



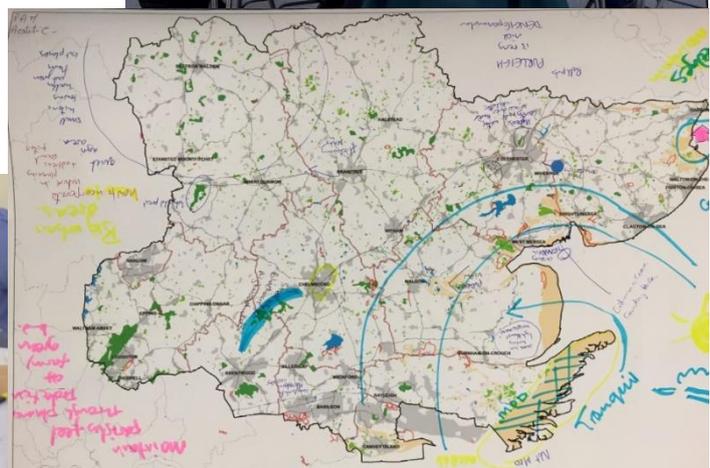
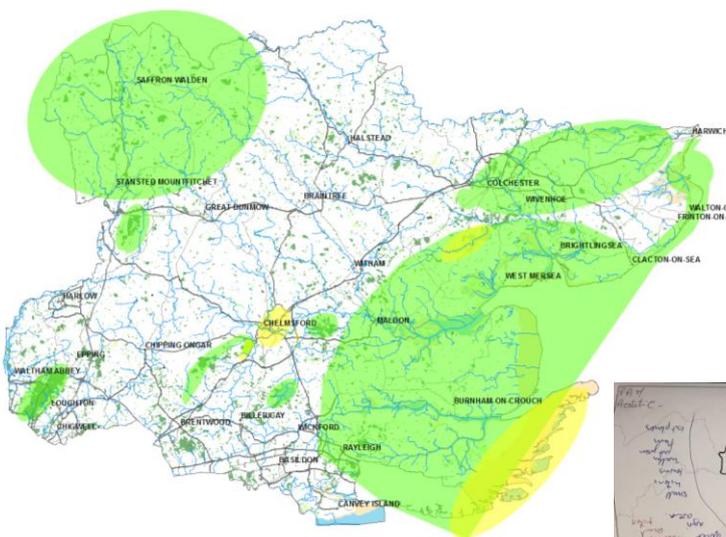
OpenNESS

Operationalisation of Natural
Capital and Ecosystem Services

Mapping Cultural Ecosystem Services in Essex

Final report, May 2017

Alison Smith, Rob Dunford, Berta Martín-López and Pam Berry



From concepts to real-world applications
www.openness-project.eu

Prepared under contract from the European Commission

Contract n° 308428
Collaborative project
FP7 Environment

Project acronym: OpenNESS
Project full title: Operationalisation of natural capital and ecosystem services: from concepts to real-world applications
Start of the project: 01 December 2012
Duration: 54 months
Project coordinator: Finnish Environment Institute (SYKE)
Project website <http://www.openness-project.eu>

Citation: Smith, A.C., Dunford, R.W., Martín-López, B. and Berry, P.M. (2017) Mapping cultural ecosystem services in Essex, OpenNESS project report, European Commission FP7.

Contents

1	Summary	3
2	Introduction	4
3	Participatory Ecosystem Service mapping	5
3.1	Aesthetic landscapes	6
3.2	Recreation	10
3.3	Education.....	14
3.4	A ‘sense of place’	17
3.5	Habitat for wildlife.....	21
3.6	The mobile exhibition.....	25
4	Flickr photo analysis	28
4.1	Types of cultural ecosystem service.....	29
4.2	Spatial patterns and hotspots of Flickr photos.....	29
4.3	Correlation between photos and PGIS maps	32
4.4	Features shown in photos	36
5	Strava	39
6	Conclusions	41

Summary

The OpenNESS project aimed to investigate how the concept of 'ecosystem services' can be put into practice in real-life decision-making, working with land managers and decision makers in 27 case studies across Europe. The Environmental Change Institute at the University of Oxford worked on two of these case studies: one in Warwickshire, Coventry and Solihull (WC&S) and this one, in Essex, which aligns with the Natural Capital Asset Check being carried out by Essex County Council.

This report focuses on mapping five cultural ecosystem services in Essex: aesthetic beauty, recreation, education, wildlife habitat and a 'sense of place'. These cultural services have significant benefits for health and wellbeing, but they are often neglected in decision-making because they are hard to map and measure. Two methods were used: participatory mapping by local stakeholders (via a workshop and a mobile exhibition board), and analysis of publically available geotagged Flickr photos showing natural landscapes, recreational activities or wildlife. In addition, a separate project within this case study modelled the impact of future climate change on the wildlife and habitats of Essex.

A rating exercise at the stakeholder workshop showed that cultural ecosystem services are thought to be highly important both for the personal wellbeing of the workshop attendees and for the wider community. However, provision of these services is mixed, and many are threatened by loss of green space to development. Activities such as felling of large numbers of mature trees in Chelmsford have had an adverse impact on cultural ecosystem services such as aesthetic value and sense of place, leading to a tangible sense of loss amongst residents attending the workshop.

Planners need information on the areas and features that should be preserved from development in order to maintain ecosystem services which are important for local residents. The places identified during the participatory mapping exercise as being important providers of ecosystem services correlate quite well with many of the clusters of Flickr photos, which gives a certain degree of confidence in the validity of both of these techniques. Both techniques identified similar hotspots of service provision, including Epping Forest, Hatfield Forest, the Lea Valley, Thorndon Country park, Hylands Park, the River Chelmer, the Maldon area, High Woods Park in Colchester, Hanningfield and Abberton reservoirs, the Stour Valley and the north-east Essex coast.

Both the PGIS work and the photo analysis confirmed the potential for more service provision through improving public access to the Foulness MOD area, and opportunities to increase planting of trees and wildflowers across Essex. The need to protect remaining green space and trees in Chelmsford from further loss to development was also a strong theme at the workshop. Several potential improvements were identified which could help to restore a distinctive local identity to Chelmsford, including development of green and blue infrastructure at the canal basin.

Feedback from the workshop attendees was that the participatory mapping approach could be a useful way of integrating the views and concerns of local people into the planning process. The Flickr analysis was found to be useful for examining spatial patterns in the aesthetic value of landscapes, although it provides less information on other cultural ecosystem services. Use of these tools as part of a suite of complementary methods can provide valuable information about the places, features and habitats that supply different cultural ecosystem services, help to identify options for improvement, and communicate the cultural importance of natural capital to decision-makers. However, the climate modelling showed that future climate change could affect the amount of suitable habitat for many species by the 2050s.

1 Introduction

The concept of ‘ecosystem services’ can be very useful for demonstrating the value of nature to humans, but it is a relatively new concept and has not yet been widely taken up by policy makers, land managers and other stakeholders. The OpenNESS project aimed to investigate how this concept can be put into practice in real-life decision-making. As part of this project, the Environmental Change Institute at the University of Oxford worked closely with local stakeholders on two case studies: one in Warwickshire, Coventry and Solihull (WC&S)¹ and this one, in Essex, which builds on the Natural Capital Asset Check being carried out by Essex County Council.

We have been trialling a number of approaches in each area to map the supply and, in some cases, the demand, for ecosystem services. In WC&S we mapped a range of provisioning, regulating and cultural ecosystem services (see Box 1), but in Essex we chose to focus just on the cultural ecosystem services, which are typically harder to assess and thus are often neglected in decision-making. We applied two emerging research techniques that are proving to be well suited to assessing cultural ecosystem services:

- **Participatory ecosystem service mapping**, using workshops and a mobile exhibition to map supply and demand of different cultural ecosystem services both in Essex as a whole and at a more local scale in the town of Chelmsford (section 2);
- **Flickr photo analysis**, using publically available Flickr photos to map cultural ecosystem services such as aesthetic beauty within the Essex area (section 3).

In addition, a separate project within this case study modelled the impact of future climate change on the wildlife and habitats of Essex (a separate report has been produced).

Box 1: What are ecosystem services?

Ecosystem services are the services that flow from nature and provide benefits for humans. They are usually classified as provisioning, regulating and cultural services. These are all underpinned by supporting services that maintain healthy ecosystems, including provision of habitat for wildlife.

Provisioning services provide goods that can be directly consumed by people, e.g. food, timber, water and medicine.

Regulating services help to maintain desirable environmental conditions, e.g. by protecting against flooding and soil erosion; regulating the climate (via carbon storage in soils and vegetation); improving air and water quality (pollution removal by vegetation); and providing pollination and biological pest control via beneficial insects, birds and mammals.

Cultural services include aesthetic beauty; opportunities for recreation (e.g. walking, cycling, boating, fishing) and education; local distinctiveness or ‘sense of place’; and places where people can interact with wildlife.

¹ Dunford, R.W., Smith, A.C., Martín-López, B., Berry, P.M., Martland, L. and Harrison, P.A. (2017) Ecosystem service mapping in Warwickshire, Coventry and Solihull, OpenNESS project report, European Commission FP7.

2 Participatory Ecosystem Service mapping

In February 2016, Essex County Council and the OPENNESS project organized a participatory ecosystem service mapping workshop for a small group of local residents and planners. The focus was on five cultural ecosystem services.

- Aesthetic: places where people can appreciate the beauty of nature.
- Recreation: opportunities for sport or leisure activities in a natural setting.
- Education: formal or informal opportunities to learn about or be inspired by nature.
- ‘Sense of place’: special places or distinctive features that contribute to local cultural identity.
- Wildlife habitat: places that offer habitats for wildlife provide the opportunity for people to enjoy interacting with wildlife, and also underpin many other ecosystem services (such as biological pest control and pollination).

At the start of the workshop, attendees filled in a questionnaire to indicate how important these cultural ecosystem services are to them personally, how important they thought they were for the wider community, and how well they thought these services were provided in the town of Chelmsford and in the county of Essex. The results are summarised in Table 1.

Table 1. Questionnaire responses showing provision of cultural ecosystem services and their contribution to wellbeing (each X = one response)

	Contribution to personal wellbeing			Contribution to community wellbeing		
	High	Medium	Low	High	Medium	Low
Recreation: being in nature	xxxxxxx	xx		xxxxxxxx	x	
Aesthetic value: beauty of nature	xxxxxxxx	x		xxxxxxx	xx	
Education: learning about nature	xxxx	xxxx	x	xxxxxxx	xx	
Special places: cultural or emotional value	xxxxxxx	xx		xxxxxxx	xx	
Habitat for wildlife	xxxxxxxx	x		xxxxxxx	xxx	

	Provision in Chelmsford			Provision in Essex			Trend in Essex		
	High	Med	Low	High	Med	Low	Up	Stable	Down
Recreation: being in nature	xx	xxxxxxx		xxxxx	xxxx		x	xxxxx	xx
Aesthetic value: beauty of nature	xx	xx	xxxxx	xxxx	xxxxx		x	xxx	xxxx
Education: learning about nature		xxx	xxxxxx	xx	xxxxx	xx		xxxxxxx	x
Special places: cultural or emotional value		xxxxx	xxxx	xxx	xxxxx	x		xxx	xxxxx
Habitat for wildlife	x	xxx	xxxxx	xx	xxxxxx	x		xxxx	xxx

The responses show clearly that the participants thought that four of the five cultural ecosystem services were very important for their own personal wellbeing, with the fifth service (education) being of medium to high importance, and that all five were important for the wellbeing of the wider community. However, supply of four of the five services was ranked as low to medium in Chelmsford, with recreation being

generally ranked as medium. In the county of Essex, supply was perceived to be medium to high, although the trend in supply was generally thought to be either stable or declining.

We then asked participants to mark on maps of Chelmsford and Essex the places where nature contributes to people's health and wellbeing by providing the five cultural services. The aim was to identify at a county scale, and also at a more local scale, where the hotspots of ecosystem service supply are now, and where they could be improved in the future. For each service, participants used coloured pens and sticky dots to mark the locations of:

-  Actual (current) supply of the service
-  Where the service could be improved in the future
-  Where there is (or will be) demand for the service but no supply

The results for each of the five cultural ecosystem services are presented in sections 2.1 to 2.5. Each section includes a qualitative description of the main findings, a summary table, and the maps for Chelmsford and for Essex. Participants were divided into two groups and the areas highlighted by each group are overlaid on the maps, so that darker shades on the maps show the areas highlighted by both groups.

The workshop was supplemented by a mobile exhibition consisting of five map boards, one for each service. The boards were displayed at several community events during the summer of 2016. People were invited to place pins in the maps to show the areas important to them for each service, and pens were available for writing comments on the maps. Different coloured pins were used to show 'actual supply', 'could be improved' and 'demand but no supply, or threat to supply', as above. The results of this exercise are presented in section 2.6.

2.1 Aesthetic landscapes

Figure 1 shows the participatory map for Chelmsford and Figure 2 shows the map for Essex. The results are summarised in Table 2.

In Chelmsford, the 'green wedges' around the three river corridors are very important for providing places where people can experience the aesthetic beauty of nature close to their homes. Danbury Woods and Hylands Park also provide this service, as do some of the small outlying villages such as Chignall St James, but these places are harder to reach without a car. However, the town centre itself has little aesthetic value: over 400 street trees have been felled in recent years, including 'Tree of the Year' 2014, leaving the town centre lacking in greenery. Development is still a threat to green space, with housing being added right up to the boundaries of the 'green wedges', and large developments planned to the north of Chelmsford which threaten the green belt that separates the city from the surrounding villages such as Boreham. Traffic noise is a major problem – it is hard to find tranquil areas, and in some places there are problems with litter and vandalism.

There are opportunities to improve provision of aesthetic value by restoring trees and green space to the town centre. In particular, Mesopotamia Island and the old gasworks at the confluence of the River Chelmer and River Wid has great potential to become an attractive blue / green space which could attract visitors to the town, although this is scheduled for grey infrastructure development. There are also opportunities to improve the interest of the green space along the River Chelmer east of the town, to clean up litter along the A12 verges, and to make more of the golf course area south of Hylands park.

In the county of Essex, provision of aesthetic beauty was perceived as being higher than in Chelmsford. Places with high aesthetic value included the coastline and views to the coast, Mersea Island, Maldon, Epping Forest and Hatfield Forest, Hanningfield reservoir, various country parks including High Woods park in Colchester (with views of the castle), and the more unspoilt parts of the county in NE Essex and the Saffron Waldon area in the NW.

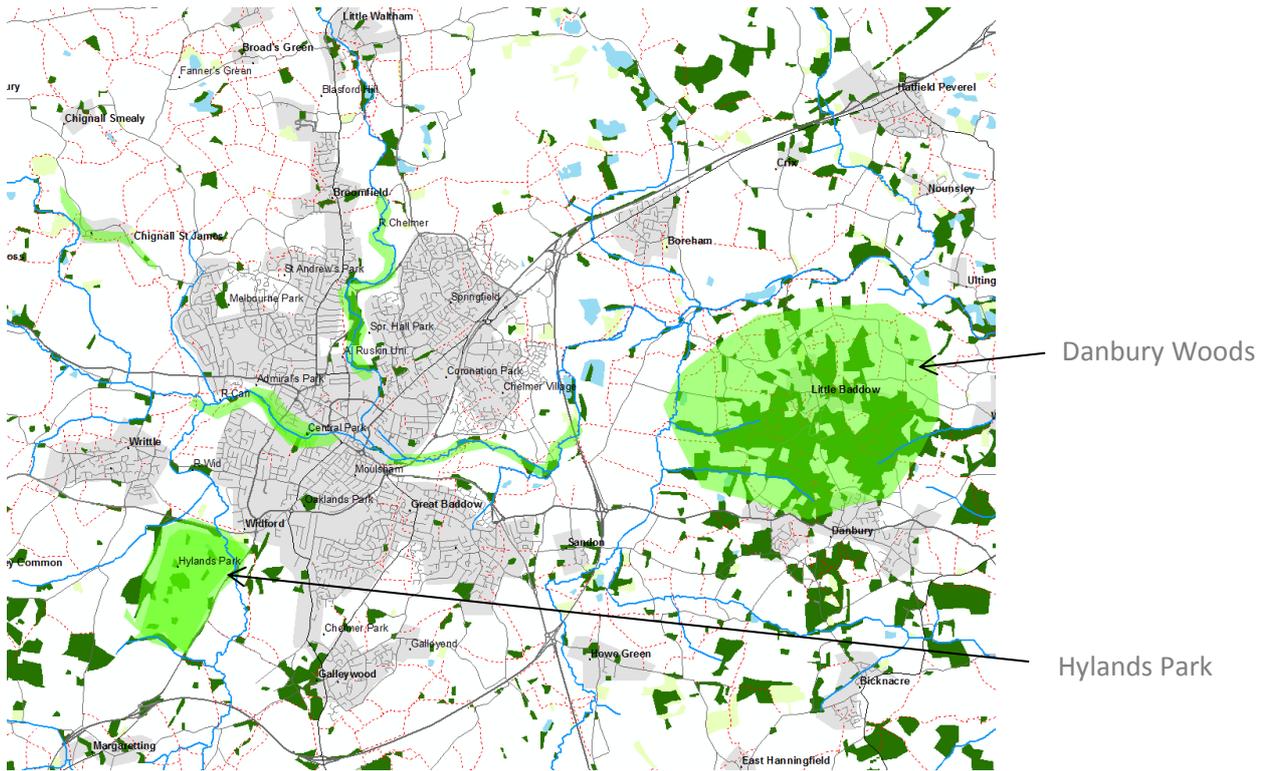
Urban centres in general were thought to be lacking in trees and green space, and threatened by development. Opportunities to improve provision of aesthetic beauty included improving public access to the Foulness MOD area in SE Essex; improved urban planning to increase provision of and protection of trees and green space; planting wild flowers along roadside verges, central reservations and on roundabouts; and maintaining hedges. The county as a whole was perceived as having relatively few forests and woodlands, and could be improved by planting more trees, e.g. at Abberton reservoir.

Table 2. Summary of ecosystem service mapping for aesthetic landscapes

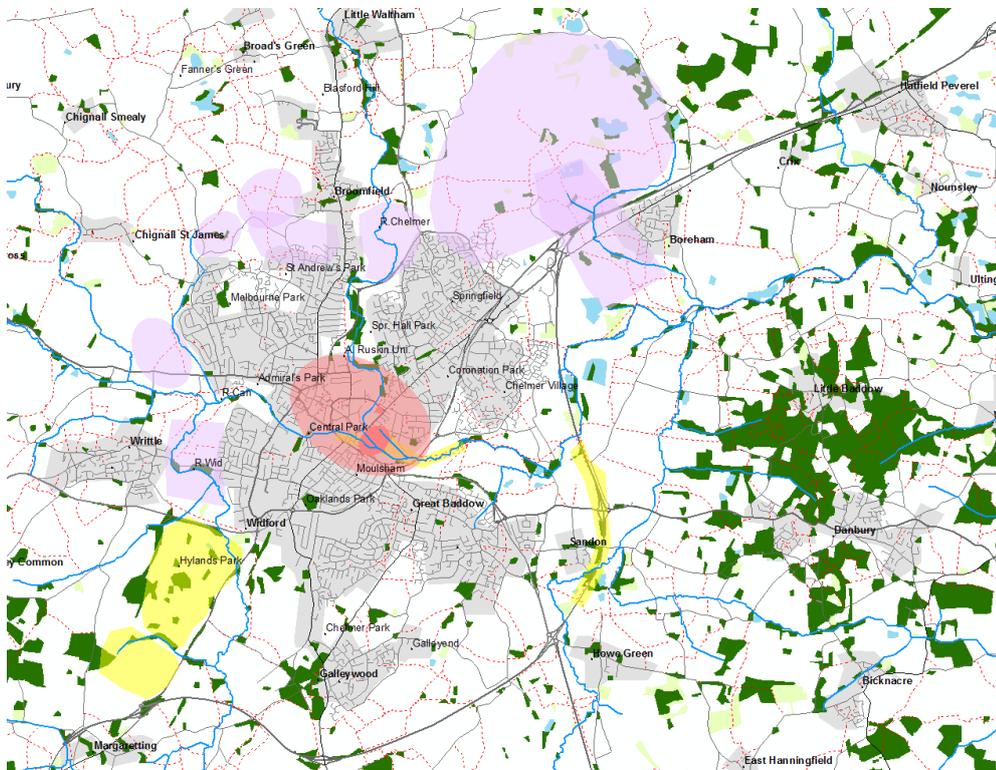
Where is this service provided currently?	Where is it lacking or threatened?	Opportunities to enhance the benefits
Chelmsford		
<ul style="list-style-type: none"> Hylands Park Danbury Woods The three river corridors Chignall St James – walk along stream 	<ul style="list-style-type: none"> City centre needs more trees and greenery. Traffic noise is a problem. New developments to north threaten green space e.g. between Boreham and Chelmsford. 	<ul style="list-style-type: none"> Improve access to area south of Hylands Park (golf course). Clean up litter along A12. Improve River Chelmer to east. Mesopotamia Island and old gasworks could be green space.
Essex		
<ul style="list-style-type: none"> Hanningfield Reservoir. Epping Forest, Hatfield Forest. The Essex coast (sunniest coast in Britain); and views to the coast e.g. from Purleigh and Dengie peninsula. Maldon and estuary. Mersea island and causeway, Cudmore Grove country park: tranquil, atmospheric. NE Essex – unspoilt. Burnham-on-Crouch: wilderness, lighthouse, can hunt for sharks’ teeth. High Woods Country Park - views over Colchester and the castle. Wivenhoe trail. Saffron Waldon area. Flitch Way. Villages and woodlands SW of Chelmsford; Langdon Hills, Thorndon Country Park. 	<ul style="list-style-type: none"> Urban areas – loss of street trees and threat to green space from development. Need better protection for green belt. 	<ul style="list-style-type: none"> Improve public access to the Foulness MOD area. Urban areas – need to incorporate nature in planning, and address social factors. Need to maintain hedges. More trees and forests, e.g. at Abberton reservoir. Wild flowers on roadside verges and roundabouts.

Figure 1. Participatory mapping of aesthetic landscapes: Chelmsford.

Actual (current) supply



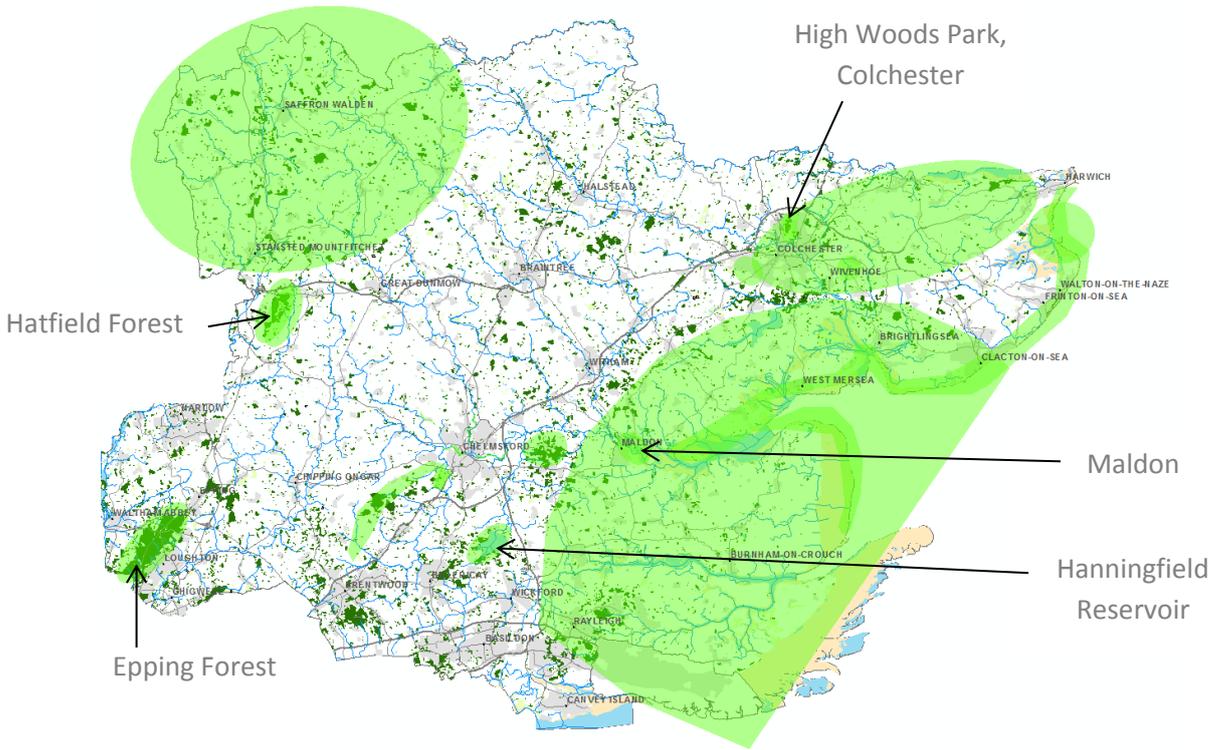
Gaps, threats and opportunities to improve



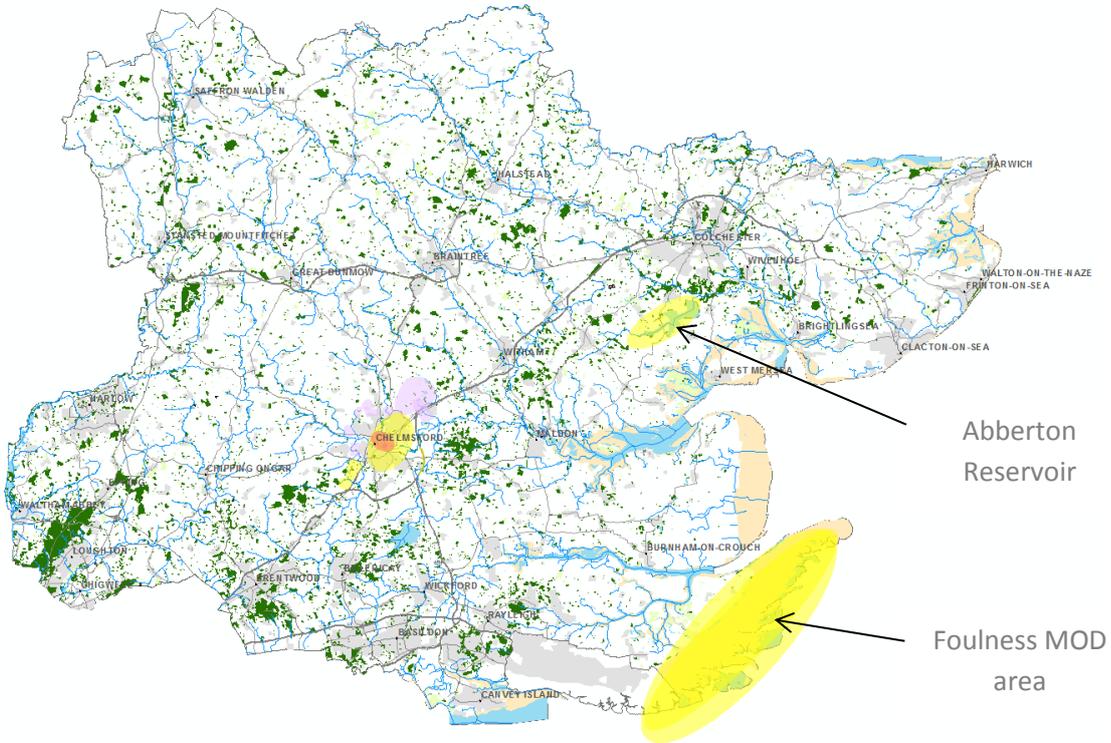
- Currently provides service
- Opportunities to improve or expand service
- Service lacking
- Threatened by development

Figure 2. Participatory mapping of aesthetic landscapes: Essex.

Actual (current) supply



Gaps, threats and opportunities to improve



- Currently provides service
- Service lacking
- Opportunities to improve or expand service
- Threatened by development

2.2 Recreation

Figure 3 shows the participatory map for Chelmsford and Figure 4 shows the map for Essex. The results are summarised in Table 3.

In Chelmsford, the river network and the surrounding 'green wedges' play a very important role in providing opportunities for recreation in a natural setting. As well as walking, cycling and running along river footpaths, boating (especially canoeing) on the rivers is very popular, and the rivers provide links to the wider countryside and eventually the coast.

City parks are also very important, including Oaklands Park, Admirals Park, Central Park and Marconi Park, and these provide facilities, such as an outdoor gym, pitch and putt, BMX and a weekly Park Run. Formal sports pitches and allotments also provide recreational opportunities. The Cathedral Green is highly valued as a pleasant green space, e.g. for relaxing in lunch breaks. However, the city parks are under pressure from a growing population, with some suffering from vandalism and safety issues, and the planned new developments in the north will increase this pressure. Hylands Park is increasingly being used for events and activities, relieving some of the pressure on the city parks. Danbury Woods and Galley Wood are also valued for recreation, although harder to reach without a car.

There are opportunities for improvement, especially by completing the last few hundred metres of the 'Cut', a channel to link the upper and lower parts of the River Chelmer. This would greatly improve connectivity for boats, which cannot currently travel through Chelmsford due to the presence of weirs on the river. Connectivity and safety for cycling in the city centre could also be improved, and access could be provided to Hylands Park along the River Wid. There was a feeling that the golf course south of Hylands Park was not widely used, and there could be opportunities to extend other types of recreation into this area, e.g. by adding cycle paths around the outside.

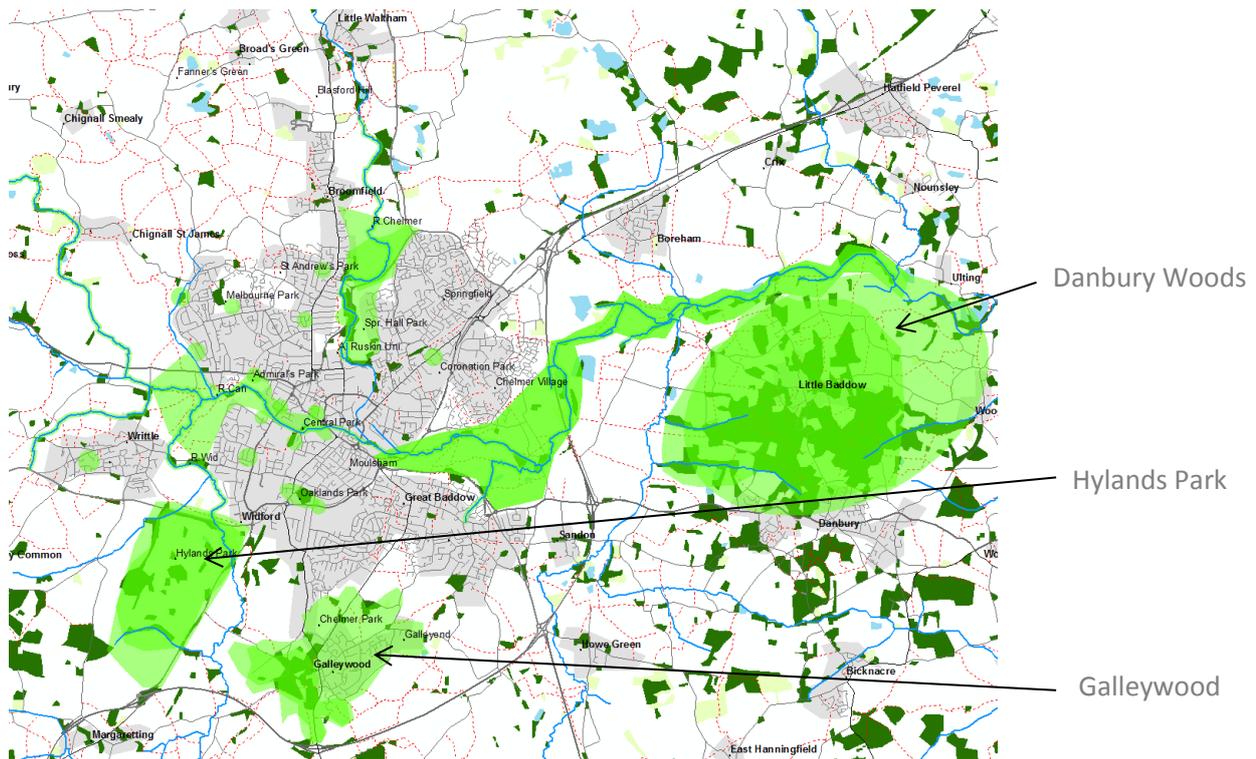
In Essex, recreation is provided in Epping Forest, at Abberton and Hanningfield reservoirs, along the coast path and the River Stour in the north-east, at various country parks and outdoor centres, and at nature reserves, especially the new RSPB reserve being developed at Wallasea Island. As mentioned in the previous section for aesthetic beauty, there is an opportunity to improve provision by opening up the coast path in the Foulness MOD area to public access.

Table 3. Summary of ecosystem service mapping for recreation

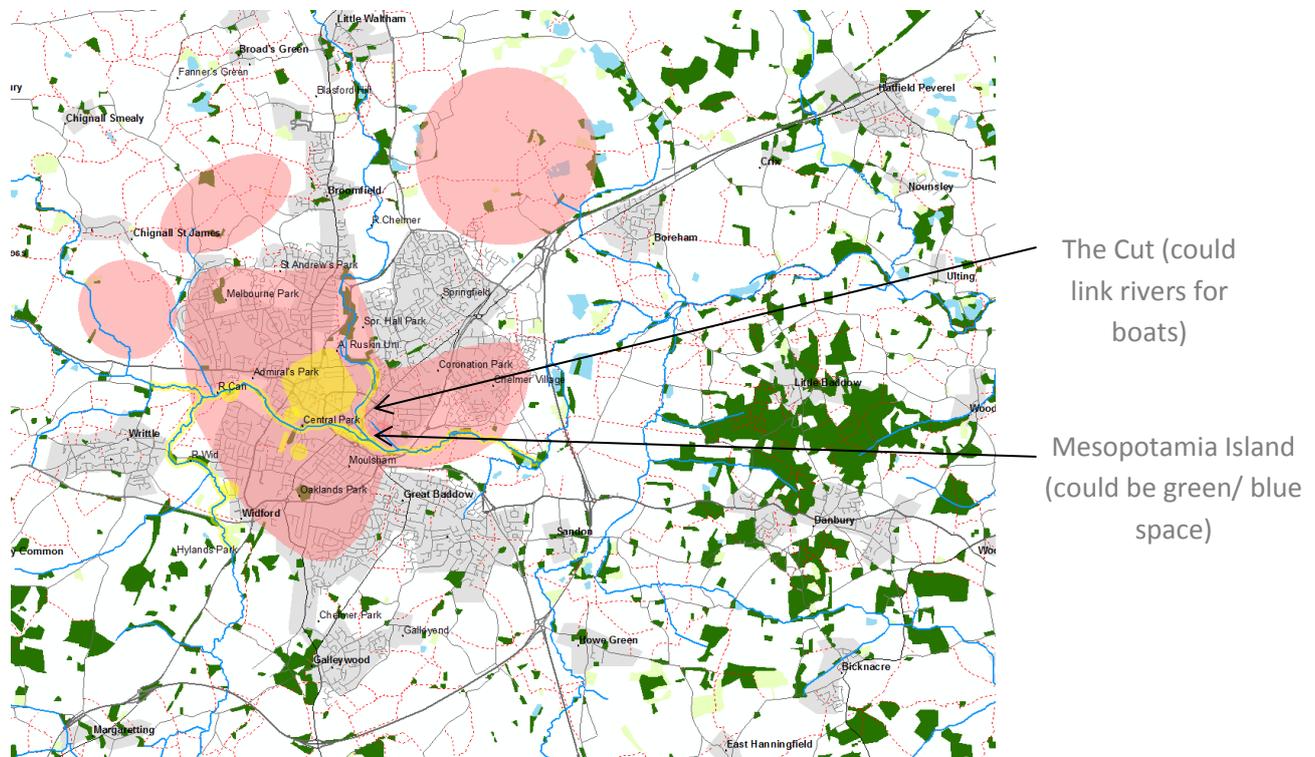
Where is the service provided currently?	Where is it lacking or threatened?	Opportunities to enhance the benefits
Chelmsford		
<ul style="list-style-type: none"> • River corridors (links to wider countryside; boating, canoeing) • City parks: Oakland Park, Admirals Park, Central Park (gym & park run, BMX, pitch and putt), Marconi Park • Cathedral green • Hylands Park and golf course • Danbury Woods and Common • Galleywood • Allotments 	<ul style="list-style-type: none"> • New developments in north will increase pressure on existing green space 	<ul style="list-style-type: none"> • Admirals Park and Central Park – overuse, vandalism and safety issues • Improve connectivity for boats (cut a channel to link rivers in the city centre) • Improve connectivity and safety for cycling in the city centre • Access along River Wid to Hylands Park
Essex		
<ul style="list-style-type: none"> • Epping Forest • North-east coast path and River Stour • Wivenhoe • Mersea Island Outdoor Centre • Maldon (Promenade park) • Abberton and Hanningfield reservoirs • Great Notley Country Park (Braintree) • Thorndon Park (Brentwood) • Hadleigh Park (mountain biking) • Wallasea Island (RSPB) 	<ul style="list-style-type: none"> • New developments in Chelmsford (as above) 	<ul style="list-style-type: none"> • Foulness MOD – future cost path? • Wallasea Island new RSPB reserve

Figure 3 Participatory mapping of recreation: Chelmsford

Actual (current) supply



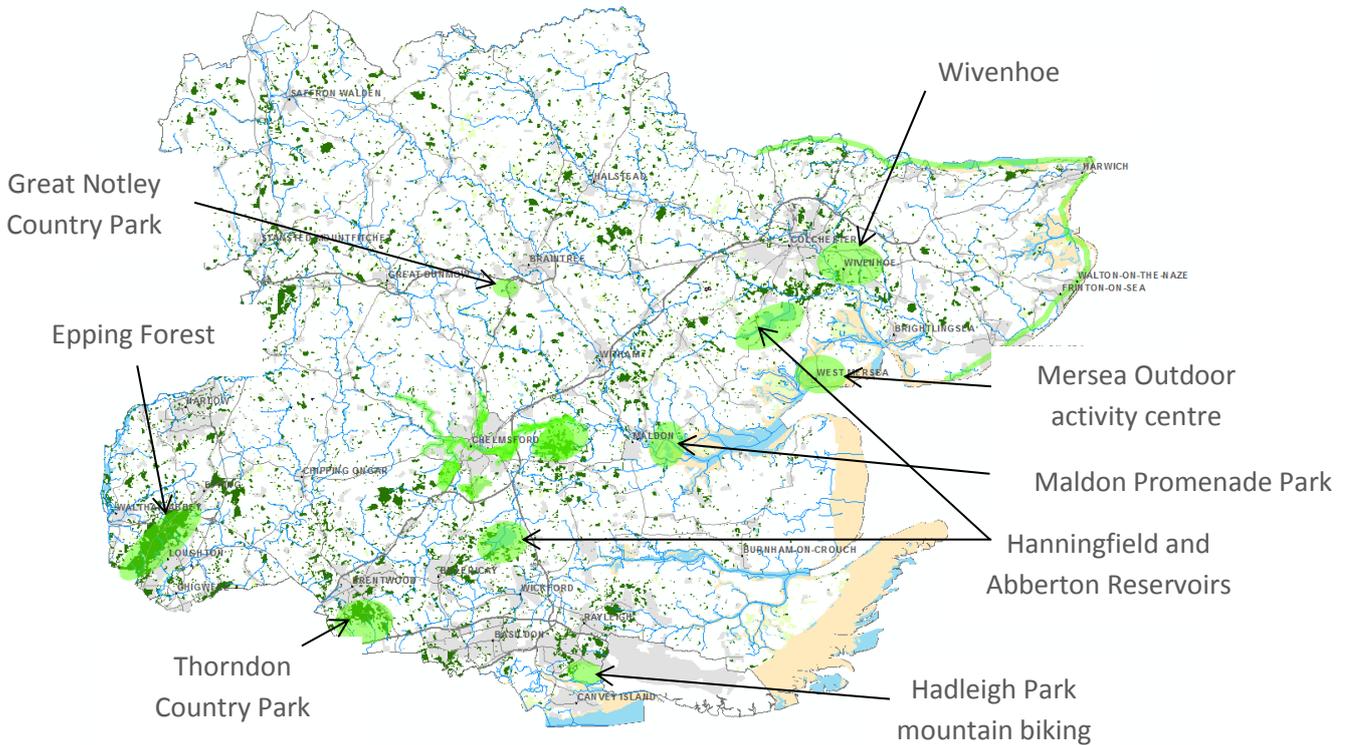
Gaps, threats and opportunities to improve



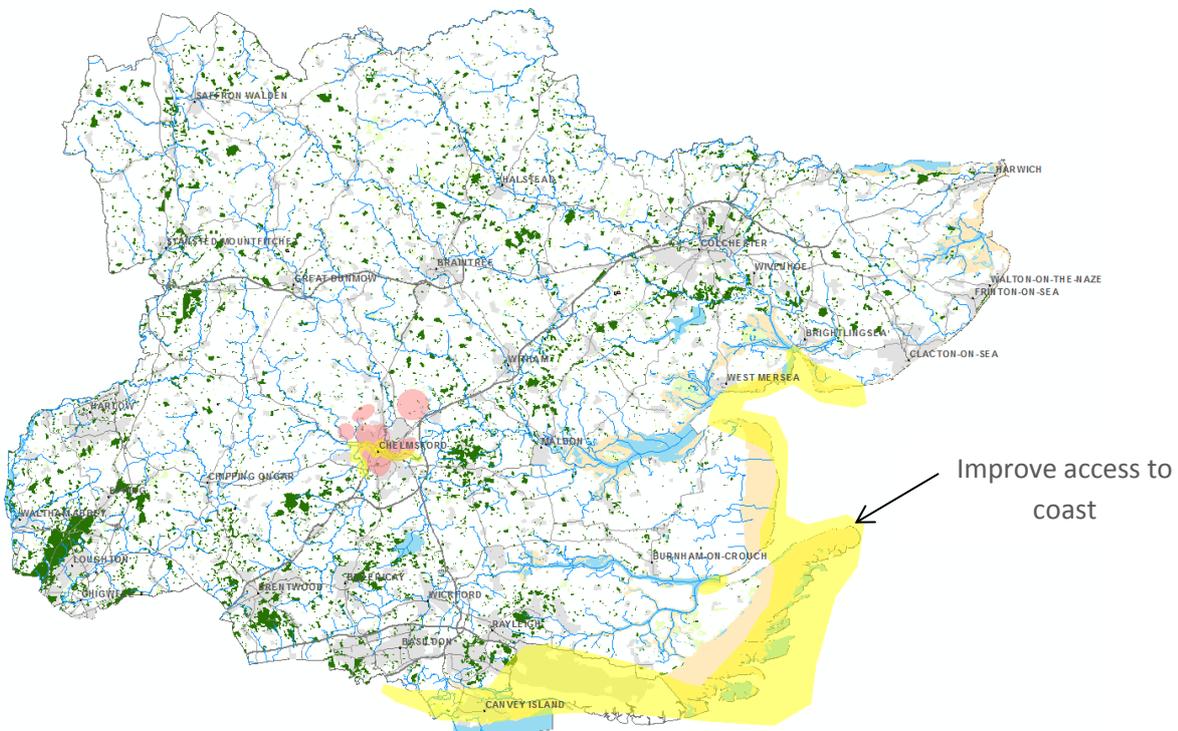
- Currently provides service
- Service lacking
- Opportunities to improve or expand service
- Threatened by development

Figure 4 Participatory mapping of recreation: Essex

Actual (current) supply



Gaps, threats and opportunities to improve



- Currently provides service
- Service lacking
- Opportunities to improve or expand service
- Threatened by development

2.3 Education

Figure 5 shows the participatory map for Chelmsford and Figure 6 shows the map for Essex. The results are summarised in Table 4. In Chelmsford, opportunities to learn about nature include a range of activities at Hylands Park and Danbury Woods, such as coppicing and ‘Wild Wednesdays’, plus a museum and beehives at Oaklands Park, and research and teaching at Writtle College. However there was a feeling that these opportunities were not widely publicised, and awareness could be increased through more signage, advertising, press coverage and other media. The number of forest schools could also be increased.

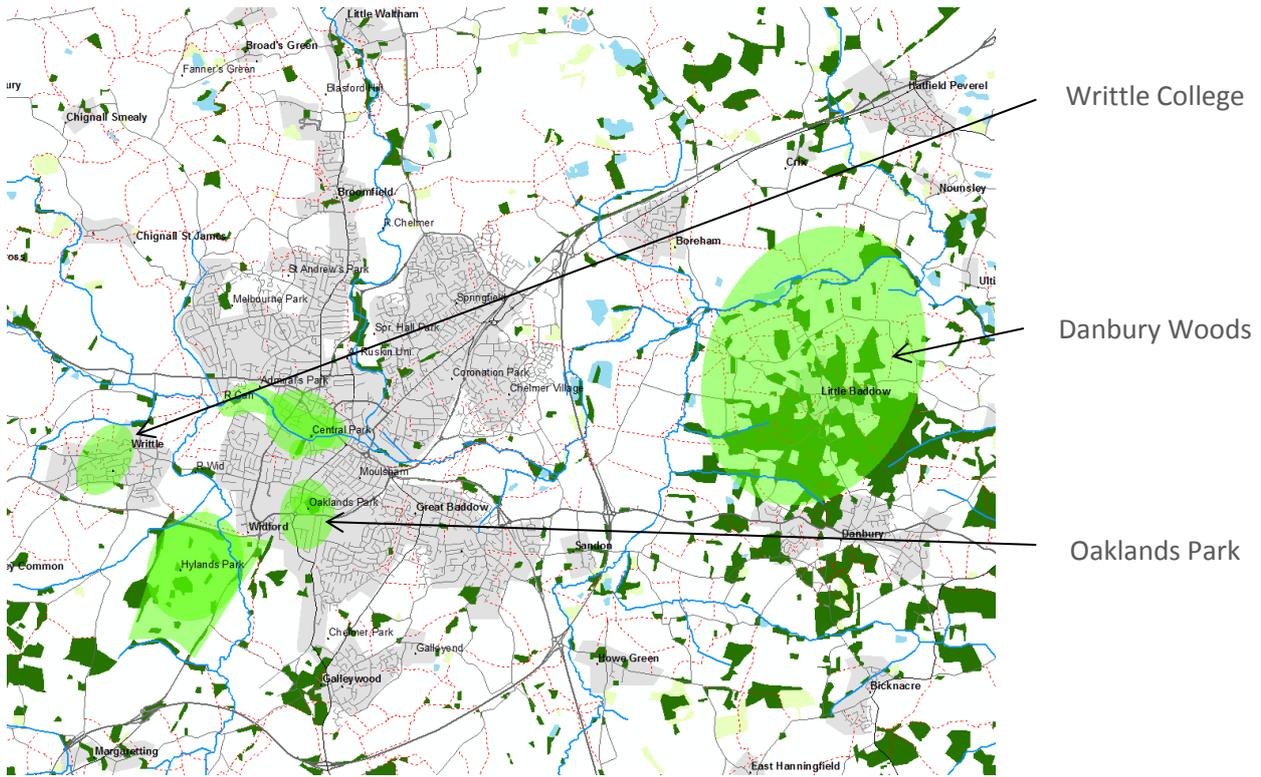
In Essex, opportunities to learn about nature are provided in a range of places (see Table 4) including country parks, Abberton and Hanningfield reservoirs, Epping Forest, nature reserves (especially Wallasea Island) and Essex Wildlife Trust learning centres, outdoor activity centres, RHS and other gardens, county shows and forest schools. The role of Wivenhoe as a transition town was specifically mentioned, as was the Thames Estuary path and its mobile app with historical and wildlife information. It was also pointed out that you can learn about nature simply by getting out and experiencing it.

Table 4. Summary of ecosystem service mapping for education

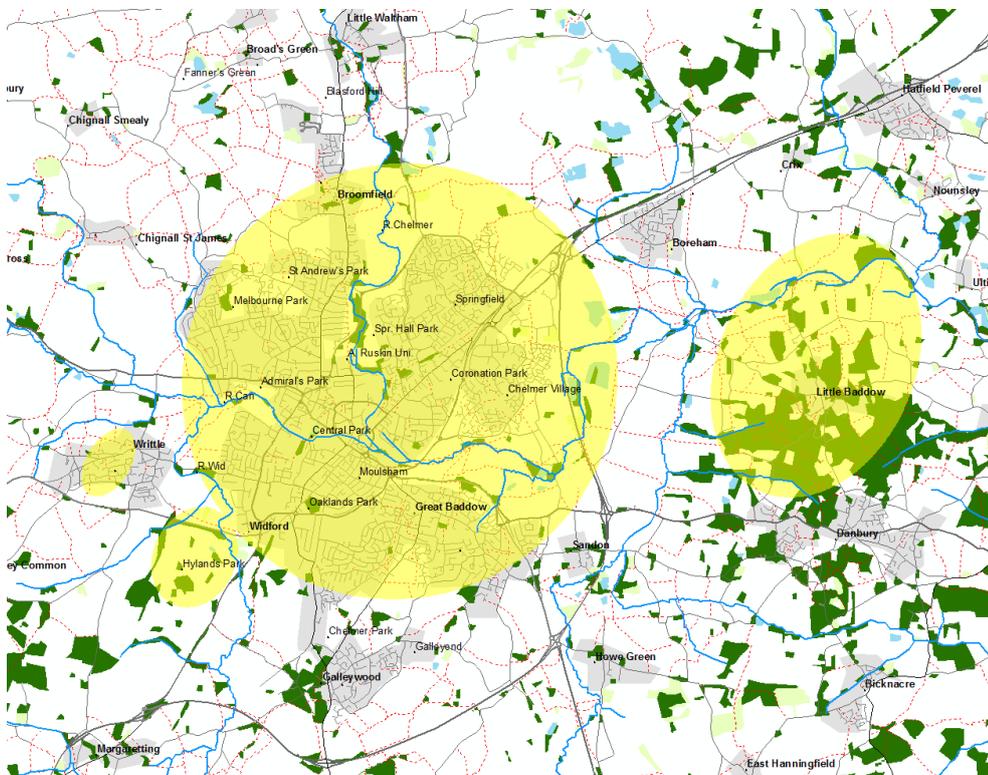
Where is the service provided currently?	Where is it lacking or threatened?	Opportunities to enhance the benefits
Chelmsford		
<ul style="list-style-type: none"> Hylands park - coppicing etc Danbury Country Park (Wild Wednesdays) Central Park Oaklands Park - museum, beehive Writtle College 		<ul style="list-style-type: none"> Potential to improve awareness of nature education in Oakland Park, Admirals Park, Central Park, Hylands Park, Danbury, Writtle College, e.g. more signs, advertising, press coverage. More forest schools
Essex		
<ul style="list-style-type: none"> Epping Forest Thorndon Country Park, South Weald Country Park, High Woods Country Park Hanningfield and Abberton Reservoirs Outdoor activity centres near Rayleigh, Maldon, West Mersea, Braintree Nature reserves including Wallasea Island- largest European salt water nature reserve - and Dengie Learning by experience - just walking through places Essex Wildlife Trust learning centres Cressing Temple, Braintree - Tudor garden County Shows e.g. young farmers RHS gardens: Hyde Hall, Beth Chatto Garden Wivenhoe Transition Town Forest Schools Thames Estuary path linking Tilbury to Southend - mobile app with historical and wildlife info 		

Figure 5 Participatory mapping of education: Chelmsford

Actual (current) supply



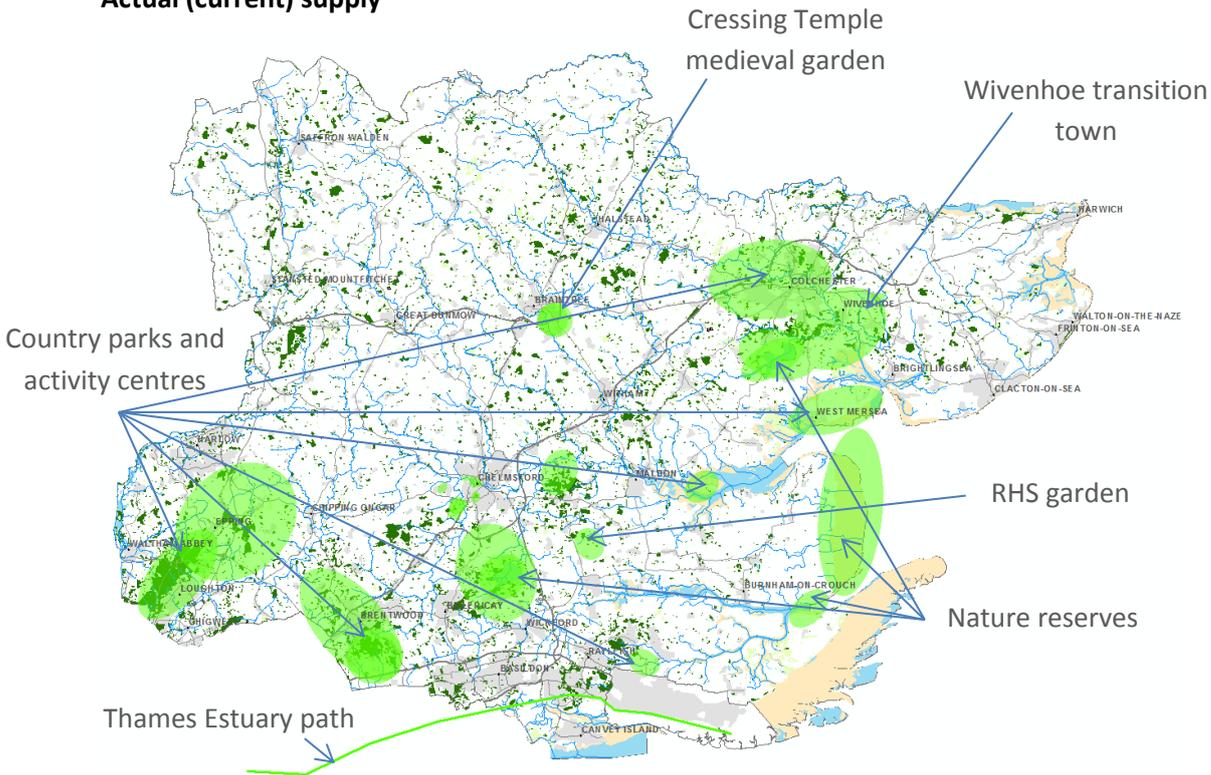
Gaps, threats and opportunities



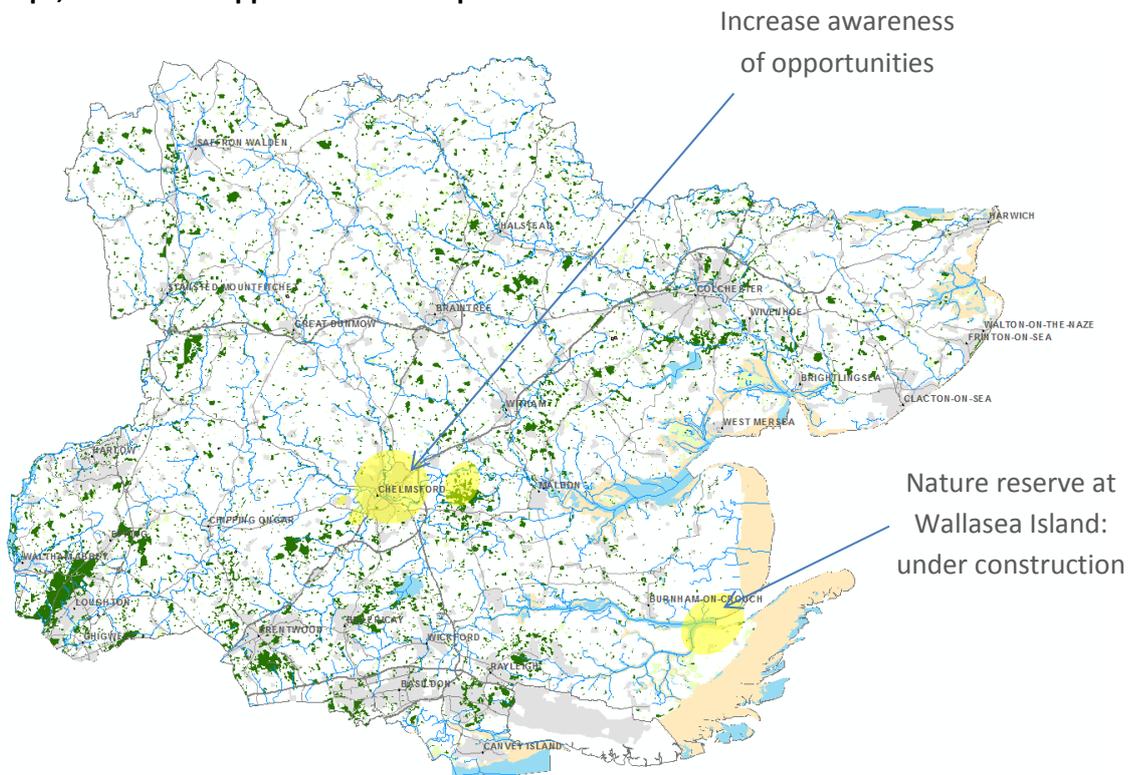
- Currently provides service
- Opportunities to improve or expand service
- Service lacking
- Threatened by development

Figure 6 Participatory mapping of education: Essex

Actual (current) supply



Gaps, threats and opportunities to improve



- Currently provides service
- Service lacking
- Opportunities to improve or expand service
- Threatened by development

2.4 A ‘sense of place’

Figure 7 shows the participatory map for Chelmsford and Figure 8 shows the map for Essex. The results are summarised in Table 5.

The cultural ecosystem service of ‘sense of place’ refers to the natural characteristics, landscapes, species and places that make an area distinctive. Although it is based on natural features, with forests, rivers and the coast all being mapped as important, it is also often very closely linked to human factors. Thus many of the places and features mapped by the participants were related to human history, including the grounds and gardens of historic buildings, Henry VIII’s old hunting forests, the Wivenhoe witch trials, Saxon forts, old Roman roads and the role of Chelmsford as capital of the Roman Empire. Links to art and literature were also mentioned, e.g. ‘Constable country’, the role of Maldon as the location for the story of ‘Beowulf’, and links to George Orwell in north Essex, as well as links to religion, e.g. the church at Danbury, and the Christian community at St Peter’s. Modern events also featured, e.g. the use of the Lea valley for the 2012 Olympic canoeing event, and the outdoor folk music festival at Leigh-on-Sea. Some places such as Mersea Island and its causeway were included because they had a special ‘atmospheric’ feel.

This service is also unusual in that many places are special on a personal level, with significance to a certain individual but not necessarily to wider society. Examples that emerged in the workshop included ‘the pond where I used to go fishing as a child’, favourite walks and lunch spots, quiet corners that people had found to ‘get away from it all’, ‘my garden’, ‘my allotment’, ‘the place where I stop to watch the Guinea fowl’, and ‘one of the first places I visited when I moved to Essex’.

Although a wide variety of these ‘special places’ were mapped in Chelmsford, and the Roman history was seen as a strong potential cultural asset, there was also a feeling that a lot of the local distinctiveness of the city centre had been lost to development, with widespread loss of trees, including the 2014 ‘Tree of the Year’ that was voted as the favourite of local residents, and also the loss of the old cattle market. Opportunities to improve the ‘sense of place’ including replacing street trees and green space, especially in the canal basin area, and making more of the Roman history. In Essex, opportunities included making more of the Roman history, linking the Saxon and Roman forts, making more of the history of the Maldon area (saltmarshes, the Beowulf story, the role of the estuary mud in protecting against invasions) and improving public access to the Foulness MOD area.

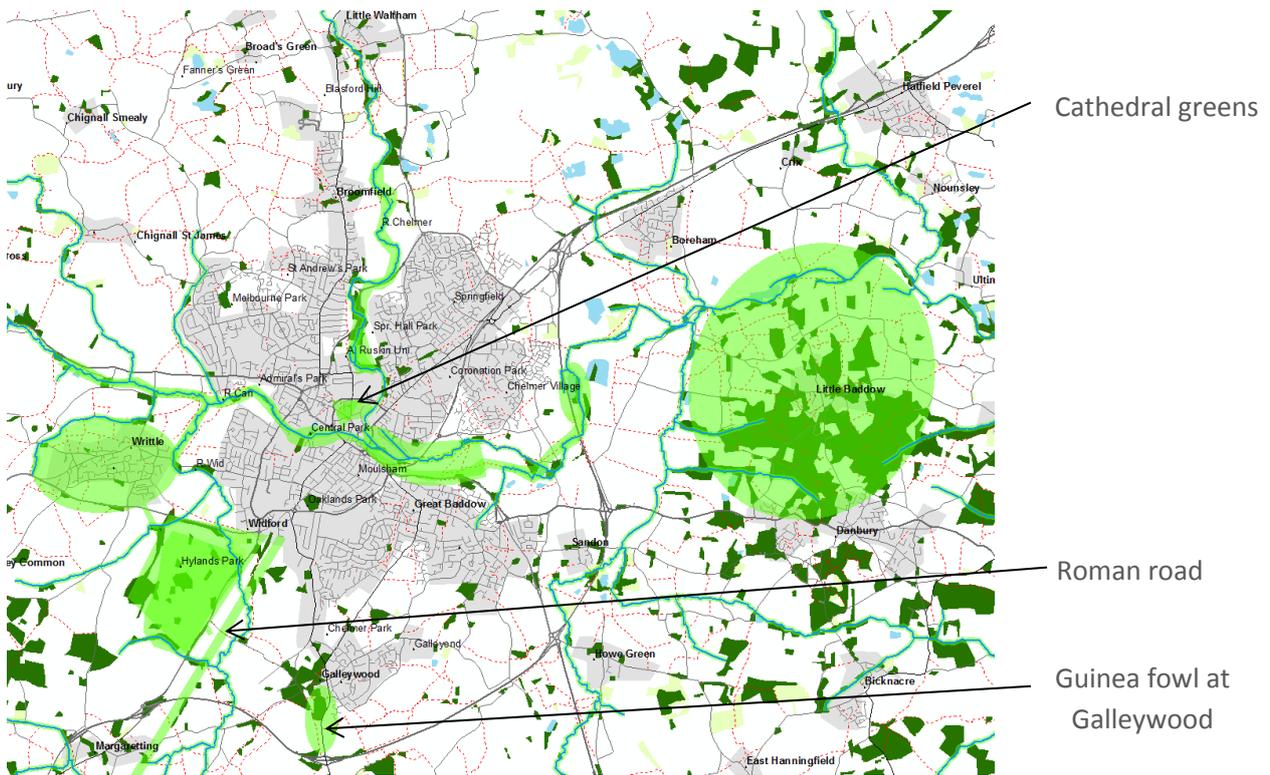
Table 5. Summary of ecosystem service mapping for ‘sense of place’

Where is the service provided currently?	Where is it lacking or threatened?	Opportunities to enhance the benefits
Chelmsford		
<ul style="list-style-type: none"> Hylands park (Capability Brown; good for getting away from everything) Galleywood (Guinea fowl) Three river corridors including blackberry picking and walk to Whittle along lower R. Wid Old bridge over R. Can Pond E of A12 (learnt to fish as a child) Sandford Mill disused water works (no-one goes there) 	<ul style="list-style-type: none"> Chelmsford city centre is lacking in features on the ground (many have been removed, e.g. old cattle market, Tree of the Year cut down). 	<ul style="list-style-type: none"> Town centre, canal basin – need to add local distinctiveness. Could make more of Roman history.

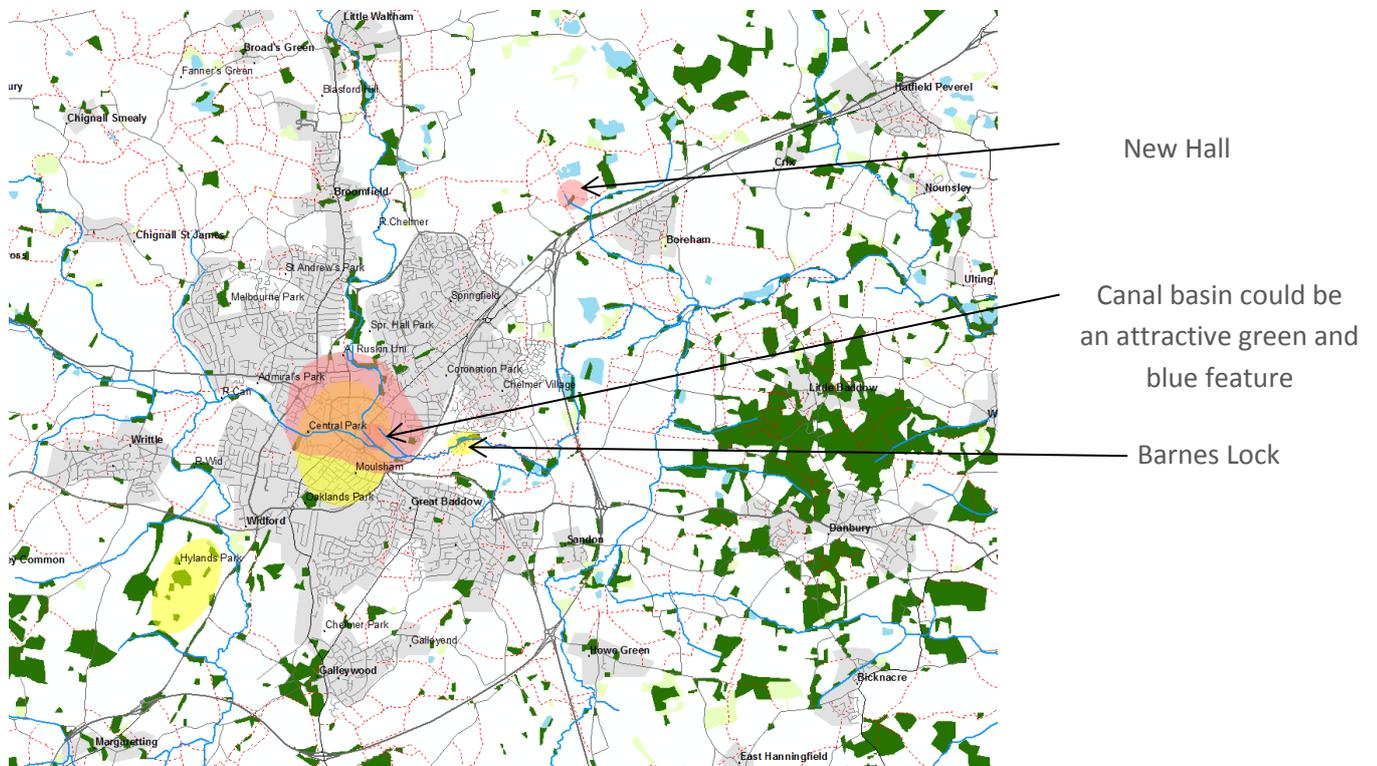
<ul style="list-style-type: none"> • Central Park (to destress) • Cathedral greens - peaceful even at lunchtime - and Springfield Hall Park (near University) • Canal basin • 'My garden'; allotment • Writtle • Roman Roads to Colchester and to Writtle • Danbury, including Blakes Wood and the church (high point) • New Hall (school?) 		
Essex		
<ul style="list-style-type: none"> • Essex coast and estuaries. • Epping and Hatfield Forests - royal hunting forests. Henry VIII hunting lodge NE of Chelmsford. • Flitch Way (historic trail). • River and canal network • R. Lea (Olympic canoeing). • Audley End, Saffron Waldon (Jacobean). • Hanningfield Reservoir - birds. • Chelmsford - capital of Roman Empire. • Saxon and Roman forts (Colchester, Mersea) and other archaeology. • Colchester - oldest town. • Gardens: Hyde Hall (RHS), Beth Chatto, Cressing Temple (medieval), Easton manor. • Hadleigh Castle Park. • Constable Country (Dedham Vale). • Wivenhoe - historic landscape (witch trials), and Transition Town. • Leigh on Sea - folk festival in greenspace. • Maldon: battle (Beowolf), salt, mud races. • Mersea Island and causeway – atmospheric, oysters. • Nr St Peters - Christian Community • Frinton-on-Sea • Stanstead Mountfichet ('one of the first places I went to in Essex') 	<ul style="list-style-type: none"> • Chelmsford – see above 	<ul style="list-style-type: none"> • Could make more of the history and ecology of the Maldon area – role of the estuary mud in protecting against invasions; saltmarshes; links to Beowolf. • Access to Foulness SSSI (MOD area). • Could link the forts and make more of the Roman history

Figure 7 Participatory mapping of 'sense of place': Chelmsford

Actual (current) supply



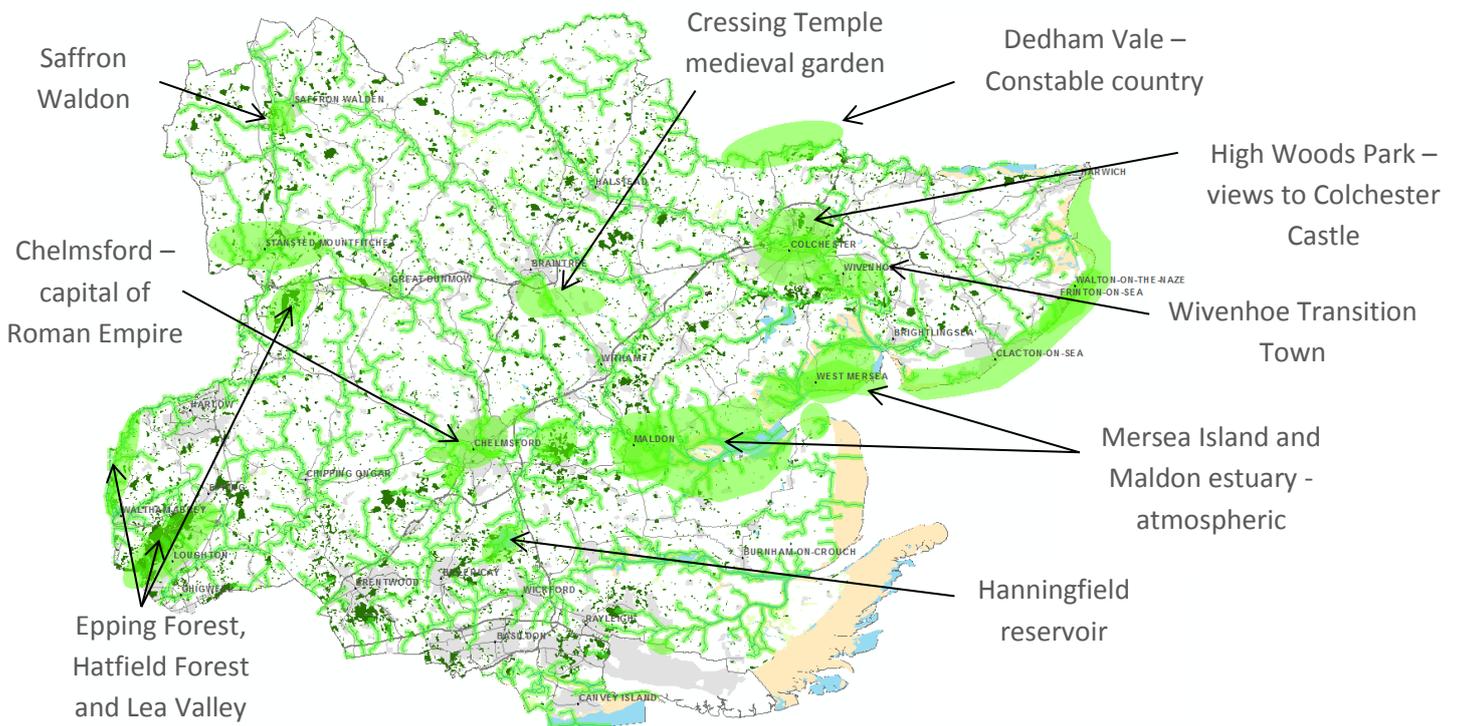
Gaps, threats and opportunities



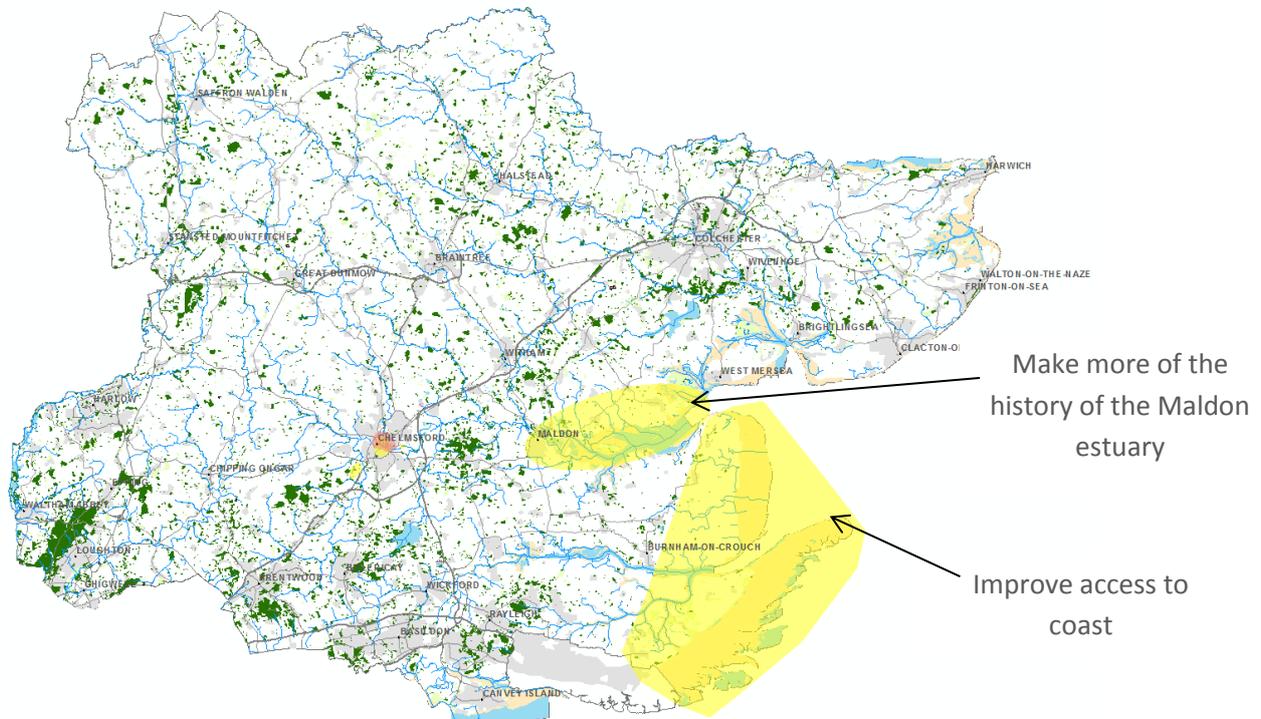
- Currently provides service
- Opportunities to improve or expand service
- Service lacking
- Threatened by development

Figure 8 Participatory mapping of 'sense of place': Essex

Actual (current) supply



Gaps, threats and opportunities to improve



- Currently provides service
- Service lacking
- Opportunities to improve or expand service
- Threatened by development

2.5 Habitat for wildlife

Figure 9 Figure 1 shows the participatory map for Chelmsford and Figure 10 shows the map for Essex. The results are summarised in Table 6.

As for the other four services, the three green wedges along the river corridors play an important role. Other places important for wildlife habitat around Chelmsford include Hylands Park, Danbury Woods, Writtle Forest, allotments, cemeteries, roadside verges (good for voles and kestrels) and railway embankments. There is planting for pollinators in Oaklands Park and some of the smaller parks in North Chelmsford, and 'bug hotels' are provided at some of the cemeteries. The hedgerows in the surrounding farmland were also mentioned, with the farmland supporting rabbits, pheasant and foxes. However, most of the city was thought to be lacking in wildlife habitat. Opportunities to improve this include creating more green space in the city, planting wild flowers along roadside verges and railway embankments to form a network for pollinators, protecting and improving the area of green space between Chelmsford and Boreham, and improving the River Wid and the area north of Hylands Park. The public could also be helped to create more wildlife-friendly gardens, through more education and raising awareness.

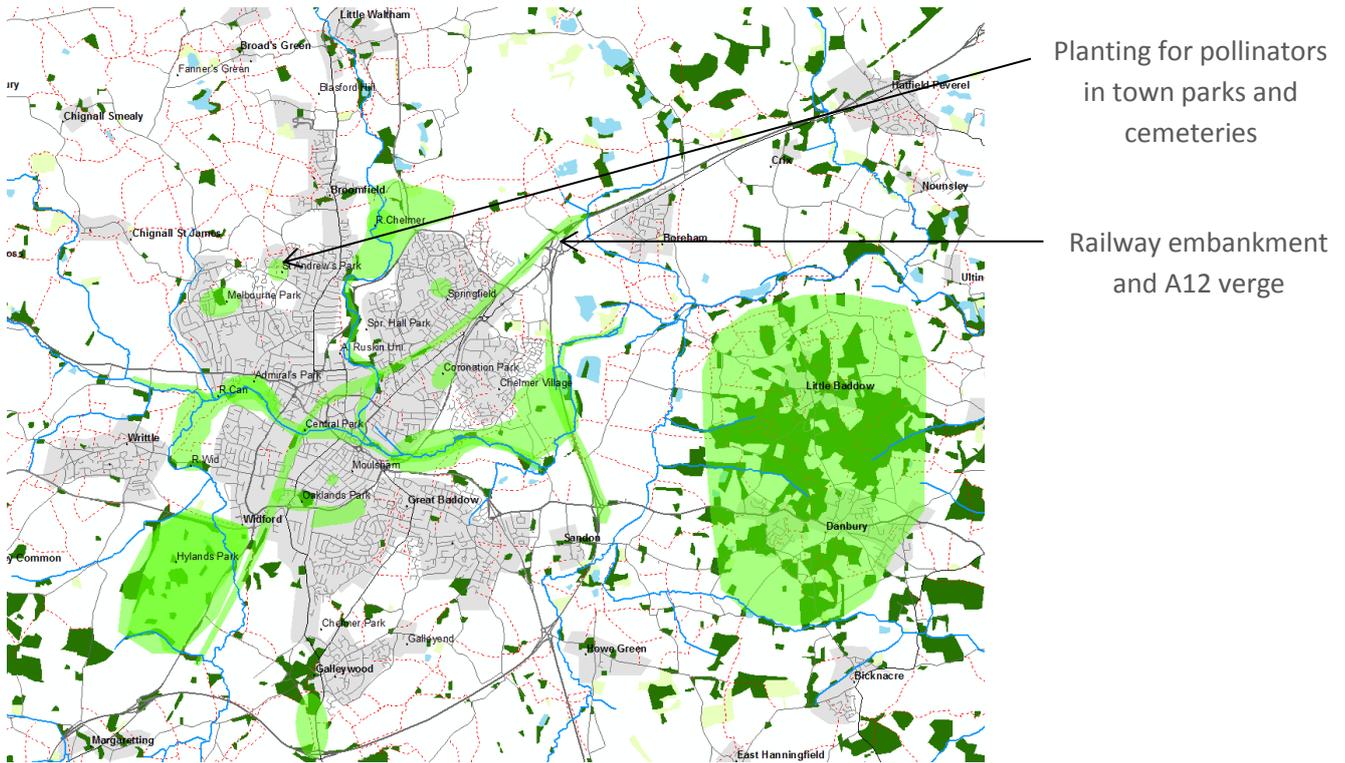
For Essex, the areas considered to be good for wildlife overlapped considerably with those providing the other four services: Epping Forest; Hatfield Forest, Danbury Woods, Thorndon Country Park, Hanningfield and Abberton reservoirs, the coast, and the valleys of the River Lea and River Stour. South-west Essex was thought to be a good place to see deer, and there was a feeling that north-east Essex was relatively untouched and probably good for wildlife. However, in north-east Essex it was thought that intensive farming was damaging wildlife habitat, with over-abstraction of groundwater and pollution from fertiliser runoff. It was thought that there was potential to improve habitat across the whole county, e.g. by improving farming methods and protecting or improving green space.

Table 6. Summary of ecosystem service mapping for wildlife habitat

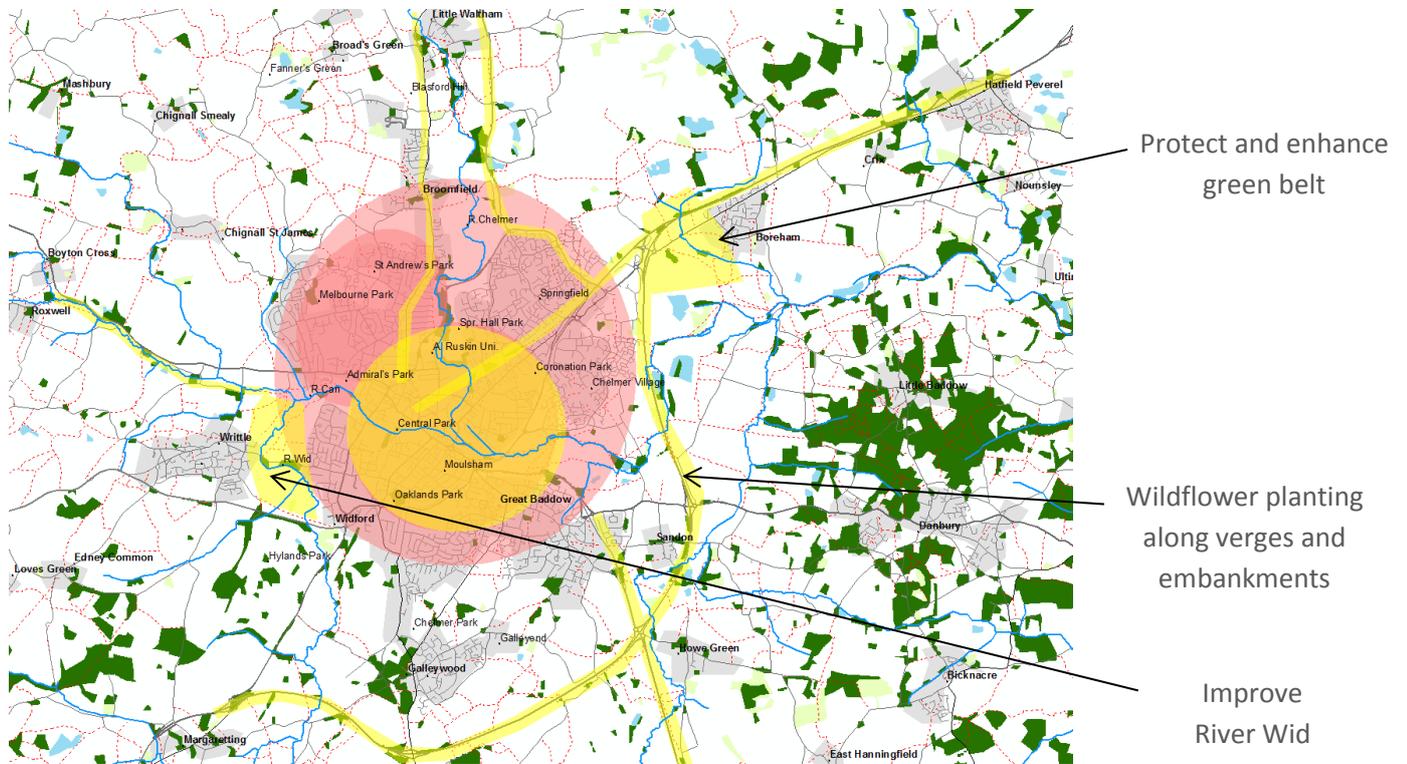
Where is the service provided currently?	Where is it lacking or threatened?	Opportunities to enhance the benefits
Chelmsford		
<ul style="list-style-type: none"> • The three river corridors • Danbury woods • Hylands park (herons, buzzards) • Writtle Forest, Writtle pond • Allotments, cemeteries (Moulsham Victorian cemetery) - some have bug hotels • Railway embankments and A12 verge (kestrels and voles) • Oaklands park and all the small parks in the N - planting for pollinators • Area SE of Oaklands park • Hedgerows and farmland - fox, pheasants, rabbits 	<ul style="list-style-type: none"> • Whole town, especially city centre and NW Chelmsford 	<ul style="list-style-type: none"> • Whole town • A12, other road verges and railway embankments - wild flower verges for pollinator network • Area N of Hylands park • Green space between Chelmsford and Boreham - protect from development and improve for wildlife • River Wid - maintain and improve for wildlife • Wildlife friendly private gardens - education
Essex		
<ul style="list-style-type: none"> • Coast - birds • Hollingfield and Abberton reservoirs • Epping Forest, Hatfield forest, Thorndon country park, Danbury (adders) • Lea valley - dragonflies and butterflies • SW Essex - deer • Foulness - oysters, seals • River Stour and NW Essex - farmland, problems with over-abstraction of water (streams drying up) and fertiliser runoff • NE Essex - perceived as probably good - relatively untouched by development 	<ul style="list-style-type: none"> • Habitat lacking across whole county 	<ul style="list-style-type: none"> • Improve sustainability of farming across whole county and add more woodland

Figure 9 Participatory mapping of habitat for wildlife: Chelmsford

Actual (current) supply



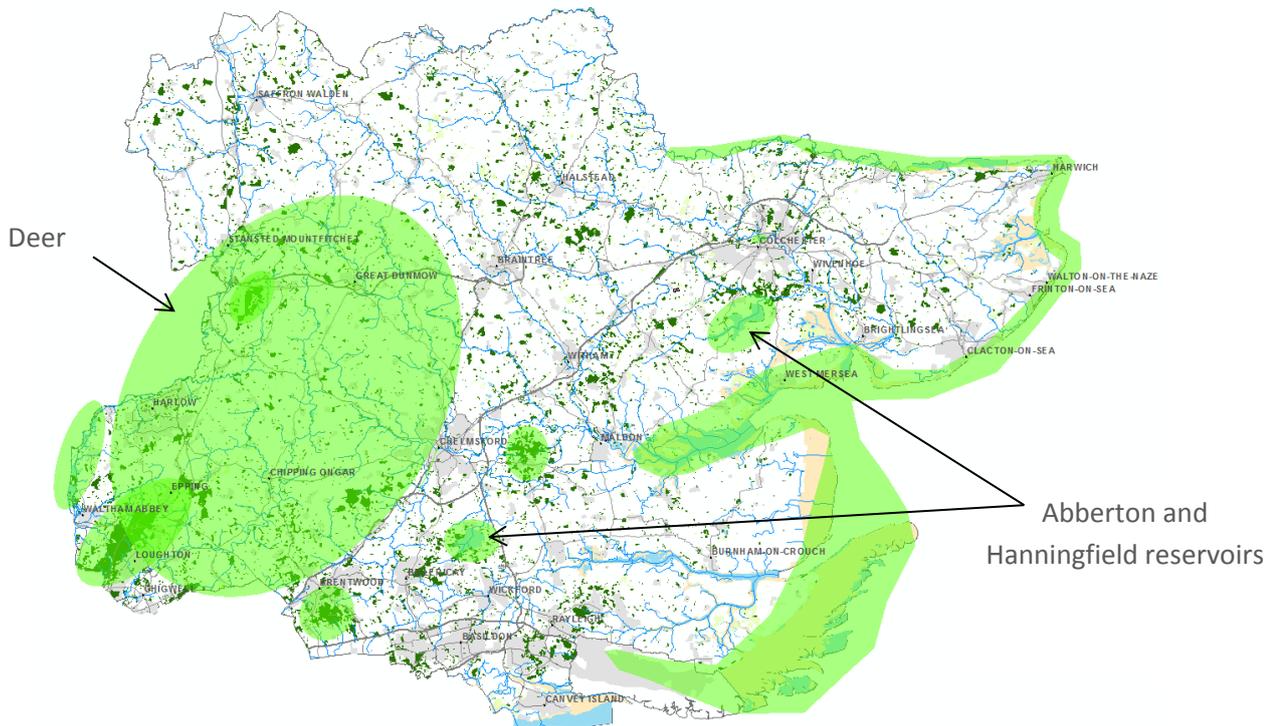
Gaps, threats and opportunities to improve



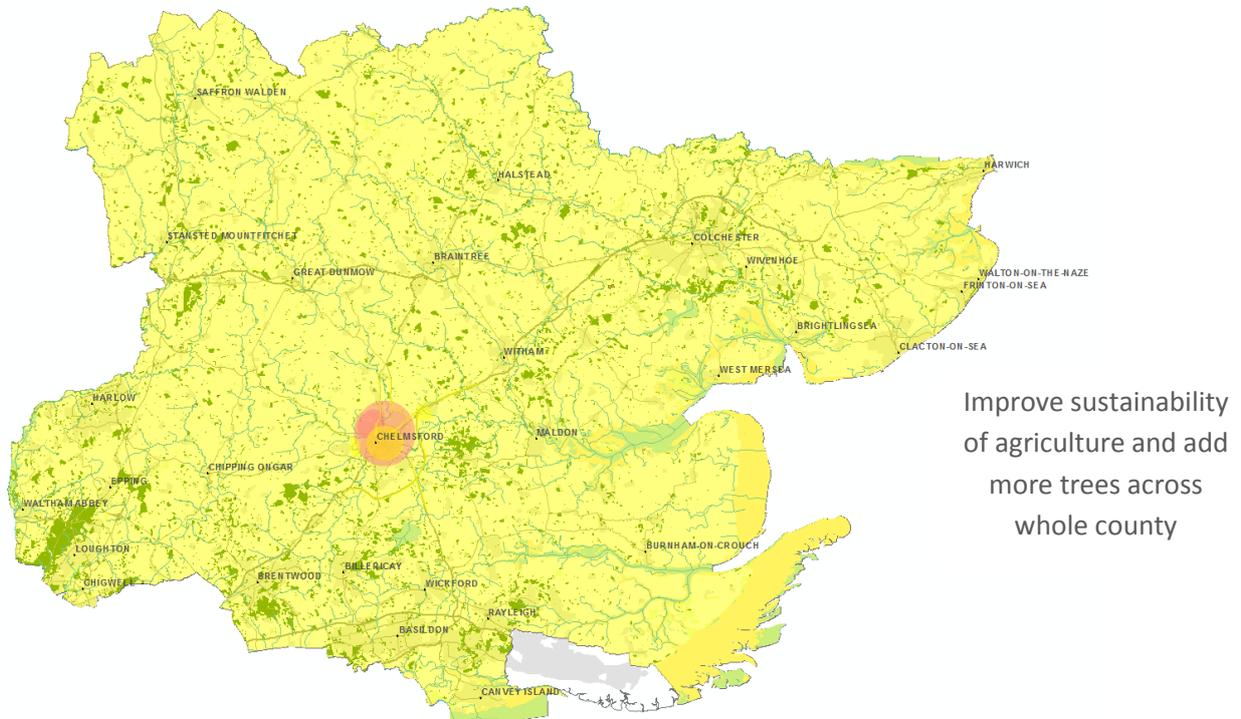
- Currently provides service
- Opportunities to improve or expand service
- Service lacking
- Threatened by development

Figure 10 Participatory mapping of habitat for wildlife: Essex

Actual (current) supply



Gaps, threats and opportunities to improve



- Currently provides service
- Service lacking
- Opportunities to improve or expand service
- Threatened by development

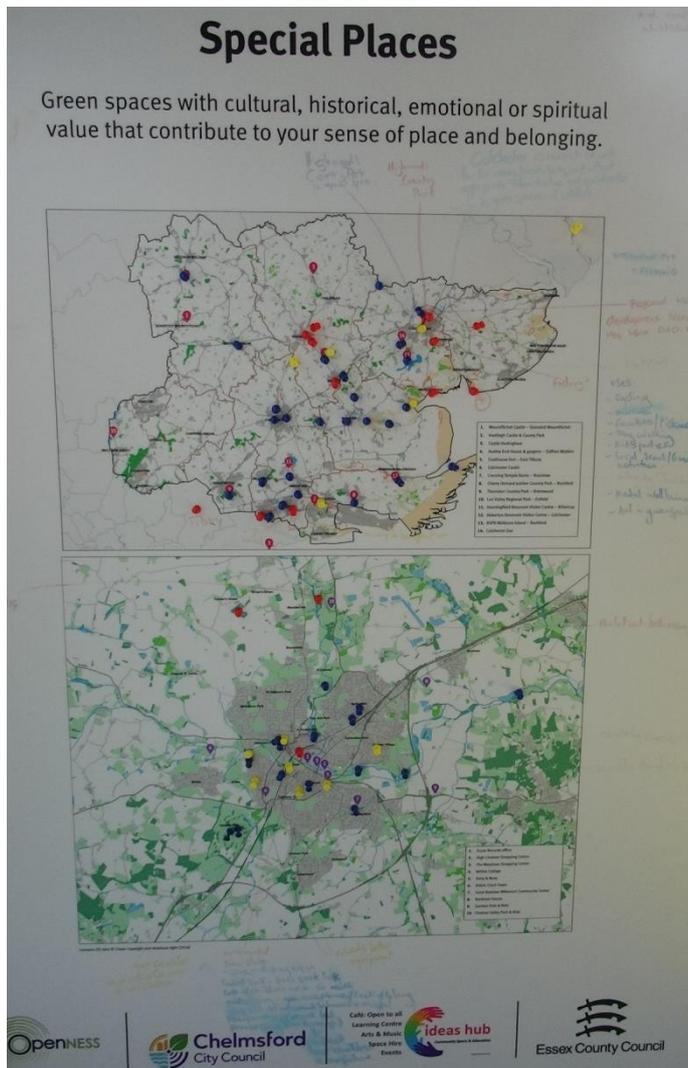
2.6 The mobile exhibition

2.6.1 How it worked

The exhibition ran from 28 June until 1 November 2016. It was displayed at the Fling festival in Chelmsford on 2 July, then at the Ideas Hub in Chelmsford from 3rd July until 21 October and finally at Writtle College in Chelmsford until the Ideas Festival on 1 November.

The exhibition followed roughly the same format as the participatory mapping workshop. There were five map boards, one for each service, and each board contained a map of Essex and a close-up map of Chelmsford. The maps highlighted a number of places of interest, to help people locate the areas they were looking for. Members of the public were free to mark places with pins and add comments around the margin of the board using pens. People were instructed to use blue pins to mark places where there was a good current supply of the service; yellow where there was some current supply but the service could be improved; and red pins to mark where there was demand for the service but inadequate or missing supply. Figure 11 shows an example of an exhibition board for the service of 'sense of place'.

Figure 11: Example of one of the five exhibition boards, showing pins and comments



2.6.2 The response

There was a good response to the exhibition, with over 200 pins being placed and many informative comments being recorded. However, it seems likely that the demand for pins at the exhibition may have outstripped supply. At some point, blue pins ran out and the participants started using white pins instead. There are also some comments linked to holes where it seemed pins may have been removed and repositioned. Some of the comments linked to red pins seem to refer to an area of current supply, rather than an area of missing supply, so it seems possible that when the blue pins ran out, other colours were used in stead. Alternatively, some participants may have interpreted the red pins as being intended to mark areas that supplied a service but were 'missing' from the points of interest that were pre-marked on the map: e.g. one comment linked to a red pin in Harlow said 'Do not forget Harlow Town Park, River Stort, cycle paths and Sculpture Town'. Therefore there may be some discrepancies in the recorded supply status derived from the pin colour.

The distribution of the pins representing different ecosystem services are shown in Figure 12 (Essex) and Figure 13 (Chelmsford). The colours of the points represent the type of cultural service – for example, green points are taken from the 'aesthetic value' map, and red points from the 'recreation' map. The shape of the point is intended to represent the level of supply, with larger circles representing current supply, smaller circles for areas where supply could be improved, and crosses for areas where there is demand but supply is missing. However, as mentioned above some of this information may be unreliable, and several of the points marked as crosses may actually refer to current supply, not missing supply. The points are superimposed on the results of the participatory mapping workshop for current supply of all five services (darker shades of green indicate more services are supplied).

Out of the 225 pins that were placed on the boards, 82 are in Chelmsford or the neighbouring Danbury Woods area, reflecting the location of the exhibition at events within Chelmsford. A further 16 are in and around Colchester, especially at High Woods Park and Colchester Castle, and 26 are scattered along the northern half of the coast, especially near Maldon. There are small groupings of pins in various country parks including Thorndon Country Park near Brentwood, Cherry Orchard Jubilee Park near Rayleigh, and Great Notley Country Park near Braintree. Very few pins were placed in the western part of Essex or the south-east.

The mobile exhibition broadly reinforced the findings of the participatory mapping workshop. Pins are clustered mainly in the areas also identified as providing one or more cultural services in the workshop – Colchester, Maldon, the north-east coast, and (in Chelmsford) Danbury Woods, Hylands Park and the town parks and 'green wedges' along the rivers. Gaps where there was a lack of service provision were identified in Chelmsford Town Centre, and comments attached to the pins re-inforce concerns over the threat to green spaces from development. There was a cluster of pins for 'missing' services along the coast near Mersea and Clacton, but only two of these had comments attached ('sea wall in need of repair' at Mersea, and 'Jaywick very run-down and neglected'). As the workshop participants identified this area as having a good supply of cultural services, it is possible that some of the exhibition board participants mis-interpreted the 'missing' category or that the wrong colour pins were sometimes used, as mentioned above.

Some comments did not appear to link to a pin. For example there was a long comment about the importance of wildlife which demonstrates 'existence value' (valuing the existence of wildlife even if the user does not see it) and 'bequest value' (the value for future generations), showing that not all values can necessarily be easily linked to a specific place.

Figure 12: Locations marked the mobile exhibition boards for Essex: colour indicates ecosystem service and shape indicates status (current supply; could be improved; missing)

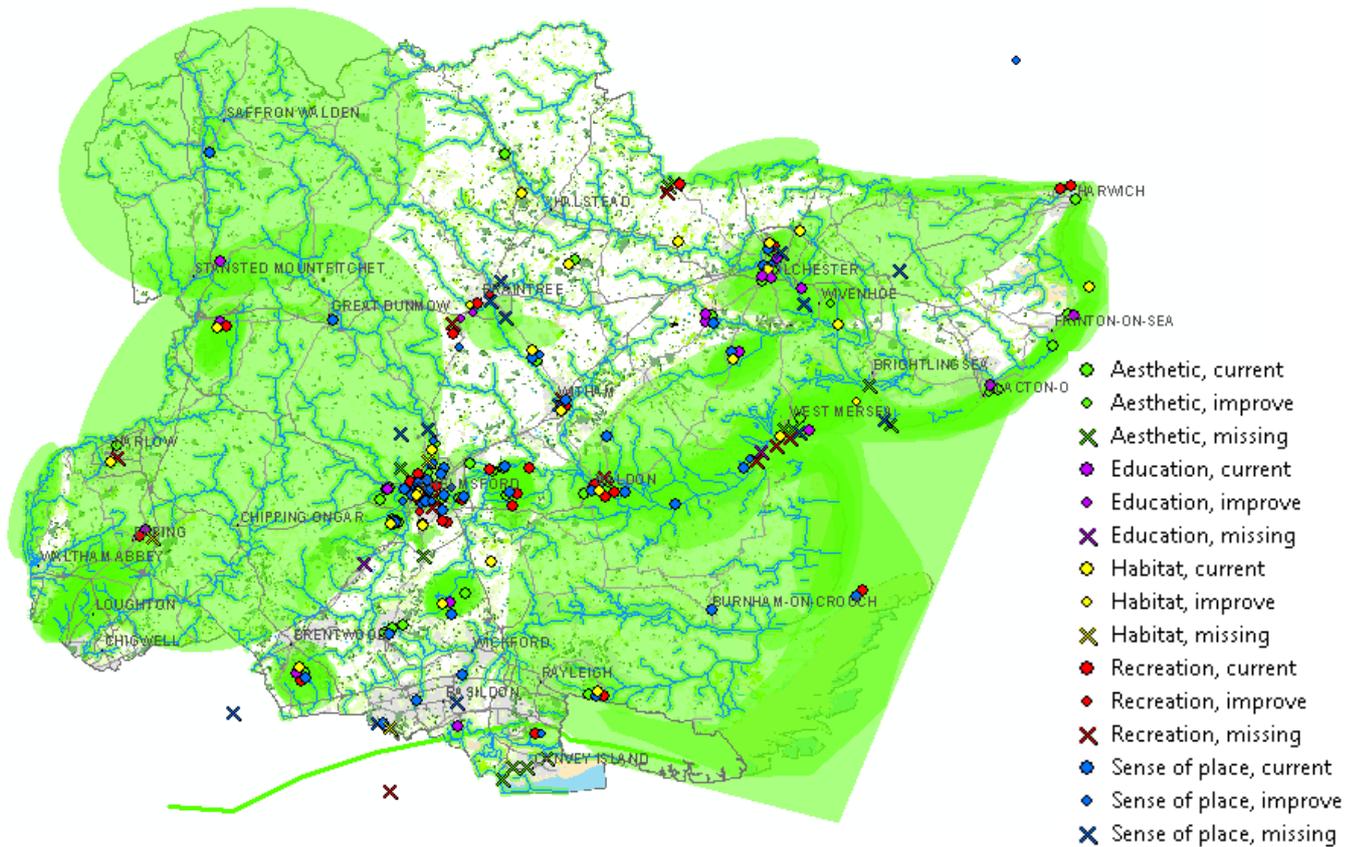
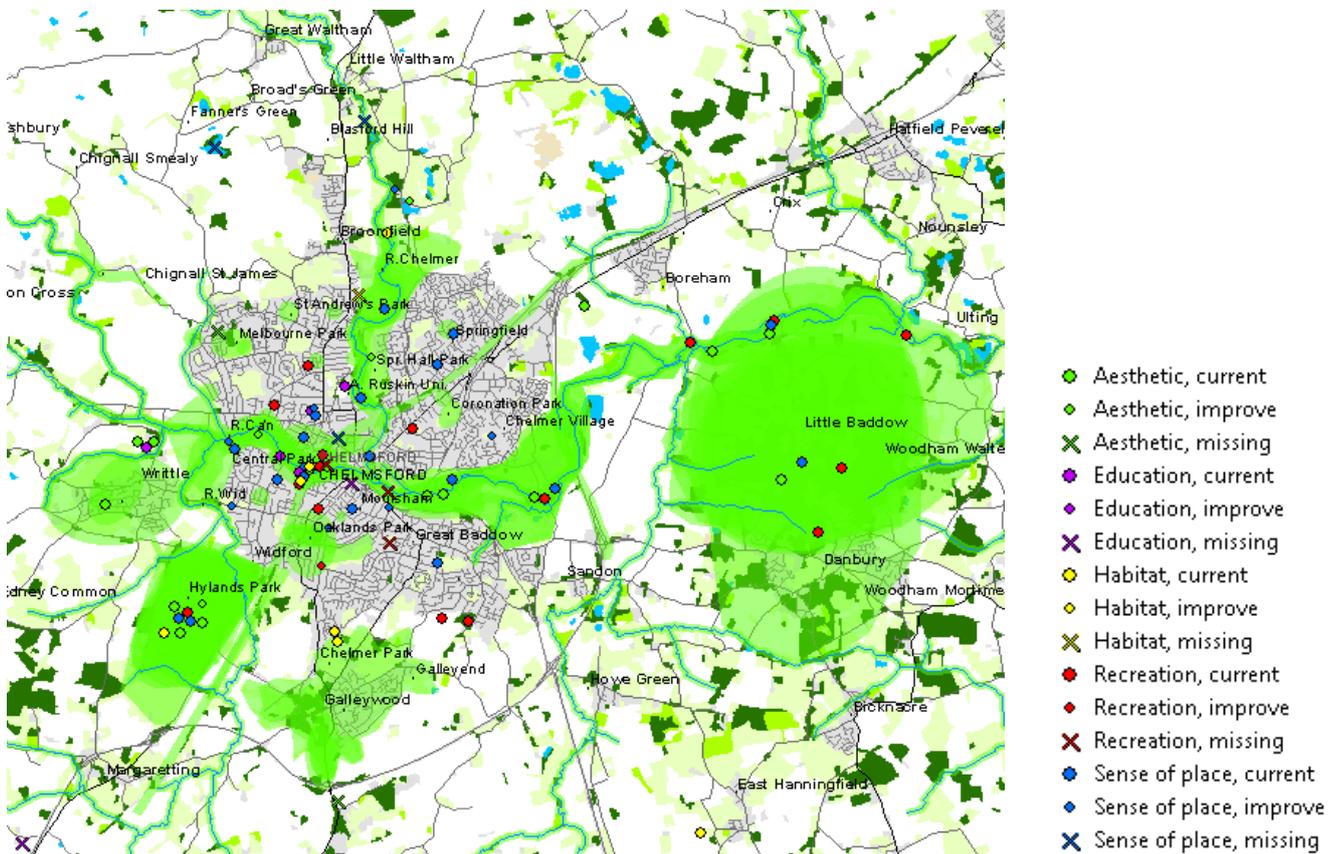


Figure 13: Locations marked the mobile exhibition boards for Chelmsford: colour indicates ecosystem service and shape indicates status (current supply; could be improved; missing)



2.6.3 Learning points

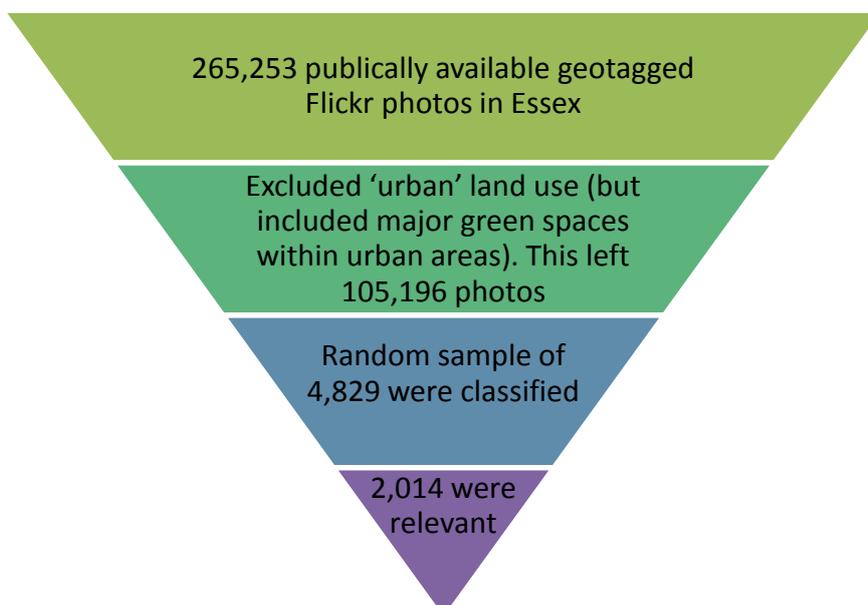
The mobile exhibition was a good way of reaching a larger number of people than those who were able and willing to spend a whole day attending a workshop. However, there were some drawbacks associated with having a partly unsupervised exhibition:

- no-one was available to guide participants to ensure a consistent interpretation of the questions, or to deal with problems such as when the blue pins ran out;
- it was not possible to tell how many different people took part in the exhibition, who they were, and how many of the pins were left by the same person;
- if no comment was left, it could be hard to understand the reasons why pins were placed in some of the less obvious locations, or why a particular supply status (colour of pin) was chosen;
- there may be some inaccuracies in pin locations, e.g. a number of pins are placed in the town of Epping but may have been intended to mark Epping Forest which is further south.

3 Flickr photo analysis

Although regulating services such as carbon storage or flood protection can often be assessed in physical terms (e.g. tonnes of carbon stored per hectare, or reduction in peak river levels), and provisioning services can often be assessed as a market value (e.g. the value of crop yield), it can be more difficult to analyse cultural ecosystem services. One technique which has emerged recently is the analysis of publically available geo-tagged photos (i.e. those where the location of the photo is recorded) posted to social media sites such as Flickr. We have analysed a random sample of around 2000 of the geo-tagged Flickr photos taken in Essex (using the process shown in Figure 14) to show what natural features and places are important to people. Photos were classified according to the main cultural ecosystem services represented: the aesthetic value of the landscape, presence of individual species (trees, flowers, birds, mammals etc.), recreation (e.g. walking, cycling, running, boating, playing) or intellectual value (artistic inspiration or learning). For each photo, we also recorded the main landscape elements, species classes and human infrastructure featured in the photo.

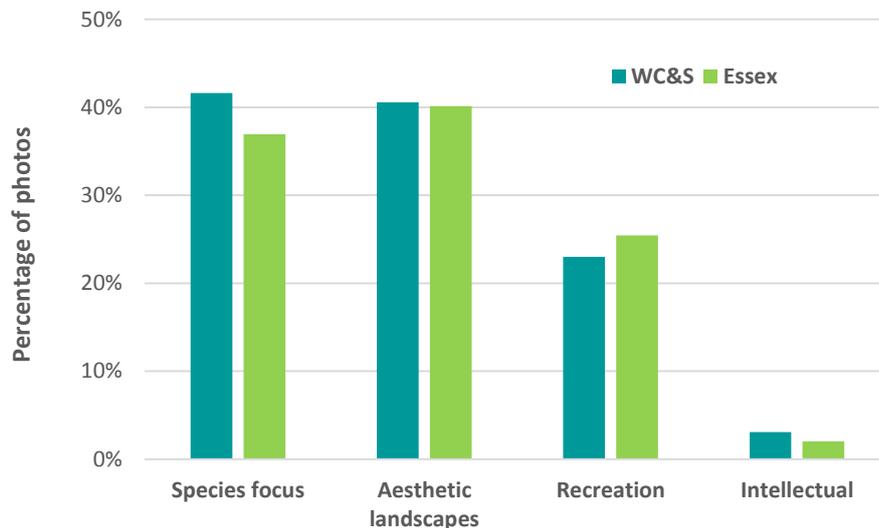
Figure 14. Process for analysing Flickr photos for Essex



3.1 Types of cultural ecosystem service

We categorised each photo according to our judgement of the type(s) of cultural ecosystem service represented (aesthetic landscape, species, recreation or intellectual), as shown in Figure 15 for both Essex and for the other case study in Warwickshire, Coventry and Solihull (WCS). The distribution between services is surprisingly similar in WC&S and Essex. Far fewer photos explicitly illustrate recreation or intellectual ecosystem services; the reasons for this are considered in the discussion.

Figure 15. Types of cultural ecosystem services



3.2 Spatial patterns and hotspots of Flickr photos

The locations of all the photos in non-urban areas are plotted on Figure 16. Urban areas, which were excluded from the photo sampling process, are shown in light grey. Photos which were classified as being not relevant to cultural ecosystem services are shown in pink, and those which were relevant to cultural ecosystem services are shown in turquoise. Clusters of irrelevant photos can be seen at Stanstead airport, Southend Airport, North Weald Airfield and at Battlesbridge motor show. The figure also reveals the presence of some clusters that arise from multiple photos posted by single users. These include a cluster of mainly relevant nature photos south of Witham, and a cluster of mainly irrelevant photos of the Beaulieu Park housing development to the north-east of Chelmsford.

Figure 17 shows just the 2,014 photos that were classified as being relevant, with the colour indicating the cultural ecosystem service(s) that were implied by the photo. Clusters can be seen in places like Epping Forest, Hatfield Forest, the Lea Valley and along the coast and some rivers. Some of these hotspots are formed of photos taken by just one or two users, whereas others are by multiple users. It is important to be aware of these differences when interpreting the spatial patterns.

Figure 16. Location of classified, unclassified and irrelevant Flickr photos for Essex

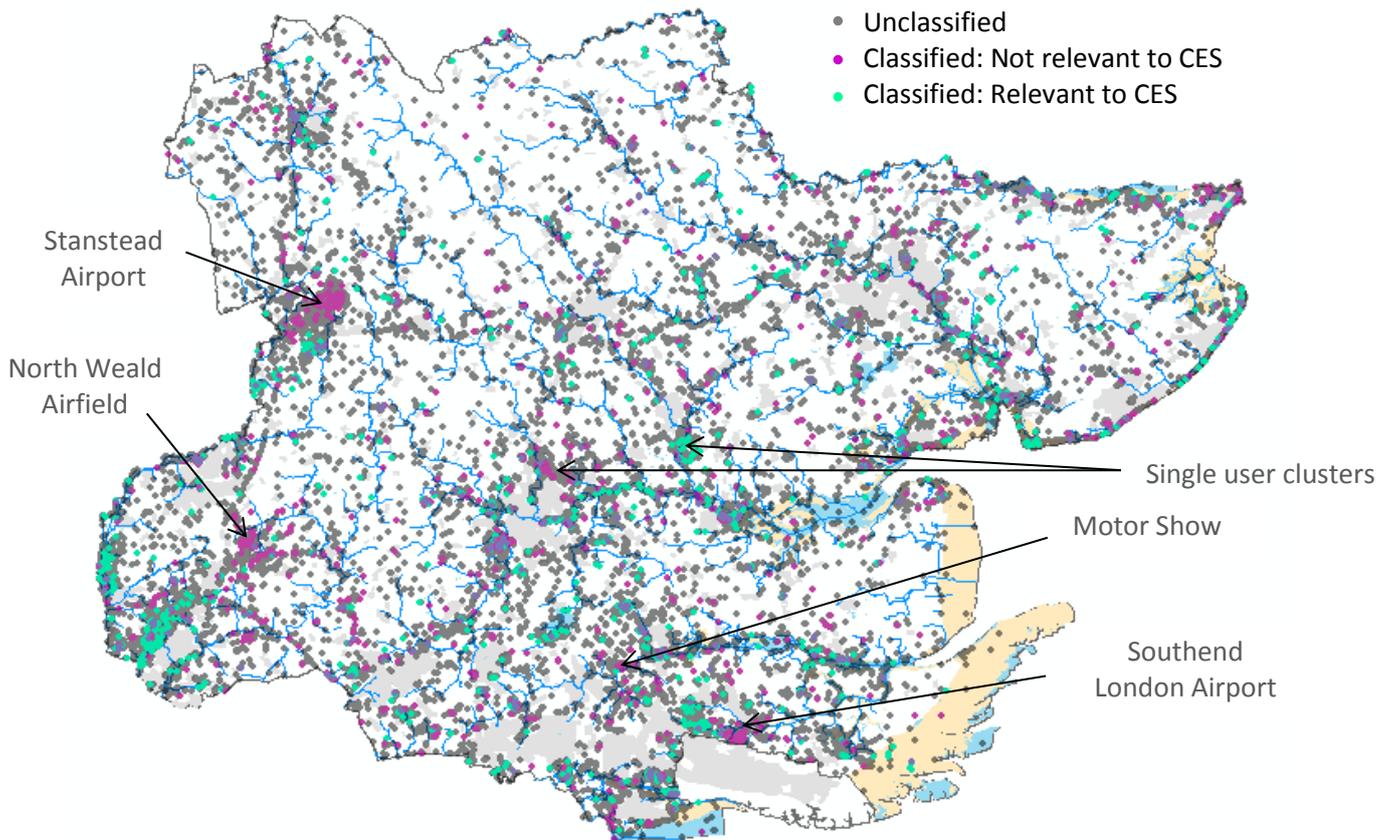
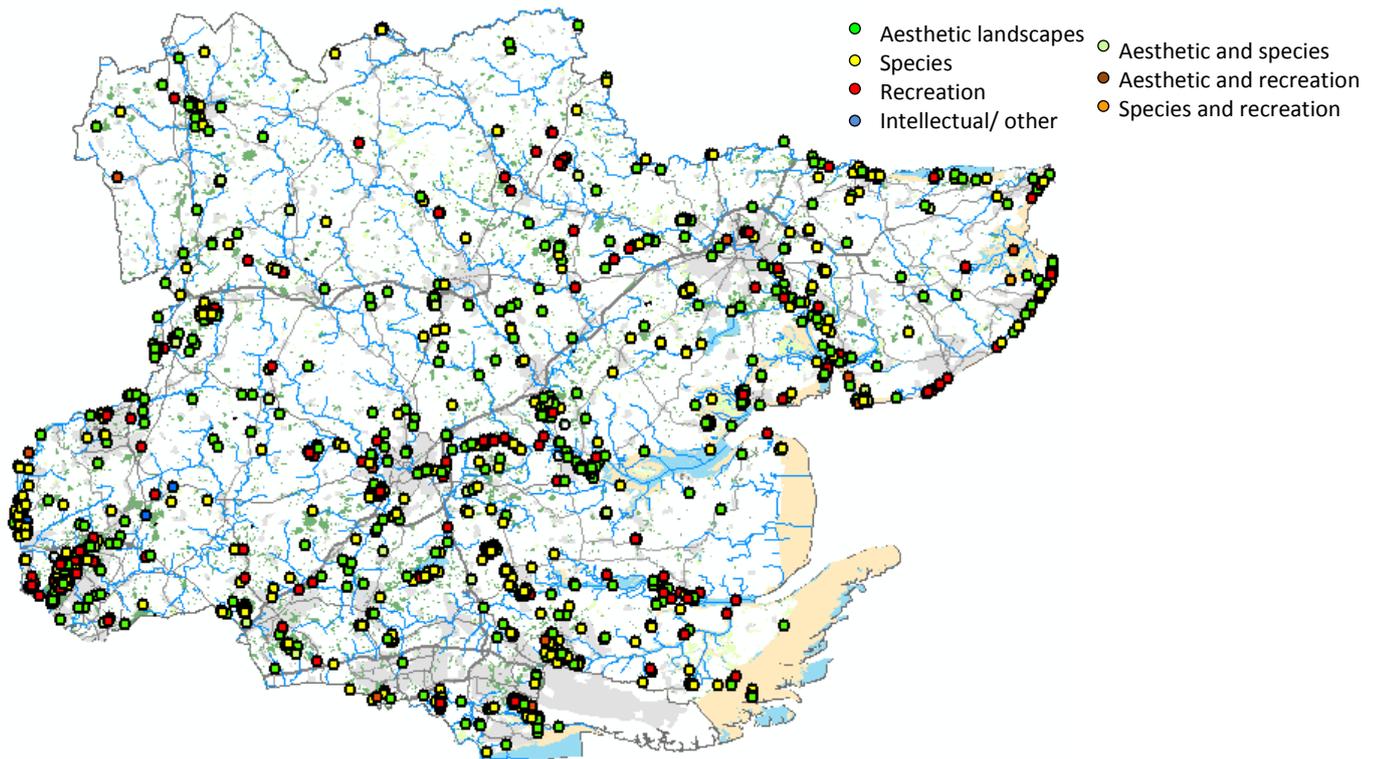


Figure 17. Location of relevant Flickr photos analysed for Essex



Simple mapping of the photos, as in Figure 17, does not reveal the locations where multiple photos are stacked on top of each other. These ‘hotspots’ are shown more clearly in Figure 18, using the kernel density function in ArcGIS which maps (and smooths) the density of photos in each grid cell.

The kernel density map reveals that the most intense hotspot is at Colchester Zoo: this is not obvious from Figure 17 because the photos are super-imposed in a single small location. These photos were classed as showing the value of species, under the sub-category ‘non-wild animals: other’ (separate sub-categories of non-wild animals are used for pets and livestock). A second hot-spot that was not visible on Figure 17 is at Hyde Hall RHS Garden – these are mainly photos of plants. The cluster of photos in Audley Park near Saffron Walden is also more obvious on the hotspot map.

Figure 18. : Hotspots for Flickr photos demonstrating supply of cultural ecosystem services (shown using kernel density mapping with a search radius of 1000m)

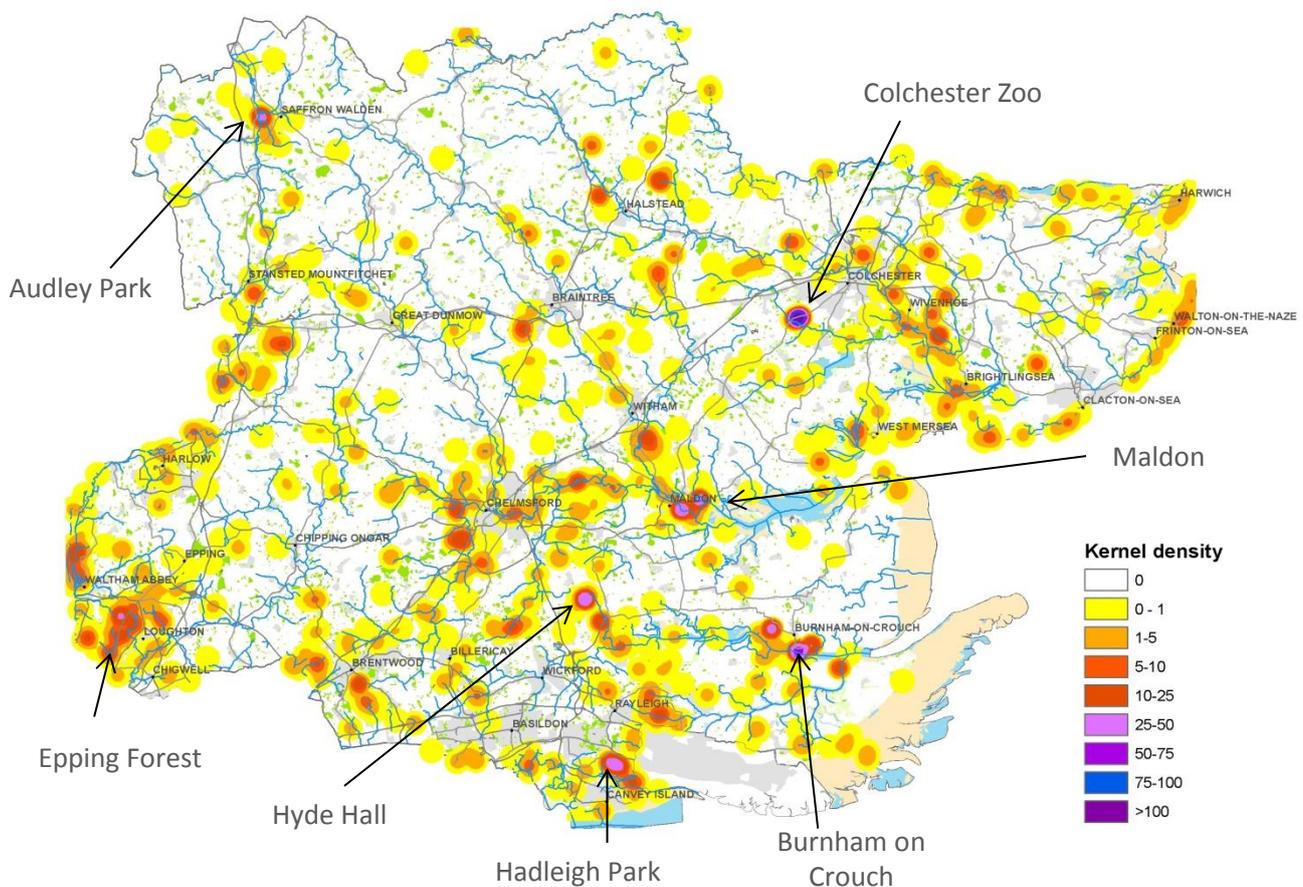
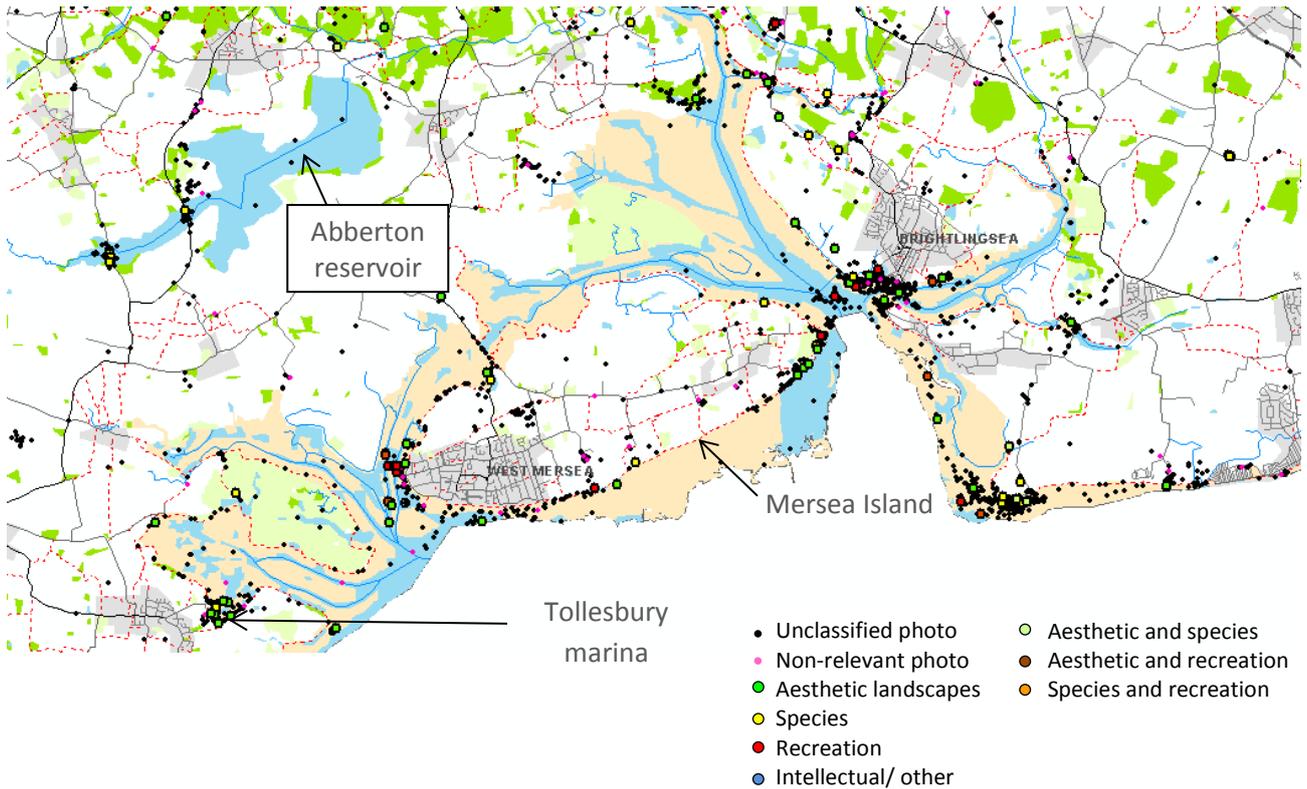


Figure 19 shows a more detailed inset of the area around Wivenhoe, Brightlingsea and Mersea Island. In this inset, small black dots show the location of unclassified photos (remembering that urban photos were excluded), small pink dots show those classified as not relevant and larger coloured dots with black rims are those classified as relevant. This inset shows the potential of the technique for detailed local analysis. For example, it shows how photos are located along footpaths, on beaches and on the seafront at Brightlingsea – but some stretches of path have many photos while others have none. There are few photographs at Abberton Reservoir except for on the bridges and in the small park north of the eastern bridge. This could reflect the lack of public access to the track around the reservoir, and the rather bleak nature of the scenery – in line with the suggestion at the PGIS workshop that more trees could be planted here.

Figure 19: Detail of photos taken around Brightlingsea and Mersea Island



3.3 Correlation between photos and PGIS maps

Figure 20 compares the location of the relevant Flickr photos with the participatory GIS (PGIS) maps of the supply of ecosystem services. All five cultural ecosystem services are overlaid on top of each other on this map, with darker shades of green indicating where there are more services provided. The figure shows that there is generally good correlation between the location of the Flickr photos and the areas identified during the PGIS workshops as being important for supply of CES. Areas identified by both the Flickr analysis and the PGIS maps include Epping Forest and Hatfield Forest, the Lea Valley, Hadleigh Park and the coast. The single-user cluster in the centre of the map was not identified at the PGIS workshop: it appears that these photos were all taken on a circular walk along some footpaths near the River Blackwater.

Figure 20. Location of relevant Flickr photos analysed for Essex, with PGIS maps of supply of the five ES

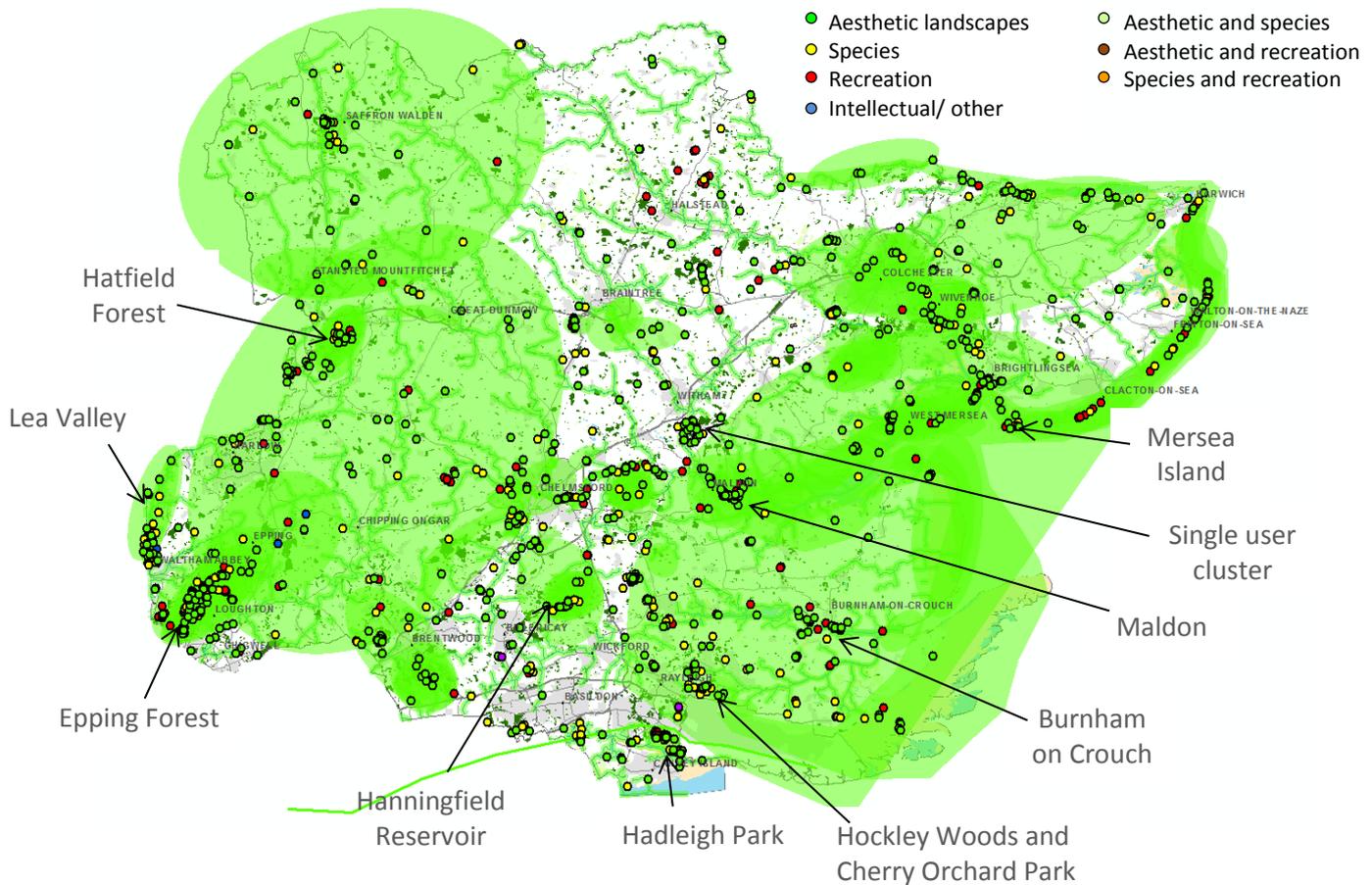
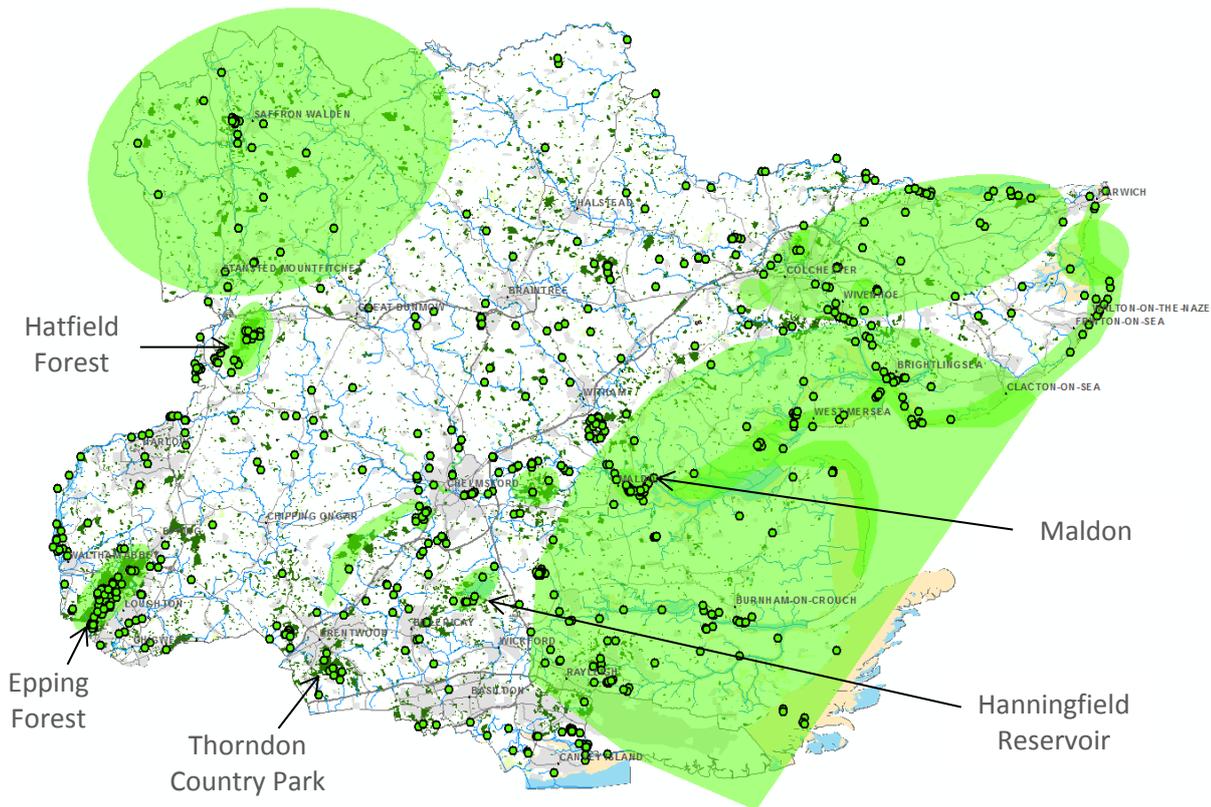


Figure 21 to Figure 23 show the correlation between the Flickr photos for the individual ecosystem services of aesthetic value, recreation and wildlife habitat and the corresponding PGIS maps. There were not enough Flickr photos showing ‘Intellectual’ services to make a meaningful comparison with the PGIS map for education.

For ‘aesthetic landscapes’ (Figure 21), the correlation is generally reasonable, showing the important role of Epping Forest, Hatfield Forest, Hanningfield Reservoir (though, in agreement with the PGIS, not Abberton Reservoir), the River Chelmer in Chelmsford, Maldon, the Stour Valley, the river near Burnham-on-Crouch, and the north-east coast. The PGIS mapping exercise did not identify Thorndon Country Park, where there is a cluster of photos, although this may simply have been an oversight as the park was mentioned later in the workshop in the context of recreation and other services.

It is interesting to note that Flickr photos are virtually absent from the Foulness MOD area, reflecting the lack of public access. This is in sharp contrast with the concentration of photos along the north-east coast, suggesting strong agreement with the PGIS workshop identification of the opportunity to improve the provision of all cultural ecosystem services by improving access to this stretch of coastline.

Figure 21. Flickr photos and PGIS mapping of aesthetic landscapes in Essex



For recreation (Figure 22) there is also good correlation between the Flickr photos and the PGIS maps, especially for Epping Forest, the north-east coast, the River Chelmer, Thorndon Country Park, Rayleigh Park (for mountain biking) and Maldon. The river at Burnham-on-Crouch again stands out as being a hotspot of Flickr photos that was not mentioned for this service during the PGIS exercise.

For wildlife habitat (Figure 23), the correlation is good for Epping and Hatfield forests, the Lea Valley, Hanningfield reservoir and Thorndon Country Park. Although a fair number of the 'species focus' photos feature common birds, garden flowers, trees, pets or captive animals, there are also photos of rarer species such as fungi, orchids, various butterflies and dragonflies, an ibis and even a bittern. We would not expect perfect correlation between Flickr photos and wildlife habitat however, as it is likely that certain areas with restricted access to people (especially the southern half of the coast) offer very good habitat, especially for birds.

Figure 22. Flickr photos and PGIS mapping of recreation in Essex

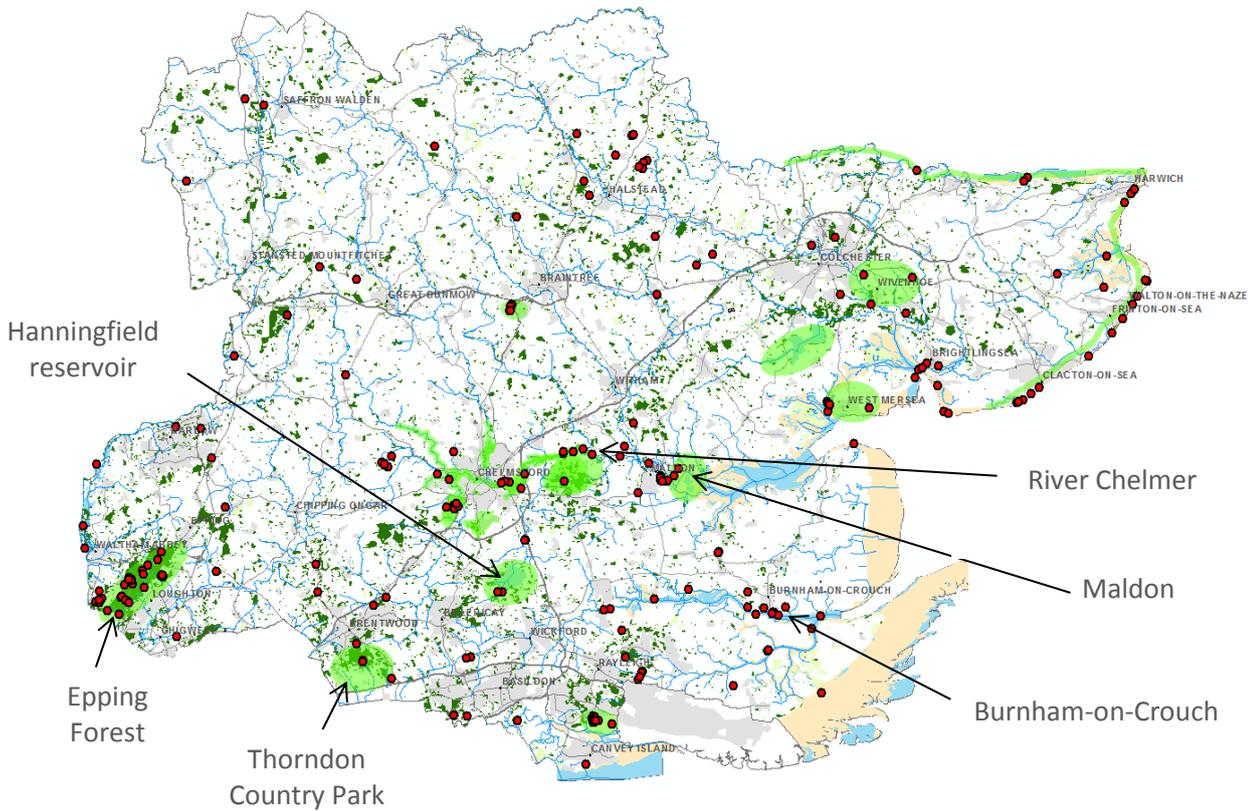
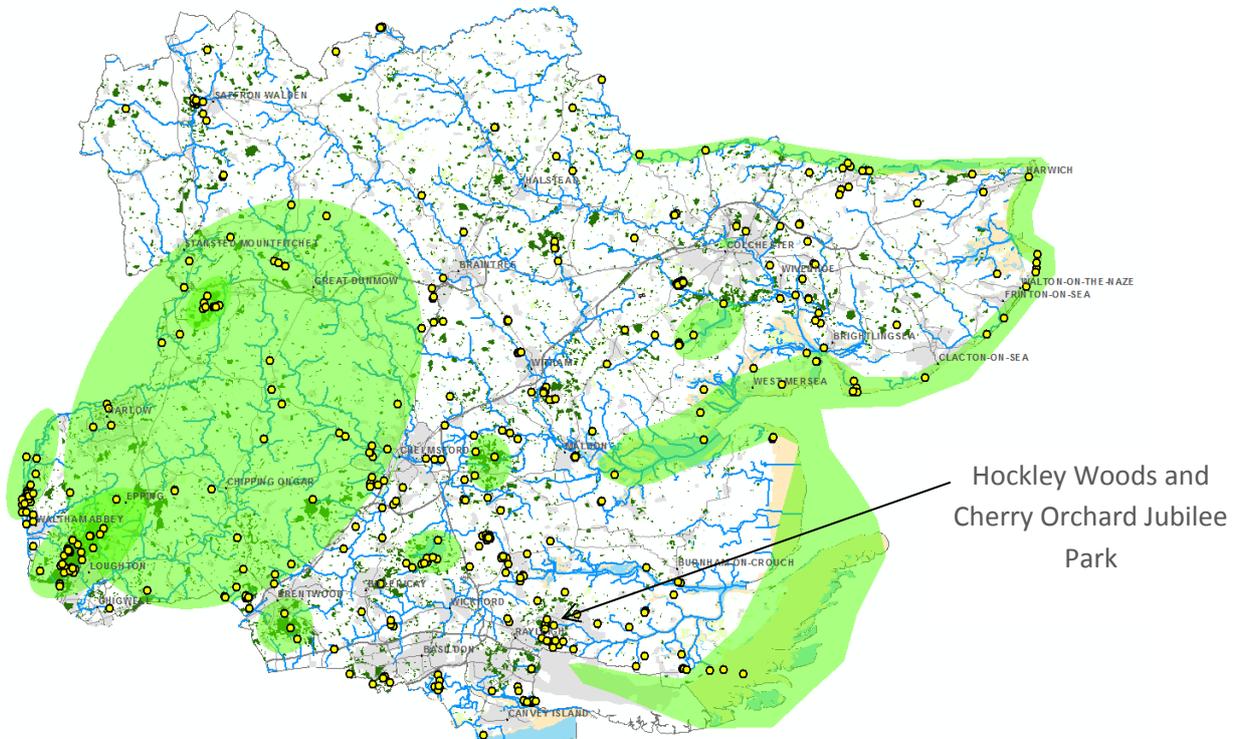


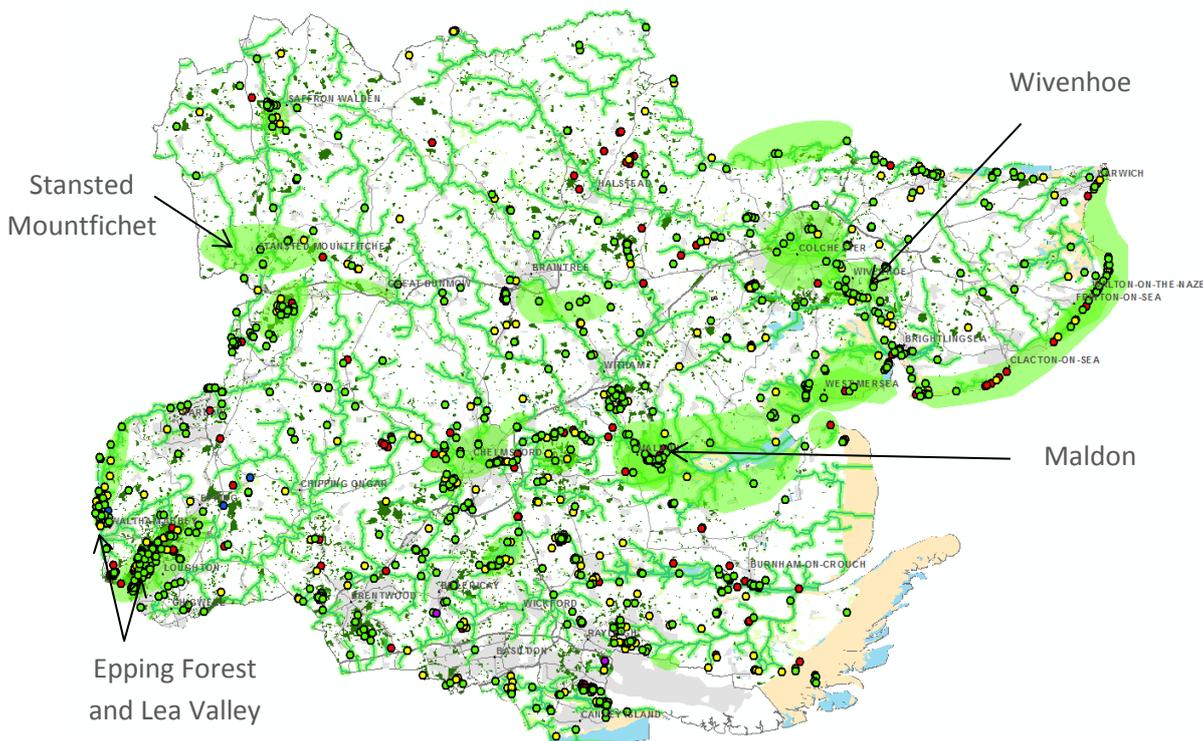
Figure 23. Flickr photos of species and PGIS mapping of wildlife habitat in Essex



We did not attempt to identify ‘sense of place’ in the Flickr photos, as there were no obvious criteria for doing this, but it is likely that the overall distribution of photos does give some indication of the ‘special places’ where distinctive views and species can be seen. Figure 24 shows the PGIS map of ‘sense of place’

and all the Flickr photos classified as relevant to cultural ecosystem services (aesthetic value, recreation, species and intellectual). There is good correlation, especially for Epping and Hatfield Forests, the north-east coast, Maldon, Hanningfield Reservoir and the River Chelmer. Some areas were identified as being important to PGIS participants for personal reasons, such as Stanstead Mountfichet, and there are fewer Flickr photos here. The Dedham Valley was identified as being important for cultural reasons – the association with Constable – but there are few photos here as well, perhaps showing that there might be potential to make more of this association. Similarly, there are surprisingly few photos at Cressing Temple although this was identified as a major cultural asset. However it is possible that the demographic of people visiting these two areas does not overlap so much with those posting geotagged photos to Flickr.

Figure 24. Flickr photos of all ES and PGIS mapping of 'sense of place' in Essex



3.4 Features shown in photos

We can compare the results presented above with the features visible in each photograph. Figure 25 shows the broad categories of features included in photos in WC&S and Essex. The patterns in both areas are broadly similar, with around half of all photos featuring vegetation, half featuring particular species, one third including human infrastructure and around a quarter including water. Interesting sky and weather features such as sunsets, rainbows, mist and snow were also present in 16-18% of photos.

Figure 25. Percentage of photos showing particular feature categories in WC&S and Essex

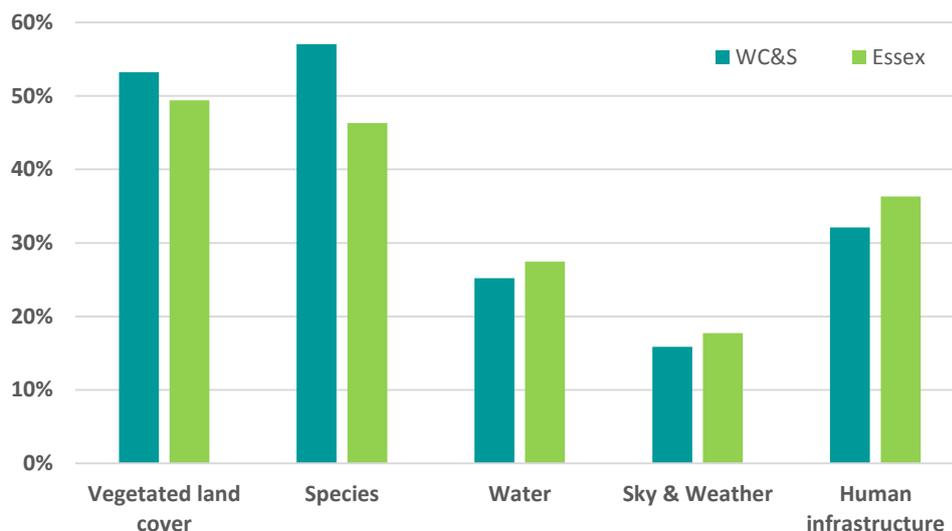


Figure 26 shows the breakdown of different types of vegetated land cover included in the photos. Woodland is the most common in both areas, followed by grassland. It should be noted that much of the grassland shown in the photos is amenity grassland, including small strips alongside paths, roads or rivers, or improved (intensively farmed) grassland, with very little being natural grassland. This is in agreement with the finding that the habitat with the largest number of photos in WC&S was amenity grassland (see Warwickshire report²). Similarly, most of the ‘shrubland’ is small patches or strips of shrubs, e.g. alongside roads and rivers, or managed shrubs in parks and gardens. There are more photos including wetlands in Essex, probably reflecting the prevalence of coastal wetlands.

Figure 26. Types of vegetation included in photos

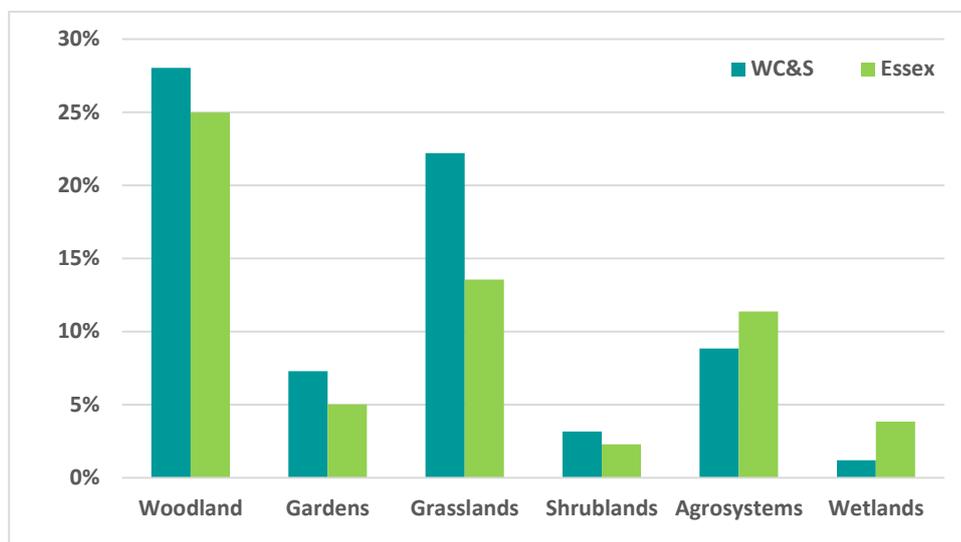
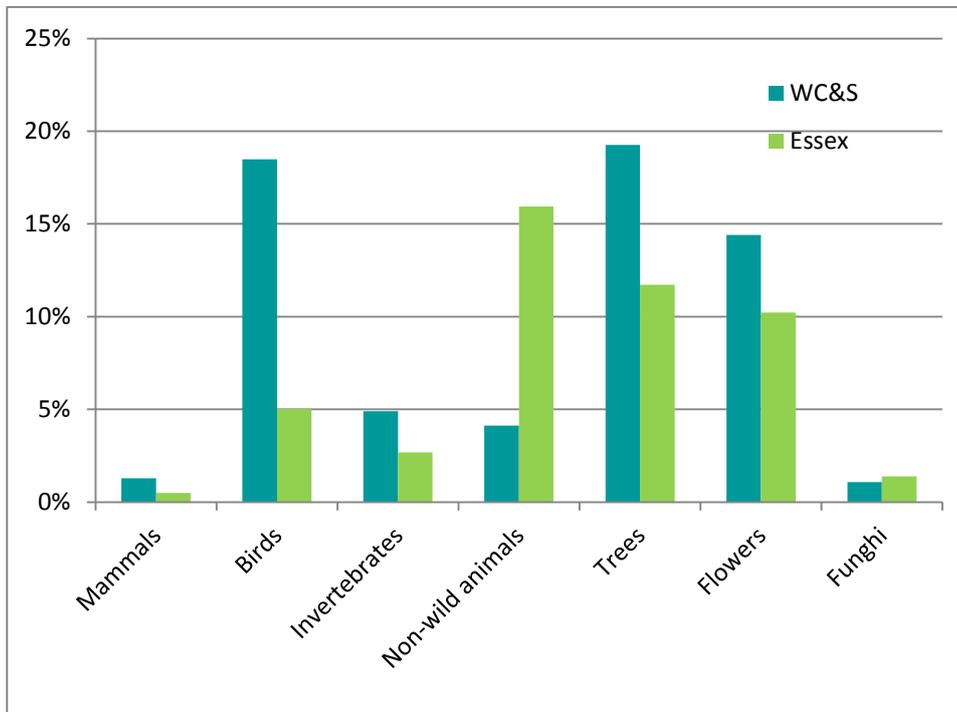


Figure 27 shows the different types of species included in photos. This shows that non-wild species are included in photos more often in Essex, largely due to a high number of photos taken in Colchester Zoo. Photos of trees and flowers are also more common in WC&S, possibly because Essex includes many photos

² Dunford, R.W., Smith, A.C., Martín-López, B., Berry, P.M., Martland, L. and Harrison, P.A. (2017) Ecosystem service mapping in Warwickshire, Coventry and Solihull, OpenNESS project report, European Commission FP7

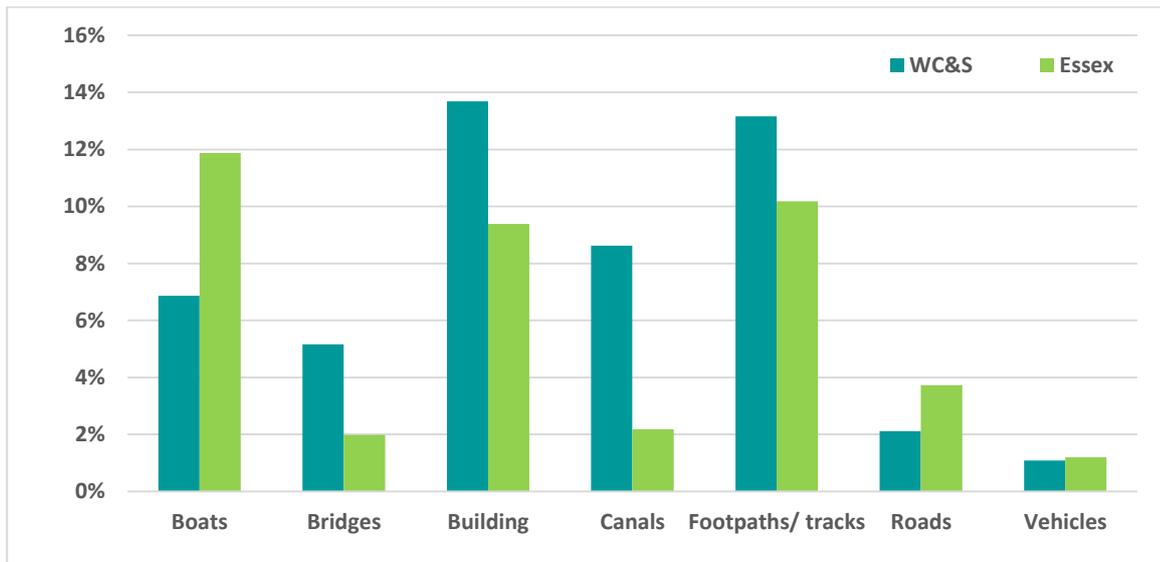
of beach and sea landscapes with no vegetation features. There are also more photos of birds in WC&S, including many photos of aquatic birds such as swans on the canals and rivers. Photos of wild mammals are rare in both areas.

Figure 27. Species shown in photos



It is interesting that around a third of all photos include human infrastructure such as buildings, bridges, footpaths and roads. Figure 28 shows that buildings and footpaths or tracks featured strongly in WC&S (in 13-14% of photos), with many photos of scenic buildings such as Warwick and Kenilworth castles, as well as numerous photos of canals which included towpaths. In Essex, the most commonly featured type of human infrastructure was boats (in around 12% of photos), with scenic shots of coastal scenery as well as photos of recreational boating. However, it is important to note that we did not distinguish between photos where the infrastructure might be judged to enhance the photo (such as a scenic castle, bridge, boat or footpath) and those where it is simply included by default (e.g. buildings or roads on the periphery or in the background of the photo). This would have involved a subjective judgement on the part of the photo reviewer as to whether the infrastructure enhanced the photo or not. Roads and vehicles featured in relatively few photographs, with the 4% of photos featuring roads in Essex being largely photos of cycling.

Figure 28. Percentage of photos showing types of human infrastructure



4 Strava

Analysis of Flickr photos has a limited capacity for identifying the service of recreation, because although many of the photos were clearly taken by people who were out for a walk, few photos directly show people walking, running, cycling or boating, with the exception of clusters of photos around certain events such as races. We have therefore started to look at supplementary methods of analysing recreation. One option is the outdoor activity routes uploaded to Strava - an online app that allows people to upload GPS tracks of their activities so that they can compare their speed with other people. Although personal information is private, Strava periodically produce 'global heat maps' covering the entire world that combine all the publically available Strava data ever uploaded, for running, cycling and water sports. The latest (November 2017) Strava running map for Essex is shown in Figure 29, with Chelmsford shown in Figure 30.

Figure 29. STRAVA map showing where people go to run in Essex (<http://labs.strava.com/heatmap>)

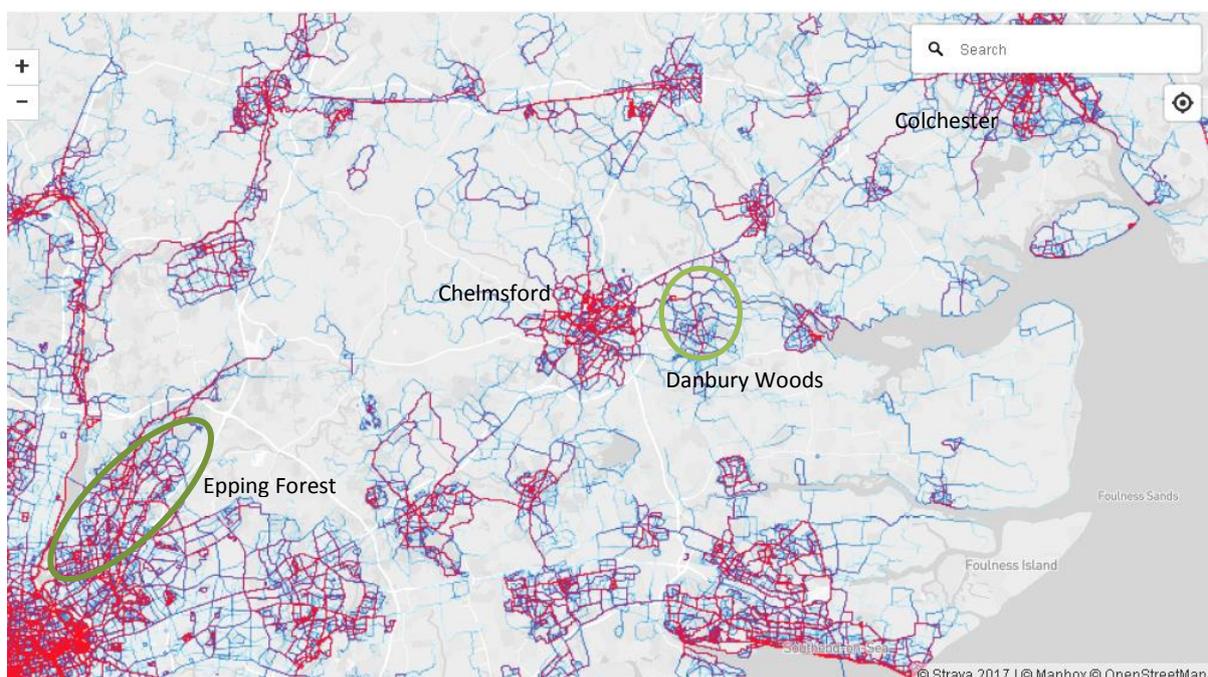
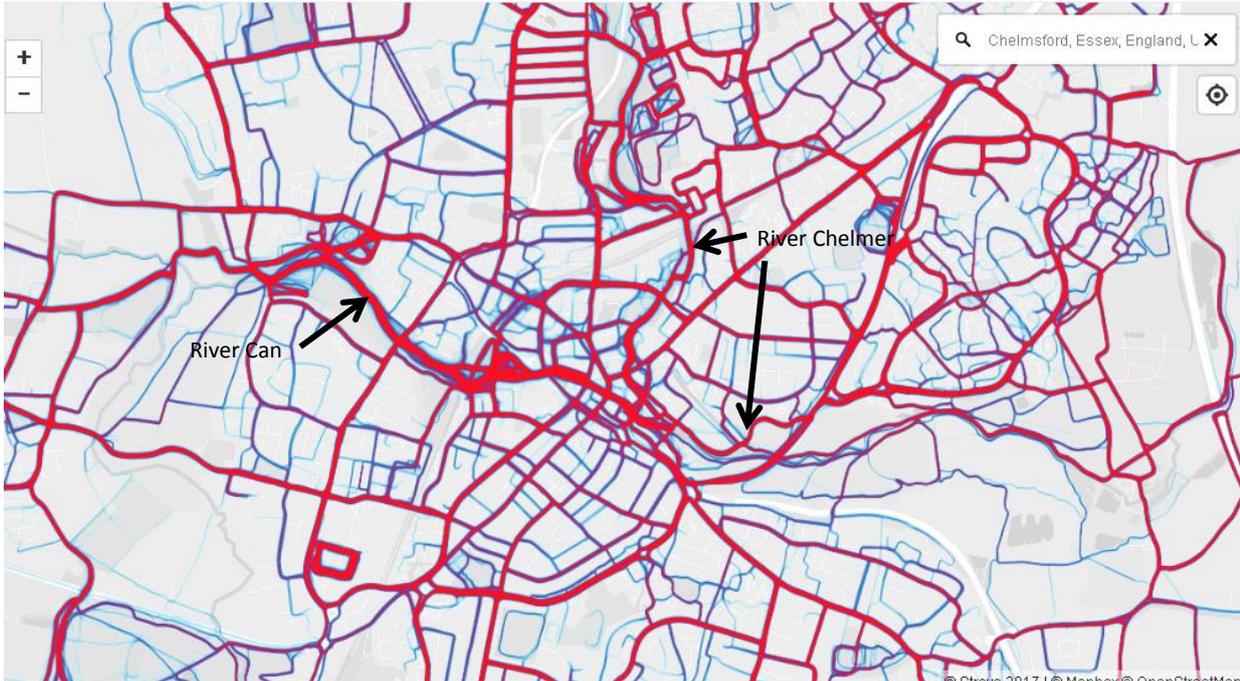
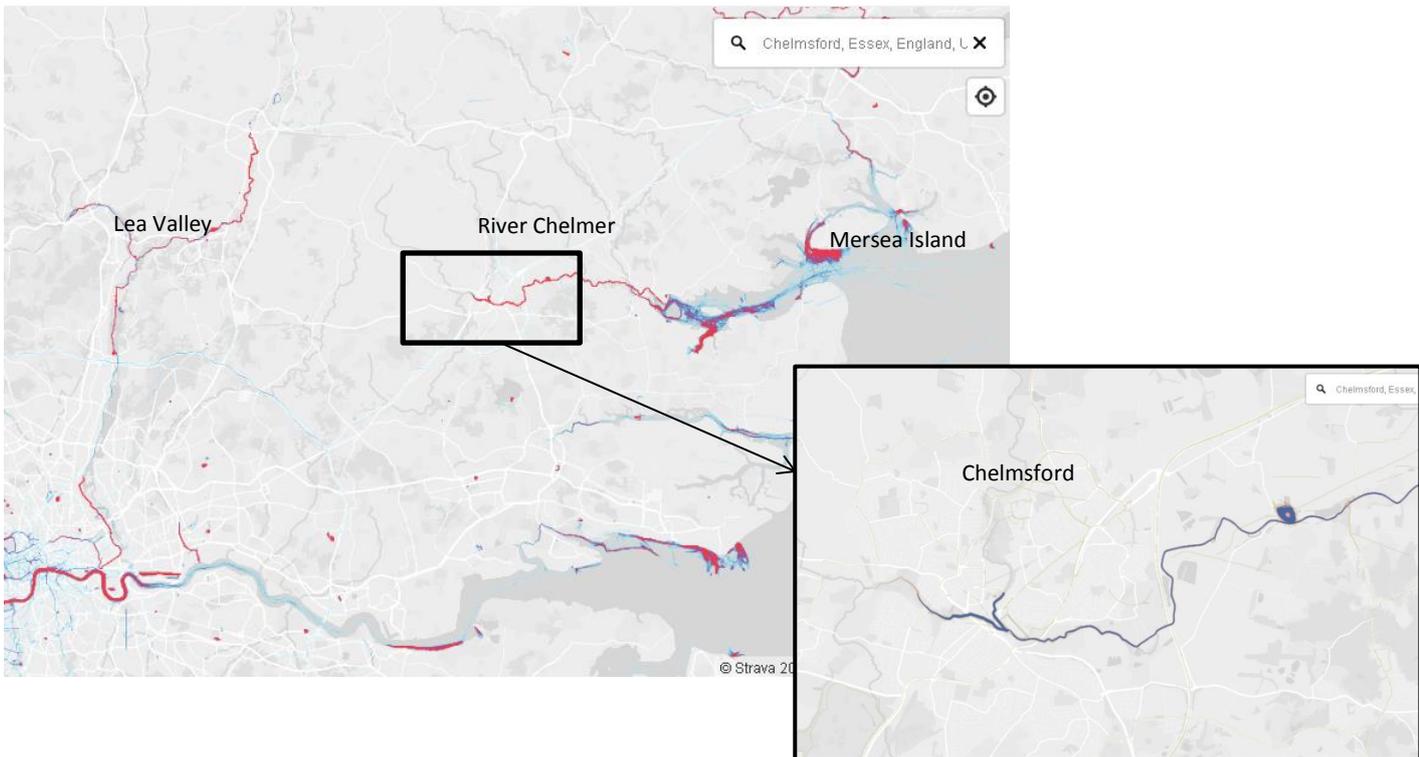


Figure 30. STRAVA map showing where people go to run in Chelmsford (<http://labs.strava.com/heatmap>)



There is a charge for obtaining this data digitally, but the free version of the heatmap could be imported into GIS for comparison with the PGIS maps and Flickr photos. The maps are useful for showing popular running and cycling routes, and even the areas used for water based activities such as canoeing (Figure 31). Although networks of minor suburban roads are well used by runners, the maps also show the importance of footpaths and parks, especially riverside paths in Chelmsford.

Figure 31. STRAVA map showing where people do water sports in Essex (<http://labs.strava.com/heatmap>)



5 Conclusions

Local residents at the PGIS workshop rated cultural ecosystem services as being highly important both for their own wellbeing and for the wider community. However, the mapping exercise revealed that provision of these services is mixed, and many are threatened by future developments.

In Essex, which is viewed as being well-endowed with natural beauty and distinctive features, provision of cultural ecosystem services was rated as being medium to high at present, although many of these services are perceived to be in decline. In Chelmsford, however, provision of cultural ecosystem services is rated as being low to medium because green space and street trees are being lost to development, with 450 mature trees being felled in recent years. There has been a large adverse impact on cultural ecosystem services such as aesthetic value and sense of place, leading to a tangible sense of loss amongst residents.

The participatory mapping exercise identified areas and features that provide a high level of cultural ecosystem services which are important for local residents. The places identified during the participatory mapping exercise as being important providers of ecosystem services correlate quite well with many of the clusters of Flickr photos, which gives a certain degree of confidence in the validity of both of these techniques. Both techniques identified hotspots of service provision, with certain areas providing multiple cultural ecosystem services. These include:

- **Chelmsford:** Danbury Woods, Hylands Park, Galley Wood, town parks including Oaklands Park, Cathedral Square, Writtle College, forest schools and the three 'green wedges' along the river corridors;
- **Essex:** Epping Forest, Hatfield Forest, the Lea Valley, Thorndon Country park, Hylands Park, the River Chelmer, the Maldon area, Wivenhoe, High Woods Park in Colchester, other country parks, wildlife reserves, activity centres, RHS and other public gardens, Hanningfield reservoir (and, to a lesser extent, Abberton reservoir), the Stour Valley, Wallasea Island and the north-east Essex coast. Including Mersea Island, and the Thames Estuary path.

Some areas with many Flickr photos were not identified in the PGIS workshops. Some of these were clusters of photos by a single user, as discussed in section 3.2. Others, such as the clusters at Audley End Park near Saffron Waldon and at Hockley Woods near Southend, probably simply reflect the fact that the workshop was held with residents of Chelmsford who were less familiar with these areas.

Conversely, some areas were identified as being important service providers in the PGIS workshops, but had fewer Flickr photos. For some of these areas, such as Danbury Woods and Galleywood, this could indicate that they are mainly of importance to local people in Chelmsford but attract fewer visitors from outside. Alternatively, it could indicate potential for use of these areas to be expanded, either through improving facilities or awareness of the areas – this could be the case for the Dedham Vale area, where the links to Constable could be highlighted.

The mapping exercise also identified gaps where service provision is poor, as well as threats from development and opportunities for improvement. Both the PGIS work and the photo analysis confirmed the potential for more service provision through improving public access to the Foulness MOD area. The need to protect remaining green space and trees in Chelmsford from further loss to development was also a strong theme at the workshop. Several potential improvements were identified which could help to restore a distinctive local identity to Chelmsford. Key findings include:

Chelmsford

- Lack of green space and street trees in Chelmsford Town Centre;
- Threats to the green wedges and the green belt from development;
- Traffic noise and a lack of tranquillity, wildness and naturalness around Chelmsford;
- Opportunities to create new green and blue infrastructure at Mesopotamia Island including completing the “Cut” to link the river corridors;
- Opportunities to improve cycle networks especially in the town centre;
- Opportunities to improve the quality of green space along the eastern River Chelmer, in some of the Chelmsford town parks and at the Golf Course;
- Opportunities to make more of educational opportunities and publicity for activities.

Essex

- Opportunities to plant more trees, e.g. at Abberton reservoir, plant wild flowers in road verges and roundabouts, and maintain hedges;
- Opportunities to improve access to the coast at Foulness MOD area;
- Opportunities to improve the sustainability of intensive farming to reduce threats to wildlife.

Feedback from the workshop attendees was that the participatory mapping approach could be a useful way of integrating the views and concerns of local people into the planning process. The mobile exhibition was also very useful for gathering additional information from a wider range of people, although it could be harder to interpret the results as not all points identified on the map had accompanying comments. We will be investigating the possibility of using an online app to gather information from an even wider user group in future.

For the Flickr analysis, there are some limitations of the method. Firstly, coverage of different types of cultural ecosystem service by different population groups is not complete and unbiased. Not everyone using a given ecosystem service takes photos, and there might be a bias towards specific types of activity, e.g. regular dog walkers might be less likely to take photos. Of those who do take photos, not everyone posts them to Flickr: there might be a bias towards younger people who are more likely to use social media. Not all of the photos posted to Flickr are both geotagged and publically available: it is possible that photos including children, for example, are less likely to be made public for reasons of personal safety and privacy. Despite these restrictions, a large and highly populated area such as an English county still yields far too many photos to analyse given the resources available in a typical research project, especially because a large number of photos are not relevant to ecosystem services and therefore must be rejected. To cut down the number of ‘reject’ photos and thus save time and effort, we filtered out photos taken in urban areas. However, this in itself limits the validity of the analysis and the conclusions that can be drawn.

Despite these restrictions, we found the method to be extremely useful for examining the spatial pattern of photos, especially for the service of aesthetic landscapes. As discussed above, the location of photos seems to correlate well with hotspots of service provision for aesthetic landscapes identified during the participatory mapping exercise. However, the analysis of Flickr photos may provide less information on other types of cultural ecosystem service.

We would not necessarily expect a strong correlation between the location of Flickr photos and the best wildlife habitat, as it is possible that high quality habitat may be in remote locations where human access is low. It is therefore recommended that other techniques such as ecological surveys are used as the primary

means to assess wildlife habitat. Nevertheless, the photo analysis does identify the locations where people can view wildlife, including both 'opportunistic' encounters when the main purpose of the trip may be to go for a walk or look at the scenery, and deliberate encounters such as visits to a nature reserve by bird-watchers. Similarly, photo analysis is not ideal for assessing the service of recreation provision. Although many of the photos were probably taken by people walking, very few actually showed the activity of walking (i.e. had walkers in the photo). Similarly, there were few photos showing running or cycling, probably because few runners and cyclists would stop to take a photo. This lack of explicit recreation photos was probably reinforced by the criteria that 'portrait' photos where the main subject was a person were rejected. We therefore conclude that other methods should be used to assess the service of recreation, such as information from clubs and societies, and from apps such as Strava. However, the existence of the photos does show that someone has visited the area and taken a photo reflecting the natural environment, and that in itself represents a type of recreational service provision, even if the exact nature of the recreational activity cannot be determined from the photo.

Despite these limitations, use of these tools together as part of a suite of complementary methods can provide valuable information about the supply of cultural ecosystem services, which are difficult to assess using other methods.