

# Development of an updating information system on Decapoda Crustacea museum collections, useful in research and education

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## Abstract

Natural-history museum collections contain large amounts of historical and contemporary data for the assessment of global invertebrate biodiversity. Nevertheless, these data can not be easily accessed due to a series of constrains, including the lack of relative internet-based databases.

Towards this end, in the Zoological Museum of the Aristoteleio University of Thessaloniki (ZMAUTH) a new information system is under development on the Decapoda Crustacea collections. ZMAUTH hosts large collections of decapod species from all habitats of the Aegean Sea and other Mediterranean areas. Recently, all these decapod specimens along with information on the habitat from which they were collected were computerized and a dynamic database was created, also suitable for use through the internet. In this database, a complete bibliographic list of the decapod species known from the NE Atlantic and the Mediterranean Sea is also included as well as the relevant information on the habitat of each one of them.

Furthermore, all literature information concerning the systematics, zoogeography, ecology, biology, conservation and cultural status of every registered decapod species are being computerised in the database.

In this study, we demonstrate the procedures through which a user of this database can: (1) acquire the existing literature information for a species or a group of species, (2) acquire new scientific information, (3) assess, through a comparison his own relative data and (4) educate students and young researchers.

Keywords: museum collections; Decapoda; diversity databases.

## Introduction

A significant proportion of the existing scientific information concerning global invertebrate diversity is in the form of museum collections. Specimens in these collections have been used to map species historical and present distribution and estimate species richness and diversity (Ponder *et al.*, 2001; O' Connell *et al.*, 2004; Suarez and Tsutsui, 2004).

However, the dissemination of the information stored in the museum collections is little and sparse due to the fact that access to collections and retrieval of specimens can be a difficult and lengthy process, constrained by work force, funding or both. Furthermore, despite some progress in the computerization of the collections, the resulting databases are not commonly available since most of them cannot be accessed through the internet (O'Connell *et al.*, 2004).

Towards these ends, the development and utilization of an information system on Decapoda Crustacea museum collections is presented in this study. This on-line database has resulted from the appropriate computerization of the numerous decapod specimens deposited in ZMAUTH along with literature information on the decapod species of the Mediterranean, the Black Sea and the NE Atlantic. The development of this information system intends to: (1) assemble and disseminate the existing information on the registered decapod species, (2) facilitate access to ZMAUTH museum collections, (3) provide tools for the acquisition of new scientific information based on the data resulting from the museum collections, (4) provide the appropriate web interface so that it can be integrated in the education of students in the relative disciplines.

### **Description of the information system**

The design and construction of the information system is based on Microsoft Access interrelated tables. At the initial stage of the information system development a detailed list of all decapod species known from the Mediterranean, the Black Sea and the NE Atlantic, as given in the review of Udekem d'Acoz (1999), were registered in a MS Access table. For each species, along with the scientific name and authority, its given geographical distribution in the certain areas as well as information on its bathymetry and habitat type was also registered in the database.

At the same time, all museum specimens of the large decapod collections hosted in ZMAUTH were registered in an interrelated Access table of the database along with the sampling station data. Until now, a total of 235 decapod species have been registered in the database.

During the second stage of the information system development, which is still in progress, a thorough review of the international relevant literature is being carried out and all the information concerning the registered species is being gathered and then categorized in the following thematic sections: systematics, zoogeography, ecology, management and cultural status. All this information is registered in the database as literature citations. The dissemination of the available information is materialized through the web site of ZMAUTH (<http://zoological-museum.bio.auth.gr>), through which a possible user can access the information system on the decapod collections. The web site runs in a client-server mode and is built with the ASP (Active Server Pages) framework, permitting the dynamic content of the web pages.

A possible user starts navigating on the museum web site by selecting the invertebrate collections link in the main home page. In this way he is transferred to a web page containing illustrated links of the major invertebrate taxa represented in the museum's

collections. By clicking the Arthropoda link he can navigate down to Decapoda through a series of static web pages, each one representing a lower rank in the systematic hierarchy of Arthropoda. The use of images and sounds in the design of these static web pages facilitates the use of this information system for educational purposes. Finally by selecting a certain decapod taxon the database is queried through SQL (Structured Query Language) and a list of the available species of this group, registered in the museum collections is given.

The selection of a certain species from this list leads the user to the species main web page containing the species scientific name and authority, an image of the species and button-links for the 6 main thematic sections (Systematics, Zoogeography, Ecology, Biology, Specimens, Management, Cultural) containing information about the certain species.

The Systematics web page contains the most important literature references concerning the etymology of the species name, major synonyms and distinct key characters for its identification as well as detailed images of these characters. Each of the references given has a specific code number which appears as a text-link next to the reference. By clicking on this link a new window pops up giving the reference full details. Links to other relevant internet resources are also provided.

The Zoogeography link in the species main page leads to a new dynamic web page where by using Macromedia Flash technology, a dynamic map is created demonstrating the distribution of the certain species in the Mediterranean regions, the Black Sea, the Red Sea and the NE Atlantic, according to the literature information stored in the database. These data are depicted on a raster map image which shows the certain geographical areas with two different colours according to the presence or absence of the species (Fig. 1).

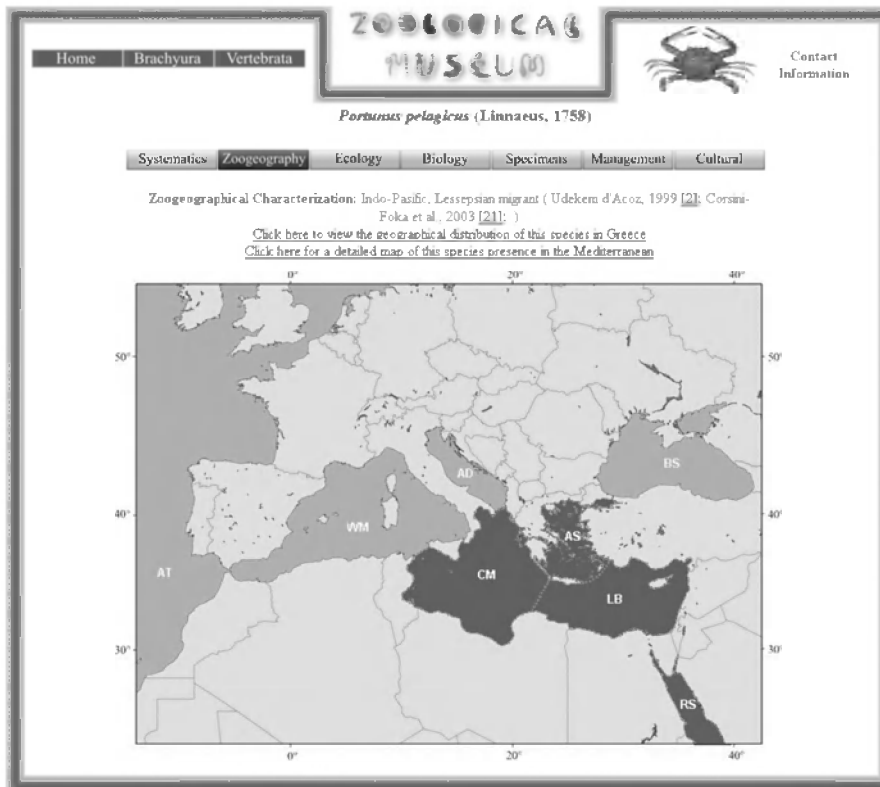


Fig. 1. The "Zoogeography" web page for the species *Portunus pelagicus* (Linnaeus, 1758). Dynamic map indicating the distribution of this species in the certain Mediterranean areas, the Black Sea, the Atlantic and the Red Sea. Black colour represents the geographical areas this species has been found according to the literature.

Following another link in the Zoogeography web page of a certain species, a dynamic map is created demonstrating the distribution of this species in the Aegean Sea as it results from the museum collection data (Fig. 2). Each dot in the map represents a locality where at least one registered specimen of the species has been collected.

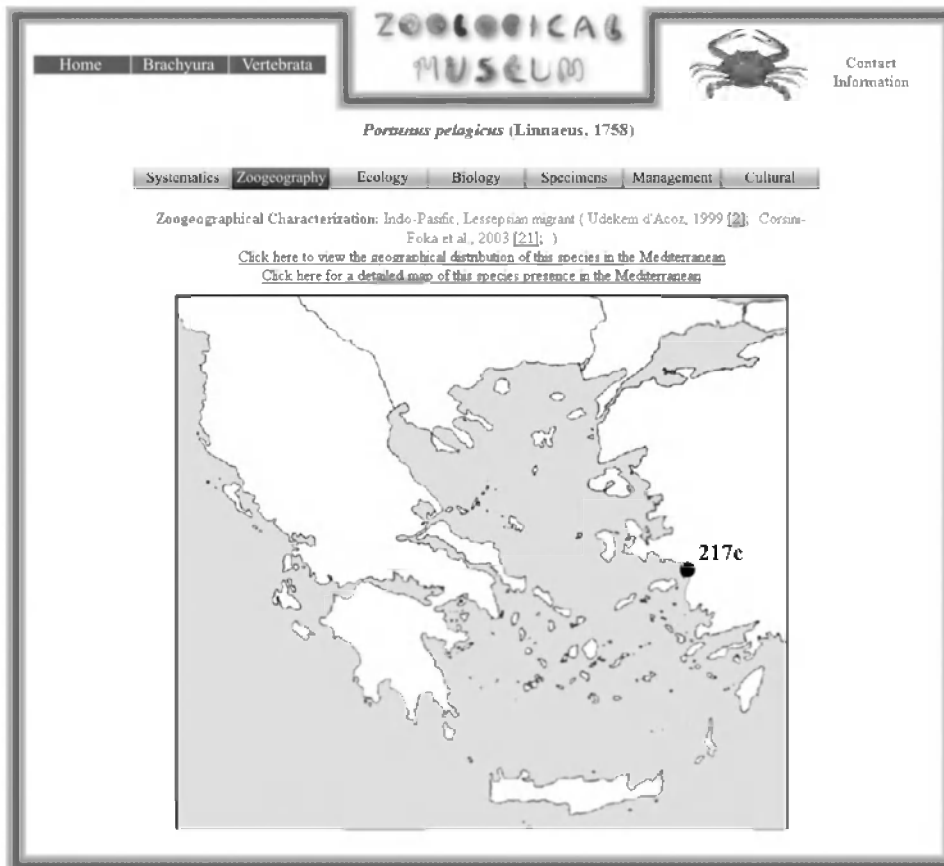


Fig. 2. The "Zoogeography" web page for the species *Portunus pelagicus*. Dynamic map indicating the distribution of this species in the Aegean according to the museum collections data. The black dot represents the station from which the only specimen of the collections has been collected. Bold number is the station code number.

Concerning the decapod species, which are listed as Lessepsian migrants, more detailed information is provided on their zoogeographical distribution. In the Zoogeography web page of each one of these species, a dynamic map of the Mediterranean is given, where all previous literature records of this species are shown as dots on the locality where the species has been reported from (Fig. 3). In the same map, the localities where the registered collection specimens of the certain Lessepsian species have been collected are also shown as dots of different colour (Fig. 3). Thus, a possible user can compare the geographical distribution of a given Lessepsian species as results from the literature and as it results based on the museum collection data and assess whether the latter extend the known geographical distribution of the species.

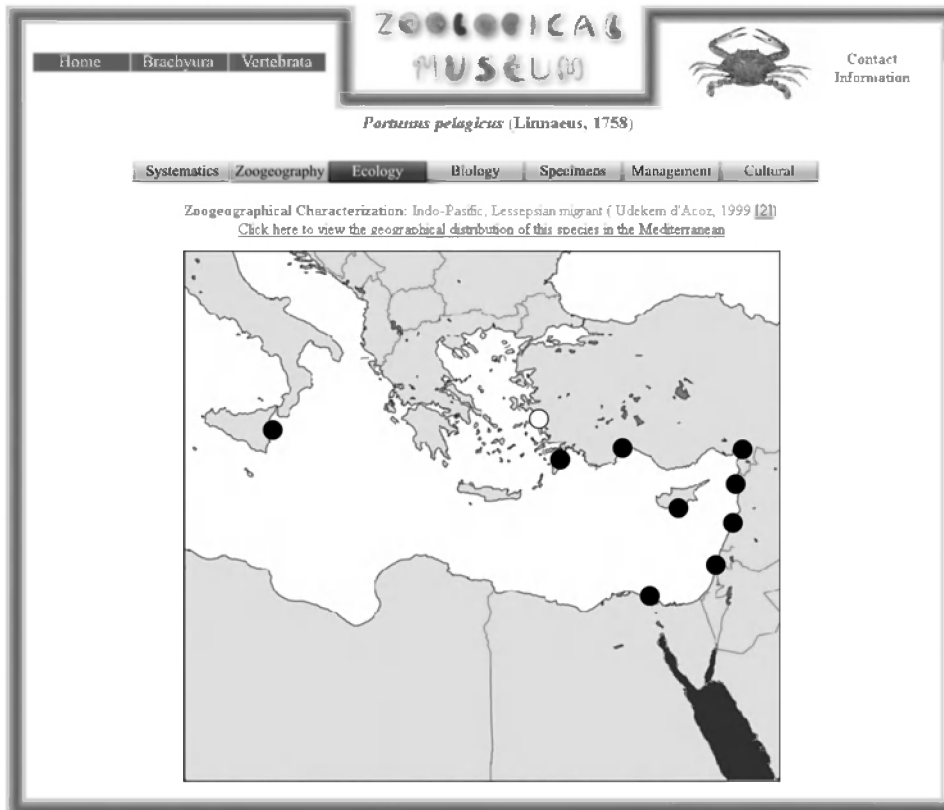


Fig. 3. The "Zoogeography" web page for the species *Portunus pelagicus*, a Lessepsian migrant. Dynamic map of the Mediterranean indicating the species geographical distribution according to the literature and the museum collections data. Each black dot indicates a previous literature record of this species. The white dot indicates the locality where a specimen of this species was collected. From the comparison it results that museum data expand the known geographical distribution of the species.

In the Ecology web page of each registered species, a possible user can acquire the most important literature references concerning the species habitat, its autoecology and synecology. Furthermore, a dynamic graph is created giving the vertical distribution of the species as it results from the literature information, stored in the database, and the museum collection data (Fig. 4). From the evident comparison a user can assess whether the museum data expand the known vertical distribution of this species.

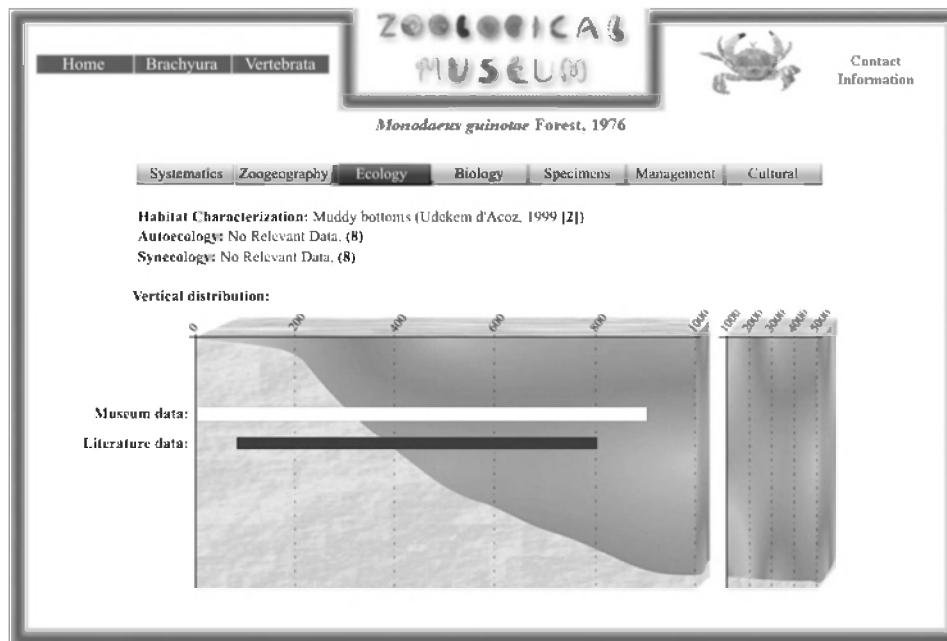


Fig. 4. The "Ecology" web page for the species *Monodaeus guinotae* Forest, 1976. Dynamic chart showing the vertical distribution of this species according to literature data (black bar) and the museum collections data (white bar). Comparing these two bars it results that the museum data expand the known vertical distribution of the species.

In the Biology web page, references on the life cycle of the certain species, its size, its feeding habits, possible predators and diseases are given, while as in all thematic web pages, links to other relevant internet resources are provided.

A table providing all the available specimens of the species selected, which can be found in ZMAUTH collections, mainly structures the Specimens web page. For each museum specimen, the museum code number, information on the station where it was collected as well as the number of individuals contained, are given. From this web page a possible user can ask for a loan or for more information about a specimen by clicking a relative link which directly opens the e-mail client.

Following the Management link from a decapod species main page a new web page is created containing the most important literature information concerning the harvest of the certain species, its cultivation and production as well as other possible uses.

One of the most important innovations of this information system is the provision of existing cultural information about each registered species. In the respective web page, a possible user can find the available historical references of this species (*e.g.*, possible reference from Aristotle), mythological references as well as the contribution of this species in literature and fine arts. Finally, references for possible threats for a certain species by human activities are also provided.

## Utilization of the information system in research and education

This information system can prove to be a very useful scientific and educational tool due to its structure, the contained information and its updating possibilities as well.

An example of the use of this information system is the acquisition of new information on the vertical distribution of a decapod species or a group of species. When a new specimen of a certain species is registered in the database, the museum data bar in the corresponding dynamic chart in the species ecology web page (Fig. 4) is updated according to the sampling station's depth. Through the comparison of this bar with that resulting from the relevant literature information, it can be assessed whether the known vertical distribution of the certain species is expanded in shallower or greater depths. Thus, through this procedure new scientific information is acquired.

A second example concerns the potential acquisition of new information on the geographical distribution of decapod species which are Lessepsian migrants. When a specimen of Lessepsian migrant species is collected and registered in the database, the position of its sampling location will appear in the corresponding dynamic map of the Eastern Mediterranean which also depicts all previous locations where this species has been recorded till now (Fig. 3). By the evident comparison of the geographic location of the sampling station with the previous known distribution of this Lessepsian species, a possible user can assess whether the known geographical distribution of this species is expanded and hence if new information is acquired.

This information system can also be a very useful medium for educational purposes. It can be integrated in courses dealing with zoology, marine biology or zoogeography. Through the static web pages students can be trained in the basic concepts of invertebrate systematics, while the resources contained in the dynamic web pages can contribute to a better training and understanding of the ecology and zoogeography of the decapod fauna of the Mediterranean and the NE Atlantic.

## Future plans

The Zoological Museum of the Aristoteleio University of Thessaloniki hosts large collections of many other invertebrate groups (*e.g.*, Porifera, Actiniaria, Polychaeta, Peracarida) which comprise more than 2,000 species. In the future, all these species will be registered in this information system along with the relevant literature information. All these data will be available through the web site of the Zoological Museum (A.U.Th) using the same presentation scheme as it has been done for the decapod species. This information system intends to be a single source of information on the marine invertebrate diversity of the Aegean Sea and to contribute to the free dissemination of the relative information in the international scientific community and to the development of educational tools for a more comprehensive training of the students in the fundamental concepts of biodiversity, zoogeography and ecology of marine invertebrates.



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