WP3 – Activity 3.4

ICT-GIS data set

Deliverable 3.4.1

Harmonization document for data cataloging, Shared database, thematic maps, forecast scenarios

Project Acronym	ECOMAP
Project ID Number	10047543
Project Title	Ecosustainable management of marine and tourist ports
Priority Axis	3
Specific objective	3.3
Work Package Number	3
Work Package Title	Monitoring / research of sea environment in marinas / ports ecosystems
Activity Number	3.4
Activity Title	ICT –GIS data set
Partner in Charge	PP8 – University of Ferrara
Partners involved	PP8 – UNIVERSITY OF FERRARA
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Contents

Introduction

The aims of the partnership between Italy and Croatia, for the Interreg V-A ECOMAP project, are the development of multidisciplinary analysis methods and cross-border protocols.

To achieve these aims, the activity 3.4 (WP 3) provides building a large shared database. This activity consists in defining shared cross-border collection and cataloging methods, harmonizing the data acquisition and management systems between the Italian and Croatian partners.

The database methodologies will allow the transfer to statistical systems of European, national and territorial level. All literature data, thematic maps and data collected for the project will be included in a smart database useful for defining and identifying criticalities, related to climate change and anthropogenic activities, and providing mitigation solutions.

After validation of results, methods and analytical protocols, the database is available on line for partnership use.

PP8 developed a model proposal for the ECOMAP project database, shared it with all PPs and a formal request (Annex I) was sent to all PPs. PP8 received also suggestions and feedback. Thanks to the partnership, it was possible to create a final model proposal for the database that satisfy the necessity of all partners. Subsequently, an ESRI license was acquired for the ArcGis PRO software, useful both for the construction of the shared database and for the publication and / or consultation of the results via WebMap. The WebMap is accessible via PC, smartphones and tablets (link).

Geodatabase

A GIS database (Spatial Database or Geodatabase) includes data about the spatial locations and shapes of geographical features recorded as points, lines, areas, pixels, grid cells, or TINs, as well as their attributes. One of the main views of the geodatabase is as a data model for representing geographical information using standard relational database technology. A second, equally important aspect is the way the geodatabase manages data access and storage. The Geodatabase data model makes geographic objects "intelligent", allowing the user to assign rules and behaviours usable in spatial analysis applications.

Cataloguing and harmonization of data received from PP4, PP7 and PP8

The data relating to sampling campaigns and results by different partners were catalogued and harmonized.

Specifically, data sent by PP4 – *Institute of Oceanography and Fisheries* (IOF), PP7 - *National Institute for Oceanography and Experimental Geophysics* (OGS) and PP8 - *University of Ferrara* (Unife) have been cataloged and harmonized in the chosen reference system (WGS84 / UTM zone 33N EPSG: 32633).

In particular, the data provided by PP4:

- *Escherichia coli*
- Intestinal enterococci
- Temperature
- Salinity
- *Prochlorococcus*
- *Synechococcus*
- Picoeukaryotes
- Heterotrophic bacteria
- High nucleic acid bacteria (%).

The data provided by PP7, for Croatian test sites and the Italian test sites, are the following:

- Very High-Resolution Seismic Survey (VHR) performed in Podstrana and Spinut sites
- Electrical Resistivity Tomography (ERT) measurements in Podstrana and Spinut sites
- Electrical Resistivity Tomography (ERT) measurements Shallow-depth seismic survey in Bibione and Ancona sites
- Boomer and Sparker surveys.

The data provided by PP8, for the two Croatian test sites and the Italian test sites are the following:

- Chemical-physical parameters of water
- Sediment geochemistry (major, minor and trace elements, stable isotopes ratio)
- TOC and TN measurements
- Sediments texture

First geodatabase structures (skeleton form)

For the creation of the geographical database for ECOMAP project, the *geodatabase technology* was used in its "file geodatabase" version (Zeiler, 1999).

The dataset is organized into "Feature Datasets" (single geometry vector datasets) that collect "Feature Classes" for each research unit (Figure 1).

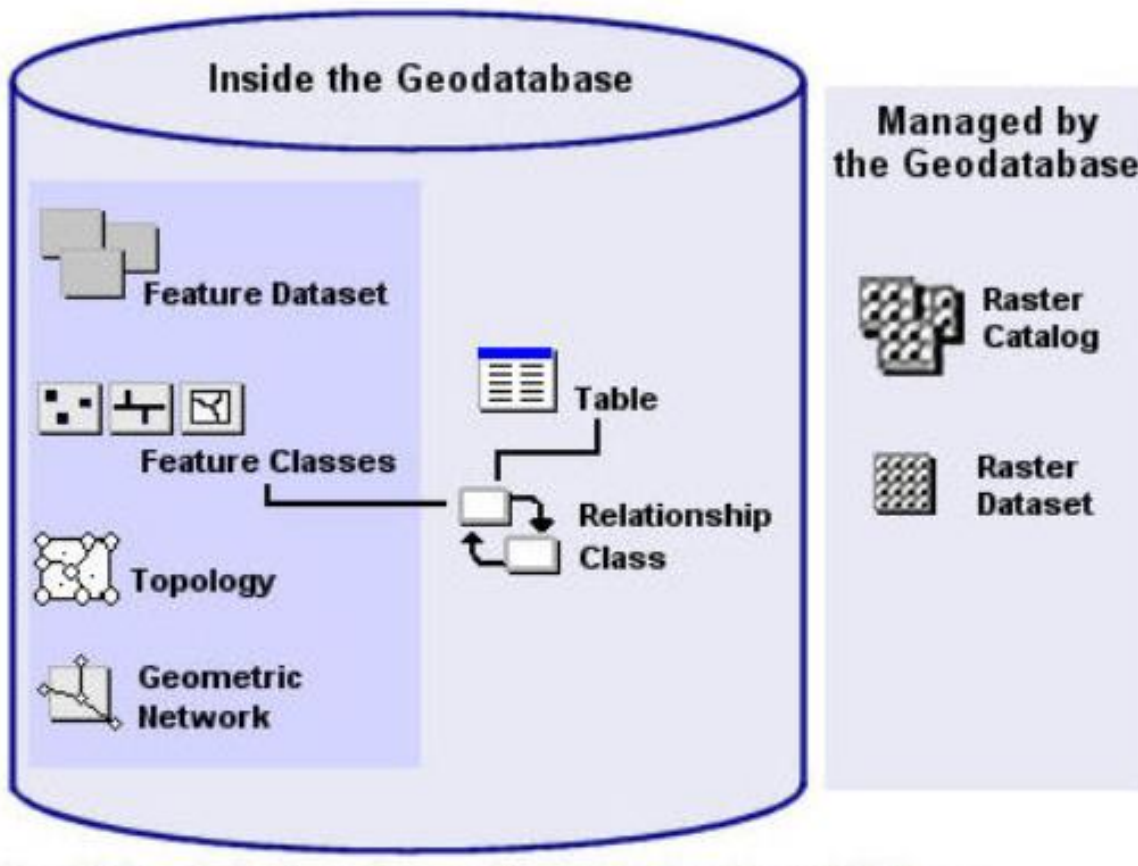*Figure 1 - Example of ESRI Geodatabase, it is shown how the different datasets are divided according to the nature of the data (http://sal.ocean.washington.edu/tutorials/arcgis/geodataset/geodataset.html).*

Database is organized as:

- Features dataset (vector data);
- Raster datasets (raster data).

The geodatabase model for the ECOMAP project has the features and raster datasets divided by study site (Ancona, Bibione, Split and Podstrana), where all the data collected in the different test sites are grouped.

Data collection

As ECOMAP is an interdisciplinary project, the data set is very large and heterogeneous. The data were obtained by different project activities that mainly concerned:

1) geophysical surveys;
2) geochemical analysis of sediments;
3) biological studies;
4) analysis of the marine habitat;
5) hydrodynamic investigation of ports in relation to sedimentation or erosion processes, chemical quality of sediments and biodiversity

Most of the data have been collected as part of the WP3 activities (3.1, 3.2 and 3.3):

- Onshore-offshore geophysical-geological surveys: Remote sensing, High-resolution bathymetry (Multibeam), Very High-Resolution Seismic (VHRS) profiles and geoelectric measurement;

- Microbiological and geochemical survey on sediments and water bodies: monitoring of physical features and the chemical characteristics of the water column, detection of organic matter, microbiological characterization of the water column, geochemical features of dredging sediments;

- Biological survey on benthic macroinvertebrates: macrobenthos classification in sediment, Total Organic Carbon (TOC), Total Nitrogen Analysis (TN) and benthos monitoring activity.

The dataset consists of structured (e.g. tables, ASCII files, geodata) data. In particular:

- Raster formats

    ➢ .tiff, ESRI-grid, .rst, .jpeg, .asc

- Vector formats

  ➢ Shapefile ESRI (.shp)

A great part of data are georeferenced by textual describing (research area is in town x), xy-coordinates in a table and GIS-formats as raster or vector data. The reference system used to harmonize data is <u>WGS84 / UTM zone 33N EPSG: 32633</u>.

Geodatabase sharing with partners and stakeholders

Common database was shared with via a google drive folder. All partners will be able to have access immediately.

The shared folder on google drive contains:

- Geodatabase;

- Folder containing all single database files divided by specific subfolders.

Regarding to stakeholders, data are shared as a WebMap, that is available online on the project website (https://www.italy-croatia.eu/web/ecomap).

Detailed description of WebMap tool

The ECOMAP project web map is an interactive map showing the results of scientific research activities and the places where the studies were performed (sampling activities, geophysical surveys). The web map is available for PC, smartphones, and tablets. This map was created using the ArcGis software, integrating the scientific information obtained during the activities of the ECOMAP project.

By clicking on the link available on the project website (https://www.italy-croatia.eu/web/ecomap/docs-and-tools-details) you will be redirected to the site hosting the map (click: **1)** "Tools"; **2)** "3.4.1_ECOMAP GIS_WEBMAP"; **3)** "View"). First, the homepage of the web map will appear (Fig.2).
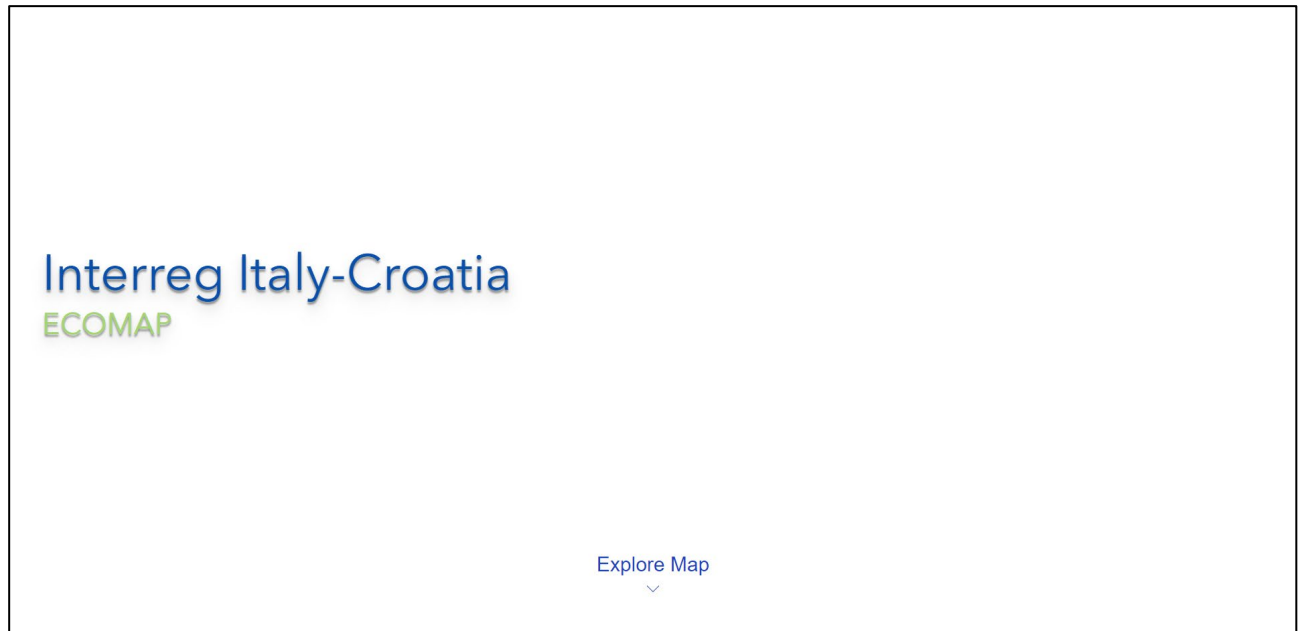
Figure 2: webmap homepage screen

By clicking on the "explore map" button, the user can then access and consult the map. At this point, a satellite image pointed at the Adriatic area will appear. The user can point and zoom in on one of the four project sites or can search for the site to consult (Bibione, Ancona, Split, Podstrana) through the search bar located at the top right (Fig. 3).
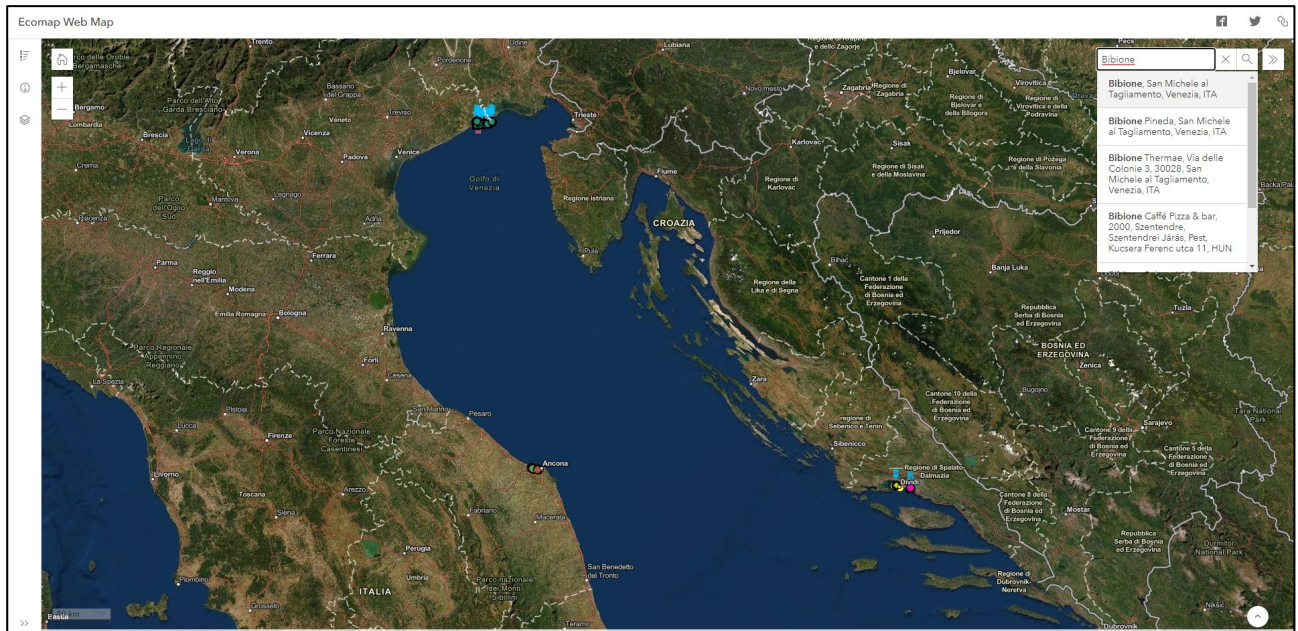
Figure 3: Screenshot of the webmap immediately after logging in. At the top right you can see an example of a location search using the search bar.

At this point the user will be redirected to the chosen location. Here the user will be able to observe numerous icons, each of which is representative of a certain type of study performed at that point. The map has a legend that can be consulted in the bar on the left. The legend is divided into the four sites, therefore by clicking on the legend button the user will be able to know what each icon refers to (Fig.4).
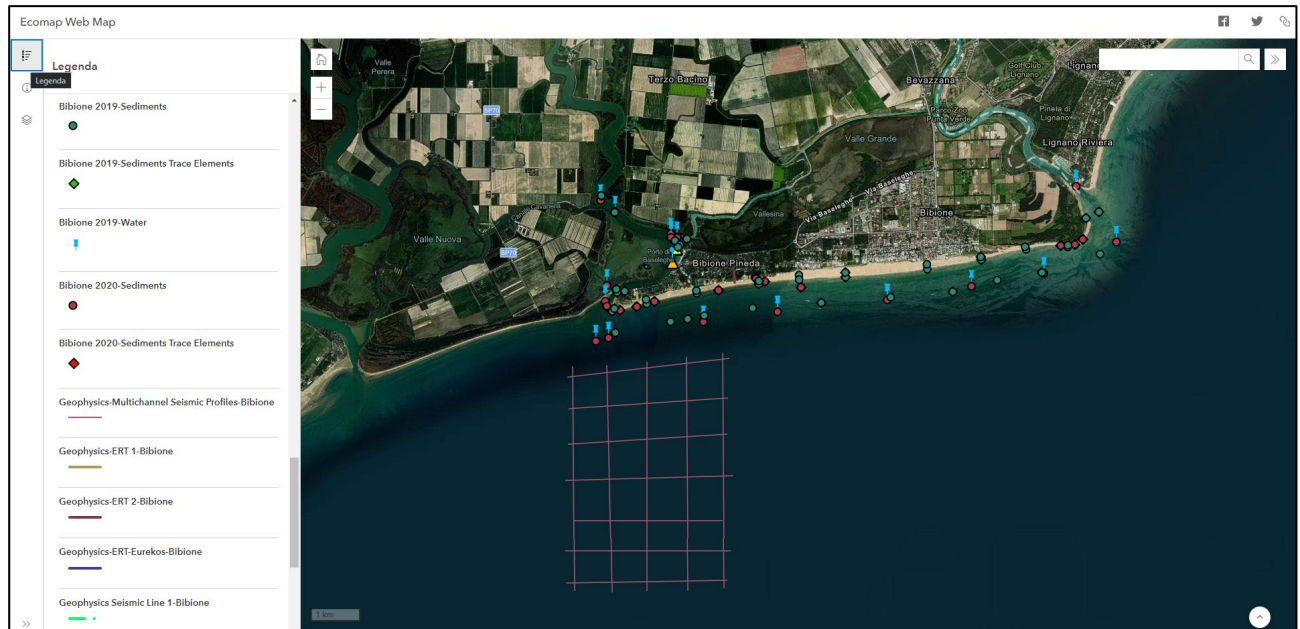
Figure 4: Screen showing an example of consulting the legend.

The user also has the possibility to choose which layers to display. In fact, on the left bar, there is the layer section. Here the user can decide to make some layers visible or not. This will allow him to reduce or increase the number of the information displayed on the map. To do this, simply go to the layer section and click on the layers that you want to hide or keep visible (Fig. 5).
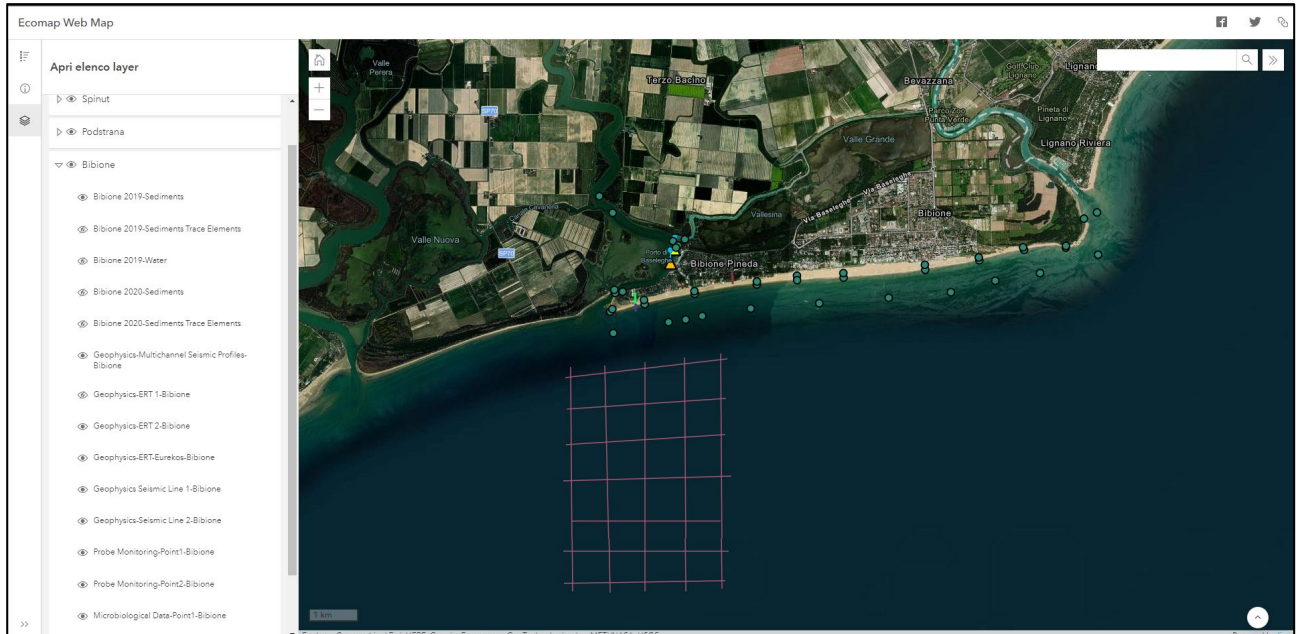
Figure 5: Screen of the webmap showing an example of using the layer section.

Each icon on the map contains information (for example, analytical results, type of study, etc.). The user can consult this information by simply clicking on the icon of interest. By doing this, a pop-up relative to the clicked icon will appear and it will be possible to consult the information contained within (Fig.6).
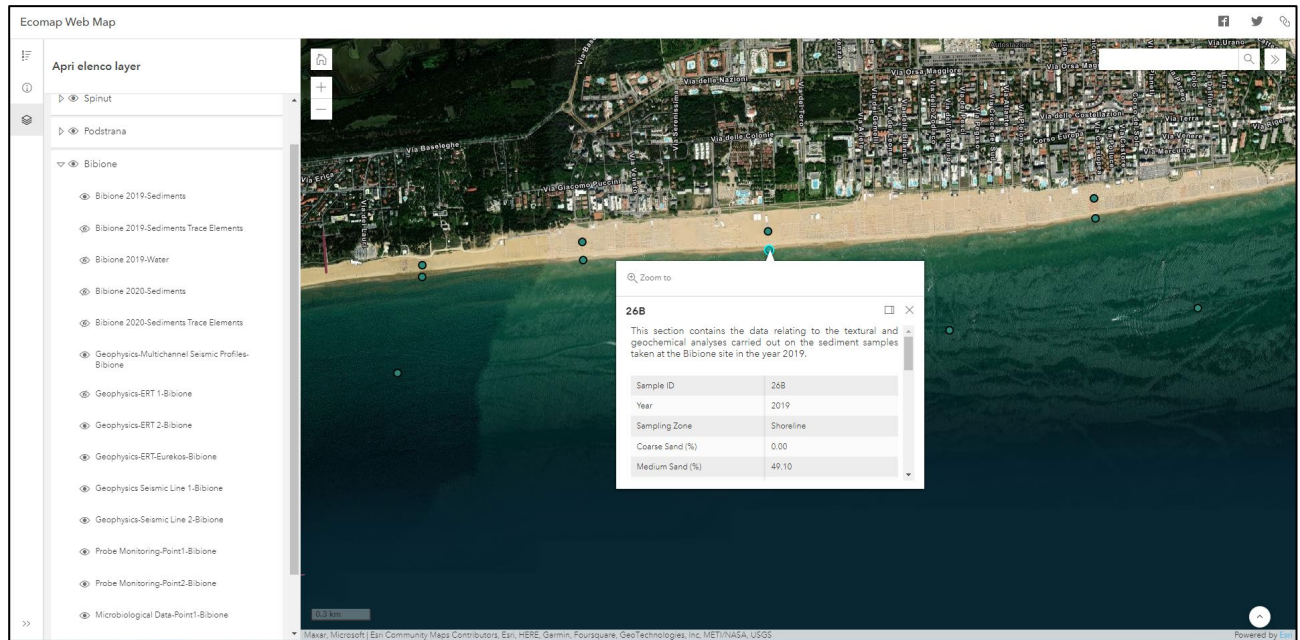
Figure 6: Screen of the webmap showing an example of consulting the icons.

References and sitography

Zeiler M., (1999). *"Modeling our World", The ESRI Guide to Geodatabase Design, published by Enviromental Systems Research Insitute, Redlands, California.*

http://sal.ocean.washington.edu/tutorials/arcgis/geodataset/geodataset.html
https://pro.arcgis.com/en/pro-app/latest/help/data/main/data-in-arcgis-pro.htm

Database model for action 3.4 of the "2014 – 2020 Interreg V – A, Italy – Croatia CBC Programme – ECOMAP project" proposed by University of Ferrara (PP8) to each partner

Shared database model proposal is aimed at each project partners.

The purpose of this proposal is to collect the opinions of PPs, to define the best structure for the creation of the shared database (act. 3.4).

A database proposal from the partner responsible for WP3 (PP8) is presented below. It is divided into:

• Date;

• Data Management;

• Geodatabase;

• Geodatabase sharing.

For each point of this proposal, opinions or any suggestions regarding the points developed will be requested, in order to have a common agreement of all partners.

Data

1) **For the database we will have data obtained from different sources:**

   - Field investigations (digitized)

   - Measurement from monitoring stations

   - Research activities and own investigations

   - Bibliography

   - Italian National public Institutions for environmental monitoring (ISPRA, ARPA, Italian Environmental Ministry)

   Other proposals from partners

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Question: Are there public Institution in Croatia involved in environmental monitoring (water, soil, air, etc.)? Are their data available online?

2) **Data will be obtained from the following activities (see described activities of WP 3):**

- Onshore-offshore geophysical-geological surveys: Remote sensing, High-resolution bathymetry (Multibeam), Very High-Resolution Seismic (VHRS) profiles and geoelectric measurement.

- Microbiological and geochemical survey on sediments and water bodies: monitoring of physical features and the chemical characteristics of the water column, detection of organic matter, microbiological characterization of the water column, geochemical features of dredging sediments.

- Biological survey on benthic macroinvertebrates: Macrobenthos classification in sediment, Total Organic Carbon (TOC), Total Nitrogen Analysis (TNA) and benthos monitoring activity.

Other proposals from partners

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3) **Bibliographic and experimental data georeferencing:**

A great part of data will be georeferenced by

- Textual describing (research area is in town x)

- xy-coordinates in a table

- GIS-formats as raster or vector data

To harmonize the data, a single reference system with metric coordinates is proposed

- WGS84 / UTM zone 33N EPSG: 32633

Other proposals from partners

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4) Data format:

The database will consist of structured (e.g. tables, ASCII files, geodata) and unstructured (documents) data.
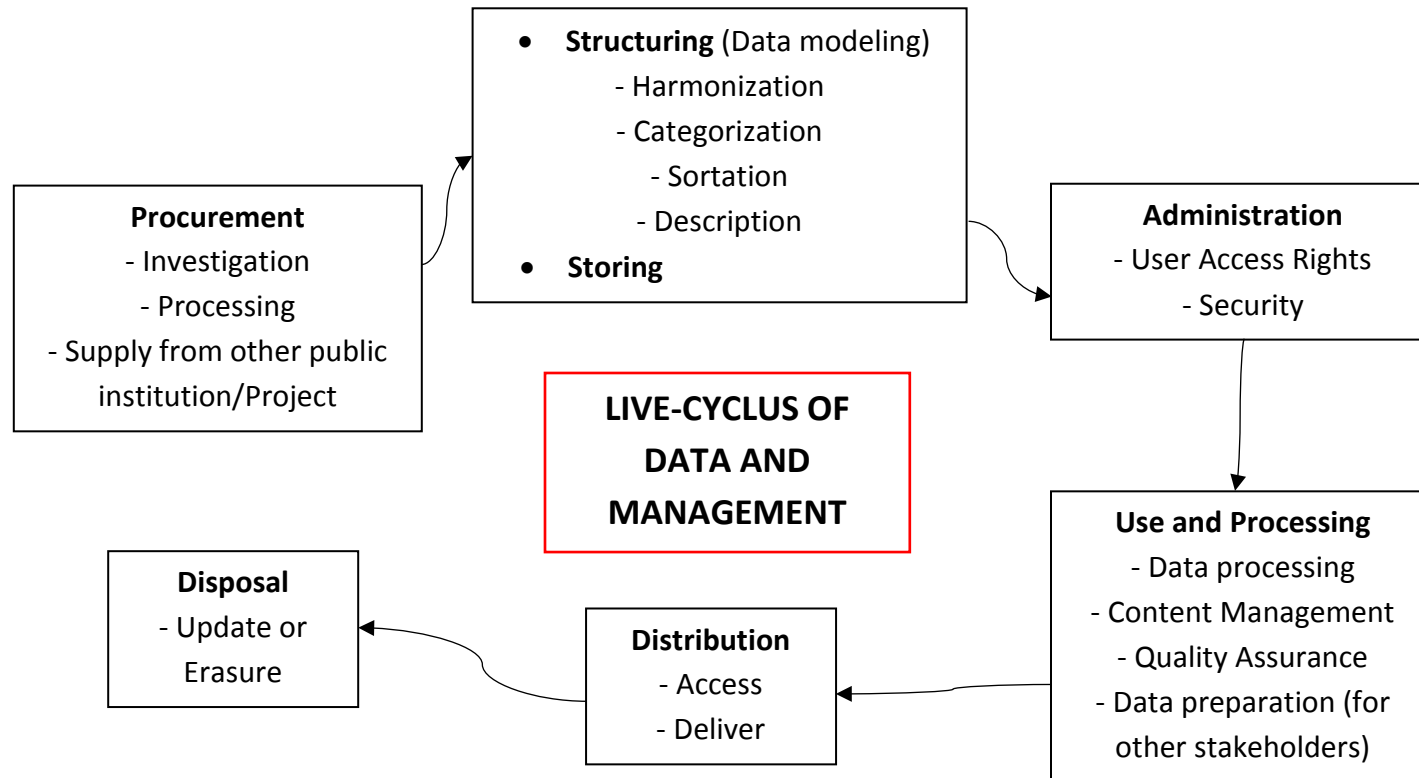
A wide range of formats will use:

- Raster formats
  - ➢ .tiff, ESRI-grid, .rst, .jpeg, .asc
- Vector formats
  - ➢ Shapefile ESRI (.shp)
- Table formats
  - ➢ .txt, .mdb, .cvs, .dbf
- Unstructured formats
  - ➢ .doc, .txt., .ipeg

Other proposals from partners

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Data management

1) **Main components of data management**

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                        │ • Structuring (Data modeling)│
                        │        - Harmonization       │
                        │        - Categorization      │
                        │          - Sortation         │
                        │          - Description       │
                        │ • Storing                    │
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Procurement
- Investigation
- Processing
- Supply from other public institution/Project

Structuring (Data modeling)
- Harmonization
- Categorization
- Sortation
- Description

Storing

LIVE-CYCLUS OF DATA AND MANAGEMENT

Administration
- User Access Rights
- Security

Use and Processing
- Data processing
- Content Management
- Quality Assurance
- Data preparation (for other stakeholders)

Distribution
- Access
- Deliver

Disposal
- Update or Erasure

Other proposals from partners

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Geodatabase

1) Geodatabase structure

Basing on an economic and technical evaluation, the database will be created as:

- ArcGIS Geodatabase (simple to structure and share, but the ESRI license is necessary)
- PostGIS PostgreSQL database (more complicated to structure and share, but it is an open source software)

The datasets collected by each partner will be contained in the shared database. Datasets will be organized as:

- Features dataset (vector data)
- Raster datasets (raster data)
- Tabular data, that cannot be georeferenced, will be added to the database as table files
- Text files (i.e. the methodologies adopted) and images will be added as hyperlink in a text or table file
- Bibliographic data (used for data processing) will be added as vectors, raster or tabular format.

Three different types of databases proposal:

Database 1: features and raster datasets are divided by study site
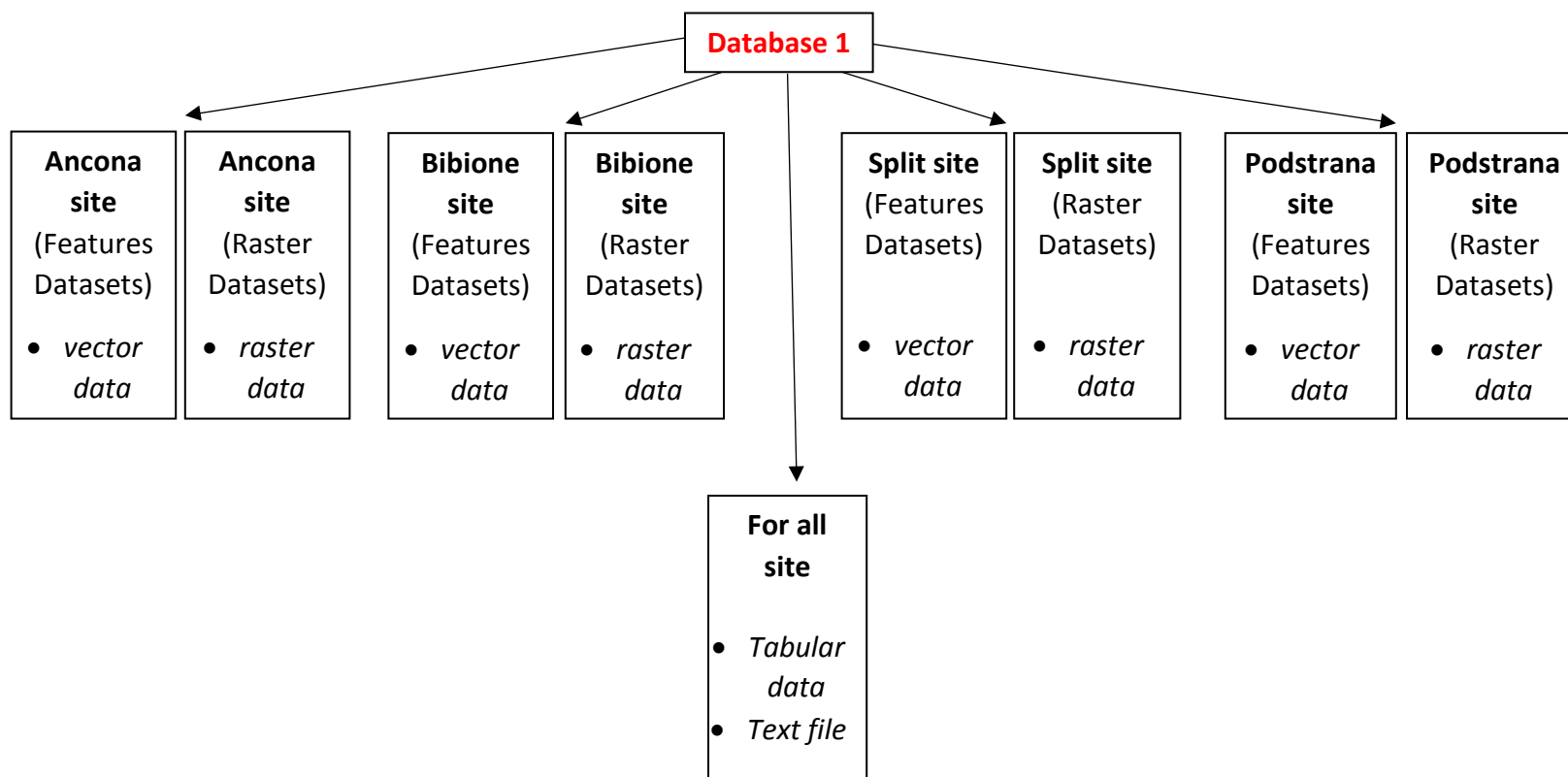
Database 2: features and raster datasets are divided by survey activity

Database 2

Geo-physical surveys
(Features Datasets)

- *vector data*

Geo-physical surveys
(Raster Datasets)

- *raster data*

Geo-chemical surveys
(Features Datasets)

- *vector data*

Geo-chemical surveys
(Raster Datasets)

- *raster data*

Biological surveys
(Features Datasets)

- *vector data*

Biological surveys
(Raster Datasets)

- *raster data*

Micro-biological surveys
(Features Datasets)

- *vector data*

Micro-biological surveys
(Raster Datasets)

- *raster data*

For all survey

- *Tabular data*
- *Text file*

Database 3: features and raster datasets are divided by project actions

N.B. University of Ferrara (PP8) proposes the Database 1 model.

Request – Partners' opinion is required for the most suitable database model:

o   Database 1

o   Database 2

o   Database 3

Other proposals from partners

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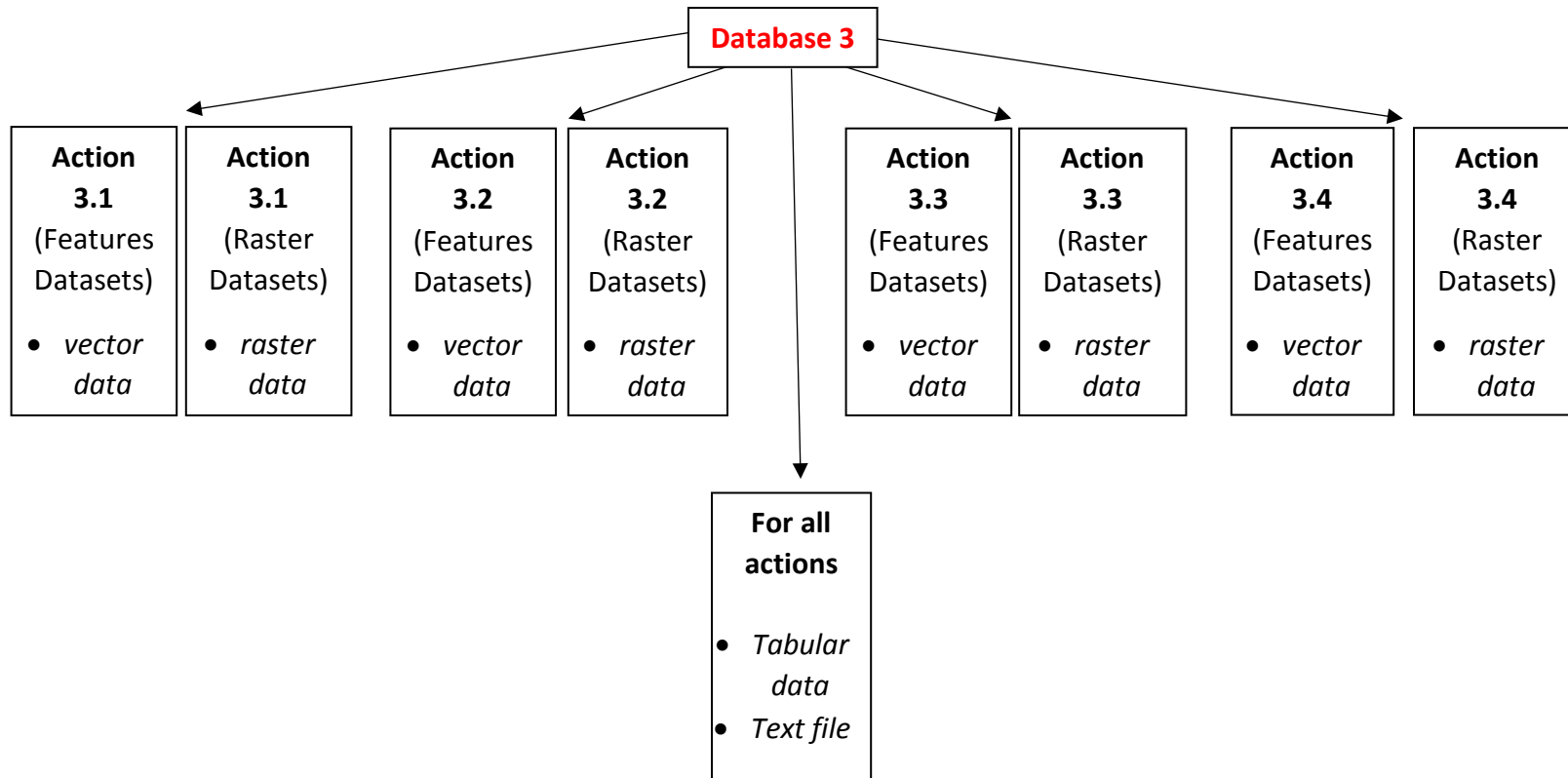
Geodatabase sharing

1) **Geodatabase sharing with partners**

Common database will be shared with via a google drive folder. All partners, or only one partner member, will be able to have access immediately. The partners will have the database available immediately and it will be constantly updated.

The shared folder on google drive will contain:

- Geodatabase
- Folder containing all single database files divided by specific subfolders
- Folder where partners add files that will be inserted later in the geodatabase (the update will be done by PP8)
- A text file, constantly updated, containing the list of files already loaded into the database
- A text file containing the guideline for using the geodatabase

Other proposals from partners

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2) Geodatabase data for stakeholders

To share data with stakeholders is proposed:

- Sharing of layers deriving from data processing (in raster format) with WebMap, where the results of the project will be visible in the GIS environment. The WebMap will be ready at the end of the project activities.

- Sharing of vector data following a written request (indicating the type of data and reasons).

The WebMap and the data request form could be placed on the project website, if it is possible.

Other proposals from partners

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Partner:

PP_____

Date _____   Signature

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