Cultural Heritage and Sustainable Valorization in the Governorate of Tartous with Reference to the Euromed IV Project: The Contribution

Cultural Heritage and Sustainable Valorization in the Governorate of Tartous with Reference to the Euromed IV Project: The Contribution of Geomatics

Grazia Tucci, Francesco Algostino, Laura Bucalossi,
Alessandro Conti, and Alessia Nobile

University of Florence, Faculty of Architecture
Department of Construction and Restoration
via P.A. Micheli 8, 50121 Florence, Italy

Abstract. Six Mediterranean countries are participating in the "Mare Nostrum" project: "A Heritage Trail along the Phoenician maritime routes and through the historic port cities"; the goal of this project is to valorize the cultural heritage of the sites involved by promoting and supporting sustainable tourism. WP4 concentrates on the port cities of Tyre and Tartous, chosen as pilot sites. The on site research was conducted in accordance with the WP4 objectives: on the one hand a survey campaign was set up to acquire metric and qualitative data on the structures chosen as samples; on the other hand an enormous amount of photographic and video documentation was collected for the 3D models that were produced in the first phase. The paper will describe how the disciplines involved in Geomatics can provide important contributions to all four phases of the Heritage and Development framework.

Keywords: Cultural Heritage, Laser scanning, Virtual Tour, Cultural Mapping.

1 Cultural Heritage and Sustainable Valorization

Six Mediterranean countries (Syria, Lebanon, Greece, Italy, Malta and Tunis) are participating in the "Mare Nostrum" project: "A Heritage Trail along the Phoenician maritime routes and through the historic port cities"; the goal of this project is to valorize the cultural heritage of the sites involved by promoting and supporting sustainable tourism.

This goal is being achieved by: raising public awareness of the importance of preserving and promoting sites; valorizing and promoting the Cultural Heritage of the different Mediterranean basin cultures in a more communicative way; promoting effective management plans to reduce the marginalization of archaeological sites and to enhance the centuries-old port-city relationship; defining management plans for target sites that will promote sustainable tourism.

WP4 concentrates on Syria and Lebanon where the port cities of Tyre and Tartous (including the nearby Arwad Island which is already on the World Heritage Tentative List) have been chosen as pilot sites. In both cities WP4 has to: identify

M. Ioannides (Ed.): EuroMed 2010, LNCS 6436, pp. 399–408, 2010.

archaeological/urban sites and proposed re-qualification projects that will enable these sites to be better used; design two kinds of itineraries in a sort of "cultural map": an urban map that includes the waterfront/city connection and a Mediterranean map that connects all the port cities involved in the project; place explanatory panels on site to provide information for tourists.

The concept of sustainability has a double meaning when it is applied to cultural heritage management: in the physical sense it means that excessive concentrations of tourists have to be avoided to ensure that the conservation of the cultural heritage is not compromised; in the economic sense it means limiting the cost-benefits differential and thus increasing the capacity for promoting development. Conservation management planning and the model for sustainable valorization can be integrated to evolve a new model wherein heritage serves as the core of the development process. This process moves through four phases: *Awareness*- Development begins with the identification of resources which have to be documented and studied to harness their potential use; *Appreciation*- Development emphasizes public participation in cultural heritage activities; *Protection*- The tools of reference are heritage charters (concepts, policies and practices) and conservation guidelines (technical standards); *Utilization.*

2 The Contribution of Geomatics

The contribution of geomatics does not only consist in the application of the latest information technology procedures but creates a new methodological behavior within the data acquisition and management process. Geomatic techniques can play a central role because they provide innovative and more complete ways of describing reality which, in their turn, allow approaches at different levels:

1. Geomatic techniques can manage enormous quantities of data relating to a single geographic location but generated at different times;
2. Extra features can be added to the representation field during the research phase using processing to reconstruct modifications that have taken place over time;
3. Georeferencing of data makes possible to lin the existing relationship between cultural heritage objects;
4. The knowledge acquired can be widely disseminated on-line;
5. The information can also be transferred to external databases and web sites.

To sum up, the research for this project uses geomatic techniques to propose innovative ways of using case studies, allowing diverse analogous elements (the port cities linked to each other in the Phoenician commercial maritime routes system) to be considered simultaneously. In this sense it is possible to propose hypotheses for valorizing these heritage objects which take into account a series of conditions such as accessibility, current transformations within the area, relations between the more important monuments which profoundly effect their use. The use of these heritage objects should be seen as an opportunity for increasing our understanding of them.

The disciplines involved in Geomatics provide important contributions to all four phases of the Heritage and Development framework: awareness, appreciation, protection and utilization.

On the one hand the acquisition and manipulation of data for studying and conserving sites: preparing geometric and thematic surveys, setting up maintenance programmes and simulating models for predicting the impact of the tourist flow. On the other a powerful tool for communication. To provide the cultural heritage with such a powerful system for learning, enriched by information technologies, is certainly a first step towards a better understanding of the sites and an essential step towards their appropriate valorization.

3 Description of the Places

Tartous was founded in the 2nd millenium B.C. as a coastal settlement on land belonging to Aradus (the present day Arwad), a small island 3 km away and one of the most important Phoenician city–states. It expanded as an independent city under the Emperor Constantine and his son Costanzo II. The city was conquered by Arabs in 636 and was of little importance until it was taken by Raymond de San Gilles during the First Crusade. In the second quarter of the 12th Century the Cathedral of Our Lady of Tortosa, one of the best preserved Crusader religious buildings, was built. Its fortified structure makes it unique among the Latin churches of the Near East.

In 1152 Tartous became one of the main settlements of the Knights Templar who built the Citadel in the north-west corner of the city. This Citadel was built with double concentric walls and a double moat. Although dwellings were later built within

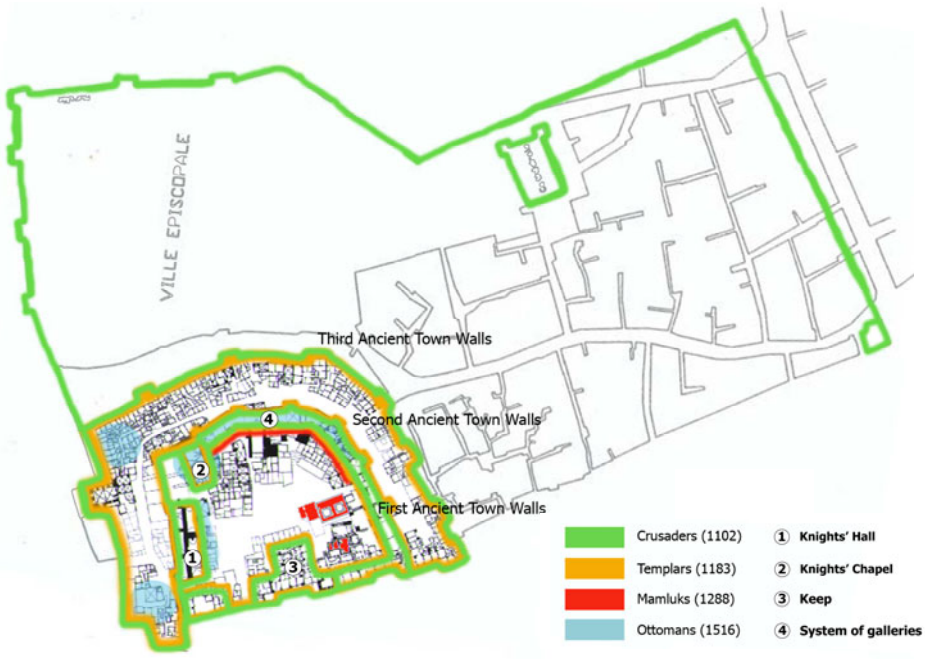

Fig. 1. Historical phases of the Citadel of Tartous. The numbers indicate the most important examples of Crusader architecture that are still recognizable.

the Citadel the remains of its walls and the most important Knights Templar buildings (the Keep, the Banqueting Hall and the Chapel) and the later Ottoman additions such as the galleries along the walls, are still clearly visible (Figure 1).

Tartous is currently the second most important city on the Syrian coast and is the main centre of a network of important points of interest for culture and tourism. The relationship with Arwad has now been reversed: the island is only a small town that depends mainly on local daily tourism. There are significant remains of the Phoenician Aradus on the island including the imposing remains of the walls facing the sea. The importance of Arwad during the Crusades is testified by the presence of two castles, one built by the Crusaders on the highest point of the island, the other built by the Arabs by the sea.

There are other important archaeological remains 7 km from Tartous at Amrit. The temple known as Maabed, is a basin carved into the rock surrounded by blocks of stone with an altar in the centre, which holds water from a nearby spring. Nearby there is a necropolis with underground tombs and two monuments called Meghazil.

There are also the remains of the docks of a port and a stadium from the Hellenistic period. Further from Tartous there are other important sites of cultural interest. One of the most interesting is the Hosn Suleiman archaeological area (the ancient Baetocece), a sanctuary dating from Phoenician times with a well preserved sacred enclosure and the remains of two temples dedicated to Zeus and Astarte. There are numerous castles in the area which date back to the Crusades. The White Castle at Safita, the Al-Marqat Castle and the Krak des Chevaliers, the most famous and best preserved of the castles of the Crusade period, were all inspected during the mission.

4 Goals and Methodological Choices

During previous WPs, graphic, cartographic, iconographic and bibliographic material was gathered for pilot sites and so, after an inspection, it was possible to define the area on which to concentrate the on-site research. Studies by G. A. Neglia and M. Bouteflika were used as references for the urban analysis of Tartous and the surrounding area; the “Memorandum on Sustainable Urban Development in Syria” and the “Workshop on the preservation and development of the old city of Tartous” held by GTZ and the Syrian Ministry of Local Administration and Environment, provided information on guiding principles and programmes in the important areas of urban policy and management.

The on site research was conducted in accordance with the WP4 objectives: on the one hand a survey campaign was set up to acquire metric and qualitative data on the structures chosen as samples; this provided the necessary information for the systematic analysis (chronological phases, construction techniques, state of preservation) required for preparing conservation guidelines; on the other hand an enormous amount of photographic and video documentation was collected for the 3D models that were produced in the first phase; this documentation is being used for multimedia popularization and communication of the most interesting sites: architectural heritage, landscape and archaeological sites.

In particular: integrated topographic and laser scanning techniques were used to provide a metric survey of the Knights’ Chapel and the urban spaces inside the Citadel; the most interesting parts of Tartous (the Citadel and the Cathedral/Museum)

and the surrounding areas (Arwad Island and the archaeological site at Amrit) were photographed for modelling for communication projects (virtual tours, integrated video and multimedia products).

4.1 Metric and Thematic Survey

The metric surveys and the studies of the materials and construction techniques were mainly carried out in the old city of Tartous. The urban fabric has a complex structure because of its pronounced vertical stratification. The Knights' Chapel and the cross-vaulted galleries, both situated in the inner circle of the city walls, and a part of the wall circle (Figure 1) were chosen because they have best preserved the peculiar characteristics of Crusader architecture. Three-dimensional metric surveys were carried out to obtain the disposition of masses on an urban scale as well as the detail required for analyzing wall textures. A topographical network with 7 vertices was defined to measure, 59 topographical targets which were necessary for the alignment and referentiation of the range maps acquired. An HDS6000 phase-based scanner was used for the detail survey. The shooting geometry and the scanning resolution were modulated to better adapt them to the morphological characteristics of the spaces. Data was acquired from different view points to ensure uniform data coverage and to minimize any possible "shadow areas". Documenting the Chapel's morphometric characteristics, the building techniques used, the extrados of the vaults, the fallen down parts and the thickness of the walls was a complex business partly because it was difficult to obtain access to the adjacent private spaces but also because it was difficult to transfer the reference system around the building. A total of 43 scans were carried out: 20 for the Knights' Chapel, 7 for the Ottoman galleries, 5 for the portion of the town walls and 11 to document the urban fabric in which these structures are inserted.

In the parts that have been studied it is possible to measure the size of the ashlars, their shape, the workmanship involved and the construction criteria used. A wide variety of wall building techniques has been documented. As an example: portion of wall from the Chapel is made up of perfectly squared parallelepiped blocks, the norm for important buildings; portion of wall from the service galleries, is composed of small blocks of rather irregular shape in a homogeneously textured wall surface.

4.2 Image Recording

All the sites that are part of WP4 – the Cathedral/Museum of Tartous, the Citadel, the Amrit site and Arwad - have been documented using the most innovative digital techniques available to produce spherical panoramas, high resolution image mosaics and digital stereo images. More than 14.000 photos were taken to cover the different aspects of the mission: they show the places, the architecture, the landscapes, the residents and the local handicraft production as well as documenting the different stages of the work. A panoramic head, combined with a 15 mm fish-eye lens, was used for photographing complex or particularly wide spaces that could not be covered by a single photo and panoramas were elaborated using cylindrical equirectangular projection. The individual photos were mounted using software so they could be visualized as 2D files and explored as immersive environments. About 70 panoramas were mounted: each one was made up of an average of 21 photos and a maximum of 60 photos. Up to 3 stop bracketing was used for every single photo: these multiple shots

also make it possible to obtain images with a colour depth of 16 bits and to recover under or over-exposed details. This process is fundamental for 360° external photography where the exposure differences are particularly strong and to obtain HDR (high dinamic range) images.

5 Graphic Output

The total points model obtained after the alignment and referentiation of the range maps is an extremely versatile 3D database as it allows graphic output to be modified to meet specific requirements. Extracting information from the data gathered by the scanning systems is a complex time-consuming post-processing operation that requires special software and skilled personnel. The following information can be obtained from the range maps: plans, elevations and vertical sections; 2D images of the range map; 3D static and dynamic digital models. Further information can be obtained from the photographic archive: spherical panoramas; high resolution image mosaics; digital stereo images.

Table 1. Summary table of metric survey and image recording data

METRIC SURVEY DATA (Tartous Citadel)	
Tartous Citadel total area	about 31.000 mq
Survey area	about 6.900 mq
Surveyors	4
Topographic survey	
Total station	Leica TCR 303
Closed traverse	1
Open traverse	1
Vertices	7
Least-squares adjustment (stdev)	80^{cc}, 11 mm
Laser scanner survey	
Laser scanner	Leica HDS6000
Laser scanner stations	43
Acquired targets	59
Acquired spatial coordinates	185.018.130
Registration mean absolute error	0.006 m
IMAGE RECORDING DATA (Tartous and surroundings)	
Photographers	2
Cameras	Nikon D3, D90 and D700
Fixed lenses	15mm f/2.8, 24mm f/2.8, 50mm f/1.4
Zoom lenses	18-200mm f/3.5-5.6, 18-55mm f/3.5-5.6, 24-70mm f/2.8
Image resolution	D90: 4288x2848 - D3 and D700: 4256x2832
Photographed locations	16
Avg. number of photos in panoramas	21
Shots for each picture	3
Avg. panorama resolution	360°x80°: 6.000x3.200
Max panorama resolution	360°x40°: 72.000x3.600
Texture pictures	160
Camera and video shooting time	42’33”

Repeated elaboration of the data collected makes it possible to extract a wide range of graphic output whose complexity and articulation depends on the goal desired and to experiment ways of representing this output that have enormous communication potential: 3D digital modelling as a method for checking the historical reconstruction; 3D and kinetic digital modelling as a tool for understanding and for education and communication; 3D digital modelling for representing morphological transformations. The preliminary results of the surveying campaign undertaken in the Tartous area during WP4 of the Mare Nostrum project are presented below.

A. Plans, Elevation and Vertical Sections The following drawings have been produced:

– A plan (Figure 2) which was realized by integrating a previous survey of the Citadel with the survey undertaken by our working unit. This mixed plan was completed with an orthogonal image of the range maps of all the connecting areas (lanes and the main square) in order to show the extension of the on-site data acquisition.

– Vertical sections (Figure 3) to analyze the urban morphology and the relationship among the buildings.

Fig. 2. Integration of the existing plan of the present situation and the plan extracted from the points cloud

B. Bidimensional Images Obtained from the Range Map. A precise digital model can simulate 2D images so well that the human eye cannot distinguish these images from perspective photographic representations. The 2D image shown in Figure 4 is example of the remarkable levels of detail that can be obtained using scanning systems. Obviously, temporal information i.e. the condition of the object at the time it was surveyed, is collected along with the geometric information.

This peculiarity, intrinsic to laser scanner data, has many positive uses for both research and for setting up multimedia instruments for popularizing, promoting and explaining the project to different user categories).

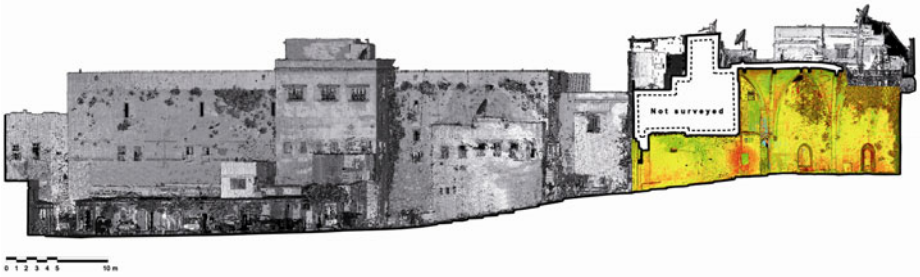

Fig. 3. Transversal section BB' passing through the Knights' Chapel

C. Static and Dynamic 3D Models. The capacity of 3D models to remain unaltered over time and their interactivity, which allows users to extract information (2D and 3D), makes such models ideal instruments for setting up virtual museums which popularize and explain the museums' contents. But this is only one of their possible applications. As these models possess the fourth dimension, time, they introduce a dynamic element to both representation and comprehension. This factor is extremely important as it provides a method for checking historical reconstructions and for representing morphological transformations.

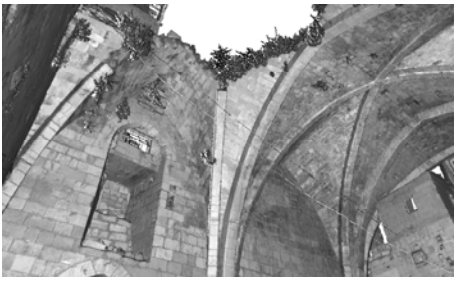

Fig. 4. 2D image of the total points model of the Knights' Chapel

D. Panoramic Images. The images were organized in a database managed by Adobe Lightroom 3. This software allows the images to be catalogued using metadata, i.e. series of information connected to the files containing the images. Some of this information is memorized when the photo is taken, such as the date, the type of camera used, the lens focus, the time and the diaphragm. Other information can be defined subsequently by designing a suitable thesaurus. About 60 keywords have been identified for cataloguing the images belonging to this project which means it is now possible to undertake detailed research within the database. This method of management has made over 30 GB of photographs accessible to the various members of the work group and will also make it possible for researchers outside the WP4 group to rapidly find images. The position from which the photos were taken is also known thanks to the GPS system connected to the camera. This type of information, known as geotagging, facilitates the use of these images allowing them to be managed in innovative ways such as classifying them on the basis of geographic proximity. The elaborated panoramas (Figure 5) can be used in various ways: to enable the use of inter-connected virtual spaces on the internet or on CDs; to integrate chromatic information with the points cloud; in pairs for photogrammetric restitution (spherical photogrammetry).

Fig. 5. Spherical panorama inside the vaulted galleries (Citadel of Tartous)

The panoramas of the most important archaeological and cultural sites in Tartous will be connected and put on line and, in the future, meta-nodes will be used to do the same for the principal Phoenician Mediterranean ports.

6 Towards a "Shared Cultural Mapping"

There has always been a direct relationship between tourism and cartography: maps of travel routes and general information about the areas to visit are used in selecting the destination and in planning travel and stay. Today cartography is numerical and is used on line. Geographically referred data can be questioned, cross-checked, up-dated and it can be a valid tool for understanding and valorizing planning activities as well as informing and preparing visitors. Cultural mapping is a process of collecting, analyzing and synthesizing information in order to describe the cultural resources, networks, links and usage patterns in a community. The technological revolution has had an enormous impact on the information content available on-line and has given rise to the phenomenon known as user-generated content (UGC). Photos, films, audio and text comments are placed on blogs, podcast guidebooks, social network sites, shared content multimedia sites and Wiki at an uncontrollable rate, allowing an undefined audience to access contents that would not have previously been available unless the places described had been visited in person. This enormous amount of content helps to form opinions among internet users regarding tourist destinations and services offered and in fact influences the choices made by future travelers. These technological innovations are opening the way for so-called virtual tourism which lets potential travelers anticipate their travel experience thereby stimulating their curiosity and increasing their interest in the areas visited.

Making a cultural mapping involves many different categories in a participatory approach: residents, administrators, schools, tourist operators, and generates new perspectives and prepares the ground for effective cultural planning. A map has much greater potential than an inventory; it communicates a rapidly increasing amount of information and appreciation, it draws attention to the cultural area identifying previously unknown resources and activities, it provides the possibility of looking at data from different perspective thereby gaining objectivity and overview and of locating gaps, needs and overlaps. The work to be undertaken, in the EuroMed Mare Nostrum project, will contribute to programming sustainable development by helping transform tourism into an element that valorizes the environmental and cultural qualities of a given territory as well as consuming them. The future of the tourist industry depends on the conservation of the environment in which it takes place. The first steps required are: to increase the awareness of the population regarding the cultural heritage of their own country, to sensibilize visitors and to train tour operators. A series of innovative and experimental measures should also be taken in order to identify strategies and instruments for reducing the pressure of tourism on the environment and for improving the quality of the environment in areas that will remain mass tourism destinations (for example the Island of Arwad where the visible degradation is due to the large numbers of visitors).

Acknowledgement

We would like to thank: Dr. Eng. Maher Hazar (Ministry of Culture of Syria), Dr. Michel Maqdissi and Dr. Bassam Jammous (Directorate General Of Antiquities And Museums) and Dr. Maruan Hassan, Arch. Alaa Hammoud (DGAM Department of Tartous) for their support and cooperation in the project.

Special thanks to arch. Davide Guerra for the photographical campaign on site.

References

1. Bouteflika, M.: PhD thesis: Tartous, Syrie: lecture stratigraphique et restauration urbanine. Tutor: Attilio Petruccioli. Polytechnic of Bari, 17th cycle (2004)
2. Neglia, G.A.: Digital Reconstruction as Part of Urban Renewal Projects: the Case of the Citadel of Tartous, Syria. In: Digital Media and its Applications in Cultural Heritage, pp. 161–175
3. Saidi, M.: PhD thesis: Les forms et le fonctionnement du paysage de Tartous (Syrie): du modele de projettation. Tutor: Attilio Petruccioli. Polytechnic of Bari, 17th cycle (2001-2004)
4. Coquais, J.P.R.: Arados et sa Pérée aux époques Grecque, Romaine et Byzantine. Beyrouth (1974)
5. Deschamps, P.: Les chateaux des croisés en terre sainte. Paul Geuthner, Paris (1934)
6. Folda, J.: Crusader art in the Holy Land. Cambridge University Press, New York (2005)
7. Barber, D., Mills, J.: 3D Laser Scanning for Heritage. English Heritage Publishing (2007)
8. El-Hakim, S., Beraldin, J.-A., Picard, M.: Detailed 3D Reconstruction Of Monuments Using Multiple Techniques. In: Proceedings CIPA WG 6: International Workshop On Scanning For Cultural Heritage Recording, Corfu, Greece, September 1-2, pp. 58–64 (2002)
9. Guarnieri, A., Vettore, A., El-Hakim, S., Gonzo, L.: Digital photogrammetry and laser scanning in cultural heritage survey. International Archives of Photogrammetry and Remote Sensing 35(5), 154–158 (2004)
10. Haggrén, H., Junnilainen, H., Järvinen, J., Nuutinen, T., Laventob, M., Huotarib, M.: The use of panoramic images for 3D archaeological survey. International Archives of Photogrammetry and Remote Sensing 35(5), 958–963 (2004)
11. Reulke, R., Scheibe, K., Wehr, A.: Integration of digital panoramic camera and laser scanner data. In: Proc. International Workshop on Recording, Modeling and Visualization of Cultural Heritage, Centro Stefano Franscini, Monte Verità, Ascona, Switzerland, May 22-27 (2005)
12. Torniai, C., Battle, S., Cayzer, S.: Sharing, Discovering and Browsing Geotagged Pictures on the Web. HPL-2007-73 (2007), `http://www.hpl.hp.com/techreports/2007/HPL-2007-73.html` {19-08-2010}
13. Tucci, G., Bonora, V., Nobile, A.: Innovative survey methods for the digital documentation of vernacular architectural Heritage in Syria. In: 22nd CIPA Symposium, Kyoto, Japan, October 11-15 (2009)
14. Tucci, G., Bonora, V., Nobile, A., Tokmakidis, K.: Geomatic methods of surveying. In: Villages of Northern Syria. In: Mecca, S., Dipasquale, L. (eds.) An architectural tradition shared by East and West - Earthen Domes and Habitats, pp. 157–162. ETS, Pisa (2009)