EUROPEAN COMMISSION

Directorate-General for Maritime Affairs and Fisheries

DG MARE

MAREA PROJECT

MEDISEH (Mediterranean Sensitive Habitats)

Specific Contract No 2 (SI2.600741)

FINAL REPORT

Task 1.1 Seagrass beds distribution along the Mediterranean coasts
(Scientific Responsible: A. Belluscio (CIBM), Partners involved: HCMR, CNR-IAMC, CNR-ISMAR, CIBM , COISPA, CoNISMa, FCD - MSDEC)

Autors: Belluscio A, Panayiotidis P, Gristina M., Knittweis L., Pace M.L.,Telesca L, Criscoli A, Apostolaki ET, Gerakaris V., S. Fraschetti, M. T. Spedicato, G. Lembo, M. Salomidi,R. Mifsud, G. Fabi, F. Badalamenti, G. Garofalo A. Alagna, Ardizzone G.D., Martin C., V. Valavanis

This study has been carried out with the financial assistance of the European Commission."

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This report was prepared by:

Hellenic Centre for Marine Research

Consorzio Nazionale Interuniversitario per le Scienze del Mare

COISPA, Tecnologia e Ricerca, Stazione Sperimentale per lo Studio delle Risorse del Mare

Centro Interuniversitario di Biologia Marina ed Ecologia Applicata "Guido Bacci", Consortium of 6 Universities and the Municipality of Livorno

Instituto Espanol De Oceanografia

Fisheries Control Directorate, Ministry for Sustainable Development, the Environment and Climate Change

Consiglio Nazionale delle Ricerche

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WP1. Protected habitats

Task 1.1 Seagrass beds distribution along the Mediterranean coasts

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Background

In the Mediterranean, "seagrass" is a collective terms for the species *Posidonia oceanica*, *Cymodocea nodosa*, *Zostera marina* and *Zostera noltii.* Other seagrasses species in the Mediterranean are *Ruppia cirrhosa* and *Ruppia maritima,* and *Halophila stipulacea.*

Main characteristics of these species are listed below:

Species	Distribution on European coasts	Description of the meadow	Approximate maximum depth
Zostera noltii	Atlantic, Mediterranean and Black Sea	Loose meadows, 20-25 cm high, thin leaves, 1-2 mm wide	Up to 10 m
Zostera marina	Atlantic (except Canary Islands) and Mediterranean	Meadows are 30-60 cm in height, reaching up to 1 m or over, with ribbon-like leaves, 10-12 mm wide	Up to 10 m
Cymodocea nodosa	Atlantic and Mediterranean	Loose meadows, 30-40 cm high, thin leaves, 2-4 mm wide	Up to 30 m
Posidonia oceanica	Mediterranean	Meadows are 40-60 cm in height, reaching up to 1 m over, with thick, ribbon-like leaves, 5-12 mm wide	Up to 30-40 m or over if there is enough sunlight

Posidonia oceanica is the only species that makes meadows, similar to the forest habitat for the terrestrial environment. *Posidonia oceanica* meadows are the most diverse, complex and productive *stratocenosis* existing along the coastline of the Mediterranean Sea (Buia et al., 2003). The phenomena of regression and fragmentation of habitat to which they are subjected, affects the composition of benthic (Turner et al., 1999), epiphytic (Hovel et al., 2004) and fish (Vega Fernandez et al., 2005) communities who live there. Other seagrasses species also occur along the Mediterranean coasts and present seasonal variability, associated to environmental variables and other local factors. The cartography of these species (*Cymodocea nodosa* in particular) often is a "secondary task", following the cartography of *Posidonia* beds. Nevertheless, these other

seagrasses often comprise an important step in the ecological succession prior or following *Posidonia* beds. Other seagrasses in the Mediterranean Sea (i.e. *Zostera noltii, Z. marina*) present a very coastal distribution, often dominating coastal lagoons. Recently the distribution of *Halophila stipulacea*, a warm waters seagrass is expanding in the eastern Mediterranean coasts since its introduction from the Red Sea (Short et al., 2001).

Regulation EC 1967/2006 defines that all destructive fishing practices should be banned upon this vulnerable habitat, named as "seagrass beds i.e. areas where the seabed is characterized by the dominant presence of phanerogams, or where such vegetation has existed and is in need of restoration action".

Objectives

The main objectives of this Task are:

- The revision of historical and current data on the locations and the status of seagrasses beds in different GSAs all over the Mediterranean basin.
- The transformation of available information into a digitilized format within a geodatabase.
- Integration of the aforementioned information within a web-based GIS vieweralong with an associated geo-referenced database. This aims to operate as a consulting tool for spatial management and conservation planning.
- Following the revision of the knowledge base identify gaps and suggest future research priorities.

In order to meet these objectives within the framework of MEDISEH an expert team was composed within the MAREA Consortium from scientists with long term expertise on seagrass beds, habitat modeling, spatial statistics, GIS expertise, working in different areas in the Mediterranean basin. Moreover, a large number of scientists outside the MAREA Consortium collaborated on a volunteer basis with data and input. Details on the list of experts and external collaborators one can see below in Tables 1.1.1 and 1.1.2. For CV details check the MAREA expert web site *http://www.mareaproject.net/*.

Table 1.1.1. List of experts involved in WP1, Task 1.1

Participant	Participant affiliation
A. Belluscio	CIBM
P. Panayotidis	HCMR
E. Apostolaki	HCMR
M. Gristina	CNR-IAMC
L. Telesca	CIBM
L. Criscoli	CIBM
M. T. Spedicato	COISPA
G. Lembo	COISPA
V. Gerakaris	HCMR
M. Salomidi	HCMR

Participant	Participant affiliation
L. Knittweis	FCD - MSDEC, Malta
G. Fabi	CNR ISMAR
G. Garofalo	CNR-IAMC
A. Alagna	CNR-IAMC
F. Badalamenti	CNR-IAMC
S. Fraschetti	CoNISMa
G.D. Ardizzone	CIBM
C. Martin	HCMR/ Current affiliation: UNEP-WCMC (Cambridge, UK)
M. L. Pace	FCD - MSDEC, Malta
R. Mifsud	FCD - MSDEC, Malta
V. Valavanis	HCMR, Input from WP3

Table 1.1.2. List of external collaborators involved in WP1, Task 1.1

Collaborator	Collaborator affiliation
Tatjana Bakran-Petricioli	University of Zagreb: *Croatia*
Marie Louise Pace	Ministry for Resources and Rural Affairs (FCD (MSDEC)): *Malta*
Sami Ben Haj	Thethis Bizerte: *Tunisia*
Enrico Cecchi	ARPAT: *Tuscany (Italy)*
Stefano Coppo	Regione Liguria: *Liguria (Italy)*
Gianni Diviacco	Regione Liguria: *Liguria (Italy)*
Annalisa Falace	University of Trieste: *north Adriatic Sea (Italy)*
Gérard Pergent, Christine Pergent-Martini	University of Corsica (Corte), Faculty of Sciences, Equipe Ecosystèmes Littoraux- EQUEL *(France)*
INCA	Institute for the Nature Conservation in Albania: *(Albania)*
Francesco Bitetto	Centre d'Estudis Avançats de Blanes (CEAB - CSIC) (*Spain)*

Moreover, for organisation purposes, responsibilities for seagrasses data collection were allocated per partner and area, based on the scheme below (Fig. 1.1.1):

Greece, S. Turkey, Egypt: HMCR (E. Apostolaki) for GSAs: 20, 22, 23 24, 26.

Libya (GSA: 21), **Syria, Lebanon, Israel** (GSA 27), **Cyprus** (GSA 25) + **Greek Natura sites**: HMCR (P. Panayotidis).

Middle/South Western Mediterranean: CNR-IAMC (M. Gristina) for GSAs: 15 (**Malta**), 16 (**Sicily**), 12, 13, 14 (**Tunisia/Algeria**), 2, 3, 4, (**Algeria, Morocco**), 21 (**Lybia**).

Western Mediterranean: CNR-IAMC (M. Gristina) for GSAs: 1, 5, 6 (**Spain**).

North Western Mediterranean: CIBM (A. Belluscio) for GSAs: 7, 8, 9 (**France, NW Italy**).

Adriatic Sea: CNR-ISMAR (G. Fabi) for GSA: 17 (north **Adriatic**).

Ionian Sea: CONISMA (S. Fraschetti) for GSAs: 18, 19 (**Ionian**).

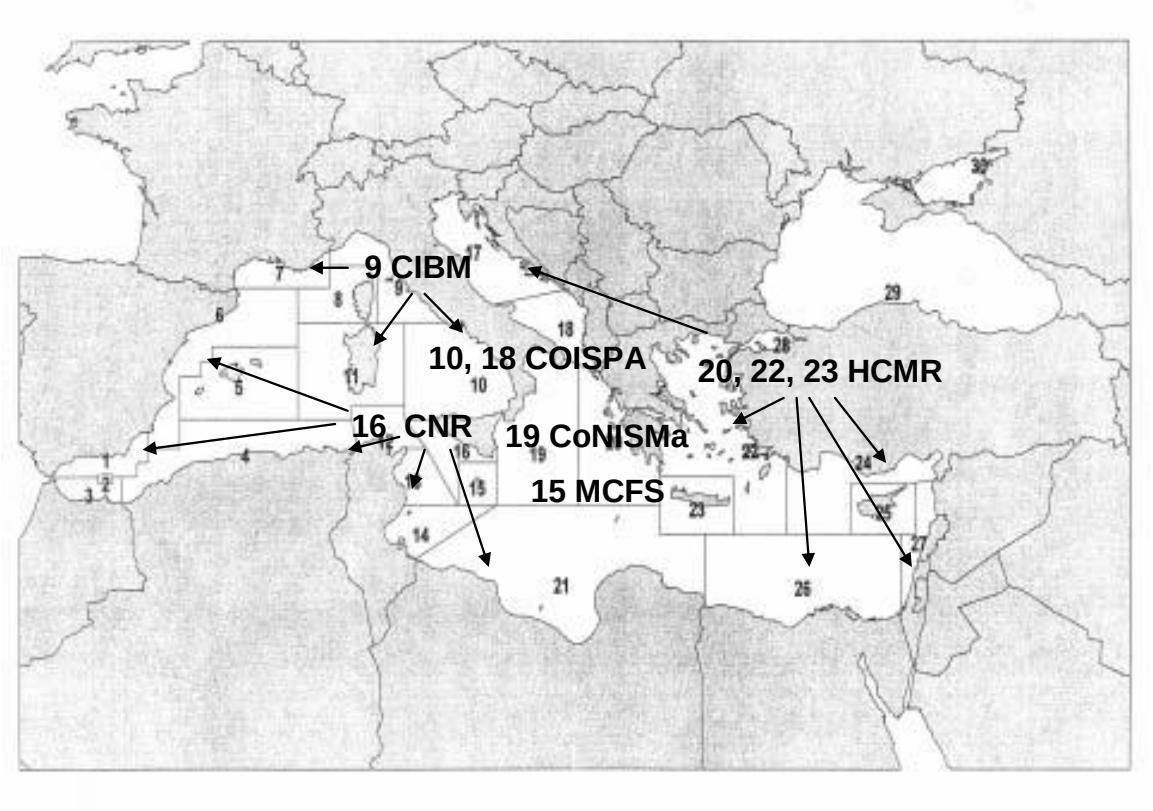

Fig. 1.1.1. Responsibilities for data collection per partner and GSA. Following the kick-off meeting of the project the responsibility for GSA 15 was moved from FCD - MSDEC (MCFS on the map)) to CNR-IAMC.

Deliverables and Milestones foreseen by the Project

The following table describes the task deliverables and milestones as foreseen by the proposal: the state of the art of each deliverable is reported.

Table 1.1.3. The state of art for the milestones and deliverables foreseen by the proposal

Deliverable	Description	% of foreseen results
M1.1.1	Revision of existing information of past seagrass beds along the Mediterranean coast	100%
M1.1.2	Revision of existing information of current seagrass beds along the Mediterranean coast	100%
M1.1.3	Production of GIS files indicating the position of past and current seagrass beds along the Mediterranean coast	100%
D1.1.1	Geo-referenced database covering all revised information on seagrass beds spatial distribution	100%
D.1.1.2	Integrated maps presenting the known spatial distribution of *Posidonia* and other seagrass species across the Mediterranean	100%
D.1.1.3	GIS compatible file for input to WP3	100%

Progress achieved

Within the framework of Task 1.1 and according to MEDISEH proposal four meetings were held within the framework of the project. Specifically:

A one day workshop took place following the kick-off meeting of the project that was held in Heraklion **(Crete) in October 2011**, in order to homogenize the work among the partners involved and standardise the input data format in order to be suitable for modeling. In addition an introduction on the modeling techniques that could be applied was made. Participants were: Eugenia Apostolaki, Vasilis Gerakaris, Vessa Markantonatou, Maria Salomidi, Nadia Papadopoulou, Chris Smith and Vasilis Valavanis (Greece), Leyla Knittweis (Malta), Gianna Fabi, Fabio Grati, Michele Gristina, Simonetta Fraschetti (Italy) and the task coordinator Andrea Belluscio (Italy).

Two days workshop was held within the second meeting of the MEDISEH in **Palermo (Italy) in February 2012**. The aim of this workshop was to define environmental and/or anthropogenic variables to be tested for habitat modeling, depending on data availability. The first session on Monday 6th February involved presentations by A. Belluscio (General introduction plus data on the W Mediterranean) (GSA 7, 8, 9, 10, 11, 17, 18), M. Gristina on the southern part of Mediterranean (GSA 1, 2, 3, 4, 5, 6, 12, 13, 14, 15, 21) and P. Panayotidis for Greece and eastern Mediterranean Sea (GSA 20,21,22,23,24,25,26,27,28). The general discussion for Task1.1 and Task1.2 mainly addressed the difficulties encountered. On Tuesday 7th and

Wednesday 8th February (Workshop) the discussion focused on problems related to habitat modeling.

Three days workshop was held within the third meeting of the MEDISEH **in Rome (Italy) in September 2012**. The aim of the workshop was to have an overview of the updates from the second meeting. The first session on Wednesday 26th September involved presentation by Andrea Belluscio, which showed the additional data collected and the main problems encountered, and Michele Scardi (overview of the work done concerning *Posidonia* using the Random Forest approach and difficulties encountered). On Thursday 27th and Friday 28 th (Workshop) the discussion focused on a review and updating of the data collected and the model.

A final three days workshop was held in Heraklion **(Greece) in January 2013**. The aim of the workshop was to have an overview of the deliverables and to evaluate the data collected and the maps created. On Tuesday 8th Luca Telesca showed a presentation with the last updates and the final maps regarding seagrasses distribution, whereas Corin Martin presented the final outcome of the model on behalf of Michele Scardi. On Wednesday 9th and Thursday 10th January has been performed a revision of the overall data. Participants were: Luca Telesca, Alessandro Criscoli, Eugenia Apostolaki, Panayotis Panayotidis.

The interim reports and meetings agendas are reported in the MAREA FTP Site.

Moreover, details on the progress achieved towards the Task deliverables and milestones within the framework of the project are cited in the report.

Sources of data

The dataset of seagrasses distribution across the Mediterranean produced in the framework of MEDISEH derived from the compilation of published and unpublished information (Table 1.1.4). For example literature search was made using mainly the ISI Web of Knowledge engine, selecting the keywords: seagrass (*Posidonia oceanica, Cymodocea nodosa, Zostera marina, Z. noltii, Halophila stipulacea, Rupia maritima, R. cirrhosa)* AND (regression OR decline OR progression OR recovery OR status OR cartography OR limits OR cover OR density). At the same time a new search started from the “Bibliographic References” at the end of each paper. We amended the data set with our own unpublished data (grey literature). Moreover, we included data from reports of national and EU research projects and data networks. A major contribution to the improvement of our knowledge on seagrasses in the Mediterranean and especially Posidonia derived from the establishment of Natura 2000 network.

To date several habitat mapping efforts have been carried out by different research institutes and countries at different spatial and temporal resolutions. A census of the available maps of distribution of *Posidonia oceanica* beds has been carried out, and data are reported in a standard form (Excel file) (see the respective folder in Annex 1.1.1).

Table 1.1.4. Sources of data used for the dataset of seagrass distribution (data include only information on presence/distribution, status and regression but not general information on seagrass (chemical, physiology, etc.).

Type of data	Number
Published articles	142
Unpublished Datasets	10
Reports of EU projects	36
Reports of national projects	59
Data Networks	12

All the information on seagrasses at different localities are reported in the respective database for species, with geographical coordinates (when available), spatial reference system, year of publication, bibliographic references, scale of detail, methods of survey.

All data collected has been listed in bibliographic tables reported in Annex 1.1.1 In Fig.1.1.2 is shown an example of these bibliographic tables. Data collected from each country, were available in different format (Table 1.1.5). Most of collected data were only available on hard copy. This means that a lot of Posidonia (and other seagrasses) data distribution were in jpeg or .pdf format, or only, as description in a text. So, this kind of information had to be digitilized in order to associate it with a map and incorporate it in the GIS viewer. The final result was a shapefile with the exact position of seagrass, limits, extent, etc (Fig.1.1.3).

Fig. 1.1.2. Example of bibliographic table from Annex 1.1.1

Ownership/ Authorship Entity	Provider name	Institute	Species	Which GSA the data refers to	Spatial Reference System	Country	Year	Data as to be cited as:						Survey/ Modeled data	Data resolution
								Authors	Title	Journal/Report	Year	Pages	Web Site		
NATURA 2000	P. Panayotidis	HCMR	*P.oceanica*	20,22,23	GCS/WGS_84	Greece	2010	Panayotidis. P. & Drakopoulou P.	*Posidonia* meadows as apriority habitat for the sustainable menagement of the Greek costal enviroment	Proceedings of the 4th Mediterranean Symposium on Marine Vegetation (Yasmine-Hammamet, 2-4 December 2010)	2010	90-94		Survey data	Point data
	E. Apostolaki	HCMR	*P.oceanica*	22	GCS/WGS_84	Greece	2006-2007	Apostolaki ET et al.	Fish farming enhances biomass and nutrient loss in *Posidonia oceanica* (L.) Delile	Estuar, Coast Shelf Sci	2009	81:390-400		Survey data	Point data
	M. Gristina	CNR-IAMC	*P.oceanica, C.nodosa, Z.marina , Z.noltii*	1	UTM/GCS/European_1950	Spain	2003	Consejería de Medio Ambiente. Junta de Andalucía.	Vegetación Submarina. Fanerógamas marinas y algas de interés general del litoral andaluz.	-	2004	-	http://www.juntadeandalucia.es/medioambiente/site/web/rediam	Survey data	1:50.000
MEPA	Leyla Knittweis / Marie Louise Pace	MRRA, FCD	*P. oceanica, C. nodosa*	15	GCS/WGS_84	Malta	2003		*Posidonia* Baseline Survey 2003	MEPA Geographic Information System	2003		http://mapserver.mepa.org.mt/frame.php?site=malta_internet&lang=en&grou	Survey data	Polygonal data
ENEA	A. Belluscio	CIBM - UniROMA	*P.oceanica*	18, 19	GCS/WGS_84	Italy	1986	Bedulli D. et al.	Caratterizzazione biocenotica e strutturale del Macrobhentos delle coste pugliesi.	Indagine ambientale del sistema marino costiero delle regione Puglia. Elementi per la definizione del piano delle coste. ENEA S.Teresa-La Spezia.	1986	227-255		Survey data	Polygonal data
	L. Telesca	UniROMA	*P. oceanica*	9		Italy	1999	Piazzi L. et al.	Mapping of *Posidonia oceanica* beds around Elba Island (western Mediterranean) with integration of direct and indirect methods	Oceanologica Acta	2000	vol.23 (3)		Survey data	1:10.000
Gérard Pergent and Christine Pergent-Martini	G. Pergent et C. Pergent-Martini	Université de Corse - Faculté des Sciences	*P.oceanica*	8	GCS_NTF	France (Corse)	2005	Pergent G. et al.	Mise en oeuvre d'un Réseau de Surveillance *Posidonies* le long du littoral de la Corse.	GIS Posidonie Publ.,	2008	1-133	http://www.ifremer.fr/sextant/fr/web/guest/catalogue	Survey data	Polygonal data

Table 1.1.5. Type of data collected related to spatial distribution of *Posidonia oceanica* along the Mediterranean basin (Y: yes; N: no).

Country	Type of data collected:		
	Shapefile	Point data	.pdf/.tiff
Spain	Y	N	Y
France	Y	N	Y
Italy	Y	Y	Y
Slovenia	N	N	Y
Croatia	N	Y	Y
Montenegro	N	Y	Y
Albania	Y	N	Y
Malta	Y	N	N
Greece	Y	Y	N
Turkey	N	Y	Y
Cyprus	Y	Y	Y
Syria, Lebanon, Israel	Y	Y	N
Egypt	N	Y	N
Libya	N	Y	Y
Tunisia	Y	Y	Y
Algeria	N	Y	Y
Morocco	N	N	N

A list of the available shapefiles has been uploaded to the FTP server of MAREA (http://www.mareaproject.net/FTPMareaProject/) and accompanied by metadata excel files (http://mareaproject.net/FTPMareaProject/#16/Specific Projects/Specific Project 2 MEDISEH/final report/ documentation for the Commission /wp1/task 1.1/Annex 1.1.2/).

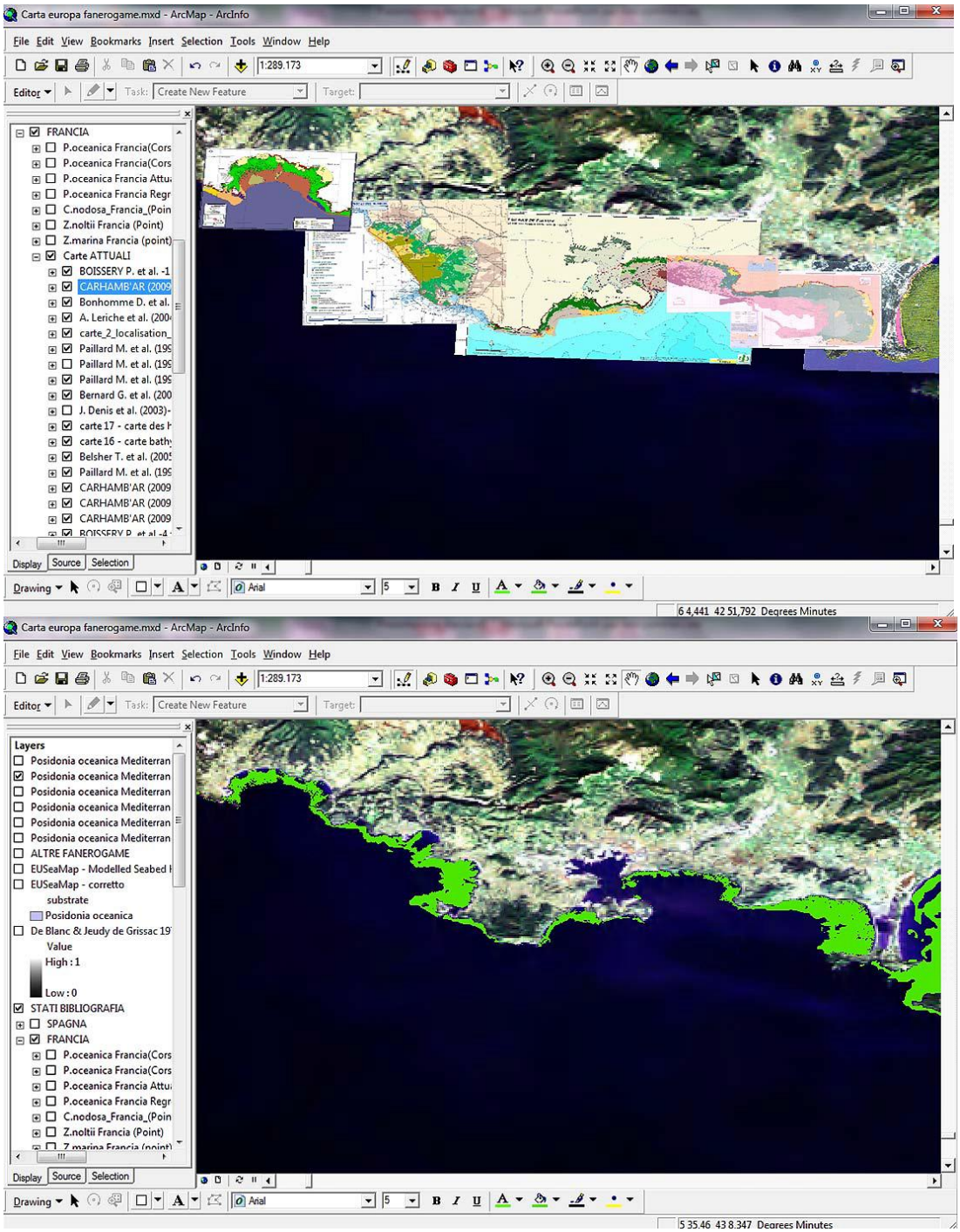

Fig. 1.1.3. An example of the work done: from different format of maps to a unique, georeferenced shapefile.

Revised information on current seagrass beds (M 1.1.1, D1.1.1)

The current distribution of *Posidonia oceanica* meadows in the Mediterranean Sea based on Task results is presented in this session. The information included in the interim report was updated with additional presence data with special focus in areas with known absence records of seagrass. Seagrass distribution maps have been completed and transformed into shapefiles for the whole Mediterranean. It should be noted that data are not equally represented across the Mediterranean, as research effort (published or not) differs between countries being less intense in the east and south part of the Mediterranean. Effort was made to cover gaps in knowledge requesting the contribution of experts from countries outside the consortium (e.g. France).

A synthesis on the data availability of seagrass spatial distribution is reported in Tables 1.1.6-1.1.7. All the available data have been added in the database and included in the MEDISEH web-based GIS viewer.

Table 1.1.6. Shapefile information types and data availability related to the spatial distribution of *Posidonia oceanica* along the Mediterranean basin (Y: yes; N: no).

Country	Shapefile:		Known current distribution	Known historical distribution
	Polygons	Points		
Spain	Y	N	100%	90%
France	Y	N	100%	80%
Italy	Y	Y	100%	27%
Slovenia	Y	N	100%	_
Croatia	Y	Y	14%	_
Montenegro	N	Y	100%	_
Albania	Y	N	100%	_
Malta	Y	N	100%	_
Greece	Y	Y	8%	_
Turkey	Y	Y	29%	6%
Cyprus	Y	Y	30%	_
Syria, Lebanon, Israel	N	Y	100%	_
Egypt	N	Y	63%	3%
Libya	Y	Y	11%	_
Tunisia	Y	Y	81%	13%
Algeria	Y	Y	16%	_
Morocco	N	N	100%	_

Table 1.1.7. Data availability related to the current spatial distribution of other seagrass species along the Mediterranean basin.

Country	*C. nodosa*	*Z. noltii*	*Z. marina*	*H. stipulacea*	*R. cirrhosa*	*R. maritima*
Italy	100%	20%	10%	100%	10%	10%
France	60%	100%	10%	0%	5%	5%
Spain	90%	30%	25%	0%	25%	20%
Greece	90%	5%	0%	100%	5%	5%
Turkey	5%	5%	0%	100%	0%	0%
Slovenia	100%	100%	100%	0%	0%	0%
Croatia	10%	5%	5%	0%	0%	0%
Montenegro	100%	100%	0%	0%	0%	0%
Albania	10%	0%	0%	100%	0%	0%
Morocco	0%	0%	0%	0%	0%	0%
Malta	100%	0%	0%	100%	0%	0%
Cyprus	50%	0%	0%	100%	0%	0%
Algeria	0%	0%	0%	0%	0%	0%
Tunisia	40%	10%	5%	100%	5%	5%
Libya	5%	5%	5%	100%	5%	0%
Egypt	30%	5%	5%	100%	10%	0%
Syria, Israel, Lebanon	30%	40%	0%	100%	0%	0%

During the last six months the upgrade of current information included also certain corrections to the data points from Greece as well as the addition of personal observations from the same area where limited cartographic data exist. This was considered necessary in order to improve and strength model output. Towards the same approach, we have added cartographic data from Tuscany (Italy) and historical data point along the Turkey and Tunisia coastline.

The overall dataset has been separated into historical and current data. The current data are further divided into presence, absence and no data. Details for each dataset are cited below.

Posidonia oceanica meadows

The current distribution of *P. oceanica* is shown in Fig. 1.1.4. This map represents "the state of art" of the actual knowledge and it is a significant improvement compared to the existing knowledge prior to the MEDISEH project. Figures 1.1.5a and 1.1.5b show the current distribution of *P. oceanica* separately for the Western and Eastern Mediterranean.

Posidonia is present along the most part of the Western Mediterranean coasts (Spain, France and Italy, Sardinia, Sicily and Corsica included), and in the Eastern basin (Tunisia, Croatia, Greece

and Cyprus). Current knowledge shows that meadows are absent along the Morocco coastline and in certain areas of the eastern part of the Mediterranean basin (Syria, Lebanon, Israel, part of the Turkish and Egyptian coasts). Along the northern African coasts (i.e. Algeria, Libya, Egypt) and along the Turkish and Greek coastline in the Aegean Sea information on *Posidonia* is relatively scarce.

In the Central – Western Mediterranean Posidonia is present along most of the coasts, excluding the area closed to the main river mouths (i.e. Ebro, Guadalquivir, Rodano, Tevere, Arno, Po) and the western Adriatic Sea.

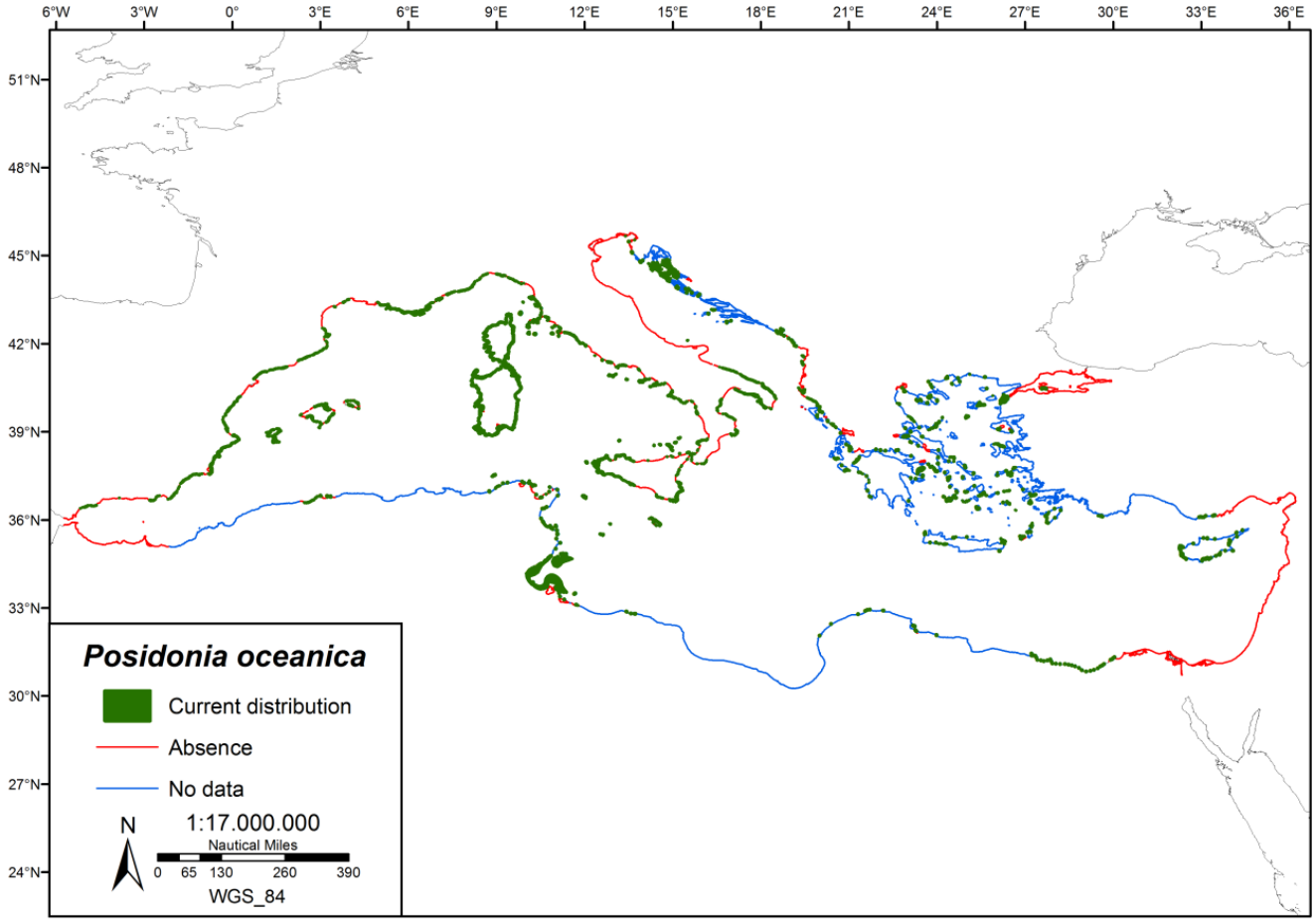

Fig. 1.1.4. Current distribution of *P. oceanica* across the Mediterranean Sea.

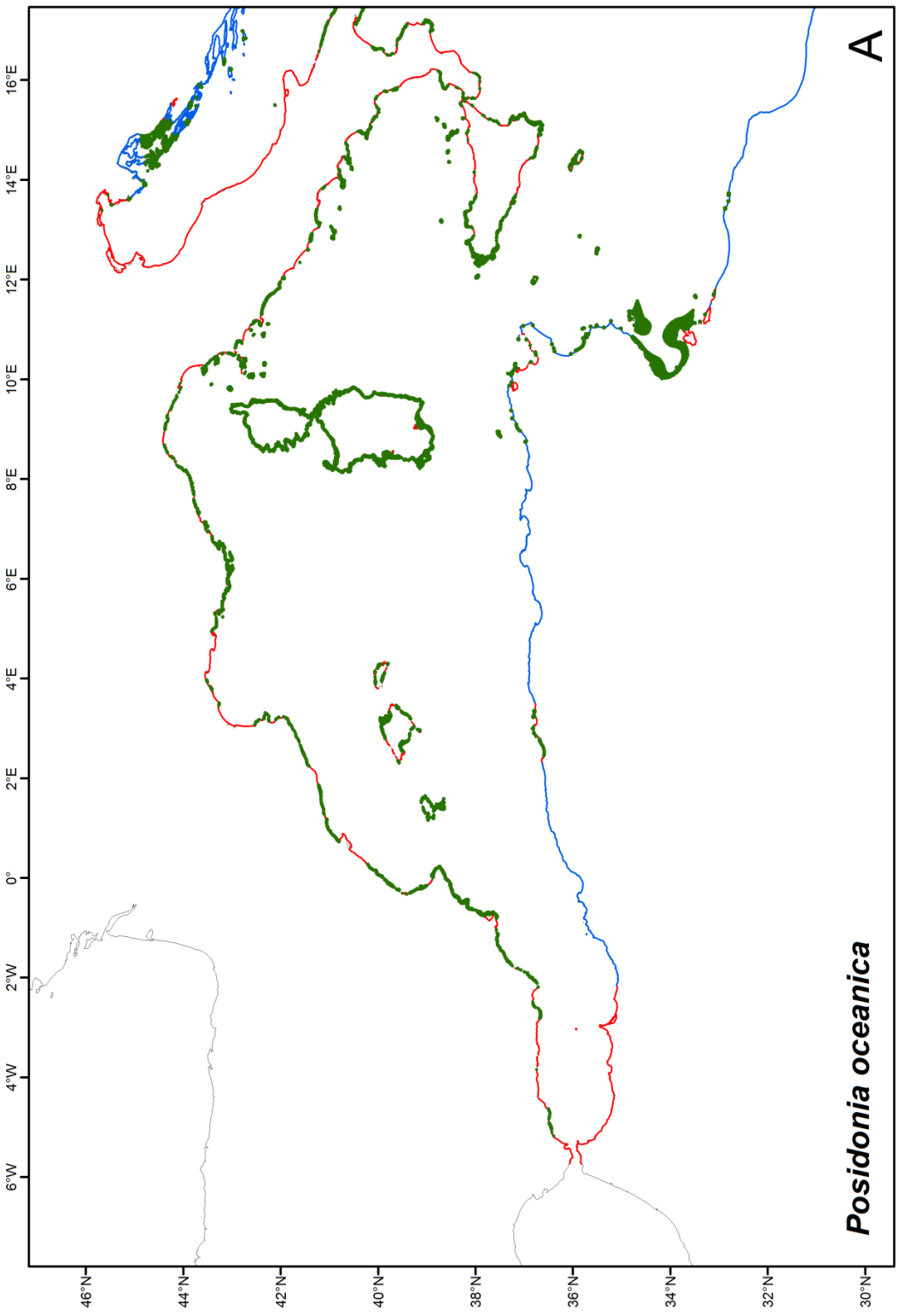

Fig. 1.1.5a. Current distribution of *P. oceanica* in the Western Mediterranean Sea (green: presence; red: absence; blue: no data).

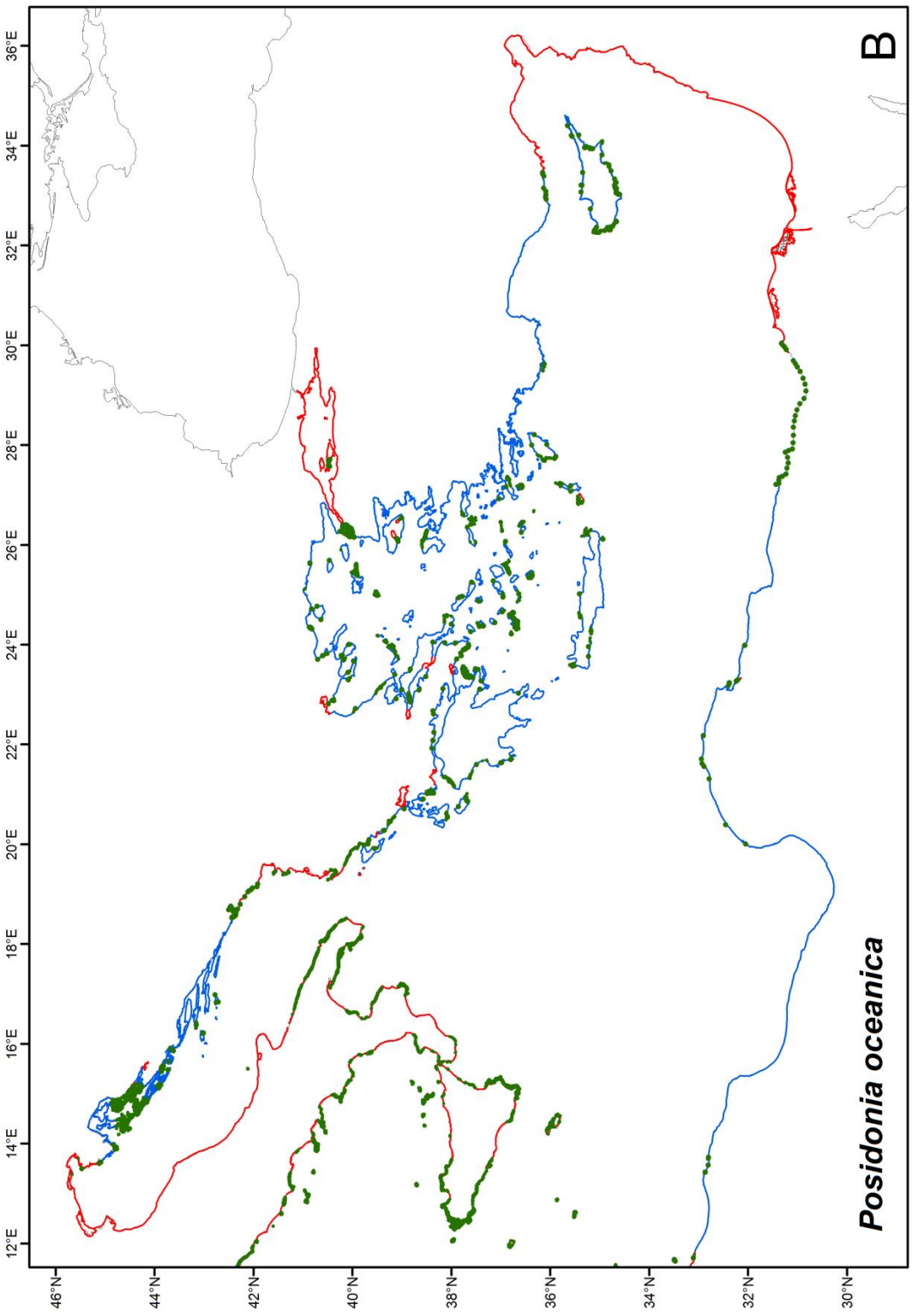

Fig. 1.1.5b. Current distribution of *P. oceanica* in the Eastern Mediterranean Sea (green: presence; red: absence; blue: no data).

In the Western Mediterranean there is a sharp difference between the European and African coasts. Along the southern part of the Spanish coasts *P. oceanica* is present although it exhibits a fragmented distribution, opposed to the Moroccan coastline where meadows are completely absent (Fig.1.1.6).

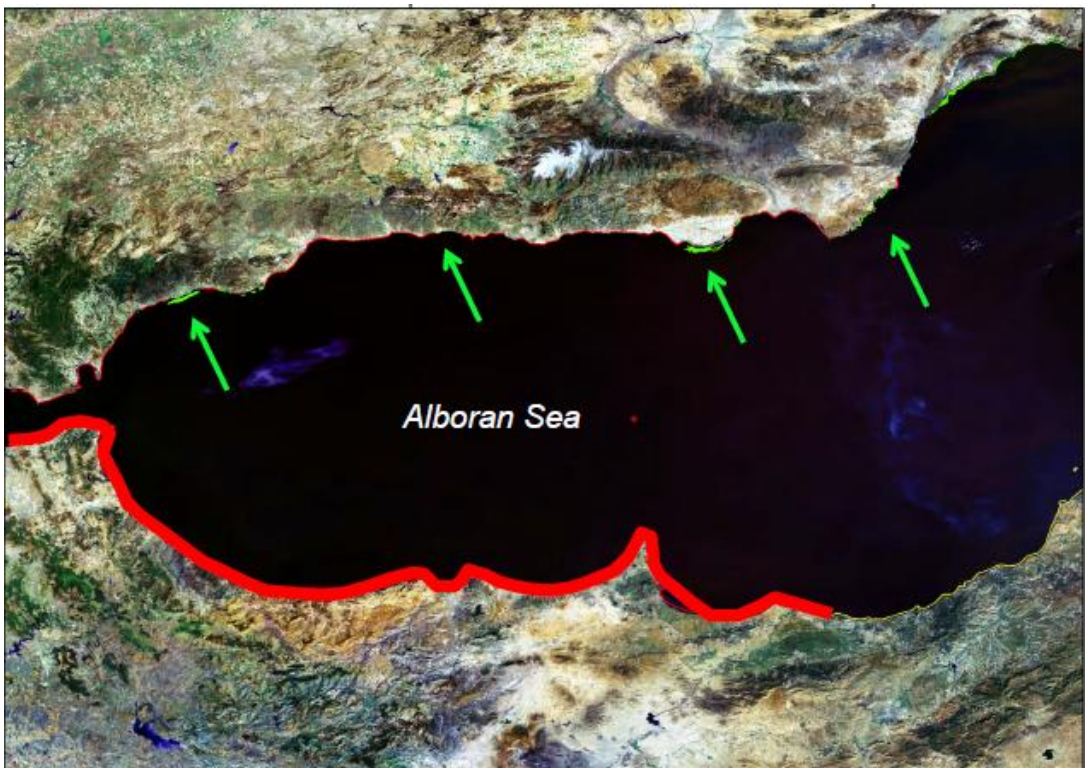

Fig.1.1.6. *P.oceanica* boundaries in the Western part of Mediterranean basin (*Alboran Sea*) (green arrow: *Posidonia* meadows presence).

In the Eastern Mediterranean *P. oceanica* spatial distribution is characterized by a gap in the distribution in the middle of the southern Turkish coastline and it is completely lacking (based on the current knowledge) from the coast of the Levantine countries (Fig.1.1.7).

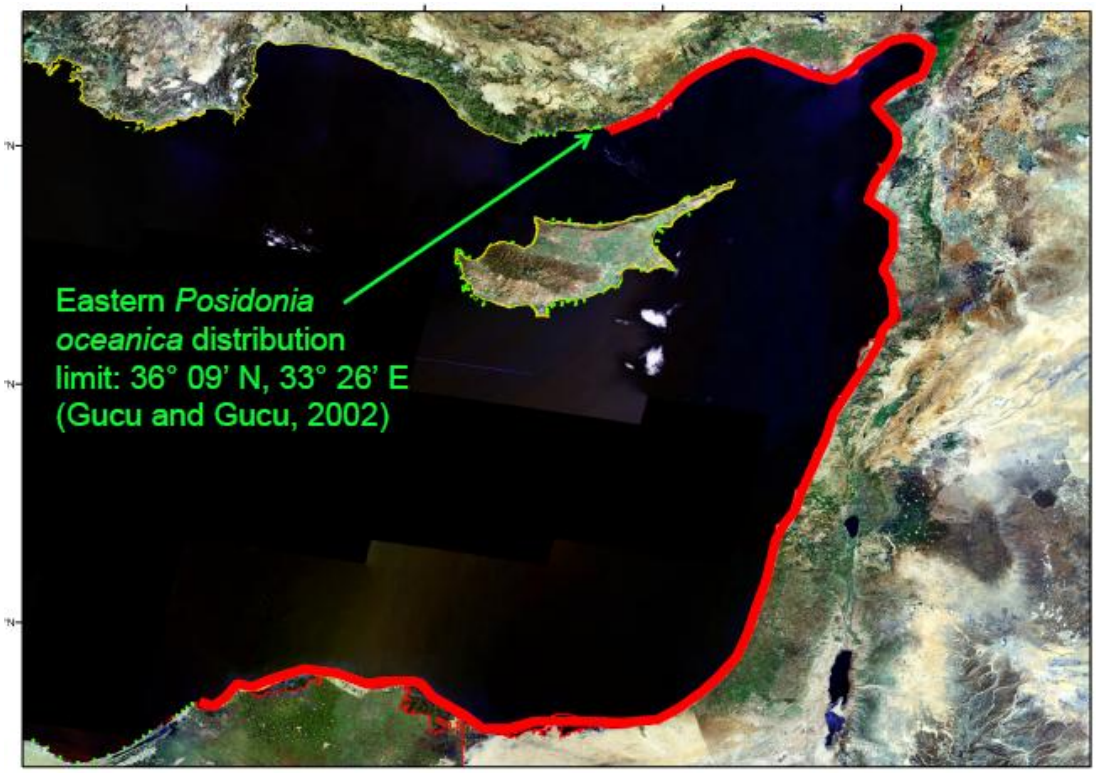

Fig.1.1.7. *P. oceanica* boundaries in the Eastern part of Mediterranean basin.

More specifically at the eastern boundaries of Posidonia in the Mediterranean the following situation occurs:

- Meadows Northern limit is a sharp cut off limit along the Turkish coastline at 36°09'N, 33°26'E (Gucu and Gucu, 2002).
- Posidonia is completely absent along the Eastern part of Mediterranean Sea (i.e. Syria, Lebanon and Israel).
- The southern limit of Posidonia along the eastern part is associated to the Nile's delta influence at the Egyptian coastline.
- Exception stands for the Cyprus coasts where *Posidonia oceanica* is present.
- In Marmara Sea only few records of *Posidonia* presence are available. The meadows are known to occur along the coasts of Dardanelles Strait and central Marmara Sea's islands (Fig.1.1.8).

Fig. 1.1.8. *P.oceanica* distribution along the Marmara Sea coastline.

On total, known *P. oceanica* meadows cover 11.687 Km² (1.168.725 hectares) in the Mediterranean basin. Reliability for this estimate is subjected to experts' knowledge and judgment. "No data area" accounts for 18.682 Km of coasts whereas "No Posidonia area" accounts for 10.974 Km of coasts. The following pictures (Figs. 1.1.9 to 1.1.13) include high resolution maps showing details in *Posidonia oceanica* meadows for selected areas (e.g. for Spain, France, Italy, Greece and Malta) as exported from our database. More detailed maps or for additional areas can be seen in the online GIS viewer (http://mareaproject.net/mediseh/viewer/med.html).

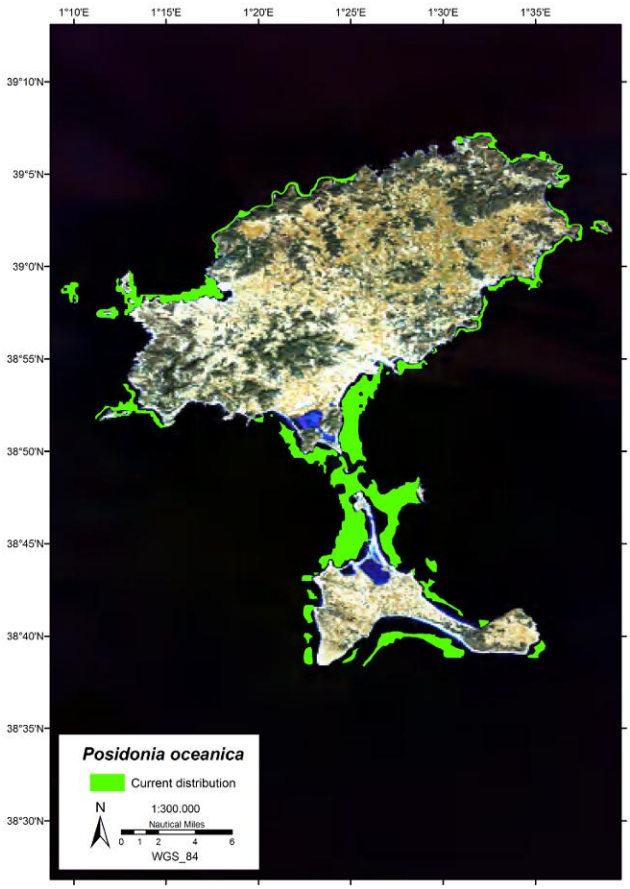

Fig.1.1.9. *Posidonia oceanica* current distribution at Ibiza and Formentera (*Spain*).

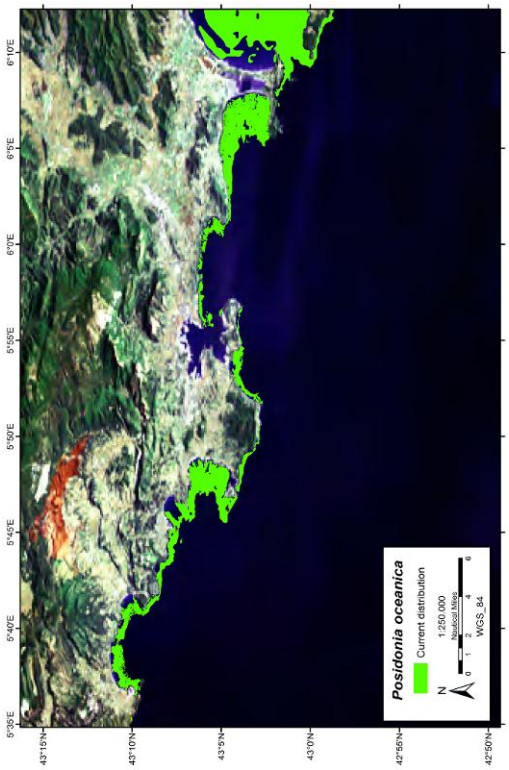

Fig.1.1.10. *Posidonia oceanica* current distribution between La Ciotat Bay and Gulf of Giens (*France*).

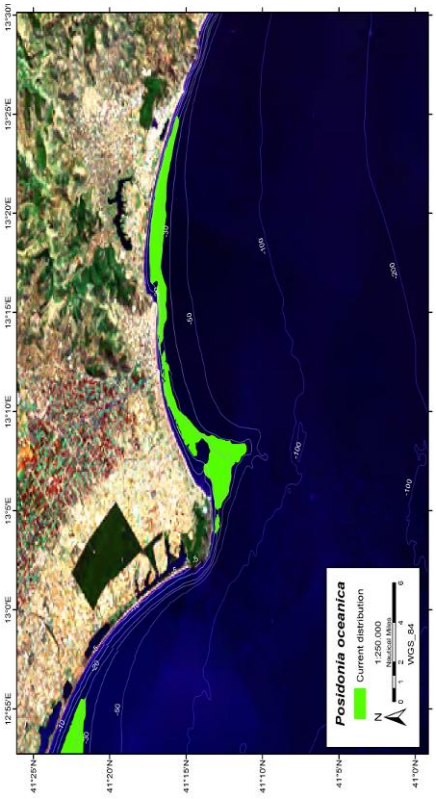

Fig.1.1.11. *Posidonia oceanica* current distribution between Circeo and Terracina (*Lazio region, Italy*).

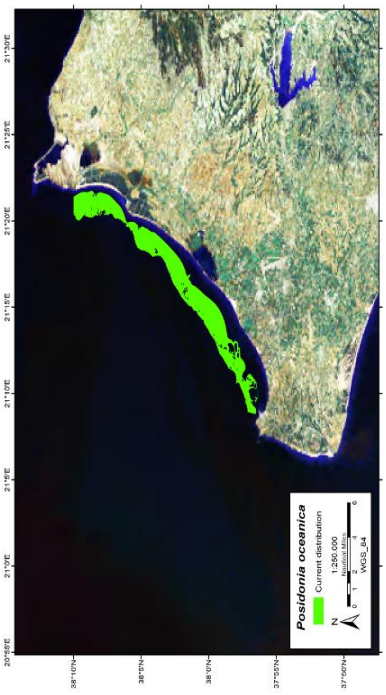

Fig. 1.1.12. *Posidonia oceanica* current distribution along the coast of the marine protected area of Killini (*Greece*).

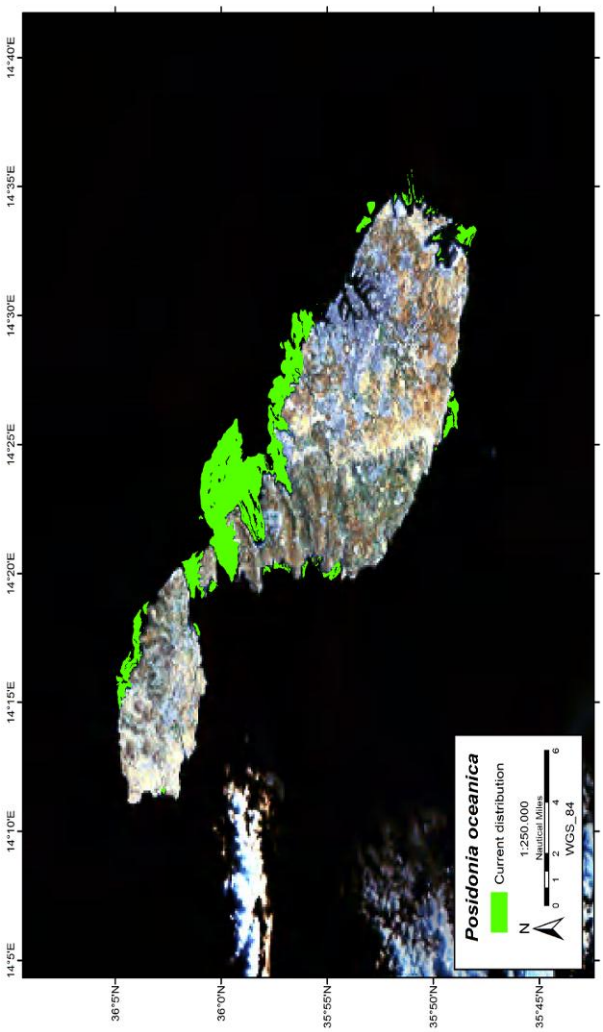

Fig.1.1.13. *Posidonia oceanica* current distribution from the coastline of Malta.

Other phanerogams

Mediterranean Sea, in addition to *P. oceanica,* hosts 6 more seagrasses species: *Cymodocea nodosa, Zostera marina, Z. noltii, Halophila stipulacea, Ruppia maritima* and *R. cirrhosa*. Although *P. oceanica* meadows represent the most significant and abundant ones, the other species are also important in terms of goods and services they provide. However, scientific research effort is not equally distributed between seagrasses species in the Mediterranean, where 72% of the published papers reported in Web of Science™ (in December 2009) refers to *P. oceanica*. As a result, there is limited cartographic information regarding the other mediteranean seagrass species. Furthermore, most of these species do not form permanent meadows or beds like *P. oceanica*, so cartographic representation can easily end up with inaccurate or invalid information.

C. nodosa is a warm water species and is widely distributed throughout the Mediterranean, around the Canary Islands and down the North African coast in the Atlantic. The species does not extend further north than the southern coasts of Portugal. *C. nodosa* can be found from shallow subtidal areas to very deep waters (50-60 m).

The current distribution of *C. nodosa* is shown in Fig. 1.1.14. This map represents "the state of art" of the actual knowledge and it is a significant improvement compared to the existing knowledge prior to this project. Figures 1.1.15a and 1.1.15b show the data for Western and Eastern Mediterranean.

C. nodosa distribution covers most part of the Mediterranean basin, distributing along the coasts of Spain, France, Italy, Tunisia, Greece and Cyprus. Current knowledge on the spatial distribution of *C. nodosa* is very good concerning the Western European coasts. Along the Eastern Mediterranean and African coastline information about *Cymodocea is* relatively scarce (Figs. 1.1.14, 1.1.15a, 1.1.15b)

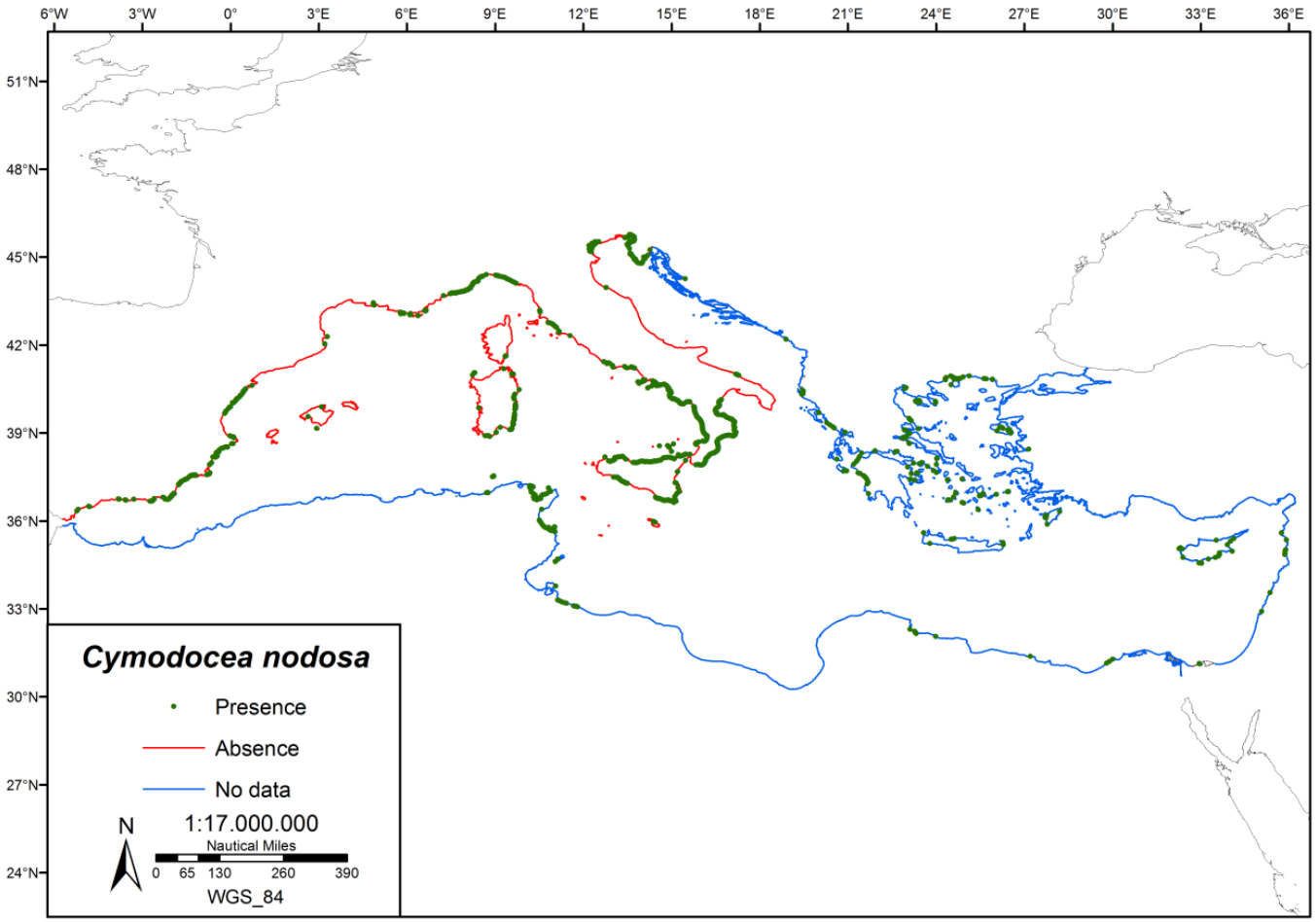

Fig. 1.1.14. Current distribution of *C. nodosa* across the Mediterranean Sea.

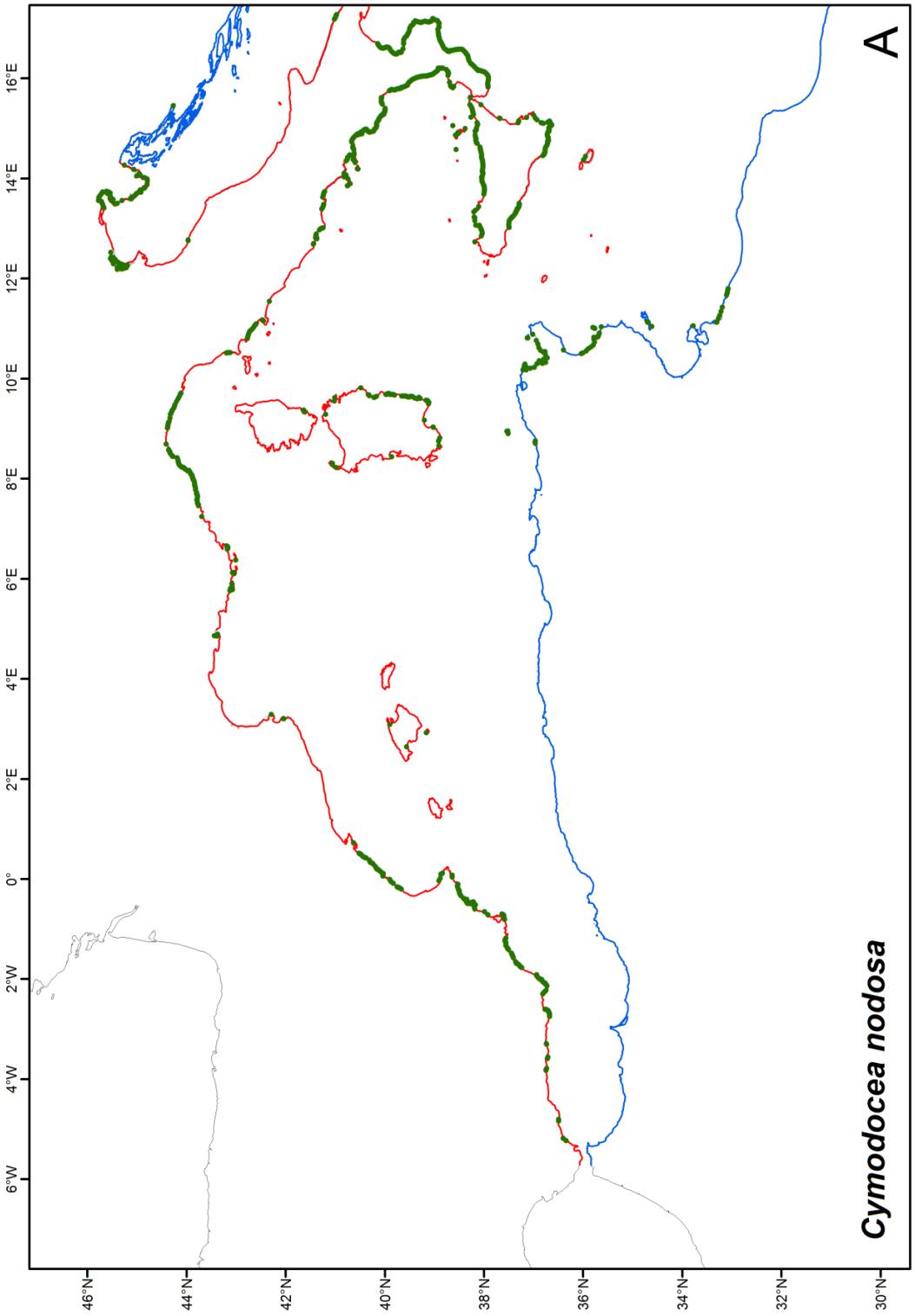

Fig. 1.1.15a. Current distribution of *C. nodosa* in the Western part of Mediterranean Sea (green: presence; red: absence; blue: no data).

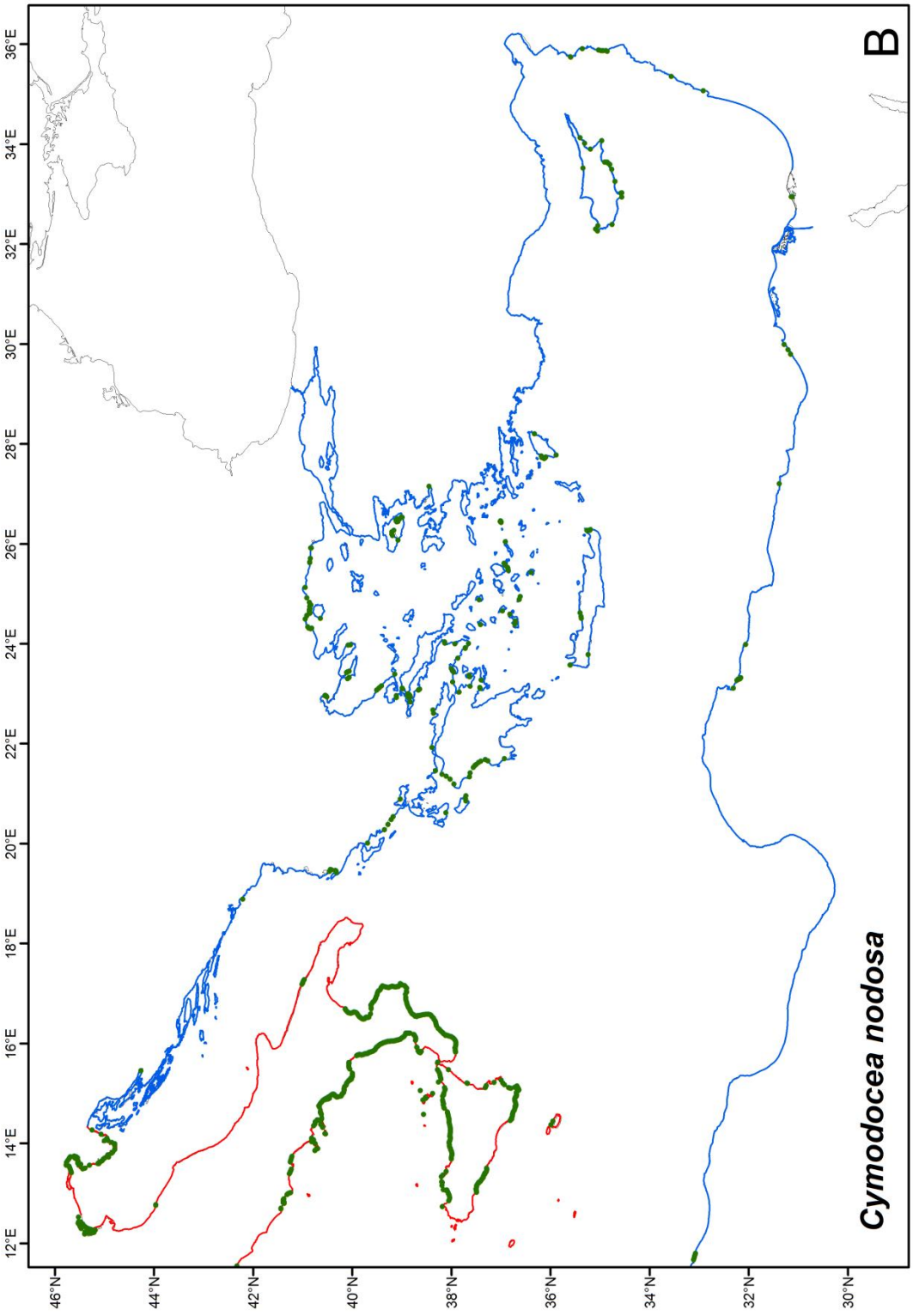

Fig. 1.1.15b. Current distribution of *C. nodosa* a) in the Eastern part of Mediterranean Sea (green: presence; red: absence; blue: no data).

Zostera spp. refers to two species: *Zostera marina* (eelgrass) and *Zostera noltii* (dwarf eelgrass). *Z. marina* in the Mediterranean is mostly found as small isolated stands, especially, in lagoons. They are predominantly subtidal species and may grow down to 10-15 meters depth depending on water clarity. *Z. noltii* forms dense beds in the muddy sand of intertidal areas, where *Z. marina* is sparse due to its lower tolerance to desiccation. *Z. noltii* also occurs subtidal but often seems to be outcompeted by other seagrasses where the water cover is permanent. Some authors separate *Z. marina* in two species, *Z. marina* and *Z. angustifolia*, but the distinction based on species characteristics is not clear.

Existing information on *Zostera* spp. seems to be limited to scattered records in Aegean Sea, the lagoon systems of the east part of Ionian Sea, the north and the south part of the Adriatic Sea, limited areas in the western part of Sicily, the Tyrrhenian Sea. Records have been identified along the Lebanese coast in the Levantine (Fig. 1.1.16). The current distribution of *Z. marina* is shown in Fig. 1.1.16., the map represents "the state of art" of the actual knowledge being a significant improvement compared to the existing knowledge prior to this project. Figures 1.1.17a and 1.1.17b show *Z. marina* distribution for the Western and Eastern Mediterranean.

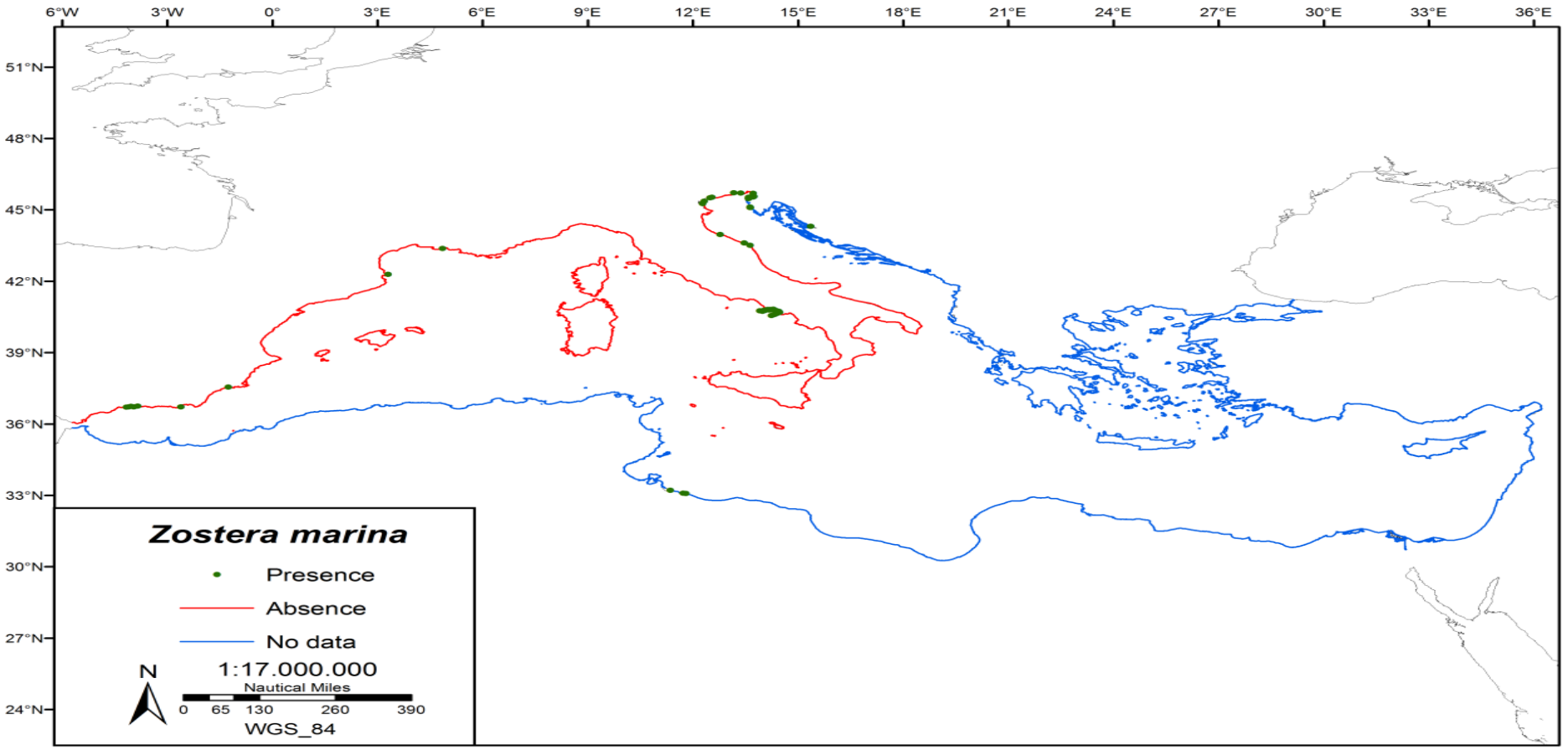

Fig. 1.1.16. Current distribution of *Z. marina* across the Mediterranean Sea.

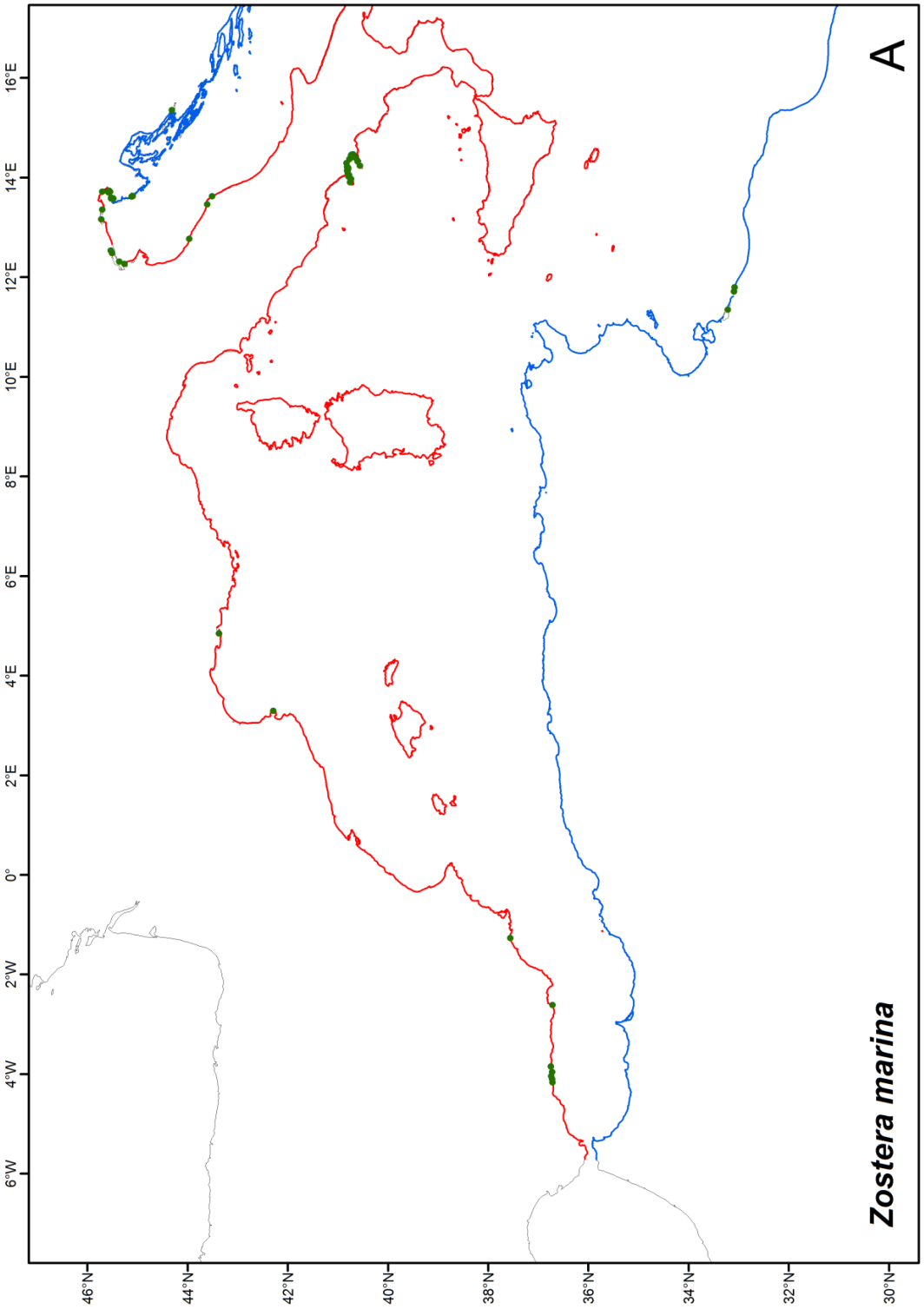

Fig. 1.1.17a. Current distribution of *Z. marina* in the Western part of Mediterranean Sea (green: presence; red: absence; blue: no data).

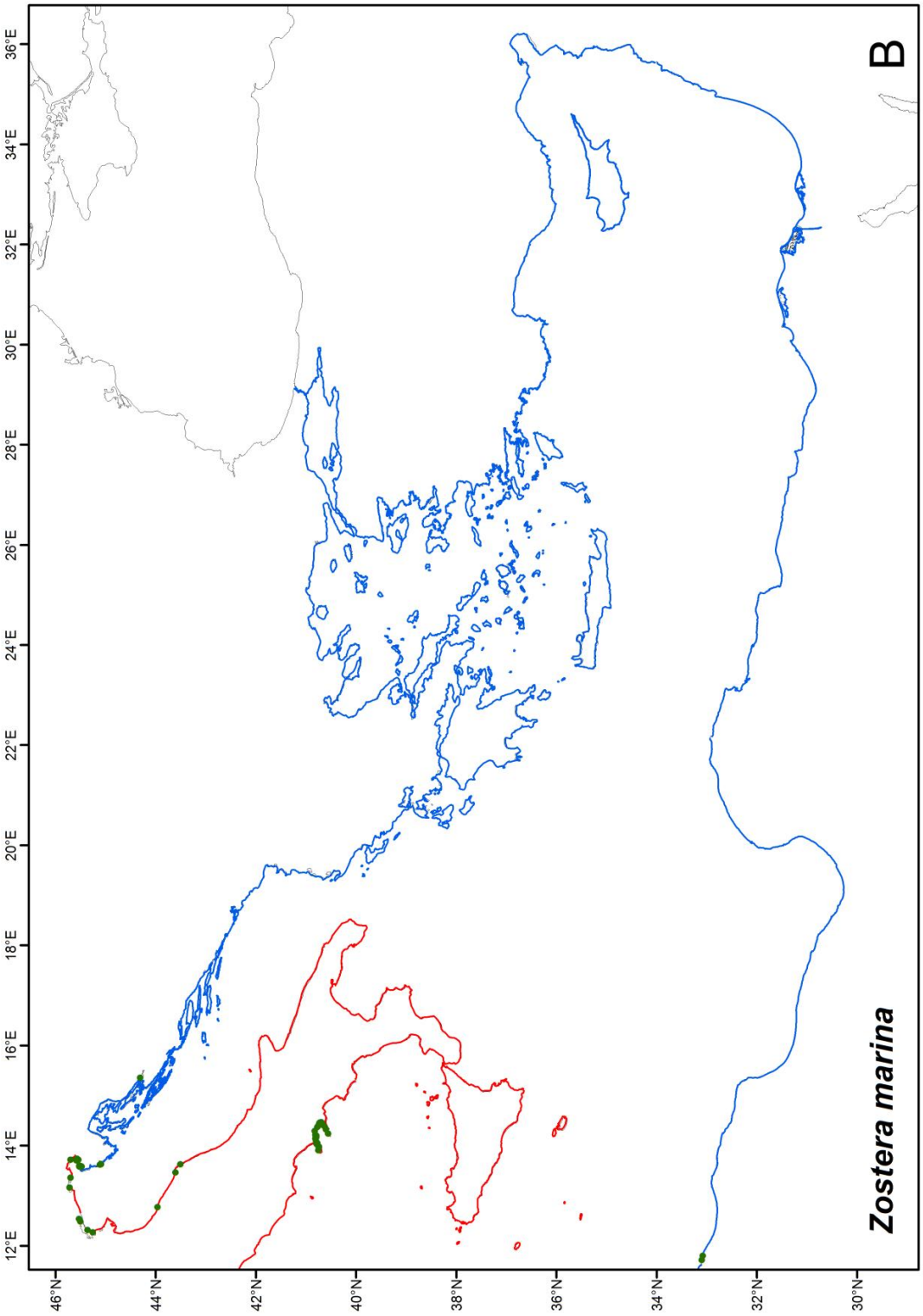

Fig. 1.1.17b. Current distribution of *Z. marina* in the Eastern part of Mediterranean Sea (green: presence; red: absence; blue: no data).

The current distribution of *Z. noltii* is shown in Fig. 1.1.18., the map represents “the state of art” of the actual knowledge being a significant improvement compared to the existing knowledge prior to this project. Figures 1.1.19a and 1.1.19b show the distribution for the Western and Eastern Mediterranean.

Existing information on *Zostera noltii* seems to be limited to scattered records in Aegean Sea, the lagoon systems of the east part of Ionian Sea, the north and the south part of the Adriatic Sea, limited areas along the Spanish coastline, the France coasts and the Tyrrhenian Sea. Records have been identified along the Lebanese coast in the Levantine (Fig. 1.1.18). Along the Eastern Mediterranean and African coastline information about *Z. noltii is* relatively scarce.

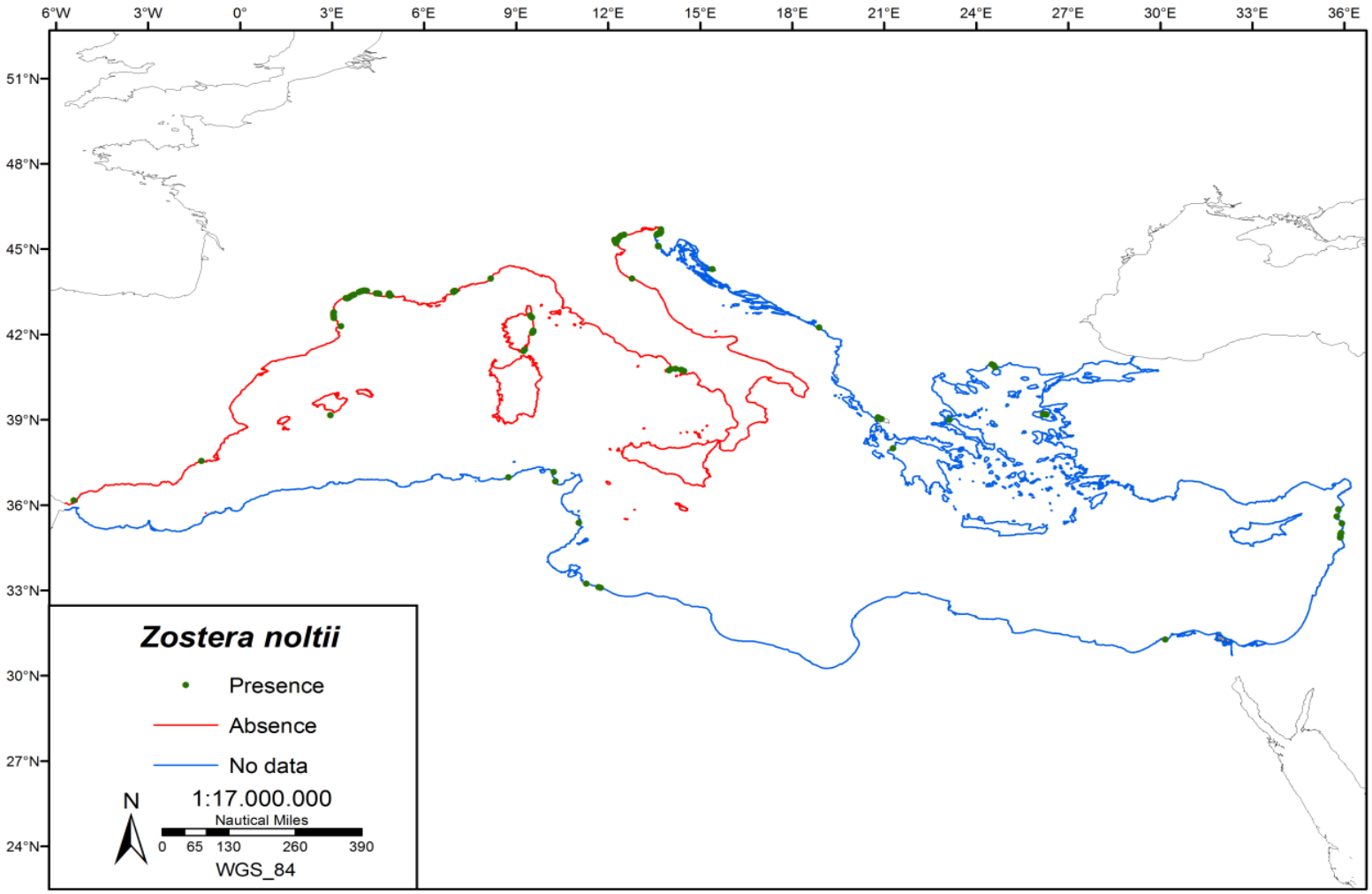

Fig. 1.1.18. Current distribution of *Z. noltii* across the Mediterranean Sea.

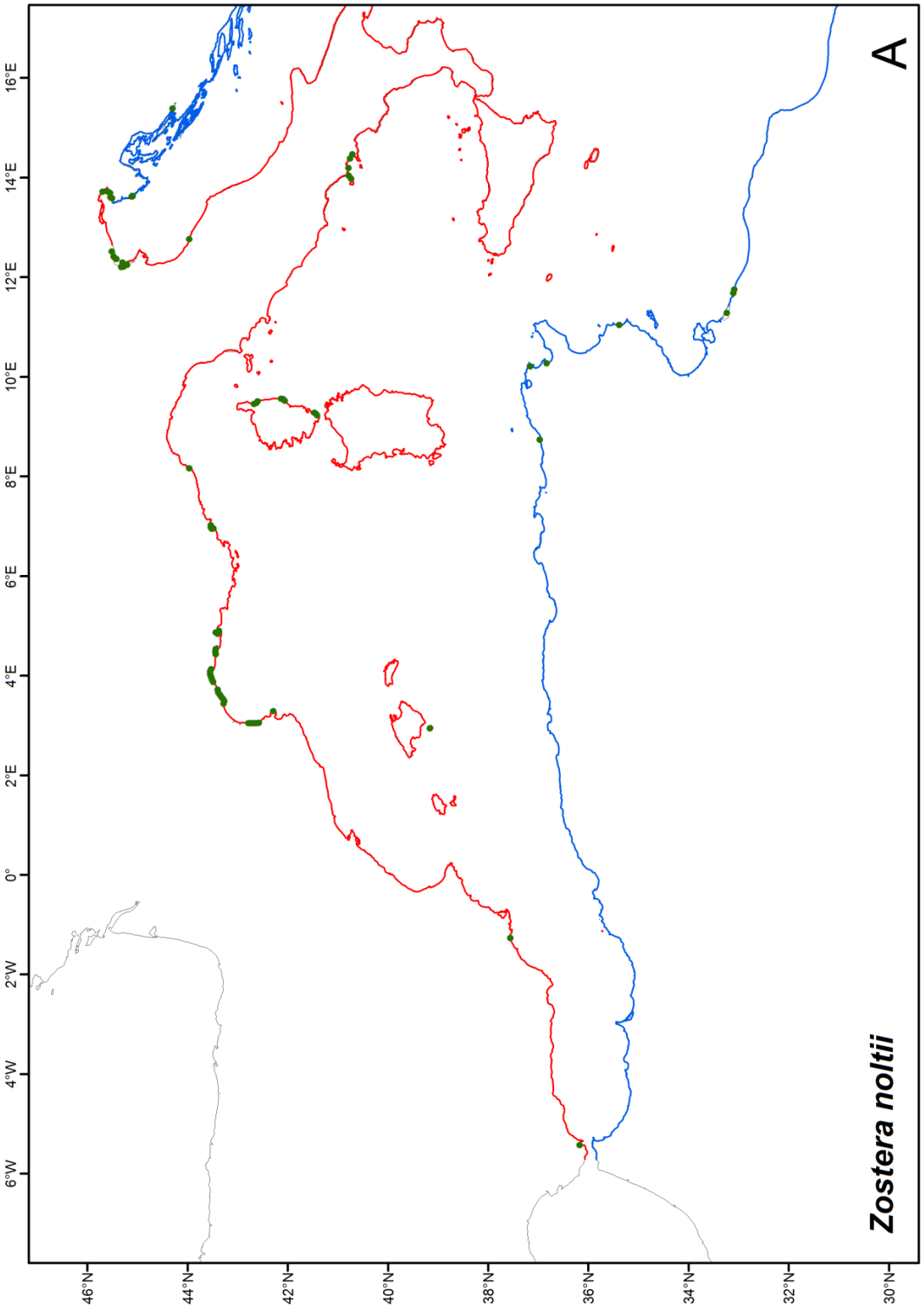

Fig. 1.1.19a. Current distribution of *Z. noltii* in the Western part of Mediterranean Sea (green: presence; red: absence; blue: no data).

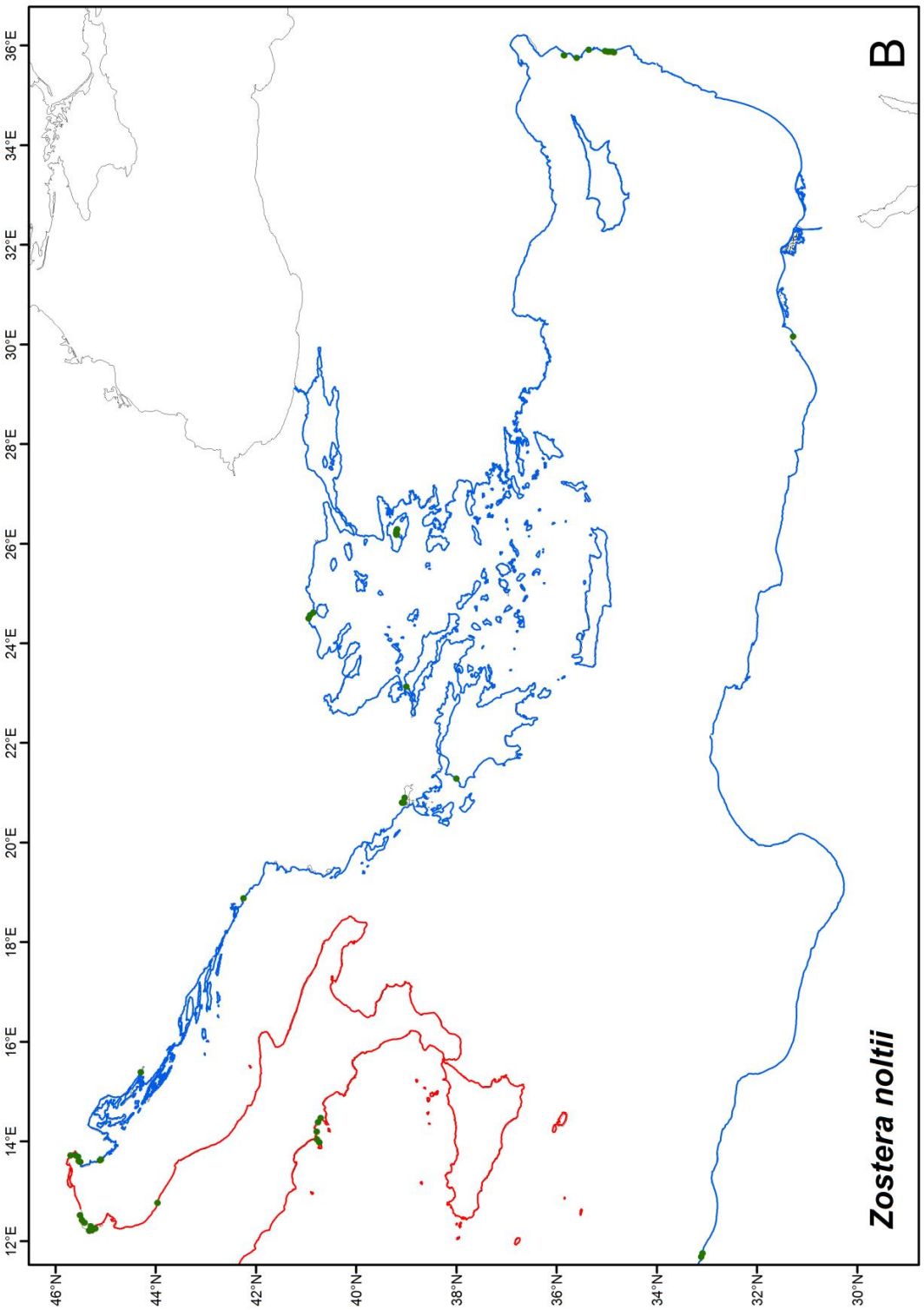

Fig. 1.1.19b. Current distribution of *Z. noltii* in the Eastern part of Mediterranean Sea (green: presence; red: absence; blue: no data).

Recently, the warm water seagrass species *Halophila stipulacea* has invaded the eastern Mediterranean and has reached the southern coasts of Italy. The species was introduced through the Suez Channel. Figure 1.1.20 shows the existing information on the distribution of this species based on projects results. The opening of the Suez Canal enabled it to enter the Mediterranean where it was first reported in 1894 (Fritsch, 1895). Since then, *Halophila stipulacea* has continued to advance, usually following prevailing currents (Galil, 2006). Fig 1.1.20 shows the existing information on the distribution of this species based on projects results. This map represents "the state of art" of the actual knowledge largely improving the available records compared to the situation prior to this project. Fig. 1.1.21a and 1.1.21b show the data for Western and Eastern Mediterranean.

Halophila is present along the coasts of Greece, Albania, Turkey, Cyprus, Syria, Lebanon, Israel, Egypt, Libya, Tunisia and the southern part of Italy. Along the most part of the Western Mediterranean, North-Western African and Adriatic coastline *H. stipulacea* is absent.

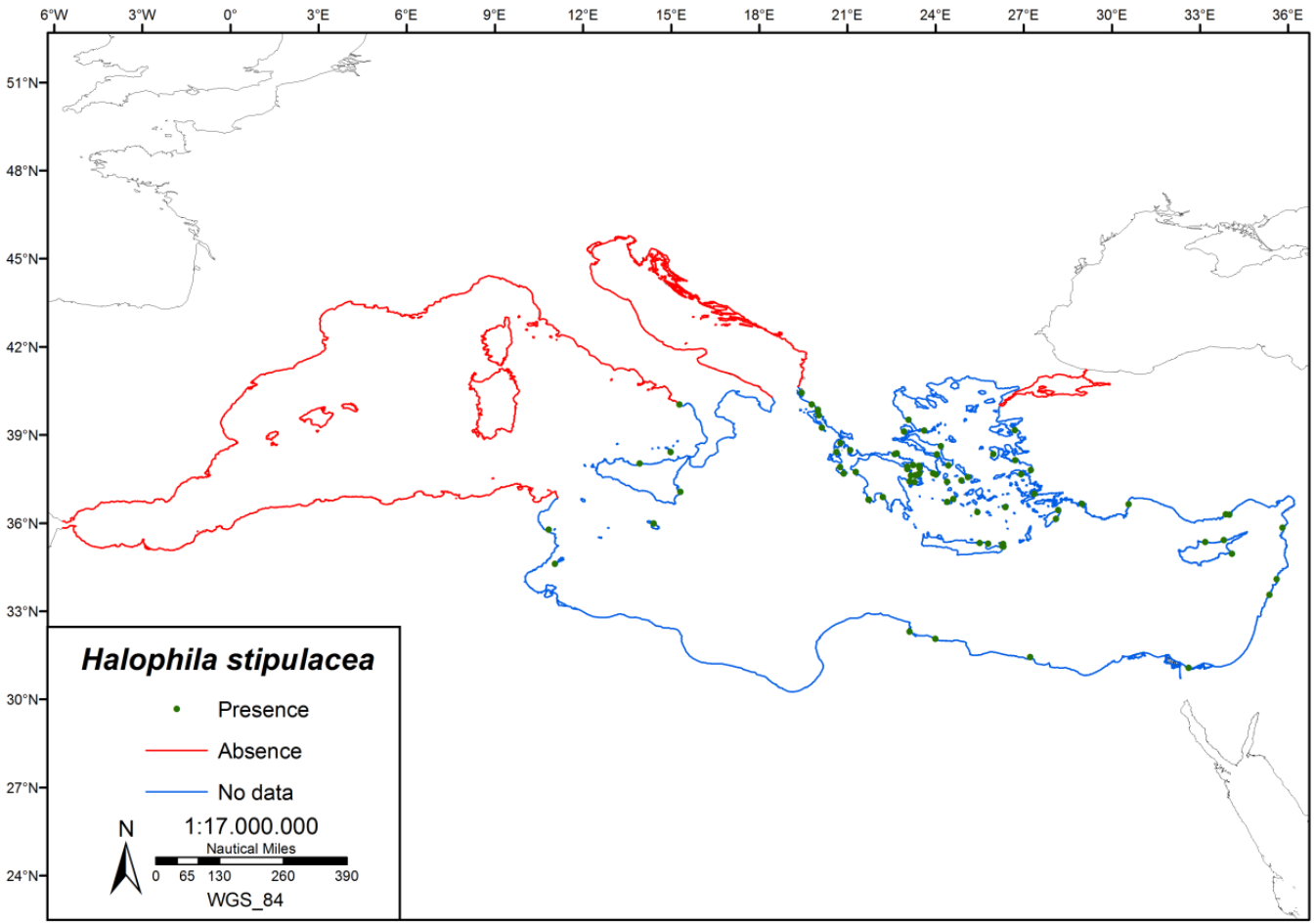

Fig. 1.1.20. Current distribution of *H. stipulacea* across the Mediterranean Sea.

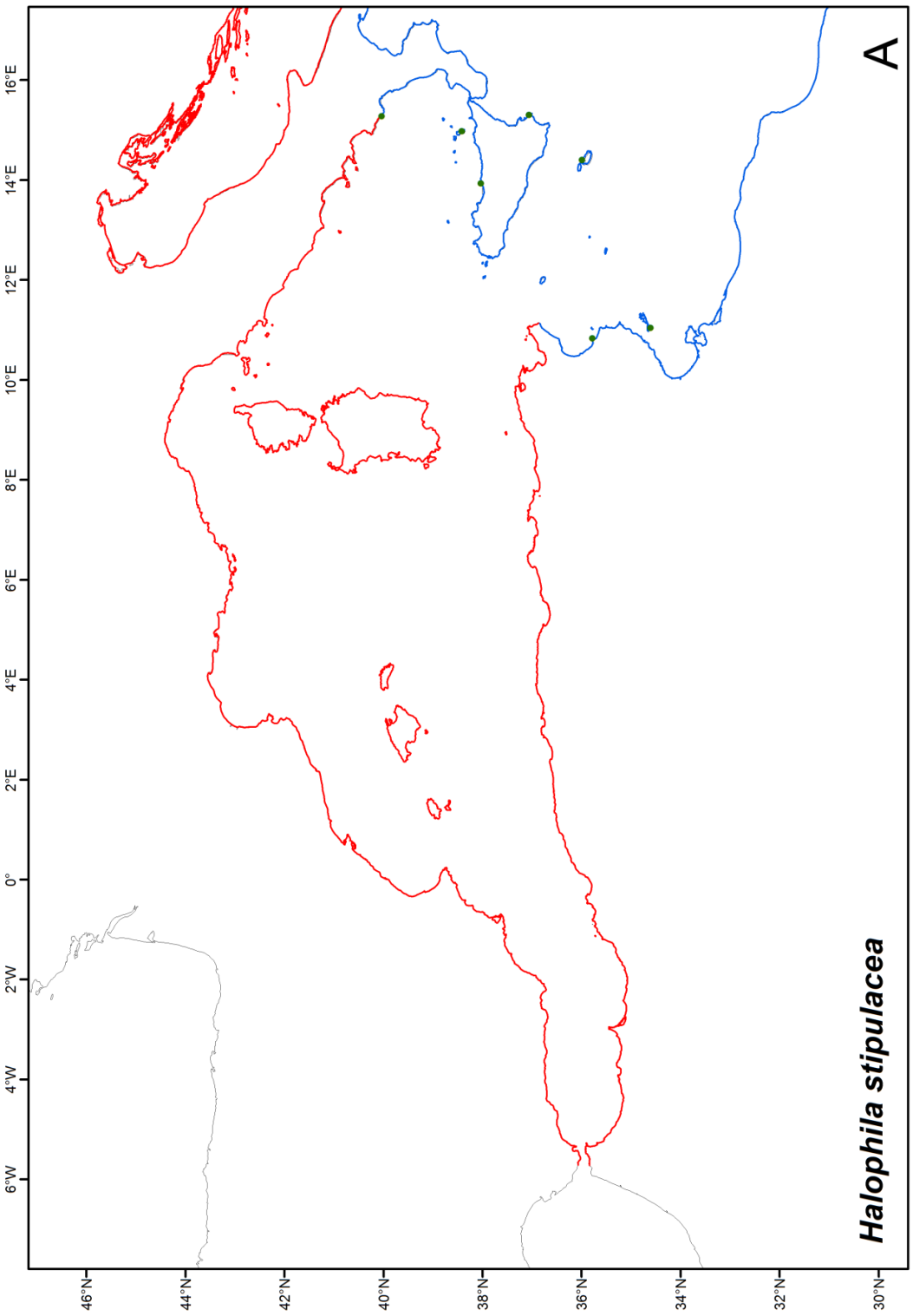

Fig. 1.1.21a. Current distribution of *H. stipulacea* in the Western part of Mediterranean Sea (green: presence; red: absence; blue: no data).

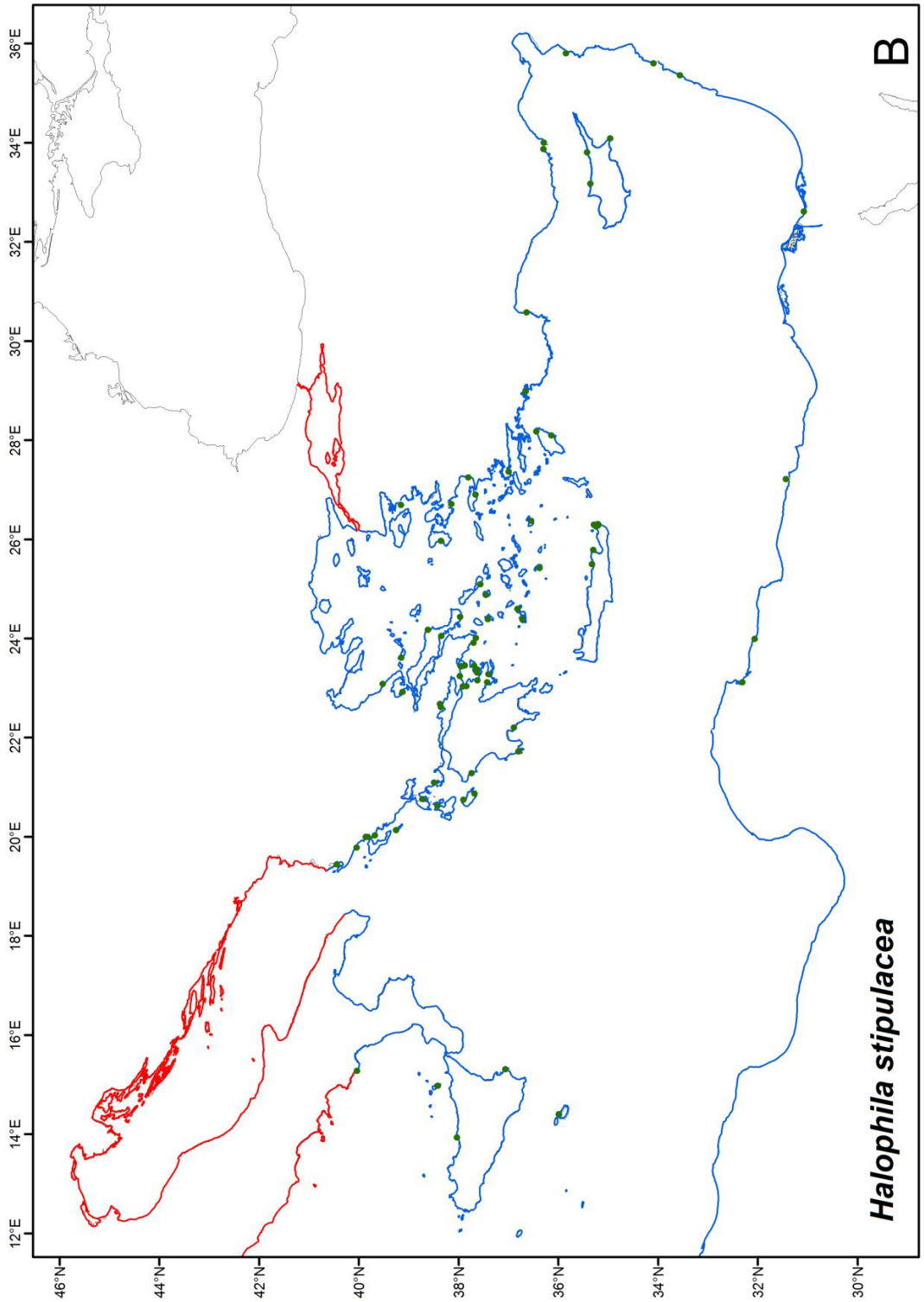

Fig. 1.1.21b. Current distribution of *H. stipulacea* in the Eastern part of Mediterranean Sea (green: presence; red: absence; blue: no data).

Ruppia spp. refers to *Ruppia cirrhosa* and/or *Ruppia maritima*. They can be found throughout the world, most often in coastal areas, where it grows in brackish water bodies,

such as marshes or lagoons. The species can be extremely morphologically variable and therefore their identifications is often linked to differences in environmental conditions. *Ruppia* spp*.* are very euryhaline species and can withstand prolonged periods of desiccation. Existing information about the *Ruppia* spp*.* are limited to few data point from Aegean Sea, a limited area in the western part of Sicily, the Ionian Sea, the north and the south part of Adriatic Sea, a point from Spain, and the lagoon system of Tunisia and Egypt. Along the Eastern Mediterranean and African coastline information about *R. maritima* are relatively scarce and the distribution appears to be rather limited.

The current distribution of *Ruppia maritima* is shown in Fig. 1.1.22. Figures 1.1.23a and 1.1.23b show the data for Western and Eastern Mediterranean. These maps represent "the state of art" of the actual knowledge.

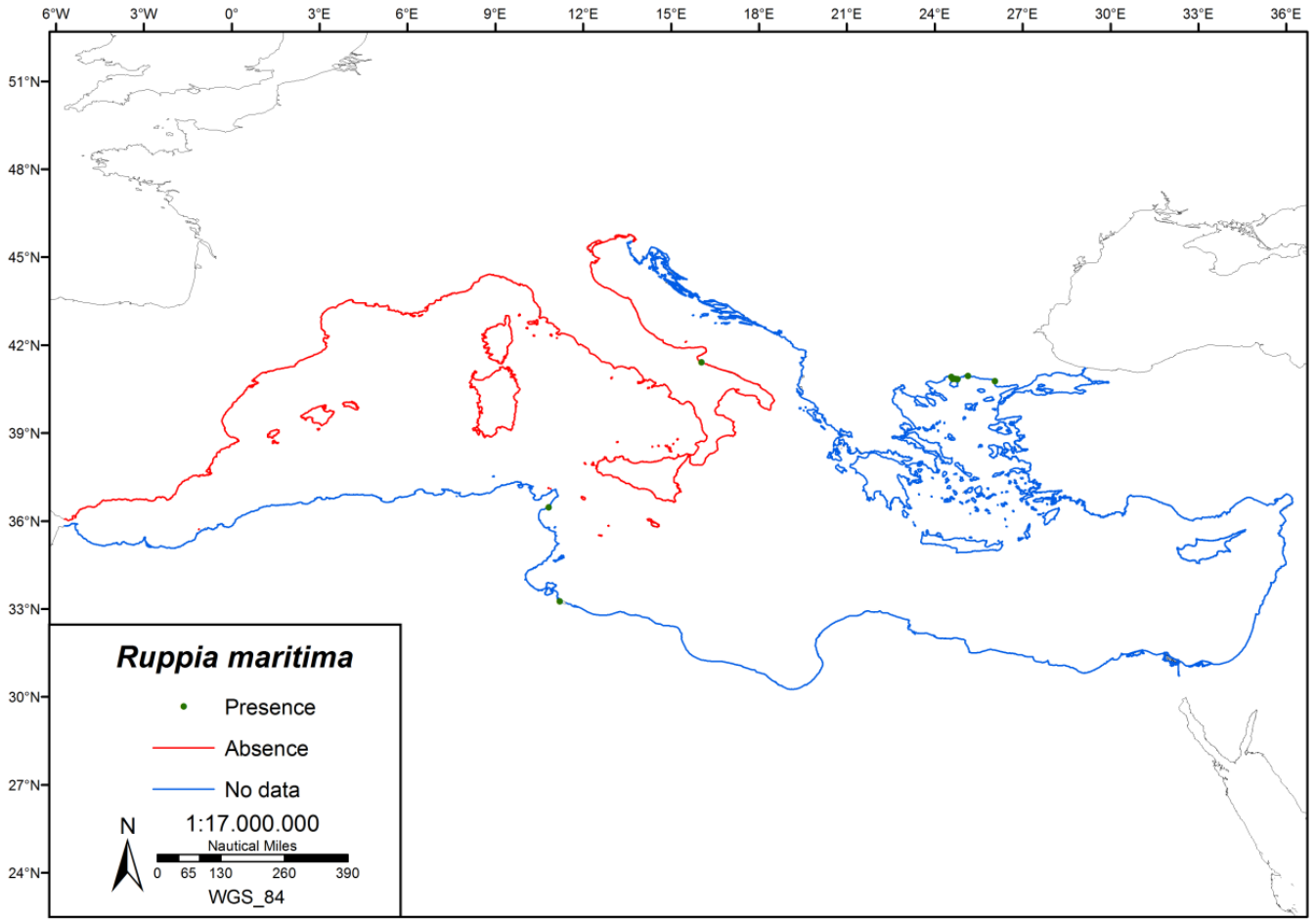

Fig. 1.1.22. Current distribution of *R. maritima* across the Mediterranean Sea.

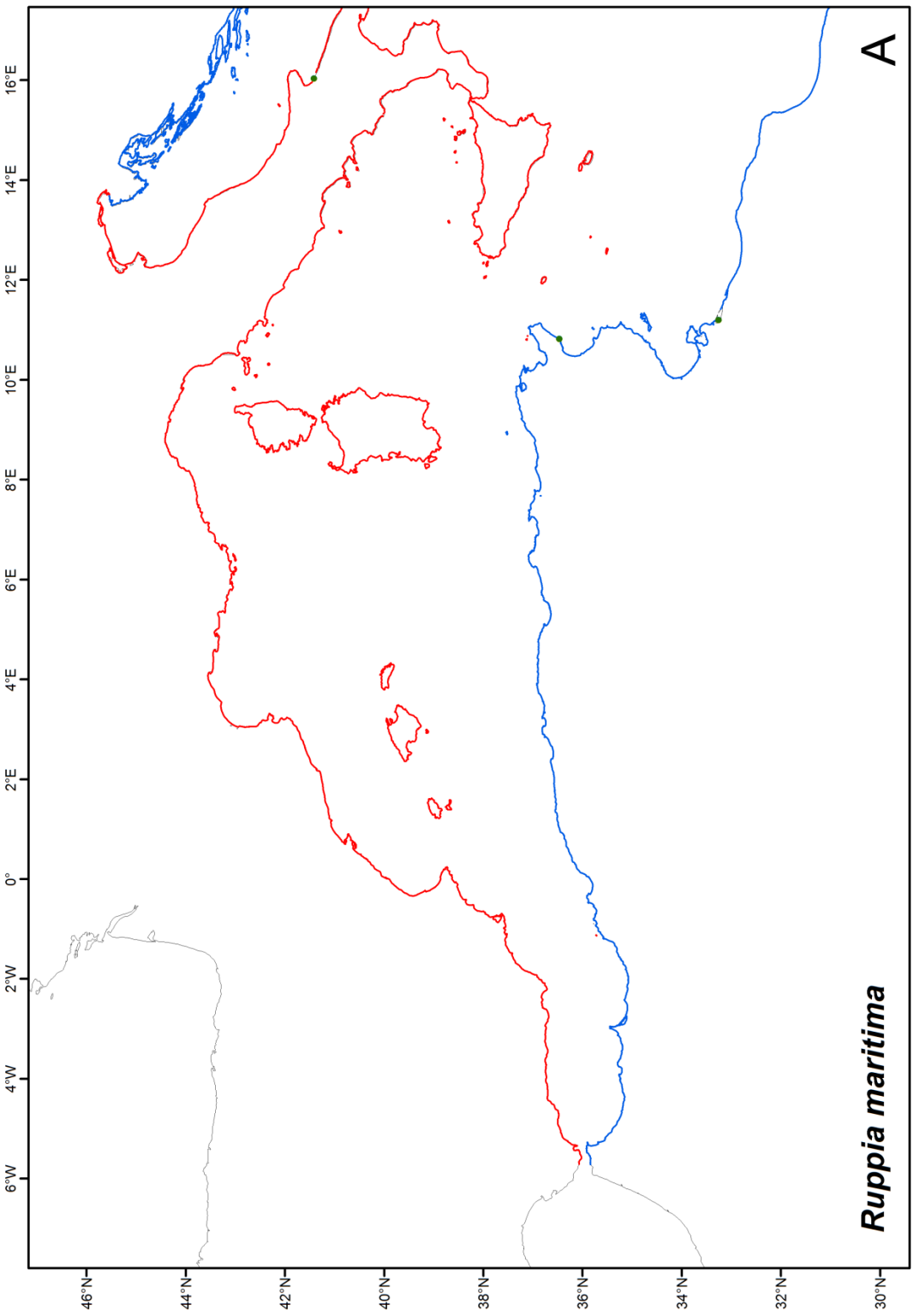

Fig. 1.1.23a. Current distribution of *R. maritima* in the Western part of Mediterranean Sea (green: presence; red: absence; blue: no data).

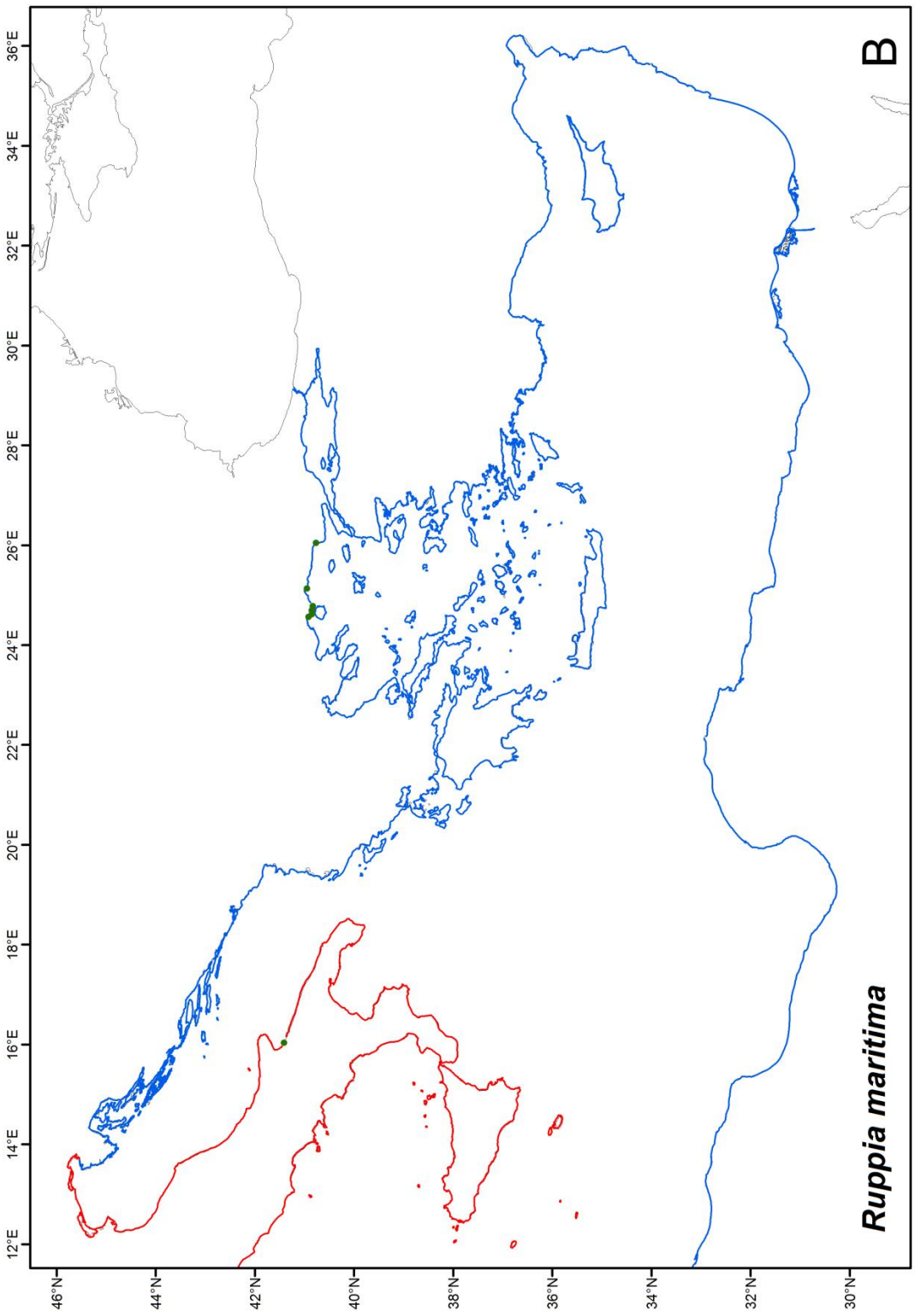

Fig. 1.1.23b. Current distribution of *R. maritima* in the Eastern part of Mediterranean Sea (green: presence; red: absence; blue: no data).

The current distribution of *Ruppia cirrhosa* is shown in Fig. 1.1.24. Figures 1.1.25a and 1.1.25b show the data for Western and Eastern Mediterranean. These maps represent “the state of art” of the actual knowledge.

Existing information on *Ruppia cirrhosa* seems to be limited to scattered records in the lagoon systems of the east part of Ionian Sea, the north part of the Adriatic Sea, limited areas along the Spanish coastline, limited areas in the western part of Sicily, a point from the coasts of Spain and the lagoon system of Tunisia. Along the Eastern Mediterranean and African coastline information about *R. cirrhosa is* relatively scarce.

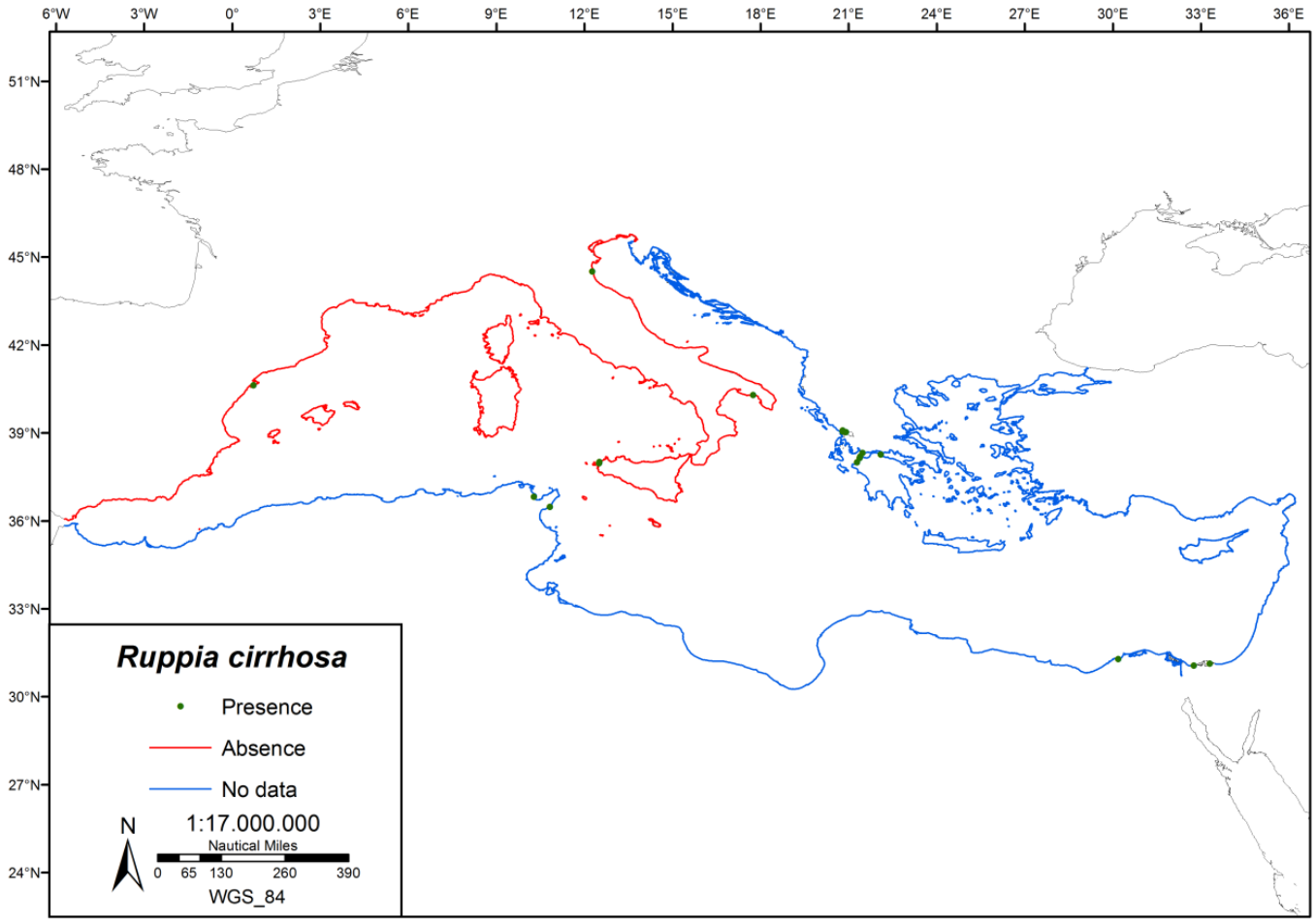

Fig. 1.1.24. Current distribution of *R. cirrhosa* across the Mediterranean Sea.

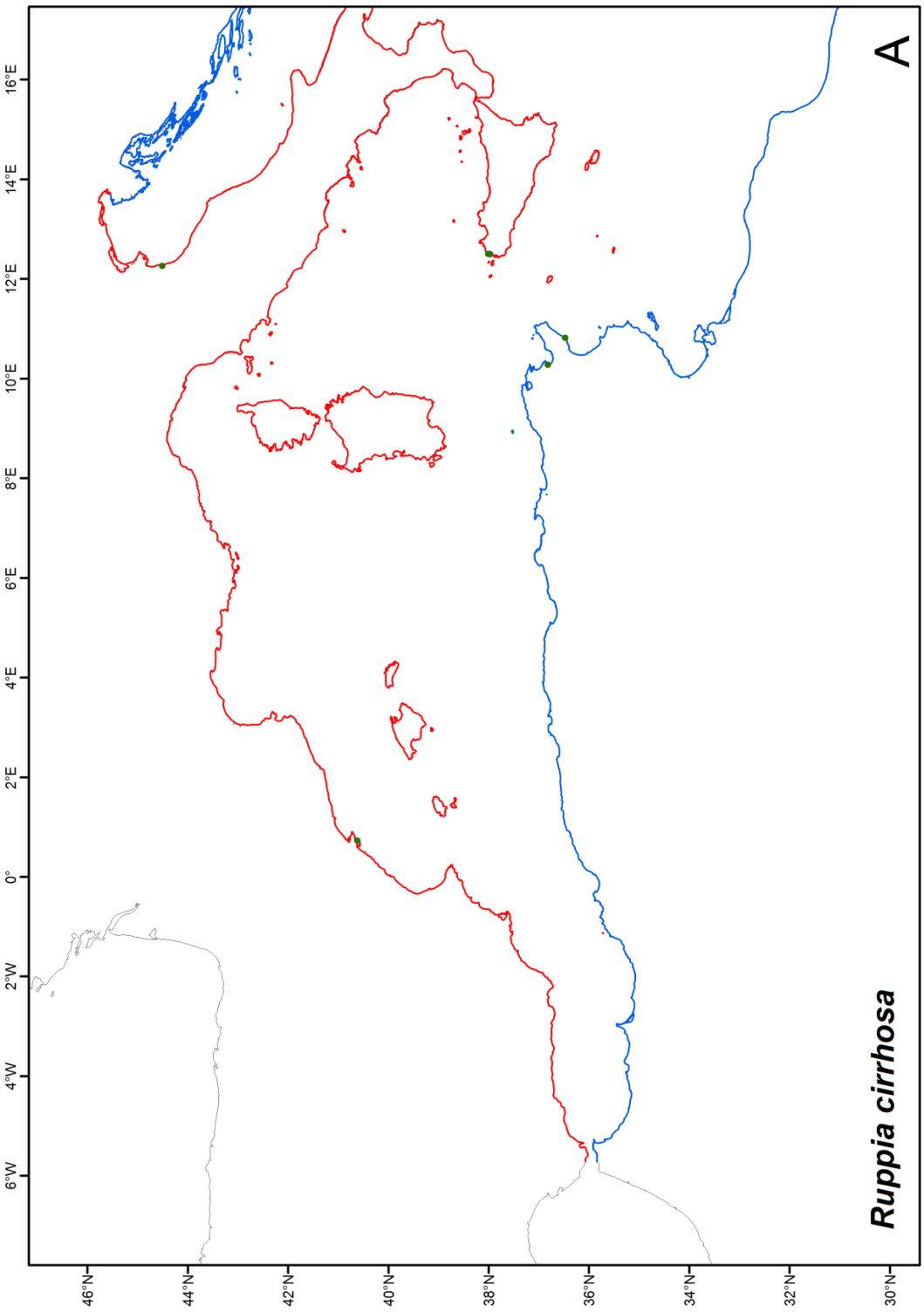

Fig. 1.1.25a. Current distribution of *R. cirrhosa* in the Western part of Mediterranean Sea (green: presence; red: absence; blue: no data).

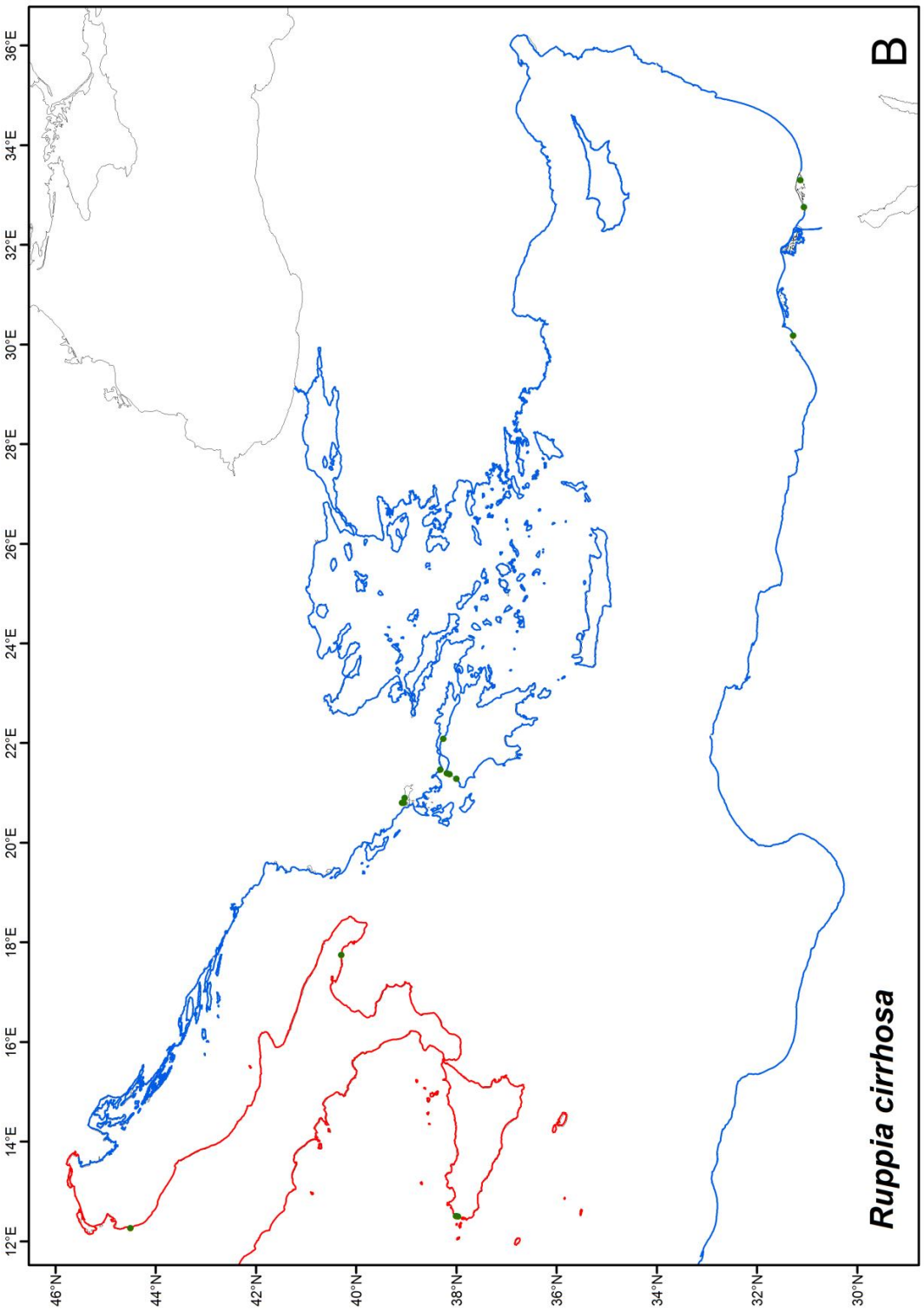

Fig. 1.1.25b. Current distribution of *R. cirrhosa* in the Eastern part of Mediterranean Sea (green: presence; red: absence; blue: no data).

An evaluation of data and information collected on the different seagrasses based on MEDISEH results is shown in Table 1.1.8.

Table 1.1.8. Reliability of the data collected (High: good knowledge on distribution; Medium: knowledge is not complete, some areas are poorly mapped; Low: poor level of knowledge).

Segrass species	Data reliability
Posidonia oceanica	High/Medium
Cymodocea nodosa	Medium
Halophila stipulacea	Medium/High
Zostera noltii	Low
Zostera marina	Low
Ruppia cirrhosa	Low
Ruppia maritima	Low

Historical data revision (M 1.1.1, D1.1.1)

The comparison of historical maps is considered a valuable tool for understanding the changes undergone by the meadows through time from a landscape and ecological point of view. This could allow us to obtain a picture of the historical *Posidonia* distribution and to identify these areas where Posidonia regression is dramatically ongoing.

Available historical data on the seagrassess beds from all areas (e.g the Iberian coast, the French coast, the Italian Tyrrhenian coasts, the north-western Ionian coasts, the Tunisian coasts) has been collected and evaluated. The reliability of historical maps was also evaluated. In those cases where a limited number of appropriate historical cartographic data are available, an appropriate bibliographic review has been conducted to obtain past records of the presence of Posidonia beds.

Historical data provided us an idea on the known *Posidonia oceanica* meadows that are under regressive phenomena in a determinate period of time. However, data were available only for certain countries, and not for the whole known distribution: Information is available for Italy (20-40% of known area), France/ Monaco (20-40% of known area), Spain (20-40% of known area), Tunisia (only locally), Egypt (only locally), Turkey (only locally) and Israel/Lebanon/Syria (only locally).

Detailed information is reported in the Table 1.1.9 where the percentage of regression (i.e. lost area compared to the total area) of the *Posidonia* meadows and the period that regression refers to, are summarize for each Country.

Table 1.1.9. *P. oceanica* percentage of regression and temporal period we refer for each Country across the Mediterranean Sea.

Country	Regression %	Temporal period
Spain	50%	2001-2011
France	15%	1980-2011
Italy (Liguria)	19%	1991-1995
Italy (Tuscany)	26%	1990-2000
Italy (Lazio)	38%	1990-1995
Italy (Puglia)	28%	1990-2005
Italy (Other regions)	_	1982-2009
Slovenia	_	2004
Croatia	_	2010
Montenegro	_	2004
Albania	16%	2007-2008
Malta	_	2002
Greece	_	2011
Turkey	_	2009
Cyprus	_	2008
Syria, Lebanon, Israel	_	2003
Egypt	_	2006
Libya	_	2011
Tunisia	2%	1972-2010
Algeria	_	2010
Morocco	_	_

The historical knowledge on the regressive phenomenon in the last 50 years for *Posidonia oceanica* meadows compared with the current distribution in the Mediterranean Sea are shown in Fig.1.1.26. It is important to highlight the geographical distribution of our knowledge. The main studies and data come from Spain, France and Italy, where Posidonia distribution maps are available from long time. In these Countries a long tradition of scientific activity on Posidonia meadows is carried out. Based on this we underastand that the regression of Posidonia meadows is a wide spread phenomenon, addressing most of the continental coasts and, to a lesser extent, the main islands (Sardinia, Sicily). Scattered information comes from some eastern Mediterranean countries, where large area of "dead matte" have been found from Tunisian researchers (EL Lakhrach et al., 2012).

In the next maps (Figs.1.1.27 to 1.1.29) we present some examples (Spain, France and Italy) of high resolution maps exported from our database, showing the current distribution and the area of regressionof *Posidonia oceanica* meadows along the Mediterranean coastline in the last 50 years.

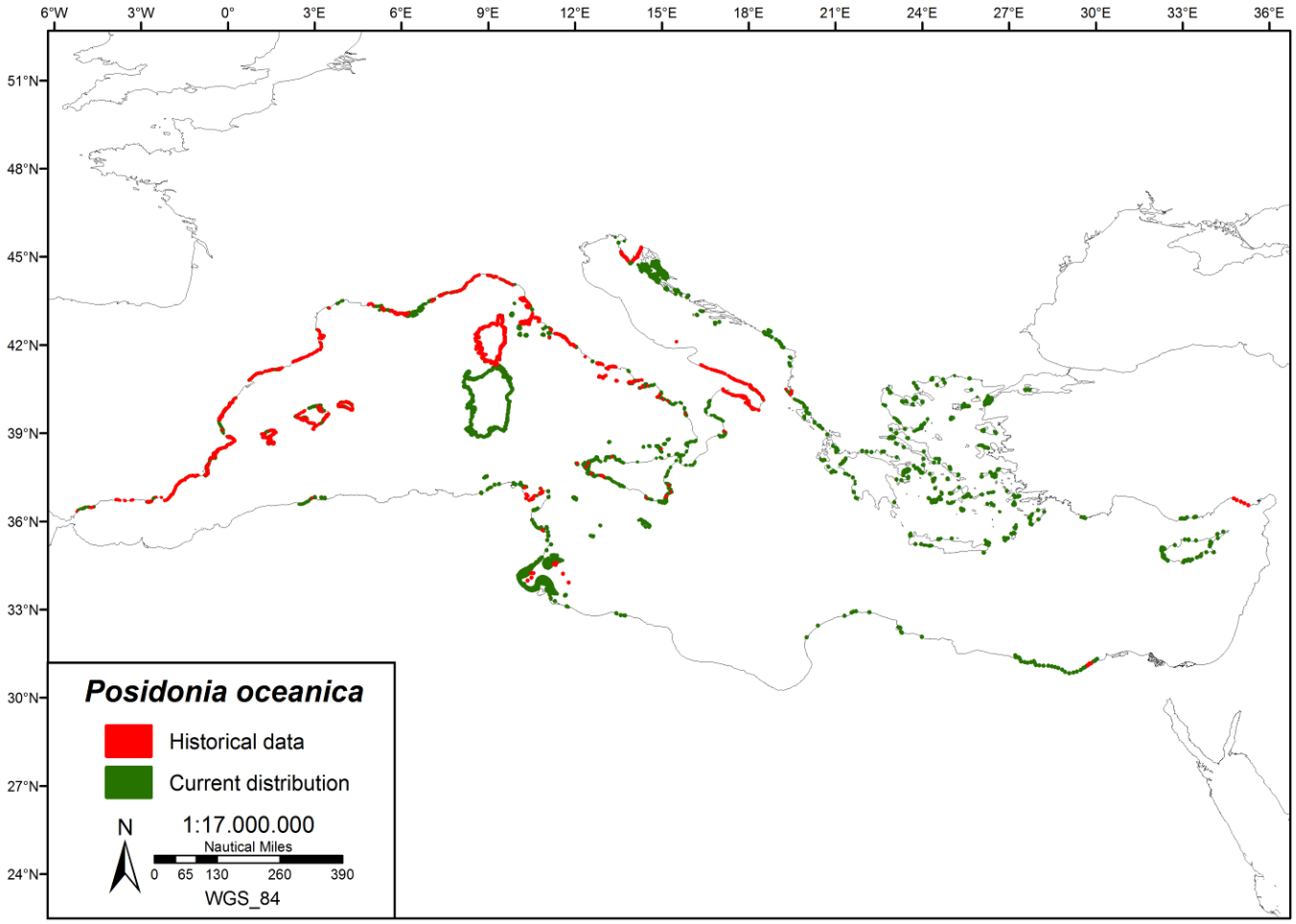

Fig. 1.1.26. Historical data: map highlighting the areas where *P. oceanica* is currently known that is in regression state (red areas).

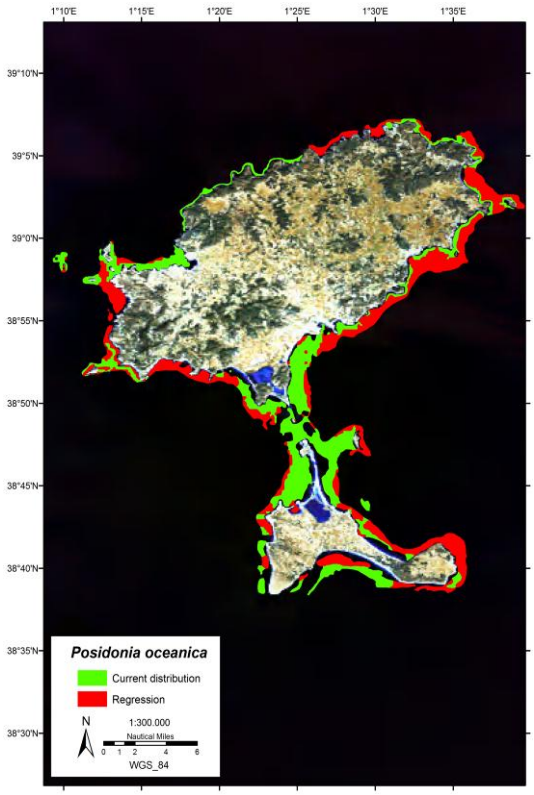

Fig. 1.1.27. *Posidonia oceanica* current distribution and regression along the coast of Ibiza and Formentera (*Spain*).

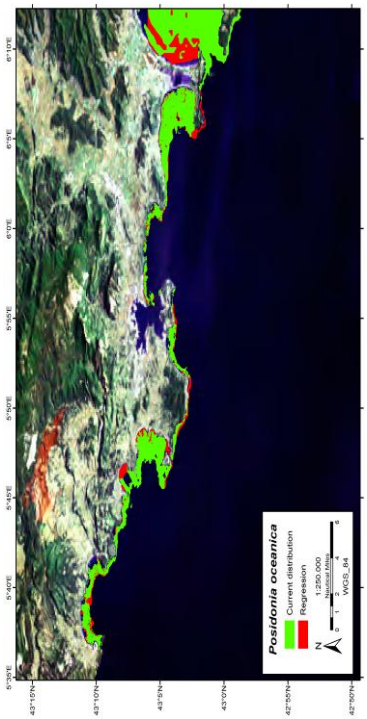

Fig. 1.1.28. *Posidonia oceanica* current distribution and regression between La Ciotat Bay and Gulf of Giens (*France*).

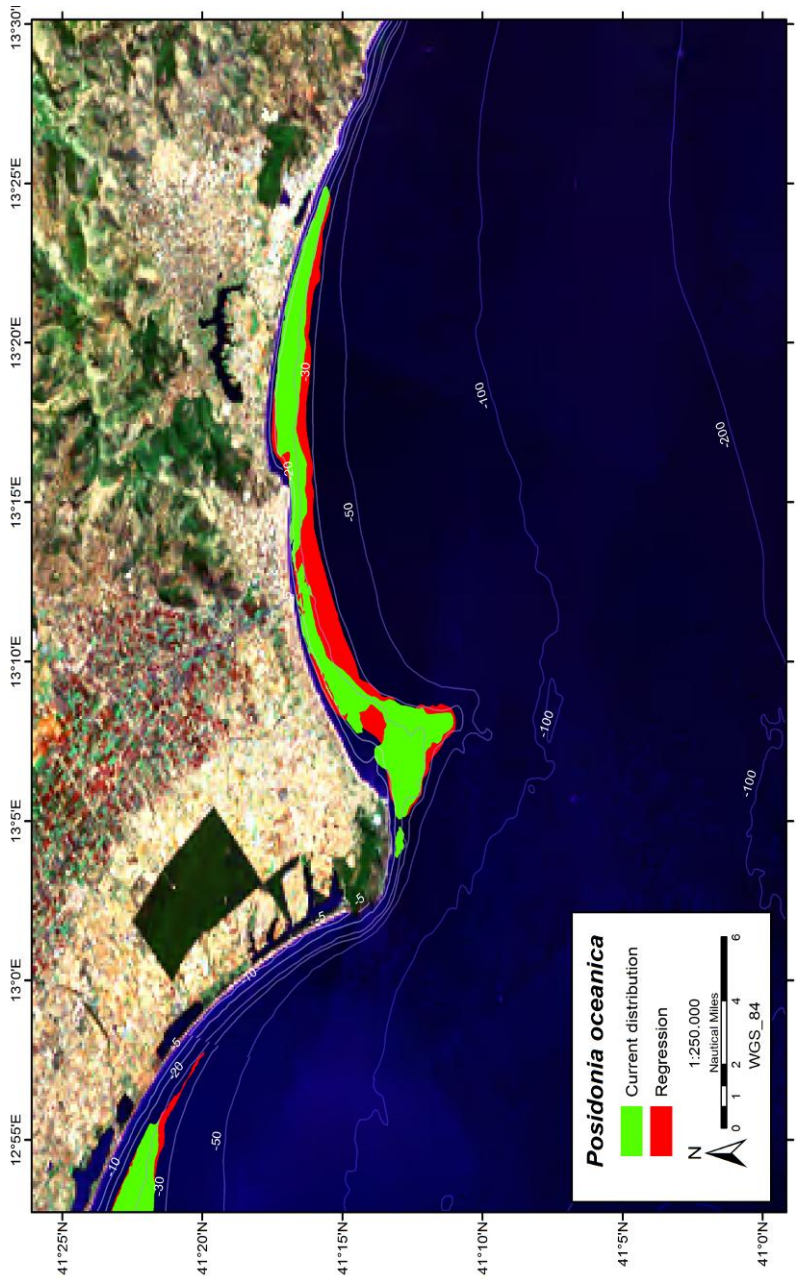

Fig. 1.1.29. *Posidonia oceanica* current distribution and regression between Circeo and Terracina (*Lazio region, Italy*).

Health status data

Data regarding health status are available mainly for *P. oceanica* and for certain countries: Italy, France, Monaco, Spain, Greece, Croatia, Albania, Tunisia (Table 1.1.10).

Tabel 1.1.10. Health status information presence for each Mediterranean Countries.

Country	Health status information
Spain	Y
France	Y
Italy	Y
Slovenia	N
Croatia	Y
Montenegro	N
Albania	Y
Malta	N
Greece	Y
Turkey	N
Cyprus	N
Syria, Lebanon, Israel	Y
Egypt	N
Libya	N
Tunisia	Y
Algeria	N
Morocco	N

Data collection evidences that these countries made substantial effort to monitor the seagrass meadows living along their coasts. In a very recent paper, Marbà et al. (2012) states that European countries are carrying out 42 monitoring programmes at European level, using a total of 49 seagrass indicators based on a total of 51 seagrass metrics used either alone or in various combinations of up to 14 metrics per indicator. Together with the classic indicators such as shoot density, biomass, or coverage a lot of more complex indicator are used, belonging to categories such as ‘‘Processes’’, ‘‘Chemical constituents’’, and ‘‘Shoot characteristics’’ that, according to Marbà et al. (2012) may respond faster to disturbance. Also other structural and physiographic descriptors can be present, for example: limit type (progressive, stable, regressive), lepidochronology and growing, production and productivity index. Table 1.1.11 reports an example of health status data for a certain area in Croatia (Bakran-Petricioli and Schultz, 2010).

The information available about the health status of *Posidonia* meadows along the Mediterranean Countries are the following (Marbà et al., 2012):

Distribution

- Depth limit
- Depth limit type
- Area

Abundance

- Shoot density
- Cover
- Dead matte cover

Shoot characteristics

- Shoot biomass
- Shoot leaf area
- No. of leaves per shoot
- Leaf width
- Leaf length
- Leaf necrosis
- Broken leaves
- Plagiotrophic rhizomes

Processes

- Leaf production
- Rhizome production
- Rhizome elongation
- Shoot recruitment
- Shoot mortality
- Flowering
- Shoot burial, rhizome baring
- Herbivore pressure

Chemical constituents

- Rhizome N
- Rhizome P
- Rhizome d15N
- Rhizomes d34S
- Rhizome sucrose
- Rhizome Cu
- Rhizome Pb
- Rhizome Zn

Associated flora and fauna

- Diversity
- Invasive sp. presence
- Epiphyte biomass
- Macrofauna abundance

Table.1.1.11. An example of the health status available for one area in Croatia.

Tab. 1: Basic descriptors noted in situ on seven Posidonia meadows in the Middle and South Adriatic: meadow bathymetric extension and shoot density per depth.

Station	Bathymetric extension	Depth of sampling	Shoot density/m^2
Sascica (Dugi otok)	7-25 m	7 m	274±52
		20 m	122±29
Cuska Dumboka (Dugi otok)	2-25 m	6 m	315±81
		19 m	155±94
		24 m	107±88
Lojisce (Dugi otok)	1-32 m	3 m	882±106
		5 m	426±48
		15 m	313±37
		20 m	165±18
		32 m	125±25
Krapanj	1-4 m	1 m	1282±28
Brodarica	2-4 m	2m	390±45
Rukavac (Vis)	5-34 m	5 m	385±19
		15 m	252±27
		20 m	163±14
		32 m	55±5
Saplun Island (Lastovo archipelago)	1-36 m	5 m	462±72
		15 m	264±13
		20 m	211±16
		32 m	37±5

Generally, the health status of meadows presents a wide heterogeneity along the Mediterranean coasts. The meadows are distributed between a few meters of depth to 45-50 m depth at maximum, mainly 35-40 m. The health situation is a very complex issue because it is linked to a great variety of local conditions (i.e. sea bottom morphology, hydrology, primary production, etc.), human impacts and, not the least, the variety of parameters considered.

Health status information collected is reported in Annex 1.1.1.

REGIONAL DETAILS

Spain

For the coasts of Spain we have good maps with the distribution of *Posidonia* (and scattered data for *Cymodocea*), information on the health status of meadows and spot data concerning the regression. *Posidonia* meadows are widely present along the continental coast and islands. The most extensive *P. oceanica* meadows are located in Murcia, Alicante and Balearic island regions. More than 58% of the Catalan coast and more than 52 % of Alicante coats are characterized by regression phenomena caused by natural processes and anthropogenic disturbances and stress. A study carried out on 29 *P. oceanica* meadows distributed on about 1.000 Km of the Spanish coast within 36"46' and 42"22' N latitude degree, shows that the meadows presenting good health conditions (in terms of biomass and density) are located in Andalusia region. However a general decline has been recorded in the main part of the surveyed meadows. (Marbà et al., 1996; Romero et al, 2007).

The main causes responsible for the regression of *P. oceanica* along the Spanish coast are: spills of wastewater; alteration of sedimentary dynamics due to the construction of infrastructure along the coast; beach nourishment; mechanical damage caused by trawling; input of organic matter produced by aquaculture facilities; discharges of brine spilled from desalination plants.

France

Distribution maps of Posidonia exist for the continental coasts of France, small islands and Corsica. Updated detailed data come mainly from Natura 2000 Network and EUSeaMap project. Information on the health status of meadows is available due to a standardized network that collects information from *Posidonia* monitoring projects. The French researchers have the oldest maps of *Posidonia* distribution in the

Mediterranean, and a lot of scientific papers testimony important regressive phenomena along the continental and insular costs. The causes are both human impacts and natural disturbances.

Italy

The current distribution of *P. oceanica* meadows along the Italian coasts is well known (Fig. 1.1.30). Distribution maps of *Posidonia* are available in shapefiles for most of the Italian coasts, and small islands. In some cases, maps are available also for long time period (Liguria, Tuscany, Lazio, and Puglia regions) (Figs. 1.1.31 and 1.1.32). Additionally, a significant amount of information on the health status of meadows is available. *Posidonia* is present along the Ligurian coasts (with few exception), the Tuscany costs (except the Magra, Ombrone mouths), and Tuscan Archipelago islands, the Latium coast (except Tevere, Garigliano and small river mouths), Campania, Calabria, Puglia (until the Gargano promontory). The health condition is very different from one area to another, but bad health status and regression areas are known and well studied along the continental coasts of Latium, Liguria and Puglia regions. *Posidonia* meadows are widely distributed along the Sardinia coast, and they generally are in good health conditions (except harbour areas).

The *P. oceanica* meadows along the Sicilian coasts are really well studied and described. Maps and relative shp files are currently available for the whole coastal area. *P. oceanica* meadows result mainly concentrated in west and south east sides of Sicily. In these areas probably due to the wide continental shelf and geological features of the sea bottom (calcarenitic substrates), *P. oceanica* meadows are particularly extended; especially in the west coast (from Mazara del Vallo at south to Egadi Island at north) where local meadows are considered to be some of the most wide ones for the whole Mediterranean sea. Although historical trends are not available, with the exception of *P. oceanica* meadows close to large urban (Palermo, Catania) and industrial centres (Milazzo. Augusta, Gela) health status of marine plants is generally good. However siltation from dumping sites and illegal activities of trawl fishing gears represent currently a serious problem for the *P. oceanica* biocenosis.

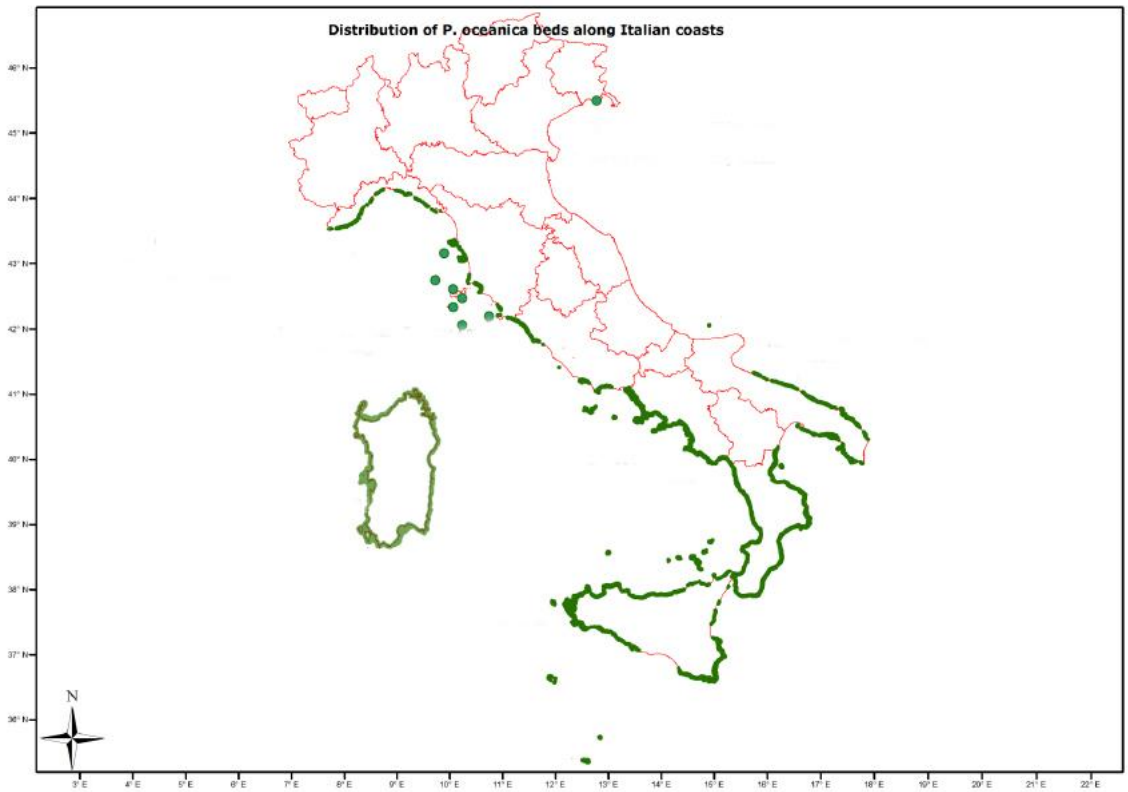

Fig.1.1.30 The actual distribution of *P.oceanica* beds along Italian coasts.

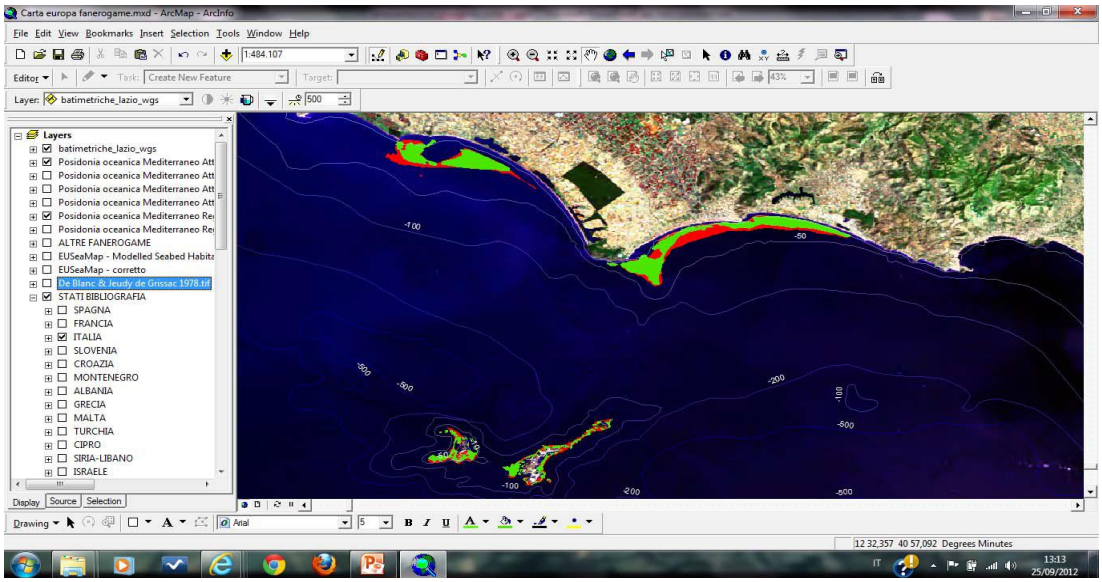

Fig.1.1.31 GIS example of *P. oceanica* current distribution (green) and lost area (red) between Circeo and Terracina (*Lazio region, Italy*).

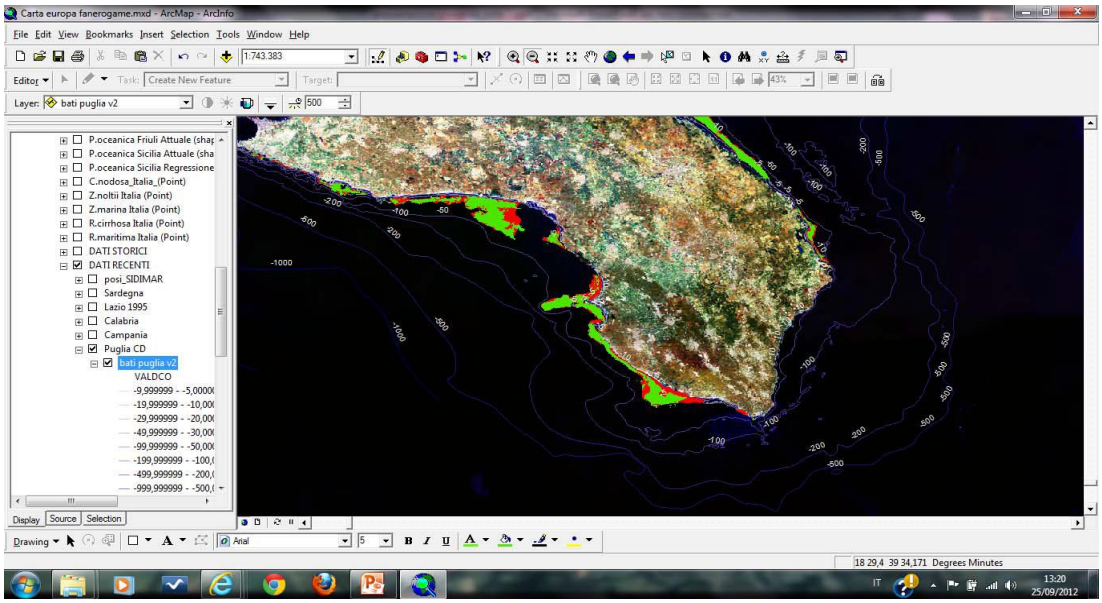

Fig.1.1.32 GIS example of *P. oceanica* current distribution (green) and lost area (red) along the southern coast of Puglia.

Greece

A large number of personal observations have been collected related to the occurrence of *P. oceanica* along the coasts of Greece.

This type of point data reflects years of experience and hundreds of diving all around the Country. The data have been provided by:

- P. Panayotidis: points from most of the Greek coasts;
- E. Apostolaki: some points from Crete Island.

However, all these personal observations highlight only the presence of the species without any information about extension and limits of the seagrass meadows; they were largely included in our database in order to heavily improve the model output (Task 1.3), as suggested by the modelers. As shown in Fig. 1.1.33 these personal points cover most of the Greek coastline complementing our official and unofficial data.

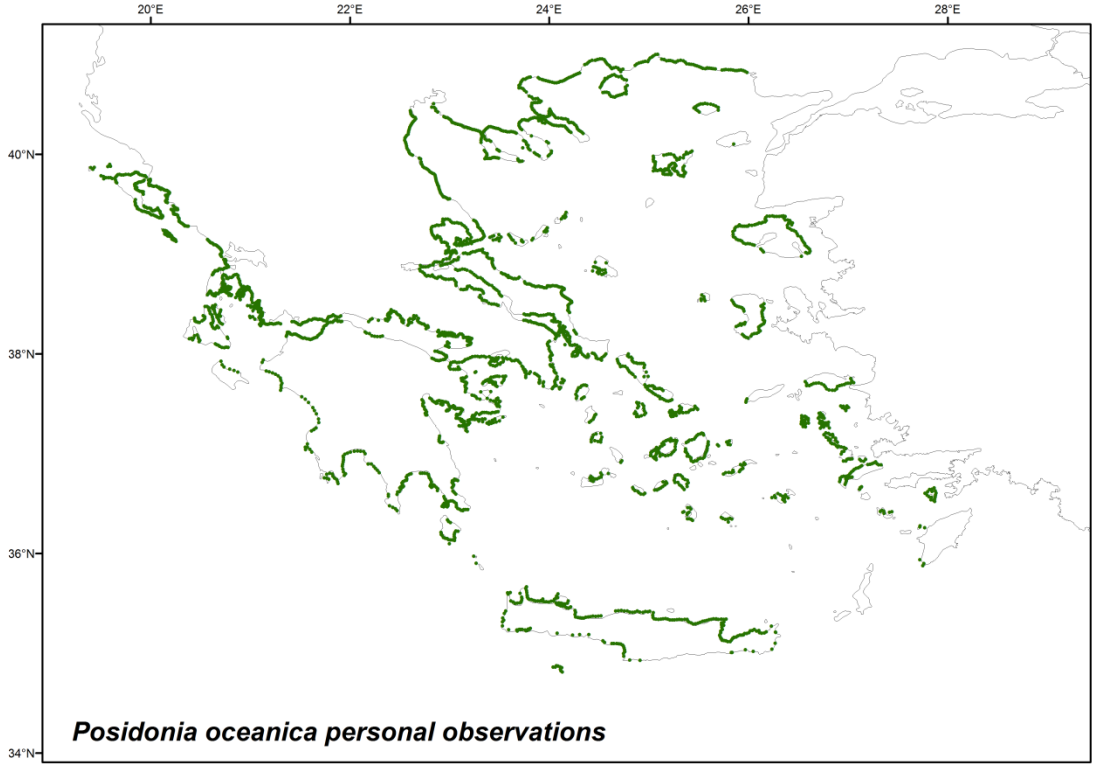

Fig. 1.1.33. *P. oceanica* personal observations along the coasts of Greece.

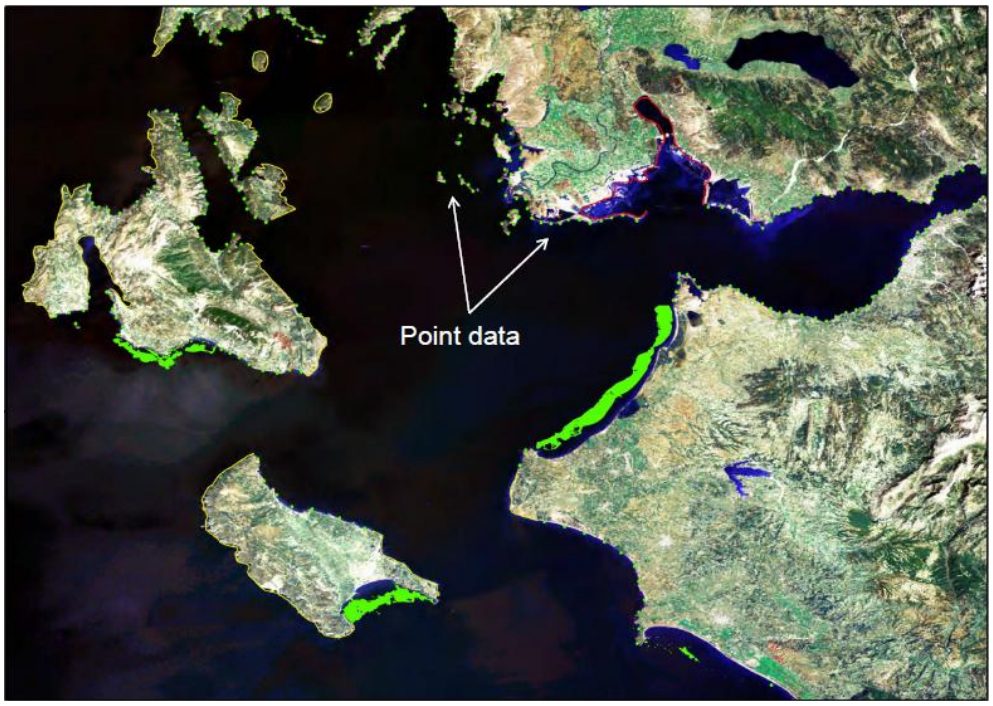

Fig.1.1.34. Some *P. oceanica* personal observation points (green) from the coasts of Greece.

Tunisia

Among the Maghreb countries, Tunisian coasts present the higher level of information on *P. oceanica* biology and spatial distribution. In the last two decades, several studies have produced useful data on the status of *P. oceanica* meadows, and a lot of meadows in regression are known. *Posidonia* maps are complete for the Gulf of Tunis, the Gulf of Gabes, Galite Archipelago and Zembra Island. Human impact on *P. oceanica* meadows is clearly described in Gulf of Gabes and several management plan have been proposed to protect the coastal area and, specifically, to slow down the *P. oceanica* regression. Many studies and projects are actually in progress in the Tunisian area, thus in a short time it will possible to refine and upgrade data collected and analyzed until now.

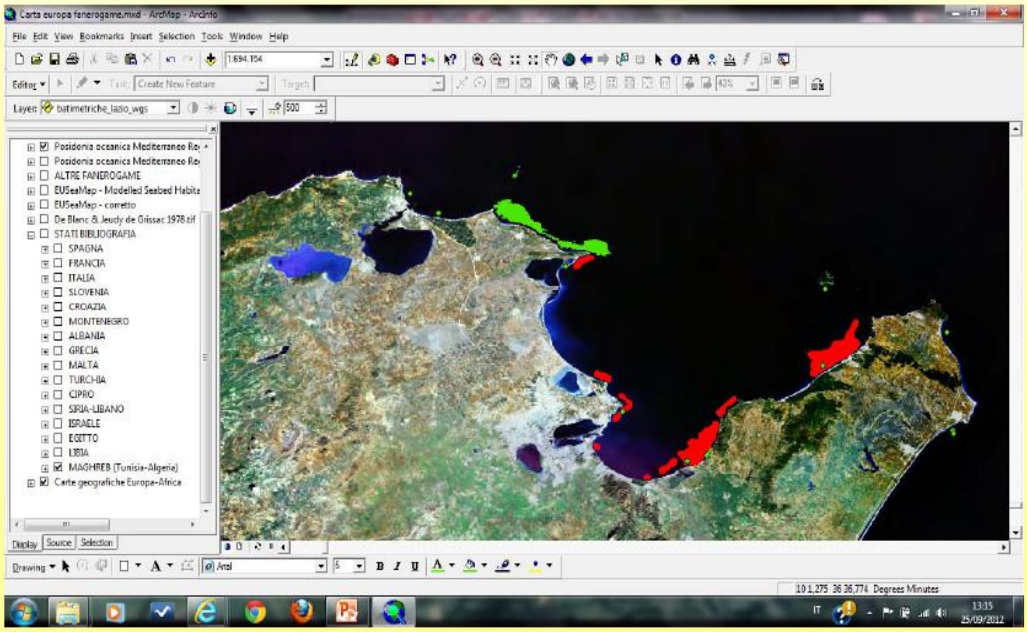

Fig.1.1.35. GIS example of *P. oceanica* current distribution (green) and lost area (red) along the Tunisian coastline(Gulf of Tunis).

Malta

For Malta, *P. oceanica* distribution maps cover 100% of the coasts. Around the Island of Malta, a dense meadow on matte grows in the NE region between Saint Paul's Islands and Qawra Point and a dense meadow is interrupted between Qawra Point and Ras il-Qrejten. A relatively dense *P. oceanica* meadow characterizes the seafloor from Ras il-Qrejten to Saint Julian's bay. Further north-west *P. oceanica* reappears between Fomm ir-Riħ and Anchor bay, with patches growing on sand and rock. Around the Island of Gozo, *P. oceanica* is widely present along the north-eastern coast. Further west and up *Posidonia* is located in two small zones: one at Dwejra (with rare patches) and another just outside the Mgarr harbour. The channels between Gozo and Comino and Comino and Malta are covered by a dense *P.*

oceanica growing on matte. The meadow further continues close to the Maltese coast and St. Paul's Islands (Mifsud et al., 2006).

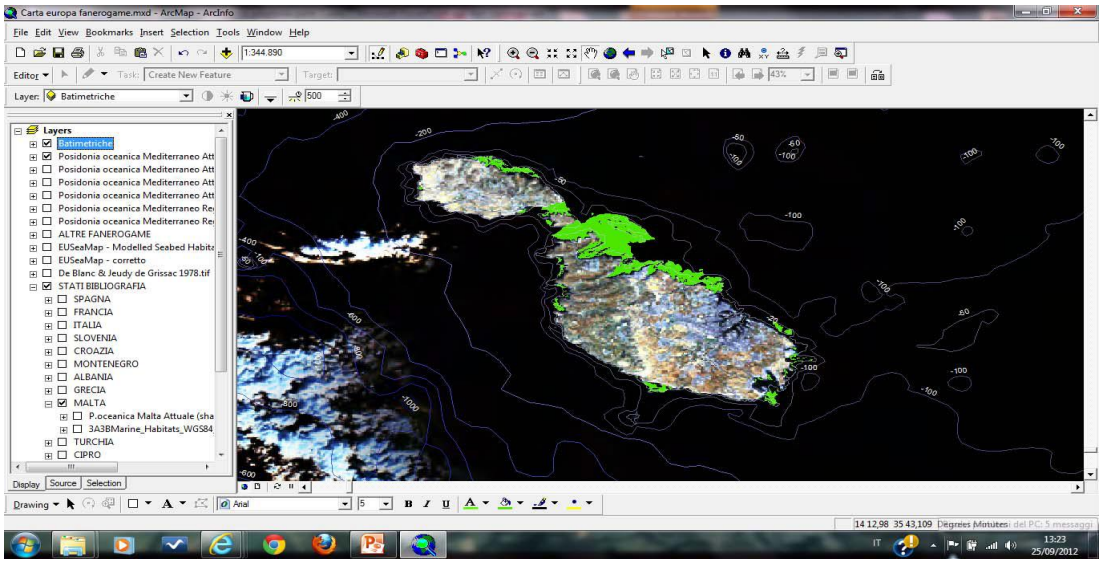

Fig.1.1.36. GIS example of *P. oceanica* current distribution (green) and lost area (red) along the Maltese coastline.

Other Countries

In the Eastern Adriatic Sea coasts only "presence points" of seagrasses are available for Slovenia, Croatia, Montenegro. In these Countries several coastal habitat mapping projects are still ongoing. Croatia is implementing the Natura 2000 marine Community Interest Sites, and Posidonia seems to be largely present.

Posidonia cartography is complete for Albania, where *Posidonia* is largely distributed. In this Country 2.837 ha of *Posidonia* meadows were mapped. Eleven meadows were identified between Cape Rodon (northern coast) and Cuke (southern coast).

The current distribution of *Posidonia oceanica* meadows along the western side of the African coasts is not well assessed. Information for Algerian and Moroccan coasts is rare and spotted. However, in the eastern side of Algeria qualitative studies describes *P. oceanica* meadows in a healthy status with a lower limit of around 35 m deep. The lack of human pressure in this wide area and the geomorphological structures of the coastal area let us imagine a wide coverage of meadows. Aerial photos from Bing Maps show the presence of seagrass along the coasts.

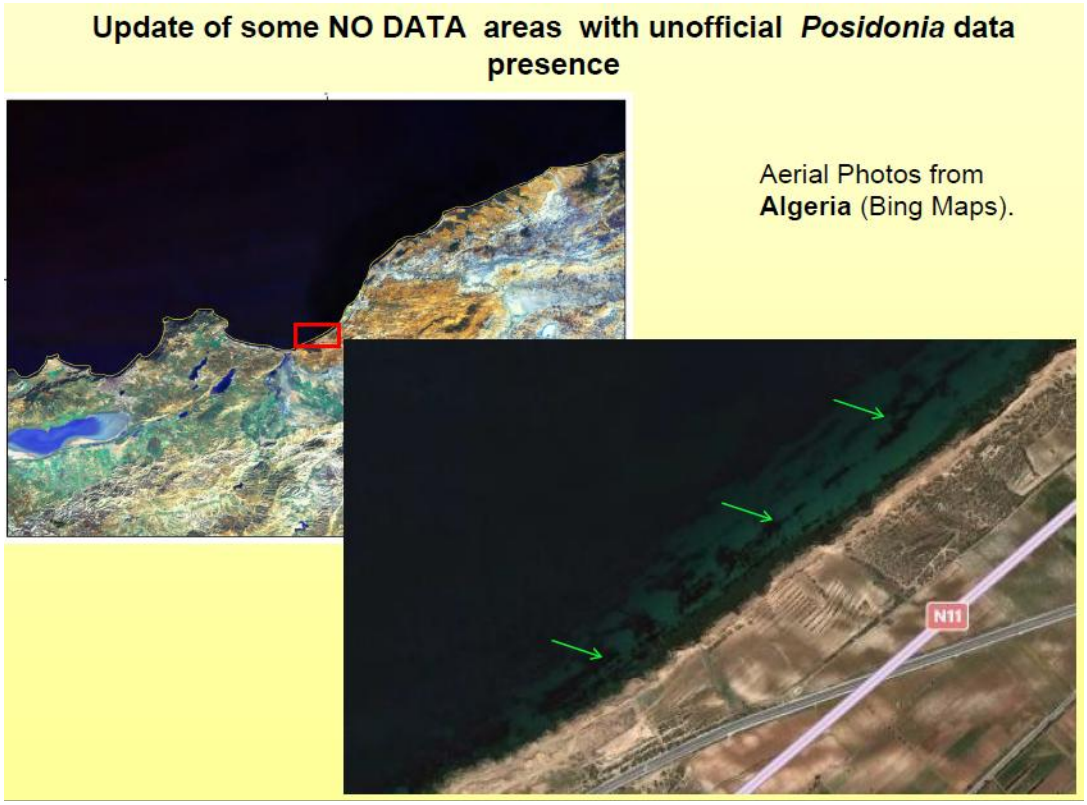

Fig.1.1.37. Aerial photo showing *P. oceanica* meadows presence along the Algerian coasts.

Information on the current spatial distribution of *P. oceanica* and other seagrass meadows along the Libyan coasts are very scattered and scanty. However, several studies carried out in coastal lagoons (Farwa, Garaboulli, Ain Al-Ghazala) describe *P. oceanica* meadows characterized by peculiar atoll-shape structures. Although information on the eastern Libyan coasts (Cirenaica region) are completely lacking, geological features of this area allow us to imagine presence of *P. oceanica* meadow.

Only localized knowledge is available about the distribution of *Posidonia* meadows in Egypt.

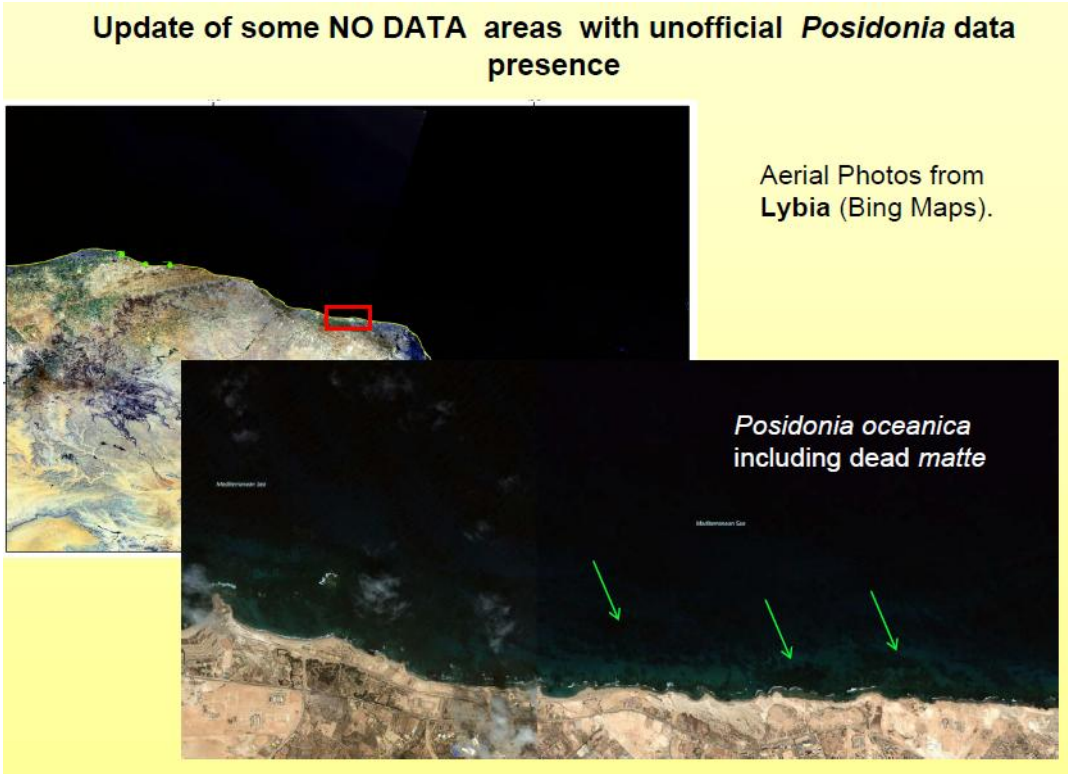

Fig. 1.1.38. Aerial photo showing *P. oceanica* meadows presence along the Libyan coasts.

Presence of seagrasses are confirmed along the Turkish Aegean coasts and in few localities along the southern coasts of Turkey.

Few data are available for Cyprus (some mapped areas deriving from Natura 2000 dataset), where *Posidonia* seems to be well present.

Difficulties encountered and remedial actions

The project collected the maximum of available information on the seagrass distribution in the Mediterranean Sea. The main problems encountered and solved were:

- The great amount of information that was available in different formats (i.e. scientific papers, reports, grey literature, websites, etc.) and the long time needed to collect it.
- The great heterogeneity in the scale of available maps (from 1:1.000 to 1:250.000) and the legends that use a suite of apparently not standardised symbols i.e., "*Posidonia*" is represented as *Posidonia* on matte, *Posidonia* on sand, *Posidonia* on rock, degradated *Posidonia*, *Posidonia* and isolated shoots, *Posidonia* and dead matte, dead matte, etc.
- Different geographical projection and datum in the available maps per Country, Region, Author.
- Lack of georeferenced information in many .doc or .pdf documents.

For all these problems different solutions were found. All available information was added into a bibliographic database and all the "geo-referenced" information into an ArcGis project, independently from the scale (this is the reason of the different resolutions in the restitution) and the legend (we consider the category "Posidonia" independently from the substrate or other). This work has requested considerable time to complete. To geo-reference the different geographic projections and datum in a unique format finally optimized our result.

Another problem was the lack of suitable data for certain areas. For the western Mediterranean basin we feel confident that the distribution map of *Posidonia* meadows represents the real distribution of *Posidonia*, for the eastern Mediterranean basin this is not the case. In most cases “absence area” actually corresponded to “non-available data”. This has been a hard job for the experts of the Consortium, involving reading of the available papers and reports and contacting local experts to obtain the right information.

A solution of “graphic type” has been adopted to solve the problem, highlighting the two different kinds of “absences”.

The main difficulty, however, was the lack of geo-referenced files in shapefile format for most countries. In fact, often the information is available only in the form of paper maps such as .jpeg file or text in .pdf or .doc. In certain cases the data owners have not agreed to provide us with .shp formats.

For some countries like Italy the problem concerned limited areas while for other countries, like France and Spain, the problem concerned very extensive areas. The problem was solved only in part using for the French coasts the information from the EUSeaMap project, but it remains for the northern coast of Spain. A time consuming solution to this problem involved the “manual digitizing” of the maps available in hard copy. For the Spanish coasts the problems concerned mainly the Catalonia Region. An effort has been directed to get additional information and greater cooperation with the RAC/SPA, under whose direction several projects of seagrasses mapping in the eastern Mediterranean basin are ongoing.

Another problem was related to the other segrassess species (*Cymodocea, Zostera* spp., *Ruppia* spp., *Halophila*) for which only point/ scattered information/ maps in paper are available. Therefore, the estimation of the real extension of their distribution grounds across the Mediterranean basin is not available. Gaps in knowledge per species and suggestions for improvement are cited in Table 1.1.12.

As far as the historical maps concern, despite the fact that there is a lot of information on the regression of *P.oceanica* around the Mediterranean basin, detailed geo-referenced and comparable maps are scarce. Thus we decided to proceed by analyzing "case studies" for those areas where information is available, and utilize only "graphical signs" for other areas.

Gaps in knowledge and suggestions for future actions

Table 1.1.12 reports the gaps in knowledge identified during the MEDISEH project.

Table 1.1.12. Gaps in knowledge

Gap	Proposal
Posidonia oceanica: Not completely known the distribution of meadows along the coast of Croatia, Greece, Libya, Algeria, Egypt and Tunisia due to the lack of investigation or diffusion of data, also if several project are locally ongoing.	Complete the *Posidonia* meadows mapping along the countries for which we have less information (eastern and southern coasts of the Mediterranean Sea) to confirm their presence or absence (historical absence too).
	Complete and confirm the personal observation along the coasts of Greece with ad hoc characterization surveys, to complete the map of the current real extension.
	Mapping of the *P. oceanica* meadows where it is not well known in order to propose the establishment of new marine protected areas (SCIs or MPAs) where appropriate

Gap	Proposal
	protection measures (Croatia) are not already taken.
Cymodocea nodosa: Limited map distribution for most of the Mediterranean countries	Increase the knowledge on the distribution of *Cymodocea nodosa* by characterization survey along the Med. coasts
Other seagrass: Only point data or very limited distribution maps for most of the Mediterranean countries. Many seagrasses are distributed mainly in coastal lagoons. Probably misunderstanding in species identification in many areas.	Increase the knowledge on the distribution of other seagrasses by characterization survey, especially inside coastal lagoons and closed waters.
	Monitoring the expansion of *Halophila stipulacea* in the western Mediterranean basin (mainly along the southern coasts of the Mediterranean and Tyrrhenian Sea).
Very abundant but locally sparse and not organized data (parameters, indices, etc.) on Posidonia meadows health status.	Creation of a Mediterranean standardized database to collect and elaborate information on health status of meadows
A large variety of known local cause of Posidonia meadows regression are available but lack of a large scale approach and of a coordinate plan at Mediterranean scale	Study on the health status of Posidonia meadows and regressive phenomena to understand, on a large scale, the actual extention of the problem.
	Monitoring the relationship between Posidonia (and other seagrass) distribution/regression and the diffusion of more competitive alien species (*Caulerpa* spp.).
	To improve the knowledge on the environmental factors that can influence Posidonia meadows regression
	To improve monitoring plans of the Posidonia meadows in the Mediterranean Sea.
Lack of historical data to evaluate the presence/status of Posidonia and other seagrasses during the time for many areas.	