ACTIONS FOR THE CONSERVATION OF COASTAL DUNES WITH *JUNIPERUS* spp. IN CRETE AND THE SOUTH AEGEAN (GREECE)

LIFE07NAT/GR/000296

Action D.6
Deliverable D.6.1

DISSEMINATION OF FINDINGS TO THE SCIENTIFIC COMMUNITY

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“Actions for the conservation of coastal dunes with *Juniperus* spp. in Crete and the South Aegean (Greece)”

- JUNICOAST -

Action D.6: Dissemination of findings to the scientific community and Layman's report

Deliverable D.6.1: Dissemination of findings to the scientific community

Responsible beneficiary: Mediterranean Agronomic Institute of Chania (MAICh)

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Περίληψη

Ο οικότοπος των παράκτιων αμμοθινών με είδη *Juniperus* αν και απαντάται σε 224 περιοχές του δικτύου NATURA 2000 σε αρκετές μεσογειακές χώρες της Ευρώπης μέχρι σήμερα δεν έχει ερευνηθεί και μελετηθεί σε ικανοποιητικό βαθμό όσον αφορά τα ιδιαίτερα οικολογικά χαρακτηριστικά του. Επιπλέον οι πιέσεις που δέχονται οι περιοχές από τον τουρισμό ποικίλουν από περιοχή σε περιοχή λόγω των ιδιαίτερων κοινωνικών και οικονομικών συνθηκών. Επίσης η προστασία και διατήρηση του οικοτόπου στα πλαίσια της διαχείρισης των περιοχών του δικτύου NATURA 2000 βρίσκεται σε αρχικά στάδια ή εφαρμόζονται διαχειριστικά μέτρα που αναφέρονται στην προστασία του φυσικού περιβάλλοντος γενικότερα.

Συνεπώς, η διάχυση της γνώσης που προέκυψε κατά τη διάρκεια του προγράμματος προς στην επιστημονική κοινότητα είναι απαραίτητη και συμβάλλει στην καλύτερη προστασία του οικοτόπου, στην αποτελεσματικότερη διαχείριση των περιοχών NATURA 2000 και στην υποστήριξη και εφαρμογή παρόμοιων δράσεων/προγραμμάτων και σε άλλες περιοχές Ελλάδας ή της Ευρώπης όπου εμφανίζεται ο εν λόγω οικότοπος.

Η παρούσα αναφορά περιλαμβάνει τις εργασίες που δημοσιεύθηκαν σε επιστημονικά περιοδικά και τις εργασίες που παρουσιάστηκαν ή αναρτήθηκαν με μορφή πόστερ σε διάφορα επιστημονικά συνέδρια.

Μέχρι σήμερα έχει δημοσιευθεί η εργασία “**Participation in the management of Greek Natura 2000 sites: Evidence from a cross-level analysis**”στο περιοδικό “Journal of Environmental Management” Evangelia Apostolopoulou, Evangelia G. Drakou and Kalliope Pediaditi (2012).

Η εργασία “**Vegetation dynamics of coastal dunes with *Juniperus* spp. in Crete, Gavdos and Chrysi islands (Greece)**” Penelopi Delipetrou, Dany Ghosn, George Kazakis, Ilektra Remoundou, Panagiotis Nyktas and Ioannis I.N. Vogiatzakis, έχει υποβληθεί για δημοσίευση στο περιοδικό «Plant Ecology and Diversity».

Η εργασία "**Imaging sand dunes at Kedrodasos coastal area, Crete, Greece**" S. Zannetidis, N. Economou, H. Hamdan, P. Nyktas, G. Kazakis, D. Ghosn and I. Remoundou, παρουσιάστηκε στο 6^{o} συνέδριο της Βαλκανικής Γεωφυσικής Εταιρείας στην Βουδαπέστη τον Οκτώβριο του 2011 και έχει δημοσιευθεί στα πρακτικά του συνεδρίου.

Η εργασία **"Ανάλυση πληθυσμιακών δεδομένων σε υποπληθυσμούς του είδους *Juniperus macrocarpa* σε τέσσερις περιοχές της Κρήτης προς την κατεύθυνση της εφαρμογής εξειδικευμένων δράσεων διατήρησης"** Καλτσής Α., Κουτσοβούλου Κ., Θάνος Κ.Α., παρουσιάστηκε υπό μορφή πόστερ στο 12ο Πανελλήνιο Επιστημονικό Συνέδριο της Ελληνικής Βοτανικής Εταιρείας στο Ρέθυμνο, 29 Σεπτεμβρίου – 2 Οκτωβρίου, 2011.

Η εργασία **"Σύνθεση και δομή των υποπληθυσμών του είδους *Juniperus macrocarpa* στην Κρήτη"**. Καλτσής Α., Κουτσοβούλου Κ., Σκούρτη Ε., Θάνος Κ.Α., παρουσιάστηκε υπό μορφή πόστερ στο 5ο Πανελλήνιο Συνέδριο Οικολογίας «Οικολογικές διεργασίες στο χώρο και το χρόνο» της Ελληνικής Οικολογικής Εταιρείας της Ελληνικής Ζωολογικής Εταιρείας και της Ελληνικής Βοτανικής Εταιρείας στην Πάτρα, 7-10 Οκτωβρίου 2010.

Η εργασία **"Study cases on conservation of endangered plants and habitats in Greece"**, Thanos C.A. (2010).παρουσιάστηκε στο συνέδριο XIII OPTIMA Symposium on Rare and Threatened Plants and Habitats, στην Αττάλεια της Τουρκίας στις 22-26 Μαρτίου 2010 και συμπεριλαμβάνεται στην έκδοση των πρακτικών του συνεδρίου.

Τέλος σε όλα τα παραδοτέα του προγράμματος, περιγράφονται αναλυτικά οι μεθοδολογίες και τα αποτελέσματα κάθε δράσης και είναι διαθέσιμα στην ιστοσελίδα του προγράμματος: (www.junicoast.gr/en/publications/deliverables/)

Introduction

From the onset of the JUNICOAST project, a communication strategy has been developed and implemented (see Deliverable D.1: Report on communication strategy). This communication strategy included an awareness and education activity entitled: "dissemination of findings to the scientific community".

The objectives of this activity were to disseminate the findings and the knowledge acquired throughout this project to the International scientific community, to contribute to the consolidation of a knowledge base and to promote future best practices on the conservation of coastal dunes with *Juniperus* spp. in order to encourage collaborative research at European and International level and increase visibility of the research across the scientific community.

Results from various preparatory actions have been published in peer-reviewed journals or presented at National or International scientific conferences. Moreover, detailed scientific reports for each preparatory action have been produced and published on-line on the official website of the project (http://www.junicoast.gr/en/publications/deliverables/).

Publications in peer-reviewed journals

A scientific paper entitled: "**Participation in the management of Greek Natura 2000 sites: Evidence from a cross-level analysis**" authored by Evangelia Apostolopoulou, Evangelia G. Drakou and Kalliope Pediaditi has been published in the "Journal of Environmental Management" on September 2012 (see annex 1 Publications in peer-reviewed journals).

A second scientific paper entitled: "**Vegetation dynamics of coastal dunes with *Juniperus* spp. in Crete, Gavdos and Chrysi islands (Greece)**" authored by Penelopi Delipetrou, Dany Ghosn, George Kazakis, Ilektra Remoundou, Panagiotis Nyktas and Ioannis I.N. Vogiatzakis has been submitted to the journal of "Plant Ecology and Diversity" and is still under "review" awaiting acceptance (see annex 1 Publications in peer-reviewed journals).

Moreover and as mentioned in the After-LIFE communication plan, more scientific papers on coastal dunes with *Juniperus* spp. will be submitted and published in scientific journals in the near future.

Presentations at national or international scientific conferences

Several scientific articles, abstracts and posters have been presented at National or International scientific conferences in Greece and Europe.

A scientific article entitled: "**Imaging sand dunes at Kedrodasos coastal area, Crete, Greece**" authored by S. Zannetidis, N. Economou, H. Hamdan, P. Nyktas, G. Kazakis, D. Ghosn and I. Remoundou has been published in the proceedings of the 6th Congress of the Balkan Geophysical Society in Budapest-Hungary on October 2011 (see annex 2 Presentations at National or International scientific conferences).

A scientific abstract entitled: "**Study cases on conservation of endangered plants and habitats in Greece"** authored by Kostas Thanos has been published in the proceedings of the International Symposium on Rare and Threatened Plants and Habitats, XIII OPTIMA Congress in Antalya-Turkey on March 2010 (see annex 2 Presentations at National or International scientific conferences).

A scientific abstract and a scientific poster entitled: "**Composition and structure of *Juniperus macrocarpa* subpopulations in Crete**" authored by Apostolis Kaltsis, Katerina Koutsovoulou, Evangelia Skourti and Kostas Thanos have been presented at the 5th National Congress of Ecology of the Hellenic Ecological and Zoological Societies in Patras on October 2010 (see annex 2 Presentations at National or International scientific conferences).

A scientific abstract and a scientific poster entitled: "**Population data analysis of *Juniperus* macrocarpa subpopulations in four sites at Crete, towards the implementation of specialized conservation actions"** authored by Apostolis Kaltsis, Katerina Koutsovoulou and Kostas Thanos have been presented at the 12th Panhellenic scientific conference of the Hellenic Botanical Society in Rethymno, Crete on September 29 - October 2 2011 (see annex 2 Presentations at National or International scientific conferences).

Annex 1 Publications in peer-reviewed journals

Participation in the management of Greek Natura 2000 sites: Evidence from a cross-level analysis

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Participation in the management of Greek Natura 2000 sites: Evidence from a cross-level analysis

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ABSTRACT

The governance of protected areas has experienced rapid advancement over the last two decades with regard to the inclusion of stakeholders and local communities into the management process. During the same period Greek biodiversity governance has been characterized by a shift, at least on paper, towards the adoption of participatory approaches primarily through the establishment of management agencies. However, this has not been institutionalized for the majority of Natura 2000 sites, thus posing questions on the existence, nature, and effectiveness of participation in sites with no management agency. This is the first conducted large scale, cross level participation analysis for Greek Natura 2000 sites enabling the formation of a representative picture of the situation in the country. We investigated the nature and role of participation in Greek biodiversity governance by exploring both general opinions regarding the national context of participation in Greek Natura 2000 network as well as site-specific opinions regarding three case study areas where Natura 2000 sites have been established. Overall, we analyzed the results of 96 interviews, conducted with national, regional and local level stakeholders and 734 questionnaires conducted with local communities of the three case study areas. Results indicate with non-significant difference among governance levels, or between case study sites, that stakeholders' participation exists mainly on paper whereas community participation is practically absent. Stakeholder engagement seems to take place through administrational documentation across levels and to be locally confined based mainly on personal contacts and initiatives. Interviewees and survey respondents indicated a preference towards improving stakeholders' participation and the community's engagement in the management of Natura 2000 sites. Overall, the results of this study revealed the urgent need for policy initiatives towards adopting meaningful, fair and collaborative two-way forms of participation through the development and implementation of facilitation, participation and engagement guidance and training programs.

1. Introduction

Over the last two decades, ideas of collaborative approaches and increased stakeholders' participation have been gradually embedded into environmental governance (Berkes, 2009; Reed, 2008; Walker and Hurley, 2004). Collaborative and multilevel governance approaches advocate the participation and involvement of a variety of stakeholders and local communities in conservation strategies and policies for the successful management of protected areas (Allendorf, 2007; Borrini-Feyerabend, 1996; Buono et al., 2012; Cihar and Stankova, 2006; Graham et al., 2003; Krott et al., 2000; Liu et al., 2010; Pediaditi et al., 2011). Participation is assumed to result in a range of benefits including increased environmental awareness and knowledge sharing through social learning (Reed, 2008), whereas the failure to incorporate local perceptions to the institutional development of protected areas has been considered to lead to inflexible systems (Glaser et al., 2010). In this paper, participation represents all forms of exchange organised for facilitating the communication between stakeholders regarding a specific decision (Webler and Renn, 1995). As such, participation could be considered as any process that includes everyone who is

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contributing in any way to multilevel governance, including the public (Wesselink, 2008).

In the case of the Natura 2000 network, the Habitats Directive (92/43/EEC) implicitly refers to participation and the need for local community involvement in the establishment of the protected sites. However, each Member State is responsible for developing and implementing its own procedures and there are no specific directions on the way that participation, consultation or incorporation of stakeholders and local communities perceptions will take place, while the input from the public is only described as "opinion" (Bouwma et al., 2010). So far, inadequate participation has been described as one of the main factors impeding the effective implementation of the Natura 2000 network and leading to the emergence of multilevel conflicts around the EU (Eben, 2006; Grodzinska-Jurczak and Cent, 2010; Hiedanpää, 2002).

In Greece the designation of the Natura 2000 network has reflected the general top-down administrative, expert-based, and protectionist approach of the Habitats and Birds Directives (Apostolopoulou et al., 2012a; Rauschmayer et al., 2009). This designation process rarely gave to the local people the opportunity to participate, to incorporate their needs, perceptions and interests (Apostolopoulou and Pantis, 2009, 2010; Hovardas and Poirazidis, 2007) or to be informed about the costs and benefits resulting from protected areas designation (Jones et al., 2011).

The last decade an, at least "on paper", institutional shift towards more collaborative governance approaches has occurred regarding the management of some Natura 2000 sites through the establishment of management agencies, mandatory management plans, and public consultation processes. Greek Law 2742/99 allows for flexibility on the synthesis and membership of these agencies, which theoretically could allow for collaborative governance including representatives from multiple governance levels. Since 1999, 29 management agencies have been established in 94 of the 419 Greek Natura 2000 sites and two official management plans have been adopted. Therefore, the majority of Greek Natura 2000 sites do not have a specific governance mechanism for their management and, given the up-to-date rates of establishment of agencies, they are unlikely to obtain one any time soon. In fact, in the context of the economic crisis, the 29 management agencies have been recently merged to 13. However, decisions on Natura 2000 sites are being taken despite the absence of agencies, which gives rise to the following questions, which we aim to answer in this paper:

1. How does participation occur in the Greek Natura 2000 sites with no management agencies?
2. How do stakeholders acting at different governance levels and local communities perceive participation?
3. What are the main perceived barriers to effective participation?
4. What lessons can be learned and recommendations made for improving participation processes?

2. Research design and methodology

2.1. Research design

The research involves a cross-level analysis with the aim of ensuring input from national level to site-specific stakeholders and local communities, thus obtaining a wider picture of participation in Greek biodiversity governance.

In particular, in order to explore the national context of participation in Greek Natura 2000 sites as well as generic opinions of key stakeholders regarding the nature, scope and effectiveness of current participation processes we conducted interviews with key stakeholders acting at the wider national level referred to here onwards as generic interviews (see Supporting Information I for details on types of stakeholders).

Our research design also entailed three case studies in areas with established Natura 2000 sites. In particular, we conducted interviews with stakeholders who have decision-making authority or are actively involved in the three sites, referred to here onwards as site-specific interviews (see supporting information I). The case studies also included local community surveys of the residents of the site municipalities (on the combination of qualitative and quantitative methods see also Bouton and Frederick, 2003; Denscombe, 2008 on mixed methodologies).

By combining generic with site-specific interviews as well as community surveys (Table 1), a more holistic analysis was possible given that in multilevel biodiversity governance no single level is likely to be effective alone (Termeer et al., 2010). From the case studies context specific issues and recommendations were identified, whilst with the generic interviews we were able to test their wider applicability.

2.2. Case studies description[4]

The three Natura 2000 case study sites [Chrysi (GR 4320003), Kedrodasos (GR 4340015), Falasarna (GR 4340001)] administratively belong to the Region of Crete and in particular in the municipalities of Ierapetra (Chrysi), Pelekanou and Inahoriou (Kedrodasos) and Kissamos (Falasarna) (Fig. 1). These sites were purposefully selected to be similar regarding their ecological-biophysical context as well as their institutional frameworks, allowing interpreting the potential differences in participation events and particularities. In particular, the three case studies are characterized by the presence of the priority habitat 2250* (coastal dunes with *Juniperus* spp.*, see Supporting Information II). Commonly all sites attract tourism, for their beautiful sandy beaches, and are also remote in relation to the local population. Through the on-site investigations conducted through the LIFE + Junicoast project, the main threats identified to the priority habitat were, restricted natural regeneration, tourism, lack of public awareness, solid waste disposal, fire, wood cutting and grazing.

With regard to their institutional framework all three case studies are similar. They are designated Natura 2000 sites and are also protected by several national laws for their natural and cultural features. In particular, Chrysi and Falasarna are protected by archeological designations, while Kedrodasos and Chrysi also by forest law. The requirements of the Greek environmental law 1650/86 are not being implemented in any of these areas and consequently, all areas lack an official Specific Environmental Study (SES), as well as the Common Ministerial Decision (CMD) and/or Presidential Decree (PD) necessary for the implementation of conservation and management measures. Similarly, the provisions of Greek law 2742/99 on the establishment of management agencies have not been enforced for these areas. However, in the Falasarna Natura 2000 site between 2004 and 2008 two LIFE-Nature projects were implemented covering a part of the site, and there have also been management plans covering part of the area as well as management of specific activities (e.g., tree felling). In Chrysi island EU funded and National projects have taken place in the past, indicatively a management plan has been developed, yet never adopted or implemented.

[4] For a detailed description of the case studies see Junicoast site (www.junicoast.gr) and Pediaditi et al. (2009a,b,c).

Table 1
Samples of interviewees and local communities' surveys.

Interviewed stakeholders		
Generic stakeholders total		**64**
Site-specific stakeholders total		**32**
	Stakeholders from Chrysi	13
	Stakeholders from Falasarna	10
	Stakeholders from Kedrodasos	9
Generic and site-specific stakeholders total		***96***
Local Communities Surveys Confidence level (95%)		
Household sample size and confidence interval for Chrysi	4.38	454
Household sample size and confidence interval for Falasarna	6.86	184
Household Sample size & confidence interval for Kedrodasos	9.67	98
Household sample size for all three sites		***736***

The case studies were selected in order to be representative of the typical status of management of Natura 2000 sites in Greece, of “no management agency” and “no official management plan” (Apostolopoulou and Pantis, 2009).

2.3. Data collection and analysis

2.3.1. Stakeholder interviews

Semi-structured interviews were conducted with 64 generic and 32 site-specific stakeholders (Table 1, see also Supporting Information I). In both cases, the selection of interviewees was based on a stakeholder analysis (Borrini-Feyerabend, 1996) of the governance structures in Greek Natura 2000 sites, in conjunction with the snowball sampling technique. Given that the number of stakeholders for decisions concerning Natura sites is undoubtedly large, we employed the snowball sampling technique whereby each interviewee was asked to indicate important stakeholders to be included in the research and the process ended only when interviewees were proposing no new stakeholders.

Regarding the three case studies a distinction has been made between stakeholders who have direct influence on the decision-making process such as government bodies, and those who although directly affected by the decisions taken, may not be directly involved in the decision making process itself, such as the local communities. Therefore, decision-making stakeholders (from here on site-specific stakeholders) were subsequently interviewed, and local community stakeholders (from here on local community) views where obtained through surveys (see section 2.3.2).

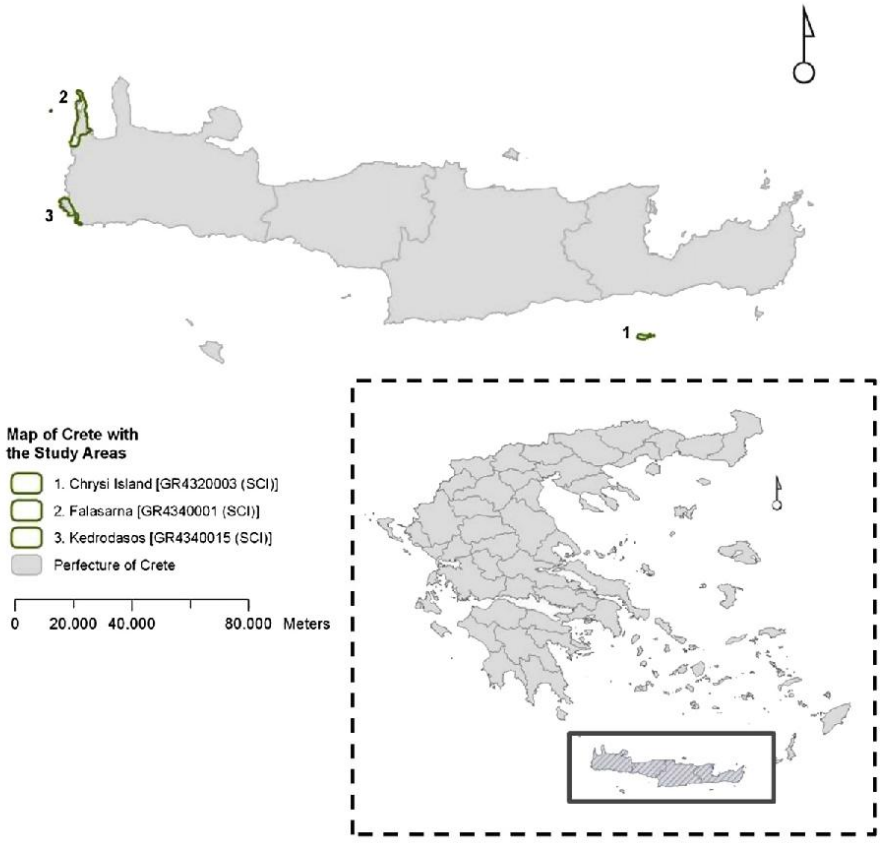

Fig. 1. Map of the region of Crete, depicting the three case study Natura 2000 sites.

The interview guide used for generic and site-specific interviewees differed only in that the latter had to answer to additional site-specific questions. The guide included both open- and close-ended questions focusing on: (i) how participation is taking place in Greek Natura sites without management agencies (types of stakeholders involved, degree and nature of participation), (ii) perceptions of participation effectiveness, (iii) determination of level of knowledge regarding the case studies' conservation and management status (this category was included only to site-specific interviews), (iv) perceptions of barriers and limitations to effective participation, and (v) recommendations for improvement.

Interviews ranged from 60 to 80 min and were tape-recorded, transcribed, and followed by extensive note taking. The data analysis for the qualitative responses (open ended questions) was based on content analysis (Miles and Huberman, 1994). In particular, the transcript data were reduced, organized and presented following the method of theme or category formation (Larsen and Valentine, 2007).

2.3.2. Local community surveys

For the three case studies (Fig. 1), we conducted household community surveys in the municipalities to which the Natura 2000 sites belong. We used random sampling and distributed self-completion questionnaires in schools and public authority buildings in each municipality enabling an even geographical coverage. Out of the 934 questionnaires 736 (Table 1) were fully completed (78.5% return rate) and maintained for further analyses. (For details see Supporting Information III).

We formulated the questionnaire themes according to the interview guide in order to ensure comparability of results. In particular, we analyzed the following main categories of questions: (i) perceptions on current participation practices and their effectiveness (1–5 Likert scale), (ii) level of knowledge regarding the three case studies' conservation and management status (binary data 0–1), and (iii) recommendations for improving participation (binary data 0–1).

We statistically analyzed data from each category to describe the main perceptions in each area. For open-ended questions we conducted content analysis (see section 2.3.1). For statistical analysis of binary data (ii, iii) we conducted Chi-square tests, while for the questions answered in a Likert scale we conducted one-way ANOVA (i), to examine potential statistically significant differences on the perceptions of the local communities among the three sites as well as to test the overall robustness and wider applicability of the results.

During data analysis, we integrated the information gathered through observations, field notes, interviews, and surveys into databases, according to informants and to different key themes and afterwards the data were coded according to topics, factors, and variables (see also Nygren, 2004).

3. Results

3.1. Participation practice in Greek Natura 2000 sites: the case of stakeholders' participation

3.1.1. Stakeholders' perceptions (generic and site-specific)

As mentioned above with Law 2742/99 there has been a shift, at least on paper, towards a more participatory approach in biodiversity governance, mainly through the establishment of management agencies.[5] However, for the majority of Natura 2000 sites for which such agencies have not been established, until very recently participation could take place through "management contracts" with central or/and local administration, universities or/and public research centres, or other legal public or/and private entities (Law 2742/99). In practice, however, as generic interviewees pointed out, evidence of such contracts being implemented and supporting participatory approaches is rare.

As of 2009 the general responsibility for the management of protected areas in Greece lies with the new Ministry of Environment, Energy and Climate Change. As the majority of generic interviewees explained, the chronic coexistence of forest and conservation legislation that foresee different provisions and mechanisms for the designation and management of Natura 2000 sites has often proven to be problematic. Interviewees identified overlapping responsibilities between management agencies (where existent), forest services, municipal authorities, and regional environmental and port authorities. Additionally, they mentioned that many other state bodies are related to biodiversity governance, resulting in increased governance fragmentation and high bureaucracy involved due to the plethora of formal co-decision procedures for a specific site limiting the accountability and legitimacy of the process. Generic interviewees pointed out that in this context individual initiatives and personal will for collaboration are often the main factors determining stakeholders' participation.

Indicatory of the implications of the above general context are the results of the case studies' stakeholder analysis and interviews that revealed on average 22 relevant stakeholders per site (including those directly involved from national and regional levels). However, from the interviews it was established that national and regional stakeholders, despite having significant decision-making powers (e.g., issuing of Environmental Impact Assessment - EIA permits for large projects), proclaimed not to have specific knowledge regarding the sites, never having visited them, and thus often relying on information provided by local level stakeholders.

When site-specific interviewees were asked which stakeholder they perceived to have the greatest influence on ensuring sites' protection, the Forest Service was ranked first, followed by the archeological authority, in cases where sites also included archeological zones. Local Forest Services were considered to play a key regulatory role, in conjunction with port and archeological authorities, which also had regulatory powers. From the site-specific interviews it became evident that financial and site maintenance' roles are mainly undertaken by municipalities whereas regional and national authorities have advisory roles in the form of issuing statutory opinions and guidance.

Overall it became clear, through both generic and site-specific interviewees that for the majority of Natura 2000 sites formal governance structures that require participation in decision-making processes do not exist. As it was confirmed from site-specific interviewees this situation is being translated at local level in a situation where the most common form of communication is the documentation exchange and the request for written opinions from the different statutory authorities, when required by law, as is the case of EIA or planning application approval within a Natura 2000 site. In the absence of formal mechanisms for participation, site-specific stakeholders underlined the importance of personal relations and interpersonal communication even with regard to collaboration within the local public authorities.

3.2. Participation practice in Greek Natura 2000 sites: the case of local community participation

3.2.1. Stakeholders' perceptions (generic and site-specific)

Local community participation provisions in Greek law are limited and at the time of data collection they were restricted to

[5] We should notice that the establishment of the management agencies is a complex issue of biodiversity governance in Greece which is not investigated in this paper.

a 15-day public consultation of the SES and CMDs and/or PDs.[6] As generic interviewees from central administration argued, the degree to which the results of the public consultation must be considered is unclear and subject to legal interpretation. Given the limited efforts historically made to initiate public dialogue to reverse the climate of mistrust between the public and authorities, the consultation process for the establishment of the Natura network mainly involved state and public authorities (see also Koutalakis and Font, 2006) as well as few big environmental NGOs. However, some generic interviewees emphasized that in many cases unofficial negotiations have occurred regarding the boundaries of the sites or their zoning plans while powerful interests have often strongly shaped governmental decisions leading to a biased participation of specific interests or to unofficial consultation processes that last many years due to strong oppositions (see also Apostolopoulou and Pantis, 2009, 2010; Apostolopoulou et al., 2012a).

In practice, as it was revealed from the results of the three case studies, it is solely up to each assigned-involved authority to initiate collaborative and consultation procedures whereas decisions regarding who will be involved in decision-making processes are often shaped from governmental actors. It is indicative that the opportunities for participation mentioned by generic stakeholders were not mentioned from the majority of site-specific stakeholders, as they have been considered of very limited importance during actual decision-making processes involved in the management of a specific site.

It is important to note that all stakeholders proclaimed as significant for effective sites' management the inclusion and representation of all relevant authorities, experts and NGOs in decision-making, yet not of the local community. The participation of the latter tended to be described more as passive one-way information provision, rather than the community having an active engagement in the sites' management. As indicated, mainly from generic interviewees, in practice, even dissemination of information is often absent despite the funds allocated mainly through EU projects for the establishment of information centers and material in several Natura sites. Most importantly, it became evident that initiatives towards promoting social learning, building trust and adaptive capacity, or encouraging incentives for local people's participation, have been quite restricted in Greek Natura 2000 sites, as site-specific interviewees confirmed.

3.2.2. Local communities' perceptions

The results from the community surveys in the case study areas are quite indicative of the above-described situation. In particular, asking the local communities, "*Has anyone ever informed you on the actions taken for the conservation of the case study site?*" the majority (~41%) responded *Never*, with quite homogeneous outcomes in all three sites (non-statistically significant difference $p >> 0.05$) (Table 2). Similarly, the opinions were negative regarding offered participation opportunities with the most negative result documented in the case of Chrysi (Table 2).

These results are most interesting when compared to the stated willingness of local communities to volunteer in actions for the conservation of the sites. This result is interesting as although the 44.5% of local communities appeared willing to allocate personal time and effort to actively participate in sites' management, the public authorities have never asked them to.

[6] Recently, there has been a shift toward "e-democracy" by giving the opportunity to citizens to participate in laws' consultation through the internet. The extent to which consultations are taken into account however not known or prescribed in any guidance or legislation.

Table 2
Local communities' perceptions of current participation practices and their effectiveness. (For the questions asked see Supporting Information IV). The results of Post-hoc Tuckey test are depicted (*F*-values), as well as the level of significance in the measured differences among the three sites. *The answers were given in a 1–5 Likert scale where 1: Never/I do not know, 2: Rarely/I strongly disagree 3: Sometimes/I disagree, 4: Often/I agree, 5: All the time/I strongly agree.*

Question	Case study site			Total	ANOVA (*F*-values)
	Chrysi	Falasarna	Kedrodasos		
Level of information provision	1.20	1.22	1.21	1.21	0.074 ($p = 0.929$)
Participation opportunities	1.52	1.71	1.72	1.60	3.479* ($p = 0.031$)
Trust in public authorities	2.29	2.03	2.51	2.25	7.953* ($p < 0.001$)
Current participation effectiveness	2.59	2.48	2.69	2.58	1.158 ($p > 0.05$)

3.3. Participation effectiveness in the Natura 2000 sites

3.3.1. Stakeholders' perceptions (generic and site-specific)

Consultation between stakeholders as well as between stakeholders and local communities was perceived as quite problematic from both generic and site-specific stakeholders (Table 3). Indicatively, in response to the statement "*Consultation and collaboration between stakeholders is being carried out effectively*" all the interviewees from Falasarna and Kedrodasos, 76.9% of the interviewees from Chrysi and 68.8% of generic stakeholders disagreed. Specific reference was made to the limited communication between national and regional as well as local level stakeholders and the absence of specific structures for ensuring meaningful cross-level cooperation. Similarly, more than 50% of site-specific and generic stakeholders considered community participation limited (Table 3).

When site-specific stakeholders were asked to give further information regarding the case study areas they mentioned that there had been *ad hoc* information provision initiatives, mainly initiated by NGOs or funded by the government, whereas in two of the sites basic information signs had been erected.

The extent to which awareness had been raised regarding the protection status of the sites was used as an indicator of participation effectiveness. The results indicate overall poor performance with an average of 15.6% of site-specific interviewees knowing the exact designation status of their sites (Table 4a). Interestingly, 25% of site-specific stakeholders declared no knowledge of the protection status of the areas. Site-specific stakeholders seemed to be only aware of the legal status and designations relevant to their profession, for instance the forestry service knew forest laws and site boundaries, whereas the archaeological authority knew the boundaries and archeological designations.

3.3.2. Local communities' perceptions

Local communities perceived the participatory and information measures carried out for the three sites as far from effective (Table 2). When questioned whether "*The current participation structures and processes ensure the effective management of the case study site*" the majority responded *I disagree*, with non-statistically significant difference between case study sites.

Regarding local communities (Table 4b), interestingly enough, although the percentage of respondents who knew all designations and the exact protection status of the site was very low (3.9%), the average percentage of community respondents (41.71%), who knew that the sites were designated as Natura 2000 was higher than that of interviewed site-specific stakeholders (34.4%).

Table 3
Stakeholders' perceptions of the effectiveness of current participation practices. (For the questions asked see Supporting Information IV). Site-specific stakeholders referred to the case study sites whereas generic stakeholders to the overall management of Natura 2000 network in Greece.

Statement	Answer	Site-specific stakeholders%			Generic stakeholders %	Total %
		Chrysi	Falasarna	Kedrodasos		
Effective stakeholder consultation	I strongly agree	–	–	–	–	–
	I agree	15.4	–	–	7.8	7.3
	I disagree	76.9	100	100	68.8	76
	I strongly disagree	7.7	–	–	17.2	12.5
	I do not know	–	–	–	6.2	4.2
Effective local community consultation	I strongly agree	–	–	–	–	–
	I agree	15.4	20	22.2	17.2	17.7
	I disagree	46.2	30	33.3	48.4	44.8
	I strongly disagree	23.1	30	33.3	23.4	25
	I do not know	15.4	20	11.1	10.9	12.5

Simultaneously, a relatively low number of local people knew the activities causing loss of the priority habitat as well as the forbidden activities to their site (Table 4b).

3.4. Barriers to effective participation

3.4.1. Stakeholders' perceptions (generic and site-specific)

When site-specific interviewees were asked to define the problems hindering consultation and collaboration the most important issues seemed to be the ambiguity or/and absence of specific and clear delegation of responsibilities, as well as jurisdiction areas, the limited representation of stakeholders, and the lack of transparency of rules during the decision-making process (Table 5). Overall, the accountability of the decision-making processes has been highly questioned by the interviewees. Indicative are the following quotes from two site-specific interviewees:

"*How can you talk about accountability when a simple permit in a protected area requires over 40 different signatures… if something is wrong how can you determine who is accountable?*"

And:

"*The local environmental authorities are our eyes and ears on the ground, if they don't voluntarily inform us of the status and issues at the sites, we have no idea what is going on… it is important to understand however, that they are not obliged by law to report to us, it is up to each individual officers good will to do so…*"

However, for generic stakeholders the hierarchy of answers was slightly different. In particular, the factor obstructing collaboration was perceived as lack of information provision and limited publicity and access to information (75%). Moreover, lack of transparency was indicated by 73.4% of generic interviewees whereas a significant stakeholder percentage (26.6%) emphasized the general lack of motivation to consult and collaborate (Table 5).

The majority of all interviewees considered the governance regime to be fragmented and without time or resource opportunities to promote collaboration, thus creating significant barriers to the effective cooperation and communication among and within different governance levels. As one site-specific interviewee stated:

"*I have been charged to conduct two site inspections in the area for over a year now, but without the traveling expenses approved, talking about participation and meetings seams a luxury, when there are no foreseen traveling budgets to do so*".

Regarding the level of consultation between local communities and stakeholders the latter emphasized the problems arising due to the absence of specific mechanisms through which local people can

Table 4a
Site-specific stakeholders' awareness of the protection status, forbidden activities and drivers causing loss of the priority habitat in the case study sites. (For the questions asked see Supporting Information IV).

Question	Answer	Site-specific stakeholders%			Total%
		Chrysi	Falasarna	Kedrodasos	
Protection status awareness	Natura 2000 site	30.8	40	33.3	34.4
	Correct answer (knowledge of all designations)	23.1	10	11.1	15.6
	Do not know or It is not protected	15.4	30	33.3	25
Activities causing habitat loss awareness	Correct answer	23.1	20	11.1	18.8
Forbidden activities awareness	Correct answer	22.2	20	15.6	28.1

Table 4b
Local communities' awareness of the protection status, forbidden activities and drivers causing loss of the priority habitat in the case study sites. Significant differences are indicated with (*). (For the questions asked see Supporting Information IV).

Question	Answer	% in the case study site			Total%	Chi-square
		Chrysi	Falasarna	Kedrodasos		
Protection status awareness	Natura 2000 site	40.5	29.9	69.4	41.7	41.71*
	Correct answer (knowledge of all designations)	3.70	5.40	2.00	3.90	2.07
	Do not know or It is not protected	10.8	7.1	11.2	9.9	2.252
Activities causing habitat loss awareness	Correct answer	15.90	19.00	22.40	17.50	2.8
Forbidden activities awareness	Correct answer	10.8	7.1	11.2	9.9	2.252

Table 5
Main perceived barriers by the stakeholders on effective participation. Site-specific stakeholders referred to the case study sites whereas generic stakeholders to the overall management of Natura 2000 network in Greece.

Barrier	Site-specific stakeholders%				Generic stakeholders %	Total %
	Chrysi	Falasarna	Kedrodasos	Site specific total		
Limited inclusion/representation of stakeholders	30.8	20	44.4	31.25	64.1	53.1
Lack of transparency of rules	23.1	20	44.4	28.1	73.4	58.3
Ambiguity or/and absence of specific responsibilities/Jurisdiction areas	61.5	40	55.6	53.1	51.6	52.1
Lack of information provision – limited publicity and access to information	7.7	–	–	3.1	75	51
Lack of awareness, knowledge and interest	7.7	–	11.1	6.25	23.4	17.7
Lack of motivation to consult and collaborate	15.4	10	11.1	12.5	26.6	21.9

participate in governance processes. Additionally, site-specific stakeholders tended to blame individual "non-environmental friendly" behavior due to limited knowledge while representatives of NGOs pinpointed the fact that there is no official interest in raising environmental awareness and promoting local involvement through specific actions, projects, and state initiatives. On the other hand, generic stakeholders emphasized the clientelistic relationships between local communities and local administration, leading to negotiations between local interests and authorities and to non-transparent, power-laden public participation processes. They also mentioned the latter as a factor creating mistrust among local people towards state initiatives.

3.4.2. Local communities' perceptions

This lack of trust in public authorities was recorded in the community surveys (Table 2) with the majority disagreeing with the statement that "*Public authorities fulfill their duties with regard to the case study site*" whereas the most negative opinions documented in the cases of Falasarna and Chrysi.

3.5. Recommendations for improving participation

3.5.1. Stakeholders' perceptions (generic and site-specific)

Ensuring better cross-level cooperation between all relevant state and non-state actors including the establishment of joint working teams, common goals, and joint decisions (89.1%), clarification and division of responsibilities and tasks (81.3%) and clearly defined legislation (75%) were recommended the most by generic stakeholders followed by the need to hire specialized educated personnel (64.1%) and ensure better exchange of information (60.9%). Interestingly, the need to change the current political culture was mentioned by 42.2% of stakeholders.

For site-specific stakeholders the ranking of answers was quite different. Establishment of an independent management agency and exchange of information as well as joint educative workshops were highly recommended (Table 6a).

On the other hand, for improving local community participation (Table 6b), 69.8% of all stakeholders recommended actions towards raising environmental awareness and education while 62.5% highlighted the need for better information provision and publicity on the allowed and forbidden activities, studies conducted and decisions made. These percentages were particularly high in the case of generic stakeholders who emphasized the need for a "constant educational campaign". Simultaneously, a significant percentage of all stakeholders considered the determination and demarcation of land uses and protection zones (55.2%) as well as the implementation of management plans (58.3%) as necessary towards participation improvement.

These percentages were particularly high for generic stakeholders, but much lower for site-specific stakeholders. It is worth noting that although a considerable percentage of all stakeholders (36.5%) proposed active participation of local people in the management process, they were unable to describe the exact form of participation, propose specific actions and define who should participate and how the current situation could change. Moreover, a relatively low percentage of all stakeholders (19.8%) perceived public consultation as necessary during policy designation and none during policy evaluation.

3.5.2. Local communities' perceptions

Regarding communities' proposals for the improvement of participation in the management of the three Natura 2000 sites (Table 7) better information provision through seminars, workshops or on site education was ranked first (78.1%) followed by the need to define explicit management measures through management plans, increased conservation funds as well as monitoring actions (72.1%). Simultaneously, the need to adopt inclusive, fair and transparent governance processes was the third most popular

Table 6a
Recommendations for the improvement of stakeholders' participation. Site-specific stakeholders referred to the case study sites whereas generic stakeholders to the overall management of Natura 2000 network in Greece.

Recommendation	Site specific stakeholders %				Generic stakeholders %	Total %
	Chrysi	Falasarna	Kedrodasos	Site specific total		
Clarification and division of responsibilities	15.4	10	11.1	12.5	81.3	57.3
Closer cooperation between public authorities and NGOs	15.4	–	–	6.25	10.9	9.4
Exchange of information - frequent meetings	15.4	40	44.4	31.25	60.9	51
Establishment of an independent management agency	23.1	40	22.2	28.1	48.4	41.6
Better cross-level cooperation	7.7	20	22.2	15.6	89.1	64.6
Joint educative workshops	15.4	20	22.2	18.75	39.1	32.3
Specialized educated personnel	7.7	10	11.1	9.4	64.1	45.8
Operational regulations, clear defined legislation and official management plans	7.7	10	11.1	9.4	75	53.1
Change of political culture	7.7	–	–	3.1	42.2	29.2
Empowerment of local level stakeholders	–	–	11.1	3.1	12.5	9.4

Table 6b
Recommendations for the improvement of local communities' participation. Site-specific stakeholders referred to the case study sites whereas generic stakeholders to the overall management of Natura 2000 network in Greece.

Recommendation	Site specific stakeholders%				Generic stakeholders %	Total %
	Chrysi	Falasarna	Kedrodasos	Site specific total		
Better information provision and publicity	46.2	10	11.1	25	81.25	62.5
Environmental awareness and education	30.8	30	44.4	34.4	87.5	69.8
Public consultation during policy designation	7.7	–	–	3.1	28.1	19.8
Active participation of local people in the management process	30.8	20	22.2	25	42.2	36.5
Change of the clientistic political culture	7.7	10	11.1	9.4	45.3	33.3
Inform people on nature conservation and sustainable development	–	10	–	3.1	51.6	35.4
Clarification of property rights	–	10	–	3.1	25	17.7
Economic incentives to local people to protect the areas	–	–	–	–	29.7	19.8
Specific environmental studies, legislative context and territorial planning instruments	–	–	–	–	70.3	46.9
Delineation of land uses and protection zones	–	10	11.1	6.3	79.7	55.2
Conservation funds/resources, management plan	–	20	22.2	12.5	81.25	58.3

suggestion (65.4%) whereas a significant percentage (42.5%) highlighted the need for state control over private exploitation of natural resources.

4. Discussion and conclusions

4.1. The role of participation in the management of Greek Natura 2000 sites

In Greece, the 27.1% of national area is designated as Natura 2000 (EC, 2011) comprising 419 sites, many of which with a strong human presence. However, as the results of this study revealed there is still a major gap in the adoption of effective, fair and meaningful participation structures and processes. This holds true for both stakeholder and local community participation as was evident from the vast majority of interviewees across all governance levels indicating several problems in the degree (Arnstein, 1969; Biggs, 1989) and nature (Rowe and Frewer, 2000; Reed, 2008; Schultz et al., 2011) of participation. Similarly, the vast majority of the local communities in all case studies, although aware of the existence of the Natura 2000 sites, had not been consulted, did not participate or ever receive specific information on their design and management. This problematic situation could be explained by the current national context where "public communication" (Rowe and Frewer, 2000) has proven to be the main form of participatory involvement in the design and management of Greek Natura 2000 sites at least for the wide majority of people (see also Apostolopoulou and Pantis, 2009).

Table 7
Local communities' proposals for the improvement of participation in the management of the three case study sites.

Proposal	% in the case study site			Total%
	Chrysi	Falasarna	Kedrodasos	
Explicit management measures	79.70	57.10	65.30	72.10
Inclusive, fair and transparent governance processes	59.30	70.10	84.70	65.40
Better information provision	85.90	51.60	91.80	78.10
More responsible authorities	45.9	66.1	30.4	54.5
Establishment of independent management agency/authority	45.80	17.90	26.50	36.30
Promotion of environmental friendly activities	27.3	30.6	21.2	26.2
Promotion of equity and justice from all levels of state administration	50.00	63.40	52.70	59.00
State control over private exploitation of natural resources	28.60	54.80	19.60	42.50

In particular, the absence of meaningful two-way communication flow and knowledge sharing observed by generic stakeholders has been reflected in the lack of information provision and the limited knowledge of both site-specific stakeholders and local communities (see also Buono et al., 2012; Xu et al., 2006) on the sites' protection status, the forbidden activities and the negative impacts of their actions. This is further underpinned by the lack of documented, context-specific information on appropriate conservation and management actions for the Greek Natura 2000 sites. Significant knowledge gaps in protected area designations have also been documented previously (Booth et al., 2009) where it has been shown that the level of knowledge regarding the importance of nature conservation enhances conservation initiatives (van den Born et al., 2001). Moreover, our results indicate that the dissemination of information during the designation of Natura 2000 network and also while implementing management plans and funded (e.g., LIFE) projects has been quite limited.

Simultaneously, the knowledge of site-specific stakeholders proved to be strongly related to their professional background, resulting in partial knowledge systems; something further aggravated by the complicated and overlapping institutional framework that creates major confusion about stakeholders' responsibilities. It is worth mentioning that there are 16 different management bodies that should cooperate in the conservation of priority habitat 2250* in the Region of Crete while 38 legislative or/and administrative measures can be enacted (see also Smpokos, 2009).

The implications of the practical absence of participation became particularly obvious in the perceptions of local communities, as well as in the role attributed to local people by both generic and site-specific stakeholders. The chronic barriers in establishing participatory processes in Greek biodiversity governance, as well as current approaches and practices have created mistrust between authorities and local residents and have reinforced the feeling of injustice between local communities especially in cases where several projects have been funded but their results have been limited as in the cases of Chrysi and Falasarna where mistrust was bigger than in Kedrodasos.

This documented underestimation of the needs and perceptions of the majority of local people in the formulation of biodiversity conservation plans has been acknowledged as a main cause of policy and management failures at least the last two decades (Borrini-Feyerabend, 1996; Harrison et al., 1998). Until today, these issues have not been solved and in a recent study the unequal social participation, and the strong hiatus in local communities trust towards government initiatives have been identified as key barriers

to the establishment of a national network of protected areas (Apostolopoulou and Pantis, 2009) creating natural resource conflicts and obstructing the integration of social and ecological resilience in Greek Natura 2000 sites (Apostolopoulou et al., 2012a,b).

It is crucial to emphasize that unclear roles and limited trust are significantly related to political and institutional factors and to the absence of a participatory governance style (see also Mostert et al., 2007). A significant consensus among interviewees concerning the absence of specific procedures promoting the equal participation of stakeholders and communities, and the problems created by the weak and fragmented institutional framework has been documented. Despite the increased involvement of various stakeholders in Greek biodiversity governance the last decade, the characteristics of corporatist governance, as well as a power laden participation process proved to be dominant. However, generic interviewees emphasized the need for better legislation and regulations over resource use, whereas local participation was perceived more as a method to reach local consensus on already designated plans (see also Durand and Vázquez, 2011) or as environmental education to change people's behavior. Similarly, site-specific stakeholders even though they considered both community and stakeholders participation as inadequate, they tended to acknowledge the better collaboration of state authorities as most significant and they showed an inability to propose specific measures for local people participation. This indicates the general lack of participation culture and is strongly related to the dominant understanding of participation as inclusion of powerful economic or political interests.

Overall, one of the most important findings of this study is that recent support towards participation as well as relevant institutional developments seemed to be mainly rhetorical (see also Durand and Vázquez, 2011) and contradictory given the absence of specific initiatives towards a meaningful and fair engagement of the wide majority of local people to Greek biodiversity governance.

4.2. Policy initiatives towards meaningful and fair participation in the management of Greek Natura 2000 sites

This study revealed the need for policy initiatives enabling participation in Natura 2000 sites. These initiatives should provide for multilevel stakeholder engagement as well as transparent mechanisms for the local community involvement. They should be designed to create the preconditions for people empowerment and capacity building at all levels (Abrams et al., 2003; Carlsson and Berkes, 2005; Tuler, 1998) by approaching participation itself as a necessary institutional prescription for adaptive co-management (Huitema et al., 2009) and as a social learning process (Koskinen and Paloniemi, 2010; Mostert et al., 2007). Social learning can deal with existent differences in knowledge systems, dominant not only in the Greek case but also in most resource management contexts (Armitage et al., 2009), and contribute to the emergence of interdisciplinary and integrative approaches. The latter can be supported through collaborative knowledge-sharing activities, active engagement with management through learning-by-doing (Armitage et al., 2009), along with a multi-directional information exchange among different stakeholders on management decisions (Stringer et al., 2006). Successful mechanisms towards this direction could include the use of interactive techniques, such as workshops or focus groups (Stringer et al., 2006), as well as structures to integrate the necessary technical expertise, regulatory requirements as well as public values in a constructive manner (Varjopuro et al., 2008 cites Renn, 2006). These issues are crucial for Greek Natura 2000 sites given the absence of official management plans, specific environmental studies and stakeholder training in engagement and facilitation methods rendering the consideration of anticipated outcomes difficult.

Most definitions of co-management require institutionalized arrangements for intensive user participation in decision making than mere consultation or *ad hoc* public participation (Berkes, 2009). However, as this study showed, both generic and site-specific stakeholders do not explicitly acknowledge the need for a two-way community engagement (see also Xu et al., 2006). In this context, the establishment of networks by the wider conservation community, including scientists, academics, local community groups and practitioners, is of fundamental importance in order to establish the necessary links and partnerships for allowing the interaction between different types of knowledge and experiences, developing best practice guidance and creating a strong basis for co-management. Bridging organizations could play a critical role in knowledge production, learning, vertical and horizontal collaboration and trust building across governance levels (Berkes, 2009; Olsson et al., 2007), all issues of great importance for Greek Natura 2000 sites as indicated from the results of this study.

Including local communities in this research proved very important given that it gave us the opportunity to document that local people show a preference for more participatory management (see also Dimitrakopoulos et al., 2010), although they do not currently participate in the management of the three Natura 2000 sites, something supportive for the adoption of the above-mentioned initiatives. In particular, despite the fact that people's perceptions about the three Natura 2000 sites proved to be diverse, complex and often contradictory (see also Allendorf et al., 2007), the comparison of the case studies revealed that there is a similar positive trend allowing for a common design of future initiatives. However, this finding should not be interpreted uncritically as a *de facto* positive attitude towards conservation. It is very possible that it is related to the limited management measures implemented in the areas, the remoteness and the perceived high recreational value of the three sites. Most importantly, the fact that negative opinions were stronger in cases where programs for participation have been implemented without actually involving local people or generating benefits for them highlights the significance for meaningful and fair initiatives and emphasizes the negative implications of implementing plans or programs with limited success. This became particularly evident from the results of the case studies where the most negative perceptions regarding offered participation opportunities were observed by the local community of Ierapetra (Chrysi), something that could be attributed to the fact that conservation funds have been utilized ineffectively in knowledge of the local people. For example, it is indicative that a license and funding was granted for a visitor information center on the island, which never materialized, but instead a restaurant was built.

Moreover, it is crucial for future research to define in more detail the differences within stakeholders and especially local communities. Even if this task goes beyond the scope of this study this does not at all imply a simplified understanding of communities or social groups as homogeneous. A more specific analysis of the way that local people and stakeholders are embedded in dependencies and hierarchies, holding different positions and views, and therefore respond differently to policies and incentives, is necessary for successful and fair participatory processes (see Apostolopoulou et al., 2012a,b; Ferse et al., 2010; Singleton, 2009) especially given the fundamental role of power relationships in shaping their terms and outcomes.

Despite the need for participatory processes it is crucial to emphasize that the institutionalization of participation is not a panacea especially given that at all governance levels remains a significant gap between the rhetoric on participation and the real-life implementation of participatory processes (Rauschmayer et al., 2009). Moreover, the character of innovative governance arrangements, such as participatory arrangements, is in most cases highly

contradicting and decidedly "Janus-faced" (Swyngedouw, 2005). Thus for steps towards participation, in terms of ensuring social-ecological resilience and environmental justice, a different philosophy and practice emphasizing empowerment, equity, trust and learning, is of major importance. Participatory processes occur in specific social-ecological and institutional contexts where power relations set limits on people's participation in research, decision-making, and action (Stringer et al., 2006). The fact that issues of justice, fairness and control of private exploitation were raised mainly by local communities further highlights that initiatives towards promoting meaningful participation need to be based on effective rights, meaningful regulations, participants' competence and reliable procedures and protocols (Ferse et al., 2010; Palerm, 2000). Such procedures in Greece currently do not exist. Participatory management needs participatory roots, i.e., some measure of effective dialogue, discussion of issues and participatory democracy internal to all relevant social actors (Borrini-Feyerabend et al., 2004: 175, cited in Berkes, 2009). These challenges are further highlighted by the fact that site-specific stakeholders seem to be much more discouraged than generic stakeholders and less willing to make proposals given the on the ground reality of failures to involve local people or promote effective cooperation between stakeholders.

This research is among the first cross-level analyses of participation in Greek Natura 2000 network, and as such is a significant first step in determining the present situation, recognizing the significance and barriers to effective participation from different perspectives. The results have been disappointing regarding the progress made over the last decade in adopting meaningful, fair and collaborative two-way forms of participation. However, stakeholder recognition of the need for change and improvement of participation, and the recorded willingness of local communities to get more involved in the management and conservation of the sites are encouraging.

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Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.jenvman.2012.09.006.

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Vegetation dynamics of coastal dunes with *Juniperus* spp. in Crete, Gavdos and Chrysi islands (Greece)

Abstract*

The aim of this paper was to determine the composition, the structure and the ecological processes of the vegetation of the coastal dunes with *Juniperus* spp. in Crete, Gavdos and Chrysi in South Aegean, Greece, in order to apply sound habitat management and restoration. Vegetation composition and structure and vegetation zonation were investigated with plots and transects, respectively. The data from seven study sites were classified using TWINSPAN. The major patterns of the vegetation data and their relation to environmental variables was explored by linear and unimodal ordination techniques. The floristic composition of the habitat includes 142 plant species. Five principal communities types were identified. Vegetation distribution was related to geomorphology and disturbance gradients. The analysis of transect data identified 20 vegetation units (corresponding to 5 habitat types) on incipient dune, foredune, interdune and hind dune. Vegetation and geomorphological data were used to construct sand dune profiles for each site, while a set of 36 keystone and 76 indicator species were identified. The sites examined have varied levels of dune development and face different threats. Habitat management should address grazing and trampling at the local level but also land use changes at the catchment level.

Key words: CCA, coastal dunes, DCA, dune vegetation, Ellenberg values, geomorphologic units, PCA

***The full text of this scientific paper will be available on the official website of the JUNICOAST project as soon as it is accepted for publication in the journal of "Plant Ecology and Diversity".

Annex 2 Presentations at national or international scientific conferences

Imaging sand dunes at Kedrodasos coastal area, Crete, Greece

P11

Imaging Sand Dunes at Kedrodasos Coastal Area, Crete, Greece

S. Zannetidis (Technical University of Crete), N. Economou (Technical University of Crete), H. Hamdan (Technical University of Crete), P. Nyktas (Mediterranean Agronomic Institute of Chania), G. Kazakis (Mediterranean Agronomic Institute of Chania), D. Ghosn (Mediterranean Agronomic Institute of Chania), E. Remoundou (Mediterranean Agronomic Institute of Chania) & A. Vafidis* (Technical University of Crete)

SUMMARY

In this work, we present preliminary results from a geophysical survey conducted at Kedrodasos, south Crete, Greece. The scope of this survey is to characterize the subsurface at the Kedrodasos Juniperus trees forest. We used GPR and electrical tomography to map the root system of these trees and to image the sand dunes. We used three methods for the inversion of the resistivity data. We applied deterministic deconvolution on the GPR data and employed a reflected wave from a lab experiment as reference wavelet. The thickness of the sand dunes does not exceed 2 m. Low resistivity regions with abundance of diffracted EM waves are attributed to the juniperous trees root system zones.

6th Congress of Balkan Geophysical Society - Budapest, Hungary
3-6 October 2011

Introduction

In this work, we present preliminary results from a geophysical survey conducted at Kedrodasos, south Crete, Greece. The scope of this survey is to characterize the subsurface at the Kedrodasos Juniperus trees forest. This is part of the European research project Junicoast, which involves actions for the conservation of coastal dunes with Juniperous in Greece. Electrical tomography and GPR methods were employed in order to map the root system of these trees and to image the sand dunes.

Geophysical survey

Kedrodasos is located at the southwestern part of Crete (Figure 1). The sand dunes, cover neogene and quaternary formations. Neogene formations are mainly marly limestones. Electrical tomography and GPR scanned the study lines K_T1 and K_T3. We collected electrical tomography measurements using the AGI Inc. Sting R1, the dipole-dipole array with electrode spacing of 1 m and 55 electrodes. The GPR method employed the Pulse Ekko 1000 and the 225 MHz antennas. Space and time intervals are set to 0.1 m and 0.4 ns respectively and recording time is 200 ns.

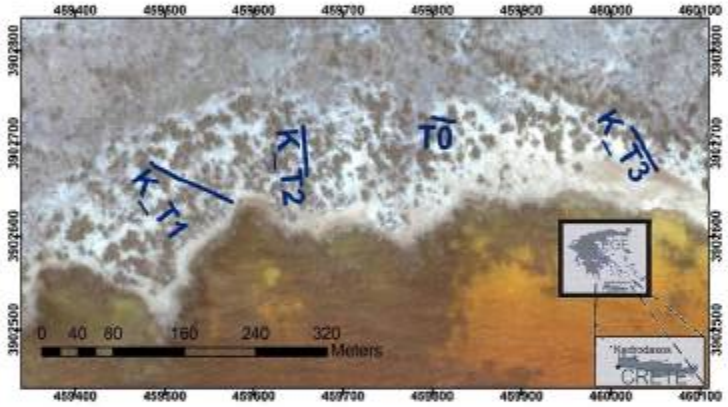

Figure 1 *Study lines in Kedrodasos, Crete, Greece (from Google Earth).*

Processing

Three inversion techniques were applied on electrical tomography data (Hamdan et al., 2010), namely: a) Smoothness constrained inversion, b) combined damping and smoothing technique, and c) the L1 norm (robust) inversion. The smoothness constrained inversion technique is the most commonly used, due to its fast convergence and quite satisfactory results. In this technique the resistivity values vary smoothly. The combination of damping and smoothing techniques delineates large variations of resistivity values (Loke, 2002). Robust inversion enhances sharp boundaries.

We processed the GPR data using a deterministic deconvolution technique which is implemented in t-f domain (Economou and Vafidis, 2011). We first apply spectral balancing, using the methodology proposed by Economou and Vafidis (2010a). The deterministic deconvolution requires a reference E/M wavelet. The deconvolution operator is calculated from this reference wavelet. This method involves reference wavelet extraction, spectral balancing, and time-variant deconvolution. It is a time-window procedure which uses the flexible S-transform. The reference wavelet corresponds to a reflected wave from an air /water interface which is recorded in a plastic tank (0.9 m x 1.6 m and 0.6 m height) filled with water. By changing the height of the GPR antenna we control the arrival time of direct and side reflected waves.

Additionally, by pointing the GPR device on the air, we record the direct air wave. Then one cross-correlates these GPR traces in order to estimate the time shift between the direct waves present on both traces. In order to get the reference reflected wavelet we apply this time shift on a recorded trace and remove the direct waves by subtracting the shifted trace from the other one. This reference reflected wavelet, radiated in air, will differ in phase and amplitude spectrum from the source wavelet radiated by a ground-coupled antenna. Although this method does not estimate the source wavelet, the reflected wave exhibits negligible dispersion and is acceptable as reference wavelet.

The GPR section (portion of line KT3 is displayed in Figure 2a) exhibits a dense sequence of reflections making interpretation difficult. Deconvolution increases the temporal resolution (Figure 2b). Additionally, we performed velocity analysis by selecting clearly visible diffractions on the deconvolved section, in order to produce GPR depth sections.

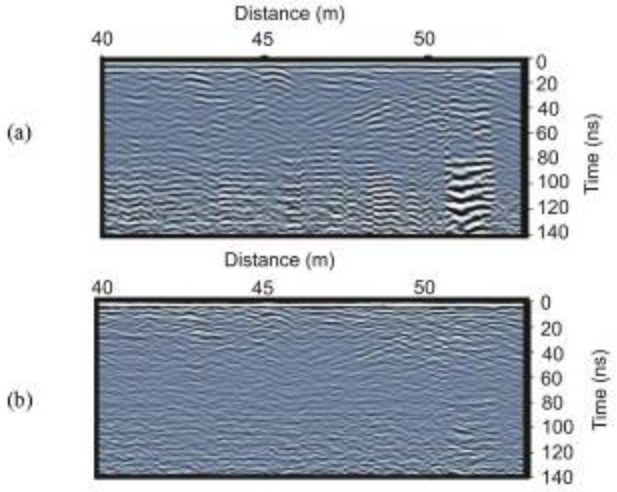

Figure 2 *GPR section (portion of line K_T3) before (a) and after (b) deconvolution in the t-f domain.*

Line K_T3

The combined interpretation of the geophysical data involves superposition of the GPR and resistivity sections. Figure 3a shows the electrical tomography section K_T3. Figure 3b displays a portion of the GPR section superimposed on the electrical tomography section. We used the electrical tomography sections derived from the robust inversion. The geoelectrical sections from the combined and smoothness constrained methods are similar for the electrical tomography lines at Kedrodasos. Meanwhile, the robust inversion sections are better, due to the ability of this method in imaging sharp boundaries and producing electrical resistivity sections more comparable with the GPR sections.

High resistivity anomalies at shallow depths (less than 2m) are attributed to sand dunes. Still, rock formations appear at the shallow subsurface. This is confirmed by the presence of diffractions (Figure 3b). The velocity exhibits values of almost 0.13 m/ns typical for sands. The low resistivity layer at depths greater than 2 m is attributed to a formation saturated by water.

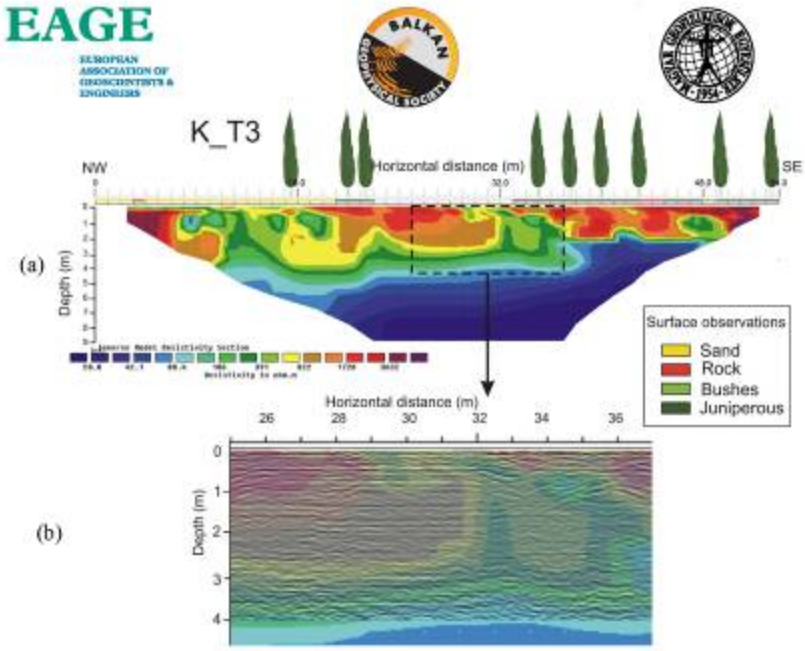

Figure 3 *Geoelectrical section K_T3 (a) and superposition of GPR and geoelectrical sections for a portion of line K_T3 (b) corresponding to the black rectangle.*

Line K_T1

Robust inversion of the electrical tomography data from line K_T1 mainly detects two geoelectrical layers (Figure 4) attributed to the sand dunes and the rock formations. Figures 4b and c show portions of the GPR section superimposed on the electrical tomography section. Sand dunes are present at regions where electrical resistivity is higher than 1700 Ohmm and the GPR section exhibits internal reflections from sand dunes horizons (Figure 4b). Diffractions from the roots of the Juniperous trees are present at depths greater than 2 m on the GPR sections, exhibit velocity of around 0.06 m/ns, correspond to low resistivity anomalies and are in accordance with surface observations (Figure 4).

Conclusions

Superposition of electrical tomography and GPR sections helped in the interpretation of the geophysical data. L1 norm inversion enhanced the sharp interfaces. Deconvolution improved the resolution of the GPR sections. Geoelectrical and GPR sections gave valuable information about the thickness of the sand dunes at the Kedrodasos which does not exceed 2 m. Low resistivity regions with abundance of diffracted EM waves are attributed to the juniperous trees root system zones.

Acknowledgements

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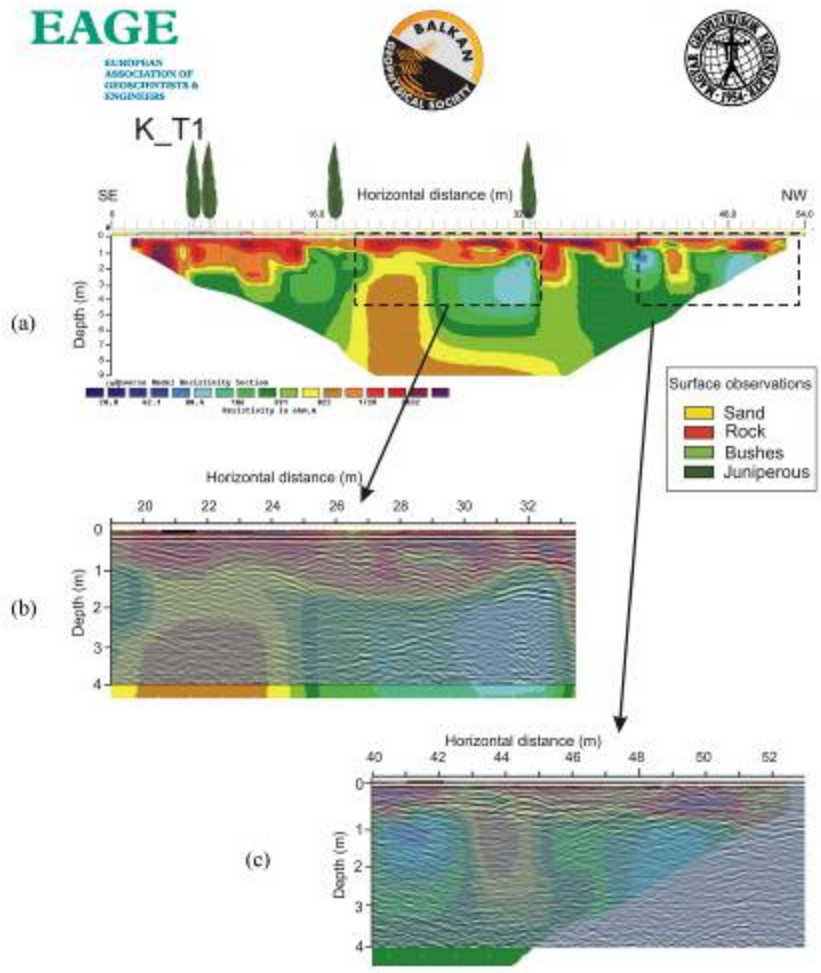

Figure 4 *Geoelectrical section K_T1 (a) and superposition of GPR and geoelectrical sections for portions of line K_T1 (b and c) corresponding to the black rectangles.*

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Study cases on conservation of endangered plants and habitats in Greece

STUDY CASES ON CONSERVATION OF ENDANGERED PLANTS AND HABITATS IN GREECE

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The Greek flora is among the richest in Europe and the Mediterranean Basin; it comprises a total of about 6500 taxa (with a high level of endemism, ca 17%), distributed over 13 discreet floristic regions and numerous (ca 115) diverse habitat types. A recent overview of the conservation status of Greek endemics indicates that at least 40% of them are threatened or near threatened while, similarly, many habitat types are challenged by considerable anthropogenic and climatic risks. On the other hand, during the past decade, a significant number of projects have increasingly addressed several conservation issues (ecological research, field inventorying, monitoring, management and environmental awareness), mainly through the implementation of the European Habitat and Species Directive (92/43/EEC) and the Global (and European) Conservation Strategy initiatives. Case studies will be presented referring to:

(a) the LIFE+ Project 'JUNICOAST - Actions for the conservation of coastal dunes with *Juniperus* spp. in Crete and the South Aegean (Greece)' that is currently implementing conservation actions on the priority habitat '2250* - Coastal dunes with *Juniperus* spp.' in several locations of southern Crete. Particular emphasis is placed on determining the *Juniperus macrocarpa* population size, composition and structure (sex ratio, reproduction and regeneration, growth, age distribution).

(b) the LIFE Project 'CRETAPLANT - A Pilot Network of Plant Micro-Reserves in Western Crete' which led to the establishment of 7 high-biodiversity, small-scale nature reserves, each characterized by 6 plant species of European Community priority: *Androcymbium rechingeri*, *Anthemis glaberrima*, *Bupleurum kakiskalae*, *Cephalanthera cucullata*, *Hypericum aciferum*, *Nepeta sphaciotica* and priority habitat type 9370, *Palm groves of *Phoenix*.

(c) the European Projects ENSCONET and SEMCLIMED and relevant activities of two important, recently established, Greek Seed Banks on the *ex situ* conservation of numerous, threatened plants.

Keywords: endemic plants, threatened plants and habitats, in situ conservation, monitoring, seed banking

Oral Lectures

Composition and structure of *Juniperus macrocarpa* subpopulations in Crete

Abstract

Οι παράκτιες αμμοθίνες με είδη αρκεύθων (2250* Coastal dunes with *Juniperus* spp.) αποτελούν οικότοπο προτεραιότητας σύμφωνα με την Οδηγία των Οικοτόπων (Οδηγία 92/43/ΕΟΚ). Στο νότιο Αιγαίο και την Κρήτη ο οικότοπος έχει χαρτογραφηθεί σε 8 περιοχές. Η σπανιότητα και σποραδικότητα της εμφάνισής του καθώς και η αυξημένη πίεση που δέχεται από την τουριστική ανάπτυξη (αλλά εν μέρει και από τη βόσκηση) καθιστούν αναγκαίες την επισταμένη μελέτη της δομής του οικοτόπου και τη λήψη διαχειριστικών μέτρων διατήρησης.

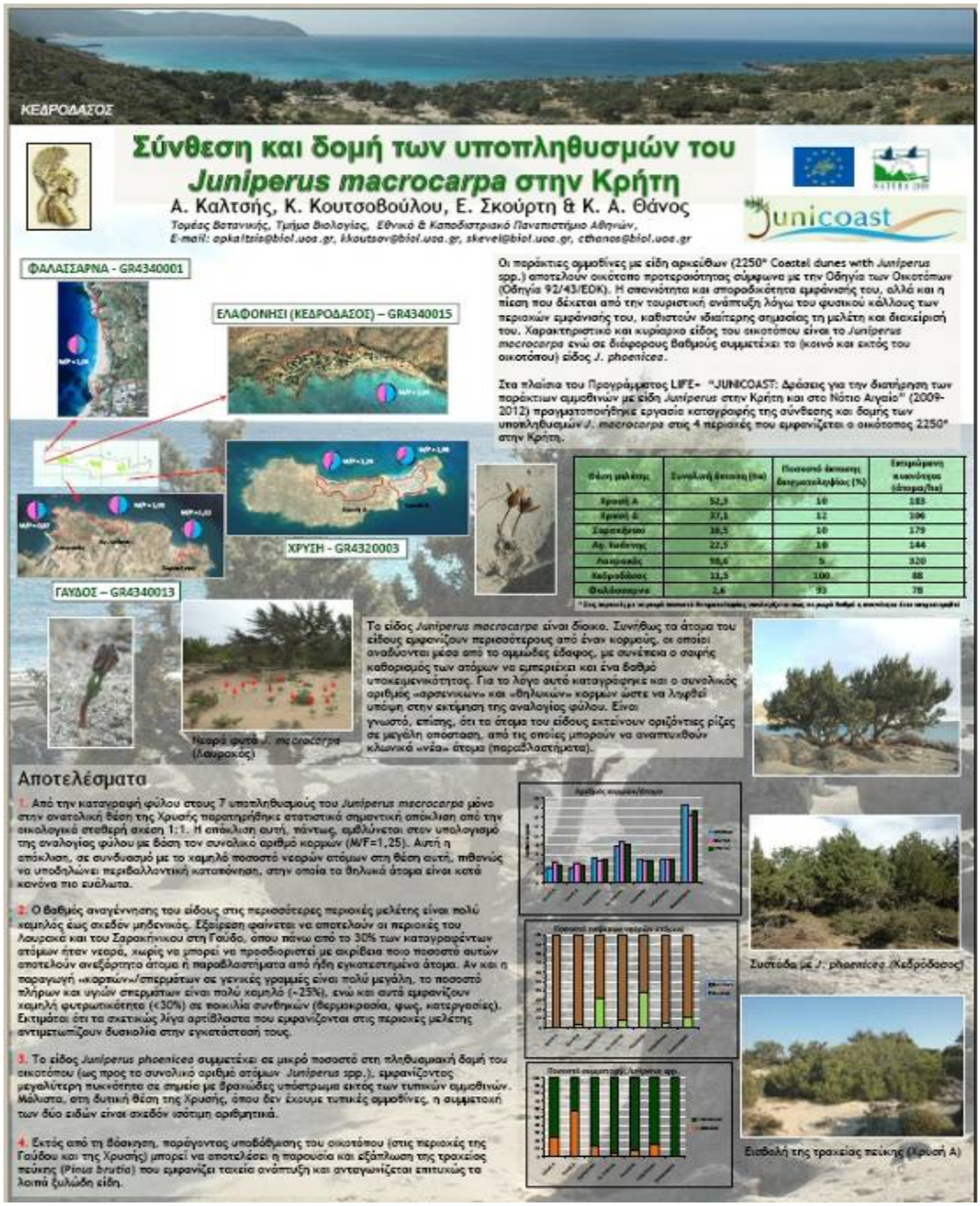
Στα πλαίσια του Ευρωπαϊκού Προγράμματος LIFE+ "JUNICOAST: Δράσεις για την διατήρηση των παράκτιων αμμοθινών με είδη *Juniperus* στην Κρήτη και στο Νότιο Αιγαίο" (2009-2013) πραγματοποιήθηκε εργασία καταγραφής της σύνθεσης και δομής των υποπληθυσμών *Juniperus macrocarpa* στις 4 περιοχές όπου συναντάται ο οικότοπος στην Κρήτη (Γαύδος, Χρυσή, Κεδρόδασος, Φαλάσσαρνα). Η εργασία πεδίου περιέλαβε την καταγραφή αρσενικών-θηλυκών ατόμων, νεαρών φυτών και αρτιβλάστων, πλήθους κορμών ανά άτομο και λοιπών βιομετρικών δεδομένων των 7 συνολικά υποπληθυσμών του είδους *Juniperus macrocarpa* καθώς επίσης και την καταγραφή της συμμετοχής του είδους *Juniperus phoenicea* στη δομή του οικοτόπου. Πραγματοποιήθηκαν επίσης συλλογές κώνων *Juniperus macrocarpa* για την εργαστηριακή μελέτη της φύτρωσης των σπερμάτων.

Ακολουθούν τα κυριότερα αποτελέσματα της εργασίας πεδίου:

- η αναλογία φύλου σε όλους τους υποπληθυσμούς δεν αποκλίνει στατιστικά σημαντικά από την οικολογικά σταθερή σχέση 1:1 (με μικρή απόκλιση στον έναν υποπληθυσμό της Χρυσής),
- η παρατηρούμενη αναγέννηση (παρουσία νεαρών φυτών) είναι χαμηλή ως ελάχιστη στις περισσότερες περιοχές μελέτης, γεγονός που αποδίδεται εν μέρει στα πολύ μικρά ποσοστά πλήρων σπερμάτων (<10%) αλλά και στη δυσκολία επιβίωσης των αρτιβλάστων,
- παράλληλα με τον συνήθη ανταγωνισμό με το συγγενές είδος *Juniperus phoenicea*, στις περιοχές της Γαύδου (κυρίως) αλλά και της Χρυσής

παρατηρείται μία σημαντική εισβολή της τραχείας πεύκης (*Pinus brutia*) εντός του οικοτόπου 2250*, που δυνητικά μπορεί να προκαλέσει σημαντικά προβλήματα στα εξαιρετικά βραδυαυξή φυτά του *Juniperus macrocarpa.*

Poster



Population data analysis of *Juniperus macrocarpa* subpopulations in four sites at Crete, towards the implementation of specialized conservation actions

Abstract

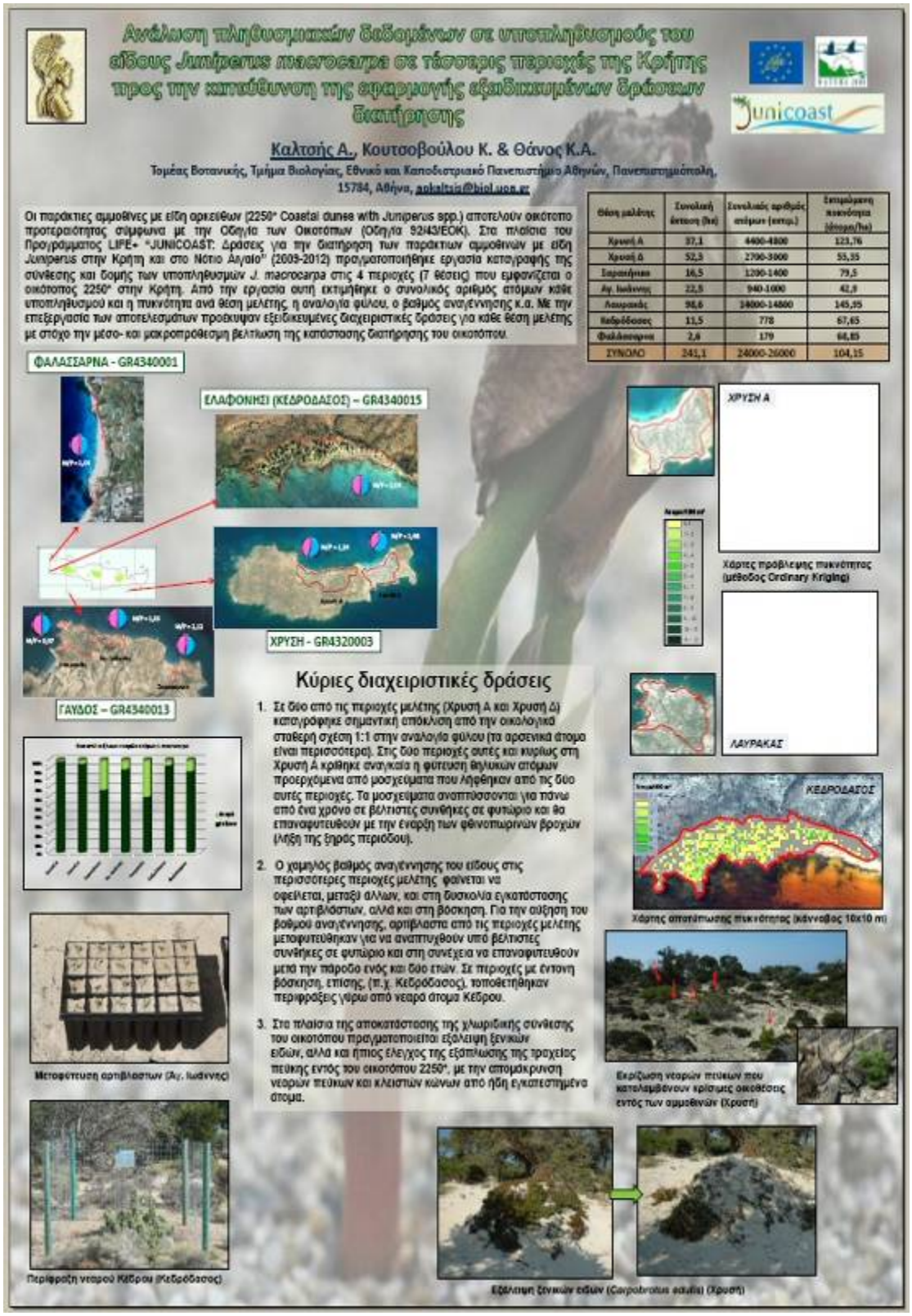
Οι παράκτιες αμμοθίνες με είδη αρκεύθων (2250* Coastal dunes with *Juniperus* spp.) αποτελούν οικότοπο προτεραιότητας σύμφωνα με την Οδηγία των Οικοτόπων (Οδηγία 92/43/ΕΟΚ). Στο νότιο Αιγαίο και την Κρήτη ο οικότοπος έχει χαρτογραφηθεί σε 8 περιοχές. Η σπανιότητα και σποραδικότητα της εμφάνισής του καθώς και η αυξημένη πίεση που δέχεται από την τουριστική ανάπτυξη (αλλά εν μέρει και από τη βόσκηση) καθιστούν αναγκαίες την επισταμένη μελέτη της δομής του οικοτόπου και τη λήψη διαχειριστικών μέτρων διατήρησης.

Η καταγραφή και ανάλυση των πληθυσμιακών δεδομένων των υποπληθυσμών του *Juniperus macrocarpa* σύμφωνα με τις κατευθύνεις των δράσεων διατήρησης. Λόγω των ιδιαιτεροτήτων κάθε περιοχής (ιδιοκτησιακό καθεστώς, υφιστάμενες χρήσεις γης και οικονομικές δραστηριότητες) σε συνδυασμό με τα ενδογενή χαρακτηριστικά κάθε υποπληθυσμού διαμορφώθηκαν και υλοποιούνται εξειδικευμένες προτάσεις δράσεων.

Η ανάλυση των αποτελεσμάτων έδωσε:

- θέσεις με αναλογία φύλου αποκλίνουσα από το 1:1, στις οποίες υλοποιείται σχέδιο φύτευσης μοσχευμάτων από κατάλληλου γένους άτομα για την εξισορρόπηση της αναλογίας φύλου
- θέσεις με χαμηλή πυκνότητα
- θέσεις με χαμηλή αναγέννηση (μικρή αναλογία νεαρών/ενήλικα άτομα), όπου εγκαθίστανται περιφράξεις γύρω από νεαρά άτομα για την προστασία τους, καθώς και φύτευση νεαρών (1-2 ετών) Κέδρων προερχόμενων από τις ίδιες περιοχές κατόπιν εντατικής φροντίδας και ανάπτυξης για εύλογο χρονικό διάστημα σε φυτώριο.
- θέσεις με ξενικά είδη ή/και έντονη εισβολή της τραχείας πεύκης, όπου κρίθηκε η αναγκαία και πραγματοποιείται είτε η ολική απομάκρυνση τους (για τα ξενικά είδη), είτε η μερική και ήπια επέμβαση στην εξάπλωσή τους (περίπτωση της *Pinus brutia*).

Poster


Ανάλυση πληθυσμιακών διαδρόμων σε υποπληθυσμούς του είδους Juniperus macrocarpa σε τέσσερις περιοχές της Κρήτης προς την κατεύθυνση της εφαρμογής εξειδικευμένων δράσεων διατήρησης
Junicoast
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Οι παράκτιες αμμοθίνες με είδη αρκεύθων (2250* Coastal dunse with Juniperus spp.) αποτελούν οικότοπο προτεραιότητας σύμφωνα με την Οδηγία των Οικοτόπων (Οδηγία 92/43/ΕΟΚ). Στα πλαίσια του Προγράμματος LIFE+ "JUNICOAST: Δράσεις για την διατήρηση των παρακτίων αμμοθίνων με είδη Juniperus στην Κρήτη και στο Νότιο Αιγαίο" (2009-2012) πραγματοποιήθηκε εργασία καταγραφής της σύνθεσης και δομής των υποπληθυσμών J. macrocarpa στις 4 περιοχές (7 θέσεις) που εμφανίζεται ο οικότοπος 2250* στην Κρήτη. Από την εργασία αυτή εκτιμήθηκε ο συνολικός αριθμός ατόμων κάθε υποπληθυσμού και η πυκνότητα ανά θέση μελέτης, η αναλογία φύλου, ο βαθμός αναγέννησης κ.α. Με την επεξεργασία των αποτελεσμάτων προέκυψαν εξειδικευμένες διαχειριστικές δράσεις για κάθε θέση μελέτης με στόχο την μέσο- και μακροπρόθεσμη βελτίωση της κατάστασης διατήρησης του οικοτόπου.
Θέση μελέτης | Συνολική έκταση (ha) | Συνολικός αριθμός ατόμων (εκτιμ.) | Εκτιμώμενη πυκνότητα (άτομα/ha)
Χρυσή Α | 37,1 | 4400-4800 | 123,76
Χρυσή Δ | 52,3 | 2700-3000 | 55,35
Σαρακήνικο | 16,5 | 1200-1400 | 79,5
Αγ. Ιωάννης | 22,5 | 940-1000 | 42,9
Λαυρακάς | 98,6 | 14000-14800 | 145,95
Κεδρόδασος | 11,5 | 778 | 67,65
Φαλάσσαρνα | 2,6 | 179 | 68,85
ΣΥΝΟΛΟ | 241,1 | 24000-26000 | 104,15
ΦΑΛΑΣΣΑΡΝΑ - GR4340001
ΕΛΑΦΟΝΗΣΙ (ΚΕΔΡΟΔΑΣΟΣ) – GR4340015
ΧΡΥΣΗ - GR4320003
ΓΑΥΔΟΣ – GR4340013
ΧΡΥΣΗ Α
Χάρτες πρόβλεψης πυκνότητας (μέθοδος Ordinary Kriging)
ΛΑΥΡΑΚΑΣ
ΚΕΔΡΟΔΑΣΟΣ
Χάρτης αποτύπωσης πυκνότητας (κάνναβος 10x10 m)
Κύριες διαχειριστικές δράσεις
1. Σε δύο από τις περιοχές μελέτης (Χρυσή Α και Χρυσή Δ) καταγράφηκε σημαντική απόκλιση από την οικολογικά σταθερή σχέση 1:1 στην αναλογία φύλου (τα αρσενικά άτομα είναι περισσότερα). Στις δύο περιοχές αυτές και κυρίως στη Χρυσή Α κρίθηκε αναγκαία η φύτευση θηλυκών ατόμων προερχόμενα από μοσχεύματα που λήφθηκαν από τις δύο αυτές περιοχές. Τα μοσχεύματα αναπτύσσονται για πάνω από ένα χρόνο σε βέλτιστες συνθήκες σε φυτώριο και θα επαναφυτευθούν με την έναρξη των φθινοπωρινών βροχών (λήξη της ξηράς περιόδου).
2. Ο χαμηλός βαθμός αναγέννησης του είδους στις περισσότερες περιοχές μελέτης φαίνεται να οφείλεται, μεταξύ άλλων, και στη δυσκολία εγκατάστασης των αρτιβλάστων, αλλά και στη βόσκηση. Για την αύξηση του βαθμού αναγέννησης, αρτιβλαστα από τις περιοχές μελέτης μεταφυτεύθηκαν για να αναπτυχθούν υπό βέλτιστες συνθήκες σε φυτώριο και στη συνέχεια να επαναφυτευθούν μετά την πάροδο ενός και δύο ετών. Σε περιοχές με έντονη βόσκηση, επίσης, (π.χ. Κεδρόδασος), τοποθετήθηκαν περιφράξεις γύρω από νεαρα άτομα Κέδρου.
3. Στα πλαίσια της αποκατάστασης της χλωριδικής σύνθεσης του οικοτόπου πραγματοποιείται εξάλειψη ξενικών ειδών, αλλά και ήπιος έλεγχος της εξάπλωσης της πρασίνης πεύκης εντός του οικοτόπου 2250*, με την απομάκρυνση νεαρών πεύκων και κλεισμών κώνων από ήδη εγκατεστημένα άτομα.
Μεταφύτευση αρτιβλαστων (Αγ. Ιωάννης)
Εκρίζωση νεαρών πεύκων που καταλαμβάνουν κρίσιμες οικοθέσεις εντός των αμμοθινών (Χρυσή)
Περίφραξη νεαρού Κέδρου (Κεδρόδασος)
Εξάλειψη ξενικών ειδών (Carpobrotus edulis) (Χρυσή)