UEL University of East London

SRI Sustainability Research Institute

University of East London: the 2015 biodiversity update

"It is that range of biodiversity that we must care for – the whole thing – rather than just one or two stars." - David Attenborough

University of East London: the 2015 biodiversity update

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Cover photo: Common carder bee (*Bombus pascuorum*) feeding on lavender at Stratford campus ©Jack Clough

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1 Introduction

In May 2012 the Rio+20 summit confirmed a 30% global decline in wildlife since 1970. Following on from the United Nations (UN) International Year of Biodiversity in 2010, global declines in biodiversity have never had such high profile. Rio+20 has been billed as a chance for world leaders to put global society on a sustainable path and an opportunity for the world to get serious about the need for development to be sustainable (Black 2012). For development to be truly sustainable this must include conserving, on a landscape scale, the valuable ecosystem services that biodiversity provides (TEEB 2010). Not only does this mean protecting and enhancing natural and semi-natural landscapes, but also restoring green and blue infrastructure of high biodiversity value in urban areas. As such, rather than merely targeting conservation efforts across the broader countryside, biodiversity also must be returned to our cities, towns and suburbs by breaking up expanses of hard impermeable surfaces and creating niches within which nature can take a hold.

Biodiversity is a word (much like sustainability) that rolls off the tongue very easily, often with little thought given to its actual meaning (Lautenschlager, 1997). So what, then, is biodiversity? In 1992 the United Nations Convention on Biological Diversity (CBD), also known as the *Rio Convention*, was set up to conserve global biodiversity and ensure the sustainable use of its components. The Convention defined biodiversity as:

"The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems." CBD Article 2 (UNEP, 1992)

Biological diversity is thus a multidimensional concept, encompassing genes, species, ecosystems and ecosystem functions (UNEP, 1992; Wilson, 1992). It is no secret that biodiversity is declining and that much of this decline is due to anthropogenic factors. Human-driven climate and land-use change are the greatest threats to biodiversity, particularly in relation to terrestrial biodiversity (Millennium Ecosystem Assessment, 2005a; IPCC, 2007). Furthermore, current predictions show that pressure on biodiversity is almost certainly going to increase (Millennium Ecosystem Assessment, 2005b; Eppink & van den Bergh, 2007). There is a clear economic and moral imperative to conserve biodiversity.

While there are no explicit habitat exemptions in the above definition, the term 'biodiversity' and its associated concepts have traditionally been associated with rural areas: the countryside. Until relatively recently, urban areas have been regarded as having a negative impact on biodiversity, largely as a result of habitat encroachment (Wackernagel & Rees, 1996). While the urban environment is undoubtedly extensively developed and artificial, it is becoming increasingly recognised for its potential to provide a diverse and complex ecosystem, capable of supporting high levels of biodiversity (Savard *et al.*, 2000; Goddard *et al.*, 2009; SCBD, 2012).

1.1 Biodiversity in the UK

The UK Biodiversity Action Plan (UKBAP) was the response of the UK Government to the Convention on Biological Diversity. It "*describes the biological resources of the UK and provides detailed plans for conservation of these resources*" (JNCC, 2010). Within this national framework London is one of nine regions which have their own Biodiversity Action Plan (BAP). This provides an overarching framework for nature conservation in London. There are also a number of Local Biodiversity Action Plans (LBAP) that are responsible for local priorities and biodiversity interest. In essence this framework was designed to protect, promote and enhance biodiversity across the UK. Coming to an end in 2012 the Biodiversity Action Plan framework is now being replaced by UK Post-2010 Biodiversity Framework which promotes a more integrated approach to the conservation of biodiversity. Whilst promoting a more coherent landscape view of conservation, the message that it is no longer acceptable to only protect biodiversity in designated areas remains the same.

1.2 Role of the Higher Education (HE) sector

The HE sector has the potential to play a huge role in conserving biodiversity. Just in terms of land area, UK colleges and universities cover approximately 38,000 hectares or for the comparison of units, 380000000m^2 (Dixon *et al*., 2007). By protecting and enhancing biodiversity, universities can benefit both their students and staff by providing a pleasant and stimulating environment in which to study and work (English Nature, 2003). Biodiversity-friendly management of estates can also provide a very visible form of environmental action which helps to reinforce other environmental policies and contributes towards the University's role supporting the local community by conserving natural heritage.

1.3 University of East London

The UEL estate covers three campuses in the London borough of Newham, which is an urban borough (see Figure 1). It is the third most deprived borough in London and the sixth most deprived in England (Shackleton, 2007). Almost 20% of Newham is classified as greenspace with the potential to support wildlife (LUC, 2009). This greenspace incorporates a range of habitats including 40 Sites of Importance for Nature Conservation (SINCs) and a number of nationally or locally important species of mammals, birds and invertebrates are found in the borough (LUC, 2009).

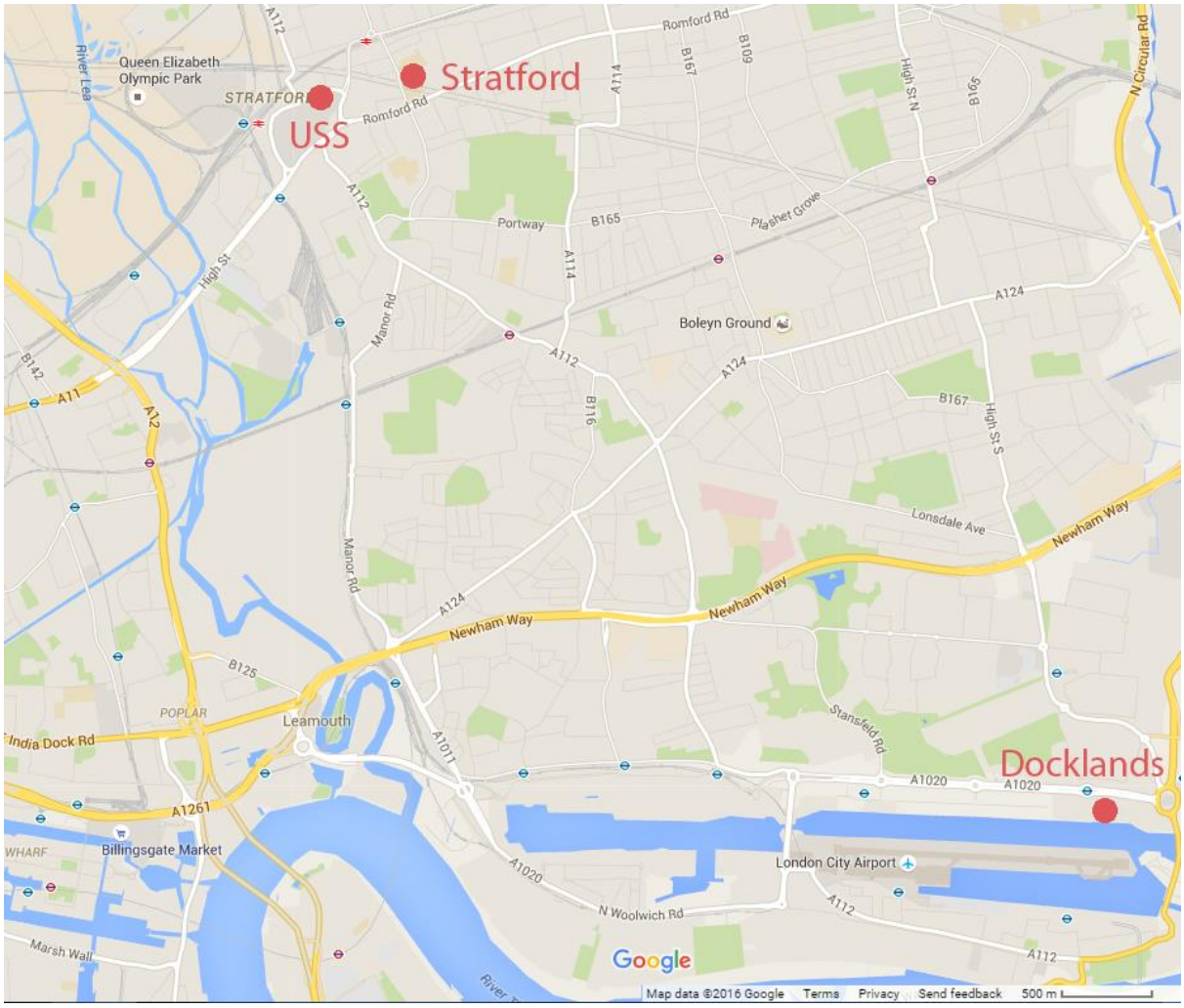


Figure 1: The UEL estate with a google maps backdrop. The Stratford and USS campuses are located in the heart of Newham by the Olympic Park whilst the Docklands campus is located by the Royal Victoria Docks, close to London City Airport. Source: Google maps.

2 Purpose of the present report

In order to protect and enhance biodiversity at any site (be it rainforest or university campus) it is very important first to recognise what is already there – that is, the 'natural capital'. To this end, in 2010 the UEL Environmental Research Group (ERG) which has now become the Sustainability Research Institute (SRI) was commissioned to carry out a baseline survey of biodiversity for the UEL estate, comprising the Stratford and Docklands campuses including Trinity Buoy wharf and Duncan house. The survey measured (mapped and described) floral biodiversity levels, the results of which were summarised in a report along with recommendations for protecting and enhancing campus biodiversity (Freeman *et al.* 2010). The report was then used to inform a University of East London Biodiversity Action Plan (UEL BAP) (UEL 2010) which was intended to act as a guide to best practice for estate management and new developments.

In order to assess the success of the UEL BAP in promoting the protection and enhancement of biodiversity on the campus it was necessary to monitor biodiversity change across the estate against the 2010 baseline. In 2012, the SRI repeated the campus biodiversity surveys and a further report detailed the results of the repeat surveys, and provided an assessment of the extent to which recommendations in the original report had been met, and recommendations for the future. (Connop et al., 2012)

This report focuses on yet another round of repeat biodiversity surveys conducted in August and September 2015 by the SRI. This survey was brought about after some large changes had occurred across the UEL estate, with the addition of a new campus: the USS building, a new Library area at Stratford campus, and the removal of Trinity Buoy Wharf and Duncan house from the UEL estate.

3 Methodology

In order for monitoring to capture change it is essential that the same methods are used for each survey. As such, the methods used to establish the survey baseline in 2010 were repeated exactly (Freeman *et al*. 2010). However, the surveys of 2012 encompassed two rounds of monitoring in an attempt to judge whether additional surveys captured any variations in seasonal biodiversity. Although due to time constraints, the 2015 survey was restricted to only one round of monitoring.

This survey was carried out between the 8th and 25th August by, Jack Clough and Elizabeth Vandergert-Wilson.

Recorders surveyed all of the descriptive units (habitat types) defined in the 2010 baseline survey and 2012 repeat survey and redefined any units where the habitat type had changed between the intervening years. All floral species within each unit were recorded. Nomenclature for flora followed Stace (2010). Similarly to the 2012 survey, it should be noted that biodiversity interest on vertical surfaces (although recorded) will be under-represented in terms of area as a result of the two dimensional polygon methodology. The recorders also established the effective baseline for the USS building during the 2015 survey.

Due to the spatial scale at which biodiversity was measured for this particular survey lower plants (in particular mosses and lichens) were noted but not identified. However these should not be entirely overlooked and there are some important implications for estates management that will be discussed below.

Similarly to the 2010 and 2012 survey periods, an explicit note was made of areas considered to be of (relatively) high biodiversity interest, in order that they are recognised and protected (where possible). A note was also made if areas previously identified as biodiversity hotspots no longer appeared to be in a favourable condition. All biodiversity hotspots should be considered for further, fine-scale survey work if a more accurate assessment of UEL's biodiversity interest is to be obtained. This is a widely accepted ecological management tool and these areas are termed 'biodiversity hotspots' (Kati *et al.*, 2004)[1].

All data collected were stored in an Excel database and are available from the SRI on request. During the 2010 and 2012 surveys, all descriptive units were also digitised into GIS in order to produce the maps and area measurements contained within previous reports. However during the 2015 survey detailed aerial photos for the new USS building and Stratford campus where unobtainable, as a result polygons and spatial analysis were performed using google maps. These new campus area data provide a comprehensive baseline that can be updated in the future as and when appropriate.

In addition, notes were made of all other easily identifiable species observed during the surveys such as birds, mammals and some invertebrate groups. Here nomenclature followed MacDonald and Barrett (1993), Mullarney (1999) and Chinery (1993).

[1] Although a widely accepted ecological management tool it is most commonly used on a much larger, global scale. For example, 44% of the known species of all plants occur on just 12% of the earth's surface and are endemic to 25 'biodiversity hotspots' (Myers *et al.*, 2000; Mittermeier *et al.*, 2000). Here we have borrowed the term for areas of potential biodiversity interest within the UEL estate.

Table 1: Complete list of descriptive units for UEL estate with code, habitat type and a brief description. A total of 34 descriptive units were recorded during survey, reflecting the complex and variable nature of the survey area.

Code	Habitat type	Description
AG	Amenity grassland	Established grassland and recently laid turf, regularly mown
AR	Aggregate roof	Organic roof created using aggregates but not vegetated
AT	Astroturf	Synthetic grass laid on permeable sand/soil base
BA	Balcony	Usable above ground external areas of buildings
BS	Bare soil and hardcore	Heavy use, no/sparse vegetation
BU	Tree buffer	Scrub areas buffering the noise of traffic
CH	Chimney	Large chimney stack
CN	Container	Temporary or permanent metal storage
CO	Concrete and tarmac	Paved areas and car parks
CS	Cycle shed	Perspex-covered cycle sheds
CT	Construction site	Area currently under construction with no access
DE	Decking	Wooden functional landscaping feature
FM	Flower-rich meadow	Species-rich grassland, cut infrequently
FR	Flat roof	Flat roofs (potential for green roofs)
GA	Gabion wall	Loose stone wall constructions
GD	Garden	Managed gardens
GE	Geomat	Synthetic rubber ground layer
GF	Green roof	Intentionally vegetated roof
GN	Greenhouse	In Stratford atrium
GR	Gravel, shingle, plum slate	Potential invertebrate habitat
MF	Metal frame	Metal covering structure
OB	Ornamental bed	Ornamental plantings/flowerbeds
OH	Ornamental hedge	Hedgerows, largely planted with ornamental species
OW	Old wall	Old brick walls, potential invertebrates habitat
PO	Porch	Flat external roofs covering building entrance
PR	Pitched roof	Roof-space with a steep pitch
RB	Raised bed	Raised planter for flowers, shrubs and/or vegetables
SB	Shrub	Includes large shrubs and small sprays (e.g. Buddleia)
SR	Sloping roof	With a more gentle slope than PR
ST	Staircase	Potential for climbing plants/green walls
TB	Tree base	Raised base for single tree plantings
TE	Tree	Several species recorded
WF	Wooden frame	Trellis structure obscuring view of bins, etc
WM	Water margin	Concrete transition between hard standing and water

4 Results

The UEL estate in 2015 had changed significantly since the 2010 baseline data and the 2012 report. This was due to several modifications in the estate boundaries. For example:

- Additional area had been added through the construction of the University Square Stratford building or USS
- Additional area had been added through the development of the Stratford campus library area, which had been previously lost due to construction site areas previously occupying the area.
- The estate area had been reduced through the loss of Trinity Buoy Wharf from the UEL estate.
- The estate area had been reduced through the loss of Duncan House from the UEL estate.

Following these changes the total area covered by the UEL estate had increased from 127,781m^2 to 129054m^2. With the total amount of greenspace (ground and roof level combined) also increasing from 25,623m^2 to 27,995m^2. As in the 2010 and 2012 surveys hard-space (e.g. concrete, tarmac, hard roofs) predominated across all three campuses, however the amount of greenspace area as a percentage of the total estate area had increased by 2% from 20% in 2012 to 22% in 2015.

A total of 323 trees were recorded across the UEL estate in 2012, in 2015 this number stood at 321 following losses from trinity buoy wharf, and gains from the USS building, Stratford, and the Docklands campuses.

A total of 392 different species of plants were recorded during the 2015 surveys.

A detailed look at each Campus area will follow:

Stratford Campus:

Stratford Library:

Since the 2010 and 2012 biodiversity surveys the new Stratford library had been completed. The 2015 survey revealed that this development has enhanced the biodiversity of the UEL campus further with the addition of a new green roof covering approximately 1020m^2 However due to access problems during the survey period the roof was not surveyed at the time, previous planting lists suggest a high degree of biodiversity, and the SRI had encouraged additional habitat improvements to be incorporated into its design.

The new library grounds have also added 5 new native pine trees meeting previous targets for increasing tree cover as referred to in previous reports (Connop et al., 2012), with an additional 281m^2 of greenspace area being provided through an area for climbing plants, a bike storage area with a raised planting bed and an area of amenity grassland. In total the new library development has added 1301 m2 of greenspace to the UEL estate.

Figure 2 the former construction site for the new Stratford library (on the left, in red) and a blown up image showing the greenspace elements on the new library site (on the right, in green). Image source: Google maps.

A summary of the new polygon and habitat codes found at the New Stratford library site can be seen in Table 2 below:

Table 2: A summary of the new polygon and habitat features found at the New Stratford library site.

Polygon	Feature	Code
5.12a	Turf – amenity grassland	AG
5.12b	Tree	TE
5.12c	Tree	TE
5.12d	Tree	TE
5.12e	Tree	TE
5.12f	Tree	TE
5.12g	Concrete and tarmac	CO
5.12h	Concrete and tarmac	CO
5.12i	Ornamental bed	OB
5.12j	Raised bed	RB
5.12k	Cycle shed	CS
5.15	Green roof	GF
5.16	Ornamental hedge	OH

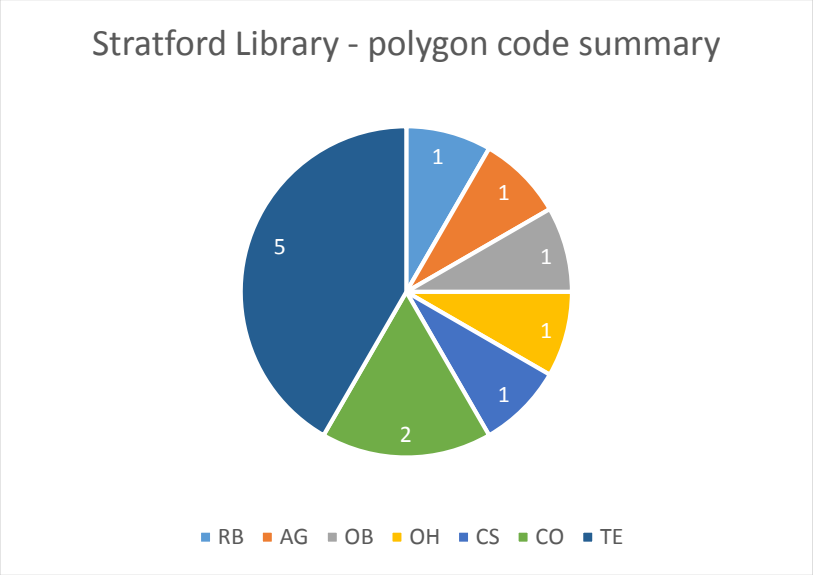


Figure: Pie chart showing the habitat features found at the new Stratford library and the number of polygons containing them.

Similarly to the 2012 survey, with the exception of the new library area, there has been no significant change in the amount of roof area being developed for biodiversity, with large proportions of the Stratford campus roof area still in place that could support some type of greening. The 2012 survey highlighted the Computer conference centre and Arthur Edwards building as areas of opportunity though these opportunities have yet to be capitalised on.

Additional species recorded during survey included: squirrel (*Sciurus carolinensis),* feral pigeon (*Columba livia*), blackbird (*Turdus merula*) and house sparrow (*Passer domesticus*). Invertebrates recorded were: buff-tailed bumblebee (*Bombus terrestris*), tree bumblebee (*Bombus hypnorum*) and the common carder bee (*Bombus pascuorum*). As in previous reports, introducing or developing further specialist mammal, bird and invertebrate surveys would be a useful addition to future surveys and would significantly increase this additional species list.

Hotspots:

Hotspots for biodiversity include the medicinal herb garden in which 59 species were recorded. Anecdotally this is an area that many people visited whilst the surveys were being carried out, with the most frequent comment relating how much the visitors really enjoyed the area. It must be noted that since the cessation of the herbal medicine degree at UEL, the area is no longer managed as frequently and will require some management and maintenance to keep the biodiversity levels high whilst keeping the space attractive as 120 species were recorded in the medicinal herb garden in 2012 – corresponding to a 49% decrease in biodiversity in this area.

A surprising area for biodiversity during the surveys was found in the Stratford Staff car park at the Western edge of the campus, where 29 species were found. However this is largely due to the lack of management on this part of the site, and does not seem to reflect a real desire to push for biodiversity in this particular area.

Trees: with the completion of the new library, there have been an additional 5 trees recorded at the Stratford campus since the 2012 survey.

Total species:

In total 199 different plant species were recorded at the Stratford campus. This is a slight reduction on the 239 species recorded in 2012. This will largely be due to the reduction in species present in the medicinal herb garden, and due to the reduced survey effort of one recording period compared to two.

Opportunities:

Converting existing amenity grass into flower rich meadow or native woodland edge habitat around University House presents a good opportunity to increase biodiversity in a relatively undisturbed area and would meet the suggested recommendations of the original 2010 biodiversity survey.

Performing biodiversity friendly management of the medicinal herb garden will keep this area attractive, increase the amount of species present by reducing plant competition for space and light, and arrest the decline in biodiversity of this hotspot.

The Stratford campus has a large number of mature trees, which could aid biodiversity through the introduction of native climbing species such as Ivy (*Hedera helix*), common honeysuckle (*Lonicera periclymenum*), dwarf honeysuckle (*Lonicera xylosteum*) (he UK native clematis (*Clematis vitalba*)

Investigating the opportunity to create a pond or other area of standing water should be investigated, as this is most likely to be achieved on the Stratford campus to avoid the perceived problems of increasing bird numbers that exist at the Docklands campus.

Re-launch the bee keeping programme at Stratford campus which has ended since the 2012 biodiversity survey was completed.

Docklands Campus.

Since the 2010 and 2012 biodiversity surveys the footprint of the Docklands campus has not changed significantly, though there are some additional areas for biodiversity provision created since the previous surveys in 2012 (see table 3).

Table 3: Polygon feature change on the Docklands campus

Polygon	Feature	Previously	Code
3.18b	Flower rich meadow	3.18 amenity grassland - (part conversion)	FM
3.24	Flower rich meadow	3.24 amenity grassland - (complete conversion)	FM
7.18a	Flower rich meadow	7.18 - (part conversion)	FM
8.3b	Green roof	8.3 - Aggregate roof – (part conversion)	GF
9.1b	Green roof	9.1 - Aggregate roof – (part conversion)	GF
9.18b	Green roof	9.18 - Aggregate roof – (part conversion)	GF

New areas of the campus that have added to the biodiversity include new areas of wildflower planting, by Knowledge Dock, the Library, and two new areas of mixed wildflowers and perennials totalling 115m^2. A brown roof retrofit experiment set up by the SRI has also enhanced the biodiversity interest to the Docklands campus, providing habitat for 20 species.

Of the additional species of note recorded during the Docklands surveys, grey squirrels (*Sciurus carolensis*) were the only mammal observed. As in the baseline survey, blackbirds (Turdus merula) and goldfinches (*Carduelis carduelis*) were observed in the Nursery garden as well as magpies (*Pica pica*) across the rest of the main campus.

In line with the 2012 survey, the Sports Dock area has recorded the greatest number of species of note including the Newham BAP species the kestrel (*Falco tinnunculus*) patrolling the green roofs, the UK Red Data Book and BAP species the linnet (*Carduelis cannabina*) and a London BAP dunnock (*Prunella modularis*) on the Beetle Bump. Another UK Red Data Book species, the fieldfare (*Turdus pilaris*) has been observed feeding on berries on the pyracantha hedging round the car park. In addition, possibly the rarest invertebrate in the UK, the UK BAP streaked bombardier beetle (*Brachinus sclopeta),* was introduced on to the Beetle Bump as a rescue attempt and recorded four months later by Buglife research intern, Ellie Passingham in 2012, further visits in 2015 have confirmed that the streaked bombardier beetle is still present on site.

In terms of other invertebrates recorded, bumblebees observed included the buff-tailed bumblebee (*Bombus terrestris*), white tailed-bumblebee (*Bombus lucorum*) and the common carder bee (*Bombus pascuorum*). Numerous rosemary beetles (*Chrysolina americana*) and 7-spot ladybirds (*Coccinella septempunctata*).

Invertebrate groups observed but not identified to species level include slugs, snails, hoverflies (Syrphidae), a number of micro-moths (Lepidoptera), woodlice (Isopoda) and Icheumonid wasps. There were also numerous moss, lichens and fungi recorded.

Hotspots:

The main hotspots at the Docklands campus are the Beetle Bump and Children's playschool where 90 species and 49 species were recorded respectively. However the two new areas of wildflower planting had added some areas of biodiversity interest beyond the normal generalist or ornamental species, most notably supporting corn chamomile a UK endangered plant.

Trees:

The campus had lost 3 mature trees; but 6 hawthorn saplings had been planted near the student residences leading to a net increase of 3 trees on the campus.

Total species:

In total 298 different plant species were recorded on the Docklands campus during the survey period. This represents a slight increase since the 284 species recorded in 2012. This is largely due to the increased biodiversity enhancement efforts at this campuses focussing on increased wildflower areas.

Opportunities:

The areas that offer the most opportunity for biodiversity improvement are:

Increasing the amount of raised beds or planters to house UK native species - especially across the long expanses of concrete along the dockside, around the East Building and the entrances to the campus.

Continuing to convert patches of amenity grassland into flower rich meadow, or encouraging a reduction in mowing intensity to encourage a wider variety of plants beyond grasses and generalist species in these areas.

Encouraging further planting of native climbers in the already bare tree pits across the campus to provide both increase biodiversity and habitat heterogeneity.

Installing bug hotels in new areas of wildflower meadow and wildflower habitat to provide homes for the insects that feed on these wildflower areas, and will provide refugia following maintenance of these habitats during winter months.

Pursue the conversion of existing shipping containers into green roof systems.

USS campus:

Since the 2010 and 2012 surveys, the addition of the new USS campus in Stratford has added an area of 3563m^2 to the campus of which 958 m^2 is green space (Fig.3). 71% of this greenspace is provided at roof level by a number of green roofs combined with PV cells making these green roofs the campuses greatest opportunity for biodiversity provision.

The other 29% of the greenspace area is provided by the USS garden area, which contains a mixture of native and non-native plants in an attractive and well managed setting. Nonetheless this provides significant biodiversity interest in a small compact area (43 species in total). The garden also contains 8 trees which contribute to the previous recommendations from 2010 concerning increasing tree cover across the UEL estate.

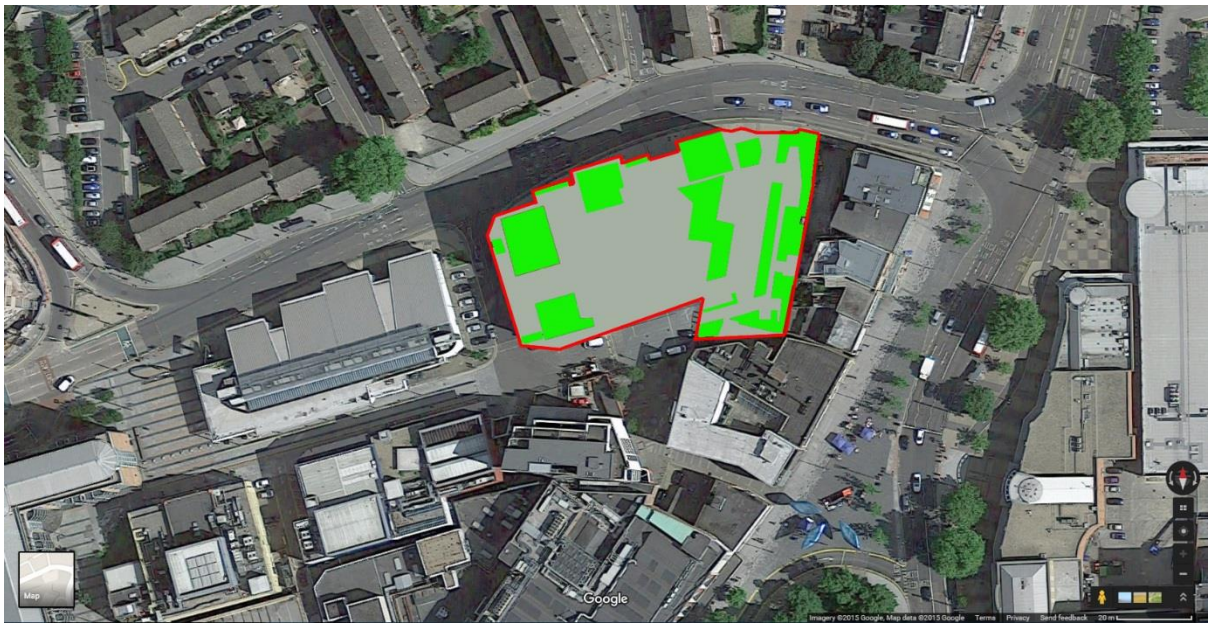
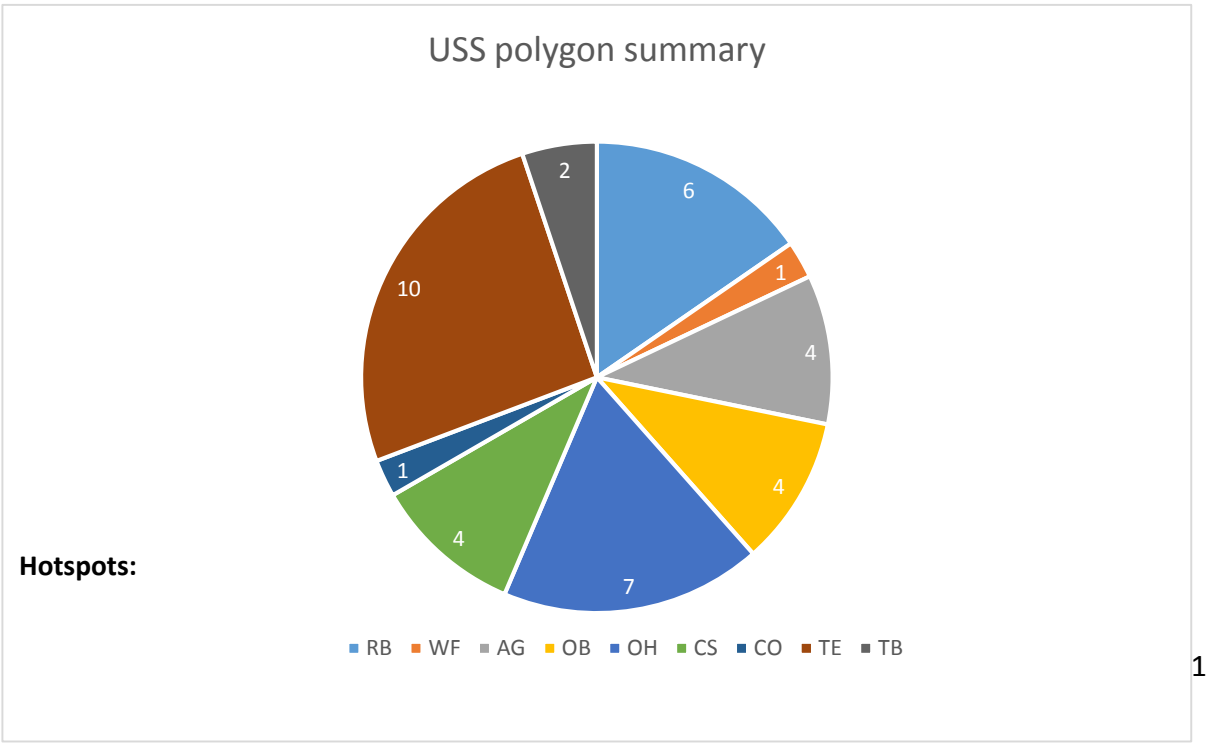


Figure 3 the USS campus with areas of hard surfaces (grey) and greenspace (green) highlighted. Image source: Google maps.

The USS campus has a good range of habitat types (Fig. 4) with trees, ornamental hedges, ornamental beds, raised beds and amenity grassland all providing habitat heterogeneity and numerous niches for biodiversity.

USS polygon list:

Polygon	Feature		Code	Polygon	Feature	Code
1.0	Raised bed		RB	2.1	Tree	TE
1.1	Fence		WF	2.2	Tree	TE
1.2	Planter		RB	2.3	Tree	TE
1.3	Planter		RB	2.4	Tree	TE
1.4	Planter		RB	2.5	Tree	TE
1.5	Planter		RB	2.6	Tree	TE
1.6	Planter		RB	2.7	Tree	TE
1.7	Turf – Amenity grassland		AG	2.8	Tree	TE
1.8	Ornamental bed		OB	3.1	Green roof	GF
1.9	Ornamental hedge		OH	3.2	Green roof	GF
1.10	Turf – Amenity grassland		AG	3.3	Green roof	GF
1.11	Ornamental hedge		OH	3.4	Green roof	GF
1.12	Ornamental bed		OB	3.5	Green roof	GF
1.13	Ornamental bed		OB	3.6	Green roof	GF
1.14	Ornamental bed		OB	4.1	Tree base	TB
1.15	Cycle shed wooden		CS	4.1a	Tree	TE
1.16	Cycle shed wooden		CS	4.2	Tree base	TB
1.17	Turf – Amenity grassland		AG	4.b	Tree	TE
1.18	Ornamental hedge		OH	4.3	Ornamental hedge	OH
1.20	Ornamental hedge		OH	4.4	Ornamental hedge	OH
1.21	Turf – Amenity grassland		AG			
1.22	Ornamental hedge		OH			
1.23	Concrete and tarmac		CO			



Hotspots:

Figure 4: Pie chart showing polygon split by habitat code for the USS campus.

The main biodiversity hotspot at the USS is the outdoor garden, which is made up of a blend of native and non-native planting. The area while small packs a surprising amount of biodiversity (56 species)

Trees:

The USS campus had 10 trees in total, which is commendable considering the small area that the campus has available to it. Future trees should be encouraged perhaps in 'Stockholm style' tree pits in the paving surrounding the building, or in planters at convenient locations.

Total species:

In total 79 different plant species were recorded at the USS campus, making this campus a good addition to the UEL estate in terms of biodiversity provision. However it would be beneficial to encourage additional native planting where possible in future.

Opportunities:

Opportunities also exist here for further enhancing biodiversity:

Native climbing plants could be planted along the currently bare wooden bike sheds, which offer themselves as a trellis type structure.

The green roofs at the USS would also benefit from additional work to improve their biodiversity function. As currently they mainly support generalist green roof species (26 in number) and would benefit from additional habitat improvement works such as wildflower seeding, habitat piles and bug hotels to increase overall biodiversity.

In addition as mentioned in the Docklands campus survey: A brown roof retrofit experiment is taking place. This experiment is designed to determine the most effective ways of retrofitting biodiversity into an underperforming brown roof. The techniques used for the experiment could also be utilised on the green roofs at Stratford to encourage more species diversity.

More bird and bat boxes should be encouraged on this campus; as only one bat box was observed during the course of the survey.

A small pond or area of standing water could be created in the garden area, providing vital water for the insects and birds attracted to the plants in the USS garden.

4.3. 1. Non-target biodiversity across the UEL estate.

In addition to the diverse wildflowers, shrubs and trees observed across the campuses, numerous other species were recorded during the surveys including mammals, birds, invertebrates, moss, lichens and fungi. Time did not permit a detailed identification of all species present but did include some conservation priority species including species of local and national importance such as kestrel, linnet and streaked bombardier beetles. The presence of all three of these species appeared to be due to biodiverse habitat enhancements incorporated within the Sports Dock design. The incorporation of green roofs and brownfield-inspired landscaping (as prescribed in the UEL BAP) should therefore be seen as a success and should be encouraged further for retrofit across the existing campus and for future new build.

The other key habitats for non-target biodiversity were the biodiversity hotspots across both campuses. Whilst the biodiversity hotspots remaining from the previous survey retained their value, new hotspots made a significant contribution to supporting a broad range of biodiversity. The diversity of plants resulted in invertebrates such as bees and beetles thriving on the rich pollen, nectar and fruit sources. The design of such garden spaces should therefore also be a target for future campus habitat improvement plans.

4.5 General and specific recommendations

In the 2012 UEL biodiversity survey report a range of general and specific recommendations were proposed in order to enhance campus biodiversity. The following section describes whether each recommendation has been met and details an assessment of the extent to which each has been met by the time the 2015 site assessments were carried out. It also includes future recommendations.

General

4.5.1 Planters

Met:

The re-use of the planters used as part of the community garden projects at Stratford and Docklands main campuses made significant contributions in terms of added biodiversity. Moreover, they provided a mechanism by which staff and students could engage with the management of campus green space.

Recommendation:

Further incorporation of raised beds for community gardens and for provision of wildflowers should be encouraged. This habitat type should be particularly encouraged to break up hard impermeable areas of concrete and tarmac. Doing this would not only have biodiversity benefits, but would also improve aesthetics and act as sustainable urban drainage elements to reduce the runoff into storm drains during rainfall events.

4.5.2 Flower rich meadows

Partially met

The overall area of flower rich meadows had marginally increased from the overall area of flower rich meadows had increased from 3465 m^2 to 3572 m^2 (3% increase in area) showing an increase in flower rich meadows, although not as dramatic an increase since the 121% increase in area from 2010-2012 due to the development of the beetle bump. The authors felt that in terms of previous advice, the flower rich meadow recommendation had only partially been met. This is because none of the amenity grassland recorded in the baseline survey had been converted into flower rich meadow by reducing the management frequency as recommended in the 2010 report. However the small increase in wildflower area is an encouraging sign that wildflower areas will be increased across the UEL estate, and is a very positive step for the future.

Recommendation:

The conversion of amenity grass to flower rich meadow should be encouraged in appropriate spots, such as around the Docklands car park and existing areas of wildflower meadow should be expanded such as the areas around the arch at Kwame house, and Knowledge dock. It is also recommended that at least some areas managed as amenity grassland have their cutting regimes reduced to allow wildflower development.

The Beetle Bump should be viewed as a key success in the development of biodiversity-rich greenspace at UEL and similar habitat should be incorporated across the other campuses and on other new build projects.

4.5.3 Staff and student involvement

Met:

As mentioned previously, the community garden projects were re-introduced to encourage staff and students to engage with their campus green infrastructure. Staff were also encouraged to plant wildflowers as part of the green impact awards in 2014. The addition of wildflower information boards are being planned and will present a useful biodiversity engagement tool for staff and students.

Recommendation

Further schemes should be run to encourage staff and student involvement with the campus green infrastructure design and engagement. Information boards detailing the purpose of the Beetle Bump should also be considered. Another idea might be the development of a blog, twitter page or other social media site on which staff and students can post about the wildlife observed across UEL.

4.5.4 Management of amenity grassland

Not met

Although some areas of amenity grass areas were converted into wildflower areas (112m^2) there was no obvious evidence of a change in management of any of the amenity grass areas across the campuses at the time of survey.

Recommendation:

Planting up amenity grass areas with spring bulbs such as the native daffodil (*Narcissus pseudonarcissus*) could provide a magnificent aesthetic improvement. As could managing areas of amenity grassland in a more sympathetic manner. If the grass was cut on a less intensive cycle it may improve the biodiversity interest. Or alternatively if areas could be converted into wildflower areas it could enhance campus biodiversity considerably. This would have the added bonus of costing the university less time in terms of management, and ultimately less money.

4.5.5 Trees

Partially met

Despite the slight decline in tree numbers across the UEL estate, the inclusion of new native trees at the USS building and new Stratford library shows a willingness to include trees in UEL's new developments. Furthermore a number of bird and bat boxes have persisted on the estate since the baseline survey and were still present in 2015. However as the previous recommendations for introducing climbing plants or woodland floor wildflowers to the bases of trees across the campus had not been carried out (many tree bases remain bare) and the overall decrease in tree numbers across the estate mean that an assessment of only partially met is the only conclusion that could be drawn.

Recommendation:

More native tree planting and further development of the fruit tree orchard would be very positive steps forward. There is also scope for the incorporation of more bird and bat boxes at Docklands campus. Monitoring of the bird and bat boxes to discover rates of occupancy and species could also be beneficial in completing the overall biodiversity story.

As recommended in the baseline report, the growing of climbing species such as ivy (*Hedera helix*), old man's beard (*Clematis vitalba*) and honeysuckle (*Lonicera periclymenum*) or, alternatively, some simple planting of woodland ground flora around tree bases would attract more invertebrates and birds.

4.5.6 Hedgerows

Met:

Much of the new hedgerow planting as part of the USS development included native species such as box hedge, future plants that could be used for native hedging are English Yew (*Taxus baccata*), Beech (*Fagus sylvatica*) or Hawthorn (*Cratageus monogyna*)

Recommendation

Native hedgerow planting is a step in the right direction and all new planting should be encouraged to follow this lead. It is also worth considering removing some sections of existing hedgerow and replacing it with a more diverse and native mix.

4.5.7 Green roofs

Met:

The addition of the new green roofs at the USS and the Stratford Library show a willingness to include these features on new build developments adding 1707m^2 of green roof area to the UEL estate. While the existing brown roofs on the Docklands campus are subject to a biodiversity retrofit project. These are clearly positive steps to increasing the green roof area on the UEL estate. However these new green roofs could benefit from additional wildflower seeding or other biodiversity improvements, such as those trialled on the brown roofs at docklands to increase their biodiversity potential.

Recommendation

Greater green roof implementation should be considered, both on new build developments and for retrofit on existing infrastructure. All new roofs should be designed as wildflower biodiverse roofs to support a greater diversity of wildlife and improve ecosystem services such as stormwater management, air quality improvement and reducing the urban heat island effect.

Retrofitting additional habitat features and sowing of wildflower seeds should also be considered on the two new Sports Dock roofs and the aggregate roofs on the halls of residence at Docklands.

4.5.8 Water

Not met

There is still no managed standing water on the UEL estae and this may be a major limiting factor for wildlife and habitat connectivity.

Recommendation

The creation of wetland areas, both ephemeral and permanent, would substantially add to the biodiversity interest on both campuses. This could be created as a ground level pond, or could be created at roof level through a wetland inspired green roof. Such a wetland roof would also support the research outputs of potential MRes students within ACE studying innovative urban green infrastructure.

Specific recommendations

4.5.9 Greening containers

Not met

Although more containers have been brought on to the campus since the baseline survey, none of these have been greened.

Recommendation

Containers make ideal candidates for green-roof systems and, due to their loading capacity, they have the potential to be used for higher loading wetland green roofs. It is recommended that funding be sought to green some of the containers across the UEL estate to add to biodiversity and the aesthetics of the campuses. Examples of container greening can be found at www.greenroofshelters.co.uk.

4.5.10 Creation of native woodland edge habitat around University House

Not met

Recommendation - the addition of a mixed, native, deciduous hedge and typical woodland ground flora would greatly add to the biodiversity interest here.

4.5.11 The addition of climbers to the mature trees around University House

Not met

Recommendation – this addition would add another level of complexity and therefore diversity to the mature trees around University House. A mixture of different native species would be the most beneficial.

4.5.12 Bulb planting on amenity grassland around University House

Not met (Although due to survey timing it was impossible to be 100% certain).

Recommendation - the planting of native bulbs could create a striking show in early spring.

4.5.13 Bird boxes on mature trees at Stratford

Met:

Recommendation – further bat and bird box incorporation at Docklands Campus and the USS plus monitoring.

4.5.14 Bird food station at Stratford

Met:

Recommendation – a similar bird feeding station could be implemented at the Docklands or USS campuses

4.5.15 Wildflower meadow creation at Stratford

Not met

Recommendation – incorporate wildflower meadows on campus, perhaps as part of the new library development.

4.5.16 Nectar-rich ornamental beds at Stratford

Met:

Recommendation – more raised beds at Docklands campus.

4.5.17 Nest boxes could also be installed for bumblebees, solitary bees and other insect groups.

Met:

Recommendation – only one bug hotel was observed during the 2015 surveys. Additional bug hotels, particularly in the vicinity of existing biodiversity hotspots (e.g. green roofs, the beetle bump), would be beneficial.

4.5.18 Honey bee keeping

Not met

Recommendation – a hive was previously located on the Arthur Edwards building at Stratford Campus. However since the 2012 survey the hive has been abandoned following the theft of two queen bees. It would be a good target to overcome this and re-introduce this practice to get more staff and student education about bee keeping and to try to increase the number of hives on campus.

4.6 Recommendation summary

8 **2** **8**

10 out of eighteen recommendations in UEL's 2010 biodiversity baseline report (Freeman *et al.* 2010) had been fully or partially implemented by the time of the 2015 survey. Although this is one less recommendation than had been met in 2012, the attitude to incorporating biodiversity in UEL's new building developments is very promising and this rate of implementation seems like an excellent step in the right direction in terms of making UEL's campus more permeable for wildlife and towards creating an exemplar case study of biodiverse urban green infrastructure. It is hoped that by the next monitoring round of the UEL estates that at least 12 of the baseline survey recommendations are met marking the highest implementation of the recommendations since their inception in 2010.

5 Conclusions

The 2015 biodiversity surveys across UEL's campuses revealed a story of continual change towards a more biodiverse estate capable of supporting a greater array of ecosystem services and providing a greater legacy for educating and connecting the students, staff and local community with the natural world.

Particular successes worth highlighting included:

- Ten out of 18 biodiversity enhancements recommended in the 2010 baseline report had been implemented or partially implemented;
- An overall increase in the area of biodiversity hotspots was recorded across the estate;
- An overall increase in the area of flower rich meadows was recorded across the estate;
- An overall increase in the proportion of the UEL estate managed as greenspace;
- 6 green roofs and large amounts of greenspace were incorporated into the new USS building;
- 1 green roof was incorporated into the new Stratford library;
- An experimental green roof retrofit experiment has been set up on the student residences brown roofs;
- Despite the herbal medicine course being disbanded, the medicinal herb garden still acts as a tremendous sanctuary for biodiversity on the Stratford Campus;
- Staff & Student 'community garden' projects have taken over from the 'student eats' and 'grow your own projects' previously in use across the estate.

These positive changes seem to be having an immediate effect on biodiversity with greater numbers of floral species recorded during the 2015 surveys than in previous years and several conservation priority species observed utilising UEL's biodiversity hotspot habitats such as kestrels, linnets, unlocks, fieldfares and streaked bombardier beetles.

Nevertheless, a word of caution must also be thrown in at this stage to provide a balanced view on progress. Whilst these initiatives are having a very positive effect on campus greens pace, the reality similarly to that of 2012 is that in 2015 there is still much potential for improvement if UEL is to be able to truly boast that it is an urban oasis for biodiversity and an exemplar for the Higher Education sector.

Key indicators of areas with greatest potential for improvement include:

- Whilst there are now green roofs at UEL, green space at roof level represents less than 3% of the total area of roof space;
- Biodiversity hotspots designated within the original baseline report were lost by the time the 2012 and 2015 surveys were carried out;
- The medicinal herb garden hotspot appears to be losing biodiversity due to a lack of management;
- Amenity grassland of little value to biodiversity still remains as the largest proportion of greenspace at both the Docklands and Stratford campuses;

It is important therefore that we celebrate the successes but view them as part of a continuing journey towards creating a campus capable of supporting biodiversity, ecosystem services and a reduced environmental footprint.

6 Future work

The negative indicators within this report provide a good foundation to build on in terms of future enhancements and updating the University of East London Biodiversity Action Plan. To be able to measure the success of any future schemes that attempt to attract more wildlife to the estate they must be monitored. As such it is recommended that the survey methodology detailed in the present report should be on a two or perhaps three year cycle to monitor broad change. In the intervening period it may be beneficial to establish some detailed monitoring programmes to identify and quantify biodiversity of other groups beyond campus flora. This could include:

- The establishment of permanent vegetation and invertebrate monitoring at selected biodiversity hotspots;
- Specific bird surveys at both Stratford and Docklands campuses in order to provide a more comprehensive baseline;
- Small mammal trapping at both campuses in order to judge the biodiversity interest, if any, of this group;
- A survey of lower plants (mosses and liverworts) and lichens would be useful. These groups are often overlooked even though they are of significant biodiversity interest;
- It would be valuable to establish a database of species records for all of the UEL estate that could be constantly updated as new records came in. The University could encourage staff and students to provide records of their sightings.

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