



#### THE JUNICOAST PROJECT

LIFE+ Nature & Biodiversity (2007-2013)

#### TITLE

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

#### **DURATION**

56 months (1 January 2009 – 31 August 2013)

#### **FINANCED BY**

The project is co-financed (75%) by the European Community's Financial Instrument for the Environment (LIFE +)

#### **TOTAL BADGET**

1.501.210 €

#### **COORDINATING BENEFICIARY**

International Centre for Advanced Mediterranean Agronomic Studies / Mediterranean Agronomic Institute of Chania (CIHEAM- MAICh)

#### **ASSOCIATED BENEFICIARIES**

- National and Kapodistrian University of Athens (NKUA), Faculty of Biology, Department of Botany
- Decentralized Administration of Crete, Forest Directorate of Chania, Forest Directorate of Lasithi, Regional Development Fund of Crete

#### **PROJECT SITES**

**Crete** (Kedrodasos, Falasarna, Gavdos Island, Chrysi Island), **South Aegean** (Naxos Island, Rhodes Island, Milos Island, Polyaigos Island)

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The Natura 2000 network is an EUwide network of nature protection areas. The aim of the network is to secure the long-term survival of Europe's most valuable and threatened

species and habitats ensuring that future management is sustainable, both ecologically and economically. It is comprised of Special Areas of Conservation (SAC) designated by Member States under the Habitats Directive, and also incorporates Special Protection Areas (SPAs) which are designated under the 79/409 Birds Directive.



The LIFE programme is the EU's financial instrument for the environment. It supports environmental and nature conservation projects throughout the

EU, as well as in some candidate, acceding and neighboring countries. It also contributes to the implementation, updating and development of EU environmental policy and legislation by co-financing pilot or demonstration projects with European added value. LIFE began in 1992 and up to date, it has co-financed some 3708 projects across the EU, contributing approximately €2.8 billion to the protection of the environment.

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## Introduction

Coastal dunes with *Juniperus* spp. are widespread along the sandy coasts of 8 countries of Southern and Western Europe, mainly on Mediterranean and Atlantic coastlines as well as in Denmark. In Greece, they can be found in 17 Natura 2000 sites mainly in Western and Southern Greece, the Aegean islands and Crete.

This rare and beautiful habitat has been classified as a "priority habitat" (code 2250\*) by the 92/43 Habitat Directive which means type of habitat in danger of disappearance of which the Community has a particular responsibility for its conservation.

Over the last decades, coastal dunes with *Juniperus* spp. have been subjected to severe anthropogenic and natural pressures and are mainly threatened by uncontrolled tourism growth, lack of public awareness, forest fires, grazing and browsing, littering and the naturally restricted regeneration of the *Juniperus* species. Moreover, climate change is expected to affect all natural ecosystems. In response to these growing threats, it was deemed necessary to undertake concrete conservation and management actions, in order to protect and ensure the long-term sustainability of this priority habitat.

Having examined the biotic and abiotic factors that influence the habitat structure and quality, as well as the effects of anthropogenic pressures, the Junicoast project implemented a range of concrete conservation actions in Crete, by applying mild interventions in the field. Moreover, dissemination actions such as information and training workshops, public awareness and environmental education campaigns were implemented on a National level throughout the duration of the project.

The elimination or reduction of threats was possible only through a participatory approach, based on the integration of several activities and on an effective and continuous cooperation between all the stakeholders of the project.

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## Aim and objectives



The aim of the Junicoast project was to promote and enable the long term conservation of the coastal dunes with *Juniperus* spp. in Greece.

#### THE SPECIFIC OBJECTIVES OF THE PROJECT WERE:

- → To contribute to the consolidation and dissemination of a knowledge base for the protection, restoration, monitoring and evaluating of coastal dunes with *Juniperus* spp. habitats in Greece,
- → To understand, quantify and halt natural and anthropogenic threats that contribute to the long term degradation of the habitat,
- → To design and implement actions for the protection and long term restoration of coastal dunes with *Juniperus* spp. habitats, and
- → To provide support for better environmental governance in Natura 2000 sites through stakeholder involvement and training.

## Project structure

Junicoast was a demonstration project that designed, implemented, evaluated and disseminated actions/methodologies for the protection and long-term conservation of coastal dunes with *Juniperus* spp. in Greece. These actions/methodologies were unfamiliar to the Greek geographical, ecological and socio-economical contexts.

The activities developed began with 9 preparatory actions in Crete in which baseline data, that is the required scientific knowledge on the abiotic and biotic factors that influence the habitat, were collected and obtained.

Preparatory actions were followed by the implementation of 8 concrete conservation actions in Crete targeting the main natural and anthropogenic threats.

In parallel, dissemination actions such as information and training workshops, public awareness and environmental education campaigns were implemented on a National level allowing the promotion of conservation of the habitat in the South Aegean, thus ensuring the wider conservation of this priority habitat throughout Greece.



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## The habitat

Coastal dunes result from the actions of the sea and the wind.

The severe influence of environmental factors such as high soil salinity, salt spray, strong winds and sand mobility have created particular types of vegetation which are by far the most important components of the biota on sand dunes because they reduce the effect of wind, hold the sand and are directly involved in establishing the dune forms and creating the structure of the dune habitat.

Depending on the vegetation they host, coastal dunes can be classified into three main categories:

- Primary or embryonic dunes occurring mainly on the seaward side of a dune system and characterized by sparse or no vegetation.
- Fore dunes usually occur further inland behind the embryonic dunes and are mainly dominated by ammophilous and sand fixing species.
- → Mature or hind dunes occur even further inland behind the fore dunes. They are characterized by the presence of more woody species. Juniper stands are dominant in this zone forming the 2250\* habitat.

Coastal dunes with *Juniperus* species are areas of high aesthetic value. They receive a great number of visitors for outdoor recreation as they are among the most attractive Mediterranean landscapes. Due to their special ecological conditions, they are important in terms of biodiversity as they host several rare or endemic flora and fauna species, while *Juniperus* is a slow-growing species and requires time to recover from any natural or human disaster.

The remaining flora of the habitat includes the presence of other shrubs and herbs adapted to grow in such unfavorable environment.



## The Junipers

In the Mediterranean region, the two Juniper species growing on habitat 2250\* are *Juniperus macrocarpa* and *Juniperus phoenicea* that belong to the Cupressaceae family



Juniperus macrocarpa is a dioecious species, that is, male and female flowers grow on different trees. Flowers bloom between February and March and produce cones, which usually contain 3 seeds that mature between September and October of the following year. The rooting system is deep and branched into an abundant and an extensive network of surface roots. Juniperus macrocarpa grows in a pyramidal shape as a shrub or a tree or in a multi-trunk group of clones originating probably from a single parent tree. It is a long living species and its age may exceed 400 years. Although many seeds germinate, the survival rate of the seedlings is very low due to the effects of grazing, trampling and particularly due to the adverse environmental conditions.



Juniperus phoenicea is a monoecious species with a short trunk, and leaves resembling cypress leaves. It produces berry-like cones, 6-14 mm in diameter and contains 3-8 seeds. Fruits mature between August and November of the following year. Juniperus phoenicea grows as a shrub or as a single tree. It occurs mainly on a rocky substrate with shallow sand.

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## Coastal dunes with

Juniperus spp.

in Greece

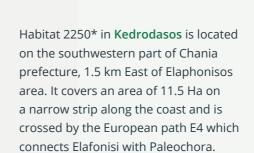
Coastal dunes with *Juniperus* spp. have been recorded in 17 areas of the Greek NATURA 2000 network mainly in Western and Southern Greece, the Aegean islands and Crete.

All actions of the Junicoast project have been carried out in all the Natura 2000 designated habitats of Crete.

Additionally, dissemination actions and public awareness activities have been carried out in the South Aegean providing the opportunity for the wider protection and restoration of this habitat.

A/A	PREFECTURE	SITE NAME	SITE CODE
1	KERKYRA	LIMNOTHALASSA KORISSION (KERKYRA)	GR2230002
2	PREVEZA	EKVOLES ACHERONTA (APO GLOSSA EOS ALONAKI) KAI STENA ACHERONTA	GR2140001
3	KEFALLINIA	ESOTERIKO ARCHIPELAGOS IONIOU (MEGANISI, ARKOUDI, ATOKOS, VROMONAS)	GR2220003
4	AITOLOAKARNANIA	DELTA ACHELOOU, LIMNOTHALASSA MESOLONGIOU - AITOLIKOU, EKVOLES EVINOU, NISOI ECHINADES, NISOS PETALAS	GR2310001
5	ACHAIA	YGROTOPOI KALOGRIAS-LAMIAS KAI DASOS STROFYLIAS	GR2320011
6	MESSINIA	THINES KYPARISSIAS (NEOCHORI - KYPARISSIA)	GR2550005
7	MESSINIA	NISOI SAPIENTZA KAI SCHIZA, AKROTIRIO AKRITAS	GR2550003
8	LAKONIA	PERIOCHI NEAPOLIS KAI NISOS ELAFONISOS	GR2540002
9	ATTIKI	ETHNIKO PARKO SCHINIA - MARATHONA	GR3000003
10	CHANIA	IMERI KAI AGRIA GRAMVOUSSA - TIGANI KAI FALASARNA - PONTIKONISI, ORMOS LIVADI - VIGLIA	GR4340001
11	CHANIA	PARALIA APO CHRYSOSKALITISSA MECHRI AKROTIRIO KRIOS	GR4340015
12	CHANIA	NISOI GAVDOS KAI GAVDOPOULA	GR4340013
13	LASITHI	NISOS CHRYSI	GR4320003
14	KYKLADES	NISOS MILOS: PROFITIS ILIAS - EVRYTERI PERIOCHI	GR4220020
15	KYKLADES	NISOS POLYAIGOS - KIMOLOS	GR4220006
16	KYKLADES	KENTRIKI KAI NOTIA NAXOS: ZAS KAI VIGLA EOS MAVROVOUNI KAI THALASSIA ZONI (ORMOS KARADES - ORMOS MOUTSOUNAS)	GR4220014
17	DODEKANISOS	RODOS: AKRAMYTIS, ARMENISTIS, ATTAVYROS, REMATA KAI THALASSIA ZONI (KARAVOLA-ORMOS GLYFADA)	GR4210005

Habitat 2250\* in Falasarna appears fragmented into 6 small patches along the coastline and covers a total area of 2.76 Ha.



Habitat 2250\* in **Gavdos** occurs on the Northern coast of the island in Sarakiniko, Agios Ioannis and Lavrakas covering an area of 16.5, 22.5 and 98.5 Ha respectively.

Habitat 2250\* in **Chrysi** island covers an area of 87.4 Ha in total and is found in two locations, on the East part of the island where the dunes' morphology is more intense and *Juniperus macrocarpa* dominates, and on the Northwest part of the island where *Juniperus phoenicea* dominates and grows in a shrub form.









## Studying the habitat

#### **GEOMORPHOLOGY**

Juniperus macrocarpa grows on deep sandy substrates up to 2 m depth unlike its main competitor species (*Pinus brutia*) which grows mainly on clay substrates. Although *Juniperus* trees grow in areas that hold moisture in their subsoil, their distribution does not depend on the presence of groundwater.

High velocity North winds and the absence of natural vegetation on the front dunes in Chrysi island cause intense wind erosion problems. Sand stabilizing fences have been installed at the North beach of the East site for the restoration of the front dunes geomorphology.

#### **HABITAT MAPPING**

The exact boundaries of all Cretan habitats have been accurately identified and mapped using aerial photographs, satellite imagery and field observations with GPS.

#### THE FLORA

A total of 142 plant species belonging to 33 families have been recorded on all Cretan sites. Therophytes were the dominant life form (56% of total species) followed by Chamaephytes (16%). A total of 7 endemic species have been found, 4 on Chrysi island and 3 in Kedrodasos and Gavdos. A set of 36 keystone species and 80 indicator species have been also identified.

#### **VISITOR IMPACT ASSESSMENT**

Visitor impact assessment is an important tool in protected areas management to design and appropriately define various visitor management interventions.

The following assessments have been conducted in all Cretan sites:

- → Visitors' use (types of activities)
- Patterns of use (trails, camping locations and hotspots)
- → Levels of use (intensity)

- → Trail and camping site conditions (damage on Juniper trees, cover of root exposure, ground cover vegetation)
- → Litter survey (quantify the distribution and the composition of debris in the habitats).

Moreover, interviews with visitors at all sites have been conducted using semi-structured questionnaires in order to establish their level of environmental awareness regarding perceived values and habitat sensitivity.



All deliverables are available on the project website: www.junicoast.gr

## COMPOSITION AND STRUCTURE OF *IUNIPERUS* POPULATIONS

The total number of juvenile plants in five study sites was under or just above 10% of the total number of adult individuals. The two study sites in Gavdos (Sarakiniko and Lavrakas) hosted a higher number of juvenile plants with regeneration index equal to 1:2.2 and 1:1.6 respectively.

Although most of the study sites showed significant number of seedlings, their survival rate was low enough.

The sex ratio of all studied populations was very close to 1:1 except those of Chrysi (Chrysi-East and Chrysi-West) where the sex ratio was 1.68 and 1.24 respectively (more male then female individuals were identified). All populations showed an average age in the range of 100-200 years. Kedrodasos and Lavrakas populations seem to be the youngest (100-120 years) while in Agios Ioannis the average age is 170-180 years. The oldest tree among those sampled was found to be 350 years old (Chrysi island).

#### **LONG-TERM MONITORING**

Monitoring and evaluation is critical in determining if the actions taken are meeting their restoration/recovery objectives, their expected results and for guiding future work within the project area. In order to evaluate the effectiveness of the concrete conservation and dissemination actions, 10 key indicators related to the amount, distribution and composition of litter, the damage on *Juniperus* trees, the *Juniperus* regeneration, the floristic composition and structure of habitat 2250\* and the level of public/environmental awareness have been identified and 5 long term monitoring protocols with their sampling design and Standard operating Procedures (SOPs) have been developed.



#### **ELABORATION OF TARGET HABITAT PROTECTION AND RESTORATION SPECIFICATIONS**

The protection and restoration specifications for habitat 2250\* have been developed based on the integration of the results of all preparatory actions. They were site-specific and aimed to guide the implementation of all concrete conservation actions. They have been developed according to the habitat attributes, identified problems and

pressures at each site and have been provided in a comprehensive form in order to be easily applicable in other sites in the South Aegean, while taking into consideration the particularities of each site. These specifications were further developed in the "protection and restoration guidelines" that have been used in the training of stakeholders involved in the conservation and management of this priority habitat throughout Greece.

#### STAKEHOLDERS AND LOCAL COMMUNITIES CONSULTATIONS

Successful implementation of habitat or species conservation measures in Natura 2000 designated areas requires the active participation of people living or working in or around these areas and the cooperation between all relevant stakeholders.

The main conclusions from the stakeholder and community consultations, recorded in dedicated reports for each site, were:

- The current management is considered insufficient or ineffective by both the community and stakeholders and is mainly due to administrative problems and duplication of responsibilities,
- 2. The threats identified by the project and especially those related to tourism, overgrazing and fire risk are recognized as important,
- 3. Greater engagement and collaboration between stakeholders and local communities depends on raising public awareness,
- **4**. Environmental education and public awareness are of paramount importance.

## DETERMINATION OF THE GOVERNANCE STRUCTURE AND LEGAL STATUS

The analysis of the governance structure showed a fragmentation of responsibilities and a lack of clarity regarding the form of governance and delegation of responsibilities resulting in confusion and inability to determine accountability. The analysis of the responsibilities of various agencies and services recognized the lack of Management Bodies, that should have the authority to ensure the effective management and long-term protection of the areas.

The legislation is not considered to be a problem, but rather the lack of its enforcement. Greek legislation does not provide specific provisions to protect habitat 2250\*. The protection of this habitat occurs under general provisions on the environment through legal and administrative acts related to protected goods, which are in direct relation to the habitat (coast, dunes, beach, etc.).

The protection of the natural environment is an obligation of the state but also a duty of each and every one of us.

The Greek Constitution, Article 24



# Conservation Actions

#### **HABITAT DEMARCATION**

The exact boundaries of all Cretan sites have been demarcated using 2 m tall wooden posts. Wooden posts have been installed at variable intervals depending on the terrain and topography of each site. This action was not intended to "seal off" the habitat but rather to reveal its area and demarcate its exact boundaries, by making them visible to the visitors and creating a sense of entering a protected area.

#### **WASTE REMOVAL**

Bulk waste such as plastic ropes and other greenhouses residues in Falasarna, remaining tents and other leftovers by campers in Chrysi and Gavdos have been removed from within the habitat boundaries at the end of the project.

Litter waste removal has been carried out manually and continuously at all Cretan habitats with the help and the engagement of various stakeholders (volunteers, the local community and campers).

Moreover, an important concept in waste removal has been highlighted in the environmental education campaign and in the "code of conduct" developed by the project consortium, that promotes the idea of collecting personal and other peoples' rubbish and placing them in appropriate rubbish bins outside the habitat boundaries. For that reason, rubbish bins were placed outside the boundaries of the habitat in Gavdos, Kedrodasos and Falasarna at specific points where the municipality's waste truck can empty them.

#### FORE DUNE RESTORATION

The East site of Chrysi island was the only site that needed fore dune restoration. Fore dune restoration has been conducted by erecting 14 units of sand trapping fences (200m long in total) perpendicular to the prevailing wind, in order to reduce wind erosion, inhibit sand removal and support the formation of embryonic dunes at already identified positions on the North beach.

## ENHANCEMENT OF JUNIPERUS REGENERATION

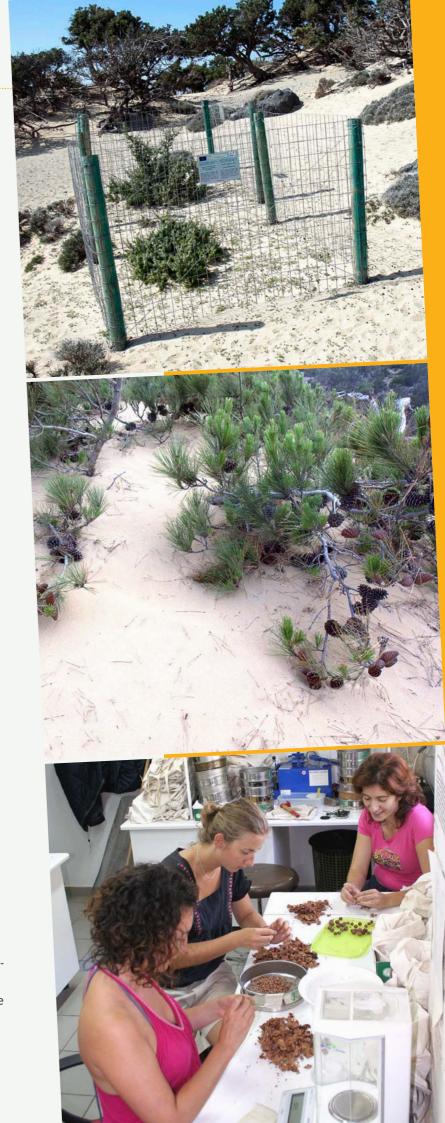
A small number of *Juniperus* young individuals and/or intense pressures such as trampling and grazing have been recorded at most Cretan sites. Hundreds of *Juniperus* seedlings have been produced in the nursery of MAICh and subsequently transplanted in the field where, along with other naturally established juvenile *Juniperus* individuals, have been fenced at various Cretan sites in order to enhance the *Juniperus* regeneration.

## RESTORATION OF THE FLORISTIC COMPOSITION

The restoration of the floristic composition of habitat 2250\* has been conducted by planting/fencing several keystone species within the habitat boundaries, by planting female individuals of *Juniperus macrocarpa* in Chrysi, in order to balance the female/male ratio among the *Juniperus macrocarpa* subpopulations and by eradicating invasive species such as seedlings of *Pinus brutia* and *Carpobrotus edulis* from within the habitat boundaries.

## EX SITU CONSERVATION AND PROPAGATION OF KEYSTONE SPECIES

Seeds of Juniperus macrocarpa, Juniperus phoenicea and 30 keystone species have been collected, cleaned and stored at the seed bank of MAICh. Protocols for seed collection, handling and storage and for seed germination of collected species have been developed. Moreover, seeds/plant material from all Cretan sites of Juniperus macrocarpa and major keystone species have been propagated at the nursery of MAICh and subsequently used for the enhancement of Juniperus regeneration and the restoration of the floristic composition of habitat 2250\*.



Junicoast Layman's report



#### conservation actions ...

## VISITOR MANAGEMENT INFRASTRUCTURES

Management infrastructures such as wooden boardwalks, directional wooden and metal sticks on either side of the main paths have been installed to channel the visitors on specific routes, in order to avoid excessive trampling and damage on vegetation throughout the habitat. Moreover, wooden rubbish bins have been installed on the main beach of Sarakiniko-Gavdos and wooden tables/benches (resting points) have been installed at strategic points in Kedrodasos, Chrysi-East and Sarakiniko-Gavdos.









## ...and public awareness

#### **INFORMATION SIGNS**

One-sided welcoming information signs including general information about the area and a visitors' code of conduct have been installed at the entrance point(s) of each Cretan habitat. Moreover, two-sided information signs including information about the Junicoast project, the geographical distribution, the ecological values/characteristics, threats, peculiarities of each site and the visitors' code of conduct have been installed at strategic points within the boundaries of each Cretan habitat.





#### **CODE OF CONDUCT**

#### Dear visitors,

the following practices would minimize the negative impact on the environment and maintain the natural beauty of the habitat.



**Don't cut juniper tree branches.** Even if they seem dry, do not cut tree branches for firewood, as these branches allow sand trapping encouraging further dune formation.



**Collect your rubbish.** If you've carried it in, carry it out. Don't burn or bury rubbish, and if you come across other people's rubbish, do the environment a favor: take it with you and dispose it correctly in the appropriate rubbish bins.



#### Walk on established paths.

To prevent damage on vegetation and to reduce soil erosion, please, walk on established paths, where possible.



Avoid lighting fires. Juniper is not a fire-resistant species and it does not regenerate after fire. Do not light fires; there is always a risk of fire.

In case of emergency call 199.



Respect your fellow visitors and the local community. Keep noise levels to a minimum to avoid disturbing others, respect the privacy, cultural heritage, habits and traditions of local community.

Upon leaving, take with you your experiences and memories.

Leave behind ONLY your footprints!



# Public awareness dissemination of results

Protected areas visitors' are more inclined to accept restrictions when they know the reasons for the rules!

The success of conservation and recreation management depends, to a large extent, on information and environmental education programmes, mainly those targeted towards the visitors of the sites, the local communities, the responsible authorities and most importantly to the children.

All communication and dissemination activities of the Junicoast project have been carried out in Crete and in the South Aegean.

#### **COMMUNICATION MATERIALS**

The communication materials produced and disseminated by the Junicoast project included: leaflets, posters, notice boards, video, project website, t-shirts, radio spot, children's fairy tale, teachers' guide on coastal dunes with *Juniperus* spp., habitat protection and restoration guidelines and a slide show presentation (available on YOUTUBE) on coastal dunes with *Juniperus* spp.





#### **FOR CHILDREN**

Student weeks have been organized at the exhibition Center and the botanical garden of MAICh. Moreover, various children local events such as school, summer camps and guided on-site visits have been organized.







#### FOR GROWN UPS

Discussions with local communities and campers, information workshops for environmental educators and tourism representatives and training workshops with stakeholders involved in the protection and management of coastal dunes with *Juniperus* spp. have been organized.





## What Junicoast accomplished

After approximately 5 years, the Junicoast project accomplished the following:

#### At the **National** level

- Increased knowledge about the geomorphology and the ecology of the habitat,
- → Increased knowledge about the *Juniperus* species and the remaining flora of the habitat,
- Increased public awareness on coastal dunes with Juniperus spp.,
- → Elaboration of habitat protection and restoration guidelines,
- → Elaboration of habitat long-term monitoring protocols.

#### At the **Cretan** local level

Improved conservation status of habitat 2250\* and minimization of threats and negative impacts on all Cretan habitats through a series of on-site concrete conservation actions.

### More specifically,

- → 239.31 ha of coastal dunes with *Juniperus* spp. have been demarcated in Crete and 327 wooden sticks for habitat demarcation have been installed,
- 30 rubbish bins have been installed and all Cretan habitats have been cleared of litter,
- 340 m of wooden boardwalks have been constructed and installed,
- → 113 directional sticks have been installed along 4.5 km of main trails,
- 200 m of sand trapping fences have been constructed,
- → 16 information signs have been installed,
- → 184 juvenile Juniperus macrocarpa and other keystone species have been planted,
- → 12 naturally established juveniles of Juniperus macrocarpa have been fenced,
- → Thousands of seeds from Juniperus macrocarpa and other 30 keystone species have been collected, cleaned and stored at the seed bank of MAICh,
- → 134 individuals of invasive species of Pinus brutia have been removed from all Cretan sites.

#### Additionally,

- → 20.000 project leaflets, 7.000 project T-shirts and 4.000 copies of the fairy tale have been distributed,
- → Radio spot in English and in Greek has been aired 1.472 times,
- → More than 3.000 school children have been informed and hopefully, motivated,
- 20.000 Internet users have been informed,
- 9 workshops and 20 local events have been organized,
- → 30 articles and news releases have been published in local or National newspapers,
- → Junicoast has been presented 6 times on TV interviews.

Moreover, Junicoast participated in organizing a network with similar current or past LIFE projects in Europe resulting in exchange of know-how and scientific methodological approaches between projects.





Upon leaving, take with you your experiences and memories.
Leave behind ONLY your footprints!

