Biodiversity and ecosystem services offsetting and net gain assessment using habitat maps

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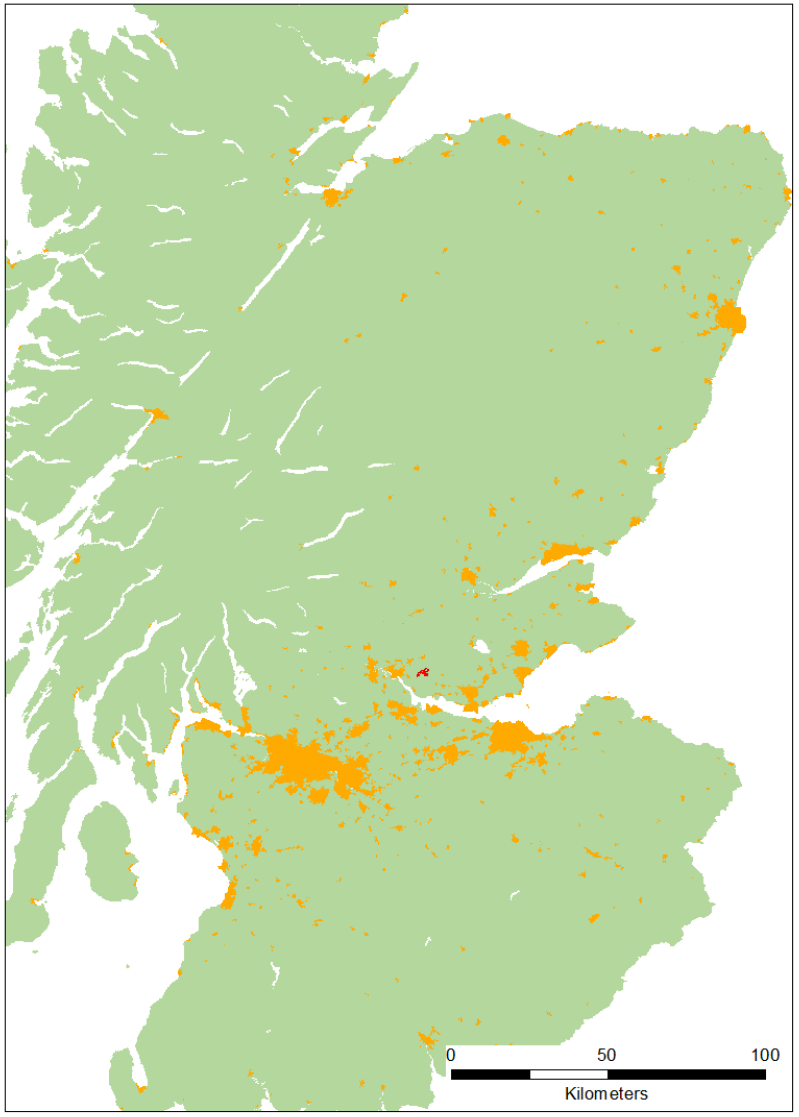
Rationale

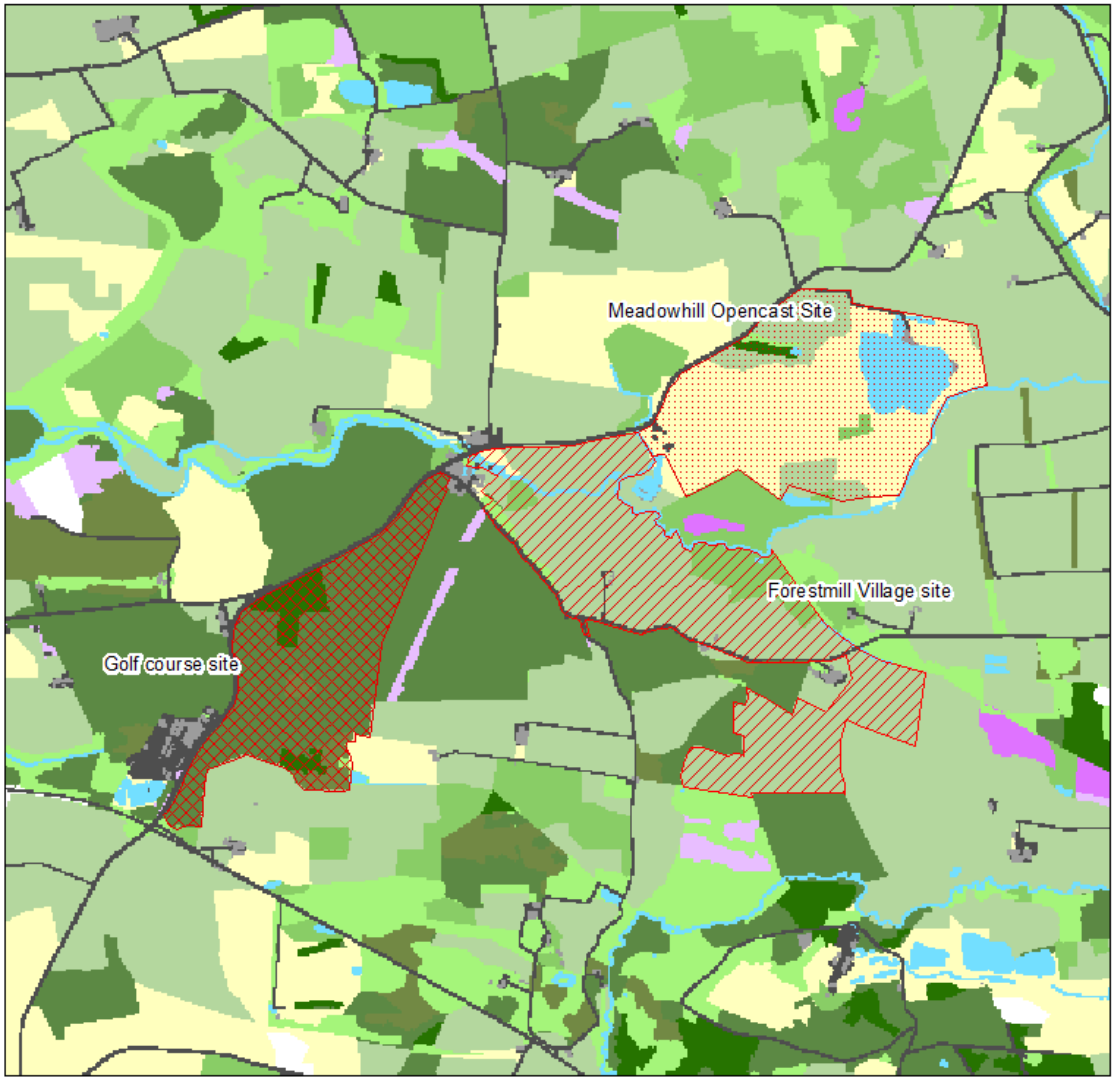
- Biodiversity offsetting metrics often focussed on narrow measures of extent and condition
- Assessment requires field based assessment, reduces potential for more ‘strategic’ applications
- Does not consider impacts on other ecosystem services

Case study site

- Forestmill, Clackmannanshire, central Scotland
- Village site:
  - 121 ha site
  - 1250 new homes
- Woodland site:
  - Golf and hotel development
  - Semi-natural woodland
- Meadowhill
  - Restored open-cast mine
- Village approval linked to restoration



Habitat map



Forestmill and associated development sites

Legend

Development type

- Forestmill village site
- Forestmill golf course site
- Meadowhill

EUNIS habitats

- C Inland surface water
- D1 Raised and blanket bogs
- E Grasslands
- E2 Mesic grasslands
- F4 Temperate shrub heathland
- G1 Broadleaved deciduous woodland
- G3 Coniferous woodland
- G4 Mixed deciduous and coniferous woodland
- G5 Lines of trees, small anthropogenic woodland, recently felled woodland, early woodland/coppice
- I1 Arable land
- J1 Buildings
- J4 Transport networks

0 0.5 1 1.5

Kilometers

Summary of habitat

EUNIS code and description	Forestmill village (Housing)	Forestmill golf course and hotel (Social infrastructure)	Meadowhill opencast (Environmental enhancement)
C Inland surface water	3.21		**13.28**
E Grasslands	**11.25**	0.02	1.15
E2 Mesic grasslands	**99.98**	0.22	**16.51**
G1 Broadleaved deciduous woodland	1.72	0.25	0.62
G3 Coniferous woodland	0.48	**60.12**	
G4 Mixed deciduous and coniferous woodland		4.86	
G5 Lines of trees, small anthropogenic woodland, recently felled woodland, early woodland/coppice		**7.48**	1.17
I1 Arable land and market gardens	0.92	0.09	**65.55**
J1 Buildings of cities, towns and villages	0.16		0.43
J4 Transport networks and other constructed hard-surfaced areas	3.50	0.52	1.49
Total	121.22	73.56	100.20

Applying the offsetting metric

- $B_{ha} = D_{hab} \times C_{hab}$
  - B_{ha} is the number of biodiversity units per hectare,
  - D_{hab} is distinctiveness scored as 6, 4, or 2 for high, medium and low
  - C_{hab} is condition scored as 3, 2 or 1 for good, moderate or poor
- Distinctiveness can be determined from the EUNIS habitat
- Condition is difficult to determine remotely and across all habitats – use as a sensitivity measure

Biodiversity metric scores

	Area (ha)	Habitat loss (ha)	Habitat gain (ha)	Biodiversity units loss			Biodiversity units gain (with multipliers)		
				Good	Moderate	Poor	Good	Moderate	Poor
Forestmill village site									
E Grasslands	11.3	5.6		101	68	34	0	0	0
E2 Mesic grasslands	100.0	100.0		600	400	200	0	0	0
E7 Sparsely wooded grasslands	0		42.2	0	0	0	253	169	84
Total biodiversity units				**701**	**468**	**234**	**253**	**169**	**84**
Forestmill golf course and hotel site									
E2 Mesic grasslands	0.2		40.0	0	0	0	200	133	67
G3 Coniferous woodland	60.1	60.1		361	241	120	0	0	0
G4 Mixed deciduous and coniferous woodland	4.9		19.1	0	0	0	77	51	26
Total biodiversity units				**361**	**241**	**120**	**277**	**184**	**93**
Meadowhill restoration site									
E2 Mesic grassland (lowland meadow)	0		69.5				695	464	232
G1 Broadleaved deciduous woodland	0		17.4				104	70	35
Total biodiversity units							**799**	**534**	**267**
Overall biodiversity units change				**1062**	**709**	**354**	**1329**	**887**	**444**

Offsetting outcomes

- Major habitat losses are grassland (village site) and coniferous woodland (golf course site)
- On-site habitat gains are insufficient to offset losses, biodiversity net gain not achieved
  - Gain can be achieved on golf course site if condition is at least one step higher
- Adjacent habitat restoration can offset and achieve net gain
  - But, only if condition of restored habitat is at least as good as lost habitat

Applying a eco-metric

- Based on Natural England proposal
- $ES_{ind} = A \times C \times ES_{hab}$
  - ES_{ind} is the ecosystem service units for each individual service
  - A is the area (ha) of the habitat patch
  - C is the condition weighting calculated in the same way as the biodiversity offsetting metric
  - ES_{hab} is the individual ecosystem service potential score

Selected ES for assessment

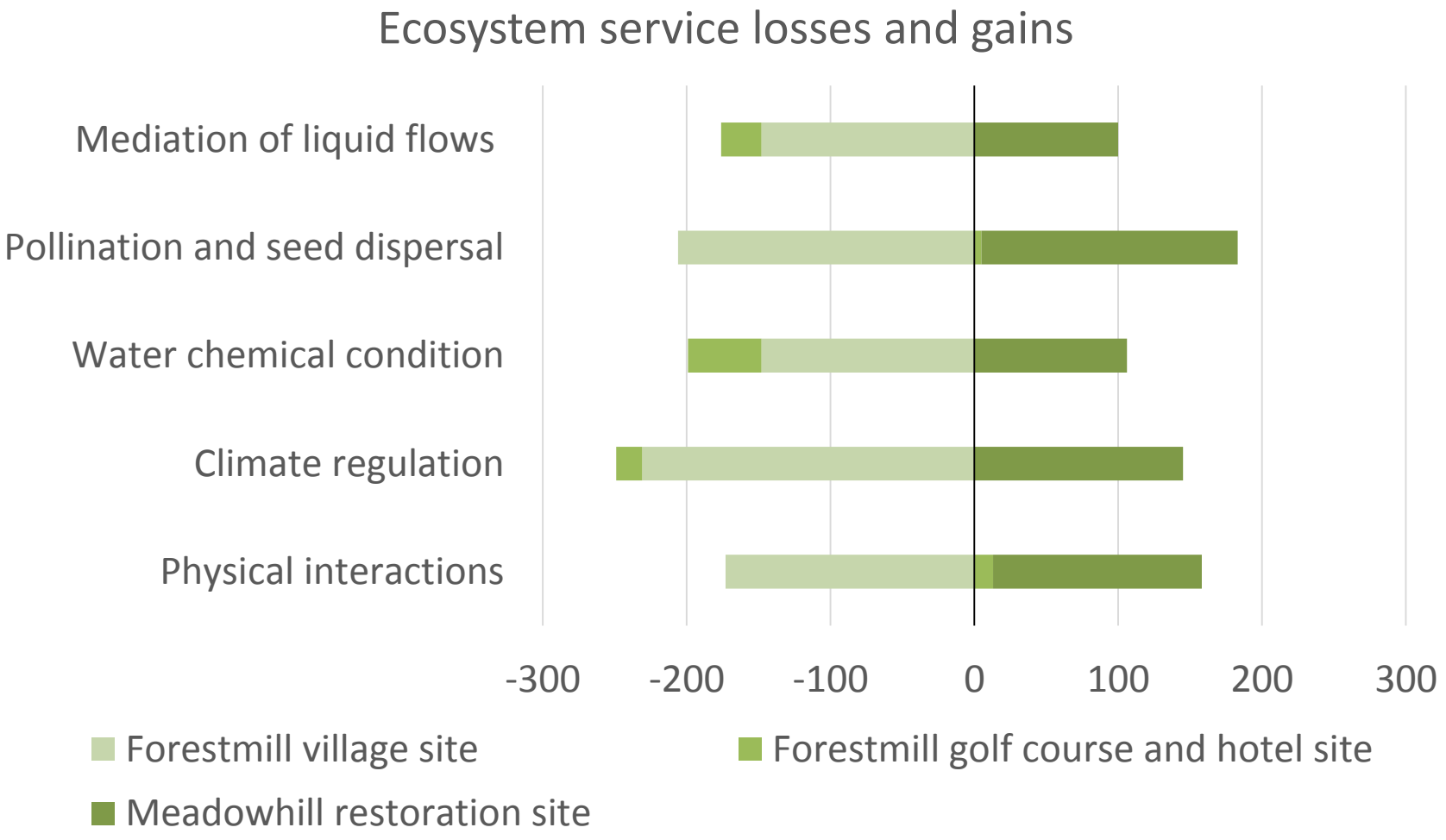
- Mediation of liquid flows, i.e. flood risk reduction
- Pollination and seed dispersal
- Maintenance of water's chemical condition, i.e. water quality
- Global, regional and micro climate regulation
- Physical and experiential interactions, i.e. recreation

ES potential scores

EUNIS habitat	Liquid flows	Pollination and seed dispersal	Water quality	Climate regulation	Physical and experiential interactions
C Inland surface water	5	1	3	2	5
E Grasslands (rough grazing)	3	4	3	3	3
E2 Mesic grassland (lowland meadow)	2	4	2	3	3
E2 Mesic grasslands (intensive)	2	3	2	3	3
E7 Sparsely wooded grasslands	2	4	2	2	2
G1 Broadleaved deciduous woodland	4	4	5	5	5
G3 Coniferous woodland	4	4	5	5	4
G4 Mixed deciduous and coniferous woodland	4	4	5	5	5
G5 Lines of trees…	3	4	4	3	3
I1 Arable land and market gardens	1	3	1	2	1
J1 Buildings of cities, towns and villages	0	0	0	0	1
J4 Transport networks and hard surfaces	0	0	0	0	2

Scoring derived from Burkhard et al, 2014

ES impacts

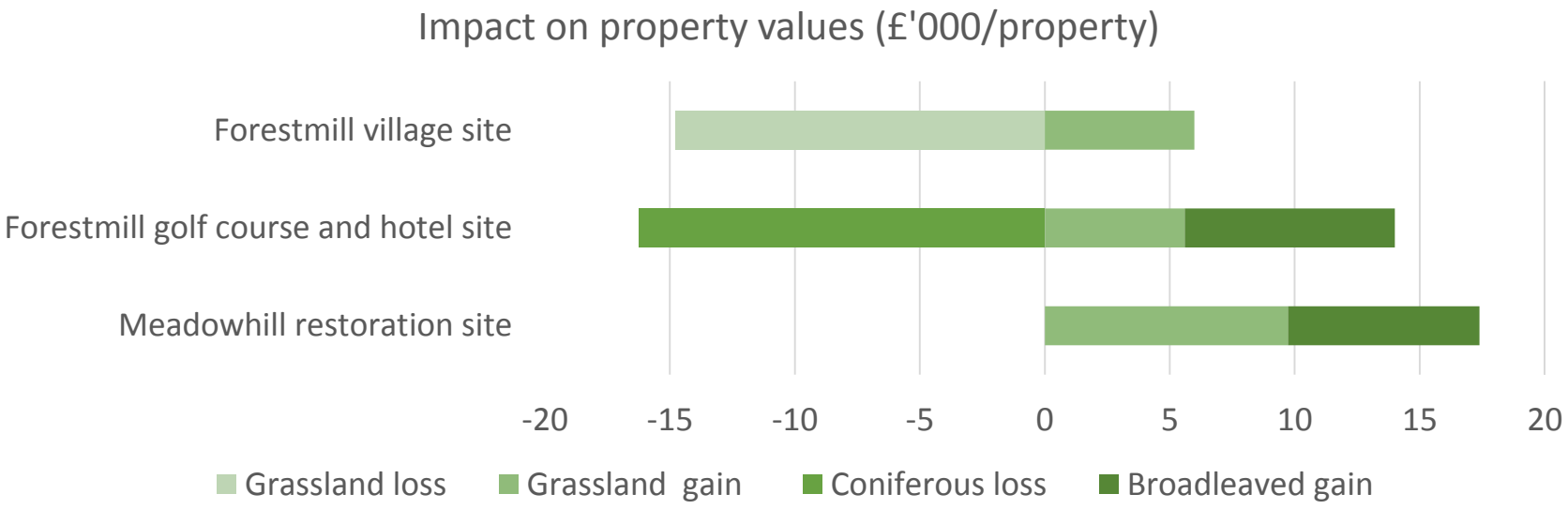

Ecosystem service losses and gains
Mediation of liquid flows
Pollination and seed dispersal
Water chemical condition
Climate regulation
Physical interactions
-300
-200
-100
0
100
200
300
Forestmill village site
Forestmill golf course and hotel site
Meadowhill restoration site

ES impacts summary

- Loss of ES potential is not offset either with each site or overall
  - Except small gains on golf course site for pollination and recreation
- But! The scoring does not account for ES demand or changes in other impacts
  - Development will bring more people to sites, i.e. residents and golf course users
  - Will also increase pressures, e.g. greater sealed surface adds to flood and water quality risks
- An accounting approach using valuation may be more appropriate

Applying values

- Defra EVL table values for Cultural heritage; recreation and tourism; aesthetic value
- Coniferous: £270/ha
- Broadleaved: £440/ha
- Enclosed farmland: £140/ha
- Net gain per household = £6,359



Acknowledgements

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