Public Health and Land Cover in the UK - Summary
Workshop at Met Office, Exeter
Monday 21st March 2016

Introduction

This document summarises key points discussed at a 1-day workshop on 'Public Health and Land Cover', held at the Met Office, Exeter on 21st March 2016. Motivation and support for the workshop was provided through the National Institute for Health Research (NIHR) Health Protection Research Unit's (HPRU) Environmental Change and Health research partnership (see http://www.hpru-ech.nihr.ac.uk/). This partnership is one of thirteen NIHR HPRU Centres of excellence in multidisciplinary health protection research in the UK, and is led by Dr Sari Kovats at the London School of Hygiene and Tropical Medicine, and includes partners at Public Health England, University of Exeter, UK Met Office, and University College London.

Presentations from the workshop are available via the workshop web page: http://www.metoffice.gov.uk/conference/public-health. Please contact the specific presentation authors for further details or to seek permission for use of any materials contained in the presentations.

Aims

The overarching aim of the workshop was to improve pull-through of research on land cover and health to better inform public health policy in the UK.
Specifically, the workshop aimed to:
- Increase engagement/collaboration between public health scientists and land cover experts.
- Identify key relationships between public health and land cover.
- Identify current and future potential capabilities of land cover datasets/information to inform public health research.
- Identify current public health and land cover activities and key research gaps.
- Define priority projects and valuation activities (both national and local), and potential funding to support these.

Background

Land cover (the physical characteristics of the land surface, including natural, agricultural and urban environments), and the activities taking place on the land, can influence public health in a wide

variety of ways. These include: i) direct effects, such as allergic rhinitis related to emissions of allergenic pollen from specific plant species; ii) indirect effects, such as the role of habitats for vectors that carry vector-borne diseases; and iii) influences on well-being, such as the psychological benefits of greenspace. Improved understanding of the relationships between public health and land cover will help inform both public health and land cover experts on the appropriate research, policies and actions by which land cover may be utilised to improve public health.

The workshop focussed on bringing together researchers and practitioners in Public Health England and related agencies with an interest in land cover mapping and related hazards and benefits for public health.

Summary of sessions

The day was split into three sessions. The first two consisted of short (15 min) presentations and plenary discussion providing a flavour of the state of science and key relationships relating to public health and land cover from both the science and policy perspectives. The third/final session consisted of small breakout groups followed by plenary discussion focussed on identifying ideas for priority joint research projects and potential funding sources. The following sections provide a summary of key points raised and discussed in each of these sessions:

Session 1: State of science in the UK

Chair: Debbie Hemming, Met Office

Aim: Provide overview of the state of science relating to Public Health and Land Cover

There were four (15 min) presentations in this session, as follows:
1. http://www.metoffice.gov.uk/media/pdf/j/r/Session_1.1_RachelMcInnes.pdf
2. http://www.metoffice.gov.uk/media/pdf/j/m/Session_1.2_JolyonMedlock.pdf
3. http://www.metoffice.gov.uk/media/pdf/k/t/Session_1.3_RichardElson.pdf
4. http://www.metoffice.gov.uk/media/pdf/k/t/Session_1.3_RichardElson.pdf

The first presentation '**Mapping vegetation to assess allergen exposures**' by Rachel McInnes (Met Office) provided an overview of methods, results and future steps for mapping specific vegetation species and/or genera that produce allergenic pollen across the UK. The method used combined a variety of land cover and tree datasets, and used habitat suitability expert elicitation to estimate likely locations of certain weeds.
Questions/discussion included:
Q. Could we use GP admissions data to compare with allergenic pollen?
Q. What about linking vegetation maps with dispersion models?

In the second presentation '**Importance of land cover in determining vector-borne disease risk**' Jolyon Medlock (PHE) introduced the ecology of disease vectors of relevance to UK, including discussion on ticks and borrelia (Lyme disease), urban disease ecology, mapping and predicting rare tick species, ticks and host habitat suitability, British mosquitoes and wetlands, West Nile virus (and *Culex modestus*), and invasive mosquitoes and 'human habitats'. As ticks and mosquitoes are impacted by land cover, a key question was should we be able to map their suitability?...considering that it may also be necessary to map their hosts, connectivity of habitats, soil type, geology, aspect,

elevation, hydrology, microclimate etc. Modelled suitability information could be used to predict risk, inform the UK risk assessment, and provide advice to the public.

Questions/discussion included:

Q. What is the role of humans in the spread of ticks? Do increased human interactions lead to more ticks being spread in an area? How much do humans know they are spreading ticks? How do Local Authorities know how to map ticks?

Q. Has the population of ticks and the prevalence of Lyme disease changed over the last 20 years?

Ticks have been spreading in Northern Europe and this data could be used to try to better understand what is going on in the UK

We could be using temperature data in assessments of the spread of ticks and also drawing on land cover maps to plot their distributions and associated habitats

The third presentation '**Spatial distribution of Shiga-toxin producing *E. coli* O157 in relation to agricultural land use in England'** by Richard Elson (PHE) introduced the Shiga-toxin pathogen, which was identified in 1982, can be life threatening, causes a range of symptoms including diarrhoea, and is linked to land cover via ruminants which are considered to be the main reservoir. Richard also discussed the modes of transmission, risk profile of cases in England and results of a spatial analysis of VTEC O157 cases and cattle. Key results were: i) rates of infection are highest in rural areas, ii) the risk appears to increase with increasingly sparse rural settings, iii) sporadic human cases of VTEC O157 cluster spatially in areas of the country that have the greatest numbers of cattle.

Questions/discussion included:

Q. Has the dispersion of cow dung in rural and urban areas been looked at?

Q. What about manure applications in different areas and associated prevalence's of E.coli 0157?

Need to look at the relationship between pathogen load and degree of risk in different areas

Q. Boot-sock data collection being done at sites across England for Vtec?

Q. Have we looked at zero prevalence studies in urban areas?

Issue of people travelling abroad and bringing pathogens back to urban areas

The last presentation of this session **'Greenspace for health and wellbeing: types of measures'** by Sahran Higgins (Univ. of Exeter) discussed how existing evidence indicates that exposure to greenspace may be a significant resource for human health and wellbeing. Health pathways linking greenspace and health were outlined, considering associations between exposures, mechanisms and outcomes. Sahran also discussed the various options, and provided case study examples, for land cover datasets suitable for health outcomes, including the Generalised Land Use Dataset (GLUD), Land Cover Map 2007 from Centre for Ecology and Hydrology (CEH), Urban Atlas, Normalised Difference Vegetation Index (NDVI), CORINE EU-wide land cover data, and the Global Land Cover (Globeland 30) data from China group at 30m resolution.

Questions/discussion included:

Q. Has anyone looked at the density of pets in relation to the use of green space?

Q. How do you control for wealth in green space analysis? Are people prepared to pay for nice green space?

Q. Do the most deprived in society get the most benefit from access to green space?

Q. Is there a relationship between size of garden and people's health? Also is there a relationship between a garden's biodiversity and health?

Q. Has there been any work on the impact of presence or removal of urban trees on health?

Plenary questions and discussion:

Q. How much mapping is done at PHE for gastro work?

There is an increasing use of mapping within PHE and this is stated within the business plan. However, don't have good data sources for all data needs

Q. How do we manage the diversity of needs in green spaces through planning and behaviour change?

Q. Ragweed as an invasive species which produces pollen after pollen burst. Can we link pollen bursts to people visiting GP surgeries?

We should do more on phenology modelling to improve links to health warnings

What sort of public health interventions can be done for pollen?

People need to know what pollen they are allergic to and then when this is most risky for them. People can then change their behaviours if they are better informed about particularly risky times for pollens that affect them (i.e. don't cycle at most risky times).

Pollen diary as an App for phones could help people. Councils could also change their grass cutting regimes to try and reduce pollen-induced allergies

Q. How much time to people need to be in green space to get health benefits? Not all time in green space is positive- such as bad weather

Evidence suggests that season doesn't have an effect but now looking at climate effects on wellbeing in green spaces

Studies show that weather affects how people view pictures of green space- better weather improves how people view green space. Mention of relationship between Vitamin D and wellbeing

Q. Can we use new satellite data and soil moisture data for green space work? New high resolution land cover data coming out (Copernicus Programme Sentinel satellites)

Someone mentioned the need to increase the pressure on the European Space Agency to produce more relevant data

Q. Can we infer micro climate effects on ticks from large data sets?

Answer was that we can't do this without data but that modelling can fill in for some of the data gaps

A need to link urban models with micro climates

Q. Using LIDAR data for coastal locations can this work for woodlands?

Answer was that we can fly over woodlands in the winter and LIDAR can then penetrate the canopy as the leaves have dropped

Q. Can we use mobile phone data to track p-people's movements in relation to green space?

Cities Catapult data in Hyde Park – some ethical issues here.

This could be a Citizen Science project

Q. We use multi-layered data in urban areas (ozone, temperature and pollen) but not so in rural areas. Can we change this?

Q. Can we get access to physical activity data?

Farm level data on cattle movements. Could use data from the OPAL-project. Can citizen science data be useful? Also the BTO would be a good source of data for birds.

William: Disconnect between risk and amenity mapping- we should be mapping preventative measures rather than risk as this sis less scary for people and gives them something positive they can do. This is already happening with the Scottish Tourist Board

Q. Any considerations of evolutionary adaptations in tick work?

Different mosquitoes have different strategies- physiological adaptations are known in some species.

Session 2: Improving evidence for public health

Chair: Sari Kovats, London School of Hygiene and Tropical Medicine

Aim: Identify key relationships between Public Health and Land Cover

There were four (15 min) presentations in this session, as follows:

1. http://www.metoffice.gov.uk/media/pdf/l/e/Session_2.1_SotirisVardoulakis.pdf
2. http://www.metoffice.gov.uk/media/pdf/l/9/Session_2.2_TinaHenry.pdf
3. http://www.metoffice.gov.uk/media/pdf/l/m/Session_2.3_TomOliver.pdf
4. http://www.metoffice.gov.uk/media/pdf/m/n/Session_2.4_TimTaylor.pdf

The first presentation **'National public health policy and land cover'** by Sotiris Vardoulakis (PHE) provided an overview of how health is determined by complex interactions of: i) where you live (or don't live), ii) what you do, iii) who you are. Explaining how environments can promote physical activity, facilitate access to healthy, affordable food and promote active travel e.g. Improving the health of Londoners, Transport Action Plan, Transport for London. Government planning policies on sustainable development of land have economic, social and environmental roles e.g. DCLG, National Planning Policy Guidance, 2014. Examples of data linking health and environment were presented, including air pollution and health outcome data across UK, lifestyle and health behaviour in London, and Urban heat Island during heatwaves and attributable mortality in the West Midlands. Land cover/use measures to adapt and mitigate poor health outcomes were presented, highlighting measures in the Natural Environment White Paper and government initiatives with implications for sustainable development of land. Conclusions highlighted the need an integrated land use and public health perspective promoting multifunctional and sustainable use of land. Land cover maps are a powerful tool for identifying and investigating spatial patterns.

Questions/discussion included:

Q. Is natural environment white paper going into policy?
Defra is developing a 25 Year Strategy and then a 25 year plan and public health and the natural environment are featuring strongly

Q. How will land use start to change in the next 10 years?
This is what we need to start doing in HPRU (Sari). Check the work of Andy Totem at Southampton. EU Environment Agency is looking at change. CORINE project is relevant to this discussion.

In the second presentation **'Local public health policy and the natural environment'** by Tina Henry (Public Health Devon) current evidence from the State of the Environment report and the State of Nature Report was highlighted and how this is being applied within Devon inc through the Devon Local Nature Partnership prospectus. Success would be considered as a greater number and diversity of people being naturally active. To do this there was a decision to focus on communications and initiatives to encourage behaviour change for those not currently using natural environment. Social behaviour scoping review research on the reasons for lack of use were presented. Examples of policy applications though 'Naturally Healthy' initiatives inc. booklets on 'Hike it', 'Walk it', 'Health at the heart of new communities', 'Health on the high street'. Final summary showed the public health approach to healthy lifestyles, which has four key areas: Educate, Design, Control and Support.

Questions/discussion included:

Q. What are the lessons from your work in Devon for the rest of the country?

The next presentation **'Quantifying the ecosystem services than underpin health and wellbeing'** by Tom Oliver (University of Reading) introduced the Biodiversity and Ecosystem Service Sustainability (BESS) NERC programme, and specifically the WESSEX BESS project entitled 'Biodiversity and

ecosystem services in current and future multifunctional landscapes'. Links between BESS and human health were discussed within the context of 'planetary health', where biodiversity is an important indicator of ecological health and resilience. Examples were provided of mapping and modelling of indicators (inc. land cover characteristics) for assessing 'natural capital' and ecosystem services, and using test areas/catchments for testing and validating the models. Lastly, cultural ecosystem services and links with mental health 'Ecotherapy: The green agenda for mental health' were discussed. As time was short questions were deferred to the end of session.

The final presentation of this session **Valuing green space: considering environmental and health benefits in planning'** by Tim Taylor (University of Exeter) discussed using spatial planning to deliver public health improvements, highlighting a number of current opportunities in this area, including the National Planning Policy Framework (NPPF) and the Health and Social Care Act 2012. The complex links between planning policy, green infrastructure and potential health outcomes were presented, including examples of evidence for green space improving health. Valuation of health impacts of green infrastructure and environmental benefits, i.e. recreation, was introduced, and barriers to valuation discussed. The approach used to value recreation in the National Ecosystem Assessment (2011) was presented, with a focus on Cornwall.

General questions on session 2 talks:
Q. Can you take property values into valuations for green space?
Yes but do people fully take in environment when valuing a potential property?
Are such valuations taking into account those things that are not being monetised?
Its harder to value specific species than to do health evaluations
Q. Have studies been done that have combined all evaluation methods together?
There are emerging studies on the social value of QUALY but these don't include environmental values
Q. Need more Multi-criteria analysis. Is Defra doing this?
This is being attempted at Defra but it's very difficult to give political weightings on specific species. Work has been helpful to Defra in deciding on policy as all the relevant data is in one place. However, difficult to get policy to understand the science
Q. How easy is scaling things from local to national level (e.g. socially derived values)?
Can be done just need to adjust the values (might need to check this further)

Plenary questions and discussion:
- A general discussion about the importance of providing local evidence
- Defra struggles to put health and environmental data together as it is an environmental government agency.
- PHE- its important to have a return on investment and this is difficult to translate into action if the benefits are to be felt elsewhere
- How do you persuade local authorities to spend money on projects if the benefits are mainly to the Department of Health?
- Do we need better methods for costing?
- We need to employ a more complex systems view of the world
This thinking is equally valued in the environmental sector
Need changes in behaviour in government departments to get cross-sectorial work and spend money across sectors.
- People fighting for money within limited budgets- need a 'society-benefit' thinking
- Government departments are about 'fiefdoms'

These are institutional factors that we don't have any power over. Methods and tools also need to be bettered

Q. Are there any longitudinal studies being dome on green space and health rather than just spatial studies?

Exeter beginning to do this through household survey data

Would it be beneficial at the local level to develop scenarios to run with met office models?

Policy makers not listening. Language needs to be simple but would be helpful to play out scenarios.

Land use maps have unhelpful legends

Also need to plan for post-development evaluations not just for the design of healthy towns

We need to push for this locally

To have more useful scenarios they need to be much more specific to have better understandings of drivers

Session 3: Priority research projects and potential funding

Chair: Lora Fleming, University of Exeter

Aim: Identify priority joint research projects and potential funding sources

The following format was used for this session:

Small break out groups with mixed health and land cover expertise (6-8 people)

1 hour: develop and discuss 2-3 research project ideas/group

- Responsive to prior Workshop discussions
- Address Health and Land Cover research gaps with Interdisciplinary vision
- Other collaborators; ongoing research on which to leverage
- Possible funding sources
- Select Rapporteur to feedback/note taker
- Write 2-3 ideas clearly

30 minutes: Feedback to entire group

- 5 min feedback/group by Rapporteurs

10 min: Vote on top 3 research idea

- Each person with 3 stickers
- Priority areas in terms of research gap, feasibility, funding, importance

20 Min: Discuss how to move forward, funding, other issues

Key ideas for joint research on public health and land cover were summarised in each breakout group and all workshop attendees voted on 3 ideas/projects that they considered priorities (Table 1).

Table 1. Summary of ideas or questions proposed from breakout groups, including details on these and ranked according to number of votes received from a poll of the workshop attendees.

Science idea / question	More detail	# votes

What do people do in greenspace?	Passive data collection
	  - using mobile phone gps data
	Active data collection
	  - Questionnaires, apps
	Monitor:
	  - Tick contact
		13

	- active travel, physical activities - generate controls for epidemiological studies	
What evidence do we need to better design urban greenspace?	Species composition Mosaics / connectivity Size	9
Pollen and health – from the perspective of the sufferer	User-driven risk mapping (standard approach)	8
Mental health determinants study	Considering land cover, socioeconomic status and other confounding factors - Develop modelling methods - Improve therapies (green prescriptions) Funders: - NIHR/ESRC/NERC/MRC?	7
Create an ecosystem rating for properties (similar to energy, EPC rating)	Would this influence behaviour? How useful would it be?	6
Local toolkits for health-environment management options	Tools showing relationships between health and environment inc land cover characteristics...and other factors - Web tools/spreadsheet highlighting benefits of different options	6
Health benefits of different vegetation types	E.g. exposure, ecosystem services... Develop Earth Observation tool to identify vegetation types for health specific metrics	5
Knowledge exchange between health and land cover experts	How are the data being used? Is it appropriate? What kind of information about land cover do health experts need?	5
Look at associations between health and land cover through hypothesis generation rather than testing existing ones	E.g. using environmental data to look at human diseases Need quality environmental data	4
Develop UK land cover/use scenarios	Consider policies, environmental drivers, population growth, (new build) Provide health and environmental outcomes National, local, city-specific (London) scenarios	3
Tick app – citizen science	Citizens identifying ticks and location in environment Analysis of citizen science data Including GPS, app designs Evaluate impact of information Funding: INNOVATE UK, Partner: NHM	3
Urban heat island – where is it hot? – citizen science	Heat (also pollution?) sensors on citizens Sensors on bicycles - Raspberry pi	3
Social media communications	Communicate about health and land cover via.. - Country File - Blue Peter - Spring/Autumn Watch - You Tube - Gamify	2
Ethnic and gender relationships to different space	Research to understand behaviour reflecting changing society	2

Environmental audit (what environmental characteristics are where?)	Including: - High granularity - Connecting / integrating - Younger generation	1
Comparison of health and environmental co-benefits of interventions	E.g. Adaptation strategies for climate change... - recreation vs tick exposure - engineered wetland vs mosquito exposure Funding: NERC, EU H2020	1
Cascading events – influence of environment and health	'Knock-on effects' Impact chains E.g. extreme events (temperature, precip) -> health risk (heat, flood) -> pressure on health services (hospital beds)...	1
How to balance the risks and benefits of land areas?	and How to communicate these to policy makers and land managers...?	0

Summary

- Ticks and climate change- question is how are ticks distributions in the environment changing and how is climate change going to impact on these distributions?
- Need to better understand the mechanisms around the transmission of disease
- How to balance the positive and negative aspects of green spaces (i.e. distance of travel versus what you get when you arrive)
- Policy changes can be long-term and difficult to push through into the political arena. Particular issues surround local planning (i.e. building in flood plains). How do we make changes here?
- Importance of work on ecosystems and wellbeing- valuing green space. Population is increasing and so is our need to build so how do we balance this?
- Some missing areas:
  - o Deprivation and ethnicity in relation to green spaces
  - o Urban/rural demography needs to be better understood
- How do we collect and adapt data sets to get what we need?