth of large data sets from the different (genetic, population, species and ecosystem) levels of biodiversity opens up an unprecedented new area of research. Comparative data mining in these data sets allows us to interlink the different levels of biodiversity and study the existence and mechanisms behind common patterns. Bio and ecosystem complexity can be understood by combinations of genes, functions, species and ecosystems together with external factors. Since the number of online biodiversity data resources through the Internet is increasing at high pace, now data visualisation, data mining and analysis or predictive modelling techniques require a Grid-based approach in a collaborative laboratory environment.

Complex and multidisciplinary problems force scientists to collaborate in virtual organisations at a global scale. Biodiversity eScience will enable 'distributed large scale' science, and will soon be the only way to participate in new developments of science in this area. Biodiversity eScience is the multidisciplinary scientific approach to organising information via computer networked collaboration and use of distributed data sources to include new developments in biology, computer science, mathematics and information and communication technology.

Such an approach will allow for:

Distributed computing

Using capabilities of the Grid to allow for efficient and effective use of CPU by dividing applications into sub-applications that can run on different processors in parallel to speed up the computation process.

High throughput computing and large-scale data analysis

For remote processing and analysis of data, rather than copying these to a single location.

Collaborative computing

For shared use of data and applications for scientists and groups working together.

The plan is to provide a Grid laboratory environment for access and computing with the data and facilities of the contributing centres.

The architecture will include the following components:

– Grid-enabled data resources
– extension with Grid services (different Globus facilities)

– Biodiversity eScience interoperability layer

The challenges are categorised in the following areas:
- data generation, management and fusion
- data integration and problem-oriented representation
- process modelling and simulations
- algorithms for complex systems
- adaptation and integration layer (matching of distributed data and analytical/modelling tools)
- portal functionalities

8.5 SERVICE CENTRE

Although the LIFE*WATCH* infrastructure is distributed and virtual by nature, it is essential users can address a recognisable service centre, which also provides publicity and other dissemination activities. This LIFE*WATCH* Service Centre will be established with tasks to:
- advertise the research and other use opportunities to the audiences involved
- process the procedures to select and admit user groups
- organise training courses to promote more effective use of the infrastructure
- operate a fellowship programme including a competitive award scheme for young researchers with original ideas

Outreach and communication with the wider public and policy will be achieved through a partnership with the European Network of Science Centres (ECSITE) a network of science visitor centres in 25 European countries that currently receive in excess of 30,000,000 visitors per year and provides a unique platform for research on attitudes and understanding related to biodiversity and ecosystems and the development of an International Press Centre for Biodiversity (IPCB).

9. MANAGING THE ESTABLISHMENT OF THE INFRASTRUCTURE

The establishment of the research infrastructure has four phases, each with a specific activities, management and governance structure.

1. Conception phase (1999–2005).
2. Preparatory phase (2005–2008).
3. Construction phase (2008–2014).
4. Test and operational phase (2012–2034).

The initial preparations were based mainly on collaborative activities of the scientific community. The challenging plans were adopted by a few national governments, which resulted in putting these forward to the ESFRI. In parallel, preparations started in pan-national working groups. The involvement of national interests will increase through time with the establishment of a governing body and a legal entity, to supervise funding schemes, and a management board, to start the construction of the infrastructure. This goes alongside organising the commitment and involvement of all data and tool providers. In this phase the user community is asked to define (potential) user requirements, to help focus the construction phase and to specify the test phase. The characteristics of the successive overlapping phases, and the changing governance and management structures are summarised below.

9.1 CONCEPTION PHASE

The conception phase finished in 2005, and went through different cycles of development planning. Important developments were made in a large number of successive and parallel EU and national projects. A few developments were crucial to move things forward.
The establishment of the Global Biodiversity Information Facility (GBIF) provided better opportunities to build on its species-level biodiversity information portals. The EU-funded European Network for Biodiversity Information (ENBI) addressed in design and pilot projects the topics of a new research infrastructure for biodiversity informatics. The Networks of Excellence in Marine Biodiversity (MarBEF) and Terrestrial Biodiversity (ALTER-Net) brought together the results of previous projects and networks, including national LTER networks, to organise the ecological input for the planned research infrastructure.

The Netherlands formally submitted the initial proposal in early 2005 to the ESFRI for consideration in its Road Map strategy. The prospect of the FP7 infrastructure programme resulted in the formal establishment of an Inter-network Preparatory Council, and the start of the next preparatory phase.

The contributing networks (in alphabetical order) and members in the Inter-network Preparatory Council are:

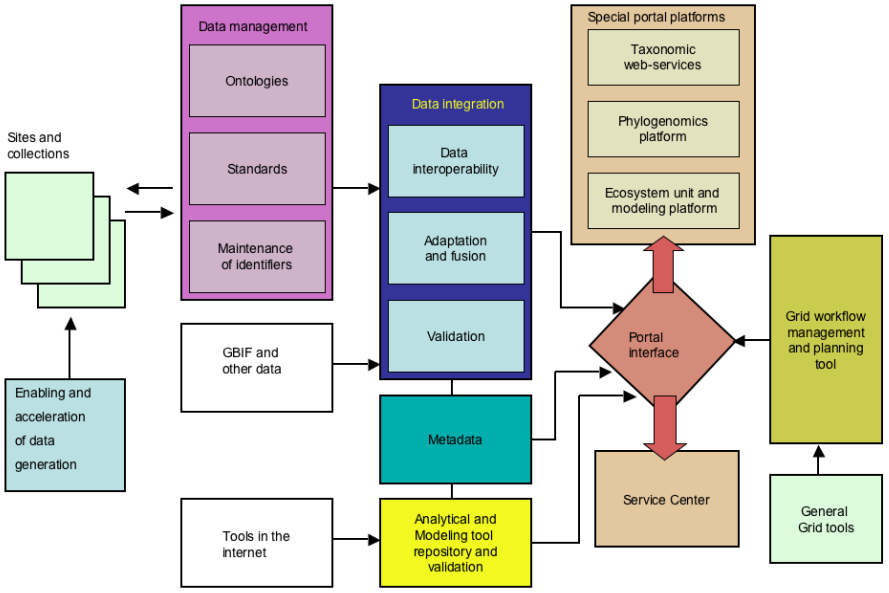
ALTER-Net	Terry Parr (Centre for Ecology and Hydrology Lancaster, UK)
BioCASE	Walter Berendsohn (The Botanic Garden and Botanical Museum, Berlin-Dahlem, Germany)
EDIT	Simon Tillier (Muséum Nationale d'Histoire Naturelle, Paris, France)
ENBI	Wouter Los (University of Amsterdam, The Netherlands)
MarBEF	Carlo Heip (Netherlands Institute of Ecology, Yerseke, The Netherlands)
Marine Genomics Europe	Catherine Boyen (Station Biologique Roscoff, France)
SYNTHESYS	Richard Lane (The Natural History Museum, London, UK)

9.2 PREPARATORY PHASE

The current preparatory phase began in 2005 with re-assessing the specifications of the integrated infrastructure.

The Inter-network Preparatory Council (see paragraph 9.1) will continue to act as the preliminary executive board. It will oversee the whole system design and interact with working group chairs over the development of key components (see below). The council will pay special attention to the integration of technical components and to the institutional arrangements required to ensure an effective governance structure. It will also interact with the initial interested or committed national governments in order to organise the next 18 months preparations and negotiate funding arrangements. It will be important to establish the mechanisms to allow additional member states to join the implementation of the research infrastructure or in a later phase during the operation. Parallel also exploratory talks with industry started to consider partnerships for development.

The structure of LIFE*WATCH* is described in paragraph 8 and summarised in the following diagram.



LifeWatch architecture

The Working groups will be established on each of the main components in this structure. The working groups, drawn from the experts in the collaborating networks (and committed institutes), will work on plans for designing and connecting together the different infrastructure components, with emphasis on scale expansion and on work-flow management.

The working groups will deliver results one year from start. Their summarised tasks are:

Sites and collections
Establish agreements and data sharing principles with data providers
Specification of site networks, specification identifying key components (sites and collections)
Procedures for securing access to historic data
Specification of core site measurements and infrastructure requirements
Preparation of the provider's platform with representation from each country

Technology
Re-assessment of data management and data integration
Input-output workflow operations
Global interoperability

Analytical and modelling tools
Generic ontologies and modules of tool components
Priorities of the first generation infrastructure tools
Interaction with the user portals working group

Grid functionalities
Liaisons with the current biodiversity Grid projects
Establishment of the presently feasible Grid workflow management tools
Interaction with generic EU and member state projects to develop the components, which are still in
design phase

User portals
Establishment of the user's platform
Selection of the initial specialised portal platforms and their specifications

Service Centre
Integration of admission procedures for users
Publicity and training activities
Management of special requests and of the user's projects programme

The first part of the preparatory phase will be reported before summer 2007 at an international conference. This conference will see the establishment of a new governance and management structure, planned with the following bodies:
– LIFE*WATCH* board, with representatives of each financially contributing country. This board appoints the management and oversees the operations of the infrastructure.
– LIFE*WATCH* council, with representatives of the major scientific networks concerned.
– Provider's and user's platform, with representatives of the interested European countries.

At this stage, the formally constituted LIFE*WATCH* council will become responsible for designing the infrastructure strategies, plans, and operations and will report to the LIFE*WATCH* board.

9.3 CONSTRUCTION PHASE

The LIFE*WATCH* board with representatives from contributing countries, and with financial mandate, is in charge of the construction phase. The construction operations are managed from a legal entity hosted by an existing scientific organisation. The operations management is accountable to the LIFE*WATCH* board.
The management tasks are to:
– execute the construction work programme
– organise the appropriate branches of the research infrastructure
– appoint the executives and establish working hierarchies
– agree on working relations with GMES and GEOSS
– keep track of milestones and deliverables
– support the board in its interaction with the LIFE*WATCH* council
– interact with the provider's and user's platforms, and prepare appropriate agreements
– report to the LIFE*WATCH* board

A crucial and preliminary milestone of the construction is the identification of the leading

country for infrastructure implementation. This country will act on behalf of the consortium of participating countries that financially invest in the infrastructure. The LIFE*WATCH* board or the legal entity acting on its behalf will enter into contract with the European Commission.

The Inter-network Preparatory Council will change in this phase into a Scientific Council with representatives of the major scientific networks concerned.

9.4 TEST AND OPERATIONAL PHASE

The operational services of the new infrastructure will start partly in the construction phase, as this allows for proof-of-concept testing. Testing is prepared with protocols (in interaction with the provider's platform and the user's platform), and is independently reviewed. At this stage it is very important to have a seed money mechanism to allow for innovative uses of the infrastructure.
The LIFE*WATCH* management will be re-designed with two executive parts:
– operational branch
– developmental branch
The latter branch is also responsible for generating additional funds to support its ambitions. The operational branch has to advertise the new research opportunities and create an inspirational research environment for original research and for potential applications.

The provider's platform, with representatives of the interested European countries, secures the data acquisition and availability by the committed national ecological sites and collections. The user's platform unites the key stakeholder communities and acts as an advisory body on user requirements.

10. BUDGETARY INFORMATION

All costs below are full construction or operational costs, including housing, administrative and overhead costs for the LIFE*WATCH* infrastructure. For each major cost item an estimate has been made of the anticipated percentage contribution from interested member states and other stakeholders.

A. PREPARATORY COST

mln € 10,50

– Initial preparation costs (most concept and design costs are being met through the activities of the contributing networks and stakeholders)	3,00
– Final preparation costs and project planning	4,00
– Co-ordination, management and PR	2,50
– Housing, administration and overhead costs	1,00

Estimated national and other contributions: 20 %

B. CONSTRUCTION COST

1. COLLABORATIVE LABORATORY ENVIRONMENT

mln € 61,00

Digital infrastructure

– co-ordination and management	2,50
– Grid enabling of data sources	1,50
– extension with Grid services	3,00
– interoperability layer with GBIF	2,50
– adaptation and integration layer	4,00
– user portal	1,00
– validation and other analytical tools	3,00
– modelling tools	8,00

Integrated data contents infrastructure

– co-ordination and management	1,50
– biodiversity unit data, names and identifiers	3,60
– data management for Biodiversity eScience	3,00
– connectivity to associated information services	2,60
– secure organisation and management	1,80
– housing, administration and overhead costs	23,00

Estimated national and other contributions: 50 %

2. ENABLING DATA GENERATION

mln € 83,00

Co-ordination and management (incl. overheads)		8,00
Terrestrial and freshwater sites – 100 sites	28,00	
– harmonised instrumentation	8,00	
– historical data in common formats	3,00	
– site-level data management	7,00	
– co-ordination costs	2,00	
– housing, administration and overhead costs	8,00	
Marine sites – 90 sites	25,00	
– harmonised instrumentation	8,00	
– historical data in common formats	2,00	
– site-level data management	6,00	

– co-ordination costs	2,00
– housing, administration and overhead costs	7,00
Taxonomic data collections network – 50 collections	22,00
– harmonised instrumentation	3,00
– historical data in common formats	6,00
– site-level data management	4,00
– co-ordination costs	2,00
– housing, administration and overhead costs	7,00

Estimated national and other contributions: 50 %

3. DATA PROCESSING — mln € 20,50

Taxonomic web-services	6,10
– co-ordination and management	1,00
– consolidation of cybertaxonomy platform	1,20
– auxiliary data repositories	1,60
– connection to the Collaborative Lab Environment	1,10
– data quality assurance measures	1,20
– housing, administration and overhead costs	PM
Phylogenomics platform	6,80
– co-ordination and management	1,00
– enabling compiling and mining phylogenetic data	1,30
– generic phylogenomics tools	2,00
– links to international databases	0,50
– tools for phylogenetic-tree visualisation	1,00
– data-quality assurance measures	1,00
– housing, administration and overhead costs	PM
Ecosystem unit platform	7,60
– co-ordination and management	1,00
– dynamic ecosystem unit data repository	1,00
– auxiliary data repositories	0,40
– linkage species to ecosystem level data	4,00
– data quality assurance measures	1,20
– housing, administration and overhead costs	PM

Estimated national and other contributions: 50 %

4. SERVICE CENTRE, OUTREACH AND CAPACITY BUILDING — mln € 24,00

– co-ordination and management	1,00
– maintenance of service protocols and web-services	0,80
– helpdesk services	0,60
– eLearning programme	2,30
– initial budget for competitive young researchers proposals (five years and in average 1,5 mln/year)	7,50
– public relations	0,80
– housing, administration and overhead costs	9,00

Estimated national and other contributions: 40 %

5. ADAPTED AND INCREASED DATA GENERATION IN (IN SITU AND EX SITU) SITES		mln € 180,00
– terrestrial and freshwater sites	30,00	
– marine sites	70,00	
– taxonomic data collections	80,00	

Estimated national and other contributions: 100 %

TOTAL for construction cost	mln € 368,50

(Total contribution from interested countries and stakeholders is 74 %)

C. OPERATION COST

Ongoing operation of data generation in sites and collections to be met from national sources	mln € 65,00/year
Central infrastructure operations and services	mln € 5,50/year
Co-ordination and data integration links to GEOSS	mln € 0,50/year
TOTAL for operation cost	mln € 71,00/year

Estimated national and other contributions: 50%

The EU contribution should be secured for 20 years, which implies in total for this period a contribution to operation costs of 20 years x mln € 3,00/year = mln € 60,00

D. DECOMMISSIONING COST

Decommissioning costs are not applicable for this infrastructure since it will not have considerable physical parts, such as buildings or large-scale equipment (apart from what will be invested locally by interested member states).

LIST OF ACRONYMS

ALTER-Net	Network of Excellence Terrestrial Biodiversity
BD-World	Biodiversity World e-Science pilot project (UK)
BioCASE	Biological Collection Access Service for Europe
BIOMARE	Network for Marine Biodiversity research in Europe
BORN	Biodiversity Observation and Research Network
CETAF	Consortium of European Taxonomic Facilities
EcoGRID	GRID enabled EcoInformatics project (Netherlands)
ECSITE	European Network of Science Centres and Museums
EDIT	Network of Excellence European Distributed Institute of Taxonomy
ENBI	European Network for Biodiversity Information
EO	Earth Observation
EPBRS	European Platform for Biodiversity Research Strategy
ERMS	European Register for Marine Species
ESFRI	European Strategic Forum for Research Infrastructures
ETI	Expert Center for Taxonomic Identification
EU	European Union
EuroCAT	European Catalogue for species names
FP6	6th EU Framework Programme for research and technology
GBIF	Global Biodiversity Information Facility
GEOSS	Global Earth Observation System of Systems
GMES	Global Monitoring for Environment and Security
INSPIRE	The Infrastructure for Spatial Information in Europe
IPCB	International Press Centre for Biodiversity
LTER	Long Term Ecological Research
MARBEF	Network of Excellence Marine Biodiversity and Ecosystem Functioning
MGE	Network of Excellence Marine Genomics Europe
NEON	National Ecological Observatory Network (US)
OBIS	Ocean Biogeography Information System
OSPAR	Convention for the protection of the marine environment of the North-East Atlantic
SEEK	The Science Environment for Ecological Knowledge (US)
SYNTHESYS	Infrastructure network Synthesys of systematic resources
TDWG	Taxonomic Databases Working Group