MANUEL ROMERO GONZÁLEZ

VISITORS' GUIDE
RESERVA ECOLÓGICA
DUNAS
DE MARBELLA

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Visitors' Guide

Reserva Ecológica-Dunas de Marbella

1st edition

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ACKNOWLEDGEMENTS

We want to dedicate this visitors' guide to our loyal partners and supporters; to the numerous volunteers and contributors that have always turned out to help us with the conservation work of the dunes; to the students that have embraced the dune environment, looking after it during term time; to the researchers and teachers of the diverse disciplines of Biology and Conservation at Malaga University; to the university graduates from other areas, including those from Michigan (USA); to Marbella Town Hall and the Regional Department of the Environment and to the Ministry of Environment and Demarcation of the Andalusian-Mediterranean Coast.

All have participated in one way or another to support Pro Dunas. Over the years we have learnt to love and respect the enormous Natural Heritage that exists on the coast of Marbella; our knowledge has been enriched by the beautiful biodiversity of flora and fauna that lives in the different dune eco-systems between Marbella East and Cabopino and we will be forever captivated by it.

This Visitors' Guide aims to encourage others to follow in our steps to ensure that this valuable Natural Heritage is never lost.

PROLOGUE

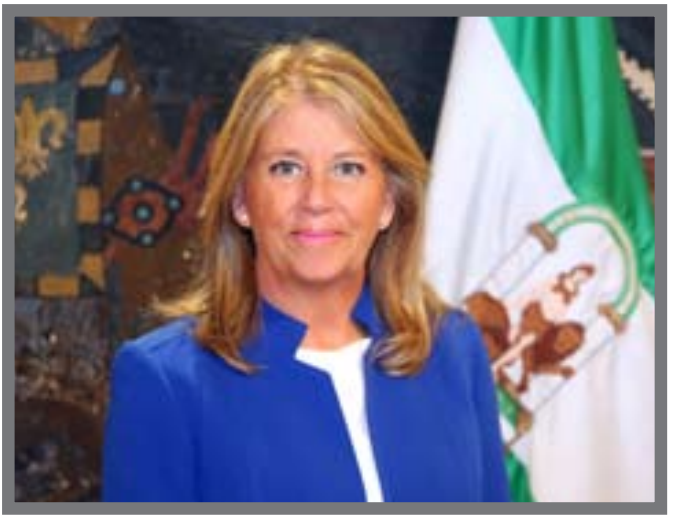
Marbella is a town with an extraordinary richness in many areas, one of the most outstanding without a doubt is its surroundings, with a rich natural heritage that makes it one of the most incredible areas to live in and visit.

The important systems of dunes, unique to this area and to the province, are of immense environmental value and provide a great attraction to our municipality.

In this respect this guide, created by the Pro Dunas association, an institution committed to our town, draws us to the natural dune formations with the double objective of deepening our understanding and raising awareness of conservation issues.

The town hall are also taking clear steps in this regard, together with Pro Dunas, because they believe that the dune system should receive maximum protection while making them available for everyone to enjoy.

I would like to highlight the incredible hard work carried out by Pro Dunas, with Fernando Piquer at the helm, protecting our natural heritage. We will never be able to thank them enough for the great job that they are doing for the municipality and their clear commitment to Marbella.



Ángeles Muñoz Uriol
Mayor of Marbella

INTRODUCTION

The coast of Marbella has always been considered one of the most beautiful of the entire Malaga coastline, embellished with rich resources and with a diverse natural environment which has been prized throughout history as a reflection of different cultures and events.

This compilation of natural and cultural value remained almost intact with little deterioration until well into the twentieth century. In the 70s, tourism discovered the charm of the area and prompted a change away from the traditional agriculture, farming, fishing and hunting in the coastal zone and towards urban activities that generated greater economic benefits for the landowners and developers.

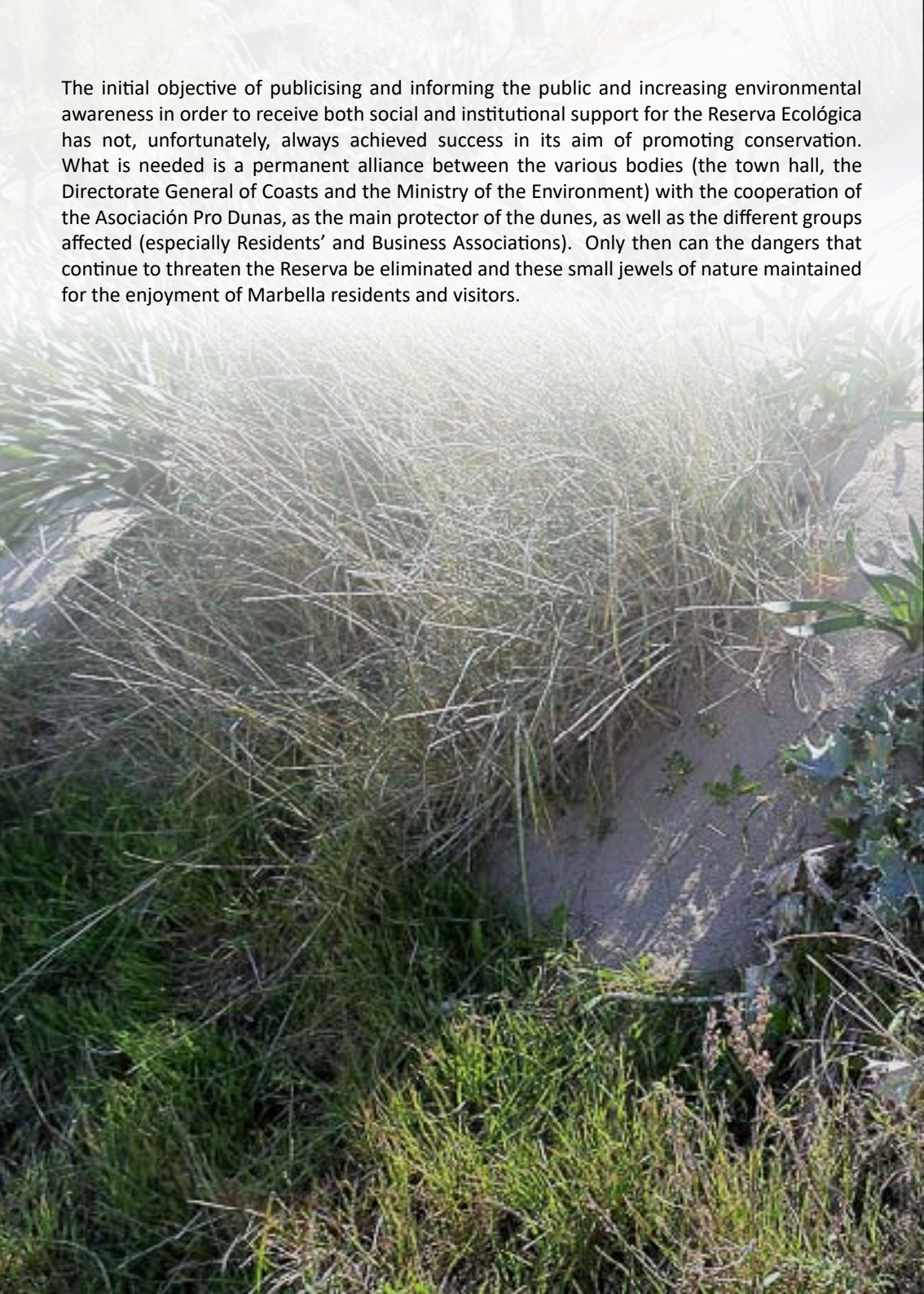
The extensive growth of the urban areas and the lack of adequate legislation as well as the limited vision of the politicians and planners, made it possible for a massive development of the coast, affecting many of the values that had made it unique. The extensive sandy areas that once stretched from Marbella to Mijas where gradually swallowed up with small sections left disconnected from others, overwhelmed by nearby developments and by the pressure of thousands of visitors and their vehicles.

This situation became the motivation for a small nucleus of residents, united under the association Pro Dunas, to promote a combative and supportive campaign for the conservation of the small quantity of remaining dunes. The association persuaded the Marbella Town Hall, later receiving the support of the Junta de Andalucía, to declare the dunes as a Reserva Ecológica on 18 September 2015. Since then, the Plan Técnico of the dunes has been developed with good and some less good, results. The plan establishes the actions that need to be taken in order to maintain the effective conservation of the area and the way in which the dunes can be conserved for the education and enjoyment of residents and visitors.

In order to publicise and inform everyone of how important these dunes are, it was decided to create a small guide which by including all the most significant information about the Reserva Ecológica, would serve as an introduction to these beautiful sections of our coast line, encouraging their conservation and protection. The contents of the guide have been designed with this in mind, incorporating not only a description of the natural and cultural value of the dunes but also with itineraries to help visitors to become acquainted with each and every one of the protected dunes which are sometimes very different in character and use.

An individual description, backed up with a photograph of each one, explains their particular importance and shows their location.

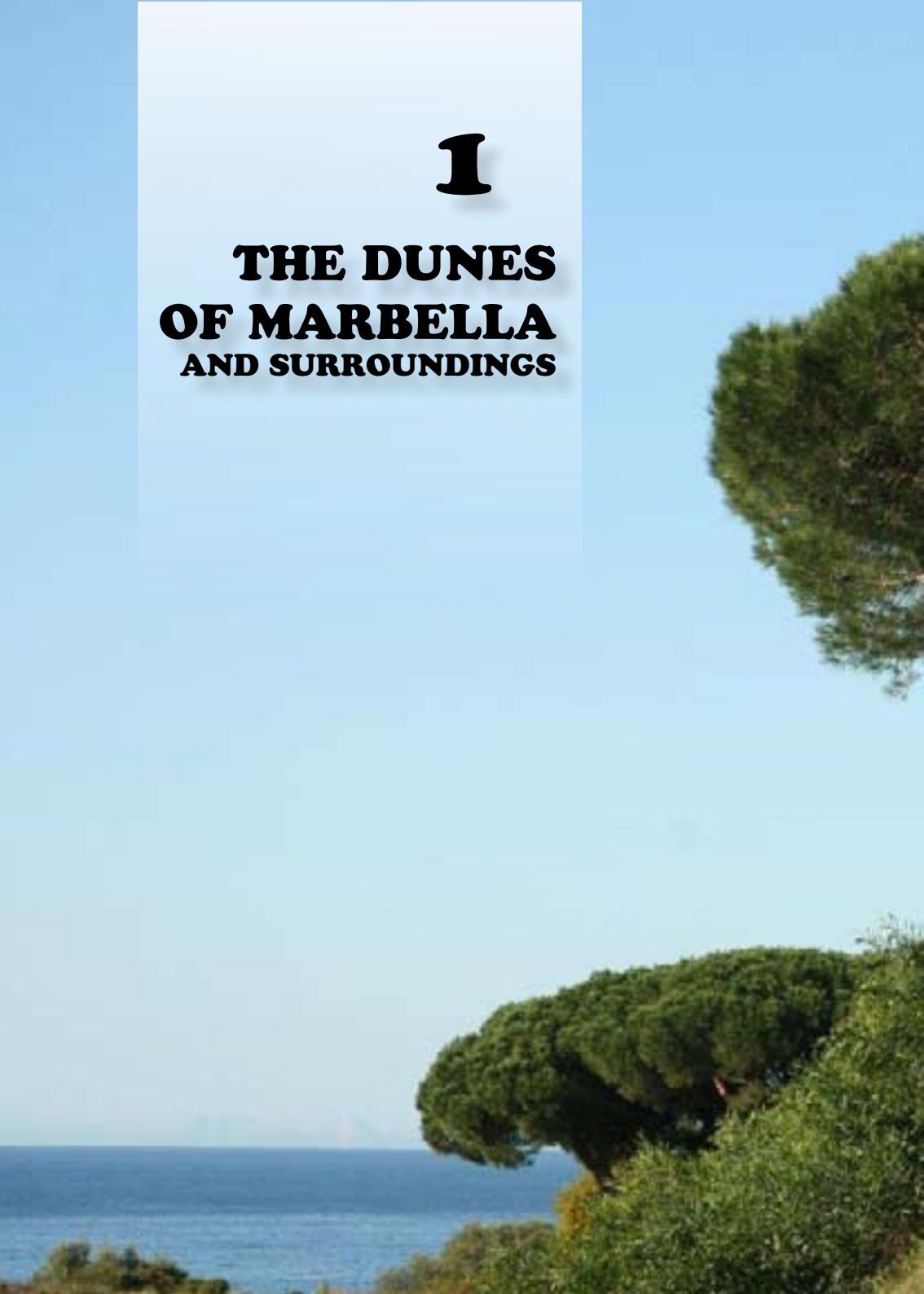
The initial objective of publicising and informing the public and increasing environmental awareness in order to receive both social and institutional support for the Reserva Ecológica has not, unfortunately, always achieved success in its aim of promoting conservation. What is needed is a permanent alliance between the various bodies (the town hall, the Directorate General of Coasts and the Ministry of the Environment) with the cooperation of the Asociación Pro Dunas, as the main protector of the dunes, as well as the different groups affected (especially Residents' and Business Associations). Only then can the dangers that continue to threaten the Reserva be eliminated and these small jewels of nature maintained for the enjoyment of Marbella residents and visitors.



INDEX

1

THE DUNES OF MARBELLA
AND SURROUNDINGS



1 THE DUNES OF MARBELLA AND SURROUNDINGS

1.1 LOCATION

Located in the heart of the western Costa del Sol and belonging to the municipal of Marbella, is a surprising system of dunes in the urban landscape. They are the remains of what up until 1962, was one of the most significant landscapes of our coast and of the Andalusian Mediterranean.

This continuum of white sand reached from the outskirts of the town of Marbella to the boundary with Mijas and characterised the coast. Little by little it has gradually been reduced in size, invaded by buildings or affected by massive extractions of sand and dumping of rubble which was later buried. The dunes today are a fragmented rosary of small stretches of sand of various dimensions, some of which can be found at the mouths of the streams and rivers that flow through the area.

1.1 Provincial location of the Reserva Ecológica-Dunas de Marbella.

The geographic coordinates of the Reserva Ecológica are as follows:

North-East limit	36° 29’ 22,70” N	4° 46’ 25,47” O
South-East limit	36° 29’ 21,74” N	4° 46’ 26,28” O
North-West limit	36° 30’ 11,94” N	4° 50’ 31,44” O
South-West limit	36° 30’ 11,05” N	4° 50’ 31,87” O

1.2 PROTECTION PROGRAMME

All the land included in the Reserva Ecológica is part of a protection programme derived from environmental and urban legislation.

The Reserva Ecológica was created in Malaga on 18 September 2015 by a legal ruling by the Delegación Territorial de la Consejería de Medio Ambiente y Ordenación del Territorio based on article 32 of 8/2003 law for the Protection of wild Flora and Fauna 28 October.

Also, with article 11 of the decree 23/2013 of 14 February by the aforementioned body, the use and conservation of the natural resources in the reserve were regulated by a Plan Técnico which established the activities, management and promotions which could be carried out.

By the application of the Ley de Costas, the corresponding protection of the Dominio Público Marítimo Terrestre (Maritime Terrestrial Public Domain) was established, as well as precautions for the use of the right-of-way in the traffic easement zone. Finally, the Ley de Aguas, protected the banks and margins of waterways bordering the dunes.

At the same time, the area was given an urban development programme derived from corresponding legislation and the Plan General de Ordenación Urbana de Marbella (General Urban Development Plan of Marbella) in which the majority of the land was designated as protected; however, in one case (the El Barronal de la Morena dune), a portion of the non-public dune was deemed suitable for development.

1.3 ACCESS

The coastal character of the protected land means that access is via the neighbouring residential areas off the A-7 motorway (the old N-340), as well as by boardwalks and paths usually open to pedestrians. Near to these access points are public car parks.

1.4 DESCRIPTION OF THE RESERVA ECOLÓGICA

The Reserva Ecológica-Dunas de Marbella occupies a small strip of land with a west – east orientation. It consists of a series of fragmented sand dunes which form part of Marbella's urban land to the east of the town's nucleus, from the left bank of the river Real to the Los Tony's beach bar in Las Chapas, a distance between both points of around 6,350 metres. The width of this strip of land varies and in order to be included in the Reserva it was made public, incorporating the stretches situated in the Terrestrial – Marine Public Domain as well as those in the easement zone and others belonging to the town council.

The approximate dimensions of the individual dunes are as follows:

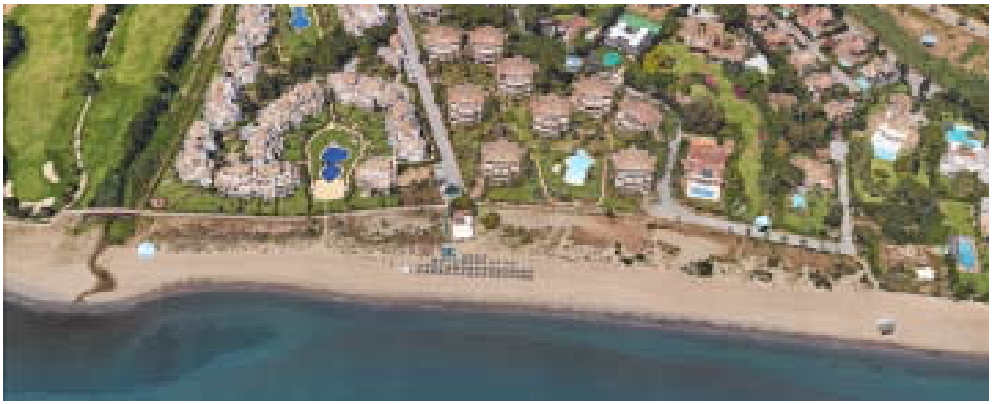
DUNE	LENGTH	AVERAGE WIDTH	PROTECTED AREA
Río Real	425	35	14.479,02 m^2
La Adelfa	742	37,9	30.504,06 m^2
El Alicate	242	11	7.075,92 m^2
El Barronal de la Morena	115	200	17.014,19 m^2
El Arenal	127	47	4.200,57 m^2
Real de Zaragoza	1248	78	123.317,42 m^2
La Víbora-Oeste	217	32	5.168,41 m^2
La Víbora-Laurel	405	32	14.690,89m^2
Las Golondrinas	187	30	5.754,20 m^2

1.2 Location of the Reserva Ecológica-Dunas de Marbella in the coast.

1.5 DUNE ZONES: Individual dunes

Due to the dissimilarity between the individual dunes, in their geomorphology as much as in the characteristics of the vegetation and the intensity of human use, it is possible to establish dune zones in the Reserva based on the individual dunes as listed below:

Duna Río Real. The westernmost part of the Reserva, also called Duna of Los Monteros, extends from the mouth of the river Real to the west (included in the LIC river Real ES6170025) to the edge of a private property to the east in Avda. Ignacio Coca, bordered to the north by the Los Monteros Beach development and the road measuring in total 425 metres long by 35 metres wide.



1.3 Partial view of the mobile dune taken from the central section of the Duna Río Real.

This dune reaches up to three metres above beach level, a little less at the western side and 10-18 metres wide. The valley or flat area between the dunes towards the residential development is up to 28 metres wide. Both areas of the dune show signs of human activity, the action of cleaning machines at the foot of the external slope and the existence of a beach bar in the central part of the dune.

1.4 The end of the dune next to the river Real.

The mobile dune conserves some good examples of psammophytes, with pasture grasses such as marram grass dominating the flat areas, a mosaic of therophytes and stands of low-growing shrubs climb the interior slope of the main dune; both have been the object of a thorough clearing of invasive exotic species which were occupying a good part of the dune. In places, mastics, junipers and other shrubs have been planted. There is not much fauna, a residual population of sand lizards and Iberian skinks, and an abundance of insects and some birds with few nesting due to hunting.

1.5 View of the eastern part of the dune.

Duna La Adelfa. Also known as Bahía de Marbella, this dune extends from the Realejo stream to the west and to a private property to the east. It is about 740 metres long and 38 metres wide, bordered on the north by residential developments and part of a pedestrian promenade. The main part of the dune consists of a low front dune (2 metres high rising here and there to 3 metres), with a large flat area behind on which there are various roundabouts for vehicles, the sewage mains and the beach bar El Mangaleta.

The dune has preserved an excellent coverage of pasture grasses and low bushes on the sand as well as numerous examples of tall shrubs and trees scattered on the slopes (these replanted). The existence of fresh water underground facilitates the presence of vegetation, allowing a larger variety of species on the flat areas. The escalation of trampling on the crest and the erosion on the exterior slope of the dune is affecting the plant communities, as well as in the interior areas which have no defined path.

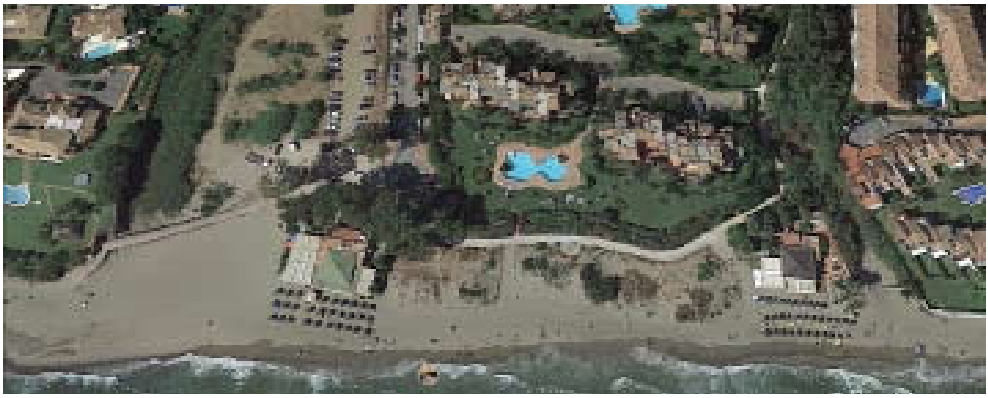
The fauna is very interesting with an abundance of insects and snails which draws reptiles and birds as well as predators such as kestrels and bats based in the developed areas.

1.6 Partial view of Duna La Adelfa with the frontal dune and valley behind.

1.7 Large species of psammophytes on the interior slope of the dune and on the flat part behind.

1.8 View of the central zone with low-growing scrub and pasture grasses invading the crest of the dune.

Duna El Alicate. The smallest of the protected dunes, just 242 metres long and 11 metres wide situated between the Siete Revueltas stream to the west and the El Alicate stream to the east. It is bordered by the residential development Alicate Playa to the north. Its morphology is particularly affected by the two beach bars at either end (which occupy nearly half the length of the dune), a road to the north and various paths across it. It consists of a main dune up to 3 metres high (6 metres wide) and a flat area of just 5 metres.



The dune front maintains a small area of embryonic dunes and an irregular crest damaged by a path through the middle and the work of eradicating invasive alien plants. This deterioration, obviously of human origin, means that biodiversity is affected, although most of the psammophylic plant species are represented. The conspicuous cedars growing on the top of the dune are of unknown origin.

1.9 View of the interior of the Duna El Alicate showing the invasive path between.

1.10 Clumps of psammophytes on the flat area and interior slope of the mobile dune.

On the crest of the mobile dune are various other communities of typical vegetation: theraphytes and marram grass. The interior slopes and part of the flat area have theraphytes and in the interior, closest to the road, are ruderal nitrophilic plants. Around the beach bars and along the edge of the road to the development, the exotic vegetation stands out, especially the eucalyptus and species of reeds.

There are few species of fauna; the spiny-footed lizard, Iberian skink and various insects (coleoptera, dung beetles, lepidoptera, diptera, etc.).

1.11 Trampling is the main cause of the deterioration of the dune even though it is fenced off.

Dunas El Barronal de la Morena. Physically separated by buildings, the Barronal dune has some of the most complete geomorphology of the whole reserve, with just 112 metres across the front and about 200 metres of land behind. It is bordered by private properties. The El Arenal dune, 127 metres wide and just 47 metres deep, is also restricted each side by a beach bar and an access way.

The Barronal dune, which reaches 10 metres above sea level, has various frontal dunes and spaces between. Most notable is the mobile dune, some 10 metres wide with another 25 metres of semi-mobile dunes which have sandy areas and high and low-growing shrubs and a strong presence of alien species.

1.12 Partial view of the front of the El Barronal dune and the valley behind.

The upper part of the dune appears to be stable with dense vegetation consisting of exotic species and indigenous shrubs and small areas between the dunes also with exotic plants. The fauna is without a doubt, the best in the Reserva.

The El Arenal dune is a large mobile dune, with a steep exterior slope 3 metres high, with pasture vegetation and psamophyllic marram grass. Further in is therophytic grassland, and in the interior and towards the back is ruderal nitrophilic grassland. The fauna appears to be limited with Andalusian lizards and geckos in the urban area.

Above: 1.13 Vegetation and terrain in the interior of the El Barronal dune.
Below: 1.14 Theraphytic grassland and marram grass on the crest of the El Arenal dune.

Duna Real de Zaragoza. - The largest on the Reserva, nearly 1,300 metres long by 118 metres wide, it stretches from the Sequillo stream to the west to the Real de Zaragoza stream to the east. It is bordered to the north by roads and the Residencia de Tiempo Libre development and other properties. It consists of the main dune of around 29 metres wide and 2.5 metres above the height of the beach. It has been somewhat affected by the beach bars and other buildings and has a large flat area in the interior with the remains of a secondary dune visible in some places.

1.15 The western slope of the mobile dune.

Beach vegetation is well represented in some areas at the front and extends into the valley between the dunes where there are diverse clumps of ephemeral grassland accompanied by stands of acacias, eucalyptus and stone pines.

In the innermost part of the dunes, there is low scrub and in the streams a dense growth of reeds and young eucalyptus. Some specimens of plants have been conserved for their interesting characteristics.

1.16 View of the scrub growing on the flat area in the centre of the dune.

The fauna is abundant. There are numerous species of invertebrates, especially insects and molluscs, as well as reptiles (particularly the sand lizard) and small mammals. It is especially rich in birds, with nesting crested larks and hoopoes and many other species, some nesting in the nearby developments.

1.17 Aleppo pine grove and acacias at the western end of the dune.

Duna La Víbora. This is another of the biggest dunes in the Reserva. It extends from the Víbora stream to the west (next to the beach restaurant Beach House) to the car park for the El Laurel beach bar, bordered to the north by the Cerrado Elviria Beach development, White Pearl Beach, Romana Playa and the pedestrian crossing. It is 620 metres long and an average of 50 metres wide becoming a little narrower (32 metres) at the eastern end.

It consists of a main dune about 2-3 metres above the level of the beach with a valley behind, of variable width, narrower at the western end.

1.18 Partial view of the Duna La Víbora, with the front elevation, valley and vegetation.

The vegetation is well maintained with clumps of psammophytes on embryonic dunes and ridges, psammophyllic plants and stands of low scrub with species of high dune scrub on the flat areas; the pastures of ruderal nitrophilic plants are found on the least anthropised areas and species of trees and shrubs have been introduced (pines, junipers etc.). There are still stands of invasive exotic species in the westernmost dune.

1.19 Small paths on the dune concentrate most of the foot traffic heading to the beach.

Interesting fauna accompanies this vegetation, abundant insects and predatory species, especially reptiles (lizards, Iberian skinks and geckos), amphibians (common frog and southern frog) in the stream and birds, of which the common kestrel is the star, especially in the migratory passages. Noteworthy are the multiple families of finches and the presence of small mammals (the greater white-toothed and pygmy shrew and field mouse).La incidencia humana aparece más controlada que en otras dunas.

1.20 View of the interior of the mobile dune in the westernmost sector of the Duna La Víbora.

Duna Las Golondrinas. - At the far eastern end of the Reserva, it barely reaches 187 metres long by 30 metres wide, but with the highest ridge (around seven metres above the beach), giving beautiful views of the coast. It is bordered by the El Laurel car park and the edge of the residential development to the west and the Los Tony's beach bar to the east.

The dune is atypical in its form, it is very solid due to the existence of sand and earth from the neighbouring developments as well as rubble and other materials not usually found in the areas around the other dunes, it has no flat area nor any difference in ridge heights.

This dune has vegetation dominated by nitrophyllous ruderal grassland on the upper part and a dense acacia grove (with reeds and other exotic species in its understorey) on the rest. The lower edge of the dune has clumps of psammophytes and marram grasses. It is subjected to intense erosion at the base by the sea and by human activity, creating a slope 2.5 metres above the beach which threatens its stability.

Although the acacias have been controlled in the past, they have returned to recolonise the majority of their previous location.

1.21 View of the slope of Duna Las Golondrinas.

With regards to the fauna, it is abundant with insects, particularly notable is the presence of reptiles (the spiny-footed lizard and geckos) and the birds; it is a good point for observing marine and other birds during coastal migration periods.

1.22 Psammophytic vegetation of the Sea daffodil (Pancratium maritimum) on the edge of the slope.

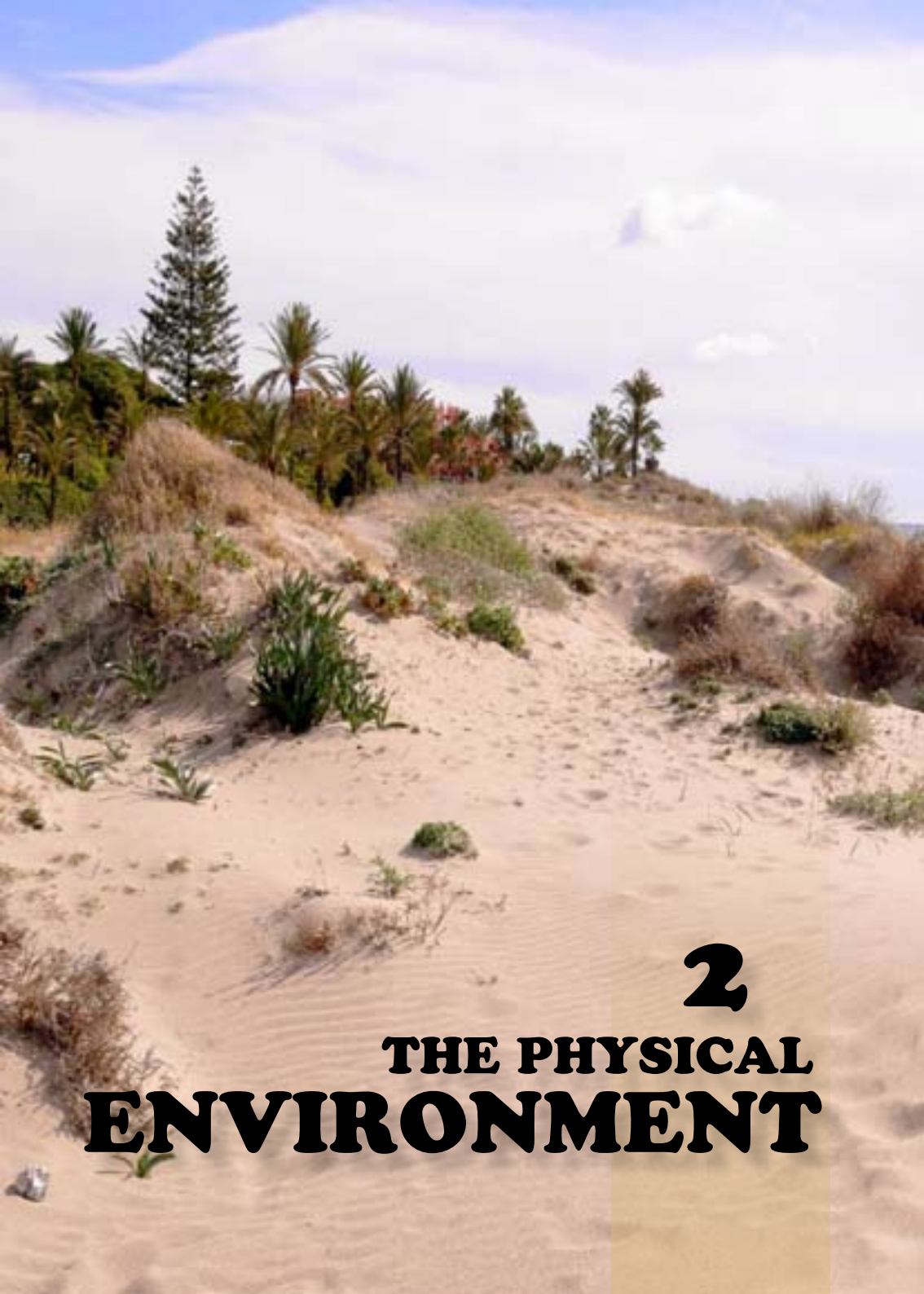
1.4.2 Surface areas and boundaries

In accordance with the limits established for the Reserva in the Resolución Declaración, the total surface area of the ecological reserve is 222,303m2.

The boundaries of each of the different dunes have also been established in the Plan Técnico of the Reserva Ecológica:

Duna Río Real	**N**	*DPMT, right of way (easement) and Avda. Ignacio Coca*
	E	*Private land*
	W	*Public Water Domain Río Real*
Duna La Adelfa	**N**	*Los Monteros residential development and boundary of the DPMT*
	E	*Public Maritime Land Domain and easement*
	W	*Private Land La Arbolada*
Duna El Alicate	**N**	*Alicate Playa residential development*
	E	*El Alicate stream*
	W	*Siete Revueltas stream*
Duna El Barronal	**N**	*Las Chapas residential development*
	E	*Private land*
	W	*Private land*
Duna El Arenal	**N**	*Playas Andaluzas residential development*
	E	*Bono Beach restaurant*
	W	*Private land and road*
Duna Real de Zaragoza	**N**	*Various private plots and the Residencia Tiempo Libre (J.de A.)*
	E	*Public Water Domain and Real de Zaragoza stream*
	W	*Pinomar residential development*
Duna La Víbora	**N**	*Los Chopitos and Los Ángeles residential developments*
	E	*El Laurel beach bar*
	W	*La Víbora stream*
Duna Las Golondrinas	**N**	*Easement and Las Golondrinas residential development*
	E	*Adva. del Naviero and Los Tony´s beach bar*
	W	*Public car park*

All have the beaches and the Mediterranean Sea as their boundary to the south.



2
THE PHYSICAL ENVIRONMENT

2 THE PHYSICAL ENVIRONMENT

2.1 CLIMATE CHARACTERISTICS

The exceptional weather conditions around Marbella, appreciated throughout history, are reflected in those of the Reserva Ecólogica. It enjoys an agreeable temperature, consistent rainfall figures, gentle winds and high number of sunshine hours every year. The nineteenth century Spanish photographer, Madoz commented on the area: "the climate is quite peaceful in all the seasons, the winds that dominate are mostly from the East and the West..."

The weather station at Marbella, which has been recording weather conditions there since 1903, gives detailed information on the climate in the area which is influenced by its geographical location and the conditions on the coast. It defines the climatic typology, affected locally by the dominant winds in the Strait of Gibraltar and the storms in the Golf of Cadiz, as well as monitoring the easterly winds, which are mainly responsible for the evolution of the dunes, and the storms induced by them over the Mediterranean.

The climatic typology of the Reserva Ecológica corresponds to the mild pluviseasonal oceanic, the lower thermomediterranean and the lower sub-humid ombrotype bioclimates with the predominance of rainfall during the winter months.

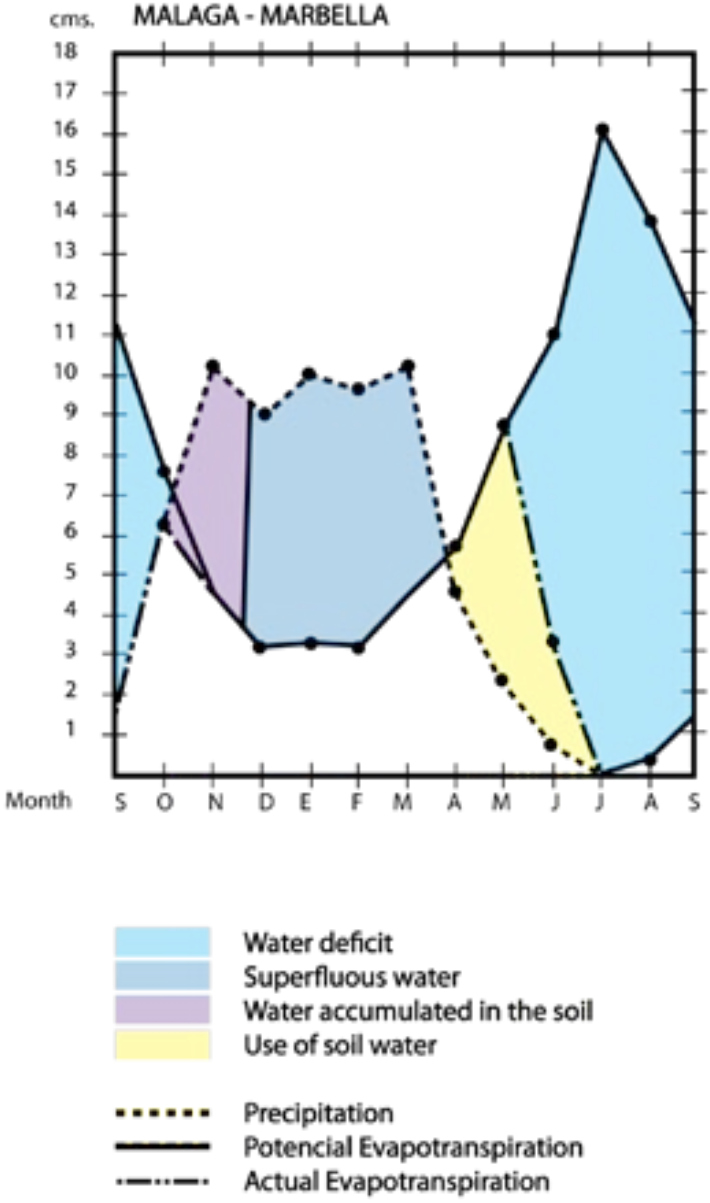
Temperatures - The climate is typically Mediterranean, with mild, wet winters and long, hot summers which are less harsh on the coast.

Average annual temperatures which are usually mild are around 18.5°C, with a maximum of between 27° and 32°C in July and August. Minimum temperature is around 13.6°C. The Sierra Blanca mountain range protects the area from cold winter winds as well as from the very hot winds from the interior in summer.

Precipitation - Rainfall is very seasonal falling in autumn and in winter. It is scarce in spring and very rare in summer. The maximum rainfall occurs in the period November – March (with 101 and 103 mm during the rainiest months), with an annual average of 649 mm of light rain with sporadic episodes of intense storms of short duration.

There is an annual water shortage (from June to October) when the risk of evapotranspiration is at its highest.

Winds - Winds in the area are predominantly levante and poniente. These are the most influential on the general dynamics of the sands, especially during the winter, when, along with high tides, they excavate the base of the dunes, eroding them with force. Their affect on the vegetation is also strong, often 'burning' the foliage with saltpetre.



(F.t.e. Cerezuela 1977)

The Levante winds are generally continuous, without gusting, with a cyclical duration (from between 3.6 to 9 days according to fishermen) and fairly strong (up to 90 km/h); the winds from the west, associated with Atlantic storms, are gusty but not so strong, changing their direction from west to northwest. The winds from the south don't have any effect while those of the north, the cold in the winter and the warm wind in the summer, are usually diminished by the Sierra Blanca and the Ojén mountains.

2.2 GEOLOGY AND TOPOGRAPHY

All the dunes in the Reserva Ecológica are formed by unvarying Quaternary deposits of quartz sand. Around the mouths of the streams, gravel and pebbles of varying sizes, most small, are incorporated, remaining hidden by the sand and clay deposited there. Occasionally, soil mixed with clay can be found in some of the dunes (El Barronal and Real de Zaragoza) and these could have been once used for agriculture. In some places, the ground and topography have been modified by the deposits of rubble and other materials that were hidden under the sand.

The current topography of the land included in the Reserva Ecológica shows a first elevation of about 2-3 metres above beach level, with an exaggerated external slope caused by the erosion of the sea, and a softer interior slope from which extends a flat area (up to 40 metres) along the length of the dunes as far as the boundary with the residential area (housing and the promenade). The larger dunes (El Barronal and Real de Zaragoza), have a succession of semi-fixed and fixed secondary dunes with a small flat area in between (El Barronal).

The origin of the dunes is due to a combination of physical factors and the typology of the beaches; The dominant marine currents, the intensity and direction of the prevailing winds and the intensity of the waves, along with the typology and density of vegetation associated with sandy areas, determine the existence of the dunes, regardless of how the beaches and surroundings were used by humans in the past.

In the Reserva Ecológica-Dunas de Marbella, the typology of the sand indicates that the majority of it comes from the Sierra Blanca and the surrounding land to the south, together with other deposits of marine and organic material brought by the marine currents. Quartzite dominates these deposits and is similar to that found on the sea floor near the coast where it is picked up in the waves and undersea currents.

According to the data provided by the Centro Meteorológico del Sur, the dominant winds are the Levante and the Poniente; their interaction with the east-west orientation of the coastline favours the formation of the dunes and has been demonstrated by special sand collectors placed by the Demarcación de Costas organisation.

The arrangement of the sand within the dunes appears to be established in a line running parallel to the coast, influenced in part by the direction of the dominant marine winds (levante); the structure of the dunes appear very altered by human activity in terms of their dimensions (height and width etc.) although the basic topology is recognisable more or less with irregular peaks, the biggest slope on the side facing the sea and the gentler slope facing the interior of the dune system. In our case it is possible to recognise the primary dune of variable height and width; with a dune valley behind, although it is camouflaged more or less by human intervention and only the El Barronal dune (and in places the Real de Zaragoza) have recognisable secondary dunes.

Of the different types or parts of dune that can be seen in well-defined systems such as Dunas de Artola the following can be seen in the Reserva:

Pioneer dunes - These have practically disappeared in the Reserva due to the heavy machinery used to clean the beach as well as severe erosion by storms. A pioneer dune is formed when a small amount of sand accumulates against a solid natural or artificial object (rubbish, a landmark, vegetation) which allows subsequent colonisation by a pioneer plant species.

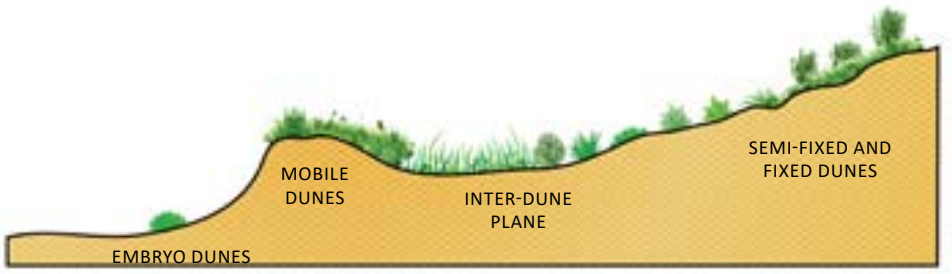
Embryo dunes - These are accumulations of sand above the tide line which form in some clump of vegetation (usually grasses such as Elymus farctus and Cyperus capitalus or a sea rocket species like Cakile maritima. As with the pioneer dunes, they are very scarce and sometimes only temporary. Today they are rarely found in any of the dunes.

2.1 Embryo dune.

Mobile dunes - They are the most common type of dune on the reserve, with a greater degree of development in height and width. They are colonised by different species of plants especially marram grasses, with accompanying pasture grasses and low scrub and some exotic species.

Semi-fixed dunes - Located leeward of mobile dunes and separated by a flat area. They are not as high as mobile dunes and have a greater cover of vegetation, some fairly dense, low scrub and even a few trees might be growing with the protection given by the mobile dunes. They are hard to find in the heart of the reserve but good examples can be seen in the El Barronal and Real de Zaragoza dunes in the central eastern part of the reserve.

Inter-dune valleys - This is the sandy, lower-lying terrain found leeward of mobile dunes or between semi-fixed dunes. It has dense areas of therophyte grassland and low scrub alongside some tall scrub and/or trees which prefer some types of soil or damp areas. These valleys have been the subject of re-population programmes with species of juniper and pine etc planted or they have been partly invaded by exotic species such as acacias.



Typical geomorphic diagram of Marbella's dunes.

2.3 THE MICRORRELIEF OF THE DUNES

Associated with the origin of the dunes, they are a result of the movement of the sand, a series of micro-formations which contribute to the value of the landscape, especially on the mobile dunes. The following are highlighted:

Rippled marks.- This is a series of parallel, wavy lines aligned transversely to the direction of the wind; they usually appear in very particular conditions, the biggest ones are spoilt by uncontrolled trampling of the sands by visitors.

Caudeyes are formed by the action of strong air currents which hollow out areas of the mobile dune eroding the top levels of sand.

Los crocs, are mounds of sand which have been colonised by grasses and other psammophytic species of vegetation.

Lastly, and formed by a series of various crocs, small mounds of sand appear with variable shape but with a marked slope towards the interior. These are called pourrieres, they are very scarce but may be found in the larger dunes such as the Real de Zaragoza.

2.4 TERRAIN

The mainly sandy composition of the terrain at the Reserva Ecológica is made up of soils called Arenosols which dominate the area, although others do appear from elsewhere (as a result of dumping of materials such as clay from excavations in the neighbouring residential developments and different types of building materials). Other types of soils of a clearly anthropogenic origin are the Anthrosols; finally in the areas close to streams and the ecotones between the streams and the dunes are found *Fluvisols*.

The *Arenosols* are azonal soils, of a sandy-loam texture, which depending on their location in the different types of dunes, and the organic material that they accumulate (more in the valleys or meadows between the dunes than on the mobile or embryo dunes) form one or more layers. In the aforementioned inter-dune valleys a greater degree of evolution of soils often occurs, with clay beds and ridges at a certain depth. In some cases, where there is very little organic material incorporated, crusting can take place under superficial pressure.

Anthrosols are soils that have originated through human activity, through the dumping of materials of different types and structures such as the tipping of waste soils from excavations, to the dumping of organic materials like rubbish and vegetation. In some dunes changes to the structure and composition of the vegetation due to tipping can be observed.

The *Fluvisols* are found occasionally in dunes which are near coastal streams, and here the soil has changed little, being of a sandy-loam and clay texture on top of a sedimentary layer which is well stratified in A/C profile showing layers of pebbles and stones in the C layer. This corresponds to material transported from the upper basins of the streams, and which becomes apparent during episodes of dune erosion caused by the action of the water during winter storms.

2.5 BEACHES

The beaches form a close association with the protected dunes in the Reserva Ecológica. Their stability depends to a great extent on the dynamic of the sand supported by the dunes. These beaches, according to the nomenclature of MIMAN are:

Playa de Río Real	*270 m long and 30 m wide*
Playa de La Adelfa	*400 m long and 40 m wide*
Playa de El Alicate	*850 m long and 25 m wide*
Playa de Los Monteros	*300 m long and 10 m wide*
Playa Real de Zaragoza	*1.700 m long and 30 m wide*
Playa de La Víbora	*900 m long and 30 m wide*

These beaches are now one of the public areas of the municipality which are used the most throughout the whole year, even in winter, due to the mild Marbella climate being popular for walks and other leisure activities.

2.2 The Rio Real beach, next to the dune of the same name.

The consequences of climate change on the marine environment are clearly affecting the stability of the beaches, with many of them reduced in width by the increase in erosion of the sands at a previously unknown rate, evident in the exposure of the coastal sewage pipes which were once buried, with some losing more than a metre of sand.

As a result in the reduction of the width of the beach, throughout the years attempts have been made to extend them by taking sand from the slopes of the dunes, especially those that seem unstable, removing sand from the artificial slopes created by landslides from high areas of the dunes. Clearly these actions, far from favouring the beach, contribute to the deterioration of the dunes, intensifying the existing environmental imbalance. For this reason, other more logical ways to protect the beaches must be found (submerged reefs for example).

2.3 El Barronal beach with hanging slopes and exposed sewage pipes.

2.6 RIVERS AND STREAMS

In several of the dunes in the Reserva Ecológica, and acting as natural boundaries to the dunes, are various streams and a river which come from basins, most small, in the Sierra Blanca and the Montes de Ojén which form part of the central-western coastal basins. The currents run from west to east.

Río Real	**Duna Río Real**
Arroyo Realejo	**Duna La Adelfa**
Arroyo Siete Revueltas y arroyo El Alicate	**Duna El Alicate**
Arroyo Sequillo y arroyo Real de Zaragoza	**Duna Real de Zaragoza**
Arroyo La Víbora	**Duna La Víbora**

Although their direct influence on the dunes is reduced to a few tens of metres in their final stretches, their role as corridors or ecological links is of great importance as it connects the dunes with other natural zones in the interior of the region.

The Rio Real, to the extreme west of the Reserva, has the biggest flow and the greates environmental value, being protected as Zona de Especial Conservación (Special Conservation Area) in the Red Natura 2000 of the European Union. With a channel width of just 34 metres, it maintains a current during most of the year which acts as a watering point for many animals including marine birds. Like the other water courses, it is constrained by developments, in this case the golf course of the same name, however it does manage to conserve a small example of the typical riparian habitats in the area.

2.4 Río Real, the most important of all the water courses in the Reserva Ecológica.

The Realejo stream, at the western end of the Duna La Adelfa, is seasonal, with plenty of vegetation dominated by a dense bed of reeds (which has even invaded part of the beach) and which includes some examples of eucalyptus, junipers, acacias and other species (pines and palms) some of which have escaped from nearby residential developments. The large, as yet un-developed, area on the left bank is of particular interest for bird-watching, especially during the migration period.

The Siete Revueltas stream has one of the largest catchment areas of the streams here, which explains the remarkable flow of water during the autumn / winter rains. At its mouth it is about 27 metres wide and is bordered by the El Alicate dune. Its ripicola vegetation is dominated by the common reed with examples of some other plant species (junipers, black poplars, oleanders, eucalyptus and acacias etc.) It has a modern walkway, partly invaded by the advance of the dune.

2.5 Arroyo Realejo wich has dense canebreaksnon either side.

The El Alicate stream is bordered to the east by the aforementioned dune. Although it has a smaller catchment area the water flows nearly continually. The vegetation here is much richer too, partly because neighbours have repopulated its banks and there are examples of acacias, junipers, reeds, poplars and pines etc. It has a metal foot path which is temporarily closed by a sand bar which helps to protect it from neighbouring construction work.

2.6 Siete Revueltas stream.

2.7The mouth of the Alicate stream and the dune of the same name.

The Sequillo stream is delimited to the west by the Real de Zaragoza dune which borders it for some 120 metres. Totally changed by human interference with various constructions on its banks such as car parks and roads, it appears to be almost completely covered by a dense reed bed with some isolated stands of pine, junipers and acacias etc. Due to its small rain catchment area it doesn't usually have much water flowing, not even in the rainy season.

2.8 View of the mouth of the Sequill stream, invaded by constructions and reed beds.

On the eastern side of the stream, at the eastern end of the dune, is the Real de Zaragoza stream, which has another of the largest catchment areas and greatest flow of water which, in storms, can increase to dangerous levels, as happened in the winter of 2016-2017, overflowing its banks and opening another channel to the sea. The vegetation along its banks is particularly interesting with a mature stand of eucalyptus and a good selection of tree species (junipers, black poplars, figs and acacias), and shrubs (oleanders, brambles). There is also a reed bed which is not quite as developed as in other streams. The final stretch of the stream is channelled by a breakwater, the mouth being relatively narrow (just 18 metres), and with a metal walkway.

2.9 The Real de Zaragoza stream with a bank of eucalyptus and reeds.

On the La Víbora dune, and forming a border at the western end (next to a beach restaurant) is the Víbora stream, enclosed between buildings and breakwaters it is very narrow (just 15 metres) and invaded by dense reed beds with a few other species similar to the other streams.

2.10 Mouth of La Víbora stream, invaded by reed beds.

3

THE LIVING ENVIRONMENT

3 THE LIVING ENVIRONMENT

Integrated into the geography of the dunes are a number of communities and species of plants and animals which are there on a permanent or transitory (in the case of the animals) basis and which take advantage of the areas resources for their existence.

Sand dune environments are known to be harsh for living organisms, the scarce organic material in the soil, the lack of cohesion and movement of the sand, the limited availability of water, the exposure to the sun and the marine winds make it hard for all living things, especially vegetation and established fauna, which need to have great strength and the ability to adapt to these conditions.

In our case, in addition to the characteristics of the physical environment other factors have to be considered. On the one hand is the high degree of humanisation of the environment magnified by the closeness of the urban developments and the existence of beach bars in the dune area as well as the degree of invasion by visitors especially during the summer months. On the other hand is the limited connection that the dunes have with other surrounding natural areas which has been reduced to the channels of streams as connecting corridors for some species).

Together with this, the various types of assault over time (the removal of sand for building work, dumping of rubble, opening up car parks, the uncontrolled creation of pathways for visitors, the invasion of exotic species from garden escapes, the proliferation of rodents, the capture of birds (finches), the massive removal of vegetation and the chopping back of large examples of dune shrubs etc) has destroyed or limited the capacity of the dunes to accommodate different species of vegetation and animals. In recent years this conditioning of the area has continued with the installation of sewer pipes that cross a large part of the dunes and the cleaning of the beaches by machinery.

With regard to natural factors, climate change (in the form of stronger storms from the east) is causing a greater loss of sand from the beaches and the erosion of the dunes by dragging the external slope towards the sea. This does not seem to be compensated by the annual contribution of marine sands.

In this context, despite the actions of humans and the determining physical-chemical environmental factors, the dune biodiversity and our system of continuing to add even more plant and animal species makes these dunes undoubtedly the best dune representation in the whole of the province together with the Dunas de Artola (Monumento Natural), the dunes of Saladillo and and Matas Verdes in Estepona, and those of the Manilva Beaches (Ecological Reserve).

3.1 VEGETATION

Identifiable by many, even the uninitiated, the Reserva Ecológica supports a unique variety of resistant plant species, adapted to withstand the harsh conditions imposed by the sandy substrate, the marine saltpetre and the general shortage of water and organic material.

In essence, the current typology of the plant communities present in our dunes are the result of the long and hard human impact on the area that has degraded the vegetation cover in many aspects and has only recently started a slow recovery. This is reflected in the increase in the number of plant species and in the density and quality of most of the plantings. In contrast, and as a result of the continued incidences of garden escapes from the neighbouring developments, a large portion of the protected area appeared to be colonised by exotic species, many of which are declared invasive aliens (IAS), and in open competition with native vegetation, at the time the Reserva was created.

Acknowledged by professor Blanca Díez Garretas (1975) in her work on the vegetation in these dunes, the area has a large community of species typical of Mediterranean dunes constituting one of the best representations in Malaga and includes, among the species found in this type of terrain, some of great interest such as *Juniperus turbinata* and *Pseudorlaya pumila.*

3.1 An example of Pseudorlaya pumila, with its characteristic flowers.

3.1.1 BIOGEOGRAPHICAL CHARACTER

Like the entire Marbella coastline, the Reserva Ecológica- Dunas de Marbella is included in the Aljíbico sector of the Provincia Costera Lusitano-Andaluza Occidental, according to the following diagram:

Kingdom	*Holartic*	**Sector**	*Algecireño-Algíbico*
Region	*Mediterranean*	**Subregion**	*Mediterráneo occidental*
Subprovince	*Gaditano-Sadense*	**Subsector**	*Marbella*

3.1.2 PLANT COMMUNITIES

In the current structure of the vegetation found in the Reserva, diverse communities are represented that are located in the area according to ecological preferences and the availability of resources (organic matter, water, etc.), or the presence of toxic elements (rubble, rubbish etc).

These communities belong to two ecological groups: psammophytic and riparian vegetation; the first group live in sandy areas and the second on the banks of rivers, streams and where there is ground water in the core of the dunes. To these native communities are added the non-native plant species (mostly invasive) which have taken over large areas, although now partly reduced thanks to the work to eradicate them by the Pro Dunas association, the Demarcación de Costas and Marbella town hall.

PSAMMOPHYTIC COMMUNITIES

Occupying the largest part of the Reserva, on the sands of the beach (where the beach cleaning machines limit their advance) to the inner limit of the bordering residential developments walkways, streets and coastal paths, various plant species, typical of sandy areas, grow in a specific pattern from the sea to the interior, taking into account the changing ecological conditions determined by the marine winds loaded with salt, the the physico-chemical characteristics of the substrate and the degree of mobility of the sand.

There are several plant communities that can be found in the sandy area:

In the frontal dunes, or in the sand accumulated closest to the beach, and with a preference to the organic material that humans leave behind or that the sea has washed up, are *Cakiletum maritimae* species such as *Salsola kali* and *Cakile maritima* (sea rocket). They have pratically disappeared as a result of the mechanical cleaning of the beach as well as by erosion by the sea although they can still be found further back inside the dunes at the foot of embryo dunes.

3.2 Embryo dunes and the crests of mobile dunes.

The embryo dunes are colonised by hemicryptophytes such as *Cypero mucronati* and *Agropyretum juncei* grasses, some of the first to colonise these sandy areas, sometimes forming clumps close to the beach. It is these that are most affected by human interference, especially when the sand is taken up by sunbeds and parasols as well as the action of keeping the beach clean and the artificial extension of the beach at the expense of the dune, not to mention the uncontrolled trampling of vegetation. The effects of storms are also apparent. Other species that dominate here are *Elymus farctus subsp farctus* (*Agropyrum junceum*) and *Cyperus capitatus*, accompanied by *Eryngium maritimum* (sea holly), *Euphorbia paralias* (sea spurge), *Cakile maritima* (European searocket), *Sporobolus pungens*, *Polygonum maritimum* (knotgrass), *Lotus creticus* (*Cretan trefoil*), *Medicago marina* (sea medick), *Otanthus maritimus* (cottonweed plant) and *Crucianella maritima* etc.

On the crests and upper parts of the mobile dunes, where the sands are more stable, *Loto cretici-Ammophiletum australis* can be found growing as well as a healthy community of hemicryptophytes such as *Ammophila arenaria*, a tall grass that forms clumps and anchors the sand. Also *Lotus creticus* (Cretan trefoil), *Otanthus maritimus* (cottonweed), *Pancratium maritimum* (sea daffodil), *Medicago marina* (sea medick), *Aetheorrhiza bulbosa* (bulbous hawksbeard), *Ononis natrix* (yellow restharrow) and *Sporobolus pungens* etc.

On the semi-fixed sands behind the mobile dunes, and on the flat areas and interior slopes of the mobile dunes to a varying extent are thickets of camephytes (small to medium sized) among which *Loto cretici-Crucianelletum maritimae* is particularily interesting. Sometimes they are mixed in with members of the communities listed previously or with herbaceous ruderal nitrophilous plants which like the increase in organic material in the substrate and therefore contribute to the fixing of the sands.
Among the species found here are: *Helichrysum stoechas* (shrubby everlasting), *Crucianella maritima*, *Scrophularia frutescens* (figwort), *Cyperus capitatus* (*capitate galingale*), *Vulpia alopecurus,* etc.

3.3 Low growing scrub of Loto-Crucianellum maritimum with shrubby everlasting.

Also in this area accompanying the anterior and growing extensively in the flat area behind the dunes are communities of ephemeral therophytic pasture, which, especially in spring, endow the area with an enormous richness due to their diversity in colour and species. *Ononido variegatae-Linarietum pedunculatae* is an annual plant that spreads among the remaining communitiesof pasture and scrubland and which has *Ononis variegata* (villous restharrow) and *Linaria pedunculata*, *Pseudorlaya pumila* (dune carrot), *Silene littorea*, *Silene nicaeensis* (shore campion) and *Malcolmia littorea* (sea stock). These are accompanied by many other species of pasture plants common on mobile dunes.

Another colony of nitrophilous grassland consisting of annual therophytes commonly found in these dunes is *Sporoboletum arenarii*, which is interspersed with the species mentioned previously and with the camephyte (scrub) *Loto-Crucianelletum maritimae*. Here the outstanding species are the grass *Sporobolus pungen*, and *Centaurea sphaerocephala* (cornflower) which form large lawns.

In a few places on the dunes (El Barronal, Real de Zaragoza) it is possible to see the remains of juniper thickets (*Osyrio quadripartitae-Juniperetum turbinatae*), with marine species of tall scrub, usually very spread out and of considerable size, dominated by *Juniperus turbinata*, *Osyris lanceolata* (African sandalwood) and *Pistacia lentiscus* (mastic). Among the other species associated with this juniper scrub, Rhamnus oleoides (black hawthorn), *Rhamnus alaternus* (Mediterranean buckthorn), *Daphne gnidium* (flax-leaved daphne stand out, accompanied by other plants such as *Asparagus acutifolius* (wild asparagus), *Phillyrea angustifolia* (narrow-leaved mock privet), *Cistus salvifolius* (Gallipoli rose), *Rosmarinus officinalis* (rosemary), *Chamaerops humilis* (European fan palm) and *Olea sylvestris* (wild olive) etc.

Riparian vegetation.- On the banks of the streams bordering the dunes are various communities of typical riverbank species, the majority are survivors of human intervention in the management of these waterways which has included the construction of breakwaters, wastewater pipes and pathways. Also, exotic species like the common reed, acacias and eucalyptus have transformed the riverbanks so much so that in some places the channels appear choked with reeds and other exotic species.

In these short stretches of water and interspersed with other species, are examples of *Polygono equisetiformis-Tamariceto africanae* (African tamarix) belonging to the Hygrophila Meso-thermo Mediterranean plant group, a group that although very reduced in numbers, is still possible to find:

Polygono-Tamaricetum africanae, found in small fragmented groups. It grows in sandy or clay soils in stream beds or rivers that maintain some water in the dry season.

Lonicero hispanicae Rubetum ulmifolii.- also somewhat fragmented along the banks of the water channels which has not been taken over by the reed beds and also in the waterchannels where *Rubus ulmifolius* (brambles) dominate.

3.4 The abundance of exotic species (reeds and eucalyptus) on the banks of the Real Zaragoza stream.

Reed beds and rushes (*Holoschoeno-Juncetum acuti*).- expanses of rushes (*Juncus acutus and Scirpoides holoschoenus*), accompanied by species of grasses and giant reeds (*Phragmites australis*).

Urtico dubiae-Smyrnietum olusatri, corresponds to plants that occupy the soil on the riverbanks, in the clearings between the reed beds or eucalyptus stands, and which include numerous ruderal nitrophilic species such as *Urtica urens* (nettles), *Ecballium elaterium* (squirting cucumber) and *Nicotiana glauca* (tree tobacco) etc.

3.1.3 HABITATS OF COMMUNITY INTEREST

According to the national classification of habitats of interest, the following have been recognised in the Ecological Reserve:

HIC 1210	*Annual vegetation on accumulated marine debris*
HIC 2110	*Embryo mobile dunes*
HIC 2120	*Mobile sand dunes with Ammophila arenaria.*
HIC 2110	*Fixed coastal dunes with Crucianellion maritimae.*
HIC 2230-0	*Dunes with carpets of Malcomietalia.*
HIC 2250	*Coastal dunes with Juniperus spp.*

Of them, the HIC 2250 is of a national level of importance while the rest are of an Andalusian level except for HIC 1210, which has no level of importance. The characteristics of the most notable habitats are as follows:

The annual vegetation on accumulated marine debris is not found often in the Reserve because of the regular, mechanical cleaning of the beaches. Produced material washed up by marine storms, they incorporate ephemeral and pioneering plant communities, adapted to such strict and extreme conditions (high salinity, substrate instability, sun and heat exposure, strong winds etc.) *Salsolo kali-Cakiletum maritimae* is one of the rarer species found in this type of location.

This Habitat of Community Interest is of mixed physiographic and phytocenological character determined by the presence of loose sand and by the typical vegetation that is found here. There is very little biodiversity with some insects, sand crustaceans and birds (gulls, shorebirds, etc.) in search of food.

3.5 A typical habitat with accumulated marine debris.

Embryo mobile dunes, these are wind-driven sand accumulations of various sizes, with or without vegetation (depending on the amount of sand deposited as it needs to be fairly low for plants to grow), that are present in a few of the dunes.

It is a mixed physiographic and phytocenological HIC, with not much plant variety. Notable plant species include: *Elymus farctus*, *Cyperus capitatus, Sporobolus pungens, Euphorbia peplis, Otantus maritimus, Euphorbia paralias, Eryngium maritimum and Pancratium maritimum* etc., enriched with species from other habitats and communities such as: *Salsola kali, Cakile maritima* etc.

Mobile sand dunes with *Ammophila arenaria*, are found in all the dune systems, depending on the particular circumstances of each one, creating a front line dune. The category has mixed physiographic and phytocenological HIC, with *Ammophila arenaria, Lotus creticus, Otanthus maritimus, Cyperus capitatus, Ononix natrix, Polygonum maritimum,* etc. They have a low biodiversity due to the environmental conditions.

The fixed dunes with *Crucianellion maritimae*, appear on stable sandy terrain closest to the interior. *Crucianella marítima* (crosswort) is charateristic of these dunes as is *Pancratium maritimum* (sea daffodil). This type of habitat is common in the Reserva being a mixed physiographic (dominant) and phytocenological HIC. The biodiversity is better here with a bigger population of dry environment insects (orthoptera, beetles etc.) and some vertebrates.

The Carpets of Malcomietalia, are annual psammophytic communities of vegetation that develop in spring, short-lived and small, they grow in the gaps between other communities of plants, woody or herbaceous. They prefer post-dune plains and soils that have a higher nutrient content. This is a mixed HIC, composed of a diverse selection of flowering species sensitive to nitrification and trampling but being replaced by other plant communities of similar requirements. It is abundant in fauna with insects and molluscs, reptiles and none nesting birds.

Coastal dunes with Juniperus spp, although this formation does not actually appear in the Reserva due to the breaking up of the communities by developments, its previous existence is indicated by the presence of the species characteristic of this type of habitat, *Juniperus turbinata* on stable sandy areas with a higher content of organic matter. It is a mixed habitat, which is present in only the best preserved dunes: El Barronal, La Adelfa and La Víbora.

3.1.4 PLANT CATALOGUE

The catalogue of plant species present in the Reserva Ecológica is wide and diverse, preserving the majority of the characteristic species and their original communities with the addition of some exotic species (sometimes invasive) and others associated with ruderal and nitrophilic environments.

Note: Consult plant catalogue (Appendix)

3.1.5 PLANT SPECIES OF INTEREST

Among the plant species present in the reserve it is worth highlighting some of them due to their scarcity at a provincial, regional or national level, their endemic condition or because they have interest as part of a group. These species include:

Juniper thicket (*Juniperus turbinata*).- In some of the most important dunes (La VÍbora, Real de Zaragoza, El Barronal etc) there are a few examples of medium sized juniper bushes whose presence have been strengthened by repopulation in recent times, helping to reintroduce them to areas from where they had been eliminated years ago.

Juniper (*Juniperus macrocarpa*).- Fruit of a erroneous introduction of garden centre specimens which were mistaken for the previous species and were planted in the La Adelfa and La Víbora dunes. The diverse specimens of the species, which can also be found in the dunes of Cadiz, are conserved as they too are an endangered species.

Linaria (*Linaria pedunculata*), is a threatened species (VU-vulnerable), that is found in small numbers inmobile sands in some of the bigger dunes (La Víbora, La Adelfa), between stands of camephyte shrubs.

3.6 Example of a juniper thicket in La Víbora dune.

3.1.6 EXOTIC PLANT SPECIES

The Reserva Ecológica has suffered the invasion of exotic plant species for years, some of which have subsequently been declared INVASORS (EEI), and have sometimes caused the collapse of native plant communities. This situation has been caused by the proximity of the private gardens in which these species are acclimatised and from which they have escaped, some have been planted in the Reserva by private individuals especially near housing developments and this has not been helped by the general abandonment of the dunes and lack of care by Public Administrations.

Studies of the Reserva have detected the following exotic species (invasive or not):

Acacia longifolia , Acacia cyanophylla, Acacia saligna	Acacias
Eucalyptus camaldulensis, Eucalyptus globulus	Eucalyptus
Agave americana Agave sisalana	Agaves
Arctotheca calendula	Cape marigold
Arundo donax	Spanish cane
Carpobrotus edulis	Hottentot fig
Ipomoea sagittata, Ipomoea stolonifera, Ipomoea indica	Morning glory
Lantana cámara	Lantana
Nicotiana glauca	Tree tobacco
Opuntia ficus indica, Cilindropuntia subulata	Prickly pear
Oxalis pes-caprae	Bermuda buttercup
Pennisetum setaceum	Fountain grass
Pittosporum tobira	Australian laurel
Yucca aloiifolia	Yucca
Phoenix canariensis, Phoenix dactylifera	Palms

Exotic species: Hottentot fig (1), Agaves (2) Yuccas (3) and Fountain grass (4)

Among these species, those which stand out for their density and spread are the following:

The acacias have been among the most widespread of all the EEI, forming large groups in some dunes (La Adelfa), and even after many attempts to eradicate them they still maintain a strong presence in the Real dunes of Zaragoza, El Barronal and Las Golondrinas.

Its ability to resprout needs constant monitoring and control in order to prevent it propagating. Three species are common in these dunes: Acacia cyanophylla (wider leaf), Acacia longifolia and Acacia saligna. Its invasory habit is made worse by its capacity to produce substances which inhibit other plants and effectively eliminates native species.

The Hottentot fig (Carpobrotus edulis), is found extensively in most of the dunes, although it is the one that has been eradicated with the most success. Native to South Africa and used extensively in gardens, it has expanded with great success by occupying large areas in the form of carpets on mobile sands, with deadly effects on other native species.

3.7 Hottentot fig, yuccas agaves andfountain grass in various dunes.

The Bermuda buttercup (*Oxalis pes-caprae*), covers the flat areas behind the dunes in a dense carpet which reaches the inner slopes of the mobile dunes.

The rest of the species are more scattered, appearing where the environment matches their ecological requirements.

Another species catalogued as EEI, with a high presence is the reed (Arundo donax), which has invaded the channels and margins of the streams in the Reserva in enormous communities, also appearing in some places in the dunes; also eucalyptus (Eucalyptus globules or E. camaldulensis) which were mostly planted in the last century, are still found inside some of the dunes (next to beach bars) but mainly on the aforementioned banks of streams.

The capacity of these species to spread has forced intensive eradication work to control them, including digging them out with heavy machinery, thus freeing large areas of dunes from their presence. It is a task that needs to be continued regularly, to avoid outbreaks. It is also essential to count on the help of neighbouring residential developments, who should avoid incorporating these species into their gardens, or dumping any gardening rubbish in the Reserva.

3.1.7 NOTEWORTHY EXAMPLES

Despite the damage suffered by the vegetation in the Reserva over time which includes some brutal deeds; the pruning and chopping back of the mature mastic and juniper bushes, (probably for firewood or to clear the view of the sea from the houses nearby. And despite the harvesting of chamomile (Helichrysum stoechas) for sale in Marbella, as well as the damage caused by the installation of sanitation pipes and extractions of sand, the dumping of rubble and the construction of beach bars and other infrastructures, the fact is that there are still exemplary specimens here which, due to their shape and size (some of them the result of authorised reforestations) can be highlighted as natural landmarks deserving of protection and recognition.

Among these examples the following are worth highlighting:

Mastic in the La Víbora dune. – A remarkable specimen, undoubtedly the largest in the Reserva in spite of being mutilated in previous years.

Juniper brush in La Adelfa dune. – a wild example of considerable size which has been lucky to survive considering the development of the land nearby.

Carob in the Real de Zaragoza dune. – This specimen is unique in all the dunes; it is a good size and with a large canopy. It was almost certainly planted at the beginning of the twentieth century and can grow to a height of six metres.

Junipers in La Adelfa dune. – A botanical curiosity; their presence in the dunes is due to an error in 2014. They are extremely healthy and are growing well.

3.8 Mastic in the Real de Zaragoza dune.

Wild olive in La Adelfa dune.- A spectacular specimen with large canopy in spite of having been pruned several times for interrupting the view of some of the owners of neighbouring properties.

European buckthorn in La Adelfa dune.- This example, (Rhamnus oleoides), is located in the meadow behind the dune and is of a considerable size although it has been pruned by someone from the residential area next to it.

African Tamarisk in La Adelfa dune.- This splendid example is unique for its size and age on the Malaga coast. It appears to have taken advantage of the high water table which brings fresh water across the dune at a depth where the roots can reach the plentiful supply.

Palms in El Barronal dune. – There are various large examples of palms (Chamaerops humilis) growing together among the clumps of high scrub in the interior of the semi-fixed dune system. They are without doubt the largest in the Reserva.

Mastics in Real de Zaragoza dune.- Various, isolated large mastics are found on the post-dune plain. Some are strange, stunted shapes having been remodelled by the sea wind in their exposed location on the ridge of the mobile dune.

3.9 Wild olive on the La Víbora dune.

3.10 Partially pruned wild olives in La Adelfa dune.

3.2 THE ANIMAL POPULATION

The structure and composition of the zoological communities in the Reserva Ecológica, appear to be affected by various factors: the ecological structure of the land, its coastal condition, its situation limited by the sea and the urban areas (which constrain it), and the size of the surface area. In fact, the connectivity of the Reserva with other natural habitats is only by way of the rivers, streams and their banks, with the remainder forming isolated islands of nature sandwiched between the houses and the sea.

These factors, combined with the extent of the vegetative cover and the intensity and frequency of human activity, also affect the development and evolution of this population; this is why the composition of the zoological community is so limited, especially in certain groups. Up until just a few years ago, small birds (finches) were regularly caught in the heart of the dunes until it was banned and not without significant protest from bird trappers. Nowadays the presence of cats, as well as rubbish, has a heavy impact on some zoological groups.

3.2.1 THE INVERTEBRATES

The population of invertebrates on the dunes is fairly large, in number as well as in species; the purity of their habitats (not affected by serious chemical pollution) and the existing vegetative cover favours this richness, although the cleaning of the beaches has eliminated some species (such as the dung beetles) from the embryonic dunes in the inter-dune valleys which are however, the preferred areas for dog owners to leave excrement.

The richness of species has still not been fully assessed, although the diversity of zoological groups is likely a consequence of the factors mentioned previously as well as the variety of habitats and the ecotone effect of the nearby landscaped areas.

The wide range of insects is especially interesting, again for the number of species and for their abundance. Among the coleoptera, the species that are typical of sandy environments dominate, especially in the grassland between the dunes although they are also found in the mobile dunes and on the external slopes. Most common here are Pimelia fornicata, sometimes in large groups which reach the footpaths where they are often killed by being trodden on or taken by cats. Not quite so abundant is *Erodius goryi*, or *Jekelius hispanus*, which is a threatened species (VU-vulnerable) and endemic of the sands along the western Costa del Sol. Other species of florivorous beetles are also present, some in good numbers.
Among the lepidoptera, which are abundantly present during the flowering season of the grasslands, several species fairly common to the coast have been noted: *Euchloe belemia*, whose caterpillars frequent various species of plants here and in adjacent gardens; *Zerynthia rumina*, found on Aristolochia plants in the tall scrub; *Pieris brassicae* is very common, with larva on brassicas in neighbouring gardens; *Colias crocea*, a few are found on the scrub of leguminous plants and *Pararge aegeria* often visit the dune grasslands etc.

3.11 Above:Snails are often found in the grasslands.
Right:Theba pissana (the most common).
Below: Cornu aspersum.

Other groups which are less represented such as the hymenoptera and the acrididae, are more plentiful in the dunes than on nearby land, presumably because there are no insecticides in use and a wider diversity of flowering plant species.

3.12 Bee (Apis mellifera).

3.13 Speckled Wood butterfly (Pararge aegeria).

Among the mollusks, which are most abundant in the vegetation of the grassland behind the dunes, several species, some which form large groups in times of drought, stand out. These species are: *Cochlicella acuta* (very scarce and thermophilic), *Xerotricha apicina*, frequently found under rocks and on the grasses; *Candidula gigaxii*, a large species, a few can be found on the grassland, under rocks and at the base of some of the exotic plants; *Xerosecta cespitum*; Theba pissana is the most common with numerous groups and which are prey for the blackbirds and other birds; a few *Cornu aspersum*, *Rumina decollata*, also very scarce with its characteristic spiral shell with blunt apex and abundant examples of *Cepea nemoralis*, among others.

3.14 The most numerous of all the species Theba pissana, in the damp grassland of the post-dune plain.

3.2.2 THE VERTEBRATES

The variety of vertebrates in the Reserva Ecológica is restricted compared to other habitats nearby (Sierra Blanca, pine forest of Elviria etc.) due to the factors mentioned previously, with many species disappearing during the years of urban development (this is the case with various ophidians including the unusual snub nosed viper, the field rabbit and all the carnivores that once lived in this environment); fish have also been affected by the extraction of water from the waterways , disappearing from most of them.

Composition and structure.

With expected annual, seasonal and daily variations, the community of vertebrates has an interesting composition, the number of different species is variable, especially birds, affected by their wandering habits and many of them influenced by spring and autumn migrations as the dunes are situated on the coastal migratory route for waders, marsh birds and passerines.

As a whole the group of vertebrates can be divided thus:

Fish	*3 species*
Amphibians	*4 species*
Reptiles	*9 species*
Birds	*60 species*
Mammals	*7 species*

The most interesting characteristics of which are as follows:

FISH - Only present in the mouths of some of the waterways, occasionally in water on the surface, and when the sand barrier has been broken by sea storms or strong floods. They are very scarce in number and species, and are affected by summer droughts and changes and cuts to the water flow as well as by contamination in some cases.

The presence of *Chondrostoma willkommi* in the Real river has been confirmed as well as some eels (*Anguilla anguilla*) and sometimes *Mugil spp.*, always in small quantities. Also, in the Realejo stream, are spawning grounds but mortality rates are high during summer droughts.

3.15 Good numbers of young C. Willkommi in the mouth of the Realejo stream.

AMPHIBIANS - Regarding the water courses, amphibians are also unevenly distributed, taking advantage of water features in the residential areas for refuge in the summer droughts. There are four species in the Reserva: the Iberian green frog (*Pelophylax perezi*), the Mediterranean tree frog (*Hyla meridionalis*), the common toad (*Bufo spinosus*) and the Iberian painted frog (*Discoglossus galganoi*), the first two are more closely linked to the waterways while the last two are much more scarce and are found there is better vegetative cover and some water, even if it's an artificial source.

REPTILES - This is one of the groups with the richest number of species, although generally population sizes are restricted. Some of them take advantage of the closeness to human habitation (houses, enclosures, infrastructure etc) although they usually prefer situations with more vegetation as there is a greater presence of food (insects, spiders) and damp soil in the ecotone area between the streams and the residential areas.

At least eight species can be found in the Reserva:

- Andalusian wall lizard *(Podarcis vaucheri)*
- Iberiam worm lizard *(Blanus cinereus)*
- Bedriaga's skink *(Chalcides bedriagrai)*
- Mediterranean house gecko *(Hemidactylus turcicus)*
- Common wall gecko *(Tarentola mauritanica)*
- Spiny footed lizard *(Acanthodactylus erythrurus)*
- Large psammodromus *(Psammodromus algirus)*
- Horseshoe whip snake *(Hemorrhois hippocrepis)*
- Water snake *(Natrix natrix)*

The Andalusian wall lizard has very low numbers and is found in isolated groups, in the ecotones between the urban areas (taking advantage of gaps in the walls and enclosures) and in the ruderal grassland dune vegetation. It is one of the species at greatest risk of disappearing from the Reserva due to the use of insecticides in the gardens and predators such as cats and rodents.

The Iberian worm lizard *(Blanus cinereus*) is frequently found in areas with more humid soils with a higher content of clay, at locations further inland and in the ecotone on the banks of the streams and other places with water.

Bedriagai's skink *(Chalcides bedriagai)* although scarce, appears to be more abundant than previously thought, especially in the clumps of Hottentot fig *(Carpobrotus edulis)*, and in areas where the soil has a higher organic and moisture content.

3.16 Eslizón ibérico joven (duna La Adelfa).

Both the Mediterranean house gecko (very scarce) and the common gecko, are present wherever there are any sort of buildings (walls, huts, houses, beach bars, wells etc) although both are scarce due to human persecution, predators and the use of insecticides.

The sand lizard is found in more untouched areas, having been wiped out elsewhere by machinery cleaning the beaches and by predators. Without question, it is one of the most important species in the ecosystem of the dunes.

The large Psammodramus is found where there is dense pasture vegetation and low scrub in the flat areas between the dunes as well as in the interior of the semi-fixed dunes (El Barronal dune).
Although their numbers are few, they appear to be more abundant than other lizards.

3.17 The large psammodramus lizard, in grassland, low scrub and in mobile dunes.

The horseshoe whip snake is occasionally found in zones that have access to the surrounding area or have good vegetation cover and sometimes in the gardens of residential properties. They are never very numerous and are usually young specimens that have been drawn to new territory by the presence of rodents.

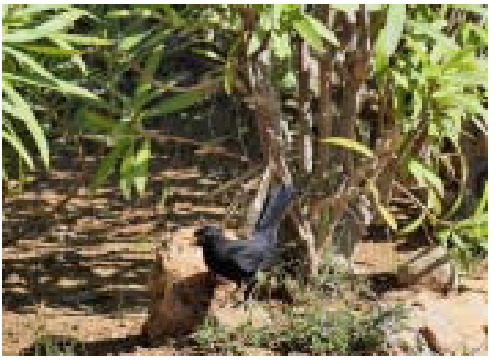
And finally the grass snake which is always found near the waterways where it can take advantage of the abundant resources of these areas. There are not many and their numbers are affected by periods of drought when the waterways dry up.

BIRDS - Like most natural species, birds make up the vertebrate group with the largest representation, in both species and numbers, in the Reserva Ecológica-Dunas de Marbella. The characteristics of the Reserva are attractive for certain groups of birds due to the proximity of the residential areas, which draw typical garden birds, and its location close to the sea for the aquatic and marine species as well as the migratory species that use a route along the coast. As a consequence it is possible to see a large number of species, up to 60, which is higher than one would expect for the size of the Reserva:

SPECIES	STATUS	ABUNDANCY	HABITAT
Cattle egret	*Transient*	*Scarce*	*Río Real, grassland*
Grey heron	*Transient*	*Very scarce*	*Río Real*
Mediterranean gull	*Transient*	*Frequent*	*Beaches*
Black-headed gull	*Visitor, over-wintering*	*Abundant*	*Beaches*
Lesser black-backed gull	*Over-wintering*	*Frequent*	*Beaches*
Kentish plover	*Transient*	*Scarce*	*Beaches*
Little ringed plover	*Visitor, over-wintering*	*Scarce*	*Beaches*
Dunlin	*Visitor, transient*	*Not scarce*	*Beaches and rivers*
Sanderling	*Visitor, transient*	*Scarce*	*Beaches and rivers*
Common redshank	*Visitor, transient*	*Scarce*	*Beaches and rivers*
Common sandpiper	*Visitor, transient*	*Scarce*	*Beaches and rivers*
Black-winged stilt	*Visitor, transient*	*Scarce*	*Beaches*
Little owl	*Sedentary*	*Scarce*	*Scrub*
Eurasian scops owl	*Summer*	*Scarce*	*River banks*
Common kestrel	*Sedentary*	*Scarce*	*In flight*
Stock dove	*Transient*	*Scarce*	*In flight*
European turtle dove	*Summer*	*Scarce*	*Trees*
Eurasion collared dove	*Sedentary*	*Scarce*	*Urban trees*
Common swift	*Summer*	*Frequent*	*In flight*
Pallid swift	*Summer*	*Scarce*	*In flight*
Common house martin	*Summer*	*Frequent*	*In flight*
Barn swallow	*Summer*	*Scarce*	*In flight*
Eurasian crag martin	*Visitor*	*Scarce*	*In flight*
Woodchat shrike	*Sedentary*	*Very scarce*	*Scrubs and woodland*
European bee-eater	*Transient*	*Scarce*	*In flight*
Common kingfisher	*Transient*	*Scarce*	*Rivers*
Eurasian hoopoe	*Summer nesting*	*Scarce*	*Scrub and wooded pasture*
Crested lark	*Sedentary*	*Scarce*	*Pasture and low scrub*
Meadow pipit	*Sedentary*	*Very scarce*	*Tall scrub and streams*
Yellow wagtail	*Transient*	*Very scarce*	*Grassland and streams*
Grey wagtail	*Transient*	*Very scarce*	*Grassland and streams*
White wagtail	*Over-wintering*	*Frequent*	*Grassland and habituated areas*
Common chiffchaff	*Over-wintering*	*Scarce*	*Scrub, streams, urban areas*
Willow warbler	*Over-wintering*	*Scarce*	*Scrub, streams, urban areas*
Cetti's warbler	*Sedentary*	*Scarce*	*Streams and tall scrub*
Sardinian warbler	*Sedentary*	*Scarce*	*Scrub and streams*
Eurasian blackcap	*Sedentary*	*Frequent*	*Scrub and streams*
Dartford warbler	*Sedentary*	*Scarce*	*Scrub and streams*

SPECIES	STATUS	ABUNDANCY	HABITAT
Spotted flycatcher	*Over-wintering, visitor*	*Scarce*	*Scrub, grass and woodland*
European pied flycatcher	*Over-wintering, visitor*	*Scarce*	*Scrub and woodland*
Common blackbird	*Sedentary*	*Abundant*	*Grassland, scrub and urban areas*
African stonechat	*Sedentary*	*Scarce*	*Grassland, scrub*
Black wheatear	*Sedentary*	*Very scarce*	*Urban areas*
Black redstart	*Over-wintering, visitor*	*Scarce*	*Grassland and scrub*
Common redstart	*Visitor*	*Scarce*	*Grassland and scrub*
European robin	*Over-wintering*	*Not scarce*	*Everywhere*
House sparrow	*Sedentary*	*Frequent*	*Urban areas*
European greenfinch	*Sedentary*	*Frequent*	*Scrub and woodland*
European serin	*Sedentary*	*Frequent*	*Scrub and woodland*
Common linnet	*Sedentary and*	*Scarce*	*Grassland, scrub and woodland*
Eurasian siskin	*Over-wintering*	*Scarce*	*Grassland, scrub and woodland*
European goldfinch	*Sedentary and visitor*	*Frequent*	*Grassland, scrub and woodland*
Common chaffinch	*Over-wintering and visitor*	*Scarce*	*Scrub and woodland*
Common starling	*Sedentary*	*Scarce*	*Urban areas*
European starling	*Over-wintering*	*Scarce*	*Urban areas*

3.17 Sardinian warbler.



3.18 Common blackbird.

3.19 Black redstart.

3.20 Barn swallow.

3.21 European greenfinch.

3.22 Jilgueros.

MAMMALS - The restricted size of the Reserva, the distribution of the small zones, their almost total isolation from other natural environments (except for the rivers and the Real de Zaragoza dune), and the proximity of the urbanised areas, plus the human activity in the dunes, have a very obvious affect on the mammal population and interfere with the trophic network. As a result, there is a low number of mammal species in the Reserva, with around seven stable species and sporadic visits by others species such as wild boars or otters, looking for food.

These species are as follows:

SPECIES	STATUS	ABUNDANCY	HABITAT
Etruscan shrew (*Suncus etrusca)*	*Sedentary*	*Very scarce*	*Scrub*
Greater white-toothed shrew (*Crocidura russula)*	*Sedentary*	*Scarce*	*Scrub*
Pipistrelle bat (*Pipistrellus pipistrellus*)	*Sedentary*	*Frequent*	*In flight*
European rabbit (*Oryctolagus cuniculus)*	*Sedentary*	*Very scarce*	*Scrub*
Wood mouse (*Apodemus sylvaticus)*	*Sedentary*	*Frequent*	*Scrub, riverbanks*
House mouse (*Mus musculus)*	*Sedentary*	*Abundant*	*Human environments*
Brown rat (*Rattus norvegicus)*	*Sedentary*	*Abundant*	*Riverbanks and human environments*

Occasionally specimens of the red fox (*Vulpes vulpes*) have been sighted, as well as the common weasel (*Mustela nivalis*) and European hedgehog (*Erinaceus europaeus*), which are normally not found in the Reserva.

3.23 Rabbit droppings in La Adelfa dune.

SPECIES OF INTEREST

Of all the animal species that populate the Reserva throughout the year, some are worth highlighting because they are a threatened species, are very low in numbers and rare at a provincial level, or for their role in the functioning of the trophic network in the ecosystem of the dunes. These species are:

The spiny-footed lizard (Acanthodactylus erithrurus) . Catalogued as being of special interest, its presence here indicates the high level of conservation of the sandy habitats. Mainly an insectivore, it also consumes other groups such as spiders, earth worms, nematodes etc. Due to its scarcity in the Reserva, special protected areas should be created for it.

The common kestrel (Falco tinnunculus). It is the main predator in the Reserva, with at least two established pairs which nest in the neighbouring residential areas. Its hunting areas are the dunes and further afield. They eat a variety of small rodents, lizards and insects (beetles).

3.24 Sand lizard.

3.25 Dung beetle.

3.27 Chameleon.

3.26 Common kestrel in flight.

Dung beetle (Jekelius hispanus). Coleoptera coprophagia, endemic to the south and east of Spain and distributed exclusively on dune systems or sandy soils, is found in one of its few remaining habitats along the coast from Estepona to Malaga. It specialises in rabbit droppings which nowadays are scarce and restricted to three locations (La Adelfa, El Barronal and the Real de Zaragoza dunes).

The Common Chameleon (Chamaeleo chamaeleon). This is a protected species. Although there are no data on recent sightings of chameleons inside the boundaries of the Ecological Reserve, they were spotted in the very recent past. For this reason several reintroduction experiments have already been carried out nearby in well-preserved areas such as the Natural Monument "Dunas de Artola" in Cabopino to see if they could adapt to the environment and, if so, to continue releasing them in the different dunes of the Ecological Reserve along the coast.

4

THE HUMAN ENVIRONMENT

4 THE HUMAN ENVIRONMENT

4.1 A LITTLE HISTORY

Integrated in the heart of an extensive urban area, the rosary of small dunes that make up the Reserva Ecológico has been in intimate contact with the evolution of the human population on the Marbella coastline since ancient times, although the relationship has changed considerably in intensity and in typology.

Until the 1960s, there were hardly any fishermen and a few hunters and farmers, who ventured into the then natural formations, accessing the dunes in an almost accidental fashion from the fossil dunes of pine and cork forests and some olive groves, which extended throughout the vicinity to the north. It would be the start of the tourist boom on the coast which would propel the increasing urbanisation of this area and, by extension, the majority of the dune system.

Aerial photographs of the coastline taken at the time are graphic witnesses of the progress of the aggressive urban invasion, which was exacerbated by the use of the sand as construction material, and the area as a dumping ground for rubble from the building works going on around the dunes. This all contributed to the deterioration of the dunes which lacked any effective protection by the coastal authority, becoming an easy conquest and generating huge profits from urban development compared to others projects.
Besides the development of the residential areas, another phenomenon which arrived somewhat later started to occupy the area of the dunes: the beach bars, which were introduced as an element of convenience for the bathers. The success of these beach restaurants, their acceptance and profitability, drew more and more establishments to be constructed in different areas, in many cases occupying the land of the dunes and increasing the destruction of the dune system with the addition of car parks, gardens, warehousing and storage facilities for materials, sun beds and parasols. The Coastal law of 1970 was the first law which allowed the regulation of the sector in some way.

In spite of this law, the urban development model implemented on the Marbella coastline increased pressure on the dunes, without reserving any areas of scenic or natural interest or any public green zones; sufficient parking areas were also not considered. This, plus a notable laxness in applying the law to regulate the beach bars and the boundary of the dunes, led to a state of constant and progressive destruction leaving the dunes in grave risk of disappearing altogether.

Most of the damage had already been done and there was barely any possibility of preventing the degradation of the area resulting from its occupation and misuse, to which was added the rapid and unstoppable natural expansion of exotic plant species (invasive or not). Undoubtedly it was the social action, led by the members of the Associación ProDunas which, since 2003, has promoted a change in the dynamics. It incorporated in a petition a request for a system of integral protection for the dunes, which crystallised in 2014 with the request by Marbella town hall to the Junta de Andalucía to create the Reserva Ecológica.

With the current legal situation of the dunes which, with their new status of protection are the object of greater attention by the public authorities, a new strategy for these residual spaces is slowly being incorporated which translates into investments and works to correct the impact on the natural resources. The Plan Técnico which has been added to the constitution of the Reserva Ecológica with various planned actions, will without doubt, guide the transformation of this natural area.

4.2 ELEMENTS OF HISTORICAL INTEREST

Due to their location and natural characteristics, which are not conducive to productive agricultural or livestock use, the human occupation of these dunes has never been intense (until the urban development from the 1960s), a situation aggravated for centuries by the permanent insecurity of the coastline; therefore the presence of historical elements in the area is very low, of interest are the following:

- Watchtower of Río Real
- Phoenician settlement of Río Real
- Guardia Civil headquarters of Real de Zaragoza
- Torre del Lance de las Cañas
- Watchtower of Torre Ladrones

The watchtower of Rio Real, is located on a coastal hill near the right bank of the river. Of cylindrical structure and made of ashlar, it was built in 1575, ceasing to be used after the War of Independence. It reaches a height of 10.85 metres and a circumference of 22 metres, with access from its northern side some 6.5 metres from the ground. It consists of a solid lower part, a chamber with a small rectangular opening to the south and a staircase leading to an upper roof, with a lowered parapet to the south; it preserves three of the four symmetrically placed machicolations.

4.1 Río Real tower.

The Phoenician settlement of Río Real, located in the gardens of the Rio Real residential development, near to the watchtower, is a small village with adobe dwellings, compacted floors with stone plinths attached with mud, the corners of which were joined at right angles, and dating from the 7th century BC, perhaps even earlier, it was extended (6th to 4th centuries BC) and then abandoned in the 1st century BC. It is possible there was a necropolis associated with this settlement on the opposite bank of the river in the area of Los Monteros (as concluded by the discovery of remains, including a Cruz de Negro vessel). What can be seen is what was saved from destruction after the whole area was taken over by the development and is surrounded by a fence inside a landscaped area.

Headquarters of the Guardia Civil in Real de Zaragoza.- Closet to the dune of the same name, and about 325 metres from the coast is this building, now abandoned, with two floors and two small wings at the back characteristic of this type of building from the beginning of the twentieth century. Still in a good condition, it could be useful as a base for the Nature Classroom proposed by the Asociación Produnas for environmental education activities. It can be visited with permission from Marbella town hall.

The Torre del Lance de las Cañas, on the Las Chapas beach, constructed in the eighteenth century, is a masonry tower in the shape of a hoof with brick corners and decoration. It is 1.85 metres high by 53.13 around the perimetre, with two floors and roof for artillery: the entrance is six metres up on the right spur and inside the lower floor has a powder magazine, storeroom and staircase to another room.

4.2
Below right: *Río Real Phoenician settlementl.*
Above right*: Torre Lance de las Cañas.*
Above left: *Torre Ladrones.*

4.3 Headquarter of the Guardia Civil in Real de Zaragoza

La Torre Ladrones, outside the reserve, near Punta Ladrones and the Natural Monument the Artola dune, is of Arabic construction, reaches 14 metres high and has a square footprint and a reinforced base of remarkable proportions. It has three rooms and an upper roof area, with machicolations for protection and an interior staircase.

4.3 OTHER CONSTRUCTIVE ELEMENTS

As a result of diverse human activities, the nature of the dunes is affected by a series of infrastructures which serve a purely functional solution to various problems. These elements

• **Drains for the sewage impulsion pipes.–** These are old pipes that cross the coast carrying wastewater to the treatment plant. Their age and the action of the sea due to the evident climate change, is causing system failures with breaks in the pipes and leaving part of the sewers exposed. It is planned to move them out of the immediate area in order to safeguard the coastline from possible leaks of pollutants and also improve its performance.

• **Sewage pumping station.-** Located at the centre of the Real de Zaragoza dune in its western part, this is a small installation that pumps the wastewater through the coastal pipeline as well as the wastewater which arrives through the pipelines from nearby residential areas. It is planned to move it further north (outside the Maritime Terrestrial Public Domain).

4.4 Sewage pumping station.

- **Red Cross point. -** Also located in the Real de Zaragoza dune, next to the mouth 5 of the Sequillo stream, is a first aid point for the support of the holidaymakers at the beach. The location is in an area at risk of flooding and it should be moved to a more suitable position.

- **Towers for the lifeguards.-** They are situated at various points along the beaches. They provide support for bathers and beachgoers.

- ***Toilet facilities.* –** Public toilets can be found at several places (and near the beach bars).

- ***Rainwater conduction.-*** In the centre of the Adelfa dune is an open canal which cuts across the mobile dune to drain off rainwater collected from the nearby residential areas.

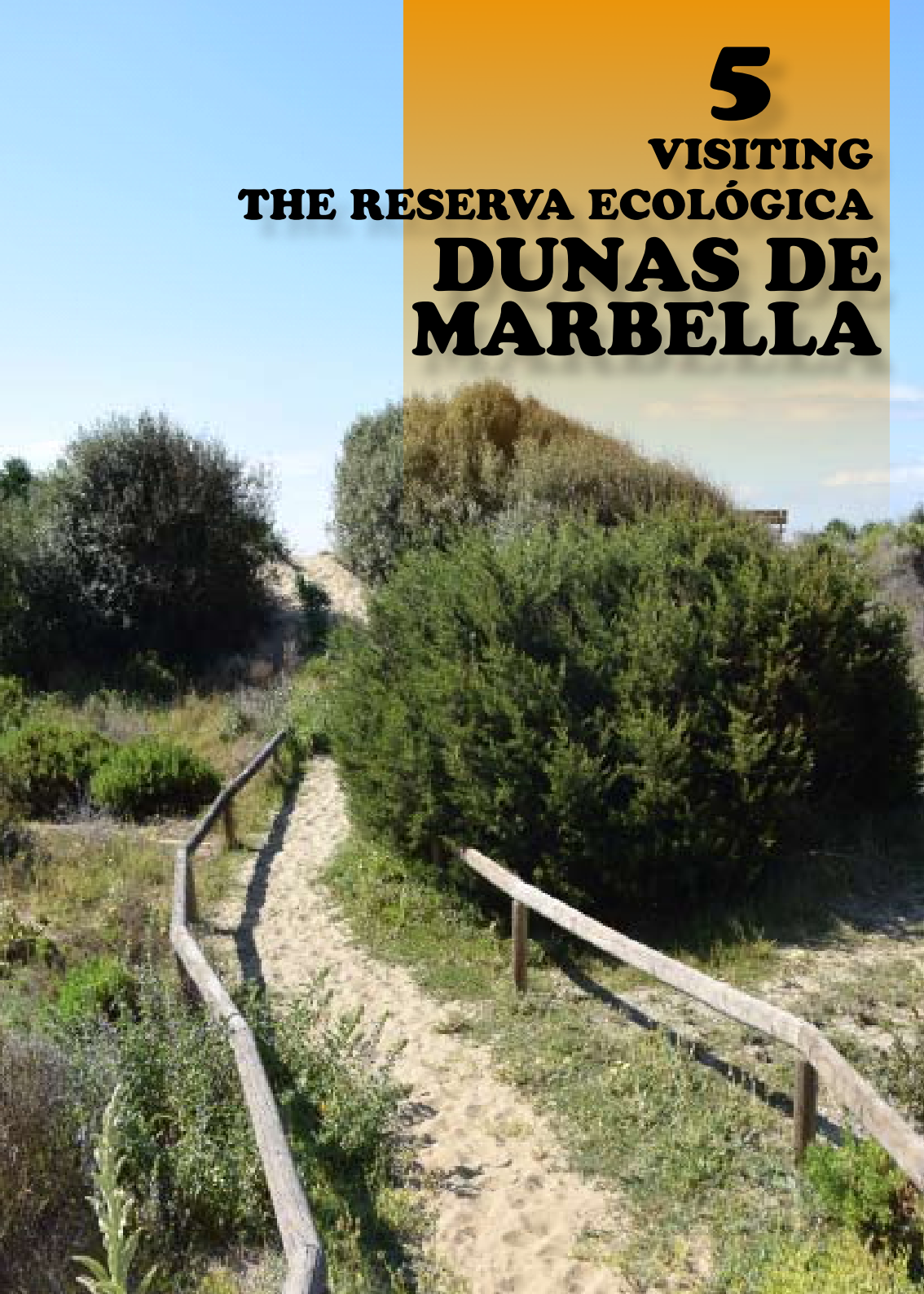
4.4 Kiosk.

4.5 Toilet facilities.

4.6 First Aid point.

5

VISITING THE RESERVA ECOLÓGICA DUNAS DE MARBELLA



5 VISITING THE RESERVA ECOLÓGICA DUNAS DE MARBELLA

It is often commented that Marbella lost the opportunity to take advantage of its exceptional natural (and archaeological) heritage by not carrying out an urban development plan that respected the valuable natural environment of the dunes. Many who visited Marbella in the 60s remember with nostalgia the impressive dune system on the coast, from close to the town centre to the border with Mijas, in which the natural wealth and beauty of the landscape was practically untouched along with the extensive pine groves, cork oak woodland and fossilised dunes.

However, the remnants of that beauty, which today we preserve in the Reserva Ecológica, still maintain many of the values that were once part of the dune system; although nowadays constrained by the closeness of the urban zone, they continue to act as green spaces adding value and quality to the prestige of the developed areas.

To enjoy without harming should be the motto for every visitor to this natural jewel. Everyone should act in accordance with the Plan Técnico of the Reserva Ecológica, using the system of walkways (which will be floating in order to allow the natural movement of the sand, the flora and fauna) which connect the urban areas with the beach and respecting the protective fencing around the different dunes.

The construction of the Senda Litoral (Coastal path) planned by the Provincial government through the Reserva will give more awareness and cohesion and reaffirm the objective of "looking and admiring without harming".

Like any coastal area, the Reserva must be able to coexist with responsible human use, subject to the conservation of its resources, which implies total or partial restriction of some uses such as indiscriminate access to the interior of the dunes, its use as an area for exercising dogs or the introduction of exotic species from nearby gardens. Likewise, the educational potential of this natural environment should be expanded, in order to make everyone aware of the need for the conservation of their.

5.2 VISITING CONDITIONS

To apply the rules established in the resolution to create the Reserva Ecológica, and those deriving from the Coastal and Natural Heritage Protection regulations, there should be obligatory guidelines established which define the nature and extent of the leisure activities that take place in the heart of the dune system.

From the laws already in existence it is possible to summarise:

AUTHORISED RECREATIONAL ACTIVITIES

In the protected area, recreational activities related to bathing and relaxing on the beach, fishing from the coast, walking and resting in the areas delimited for it, are authorised, as are passage across the footbridges and temporary pathways established within the various dunes.

ACTIVITIES NEEDING AUTHORISATION

In order to improve the integration of the different activities with the sustainability and protection of the natural resources, the following activities are subject to previous authorisation by the managing body:

- The pruning of trees and bushes.
- The collecting of examples of vegetation (including flowers, cuttings, fruits and seeds etc) and/or animals.
- Driving through the dunes in official vehicles.

PROHIBITED ACTIVITIES

The following activities are prohibited in the dunes:

- Driving any motorised vehicles or bicycles outside the pathways or footbridges.
- Hunting in general and especially the capture of wild finches.
- The tipping of rubble or garden waste.
- Lighting fires, including bonfires.
- Allowing dogs to run off the lead in the Reserva.
- People walking off the designated footpaths or walkways.

5.3 PROVISION OF INFRASTRUCTURES FOR PUBLIC USE

Distributed throughout the dunes are various facilities provided to assist the public which also help to protect natural resources. It is everyone's responsibility to use them properly and look after them.

There are various types of facility:

Carparks.- Behind the dunes there are various carparks for public use.

Walkways.- Built into several of the dunes are wooden (or concrete) walkways on the sand which enable access from the pedestrian footpaths to the beach, sometimes crossing mobile dunes. Occasionally they are marked with wooden posts to stop people from straying from the path.

Footpaths and pedestrian walkways.- Of different configurations and sizes, some of the dunes (e.g. La Víbora, La Adelfa, etc.) have pedestrian walkways that run along the rim of the dunes; in other cases (El Alicate, Real de Zaragoza, Río Real), these paths are on the ground.

Hopefully in the near future, all the dunes will be part of the Senda litoral, which the Malaga Provincial Government has been constructing along the whole of the Malaga coastline, and which will help to conserve the dunes and control the occasional damage from indiscriminate trampling.

Viewpoints.- Areas with benches and other seating structures will be created so that visitors can sit and enjoy the landscape.

Beach bars. – All the dunes in the Reserva have beach bars which attract visitors to the area all year round.

Other facilities.- The protected area contains other elements related to the safety of bathers in various places, especially during the summer months such as watchtowers and Red Cross points.

Information boards.- Various posters and information boards have been erected in the Reserve providing information for visitors. The Reserva Ecológical posters and the information on its natural resources stand out as they are part of the programme "Dune sponsorship by schoolchildren", promoted by the ProDunas Association.

Identification signs.- The dunes are identified by way of identification signs placed at the main accesses to them, as a reminder that the dunes are protected by law.

5.4 ITINERARIES

In order to promote in-depth knowledge of the natural resources found in or connected to the protected dunes, and in particular the formation and operation of these interesting ecological systems, these itineraries have been designed, and their use strongly recommended, to ensure a complete overview of the different dunes and their resources.

There are nine itineraries in total, one for each dune:

Itinerary 1.- Duna Río Real
Itinerary 2.- Duna La Adelfa
Itinerary 3.- Duna El Alicate
Itinerary 4.- Duna El Barronal de la Morena
Itinerary 5.- Duna El Arenal
Itinerary 6.- Duna Real de Zaragoza
Itinerary 7.- Duna La Víbora - Oeste
Itinerary 8.- Duna La Víbora - El Laurel
Itinerary 9.- Duna Las Golondrinas

ITINERARY 1
DUNE AND MOUTH OF THE RIO REAL

ITINERARY 1
DUNE AND MOUTH OF THE RIO REAL

Itinerary

The itinerary gives information on two very different but complementary ecological areas: the dune system and the fluvial system of the mouth of the Real River (designated by the EU. Special Conservation Zone - ZEC), incorporating in the same the visit, two cultural heritage elements of great interest: the Phoenician site of the Río Real Urbanisation and the tower of the same name.

Location of the itinerary.

Diagram of the dune system.

Starting point

Both ends of the itinerary can be reached from the A-7: from the Rio Real Urbanisation exit, at the Torre Rio Real overpass, and then descending to the beach and the car park. You can also take the exit to the Urbanisation Los Monteros Playa, following Calle Los Cipreses and then Avd. Ignacio Coca, where there is another carpark.

The itinerary characteristics

Name	*Duna Río Real*	**Type**	*Circular*
Length	*1.300 metres*	**Duration**	*1 h 15 minutes*
Difficulty	*Low*	**Best season**	*All year*

What to discover:

- The basic charcteristics of a dune system
- Dune vegetation, introduced exotic vegetation and associated fauna
- The effects of human activity on the dunes
- The mouth of the Real River (ZEC)
- History of the occupation of the area
- Torre Real and the Phoenician settlement

The itinerary can be started from Calle Ignacio Coca, heading to the east, following the protective fence around the dune and oleander *(Nerium oleander)* hedge until you arrive at the eastern side of the dune next to a fence around building work de la duna junto a un cerramiento de obra. Cross the dunes towards the beach and observe the vegetation here in this corner of the dunes with beautiful Pinos pinea and the dune rim, walk down to the beach in order to see the whole of the exterior slope and its characteristics. Continue towards the west at the foot of the dune until you reach the Palm Beach bar and then take the pedestrian path to the mouth of the Real River. You'll see here the coastal sand bar that cuts off the river. Crossing the bridge, continue along the other side of the river and onto the road to the Río Real residential development until you reach the Phoenician settlement. Above is the Río Real tower. Turning back to the river and crossing the footbridge, go back by the foot of the dune to the Palm Beach bar. Then return to the interior of the dune by the path next to the residential development until reaching the beginning of the route and the carpark.

ENVIRONMENTAL ELEMENTS

In the course of this visit we can see the following different formations:

- The grasslands of post-dune plain
- Mobile dunes
- Dune slopes and embryo dunes
- Scrub growing on the sand
- The mouth of the river

Distribution of the environmental aspects.

1. The post-dune plain

A wide plain extends between the houses and the mobile dune, covered with dense vegetation made up of a variety of species depending on the characteristics of the soil and the time of year; it is dominated by the invasive Bermuda buttercup (Oxalis pes-caprae). In autumn-spring there are other native plants, among them euphorbias and grasses, which are associated with species typical of sand dunes and communities of mainly ruderals with a significant nitrophilous element. It was once colonised by invasive exotic species (Hottentot fig, acacias, mountain tea, yuccas etc) most of which have been removed by Asociación ProDunas volunteers, Marbella town hall and the Demarcación de Costas.

5.1.1 The eastern grasslands of the post-dune plain.

In this dense vegetation, sometimes over 30 cm tall, insects and snails proliferate and with them, their predators. These include reptiles (spiny-footed lizard, Bedriaga's skink) and birds, some already settled and nesting (like the Crested lark), but the majority just visiting in search of food.

In the centre of the plain, the vegetation cover decreases leaving large bare areas casued by the elimination of exotic species and the pollution of the soil with rubble and other rubbish. Closet to the pedestrian footpath there is another area of nirtrophilic ruderal grassland.

5.1.2 Central area of the post-dune plain, with ruderal nitrophilous grassland next to fence.

In the westernmost sector of the plain, the existing path protects the vegetation that appears more developed, including low scrub (natural and repopulated) that reaches the internal slope of the mobile dune. The grassland is dense, with a great diversity of species, having been repopulated with junipers, junipers, mastics, palms and brooms. Highlighted here is the presence of several palms (adult date, canary and washingtonia).

2. The mobile dune

Occupying a narrow strip averaging 16 metres wide, the mobile dune extends from the fence of the residential development Los Monteros Palm Beach, to the river; it has an average height of 3 metres above the beach with a rounded top and very steep slope at its eastern end, less marked along the rest, with some gaps partly caused by the elimination of exotic and other species. There are many typical dune micro-reliefs and the large accumulation of sand at the eastern end is significant.

The plant species include European marram grass, sea thistle, various grasses, European sea rocket, sea daffodil and many others, generally in low densities. There are still some examples of exotic species such as palms. There is a significant presence of beetles in the area, together with a few scarce examples of sand lizards and birds which hunt for food throughout

3. The dune slope and embryonic dunes

From the beach, the slope of the dune has a changing morphology along the entire dune front: at its eastern and western ends.

The accumulation of sand favours the colonisation of hardy plant species which are adapted to the conditions of the environment. The very steep dune slope has less vegetation cover, while the presence of insects and vertebrates is scarce; despite being protected and roped off, there is frequent trespassing and trampling without respecting the established paths, damaging the mobile dune.

5.1.3 View of the mobile dune and plain next to the mouth of the Real River.

4. The mouth of the river

A designated Special Conservation Zone (ZEC) by the EU, the Real River, typical for this part of the province, appears to be channeled in its final stretch to the beach by the sand bar formed by the Levante and Poniente winds. In the lower stretch, the riverside vegetation lacks trees and shrubs and is dominated by meadows of nitrophilous grasses and reeds; in large bodies of filamentous algae live in the water, with significant populations of amphibians (common frog, Mediterranean frog, etc.), as well as small schools of fish (mullets and Iberian nase).

This area is a point of ornithological interest because of the numerous birds that use it as a watering hole and resting area, especially in times of migration, including herons, cattle egrets, kingfishers and other waterfowl and seabirds, as well as many perching birds that are in transit.

5.1.4 Kingfisher.

5.1.5 End of the area with water in the Real River.

5. The human environment: the historical elements

In addition to the beach bar, the pedestrian walkway and the footbridge, other human elements of certain interest are on the itinerary: From the mouth of the river, along the road on the left bank, two cultural elements of interest can be visited in the Río Real Urbanisation: the Phoenician settlement and the Torre de Río Real (Torre Real), whose characteristics have been explained above.

Afterwards, we return to the footpath, cross the river and return along the river bank to the beach to see the eastern dune slope. When we reach the Palm Beach bar, we return to the path next to the Urbanisation and continue towards the east; two majestic specimens of cypress *(Cupressus arizonica)* are planted next to the beach bar and are unique in the Reserva.

ITINERARY 2
DUNE AND MOUTH OF THE ADELFA

ITINERARY 2
DUNE AND MOUTH OF THE ADELFA

Itinerary.

The Duna La Adelfa, also known as Bahía de Marbella, is one of the largest and best preserved dune systems and extends from the mouth of the Realejo stream to a privately owned property to the east which encloses it, invading the Dominio Público Marítimo-Terrestre (Maritime-terrestrial Public Domain).

Location of the itinerary.

Diagram of the dune system.

Access to the start

Due to its length, access can be obtained from the A-7, via the entrance to the Urbanización Bahía de Marbella, and then by way of several roads: the Alameda de Las Brisas, the Alameda del Presidente the Alameda del Mar and the Alameda de Levante, as far as the roundabout and then via the Avda. de Reina Sofía.

Characterists of the itinerary

Name	*Duna La Adelfa*	**Type**	*Circular*
Length	*1,500 metres*	**Duration**	*1 h 50 minutes*
Difficulty	*Low*	**Best season**	*All year*

What to discover

Objectives.
The following can be noted at this dune:

- The peculiarities of the dune system
- The natural vegetation in its various forms
- The fauna associated with the dune
- The effects of human activity on the resources

The length of the dune makes it advisable to start at either end as it is easy to cross the majority of it in comfort by using the existing coastal path and then heading towards the beach on one of the footpaths, continuing the itinerary along the fot of the slope until you reach the other end. It is also possible to make shorter, partial itineraries. The dune appears to be cut into sections due to the roundabouts built to control the traffic.

ENVIRONMENTAL ELEMENTS

The formations asscociated with this dune are as follows:

- The Realejos stream
- The human environment
- The low psammophytic scrub
- The post-dune pasture
- Water points
- The mobile dune
- The dune slope and embryo dunes

Distribution of the environmental aspects.

If we take the parking of the El Mangaleta beach bar as the starting point, we first come to the area by the Realejo stream.

1. The Realejos stream

With the characteristics already described above, a mobile dune of good height appears at the western end of the left bank, with diverse dune vegetation including low scrub that reaches to the stream. Only during heavy rains does the stream break through the coastal barrier and drains into the sea. The banks include, in addition to eucalyptus and acacias, a dense field of cane, expanding along the sands of the beach, creating a closed system where amphibians, fish and birds can sheltered, rodents are present as well, due to the abandonment of rubbish. The erosion of the dune adjacent caused by the force of the stream flooding, is evident and has left the sanitation pipe exposed along the coast.

5.2.1 Vegetation of the dune along the banks of the Realejo stream.

5.2.2 Way out to the beach of the Realejo stream.

2. The human environment

The residential areas along the northern limit of the dune, the El Mangaleta beach bar (unique construction, with a landscaped area) and the presence of a pedestrian promenade (partially unfinished) are the most significant human elements. The future Coastal Path will run along the southern edge of the residential developments. Also, four roundabouts leave their human fingerprint on the environment of the Reserva. As well as various walkways to the beach and a rainwater drain.

This unique environment is home to species of fauna that easily adapt to different environmental conditions (common sparrow, blackbird, house mouse, etc.) and exotic and garden plants, some planted outside the enclosures. Other species settle in this environment as it offers better protection (the geckos, common wall and Mediterranean; the Andalusian wall lizard), as well as numerous birds such as swallows, house martins, goldfinches, greenfinches and the common kestrel being typical.

5.2.3 The blackbird, a regular visitor to the Reserva.

The greatest human impact on the dune is produced by excessive trampling on paths, as well as by the planting of exotic species (some invasive) in the post-dune plain, even on the small roundabouts which then spread into the protected areas; this is the case with the cacti, palms, agaves, etc. that have to be removed from this area. Also, the proliferation of domestic cats poses a danger to protected fauna, hunting both vertebrates and insects throughout the Reserva.

3. Psammophytic low scrub

Along the length of the inner slope of the mobile dune are areas of better soil, with good clumps of psammophytic scrub giving varying cover, and generally quite dense, with an average height of around 40cm and made up of several species, (chamomile, spiny broom, silver broom,etc). This scrub includes larger species such as junipers, enebros, Aleppo and stone pines, many of them re-introduced, as well as high dune scrub species which have disappeared over time (mastics, silver broom etc.)

Some are of great interest:

5.2.4 Among the scrub are examples which are of good dimensions and morphology: wild olives, white broom, mastics etc.

4. The grassland of the post-dune plain

The whole of the wide post-dune plain which extends from the footpath and the residential developments to the mobile dune, are dominated by psammophytic grassland, interspersed with low scrub. This pasture area consists of diverse communities of typical plant groups, according to the composition of the soil such as *Ononido - Linarietum pedunculatae* already indicated. Its distribution is quite random, appearing mostly in the most extreme spaces of the dune system.

At the far eastern end of the dune is a small plain, badly affected by uncontrolled trampling.

The fauna is very varied, with an abundance of insects, spiders and snails, as well as their predators: Bedriaga's skink, large psammodromus, greater white-toothed shrews and wood mice; birds (larks, hoopoes, common house martins and common kestrels).
The finches deserve a special mention which have returned to the dunes throughout the Reserva Ecológica, thanks to the laws that prohibit their capture: European goldfinch, European serin, European greenfinch, Eurasian siskin, common chaffinch and common linnet.

5. Water catchment

Since ancient times, the existence in the post-dune plain and in the urban area of phreatic water at shallow depths was well known and was responsible for the lush vegetation. Healthy vegetation, including tall shrubs such as mastic trees, juniper and even African tamarix is found growing around the water on the plains.

5.2.5 Water catchment with healthy African tamarix and mastics.

5.2.6 Exterior slope of the dune.

5.2.7 Large psammodromus.

6. The mobile dune

The mobile dune stretches along the coast in a strip averaging around 15 metres wide and with an average height above the beach of about 2.5 metres. It has an external slope which is somewhat damaged by marine erosion and by sand-slides caused by erosion at the base. The severe trampling has uprooted vegetation on the rim, while the interior slope has been colonised by grasses and lower dune scrub.

In the heart of the dune are many typical species of grasses and hemicryptophytes including marram grass, sea daffodils, sea thistles, creta trefoils, yellow restharrow and European sea rocket.

ITINERARY 3
DUNE AND MOUTH OF THE ALICATE

ITINERARY 3
DUNE AND MOUTH OF THE ALICATE

Itinerary

The Duna El Alicate is a small dune, with the morphological characteristics of the mobile dunes of the Reserva, stretching between the coastal streams that limit it and also representing an example of the different easements that human management has imposed on these unique coastal ecosystems, and the constraints to their conservation.

Location of the itinerary.

Geomorphological diagram of the dune.

Access to the start

From the A-7, at kilometre 185, take the road to the Urbanización Urb El Alicate on Avda. del Gaviero, which continues parallel to the Siete Revueltas stream, arriving at Urbanización Alicate Playa with a roundabout that gives access to the carpark.

Characteristics of the itinerary

Name	*Duna El Alicate*	**Type**	*Circular*
Length	*580 metres*	**Duration**	*50 minutes*
Difficulty	*Low*	**Best season**	*All year*

What to see

In this visit to the dunes the following are considered of interest:

- The vegetation and typical fauna of the dunes.
- The nearby coastal streams.
- The effect of human activity on the dunes.

The itinerary uses as a starting point, the public carpark next to the mouth of the Siete Revueltas stream, crossing over on the footpath in order to see the last stretch of the stream and its relation to the dunes which are advancing towards it. Then we retrace our steps and head towards the path to the Los Cano beach bar but turning to the right on to a track next to the eucalyptus grove and the Los Sardinales beach bar. Note the typical inter-dune pasture and the ruderal nitrophilous grassland that replaces it in areas where there is most human activity. We reach the beach following the posts and roped off protected area and from there head towards the east via the foot of the dune in order to see the marine slope and the community of vegetation on the crest of the dune. Finally arriving at the Los Cano beach bar, we head towards the interior of the dune on the path alongside the bar and turn off towards the banks of the El Alicate stream. We return by the same route and take the service road to see the interior slope of the mobile dune on the left which has been transformed by human action. To the right, the scub consists of invasive exotic plant species, planted there for security for the Urbanization. This road is flanked by huge rocks to protect the dunes from vehicles and ends the visit at the roundabout that we started from.

ENVIRONMENTAL ELEMENTS

On this route we can see different elements:

- The Siete revueltas stream.
- Grassland vegetation in the post-dune valley.
- The mobile dune and associated fauna.
- The Alicate stream.
- The area affected by human action.

Distribution of the environmental elements.

1.The Siete Revueltas stream

The Siete Revueltas stream, so called because of the movement of its current, reaches as far as the eastern end of the Reserva. From the footbridge, we can see the mouth, its surroundings and the riverside vegetation, dominated by reeds, with some acacias, eucalyptus, African tamarix, some pine and oleanders. Being both shallow and wide, the sands close off the mouth for much of the year although seasonal winter rains often open a channel. The amphibian fauna is abundant (Iberian water frog, Mediterranean tree frog, Iberian parsley frog), as are birds, with the presence of waders (common sandpiper, dunlin, little ringed plover, etc.) and riverside birds (grey wagtail, melodious warbler, common chiffchaff, etc.). In spring dragonflies and other aquatic insects abound.

5.3.1 Dunlin.

5.3.2 The black- tailed godwit.

2.The grasslands

Returning from the footpath in the direction of the dune, we pass in front of the Los Sardinales beach bar, and reach a eucalyptus grove at the beginning of the service road, from where we can see the pasture in what would be the post-dune plain, very affected by this road. In this small flat area, there is therophyte grassland (annual) with typical dune species, partly mixed with ruderal nitrophilic species, more abundant on the outer edge, next to the road and the beach bar. The significant grasses here include: hare's tail (Lagurus ovatus), wall rocket, mallows, geraniums, euphorbias, etc.

5.3.3 The therophyte grassland covers a good portion of the internal slope of the mobile dune.

We head towards the hedge of Japanese cheesewood (*Pittosporum tobira*) at the side of the beach bar and walk towards the beach, reaching the eastern edge of the living dune, protected by posts and roped-off.

Here there is a small group of eucalyptus, of little interest and badly affected by marine saltpetre. The fallen leaves increase the acidity of the soil and affect the growth of grasses. Around them the vegetation is mostly ruderal (by the roads) and nitrophilous (nitrogen loving) with many common species.

5.3.4 The eucalyptus next to the dune and a typical dune and grassland beetle.

The grassland holds the greatest wealth of fauna, with numerous insects (the psammophytic beetles are significant), spiders, a few snails and predators such as the large psammodromus lizard, the greater white-toothed shrew and the woodmouse.

5.3.5 Psammophytic grassland.

3. The mobile dune

From the corner of the dune, infront of us is the exterior protected slope which has fairly low density communities of *Agropyretum*, sea holly, sea daffodil and other typical species.

This dune has been the object of almost constant manipulation since ancient times, which is shown in the irregular relief of the ridge and its vegetation. You can see dogs and people trampling on the sand, and the dune has a low height above beach level. The existence of an excavated path through the middle of the dune to make access easier for residents of the residential development is shocking.

5.3.6 Various aspects of the mobile dune, the protected areas and path through it.

On the short length of dune, along the crest, are the remains of typical *(Loto-Ammophiletum)* clumps of European marram grass, sand-couch grass *(Elymus farctus)* and curiously, examples of African tamarix *(Tamarix Africana)* which are scarce throughout the Reserva, together with reeds which continue to reshoot despite being controlled.


5.3.7 Typical vegetation of dune crests with grasses, thistles, pancratiums, marram grass and other annuals.

4. The El Alicate stream

After returning to the end of the dune next to the Los Cano beach bar, we take the road inland and reach El Alicate stream, the vegetation here is dominated by cane, with reeds, and grasses, in addition to a repopulated grove of trees. The left bank is invaded by the neighbouring residential development. There is a good population of amphibians (Mediterranean tree frog, Perez's frog, European toad), and the area is visited by numerous birds.

5.3.9 View of the last stretch of El Alicate stream with reeds and bushes.

5.3.8 Footpath and exit from the stream to the beach.

5.3.10 Western yellow wagtail.

5. The human environment

The El Alicate dune has a lot of human traffic due to the excessive occupation of thespace: two beach bars, a service road and the steps through the dune occupy more land than the dune itself. The service road, bordered with large rocks to protect the dune, which should be pedestrian, has a dense group of mostly exotic and invasive species growing on the slope of the residential area: agaves, palms, pampas grass and lantanas etc., together with other autochthonous species: mastics and brooms, etc., which reinforce the security of a metal fence in the urbanisation. These species present a risk to the dune, as when the seeds disperse they may expand into the protected area.

5.3.11View of the post-dune meadow largely occupied by the road and exotic vegetation.

From the stream, we return to the beginning by the service road, ending at the municipal car park next to the roundabout and the footpath.

ITINERARY 4
DUNE AND THE MOUTH OF THE BARRONAL

ITINERARY 4
DUNE AND MOUTH OF THE BARRONAL

Itinerary

This itinerary is for a unique dune, rhomboidal in its shape and extension but hemmed in between constructions. It reaches a greater distance inland from the sea, which allows it to incorporate semi-fixed and fixed dunes; this is why it is the best representation of the original structure and the most natural geomorphology of the dunes and their resources.

Location of the itinerary.

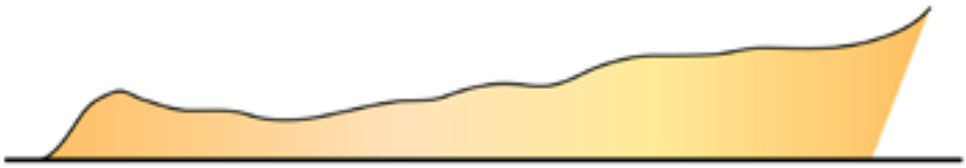


Diagram of the dune system.

Access to the start

From the A-7, coming off at the exit for El Rosario, passing the bilingial school Las Chapas, follow Calle Bonanza, and Avda. Playas Andaluzas to the end.

Characteristics of the itinerary

Name	*Duna El Barronal*	**Type**	*Circular*
Length	*1,300 metres*	**Duration**	*1 hour 15 minutes*
Difficulty	*Low*	**Best season**	*All year*

What to see

The objectives of this itinerary are:

- *To see the characteristics of dune ecosystems*
- *The natural and exotic vegetation*
- *The wildlife found on this dune*
- *The affects of human activity on the dune*

ENVIRONMENTAL ELEMENTS

Depending on the characteristics of the postion the following formations can be seen:

- Ruderal and psammophytic grassland
- The post-dune plain
- Semi-fixed and fixed dunes
- Low scrub
- Thickets of acacias and other exotic species
- The mobile dunes and exterior slopes

Distribution of the environmental elements.

The itinerary starts at the Las Flores beach bar car park, at the entrance to the post-dune plain from the residential street. From this point you can already see the different dune systems that make up the El Barronal dune. From there, on an interior path, you can access the central part of the dune, then on to the second dune front, reaching the central mass of wild olives, high scrub, and the thicket of acacias. We continue towards the upper part of the dune, passing through a valley or central depression which has hygrophilous vegetation. We continue by a path which goes around the acacias and takes you to the upper part of the dunes, bordered by a metal fence belonging to the residential area. Coming back down, we arrive at the mobile dune, bordered on the west by the post-dune plain. From here you can reach the beach, crossing it towards the east, following the foot of the external slope and returning to the Access to the beach and back to the start.

The visit to the El Barronal dune allows us to get a better idea of how the Marbella dunes looked before the urban development. In a quite complete sample of the dune geomorphology, it includes at its heart, semi-fixed and fixed dunes, like a second dune front, with a small inter-dune valley and with mobile dunes and external slopes. The relief is arranged with a dune front parallel to the coastline, which is extended by fingers of sand that reach towards the interior. Followed by a dune plain at a lower height, several ridges reach towards the interior as a second dune front, inclined towards the first one. They leave a hollowed area between them. The complete dune system increases its altitude to up to 11 metres above sea level at the northern end of the protected area.

5.4.1 General view of the southern half of the dune with post-dune plain and mobile dune.

1. The post-dune plain. It is found behind the mobile dune and has the highest point in the centre, which camouflages its morphology somewhat; it incorporates psammophytic pasture which changes to ruderal in the vicinity of the car park and the houses. The majority of the plain is covered by low psammophytic scrub that reaches as far as the mobile dune, and in which the species typical of the semi-fixed dune *(Crucianellum maritimae)* dominates. Worth noting here is: camomile, sea daffodils, thyme and mullein etc.

5.4.2 View of the grassland in the post-dune plain.

5.4.3 View of the low scrub that has taken over the majority of the area with a few trees.

2. Fixed and semi-fixed dunes. In the central part and to the north of the area, there are several cordons of sand dunes near to a small central depression, which reach to the end of the protected area. They are mainly covered in the remains of the original juniper scrub with a rich diversity of flowering plants with wild olives, palms, hawthorn, germander, Adenocarpus, asparagus, thyme, jarillas and many other species of varying densities, as well as open areas of grassland.

Now in the higher part of the dune, the scrub thins out and loses its diversity. The sand is very fine and stretch to the fence of the protected area with some patches of psammophytic grassland.

In the centre of the area, between two ridges of fixed sand, is a depression in the ground. This damper environment encourages brambles, African tamarisk, tree germanders and many other species to thrive and grow large and leafy, attracting a concentration of fauna, especially birds.

5.4.4 Scrub in the upper part of the protected area.

Among this scrub and shrubs there is interesting fauna of both vertebrates and inverterbrates including rabbits, the horseshoe whip snake, turtle doves and Little owls not often seen in the other dune systems.

5.4.5 Tarabilla común.

5.4.6 Depression between the ridges of fixed sand.

4. The mobile dune which extends across 2,604 m^2 (124 x 21 m), has a fairly constant mass and width. It has a good quantity of typical vegetation as mentioned before, and some really good examples such as the large mastic in the eastern area. The upper part of the crest of the mobile dune, has clumps of typical marram vegetation *(Loto-Ammophiletum australis)*, with large areas of mobile sands that advance into the post-dune plain. In the post-dune area we find communities of camephytes more typical of somewhat stabilised dunes, *(Loto cretici-Crucianellum maritimum)*, and in particular chamomile, mullein and other herbaceous plants. This area is home to dense growths of exotic species *(acacias*, Myoporum and yuccas etc.), some of which have been removed although there are still clumps near the perimeter fence and in the centre.

The fauna here is typical of mobile dunes, it prefers the dense and rich vegetation cover that rises up the inner slope to the top, leaving areas of mobile sand between.

5.4.7 The mobile dune with typical vegetation.

The majority of the exterior slope has been affected by storms and the upper part has suffered with sand slides, however the western end is better conserved.

5.4.8 View of the western and central-eastern dune slope respectively.

5. The acacia woodland and other exotic plants. The El Barronal dune has been one of the areas most affected by the proliferation of invasive exotic species; many have escaped from nearby gardens. Although a large proportion have been removed, here is still the largest concentration in all the Reserva, in the form of dense thickets of clumps of acacias in the northeastern central zone and in the central part of the post-dune plain, as well as other species such as palms, yuccas, castor-oil plants and a large mass of Myoporum laetum on the edge of the southwestern dune. This presence interferes with the development of the autochthonous flora, invading a notable portion of the dune surface.

5.4.9 Thicket of acacias.

5.4.10 A clump of myoporum next to the houses.

5.4.11 Agave.

ITINERARY 5
DUNE AND MOUTH OF THE ARENAL

ITINERARY 5
DUNE AND MOUTH OF THE ARENAL

The itinerary

The El Arenal dune corresponds to a small mobile dune, previously joined to the El Barronal dune, but with very unique characteristics, due its mass of sand, the largest in La Reserva Ecológica, and which conserves a complete sample of the typical vegetation of the mobile dunes.

Location of the itinerary.

Geomorphology diagram of the dune.

Access to the start

From the A-7, heading towards El Rosario and passing the bilingual school Las Chapas on Calle Bonanza towards Avda. Playas Andaluzas or continue eastwards until you reach the Mancomunidad de Municipios de la Costa del Sol Occidental building, then turning towards the sea on Avda. Cervantes until you reach the end. There is parking all along this road.

Characteristics of the itinerary

Name	*Duna El Arenal*	**Type**	*Circular*
Length	*400 m*	**Duration**	*55 minutes*
Difficult	*Baja*	**Best season**	*All year*

What to see

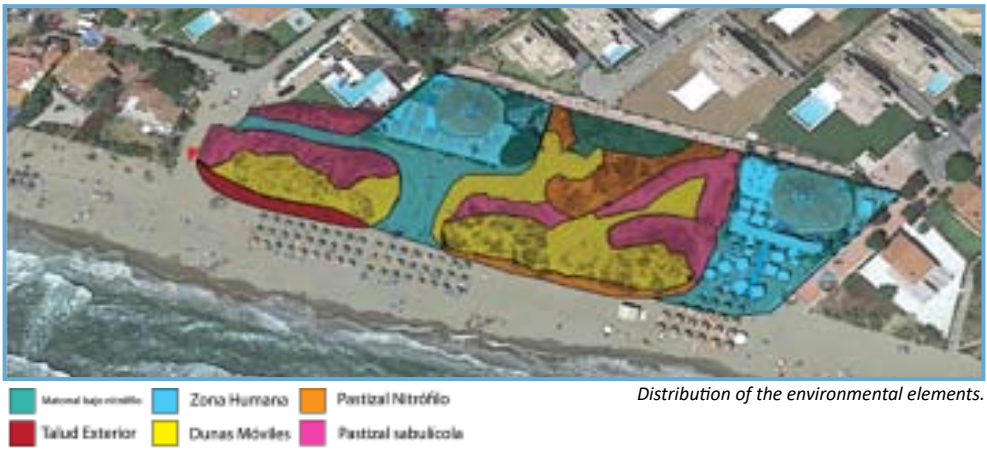
In the visit to this unique dune it is worth noting the following elements:

- The mobile sands
- The relative distribution of the vegetation and its different elements
- Human influence on the modelling of the dune

ENVIRONMENTAL ELEMENTS

According to the characteristics of the territory and its resources we can differentiate the following environmental units:

- Ruderal nitrophilous low scrub
- Ruderal nitrophilous pasture
- Sabucola grassland
- Mobile dune
- Exterior slope
- Human environment



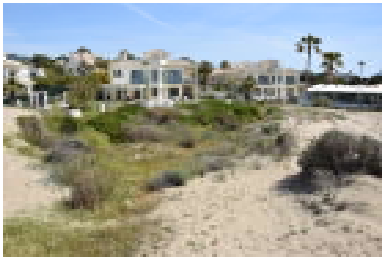
Distribution of the environmental elements.

The itinerary can be started at the pedestrian crossing Access to Arenal Beach beachbar from where we can see the composition of the scrub and nitrophilous grassland which is situated nest to the northern fence of the dune. From here we can walk along the wooden pathway around the beachbar to see the different natural elements on the upper level of the dune: psammophytic pasture, and the crest of the dune. We can also see the gullies in the middle of the dune created by channeled air. We continue along the wooden pathway to the west until the street which separates the dune from prívate houses and which gives access to the beach. From this footpath we can clearly see the composition of the pasture areas. Once on the beach we can follow the foot of the dune around the structure of the dune and its exterior slope. We end the itinerary at the Bono Beach beach bar and walk along the attached path.

1. Nitrophilous low scrub

Occupying the northern limit of the dune, next to the protecting fence and on lower ground than the rest, is dense low scrub, ruderal and nitrophilous, with yellow fleabane *(Dittrichia viscosa)*, red chickweed *(Anagallis arvensis)*, various grasses, dasies, mallows, geraniums and even a small black poplar (*Populus nigra*), in a very small area (barely 35 m^2).

5.5.1 General aspect of the eastern portion (the most extensive) of the dune, with gullies and undulations.



2. Ruderal notrophilious pasture

From the same fence, and around the Arenal Beach bar, is thick grassland, with diverse species of plants, grasses, white rocket, daisies, mallows, etc on a small patch of ground 28 m^2. It forms a community rich in fauna, with the Large psammodromus lizard, common wall gecko and Bedriaga's skink, as well as birds in search of food from nearby gardens (blackbird and house sparrow) as well as from other areas (swallows, common house martins, common swift, finches, white wagtail and robins in winter etc).

5.5.2 Views of the nitrophilous grassland in the post-dune plain.

3. Psammophytic pasture

Extending along the upper level of the plateau and post-dune plain as well as along the interior slope of the dune and covering a good portion of both, are several communities of pasture grasses, distributed according to the conditions of the sand and its organic matter content. In some cases it shows significant floristic diversity, while in others only one or two species dominate.

4. The mobile dune

A large portion of the dune system is a mobile dune, one of the most beautiful in the Reserva, with fingers of sand among the psammophytic grassland. The dune ridge rises about two metres above the plain in the eastern part and barely one metre at the western end, separated by the central pedestrian crossing.

5.5.3 View of the dune vegetation (Loto-Ammophiletum) on the crest of the mobile dune.

On the mobile dune, the communities of scrub and hemicryphtophytic grassland are well represented and are interspersed with communities of typical therophytic pasture. The fauna is not very diverse, similar to that of other mobile dunes, and probably because the dune is only short and suffers a lot of human traffic.

5. The exterior slope

The entire marine front of the dune has a high slope (up to 3 m), more inclined to the west and with some sinking along the rest, with ridges of hardened sand in the elevated and middle area and the layered structure of the accumulated sand beds visible. This situation is due both to the action of the sea in storms and to the destabilisation of the sands themselves caused by machinery used to enlarge the beach.

The dune vegetation of the scrub *(Loto-Ammophiletum)* covers the elevated areas, with good clumps of marram grass *(Ammophila arenaria)*, prickly drop seed grass *(Sporobolus arenarius)*, sea thistles and other typical species, that spread to the slope with the unstable sands, dragging the sabulicola fauna (creatures with a preference for sandy habitats) of beetles, antlions, some snails and not much else, with it.

6. The human environment

One of the characteristics of this dune system is the density of human occupation; more than half of the surface of the dune is occupied by human installations (two beach bars, walkways, etc). As a result of this, the conservation of the dune is compromised by the level of respect shown by the users of the facilities to the protected character of the dune.

5.5.4 The human presence and visitors activities of take up the whole length of the dune.

5.5.5 A different view of the human presence on the dune.

The survival of this dune must be achieved through the collaboration of the beach bars and visitors to the dune, with a more logical provision of steps for users heading towards the beach; with a floating footbridge that allows the regeneration of the dune morphology as well as controling the passage of people through the dune. Similarly, the adaption of the surface area occupied by the beach bars in the Maritime Terrestrial Public Domain, as established by the Coastal Law, should free the dune from current rights of way.

ITINERARY 6
DUNE AND MOUTH OF THE REAL DE ZARAGOZA

ITINERARY 6
DUNE AND MOUTH OF THE REAL DE ZARAGOZA

The itinerary

Extending from the Sequillo stream to the west to the Real de Zaragoza stream to the east, this dune is the largest in the Reserva. It is also one of the most interesting, for the remarkable richness in dune habitats and for the abundance of species of flora and fauna. It is also the one that has undoubtedly suffered the greatest human environmental pressure, the effects of which can be clearly seen.

Location of the itinerary.

Geomorphological diagram of the dune.

Access to the start

From the A-7 there are two possibilities: Access can be obtained by passing the Andalucía Lab building on the right and then turning right, along the edge of the Sequillo stream and via Avda. de la Urbanización Jardín de los Pinos as far as the public carpark; or, by the same access, continue south on Avda. de Cibeles arriving at the second public car park. Beyond the Residencia de Tiempo Libre, there is a track to the Reserva Ecológica marked for pedestrians. From this path you can reach the beach and the various beach bars.

Characteristics of the itinerary

Name	*Duna Real de Zaragoza*	**Type**	*Length*
Length	*1.300 metres*	**Duration**	*1 hour 35 minutes*
Difficult	*Low*	**Best season**	*All year*

What to see

- The dune geomorphology
- The characteristics of dune and ripicola habitats
- Dune flora and fauna: invasive exotic species
- The effects of human activity on the dune environment
- The evolution of human presence on the dune
- The fluvial environment

It is recommended that you start the itinerary from the far west of the Reserva, heading from the public car park to the mouth of the Sequillo stream. We start the walk along the Senda Litoral heading towards the east, observing the post-dune plains that stretch to the fence and outside wall of the Residencia de Tiempo Libre. We reach the end of the path and cross the mobile dune towards the beach arriving at the flat area next to the La Plage Casanis beach bar and the mouth of the Real de Zaragoza stream. W e go back along the beach to the Sylt beach bar, ending the itinerary in the public car park.

ENVIRONMENTAL ELEMENTS

Around the Real de Zaragoza dune we find the richest ecosystems of all the protected dune systems. These are:

- The human environment.
- The fluvial or ripicola habitat
- The Pino Carrasco pine grove
- The acacia thickets
- The grasslands
- Mediterranean scrub
- . The mobile dune.

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Distribution of the environmental aspects.

The size of the dune system includes a fairly complete sample of the current dunes of the Reserva Ecológica in spite of the damage caused by human activities; therefore, for your visit, it is recommended to split it into sections. Three areas can be considered in the dune: the western section, up to the road that leads from the central public car park to the Sylt beach bar; a central section, up to the end of the Residencia Tiempo Libre and an eastern section up to the Real de Zaragoza stream.

The western section, the one with the greatest human impact, is home to the widest diversity of biomass environments, with a small pine forest, acacia scrub and a wide plain (which reaches the banks of the river with its dense reed beds), with both ruderal nitrophilous and psammophytics grasslands, while the mobile dune is invaded by humans with beach bars and a pumping station, its exterior slope affected by sand slides caused by erosion by the sea. The presence of exotic plant species is very high, caused to a large extent by the beach bars.

The central section, the largest, is dominated by the post-dune plain, in addition to the mobile dune and the exterior slope; it incorporates a pedestrian path next to the Residencia Tiempo Libre, and several walkways to the beach and the Ranchón Cubano beach bar. In its innermost part, there is a small area of low scrub at the beginning, with woody fleabane *(Dittrichia viscosa)*, mullein *(Verbascum sp.)*, palms *(Chamaerops humilis)* and replanted mastics and some stands of small pines. Further north of the path, low Mediterranean scrub appears, with numerous stands of wild olives, cistus, creosote bushes, palms and exotic species (castor oil plants and acacias).

The rest of the plain is occupied by several communities of psammophytic grassland and there are several paths to the beach. In this area the undulations were constructed by machinery, at the time aimed at improving access to the beach for visitors to the Residencia Tiempo Libre. Here there are also some large interesting plants including some replanted specimens of wild olive *(Olea sylvestris)*. The dune has a good covering of vegetation with grasses and hemicryptophyte scrub and the exterior slope is similar to the western part.

The eastern section, from the boundary of the Residencia Tiempo Libre to the Real de Zaragoza stream, is the best preserved, despite the abundance of invasive alien species and the existence of a private property that cuts off the continuity of the dune. It is currently in the process of environmental restoration and dune recovery (2018).

It contains a well-structured mobile dune with an external slope that has collapsed due to erosion by the sea, and a well-preserved post-dune plain with therophytic grasslands and low scrub. The presence of high scrub on the plain, with mastics, blackthorn, silver broom and some stone pines hosts an abundant fauna, especially forest birds and reptiles, as well as abundant invertebrates. Once past the private property, the mobile dune becomes natural, while the wide post-dune plain extends towards the river and inland, restricted by low scrub, reedbeds and a beach bar.

1. The human environment. Despite its larger size, the Real de Zaragoza dune is under the greatest human pressure, through beach bars, a sewage pumping station, a private property, and buildings for the Red Cross and services, along with several walkways to the beach and an interior path. These all add up to an important surface area, increased by the access roads and annexed parking areas, together with an intense use in summer by beach-goers. Such environments and facilities form a unique habitat. There is also a unique flora and fauna while in the occupied area the autochthonous communities of plants have been diminished.

2. The river or fluvial habitat. The Sequillo and Real de Zaragoza streams are unique habitats in the Reserva. The first, with a smaller flow due to its smaller basin, barely manages to carry water until mid-April; its riverbed is occupied by a dense reedbed *(Arundo donax)*, which has eradicated the typical community (tamarisk), leaving only pastures in the clearings and in them, some isolated tamarisks, acacias and oleanders. The Real de Zaragoza stream, with the largest riverbed and flow, has several eucalyptus with some specimens of tamarisk, fig, oleanders, poplars, etc. and the presence of reeds.

The importance of these channels is decisive for amphibians, being a watering point for many birds and biodiversity corridors between the Reserva and the rest of the territory.

3. The pine grove of Aleppo pines. Of uncertain origin, perhaps old plantations prior to the urban development of the area, appear in the western area of the dune. The grove consists of a small number of specimens, of remarkable height and accompanied by a carob tree *(Ceratonia siliqua)*, the only one in the entire Reserva, perhaps because here the soil contains more clay (fluvial) and is damp. There is also a large, unique specimen of oleander *(Nerium oleander)*. It is characteristic of an area where the soil has become acidic due to the fallen pine needles and is accompanied by dense therophytic and hemicryptophytic pasture with abundant ruderal and nitrophilous species such as mallows, sea rocket, grasses and daisies.

The associated fauna is also abundant: Bedriaga's skink, the large psammodromus, large White-toothed shrew and numerous birds, the majority non-nesting such as European turtle dove, the stock dove, European serin, blackbird, chiffchaff and the Sardinian warbler etc.

4. Acacia thicket. Without a doubt, one of the biggest conservation problems in the reserve is the invasive alien species (IAS), including acacias. Spreading from nearby gardens, they break down and modify the biodiversity of the environment that they occupy. There are several species present *(Acacia salisigna, A.cyanophylla)*, which in spite of being cut down and removed, have once again proliferated in the area, with greater vigour than before.
They are a species that are not welcoming for birds (birds do not nest in them and they only provide food to the insectivores in spring when insects are attracted to the flowers). Their vigorous production of leaves, flowers and seeds, help the insects proliferate and with them their predators: Bedriaga's skink, large psammodromus, greater white-toothed shrew, field mouse, and in the trunks of the oldest specimens, the geckos.

5.6.1 Pine grove.

5.6.2 Carob.

5. The pasture. The post-dune plain, stretching between the mobile dune and the interior road, constitutes the dominant environment in this dune next to the residential area. It is of significant size and flat with some higher areas divide it up, the result of machinery moving soil to make it easier to get to the beach.

The soil is affected by the anterior dumping of building materials, influencing the distribution of the pasture which includes several communities: from ruderal nitrophilous pastures around the areas most used by humans, to hemicryptophytes and nitrophilous therophyte pasture. This extensive grassland incorporates some shrub specimens (mastics, oleander, wild olive), some of interest due to their size and age, having recently been replanted with wild olive (Olea europaea var. sylvestris) and other shrub species.

5.6.3 View of the central grasslands from the mobile dune.

The fauna is home to numerous insects and spiders and in spring vertebrates, especially insectivorous (spiny-footed lizard, wood mouse, greater white-toothed shrew, pipistrelle bat etc). Birds are abundant, with crested larks, hoopoes, barn swallows, house martins, blackbirds, kestrels, and many perching birds: warblers, chiffchaffs, stonechats, white wagtails, goldfinches and greenfinches, many of them nesting in gardens and nearby dwellings. There are few Bedriaga's skink; they are found in the areas of taller vegetation cover and in exotic species (Tottenhot fig).

6. El matorral mediterráneo. Occupying two very small areas located in the centre and to the east of the dune system, there is very interesting low scrub. It is the remains of what was there before the urbanisation of the surroundings and used to occupy the semi-fixed and fixed dunes. It consists of short (around 50cm) woody plants such as rockroses (Cistus monspeliensis), cistus *(Halimium halimifolium)*, mullein *(Verbascum sinuatum)*, etc., accompanied by specimens of wild olive and mastics, as well as exotic species such as castor oil plants *(Ricinus comunis)* and grasses.

This is the area with the greatest variety of fauna, with a significant presence of insects, reptiles and birds all year round.

5.6.4 Views of the deteriorating low shrub.

7. The mobile dune. Stretching in a cordon about 26 metres wide, about 3-3,5 metres above the beach, the mobile dune's morphology has been very affected by the beach bars and footpaths as well as by indiscriminate trampling and the aggressive action of storms. These have seriously eroded the outer slope and caused a marked loss of sand and dune vegetation, leaving only samples of embryo and pioneer dunes (due to marine erosion and the mechanical cleaning of the beaches) and with the dune micro-relief barely represented (sometimes temporarily because of trampling).

In spite of work to eradicate exotic spespecies from the dunes, there are still numerous invasive plants, especially at the far ends. At the western extremity is Japanese cheesewood, Myoporum, lantana, yuccas and Hottentot fig.

In this final section, after the private property that invades el Dominio Público Marítimo Terrestre (DPMT), the dune reappears, and is well conserved. Its morphology is little altered, although with some erosion of the outer slope and marram grass vegetation (Loto-Ammophiletum) that extends to the post-dune plain.

The vegetation has colonised the outer slopes of the dune near to the beach providing cover to a large number of sand fauna of such as sand lizards and numerous insects.

In the westernmost portion of the mobile dune, from the Sylt beach bar to the Sequillo stream, the dune structure holds much more sand, higher and with less vegetation cover, together with invasive exotics, despite attempts to eradicate them.

The external slope is very similar throughout the dune; the eastern section is affected by erosion and the sliding of the sands of the upper area, as well as by uncontrolled trampling; in the central section a spectacular mastic stands out, its size and shape modelled by the sea winds. In general, the whole environment has been very affected by people passing through.

5.6.6 The mobile dune next to La Plage Cassanis dune.

5.6.7 Mastic specimen shaped by sea winds.

5.6.8 There are also some examples of micro-reliefs, with crocs and caudeyes.

ITINERARY 7

DUNE LA VÍBORA - WEST

ITINERARY 7
DUNE LA VÍBORA - WEST

The itinerary

La Víbora dune, one of the three largest dunes in the Reseva Ecológica, stretches between the Beach House beach bar and La Víbora stream to the west and El Laurel to the east. It is a well-preserved dune in most part, with a complete representation of typical dune vegetation especially in the post-dune plain, due to the protection afforded by the existence of a pedestrian walkway that decreases trampling. This dune is divided in two remarkably different parts which is why it is interesting to divide the visit in two separate itineraries; in this one, the western portion of the dune is visited, between the Perla Blanca beach bar and La Víbora stream.

Location of the itinerary.

Diagram of the dune system.

Access to the start

From the A-7, taking the exit for Elviria, go down the street of the Conjunto White Pearl Beach and Avda. de Las Antillas until you reach the public car park next to the Perla Blanca beach bar.

Name	*Duna La Víbora-Oeste*	**Type**	*Length*
Length	*430 metres*	**Duration**	*45 minutes*
Difficult	*Low*	**Best season**	*All year*

What to see

The objective of this itinerary is to identify the following features:

- The peculiarities of this dune and its components
- The dune vegetation: characteristics and distribution
- The fauna associated to the dune
- Characteristics and effects of human activities on the dune

It is recommended to start the itinerary from the existing public car park next to the Perla Blanca beach bar; we continue the walk along the open road next to the fenced private properties and reaching the edge of the Beach House Restaurant from where we descend to La Víbora stream. On the way back we walk along the outer edge of the dune along the beach until we reach the Perla Blanca beach bar.

ENVIRONMENTAL ELEMENTS

Although deteriorated in places, this dune incorporates a list of environmental elements typical of coastal areas. The following can be identified:

- Nitrophilous ruderal grasslands
- Psammophytic grassland
- Mobile dunes
- The dune slope
- The human environment

Distribution of the environmental elements.

1. Nitrophilous ruderal grassland

Next to the interior path fence and inside at the foot of the dune are two narrow strips with a typical community of annual nitrophilous grasses; not a large patch but important for its attractiveness to insects and their predators. Averaging around 30-40 cm high, it is quite dense as it receives a supply of irrigation water and organic nutrients from the neighbouring residential properties. The species here are very common: *(Euphorbia peplis, Lobularia marítima, Malva cretica)*, grasses *(Lagurus ovatus, Avena sterilis)*, daisies *(Bellis annua)*, etc. forming a dense community in spring which dries up in the summer. It is joined by other species and exotic plants.

5.7.1 Nitrophilous grassland bordering the internal path.

This pasture attracts an interesting fauna of insects: lepidoptera (*Zerinthya rumina, Pieris rapae,* etc.), coleoptera, ants, diptera, hymenoptera, etc. and in turn a whole series of predators: Andalusian lizard, large psammodromus, geckos, Bedriagai's skink, mammals (greater white-toothed shrew, wood mouse, etc.) and birds, especially insectivorous.

2.- Psammophytic grassland

In the post-dune plain, at the foot and on the interior slope and part of thesummit of the dune are grasslands of varying types depending on the quality and structure of the soil. They have been affected by the opening of the road, as well as by trampling and dogs. There are some adult specimens of shrubs and trees, some of which are of interest for their size and age such as junipers, pines, mastic and hawthorn.

5.7.2 Sparse grasses between the mobile dune and the nitrophilous grasslands next to the inner path.

They correspond to different communities types: *Sporoboletum arenarii* and *Ononido-Linarietum pedunculatae*, already described in previous sections.

5.7.3 Pasture in the middle of clumps of psammophylitic scrub and reeds.

The fauna found in these grasslands is similar to that of ruderal nitrophilous pasture, but with a smaller presence of the same species. Its role as a hunting ground for insectivorous birds, including the common kestrel (which regularly visits the area), hoopoe, crested lark, etc is significant.

3. Mobile dunes

Throughout the entire dune system, there is a mobile dune, of medium size, and about 3 metres height above the beach. The sands form narrow strips which penetrate into the rear plain and covering the majority of this part of the dune system. The vegetation is very variable according to the zone, with the interior slopes covered with therophytic pasture, that become mixed with the marram grasses at the summit and the community of hemicryptphytes *Cypero mucronati-Agropyretum juncei*. There is less vegetation on the outer slope; it is subjected to excessive trampling, erosion and movement of the upper sands. The stability of the summit is affected by intense trampling, which opens paths between the vegetation and erodes the sand by displacing it.

5.7.4 Summit zone of the dune.

5.7. 5 Cypero mucronati-Agropyretum juncei.

5.7.6 The scrub reaches the higher levels near to the Summit at the western end.

At the extreme western end of the mobile dune, which is an important height (3 metres), are examples of hemicryptophytic scrub or *Loto cretici-Ammophiletum australis*, close to hemicryptophytic grasses *Cypero mucronati-Agropyretum juncei*. There are abundant species such as the sea thistle (*Eryngium maritimum*), sea daffofil (*Pancratium maritimum*), Lotus creticus, cotton weed (*Otanthus maritimus*) and European sea rocket (*Cakile marítima*), etc. There are also stands of exotic species (yucca, acacias, etc.) of varying sizes.

The fauna is similar to other dunes, with the presence of psammophytic beetles (*Pimelia, Erodius*, etc.), as well as sand wasps and in the flowering season, diverse butterflies. Snails are scarce. Spiny-footed lizards are present, while insectivorous birds visit the area, especially the kestrel, swallow, hoopoe, wren, finches (goldfinch, chaffinch, greenfinch, European serin), white wagtail, common stonechat, and so on. The seagulls regularly visit the area in search of food.

4. Dune slope and embryo dunes

The external slope shows similar deterioration to the other dunes, with sand slides caused by the erosion of the foot of the dune by the marine storms, the uncontrolled trampling and the use of machinery to clean the beach.

5.7.7 View of the embankment at the far western end.

5.7.8 Outer slope of the western end of La Víbora dune.

In this area, the embryo dunes are usually quite small because of the cleaning machines and the trampling, which constantly wear them away. They are therefore few and far between and with little mass, mainly consisting of those formed on the remains of plants and objects left by the high tides. The fauna is similar to that of the mobile dunes, but reduced in quality and quantity, the presence of antlion, dung beetles and sand fleas is significant, but vertebrates are scarce, just gulls or waders that are searching for food, and lizards (large psammodromus and sand lizard).

5.- La Víbora stream

The stream runs next to the Beach House restaurant, between it and a small dune on the right bank. It is a small stream, with a small basin, which reaches the coast in a channel restricted by buildings from the Ojén mountains. As other streams in the area, it is invaded in its final stretch by dense reedbeds of an invasive species that has suffocated nearly all the native ripicola vegetation except for a few stands of tamarisks, some oleanders and acacias and some eucalyptus.

5.7.9 La Vibora stream next to the Beach House restaurant.

The narrow flow (barely 18 metres between the buildings) of this stream is partly caused by the protective breakwaters; however these don't affect the importance of thearea for the conservation of amphibians (Perez's frog and the Mediterranean tree frog etc.). There is also an abundance of birds who seek shelter and food here.

6.- Human environment

Human activities on the dune are concentrated at either end and on the track behind the mobile dune thus affecting the mouth of the stream. The La Vibora dune, the Beach House restaurant and the Perla Blanca beach bar and associated carpark, are the hub ofthe activity as well as various paths through the dune to the beach. This, which today is still not controlled, invades an important section of the dune, modifying its characteristics and encouraging severe trampling affecting the flora and fauna.

7. Semi-fixed dune

Here and there, on the Summit of the dune and part of the rear slope, are clumps of psammophytic species. The typical communities consist of Loto cretici-*Crucianellum maritimae*, which is quite short (less tan 50cm) and quite dense in places, including shrubby everlasting (*Helichrysum stoechas*) and *Lotus creticus*, and many other species such as mullein (*Verbascum thapsus*), silver nailroot (*Paronychia argéntea*) and scarlet pimpernel (*Anagallis arvensis*) etc. They create a mosaic mixed in with *Ononido-Linarietum pedunculatae* plants, consisting of many species (*Malcomia littorea, Vulpia alopecurus, Senecio leucanthemifolius*) and nitrophilous communities of annual therophytes *Sporoboletum arenarii*, with the daisy *Centaurea sphaerocephala* and the grass *Sporobolus pugens*, as well as other more common plants such as *Cynodon dactylon*, *Panicum repens*, etc. The fauna here is also rich in species with good populations of the large psammodromus, Bedriagai's skink, greater white-toothed shrew, woodmouse, pipistrelle bat (coming from the residential area) as well as numerous insectivorous birds like the barn swallow, house martin and house sparrow.

5.7.10 Kiosk next to the start (Perla Blanca).

5.7.11 Part of the low scrub on the slope and crest of the dune.

ITINERARY 8
DUNE LA VÍBORA - EL LAUREL

ITINERARY 8
DUNE LA VÍBORA - EL LAUREL

The itinerary

The eastern section of the La Víbora dune stretches between the Perla Blanca beach bar to the west and El Laurel beach bar to the east. It is in an excellent state of conservation and includes a complete representation of typical dune vegetation, especially in the post-dune plain, due to the protection provided by the pedestrian walkway that has reduced trampling.

Location of the itinerary.

Diagram of the dune system.

Access to the start

From the A-7, take the Elviria exit, following the road to the public car park next to El Laurel beach bar; you can also go along Conjunto White Pearl Beach road and Avda. de Las Antillas to reach the public car park next to the Perla Blanca beach bar.

Characteristics of the itinerary

Name	*Duna La Víbora-Oeste*	**Type**	*Length*
Length	*925 metres*	**Duration**	*55 minutes*
Difficult	*Low*	**Best season**	*All year*

What to know

The objective of this itinerary is to identify the following features:

- To identify the characteristics of this dune and its components
- Dune vegetation: its characteristics and relative distribution
- The fauna associated with the dune
- The effects of human activity on the dune components

The itinerary can start from one of the existing public car parks next to the El Laurel and Perla Blanca beach bars, taking the visitor along the pedestrian promenade and returning along the outer foot of the dune, until you reach the starting point.

ENVIRONMENTAL ELEMENTS

Like the other major dunes of the reserve, this dune integrates a complete list of environmental elements typical of coastal areas, many of their initial characteristics having been recovered. The following can be identified:

- Nitrophilous ruderal pasture
- Psammophytic pasture
- Mobile dunes
- Dune slopes and embryo dunes
- The human environment

Distribution of the environmental elements.

1. Nitrophilous ruderal pasture

Next to the pedestrian foot path, in a narrow strip, there is a community of typical annual nitrophilous grasslands, not very large but important as it attracts insects and their predators. Around 30-40 cm tall, it grows thickly thanks to the supply of irrigation water and organic nutrients from the path. The species here are very common: Euphorbia peplis, Lobularia marítima, Malva cretica, grasses (*Lagurus ovatus, Avena sterilis*), daisies (*Bellis annua*), etc. in a dense community in spring that dries up in the summer and to which join other species of sand loving plants (*Pancratium maritimum, Eryngium maritimum*, etc).

5.8.1 Nitrophilous pasture, close to the inner pedestrian walkway.

Associated with them is an important fauna of insects: lepidoptera (Zerinthya rumina, Pieris rapae, etc.), coleoptera, ants, diptera, hymenoptera, etc. in turn attracting a whole series of predators: Andalusian wall lizard, large psammodromus, Moorish gecko, Berdriagai's skink, mammals (greater white-toothed shrew, wood mouse, etc) and birds, especially insectivorous.

2. Psammophytic pasture

This occupies the majority of the post-dune plain, and is of varying composition based on the quality and structure of the soil, affected by the past dumping of rubble and other materials,as well as by trampling and dog walking. There are some isolated adult specimens of shrubs and trees, which are sometimes of interest such as junipers, pines, mastic and blackthorn, all notable for their antiquity or their size.

5.8.2 Sparse grasslands between the mobile dune and the nitrophilous grasslands next to the inner pedestrian walkway.

Corresponding to community types: *Sporoboletum arenarii* and *Ononido-Linarietum pedunculatae*, already described in previous sections.

5.8.3 Grassland in the middles of stands of psammophilic.

The fauna sustained by these grasslands is similar to that of nitrophilous ruderal pasture, but with fewer of the same elements. Its role as a hunting ground for insectivorous birds, including the common kestrel, which regularly visits the area, is highlighted. It is also usual to find the nests of species such as the common wren, and the hoopoe.

3. Mobile dunes

Throughout the entire dune system, there is a front of mobile dunes, of medium size, which rise to about 3 metres above the beach and that sometimes penetrate in narrow strips into the middle of the plain, covering a substantial surface area. The vegetation varies according to the zone, with the interior slopes covered with therophytic grasslands that become mixed with the low scrub of the summit and the hemicriptophytes *Cypero mucronati-Agropyretum juncei*, with fewer on the exterior slope, reduced by excessive trampling, the erosion and the movement of the upper sands. The stability of the summit is affected by intense trampling, which opens paths between the vegetation and erodes the sand by displacing it.

5.8.4 Sand can be on the move as far back as the middle of the plain behind the dunes.

5.8.5 The grassland scales the internal slope up to the summit at the far western end of the dune.

At the far western end of the mobile dune, which reaches 3 meteres, there are examples of hemicryptophyte scrub and low scrub *Loto cretici-Ammophiletum australis*, hemicryptophyte grasses nearby *Cypero mucronati-Agropyretum juncei*, and an abundance of other species such as sea thistle (*Eryngium maritimum*), sea daffodil (*Pancratium maritimum*), Cretans's Bird's-foot trefoil (*Lotus creticus*), cotton weed plant (*Otantus maritimus*), European sea rocket (*Cakile marítima*), etc. There are also stands of exotic species (yucca, acacias, etc.) of varying dimensions.

The fauna is similar to other dunes, with psammophilous beetles (*Pimelia, Erodius*, etc.), as well as sand wasps and in the flowering season, diverse butterflies. While snails are scarce, there are some spiny-footed lizards. Various insectivorous birds visit the area, worth noting are the common kestrel, common swallow, hoopoe, crested lark, the finches (goldfinch, finch, greenfinch snd European serin), as well as white wagtail, African stonechat, and so on. Along the beach, the seagulls visit in search of food.

4. Dune slope and embryo dunes

On the outside, the slopes are similar to other dunes, with sand slides caused by the erosion at the dune foot by marine storms, which affect the stability of the sand.

5.8.5 Slope and embryo dune at the Eastern end.

In this area, the embryo dunes are usually very small, as a result of the mechanical cleaning and trampling which constantly erode them. Their presence is thus ephemeral and with little significance. The most obvious are those that have formed on the remains of plants and elements left by the high tides. The fauna is similar to that of the mobile dunes, but lower in quality and quantity. Ant lions, dung beetles and sand fleas are present but there are few vertebrates, mainly gulls or waders that approach in search of food and lizards (large psammodromus and sand lizards).

5. The human environment

Along the length of the dune, there are several areas directly or indirectly transformed by man: the Perla Blanca and El Laurel beach bars, with their associated car parks, and the pedestrian walk between them, are complemented with several open paths on the plain and the dune to give access from the housing estates to the beach. This area interacts with the dune, invading an important part of it modifying its characteristics with intense trampling of the mobile dune affecting the fauna and flora. It also has caused the introduction of exotic plant species that grow in the interior of the dune, invading it.

5.8.6 Damage caused by trampling on the mobile dune.

5.8.7 The system of open paths across the dune.

6. Semi-fixed dune

One of the peculiarities of this dune is the excellent development of the communities of bushes that, protected from trampling, have increased their presence in the post-dune plain. The typical community is the *Loto cretici-Crucianellum maritimae*, which exists as a low growing community (less than 50 cm), in places quite dense, with everlasting (*Helichrysum stoechas*) and the Cretan's bird's-foot trefoil (*Lotus creticus*), accompanied by many other species such as mullein (*Verbascum thapsus*), silvery paronchia (*Paronychia argéntea*), and scarlet pimpernel (*Anagallis arvensis*) etc. It forms a mosaic with others such as the annual grasses of the *Ononido-Linarietum pedunculatae* community, rich in species (*Malcomia littorea*, *Vulpia alopecurus*, *Senecio leucanthemifolius*) and the *Sporoboletum arenarii*, a nitrophilous community of annual therophytes, with *Centaurea sphaerocephala* and the grass *Sporobolus pugens*, besides other more common species such as *Cynodon dactylon*, *Panicum repens,* etc. It is here that there is the greatest richness of fauna, with good populations of large psammodromus, Bedriaga's skink, greater white-toothed shrew, wood mouse, common bat (coming from residential areas), as well as numerous insectivorous birds: common swallow, house martin and common sparrow.

5.8.8 Central portion of the post-dune plain with scrub.

5.8.9 Black redstart.

5.8.10 Dartford warbler.

The quality of the scrub in the post-dune plain varies according to the quality of the soil, from isolated bushes in the sparse grassland, some pines, mastics and hawthorns, even some junipers, as well as other small islands of species, to dense growths of everlasting (*Helichrysum stoechas*) which reach the inner slope of the mobile dune.

5.8.11 Different views of the scrub in the post-dune plain.

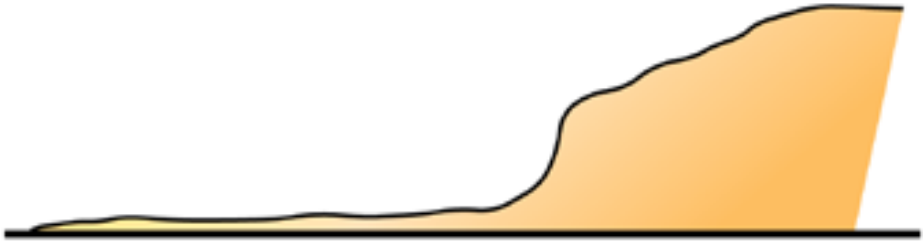
ITINERARY 9
DUNE LAS GOLONDRINAS

ITINERARY 9
DUNE LAS GOLONDRINAS

Itinerary

This itinerary takes you around a dune that is unique in its morphology, unique that, although small in size, it reaches the highest height above sea level of the entire Reserva Ecológica, and having a good reputation as an observation point for seabirds and other birds during the annual migration.

Location of the itinerary.



Geomorphological diagram of the dune.

Access to the start

From the A-7, take the Elviria Playa exit and follow the road to the sea. At the end there is a public car park, next to the El Laurel beach bar. As an alternative and from the second roundabout, turn left onto Avenida Marbella Arbolada and choose the detour along Avenida Naviero to Los Tony´s beach bar.

Characteristics of the itinerary

Name	*Duna La Víbora-Oeste*	**Type**	*Length*
Length	*350 metres*	**Duration**	*50 minutes*
Difficult	*Low*	**Best season**	*All year*

What to see

The objective of this itinerary is to identify the following features:

- To understand the characteristics of this dune with its unique morphology.
- Characteristics of the vegetation cover and its distribution.
- The accompanying fauna.
- The effects of human activity on the dune.

It is advisable to start the itinerary from the El Laurel car park, although it can be done from the other side (Chiringuito Los Tony's), located to the east of the dune. In this case it will start by the base of the dune towards the west.

From the Laurel, access is via a path that goes up the hillside, next to the enclosure of the Las Golondrinas Urbanization, running through a leafy stand of mimosas (Acacia spp.) and fairly dense grassland undergrowth, which occupies the clearings between the bushes. On continuing, you reach the upper part of the dune, from where you can see the sea (at this point the creation of a viewpoint for the observation of birds and the landscape would be ideal).

From there, descend following the path to the other end of the dune next to the access road to the beach. Continue along a foot path that goes down to the beach and then continue west along the base of the dune fot its entire length, until you end up at a new foot path that leads to the Laurel car park where the itinerary ends.

ENVIRONMENTAL ELEMENTS

Unlike other dunes in the Reserva Ecológica, this dune contains a small number of ecosystems which have been influenced by human activity. These are:

1.-Annual therophytic pasture.
2.-High acacia scrub.
3.-Mobile dune.
4.-Dune slope.
5.-Accumulated marine waste.
6.-Embryo dune.

Distribution of the environmental elements.

1. Annual therophytic pasture

From the beginning of the path, you climb up the high part of the dune, crossing a dense community of annual therophytes, about 40 cm high, with abundant nitrophilous and ruderal species (geraniums, mallows, rocket, daisies, grasses, etc.), which sprout after the autumn rains and reach their maximum in the early spring, dying later in the heat of the summer. The wealth of flowers attracts many insects, accompanied by some reptiles (Iberian wall lizard and coastal geckos) that take refuge inside the fenced area of the residential development. There are abundant bird species (perching birds), some of them from the nearby human environment and some mammals (wood mouse and greater white-toothed shrew). In the residential fenced area, several plant species appearto have been planted and give refuge to some interesting species of fauna.

5.9.1 The start of the walk with pasture land.

2. Acacia scrub

Most of the dune is occupied by a dense scrub of mimosas or acacias (Acacia spp.), accompanied by pasture that dominates the clearings inbetween with grasses and other rarer species: white broom, palms, blackthorn, some giant cane, lantana, and so on. This dense scrub, about 2 metres high, is the regrowth after having cleared the dune thoroughly, being a living example of the strength and invasiveness of exotic species, which create special conditions in the sandy soil, making it difficult for other species to take root; in it, the seeds (very abundant) of acacias, tend to take root easily, creating an edaphic substratum with the abundant dry leaves and seeds that inhibit the growth of other species.

From the beginning of the itinerary, we can observe the interesting fauna that visits this dune, especially the birds, which use it to rest or as a refuge and hunting area, but not to nest. There are an abundance of warblers, chiffchaffs, blackbirds, sparrows, African stonechats and goldfinches etc, with house martins, swallows and swifts in flight over it. The kestrel usually uses it as a perch.

Spiny-footed lizards and geckos live in the vegetation and on the edge of the residential fencing, as well as Bedriagai's skinks.

5.9.2 Cetti's warbler, a migrant to the area.

5.9.3 Eurasion blackcap.

5.9.4 The reeds are usually present in substantial stands, accompanying the acacias.

3. Mobile dunes

Arriving at the eastern part of the dune, the small storage shed and the Los Tony's beach bar and access road are visible; the pastures and scrub disappear, the clean sand with a stand of reeds and some scruffy acacia bushes occupy the corner of the dune. From here the mobile sands stretch in a narrow belt of variable width, circuling all the dune towards the west, to the upper part of a strong dune slope of up to 3 metres, caused by the marine storms and the wind swept sands. Following the route we reach the beach by a wooden foot path from where we can appreciate the steep slope up to three metres high that the marine storms have caused.

The vegetation cover on this mobile dune is restricted and contains a mosaic of several communities of which some species are abundant such as the European sea rocket (*Cakile maritime*), sea daffodil (*Pancratium maritimum*) and the sea holly (*Eryngium maritimum*) etc. The communities of plants here are recovering after the exotic species have been cleared however some stands of giant cane persist.

5.9.5 European sea rocket is common in mobile sands.

5.9.6 View of mobile sands in the interior of the dune.

5.9.7 Stand of giant cane in the mobile dune.

5.9.8 View of the mobile dune at the eastern end.

In the western part of the mobile dune, near to the end of the itinerary, there are hemicryptophytic grasslands, with abundant species, with a notable presence of sea holly, sea daffodils, sand dropseed (*Sporobolus pungens*) and sea knotgrass (*Polygonum maritimum*), and numerous other grasses, in the best representation existing in the dune.

The fauna is scarce, with psammophytic beetles, lepidoptera and grasshoppers, and few large psammodromus and Bedriagai's skinks. Birds come to feed on insects especially perching birds, kestrels, swallows and house martins in flight.

5.9.9 Accumulation of grasses and sea daffodils, in the sands of the mobile dune next to the El Laurel public car park.

4. The dune slope.

The whole dune front at the foot of the beach, appears as a steep cliff and slope, created by the erosion caused by marine storms and man; its remarkable height (up to 3 metres), makes it very noticeable. This is a clear example of the instability of the dune system in the area, as a consequence of the human management of the beach and the force of the storms that have significantly reduced the width of the beach. On this beach the huge loss of sand is more noticeable than in others, pipework is exposed (before it was buried), and the dune has been shortened at its eastern end by machinery.

The front allows us to observe the sand levels, as well as the strata formed by the (buried) accumulation of debris and rubbish. Significant here is the chance to observe the root systems of the psammophitic plants, many of which have become loose and fallen down the slope.

5.9.10 Sea edge of the dune with formed slope and human occupation.

5.9.11 Slope of the dune with sand slides.

Due to its steepness, there are hardly any traces of fauna, which tend to accumulate at the base and on the beach.

5. Accumulated marine waste

The marine storms often cause marine waste made up of reeds, organic debris and seaweed etc. to accumulate at the foot of the eroded sand slopes. This constitutes a unique and interesting habitat.

Taking advantage of this residue, a specific community of plants is usually represented: *Salsolo Kali-Cakiletum maritimae*, formed of just a few species, notably the prickly saltwort (*Salsola Kali*) and European sea rocket (*Cakile marítima*). There are isolated specimens, which give cover to a community of very unique insects, including dung beetles, sand fleas and antlions, among others. These are visited by sand lizards and many coastal birds.

The mechanised beach cleaning, and the sunbed rental business, repeatedly eliminates this community so it is has a very ephemeral existence.

5.9.12 Marine debris and vegetation eroded from the dune.

5.9.13 Typical habitats of accumulated marine debris.

6. Embryo dunes.

Continuing along the foot of the slope, we find at the end of it a small area of sand that forms an embryo dune. In its centre, there are some plants which are the remains of the typical vegetation of these sands adapted to intense sunshine, drought and the influence of the saline sea air: sand couch grass (*Elymus farctus*), sea knotgrass (*Poligonum maritimum*), European sea rocket (*Cakile maritime*), seablite (*Suaeda maritime*) and sea daffodil (*Pancratium maritimum*).

The accompanying fauna, similar to that of the marine debris, is limited. Significant are the sand beetles, the antlions, and the large psammodromus lizards which occur in this domain, and are directly affected by human activities in the summer and by the tides.

5.9.15 Embryo dune at the foot of the mobile dune.

From this point, access is via a fixed foot path to the starting point of the itinerary in the public car park.

5-5. Beach bars

There are various chiringuitos or beach bars located near to each of the dune systems which allow beach goers to enjoy refreshments and relaxation. These establishments are authorised by the Regional Government of Andalucía at the proposal of Marbella town council. There are also concessions for the installation of hammocks and parasols for rent.

Their distribution by dune and their characteristics are as follows:

DUNE RIO REAL

Chiringuito	*Trocadero Arena*
Telephone	*952 865 579*
Speciality	*Mediterranean and international dishes*

Chiringuito	*Palm Beach*
Telephone	*952 859 034*
Speciality	*Andalusian dishes*

DUNE LA ADELFA

Chiringuito	*El Mangaleta*
Telephone	*952 822 872*
Speciality	*Fish, Mediterranean dishes*

DUNE EL ALICATE

Chiringuito	*Los Sardinales*
Telephone	*952 837 012*
Speciality	*Fish and seafood*

Chiringuito	*Los Cano*
Telephone	*952 838 989*
Speciality	*Mediterranean, grilled and rice dishes*

DUNE EL BARRONAL

Chiringuito	*Las Flores*
Telephone	*952 832 238*
Speciality	*Homemade and Mediterranean*

DUNE EL ARENAL

Chiringuito	*Arenal Beach*
Telephone	*951 507 426*
Speciality	*International dishes*

Chiringuito	*Bono Beach Marbella*
Telephone	*952 839 236*
Speciality	*International dishes*

DUNE REAL DE ZARAGOZA

Chiringuito	*Siroko Beach*
Telephone	*626 569 729*
Speciality	*Medterranean dishes*

Chiringuito	*Aquí te quiero ver*
Telephone	*952 834 554*
Speciality	*Mediterranean dishes*

Chiringuito	*Sylt*
Telephone	*951 170 979*
Speciality	*Mediterranean dishes*

Chiringuito	*Ranchón Cubano*
Telephone	*662 643 411*
Speciality	*Seafood and salads*

Chiringuito	*Las Mimosas*
Telephone	*651 986 697*
Speciality	*Paella and Mediterranean dishes*

Chiringuito	*La Plage Casanis*
Telephone	*952 837 862*
Speciality	*Vegetarian options*

DUNE LA VIBORA-OESTE

Chiringuito	*Beach House*
Telephone	*952 839 458*
Speciality	*International dishes*

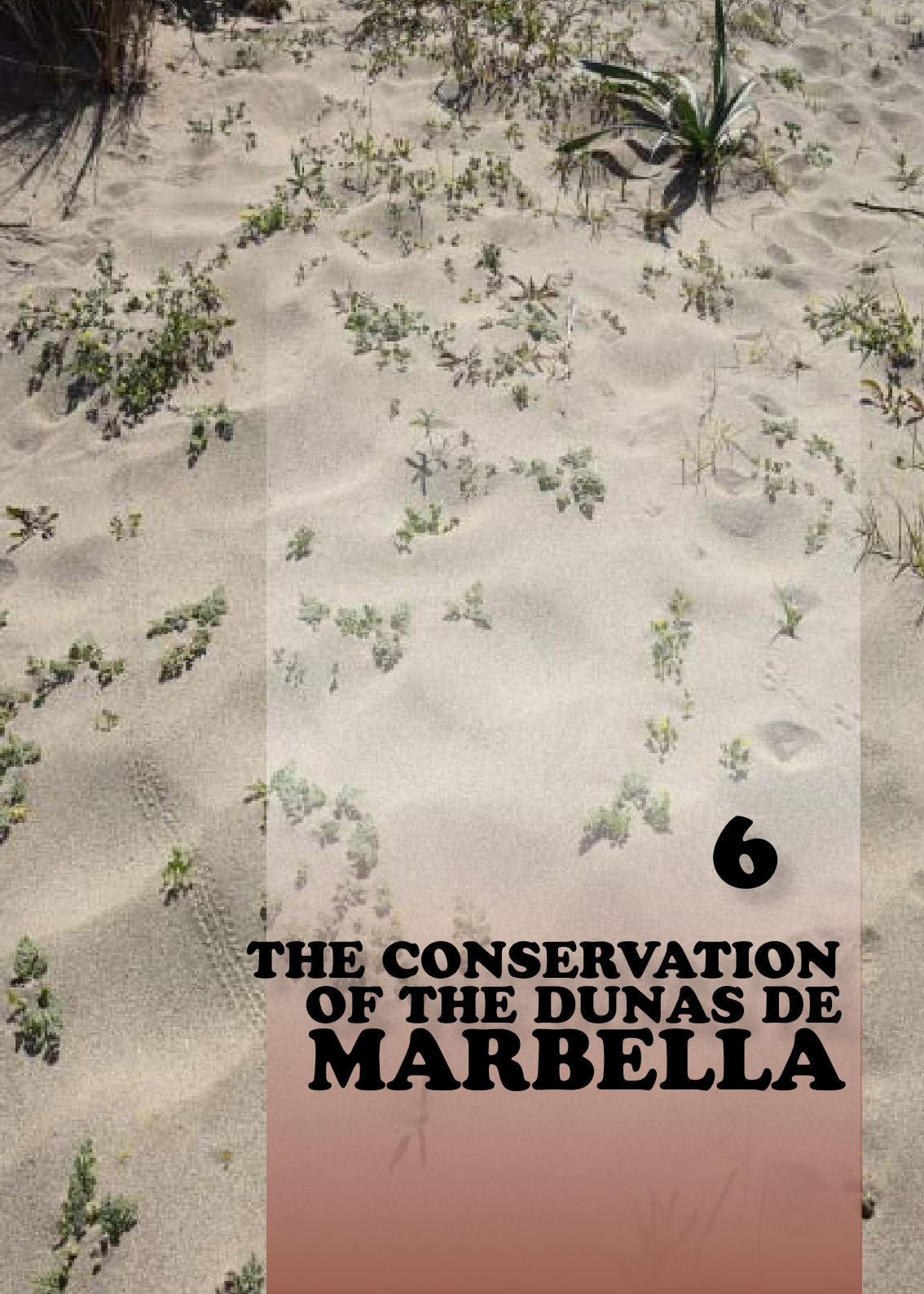
DUNE LA VIBORA

Chiringuito	*Perla Blanca*
Telephone	*952 835 914*
Speciality	*Mediterranean dishes, rice and fish*

Chiringuito	*El Laurel*
Telephone	*952 834 934*
Speciality	*Rice, fish and seafood dishes*

DUNE LAS GOLONDRINAS

Chiringuito	*Los Tony´s*
Telephone	*952 113 142*
Speciality	*Mediterranean dishes, rice and fish*



6

THE CONSERVATION OF THE DUNAS DE MARBELLA

6 THE CONSERVATION OF THE DUNAS DE MARBELLA

6.1 The outline of the problem: summarising the issue

The dunes included in the Reserva Ecológica de Las Dunas de Marbella (and also the rivers and streams that border them in places), are subject to environmental problems, which, although seem common to the majority of these types of places throughout the world, hold a unique significance due to some differenting elements. Not all coasts are the same, not even by law. The discovery that the Marbella coastline was one of the most beautiful places on earth, rich in nature and with a benign climate, mobilised multiple investments and interests, thereby determining the urban development of the coast and also the interpretation of various laws applicable to the region.

As an understandable consequence, after a long period of uncontrolled urban development with no real studies as to the problems of accessibility and infrastructures etc, the conservation of these natural habitats and resources whose value was the basis for the tourism to the municipality, was not taken into account.

As a consequence, and nearly forty years after the start of Marbella's urban expansion, which is now consolidated except for a few places on the periphery, the opportunity and need to conserve those resources and natural spaces that still exist, albeit precariously amidst the vortex of construction, has been discovered. This is how the interest and concern of groups of citizens for the conservation of the dune fronts of Marbella first arose. Unlike what happened with the Dune of Artola (declared a Natural Monument by the Junta de Andalucía in 2003), which had remained a no-man's land among the constructions; its natural limits not even part of the public maritime terrestrial domain.

It was in 2004 when the Asociación ProDunas became a new way to channel the concerns of the people who supported protecting the dunes. It was with the backing of Marbella town hall, who officially presented the proposal to make the dunes an Ecological reserve to the Ministry of Environment and Land Management of the Junta de Andalucía, that Malaga Territorial Delegation passed a

Resolution on 18 September, 2015. Since then, it has been possible to implement the entire system of protection of natural resources, based on the Technical Plan of the Reserve, which obviously needs not only the involvement of the population of Marbella, but also the technical, economic and institutional support of those agencies of the Administration who wield power in the dune territory. This has made it possible to consolidate and improve all the unique natural resources present in the reserve, as well as regulating their proper use by the public visiting them and reconciling the interests of all those who are somehow related by proximity or economy with the Reserva.

6.2. Environmental problems

At present, the dunes that make up the Reserva Ecológica have a wide and difficult range of problems that to a greater or lesser degree affect their conservation. The combination of these problems at any one time endangers the future of such systems and with it the effectiveness and raison d'être of the Reserva Ecológica itself. These problems are due to a number of different factors, all with a different effect according to each dune and each element of it:

Problems of natural origin

As in the entire coastal area, the consequences of climate change are clearly evident in the Marbella dunes, through stronger marine storms, especially those from the Levante and Poniente (and lately of the South-Southwest), which are causing the intense erosion of embryo dunes and first line mobile dunes.

This greater erosive capacity, whose effects can be seen especially in the dunes of La Víbora and Las Golondrinas, implies losses of several hundred m3 of sand that is eroded, without the natural compensation systems, which have been altered by human management of the coast and rivers, being able to balance them out.

6.1 Erosion of the mobile dune with sand slides and marine storm debris.

Problems of a structural nature

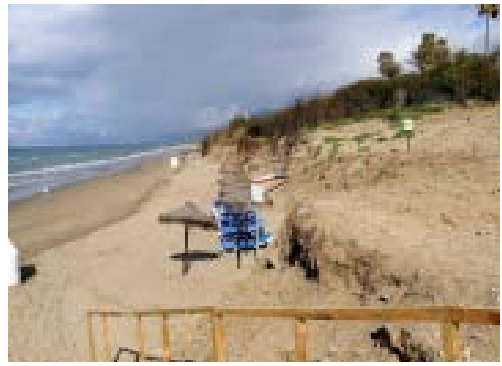
Some of the dunes' 'ailments', are caused by structural elements (such as the size or fragmentation of the area), as well as by rights-of-way created by inadequate enforcement of coastal regulations (in the delimitation of the DPMT, the occupation of the ZPS, and in the incorporation of beach establishments and services), including the definition of beaches bordering the dunes as urban beaches and not as natural beaches.

Problems arising from the misuse of dune spaces.

These problems can be differentiated in respect of the different eco-systems in the protected zones, and even more specifically for each one of the dune systems; they frequently have significant diverse aspects:

1. <u>For embryo and mobile dunes.</u>

- The uncontrolled trampling of the embryo and mobile dunes which displace sand, eroding the summits and destroying the vegetation as well as (indirectly) the psammophytic fauna.



- The removal of embryo dunes and part of the dune slope by beach cleaning machinery or to install sunbed or massage points.
- The invasion of exotic species.

2. <u>For the post-dune plains:</u>

- Uncontrolled trampling.
- Uncontrolled loose dogs (when they should be on a lead)
- The planting of exotic species, both on the edge of the fences of the housing estates and inside the plain.
- Pruning or felling good-sized tres or shrubs.
- The proliferation of cats that prey on the fauna.

- The dumping of rubbish

3. For semi-fixed and fixed dunes (of which there are few in the Reserva Ecológica)
- The dumping of rubbish
- The dumping of organic waste from nearby gardens
- Dogs roaming frees
- The parking of vehicles

6.2 Dumping of rubbish.

6.3 Excrement.

6.4 General trampling in the dune even outside the signposted paths.

Problems arising from lack of control and vigilance of the natural resources of the area and towards the elements installed for public use and protection. The quasi-urban nature of these dune spaces, and their protection by two bodies (Demarcación de Costas and Delegación Territorial de Medio Ambiente de la Junta de Andalucía) together with the local authority, security bodies and state forces (SEPRONA of the Guardia Civil, Local Police, Environmental Agents), should in theory guarantee complete control of the condition of the zone and behaviour of personnel related to the area, provided that there is a framework of coordination between them and the will to achieve and apply it.

6.5 Removal of the posts and ropes that protect and delimitate the dune.

With regard to the ***fluvial spaces*** on the edges of the protected dune systems, the conservation problem is equally important, and in some way similar to that of the dune areas:

Problems of a natural origin

The changes in the distribution of rainfall in the Mediterranean climate enjoyed by the area are now more often defined by a greater, more forceful concentration of rainfall and a more open seasonal distribution of the same. This leads to deluges of water that instantly increase the flow through the water courses, sweeping materials along with it and eroding the channels, especially at the mouths of some rivers and streams.

6.6 Erosion on the Banks of the Realejo stream affecting the dune and the sewage pipes.

Structural problems

As with the dunes, some streams in the public domain have been invaded by constructions with a loss of five metres on each bank, a valuable public space that lacks an effective replanting of native vegetation. None of the streams have documented boundaries nor is the public domain defined (except for part of the Río Real) leading to their current marginalisation..

Problems arriving from the misuse of the rivers

Frequently, in some watercourses, there are problems derived from misuse among which the following are significant: the creation of breakwaters to protect dwellings on the edge of the watercourse (invading the DPH area); wastewater discharged directly without filtering and which ends up on the beach where it is not uncommon to see children playing in the watercourse; and finally, the dumping of rubbish and waste in the watercourse and on the banks in many of the final stretches, thereby attracting unwanted rodents (common rat).

6.7 Dirty, unfiltered water in the watercourse.

However the most pressing and important problems are those that affect the loss of natural resources, especially the loss of native riparian vegetation as a result of the expansión of exotic species on the banks and edges of all the streams with the exception of the Río Real, (probably because of controlled efforts); their excepcional vigour, especially the giant cane (Arundo donax), has eliminated native species from those environments and at the same time, has reduced the quality and quantity of the associated fauna.

6.8 Giant cane at the mouth of the Realejo stream invading the beach.

6.3 Restoration and conservation action

Faced with a chain of bad examples, a daily reality in the Reserva Ecológica, motivated residents supported by the Produnas Association and (a few) other social groups came up with different projects to conserve and protect the Marbella dunes and many have been initiated since the value of the dunes became recognised in 2004. These include the banning of capturing birds (finches) and the massive harvesting of the 'everlasting' plant (Helichrysum stoechas).

Without a doubt, the municipal initiative and the support of the Ministry of Environment which declared the area an ecological reserve plus the demarcation and approval in the Plan Técnico marked a milestone in these activities. The granting of legal status to the area was now at least visible to society and other administrations. Action since has followed a marked path, with the Town Hall, the Coastal Demarcation MAPAMA in Malaga and the Territorial Department of the Environment working to restore the coastal environment, although there was a lack of fine detail in the planning of investments and their coordination for the achievement of the objectives set out in the Plan.

These actions have essentially affected the following aspects:

Protection of the dunes	*The placing of foot paths, (wood)*
	The placing of wooden fencing posts
	Roped off areas at the edge of the beach
	Refurbishment of rainwater outlet. (La Adelfa dune)
	The placing of obstacles to prevent passage of vehicles
Clean-up	*Removal of rubbish and waste*
	Provision of litter bins and containers
Improving vegetation	*Removal of exotic species*
	Replanting of native species
	Pruning of bushes and trees
Improving the dune geomorphology	*Repairing damage caused by trampling*
	Placement of sand traps
Provision of elements for public use	*Information boards*
	Rest areas
	Protection warnings

6.9 The participation of children and young people has been very important in the cleaning and restoration of the dunes.

The value of this set of initiatives carried out mainly by the Asociación ProDunas under the guidelines of the Plan Técnico of the Reserva Ecológica, highlights the need for an increased involvement by the associated bodies, within the framework of their abilities and attributions to further develop the initiatives, particularily through economic investment and reinforcement of controls and surveillance in the affected areas.

Unfortunately that which is the object of great concern for many, can be destroyed by just a few. The character of these public spaces should be sufficient stimulus for others to become involved.

From experience obtained in the years since the declaration of the Reserva Ecológica, it can be concluded that the effectiveness of any action depends on the control and elimination of the existing problems causing the deterioration of the dunes, before any effective restoration can be carried out.

All this should be accompanied by conscientious damage control and surveillance of the area, as well as continuous education and training. The involvement of the public authorities will help with the conservation of the resources.

6.10 The involvement of administrations will facilitate conservation.

6.11 Avoiding damage to the mobile dunes with the installation of floating/ raised walkways is urgent.

6.4 Environmental education as a conservation tool

The protection of any natural area and its resources cannot be achieved without strong and continuous social support based on the most complete knowledge possible of the current situation to assist in the evaluation and justification of such support.

To achieve this social support for the Reserva Ecológica-Dunas de Marbella, the collective ProDunas have worked together to make the need for such protection more visible, and to publicise the social benefits that it brings for the entire population of Marbella, for the residents of neighbouring developments and for users of environments such as these in general, as well as highlighting the natural values of the municipality and the entire province.

Over the years, and especially since its declaration, a growing and broad group of activities conducive to the dissemination and environmental training, as well as for environmental improvement of the Reserva have been carried out by both the Produnas Association and the Marbella town hall, (through the Delegation of Environment). Activities have continued to be developed through the Voluntariado Ambiental, especially through the Program Pleamar (formerly Cuidemos la Costa), in collaboration with the Departments of Environment and Education of the Junta de Andalucía, (Andalusian Government).

These activities can be divided into two main groups:

- Activities to promote environmental training, aimed at both schoolchildren and teachers and also at various social groups.

This programme has incorporated numerous activities to raise public awareness, for which the number of participants has been significant: Workshops on cleaning up dune environments; Workshops on eradicating invasive exotic species; Workshops on reforestation with native plants; Dune sponsorship by schoolchildren; Educational talks in schools, with escursions to the Reserva Ecológica, etc. It is worth highlighting the support of the town hall through the provision of personnel and materials as well as skips for the subsequent removal of waste.

The Cleaning Days are aimed at raising participants' awareness of the amount of rubbish left in the protected environment and the importance of its recycling; the workshops on the eradication of invasive exotic species (IAS), as well as reforestation, with the participation of schools in the municipality and in the province, have been more widely acknowledged.

With regard to the learning activities carried out in the schools as well as in the dunes themselves, diverse educational material has been created and workshops for school children.

6.12 Educational activities for Primary and Secundary students.

- Activities to educate and publicise the Reserva Ecológica, is more widespread and includes tourist groups and visitors to the coast as well as social groups within the municipality itself and neighbouring developments.

Among those with the widest uptake are: Ecotourism in the dune environments; various types of educational tours (biodiversity, olfactory routes, etc.); local cultural heritage routes (Torre Ladrones and Torre Lance de Las Cañas).

This community participation, promoted by the ProDunas Association, also includes the sponshorship of dunes in the Ecological Reserve by schoolchildren and activities for the conservation of the natural environment. Volunteers and employees from various companies who want to be actively involved in environmental activities also participate in these tasks.

Educational tour with foreign visitors to learn about the Reserva Ecológica and its natural resources.

6.5 New management guidelines: The Plan Técnico

The resolution for the creation of the Reserva Ecológica, established as a reference document the Plan Técnico; which identifies the different initiatives and the seasonal schedule to be adopted by the various administrations as well as by the supervisory body Marbella town hall, to achieve and manage the objectives for the protected areas.

Although the aforementioned schedule is carried out subject to the availibilty of funds in the budget, the experience accumulated over the years suggests establishing priorities for development, depending on the degree of their positive impact on natural resources and the stability (viability) of the different protected dune systems.

Having defined the two main problems of the dunes, their alarming deterioration due to human misuse (in the form of uncontrolled trampling, excessive occupation by beach bars and sun beds, and the erosion of the external slope, and the proliferation of exotic plant species (invasive or not) in the dunes which is detrimental to the native vegetation, it seems obligatory to prioritise activities to safeguard them.

The almost continuous traffic due to public use of the dunes, especially in summer, which increases year after year, makes it impossible to restore the dunes in a natural way. This is due to two fundamental factors: the lack of adequate facilities for the public that contain and channel the transit of water, as well as the lack of a surveillance system to enforce the regulations that are there to protect the natural resources. The floating footpaths and fences alongside the coastal path that the Diputación Provincial de Málaga is installing along the

entire coast line, should help to avoid trampling, alowing the free movement of sand and the growth of vegetation and psammophytic fauna. The provision of a staffed monitoring system by the town hall, with the support of the Coastal Demarcation Department and the Coastal Environment Agency, should be sufficient to maintain control of the situation.

The excessive occupation by licensed establishments in the reserve, evident even on Google, will have to be revised and adjusted to comply with regulations for the conservation of the area.

The erosion of the external slope of the dunes, which is caused naturally by marine storms, should not be accentuated by the beach cleaning machines at the foot of the slopes, and the natural process of creating new embryo dunes should be conserved.

Finally the capacity for expansion of the invasive species requires constant attention in order to maintain control, eliminating new shoots and controlling spreading, even if it means using the appropriate machinery to dig out the roots of the specimens. Only in this way can the native vegetation return to colonise the vast expanse. This control is currently carried out by the Association ProDunas through constant monitoring and where necessary, the eradication and elimination of invasive exotic species.

THE FUTURE OF THE RESERVA ECOLÓGICA DUNAS DE MARBELLA

Any protected space needs, for its consolidation first and its maintenance in the time after, the adoption of two fundamental elements: an adequate management and decisive social and institutional support, protected from the political ups and downs or personal interests.
On the basis of the administrative declaration of the Dunas de Marbella as a Reserva Ecológica, and the approval of its Plan Técnico, which define the actions to be taken and the development of the same, and taking into account established conservation objectives, it can be said that the path for management appears to be quite clear and it is only a question of will (and budget). The coordination of all the administrations involved (Junta de Andalucía, Ministry of the Environment and the town hall) should take priority, given the nature of these public spaces.

It is also preferable to extend the reserve, with the incorporation of the El Pinillo dune which is the closest to the urban nucleus of Marbella, in order to achieve legal and protected status to all the dune systems in Marbella and thus provide a defined framework of action for these areas of the highest natural value, which until now have not received recognition for their environmental value nor for their central role in tourism for the municipality. The dunes are not beaches: a dune is a space of environmental value for which there is an ethical and legal obligation to protect both the habitats and the natural resources.

On the other hand it is evident that there is an enormous burden of social pressure on the dunes in the form of demands for space for both leisure and maritime / coastal pursuits. The proximity of the dunes to the urban framework, the absence of infrastructures to manage vehicular access, as well as the territorial structure of the reserve itself, fragmented into small units restricted by man, heightens the risk of its deterioration. It is a fragile environment that faces diverse negative activities being carried out within it and which counts on the social support of the reserve's own residents to control damage.
It is clear that the dunes legal protection status must be respected, but also their status as actual gardens, protected green areas that benefit everyone, especially the residents of neighboring residential areas for which the environment adds value to their homes. The solution to some of the current problems of the dunes: parking near the beach bars and uncontrolled trampling, must be corrected with the creation of external parking infrastructures and floating pathways, as has been done in other coastal areas; some others problems such as the excessive occupation of dune land by beach bars and sunbeds, the erosion of the dune foot by beach cleaning machines, or the proliferation of invasive plant species, simply demand a greater application of the existing regulations.

Understandably, the Reserva Ecológica is called the natural jewel of Marbella and is incorporated into a group of protected areas unique to the province of Malaga, serving as the flag of ecological quality of the municipality and thereby reinforcing its role as a place of excellence in tourism. It is therefore necessary that the people of Marbella, headed by the town hall, are considered trustees of the obligation to ensure its survival by involving visitors in the task and inviting them to enjoy its existence.

8 EPILOGUE

The Vistor's Guide to the dunes aims to be a tool for all people who feel close to nature and who do not want to remain indifferent about environmental matters in which sooner or later we will all have to involve ourselves. This guide was born thanks to the support of the local and provincial Public Administrations, who for many years have supported the Asociación ProDunas. Without the necessary resolutions taken by these administrations, it would not have been possible either to protect the different dune ecosystems or to include them in the Reserva Ecológica-Dunas de Marbella.

In 2004, to the east of Marbella, a group of citizens set out to preserve the survival of a beautiful biodiversity with dune formations that was in danger of disappearing due to the massive building boom on the Marbella coastline, thus the Asociación ProDunas de Marbella was born. Since then this association has patiently devoted itself to the defence and care of the natural treasures that these dunes house, always in an altruistic way, investing its free time and enthusiasm.

As an association they have managed to sensitise and involve the different local, provincial and autonomous administrations, achieving the recognition of the environmental and landscape value of these dune formations that are an enormous natural treasure for the Natural Heritage of Marbella.

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ANNEX - Plant catalogue

Species of wild plants in sandy habitats:

Acacia saligna (mimosa)*
Acacia cyanophylla (mimosa)*
Acacia longifolia (mimosa)*
Aetheorhiza bulbosa (tuberous hawk's beard)
Agave americana (century plant)*
Agave sisalana (sisal)*
Allium roseum (rosy garlic)
Ammophila arenaria var. arundinacea (European marram grass)
Anthyllis tetraphylla (bladder vetch)
Arctotheca calendula (cape dandelion)*
Aristolochia baetica (Andalusian Dutchman's pipe)
Arundo donax (giant cane)*
Asparagus stipularis (asparagus)
Asphodelus aestivus (summer asphodel)
Asphodelus albus (White asphodel)
Austrocilindropuntia subulata (Eve's pin)*
Cakile maritima (European sea rocket)
Calicotome villosa (spiny broom)
Carpobrotus edulis (Hottentot fig)*
Centaurea sphaerocephala (common knapweed)
Chamaerops humilis (European fan palm)
Conyza canadensis (horse weed)
Cortaderia selloana (pampas grass)*
Crucianella maritima (crossworts)
Cutandia maritima (cutandia grass)
Cynodon dactylon (Bermuda grass)
Cyperus capitatus (sand galingale)
Daphne gnidium (flax-leaved daphne)
Delphinium nanum (larkspur)
Dianthus broteri (wild pink)
Dittrichia viscosa (woody fleabane)
Echium gaditanum (viper's bugloss)
Elymus farctus subsp. farctus (sand couch grass)
Equisetum ramosissimum (branched horsetail)
Erodium cicutarium (redstem stork's bill)
Eryngium maritimum (sea holly)
Eucalyptus camaldulensis (red river gum)*
Eucalyptus globulus (Tasmanian blue gum)*
Euphorbia baetica (spurge)
Euphorbia paralias (sea spurge)
Hedypnois cretica (cretanweed)
Helichrysum stoechas var. maritimum (shrubby everlasting)
Ipomoea indica (blue morning glory)*
Ipomoea sagittata (saltmarsh morning glory)*
Ipomoea stolonifera (beach morning glory)*
Juncus acutus (spiny rush)
Juniperus oxycedrus subsp. macrocarpa (cade juniper)
Juniperus turbinata
Lagurus ovatus (hare's tail)
Lantana camara (shrub verbena)*
Lavatera cretica (mallow)
Linaria pedunculata (toadflax)
Lobularia maritima (sweet alyssum)
Lotus creticus (cretan trefoil)
Malcolmia littorea (silver sea stock)
Medicago marina (sea medick)
Mentha rotundifolia (mint)
Nerium oleander (oleander)
Nicotiana glauca (tree tabacco)*
Ononis natrix subsp. ramosissima (bush restharrow)
Opuntia ficus indica (prickly pear)*
Otanthus maritimus (cottonweed plant)
Oxalis pes-caprae (sour grass)*
Pancratium maritimum (sea daffodil)
Panicum repens (torpedo grass)
Pennisetum setaceum (crimson fountain grass)*
Phoenix canariensis (Canary Island date palm)*
Phoenix dactylifera (date palm)*
Pinus halepensis (aleppo pine)
Pinus pinea (Italian Stone pine)
Pistacia lentiscus (mastic)
Pittosporum tobira (Japanese cheesewood)*
Polygonum maritimum (knotgrass)
Pseudorlaya pumila (small carrot)
Pteridium aquilinum (bracken)
Retama monosperma (bridal veil broom)
Rhamnus alaternus (Mediterranean buckthorn)
Rhamnus lycioides (black hawthorn)
Rhamnus oleoides (olive-leaved buckthorn)
Rubia peregrina (wild madder)
Rubus ulmifolius (elm leaf blackberry)
Rumex bucephalophorus (red dock)
Salsola kali (prickly saltwort)
Scirpus holoschoenus var. australis (round headed club rush)
Sedum sediforme (pale stonecrop)
Senecio leucanthemifolius (coastal ragwort)
Silene nicaeensis (campion)
Solanum nigrum (European black nightshade)*
Sonchus tenerrimus (slender sow thistle)
Sporobolus pungens (sand dropseed)
Tamarix africana (African tamarisk)
Thymbra capitata (Mediterranean thyme)
Verbascum thapsus (mullein)
Vulpia alopecurus (fescue grass)
Yucca aloifolia (Spanish bayonet)*

***Exotic/invasive species**

Pancratium maritimum

Helichrysum stoechas

Ononis natrix subsp. ramosissima

Asphodelus albus

Delphinium nanum

Cyperus capitatus

Cakile maritima

Lobularia maritima

VISITORS' GUIDE
RESERVA ECOLÓGICA

DUNAS
DE MARBELLA