This section describes the situation concerning green infrastructure and biodiversity in Barcelona. The diagnoses made have been prepared through parallel processes using the same methodology, which consists of the following:

- Compiling information.
- Detecting shortcomings in knowledge and processes.
- Developing supplementary internal reports and studies.
- Investigating the experiences of other cities.
- Extracting the most significant data.

One major aspect in the preparation of Barcelona Green Infrastructure and Biodiversity Plan has been the organisation of participatory processes carried out during several meetings which helped to share the diagnosis made, to agree on the long-term challenges and goals and to gather proposals on biodiversity and green infrastructure in order to draw up the plan of action.

The conclusions of the diagnosis are summed up in two blocks: one on the work carried out to date and on the situation regarding biodiversity; the other on green infrastructure according to the various spheres covered.
Poster 20.

The green network of Barcelona

[Map showing various areas such as open natural space, river area, forest, park, garden, vegetable garden, pond, square, tree-lined street, landscaped street, green roof, and green wall and/or vertical garden.]
### 2.2 Diagnosis of biodiversity (2010)

#### 2.2.1 Work carried out to date

**Strengths**

Biodiversity has been incorporated into the local political commitments and human and financial resources have been allocated to it. Moreover, work is carried out in a coordinated manner ensuring goals are aligned with other similar municipal local projects and plans, other institutions and other bodies affording knowledge, energy and action with a view to bringing about change. Similarly, Barcelona has taken on commitments in the IUCN Countdown 2010, the first international cities and biodiversity project – Local Action Biodiversity (LAB), ICLEI-Local Governments for Sustainability – and the Spanish Network of Local Governments + Biodiversity 2010. The recently enacted environment bylaw incorporated the concept of biodiversity for the very first time.

It is worth highlighting improvements made in the preservation of territory. Indeed, progress has been made in metropolitan urban planning in taking care of open spaces (Territorial Plan for the Metropolitan Region of Barcelona), and in the protection and management of Parc de Collserola – currently part of the Natura 2000 network – which is included in the Plan for Areas of Natural Interest and has been declared a nature park. Preservation criteria and measures have also been incorporated into current urban planning projects and endeavours are made to establish conditions to avoid the impact of works and population on fauna.

The improvement of green infrastructure in the city and the creation and restoration of habitats have involved the creation of urban vegetable gardens and underwater reefs, the improvement of marine and river abutting systems, city greenery planning works and the commitment to increase the extent of green infrastructure (new gardens, city block inner courtyards) and its sustainable management. Efforts are also being made in order to envision the future of the city with green walls, roofs and corridors and in preparation to adapt the green infrastructure of the city to climate change.

**Management for the preservation of species and habitats** has also taken on a broader horizon in recent years with noteworthy, positive results in cases such as protected, listed trees, amphibians, birds, hedgehogs, and non-captive birds in Barcelona zoo, or in a case such as the falcon, whose reintroduction programme has reached a successful conclusion. A wealth of experience has been gained on how to preserve birds in walls and amphibians in ponds, with progress having been made in managing excessive animal populations (cats, wild boars, pigeons, tortoises, etc.). When it comes to international commitments, since 2004 Barcelona has implemented an ethical wood purchase policy.

In the sphere of knowledge, significant progress has been achieved in recent years in describing the values of spaces of natural interest and habitats, of ecological areas in Barcelona and of the environmental services in those areas; progress has also been made in knowledge concerning the history of the city’s nature, and in relation to the trees and shrubs in parks, gardens and streets, allergenic flora, invasive flora and fauna, and vertebrate fauna. The biodiversity of Collserola and its development are widely known.

The social commitment has been reflected through improvements in the social and educational potential of green infrastructure and by promoting responsible ownership of animals. As regards dissemination, education and participation, it is significant to note that a majority of the 283 schools taking part in the Agen-
da 21 for Schools (as at 2010-2011) work on projects linked to nature (vegetable gardens, gardens, fauna, etc.). Moreover, facilities for dissemination and research on the values of biodiversity in the city (museums, Barcelona zoo, the Botanic Garden, etc.) should be highlighted along with their renovation projects and the range of activities and publications they offer. The Fàbrica del Sol (CRBS), the journal BVerda and Aula d’Ecologia are initiatives that have been responsible for major dissemination in recent years.

Scope for improvement

There has been very little progress in protecting areas aside from Collserola, despite the advances made in protecting the cliffs of Montjuïc and the surrounding area (initial approval has been given). Although this constitutes a major milestone in achieving the goal of the commitment (“protecting all open spaces”), more needs to be done. Difficulties have also been encountered in preparing a design to foster biodiversity and develop green infrastructure in public and private constructed areas, to launch the network of green corridors and to offset the scant introduction of pervious surfaces. The reporting and pursuance of illegal animal trading is also an outstanding issue, as is the achievement of more proactive management of invasive species.

With regard to knowledge, further information is required on native urban flora, on invertebrates and on the situation in terms of biodiversity (loss of flora, fauna and habitats), along with information on the likely development of the structure of biodiversity in the city in relation to climate change. Information on biodiversity needs to be more systematically organised (database) and there is similarly a need for a monitoring system to be set up (indicators).

Furthermore, it is necessary to gain an awareness of the impact of the city on the Earth's biodiversity (exotic species, use of resources, ecological footprint). Nonetheless, it would not be daring to state that Barcelona's ecological footprint must have increased in recent years in parallel to that of Catalonia as a whole. This is significant because a large part of the city's impact on biodiversity as a whole is seen beyond the municipal district: in Catalonia, in Spain and the world over.

When it comes to preserving natural heritage certain areas of outstanding natural interest found within the city are subject to notable urban pressure (e.g. the Rec Comtal irrigation channel), and a number of habitats and species have been lost. Indeed, the lives of species closely linked to buildings has been hindered owing to construction work even though endeavours are being made to preserve them.

Despite the progress made on a local level as regards the consideration given to biodiversity and its benefits, there is still a long road ahead. It is no trivial matter that not enough acknowledgment is given to the role nature plays as green infrastructure providing environmental services that are essential to the city. Similarly, the benefits afforded to humankind as a result of contact with nature and the extent to which humans depend on it are also not socially recognised. Society's knowledge of nature is lacking as is its involvement in preserving natural heritage and there is a great deal to be done when it comes to promoting urban biodiversity and providing a series of means for people to become involved in and reap the benefits of preservation locally and worldwide. In order to make progress, an organisation is needed to focus efforts on the challenges we face because the benefits to be obtained from addressing these challenges and engaging in projects on a major scale are patent, as indeed can be exemplified by Barcelona and other cities analysed.
2.2.2 The situation in terms of biodiversity

Barcelona houses remarkable natural heritage thanks to the size of the Serra de Collserola mountain range, which rises over the city (encompassing more than 8000 ha) providing a mosaic of habitats which generate a wealth of species. The EU Habitats Directive, approved in 1992, designates three such habitats (holm-oak forests, pine forests and dry grasslands) as places to be preserved. The ecological map of Barcelona (analysing its development since 1977) leads to the conclusion that there has been an increase in the city's green areas and forests with few crops being observed at present.

Rivers and the sea complement Barcelona’s natural environment, albeit highly man-made. There are notable parks and gardens in the city centre (comprising 1,076 ha), laying the foundations for the urban green infrastructure, with particularly important features: Montjuïc (with the cliff included in the Inventory of Areas of Geological Interest of the Government of Catalonia), Els Tres Turons and Parc de la Ciutadella. With some 153,000 units and more than 150 different species and cultivars, street trees constitute a major part of Barcelona’s urban green infrastructure. Private green infrastructure makes up some 740 ha, but its contribution to quality of life in the city has not been valued. The city is still home to 54 areas of natural interest in the centre which have been listed, although they are not protected.
1. Areas linking with collserola
1.1 Can Caralleu
1.2 Ciutat Meridiana
1.3 Finestrelles
1.4 Horta
1.5 Montbau
1.6 Sant Gervasi

2. Areas with natural and semi-natural features
2.1 Torrent de Sant Joan (stream)
2.2 Torrent de Bellesguard (stream)
2.3 Torrent Maduixer (stream)
2.4 FGC railway in Sarrià
2.5 Cliffs in Parc de la Creueta del Coll
2.6 Can Móra forest
2.7 Turó del Carmel (hill)
2.8 Turó de la Rovira (hill)
2.9 Turó de Vallbona (hill)
2.10 El Morrot de Montjuïc (spur)
2.11 Camí de l’Esparver and other drylands in Montjuïc
2.12 Torrent de les Monges

3. Water areas
3.1 Besòs river
3.2 Former Llobregat riverbed
3.3 La Foixarda bassin
3.4 Diagonal Mar ponds
3.5 La Ciutadella pond
3.6 L’Espanya Industrial pond
3.7 Rec Comtal irrigation channel
3.8 Tres Pins nursery
3.9 Parc del Laberint
3.10 Port breakwater and artificial reefs

4. Agricultural areas
4.1 Torrent d’en Marcel-lí (stream)
4.2 Urban vegetable garden network – Hort de l’Avi
4.3 Urban vegetable garden network – Hort Can Mestres
4.4 Urban vegetable garden network – Hort Can Soler
4.5 Urban vegetable garden network – Hort Turull
4.6 Urban vegetable garden network – Hort Trinitat
4.7 Urban vegetable garden network – Hort Can Cadena
4.8 Urban vegetable garden network – Hort Sant Pau del Camp
4.9 Urban vegetable garden network – Hort Torre Melina
4.10 Urban vegetable garden network – Hort Sagrada Família
4.11 Urban vegetable garden network – Hort Collserola
4.12 Urban vegetable garden network – Hort Casa de l’Aigua
4.13 Urban vegetable garden network – Hort Pedralbes
4.14 Urban vegetable garden network – Hort Peguera

5. Areas of geological interest
5.1 Limestone on Turó de la Rovira
5.2 Slope of Sant Josep de la Muntanya
5.3 Geological section of El Guinardó
5.4 Edge of Park Güell
5.5 Mare de Déu del Port slope
5.6 Marls and sandstones of Montjuïc
5.7 Quarries at El Morrot de Montjuïc
5.8 Small slopes of Montjuïc
5.9 Roman wall in Correu Vell
5.10 Ronda de Dalt slope
5.11 Sedimentary materials in Park Güell
The presence of vertebrates in the city has been well-documented, with a total of 103 native species listed and 75 species of common birds (most vertebrates in Barcelona are protected by law: 55 birds, 2 amphibians, 8 reptiles and 7 mammals). Accordingly, there is a great deal of natural heritage for a city. The presence of a colony of hedgehogs in the zoo and several species of bats are astonishing examples of the natural phenomena one can find in a city. However, such heritage is constantly under threat due to urban pressure and needs protection. Amphibians, which are under a major threat all over the world, also bear the brunt of the impacts of Barcelona, although careful management is carried out in their favour. It is known, however, that two species of amphibians and one species of reptile disappeared from the city some years ago.

There are certain species of birds present in Barcelona which are important to Catalonia’s avifauna: the grey heron, the alpine swift, the peregrine falcon and the western jackdaw. Other significant birds include owls and kestrels. Avifauna differs from winter to spring demonstrating the city’s carrying capacity. Furthermore, Barcelona is also a staging point for migratory birds. However, these aspects are accompanied by a less optimistic fact: it would appear that the general trend with common birds in Barcelona is that they have been witnessing a gradual decline in the past few years (although this needs to be confirmed), while such a decline has not taken place in the rest of Catalonia.

In addition, it is necessary to underline the huge potential afforded by aquatic habitats (fresh waters and the sea), a
improved management should not stop action being taken, even if all the information needed is not available. Given that it would be impossible to ever gather all detailed information regarding the reasons behind the evolution of animal populations, it is vital to manage species and create habitats because, generally speaking, the outcomes are patently positive.

It is not known what would have happened in Collserola if efforts had not been made to protect it over so many years. The protection of an area does not appear to improve biodiversity but there is no doubt that lack of protection would result in it getting worse. Some years ago, Collserola did not form part of the lives of Barcelona's people; however, at present, many people are familiar with the park and enjoy it. Consequently, greater value must be lent to such urban heritage; more species and habitats must be prevented from disappearing; and these values must be made more visible by demonstrating how they benefit people in their everyday lives, how they can further improve quality of life and, lastly, how humankind survives thanks to the Earth's natural resources.

Ignorance with respect to the values of local and global biodiversity does not help to bridge the gap between the urban setting and nature, or at least does not prevent the city from having a predatory effect on such nature, and it results in people losing sight of the extent to which humans depend on nature, not simply to lead an excellent lifestyle but merely in order to survive.

Certain animal and plant species do show invasive behaviour in Barcelona, they damage habitats and native species as well as the city heritage, they pose problems in terms of safety and may pose risks to health. When it comes to flora, tree of heaven is one species showing invasive behaviour. In terms of fauna, certain animals are subject to management in order to contain their numbers (pigeons, cats, wild boar, parakeet, tortoises, fish and snout beetles), although more still needs to be done. Presently the monk parakeet, the rose-ringed parakeet, the red-billed leiothrix, the read-eared slider and the mosquito fish are all invasive species.

In conclusion, it can be stated that Barcelona's natural heritage is highly rich and diverse, although it is impossible to establish what is disappearing in terms of species and habitats and what is being gained (or is ceasing to decline) given current urban pressures on the one hand and on account of the preservation management being carried out on the other. The importance of knowledge for
Barcelona is home to the following natural heritage:

- Collserola: 1,795 ha in the municipal district with more than 8,000 ha in total.
- Two rivers and the sea forming its borders.
- 1,076 ha of public parks and gardens, 30 ha of beaches, 30 ha of crops and 740 ha of private greenery.
- Montjuïc, Els Tres Turons and Parc de la Ciutadella are its main natural strengths.
- 53 local listed areas of natural interest.
- Constructed space serving as a habitat for fauna.
- Plant heritage with exotic and native species in the parks and gardens with nigh on 77,000 trees (excluding forest areas).
- 153,000 street trees from 150 species.
- Aquatic flora and fauna in naturalised ponds.
- 103 native species of vertebrates in the city centre.
- 75 native species of common birds in the city centre.
- Barcelona’s birdlife: swifts and other birds, as well as bats.
- Migratory birds.
- Key vertebrates: falcon, jackdaw, heron, alpine swift, squirrel, hedgehog, owl, amphibians, etc.

Formally recognised values of Barcelona:

- Collserola incorporated into the Natura 2000 network and recognised as a nature park.
- Cliffs of Montjuïc included in the Inventory of Areas of Geological Interest of the Government of Catalonia with initial approval as a protected natural open space.
- 72 vertebrates protected by law in the city: 55 birds, 2 amphibians, 8 reptiles and 7 mammals.
- 138 trees in the Listing of Trees of Local Interest in Barcelona.

How it has evolved and what we gain:

- Increase in forests and urban green infrastructure.
- New habitats created in Barcelona and the surrounding area successfully colonised by flora and fauna: network of urban vegetable gardens, underwater reefs, Besòs shores, Vallvidrera reservoir, etc.
- Habitats where nature is taken care of: buildings (where alpine swifts, swifts, swallows and bats are preserved, etc.), ponds, Barcelona zoo (where the colony of grey herons and herons is growing).
- Habitats securing protection: cliffs of Montjuïc and the surrounding area.

How it has evolved and what we lose:

- Virtual disappearance of crops.
- Disappearance of wasteland, meadows and scrubs.
- Valuable habitats that may be lost: part of the agricultural area of the Rec Comtal.
- Gradual loss of unacknowledged local areas of geological interest.
- Slight trend of a decline in avifauna (to be confirmed).
- Loss of fauna owing to urban pressure (construction, collisions): swallows, swifts, jackdaws, sparrows, hedgehogs, snakes, etc.
- Detriment to natural systems caused by invasive or excessive volumes of specific flora and fauna: tree of heaven, red-eared slider, exotic fish, parakeets, cats, etc.
2.3 Diagnosis of green infrastructure (2009–2010)

2.3.1 Local green infrastructure

Barcelona has 3,611 hectares of green infrastructure covering 35.3% of the city land (according to 2009 data). Of this area, 1,076 hectares are strictly urban greenery, 1,795 pertain to the municipal district within Collserola Nature Park and 740 are private greenery generally in the highest part of the city. This is equivalent to 17.71 m² green space/inhabitant (6.64 m² within the urban setting not including Collserola). Consequently, the overall abundance of green areas is rather high, but only 30% accounts for strictly public, urban greenery: 20% of the remainder belong to private greenery – which contributes to make the city greener and provides environmental benefits, albeit without the possibility for public use – and the 50% corresponds to wooden greenery in Barcelona municipal district in Collserola.

The 1,076 hectares of public city greenery are essentially situated in three districts: Sants-Montjuïc (27.8%), Sant Martí (15.4%) and Horta-Guinardó (11.3%). On the other hand, districts with historic centres, such as Gràcia (3.6%), Sant Andreu (5.1%) and Ciutat Vella (5.9%), have a less abundant presence of green areas owing to the compactness of the urban fabric and the smaller area they cover. If we add Collserola, Sarrià-Sant Gervasi would be the district with the greatest area of greenery with over 1,266 hectares.

Despite the size of the two major wooded parks (Collserola and Montjuïc), green infrastructure within the city tends to cover small areas (between 1 and 5 hectares) and given its distribution amid the urban fabric, it is well within the reach of citizens. 57% of green areas cover a surface of less than 1,500 m² and, generally, there is very scant connectivity between them.
Green infrastructure in the city also includes street trees. During the past thirty years, the number of trees has been doubled to its current number of 153,000 (1 for every 8.6 m of street).

Currently there are 3.5 ha of green roofs in Barcelona, although the potential area, simply by including public buildings alongside proposed green corridors, is 65 ha, a figure that is even greater when considering private, business initiatives. As far as green walls are concerned, there is only the odd private case known.

A few years ago, the Urban Landscape and Quality of Life Municipal Institute launched a line of grants for private parties to create green roofs in buildings. To a lesser extent, Barcelona City Council has encouraged flowering on balconies and terraces, by giving plants and seeds in a host of dissemination and citizen campaigns and through balcony flowering photography contests.

### Distribution of public green infrastructure according to district – city and Collserola – in hectares (2009)

<table>
<thead>
<tr>
<th>District</th>
<th>Green area open to the public</th>
<th>Collserola area</th>
<th>Total green area</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Ciutat Vella</td>
<td>63.32</td>
<td>-</td>
<td>63.32</td>
</tr>
<tr>
<td>2. Eixample</td>
<td>49.47</td>
<td>-</td>
<td>49.47</td>
</tr>
<tr>
<td>3. Sants-Montjuic</td>
<td>300.29</td>
<td>-</td>
<td>300.29</td>
</tr>
<tr>
<td>4. Les Corts</td>
<td>73.2</td>
<td>41</td>
<td>114.2</td>
</tr>
<tr>
<td>5. Sarrià-Sant Gervasi</td>
<td>95.04</td>
<td>1,171</td>
<td>1,266.04</td>
</tr>
<tr>
<td>6. Gràcia</td>
<td>38.87</td>
<td>-</td>
<td>38.87</td>
</tr>
<tr>
<td>7. Horta-Guinardó</td>
<td>122.27</td>
<td>409</td>
<td>531.27</td>
</tr>
<tr>
<td>8. Nou Barris</td>
<td>112.18</td>
<td>175</td>
<td>287.18</td>
</tr>
<tr>
<td>9. Sant Andreu</td>
<td>55.02</td>
<td>-</td>
<td>55.02</td>
</tr>
<tr>
<td>10. Sant Martí</td>
<td>167.07</td>
<td>-</td>
<td>167.07</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,076.74 ha</strong></td>
<td><strong>1,795 ha</strong></td>
<td><strong>2,871.74 ha</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>District</th>
<th>Public green area per inhabitant in m² (1)</th>
<th>Total public green area per inhabitant in m² (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Ciutat Vella</td>
<td>5.89</td>
<td>5.89</td>
</tr>
<tr>
<td>2. Eixample</td>
<td>1.85</td>
<td>1.85</td>
</tr>
<tr>
<td>3. Sants-Montjuic</td>
<td>16.46</td>
<td>16.46</td>
</tr>
<tr>
<td>4. Les Corts</td>
<td>8.82</td>
<td>13.77</td>
</tr>
<tr>
<td>5. Sarrià-Sant Gervasi</td>
<td>6.6</td>
<td>87.97</td>
</tr>
<tr>
<td>6. Gràcia</td>
<td>3.15</td>
<td>3.15</td>
</tr>
<tr>
<td>7. Horta-Guinardó</td>
<td>7.14</td>
<td>31.03</td>
</tr>
<tr>
<td>8. Nou Barris</td>
<td>6.67</td>
<td>17.07</td>
</tr>
<tr>
<td>9. Sant Andreu</td>
<td>3.75</td>
<td>3.75</td>
</tr>
<tr>
<td>10. Sant Martí</td>
<td>7.3</td>
<td>7.3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6.64 m²/hab</strong></td>
<td><strong>17.71 m²/hab</strong></td>
</tr>
</tbody>
</table>

(1) Green areas open to the public except Collserola / (2) Green areas open to the public including Collserola
However, because expanding green areas in Barcelona is a complex task owing to the city’s structure and layout, one local goal is to make the most of urban transformations in order to create new green areas linked to them. At present, the City Council is endeavouring greatly to transform the city, for instance, with the high-speed railway station in La Sagrera, the new Marina del Prat Vermell neighbourhood in Zona Franca or Vallbona eco-neighbourhood. Moreover, actions are being carried out in five major areas of the city – Collserola, Els Tres Turons, Montjuïc, Parc de la Ciutadella and the city blocks in the Eixample district – in order to improve the overall network of green infrastructure.

The following table shows the volume of urban green area per inhabitant in Spanish cities over 500 thousand inhabitants.

<table>
<thead>
<tr>
<th>City</th>
<th>m²/hab</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barcelona</td>
<td>6.6</td>
</tr>
<tr>
<td>Madrid</td>
<td>17.0</td>
</tr>
<tr>
<td>Malaga</td>
<td>5.7</td>
</tr>
<tr>
<td>Sevilla</td>
<td>6.2</td>
</tr>
<tr>
<td>Valencia</td>
<td>5.4</td>
</tr>
<tr>
<td>Average</td>
<td>6.2</td>
</tr>
</tbody>
</table>

Source: prepared by OSE using data from INE and the OMAU-OSE survey, 2009

Castell de Montjuïc
• 3,611 hectares of green infrastructure: 30% is strictly public urban greenery, 50% pertains to the local area of Parc de Collserola and 20% to private property.
• 17.71 m² of green infrastructure/inhabitant (6.84 m² in the city area).
• Significant extension of natural greenery (Parc de Collserola).
• Heightened areas of public green infrastructure in the districts of Sants-Montjuïc, Sant Martí and Horta-Guinardó. If we include Collserola, Sarrià-Sant Gervasi is the district with the highest degree of green infrastructure.
• Green areas not interconnected.
• Small green areas: 57% are below 1,500 m².
• 1 tree lining every 8.6 m of street (153,000 in all).
• Scant presence of green walls and green roofs.