Tipping points in lowland agricultural landscapes (TPAL): A case study from Dorset

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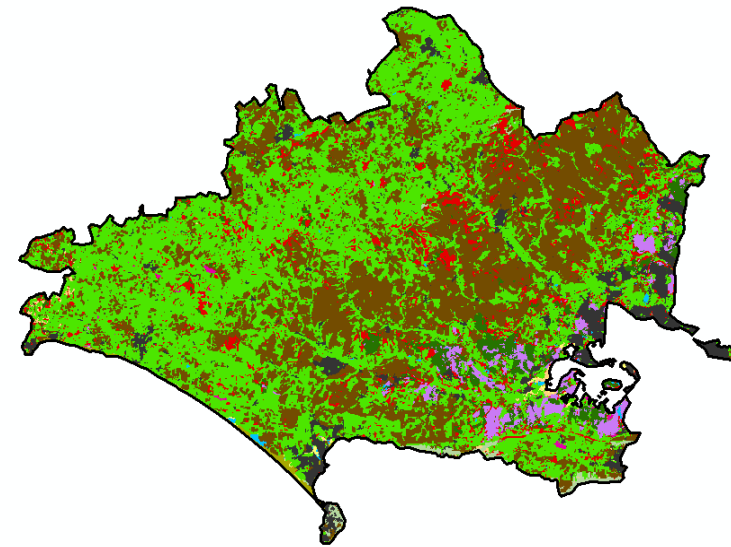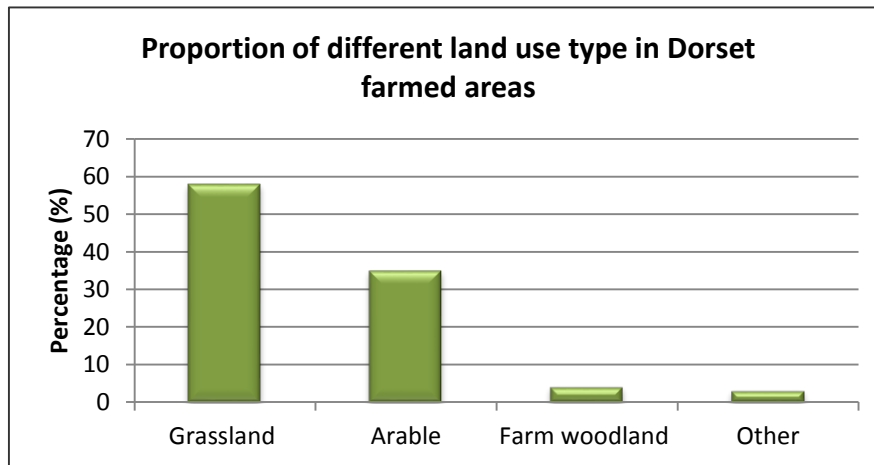
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Approaches

The aim is to detect and analyse tipping points in the:

- *Past* – using analysis of long-term data sets (WP1)

- *Present* – using field measures of natural assets and benefits along degradation gradients (WP2)

- *Future* – using agent based modelling (WP3)

- *Societal impact* –Scenarios of tipping points and response options (WP4) e.g. BREXIT

Context- Research area

Case study: based on spatial data describing changes in **natural capital**, associated provision of **ecosystem services** and environmental pressures between the 1930's and the present day for Dorset.

- The analysis undertaken in TPAL reminds us that the current land use (2015) of Dorset is primarily agricultural 74%.

Proportion of different land use type in Dorset farmed areas

Legend:
- Water
- Arable
- Neutral Grassland
- Calcareous Grassland
- Acid Grassland
- Fen, Marsh, Swamp
- Improved Grassland
- Heathland
- Coastal
- Urban
- Broadleaved Woodland
- Coniferous Woodland

- Therefore in terms of Natural Capital, and flows of ecosystem services, agricultural land-use is key.

CEH Landover map 2015

WP 1 Creating a time-series of Dorset

Hooftman and Bullock (2011)

Ordnance Survey data
Aerial photography.

Legend (1930 and 1950 maps):
- Water
- Arable
- Neutral Grassland
- Calcareous Grassland
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1930

1950
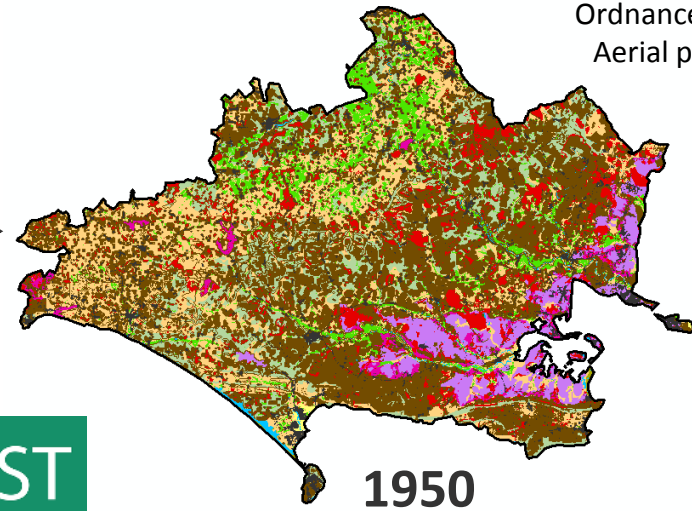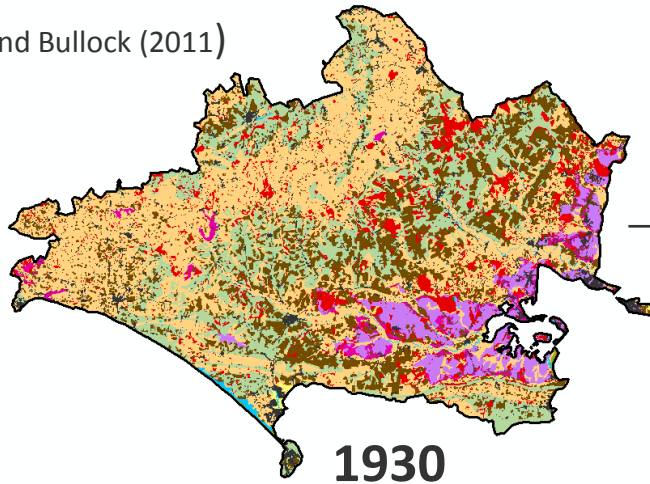
InVEST
integrated valuation of ecosystem services and tradeoffs

CEH 1990 Land cover map &
Anne Horsfall's Revisit of Good sites
(unpublished)

CEH Land Cover Map (2015)

Legend (1980 and 2015 maps):
- Water
- Arable
- Neutral Grassland
- Calcareous Grassland
- Acid Grassland
- Fen, Marsh, Swamp
- Improved Grassland
- Heathland
- Coastal
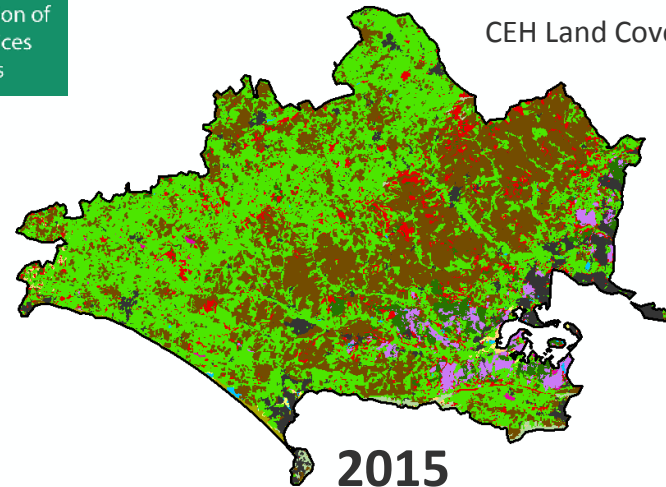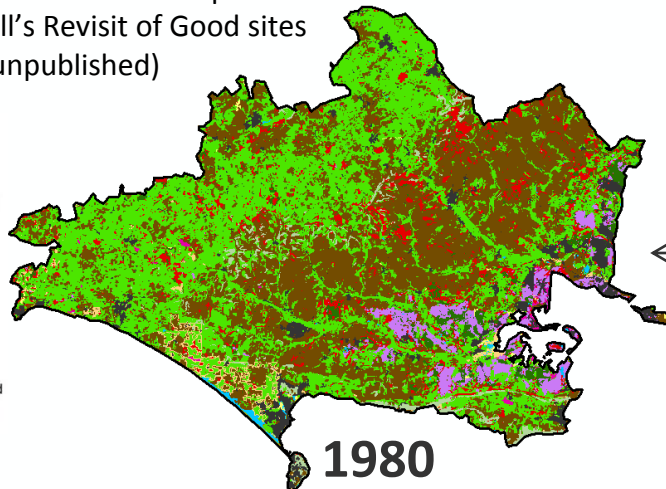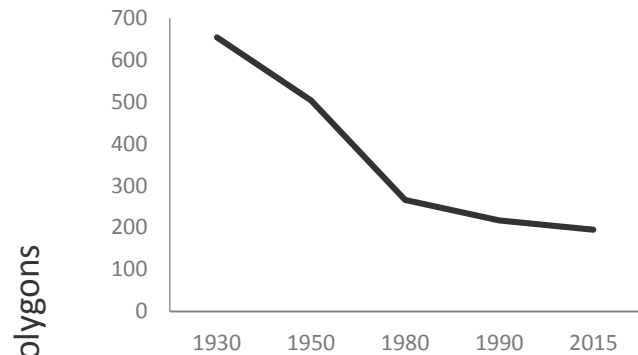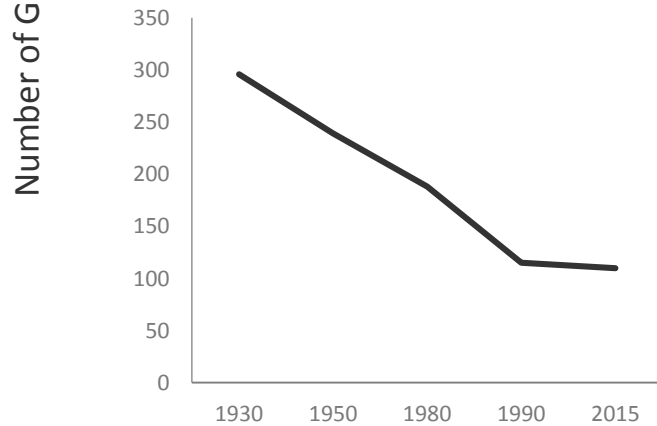- Urban
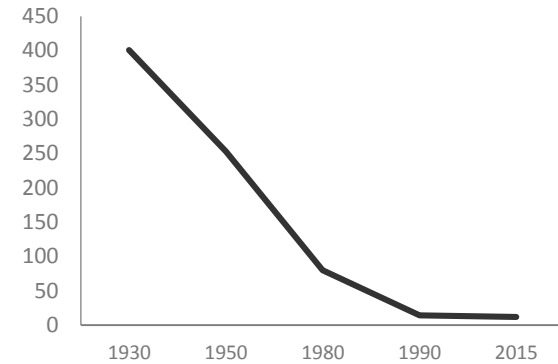- Broadleaved Woodland
- Coniferous Woodland

1980

2015

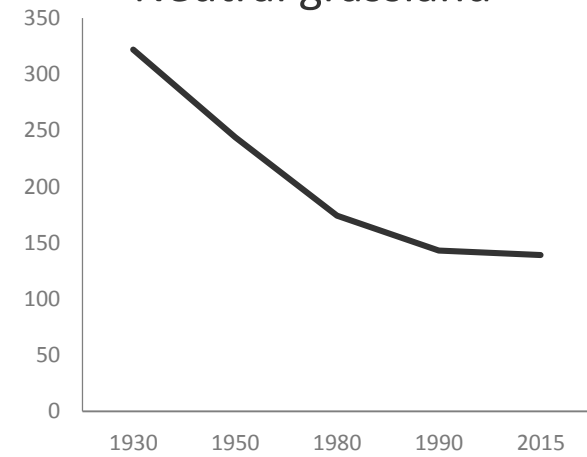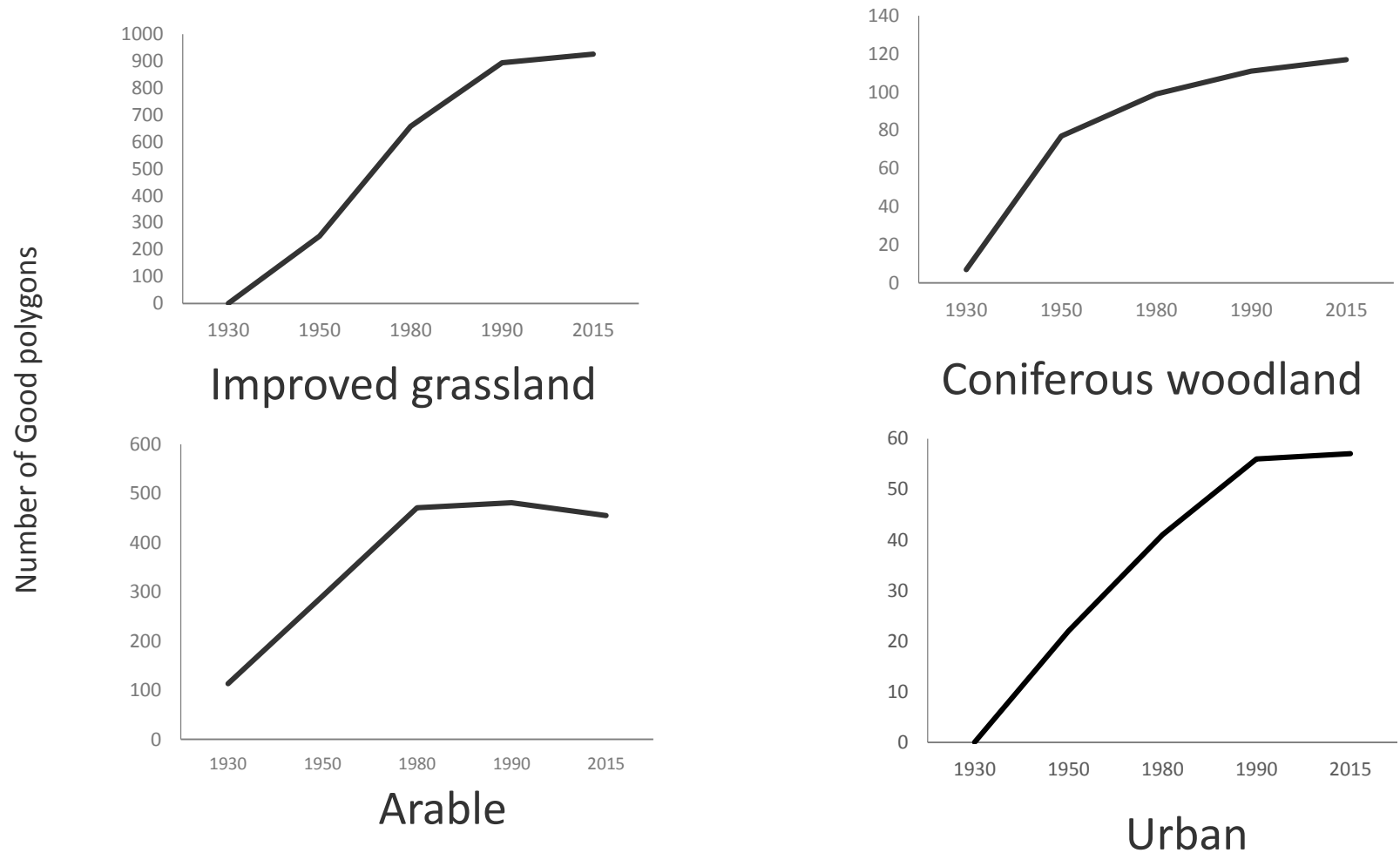# WP1 Trends in habitat loss

Calcareous grassland

Neutral grassland

Fen, Marsh, Swamp

Heathland

Number of Good polygons

WP1 Increases in land cover

WP1 What has driven changes in Dorset's natural capital in the recent past?

- Drivers of change such as advances in agricultural technology, increased use of fertilisers, population growth and economic growth and have all affected natural capital *via* land-use change.

- Next step – how has land use change effected ES?

Total N deposition from all sources (wet, dry, oxidised, reduced N)

Legend: 1800, 1900, 1950, 1970, 1990, 2010

Categories: Arable land, Fertilised/improved grassland, Low-growing semi-natural vegetation (Moorland), Woodland (Forest)

Dorset's Population ('000)

Dorset's Employment ('000)

Dorset GVA (£mn)

Dorset Local Economy Forecasting Model for Dorset County Council 2016/17, Cambridge Econometrics; baseline data.
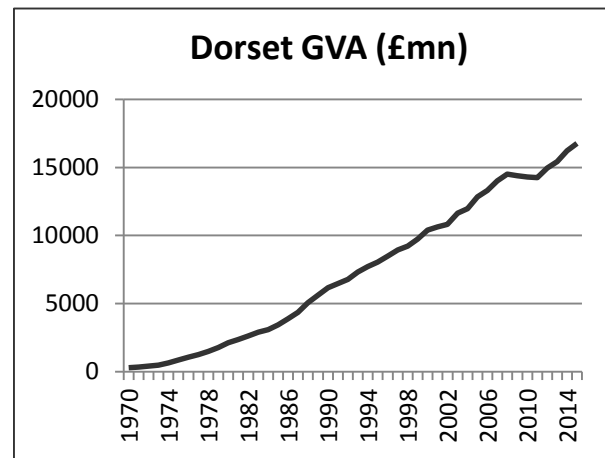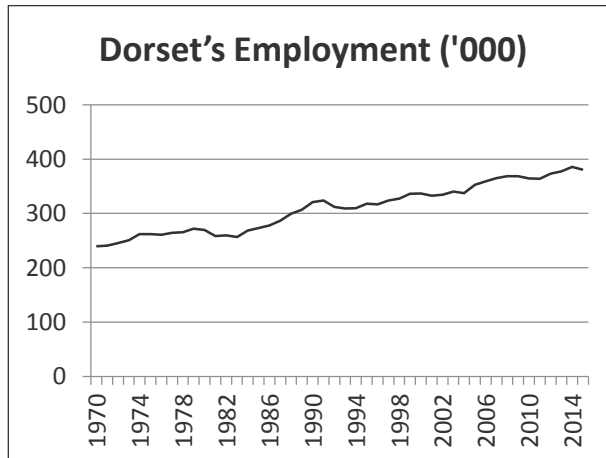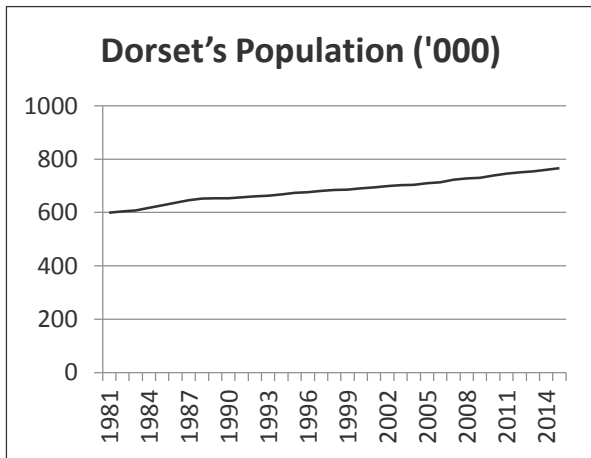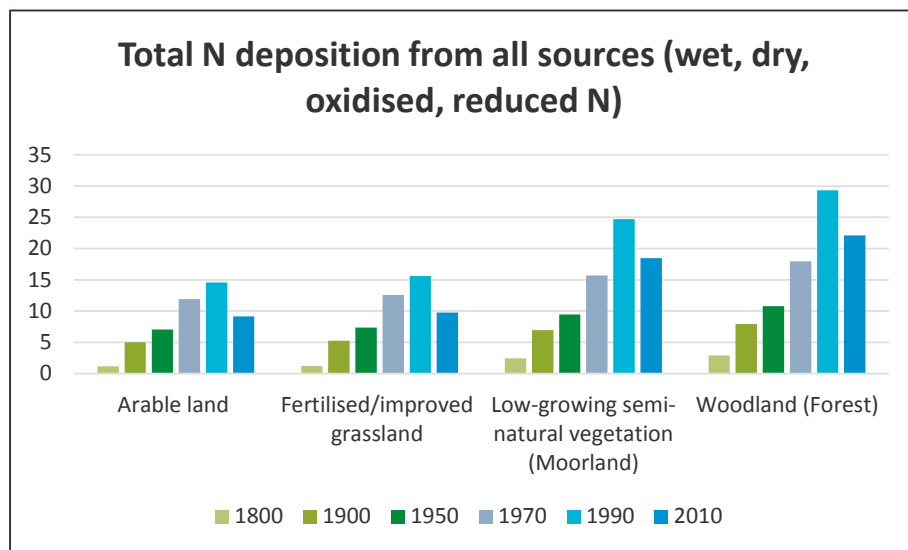
WP 1 How the ecosystem services of Dorset have changed in the past?

- We assessed 11 different ES using the InVEST model.

| Physical flow account	General trend	
Regulating ES	1930-1950	1950-2015
1. Carbon sequestration and storage	Decrease	Decrease
2. Hydrological modelling: Water Yield	Increase	Increase
3. Nitrogen retention	Decrease	Decrease
4. Flood risk	Increase	Increase
Provisioning ES		
5. Timber production	Increase	Increase
6. Crops and livestock (Numbers/Yield)	Increase	Increase
7. Soil quality	Decrease	Decrease
Cultural ES		
8. Visitation and recreation	Increase	Increase
9. Tranquillity & 'naturalness'	Decrease	Decrease
Habitat and supporting ES		
10. Habitat quality for pollinators	Decrease	Decease
11. Biodiversity (Area for BAP species)	Decrease	Decrease

InVEST
integrated valuation of ecosystem services and tradeoffs

WP 1 How the ecosystem services of Dorset have changed in the past?

Carbon storage and sequestration (Mg ha^{-1})

Crops (Wheat)

Soil quality (erosion rate (t ha^{-1} a^{-1}))

Time

1930   1950   2015

WP 1 How the ecosystem services of Dorset have changed in the past?

Biodiversity (area for BAP species)

Habitat quality for pollinators

Water Yield (surface water yield (m^3))

Time

1930   1950   2015
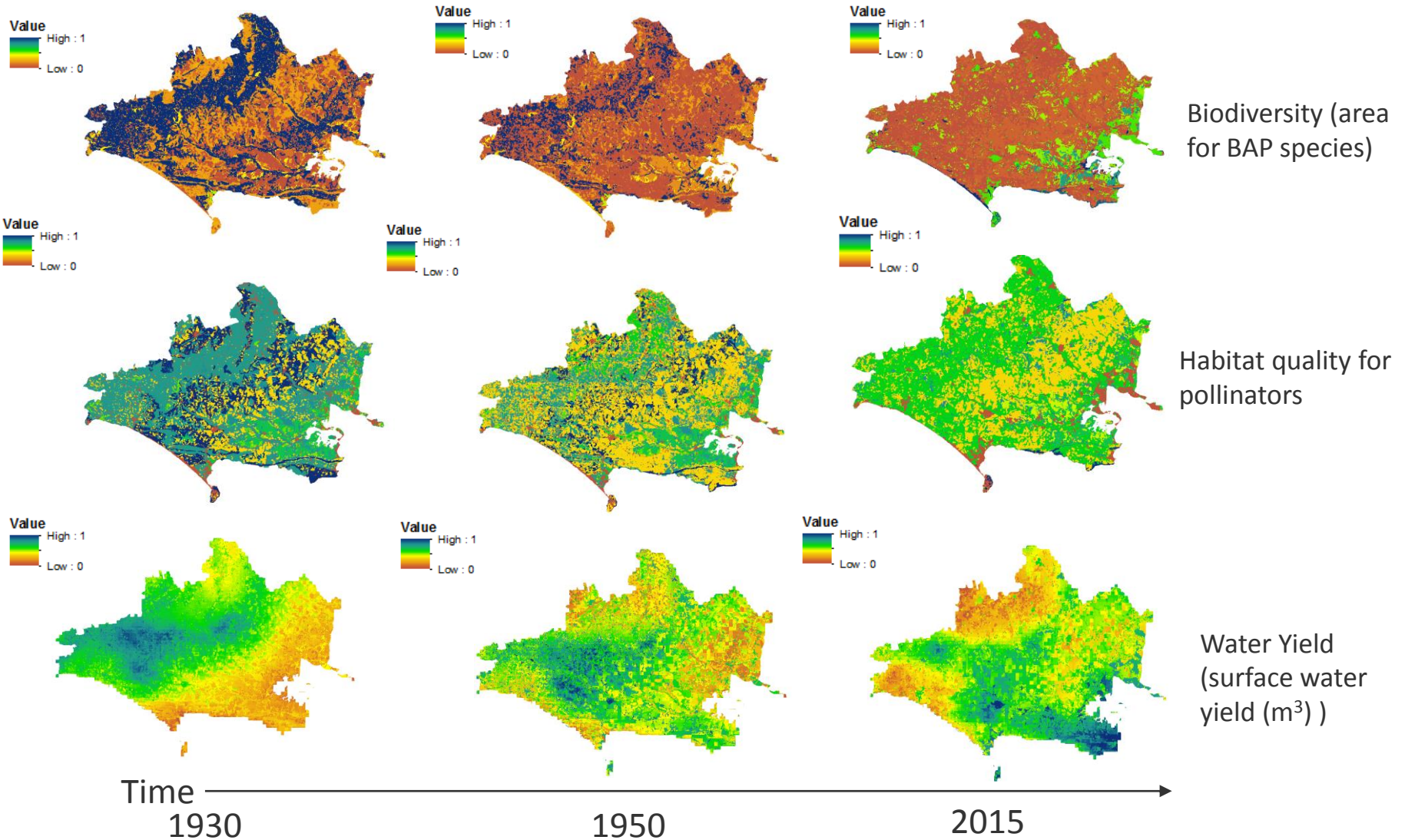
WP 1 Summary

- Time series data suggests a linear decline in environmental condition, and linear economic growth…no tipping points?

- 97% of all semi-natural grasslands were converted into agriculturally-improved grassland or arable land, as were large proportions of the heathlands and rough grasslands (-57%).

- Overall, significant increases in agricultural provisioning and large losses in ES over the past 80 years, reflect widespread conversion and intensification of land use, current conflicts in future delivery of multiple services.

- Brexit - Possible opportunity to invest in natural capital - and flows of ecosystem services – and therefore the wider environment and economy?

WP4 Developing Future Scenarios for Dorset –Brexit

- At present it is very uncertain what the terms of the Brexit deal will be, or even if there will be one. Scenarios are a useful tool to deal with this uncertainty.

- 1) The new agricultural policy might deliver a **"Green Brexit"**, by paying farmers to produce public goods, including ecosystem services other than food and strengthened biodiversity conservation.

- 2) Alternatively, a **"No deal"** Brexit may significantly undermine our food security, there may be great pressure to increase agricultural productivity "**Agri Brexit ?",** leading to an intensification of agriculture/ forestry, and infrastructural developments affecting land use, focus on supporting economic growth and employment.
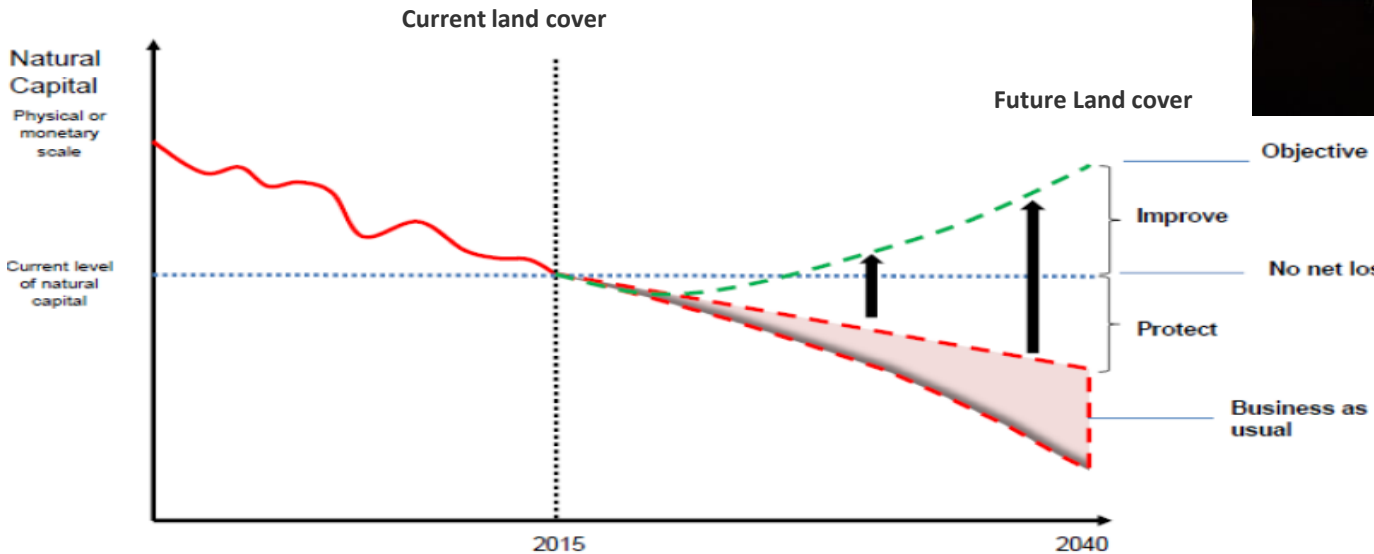
WP4 Developing Future Scenarios for Dorset

- To explore these two possible, post Brexit futures for Dorset we held two workshops with 30 + stakeholders with the aim to explore these counterfactual scenarios.

Rewilding as a restoration strategy for lowland agricultural landscapes (2016)

Exploring Horizons for Dorset's Natural Capital (Oct 2018)

Protecting and improving natural capital of Dorset over a generation – a stylised interpretation

WP4 Emerging Results

QU 1) What investments would you like to see? (Exploring Horizons)

"Green Brexit" n 15

Top 8 (highly or very highly)	
Improving the environmental performance of farming	73%
Development of ecological networks	73%
Woodland planting	73%
Green infrastructure	66%
Wetland creation	66%
Creation of new habitats	53%
Semi natural grassland creation.	53%
Heathland restoration	46%
Last	
Increased protected areas e.g. (AONBs)	26%

"No deal/ Agri brexit" n 10

Top 8 (highly or very highly)	
Investment in farming and agri-technology	90%
Accessible, affordable houses.	90%
Improving and expanding urban green space.	90%
Investment in renewables.	80%
Broadband and communications infrastructure.	70%
Green infrastructure.	70%
Investment in transport infrastructure and roads.	70%
Managing catchments to improve water quality and soils.	60%
Last	
Investment in mining.	10%

WP4 Emerging Results

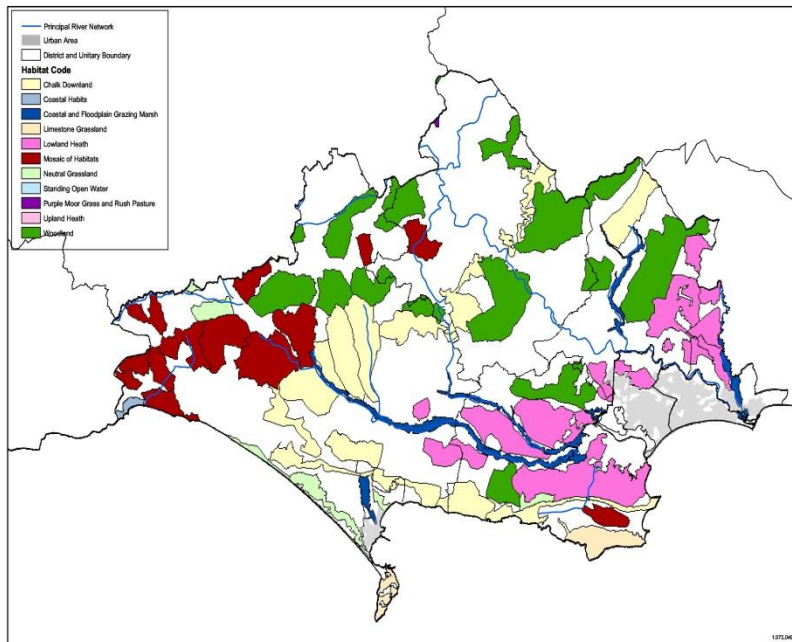QU 1) What investments would you like to see? (Rewilding)
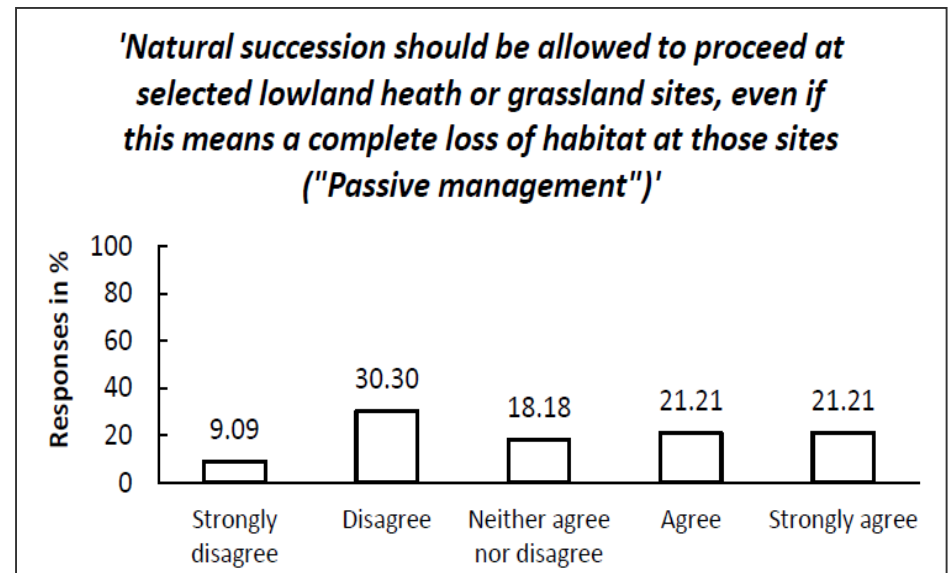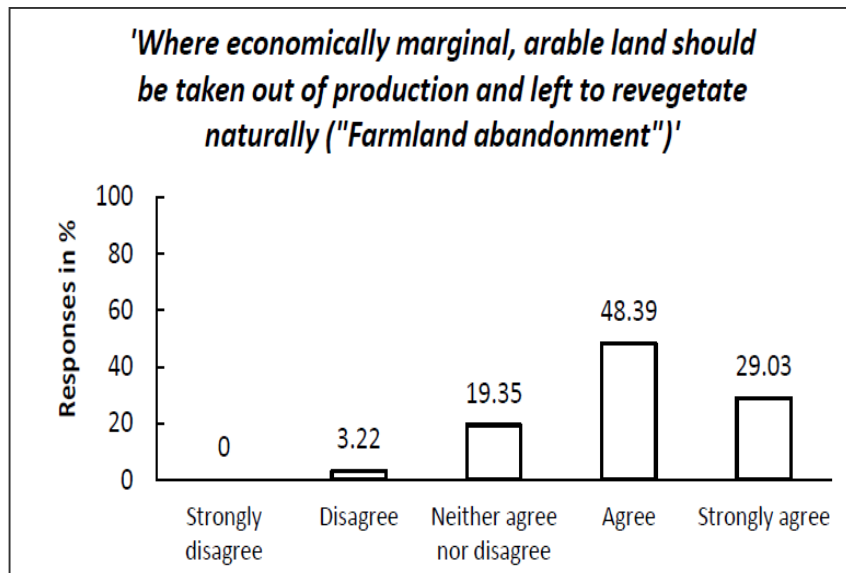
Loth, A.F. and Newton, A.C., (2018). Rewilding as a restoration strategy for lowland agricultural landscapes: stakeholder-assisted multi-criteria analysis in Dorset, UK. *Journal for Nature Conservation*.
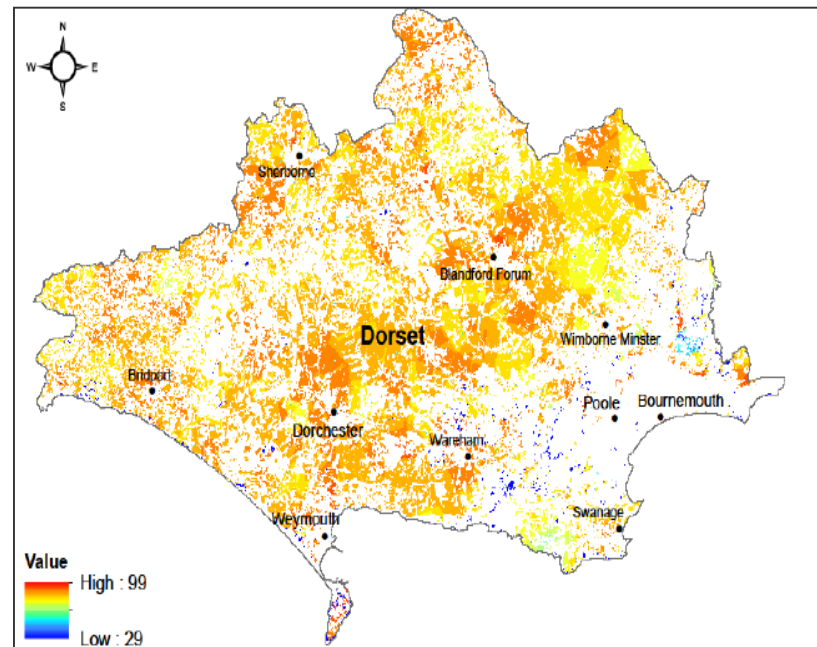
WP4 Developing Future Scenarios for Dorset

QU 2) Where would you like to see these improvements?

Future Map for Dorset, prepared from the Exploring horizons workshop . Each polygon represents a Strategic Nature Area.

Map reflecting the suitability for farmland abandonment across all 25m x 25m raster cells corresponding to the relevant habitat type for this scenario (Loth & Newton 2018).

Loth, A.F. and Newton, A.C., 2018. Rewilding as a restoration strategy for lowland agricultural landscapes: stakeholder-assisted multi-criteria analysis in Dorset, UK. *Journal for Nature Conservation*.

Conclusions and Next steps

- The TPAL project, will develop two spatially explicit possible futures for Dorset to help inform land use decisions post Brexit.

- This will be coupled loosely with an Agent Based Model that has been developed as part of this project (DONC, Dynamics of Natural Capital).

- DONC will couple the environment and economy of Dorset and enable tipping points to be explored under different investment options for natural capital.

- A final report of the TPAL project including outputs developed from the workshop will be available by April 2019.
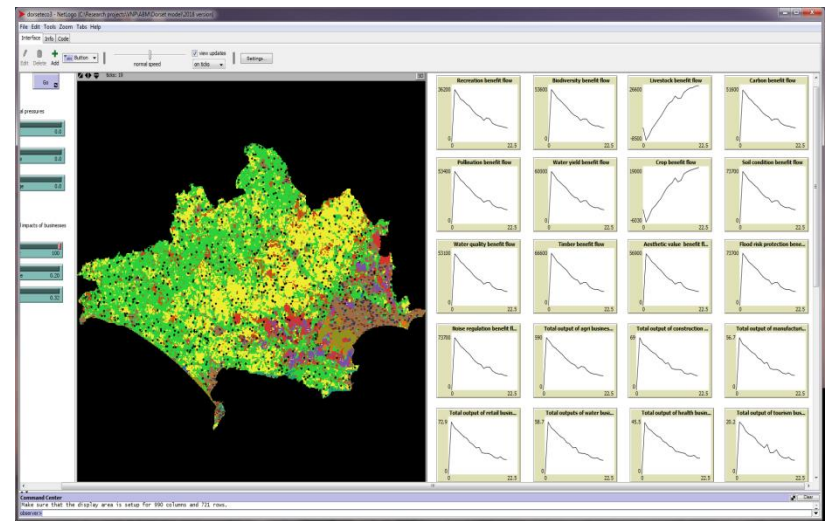
(DONC, Dynamics of Natural Capital).

Thank You- Please keep in touch!
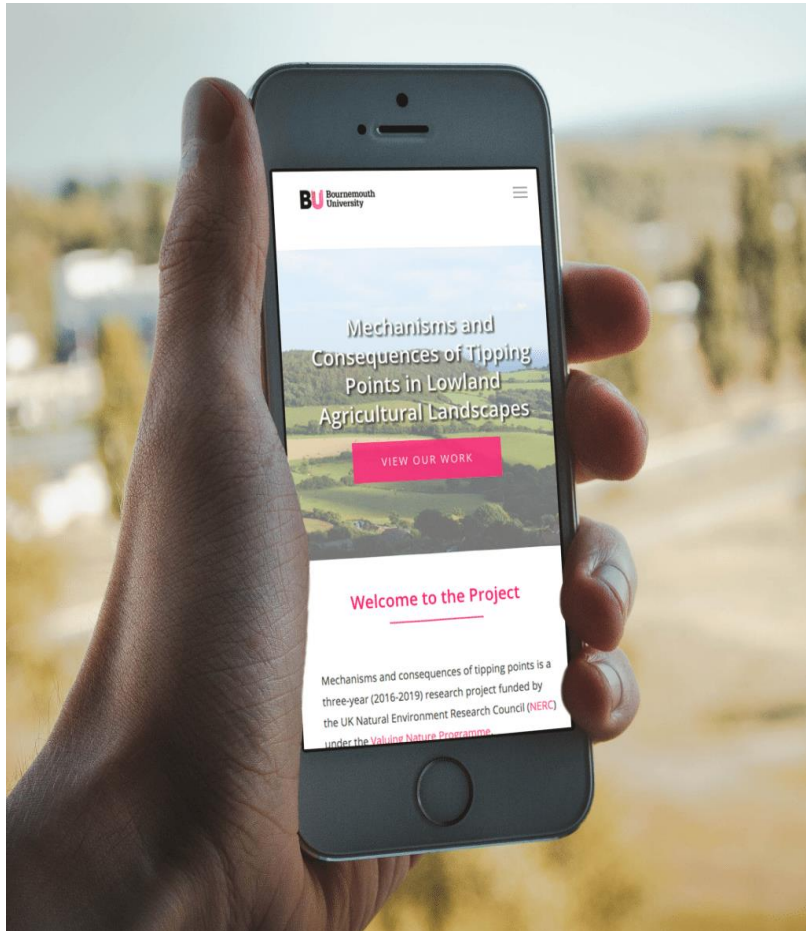
Thank you also to our various project funders and partners including:

TPAL Publications

Loth, A.F. and Newton, A.C., 2018. Rewilding as a restoration strategy for lowland agricultural landscapes: stakeholder-assisted multi-criteria analysis in Dorset, UK. *Journal for Nature Conservation*.

Watson, S.C.L and Newton, A., 2018. Dependency of Businesses on Flows of Ecosystem Services: A Case Study from the County of Dorset, UK. *Sustainability*, *10*(5).

Watson, S.C.L Grandfield, F.G., Herbert, R.J. and Newton, A.C., 2018. Detecting ecological thresholds and tipping points in the natural capital assets of a protected coastal ecosystem. *Estuarine, Coastal and Shelf Science*.

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