

EP



**United Nations
Environment
Programme**



UNEP(DEPI)/MED WG.359/inf.9
April 2010

ENGLISH
ORIGINAL: FRENCH



MEDITERRANEAN ACTION PLAN

Tenth Meeting of the Focal Points for SPAs

Marseilles, France, 17-20 May 2011

**FEASIBILITY STUDY IN SETTING UP A REGIONAL MECHANISM FOR
COLLECTING, COMPILING AND CIRCULATING INFORMATION ON
MARINE ALIEN SPECIES IN THE MEDITERRANEAN**

*In the framework of a sustainable development approach, this document will be available
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LIST OF ACRONYMS

BMB: Baltic Marine Biologists
BWC: Ballast Water Convention
BSASD: Baltic Sea Alien Species Database
CBD: Convention of Biological Diversity
CGRS: Chronological Grid Reference System
CABI: Commonwealth Agricultural Bureaux International (a not-for-profit, science-based development and information organisation) <http://www.cabi.org>
CABI-ISC: CABI Invasive Species Compendium
CIESM: International Commission for the Scientific Exploration of the Mediterranean Sea
CNEPRU/MESRS: National Research project funded by the Algerian Ministry of Higher Education and Scientific Research
DAISIE: Delivering Alien Species in Europe. An EU project
EEA: European Environment Agency
ELNAIS: ELLenic Network on Aquatic Invasive Species
ERNAIS: European Research Network on Aquatic Invasive Species
GIS: Geographic Information System
GISIN: Global Information System on Biological Invasions
HCMR: Hellenic Centre for Marine Research
HELCOM: Helsinki Commission
ICES: International Council for the Exploration of the Sea
ICRAM: Istituto Centrale per la Ricerca scientifica e tecnologica Applicata al Mare
IMET: Italian Ministry for Environment and Territory
IMO: International Maritime Organization
IOC: Intergovernmental Oceanographic Commission
NEMO: Non-Indigenous Estuarine and Marine Organisms
NOBANIS: North European and Baltic Network on Invasive Alien Species
PICES: North Pacific Marine Science Organization
PORTAL: PORT surveys in the Mediterranean Sea for ship-transported Alien organisms
REABIC: Regional Euro-Asian Biological Invasions Centre: www.reabic.net/
REMPEC: The Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea
SGBWS: Study Group on Ballast Water and Sediments
SGBOSV: Study Group on Ballast and Other Ship Vectors
SIBM: Italian Society of Marine Biology
SAP BIO: Strategic Action Programme for the Conservation of Biological Diversity in the Mediterranean Region
UNEP/MAP: United Nations Environment Programme/Mediterranean Action Plan
WGITMO: Working Group on Introductions and Transfers of Marine Organisms
WGBOSV: Working Group on Ballast and Other Ship Vectors

EXECUTIVE SUMMARY

The planning of more effective strategies to deal with biological invasions has become a global conservation priority. A feasibility study concerning the whole “regional mechanism for collecting, compiling and circulating information on invasive non-indigenous species in the Mediterranean” provided for by the regional Action Plan on species introductions and invasive species, in its Paragraph 22 was assigned to HCMR. In preparing this report national and international initiatives addressing IAS were investigated, services and tools of relevant European databases were discussed and commented, and an attempt to describe an integrated system based on the experience of existing databases was made.

International initiatives addressing IAS in the Mediterranean

A number of international initiatives address and deal with alien marine species in the Mediterranean Sea. These include Mediterranean scientific bodies such as the International Commission for the Scientific Exploration of the Mediterranean Sea (CIESM), individual scientists who have been often involved in international fora (ICES/IOC/WGITMO, ICES/IOC/WGBOSV groups and GLOBALLAST) as national experts, as well as a number of national publications (that include check lists of alien marine species) and papers that deal with reviews of taxonomic groups and/or the first findings of new species and range expansion of introduced species.

Initiatives of CIESM relevant to biological invasions include the preparation of a series of reports published as a CIESM Atlas on the major taxa of non-native species introduced into the Mediterranean Sea, the convening of expert panels on ship-mediated transfer of species and the organization of a relevant workshop (Istanbul, 2002), and the launching of the basin wide program PORTAL on port surveys for alien species. In the CIESM atlases, only those exotic species of Indo-Pacific origin that were recorded after 1920 and of Atlantic origin that were recorded after 1960 (1950 for crustaceans) are considered. Drawbacks of the CIESM atlases compilation include its limited taxonomic coverage (Fish, Crustaceans, Molluscan Macrophytes), irregular or no updates (molluscan), use of outdated terminology, and its limited access to the world scientific community. It is not a database per se as it provides static html pages with no search option besides the species name. It is only taxonomic based, not country based. The status per country even for the four well treated groups is not accessible.

ICES (International Council for the Exploration of the Sea) have been confronted early on with issues related to the introduction of alien species. The need to assess the risks associated with the deliberate transfer of marine species led to the organization and launching of the Working Group on Introductions and Transfers of Marine Organisms (WGITMO). In order to address the problem of ship-mediated species introductions, another working group (Working Group on Ballast and Other Ship Vectors – WGBOSV) was organized and launched by ICES.

In 2000, IMO joined forces with the Global Environment Facility (GEF), to tackle the ballast water problem. The GloBallast Project is specifically aimed at vulnerable developing States, with a view to assist them in implementing sustainable, risk-based mechanisms for the management and control of ships' ballast water and sediments and to subsequently minimize the adverse impacts of aquatic invasive species transferred by ships. Presently, 22 countries have ratified the BWC (Ballast Water Convention) which represent 22.65 % of the world tonnage among which four Mediterranean coastal States (Egypt, France, Spain and Syria).

Alien databases and similar initiatives in the Mediterranean Sea include the DAISIE project (Delivering Alien Species in Europe). This project's main objective was to create an inventory of invasive species that threatened European terrestrial, fresh-water, and marine environments, structured in such a way as to provide a basis for the prevention and control of biological invasions through the understanding of all factors involved. Although DAISIE includes a large amount of valuable information concerning Alien Species in Europe, there are a number of discrepancies and information gaps on the Mediterranean Sea. There are no accounts of aquatic alien species for 4 Mediterranean countries (Monaco, Bosnia-Herzegovina, Montenegro, and Palestinian Authority) and some taxonomic/ecofunctional groups such as the foraminifera and unicellular algae are entirely missing. There is no listing of cryptogenic aquatic marine aliens from any country and a number of alien species are misspelled. Furthermore, the alien species list of DAISIE includes 10 species that should be excluded for various reasons. Finally, there is a number of species in the DAISIE database that have not been updated taxonomically. There are also certain problems in the site functions. Specifically, the option to contact specialists always resulted in error and did not provide the information sought. Much more significant is the complete absence of sources for information concerning aquatic alien species (distribution, pathways, and vectors). It should be noted that the lack of updates is the main drawback of the DAISIE database. A total of

501 species are listed as alien by December 2006 vs 960 species archived in the relevant HCMR database by March 2010.

ICRAM with the collaboration of SIBM finished an important work funded by the Italian Ministry of Environment (IMET): Introduction of non-indigenous and genetically modified species project. The project deals mainly with: a) the formulation of a taxonomic and diagnostic atlas for the identified species of each taxonomic group, realized through GIS; b) the monitoring of ballast waters; c) the drawing up of guidelines for aquaculture practices (one of the main causes for the penetration of alien species) to avoid the expansion of this phenomenon. In materializing the project 30 taxonomic experts coming from ICRAM, Italian Universities, CNR, ARPA, Stazione Zoologica di Napoli, LBM collaborated. The project also foresaw the creation of an inventory and atlas of non-indigenous and genetically modified organisms (GMOs) utilized in aquaculture and the aquaria industries. An updated list of NIS present in Italy was compiled by the SIBM group. Drawbacks of the ICRAM compilation include its limited taxonomic coverage (only 8 taxonomic groups considered) and the fact that it is outdated.

The *FAO database on introductions of aquatic species* currently contains about 3,150 records of introductions of freshwater and marine fishes, and other taxa, and can be accessed through a Search Form. The database includes records of species introduced or transferred from one country to another. Coverage of accidental introductions of organisms (e.g., through ship ballast waters) is not complete and records on this topic have been entered only when important impacts on fisheries or on the environment have been caused (*Mnemiopsis* introduction to the Black Sea, for instance).

A simple information system has been developed in the HCMR (for internal use only) to serve as a resource in developing an alien species trends indicator. The database, structured in ACCESS application, includes information on marine aliens in the Mediterranean Sea for reporting to UNEP/MAP and EEA respectively. The database includes species reported as aliens that were excluded in subsequent publications as well as Atlantic fish species that entered the Med since 1900. The database is updated on a monthly base and results are reported to UNEP/MAP and EEA and/or communicated to international congresses. One of the main uses of the aforementioned systems is the development of a trends indicator on marine and estuarine species in Europe for the SEBI2010 program (EEA, 2007) and the Mediterranean (UNEP/MAP, 2007).

The main advantages of the HCMR database are that: a) it includes species excluded in recent literature and the reasoning for their exclusion, b) even cryptogenic or debatable species are archived along with their distribution, c) it includes both introductions via the Gibraltar and via the Suez since late 19th century, and d) it addresses nearly all taxonomic groups. Drawbacks of the HCMR database include: a) first sighting date is not available for all records, b) phytoplankton entries have not been cross-checked with local experts, c) taxa like tintinnids are not included, d) it is not GIS connected, and e) it is a desk top local application, not freely available.

Current human capacities and initiatives at national level of all UNEP/MAP-RAC/SPA member states

For the purposes of Inventorying and Management of NIS on a National level, relevant queries were sent out to several specialists and institutions working with biological invasions across the Mediterranean countries. The response of each country was varied, and for some countries there were no contacts made. A network of experts on alien organisms does not exist in most countries (with the exception of Syria, Greece, Italy) and there are few databases (Syria, Italy, Greece, Turkey?) or national programs that deal with the phenomenon. Review papers on alien species have been published only for seven Mediterranean countries: Greece (2009), Cyprus (2009), Israel (2007), Malta (2007), Italy (2010) Turkey (2005), and Spain (2008). Contact details of key scientists engaged in biological invasion studies across the Mediterranean on a country by country level are provided. A selection of experts from the list could serve as a consulting/managing body assigned by RAC/SPA. Greek scientists are not included in the annex but can be retrieved from the Hellenic Network of experts on Alien Species (ELNAIS).

Existing European Regional Systems (NOBANIS, BSASD) addressing IAS

Existing European Regional Systems (NOBANIS, BSASD) addressing IAS were explored and their services and tools discussed

The North European and Baltic Network on Invasive Alien Species (NOBANIS) is a gateway to information on alien and invasive species in North and Central Europe. NOBANIS has developed a network of common databases on alien and invasive species of the region, which covers marine, freshwater, and terrestrial environments. It provides a distributed but integrated database on introduced species in the region, fact sheets on many of the most invasive aliens, a catalogue of the regulation relevant to invasive species in participating countries, and a literature database. A connection to

regional and global networks and projects is also provided. It is a model of a common portal access to IAS-related data, and facilitates the sharing of information and knowledge in the region.

The NOBANIS database of alien species includes all species that have been introduced as a result of human activities either intentionally or unintentionally. This means that the database covers both invasive alien species and non invasive alien species. The core species of the NOBANIS database of alien species are organisms that are established (naturalised) in natural or semi natural ecosystems. Alien species that are only present from time to time (incidental), or species that are constantly being introduced, but do not breed are also included in the database.

The database is being updated regularly by each participating country, since by nature a database on alien species is under constant development as new species arrive while others become extinct.

An Internet Database on aquatic alien species in the Baltic Sea area (BALTIC SEA ALIEN SPECIES DATABASE -BSASD) was developed as an initiative of the Baltic Marine Biologists' Working Group on Non-indigenous Estuarine and Marine Organisms in 1997; in 2000, a new concept of the online Database appeared with support received from the Baltic Marine Environment Protection Commission (HELCOM). The database is built on the principles of scientific background and information quality to meet the needs of many different kinds of users (governments, management agencies, shipping and port industries, and scientists and students (academics). Other principles upon which the database was built include user-friendliness, support of multiple search options and cross-linking, and of course timely updates. This last principle is largely dependent on the availability of experts. The core component of the database structure is *species*: all of the information in the database is related directly to *species*.

The NOBANIS database is country based and as such a useful tool to national stakeholders as well as to regional ones. However, it is maintained and fed by the country focal points which implies that the information archived is not always quality controlled by local experts. It is very important to maintain a reliable flow of information and a level of quality control. In contrast the BSASD database which is quality controlled is hindered by a lack of funding. It is also lacking the country analysis which is essential so as to follow effectiveness of measures taken at national level.

Proposed system

The system proposed (MEDIAS-Mediterranean Alien Invasive Species) includes data on alien species in a common format for all countries participating in the network, and the database of alien species is one of the central products. Development of more detailed databases may be possible to design for national purposes. As in NOBANIS and DAISIE, the database can be used to identify species that are invasive at present and species that may in the future become invasive, thus providing the foundation for the future development of an early warning system for invasive alien species.

The network should have a national focal point in each of the UNEP RAC/SPA participating countries. The ideal is to have a network for cooperation between competent authorities of the country and scientific specialists.

Information archived in MEDIAS is related to the skill level of those who participated in data collection and the presence of a quality assurance/quality control (QA/QC) procedure. Therefore, it would be desirable to establish a standardized and rigorous quality assurance /quality control procedure for the MEDIAS database. Data should be quality controlled by regional experts (as in CIESM) and archived at the national focal points.

Alternatively it can be central, that is information provided by the focal points will be archived at a central server by the database manager. Considering the different degree of expertise among the focal points, the latter will ensure quality control of the stored information.

An innovation of the proposed system is to include naturally introduced species that have expanding their distribution range due to climate changes as for example temperate Atlantic species progressively introduced via Gibraltar. This will be useful in tracing entries due to climate changes. A second innovation will be to archive those species reported as aliens in the literature and exclude them later (as in CIESM) along with the reasoning for exclusion. This will be useful because some recent entries are in fact old introductions that were excluded by the CIESM task groups as very old records with no follow up or due to insufficient data.

An early warning and inspection system to protect against the invasion of alien species will be established. An interactive tool will be available to provide information on the

latest entries (either newly introduced species or geographic expansion of the top most invasive species). In parallel query/new info forms, will enable the wider public to communicate new information and/or queries of unknown species. The forms will be read by the database manager who will be responsible for channelling the information to taxonomic experts, so that a response is given to the interesting body. Under the early warning and inspection system, alien species will hopefully be discovered as early as possible. The new system will also tackle the increasing number of biological invasions by providing trends in introductions at a country level as well as at Mediterranean level.

Depending on the urgency and the resources available, RAC/SPA can either use the HCMR application by allocating some funds for its development via internet (computer expert) with the guidance of the biologists who have built it, and further develop it into an integrated GIS database to include all the tools described in chapter 6.1 or start building its own database. The proposed database is seen as a regional node in a future global information system on invasive species.

In the Mediterranean with the rate of introductions and species dispersal as increased as it stands to date, there must be someone tasked with maintaining the database on a daily basis because there is a lot of new information being gathered that must be quickly processed and incorporated into the database. The database will be available on the website, through a friendly user's interface, accessible to everyone to see it and interactive in accepting comments and information on new findings but entry forms will be password protected and open to the assigned scientists /focal points by RAC/SPA.

As to Governance arrangements, prior to the development of MEDIAS scientists, NGOs and governmental representatives should come together for a workshop on the *Development of a Mediterranean Invasive Species Informational Network*, to discuss and establish regional cooperation on the problem of invasive alien species in Mediterranean region. Among other issues to be discussed, the question of data flow and quality assurance and control should be top priorities.

INTRODUCTION

The planning of more effective strategies to deal with biological invasions has become a global conservation priority. In recent years, Invasive Alien Species has become a high-profile policy topic for the international community which has emphasized the need for cross-sectoral coordination between competent institutions and stakeholders at all levels.

The aim of the RAC/SPA consists in assisting the Mediterranean countries in the implementation of the Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean (SPA/BD Protocol) and its related thematic action plans related to the conservation of threatened species and habitats. One of these action plans is the Action Plan concerning Species Introductions and Invasive Species in the Mediterranean Sea.

In the framework of this Action Plan, the RAC/SPA has to set-up a regional mechanism for collecting, compiling and circulating information on invasive non-indigenous species that should be harmonised with the Mediterranean Clearing-House Mechanism.

This regional mechanism should in particular include:

- procedures for notifying the fact that non-indigenous marine species have been detected in the Mediterranean;
- a database on invasive marine species (taxonomy, ecology, affected ecosystems or species, means of fighting the problem, specialists, etc.);
- systems for circulating information on the impacts due to the introduction of species and on the approaches to prevention and management;
- a procedure for the rapid circulation of information on new introductions of species; and
- links of cooperation and exchange with the main pertinent world or regional initiatives.

Developing effective prevention strategies in the Mediterranean requires global information on pathways, vectors and potential invaders but most datasets are local or regional. The first global assessment, drawing from over 350 databases and other sources, reports information on 329 marine invasive species, including their distribution, impacts on biodiversity, and introduction pathways. Initial results confirm earlier assessments of the primary importance of shipping and aquaculture as introduction pathways and of the high levels of invasion in the temperate regions of Europe (Molnar et al. 2008). In addition, the role of maritime canals as corridors for the dispersal of

marine organisms, and natural canals and Straits for the unintentional and/or shipping-mediated transport is discussed in Gollasch et al. (2006) and ECNC/CoE (2007) respectively. Mediterranean hosts three of the 20 most visited harbours in the world: Peiraia, Las Palmas, Barcelona: Kaluza et al 2010.

A feasibility study concerning the whole “regional mechanism for collecting, compiling and circulating information on invasive non-indigenous species in the Mediterranean” provided for by the regional Action Plan on species introductions and invasive species, in its Paragraph 22 was assigned to HCMR. In doing this the undersigned has:

- investigated the international initiatives either addressing or incorporating alien marine species in the Mediterranean (CIESM, DAISIE, HCMR, REMPEC) (chapter 2);
- examined and comment existing system on IAS in the Mediterranean (chapter 3);
- compiled information on current human capacities and initiatives at national level of all UNEP/MAP-RAC/SPA member states (chapter 4);
- explored and discussed the services and tools provided by existing European Regional Systems (NOBANIS, BSASD) addressing IAS (chapter 5);
- Attempted to draft a new integrated system by describing needed prerequisites. Bearing in mind that avoiding invasive phenomena appears impossible due to natural corridors, and other human activities (shipping, aquaculture), one of the key facilities of the new system is an early warning and detection system. (chapter 6);
- provided a roadmap towards materialization of the new system (chapter 7);
- Provided contact details of key scientists engaged in biological invasion studies across the Mediterranean on a country by country level. A selection of experts from the list could serve as a consulting/managing body assigned by RAC/SPA. (Annex 2). Greek scientists are not included in the annex but can be retrieved from the Hellenic Network of experts on Alien Species (ELNAIS).

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2. ALIEN SPECIES IN THE MEDITERRANEAN: INTERNATIONAL INITIATIVES

Mediterranean scientific bodies such as International Commission for the Scientific Exploration of the Mediterranean Sea (CIESM) have been long active in addressing the phenomenon of biological invasions in multiple ways. Moreover, individual scientists have been often involved in international fora as national experts such as the ICES/IOC/WTIMO; ICES/IOC/WGBOSV groups and GLOBALLAST. Over the last decade, check lists of alien marine species have been published for a few countries (Cyprus, Greece, Israel, Malta and Turkey) while a plethora of papers deal with reviews of taxonomic groups and/or the first findings of new species and range expansion of introduced species.

2.1 CIESM

The CIESM is an organization that promotes international research in the Mediterranean and Black Seas. At the moment exotic species is one of the eight programs, involving a large number of associated research institutes in CIESM Member States, monitor parameters of importance for understanding the changing dynamics, biodiversity, hydrology and health of the Mediterranean and Black Seas. The advent and spread of alien species in the Mediterranean Sea were repeatedly discussed in CIESM fora over the past three decades, and it was widely perceived that the littoral and infralittoral biota of the sea is undergoing a rapid and profound change.

Initiatives of CIESM relevant to biological invasions include:

- a) The preparation of a series of reports published as a CIESM Atlas on the major taxa of non-native species introduced into the Mediterranean Sea.
- b) The convening of expert panels on ship-mediated transfer of species and the organization of a relevant workshop (Istanbul, 2002).
- c) The launching of the basin wide program PORTAL (see below) on port surveys for alien species.
- d) Dedicating sessions in the late CIESM Congresses.

2.1.1 Atlases

Three finely illustrated volumes of the Atlas have been published – fish (2002), crustaceans (2002), and molluscs (2004), while a volume on alien macrophytes is in press. Special care was taken to identify and eliminate from the Atlases those species historically, but mistakenly, considered to be non-indigenous due to misidentification or insufficient scientific evidence. These cases are carefully and explicitly detailed in each volume

2.1.2 Istanbul Workshop

The Mediterranean and Black Seas have been subjected to introduction of ship-borne exotic species since the opening of interoceanic maritime routes five centuries ago. The 'Atlas' revealed that the rates of invasions by fouling- or ballast transported organisms has increased in recent decades in the Mediterranean Sea. The organisation in 2002, in Istanbul, of the CIESM Workshop "*Alien marine organisms introduced by ships in the Mediterranean and Black seas*" focused on ship mediated introductions. This workshop produced an original synthesis, drawn from research studies from a broad range of marine disciplines (biology, shipping and management), reviewing the major gaps in knowledge and offering practical recommendations for action and research concerning ship-borne species invasions. This 136-pages document, published by CIESM in its Monographs Series (n°20), is freely available for download online (<http://www.ciesm.org/online/monographs/Istanbul.html>).

2.1.3 The PORTAL programme

In 2003, CIESM launched the first basin-wide port-survey program "**PORTAL - PORT** surveys in the Mediterranean Sea for ship-transported **Alien** organisms". PORTAL is a research programme that aims at implementing a Mediterranean-wide port and port-proximate survey using standardized protocols to collect baseline data on alien species, particularly those which might be introduced by shipping. The programme aimed at providing baseline data on alien species of targeted taxa (e.g., molluscs, barnacles) inhabiting port and the nearby manmade structures, including micro-organisms (e.g., *Vibrio cholerae*) that pose significant risk to human health. Further details of the programme will be found at <http://www.ciesm.org/marine/programs/portal.htm>. While recognizing that only a spatially and temporally comprehensive survey is likely to detect all alien species, scientific, logistic and cost constraints necessarily restricted the survey's scope. CIESM thus adopted a targeted phyla (macrophytes, bryozoans, serpulids, hydroids, ascidians, mollusks and barnacles) inhabiting port and port proximate manmade hard-substrates. Scientists were enlisted to sample 9 shipping ports, from Barcelona to Izmir, and two recreational marinas. Taxonomic experts were consulted on the protocol, and were engaged in the identification.

The scope of the program and preliminary results were presented and discussed during the 37th CIESM Congress, June 2004, in Barcelona and 38th CIESM Congress in Istanbul 2007 (e.g. Muscat *et al.*, 2007).

2.1.4 CIESM Congresses

In the last three CIESM Congresses (2001, 2004, 2007) scientists were encouraged to present their results on alien (exotic) species discovered in their countries while the coordinators of the Atlases volumes [fish: D. Golani , crustacea/decapoda: BS Galil, mollusca: A. Zenetos and macroalgae: M. Verlaque] were invited to present the state of art on the respective taxonomic groups. As a result there were 11 relevant communications in 2001, 17 in 2004, and 38 in 2007 presented in the congress sessions. In the forthcoming 39th Congress to be held in Venice (10-14 May 2010) 19 presentations are scheduled. For a full list of presentations see Annex 1.

In the last CIESM congress, the 3 contributions focused on patterns and trends in the introduction and distribution of alien species based on the analysis of datasets from the CIESM Atlases of Exotic Species (fish decapods, macroalgae). Dr Daniel Golani showed the abrupt increase in exotic fish in the Mediterranean Sea in recent years, with 18 newly introduced species since 2002, mainly through the Suez Canal. Many established species extended their range of distribution considerably, and for some species real population explosions occurred in just few years time (Golani *et al.*, 2007). The rate of invasions in the Mediterranean Sea is steadily increasing also for other taxa, as was clearly shown in the communication by Dr Bella Galil. By 2007, 66 exotic crustacean decapod and stomatopod species have been recorded in the Mediterranean Sea and the number of introductions has increased in the last decade (Galil, 2007). Dr. Marc Verlaque introduced the forthcoming CIESM Atlas on Exotic Macrophytes, which is the first inventory of macroalgal species introduced in the Mediterranean Sea (Verlaque *et al.*, 2007). Since the Mediterranean Sea harbours the greatest number of exotic macrophytes in the world, and since new species introductions are increasing exponentially mainly due to shellfish farming, this Atlas represents a unique benchmark to assess past and future changes on macroalgal diversity.

2.2 WGITMO - WGBOSV

ICES (International Council for the Exploration of the Sea) is a fishery-oriented intergovernmental organization, and as such has been confronted early on with issues related to the introduction of alien species. Of particular interest to ICES have been diseases and parasites introduced with live transport of fish and shellfish for relaying, stocking, ranching, and for fresh-fish markets. The need to assess the risks associated with the deliberate transfer of marine species, being of primal concern, led to the organization and launching of the Working Group on Introductions and Transfers of Marine Organisms (WGITMO) in 1979 (ICES/IOC/ WGITMO, 2002).

Although WGITMO, as mentioned above, was primarily concerned with deliberate introductions of species in the North Atlantic waters, unintentional species introductions and other marine regions (such as the Mediterranean) were also investigated and assessed. The National Reports from the Mediterranean countries (Croatia, France, Israel, Italy, and Spain) provide valuable information on the subject. These reports contain new laws and regulations relevant to species movements and biological invasions, data on deliberate releases, accidental introductions and transfers, live imports/exports, planned introductions, and meetings relevant to these subjects. As stated in the ICES/IOC/WGITMO (2006) report, these National Reports may be used for:

- Documentation of the spread of intentionally imported and/or invasive species over time and to new geographic areas. This is a unique data set especially when considering the long time series.
- Answering information requests for organizations.
- Providing a warning system for ICES member countries that invasive species have been found in neighboring jurisdictions, or countries having similar habitat conditions and enabling follow up of the spread of previously introduced species, especially for secondary spread across political borders.
- Giving indications which intentionally introduced species (e.g. for aquaculture use) have the potential to become invasive and to provide a follow-up to track their spread.
- Documenting exports and imports of marine species.
- Documenting the occurrence of unintentional introductions of parasites and disease agents.
- Providing information to other working groups, both within and outside of ICES and raising awareness of invasive and imported/transferred species in such groups.
- Facilitate the coordination of research activities within ICES member countries.
- Promotion of relevant scientific meetings and research initiatives.
- Documenting the success of mitigation measures or management of introduced non-target species, i.e. avoidance to duplicate unsuccessful approaches

Table 1 summarizes the participation of the Mediterranean countries on WGITMO meetings (1998-2009) and their submitting of National Reports relevant to the Mediterranean Sea (1998-2009).

Table 1. Participation of the Mediterranean countries on WGITMO meetings (1998-2009). (P: participation, P* participation and submitting a National Report).

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Croatia										P*		P*
France		P	P	P	P	P	P	P	P	P*	P	P
Israel	P*											
Italy	P		P	P	P	P*	P*	P*	P*	P*	P*	P*
Spain				P					P*	P*	P*	

Since the early 1990s ballast water became more and more into focus as vector of biological introductions. In the beginning WGITMO dealt with this phenomenon, but it was suggested to be more appropriate to launch a stand-alone group to address ballast water issues. ICES linked with IMO (the International Maritime Organization, the United Nations body which deals with shipping), IOC (Intergovernmental Oceanographic Commission) and other organizations in order to address the problem of ship-mediated species introductions. This led to the establishment of the Study Group on Ballast Water and Sediments (SGBWS), which was subsequently renamed to SGBOSV (Study Group on Ballast and Other Ship Vectors) to include other ship vectors such as hull fouling. Finally, in order to allow for a longer term operation, the group was reorganized as a working group (Working Group on Ballast and Other Ship Vectors – WGBOSV) and the ICES/IOC/IMO WGBOSV was launched in 2003 (Gollasch, 2007).

Both WGITMO and WGBOSV benefit from the input of guests originating from outside the ICES area, including representatives from the Baltic Marine Biologists (BMB), International Commission for the Scientific Exploration of the Mediterranean Sea (CIESM), European environment agency (EEA), North Pacific Marine Science Organization (PICES), and the European Research Network on Aquatic Invasive Species (ERNAIS) (Gollasch, 2007).

2.3 IMO: Globallast and BWC

In the year 2000, IMO joined forces with the Global Environment Facility (GEF), the United Nations Development Programme (UNDP), member governments and the shipping industry to assist less-industrialised countries to tackle the ballast water problem. The full title of this project was *Removal of Barriers to the Effective Implementation of Ballast Water Control and Management Measures in Developing Countries*. It was more simply referred to as the Global Ballast Water Management Programme, or **GloBallast**. This programme assisted developing countries to implement effective measures to control the introduction of foreign marine species.

The International Convention for the Control and Management of Ships Ballast Water & Sediments (**BWC**) was adopted by consensus at a Diplomatic Conference at IMO in London on Friday 13 February 2004. The Convention will enter into force 12 months after ratification by 30 States, representing 35 per cent of world merchant shipping tonnage (Article 18 *Entry into force*). Presently [28.2.2010], 22 countries have ratified the BWC, which represent 22.65 % of the world tonnage among which four Mediterranean coastal States (Egypt, France, Spain and Syria).

In January 2008, REMPEC started implementing, in the Mediterranean region, the Global Environmental Funds (GEF) / United Nations Development Programme (UNDP) / International Maritime Organization (IMO) Project entitled "*Building partnerships to assist developing countries to reduce the transfer of harmful aquatic organisms in ship's ballast water*" (GloBallast Partnerships). The Project is of five years duration (2008-2012).

The GloBallast Partnerships Project follows and is intended to replicate at a larger scale a first IMO-GEF-UNDP Project carried out between 2000 and 2004 in pilot countries on the issue of ships' ballast water management (BWM), taking also into consideration further developments which occurred after its completion, notably the adoption in 2004 of the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BW Convention).

The Project is specifically aimed at vulnerable developing States, with a view to assist them in implementing sustainable, risk-based mechanisms for the management and control of ships' ballast water and sediments and subsequently minimize the adverse impacts of aquatic invasive species transferred by ships.

Five high priority regions were identified within the GloBallast Partnerships Project, including the Mediterranean. GloBallast Partnerships cooperates with the Mediterranean region as a whole through the UNEP's Mediterranean Action Plan and in particular with its two relevant Centres: the Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea (REMPEC), administrated by IMO, and the Regional Activity Centre for Specially Protected Areas (RAC/SPA).

The development in the Mediterranean region of a Strategy addressing the transfer of harmful aquatic organisms and pathogens via ships' ballast water and sediments is on the right track as eighteen Mediterranean coastal States and the European Commission, during a meeting held on the 11 and 12 September 2008 in Dubrovnik, Croatia, decided to form a regional Task Force to develop such a Strategy and promote bringing into effect the 2004 BWC International Convention. The Meeting unanimously agreed that Croatia should chair the Task Force during its first term, i.e. until the second Meeting of the Task Force, to take place in 2010.

In the intersessional meeting of the GloBallast Regional Task Force, held in Malta (22 April, 2009), Croatia (the focus group on legal aspects) submitted a review of all the relevant legal instruments, mechanisms and initiatives on all levels (international, regional and sub regional). Cyprus (the focus group on capacity building) submitted a review on the development of training programmes to implement the ballast water convention, and Italy (the focus group on policies and monitoring) had the task of preparing a report on the definition of a harmonized ballast water regime and a harmonized monitoring system. Finally, **Turkey** (the focus group on assessment) prepared a very detailed overview of the situation in the Mediterranean (shipping patterns, alien biota, impacts), a review of experience and research studies in the Mediterranean, **and proposed an information exchange system.**

In July 2009, a meeting of MAP Focal Points took place in Athens (Greece), included in its agenda an item on “*Regional Strategy Addressing Ship’s Ballast Water Management and Invasive Species*”. In that meeting, an agreement was reached on the necessity of developing a regional strategy on ships’ ballast water to address the transfer of harmful aquatic organisms and pathogens in the Mediterranean, and the decision for the development of a regional strategy on ships’ ballast water management in the Mediterranean (within the Mediterranean Action Plan-MAP) was taken (UNEP/MAP 2009).

2.3.1. REMPEC: The Turkish proposal

At the Intersessional Meeting of the GloBallast Regional Task Force in Malta (REMPEC, 2009) Turkey proposed a mechanism for exchanging information is a web based system that covers all kind of information which will be collected by the contribution of littoral states of Mediterranean. The data input to the system will be elaborated by three streams (figure 1). The scientific institutes of the Mediterranean countries will produce relevant information. This information will be coordinated and evaluated by the governmental authorities of the countries. The Regional Activity Center will also make a gap analysis and coordination in order to produce information.

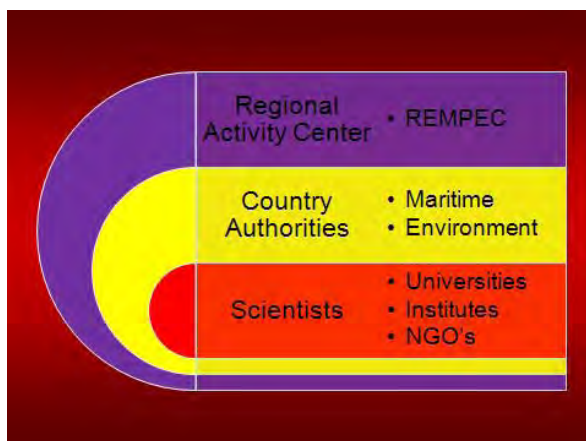


Figure 1. Data flow assessment and management as proposed by REMPEC, 2009.

SYSTEM ARCHITECTURE

The system will be using via internet. Every country could enter the system by using username and password. It will contain a home page that you can access to the information module pages. Ten information modules were defined (Figure 2).

These ten modules are as follows;

1. Risk assessment

Risk assessment of the Mediterranean Ports

Risk assessment methodologies, guidelines

The results of risk assessment studies done by other countries

Target invasive species

2. Ballast Water Reporting Form

Ballast water reporting form system

Statistical results of ballast water discharges

3. Invasive species Database

Searching by name and habitat

4. Scientists database

5. Legal Instruments

Ballast water convention

Guidelines

National legal instruments

6. National Competent Authorities

Global Partnership focal points

Maritime Authorities

Scientific Institutes

7. Ship routes

8. Raising awareness tools

9. Port biological baseline surveys

Port biological baseline survey guideline

PBBS Workshop presentations

PBBS Studies in countries

10. Treatment

Treatment system inventory

IMO approval procedure

Approved systems in Mediterranean countries

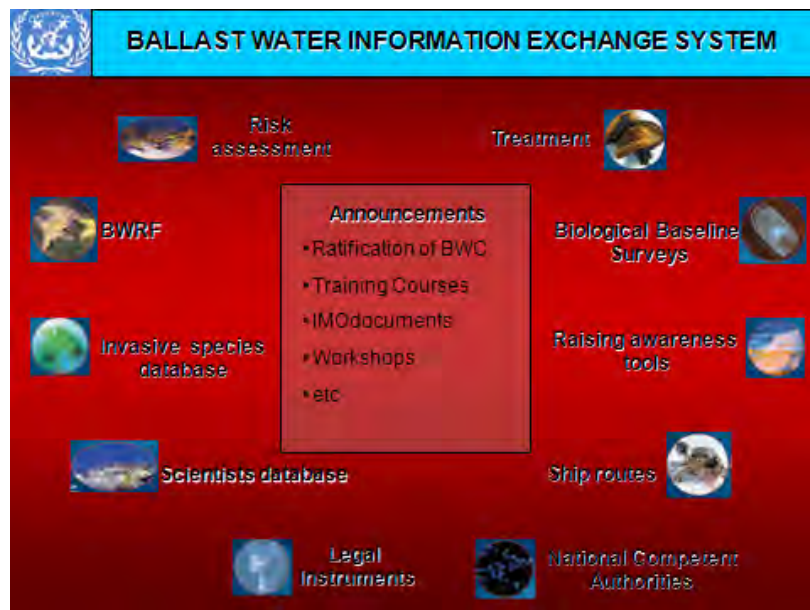


Figure 2. Home page with the links of the general information modules proposed (REMPEC, 2009).

3. ALIEN SPECIES DATABASES IN THE MEDITERRANEAN

3.1. DAISIE

The European Alien Species Database and its website (Invasive Alien Species Gateway) were created as part of the DAISIE project (Delivering Alien Species In Europe, funded by the sixth framework programme of the European Commission - Contract Number: SSPI-CT-2003-511202), and have been developed by an international team of experts in biological invasions, consisting of 19 partners from 15 nations, as well as a number of contributors/ collaborators from 26 countries.

The project's main objective was to create an inventory of invasive species that threatened European terrestrial, fresh-water, and marine environments, structured in such a way as to provide a basis for the prevention and control of biological invasions through the understanding of all factors involved (environmental, social, economic, etc.). Furthermore, it aimed to assess and summarize the ecological, economic and potential health risks and impacts of the most widespread (and/or noxious) invasive species, while using distribution data and the experiences of the individual Member States as a framework for considering early warning indicators.

The European Invasive Alien Species Gateway links four individual data systems developed during the DAISIE project for public access over the internet (Figure 3). These are:

1. The European Alien Species Expertise Registry, which contains details of individual experts and represents a step towards linking different research organizations throughout Europe
2. The European Alien Species Database, It contains information on 8996 species in 63 inland **and 39 coastal and marine areas** (figure 4).
3. The European Invasive Alien Species Information System, which focuses on the 100 species that represent the worst invasive organisms in terms of their impact on biodiversity, economy, and health.
4. Distribution Mapping and Spatial Analysis, which uses the Common European Chronological Grid Reference System (CGRS) to produce distribution maps for the 100 species that represent the worst invasive organisms in terms of their impact on biodiversity, economy, and health. (figure 5)



Figure 3. Homepage of DAISIE.

3.1.1 DAISIE data on the Mediterranean

For coastal aquatic groups, coastlines of all European countries are included, as well as non-European countries on the Mediterranean Sea (Figure 2). Concerning the Mediterranean Sea, DAISIE gives an account of alien aquatic marine organisms from 18 countries and lists 501 species as alien. The number of species per country is presented in table 2. These species comprise 15 taxa as presented by DAISIE. These are presented in Table 3.

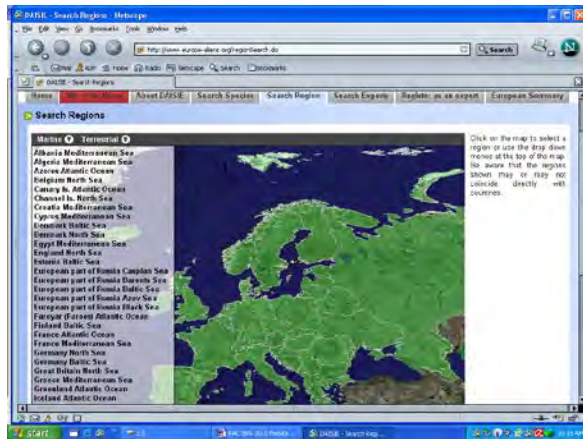


Figure 4. The search option in DAISIE for marine aliens in European waters including non-European Mediterranean countries.

DAISIE had as an objective to establish a common European standard for the graphical presentation of the alien species data as distribution maps. Examples of Mediterranean species are presented in figure 5.

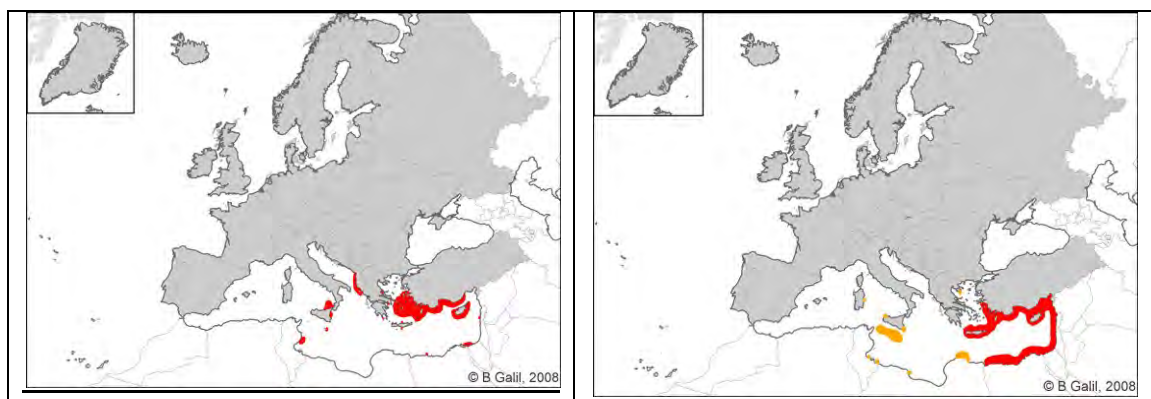


Figure 5. Distribution of *Halophila stipulacea* (left) and *Fistularia commersonii* (right) (DAISIE website). Yellow indicates infrequent distribution, red is for key distribution area.

Table 2. Number of marine Alien species per country in the Mediterranean Sea. Countries in alphabetic order.

country	No of species
Albania	9
Algeria	11
Croatia	18
Cyprus	75
Egypt	141
France	83
Greece	88
Israel	261
Italy	120
Lebanon	113
Libya	31
Malta	23
Morocco	10
Slovenia	11
Spain	39
Syria	45
Tunisia	50
Turkey	182

Table 3: List of taxa and their respective species number as archived in DAISIE.

Taxon	No of species
Algae (Rhodophyta)	57
Algae (Chlorophyta)	16
Algae (other)	14
Algae (Chromista)	4
Annelida	46
Cnidaria	11
Crustacea	84
Echinodermata	5
Bryozoa	6
Fish (Chondrichthyes)	2
Fish (Osteichthyes)	72
Invertebrates (other)	1
Magnoliophyta	1
Mollusca	177
Tunicata	5

As mentioned above, DAISIE has produced a list of 100 species that represent the worst invasive organisms in terms of their impact on biodiversity, economy, and health. 32 of those species are aquatic marine, and of these 20 have a Mediterranean distribution. These are: *Brachidontes pharaonis*, *Caulerpa racemosa*, *Caulerpa taxifolia*, *Codium fragile*, *Crassostrea gigas*, *Crepidula fornicata*, *Ficopomatus enigmaticus*, *Fistularia commersonii*, *Halophila stipulacea*, *Marsupenaeus japonicus*, *Musculista senhousia*, *Percnon gibbesi*, *Pinctada radiata*, *Portunus pelagicus*, *Rapana venosa*, *Rhopilema nomadica*, *Saurida undosquamis*, *Siganus rivulatus*, *Tricellaria inopinata*, and *Undaria pinnatifida*.

3.1.2 Comments on DAISIE

Although DAISIE includes a large amount of valuable information concerning Alien Species in Europe, there are a number of discrepancies and gaps in information that need to be pointed out.

First of all, there are no accounts of aquatic alien species for 4 Mediterranean countries. These are Monaco, Bosnia-Herzegovina, Montenegro, and Palestinian Authority. Furthermore, there is no listing of cryptogenic aquatic marine aliens from any country.

In the DAISIE database, we located three misspelled species. These are: *Microcosmus squmifer* (the correct name is *Microcosmus squamifer*), *Paracereis scuplta* (correct name is *Paracerceis scuplta*), and *Pedicrice sulcata* (correct name is *Pedicirce sulcata*). Even something as insignificant as a spelling mistake, can produce faulty result in a database.

Also, there is a number of species included in the database that ought to be excluded, according to the bibliography. These are:

- *Branchiosyllis exilis* (Gravier, 1900). A widespread species (Atlantic, Indo-Pacific), including east Atlantic (see Zenetos *et al.*, 2005/6).
- *Tharyx dorsobranchialis* syn with *Monticellina dorsobranchialis* CINAR, 2005 Atlanto-Mediterranean species (Kirkegaard, 1959) (Zenetos *et al.*, 2005/6).
- *Opisthosyllis brunnea* (see Zenetos *et al.*, 2005/6).
- *Uncionella lunata*: in Algeria: Native: Described from Algeria: Chevreux (1911)
- *Dipterosiphonia dendritica* (see Zenetos *et al.*, 2008).
- *Aphanius dispar*: This species was considered for many years to be a lessepsian migrant. However, electrophoretic analysis of Red Sea and Mediterranean populations of this species by Kornfield and Nevo (1972) led to the conclusion that its presence in the Mediterranean preceded the opening of the Suez Canal (Golani, 2010)
- *Gracilaria disticha*: Old record to be confirmed: Fox (1926) (see Zenetos *et al.*, 2008).

Furthermore, three more species are wrongly included in the country lists, since they are not present in these areas according to the literature and expert opinion:

- *Thais sacellum* (Cyprus). Not present in Cyprus: Katsanevakis *et al.*, 2009.
- *Sargassum muticum* (Spain). Not present in the Spanish Mediterranean as an attached algae. The reports come from unattached individuals that have been seen in the sea or ashore, specimens that probably come from the lagoons from southern France. In my opinion it cannot be considered as an introduced species in the Spanish Mediterranean. Enric Ballesteros, pers. Comm. 16.2.10 (kike@ceab.csic.es).
- *Parexocoetus mento* (Italy). Not present in Italy: Orsi-Relini, 2010.

Three more species are wrongly included in the aquatic marine list of alien species of DAISIE. These are the freshwater species *Oreochromis niloticus* and *Salmo trutta* (Italy), and *Gambusia affinis* (Slovenia). A further misplacement, of taxonomic nature, concerns the species *Lomentaria hakodatensis* which is a Rhodophyte but classified under “Algae, other”. Similarly, all other species classified as “Algae, other” and “Chromista” are *Fucophyceae*, and should therefore be put in the same taxonomic group.

Finally, there is a number of species in the DAISIE database that have not been updated taxonomically. The size of the lack of taxonomic updates in the database can be seen in table 4.

Table 4. Taxonomic updates of species presented in DAISIE.

Name in DAISIE	Valid name	Notes/SOURCE
<i>Branchiomma boholense</i>	<i>Branchiomma bairdi</i> (McIntosh, 1885)	Cinar, 2009
<i>Linopherus acarunculata</i>	<i>Linopherus canariensis</i>	Cinar, 2009
<i>Asyschis gotoi</i>	<i>Metasychis gotoi</i>	Bellan, 2009 in WoRMS
<i>Sphaerosyllis longipapillata</i>	<i>Prosphaerosyllis longipapillata</i>	Cinar, 2009
<i>Anadara demiri</i>	<i>Anadara transversa</i>	Albano <i>et al.</i> , 2009
<i>Ergalatax obscura</i>	<i>Ergalatax junionae</i>	re-evaluated by Houart, 2008
<i>Crepidula aculeata</i>	<i>Bostrycapulus odites</i>	Collin, 2005
<i>Styloptygma beatrix</i>	<i>Syrnola lendix</i>	Van Aartsen & Goud, 2006
<i>Anoplodactylus portus</i>	<i>Anoplodactylus californicus</i>	Bamber, 2009 in WoRMS
<i>Monostroma obscurum</i>	<i>Ulvaria obscura</i>	AlgaeBASE
<i>Audouinella robusta</i>	<i>Acrochaetium robustum</i> Børgesen, 1915	AlgaeBASE and Guiry, 2009 in WoRMS
<i>Audouinella spathoglossi</i>	<i>Acrochaetium spathoglossi</i> Børgesen, 1937	AlgaeBASE and Guiry, 2009 in WoRMS
<i>Audouinella subseriata</i>	<i>Acrochaetium subseriatum</i> Børgesen	AlgaeBASE and Guiry, 2009 in WoRMS
<i>Cladophoronopsis javanica</i>	<i>Cladophora herpestica</i>	AlgaeBASE
<i>Hypnea spicifera</i>	<i>Hypnea flagelliformis</i>	AlgaeBASE
<i>Antithamnion pectinatum</i>	<i>A. nipponicum</i>	AlgaeBASE ; Cho <i>et al.</i> , 2006
<i>Audouinella codicola</i>	<i>Acrochaetium codiculum</i>	AlgaeBASE
<i>Codium fragile subsp tomentosoides</i>	<i>Codium fragile fragile</i>	AlgaeBASE
<i>Leathesia difformis</i>	<i>Leathesia marina</i>	AlgaeBASE
<i>Grateloupia filicina</i> in France	<i>Grateloupia asiatica</i>	<i>Grateloupia asiatica</i> corresponds to the alga previously misidentified as <i>Grateloupia filicina</i> in Japan (Kawaguchi <i>et al.</i> , 2001).
<i>Mugil soiuy</i>	<i>Liza heamatocheila</i>	FISHBASE
<i>Chilomycterus spilostylus</i>	<i>Cylichthys spilostylus</i>	FISHBASE
<i>Stomega lorioli</i>	<i>Odostomia lorioli</i>	Gofas, 2009 in WoRMS
<i>Asterina burtoni</i>	<i>Aquilonastra burtoni</i>	O'Loughlin & Waters, 2004

While evaluating the DAISIE site, we came across certain problems in the site functions. Specifically, the option to contact specialists always resulted in error and did not provide the information sought. Much more significant is the complete absence of sources for information concerning aquatic alien species (distribution, pathways, and vectors).

Finally the main drawback is the lack of updates. For example in Cyprus it lists 75 alien species as opposed to 131 species reported to date (Michailidis et al, 2010).

3.2 CIESM Atlases

The CIESM “Data Base” on “exotic” Species in the Mediterranean (Figure 6) is now the authoritative reference for specialists world-wide, as affirmed by its integration in NISBase, <http://www.nisbase.org/index.jsp>, the global database of introduced species, which is managed by Smithsonian Institution.

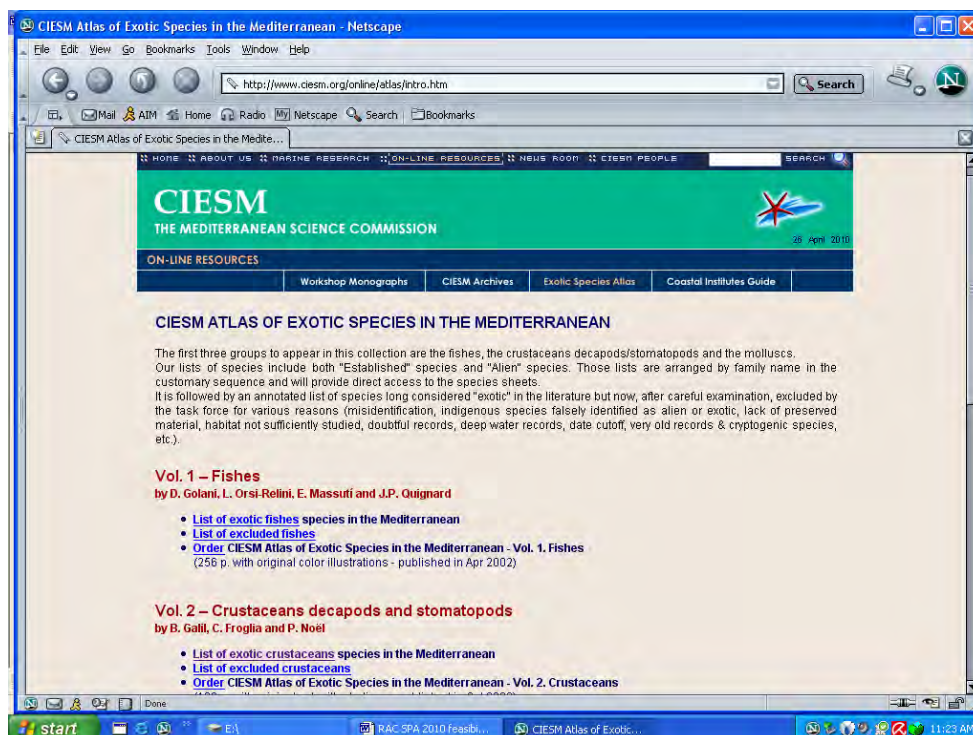


Figure 6. Users interface of the CIESM Atlas on exotic species in the Mediterranean.

In the CIESM atlases, only those exotic species of Indo-Pacific origin that were recorded after 1920 and of Atlantic origin that were recorded after 1960 (1950 for crustaceans) are considered.

It comprises three separate, illustrated volumes and is also freely available for consultation on the CIESM website <http://www.ciesm.org/online/atlas/index.htm> where it

is regularly updated.

The Atlas provides a full description of valid, verified cases of introduced species in the Mediterranean Sea. This includes:

- Distribution maps (kept up-to-date) of each introduced species, based on scientific, published records or newly collected material, rigorously validated by a CIESM group of experts (see experts under each taxonomic group).
- A detailed description, accessible to both specialists and non-specialists, of the morphological features of the species, plus a special section focusing on distinguishing characteristics to help avoiding misidentification with similar Mediterranean species.
- Information on the biology of the species, with particular reference to its life histories, diets and habitats.
- Further information on the geographical distribution (including first record in the Mediterranean), mode of introduction, establishment, importance for the ecosystems and implications for humans (living resources and health)
- An exhaustive list of scientific references.

3.2.1 Fish

The CIESM task force responsible for the fish Atlas initially comprised four biologists: Drs Daniel Golani (the Hebrew Univ. of Jerusalem, Israel), Enric Massutí (Oceanographic Centre, Palma, Spain), Lidia Orsi-Relini (Univ. of Genoa, Italy) and Jean-Pierre Quignard (Univ. of Montpellier, France). They are co-authors of the volume printed in 2002 and of the data produced until 2006. In 2006 the group was reinforced by the addition of Dr Jakov Dulčić (Inst. of Oceanography and Fisheries, Split, Croatia), and in 2008 by Dr Ernesto Azzurro (Inst. for Environmental Protection and Research, Milazzo, Italy).

The fish Atlas includes 116 alien species (from 64 families), of both cartilaginous and bony fishes, found in the Mediterranean Sea that originate from three different geographical areas (Boreal Atlantic, Indo-Pacific, and Tropical Atlantic).

3.2.2 Crustaceans

The CIESM task force comprised three biologists: Drs Bella Galil (Israel Oceanographic and Limnological Research, Haifa), Carlo Froglia (Istituto di Ricerche sulla Pesca Marittima, Ancona) and Pierre Y. Noël (Museum National d'Histoire Naturelle, Paris).

The Atlas for Crustaceans contains 70 alien decapod species (from 31 families) and 2 alien stomatopod species from a single family. According to the Atlas, alien crustaceans

in the Mediterranean originate from six geographical areas. These are: American Atlantic, Boreal Atlantic, Tropical Atlantic, Eastern Pacific, Indo-Pacific, and Western Pacific. Crustacean species classified as “Alien” are considered to be non-established on the basis of a single reliable record so far, while those classified as “Established” are presumed so, on the basis of at least two reliable records distinct in time and/or space.

3.2.3 Molluscs

The CIESM atlas on Exotic Molluscs in the Mediterranean Sea was developed by a CIESM task force of four biologists : Argyro Zenetos (Natl. Center for Marine Research, Athens), Serge Gofas (Univ. Malaga), Giovanni Russo (Univ. di Napoli), Jose Templado (Museo Natl. de Ciencias Naturales, Madrid). The team of experts is now coordinated by Dr Gofas.

The CIESM molluscan Atlas includes 137 alien species of prosobranch gastropods (25 families), heterobranch gastropods (2 families), opisthobranch gastropods (17 families), pulmonate gastropods (1 family), pteromorph bivalves (9 families), heterodont bivalves (13 families), anomalodesm bivalves (1 family), and a single polyplacophore species from a single family found in the Mediterranean Sea. 85 of these species are classified as “Established”. Alien molluscs in the Mediterranean originate from 13 areas (American Atlantic, Arabian Sea, Circumtropical, Indian Ocean, Indo-Pacific, North Eastern Pacific Ocean, Persian Gulf, Pacific Ocean, Red Sea, Suez Canal, Tropical Pacific Ocean, Tropical Atlantic, Western Pacific Ocean).

3.2.4 Macroalgae

The data base of Exotic Macrophytes in the Mediterranean Sea was developed by a CIESM task force of four biologists: Drs Marc Verlaque (DIMAR-CNRS, France), Sandrine Ruitton (DIMAR-CNRS, France), Frédéric Mineur (Queen's University of Belfast, UK) and Charles-François Boudouresque (DIMAR-CNRS, France). The Atlas will provide comprehensive, referenced information on the morphological features, ecology and biogeography of 110 exotic macroalgal species. The Atlas is accessible online since 2009, and will be published by the end of 2010. It currently lists only the name of species and their distribution maps.

3.2.5 CIESM database commented

Drawbacks of the CIESM compilation

- It is not a database per se as it provides static html pages with no search option besides the species name. It is only taxonomic based not country based. The status per country even for the four well treated groups is not accessible.
- it is limited in taxonomic coverage. The 4 groups, include 433 species altogether versus the 947 known in the Mediterranean to date (Zenetos, 2010a)
- Updates are not regular (Table 5). No update for molluscan after 2005 (137 species vs 220 present to-date). List of excluded species are not updated. E.g *Lagocephalus sceleratus* is still listed as excluded although it has been added in the fish aliens list since 2005.
- The terminology used is outdated. For example alien species which is a synonym of exotic species is used to define casual records. This creates a misunderstanding to users who are familiar with the CBD terminology.
- It is not freely accessible to the world scientific community. Only Mediterranean countries have free access as CIESM members

Table 5. Updates per taxonomic group in the CIESM Atlases (* year of last update).

	fish	decapods	mollusca	macroalgae
2002	89	61	-	-
2003	-	62	137	-
2004	96	-	-	-
2005	99	64	137*	-
2006	-	66	-	-
2008	-	70*	-	-
2009	116*	-	-	110*

3.3 IMET/ICRAM database

ICRAM with the collaboration of SIBM finished an important work funded by the Italian Ministry of Environment (IMET): Introduction of non-indigenous and genetically modified species project, a government-funded program stemming from the application of article 13 of the SPABIO Protocol. The project deals mainly with: a) the formulation of a taxonomic and diagnostic atlas for the identified species of each taxonomic group, realized through GIS; b) the monitoring of ballast waters; c) the drawing up of guidelines for aquaculture practices (one of the main causes for the penetration of alien species) to

avoid the expansion of this phenomenon. In materializing the project 30 taxonomic experts coming from ICRAM, Italian Universities, CNR, ARPA, Stazione Zoologica di Napoli, LBM collaborated

As a result Identification sheets for 552 mediterranean NIS species have been produced. A summary of Non Indigenous species archived in ICRAM is given in table 6 while an example of online GIS-based data-bank on abundance and distribution of fish is depicted in Figure 7.

Table 6. Summary table of NIS data for Mediterranean Sea (F. Andaloro in ICES/IOC/WGBOSV, 2004).

Taxonomic Group	No of NIS	pathway	% of pathway
Mollusca	150	Lessepsian migration	44 %
Plants	129	shipping	16 %
Fish	104	Atlantic migration	9 %
Crustacea decapoda	60	mariculture	8 %
Polychaeta	58	others	1 %.
Cnidaria		Unknown	21 %
Bryozoa	16		
Tunicata	10		
Total	552		

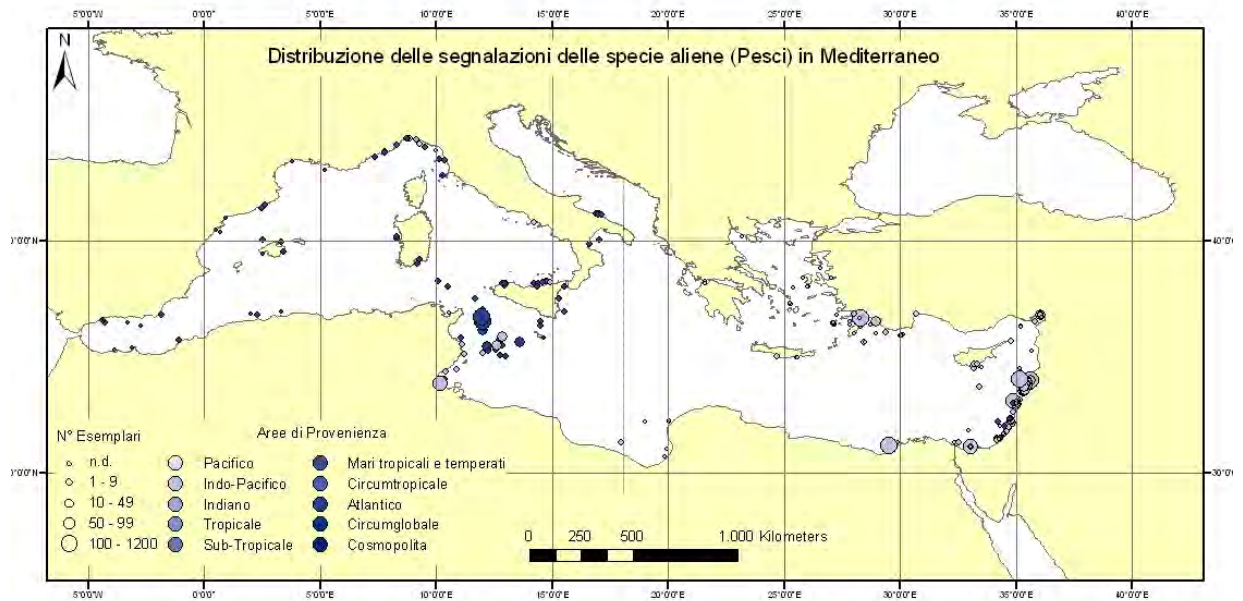


Figure 7. Distribution map of fish species in the Mediterranean. Source: F. Andaloro in ICES/IOC/WGBOSV, 2004.

ICRAM carried out also a project concerning the identification of alien species in Italian seas, funded by IMET. Such effort was especially focused on supporting the adoption of the new *Protocol Concerning Specially Protected Areas and Biological Diversity in the Mediterranean Sea* of the Article 13 ASPIM of Barcelona Convention, that requires, *inter alia*, the regulation of the introduction of non-indigenous or genetically modified species, and also in adoption, for marine biodiversity, of Article 8h of the Biological Diversity Convention.

The project also foresaw the creation of an inventory and atlas of non-indigenous and genetically modified organisms (GMOs) utilized in aquaculture and the aquaria industries. 165 NIS species recorded in Italian seas belonging to 8 taxonomic groups were archived (Table 7). This project ended in 2005. Results of the project included:

- critical review of the international literature, particularly on HAB microalgae, resting spores and cysts;
- identification of the Italian harbours at major risk of invasion, (analysis of commercial ships' routes and traffic and of the volume of ballast waters exchanged);
- ballast water samples collected and analysed for the ports of Trieste and Naples; IMO forms compiled on a voluntary basis
- establishment of sampling protocols for tank waters and sediments

Table 7. Summary table of NIS data for Italian seas.

Taxonomic group	No of NIS
Mollusca	16
Plants	80
Fish	18
Crustacea decapoda	14
Polychaeta	18
Cnidaria	25
Briozoa	4
Tunicata	5

An updated list of NIS present in Italy was compiled by the SIBM group. According to the latest update 163 species have entered the Italian waters after 1945.

3.3.1. IMET/ICRAM database commented

Drawbacks of the ICRAM compilation

- it is limited in taxonomic coverage. Only 8 taxonomic groups
- outdated. Latest compilation in December 2007.

3.4 FAO DIAS

The *FAO database on introductions of aquatic species* currently contains about 3,150 records of introductions of freshwater and marine fishes, and other taxa, and can be accessed through a Search Form. The database includes records of species introduced or transferred from one country to another. Coverage of accidental introductions of organisms (e.g., through ship ballast waters) is not complete and records on this topic have been entered only when important impacts on fisheries or on the environment have been caused (*Mnemiopsis* introduction to the Black Sea, for instance).

3.5 HCMR Application (Greece)

A simple information system has been developed in HCMR (for internal use only) to serve as a resource in developing an alien species trends indicator. The database, structured in ACCESS application, includes information on marine aliens in the Mediterranean Sea for reporting to UNEP/MAP and EEA respectively.

For the Mediterranean system, main sources are the CIESM atlases, country reports to UNEP/MAP, scientific papers and collaboration with regional experts on taxonomic groups. More than 15 experts have contributed to the Mediterranean database, which presently (March 2010) includes 1238 species, and 4949 records (findings along the Mediterranean per biogeographic region/country). The database includes species reported as aliens that were excluded in subsequent publications as well as Atlantic fish species that entered the Med since 1900.

The database is updated on a monthly base and results are reported to UNEP/MAP and EEA and/or communicated to international congresses. One of the main uses of the aforementioned systems is the development of a trends indicator on marine and estuarine species in Europe for the SEBI2010 program (EEA, 2007) and the Mediterranean (UNEP/MAP, 2007).

The database (desk top local application) (figure 8) contains fields including:

- Taxonomic authorship, synonyms, higher level classifications, classification per ecofunctional group and Notes on origin of species and/or known impact in the Mediterranean
- Distributional information in hierarchical levels (regional Seas, and countries)
- Establishment success, known or suspected mode of introduction and first sighting date
- Notes on location and habitat information including substrate and depth if available
- Bibliographic information

Simple queries have been designed to provide information on distribution per a region (Figure 9)

distribution per country (Figure 10)

species within a taxonomic group (Figure 11)

species discovered for a specific year (Figure 12)

Species ID	ANA01	Author	(Say, 1822)		
Species Name	Anadara transversa	Success	Established	imis. Arca amygdalum Philippi, 1847	
Origin	West Atlantic	Vector	shipping/aquaculture	imis Scapharca demiri Piani, 1981	
Ecofunctional	Zoobenthos	First Sighting	1972	imis Anadara demiri (Piani, 1981)	
Taxon	Mollusca	First Record	Demir, 1977: Turkey		
Subgroup	Bivalvia	Notes	Morphological comparison may suggest the origin of the Mediterranean population is from the southern part of the range of A. transversa on Gulf of Mexico coasts of		
Findings					

Species ID	LME	First sighting	Success:	Notes	Reference
Anadara transversa	Aegean Turkey	1972	Established	1972, Izmir, Turkey (Kocatas, pers. commun.) (Demir, 1977 as Arca amygdalum)	Demir M., 1977. On the presence of Arca (Scapharca) amygdalum Philippi, 1847 in the harbour of
Modification Date: 5/31/2009 11:10:44 AM					
Anadara transversa	Turkey	1972	Established	1972: see Aegean Turkey Cinar et al., 2006	Demir M., 1977. On the presence of Arca (Scapharca) amygdalum Philippi, 1847 in the harbour of
Modification Date: 5/31/2009 11:10:52 AM					
Anadara transversa	Greek North Aegean	1993	Established	1993: N. Aegean: Thermaikos Gulf (Zenetos, 1994)	Zenetos, A., 1994. Scapharca demiri (Piani, 1981): First finding in the North Aegean Sea. La
Modification Date: 5/31/2009 11:10:59 AM					
Anadara transversa	Greece	1993	Established	1993: Thermaikos: Thessaloniki	Zenetos, A., 1994. Scapharca demiri (Piani, 1981): First finding in the North Aegean Sea. La
Modification Date: 5/31/2009 11:11:05 AM					

Figure 8. Example of a data entry form for distribution of a molluscan (*Anadara transversa*).

Country/Region: N Adriatic Print Region Report

Distribution ID	Species Name	First sighting	Establ. Success	Notes	Reference
BRA-01-013	Brachidontes pharaonis		Excluded	see Croatia	DE MIN R. & VIO E., 1997. Molluschi
Modification Date: 30/9/2009 8:09:54 μμ					
BRY-01-007	Bryopsis plumosa	2000	Excluded	Venice Lagoon: Curiel et al, 2006	CURIEL et al, 2006. Acta Adriatica, 47 (1):
Modification Date:					
BUR-01-018	Bursatella leachii	1989	Established	Gulf of Trieste (Jaklin & Vio, 1989; Vio & De Min, 1996; De Min &	MIZZAN L. & VIANELLO C., 2009. Bursatella
Modification Date:					
CAL-09-001	Callinectes danae	1981	Casual	Venice	MIZZAN 1993
Modification Date:					
CAL-10-010	Callinectes sapidus	1949	Established	1949 & 1959: Gulf of Venice as Neptunus pelagicus: 2 animals	GIORDANI SOIKA, 1951; MIZZAN, 1993
Modification Date: 16/3/2010 11:03:49 μμ					
CEL-03-001	Celleporella carolinensis	1993	Casual	collected on Mytilus in several places of the Venice Lagoon	OCCHIPINTI & d'HONDT, 1996. Introduzione di
Modification Date:					

Record: 15 of 63

Figure 9. query extract for list of species at a region (North Adriatic). The output can be extracted either as a report or as an xls file.

DistributionID	Species_Name	First_sighting	Country_Success	Reference
ACA-NAY-003	Acanthophora nayadiformis	1969	Established	Lanfranco, 1989
AEO-IND-002	Aeolidiella indica	1992-98	Established	Sammut, C. and Perrone, A.S., 1998.
ALE-DJE-010	Alepes djedaba	1961	Established	Lanfranco, 1993
AMP-LOB-005	Amphistegina lobifera	2006	Established	Yokes, et al, 2007
APL-DAC-006	Aplysia dactylomela	2008	Casual	Schembri, 2008
APL-PAR-002	Aplysia parvula	1967	Questionable	Bebbington, 1970
ASP-ARM-006	Asparagopsis armata	1994	Established	Cormaci et al., 1997
ATA-GLA-002	Atactodea glabrata	1977	Casual	Cachia et al., 2004
BOT-MAD-002	Botryocladia madagascariensis	1994	Questionable	Cormaci et al., 1997
BRA-PHA-011	Brachidontes pharaonis	1970	Established	Cachia et al., 2004
BUR-LEA-005	Bursatella leachii	1969	Established	Bebbington, 1970
CAL-SAP-009	Callinectes sapidus	1972	Established	Schembri & Lanfranco, 1984
CAU-RAC-009	cylindracea	1997	Established	Stevens, 1999
CEL-APE-003	Celleporaria aperta	1975	Questionable	Agius et al., 1977
CEL-PIL-001	Celleporaria pilaefera	1975	Questionable	Agius et al., 1977
CER-SCA-009	Cerithium scabridum	2005	Established	Mifsud & Sammut 2006

Figure 10. Query extract in xls format for list of species at a country (Malta).

Taxon Name	Species Name	Ecofunction	Subgroup_ID	Author	First_Sighting	First_Record	Success
	Theora (Endopleura) lub	Zoobenthos	Bivalvia	Gould, 1861	2001	Balena et al., 2002	Established
	Vexillum depeyum	Zoobenthos	Gastropoda	(Deshayes in Lab	1964	Bat Yam, Israel; Menis 1985 &	Casual
	Vexillum cadaverosum	Zoobenthos	Gastropoda	(Reeve 1844)	1871	Menis, 2004	Excluded
	Voorwindia tiberiana	Zoobenthos	Gastropoda	(Issel, 1869)	1972	Piani, 1980, as Putilla tiberiana	Casual
	Xenostrobus securis	Zoobenthos	Bivalvia	(Lamarck, 1819)	1992	Sabelli & Speranza 1993	Established
	Zafra savignyi	Zoobenthos	Gastropoda	(Moazzo, 1939)	1954	Menis, 1972	Established
	Zafra selasphora	Zoobenthos	Gastropoda	(Melvil & Stande	1980	Palazzi S., 1993	Established
	Mitrella psilla	Zoobenthos	Gastropoda	(Duclos, 1846)	2008	Antit et al, 2009; Tunisia	Established
	Turborilla edgarii	Zoobenthos	Gastropoda	(Melvil, 1896)	1980	van Aartsen et al., 1989	Established
	Synnola cinctella	Zoobenthos	Gastropoda	A. Adams, 1860	1994	van Aartsen & Recevik, 1998	Casual
	Sticteulima cf. lentiginos	Zoobenthos	Gastropoda	(A. Adams, 1861)	1989	Tringali, 1994	Casual
	Stomatella impertusa	Zoobenthos	Gastropoda	(Burrow, 1815)	1999	Schniebs, 2000	Casual
	Strombus mutabilis	Zoobenthos	Gastropoda	(Swainson, 1821)	1991	Menis, 2001	Questionable
	Strombus persicus	Zoobenthos	Gastropoda	Swainson, 1821 (1978	Nicolay & Romagna-Manoja, 1	Established
	Strombus lentiginosus	Zoobenthos	Gastropoda	Linnaeus, 1758	1934	Aharoni (1934)	Excluded
	Strigatella virgata	Zoobenthos	Gastropoda	(Reeve, 1844)	1970	Brindisi; Parenzan (1970)	Excluded
	Trapezium oblongum	Zoobenthos	Bivalvia	(Linnaeus, 1758)	1980	Menis, 1980c	Casual
	Syphonota geographica	Zoobenthos	Gastropoda	(Adams & Reeve, 1989		Terreni, 1997 as Phylaplysia	Established
	Potamides conicus	Zoobenthos	Gastropoda	(Blainville, 1826)		Plaziat, 1989	Excluded
	Synnola fasciata	Zoobenthos	Gastropoda	(Jickeli, 1882)	1947	1958; van Aartsen et al., 1989	Established
	Synnola lendix	Zoobenthos	Gastropoda	(A. Adams 1863)	1988	Micali & Palazzi, 1992	Established
	Tellina valtonis	Zoobenthos	Bivalvia	Hanley, 1844	1970	Barash & Danin, 1977	Established

Figure 11. Report of species within a taxonomic group (Mollusca).

<i>First Sighting</i>	<i>Species Name</i>	<i>Region</i>	<i>Reference</i>	<i>Notes</i>
2009				
	<i>Kyphosus incisor</i>	Italy	Orsi-Relini L., Costa MR & Relini M., 2010. First record of the yellow sea chub <i>Kyphosus incisor</i> in the Mediterranean. <i>Marine Biodiversity Records</i> , page 1 of 3. Vol. 3; e4; Marine Biological Association of the United Kingdom, doi:10.1017/S1755267209991096	23 July 2009: two specimens were caught at Camogli (eastern Ligurian Riviera) by an artisanal gear at the rocks that form the south-western corner of the Portofino promontory.
	<i>Pomacanthus imperator</i>	Israel	Golani D., Salameh P. and Sonin O., 2010. First record of the Emperor Angelfish, <i>Pomacanthus imperator</i> (Teleostei: Pomacanthidae) and the second record of the Spotbase Burrfish <i>Cyclichthys spilostylus</i> (Teleostei: Diodontidae) in the Mediterranean. <i>Aquatic Invasions</i> 5, 2 DOI 10.3391/ai.2010.5.2	30 November 2009: a specimen of <i>Pomacanthus imperator</i> weighing 1114.4 g was speared at a depth of 5 m at the Mediterranean coast of Shiqmona just south of Haifa, Israel (32°49'N, 34°56'E)
	<i>Priacanthus sagittarius</i>	Israel	Goren M., Stern N., Galil BS and Diamant A., 2010. First record of the Indo-Pacific Arrowbulley <i>Priacanthus sagittarius</i> Stames, 1988 in the Mediterranean Sea. <i>Aquatic Invasions</i> , 5, 2 DOI 10.3391/ai.2010.5.2	28 November, 2009: off Tel-Aviv, Israel, (N 32°09'55" E 34°47'09") 40 m depth, TL 136 mm
	<i>Stiganus javus</i>	Syria	Ibrahim A., Lahlah M., Kassab M.Y., Ghanem W., Ogaily S., 2010. <i>Stigans javus</i> , a new record from the Syrian waters with a reference to feeding and growth of two lessepsian fish. 39th CIESM Venice	10 Oct 2009 : 1 specimen captured by a trammel net, at a depth of 20m, above a rocky-muddy bottom facing to Lattakia port

Figure 12. Report of new species in the Mediterranean discovered within 2009.

3.5.1 HCMR database commented

Advantages of HCMR database

- It includes species excluded in recent literature and the reasoning for their exclusion. This means that old records excluded in the CIESM atlases are re-entering the list once they are found again as for example the puffer fish *Lagocephalus sceleratus* (Akyol et al, 2005) and the bivalve *Petricola hemprichi* (Ceviker & Albayrak, 2006).
- Even cryptogenic or debatable species are archived along with their distribution. Once genetic studies clarify their status they are entering the list or permanently excluded.
- It includes both introductions via the Gibraltar and via the Suez since late 19th century. Thus trends related to climate change can be traced.
- It addresses nearly all taxonomic groups (tintinnids are not included)

Drawbacks of the HCMR database include

- First sighting date is not available for all records.
- Phytoplankton entries have not been cross-checked with local experts.
- Taxa like tintinnids are not included yet.
- It is not GIS connected
- It is a desk top local application, not freely available

4. NATIONAL INITIATIVES AND REVIEWS

4.1 Inventorying and Management on a National level

For the purposes of this report, relevant queries were sent out to several specialists and institutions working with biological invasions across the Mediterranean countries. Data and information received is compiled in the following section. For countries that didn't provide relevant information, such information was obtained from national reports (Algeria, Egypt and Morocco). For Libya, Palestinian Authority and Monaco there are no contacts.

The response level was varied, and a complete list of experts consulted can be found in ANNEX 2.

4.2 Country Information

4.2.1 Albania

In 2007, the Ministry of Environment and Water Administration of Albania and the International Bank for Reconstruction and Development (part of World Bank) funded a study (in the frame of "*Biodiversity Enabling Activity II Related to the Assessment of Capacity Building needs to Address the Priorities of Albania's Biodiversity Strategy and Action Plan*" Project) in order to assess the extent of the threats posed by alien invasive species in Albania (MoEFWA, 2007).

This report notes that although the Albanian government recognizes that the problems caused by non-native species can be serious (by transforming ecosystems, causing economic damage, altering natural habitats and threatening native species), the present legal framework (that does not include specific provisions to deal with invasive alien species) and the scarce funds available severely limit the actions aimed at reducing this threat.

A series of objectives and measures were outlined, including the establishment of an information center, awareness raising (organisation of seminars and training programmes, preparation of a popular scientific book with short descriptions of important IAS), and the spreading and imparting of topical, up-to-date information and data at the national level (access to the database on alien species, e.g. via www.biodiv.al). The need for the establishment of a national "IAS" working group for alien species, as part of capacity building, and international cooperation and networking was also expressed in the report.

MoEFWA (2007) states that, in Albania, public awareness regarding alien species is low, and there is opposition to government intervention. There is shortage and inaccessibility of scientific information (species identification, risk analyses, detection and mitigation techniques etc.) and absence of clear and agreed priorities for action. Furthermore, relevant legislation is both outdated and lacking, the monitoring capacity is limited, and inadequate inspections and quarantine measures make the introduction and movement of alien species a relatively easy matter. MoEFWA (2007) conclude that the capacity and expertise to deal with IAS are not yet sufficient and therefore further research on and capacity building around the biology and control of IAS and biosecurity issues need to be given attention and priority.

Dr Aleko Miho (a hydrobiologist in the department of Biology, University of Tirana) has confirmed that despite some weak efforts, a solid network focused in marine research and especially on IAS does not yet exist, and only a few sparse experts deal with the phenomenon. Dr Sajmir Beqiraj (a marine biologist in the department of Biology, University of Tirana) is following the spread of the blue crab *Callinectes sapidus* in Albanian waters, and has prepared a short communication (Beqiraj and Kashta, 2010) on the matter. Some data about alien algae and macrophytes (such as *Halophila stipulacea* and *Caulerpa racemosa*) in Albania has also been published. He has informed us that presently there are only 3-4 taxonomists at the Univ of Tirana, who could investigate the coastal area in collaboration with neighbouring experts (Italians, Greeks) provided that funds are provided by an international organization.

Conclusively, as indicated in UNEP RAC/SPA (2009a) action required include Capacity building inside government institutions and training for scientists, researchers and scientific institutions, in particular on coastal taxonomy.

4.2.2 Algeria

Little work has been done regarding invasive species in Algeria due to the lack of vision about the risk associated with this category of species. Currently, there is no program for ballast waters and their effect on the phyto-zooplankton, and no program of bio-monitoring. Program development is suggested on the basis of various thematic zones (invasive species, thermophile species, cetaceans, marine mammals etc). Finally, for the completion of the beach/marine biodiversity of Algeria, the organization of the researchers and of the taxonomy is required (Grimes, 2008).

Invasive fish species are among the concerns of the laboratory of biological resources at

the University of Annaba (MH Kara, pers. Commun). Relevant programs funded by CNEPRU/MESRS <http://www.lbm-univ-annaba.org> include:

- Ichtyofaune côtière du golfe d'Annaba : inventaire et biologie halieutique 1997 - 2001
- Diversité des téléostéens côtiers de l'Est algérien. Ecologie, biologie et exploitation de quelques espèces d'intérêt commercial. 2009-2011.

4.2.3 Croatia

There is no network of experts nor any database on invasive species in the Adriatic coast of Croatia, and only sparse experts are working on the subject. Dr Dragicevic informed the author that the issue of non-indigenous species in Croatia is addressed through standard monitoring programs such as the monitoring of coastal, pelagic and demersal resources. A module in Croatian National Monitoring Project "Jadran" (responsible Jakov Dulcic) is occupied with invasive non-indigenous species in the Adriatic Sea (Vedrana Nerlovic, pers. Commun). However, stand-alone projects that would monitor invasive or non-indigenous species are still lacking as long as the fisheries sector is concerned. A monitoring project of *Caulerpa* species exists in the benthos laboratory of the Institute of Oceanography and Fisheries in Split (Marija Despalatovic, pers. Comm.)

Although a number of non-indigenous species have been encountered in the Adriatic in the last few years, it seems that they are unable to settle their populations which would allow an evaluation of their status through ecological studies. Databases of species are available in each sector, but a unified system that would allow tracking of changes on a wider basis is lacking. Lastly, there is only few institutions, and consequently a small number of experts that are working on this issue.

4.2.4 Cyprus

A list of alien species is compiled at the Department of Fisheries and Marine Research (DFMR)(M Argyrou pers. Comm). No network, national program, nor national database concerning non-indigenous species exists in Cyprus (Angelos Hannides, pers. Comm.). Nevertheless, a project proposal named "*An information system for the assessment and monitoring of impacts from the invasion of Red Sea thermophilic species at the coast of Cyprus*" has been submitted for funding to the Cyprus Research Promotion Foundation, still to be accepted (Nikolas Michailidis, pers. Comm.).

4.2.5 Egypt

In contrast with scientific interest, at the beginning of the 19th century, in inventorying Red Sea immigrants (Tillier Bavay, Steinitz, Steuer, Moazzo,) and later by (Alem, Barash & Danin, Ben-Tuvia), very few studies have been published the last decades including introduced species. In too many cases the investigations remain fragmentary, geographically uneven and descriptive.

There is need in Egypt for an ecosystem oriented research and monitoring programme. There are many available capabilities, but the lack of a Plan and insufficient funding lead to dispersal and waste of efforts. Planning and upgrading the scientific monitoring process through various capacity building procedures, including more interfacing with the international scientific community, would open the way to progress (Halim, 2010).

In contrast with scientific interest, at the beginning of the 19th century, in inventorying Red Sea immigrants (Tillier Bavay, Steinitz, Steuer, Moazzo,) and later by (Alem, Barash & Danin, Ben-Tuvia), very few studies have been published the last decades including introduced species. Considering the rate of introductions in the Mediterranean, attributed to climate change, and the Strategic position of Egypt (first visited area by newcomers of Indo-Pacific origin via the Suez Canal) it is here suggested and in line with the needs identified by UNEP RAC SPA (2009c) to organise a watch watch programme and decision-making involving institutions NGOs and the wider public (fishermen, divers, tourists)

4.2.6 France

According to M Verlaque (pers. Communication) there are very few specialists active in alien species in Mediterranean France. These include Patrice FRANCOUR for Fish; Thierry PEREZ for Porifera; Pierre NOEL at the National Museum d'Histoire naturelle for Crustacea, Marc Verlaque for macroalgae and of course the pioneer Helmut Zibrowius author of the memorial work (Zibrowius, 1992).

IFREMER is the body responsible for the issue with a short term plan to establish a national database. (L. Miossec pers. Commun). Presently the emphasis is given on the Atlantic coast and particularly on port areas such as Grand Port Maritime du Havre in the framework of the EFFORTS (FP6) Program.

With regard to Legislation, no specific regulations on ballast water management until now, except the general prohibition about deballasting in ports, due to French Water Act. The next designation of Marine Protected areas along the French coasts could (and certainly will) lead to deballasting prohibition close or in those areas (Masson, 2010)

The modification of fish assemblages along the French Mediterranean coasts, caused by tropicalization and the entry of alien species from the Atlantic and the Red Sea, are monitored by Professor Patrice Francour at Nice-Sophia Antipolis University. Few erythrean species of fish have been recorded in France until now, and there is no official relevant network or database that deals with the subject. However, there is active work in the ECOlogy of Marine Ecosystems and Responses to Stress (ECOMERS) laboratory for the building of such a network that will record alien species of fish. Professor Francour expressed his opinion to the author that the invasion of Red Sea species from the Eastern Mediterranean to the Western basin will increase in the next years due to the modifications of current flow within the Sicily-Tunisia Strait.

Dr M. Verlaque, is the co-ordinator of the CIESM atlas volume on macroalgae and keeps track of alien macroalgae. Dr P. Noel is co-author of the CIESM atlas on Decapoda Crustacea.

4.2.7 Greece

Recognizing the need for collaboration in the research and management of aquatic alien species at both national and international levels, and data exchange in particular, a network of experts was established in 2007 at HCMR. To date, the Hellenic network for Aquatic alien species (ELNAIS: <http://elnais.ath.hcmr.gr/>) includes 50 experts carrying out relevant research, who are based in 11 research centres/Universities across the country. ELNAIS is an open information system providing on line the state of art in aquatic alien species in Greece. There are currently 200 marine alien species recorded in ELNAIS, accompanied by photographs and distribution maps within Greece. ELNAIS, though without any financial support, is continually updated thanks to the input of experts and the enthusiasm of a small group, and aims to improve and become a powerful tool to scientists and stakeholders.

In 2009, Greek coastal and marine waters hosted 40 species of the worst invasive alien species threatening biodiversity in Mediterranean (i.e. species which are highly invasive and with negative impacts on native ecosystems, human health and the economy) (Streftaris & Zenetos, 2010). Of these 19 are invertebrates, 11 primary producers, and 10 vertebrates. These compared to the 29 species recorded up to 2000 represent a 28% increase (Streftaris & Zenetos, 2010). The observed increase is a serious cause of concern, although it may be partially related to the lower level of detail in screening alien species in earlier years.

4.2.8 Israel

Israel has a long history regarding the study of non-indigenous marine species. Over the past three decades a number of experts (Ben Eliahu, Diamant, Galil, Golani, Goren, Mienis, Por, Almogi Labin and Perelis-Grossowicz) have recorded the spread, biology and impact of alien species along the Israeli coast. Yet, no concerted effort has been undertaken to survey the entire coast since the early 1970s, and most of the records stem from fortuitous finds. There is currently no comprehensive project on studying the changes in the flora and fauna of the Mediterranean coast of Israel (Dov Por, pers. Comm.) and a national targeted effort to survey the presence and abundance of the Erythrean species and study their biology and ecology is wanting (Bella Galil pers. Comm.).

Extensive collections of samples exist in Israel, including the collections of the Hebrew University-Smithsonian Institution Project " Biota of the Red Sea and the Eastern Mediterranean (1967-1972)" as well as the collection of zooplankton collected by the late Prof. B. Kimor during the 1950's and 1960's (both curated now by Dr. Ariel Chipman) . The algae collected by the Smithsonian project are kept at the Tel Aviv University (Dov Por, pers. Comm.). **The National Institute of Oceanography, Israel Oceanographic & Limnological Research, has, in fulfillment of its mandate as a national institution, stored data on alien species off the Israeli coast in the "Israel Marine Data Center"** (Bella Galil pers. Comm.).

4.2.9 Italy

Within the SIBM (Italian Society of Marine Biology) Prof. Anna Occhipinti has been chairing since 1999 the "Allochthonous Species Group". It is formed by a network of experts that on voluntary basis allow to produce each year the National Reports for Italy presented at the ICES WGITMO and to keep adjourned the list of alien species along the Italian Coasts.

Prof Franco Andaloro is in charge of the Italian database on alien marine species in Italian water described in chapter 3.3 as IMET/ICRAM database. There are 20 Italian experts that are working to update the data. There is a GIS cartography for all the species, a tissue bank on new records, an atlas on marine fish species imported for aquariology and a study on ballast water in 3 pilot ports of Italy (Andaloro pers comm.).

There is also a study (responsible F. Andaloro) on the relationship between climate change and alien fish invasion in Italian waters. In addition, a Committee on alien species introduced in aquaculture has been established by the Ministry of Agricultural (chairman Giovanna Marino) and another one by ISPRA on marine alien

species as an indicator for Good Environmental Status (GES) for implementation within the Water Framework Directive and the Marine Strategy Framework Directive (Piero Genovesi, Franco Andaloro, Giovanna Marino, Claudio Piccini, Susanna Dantoni, Piero Baccetti).

Other initiatives include the jellyfish watch programme. This is a CIESM initiative aiming at acquiring a more precise picture of the occurrence of gelatinous plankton aggregations, whose pilot phase took place in Italian waters. A poster with the main gelatinous plankters of the Mediterranean Sea was distributed nationwide with great media coverage helped by the environmentalist association "Marevivo" (<http://www.marevivo.it>). In the framework of the Jellywatch campaign in the summer of 2009, the alien gelatinous macroplankters *Mnemiopsis leidyi* and *Phyllorhiza punctata* were recorded for the first time from the Italian coasts of the Western Mediterranean (Boero et al, 2009)

Finally, the intensity of HABs caused by the invasive microalga *Ostreopsis ovata* along the Italian coasts has led the Italian authorities (Environmental Ministry) to undertake a systematic monitoring programme (ISPRA) on *Ostreopsis ovata* and *Ostreopsis spp.*

4.2.10 Lebanon

The Ministry of Environment is involved in the alien species issue. The researchers of the National Marine Center provide information to the Ministry to fill the annual report or to fill a questionnaire concerning this subject. CNRS, until now has sparse experts and sparse publications concerning this subject (Marie Abboud - Abi Saab pers. Commun.)

The National Marine Center has identified several alien species based on informal information such as a consensus about the natural invasion of marine species coming from the Suez Canal and from Gibraltar. However no formal measures have been taken to monitor the alien species. There is no serious database, neither a national program including all exotic or invading or alien species in our area. Awareness and knowledge of alien species is limited to the scientific community due to the lack of continuous studies. No action has been taken. Each Lebanese specialist can provide information in his group, if any. The marine groups studied are: Phyto-Zooplankton, Macroalgae, Fishes and Some benthic groups.

In 1996, Prof.Sami Lakkis conducted a research project on Marine Biodiversity of Lebanon, supported by UNDP, UNEP. The incomplete and short report published in Lebanon by the Ministry of Agriculture includes floristic and faunistic lists of all marine group species, known by that time in Lebanese seawaters, indicating the introduced and exotic species in the area.

A recent research study conducted at the American University of Beirut in 2002 determined 22 invasive plant species on the Lebanese coast. However, the scope of this study only covered the presence of these species and not on their status and degree of invasiveness (Michel Bariche, pers. Commun).

In the frame of a French-Lebanese Cooperation CEDRE, field trips conducted between 1999 and 2003 in the coastal waters of Lebanon, from Tripoli in the north to Sour (Tyre) in the south, revealed the presence of seven species of Smittinidae (BRYOZOA). Only two of these were previously known from other Mediterranean areas. *Parasmittina serruloides* n. sp. and *P. spondylica* n. sp., together with *P. egyptiaca* (Waters, 1909), are presumed to be Red Sea immigrants (Harmelin et al, 2009).

4.2.11 Libya

According to Libyan Environment General Authority (UNEP RAC/SPA, 2009e: Annex V), there is an assessment of the situation regarding the introduction of marine species. However, Libya has not yet a) adopted legislation to control the introduction of marine species and taken the necessary steps to express in its national laws the provisions of the pertinent international treaties; b) Taken steps to deal with the deliberate or accidental introduction into the wild of non-native or genetically modified species; c) developed training and awareness raising programmes on risks, legal aspects, ballast water management /fouling.

Considering the 237 and 122 alien species reported in the neighbouring Egypt and Tunisia respectively, the figure of 61 species in all reported from Libya appears to be very low reflecting the low scientific effort rather than the true situation. Indeed the human capacity is lacking. In addition to local experts, such as A. Ben-Abdallah and EA. Shakman (Al-Fateh University, Tripoli), some recent records on marine alien species along the Libyan coast have been reported by renowned Mediterranean taxonomic experts such as macroalgae Verlaque et al CIESM Atlas - mollusca: Zaouali et al, 2007 - Crustacea: Zaouali et al, 2007; Relini et al, 2000.

4.2.12 Malta

In Malta the authority known as the Malta Environment and Planning Authority (MEPA) has the responsibility for environmental protection, biodiversity management etc. In the past they had commissioned a database of non-indigenous terrestrial plants but this is not publicly available and nothing is known about an equivalent database of alien animals, terrestrial or aquatic (Patric Schembri pers. Commun). However, if there are any official initiatives as regards information on alien species, these would be within MEPA. Their website is at: <http://www.mepa.org.mt/home?l=1>. I do not know of any Maltese NGOs who have databases on alien species. Apart from the above, there are individual researchers, who work and publish on alien species.

4.2.13 Morocco

Little data is available concerning the invasive species in Morocco and they contain general information. There are no databases about the biological introduction and as such there is no concrete data about biological disturbances. Most disturbances are brought to light by the fishery sector and there is no data regarding the degree of exploitation. National research about the stock of certain species shows that there is a 30-40% increase from the optimal exploitation level. The impact of overexploitation cannot be properly measured as proper studies have not been conducted (Bazairi, 2008; 2010).

4.2.14 Montenegro

Montenegro is presently involved in a number of Climate Change and or Biodiversity related activities as part of international co-operation, but still lagging behind other countries. Although introduction of thermophilous species might be expected as a result of tropicalization (UNEP RACSPA 2009a), the coastal Montenegrin area of Adriatic Sea is virtually unexplored. Scattered referenced on alien species could be traced after 2003, some of which in Serbian language reporting 6 species in all: 3 fish, 2 phytobenthic and 1 zoobenthic. Two of the publications are authored by Croatian and Italian scientists. Not only lack of taxonomists is identified but unfortunately in the Biological institute of Mora, Kotor there is only one scientist interested in the issue (Vesna Macic pers. Commun).

4.2.15 Slovenia

Few studies exist on Climate Change and biodiversity in marine coastal areas of Slovenia (UNEP RAC SPA 2009a). Northward shifting of thermophilous species, NIS spreading, change of masses circulation is envisaged to affect the relict / "boreal" species in N. Adriatic and Trieste bay. It is also predicted that climate changes will impact fisheries productivity, population processes, spread of pathogenes.

Among the needs identified at national level comprehensive research and establishment of monitoring: hot-spots inventory, including NIS, N-ward spreading of species has been proposed (UNEP RAC SPA 2009a).

The National Institute of Biology, Marine Biology Station (NIB) has been engaged in studying and reporting information on new species such as the non-native ctenophores in the Gulf of Trieste (Shiganova & Malej, 2009) and fish, often in collaboration with Italian and/or Croatian specialists (Dulčić & Lipej 1997). Other researchers (M. David, Univ. of Ljubljana) have participated in different national and international projects, scientific and/or governmental groups or organisations (e.g. IMO, BWWG, WGBOSV) where different aspects BWM were dealt with and have conducted the first ballast water study in the Mediterranean Sea -at the Port of Koper, Slovenia.(David et al, 2007). The results of the aforementioned study may be considered as background information for an initial risk assessment of future species introductions – an important tool for the implementation of ballast water management measures.

Slovenia as an EU member state is acting within and in accordance with EU strategies, framework programmes, actions and Directives.

4.2.16 Spain

Several legal activities are designed at European level and coordinated and implemented in Spain by the Spanish and autonomic governments concerning climate change and biodiversity. However, with the exception of the Water Frame Directive, legal actions concerning vulnerability and impacts of climate change on marine biodiversity are limited, particularly so in the Mediterranean coast. Spain participates and reports annually at the annual meetings of ICES/IOC/WGBOSV & WGTIMO, yet the emphasis is put on the Atlantic coast. The National representative in ICES/IOC/WGTIMO, has informed us that there is no national database on alien species (Gemma Quílez-Badia, pers. Commun). Thus, despite the evidence of climate change impacts on biodiversity, the magnitude of Mediterranean marine biodiversity responses to climate change remain largely unknown. This is partially due to the lack of long-term monitoring of Mediterranean marine biota and ecosystem processes, and the scarce information available on climate change impacts on marine organism physiology, population demography, reproduction, species distribution and ecosystem function (UNEP RAC SPA 2009b).

Publications reporting findings of alien species are accumulating the last decade, while a concerted action by a group of specialist has produced a provisional list (Luque et al, 2008).

In the context of the monitoring programme of the Catalan Water Agency (ACA), performed by the Institute of Marine Sciences in Barcelona (ICM-CSIC), the distribution and abundance of *Pseudo-nitzschia* and other potentially harmful algae are continuously evaluated along the NE coast of Spain (Catalonia). This programme, initiated in 1995, includes 16 representative harbours, several beaches and two coastal bays. This programme has brought to light some alien microalgae such as the diatom *Pseudo-nitzschia brasiliiana* (Quijano-Scheggia et al, 2005; 2010).

4.2.17 Syria

The Ministry of Environment collects research data annually from researches and/or from publication and reports. In 2004 had prepared a National Action Plan for invasive species (*Action Plan for reducing allocthonous species invasion and imposing measures to manage foreign species*) was submitted to RAC-SPA but no initiative has been taken so far (Amir Ibrahim, pers. Commun).

At present the monitoring and study of invasive species is carried out by network and sparse experts depending the organism group) for example: concerning the invasive fish species, the Marine sciences Laboratory and Aquatic Environment, started

this work since 1990, and process all national information about this subject. (Adib Saad pers. Commun). Invasive species are routinely monitored by the High Institute of Marine Research (Tishren University) within the context of the research projects (Amir Ibrahim pers. Commun).

The Syrian society for aquatic environment protection (NGO) have created a database for marine invasive species. This society can provide any data or information about invasive marine species in Syrian waters.

4.2.18 Tunisia

Increase, proliferation and spatial extension of thermophilous non-native species has been identified as one of the vulnerability issues due to climate change in Tunisia It is expected that changes will be noticed in the productivity of fisheries and fishing areas, with an increase in exotic species in sea catch and an increase in the productivity of the lagoon areas and *sebkhas*. To date, the main activities related to the climate change are those identified via the national study on the effects and consequences of climate change on the farming ecosystems (UNEP-MAP RAC/SPA 2009c).

Publications concerning alien species in Tunisia are rapidly increasing the last decade, though most of them are qualitative. Some universities conduct relevant research (mostly on the biology of alien species such as the pearl oyster *Pinctada radiata*, and the indication of new records).

Currently there isn't a national programme that deals with this phenomenon (Nejla Bejaoui, pers. Commun).

Gaps in quantitative data call for the establishing of databases on a chronological, spatial base.

4.2.19 Turkey

A network of experts on alien organisms does not exist in Turkey. There are even no databases or any national programs. Although some trials of database enterprises were made by the government, available biodiversity databases do not consider non-native species. (Murat Bilecenoglu, pers. Commun)

However, studies on alien marine species have been performed in Turkey (not published yet) within the framework of some projects commissioned by the Ministry of Environment, Environmentap Protection Agency for Special Areas (visit the website <http://www.ockkb.gov.tr/EN/>). (Melih Cinar, pers. Commun)

4.3 Review papers

4.3.1 Cyprus

Katsanevakis *et al.* (2009) presented an updated inventory of alien marine species from the coastal and offshore waters of Cyprus. Records were compiled based on existing scientific and grey literature (including the HCMR Mediterranean alien species database-Zenetos and Fraggos, 2008; HCMR, 2009), technical reports, scientific congresses, academic dissertations, websites, and unpublished data/personal observations.

Up to July 2009, a total of 126 marine alien species have been reported in Cyprus (42 molluscs, 28 fish, 19 polychaetes, 15 phytobenthic species, 12 crustaceans, and 10 species from other taxa) (Katsanevakis *et al.*, 2009). Information concerning their establishment success, mode of introduction, and year of first sighting is included in the review, while twelve established species were characterized as invasive due to their substantial impact on biodiversity and/or local economy (Katsanevakis *et al.*, 2009). The authors expect the impact of marine alien species in Cyprus to grow in the near future, and propose that further effort directed towards recording alien invasions and their impact is needed. Indeed new research has brought to life more species (Tzomos *et al.*, 2010).

4.3.2 Greece

Zenetos *et al.* (2009) presented an updated inventory of aquatic alien species from both inland (including estuarine habitats) and coastal waters (Aegean and Ionian seas) of Greece. Marine biota records were compiled based primarily on the checklist of alien species reported by Pancucci-Papadopoulou *et al.* (2005), but also include unpublished records, grey literature (HCMR and E U technical reports, scientific congresses, personal communications by specialists and websites), as well as species belonging to taxonomic groups not considered previously.

Up to June 2009, a total of 193 marine alien species were reported in Greece (42 fish, 42 mollusca, 40 phytobenthic species including microphytobenthos, 22 benthic crustacean, 17 polychaetes, 9 zooplanktonic species and 22 species from other taxa). The rate of introductions is difficult to follow as by February 2010 another 8 species have been added to the list (Zenetos 2010b)

4.3.3 Israel

Galil (2007), presented a very detailed overview of marine alien species off the Israeli coast by assembling and critically examining a plethora of sources including research papers, conference abstracts, the local Fishermen's Bulletin, unpublished M.Sc. and Ph.D. theses, and the author's own databases.

A total of 296 marine alien species were identified as alien to the Israeli Mediterranean coast by September 2009, a taxonomic classification of which, shows that the alien phyla most frequently recorded are Mollusca (43%), Chordata (22%), Arthropoda (16%), and Annelida (7%) (Galil, 2007). The native range of the alien taxa recorded in Israel is most commonly the Indo-Pacific Ocean (48%), the Indian Ocean (24%), the Red Sea (17%), and pantropical (6%), while the great majority of aliens off the Israeli coast seem to have entered and expanded through the Suez Canal, with shipping and mariculture having a small contribution as vectors (Galil, 2007).

The list of Israeli marine alien species in Galil, 2007 is limited to multicellular organisms, and phyla not represented in the list include Porifera, Nemertea, Priapula, Nematoda, Pogonophora, Sipuncula, Echiura, Brachiopoda and Phoronida.

4.3.4 Italy

Distribution of alien species has been assessed for the whole Italian coast, gathering literature records for the following taxa: Macrophyta, Porifera, Ctenophora, Cnidaria, Annelida, Mollusca, Crustacea, Picnogonida, Bryozoa, Tunicata and Vertebrata. Only species of "recent" introduction (after 1945) have been taken into account. A total of 163 alien species introduced has been recorded in Italian waters. Some localities have yielded a very high number of species, and can be considered hotspots for present and future bioinvasions. Intense ship traffic in large ports and non voluntary transport of species connected with aquaculture activities are common in the three main hotspots. Three main hotspots were clearly identified: the Lagoon of Venice, Taranto and Sicily, but the high number of species identified is also a consequence of the concentrated marine biological monitoring effort by expert teams (SIBM & Occhipinti-Ambrogi, 2010).

4.3.5 Malta

Sciberras and Schembri (2007) presented an updated list of marine alien species recorded from the Maltese islands and surrounding waters. Records were compiled from scientific and grey literature as well as from authenticated unpublished reports to the authors.

A total of 49 marine species (including nine debatable ones) are reported by June 2007 as alien to the Maltese islands, and six of them are classified as invasive (Sciberras and Schembri, 2007). The most represented groups are molluscs (14 species), fish (13 species), and macrophytes (10 species), while transportation via shipping and in connection with aquaculture, as well as range expansion of Red Sea immigrant species, appear to be the most common vectors of introduction (accounting for 20%, 11%, and 32% respectively). The authors presume that the general warming trend of Mediterranean waters and increasing marine traffic may be facilitating the spread of warm-water Atlantic and Indo-Pacific species to the central Mediterranean, including the Maltese Islands.

4.3.6 Turkey

Cinar *et al.* (2005) reviewed the alien species reported from the Turkish coasts and constitutes the first comprehensive database for future studies. For the Mediterranean coasts (Sea of Marmara, Aegean and Levantine seas) the compilation of data on alien species, yielded a total of 261 species belonging to 11 systematic groups. Mollusca had the highest number of species (84), followed by crustacea (52 species), and fish (43 species). Additions to the list are numerous reported in a plethora of scientific publications and communications at international Congresses

4.3.7 Spain

An updated list of marine alien species (both man-mediated introduced species or self-introduced ones by active dispersal through natural pathways) in Spanish Mediterranean waters (Fig. 1) has been compiled, taking into account both published and unpublished data. A total of 125 alien species have been reported from this area, most of which are fish (46, 36.8%) and zoobenthos (46, 36.8%; mainly Crustacea and Polychaeta) and macroalgae (25, 20%). More than 80% of the alien species recorded in this study are present in the neighbouring Atlantic warm waters (West Africa), and should be considered natural immigrants through the Gibraltar Strait, probably favoured by progressive warming. Most of casual findings probably represent range extensions or range limits of West African species. The remaining 20% has been probably introduced by shipping or aquaculture. No Lessepsian immigrants have been identified with certainty in the studied area, except for the fish *Fistularia commersonii* (Luque *et al.*, 2008)

5. INTEGRATED ALIEN SPECIES INFORMATION SYSTEMS IN EUROPE

5.1 NOBANIS

The North European and Baltic Network on Invasive Alien Species (NOBANIS) is a gateway to information on alien and invasive species in North and Central Europe. NOBANIS has developed a network of common databases on alien and invasive species of the region, which covers marine, freshwater, and terrestrial environments. It provides a distributed but integrated database on introduced species in the region, fact sheets on many of the most invasive aliens, a catalogue of the regulation relevant to invasive species in participating countries, and a literature database. **A connection to regional and global networks and projects is also provided.** Thus, the establishing of a common portal access to IAS-related data facilitates the sharing of information and knowledge in the region.

The NOBANIS network has a national focal point in each of the participating countries - Austria, Belgium, Denmark, Estonia, Finland, Faroe Islands, Germany, Greenland, Iceland, Ireland, Latvia, Lithuania, the Netherlands, Norway, Poland, Slovakia, Sweden and the European part of Russia. It is a network for cooperation between competent authorities of the region and contributes to implementing recommendations from CBD's COP6 (Convention on Biological Diversity). One of the goals of NOBANIS is to provide administrative tools for making the precautionary approach operational in preventing the unintentional dispersal of invasive alien species. Furthermore, NOBANIS establishes a regional cooperation to aid countries in eradication, control and mitigation of ecological effects of invasive alien species.

The NOBANIS Network compiles existing data on alien species in a common format for all countries participating in the network, and the **database of alien species is one of the central products.** (Figure 13)

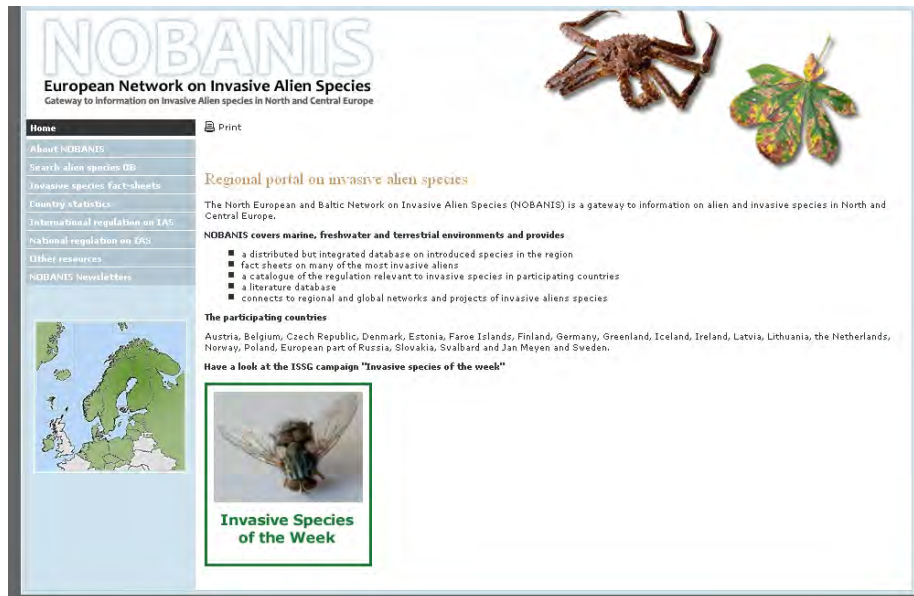


Figure 13. Homepage of NOBANIS database.

The NOBANIS database of alien species includes all species that have been introduced as a result of human activities either intentionally or unintentionally. This means that the database covers both invasive alien species and non invasive alien species. The core species of the NOBANIS database of alien species are organisms that are established (naturalised) in natural or semi natural ecosystems. Alien species that are only present from time to time (incidental), or species that are constantly being introduced, but do not breed are also included in the database.

The database is being updated regularly by each participating country, since by nature a database on alien species is under constant development as new species arrive while others become extinct.

Factsheets for a selection of invasive alien species provide information on their biology, ecology and distribution as well as on their impact in the recipient habitats. These factsheets are written by regional experts, and management approaches including preventive, eradication and control measures are suggested. Important resources such as contact persons, links and references are also presented, and information for dissemination to authorities, specialists, the news media and the general public, can be also extracted from these datasheets.

Services

Database (simple search) (Figure 14)

1. Selection of habitats (24 options) (search by habitat. e. g.: marine, coastland, lakes, wetlands etc). All habitats are described and explained in a separate page.
2. Selection of taxonomic group (24 options) (search by group. e. g.: macroalgae, phytoplankton, nematodes, mollusks etc). All groups are defined in a separate page.
3. Selection of countries (search by country).

Multiple selection of search options is allowed.

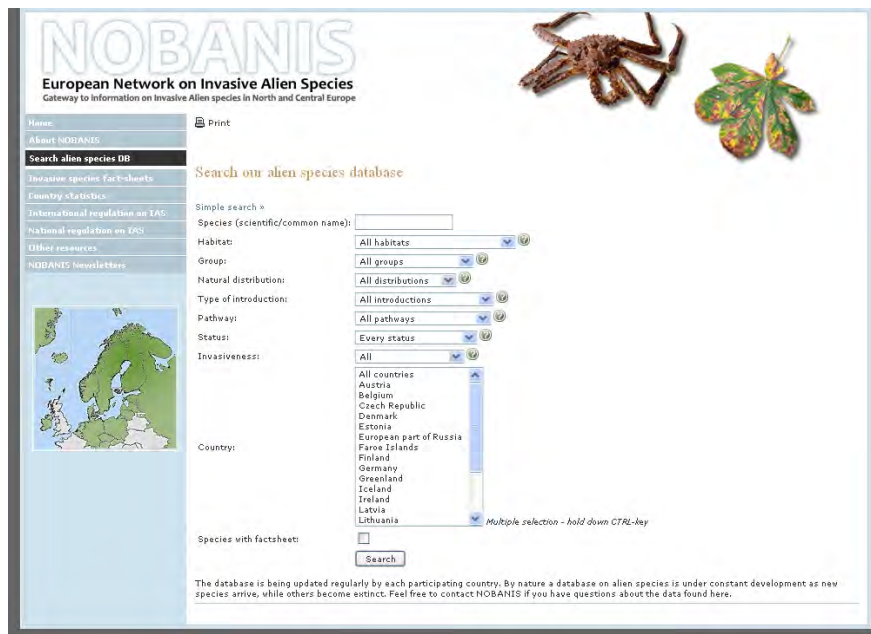


Figure 14. NOBANIS database simple search.

Database (advanced search) (Figure 15)

1. Selection of habitats, taxonomic group, and country (as in simple search)
2. Selection of regions of natural distribution (16 options) (search by distribution. e.g.: Europe, Oceania, N. Pacific Ocean, Indian Ocean etc). Fieldnames are explained in a separate page.
3. Selection of type of introduction (5 options) (search by type of introduction. e.g.: Intentional, Unintentional etc). Types are explained in a separate page.
4. Selection of pathway (21 options) (search by pathway. e.g. Hull fouling, Escapes, Aquaria, Biological control etc). Pathway search criteria are explained in a separate page.

5. Selection of status (7 options) (search by status. e. g.: Established, Suspected, Unknown etc). Status search criteria are defined and explained in a separate page.
6. Selection of invasiveness (5 options) (search by invasiveness. e. g.: Invasive, Potentially invasive, Not known etc). Invasive search criteria are explained in a separate page.

Multiple selection of search options is allowed.

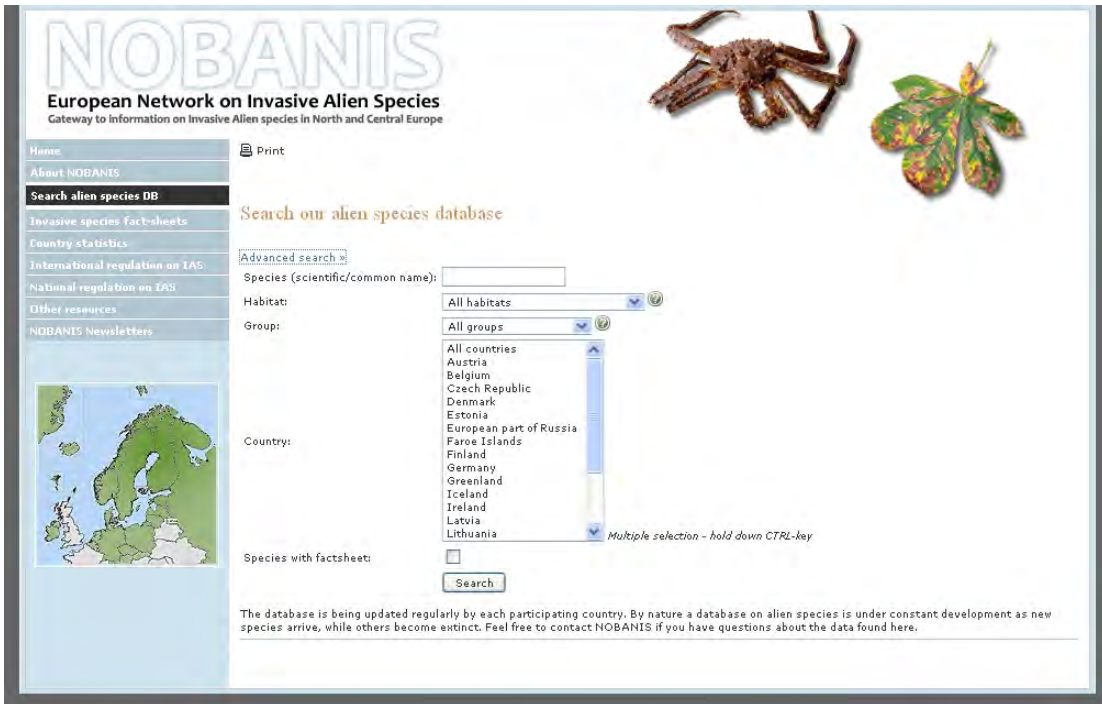


Figure 15. NOBANIS database, advanced search.

Species factsheets (Figure 16)

The species factsheets are in .pdf format and can be downloaded. They contain information about the alien species concerned, and photographs are provided. Information includes:

1. Species description (scientific name, taxonomic authority, synonyms, common names, identification features, native range).
2. Alien distribution (history of introduction and geographical spread, pathways of introduction, alien status in region, frequency and establishment in the participating countries).
3. Ecology (habitat description, reproduction and life cycle, dispersal and spread).

4. Impact (affected habitats and indigenous organisms, genetic effects, human health effects, economic and social effects).
5. Management approaches (prevention methods, eradication-control and monitoring efforts, information and awareness, knowledge and research, recommendations or comments from experts and local communities).
6. References and other resources (contact persons, links, references).

Each datasheet contains the date of its creation/modification, its author and his/her contact details, and a citation format.

NOBANIS
European Network on Invasive Alien Species
Gateway to information on Invasive Alien species in North and Central Europe

Home | About NOBANIS | Search alien species DB | **Invasive species fact-sheets** | Country statistics | International regulation on IAS | National regulation on IAS | Other resources | NOBANIS newsletters

Fact sheets on Invasive Alien Species

The NOBANIS project provides fact sheets on some of the invasive alien species of the region, covering both animals and plant as well as microorganisms. We are currently in the process of uploading the fact sheets - so please visit this page regularly.

The NOBANIS fact sheets
The species profiles below follow the same format and provide information on the biology, ecology and distribution of the invasive alien species as well as on the impact of the species in the recipient habitats. Furthermore, management approaches are suggested. Important resources such as contact persons, links and references are also presented in the fact sheets. The fact sheets are written by experts of the region and all fact sheets are furthermore refereed by scientific experts from all NOBANIS countries - thus ensuring that the collated regional knowledge is reflected in the fact sheets.

The fact sheets presented below are not to be regarded as a consensus list of "worst invasive alien species" for the region. The fact sheets fall in several categories, some can indeed be regarded as the worst invaders of the entire region, while others are only a problem in one or a few countries. In each case the impact and status of the species should be clear from the fact sheet. The fact sheets are organised as pdf-files with bookmarks for the 6 section headings.

1. <i>Acer negundo</i>	2. <i>Acer pseudoplatanus</i>	3. <i>Amelanchier spicata</i>
4. <i>Anguillicola crassus</i>	5. <i>Anthriscus sylvestris</i>	6. <i>Aphanomyces astaci</i>
7. <i>Arion lusitanicus</i>	8. <i>Arthurdendys triangulatus</i>	9. <i>Azolla filiculoides</i>
10. <i>Branta canadensis</i>	11. <i>Bunias orientalis</i>	12. <i>Cameraria ohrdella</i>
13. <i>Campylopus introflexus</i>	14. <i>Castor canadensis</i>	15. <i>Cercopagis pengoi</i>
16. <i>Chattonella cf. verruculosa</i>	17. <i>Craspedacusta sowerbyi</i>	18. <i>Crassostrea gigas</i>
19. <i>Dreissena polymorpha</i>	20. <i>Eriochair sinensis</i>	21. <i>Fallopia japonica</i>
22. <i>Galinsoga quadriradiata</i>	23. <i>Gyrodactylus salaris</i>	24. <i>Heracleum mantegazzianum</i>
25. <i>Heracleum sosnowskyi</i>	26. <i>Homarus americanus</i>	27. <i>Impatiens glandulifera</i>
28. <i>Lepomis gibbosus</i>	29. <i>Lupinus nootkatensis</i>	30. <i>Lupinus polyphyllus</i>
31. <i>Lysichiton americanus</i>	32. <i>Marenzelleria neglecta</i>	33. <i>Melampsorium hiratsukanum</i>
34. <i>Mimulus guttatus</i>	35. <i>Mustela vison</i>	36. <i>Neogobius melanostomus</i>
37. <i>Nyctereutes procyonoides</i>	38. <i>Oncorhynchus mykiss</i>	39. <i>Ondatra zibethicus</i>
40. <i>Pacificastacus leniusculus</i>	41. <i>Paralithodes camtschatica</i>	42. <i>Phoxinus phoxinus</i>
43. <i>Phytophthora ramorum</i>	44. <i>Pinus mugo</i>	45. <i>Pontogammarus robustoides</i>
46. <i>Procyon lotor</i>	47. <i>Prunus serotina</i>	48. <i>Pseudorasbora parva</i>
49. <i>Rosa rugosa</i>	50. <i>Salmo salar</i>	51. <i>Salvelinus fontinalis</i>
52. <i>Sambucus nigra</i>	53. <i>Sander lucioperca</i>	54. <i>Sargassum muticum</i>
55. <i>Senecio inaequidens</i>	56. <i>Solidago canadensis</i>	57. <i>Spartina anglica</i>
58. <i>Teredo navalis</i>	59. <i>Trachemys scripta</i>	

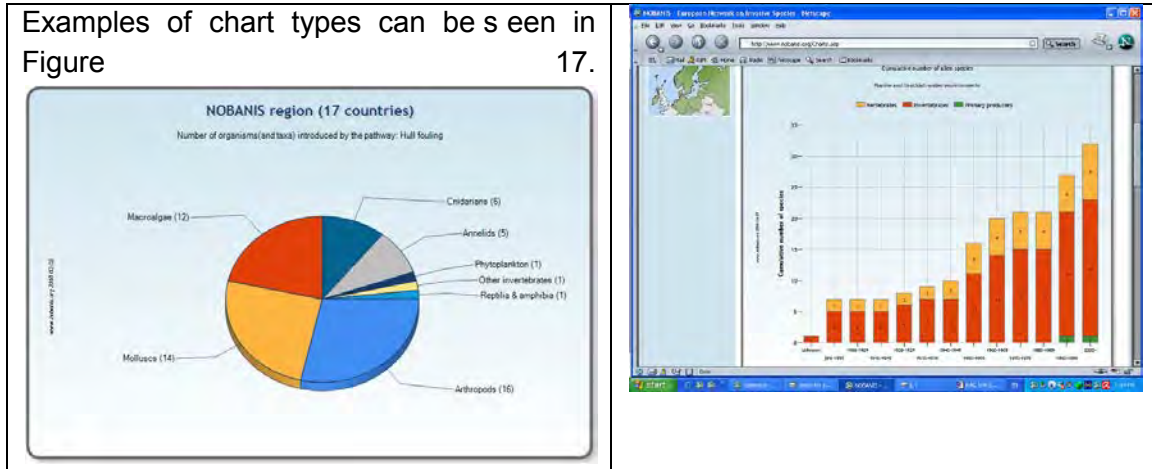
Figure 16. The list of fact sheets on Invasive alien species in NOBANIS.

Country Statistics

NOBANIS provides descriptive statistics charts for each of the participating countries. Five chart types are available:

1. Number of alien species.
2. Number of alien species by habitat.
3. Number of alien taxonomic groups by pathway of introduction (choice of 21 different pathways).

4. Number of alien species by pathway of introduction.
5. Trends in introduction of alien species (choice of 4 different environments).



5.2 BALTIC SEA ALIEN SPECIES DATABASE (BSASD)

An Internet Database on aquatic alien species in the Baltic Sea area was developed as an initiative of the Baltic Marine Biologists' Working Group on Non-indigenous Estuarine and Marine Organisms in 1997; in 2000, a new concept of the online Database appeared with support received from the Baltic Marine Environment Protection Commission (HELCOM). www.corpi.ku.lt/nemo

Now, the online BSASD is an interactive tool, which includes several information retrieving options. (Figure 18) The next step includes development of schemas for continuous updating and fast dissemination of information. The BSASD is seen as a regional node in a future global information system on invasive species. The experience of the Baltic international co-operation may be applied in the implementation of GISIN tasks (Olenin, 2004)



Figure 18. Homepage of the Baltic Sea Alien Species database.

Database Principles

The database is built on the principles of scientific background and information quality to meet the needs of many different kinds of users (governments, management agencies, shipping and port industries, and scientists and students (academics). Other principles upon which the database was built include user-friendliness, support of multiple search options and cross-linking, and of course **timely updates**. This last principle is **largely dependent on the availability of experts**.

The core component of the database structure is *species*. All of the information in the database is related directly to *species*. It includes presently 124 aquatic species (19.1.2010). One can click on any particular species to view and print out all of the information available for that species, including references. Alternatively, users can access the data through the species directory and click on the species listed there to view available information for each species.

The references component of the database allows you to search over 300 references in all of the languages of the Baltic Sea region (Finnish, Swedish, Estonian, Latvian etc.). International readers in general cannot read all of these languages so one of the goals of this regional database is to translate and make all of the information available for international users.

The database species-directory contains individual species entries.

An entry includes the complete taxonomy of a species and available comments, complementing and specifying the database features (year of introduction, ecological impact, etc.) (Figure 19).



Figure 19. Baltic Sea alien species. Species details.

The Database Search tool offers a direct way to retrieve information according to a number of major features. It allows the retrieval of data by a single feature (i.e. by "Taxon") or by combined features (i.e. "Taxon" and "Origin" and "Ecological impact"), including multiple selections of items within any feature. (Figure 20). A list of species, retrieved according to the selected criteria, is linked to relevant individual entries on

species and references (Baltic Sea Alien Species Database 2002, Olenin et al. 2002).

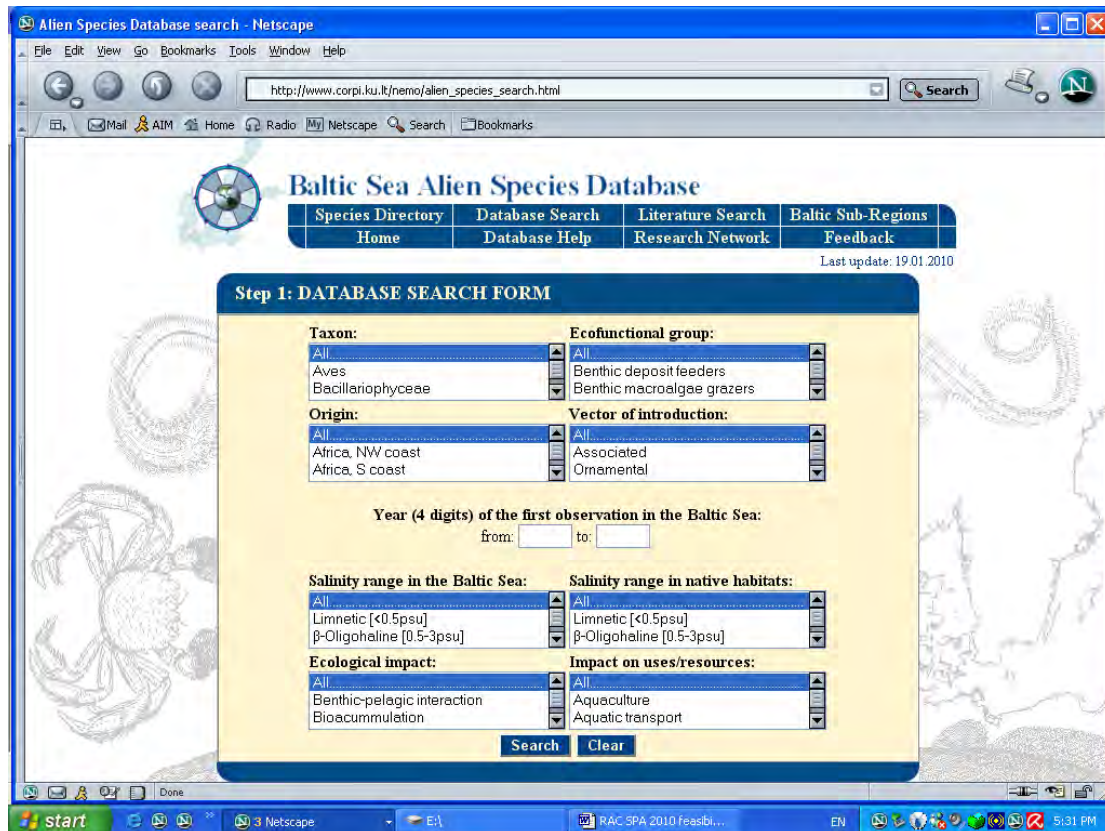


Figure 20. Baltic Sea Alien species database. Search criteria.

The database management system is MySQL. The database resides on a server running the Linux operating system and Apache, and is physically located at the Klaipeda University computer center. The database itself is very small. There is no special software involved in its development except for the Internet server that reports to the PHPMyAdmin tool for publishing data.

5.3. COMMENTS

The NOBANIS database is country based and as such a useful tool to national stakeholders as well as to regional ones. However, it is maintained and fed by the country focal points which implies that the information archived is not always quality controlled by local experts. It is very important to maintain a reliable flow of information and a level of quality control.

In contrast the BSASD database which is quality controlled is hindered by a lack of funding. As Olenin (2004) stated *“during the ten years of database development, the team learned that it is very important to establish a research and administrative network that allows researchers around a particular area to get to know each other and*

communicate regularly". The BSASD database is also lacking the country analysis which is essential so as to follow effectiveness of measures taken at national level.

The BSASD Database developers give preference to peer-reviewed papers because they represent relatively reliable information. But they are often also obliged to use data from environmental reports and other sources that may not be as reliable, so there must be a filter in place. This lesson, that maintenance requires committed personnel and resources for the long term, is applicable to all regions developing databases on invasive species.

The proposed database by Turkish scientists appears to be too complicated to be materialized at regional level. It is designed for IMO/Globallast and will be useful to REMPEC but difficult to be materialized in practice. A regional database intended for a wider public and scientific use should include metadata so as to be practically managed. For example risk analyses of Mediterranean ports is a potential field for the future in the lack of data. One more flaw is that the wider public as a source of information is missing from the dataflow presented in figure 1.

6. PROPOSED SYSTEM

6.1. MEDIAS SYSTEM Structure details

Data on alien species in a common format for all countries participating in the network, and the database of alien species is one of the central products. Development of more detailed databases may be possible to design for national purposes.

As in NOBANIS and DAISIE, the database can be used to identify species that are invasive at present and species that may in the future become invasive, thus providing the foundation for the future development of an early warning system for invasive alien species.

The users interface will include the following modules: Species directory, Database Search, Literature Search, Country /subregion statistics, Port profiles, Programs, Experts registry, Invasive species, Legal instruments, Link to regional/ global networks and databases, Early warning (Figure 21)



Figure 21. Provisional home page for the proposed system (design NJ Xentidis).

6.1.1 Species Directory

As in all previously described databases, the RAC/SPA development should include all species that have been introduced as a result of human activities either intentionally or unintentionally. This means that the database covers both invasive alien species and non invasive alien species. The core species of the database of alien species are organisms that are established (naturalised) in natural or semi natural ecosystems. Alien species that are only present from time to time (casual), or species that are constantly being introduced, but do not breed are also included in the database. An innovation of the proposed system is to include species naturally introduced species that have expanding their distribution range due to climate changes as for example temperate Atlantic species progressively introduced via Gibraltar. This will be us efull in tracing entries due to climate changes. A second innovation will be to archive those species reported as aliens in the literature and exluded later (as in CIESM) along with the reasoning for exclusion. This will be usefull because some recent entries are in fact old introductions that were excluded by the CIESM task groups as very old records with no follow up or due to insufficient data. For example see Figure 22.



Figure 22. Baltic Sea alien species directory. Example from BSASD.

List of aliens	List of species naturally introduced	Excluded «aliens»
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Fields to be filled in for each species in «aliens» and «natural introductions» (figure 23) include: Species name and authorship, Synonyms, Origin, Biotope, establishment success [established, casual, cryptogenic, range expansion], Pathway of introduction, Vector(s) of introduction, First sighting in the Mediterranean, First citation in the Mediterranean, Comments: taxonomic or geographic.

Note: This is already stored in HCMR. The number of alien species archived to date at the HCMR application, on a country basis and per taxonomic group are given in table 8 and 9 respectively, along with comparison data archived in other existing systems.

The screenshot displays a web-based data entry form for the Mediterranean Alien Species Database. The record is for the species *Brachidontes pharaonis*. Key fields include:

- Species ID:** BRRA-01
- Species Name:** *Brachidontes pharaonis*
- Author:** (Fischer P., 1870)
- Ecofunctional ID:** Taxon (Mollusca) / Subgroup (Bivalvia)
- Zoobenthos:** Mollusca
- Origin:** Indian Ocean/Red Sea
- First Sighting:** 1876
- Success:** Established
- First Record:** Fuchs, 1878
- Notes:** This is one of the earliest recorded and most successful of the Lessepsian immigrants, which now constitutes large, stable populations where the environment is suitable. It is locally invasive. Via the Suez Canal. However, preliminary results of molecular studies have shown that there are some Red Sea genotypes in the Mediterranean Sea, but the non-Red Sea genotypes are fairly common and their frequency increases as we get farther from the Suez Canal (Abelson, pers. Commun.). This suggests that ship transport from elsewhere may have occurred for this species rather than natural migration (ICES, 1999).
- Synonyms subform2:** A table listing synonyms such as *Brachidontes variabilis* and *Mytilus pharaonis* (Fischer P., 1870).

The interface includes a navigation bar at the top, a toolbar with various icons, and a status bar at the bottom showing the current record (171) out of 1235.

Figure 23. Fields for each alien species archived at the HCMR application

Table 8. State of art of alien species archived in different existing databases by March 2010.

COUNTRY	DAISIE	ICRAM	HCMR	Review papers	comments
	12/2006	12/2005	3/ 2010		
ALBANIA	9		12		understudied
ALGERIA	11		43		
CROATIA	18		42		understudied
CYPRUS	75		131	July 2009=126	
EGYPT	141		237		Few publications
FRANCE	83		148		
GREECE	88		201	June 2009=193	
ISRAEL	261		390	Sept. 2007=296	many PP
ITALY	120	165	225	Dec 2009 >1945 =163	+many PP in HCMR
LEBANON	113		270		
LIBYA	31		61		
MALTA	23		55	June 2007=49	
MONACO	-		5		NA
MOROCCO	10		30		
PALESTINIAN AUTHORITY	-		29		NA
MONTENEGRO	-		6		understudied
SLOVENIA	11		18		understudied
SPAIN	39		132	July 2008=125	109+natural expansion
SYRIA	45		125		
TUNISIA	50		122		
TURKEY	182		397	Sept 2005=261	
	501	552	960		

Table 9. State of art of alien species per taxonomic group archived in different existing databases by March 2010.

	Taxonomic groups	CIESM	ICRAM	DAISIE	HCMR
	fish	116	104	74	138
	mollusca	137	150	177	220
	Crustacea/Decapoda	70	60	60	73
	Crustacea other (Copepoda included)			23	75
	Macroalgae (Rhodophyta, Chlorophyta, Chromista)	110	12	95	121
	Microalgae (Diatoms, Dinoflagellates)				65
	Magnoliophyta		1	1	1
	Annelida/polychaeta		58	46	96
	Echinodermata			5	11
	Cnidaria		25	11	34
	Bryozoa		16	6	19
	Tunicata		10	5	16
	Foraminifera				53
	Sipuncula				6
	Invertebrates (other) Platyelminthes, Porifera			1	24
	Vertebrates (other)				1
	Protozoa				6
	Total	416	552	501	960

6.1.2 Species distribution/ search

(example from HCMR application: see Figure 8)

For each species details on its distribution covering

countries: selection of x countries

subregional seas: Alboran Sea, west Mediterranean, Sicily Channel, Adriatic (N & S),
Ionian (N& S), Aegean(N& S), Levantine

Biotope: details on its habitat and geographic area

First sighting in the country/subregional sea

Assumed mode of introduction

Literature

Note: This is already stored in HCMR application but not GIS connected.

The network should have a national focal point in each of the UNEP RAC/SPA participating countries. The ideal is to have a network for cooperation between competent authorities of the country and scientific specialists. Data should be quality controlled by regional experts (as in CIESM) and archived at the national focal points. Alternatively it can be central, that is information provided by the focal points will be archived at a central server by the database manager. Considering the different degree of expertise among the focal points, the latter will ensure quality control of the stored information.

The available information on IAS allow for a GIS module concerning distribution at a country level as in DAISIE /subregional level (as in BSASD). However, this will have to be further developed to incorporate feasibility to map species distribution within a country as in ELNAIS. Such a tool will be very useful at national level to follow spread of species within a country, particularly so for the worst invasive species.

6.1.3 Literature

Detailed literature with links or pdfs if available

Search option by name

Note: This is already stored in HCMR application but not with pdfs and no search tool.

6.1.4 MEDIAS Experts Registry

The European Alien Species Expertise Registry, contains details of individual experts and represents a step towards linking different research organizations throughout Europe. It can be used, among others, to identify experts who can contribute information regarding alien species and facilitate information sharing among different national programmes. According to the DAISIE website, by the end of 2007 the registry contained 1628 experts from 91 countries.

The registry is very efficient and easy to use and a similar layout is proposed for the MEDIAS database (Figure 24). Search options by name, taxonomic group, country.

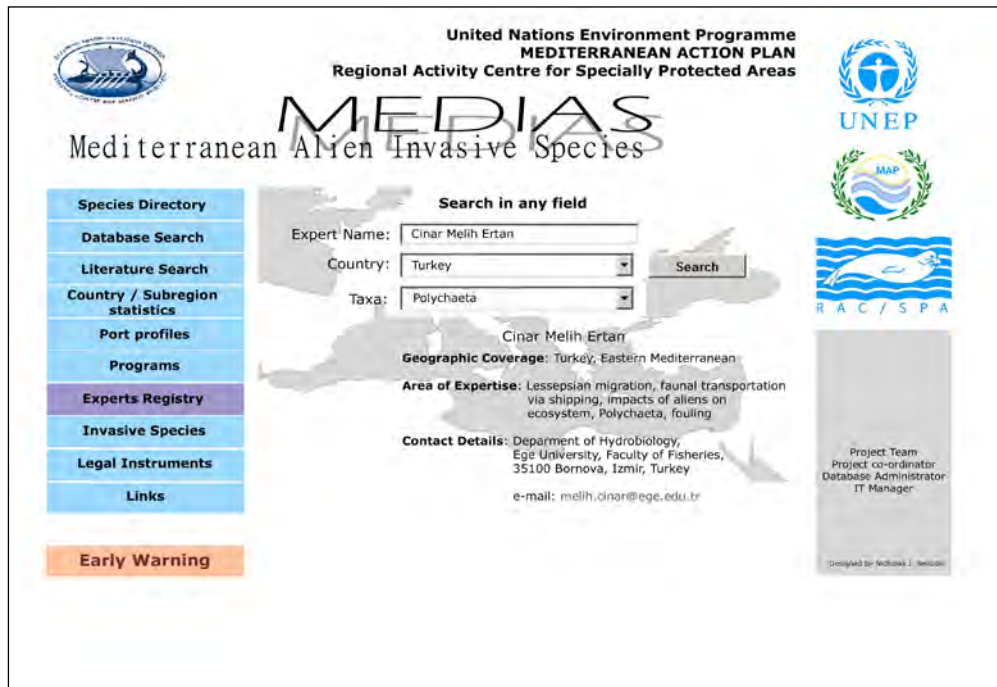


Figure 24. Search experts interface and example of results in MEDIAS (design by NJ)

However the information provided is limited when it comes to the Mediterranean. For example in Greece according to the national Network (ELNAIS) there are 46 Greek experts engaged in the study and reporting of alien marine species as opposed to 11 experts cited in DAISIE (15 including the freshwater specialists).

6.1.5 Invasive species

Factsheets for a selection of invasive alien species will provide information on their biology, ecology habitat and distribution as well as on their impact in the recipient habitats. These factsheets will be written by taxonomic experts, and management approaches including preventive, eradication and control measures will be suggested. Important resources such as contact persons, links and references will also be presented, and information for dissemination to authorities, specialists, the news media and the general public, can be also extracted from these datasheets.

Search option by species

As mentioned above, of the 32 worst invasive aquatic marine, invasive organisms produced by DAISIES only 20 species have a Mediterranean distribution.

Streftaris & Zenetos, 2006 have produced a list of 100 worst invasive species in the Mediterranean in terms of their impact on biodiversity, economy, and health.

Galil (2007) has discussed the role of a few invasive aliens on the biodiversity in the Mediterranean Sea along with the relevant environmental policy and management.

An interface example of Species Directory with searching by species name for the new system is presented in figure 25

Figure 25. MEDIAS directory of worst invasive species (design NJ Xentidis)

6.1.6 Early warning

An early warning and inspection system to protect against the invasion of alien species will be established (figure 26). An interactive tool will be available to provide information on the latest entries (either newly introduced species or geographic expansion of the top most invasive species). In parallel query/new info forms, will enable the wider public to communicate new information and/or queries of unknown species. The forms will be read by the database manager who will be responsible for channelling the information to taxonomic experts, so that a response is given to the interesting body. Under the early warning and inspection system, alien species will hopefully be discovered as early as possible. The new system will also tackle the increasing number of biological invasions by providing trends in introductions at a country level as well as at Mediterranean level. A Pan European initiative, SEBI2010 (Streamlining European 2010 Biodiversity Indicators), has developed trends in alien species among a European set of biodiversity indicators to assess and inform about progress towards the European 2010 targets. Any leaflets, posters, films produced in raising awareness will also be achieved under this system.

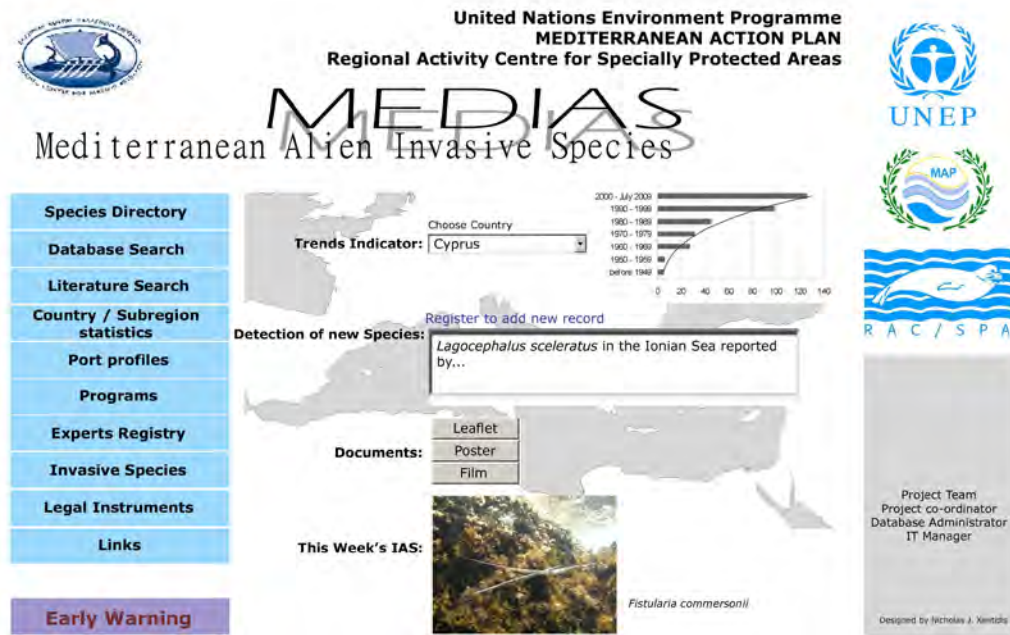


Figure 26. MEDIAS provisional interface under early warning (design NJ Xentidis)

6.2. MEDIAS SYSTEM QA/QC Governance arrangements

Regardless of data completeness or the number of records within a database, alien species data is not very useful if it is not of good quality. Data on alien species are collected using various research methods, spatial and temporal scales, and data quality procedures. According to Crall et al. (2006) only 55% of the databases on alien species in USA had a Quality Assurance/Quality Control QA/QC procedure.

Data quality is tightly linked to data analysis because the quality of the data determines the importance and value of the results that are gathered through mining the data (AT&T Corporation 2004). Poor data quality can affect the findings of any study, produce inaccuracies in spatial predictive models, and misguide management efforts, costing land managers both time and money. Therefore, data quality has to be monitored and managed from the very beginning to encompass data gathering, data delivery, data storage, data integration, data retrieval, publishing, and analysis (AT&T Corporation 2004).

Information archived in MEDIAS is related to the skill level of those who participated in data collection and the presence of a quality assurance/quality control (QA/QC) procedure. Therefore, it would be desirable to establish a standardized and rigorous quality assurance /quality control procedure for the MEDIAS database.

Data archived in MEDIAS can be classified as of high, medium and low data quality.

- High data quality was defined as data that have been put through a standardized, rigorous quality assurance/quality control process; data were collected by experts in the field (e.g., data collected by graduate student, researcher, taxonomist).
- Medium data quality was defined as data that have had some quality assurance/quality control, but not rigorous and standardized; data were collected by people with some knowledge, but were not experts in the field (i.e., data collected by undergraduate student, field technician).
- Low data quality was defined as data that were never subjected to a QA/QC process; data were not collected by experts in the field (e.g., data collected by student, naturalist/hobbyist). Low quality data are termed as questionable.

High quality data is ensured only through interaction of a network of taxonomic experts who would regularly meet. For the four taxonomic groups treated in the CIESM atlases this is achieved but there is a need for confirmation /verification of all groups. Robust identification of species 'in the field' and validation of species names listed in literature is needed before data archive. Inevitably a number of species "bibliographically introduced" will have to be excluded. Double records of species archived by different countries under scientific names that are synonyms such as in NOBANIS, will be avoided. If MEDIAS is maintained and fed by the country focal points (administrators) this implies that the information archived will not always be quality controlled by taxonomic experts. It is very important to maintain a reliable flow of information and a level of quality control prior to data depository.

As to Governance arrangements, prior to the development of NOBANIS, scientists, NGOs and governmental representatives came together for the workshop *Development of a Nordic/Baltic Invasive Species Informational Network*, to discuss and establish regional cooperation on the problem of invasive alien species in the Nordic/Baltic region. Among other issues the question "How can data quality be controlled (quality assurance and control)" was raised. See http://www.nobanis.org/files/Tallin_meeting_Workshop_2_Report.doc

A workshop like should be the first step, once MEDIAS development is decided.

6.3. Alternative proposal

The HCMR desktop application, developed in access, can be easily transported to an internet supported system and distributed to the countries via RAC SPA. At a later stage the following systems will be incorporated in the database

- Literature Search
- Country /subregion statistics
- Port profiles
- Programs
- Experts Registry
- Invasive species
- Legal instruments
- Link to regional/ global networks and databases

7. THE WAY FORWARD

Depending on the urgency and the resources available, RAC SPA can either use the HCMR application by allocating some funds for its development via internet (computer expert) with the guidance of the biologists who have built it, and further develop it into an integrated GIS database to include all the tools described in chapter 6.1 or start building its own database (computer and biologist working together) always taking into account the experience gained within the existing system described in chapter 5. But even in this case the information gathered by HCMR on species and their distribution can be transported to the new system.

The next step includes development of schemas for continuous updating and fast dissemination of information. For this, in practice it is better to have a network of leading experts and the national data archived by national researchers (one per country) that will update and disseminate the information to the national UNEP RAC/SPA focal points. Researchers should meet periodically like the members of the Baltic Sea Working Group, which is convened every 3 to 5 months. Increased co-operation and coordination between countries on common issues related to invasive alien species, as well as some action plans on related issues such as the impact on biodiversity of ballast water discharge and hull-cleaning procedures may also help. The proposed database is seen as a regional node in a future global information system on invasive species.

In the Mediterranean with the rate of introductions and species dispersal as increased as it stands to date, there must be someone tasked with maintaining the database on a daily basis because there is a lot of new information being gathered that must be quickly processed and incorporated into the database.

The database manager needs to be a marine biologist who will co-operate closely with a RAC/SPA officer.

The database will be available on the website, through a friendly users interface, accessible to everyone to see it and interactive in accepting comments and information on new findings but entry forms will be password protected and open to the assigned scientists /focal points by RAC SPA. This regional database will be co-ordinated by RAC/SPA and could be hosted either by RAC/SPA (if the administrator works in RAC SPA) or by another regional /national institution (HCMR is willing to undertake the task. The development of the system is the responsibility of a computer scientist by 80% and of an experienced biologist (20%). However, its maintenance is the responsibility of a biologist as administrator (90%) and an IT manager (10 %).

Newly introduced species will be highlighted in the homepage and circulated to the Mediterranean forum (network of experts) and to authorities, specialists, the news media and the general public (e.g. schools).

The steps needed towards the materialization of the proposed system include

Design of a new data base	– Estimated time 1 man/month
Construction of the data base	– Estimated time 1 man/month
Data storing	– Estimated time 1 man/month
transportation of existing data	– Estimated time 15 days
entries of experts	– Estimated time 15 days
Data entry forms	– Estimated time 1 man/month
Statistical analyses algorithms	– Estimated time 1 man/month
Development of a website application using GIS technologies (web services) –	
Estimated time 5 man/months	

The system will be built in LINUX environment, will be freely available to end users but the entry forms will be accessed from authorized focal points and be password protected. What is of primary importance is the maintenance of the system (see conclusions).

The following five of the MEDIAS modules are of global interest and can be individually linked to existing international systems.

The list of species and their distribution – link to CABI-ISC and GISIN

The experts registry – link to REABIC

The invasive species fact sheets – link to EEA, GISIN

The country statistics – link to EEA, EU Marine Strategy

The early awareness – link to GLOBALLAST, REMPEC

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9. ANNEXES

ANNEX 1. CIESM Congress communications (2001, 2004, 2007, 2010)

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39th Congress 2010

Session: Indo-Pacific Aliens, new species to science, threatened species

Spatial density and morphology variation of *Caulerpa scalpelliformis* (Brown ex Turner) c. Agardh (caulerpaceae, chlorophyceae) in Antalya Gulf (Turkey). Pres: Banbul Acar

Inventaire des crevettes pénaïdes exotiques collectées sur les côtes sud-est de la Tunisie (Golfe de Gabes). Pres: Ben Hadj Hamida-Ben Abdallah

Les espèces non indigènes du macrobenthos des lagunes du Sud-est Tunisien : point sur la situation Pres: Ben Souissi

Patterns of bioinvasion in the Mediterranean Sea – management and Mismanagement. Pres: Galil

The Impact of the CIESM Atlas of Exotic Species (Fishes) in the Mediterranean. Pres: Golani

Impact des changements climatiques et des espèces exotiques sur la biodiversité et les habitats marins au Liban. Pres: Bitar

The Indo-Mediterranean; the emerging of a manmade biogeographical province. Pres: Goren

Parasites of red-med immigrant and native mediterranean coastal fish species: new observations from the Israeli and Turkish coasts. Pres: Diamant

Re-appearance of *Caulerpa scalpelliformis* (r. Brown ex Turner) c.ag. Weber van Bosse (caulerpaceae, caulerpales) in the Gulf of Aantalya, Turkey. Pres: Gökoglu

Signatus javus, a new record from the Syrian waters, with a reference to growth & feeding of two lessepsian fish Pres: Ibrahim

Invasive host, *Charybdis longicollis* (Decapoda: Brachyura: Portunidae), and invasive parasite, *Heterosaccus dollfusi* (Cirripedia: Rhizocephala: Sacculinidae). Pres: Innocenti

Diversity, structure and function of fish assemblages associated with *Posidonia oceanica* meadows in Eastern Mediterranean. Pres: Kalogirou

Lessepsian fish migrants in the Hellenic Seas: spatial variation of their occurrence in boat-seine catches. Pres: Lefkaditou

Hotspots of introduction of marine alien species in Italian Seas. Pres: Occhipinti-Ambrogi

The status of the exotic fish species in the Gulf of Antalya, Turkey (Levantine Sea)

Pres: Özgür Ozbek

First results on the maturity of the lessepsian migrant *Lagocephalus sceleratus* (Gmelin 1789) in the Eastern Mediterranean Sea. Pres: Peristeraki

The contribute of the manila clam to the secondary production of the benthic compartment in the Venice Lagoon. Pres: Pranovi

Impact of invasive species on the biodiversity and fish stock; case study: *Fistularia commersonii* Ruppel, in the Syrian coast. Pres: Saad

Rapid expansion of recently introduced species populations off the Mediterranean coast of Turkey. Pres: Yokes

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