This is an informal report on a day excursion, undertaken on 31 May 2019, during the European Climate Change Adaptation (ECCA) Conference in Lisbon, Portugal. The excursion provided conference attendees the opportunity to view the impressive diversity in Lisbon’s green and blue infrastructure, and thus understand how these natural resources are used to provide a significant array of ecosystem services for local residents. The excursion itself consisted of two parts: a visit to the Monsanto forest park in the morning and a tour of Lisbon’s other urban green corridors in the afternoon.

**Monsanto Forest Park**

Construction of Monsanto forest park began in the 1930s, and now provides a significant area of greenspace (10km²) in the centre of the metropolitan area. The current management team is highly focused upon the ecosystem services provided by the park. This includes functions supporting social and recreational activity, in addition to providing a large-scale biodiversity hotspot in the middle of the urban area. The majority of the park area is freely accessible to members of the public. Visitors can indulge in various activities, from mountain biking, skateboarding, and organised sports (e.g. football, basketball), to taking a gentle walk along the numerous pathways. In contrast, a small area of the park is designated as a closed-to-the-public ecological ecosystem, which is used primarily as an educational area for school students and other interested groups, as well as providing supporting biodiversity ecosystem services to the surrounding natural areas.
The excursion was led by a technical member of the park team (sorry I forgot your name – you were great!), who was extremely knowledgeable about the park’s history, development, climate, management issues and of course biodiversity. During the creation of the park, he explained how a number of tree species were introduced to encourage rapid canopy growth, to encourage immediate park usage, with varying levels of success. Species such as the Aleppo pine, Canary island pine and numerous types of oak (Portuguese, Cork, English), are well adapted to local conditions and the underlying limestone and basalt geology, and have prospered within the park extents. In contrast, other introduced species are gradually dying out. This includes the numerous eucalyptus trees in the area, which are prone to over-exhaust minerals within the forest soil. The changing structure of flora species somewhat demonstrates why suitable plant selection is an important consideration in any urban greening scheme.

Other plants have appeared in the park without management interference. The guide pointed out that numerous wild mushroom (>100) and orchid species have appeared through natural travel since the park’s creation, thus demonstrating the areas role as a hub for improving biodiversity. Connecting the parks many forest patches is therefore crucial to ensuring this function. Maximisation of biodiversity at patch edges thus ensures cross-pollination and the spread of plant species within and between neighbouring patch areas. Climate change too is also playing a role in the shifting patterns of flora within the park. Warmer temperatures thus increase the risk of forest fires, specifically during the dry months in July and August. However, as explained by our guide, park management is well prepared for these inevitable occurrences! With three fire stations located on the park edges, any outbreak is dealt with promptly and effectively. Park visitors provide a community service in this regards, and report the majority of fire outbreaks. Smoking is of course completely banned in the park itself!

The park includes a visitor centre, which provides the main base for excursions into the closed off ecological park, which has been specifically designed and maintained to encompass a significant range in flora and fauna. The area is a designed and managed ecosystem, and is only accessible to small groups (less than 20) accompanied by a trained guide. The area is traversed by a path which can take up to four hours to walk, and incorporates the various forest regions in this small area. School groups traverse this path and students are educated along the way about the forest and it’s biodiversity benefits. Mercifully, due to the excessive heat (35°C) this was tour cut to around an hour. Here the group was led to a viewing platform, which provided interesting views of the almost rainforest type canopy cover (and a couple of flying kestrels) in contrast to the densely urbanised infrastructure encircling the park.

The forest canopy has witnessed the introduction and spread of many bird species. The guide however, was less than enthused by competitive members of the photography community, who often descend en-masse to capture the first shot of a new bird species found in the park. Arguments between visitors, from afar as the United Kingdom and Denmark, have occurred in relation to who gets the best spot for a potential photo opportunity! In contrast, artificially constructed drainage facilities ensure water flows efficiently from the hillsides into forest area below, and serve as entry routes for various mammal and amphibious species into the area. An artificially created pond demonstrated wetland management in the area, which has resulted in the recent appearance of heron. From a personal perspective I was highly impressed by the sheer variety of dragonfly species observed in this area, although a trained botanist may disagree with me here on this regards! The sheer scope and biodiversity of the park is thus certainly impressive, and demonstrates what can be achieved by manmade efforts to re-wild areas of towns and cities. Considering that the original area was nothing more than bare grassy hillsides 80 or so years ago this is a considerable achievement.

The ecosystem service benefits of the park are thus numerous and varied. Indeed the presence of skateboarding hexagenerians demonstrates the accessibility of the recreational park ecosystem services to different community groups! The area is completely funded by the municipal authority; and while the guide complained about the lack of resources in some instances (park guards have declined by 50% in number over the last 30 years), it is clear that this place is fantastically managed and cared about by its employees. Local government investment in the multi-functionality of the area, in providing a dedicated and managed space for bio-diversity enhancement and education,
would be nice to see in more parks in Manchester and the UK in general. Providing designated spaces, and employees to educate and inform the wider community on the benefits of urban greening, would certainly help to improve local public knowledge about nature based solutions for supporting climate change adaptation strategies.

**Lisbon’s Green Corridors**

Fortunately, for local residents, Monsanto park was created before Lisbon developed into the major metropolitan area it is today. Whilst creating a similar size place in already developed Manchester today is practically unrealistic, the second part of the excursion was useful for demonstrating both the local benefits of smaller scale greening solutions, and provided a useful demonstration of how existing built infrastructure can be re-purposed into nature-based facilities. The first stop on this part of the tour was in central Lisbon, where the group was introduced to the very first green corridor developed in the city. This area begins on a hill above the old town, and includes a park, and a mixed tree-lined grass and street avenue with extends down to the city below. In previous centuries the city of Lisbon suffered from an all evading odour, emanating from cramped conditions in the urban centre. The corridor trees thus provided a designed ecosystem service in the 19th century, by enabling better circulation and filtration of the local tepid air conditions. Today, this smell has all but disappeared, however the remaining trees are now useful for cooling the surrounding streets during the hot weather spells, and capturing particulates generated by local car traffic pollution.

Indeed, this area and Monsanto forest park are just some of the nine green corridors located within the urban area. The green corridors themselves serve as interconnected areas of nature, providing biodiversity highways across the city, and are designed to provide specific ecosystem service functions in relation to the needs of the local community. The second stop of the tour demonstrated this principal in practise, and focused upon another green corridor within a low socio-economic area. The once derelict and unproductive valley has now been partially converted into a space for urban farming. Here members of the surrounding community can both rent and receive training on how to conduct responsible vegetable farming. Responsible farming in this instance requiring the proper use and conservation of urban water resources. Other areas of the same corridor are converted for recreational purposes (e.g. skateboard park, cycle lanes etc.). In the near future, the municipal authority aims introduce sheep to the site in order to provide a natural maintenance solution to grass overgrowth. The green solutions in this area thus provide numerous social, recreational and economic ecosystem services, which are designed specifically to improve the lives of nearby residents.
The actual re-purposing of existing urban infrastructure has occurred in numerous parts of the city. For example in one area, slum housing was cleared in the 1970s and converted into vineyards, providing provisioning agriculture and economic ecosystem services. In recent years (as part of the local 2012 Biodiversity Meadows scheme) former maintained grassland outside the central city courthouse has been converted into a natural meadow. The diversity of weeds and other plants that now grow here have improved carbon storage through both an increase in above ground biomass, and the alteration of soil structure for carbon infiltration services. In comparison to the previous grass lawn, this same area now requires no outside irrigation, thus reducing the associated ecosystem dis-services for this area. The tour bus also passed a green lanes initiative, with two lanes of existing highway converted to tree lined green routes for cycling purposes. The increase in the use of bikes amongst Lisboans is a policy in practical effect. Conversion of existing paving into grasscrete areas is also earmarked for various parts of the city, as a method for urban cooling and surface water runoff reduction.

Indeed the final stop of the tour demonstrated ecosystem services in place for managing potential environmental hazards associated with climate change. This presented work in another green corridor area currently underway to create a large-scale sustainable urban drainage system (SUDS). Here, water runoff from the surrounding university, and residential buildings, will divert into a connected channel system and collect within a natural ponding area. The use of biological filters in the pond is under investigation as a method for natural filtration of human waste. The SUDS scheme will thus provide additional drainage functionality to existing artificial infrastructure, thus providing some alleviation of stress on the local water system during extreme precipitation events.

Current greening policy in the city is politically driven, and thus continues a long tradition of ecosystem service development within the local urban area. As explained by the tour guide, the improvement of city’s green and blue infrastructure was a promise of the municipal government during the previous election. The government certainly appears to be honouring their pledges in this regards, as evidenced by the sheer number and variety of urban greening initiatives underway within the city. However, as discussed during the tour, the cost of implementing such policies is not without cost, and demonstrates the value of protecting established green and blue infrastructure resources. This has particularly relevancy for the future, as conservation of current resources can help offset significant potential costs for climate proofing cities in the future.

It is thus clear that organisation on this scale requires significant political will power and the use of local resources. Lisbon demonstrates what is possible. The coming implementation of a purposefully built nature link bridge over the highway system again demonstrates the scope of the city’s ambition in this regards! From a personal perspective, the sheer scale of greening work within Lisbon is impressive, and should serve as an inspiration for cities around the world, including Manchester, on how to improve urban environment and living conditions. Overall, for a researcher interested in improving urban ecosystem services, the excursion was a personal highlight of the conference. Most talks and presentations (including my own work here!), whilst extremely valuable for climate change adaptation purposes, appeared to discuss adaptation in purely theoretical and conceptualised terms (e.g. development of stakeholder engagement frameworks, climate adaptation scenario modelling). Viewing positive green infrastructure work in practise was thus hugely rewarding, and provides some further motivation for my own thesis work! Despite current challenges in the UK, Lisbon provides some hope of what can be achieved with the political will to improve our urban environments and adapt them for climate change.