DRIVERS OF CHANGE

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Wilder Rivers, Lakes and Wetlands
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Sheep grazing in rolling countryside

AGRICULTURAL MANAGEMENT

RORY HARDING, KENT WILDLIFE TRUST, AND DAN TUSON, NATURAL ENGLAND

Introduction

Known as The Garden of England, Kent has a long historical and cultural association with agriculture. Agricultural land and its management, therefore, plays a key role in the fortunes of nature in the county. In order to keep pace with the competition from global food markets, much of the agriculture across Kent has successfully industrialised to maximise outputs and efficiency. With just over 70% of Kent designated as farmland, and with increasing urban development on marginal land, wild spaces are gradually being squeezed. Making changes to the way we farm in Kent to support more wildlife alongside food production will be crucial to supporting a rich and biodiverse landscape into the future.

The landscape and topography of Kent varies widely, and, with this, a diverse agricultural scene is set. The county contains two thirds of the UK's fruit production, as well as hops, vineyards, cereals and livestock. The Kent Habitat Survey undertaken in 2012, suggests that arable and horticulture cover 137,227 hectares (35%) of the county, followed by improved grassland at 116,319 hectares (30%) (ARCH, 2012).

Post-war agricultural policy aimed at increasing agricultural production has left its mark, with many areas of farmland supporting a relatively restricted range of wildlife and a variety of habitats fragmented across the landscape. However, since the introduction of agri-environment schemes over the last 30 years, plus advances in ideas around nature friendly farming, pockets and networks of 'high nature value' farmland have been restored in recent decades. These areas harbour species ready to re-colonise a better connected farming landscape of the future.

The pressures on nature

Key pressures on nature in the agricultural landscape

The reduced economic viability of smaller family farms has moved trends in favour of agri-businesses, which often have a more commercial and short-term approach to managing land. The post Second World War push for ever higher yields and booming market for artificial fertilisers and pesticides is now giving way to a greater understanding of soil health and the role of soil biology (Howard, 2019). There has also been a huge decline in the number of wildflower rich hay meadows (more than 90%) as a result of increased fertiliser use, re-seeding with rye grass and early cutting times predominantly for silage production. Some restoration of quality hay meadows has taken place through concerted efforts to restore meadows under Countryside Stewardship. Mirroring a trend across the UK in all sectors of life, a very controlled and 'tidy' approach to maintaining the countryside has resulted in many shorter and narrower hedgerows, which no longer act as a scrub proxy and, therefore, have less ecological value for a range of fauna and flora.

Drought in the summer months has long been an issue for South-East England. Now exacerbated by climate change, Kent has less predictable but generally dryer summers, and wetter winters prone to flood events (JBA Consulting, 2020). The increasing human population and requirement of the many fruit farms of Kent to irrigate, puts further pressure on the natural water available for other wildlife. This is further exacerbated by water quality issues from pesticide run-off from arable land and inadequate sewage waste water management during storm events. Freshwater species in Kent are, therefore, under threat from these multiple issues, with only 11 water bodies out of 124 being recorded as being in good condition as opposed to poor (KCC, 2020).

Farmers have voiced concern over these issues and, in particular, to the increasing risks to areas set aside for ground nesting species. Such disturbances by other users of the countryside are likely to negatively impact breeding and foraging success for species such as ground nesting birds. These issues have been highlighted by both the pandemic and ongoing pressures from housing developments.

The state of nature

The picture for farmland wildlife

As with the rest of the UK, Kent has seen a steady decline in terrestrial and freshwater species across the county, and many have declined most steeply on farmland. A few key indicator species suggest there are a range of contributing factors; however, some upticks in recent years suggest agri-environment schemes and a concerted effort from some farmers and conservationists is turning the tide.
A key factor for the health of many species in the agricultural landscape begins with the soil. Across Kent, conventional farming and agrochemical inputs in improved pasture, arable and in top fruit, have reduced the soil biology, leading to a break in the

food web at the very base. Many species such as Grey Partridge (a useful indicator for other arable farmland wildlife), struggles to brood successfully as the insects needed to feed the chicks in spring are not available in sufficient abundance (Rands, 1985). New management techniques, such as using regenerative farming principles to build soil health and reduce pesticide use, could help see an improvement in the restoration of farm ecosystems from the soil up. Loss of soil health is not only linked to insect abundance, but also arable weeds growing among the crops. These provide a diversity of functions, including pollinator forage, larval food plants and seed provision, which are vital for species such as Turtle Dove – a Kent Biodiversity Strategy priority and indicator species.

As agrochemical use has increased over time in terms of surface area covered (FREA, 2020), more monocultures with very little plant diversity are seen, and there are higher rates of mowing, both in cereals and grassland.

Other farmland indicator species, such as Yellowhammer, Skylark and Lapwing (a Kent Biodiversity Strategy priority and indicator species) have suffered from these changes. Government agri-environment schemes paying for buffer areas, pollinator and bird seed mixes, and greater awareness among farmers, may have helped arrest declines and brought back some floral diversity to farms – with some minor upticks in numbers of some species such as Goldfinch, Skylark and Yellowhammer (Figures 1-3).

According to the 2012 ARCH habitat survey data, improved grassland covers a significant area of Kent (roughly 30%). Field drainage and changes in cutting regimes that now favour silage over hay production have, again, impacted floral diversity, as well as opportunity for pollinating insects. Nevertheless, livestock farms in Kent are still vital for wildlife. They traditionally have smaller field sizes, making the landscape better stitched together with hedgerows, copses and ponds. Farmland ponds saw a 90% reduction in the 20th century; however, from the 1990s, the number of ponds and their condition have remained roughly stable in Kent. Farmers have increasingly seen the value in restoring silted up ponds for wildlife. Amphibian populations seem to have maintained successful dispersal and colonisation of new or restored ponds (Baker, 1999).

Unfortunately, the same cannot be said for the rivers in Kent, which, according to the Environment Agency, are scored predominantly as being in poor or moderate condition. Along with waste water management issues, diffuse pollution from agricultural run-off is also an issue. The full impact of continued poor river condition on freshwater species is well documented at a local scale.

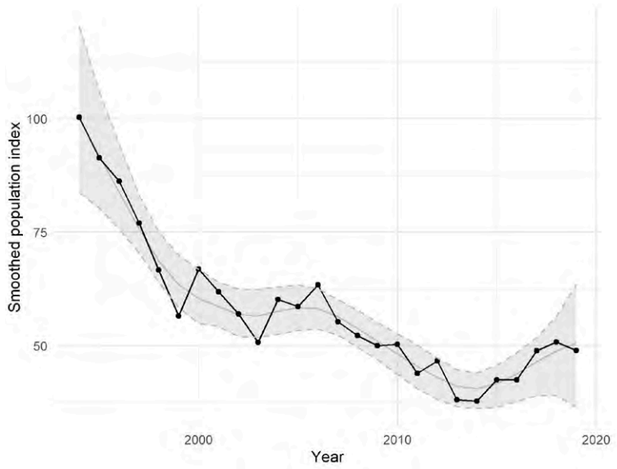


Figure 1 Trends in the abundance of Yellowhammer in Kent derived from British Trust for Ornithology Breeding Bird Survey data (Harris *et al.*, 2020)

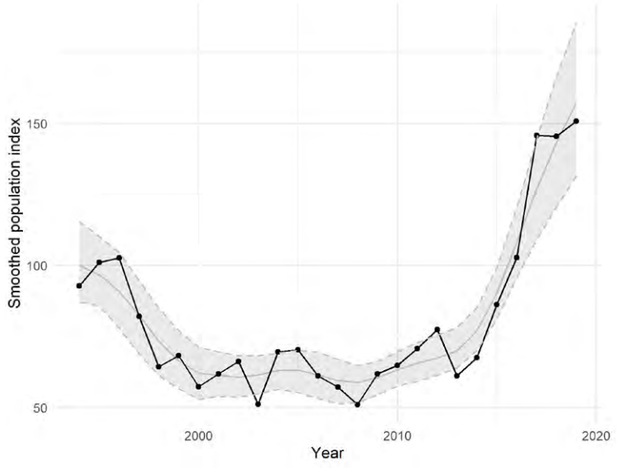


Figure 2 Trends in the abundance of Goldfinch in Kent derived from British Trust for Ornithology Breeding Bird Survey data (Harris *et al.*, 2020)

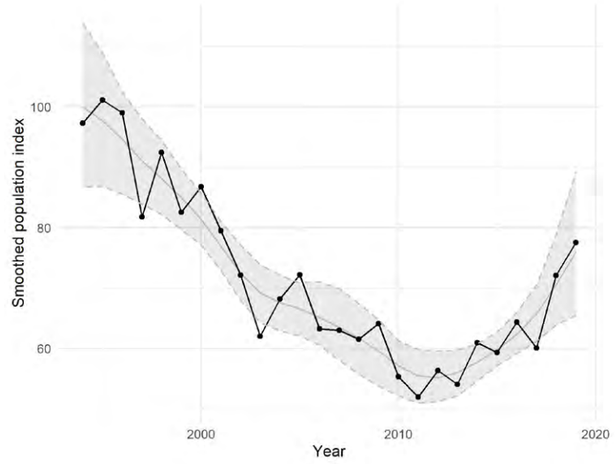


Figure 3 Trends in the abundance of Skylark in Kent derived from British Trust for Ornithology Breeding Bird Survey data (Harris *et al.*, 2020)

The response for nature

Key opportunities for nature's recovery across the farmed landscape

There is huge opportunity for the restoration of wildlife across Kent, no less so than in the farmed landscape. Changes to agri-environmental schemes, farmer clusters, and catchment sensitive farming, offer significant opportunities for the restoration of wildlife and resilient ecosystems in the farmed landscape.

Agri-environment schemes

With the UK leaving the Common Agricultural Policy, mechanisms for farming and forestry support are changing; keeping as much land in production will no longer be incentivised. The agri-environment schemes (countryside stewardship and environmental stewardship schemes) continue to be offered to landowners; however, by 2024, the SFI and ELMS will be the alternative offer. At the same time, the BPS for farmers and landowners is being withdrawn on a year-by-year basis. The replacement SFI and ELMS could support far more habitat provision between productive fields, creating a diverse patchwork of habitat across the landscape; however, until the details of the new ELMS proposals are revealed, we are yet to see how big a shift this will be. Farmers and landowners will only be paid for the public benefits under ELMS. The scheme has three components that will reward environmental land management:

- Sustainable Farming Incentive
- Local Nature Recovery
- Landscape Recovery

These schemes are intended to support the rural economy while achieving the goals of the 25 Year Environment Plan and a commitment to net zero emissions by 2050. The Sustainable Farming Incentive began piloting in 2021 before launch in 2022. The Local Nature Recovery scheme will pay for actions that support local nature recovery and meet local environmental priorities. The scheme will encourage collaboration between farmers, helping them work together to improve their local environment. The scheme will begin piloting in 2022 and launch in 2024. The Landscape Recovery scheme will support landscape and ecosystem recovery through long-term projects, such as restoring wilder landscapes in places where it's appropriate, large-scale tree planting and salt marsh restoration. The scheme will begin piloting around 10 projects in 2022 and launch in 2024. A recent example of this is in Kent.

North Kent Coast and Wetlands: In North Kent, the Natural England partnership with RSPB – which looks at breeding waders and positive encouragement around delivery of the stewardships schemes (on and adjacent to SSSI), using a long standing independent ecologist – has paid dividends for Lapwings, Avocets and Redshanks. It has also achieved a landscape-scale understanding of how farmers and landowners can work better with conservation organisations into the future and deliver more nature recovery.

Work to connect the land with corridors of species rich grasslands by Natural England and farmers across the North Downs has resulted in a new nature recovery network in East Kent as part of the East Kent Grasslands Project

Farmers from the Upper Beult Farmer Cluster on a Dung Beetle Safari in May 2021, led by ecologist Tony Witts and farm vet Alex Walters. An opportunity to discuss nutrient recycling in pastures and the value of different species on pasture health.

Farmer clusters

Farmers working together through local groups or clusters is one developing mechanism for more nature recovery in Kent. So far, pilot clusters in the county have generated enthusiasm from farmers keen to improve provision for wildlife and explore new methods of farming more sustainably. Novel approaches to bring in additional funding for collaborative working between farmers are being tested across Kent, one example being the collaboration of Southern Water and KWT to directly support the Upper Beult Farmer Cluster, enabling joint action on water quality in the river's upper catchment. The ambition to work together for a greater impact is an exciting development, with farmers taking on board a bigger, better and joined up vision (Lawton, 2010). A farm cluster in Marden is a shining example, where with the local community, farmers and conservationists are working together to monitor and enhance habitat species such as Yellowhammer and Turtle Dove.

One-to-one farm advice

The tried and tested traditional methods of scheme/advice delivery will be critical as part of a broad palette of delivering 'on-farm' conservation gains. The traditional 'adviser-led' approach of working with farms as individuals on a long-term one-to-one basis, has been shown to be critical to delivering more transformative land use change/high nature value projects; this approach has characterised the delivery of agri-environment schemes over the last 30 years. Natural England's four long running 'East Kent Grassland Projects' show how working over 25-30 year timescales, and working with a single vision of creating a new generation of species rich grasslands from arable land/species-poor grasslands, can bring about landscape scale networks of contiguously linked 'new' wildflower grasslands. This work is now beginning to yield positive responses from a range of species/groups, including breeding site expansion and colonisation for both generalist and specialist butterfly and moth species, such as Small Blue, Duke of Burgundy, Dingy Skipper and Black-veined Moth. With the increases in insect abundance, other wildlife, such as bat species (e.g. Serotine) and farmland birds, including Yellowhammer, Linnet, Corn Bunting and Grey Partridge, are also responding positively.

Yellowhammers being ringed through a partnership project with Natural England, Ray Morris and the Marden Farmer Cluster. As a result of this ongoing study, more habitat has been created to benefit the yellow hammer on surrounding farmland.
(Photo credit: Darren E Nicholls)

Biodiversity net gain

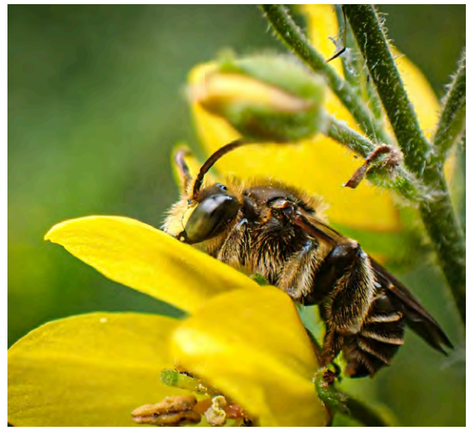
Although development pressure is a key issue for wildlife, there is an opportunity through net gain for improved habitat on farmland to bolster species recovery more widely. Carefully planned access for the public with information campaigns could mitigate disturbance issues (Mallord, 2006). There is the increasing opportunity to maximise other services farmland can provide, such as carbon sequestration and nutrient neutrality. With the right guidance, this would mean many farmers could significantly increase areas of great biodiversity value on the farm, while continuing to run a profitable business. This, however, needs to be managed carefully to ensure true value for wildlife. Biodiversity net gain is considered in more detail elsewhere in this report.

Catchment sensitive farming

Natural England host the CSF partnership with CSF Advisers working with farmers to tackle environmental objectives in a positive proactive way. This partnership of Natural England, the Environment Agency and Defra is now in Phase 5 (from 2021-2024). The partnership plans to not only increase the number of catchments covered by advisers, but also to provide a greater emphasis on finding agricultural solutions to catchment flooding and capturing water resources. It also looks to reduce air pollution from agriculture and improve water quality.

The CSF advisers work alongside other partners such as water companies, the Rivers Trust and specific wetland projects by conservation organisations to seek catchment solutions. CSF measures to tackle soil degradation include using cover crops to protect soils and encourage biodiversity, promoting vegetated margins (with no inputs) against water courses, increasing ground water protection, and targeted tree planting. These have particular benefits to tackling the loss of invertebrates and increasing biodiversity in Kent's soil and water.

Skylark nest at Coldharbour Farm, 2021. This was found in an area with a wader scrape, part of a larger effort by the farmer to manage the land more sensitively for wildlife.



The Yellow Loostrife bee, macropis europea, on a farm within the Marden Farmer Cluster. This is one of many species identified by local experts in Marden, helping inform and inspire conservation actions on farms and in gardens throughout Marden.
(Photo credit: farmer Lou Carpenter.)

Conclusion

Further to the responses considered here, advances in soil and carbon research – and a move by farmers to utilise regenerative principles – means a more mixed farming picture could be on the horizon, with agroforestry and livestock integrated within arable systems. This kind of diverse agricultural landscape, with a focus on soil health and long-term sustainability, will rapidly allow more functional ecosystems to return – and with it a greater abundance of wildlife. Coupled with the new approaches to agri-environment schemes, rapid changes in farming are on the horizon, and there is significant opportunity for positive change for wildlife in the wider countryside and a fairer, more sustainable farming system. Farmer Clusters provide the opportunity for farmers to be at the forefront of decision making when it comes to conservation actions on their farms and across the landscape. This is the time to work together with farmers to maximise the potential for a better future for both wildlife and farming.

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Skylark *Alauda arvensis* © WildlifeTrusts

Flooding in fields © Bruce Shortland

CLIMATE CHANGE

LUCY BREEZE, KENT COUNTY COUNCIL

Introduction

Our climate is changing because of rising greenhouse gas emissions caused by human activity. The IPCC states that it is "unequivocal that human influence has warmed the atmosphere, ocean and land" and that this warming is "already affecting many weather and climate extremes across the globe" (IPCC, 2021). Global temperatures have already increased by 1.1°C since pre-industrial times, and the effects are already being felt locally. Despite international agreements to limit global warming to well below 2°C, the IPCC estimates that the actions currently pledged are not enough, with current global ambition likely to result in warming of 3°C by 2100 (IPCC, 2018).

The pressures on nature

In England, average annual temperatures are 0.9°C warmer than they were 30 years ago, and the chances of experiencing hot summers – like the one in 2018 – have doubled in recent decades and are now about 10-20% per year. This will rise to 50% (i.e. every other summer), by 2050. Sea levels have also risen by 16 cm since 1900 (UK Climate Risk, 2021).

The 2018 UK Climate Projections identified the following climate changes for Kent (Kent County Council, 2020):

- Hotter summers with an increase in average summer temperature of 2-3°C by 2040 and 5-6°C by 2080
- Warmer winters with an increase in average winter temperature of 1-2°C by 2040 and 3-4°C by 2080
- Drier summers with a reduction in average precipitation of 20-30% by 2040 and 30-50% by 2080
- Wetter winters with an increase in average precipitation of 10-20% by 2040 and 20-30% by 2080
- Increases in sea level rise by up to 30 cm by 2040 and 80 cm by 2080

As well as winters becoming wetter overall, the intensity of rainfall is also projected to increase by as much as 25% in southeast England (UK Climate Risk, 2021). Such climatic changes will put pressure on nature through the loss of coastal habitats as a result of sea level rise, storm related erosion and saline intrusion; alterations to species distributions and habitat composition as a result of rainfall and temperature changes; emergence of new pests, diseases and invasive non-native species; exacerbation of nutrient run-off issues and degradation of soils from more intense rainfall events; and long-term damage to ecosystems following periods of prolonged drought or frequent water scarcity.

The state of nature

Impacts from changing climatic conditions and extreme weather events

Over the last 40 years, there have been noticeable changes in Kent's seasonal patterns in line with overall warming temperatures. Across Britain, the first flowering date for 385 plant species has advanced by 4.5 days during the past decade, in comparison with the previous four decades. Changes to seasonal weather patterns can have a significant impact on species balance, particularly those sensitive to seasonal timings and emergence of food and prey species (Kent County Council, 2020).

Warmer and drier conditions are likely to increase the risk of wildfire damage to woodlands by 10-50% by 2080, which could pose a risk to the survival of endemic plant and animal species, as well as the natural environment. Following the 10-day August 2003 heatwave, in which temperatures reached record highs, three times more grassland fires (990) occurred in Kent than usual (Kent County Council, 2010). Higher summer temperatures could also lead to a loss of sensitive tree species, such as Beech (Kent County Council, 2020).

Changes to temperatures and rainfall amounts are affecting river flows, temperature, water chemistry, depth of sunlight penetration and the timing of seasonal events. Freshwater fish species have a limited ability to regulate their body temperatures and any change in water temperature has the potential to impact key fish species. Salmonid fish and macroinvertebrate species, particularly those near or at their southern limit, and/or where connectivity to upstream habitats is inhibited, may be particularly vulnerable to changes in water temperature caused by climate change (Natural England, 2013). Increased river temperatures may also increase disease transmission and reduce health of juvenile fish (Johnson *et al*., 2009).

Higher temperatures and reductions in summer rainfall amounts is likely to increase the frequency of low flows, exacerbating existing issues caused by water pollution and increasing the risk of deoxygenation

and raising the concentration of nutrients. Increased risk of higher temperatures and drought and resulting low flows, coupled with over abstraction, may cause rivers and ponds to dry out more frequently or earlier in the year. Kent's globally significant Chalk Streams, including the River Darent, River Dour and Little Stour, are unique important freshwater ecosystems that are at risk of drying out for large parts of the year or entirely (Kent County Council, 2020).

Increased risk of drought and more intense rainfall events amplify soil erosion and may cause greater rates of siltation in rivers and ponds. This can reduce water quality and negatively impact fish, invertebrates and aquatic vegetation.

Increasing sea temperatures and acidification of marine environments will affect marine biodiversity around the Kent coast. These rising sea temperatures, which result in a reduction of dissolved oxygen, will have a negative impact on a range of species. Marine organisms and corals with calcium carbonate shells will grow at a slower rate and require more energy as acidity levels in the sea rise, while temperature increases and reduced oxygen levels may have a significant impact on a range of species, including cold water fish.

Impacts from pests, pathogens and invasive species

Increasing temperatures may create a more hospitable environment for pests, diseases, and INNS to colonise where they were previously unable to survive. Milder winters can increase the ability for some species to overwinter in the UK, while earlier springs will favour the growth of others. The Asian Tiger Mosquito and the Killer Shrimp have already been identified as posing a risk to Kent as temperatures increase (Kent County Council, 2020).

Impacts from sea level rise

Coastal habitats, particularly those in Romney Marsh and on the Isle of Sheppey, are sensitive to the impacts of sea level rise and increased storminess, and are exacerbated by humans' response to these, in the form of hard coastal defences. These impacts are already changing the availability and movement of sediment, increasing the frequency of waterlogging and increasing silt accumulation, with knock-on effects on species composition and habitat loss. Loss of mudflats and eelgrass beds reduces the areas available for overwintering bird populations (including Dunlin, Knot and Widgeon), and the loss of saltmarsh habitat threatens breeding birds such as Redshank (Kent County Council, 2020).

Coastal grazing marshes, raised bogs, and saline lagoons (such as those at Cliffe) are all threatened by rises in salinity that can result from increased percolation and inundation of sea water during storm tides and flooding. With potential increases in inundation under climate change, some of these habitat areas may become saltmarsh or other intertidal habitats, and some may be lost altogether (Kent County Council, 2006).

The response for nature

Governments, together with local authorities, charities, businesses, schools, voluntary groups and individuals, are coming together across Kent and around the globe to reduce greenhouse gas emissions and limit global warming. However, even if emissions were reduced to zero tomorrow, the gases already in the atmosphere will have locked us into warmer, wetter winters and hotter, drier summers for many decades to come. The natural environment will, therefore, need to be supported to enable it to withstand and adapt to current and future climate pressures.

Habitat connectivity and habitat restoration will be key to managing climate risks and impacts, allowing greater opportunities for species to move into more suitable or less impacted habitats. Ideally, this needs to be done at a landscape scale to provide the greatest benefits of resilience. A key aim of the Kent Biodiversity Strategy is to improve the quality, extent and connectivity of high value habitats, and this will be essential if we are to effectively "climate proof" our vulnerable habitats and species (Kent Nature Partnership, 2020).

Climate change also exacerbates existing pressures, such as those related to water quality, over abstraction, urbanisation and land use change. Successfully tackling those pressures, as outlined in the corresponding chapters within this report, will help boost the resilience of terrestrial, freshwater and marine ecosystems.

Finally, the natural environment provides an opportunity to help mitigate climate change and reduce greenhouse gas emissions. Soils, trees, hedgerows, grasslands, wetlands and saltmarsh all store carbon, so increasing coverage of these habitats and improving land management practices will help support carbon reduction targets, whilst also protecting and enhancing biodiversity. Consequently, the Kent and Medway Energy and Low Emissions Strategy has identified the expansion of green infrastructure and natural climate change solutions as a key priority for action (Kent County Council, 2020b).

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HYDROLOGICAL CHANGE

HANNAH REID, KENT WILDLIFE TRUST

Introduction

There are five river catchments across Kent; the Medway and the Stour being the largest. Traversing through Kent's largely rural landscape, the rivers are diverse in character and include several chalk streams and rivers, which are species rich and represent rare habitat types. The hydrological regime, the amount, timing, and frequency of water, sediment and nutrients moving through the catchment, is a fundamental component of river and wetland habitats, including reedbeds, grazing marsh, lakes and ponds, bogs and fenland. Wetlands and rivers are particularly vulnerable because the hydrological regime can be influenced by any activity within the catchment, including land-use change and management, modifications to river channels, and changes in weather patterns.

Rivers and wetlands are dynamic, complex habitats that support a wide range of plants and animals, and are the most valuable ecosystem for providing essential ecosystem services. All major rivers within Kent have been modified to maximise some of these services, such as navigation, water supply, food production and urban development; however, this has come at a cost to wildlife. Modifications have resulted in the loss and degradation of habitat and pollution, contributing to the widespread decline of wetland species. Many of these changes are historic, dating as far back as Neolithic farmers who cleared trees for agriculture. While advances in technology and population growth saw widespread changes during the 20th century, contemporary changes have largely been driven by agricultural practices, expansion of urban areas and modifications for flood protection.

Recent conservation efforts have focused on reducing the impact of river modifications, recreating and restoring areas of wetland habitat, continuing to reduce pollution, and restoring natural processes within rivers. Restoration through restarting natural processes, including a natural hydrological regime, is sustainable and creates a functional and dynamic habitat; this is much more beneficial to wildlife, as it delivers more ecosystem services and is much better at adapting to climate change. However, returning to an entirely natural hydrological system is often not viable due to constraints and conflicts (Mainstone, Hall and Diack, 2016).

The pressures on nature

The UK has reportedly lost 90% of its wetlands over the last 100 years (Environment Agency, 2019; The Wildlife Trust, 2021). Although the data and evidence for this figure are unclear (O'Connell and Yallop, 2002), it is widely acknowledged that wetland habitat loss due to anthropogenic activities has been extensive and accelerated in the latter half of the 20th century. Government policies and advances in technology allowed for increased drainage of land, which enabled agriculture and development on previously unsuitable land, and more rivers to be straightened, widened, and deepened. These changes, along with the impact of flood defence structures, weirs and dams – many of which are historical – have caused disruption to the natural ecosystem processes, which are needed to maintain a healthy, dynamic ecosystem that enables wildlife to thrive (Holmes and Raven, 2014). Around 70% of surface water bodies in Kent are artificial or heavily modified (Environment Agency, 2020).

Agricultural intensification has not only led to a significant loss of ponds, but also pollution issues from the use of pesticides, fertilisers and soil erosion. The water quality in Kent's rivers is also impacted by pollution from wastewater and urban sources, which is increasing due to population growth. Population growth has led to an increase in development and infrastructure, which increases polluted run-off, increases flood risk, and fragments remaining wetland habitats. Water pollution has a detrimental

Faversham Creek © Terry Ball @pixabay

Views over marshland and reedbeds towards nearby farms, Elmley Marshes RSPB Reserve © Andrew Parkinson 2020Vision

impact on wetland biodiversity and leaves it more vulnerable to climate change impacts. Only 10% of Kent's waterbodies have good ecological status, with physical modifications and pollution from wastewater listed as key reasons for water bodies not reaching the required status under the Water Framework Directive (Environment Agency, 2020; KCC, 2015).

Kent's high population growth rate also contributes to water resource issues. The majority of water is abstracted from groundwater for public supply – in particular, chalk aquifers – but rivers are also an important source. Other users include industry such as paper production, horticulture and agriculture. Kent is one of the driest parts of England, and, during dry periods, most catchments have little or no water available for abstraction (KCC, 2015). This results in restrictions on water use being put in place and is also damaging to the environment. Over-abstraction has a serious impact on river ecosystems, especially chalk streams, which rely on chalk aquifers for flow. Low water flows lead to increased water temperature, and pollutants become more concentrated, which can cause agal blooms and reduced oxygen levels. The water also becomes slower, and sediment builds up on the river bed, reducing the habitat quality for invertebrates and fish.

Other pressures arise from invasive non-native species, which impact on native wildlife; increased disturbance and erosion issues associated with recreational use; and changes in precipitation patterns as a result of climate change.

The state of nature

The extent of priority wetland habitat in Kent was measured by the Kent Habitat Survey in 2012 (Table 1). The area of standing water and canal habitat types slightly increased by just under 2% (79.8 ha) from 2003 to 2012. Much of this was the result of the creation of lakes and, within agricultural and grassland areas, old quarries, waste tips and gravel pits – although there were losses of open water habitat where it was converted to grassland, and where areas have succeeded to wetlands and wet woodlands (KHS, 2012). Corine Land Cover Change data from 2012 to 2018 also shows an increase in water bodies from mineral extraction and construction sites, but it also shows a loss of 197 ha inland marshes to pastures (EEA, 2019). An updated Kent Habitat Survey is needed to better assess change in extent of priority habitats over the last 10 years.

Table 1 The extent of priority wetland habitats in Kent measured by the 2012 Kent Habitat Survey

Priority habitat	2012 extent
Rivers	6,592 ha
Chalk streams	104.5 km
Ponds	19,206 ponds 7,039,121 m^2
Coastal and floodplain grazing marsh	14,174 ha
Intertidal mudflats and coastal saltmarsh	10,078 ha intertidal mudflats 1,338 ha coastal saltmarsh
Wet woodland	662 ha
Vegetated shingle	2,104 ha

As well as changes in habitat extent, changes in population and distribution of key wetland species can be used to indicate the impact of hydrological changes on the health of wetlands (Kent Nature Partnership, 2020).

Wetland birds

The wetland bird index is calculated using population data for species that have a strong association with wetlands. Across England, the index has remained stable since 1975 when data collection began, although this baseline should not be seen as a target, as declines in wetland birds have occurred prior to 1975. The index can be broken down into four habitat types. Having benefited from habitat creation previously, birds associated with slow flowing and standing water have shown a recent decline, and reedbed birds have also slightly decreased. Birds of fast flowing water and wet grassland both showed a non-significant increase, following a decrease in the long term, having been affected by land drainage and intensification of grassland management (DEFRA, 2020). Lapwing – a Kent Biodiversity Strategy priority species – is particularly vulnerable to changes in agriculture, and, although nationally, it has shown little change, it has declined across south east England over the last 10 years (BTO, JNCC and RSPB, 2019).

European eel

The European eel is a critically endangered species. It has a long and complex life cycle travelling from the Sargasso Sea to reach European waters where they mature before returning across the Atlantic. A study in 2015 showed that the eel population within the Great Stour had a much higher population density across its length than the river Medway; this was attributed to there being a higher number of obstructions along the Medway, which were preventing the migration of eels (Foster, 2017).

Introduction | Headlines | Drivers | Conservation | Kent's Species | Landscape-scale | Case Studies | Conclusion
Agri management | Climate change | Hydrological change | Urbanisation | Invasives | Pollution | Habitat management | Marine | Wildlife recording | Licensing | Engagement | Public health

Water vole

Situated within Kent's coastal and floodplain grazing marshes are three key regional areas for water voles; Elmley, North Kent Marshes, and Stodmarsh. Despite still being very important populations, the National Water Vole Database and Mapping Project report for 2009-2018 showed that the distribution of water vole is still declining in these areas, despite conservation efforts (McGuire and Morse, 2020). Water voles require a complex habitat of ditch networks and reedbeds, which help them evade predation from the invasive American Mink. Romney Marsh, the Upper Stour and Lower Stour have locally important populations of water voles.

The response for nature

Over the last decade, a key change in the way the water environment is managed in the UK and Kent has been due to the establishment of the CaBA. This approach encourages collaboration between the Environment Agency and a wide range of organisations, water companies, businesses, landowners and groups at a river catchment scale, to better understand the issues affecting each river and plan and deliver improvements that benefit both people and nature (Defra, 2013). Projects being delivered by those within CaBA partnerships tackle a wide range of issues, from water resources and water quality, to invasive species; they also deliver habitat creation projects (CaBA Benefits Assessment Working Group, 2021). For example, the Medway Catchment Partnership has delivered a number of natural flood management measures, including leaky woody dams in Bedgbury Forest; in addition, the Darent Catchment Partnership installed a bypass channel to improve fish passage past Sundridge weir (Cook, 2020; South East Rivers Trust, 2016).

Ponds for newts

In response to the continuing decline of Great Crested Newts and the cost of Great Crested Newt licences, Natural England piloted District Level Licensing in Kent. Developers make a conservation payment for damaging activity: this is then used to create or restore ponds in strategic areas. Kent Countryside Management Partnerships work with landowners to deliver the habitat work and monitor the ponds. Figures on how much habitat has been created or restored versus that lost are not yet available; however, in high value areas it is meant to be a ratio of 4:1 (DEFRA and NE, 2019). If this is achieved, the scheme has the potential to significantly increase the number of high-quality ponds in Kent, benefiting a wide range of wildlife.


European Beaver *Castor fiber*

Return of the European beaver

The European beaver became extinct in the UK at the end of the 16th century; however, steps are now being made to reintroduce this former native species into the wider countryside (Begum, 2021). As ecosystem engineers, they can alter their environment through foraging, dam building and digging channels, which creates diverse wetlands. Beavers have an ability to restore wetlands and are a natural alternative to traditional management techniques that are difficult and labour intensive; it was for this reason that KWT introduced beavers to Ham Fen 2001. A growing number of studies across the UK have shown that beavers provide ecological benefits and ecosystem services, including flood prevention, although they can come into conflict with humans (Brazier, 2020). In addition to the enclosed beavers, Kent has a wild population on the lower reaches of the River Stour, which led to the establishment of the East Kent Beaver Group. The group collates records and provides advice to landowners on how to manage beaver activity.

Conclusion

Despite conservation efforts, wetland species are still declining in Kent and we are facing ever increasing water management challenges. The pressures and demands on water systems are numerous and interlinked, which make working in partnership across multiple sectors at a catchment scale imperative. Current restoration projects are still relatively small scale, and, in order to make impactful change, we need to engage with landowners and stakeholders to deliver larger, more ambitious, projects, that tackle multiple pressures, focusing on nature-based solutions that restore ecosystem processes. To achieve this, there needs to be more ambitious policy, effective regulation of activities that can harm the water environment, as well as significant, long term funding for restoration work. Due to the wide-ranging benefits of wetland and river restoration, sustainable funding could be achieved through blended finance, taking advantage of new and emerging markets, such as carbon credits, Biodiversity Net Gain, and the new Environmental Land Management Scheme to supplement traditional funding streams.

Little egret *Egretta garzetta* © Susan Potter

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European wigeon *Anas penelope* flock in flight over Elmley Marshes RSPB Reserve. © Andrew Parkinson 2020Vision

URBANISATION

NICKY BRITTON-WILLIAMS, KENT WILDLIFE TRUST

Introduction

The State of Nature (2019) report recognised urbanisation as a key driver of change in the environment across the UK. Urbanisation is the increase in the proportion of people living in towns and cities compared to in rural areas. Urban areas are rapidly expanding and there is a need to ensure that these areas support wildlife. High-quality green infrastructure, creative town planning and housing design, and the active participation of local communities in supporting wildlife are key to promoting the integration of biodiversity within urban areas. The dramatic biodiversity declines across the UK clearly demonstrate that existing mitigation measures for development have not been effective in tackling the biodiversity crisis. A shift in focus, policy and legislation is beginning to tackle this issue, but drastic action is needed to reverse impacts to wildlife.

The pressures on nature

In mid-2019, Kent's population was estimated to be 1,581,600 (KCC, 2020). Over the last 15 years, Kent's population has seen rapid increases above the average growth rate for the UK, with the borough of Dartford experiencing the highest growth. The rise in population has predominantly been attributed to migration into the county. Consequently, Kent and Medway have delivered some of the highest rates of house building in the UK (KCC, 2018). The Kent Habitat Survey 2012 showed that land covered by development in Kent had increased from 10.7% in 1961 to 17.3% in 2008, an increase of around 62% of the original resource (Brennan, 2012). Furthermore, the recent study by the Centre for Ecology & Hydrology (2020) found that Kent had the largest net rise in urban land cover in terms of geographical area (136km^2) between 1990 and 2015.

The Kent and Medway Growth and Infrastructure Framework (2018) reported that Kent experienced a 14.3% increase in the number of vehicles on the roads between 2006 and 2016, with high levels of congestion. In addition to housing pressures, 12 NSIPs and significant transport infrastructure projects have been brought forward in Kent over the last 10 years, of which the majority have been approved. Post-Brexit lorry parks have been approved in Kent by the Secretary of State, and concerns continue to mount in response to these 'fast-tracked' applications and the regulation of their impact on wildlife.

The protection of biodiversity within the planning process is set out by national planning policies. Until 2019, these policies required development to achieve no net loss of biodiversity. Despite this requirement, biodiversity has continued to decline nationwide, with 41% of UK species in decline (Hayhow *et al.*, 2019). In an attempt to reverse this decline and recover nature, the Environment Bill introduces a new mandated requirement on development to now deliver a net *gain* for biodiversity. BNG is an approach whereby development, and/or land management, aims to leave the natural environment in a measurably better state than it was beforehand, with the impact of development on biodiversity quantified using a 'Biodiversity Metric'.

The state of nature

The most recognised impact of urbanisation on wildlife is direct habitat loss. Housing development and infrastructure will often result in the destruction of habitats and, in its place, the creation of impermeable surfaces with none or little natural space. This process not only results in the loss of habitat and its associated wildlife, but also causes permanent damage to soil health.

Continuous growth in development and urbanisation exacerbates the already highly fragmented landscape, resulting in small pockets of habitat, which are often supporting rare and/or vulnerable species. Fragmentation impairs species movement and migration, which means these isolated populations are less able to survive or adapt to changing climate conditions and are put at further risk. In addition to the direct loss of habitat beneath sealed impermeable materials, development can drive negative impacts on nearby habitats and wildlife sites. Impermeable surfaces greatly increase the occurrence of polluted surface water runoff, which degrades adjacent habitats and nearby watercourses. In the absence of proper mitigation, surrounding habitats may experience damage and degradation arising from decreased air quality and nitrogen deposition. Excess nitrogen deposition increases the nutrient content of grasslands, resulting in reduced species richness, especially among flowering plants. This loss of floral diversity can be devastating for annual plant communities and pollinators which depend on them. Dust arising from development can also damage plants, by smothering their foliage and affecting the plants ability to photosynthesise (Holman *et al.*, 2014).

A major driver of biodiversity loss near development is disturbance of wildlife. Disturbance can arise due to increased noise and light pollution, as well as through the presence of humans. Lily and Fearnley (2011) reported bird disturbance at internationally important wildlife sites, particularly in response to people walking with their dogs; disturbance of foraging and roosting birds can have detrimental impacts on their survival and distribution. Light pollution impacts upon nocturnal wildlife, such as bats, by affecting emergence from their roosts and their ability to hunt. In addition, it can impact insects; a recent study showed that the abundance of moth caterpillars in hedgerows by rural roads in England was 52% lower under LED lights and 41% lower under sodium lights when compared with nearby unlit areas. (Boyes *et al.*, 2021). Kent would appear to be a highly lit area, being only the 29th darkest county in England out of 41 counties (CPRE, 2016). Within Kent, Dartford has the worst levels of light pollution, closely linked to the major transport routes through this district.

Urbanisation also brings with it increased numbers of domestic animals, particularly cats. It is estimated that free roaming domestic cats kill up to 100 million prey items annually, including mammals, birds, reptiles and amphibians (May, 1988).

It is important to recognise that most urban areas are not completely covered with impermeable surfaces and buildings. Our towns and cities include parks, allotments, cemeteries, ponds, road verges and domestic gardens. Slowly, the inclusion of green walls and green roofs is increasing on new builds, as are the integration of other wildlife niches and features. If managed correctly, each of these areas of green space has the potential to provide a wide range of benefits for nature, contributing to the ecological network in the urban environment and providing much needed stepping stones. Safeguarding and enhancing this network of green infrastructure is vital for supporting urban wildlife and the health and wellbeing of residents. Brownfield sites can also be wildlife rich, being of particular importance for invertebrates, which support entire ecosystems.

The response for nature

Historically, development has not been designed with biodiversity in mind, with mitigation and wildlife features being considered as a secondary issue. A much overdue shift is beginning to take place in both the political and social arenas. In an effort to reverse biodiversity losses associated with development, the principle of BNG was introduced in national planning policy and is set to be mandated via the Environment Bill in 2021. The mandate requires a minimum of 10% biodiversity uplift within development. The Kent Nature Partnership is proposing a county-wide approach to BNG to be adopted by all planning authorities. These principles include a commitment to providing net gains in perpetuity and to deliver a minimum of 20% net gain. Given the exceptional growth pressures in Kent, and the scale of the previous biodiversity loss, it is considered that a more aspirational 20% biodiversity net gain target is a proportionate response and one that illustrates the county's commitment to tackling the ecological crisis that faces Kent. The recovery of nature in the county will be guided by the Local Nature Recovery Strategy, which will be instructed by the Environment Bill; mapping work to inform their development is already in progress.


The Thames from Swanscombe SSSI

The North Kent SAMMS, referred to as Bird Wise, was set up to address the detrimental impact that new development in north Kent will have on protected bird populations in the Thames, Medway and Swale Estuaries. Research has demonstrated that recreational visitors to the coast cause disturbance to the 250,000 waders and waterfowl that depend on these sites. Bird Wise uses developer contributions to implement strategic measures to reduce the level of disturbance to wintering birds arising from housing development. These measures include wardening and visitor engagement, with a particular focus on dog walking. This scheme has managed to engage with thousands of people in person, and reached a wider audience on social media to promote the importance of these wildlife sites for wintering birds.

Transport infrastructure typically serves as a barrier to wildlife and fragments ecological networks. The Kent and Medway Road Verge Project was established in 1994 as a partnership between Kent Wildlife Trust and Kent Highways Services, with the aim of protecting and managing road verges which contact threatened habitats or wildlife. These Roadside Nature Reserves help to promote connectivity within the landscape, reducing habitat fragmentation. The verges are made up of a wide range of threatened habitats, including ancient woodland, chalk grassland and heathland. A single chalk grassland road verge supports multiple scarce and threatened plant species and these flowers and grass seed are regularly collected and used to create new chalk grassland habitat on nearby arable land.

One of the benefits of urban green spaces and private gardens is the opportunity to connect people with nature in their local area. KWTs Gardening for a Wilder Kent scheme encourages everyone to promote nature's recovery in their gardens or local communal open spaces. Schemes such as this have inspired Kent's residents to garden with wildlife in mind and work together with their local communities to encourage wildlife into their gardens with bird feeders and hedgehog highways.

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Roadside Nature Reserve

INVASIVE NON-NATIVE SPECIES, PATHOGENS AND PESTS

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Introduction

Introduced species are those which have been brought, deliberately or accidentally, by humans, into a new range and location. Many naturalise, however, since the new species have not co-evolved with the native biota, many have no limiting factors and become invasive, damaging and problematic, and are termed INNS.

The pressures on nature

There are many examples of how INNS have had devastating biodiversity, economic and environmental impacts. Examples include competition with, and predation of, native species, increased flooding risk, infrastructure and land damage, loss of habitat leading to fragmentation, and species hybridisation. Many INNS also bring with them implications for human, animal and plant health, due to direct predation and via the spread of diseases. INNS also compromise the ability to meet other environmental targets; for example, INNS impact negatively on the UK's commitment to achieving and delivering Water Framework Directive objectives, as the presence of INNS within a catchment can prevent a waterbody from achieving 'Good Ecological Status' or 'Good Ecological Potential'.

There are more than 2,000 non-native species in Great Britain (GB Non-Native Species Strategy, 2015) and while we know that the majority of these naturalise, many have become invasive. Via the EU funded Rapid Life project, in 2018 RIMPs were written to describe the threats to aquatic and riparian systems at a localised level. The South East RIMP identified more than 50 existing INNS currently affecting coastal and freshwater habitats across Kent (Griffiths & Loos, 2018). Several of these species, including Wakame Seaweed *Undaria pinnatifida* and Chinese Mitten Crab *Eriocheir sinensis*, are listed in the top 100 of the 'world's worst' invaders by the International Union for Conservation of Nature (IUCN) (Lowe *et al.*, 2000). When adding the known terrestrial species to this list – as well as those not currently in the county, but with the pathways and potential to arrive – we can see the significant threats and challenges which INNS pose to the wildlife and natural areas in Kent.

The state of nature

Examples of the impacts of Invasive Non-Native Species in Kent

Many INNS affect Kent Biodiversity Strategy priority habitats and species; for example, the European Water Vole *Arvicola amphibius* has been dramatically impacted upon by predation from American Mink *Neovison vison*. In addition, some designated Kent wet woodlands and important pond habitats are also affected by aquatic invasive non-native flora, such as Australian Swamp Stonecrop *Crassula helmsii* and Parrot's Feather *Myriophyllum aquaticum*. Another example is that of our native Bluebell *Hyacinthoides non-scripta*, which is at risk because it now hybridises with both its introduced Spanish cousin *Hyacinthoides hispanica* and with the resulting fertile hybrid *Hyacinthoides hispanica x non-scripta* (Plantlife, 2004).

Kent contains six MCZ that are significant in a European context; however, the Southeast RIMP identified at least 25 existing marine and coastal INNS currently affecting them (Griffiths & Loos, 2018). One species is the Pacific Oyster *Magallana gigas*, which is now widespread. This can displace native oysters via its building of massive oyster beds through its natural spat settlement and population recruitment (CABI, 2021). The creation of oyster beds changes habitats, potentially impacting on protected features, such as estuary rock habitat (Herbert *et al.*, 2016). Pacific Oysters may also transfer parasites, diseases and other pest species to native oyster stocks (CABI, 2021).

Pacific Oyster *Crassostrea gigas* © GBNNSS

Pacific oyster *Crassostrea gigas* © Lara Howe

This risk of disease is significant with INNS. For example, the fungal pathogen *Hymenoscyphus fraxineus*, which originated in Asia, causes the tree disease known as Ash dieback. Whilst this disease does not cause much damage to native Ash species in Asia, the accidental introduction of the pathogen to the UK via imported infected trees has had a significant impact to native Ash trees as they have not co-evolved with the pathogen and therefore have no resilience to it. Ash dieback is a significant worry for Kent, because European Ash *Fraxinus excelsior* is the most widespread tree species found in the county (Philp, 2010) and it is an important tree species for biodiversity with several invertebrates, lichens and mosses dependent wholly on it for habitat and food (Forest Research, 2021a).

The increasing loss of this widespread and important tree species from Kent poses a considerable threat to our woodland infrastructure, biodiversity, and our economy. Similarly, Oriental Chestnut Gall Wasp *Dryocosmus kuriphilus* was discovered for the first time in the UK in Farningham Wood in Kent in June 2015, and has since been found at several sites in the South-East. The Oriental Chestnut Gall Wasp affects the naturalised Sweet Chestnut *Castanea sativa*, a popular tree species due to its timber value and chestnuts – not to mention their aesthetically pleasing significance in our countryside. The activity of the wasp larvae causes abnormal growths, called galls, to form on the buds and leaves; at high density, this can weaken the trees, causing them to be susceptible to other tree diseases and pests, such as Sweet Chestnut Blight *Cryphonectria parasitica* (Forest Research, 2021b). This further demonstrates the spiralling effect of INNS and their added weight on top of other existing stressors.

Populations of native White Clawed Crayfish *Austropotamobius pallipes* have dramatically declined in many parts of the UK, including in Kent; they have also become locally extinct in other areas due to the deliberate introduction of the American Crayfish species, which carry Crayfish plague (Holdich *et al.*, 2009). Crayfish plague, caused by the fungus-like organism *Aphanomyces astaci Schikora*, is listed in the top 100 of the "world's worst" invaders by the IUCN (Lowe *et al.*, 2000). Some non-native amphibians are known to be vectors of a fungi that cause the disease chytridiomycosis, which could affect native amphibians. Even if not carrying diseases, many INNS still pose a health and safety risk; for example, the sap of Giant Hogweed *Heracleum mantegazzianum* can burn the skin, leaving lifelong scars. Additionally, the caterpillars of the increasingly common Oak Processionary Moth *Thaumetopoea processionea* can also cause significant skin irritation, as well as damaging the health of our iconic oak trees.

Despite current emphasis on improving our rivers and waterbodies, these habitats continue to be affected by aquatic and riparian invasive non-native flora, such as Floating Pennywort *Hydrocotyle ranunculoides* and widespread Himalayan Balsam *Impatiens glandulifera*. While these species are familiar to many and controlled where possible, other threats are less obvious, such as the increase in Water Fern *Azolla filiculoides* and the often-misidentified Lesser Duckweed *Lemna minuta*, which has significantly impacted on other waterbodies. These species, if not controlled, can spread exponentially, clogging waterbodies, causing deoxygenation, and reducing water quality and native biodiversity.

Lesser duckweed in Paddington Basin, London
© Newman (2021)

The response for nature

Thankfully, more people and organisations in Kent are now becoming more attuned to INNS, their impacts, management requirements and our need to improve biosecurity to stop spread. Water companies, for example, are increasingly becoming more attuned to risk-assessing their operational impact in terms of the INNS risk and what more they can do to help. The future also holds more options for INNS management. The increasing research into biocontrol, for example, will make management more sustainable, proactive, and environmentally friendly. Ultimately, too, there are brighter future intentions from the Government to support local community action and involvement.

INNS are both a catalyst for negative change and an indicator of a degraded environment – with the two interlinking to create a vicious circle and an accumulative impact. They can affect all habitats, from ancient woodlands to coastlines and, while it is unlikely INNS in Kent are the sole driver of biodiversity decline, the added pressure they create atop other existing stresses and negative drivers of change are clear and contribute to species decline, habitat loss and fragmentation.

The Lawton principles of *more, bigger, better* and *joined* are directly affected by INNS as they reduce, degrade and fragment available habitat and wildlife populations. INNS are affecting existing designated priority species and landscapes, and the lack of control of certain invasive species is in direct conflict with current species-specific conservation effort and environmental targets.

Despite the clear impacts and the requirements for catchment-based and landscape-scale supervised control, and the apparent intentions of the Government to support local projects, Kent catchment INNS control projects struggle to find the required level of funding needed to control on a landscape-scale; this needs to be better prioritised alongside other efforts to support the conservation and enhancement of Kent's nature.

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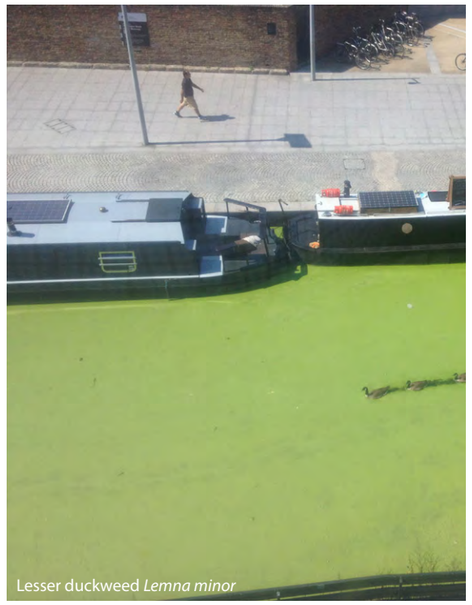

Lesser duckweed *Lemna minor*

POLLUTION

View over frost covered Elmley Marshes towards cooling towers of nearby industrial site.
© Andrew Parkingson 2020Vision

AIR POLLUTION

STEPHEN PECKHAM, UNIVERSITY OF KENT

Introduction

Air pollution is the contamination of the air by noxious gases and tiny particles of solid and liquid matter in concentrations that are harmful to humans or the natural environment. Air pollution sources include almost anything that involves fuel combustion, such as vehicle engines and open fires; friction from brakes, tyres and the road surface during driving; industrial processes; some agricultural practices; and even some natural vegetation and livestock. Air pollutants include fine particulate matter (PM_{10} and $PM_{2\cdot5}$), Nitrogen oxides (NO_x), Ozone (O_3), Ammonia (NH_2), Carbon Monoxide (CO) and Sulphur Dioxide (SO_2).

There has been increasing concern about the direct impact of air pollution on the environment over the last 40 years. Key responsibilities for protecting the environment from air pollutants are included in *The Conservation of Habitats and Species Regulations 2017*, commonly called *The Habitats Regulations*, that interprets the European Birds Directive and Habitats Directive into English and Welsh law. While habitat changes have, more commonly, been connected with climate change, there is an increasing awareness of the impact nitrogen deposition and other airborne pollutants are having on ecosystems.

Air pollution can influence the quality of soil and water bodies by polluting rain and snow, which falls into water and soil environments. Of particular concern are small particulates (PM_{10} and $PM_{2\cdot5}$) in the atmosphere, as they remain suspended in the atmosphere for a long time and can be dispersed over a wide area. These particles are able to change the nutrient balance in water ecosystems, leading to species loss and damage to forests and crops. They also acidify water bodies.

Atmospheric nitrogen is also having a significant impact on nature, with excessive levels of nitrogen causing loss of sensitive species, changes to habitat structure and function, reduction in biodiversity, changes in soil chemistry, and increased sensitivity to climate change and pests. Ground level ozone can reduce plant growth, flowering and crop yields.

The pressures on nature

The UK $PM_{2.5}$ levels are highest in the South East, and a recent study of atmospheric fine particulates suggested that, across Kent, atmospheric levels of $PM_{2.5}$ are more than 20µg/m^3, which is double the World Health Organization's recommended annual average maximum limit of 10µg/m^3. The impact on wildlife and biodiversity can be significant, leading to health problems for animal species, including reproductive failure and birth effects when exposed to high levels of pollutants.

Kent's location between London and mainland Europe makes nitrogen deposition a particular concern, due to significant cross channel traffic and disproportionately large numbers of heavy goods vehicles passing through the county. Around the coast, ports and maritime shipping bring additional sources from the use of maritime diesel. Even air pollution from outside Kent impacts the environment, with westerly winds bringing pollutants from London and easterly winds bringing air pollutants from the continent.

Ammonia from agricultural activity, including fertiliser application and intensive livestock production, also produces additional nitrogen air pollution. Although 78% of the atmosphere is made up of nitrogen gas, most of it is inert. Reactive nitrogen describes all forms of oxidised nitrogen (NO_x). The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services highlighted reactive nitrogen in the environment as one of the most significant threats

Port of Dover
© Danny Hawkwood @Pixabay

to global biodiversity (IPBES 2019). Reactive nitrogen gets deposited in soils and vegetation, where it can acidify soil and over-fertilise sensitive ecosystems; it also acts as a fertiliser, making conditions too rich for many wild fungi and plants. In 63% of special areas of conservation – our best wildlife sites – nitrogen levels are already too high with dire consequences for animals, including pollinating insects, which depend on wild fungi and plants for food, nutrients and shelter.

Of significant concern is the Thames Estuary corridor – given the importance of coastal wetland sites in Kent. The Thames is the busiest inland waterway for the transport of freight in the UK, with over four million tonnes of cargo transported between terminals on the River Thames in 2017; and freight traffic is increasing. Marine traffic is also a significant source of nitrogen and other airborne pollutants. Road traffic is also responsible for some 8% of airborne micro-plastics – a pollutant of increasing international concern.

Nitrogen dioxide can negatively impact on insect biomass (e.g. Campbell & Vallano, 2018) or directly impair the fitness of birds via inhalation exposure (Sanderfoot & Holloway, 2017). When leached into water, it leads to eutrophication, where elevated concentrations of nutrients stimulate the blooming of aquatic algae, which can cause an imbalance in the diversity of fish and ultimately high numbers of fish deaths.

Ongoing analysis in the Countryside Survey has clearly demonstrated that over the last 30-40 years, roadside verges have seen significant decline in once common wildflowers such as Comfrey, Lady's Smock, White Dead-nettle, Garlic Mustard, Bird's-foot Trefoil, Ox-eye Daisy, and Early Purple Orchid. At the same time, Cow Parsley, nettle species and some grasses have flourished because it has been fertilised into excessive growth by nitrogen compounds from car exhausts, especially diesel ones. Typically, contributions to ambient NO_x concentrations from roads can extend to 100 to 200 m from the kerbside, and, in places, the influence of the road may be detected at around 250 m (English Nature, 2004).


Early Purple Orchid *Orchis mascula*

Deposited directly from the air and in rain, the nitrogen enriches the soil, creates acidic conditions and causes direct damage to our flora. More than two thirds of our wild flowers, including plants like Harebell and Betony, require low or medium levels of nitrogen. Only robust species, such as Common Nettle, Cleavers and Hemlock thrive in nutrient enriched soils. Woodlands, grasslands, heaths and bogs have all become colonised by nitrogen-loving plants, with knock-on effects for all our wildlife. In 2014, 90% of land in SACs in England and Wales received excessive levels of nitrogen (Plantlife, 2017).

The state of nature

Kent has extensive areas of internationally important wetland, ancient forest and important AONB.
The county is also home to 36 priority habitats and 387 priority species (KCC, 2020), many of which are threatened by historical and continuing nitrogen deposition and particulate pollutants, including microplastics.

There is extensive woodland cover in the Kent Downs covering some 20% of the AONB. Almost 70% of the woods in the AONB are ancient, the second highest concentration in the AONBs in England and Wales, with indicative species such as Wood Anemone and Dog's Mercury present. Kent's most wooded area is the Blean – a unique and distinctive landscape – and one of the largest areas of ancient woodland in England. It is also among the most valuable; a third of it is of international importance for wildlife. However, a recent Woodland Trust report found that existing native woodlands are isolated and in poor ecological condition, with just 7% in a "good" condition.

Pollution – in the form of acid rain, nitrogen deposition and particulate pollutants from traffic – threatens significant areas of woodland, leading to loss of canopy cover and declines in lichens, such as Horsehair *Bryoria spp*. Links between nitrogen pollution and tree diseases, such as acute oak decline, may be related to mycorrhizal fungi declines. All woodlands in Kent exceed the critical levels of nitrogen, and historic and current nitrogen deposition will have led to the deterioration of ecosystems, with ecological integrity compromised (Woodland Trust, 2021).

Wetlands in Kent (e.g. Stodmarsh, the Swale, and the Medway Estuary) are internationally recognised. Nitrogen deposition is a significant problem given the proximity of some sites to shipping channels and industry, and to high volumes of road traffic on key transport links. In addition, housing development represents a threat. Natural England is already concerned about nitrogen and phosphorous pollution levels in Stodmarsh NNR on the Stour – one of the UK's major chalk streams. The Stodmarsh aquatic environment is internationally important for its wildlife and is protected under the Water Environment Regulations and the Conservation of Habitats and Species Regulations, as well as national protection for many parts of the floodplain catchment. These levels of nitrogen and phosphorous input to this water environment are causing eutrophication at part of these designated sites (Natural England, 2020).

The response for nature

Under the Clean Air Act and parts of the Environment Act 1995, local authorities are required to review and access air quality in their area. If air pollution exceeds defined thresholds, local authorities should designate those areas as Air Quality Management Areas and must draw up and implement an action plan aimed at reducing levels of that pollutant. There are currently 43 Air Quality Management Areas in Kent and Medway, all with associated action plans. While the focus of this legislation is aimed at improving human health, the actions being implemented to reduce emissions from transport sources will have benefits for nature.

There is increasing recognition that green infrastructure (roadside trees, shrubs, hedges and urban green spaces) can play an important role in improving urban air quality, with many local authorities actively increasing trees and hedgerows in urban areas and roadsides. Vegetation acts as a natural filter, with the surface of leaves absorbing carbon dioxide, dust particles and other pollutants such as sulphur dioxide. A 2017 study for the Office of National Statistics, however, estimated that, although existing UK vegetation reduces the average annual surface concentrations of $PM_{2.5}$ by 10%, PM_{10} by 6%, ozone by 13%, ammonia by 24% and sulphur dioxide by 30%, it did not markedly change nitrogen dioxide concentrations. For this reason, whilst appropriately designed green infrastructure can improve air quality and support urban biodiversity, it should not be used in isolation to address air pollution.

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Litter pollution on Kent beach © Nia Jones

WATER POLLUTION

PHILIPPA TAYLOR, ENVIRONMENT AGENCY

Introduction

Kent's rivers, lakes and groundwater are important natural assets. Not only do they support communities of fish, invertebrates and plants, but they also provide ecosystem services and natural capital, providing water for drinking, agriculture and industrial purposes; they even provide natural retreats for recreation and wellbeing. One of the biggest threats to water bodies in Kent is pollution. Although water pollution has been significantly reduced over the last 20 to 30 years, our water bodies are still under pressure from a number of pollutants. Two of the most common of these pollutants affecting Kent's water bodies are phosphorus and nitrates. A small number of persistent chemicals are also a cause for concern (Environment Agency, 2020).

The pressures on nature

Phosphorus

Phosphorus found in the aquatic environment has many different sources. It is used in a variety of products including agricultural and domestic fertilisers, animal feed, detergents, drinking water treatment and even food and drink. Phosphorus used domestically ends up in wastewater, along with the phosphorus from human waste. It is, therefore, no surprise that the most common sources of phosphorus loading in Kent's water bodies are sewage effluent and agricultural activities (Environment Agency, 2020).

As seen in Figure 1, water industry discharges are the biggest contributor of phosphorus to Kent's rivers and lakes. Although sewage is treated by water companies, the final effluent can still contain levels of phosphorus that can be detrimental to the environment. Additionally, permitted storm overflows may discharge untreated wastewater into our rivers during extreme rainfall events and result in higher loads of phosphorus entering our rivers at these times (Environment Agency, 2019a).

The second largest source of phosphorus is diffuse agricultural pollution. If fertilisers are applied to fields in excessive quantities, or during adverse weather conditions, they can run-off into rivers and lakes. The poaching of river banks by livestock can also result in animal waste and sediments containing phosphorus entering rivers and lakes.

The third most common sources of phosphorus in Kent's rivers and lakes are private sewage treatment plants and septic tanks. Poorly maintained or misused systems can fail to treat waste properly, resulting in high concentrations of phosphate reaching rivers. While the discharges from these private systems are small in volume compared to a water industry discharge, the cumulative impact over time can still be harmful to the environment (Environment Agency, 2019b).

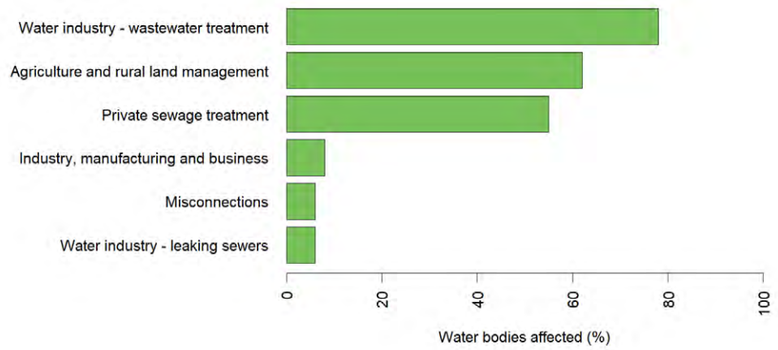

Figure 1 Phosphorus sources affecting Kent's surface water bodies and the percentage of water bodies affected by these phosphorus sources
Source: Catchment Data Explorer


Poached River Bank
© Wendy Hockaday

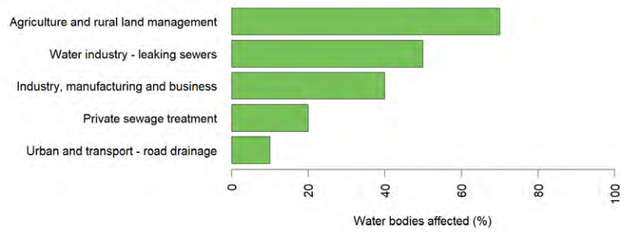

Figure 2 The nitrate sources affecting Kent's groundwater bodies and the percentage of water bodies affected by each nitrate source
Source: Catchment Data Explorer

Nitrates

Nitrates found in the aquatic environment have a number of sources. The two most common sources affecting Kent's groundwater are agriculture and leaking sewers, although private sewage effluent and historic waste disposal are also important contributors (shown in Figure 2) (Environment Agency, 2020). The predominant source of nitrates affecting Kent's groundwater is agriculture. Nitrate fertilisers are used to increase crop yields and can leach into groundwater when applied in high quantities or inappropriate weather conditions. Nitrates can also leach into the groundwater if farm infrastructure, such as slurry pits and fertiliser storage areas, are not properly constructed or maintained (Environment Agency, 2019c). Out of 10 groundwater bodies affected by high nitrate levels in Kent, five have leaking utility sewers identified as one of the probable sources. Broken underground pipes provide a direct route for untreated sewage to leach into the groundwater.

Chemicals

Other pollutants of concern in Kent include a small number of chemicals, which were used historically, but remain persistent in the aquatic environment. Two of these chemicals are PBDEs, which were historically used as flame retardants on electricals and furnishings, and PFOS, which was used in firefighting foam and as a stain repellent on textiles.

Kent's groundwater is also affected by historical and persistent chemicals, particularly chlorinated solvents such as tetrachloroethene and trichloroethene. These chemicals were used in a variety of industries, including engineering and dry cleaning, and were added to inks and dyes. The historical use and disposal of these chemicals has resulted in them collecting in the groundwater where they are likely to persist for decades to come (Environment Agency, 2019e).

The state of nature

Phosphorus

In 2019, 79% of the rivers and lakes in Kent monitored for phosphorus did not meet the required standard for good ecological status as set out under the Water Framework Directive (WFD) (Environment Agency, 2020). This is compared to 67% of water bodies across the South East and 56% throughout England. An excess of nutrients, particularly phosphorus, can cause eutrophication, resulting in increased aquatic weed growth and algal blooms. Plants such as blanket weeds *Cladophora spp.*, Canadian Pondweed *Elodea canadensis* and Duckweeds *Lemna* spp. thrive in eutrophic conditions, outcompeting other species and dominating the water body. The reduction in light penetration causes submerged aquatic plants to die and decompose as they cannot photosynthesise. This depletes oxygen levels, which can cause fish and invertebrate mortality, and an overall reduction in the biodiversity of the water body can occur.

Human activities can also be impacted by high levels of phosphorus. Algal blooms in rivers and lakes can impact on recreational activities such as angling and water sports. Blue-green algae in particular can be harmful to human health if it is inhaled or comes into contact with our skin; plus it can be toxic to livestock and pets (Environment Agency, 2017).


Eutrophic water body, Minster Marshes
© Wendy Hockaday


Algal bloom
© Philippa Taylor

Nitrates

In 2019, 77% of Kent's groundwater bodies did not meet the required WFD standard for good chemical status, and two groundwater bodies deteriorated, in part, due to the presence of nitrates in the water. It is a similar picture across England, with nitrates being the most common cause of groundwater test failures. Groundwater is a valuable resource in Kent, providing more than 75% of our drinking water supply. Water polluted with high levels of nitrates requires additional treatment to ensure it meets drinking water standards (Water Industry Act, 1991). Groundwater fed rivers and lakes, including the Medway around Hartlake and the Denge Marsh Lakes, and wetlands such as the Hacklindge Marshes, experience nutrient loading and eutrophication due to increased concentrations of nitrates in the water.

Other chemicals

Most of the 52 chemicals monitored by the Environment Agency have shown little change over several years and continue to be found in low concentrations in Kent's rivers and lakes. However, improved monitoring and assessment techniques for some chemicals have resulted in better detection and understanding of the extent that these chemicals are present in the environment. For this reason, all of England's surface water bodies did not meet the criteria for achieving good chemical status in 2019. In particular, PBDEs and PFOs have been identified as being particularly widespread following improved monitoring and assessment techniques. These two chemicals can be toxic to aquatic life and have been found to bioaccumulate and biomagnify through the food chain. Despite the use of these chemicals now being highly restricted, they remain persistent in the environment and their presence may persist for decades, particularly whilst products such as carpets and upholstery that have been treated with these chemicals remain in use (Environment Agency, 2019d).

The response for nature

Actions to address these sources of pollution are identified by the Environment Agency, which works with water companies, farmers, local partnerships, land owners and industry to protect the aquatic environment. Actions are based on a fair share principle: each sector causing water pollution is expected to undertake proportionate improvements to aid the water body to achieve good status. Water company investment through the Water Industry National Environment Programme focuses on delivering environmental benefits by reducing the amount of phosphorus and other pollutants entering rivers, lakes and groundwater. Interventions include infrastructure improvements, new or amended permit limits, and technological advancements at wastewater treatment works. Between 1995 and 2010, water industry phosphorus loadings to rivers in England and Wales was reduced by more than 50% and a further 16% between 2010 and 2020 (Environment Agency, 2019b).

There are also a number of regulations to reduce agricultural diffuse pollution. The Reduction and Prevention of Agricultural Diffuse Pollution (England) Regulations 2018 (also known as Farming Rules for Water) came into effect in April 2018 to ensure that farmers manage their land, fertilisers and livestock activities to prevent diffuse pollution from occurring.

Specific rules for the storage of silage and slurry are set out under the Water Resources (Control of Pollution) (Silage, Slurry and Agricultural Fuel Oil) Regulations 2010. The regulations ensure that these potential pollutants are stored securely away from inland or coastal waters and a minimum distance from a protected water supply source. There are also stricter rules for farms located in Nitrate Vulnerable Zones, which cover nearly 60% of Kent. The Nitrate Vulnerable Zones across England are displayed in an interactive map. Requirements include the safe storage and application of nitrogen based fertilisers to reduce the risk of run-off into rivers and lakes or leaching into groundwater (Environment Agency, 2019f).

Agricultural grants are also available for farmers via the Countryside Stewardship scheme to improve farming practices to prevent deterioration of surface water and groundwater quality. This scheme is due to be replaced by the Environmental Land Management Scheme, which is currently under development. This scheme will pay farmers for ensuring that their land management practices do not cause environmental harm and for contributing to clean and plentiful water alongside other environmental benefits.
Numerous other actions are also taking place to tackle the sources of phosphorus and nitrates. The

Environment Agency is reviewing permitted sites in the highest risk catchments, working with local authorities regarding contaminated land sites, and is also providing information to water companies for the development of their Drainage and Wastewater Plans. Although many of Kent's rivers and lakes are still currently at 'less than good' status due to phosphorus, corrective actions are beginning to result in improvement. Since 2015, 16 of Kent's rivers have experienced improvements in their phosphate classifications, with seven of these improving to 'good' status (Environment Agency, 2020).

Improvements in groundwater quality, however, are not expected for several more decades. This is due to the high quantities of nitrates used in the past, as well as current issues and the time it takes to filter down to the water table (Environment Agency, 2019e).

As the Environment Agency's understanding of persistent chemicals improves, it will be in an increasingly better position to investigate and identify its sources and pathways. This will not only help determine where remedial action could take place, but it will help improve the quality of surface water and groundwater for future generations.

Population growth and the effects of climate change may pose additional risks in dealing with water pollution. As Kent's population grows, housing development and the associated sewage treatment discharges could lead to increased levels of phosphorus pollution. There will also be greater demand on our water resources, resulting in lower flows in our rivers and less dilution of pollutants. Climate change is expected to lead to higher temperatures and lower river flows in the summer months, increasing the likelihood and impact of eutrophication. Wetter winters are likely to increase erosion and nutrient run-off from fields, further adding to the phosphorous loading in our water bodies (Bowes *et al.*, 2019).

It is, therefore, vital that all stakeholders continue to work together towards improving the quality of water through a catchment based, fair share approach, to ensure that Kent's rivers, lakes and groundwater are protected from pollution so native wildlife can thrive.

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Riverbank poaching

HABITAT MANAGEMENT

Walkers in West Blean woods
© Stephen Ribeiro

WOODLAND

MATT HAYES, KENT WILDLIFE TRUST

Introduction

Kent has approximately 11% woodland cover, which is slightly above average for England (Forestry Commission, 1996). The woodland varies greatly in type, size and tree species composition, and includes mixed broad-leaved, Beech and Yew, Oak high forest, Sweet Chestnut coppice, conifer plantation, wooded ghylls, wet woodland, wood pasture and much more. Woodland cover in Kent has remained largely stable in recent decades. Woodland is broadly present throughout the county with higher concentrations on the North Downs, the High Weald and the Blean near Canterbury, the majority of which is classed as ancient woodland.

Pressure on woodland habitats

Pressure on woodland habitats are varied and wide ranging. There is an increasing burden from pests and diseases such as ADB, OPM, *Phytopthora ramorum*, SOD and Chestnut Blight. Kent's location makes it more vulnerable to new pests and diseases due to its proximity to mainland Europe, and imports/trade passing through the county. Grey Squirrel is also impacting on certain tree species, stripping bark which damages trees species often being grown as crops, such as Sweet Chestnut, and particularly Oak, which is a major recipient of Grey Squirrel stripping. This makes growing Oak for timber difficult unless good squirrel control can be achieved.

Deer pressure is also increasing, with western parts of Kent seeing larger populations of deer, while in East Kent, deer are more isolated and limited in numbers. Overgrazing and browsing in high density prevents regeneration and damages woodland structure – in the worst cases, leaving no understory and severe browse lines.

Climate change and associated weather patterns, such as increased periods of heavy rainfall and prolonged periods of drought, affect the viability of some tree species and the associated wildlife that rely on them.

The lack of management and sustainable management within woodland habitats is also a problem. This can be related to changing markets for woodland products and economic reasons, change of ownership (sometimes with no intention of management), and a lack of woodland workers or suitable contractors.

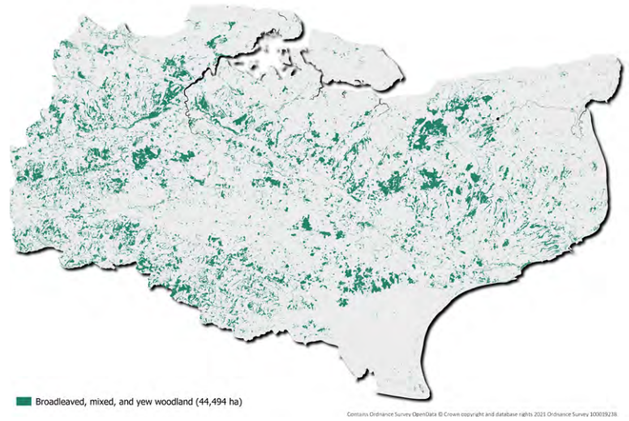

Figure 1 The extent of broadleaved, mixed and yew woodland in Kent in 2012
Source: ARCH Habitat Survey 2012. Contains Ordnance Survey OpenData © Crown copyright and database rights 2021 Ordnance Survey 100019238.

One of the major threats to ancient woodland is the lotting up of large woodlands into small plots by companies such as woodlands.co.uk. Enthusiastic plot owners who want to manage and look after woodlands in an appropriate way can be an asset, though the reality is often very different. Under new ownership, plots may fall out of management or may be managed inappropriately. In addition, once a woodland is split up, there is a loss of continuity of habitat management. When this occurs over large connected areas of woodland it becomes an issue.

INNS also present a risk to woodlands; this is exacerbated when combined with a lack of management. Species such as Rhododendron, Cherry Laurel, Periwinkle and the cultivated form of Yellow Archangel are an issue in Kent and can, over time, dominate areas of woodland, with no management.

Recreational use of woodlands and the pressures that come with it, such as high numbers of dog walkers and visitors, is a growing issue. Antisocial pressures include camping, fires, motorbikes and unofficial trails. Trespass and creation of new paths within woodlands is also commonplace, which can leave little undisturbed space within woodland habitats for vulnerable woodland wildlife to flourish.

Deforestation is also a constant threat to Kent's woodlands; although this usually occurs at a relatively small scale, it often goes unnoticed until it's too late. The causes for this vary and include small-scale development, garden expansion and unauthorised settlements. Woodland habitats and their species are prone to isolation and fragmentation, particularly for species such as specialist woodland butterflies, and birds such as Marsh and Willow Tit.

Limited funding opportunities, plus the lack of availability of grants for woodland management, also have negative impacts on the habitat.

The state of woodlands in Kent

The state of woodland in Kent is similar to the national picture. The Woodland Trust's 2021 report on the State of the UK's Woods and Trees outlines many of the issues woodland habitats and associated species are currently facing. In spite of efforts to restore tree cover through planting and natural regeneration, much woodland wildlife is decreasing. Existing native woodlands are often isolated and in poor ecological condition; this, combined with the loss of trees from the wider landscape – including ancient trees – has contributed to wildlife loss. Due to a lack of evidence at a strategic scale, it is a challenge to report on the state of Kent's woodlands.

The impact and effects of pests and diseases is also increasing, notably ADB. Since being first recorded in the county in 2012, ADB now affects trees of all sizes throughout the county. The limited resistance to the disease will have greater impacts on areas dominated by ash, and the North Downs in particular may see greater impacts than other parts of Kent. Species such as sycamore are likely to dominate in many of the areas where ash fails.

Deer populations are lower in Kent than many other parts of the UK, meaning woodland understory and regeneration is under less browsing pressure than in other areas. This, however, can lead to complacency, and where there is a small, limited network of people managing or controlling deer, it can lead to certain species causing significant impacts on areas.

There is a lack of management in all woodland types, from un-thinned and densely planted conifer plantations, to unmanaged overstood Sweet Chestnut coppice. Sweet Chestnut is the dominant coppice in many parts of the county, originally planted at scale in Kent to supply hop pole and fencing markets that have since declined. Market prices for many wood products have not increased in line with inflation, squeezing the viability of coppice businesses and woodland workers. This lack of management has led to a lack of structural diversity and low levels of open space within many woodlands. In the case of planted areas of cropped species, there is a limited diversity of tree species. Woodland management may, however, be starting to increase with new markets – such as the Sandwich biomass energy plant. This is providing a new market for low grade material, making the management of some woodland areas slightly more viable than in previous years. In addition to new markets, a push from grant schemes through the Forestry Commission and Countryside Stewardship to fund the creation of woodland management plans, may also be having an impact on woodland management. Increased mechanisation, such as harvesting machines for chestnut coppicing, and new machinery allows for scaling up operations; this may have positive affects in the area of woodland managed; however, it may also have negative effects in areas such as soil health if machinery is used inappropriately.

Kent's population is increasing and the impacts of people on woodlands are increasing as a consequence. It can be difficult for woodland owners to control access, and this is often the case in Kent. High levels of use and the creation of multiple unofficial paths leads to high levels of disturbance, which affects vulnerable species, particularly ground nesting birds. Dealing with antisocial behaviour is also a drain on resources for many.

Woodland specialist species are being affected in Kent, mirroring the national picture with steep declines and losses of many woodland birds (pre-2011: Willow Tit, Wood Warbler, post-2011: Redstart). However, in contrast to pre-2011 losses of other woodland butterflies, some Kent Biodiversity Strategy priority butterfly species that are woodland specialists are faring better (Heath Fritillary, Duke of Burgundy) (see bird and butterfly sections of this report for further detail).

Woodlands at Delmonden © Emma Khan

The response for woodland habitats

Sustainable long-term management – be that traditional, commercial, or conservation approaches – is needed. Building on the recent drive for woodland management – alongside the developing funding and grants available for woodland creation – plans are enabling more assistance with woodland management. However, getting woodland to an established state – or indeed back into management with a full range of structure and niches – takes longer compared to many other habitats. A long-term view is, therefore, needed for all woodland timescales.

New approaches to management should, therefore, be considered – such as grazing or wilding – with the use of natural processes as opposed to human intervention attempting to replicate lost functions within the woodland environment. This is particularly applicable in woodland where production of a crop is not the main aim. As it stands, however, it is difficult for woodland owners to do anything other than what could be seen as commercial woodland management. This could be resolved if the current grant and legislative systems were updated to reflect this. One example is grazed woodland (other than wood pasture): this is largely ineligible for the current Countryside Stewardship schemes because there are often preconceived ideas of the purpose of what a woodland should be or look like.

The issue is that there is a diverse range of woodland in Kent that requires a diverse range of options for management. Woodlands provide many ecosystem services and this should be included and valued more in new schemes and funding. The return of iconic species with key roles/functions to play within woodlands, such as Pine Marten and Red Squirrel, should, therefore, be an ambition.

Woodland creation should be well thought out with natural regeneration more widely considered and new planting carefully planned and considered to connect, buffer and expand existing woodland. Care and consideration is also needed around the use of "new" species, such as eucalyptus. A balance is needed. Plantations of eucalyptus or single species conifers will not provide the habitat connectivity for woodland specialists such as Heath Fritillary.

Public education is needed around recreational use, encouraging respect and understanding that management in some form is generally needed. Resource is needed for the monitoring of pests and disease, along with appropriate controls and research, vigilance and biosecurity.

New markets and funding opportunities, such as carbon offsetting, need to be capitalised on. Resources for monitoring key woodland species is also needed, as is developing a joined up approach to understand the full picture of declining species. Alongside this, the maintenance of key sites and habitats, plus funding to expand, connect and create new suitable future habitats is also needed.

While there is great potential for increasing woodland cover in Kent, there is a great need to improve the biodiversity and quality of existing woodland within the county; this can be achieved by diversifying woodland structure and variety, and restoring functional and balanced ecosystems with dynamic natural processes. If we are to deal with the increased challenges and pressures on woodland management, such as disturbance, then public education and encouraging respect and understanding for woodlands is required. Ultimately, Kent's woodlands need more attention, planning and management; threats need to be mitigated, and natural woodland ecosystems need to be restored, all while taking advantage of new opportunities as they arise.

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Chalk Grassland Kent © Lucy Carden

LOWLAND CALCAREOUS GRASSLAND

ALISON RUYTER, KENT WILDLIFE TRUST

Introduction

There is approximately 1,900 ha, or 2.5% of the world's remaining lowland calcareous grassland or downland resource in Kent, shown in Figure 1 (Kent Habitat Survey, 2012). Stretching from the M25 to the Port of Dover, this incredibly rare habitat winds its way round some of the most urban parts of the country. The aquifers it supports are a key water source for these towns and cities. The thin, south facing, free draining, steep and very alkaline soils create a habitat that supports many specialist plants and animals, and when well-managed, it is one of our richest, with more than 40 plant species per square meter and a multitude of specialist invertebrates bound tightly to their presence (KWT, 2018).

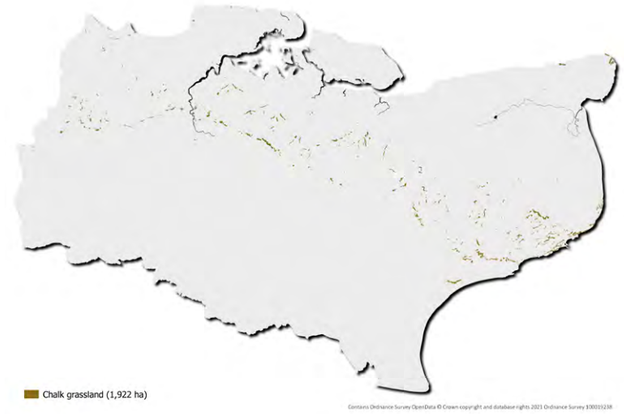


Figure 1 The extent of Lowland calcareous grassland in Kent in 2012 Source: ARCH Habitat Survey 2012

Pressures on lowland calcareous grassland and associated habitats

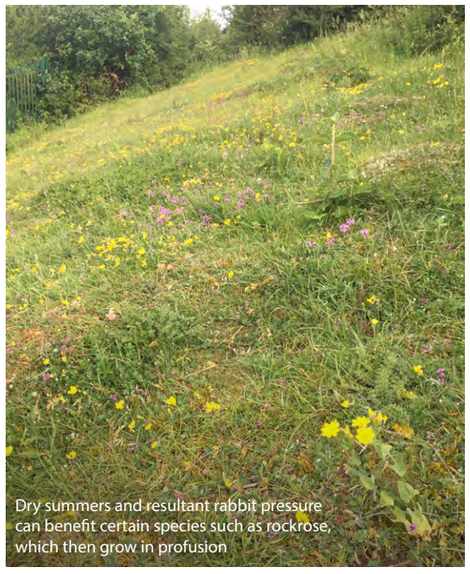
Natural England consider this habitat type to be relatively unaffected by climate change and cite direct habitat management as the biggest driver of change across the UK. Fragmentation and loss of connectivity through development in the western half of the county, and conversely through under-management and scrub encroachment in the eastern half, have reduced the area of quality downland Kent holds.

With so many key areas close to large conurbations (Sevenoaks, Medway, Maidstone, Ashford, Folkestone, Dover), public pressure on the remaining areas is also a significant factor. The North Downs is particularly impacted by local authority and government targets for greenspace recreational access commensurate with housing allocations being met by these remaining wild spaces. Damage to infrastructure reduces the ability and increases the cost of managing sites: Direct habitat damage is caused through nutrient enrichment, burning, digging, trampling, planting and incidental introduction of non-native species, theft of rare species, antisocial use of off-road vehicles, and fly tipping; all of these require specialist knowledge and high levels of 'per acre' resourcing to mitigate. Fragmentation of connectivity required by many specialist chalk grassland species occurs as a result of the high housing and infrastructure pressure faced by the South-East. All these factors contribute to no more than 60% of downland reaching the standards for UK BAP Priority Habitats at a national scale, despite concerted and targeted efforts by conservationists (JNCC, 1998).

Restoration takes a long time; it is usually more than 10 years before appreciable gains can be seen in the specialist species. Most funders anticipate success within one-to-three years, resulting in many restoration projects starting and stopping without ever reaching a position in which habitat maintenance takes over from restoration, at a more affordable cost.

The polar opposites of increased rainfall and drought, which are becoming more frequent and severe in their intensity, are putting another layer of pressure on calcareous grassland habitats. Ash dieback is most strongly associated with the downlands of Kent and the loss of these trees will have an impact that we cannot yet quantify, particularly when set against the dynamic nature of grazing/browsing pressure from animals such as rabbit and deer.

Access damage on chalk grassland



Dry summers and resultant rabbit pressure can benefit certain species such as rockrose, which then grow in profusion

The state of lowland calcareous grassland in Kent

There have been notable successes against the background of pressure. Iconic species such as Adonis Blue are now well established and spreading across the landscape once more. Landscape-scale partnerships such as Valley of Visions, Old Chalk New Downs, Darenth Valley Landscape Partnership, High Downs, and Up on the Downs, have created big wins for the habitat over the last 15 years (OCND, 2021). Countryside Stewardship has been used to develop and protect high-quality species-rich grassland, notably in the east of the county, where 900 ha of arable and low diversity grassland has been converted to species-rich grasslands in the last 15 years via targeted one-to-one support from Natural England (Tuson, 2019). Big public landowners, such as Medway Council and English Heritage, are stepping up and developing coherent delivery plans for their chalk downland with exciting and engaging projects.

However, overall chalk grassland is still in decline, and notable species such as Wart-biter Bush-cricket, Glow-worm, Straw Belle and many specialist orchid species are barely hanging on. Sites that hold notable species may require more specific management approaches to benefit, and it can take a long time for populations to respond. More loosely associated species such as Adder and Nightingale, for instance, are also still well below previous population numbers through the loss of preferred habitat (Eaton *et al*., 2015). Much of the North Downs is in private ownership and, here, the challenges are much greater in supporting and encouraging sympathetic management of this complex habitat.

Adonis Blue butterfly *Lysandra bellargus* on Horseshoe Vetch

Man Orchid *Orchis anthropophora*

The response for lowland calcareous grassland

When challenged on damaging behaviour, the phrase "It's just grass" is the most common retort from both the general public and landowners. A knowledge campaign to educate people about the difference between monoculture rye grass lays or amenity grassland, species-rich grasslands and nature reserves is desperately needed. A campaign will encourage people to see this fragile habitat in the way they do woodlands or rainforest, as something special to be protected.

One of the ways the profile of species-rich grassland can be raised is by the re-establishment of charismatic and iconic species such as Red-billed Chough, Black-veined White butterfly or Frog Orchid. Though, while they can be effective both for species conservation and profile, they are often resource intensive. There also needs to be a greater emphasis on re-establishing lost populations and enhancing colonies of threatened species for their own sake, such as Wart-biter Bush-cricket, Black-veined Moth and Kentish Milkwort.

Calcareous wildflower mix sown across arable reversion can be very successful in creating new habitat for associated species

The new ELMS scheme is expected to build on the best successes of the Higher Tier Countryside Stewardship schemes and provide the longer-term funding incentives, which are crucial to restoration at the landscape scale. These must also address issues such as chemical inputs. Fertilizers and insecticides have been shown to be particularly damaging to this habitat and its associated wildlife, and land managers must be helped to find suitable alternatives. More livestock owners are switching to lower intensity, higher value, traditional breeds, which allows utilisation of more marginal grasslands. This protects them to some extent from conversion to arable, or from fertilizer inputs. It also offers greater opportunity for targeted conservation grazing as the availability of suitable animals for land managers is higher.

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Highland Cattle *Bos taurus* at The Larches nature reserve.

Sunset over a marshland area
© Louise Matthews

COASTAL AND FLOODPLAIN GRAZING MARSH

ALAN JOHNSON, RSPB

Introduction

Coastal and floodplain grazing marsh (often referred to simply as grazing marsh or lowland wet grassland), which originated from the drainage of river floodplains and reclamation of saltmarshes, is a landscape type that encompasses several habitats, including grassland pastures, meadows, ditches, reed-fleets and seasonal water bodies (JNCC, 2016). Grazing marsh covers 14,174 ha of Kent, the majority of which is coastal and saline-influenced, such as the North Kent Marshes; however, it also includes areas of floodplain grazing marsh in river catchments, such as that found at Stodmarsh in the Stour catchment (KNP, 2020).

Grazing marsh in Kent is used as feeding and roosting habitat by internationally important populations of waterfowl, in particular Dark-bellied Brent Goose, Wigeon, Teal, Lapwing, Curlew and Golden Plover. Waders, such as Lapwing and Redshank, which rely heavily on grazing marsh as breeding habitat. Lapwing, which has declined in England and Wales by 63% since the 1960s, was formerly more widespread in the farmed landscape; however, their breeding distribution is now much more restricted to grazing marsh due to changes in land management (Eaton *et al*., 2015). Redshank also rely heavily on grazing marsh, and their other key breeding habitat, saltmarsh, is under threat from sea level rise.

Grazing marsh is important for other breeding bird species, including Yellow Wagtail, and breeding ducks such as Gadwall, Pochard, Shoveler and Shelduck. It is also a notable habitat for wintering raptors, such as Hen Harrier, Merlin and Short-eared Owl. Grazing marsh in Kent is a stronghold for Water Voles, Brown Hare and scarce invertebrates, including Scare Emerald Damselfly, oil beetles, Shrill Carder Bee and the Maid of Kent Beetle. The ditches within the grazing marsh landscape are integral to the importance of this habitat and can have a very species-rich flora and fauna.

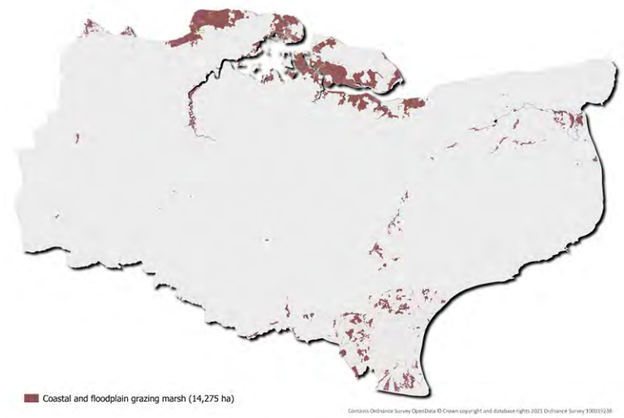

Figure 1 The extent of coastal and floodplain grazing marsh in Kent in 2012
Source: ARCH Habitat Survey 2012

The pressures on coastal and floodplain grazing marsh

Large areas of grazing marsh in Kent have been lost due to land drainage, conversion to arable, and development during the 20th century. The Greater Thames suffered particularly severe losses, with 64% of habitat lost between the early 1930s and the mid-1980s, and 48% lost from Romney Marsh (JNCC, 2011; Williams & Hall, 1986). Much of the habitat that remains often lacks focused management, so high-quality grazing marsh is a fragmented habitat largely restricted to nature reserves, such as Elmley, RSPB North Kent Marshes Reserves, KWT Oare Marshes and Stodmarsh.

The key management practices on grazing marsh are grazing, particularly by cattle and sheep, and water level control. The habitat conditions required for breeding waders can be considered as a good proxy for a healthy, biodiverse grazing marsh and aim to produce a short, heterogenous grass sward and extensive surface flooding in winter, with some wet pools still being available through the breeding season into June. Ideally, there should be a plan for managing the impacts of predation, such as anti-predator fencing. Ground nesting birds on grazing marsh are particularly vulnerable to the effects of mammalian predation, causing low breeding productivity and population decline. Rotational ditch management should be managed carefully to avoid impacts on Water Voles and should seek to create the broad range of conditions required by different species of plants and invertebrates.

Of the grazing marsh in Kent, 55% is designated as SSSI and direct loss of habitat has slowed; however, significant threats remain. Invasive non-native species that impact on grazing marsh include Floating Pennywort and Crassula, which severely affect ditch fauna and flora, and American Mink, which is a key factor in the decline of Water Vole populations.

Nutrient inputs into wetland habitats from agriculture and wastewater are now recognised as a significant negative impact, causing eutrophication and impacting on water quality and biodiversity. Recreational disturbance can have a significant impact on wintering waterfowl and ground-nesting birds and is likely to become a growing issue in Kent due to increased house building in the county. Studies from the Netherlands indicate that disturbance by walkers can reduce densities of breeding waders up to 500 metres from routes taken by walkers. (Holm & Laursen, 2008).

Climate change is a major threat to grazing marsh in Kent. Predicted sea level rise will require strategic changes to the coastline that are likely to result in losses of grazing marsh, e.g. due to the realignment of coastal defences, and the subsequent requirement to provide compensatory habitat for these losses. The predicted warmer and drier summers will result in large areas of grazing marsh becoming unsuitable for freshwater wetland species, including breeding waders. The range of species associated with grazing marsh is also likely to change significantly as climate envelopes shift across the continent, with new species colonising. This effect is already becoming apparent with the rapid colonisation of new species like the Willow Emerald Damselfly and Norfolk Hawker Dragonfly.

Restoration of grazing marsh can be achieved quickly on unimproved grasslands. Improvements to grazing and hydrological management delivered in autumn can result in breeding wader population increases the following year (e.g. the restoration of Higham Marsh in 2013 increased the Redshank breeding population from zero to 10 pairs by 2014, increasing to a further 74 pairs by 2015). The reversion of arable sites to grazing marsh is a much slower process. Arable sites lack the intimate topography and soil structure that are present on unimproved sites and take longer to establish high densities of breeding waders.

The state of coastal and floodplain grazing marsh in Kent

Despite the historic loss of grazing marsh and the continuing threats, there have been significant habitat gains in Kent. With targeted agri-environment schemes, improved habitat management, and large-scale habitat creation over the last 30 years, the extent of well-managed habitat has increased by at least 1,800 ha since the 1980s, with an additional 450 ha of restoration planned in 2021-22 at Lydden Valley and Seasalter. The most significant change occurred at Elmley, where the Elmley Conservation Trust converted 485 ha of arable land back to grassland in the 1980s, providing new habitat for hundreds of pairs of waders. From the 1990s, the RSPB and Environment Agency created and restored an additional 720 ha on the North Kent Marshes, including the award-winning habitat creation project at Great Bells Farm. These improvements resulted in a substantial increase in breeding wader populations in North Kent between 1982 and 2010/12, as recorded by the Breeding Birds of Wet Meadows Survey (BTO, RSPB; 1982, 2002, 2010, 2012), with the number of Lapwing increasing from 561 to 833 pairs and Redshank increasing from 430 to 849 pairs.

The continued creation and enhancement of grazing marsh will be essential to ensure this habitat is resilient to the impacts of climate change. By delivering the Lawton principles, suitable habitat is more likely to be available for the diverse range of species that use grazing marsh, including those arriving from the continent in the near future. Not all grazing marsh sites will be viable in the long term as freshwater wetlands, due to reduced summer rainfall and increasing temperature. It will also be necessary to ensure that sites with reliable freshwater supplies are protected for the future; alternative options for sites that are likely to become drier, such as saline lagoon creation, will also need to be considered.

The response for coastal and floodplain grazing marsh

Delivering the Lawton Principles is the key to ensuring that grazing marsh is sustainable in the long term, particularly in the face of climate change and increasing development pressures. Larger, contiguous areas of habitat are more likely to provide suitable breeding and wintering habitat in years when rainfall is in short supply. The creation of larger areas will also provide the opportunity to introduce less intensive management, creating a wilder landscape with a wider range of ecological niches.

To increase the extent and connectedness of grazing marsh, new habitats in optimal locations will need to be created; these will seek to 'fill in the gaps' in the landscape and create much larger blocks of connected wetland. This will involve the conversion of farmland in floodplains and coastal areas below 5 m AOD to grazing marsh habitat, by installing new grazing and hydrological infrastructure.

The quality of existing habitat should also be increased by working with land managers to improve grazing regimes, hydrology management and tackling predation impacts. The future ELMS will be key to supporting these changes, and it will be vital to ensure that payments deliver the best outcomes and that schemes are supported by expert advice.

Across the wider landscape, water will need to be managed in a way that maximises the benefits for nature, particularly during the breeding season when rainfall will become increasingly scarce. It would also be sensible to work with stakeholders to design and deliver water-level management plans that safeguard the most important wetland sites and use 'smart' pumping technology to move water around in a more cost effective, low-disturbance and low-carbon way. The management of grazing marsh should increasingly consider the needs of 'colonist' species, such as Black-winged Stilt and Bluethroat, seeking to provide a corridor of suitable habitat for species moving in response to climate change. In the long-term, for sites that are no longer viable as freshwater wetlands due to the impacts of climate change, alternative habitats that deliver the best value for nature, such as saline lagoons, will need to be considered.

To prevent any further losses, grazing marsh needs to be protected from several threats; this includes avoiding the impacts of built development, including over-abstraction, increased nutrients, and increased recreational disturbance. As part of the Estuary-wide consideration for coastal realignment – in response to sea level rise – the best and most viable freshwater sites will need to be protected at all costs; and where realignment takse place over grazing marsh, losses should be compensated for elsewhere. A robust, Kent-wide plan to tackle INNS on grazing marsh, where ditch flora and fauna is particularly vulnerable, is needed. A few grazing marsh sites in Kent are still undesignated and under constant threat of development. Therefore, new designations for these sites – and to recognise them as important elements of the wider wetland landscape – must be considered.

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COASTAL HABITATS

STEPHEN WEEKS, KENT WILDLIFE TRUST

Introduction

Kent has an extensive and diverse coastline and the coastal habitat umbrella reflects this by including several different habitats. These include littoral sediments (mud flats, sandbanks, beaches, saltmarshes and seagrass beds), littoral rock (chalk and Hythe Beds reefs), supralittoral sediments (sand dunes and vegetated shingle) and supralittoral rock (chalk, mud, and clay and Gault clay cliffs). Many of these habitats are of national and international importance for their wildlife. The vegetated shingle at Dungeness is one of the largest such expanses in Europe, and areas such as the coastal mosaic found in the Medway/Swale estuary and Sandwich Bay support globally important numbers of migratory, breeding and wintering waders and wildfowl.

Table 1 Kent Biodiversity Priority Habitats categorised as Coastal Habitats

Coastal habitats	Coastal saltmarsh
	Coastal sand dunes
	Coastal vegetated shingle
	Seagrass beds

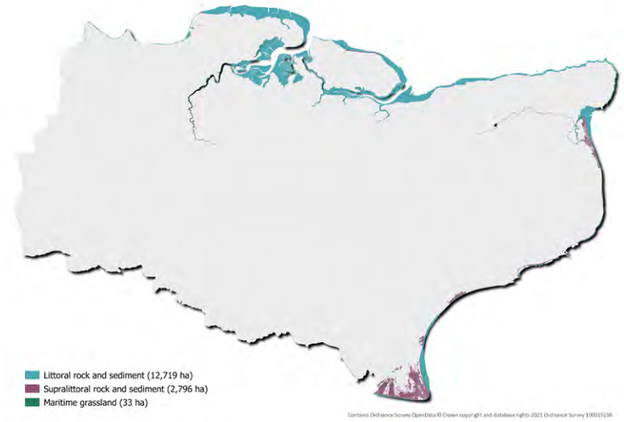

Figure 1 Coastal habitats in Kent
Source: ARCH Habitat Survey 2012

Pressures on coastal habitats

Rising sea levels, through a combination of isostatic fall of land in southern England, thermal expansion of water as it is heated by global warming, and the shrinking of continental ice sheets, will threaten many coastal habitats. While there are still significant uncertainties in sea level rise projections, global mean sea levels are currently rising by 3 mm per year and a global estimate of 500 mm rise is expected in the next 100 years (Parliamentary Office of Science and Technology, 2010). Higher mean sea levels will also increase the frequency of sea (salt) water incursion on neighbouring freshwater habitats, due to storm and tidal surge events, placing increased pressure on freshwater habitats close to the coast.

Land-based commercial harvesting of coastal plants, shellfish and fish, coupled with boats using bottom trawling gear, can lead to damaging exploitation of intertidal communities if not managed in a sustainable manner.

Pollution and nutrient enrichment from land run-off and atmospheric nitrogen deposition can lead to eutrophication of intertidal communities and can have a damaging effect on the sparse vegetation communities found on shingle and sand dunes. These communities rely on low nutrient levels to prevent the spread of coarser, more competitive species. Increased nutrient levels have also been shown to aid the spread of invasive, non-native species such as wireweed, *Sargassum muticum* (Incera *et al*., 2009).

Recreational disturbance is a constant pressure on coastal habitats due to their intrinsic appeal to people and the potential for a wide range of recreational activities. Poorly or uncontrolled access can lead to disturbance of shorebirds and negatively impact feeding, roosting and breeding success, as well as damaging fragile habitats such as dunes and shingle.

Developmental pressures, both from housing and commercial development, can impact coastal habitats through direct loss and fragmentation of habitats. Residential developments increase local populations with the associated potential for increased recreational disturbance.

INNS pose a threat to native wildlife through direct competition for space and resources. Global warming is also likely to increase the risk and impact of INNS (Cottier-Cook *et al*., 2017). Current threats include Pacific Oysters *Crassostrea gigas*, Common Cord-grass

Spartina anglica, Wireweed *Sargassum muticum*, and the Slipper Limpet *Crepidula fornicate.*

Dynamic geomorphological processes, such as sand dune accretion, can be influenced by coastal flood defence work. For example, at Deal beach, replenishment work adds shingle and other material, which is then carried by unchecked longshore drift to the north (Environment Agency, 2017), leading to an overlaying of sand with shingle.

State of coastal habitats in Kent

Table 2 summarises the most recent data for Kent on littoral sediment and rock, and the supralittoral sediment and rock habitats from the ARCH 2012 Habitat survey, and the Kent BAP figures from 1997.

Large areas of coastal habitats are in protected areas (SPA, SCA, SSSI, Ramsar), while 90% of supralittoral habitats, 50.7% of littoral sediment and 87% of supralittoral rock are in SSSIs. The presence of these statutory designations provide legal protection and a mechanism by which Natural England can work with land owners to ensure suitable management. The condition of a SSSI is measured, at varying intervals, by Natural England. While it is beyond the scope of this report to give a detailed analysis of all the coastal SSSIs, the majority of units are in favourable or unfavourable recovering condition. The notable exceptions are significant areas of the Medway Estuary and Marshes SSSI, which are in unfavourable declining condition due to nutrient enrichment (Magic website, data extracted 25/11/2021).

Information on the current condition of SPAs and SAC has been more difficult to obtain, so this report cannot assess their current state. However, what can be noted is that Little Terns were lost as a breeding species in 1997 at Sandwich; this was one of the designating features for the Thanet Coast and Sandwich Bay SPA.

Important areas of supralittoral sediments (sand dunes and vegetated shingle) are, for the most part, within areas actively managed for their biodiversity. The sand dunes at Sandwich are grazed to maintain the value of the dune pasture, and extensive work has been undertaken to control invasive sea buckthorn. The unique landscape of Dungeness with its internationally important areas of vegetated shingle includes an important RSPB reserve where appropriate management is carried out. Organisations such as the Romney Marsh Countryside Partnership and KWT's Fifth Continent Project, have been working with other landowners, including the Ministry of Defence, to promote and support appropriate habitat management of the shingle.

Table 2 Areas of coastal habitats in Kent

Source	Littoral sediment	Littoral rock	Supralittoral sediment	Supralittoral rock
ARCH 2012	11989 ha	723 ha	2559 ha	216 ha
Kent BAP 1997*	11703 ha	No figures given	2407 ha	Only lengths given, not area 35.2km hard cliff 13.4km soft cliff

* habitats combined to match ARCH

The response for coastal habitats in Kent

Conservation organisations have been working to ensure biodiversity is given sufficient weight in SMTs, to enable the plans to meet the medium and long term challenges faced by these habitats. SMTs set the strategic policy direction for coastal management and identify the most sustainable approaches to managing the risks to the coast over the short, medium and long term.

Climate change related threats to Kent's coastal habitats are recognised by all the conservation organisations working in the county. KWT, RSPB and others continue to pressure for action to reduce greenhouse gas emissions, especially as sea level projections in the UK from now until 2300 are significantly influenced by the success of these measures. The difference in modelled sea level change between low and high emissions (RCP2.6 and RCP8.5, respectively) is significant: 0.5m to 2.2m for low, compared to 1.4m to 4.3m for high (Howard *et al.*, 2019). Many organisations are taking steps to review and reduce their own carbon footprint; the Environment Agency, for example, has committed to reaching net zero by 2030 (Environment Agency, 2021).

Since its establishment in 2011, KEIFCA has been tasked with considering biodiversity and environmental considerations when ensuring sustainably managed inshore fisheries. Conservation bodies such as Thanet Coast Project have been promoting a greater awareness of illegal coastline shellfish collection. The Police and the Gangmasters and Labour Abuse Authority have been running joint enforcement operations in problem areas such as the Isle of Sheppey, Swalecliffe, Thanet and Whitstable, to provide a more joined up response to illegal shellfish collecting.

As part of a national campaign to reduce marine pollution, the six most hazardous substances to the UK marine environment have shown a long-term decrease of 78% since 1990, and it was anticipated that it would decrease to levels that are non-detrimental by 2020 (JNCC, 2021). Nutrient enrichment from agriculture and development continues to be an issue, as can be seen in the Medway Estuary and Marshes SSSI. Natural England has developed guidance on nutrient neutrality on the Stour (Natural England, 2020), and while this does not reduce nutrients reaching the coast, it will ensure there isn't an increase in nutrients because of new housing developments. KWT Consultancy Services has been working with a number of developers to help them meet this guidance in the Stour catchment. A similar scheme operates in the Solent (Natural England, 2020), and it would be a useful measure where internationally designated coastal sites in Kent suffer from nutrient enrichment.

Recreational disturbance is a significant issue on both protected coastal reserves and the wider coast. Where important sites fall within nature reserves, site managers can work to reduce disturbance or damage through visitor engagement and zoning access to protect the most sensitive areas. The success of this approach can be heavily influenced by existing public rights of way or established visitor behaviour. After many years of failure due to disturbance, South Swale Local Nature Reserve, for example, has successfully fledged Little Tern chicks; this was thanks to electric fencing and increased volunteer wardens on the nesting site.


Sevenoaks Nature Reserve

Increased visitor pressure is also linked to development in coastal areas, and Local Planning Authorities are obliged to consider the impact of development on internationally protected sites (SPA and Ramsar). To help mitigate any increased disturbance, SAMMS have been developed. This work is delivered through BirdWise projects (Bird Wise North Kent and Bird Wise East Kent), which work to ensure people can still enjoy access to the coast without having a detrimental impact on wintering birds.

Recreational pressure from development also creates additional bird disturbance during the spring and summer, impacting breeding shore birds and sensitive coastal habitats. The SAMMS approach cannot help in these situations as they are developed for SPAs and Ramsar sites which, in Kent, are principally designated for wintering and migratory bird species. KWT and other partners will comment on development applications, through the planning process, where it is believed there will be a disturbing or damaging impact to SSSIs and local wildlife sites.

Research, such as the KWT's bird disturbance study in Sandwich and Pegwell Bay National Nature Reserve, is helping to lobby for greater support from Local Authorities and Natural England to protect areas from disturbance. Local Authorities need to have effective sustainable access and recreational management strategies in place to reduce human pressure on sensitive coastal habitats by directing activities to less sensitive parts of the coast.

North East Kent Scientific Advisory Group has been working within the North East Kent Marine Protected Area to provide information on the distribution, impact and control of selected INNS. This work is closely tied into Natural England's 'Coastbusters' volunteer project to control Pacific Oysters. It is estimated that these teams have removed more than 300,000 oysters since 2011. Support and funding is still required to continue the work of monitoring and controlling the spread of INNS as existing and new species continue to impact our native coastal communities.

There are great benefits from close and collaborative working between all organisations involved in managing coastal sites, from sharing knowledge on what management approaches work, to ensuring clear and consistent messaging for visitors around responsible enjoyment of the coast in protected areas. The success of conservation projects which support iconic species, such as Little Terns, Sand Lizards and Shrill Carder Bee, can be used to champion effective habitat management and strengthen the message to visitors about exciting local wildlife projects and how they can help by adopting positive behaviours.

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CASE STUDY: SALTMARSH

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Summary

Saltmarshes in Kent appear not to have suffered reduction in extent during the past decade, although this needs to be confirmed by aerial photography and other remote sensing methods. The processes of accretion and erosion are ongoing with advances and retreats locally. Saltmarshes occupy only a tiny fraction of Kent's area and a small proportion of the extent of littoral sediment; however, they are one of the most important habitats in the county for biodiversity, and, as such, are recognised both nationally and internationally. New plant and animal records and monitoring of its bird populations continue to be made, mostly by the voluntary sector, and are important contributions towards assessing the state of saltmarshes in Kent. The cord grass Spartina anglica occurs widely and commonly, although its impact on sites locally requires further investigation. Sea level rise around Kent has been an ongoing process since the last ice age, however, today it is enhanced by climate change. The worst-case scenario is that saltmarshes in southeast England will be in retreat by 2040, while an alternative scenario is that there will be sufficient sedimentation to allow saltmarshes to elevate vertically and keep pace with sea level rise. Both indicate the need for more studies on the underpinning hydrographical and sedimentation processes.

Saltmarshes and their importance

Saline wetland or saltmarsh has long been a feature of the Kent coast. Saltmarshes form areas of the upper intertidal zone, where gentle wave-action allows sediments to be deposited and accumulate, allowing stands of salt-tolerant flowering plants to develop. Saltmarshes are a transitional habitat between the land and the sea, and in Kent they occur in or near its major estuaries. They were historically more widespread in the county; however, natural processes, combined with the activities of man, have brought about significant changes. Land-claim for agricultural, urban and industrial purposes has reduced their extent since medieval times (Young, 2004; Historic England, 2018), resulting in long lengths of saltmarsh coast bounded by sea-walls, although none have been added in the past decade. Consequently, a distinction can be made between those marshes with a natural upper boundary, and those with a seawall, as the landward limit (Boorman, 2003). Historically, in the Medway estuary and elsewhere, saltmarshes were dug out for clay extraction for the brick and cement industries, significantly changing the nature and processes in the marshy estuarine environment (Young, 2004; Kirby, 2013). Natural processes of sea level rise, sediment deposition, accretion and erosion have, over the centuries and millennia, also brought about changes to Kent's saltmarsh environments.

Coastal wetlands occupy a tiny fraction of the world's surface, and yet they are some of the most valuable ecosystems on Earth (Badmin, 2014a). They are one of the rarer habitats in Kent – occupying only a tiny fraction (0.33%) of the county. Nevertheless, they are extremely important in relation to Kent's coastal ecology and biodiversity. Saltmarshes have an important function in protecting coastal areas from erosion by acting as a dynamic buffer against wave action. They are a rich and diverse habitat, are nationally and internationally important for waders and wildfowl, and support a special invertebrate assemblage with national rarities (Badmin, 2014a). Saltmarshes are also nursery areas for fish and crustaceans, contain specialised plant communities, and at a time when atmospheric carbon dioxide is increasing, they function as an important carbon sink.

A compendium of information on saltmarsh fauna and flora, including species inventories and commentaries on conservation importance, has been collated during the past decade and published in *The Natural History of the Isle of Sheppey* (Badmin ed., 2014b), complementing data in the *Kent Habitat Survey 2012* (Brennan, 2013).

Status and trends

Saltmarsh is a UK BAP-protected habitat, and areas of saltmarsh in Kent are protected under other conservation designations (Table 1). Saltmarshes occur in two separate areas in Kent; those in North Kent, which form a more or less connected stretch from Dartford to Faversham and are part of a regional European complex (Boorman, 2003); and those to the east in Pegwell Bay and the Stour estuary. In Kent, there are 1345.15 ha of saltmarsh, of which more than half (56%) is in the Medway estuary (Boorman, 2003; Table 1) (a similar figure of 1338.2 ha in Brennan, 2013, represents 11.2% of the county's littoral sediment area). Comparison of extent estimates in 1973 and 2006-9 for the Medway Estuary and The Swale suggest perhaps an increase in The Swale and decrease in the Medway (Table 1A; Phelan *et al*., 2011 who note caveats to the comparisons).

Table 1 Extent of saltmarsh in Kent

Location	Area ha	MCZ	SAC	NNR	SPA	Ramsar	SSSI	LNR
Medway	754.46	Medway Estuary			Medway Estuary & Marshes	Medway Estuary & Marshes	Medway Estuary & Marshes	
Swale	413.82	Swale Estuary		The Swale	The Swale	The Swale	The Swale	South Bank of the Swale
Thames south	77.67	Thames Estuary Swanscombe			Thames Estuary & Marshes	Thames Estuary & Marshes	South Thames Estuary & Marshes	
Stour	62.00		Sandwich Bay	Sandwich Bay & Pegwell Bay	Thanet Coast & Sandwich Bay	Thanet Coast & Sandwich Bay	Thanet Coast Sandwich Bay & Hacklinge Marshes	Sandwich Bay & Pegwell Bay
Pegwell Bay	37.20	Thanet Coast	Thanet Coast & Sandwich Bay	Sandwich Bay & Pegwell Bay	Thanet Coast & Sandwich Bay	Thanet Coast & Sandwich Bay	Thanet Coast Sandwich Bay & Hacklinge Marshes	Sandwich Bay & Pegwell Bay

Table 1A Historical extents (Phelan *et al.*, 2011)

	1973	2006-9
Medway	843.8	763.8
Swale	377	462.89

Five main saltmarsh zones relative to tide level can be recognised in the upper intertidal area (Table 2, from Boorman, 2003) and are generally parallel to the shoreline; these are less species-rich at low shore levels and more varied in the drier upper parts and assigned to two Annex 1 classes in Kent (Table 2A). All are present in Kent, as seen from historical records and from fieldwork during the past decade (Badmin 2014a) and reports in the annual Bulletin of the *Kent Field Club* from 2011 - 2021.

Table 2 Saltmarsh zones

Zone	Communities	Tidal extent
Pioneer marsh (above midlittoral mudflats)	Open communities with *Spartina anglica, Salicornia spp., Aster tripolium*	Covered by all tides
Low marsh	Closed marsh with the previous species and *Atriplex portulacoides, Puccinellia maritima*	Covered by most tides
Middle marsh	Closed community with the previous species and *Limonium spp., and Plantago maritima*	Covered by most spring tides
High marsh	Closed communities with *Festuca rubra, Armeria maritima, Elytrigia spp.*	Covered by only the highest spring tides
Transition area (to the land)	Intermediate between high marsh and non-haloplytic areas	Covered by occasional surges during extreme storm events

Table 2A Kent Annex 1 classes

Broad Habitat	Priority Habitat	Annex 1 Classes	Area ha
Littoral sediment	Coastal saltmarsh	*Salicornia* and other annuals colonising mud and sand	15.9
		Spartina swards (*Spartinion maritimae*)* **S. maritma* recently rediscovered in Kent	
		Atlantic saltmeadows (*Glauco-Puccinellietalia maritimae*)	780.1

Introduction | Headlines | Drivers | Conservation | Kent's Species | Landscape-scale | Case Studies | Conclusion
Agri management | Climate change | Hydrological change | Urbanisation | Invasives | Pollution | Habitat management | Marine | Wildlife recording | Licensing | Engagement | Public health

Overall, around 40 species of halophytes grow in saltmarshes, but with individual areas supporting between 10 and 20 (Boorman, 2003; Philp, 2010); most have been recorded during the past decade (cf. reports in the annual *Bulletin of the Kent Field Club* from 2011 - 2021) and new recordings continue to be made. The endangered species *Spartina maritima* was recently rediscovered in North Kent in upper saltmarsh at Castle Coote by Nagden Marshes (Kitchener, 2021) and the discovery of *Salicornia emerici* adds to the six glassworts in Kent (Kitchener, 2012, 2021). Associated with halophyte assemblages are brown, green and red marine algae (seaweeds), some of which (e.g. the red alga *Bostrychia scoripiodes*) are largely restricted to saltmarshes (Tittley, 2016).

Saltmarsh is also an important environment for non-marine invertebrates, with 143 exclusive to saltmarshes (Boorman, 2003); there are butterfly and bumblebee foragers on Sea Aster (*Aster tripolium*) and Sea Lavender (*Limonium spp.*), the hemipteran *Henestaris haophilus* whose nymphs can withstand tidal submergence, and some special to Kent such as the Saltmarsh Horsefly *Atylotus latistriatus* (Badmin, 2014a, c). The Swale saltmarshes of Sheppey are the last locality where the Essex Emerald Moth *Thetidia smaragdaria ssp. maritima*, a British endemic, occurred and not seen since 1991 (Badmin, 2014a).

Saltmarsh pools (saltpans) create habitat for marine invertebrates and non-marine species, such as the fly *Dolichopus diademus* (Badmin 2014a), as well as marine algae. Muddy channels through the saltmarshes are often lined with yellow-green algae (*Vaucheria spp.*), of which 10 species have been recorded for Kent.

Mudflats at the lower saltmarsh fringe and below contain infaunal invertebrate communities, including the Tentacle Lagoon Worm (*Alkmaria romijni*), a listed species and FOCI of the Swanscombe Marine Coastal Zone (bounding Broadness saltmarsh) designated in 2019; brackish lagoons at Cuxton in the Medway also host this species. Invertebrates such as the polychaete *Nereis diversicola* and the amphipod *Corophium volutator*, present in Kentish saltmarshes (Trigwell & Dussart, 2001), may play an important role in controlling saltmarsh erosion (Hughes & Paramor, 2004).

Drivers of change

Habitat loss

As mentioned, land-claim and industrial use has brought about extensive loss of saltmarsh, although the rate of loss is now much slower. The existence of saltmarsh reflects a dynamic relationship between erosion by action and the supply and vertical accretion of sediment by tidal flow and cover, which saltmarsh plants entrap and enable the marsh to keep building for as long as its height allows tides to flood. Accretion is also aided and abetted by the alien Common Cord Grass *Spartina anglica*, which occurs widely in Kentish saltmarshes. Habitat loss has been attributed to sea level rise (Boorman, 2003; Horton *et al.*, 2018) and biogenic factors (Hughes and Paramor, 2004). Recent field studies have noted the disappearance of saltmarsh islands in the Medway. In the outer estuary, fine sediment budget measurements show saltmarsh cliff, creek and tidal surface losses greatly exceed gains on vegetated saltmarsh surfaces (Kirby, 2009).

Climate

Temperature extremes and lack of rainfall are likely to affect the saltmarsh ecosystem (Boorman, 2003).

Sea level rise

The effects of sea level rise may impact a complex of physical and biological processes; sea level is rising in Kent because of isostatic rebound and climate change, with accretion in the Medway saltmarshes not keeping pace with Relative Sea Level rise (RSL) (Young, 2004). Predictions for the Thames area marshes are that RSL will rise 3 to 7mm per year between 2010 and 2030, 3 to 11mm per year between 2030 and 2050, and that southern and eastern saltmarshes will be in retreat by 2040 (Morton *et al.*, 2018). In the outer Medway estuary, where low and lowering tidal flats are vulnerable to sea level rise in a sediment-starved ebb-dominated system, a return to accretion appears unlikely (Kirby, 2009; Young, 2004). Alternatively, saltmarshes in southeast England will accrete vertically at the same rate as sea level rises – this rate rise would be no higher than in the past when saltmarshes developed; for example, saltmarsh accretion at 4-5mm per year, would keep pace with a sea level rise of 6mm per year (Hughes & Paramor, 2004). Recent saltmarsh erosion in the region is attributed to changes in intertidal biota, notably an increase in abundance of *Nereis diversicolor*, bioturbation and herbivory by *N. diversicolor*, and a decrease in abundance of intertidal sea-grass beds, which is causing the loss of pioneer plants and sediment stability (Hughes & Paramor, 2004). The balance between sea level rise and rate of accretion and elevation will determine the future for the North Kent saltmarshes (Young, 2014).

Anthropogenic disturbance

While land-claim, marsh digging, dredging of channels, and the construction of marinas have historically caused major disturbance, during the past decade there have been fewer of these activities. However, a major development is planned for the Swanscombe peninsular, potentially impacting one of the few remaining areas of saltmarsh (Broadness) on the south bank of the Thames. Other potentially disruptive activities include changes to grazing regimes, wildfowling, birdwatching, maritime activities, and recreational pursuits, which cause trampling.

Saltmarsh is an important aspect of human wellbeing (Badmin, 2014a), mainly due to its remote location, and peaceful and quiet environment.

Historically Samphire (*Glasswort, Salicornia spp.*) was gathered from Kent's saltmarshes; today, it is a fashionable vegetable and it is to be hoped that foragers do not disturb the saltmarsh environment by their presence when collecting, and that moderation is practiced.

Increased nutrient loading, causing eutrophication, encourages the development of 'green tides', as seen in the sheltered parts of the Medway Estuary. These are algal mats, which may smother the germination and growth of pioneer saltmarsh species; they may also bring about anoxic conditions to the detriment of nearby sediment-dwelling invertebrate communities (Boorman, 2003; Aldridge & Turner, 2009).

Non-native species

The most impactful non-native species in Britain and Kent's saltmarshes is the Common Cord Grass *Spartina anglica* (Stace & Crawley, 2015), which grows abundantly in the Thames, Medway, Swale and Pegwell Bay marshes, where it may form pure stands (Trigwell & Dussart, 2001). It colonises bare mud and invades saltmarshes at the earliest stages of succession, potentially outcompeting native species and altering plant and animal community structures (Trigwell & Dussart, 2001). *Spartina anglica* traps fine sediment particles, which build up and raise the level of saltmarsh. Its overall range in Kent has not changed a lot with slightly fewer tetrads (80) recorded by Philp (2010), compared with 84 in Philp (1982). Stands of the species in southeast England have suffered some dieback because it has changed the sedimentary and drainage conditions that lead to waterlogged conditions (Gray *et al.,* 1991); the ergot fungus *Claviceps purpurea* has also caused *Spartina* dieback (Badmin, 2014a).

Recording, monitoring and research

The main objectives for saltmarsh research, monitoring and recording are to identify loss or gain in area, the physical structure of a marsh, its vegetation zonation, structure and composition, and damaging events or activities to avoid deterioration of sites and create benchmarks for conservation objectives (JNCC, 2004; Phelan *et al.,* 2011). As Kent's saltmarshes represent a complex of physical environmental and biological interrelationships, a spectrum of specialist skills and knowledge is required, especially in hydrography and sedimentation processes, water quality, climate change and sea level rise, to achieve a better understanding of their roles.

Unfortunately, information on the overall extent and structure of Kent's saltmarsh is not available from the past decade, which means it is impossible to tell whether it has changed. To provide an overview that can then be assessed in the future, aerial photography and remote sensing will be instrumental (JNCC, 2004; Phelan *et al.*, 2011).

Quality indicators of the state of the saltmarshes are gained from quantitative ecological surveys; however, these are few and far between in Kent (Bishop & Dussart, 1986, Stour estuary; Clarke & Tittley, 1979, South Swale; Foyt, 1978, Faversham Creek; Trigwell & Dussart, 2001, Pegwell Bay). Transect and quadrat methods benchmark and improve awareness of the richness and significance of sites, and provide a statistical basis for future comparison – an approach advocated in monitoring guidance (JNCC, 2004); they may provide information on whether or not *Spartina anglica* is increasing and could provide clues about its impact. Quantitative studies, other than bird counts and surveys, have not been undertaken during the past decade.

Quality indicators can also be gained by species recording. For this, the skills and commitment of the voluntary sector have played a major role, with a long track-record of ornithological and other natural history recording, largely from walk-over surveys. Much data has been gathered during the past decade and new discoveries have been made as mentioned previously; this data has been used to prepare published atlases (Allen, 2009; Clements *et al.*, 2015; Philp, 2010; Tittley, 2016), papers (e.g. Badmin, 2014b) and reports (e.g. Clements, 2019; Kitchener, 2021) that help to create a more complete picture of the state of the biodiversity of Kent's saltmarshes.

Introduction | Headlines | Drivers | Conservation | Kent's Species | Landscape-scale | Case Studies | Conclusion
Agri management | Climate change | Hydrological change | Urbanisation | Invasives | Pollution | Habitat management | Marine | Wildlife recording | Licensing | Engagement | Public health

Conclusion

Kent is still blessed with a considerable extent of saline wetland, a habitat of local and national importance for its biodiversity. Its current overall appearance, extent and content appears generally not to have changed over the past decade. While land claim and drainage have no longer reduced the extent of saltmarsh, sea level rise and associated climate change factors may do so if the balance with sedimentation and elevation is not maintained. There remains a need for recording, monitoring, and research on the many aspects of the state of Kent's saltmarshes.

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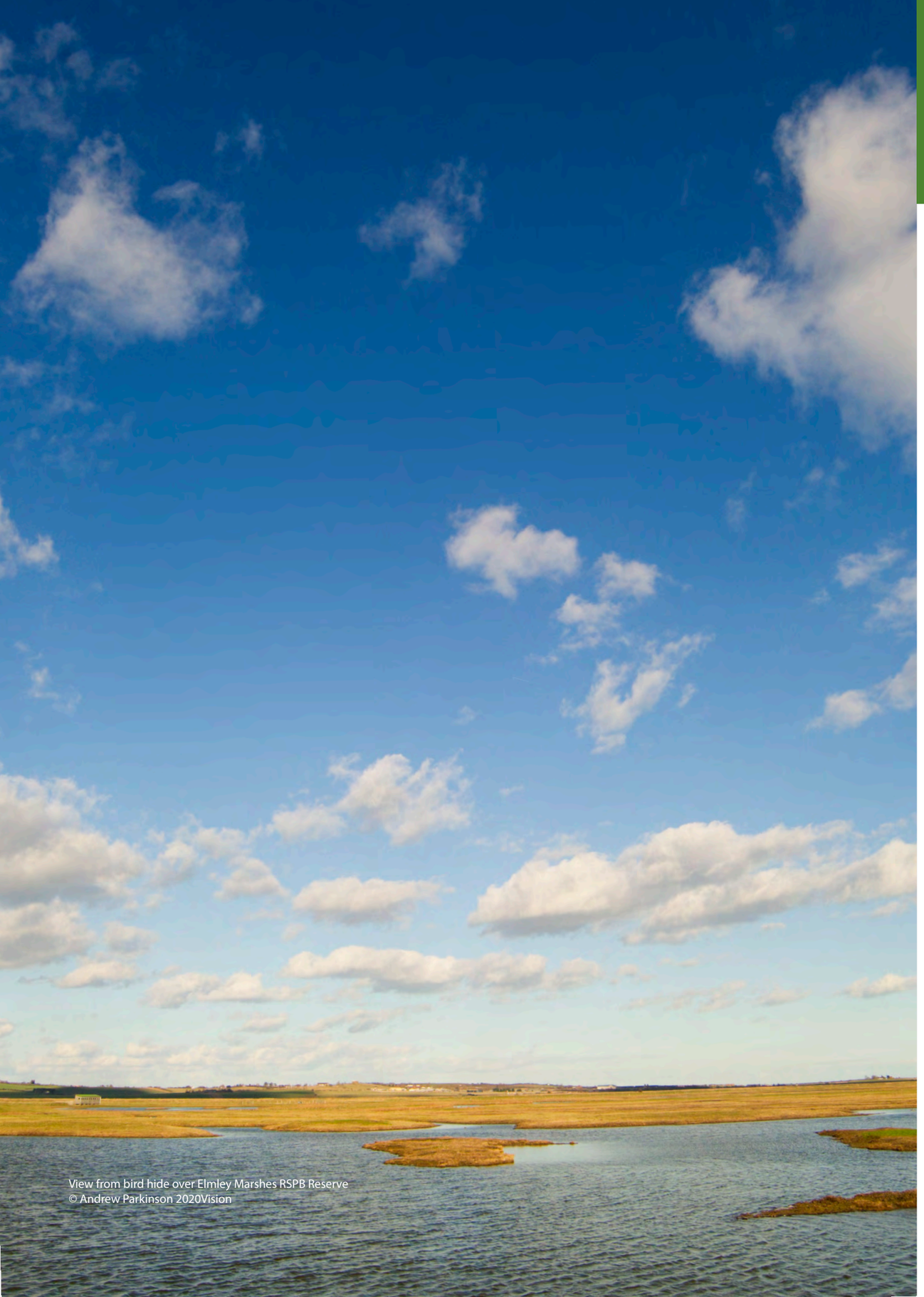

View from bird hide over Elmley Marshes RSPB Reserve
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CASE STUDY: SEAGRASS BEDS

IAN TITTLEY, NATURAL HISTORY MUSEUM, LONDON

Summary

The two species of seagrass known for Britain occur in Kent, although the wide-leaved variety of *Zostera marina* is recorded only in the historical literature. Sea-grass beds are restricted to the north of the county with no major decline noted during the past decade. They are nationally important habitats, and, in Kent, are afforded a high degree of protection under local, national and international site designations. The main likely drivers of change to seagrasses and associated communities are habitat loss and change, sea level rise, and anthropogenic disturbances. Monitoring in the field is required to understand more precisely their current health and future state.

Seagrass beds and their importance

Seagrasses are marine flowering plants that live in sheltered intertidal and subtidal areas around the coast of Britain and may form extensive green swards. They flower and set seed while immersed; rhizomes and seed maintain meadows of the species. Seagrasses are highly productive and play an important role in the marine ecosystem and in maintaining ocean health, not least in carbon absorption and sink. They are sensitive to physical disturbance, pollution, and nutrient enrichment of inshore waters.

Seagrasses stabilise the sea bed and encourage accretion by trapping sediment. Their rhizomes and roots are home to an infaunal community of molluscs, polychaetes, amphipods and others; their blades create habitats for seaweed epiphytes. Seagrass beds are nursery grounds for fish including seahorses (found across the Thames estuary at Leigh-on-Sea where beds occur) and wildfowl, especially Teal and Brent Geese, which feed on seagrass when the tide is low.

Status and trends

There are four species of seagrass in Britain and Kent: two eel grasses (*Nanozostera noltei, Zostera marina*) and two tasselweeds (*Ruppia cirrhosa, R. maritima*). The tasselweeds in Kent occur in coastal brackish pools and dykes above mean high water level and are not included in this marine section of the *State of Nature Report*. In general, eel grasses have been poorly recorded in Kent.

Past taxonomy of British seagrasses recognised three species within a single genus *Zostera* (*Z. angustifolia, Z. marina, Z. noltei*); more recently, the dwarf eel grass has been placed in a separate genus (*Nanozostera*), and the narrow-leaved eel grass (*Z. angustifolia*) classified as variety *stenophylla of Z. marina*.

The eel grass *Z. marina var. marina* is a wide-leaved plant for which there are historical records for the north Kent coast from Sheppey to Thanet, and for south Thanet, probably Pegwell Bay (Preston *et al.*, 2002). Wide-leaved plants have not been known since the 1930s according to Philp (2010) when populations were devastated by the marine protist slime nets *Labrynthula zosterae* and *Aplanochytrium sp.* (Hughes *et al.*, 2018). The occurrence of *Z. marina var. marina* in Kent was questioned by Tittley (2014) as it is a subtidal species in gravelly habitats; he posited that historical records may have been *Z. marina var. stenophylla*.

Seagrass beds are declining habitats, and are, therefore, protected under OSPAR, EU Habitats and Water Framework Directives, and by HAP under the UK BAP. They are also priority habitats under the post-2010 Biodiversity Framework. In addition, they are FOCI, for which MCZ can be designated. In Kent, seagrass beds are afforded a high degree of protection under local, national and international site designations (Table 1).

Table 1 Seas-grass bed site designations

MCZ	SSSI	LNR	SPA	Ramsar
Swale Estuary	The Swale	South Bank of the Swale	The Swale	The Swale
Medway Estuary	Medway Estuary and Marshes		Medway Estuary and Marshes	Medway Estuary and Marshes
Thames Estuary	South Thames Estuary and Marshes		South Thames Estuary and Marshes	South Thames Estuary and Marshes

Seagrass beds fall into the British NVC as community SM1, but without sub-communities with stands defined by the species present (Rodwell, 2000). The Marine Nature Conservation Review (Connor *et al.*, 2004) identifies two biotopes: "*Zostera noltei* (sic) beds in littoral muddy sand' [LS.LMp.LSgr.Znol], and '*Zostera marina* beds on lower shore infralittoral clean or muddy sand' [SS.Smp.SSgr.Zmar] but which does not distinguish var. *marina* from var. *stenophylla* stands."

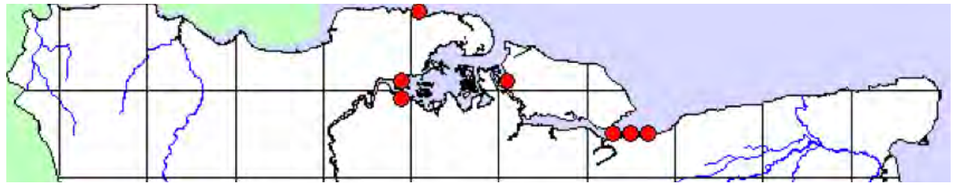

Figure 1 Occurrence of seagrass beds in Kent

Narrow-leaved eel grass (*Zostera marina var. stenophylla*) in Kent is an intertidal species that grows on mud and sand flats, often in shallow standing water. It is restricted to the north coast of the county, west of Whitstable, in the Swale, the Medway and outer Thames estuaries. Philip (2010) recorded it in fewer tetrads (seven) than previously (14 in Philp, 1982). During the past decade, populations have been confirmed in the Medway and outer Thames estuaries and on the north coast of Kent, but only from five tetrads indicating a slight decline in AOO since the 1980s.

Dwarf eelgrass (*Nanozostera noltei*) in Kent is also restricted to the north coast to the west of Whitstable, Medway and outer Thames estuaries; populations at Allhallows and Graveney to Seasalter mapped by Philp (1982; six tetrads) were confirmed present by Philp (2010; five tetrads); during the past decade populations have been relocated and also found near Gillingham, Hoo and at Rushenden on Sheppey, in seven tetrads altogether suggesting its AOO in Kent has not declined. Dwarf eelgrass is a nationally scarce plant listed as 'vulnerable' with a national decline in AOO of 44% and a decline in habitat quality.

Drivers of change

Habitat loss

There is no clear evidence to indicate change in extent of intertidal seagrass beds of North Kent during the past decade due to habitat loss, although there remains a need for research and monitoring; D'Avack et al. (2019, 2020) identifies seagrass biotopes nationally as being highly sensitive to habitat loss, changes to the seabed and sediments, water clarity and siltation. They also note that a healthy population of suspension feeding bivalves improves habitat quality and seagrass productivity by reducing water turbidity.

Climate

According to D'Avack *et al.* (2019, 2020), seagrass beds are not sensitive to global warming, but they are more sensitive to extreme heat-waves.

Sea level rise

Sea levels are rising around Kent because of isostatic rebound and climate change; isostatic sinking in North Kent is measured at 1.5mm per year, while melting of the polar ice caps adds an annual 1.5 – 3mm rise. Together these are causing coastal squeeze, potentially reducing the extent of intertidal area available for seagrass beds. Data is lacking as to whether this has caused the extent of seagrass to decrease in North Kent, and thus the need for research and monitoring. D'Avack *et al.,* (2019, 2020) identified seagrass beds as nationally having medium to high sensitivity to sea level rise.

Ocean acidification

D'Avack *et al.,* (2019, 2020) state that seagrass beds are not sensitive to ocean acidification.

Anthropogenic disturbance

Seagrass beds are sensitive to physical disturbance particularly from bivalve fisheries involving dredging, digging or raking (D'Avack *et al.*, 2019, 2020). Areas of seagrass occurrence in North Kent fall within cockle harvesting areas; information is lacking as to whether bivalve fisheries have had an impact on seagrass beds in North Kent, and thus the need for research and monitoring.

Engineering works are also potentially damaging to seagrass beds; for example, in 2021, the construction of the Cleve Hill substation in North Kent, plus the works for cable laying to connect with offshore wind turbines, impacted the intertidal area where seagrass occurs. However, recovery monitoring of seagrass beds following pipeline laying in northwest England revealed temporary loss in the short term, but recovery in the medium term (Tittley & Huxley, 2016). This may be the case in Kent.

Losses in seagrass beds due to increased nutrient loading and organic enrichment is a world-wide feature (Bertness, 2007), particularly where agricultural run-off has increased plankton production and limited light transmission in the water column; D'Avack *et al.* (2019, 2020) rate seagrass beds as highly sensitive to changes in water clarity. Although recent field studies and Preston *et al.* (2002) note the persistence of *Nanozostera noltei* in the Thames and Medway estuaries, the impact of inshore water quality in Kent on seagrass beds remains a subject for investigation.

Non-native species

D'Avack *et al.* (2019, 2020) identified non-native plants and invertebrates as negatively impacting seagrass beds and refer to *Sargassum muticum, Spartina anglica, Didemnum vexillum, Urosalpinx cinerea* and *Magellana gigas*, all of which occur in North Kent. The blanketing effects of excessive growths of *S. muticum*, while occurring in East Kent chalk shore habitats, have not been recorded over seagrass beds to the west. The spread of *Magellana gigas* appears also not to have impacted seagrass beds. Encroachment by *Spartina anglica* (of non-native parentage), a species that has been transplanted and spread naturally, is of concern in Britain, invading saltmarshes at their early stages of succession (Stace & Crawley, 2015) and potentially spreading over intertidal seagrass areas. Despite its widespread occurrence in North Kent (Philp, 2010) as extensive swards (Badmin, 2014), evidence for its outcompeting of seagrass beds there requires investigation.

Recording, monitoring and research

Seagrass beds have been relatively poorly studied in Kent, not least because of difficulty of access, especially in estuarine areas (Philp, 2010). Area polygon mapping and quantitative and time-series monitoring have been undertaken rarely previously (e.g. Clarke & Tittley, 1979) and are required to be able to assess future change and understand the causes and processes involved.

Conclusion

Seagrass beds are a rare and, therefore, important intertidal habitat in Kent and currently restricted to only seven tetrads in the north of the county. In view of their ecological and conservation importance, and sensitivity as a nationally declining habitat with potential decline in Kent caused by sea level rise and coastal squeeze, encroachment by *Spartina anglica*, and other anthropogenic pressures, further study is required to record their overall area of occupation, assess their local extents and follow changes with time.

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MARINE

COMPILED BY CHRIS DRAKE, KENT COUNTY COUNCIL

Introduction

The Kent and Medway marine and intertidal area is extensive and rich in biodiversity. This contributes to the wider UK marine environment, which has the widest range of marine habitats of any coastal waters in Europe. These marine and intertidal habitats and species have been subject to many pressures over the last 10 years, ranging from development, human disturbance and pollution to climate change and the rise of invasive non-native species. These areas are covered in this section with contributions from a range of experts. Positive drivers, including major policy changes, have also been included. This mainly focuses on the MCAA 2009, including the establishment of MCZs and Marine Plans. The focus of this section of the report is the marine and intertidal area; however, other coastal habitats adjacent to the high tide mark are also covered in the coastal habitat management section in *Drivers of Change*.

Drivers of change

Policy change

The MCAA 2009 marked a significant change in government policy in response to the recognised pressures on the marine environment and the complexity of managing these pressures. Amongst other aspects, the act resulted in MCZs, Marine Planning, and the England Coastal path. It also established the Marine Management Organisation and IFCAs.

This report examines how the act has been implemented for the Kent marine area, and, where possible, evaluates the effectiveness of this. Some important aspects, such as the South East Marine Plan, have only recently been completed, and there is currently not enough evidence or condition assessments to fully demonstrate what MCZs are achieving, so it is too early to evaluate all aspects of the act. If implemented and enforced well, however, the Marine Act has the potential to address some of the other pressures described in this chapter.

Marine Conservation Zones

Lucy Crooks, Natural England

There are 91 MCZs in English waters, which have been designated in tranches since 2013. The final designations in 2019 completed the Blue Belt in the United Kingdom, and these areas protect a range of important and diverse species and habitats. In Kent, there are now 11 MCZs:

Tranche 1 (2013):

- Medway Estuary MCZ – features include subtidal sediments, peat and clay exposures, Tiny Bristle Worm and Smelt.
- Thanet Coast MCZ – features include subtidal sediments, moderate energy rocks and complex intertidal reef species.
- Folkestone Pomerania MCZ – features include subtidal sediments and *Sabellaria* sp.

Tranche 2 (2016):

- Swale Estuary MCZ – features include intertidal sediments, subtidal sediments and rocky habitats.
- Dover to Deal MCZ – features include intertidal sediments, subtidal sediments, moderate energy rocks and bivalve species.
- Dover to Folkestone MCZ – features include intertidal sediments, subtidal sediments, moderate energy rocks and native oysters.

Tranche 3 (2019):

- Goodwin Sands MCZ – features include subtidal sediments, Blue Mussel beds and Ross Worm reefs.
- Foreland MCZ – features include circalittoral rock and subtidal sediments.
- Swanscombe MCZ – features are intertidal mud and Tentacled Lagoon Worm *Alkmaria romijni*.
- Kentish Knock East MCZ – features include subtidal sediments.
- Inner Bank MCZ – features include subtidal sediments.

Furthermore, due to new evidence, tranche 3 also designated additional features to existing Kent MCZs:

- Medway Estuary MCZ – Smelt *Osmerus eperlanus*.
- Thanet Coast MCZ – Stalked Jellyfish *Haliclystus sp.*.
- Dover to Deal MCZ – Blue Mussel beds, high energy circalittoral rock, moderate energy circalittoral rock and Ross Worm reefs.

For each feature of the MCZs, a GMA is assigned; this describes what is required for each feature for the site to achieve the conservation objective. The GMA can either be Maintain (in favourable condition) or Recover (to favourable condition). The GMA considers the sensitivity of the features to pressures, as well as the extent of features. The GMA should be referred to when determining appropriate management of a site.

Marine Conservation Zones are just part of an overall network of MPAs, which include European designated sites such as SPAs and SAC. The Kent

Crab fishing in Whitstable

coastal and marine area has many such designations, which with varying degrees of success have served their purpose over the last two decades. Backed up by MCZ designations, there is now an extended network of Kent MPAs; however, bylaws, enforcement and education are covered in the marine conservation chapter.

Cultural Heritage within the Natural Environment

Kathryn Collins, Howell Marine Consulting

Protection of marine areas is not only limited to nature conservation purposes; areas of local or national cultural significance also require consideration within decision making. These areas include shipwreck sites, and often have a dual importance for both nature conservation and cultural heritage. Indeed, nature conversation and heritage do not exist in isolation of each other. A good example of how heritage can increase biodiversity is the MPA around Lundy, off the coast of North Devon, where protected shipwrecks provide habitat for both protected species and important cultural assets for the island's tourist economy.

In the waters around Kent, the Goodwin Sands is one such example of a marine area which affords consideration of its cultural significance. Culture and heritage both link our contemporary uses of the sea to those of our ancestors, and, regarding the Goodwin Sands in terms of its cultural heritage, gives us insight into changes uses of the sea – and our changing relationship with it.

The Goodwin Sands comprises both subtidal (always underwater) and intertidal (above water at low tides) sandbanks. Located approximately six miles east of Deal, they are an important cultural heritage asset within the marine area surrounding Kent. The sandbanks provide some coastal protection for the East Kent coast from the storm waves and are an important site for breeding and pupping seals. In May 2019, the Goodwin Sands was designated as a Marine Conservation Zone to protect its rich benthic habitats, including Ross Worm reefs (*Sabellaria spinulosa*) and Blue Mussel beds.

The cultural heritage value of the Goodwin Sands is multifaceted. Due to the shallow waters and hidden navigational hazards, the area is infamous as a site of historic shipwrecks. Historic shipwrecks lead to a trade in 'huvveling' from the nearby Deal, where locals would help rescue those in peril… with payment made of course. These shipwrecks were joined by WW2 aircraft during the Battle of Britain.

Historic accounts of the Goodwin Sands attribute many 'fanciful legends and stories' to them. Among


Seals laying on the sand

these are several versions of stories linking the Goodwin Sands to the 11th century Earl Godwin, in which the 'drowning' of an island resulted in the sandbank as we know it today. Earl Godwin is said to have lost his island to the sea as either "a just judgment upon him for his many crimes and his wicked life", or for failing to make good on a vow to the Saints to construct a church spire at Tenterden in payment for his safe passage home during a stormy night at sea. In recent years, the Goodwin Sands has been less of a 'hazard' and more of a 'recreation' space. During the 1900s, for example, hovercraft voyages were made to the Goodwin Sands – and even the odd game of cricket has been played there, recreating games that had occurred there as early as 1824.

The numerous stories attributed to the Goodwin Sands, whether fact or fiction, provide a rich representation of the space as one of great cultural value. Historical accounts of shipwrecks, and stories of the destruction of land to make the Sands, remind us of the power of the sea. At the same time, their presence has helped shape coastal towns, bringing both opportunities, as well as dangers. Their cultural value is, therefore, an important part of the story of East Kent.

So, how do we balance the needs of today with looking after our much-loved cultural assets? This is a question which has no easy answer. Much depends on individual beliefs about the importance of preservation versus the importance of providing goods and services to meet the needs of people. Today's multiple uses of the marine environment form part of the story of Kent going back hundreds of years. This falls outside the scope of this report; however, an understanding of these different value judgements is relevant to protecting marine habitats for nature conservation purposes.

The reality is that Kent's seas are some of the busiest in the world. Shipping for trade and leisure, plus

the multiple offshore industries that operate in the area – offshore renewables, telecommunications and electrical cabling, aggregates extraction, and tourism activities – need to be given space to operate in a way that balances their requirements while minimising impacts on the marine environment.

How people value their environment can be a material consideration within plan making and development management. Marine planning (described below) presents an opportunity for people to contribute to these challenging discussions and help to shape the future management of our coastlines and marine environments.

The Dover Strait seascape character assessment provides a reference document and planning tool for the coastal and marine area in this part of the Kent. Seascapes assessments are being used in marine and terrestrial planning, and such character assessments allow cultural heritage to have a voice in decision making. This approach can lead to better decision making and win-win outcomes for both cultural heritage and biodiversity.

Marine Planning

Sourced from the Marine Management Organisation

Marine plans form a part of the government's long-term vision for the environment, providing confidence for decisions in the marine area. The South Marine Plan only covers a small part of the Kent marine and coastal area; however, it is still interesting to consider as it is already being used in decision making – despite only being adopted in July 2018.

The South East Inshore Marine Plan area covers most of the Kent marine and coastal area, stretching from Felixstowe in Suffolk to near Folkestone in Kent; it covers approximately 1,400 km of coastline, taking in approximately 3,900 km^2 of sea. This was only adopted in June 2021, so it is too early to evaluate this plan. The South Marine Plan covers the inshore and offshore marine plan areas from Folkestone in Kent to the river Dart in Devon and to the international boundary with France and the Channel Islands. The plan includes 12 plan objectives supported by 53 plan policies, which helps to deliver the government's vision and HLMOs. As with all marine plans, it will be kept under review and reports will be published every three years following adoption.

The review for the South Marine Plan and other aspects of marine planning are covered in the Conservation chapter.

The pressures on nature

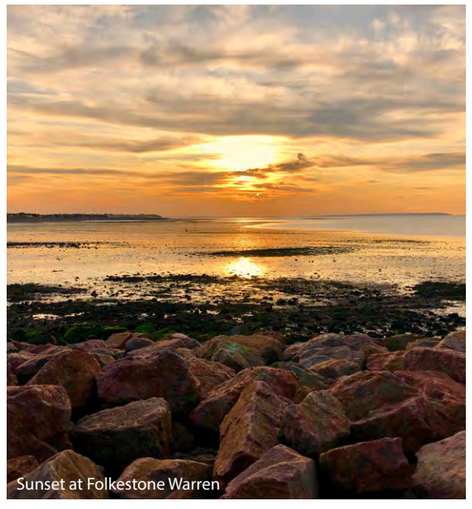
Climate Change

Chris Drake, Kent County Council

Climate change is having severe impacts on our marine environment through rising sea temperatures, ocean acidification, and rising sea levels. The latter is more advanced in the southeast due to isostatic rebound, which is the gradual rise of land that was depressed by the huge weight of ice during the last ice age.

Saltmarsh is one of the most important habitats in Kent for biodiversity and recognised as such nationally and internationally. It is also a habitat prone to the effects of coastal squeeze, whereby sea level rise results in the habitat being pinched against hard coastal defences. The existence of saltmarsh reflects a dynamic relationship between erosion and accretion of sediment, and these processes are described under Habitat Management – Coastal Habitats, in this report.

Climate change is also likely to increase the risk and impact associated with marine INNS, which pose a threat to native wildlife through direct competition for space and resources. Over the years, many species have arrived through shipping, fisheries and other sources, and some have been on the rise in the last 10 years, in part enabled though climate change. The impact on native species and the conservation response is described in this report. The Pacific Oyster is a good example; a species once thought unable to survive in colder UK seas, it is one which is now smothering native common mussel beds off the Kent coast.


Sunset at Folkestone Warren

Invasive non-native species

Willie McKnight, independent (formerly Natural England)

INNS continue to increase their distribution and abundance around the Kent coast. Some species, such as the Slipper Limpet *Crepidula fornicate*, are long established, while others such as Wireweed *Sargassum muticum* and the Pacific Oyster *Magallana gigas* are more recent arrivals. Most recent to arrive in Kent include the Carpet Sea Squirt *Didemnum vexillum* and the Brush Clawed Crab *Hemigrapsus takanoi*. The NBN Atlas shows the distribution of marine INNS around the county coastline. *Crepidula fornicata* is present from Greenhythe to Lydd. *Sargassum muticum* is seen between Faversham and Lydd with greatest density between Seasalter and Margate. *Magallana gigas* is recorded from Greenhythe to Littlestone-on-Sea and is most abundant between Medway and Ramsgate. *Didemnum vexillum* is established between Seasalter and Birchington with Bishopstone, Herne Bay, hosting the largest population. *Hemigrapsus takanoi*, the most recent recorded arrival, is present in Medway and Thanet. *Eriocheir sinensis* is established in the Thames and is recorded from Gravesend to Medway and around the Stour estuary at Pegwell Bay. *Undaria pinnatifida* is seen in Ramsgate and Dover marinas. The Thames estuary and north Kent coast host the largest recorded populations, along with the Medway and Swale estuaries, where the Chinese Mitten Crab *Eriocheir sinensis* and Asian Shore Crab *Hemigrapsus sanguineus* are also found.

INNS summary for North East Kent Marine Protected Area Swalecliffe to Deal

Natural England's INNS project operating within the intertidal zone of the NEKEMS, now known as the NEKMPA, provides a useful case study.

In 2012, Natural England added five target species to their INNS project: Wireweed *Sargassum muticum*, Wakame *Undaria pinnatifida*, Carpet Sea Squirt *Didemnum vexillum*, Chinese Mitten Crab *Eriocheir sinensis* and a red turf alga *Caulacanthus okamurae*. The project, previously launched in 2007, focused exclusively on the distribution, abundance, and impact on native species of wild Pacific Oysters.

Baselines were produced for each species using similar methodology deployed in the initial Pacific Oyster survey. Data showed oysters present across the protected areas from Swalecliffe to Ramsgate, occupying 33 of 46 1 km sections, which form the NEKMPA. Abundance was greatest along the north Kent coast, reducing on the east Kent sections. Peak abundance, 212 oysters/m^2, was recorded at Epple Bay, Birchington. The native species most affected was the Common Mussel *Mytilus edulis*. Mussel beds at Epple Bay and Beresford Gap, Birchington, had been overlaid and converted to oyster reefs. An adjacent population of Ross Worm *Sabellaria spinulosa*, in intertidal reef format, suffered a similar fate. Both these native habitats are listed as Habitat Features of Conservation Interest within the NEKMPA and are required to be maintained in favourable condition.

At Ramsgate, oysters were seen displacing a population of Sand Mason Worms *Lanice conchilega* established in the lower shore zone. Widespread oyster settlement was recorded on Thanet's intertidal chalk reef, which is a feature of the Thanet Coast SAC and provides a habitat for infauna such as the Common Piddock *Pholas dactylus*. Wireweed was present in 17 of the 1 km sections, with greatest abundance at Fulsum Rock, Margate, where it had become the dominant alga in the mid-shore zone, smothering native algae. Wakame (a type of seaweed) was contained in a single section at Ramsgate harbour, with scattered specimen attachment to pontoons and hulls.

Distribution of the Carpet Sea Squirt was recorded in eight sections on the north Kent coast between Swalecliffe and Minnis Bay, Birchington. Peak abundance was recorded at Bishopstone, Reculver. Native species affected were wide ranging, resulting in the smothering of in situ flora and fauna. The Chinese Mitten Crab was seen in one section at Pegwell Bay, Ramsgate. Abundance was low, equating to a single live specimen thought to have arrived in the marine environment from the adjacent River Stour to reproduce. *Caulacanthus okamurae* was recorded in eight sections between Pegwell Bay, Ramsgate and Foreness Point, Margate. Abundance was greatest at Western Undercliff, Ramsgate, where the native alga *Gelidium pusillum* was displaced and patches of mussel bed were overlaid.

The conservation response to these issues is described in the *Marine Conservation* chapter.

Development

Ian Humpheryes, Environment Agency, and Chris Drake, Kent County Council

The Kent marine and coastal area is rich in biodiversity and is vital for tourism, shipping, renewable energy, fisheries and other industries. Dover Strait represents the world's busiest shipping lane, and the Thames estuary is the corridor to DP World London Gateway in Essex, handling the largest deep-sea container ships in the world.

Biodiversity lives alongside this industry and there are both negative and positive pressures on the marine environment explored in this report. It is also the case that, in the coming years, new Marine Plans will help to determine the type of development that occurs off the Kent coasts, taking greater account of the impacts on biodiversity.

The increasing dependence on renewable energy production and creating a sustainable energy grid has contributed to the pressure on some habitats. Offshore windfarms have increased in number or are in the process of enlarging. The turbines require heavily armoured cables to be buried in the seabed and intertidal areas on route to a land-based substation. Significant numbers of these cables have been installed across the marine habitats of the Kent coast, particularly at Pegwell Bay and around the Isle of Grain. High current power cables have been laid from Europe to the UK, and several have come to shore in Kent with the same effect as the windfarm power cables. These have been observed to affect salt marsh habitats where restoration work following their installation was insufficient.

Ports have continued to expand resulting in significant amounts of dredging and pier expansion replacing established harbour habitats. Some mitigation measures have been successful, particularly at Dover Port, to replace lost habitat.

Replacement of artificial structures – where wooden piers/stone walls and sea defences are removed, along with their established biota and replaced by sheet piling – is common, particularly within the estuaries. Sea defences are necessary, but alternatives such as managed retreat (where possible) allow for the management of water, while allowing inland movement of saltmarsh and mudflat habitats. Site "X" on the Hoo Peninsula is a successful example of managed retreat. In contrast, hard sea defences such as sheet piling have very little biodiversity value, but they may protect valuable grazing marsh habitat on the landward side of the defence.

Wildlife disturbance

Sourced from North Kent Bird Wise Project

Wading birds and wildfowl travel thousands of miles to spend the winter on mudflats, saltmarsh and other habitats along the Kent coast. Meanwhile, the human population in Kent is rising fast and the targets for housebuilding are massive. The additional population from the building of new homes will mean an increase in recreational activity at the coast. Disturbance reduces the birds' feeding opportunities, meaning they may have insufficient energy to survive the winter or to complete their migratory journey to their breeding sites, leading to a reduction in the bird population. Special Protection Areas on the north Kent coast and in Dover/Thanet district are particularly prone to bird disturbance from dogs off leads, cycling, jogging and other activities. People need to enjoy their coastal environment, but there are ways of doing this that are sensitive to bird and other wildlife disturbance.

Through financial contributions from developers, mitigation measures are attempting to address these issues and engagement programmes, such as Bird Wise, are described in the *Marine Conservation* chapter.

Pollution

Chris Drake, Kent County Council

The Kent coast has not seen a significant petroleum oil incident this century, but as it sits alongside the busiest shipping lane in the world, there is always the risk of a major oil spill from shipping occurring. Smaller incidents involving refined crude oil still occur, along with vegetable and mineral oil pollution from fuel. These incidents are often dealt with at a local level, but multiagency responses have been taken, for instance in 2016 where clumps of paraffin-based waxy mineral oil washed up from Hampshire to Kent. Unless removed, these oils remain in the marine environment, killing coastal wildlife. Vegetable oil and palm oil are also toxic to dogs that may eat it. Although the risk of a major spill is small, the impact it would have would be disastrous. These risks are mitigated by local emergency plans and international, UK and EU shipping legislation, which has been significantly tightened up since the crude oil Sea Empress incident in Pembrokeshire in 1996.

Unfortunately, these are not the only type of marine pollution incidents, and sewage pollution is an ongoing problem, with significant incidents occurring as recently as summer 2021, because of pumping station failures. Legal discharge of wastewater is permitted by the Environment Agency in certain circumstances; however, such faults in water company infrastructure have resulted in illegal sewage pollution at various points around the Kent coast, including the estuaries.

For bathing beaches, the economic and tourism impacts are obvious; however, high nitrate and phosphate levels from sewage have a damaging effect on shoreline biodiversity and can aid the spread of more resilient invasive species. Nitrate and phosphate pollution is also occurring from agricultural run-off and can have the same damaging effect on shoreline biodiversity, particularly in estuaries and creeks. While this type of pollution does not have the same devastating impact on biodiversity as a petroleum-based oil spill, cumulatively, this type of pollution is concerning; however, more research is needed on the marine impacts of nitrate and phosphates.

Plastic pollution has rightfully caught public attention in recent years, and this is a big problem for the Kent marine and coastal area, with many volunteering

hours dedicated to removing a tonne of waste from our shorelines every year. While larger pieces of plastic are inert, they can get caught around and in the bodies of marine wildlife causing death. The problem of virtually invisible microplastics building up in the food chain is perhaps even more worrying.

Insufficient data on the marine environment

Chris Drake, Kent County Council

There is an innate difficulty in undertaking meaningful monitoring of marine species at a county level, and apart from new work carried out for the MCZs, we appear to be in no better a position than in 2011. There are some excellent programmes, such as Seasearch and Shoresearch, as well as detailed surveys for the likes of wind farm developments; however, overall, there are many gaps in annual recording, and if we do not have a good baseline, it will be difficult to direct future conservation action.

The state of nature

Chris Drake, Kent County Council

This section has explored some of the drivers of change in Kent's marine and intertidal areas; this includes a range of pressures from land-based development and pollution, to international pressures such as climate change and plastics at sea. Positive drivers, such as new marine designations and plans, have also been included, though it has not been possible to cover all the pressures, including the impact of different types of fishing, for example.

The state of nature as a result of all these influences is a more difficult area to assess. This is partly due to the difficulty in accurately recording marine biodiversity and identifying trends, but also the difficulty in reliably linking those trends with specific pressures. One thing, however, seems to be clear: pressures on marine biodiversity are increasing around this busy part of the South East.

There have, however, been some positive trends over the last 10 years. For example, the Zoological Society of London's annual seal population survey – which started in 2013 – demonstrates increasing population trends, with 2,866 Grey and 797 Harbour Seals recorded in the Greater Thames Estuary (Felixstowe to Deal) in 2021. A high population of apex predators, such as seals, provides an indication that prey species are also thriving, and ,therefore, indicates that the Thames Estuary is far healthier than public perceptions might suggest.

While the health of the Thames – considered biologically dead in the 1950s – is a positive story of how nature can recover, the Kent marine area and coast is still facing new pressures, from ports and renewable energy schemes, right through to meeting the needs of a growing population.

The difference between now and the 1950s – or even 10 years ago – is that there is a much better understanding of the importance of marine biodiversity. Going forward, proper planning and mitigation will need to be ensured to limit the negative impacts of future development. This approach could also unlock opportunities for marine biodiversity to recover though principles such as net gain. Education and public support, better recording of marine biodiversity, and effective implementation of the Marine Act and other environmental legislation will also be key to securing marine nature recovery around Kent and Medway.

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Grey seal *Halichoerus grypus* © Neil Aldridge

Vegetation monitoring

WILDLIFE RECORDING

TONY WITTS, KENT & MEDWAY BIOLOGICAL RECORDS CENTRE

Introduction

Biological recording is the formal process of making a wildlife observation into a piece of scientifically useful information that can be used to detect changes in the distribution and abundance of species. For a record to be valid, it must have four basic pieces of information:

1. **What** – the species observed, preferably with its scientific name to avoid confusion.
2. **Where** – a named location and a spatial coordinate e.g. Ordnance Survey grid reference.
3. **When** – the date it was observed.
4. **Who** – the person(s) who saw it.

Additional information such as abundance, the name of the person who identified it (the determiner), associated species, food plants, life stage and sex can also be recorded to enhance the value of a record. Kent has a long history of biological recording reaching back to the 16th century. John Gerrard mentions several Kentish locations in *The Herball or Generall Historie of Plantes* of 1597, while Thomas Johnson's *Iter Plantarum* (1629) and *Descriptio Itineris Plantarum* (1632) record two botanical excursions through Kent by the author and his companions. With the development of the railway network in the 19th century the number of naturalists visiting the county grew; this continues to this day, though coverage tends to be patchy and focused on high biodiversity areas, i.e. nature reserves. There have been periodic, concerted efforts made to cover the entire county for specific species groups for locally published floras and species atlases (Philp, 1982; Philp, 2010; Tittley, 2016; Young *et al.*, 2015); while studies of other species groups' distribution in Kent, such as dragonflies (Brook & Brook, 2009), and bees, wasps, and ants (Allen, 2009; Allen, 2020) have also been published and provide a useful snapshot of the general state of their focal species in Kent. These publications require an enormous amount of time, effort and technical expertise to produce.

The pressure on nature

There is a well acknowledged disconnect between the general public and nature, which has been increasing since the 1950s (e.g. Kesebir & Kesebir, 2017 and Balmford, *et al.*, 2002), as well as a simultaneous decline in natural history teaching in schools, resulting in poor nature literacy across the population (Robertson, 2020). Interest in observing and recording wildlife among the public has increased in the last 20 years or so, with the development of 'citizen science' programmes and concerns over the state of nature. Nevertheless, other than birdwatching, general wildlife recording is still considered to be a rather odd occupation. For many people, wildlife recording only comes to mind when there is an imminent threat of development on their doorstep, by which time it is usually too late (although see Hall & Gibson (2021) for an exception where recording helped defend a site against a potential development). A lack of interest in wildlife and the concurrent loss of general knowledge that enables the labelling of species is a pressure on wild flora and fauna. Nature needs the public to care about it – especially if pressure is to be placed upon politicians and businesses to consider wildlife in their decision making.

The loss of natural history in education means that fewer children are exposed to the diversity of wild species in Kent; therefore, fewer can take their study further and develop the skills required to find and name species. Identifying many plants, fungi and insects is difficult. Without local taxonomic experts, they become effectively invisible, and changes in the environment go undetected until larger and more obvious species are affected, e.g. farmland birds. It is perhaps in the wider countryside, outside nature reserves, that the effects of these issues are felt most, where species live unnoticed, unrecorded and are potentially under most threat.

The state of nature

With the development of the internet and digital photography, there has been a relative 'boom' in biological recording. There is a wealth of good identification information for a wide range of species groups on the internet, and websites such as iRecord, iSpot, and iNaturalist have become very popular as they enable the users to easily record what they see. By uploading photographs, users can get help with identification from peers and experts. Although there are record flows from these systems, they do not always make local data easily available; however, some like iRecord do.

For some taxonomic groups, digital photography is an effective tool for identifying a species, i.e. birds, butterflies, and most moths; however, it tends to be the more conspicuous species that dominate the records and more cryptic species are rarely recorded. This leads to a bias in the dataset that is absent from

records made by expert field naturalists. It has been estimated that only 10% of British flies, bees, wasps and ants are identifiable[1] from photographs (Morris, 2020), meaning only 1,400 species of the c14,000 species are detectable by this method.
Online platforms rely on there being a steady supply of voluntary taxonomic expertise on hand to verify identifications.

In Kent, at the KMBRC, only records that have been assessed as accurate are accepted into the database, meaning that, where there is no expert active to do the verification for a taxonomic group, the records are discarded. KMBRC downloads records from iRecord every six months, and, since 2018, has accessed nearly half a million records. More than 30% of these have been unusable because they are not verified. The discarded records are largely for plants and birds, as there is currently only capacity and experience amongst entomologists (though not necessarily locally) to verify most of the insect records. However, as this population ages and the volume of records increases, it is not certain how sustainable this is. Mammal records are covered by the Kent Mammal Group. There is a risk of losing a vast amount of critical information if new field entomologists are not recruited and nurtured. It is hoped that the increase in photographers interested in wildlife will result in a proportion of them going on to a deeper study of their favourite groups and begin responsibly collecting[2] insects for microscopical examination.

The response for nature

There are positive signs for the future of biological recording and, consequently, the nature of Kent. There is the possibility that a GCSE in Natural History could be available for schools to teach in 2023; this, as well as the terrific growth in the delivery of Forest Schools, could go a long way toward bringing nature into the lives of thousands of pupils.

The growth of birdwatching as a pasttime amongst adults is also a good sign. The challenge of trying to identify birds can sometimes be a gateway to other taxa, i.e. The British Trust for Ornithology's recording application now encourages birders to record mammals and Odonata, the records from which are made available locally through iRecord.

The KFC aims to deepen the understanding and appreciation of the natural history of Kent. Founded in 1955, it has around 200 members ranging across the spectrum, from professional experts in a particular field of study, to those who simply appreciate the


Survey work at Blean Woods
© Robert Cannis

aesthetic beauty of our countryside and love to walk in it, observing its wildlife in the company of like-minded people. The KFC arranges an annual programme of field meetings, publishes journals, newsletters and books, and works closely with the KMBRC in helping to provide a better knowledge of Kent's wildlife to assist its conservation. Its work makes a huge contribution to the gathering of biological records within the county. KWT runs a programme of Wildlife Study Days, designed to help the people of Kent learn more about the wildlife of the county. Beginners are welcome and those with some experience are able to improve their knowledge and identification techniques. Subjects include ornithology, mycology, entomology and botany, and participants are encouraged and informed about the value and pleasure of wildlife recording. Some have been inspired to develop their skills and interest to a level at which they have become expert contributors to biological recording in the county and more widely.

Baseline surveying and ongoing botanical monitoring have often been seen a 'nice to have' rather than an essential pillar in conservation land management. The recent inception of the Conservation Evidence Team within KWT is a valuable asset to wildlife in Kent; species monitoring and recording is now formally at the centre of conservation action and management decisions on their reserves, as well as in conservation delivery by many other organisations working in the county. Species surveying and identification can be time consuming and, therefore, expensive; for funding bodies, it is often hard to see the value in this compared to the more tangible outcomes delivered through capital works. An additional challenge to securing funding for effective species monitoring is that outcomes are often realised beyond the timescales of project funding.

[1] Identifiable by an expert who has spent many hours studying the fauna down a microscope
[2] Guidance on responsible collecting developed by entomologists, conservationists and statutory bodies can be found here: https://www.royensoc.co.uk/invertebrate-links/

Even still, the value of biological recording, survey and monitoring is increasingly being recognised. For instance, KWT is increasingly investing in monitoring programmes for core delivery on its estate and Wilder Landscapes programmes, and it is working to increase the role of species data in informing adaptive management. It remains challenging and difficult to justify funding for biological recording and monitoring within projects; however, the Conservation Evidence Initiative is driving a cultural shift among both practitioners and funder organisations around the use of evidence and the testing of effectiveness of conservation interventions. Through its 'Evidence Champions' programme, some funders now place more emphasis on the funding and testing of interventions, and practitioners commit to testing the effectiveness of interventions. Interventions are often designed to directly benefit species, and testing their effectiveness has an inherent component of biological recording. At the time of writing, the following organisations either based in Kent, or with a focus in Kent, have become Evidence Champions: KWT, Medway Valley Countryside Partnership, The National Trust and The Woodland Trust.

There is much to celebrate in the established traditions and ongoing development of biological recording in Kent; however, if we are to maintain and build the evidence base required to inform and deliver nature's recovery in the county, then effective and adequately resourced biological recording, survey and monitoring, and the necessary skills, must be at the heart of the Nature Recovery Strategy for Kent, not only on the key sites for nature, but critically in the wider landscape where nature is most at threat.


Survey work at Blean Woods
© Robert Cannis

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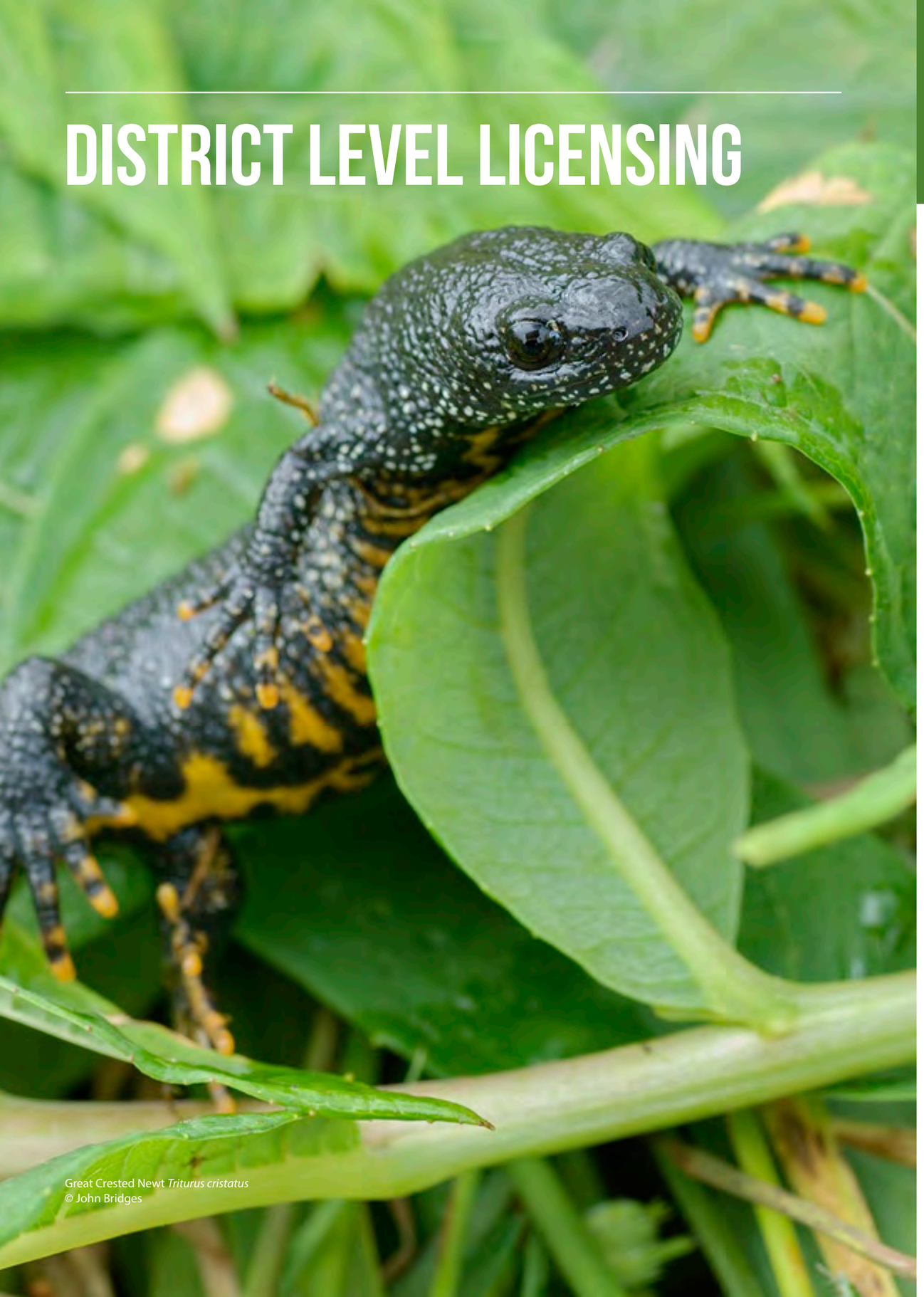
DISTRICT LEVEL LICENSING



Great Crested Newt *Triturus cristatus*
© John Bridges

GREAT CRESTED NEWT

NICKY BRITTON-WILLIAMS, KENT WILDLIFE TRUST

Introduction

The Great Crested Newt *Triturus cristatus* is the largest native British newt, known to reach up to 17cm in length. They rely on aquatic habitat, predominantly medium-sized ponds with suitable vegetation, to breed. Great Crested Newts are found in a variety of settings including rural, urban and post-industrial, with farmland, woodland, scrub and grassland being favoured terrestrial habitat types. Of particular importance for the success of a Great Crested Newt population is habitat connectivity.

Great Crested Newts typically form metapopulations throughout the wider landscape, moving up to 1,500m between ponds where terrestrial habitat allows (Haubrock & Altrichter, 2016); the majority of adults, however, are likely to stay within approximately 250m of a breeding pond (Langton *et al*., 2001). This network of ponds is essential for their survival as it ensures that the loss or failure of one pond does not result in the extinction of the local population. The greatest threats to Great Crested Newts are the loss of breeding ponds, degradation of breeding ponds due to impacts to water quality and lack of suitable management, the introduction of fish, and fragmentation of terrestrial habitat. The cause of these impacts is primarily attributed to development and agricultural intensification (Langton *et al*., 2001). More than 50% of the UK's ponds were lost during the 20th century, and Great Crested Newt populations have declined drastically over the last 50 years.

As a European Protected Species, Great Crested Newts are afforded strict protection under the Wildlife and Countryside Act 1981 (as amended) and the Conservation of Habitats and Species Regulations (2017). A licence from Natural England must be obtained prior to undertaking any activity that will impact Great Crested Newts and their habitat. Under the traditional species licensing approach, developers apply for a mitigation licence, which allows the trapping and relocation of Great Crested Newts to receptor sites prior to work commencing. However, after many years of issuing licences for small scale developments, where there are impacts on Great Crested Newts, there has been little or no benefit to the overall conservation of the species – despite meeting the legislative requirements. The traditional licensing approach saw vast amounts of money spent of surveys, trapping and exclusion using plastic fencing, with far less investment into habitat creation and management. The result was that large amounts of money were being spent, without any demonstrable benefits for Great Crested Newt conservation, as evidenced by their continued decline.

Another driver for the introduction of DLL was the inadequacy of pre-development surveys. Discovery of newts on a development site that had already received planning permission, or where development had already started, would cause major delays, which incurred significant costs. DLL was introduced by Natural England as a pilot project in Kent, with the Chilmington Green development being the first to receive a licence under the new scheme. Under DLL, developers pay for habitat creation and management based on the predicted impact of their development. The conservation payment paid by the developer covers the creation or restoration of compensation ponds in Strategic Opportunity Areas. The aim of the scheme is to deliver Great Crested Newt conservation at a landscape-scale, with habitat strategically located to benefit Great Crested Newts and enhance connectivity. New habitats created will be maintained and monitored for 25 years – all funded by the initial payment. This approach to licensing is about streamlining regulation to better protect Great Crested Newts, and has benefits for other wildlife by securing habitats for at least a generation. As the process becomes established, other species could become included with benefits for securing other habitats.

The pressures on nature

Key pressures on nature caused by District Level Licensing

One of the key features of DLL is a drive towards increasing the amount of suitable aquatic habitat available to Great Crested Newts. In stark contrast to the standard licensing approach, 85% of the developer investment goes directly towards habitat creation/ restoration, management and monitoring, compared to approximately 16% under traditional mitigation licensing. On the basis that habitat loss has been identified as a key factor contributing to the decline of Great Crested Newt populations, this approach looks to tackle the root of the problem.

Given the high development pressure in Kent, there is an urgent need for Natural England and its habitat delivery partners to ensure that sufficient pond creation is undertaken in advance of development. Compensation ponds must be created or restored in advance of any development in order for DLL to

be implemented. DLL allows local authorities to take account of Great Crested Newts at an earlier stage of the planning process and to ensure that mitigation and compensation for Great Crested Newts has maximum benefits. This is achieved through shifting the focus from site-based interventions to landscape-level interventions, creating bigger, better and more joined up habitat for Great Crested Newts, in line with the Lawton principles. The DLL scheme in Kent is primarily focused on the creation of aquatic habitat, with little regard for the creation of terrestrial habitat. The introduction of Biodiversity Net Gain may help to build on habitat creation through DLL, ensuring that the area of suitable terrestrial habitat is expanded. While a criticism of the scheme is that it can allow harm to individual Great Crested Newts, it is highly likely that due to imperfect detection during surveys and translocations, the same is true of the traditional licensing process – with undetected newts remaining on site as works start.

Due to the high rate of compensation delivered by the scheme, it has been assessed that on-site losses of individuals and their habitat should not further contribute to the decline of Great Crested Newts. DLL requires that all schemes monitor the success of pond creation and restoration; this data is then fed into a national surveillance programme. It is, however, currently too early to tell if DLL is having the desired impact on Great Crested Newt populations.


Pond creation

The state of nature

The current state of district licensing in Kent

Seventy-six restored or newly-created ponds in Kent were surveyed using eDNA during the first year of monitoring. Of these ponds, 36 tested positive for Great Crested Newts, representing a 39.5% success rate of colonisation one year after their creation/restoration. This figure exceeds the 16% success rate predicted by Rannap *et al*., (2009); however, it is important to consider that this figure was based on a study undertaken in Estonia, under different environmental conditions. The Rannap *et al*., (2009) study is, therefore, not necessarily directly comparable to pond creation in Kent. Given that the majority of ponds in Kent have been created or restored in the Low Weald, in areas with good connectivity to existing Great Crested Newt populations, then a higher rate of colonisation in year one could be expected. Continued monitoring of ponds over their 25-year lifetime will be essential for establishing the success of DLL in reversing the losses of Great Crested Newts in the long term.

Because DLL is fulfilling a specific legal requirement – to maintain the favourable conservation status of Great Crested Newts – the scheme does not seek to address the wider biodiversity implications of pond loss. PondNet surveys of ponds in southern England outside of nature reserves found that the number of wetland plants recorded per pond was less than half of that identified in high-quality ponds (Biggs *et al*., 2005). Following best practice when creating an amphibian pond will also deliver a great number of benefits for a range of other species. The integration of DLL with the development of a coherent Nature Recovery Network could provide opportunity to incorporate multi-species benefits and to safeguard ponds created under the scheme beyond the 25 years for which they have funding.

The response for nature

Is this conservation action working?

Uptake of the scheme by developers highlights the advantages of the scheme to the sector, streamlining the licensing approach and removing costly delays to construction due to Great Crested Newt surveys and subsequent mitigation. It is, however, too early to fully understand the impacts of the scheme on Great Crested Newt populations within the county. DLL was introduced as a pilot project in 2019 and there has not yet been sufficient monitoring to draw conclusions on its long-term success. While a 39.5% success rate of colonisation one year after pond creation/restoration exceeds Natural England's predicted 16% success rate, it is argued that this figure should be substantially higher.

Many of the ponds created during the first year of the scheme were restoration projects. It is likely that restoration of ponds is likely to lead to swifter recolonisation than the creation of a new pond due to the presence of an established seed stock of suitable aquatic vegetation. Data on the differing success rate of pond creation and pond restoration will be required, as will data on longer term successes of these ponds.

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It is not yet clear if DLL will result in loss of range, and if this will lead to impacts on the favourable conservation status of Great Crested Newts in Kent. To date, the majority of compensation has been delivered in the Low Weald, whilst development is happening across the county.

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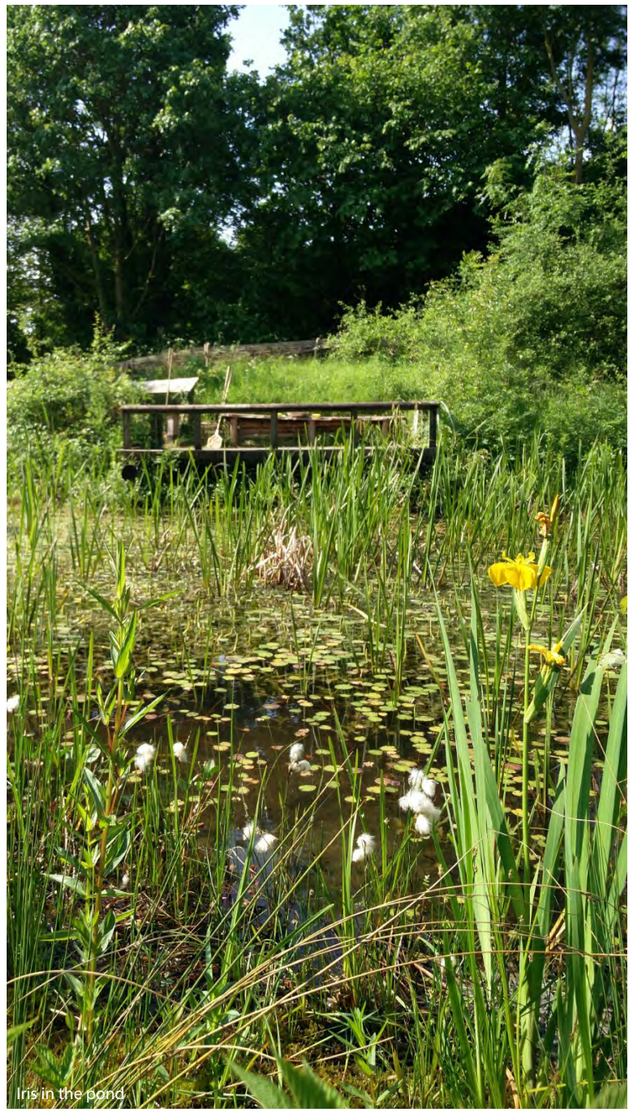
Iris in the pond

PEOPLE ENGAGEMENT IN CONSERVATION

KEELEY ATKINSON, LEE MASON-BALDWIN AND AMY FITZMAURICE, KENT WILDLIFE TRUST

Introduction

"Only if we understand, will we care. Only if we care, will we help. Only if we help, shall all be saved."
– Jane Goodall

People engage with nature in different ways and to varying levels, with both positive and negative consequences for wildlife. In this section, there will be a focus on the pressures on nature and its state as a consequence of people's engagement with it. In the next chapter of this report, the responses taken by the conservation community in Kent to the pressures, challenges and opportunities presented by engaging people with nature in the county will also be considered.

The pressures on nature

Throughout this report, the impacts of the various pressures people can exert on our wildlife are highlighted. Indeed, many conservation projects deal with threats to wildlife that are caused by humans. Rural crime is an issue for large areas of the county, but tends to go unreported. In addition to negative consequences for wildlife, it can impact on insurance premiums, food prices and damage local communities. Rural crime tends to fall into one of four categories: agricultural, equine, wildlife, and heritage. It can also fall under environmental crime, which covers illegal waste dumping, fly tipping, and polluting watercourses and land.

There has been an overwhelming increase in anti-social behaviour across wildlife sites in Kent. This can, in part, be linked with the general lack of awareness and understanding of the countryside and wildlife, brought about by a gradual disconnect from society with nature. In the past, society needed the countryside as part of a natural coexistence; wood was used for fire to cook food and keep warm, and to build fencing for livestock; bracken was used for bedding, and people would forage for food etc. As society has evolved, so, too, has it moved away from its reliance on the countryside to provide, and, therefore, the natural respect and understanding has eroded to the point of complete disconnect.

During the 1970s, The Countryside Code was introduced, providing people with an abundance of information about how to enjoy the countryside safely – including general rules for behaviour. Over time, however, this has diminished. Coupled with the loss of natural history from school and university curriculums, it's not hard to see why issues arise.

"If you ask people where birds nest, they are likely to say a tree, hedge or nest box. It's an image we've all grown up with, but for some of our most threatened species it's simply not true. Almost every natural habitat in the English countryside can be home to ground-nesting birds, and many of these species are under increasing pressure due to habitat loss, predators and climate change. Yet we can all help protect them from disturbance by simply following The Countryside Code and keeping to footpaths."
– Sara Humphrey,
Communications Manager, RSPB:
(Bird Guides, 2021).

The global pandemic in 2020/21 exacerbated human impacts to new levels. Many sites saw an increase in incidents of livestock being harassed, and livestock-dog incidents resulting in livestock being injured and some put down – as well as dogs having to be euthanise (Kent Online, 2021). All this happened despite signage on reserves asking dog owners to ensure their dogs are on a lead around livestock. Many owners believe their dogs are not capable of harming or harassing livestock; however, for many dogs, their natural instinct is to chase. For example, at a KWT site in Dover, managers have now stopped using sheep for grazing due to issues with dogs off-lead, resulting in sheep being chased over the cliff edge. Indeed, some dogs have also gone off the cliff edge (ITV, 2021).
A lack of knowledge and respect for the countryside has also led to an increase in the amount of litter being reported – both on sites and on daily view for those using the major roadways across the county. Litter damages natural spaces and has a detrimental impact on the wildlife that rely on these sites; it also creates a drain on resources, as staff time is diverted from conservation activities to clear up after visitors.

Kent is by no means alone: fly tipping and littering has increased across the county. This may be due to restricted access to waste recycling sites during the COVID-19 pandemic, with 35% of local people (n=1008) reporting an increase in fly tipping (Kent County Council, 2020); and because Kent has a wide rural expanse and the chances of being caught and

Family enjoying the Bluebells
© Tom Marshal

convicted are low, it increases the problem. In addition, where fly tipping occurs on private land, this can cause a financial burden to nature-based organisations. Almost a million cases of fly tipping were handled by local councils in the year up to March 2020 (DEFRA, 2021).

Wildlife crime is another issue. This includes poaching; coursing; persecution of badgers, birds and bats; egg theft and collection; collection of or trade in protected species and animal products; not registering animals which require a licence; taking protected plants; use of poisons, snares or explosives to kill or injure animals; animal cruelty; hunting with dogs; introducing invasive species; and killing or capturing, damaging or destroying the habitat of any protected animal. Many of these issues are faced in Kent, from hare coursing in agricultural landscapes and the perennial issue of hedge cutting during the bird breeding season, right through to the theft of orchids from nature reserves. Even raptor persecution is not confined to the uplands, and in 2020, birdwatchers were witness to a Common Buzzard being shot out of the sky at RSPB Northward Hill.

In spite of the increasing availability of free time, time still presents a barrier to engagement in the natural world – for instance, volunteering and conservation organisations find themselves competing with each other, and other sectors, for a finite volunteer resource.

The state of nature

This report is peppered with examples of the negative consequences that people engaging with nature can have. Beyond those issues discussed here, the decline of breeding terns and gulls on islands and previously isolated parts of our shoreline has also been witnessed, mainly due to disturbance, erosion and habitat degradation caused by increasing footfall. Disturbance to ground nesting birds in woodlands has also occurred. Rather than provide detail here, the reader is invited to explore these impacts throughout the pages of this report.

Fly tipping outside Queendown Warren Nature Reserve © Paul Glanfield

Conclusion

People are a key component of nature, it's protection and recovery. Inevitably, there are conflicts and pressures, but there are also opportunities and improvements to be made in how to engage people and communities. If the negative consequences of engagement with the natural world reported here are to be mitigated and reversed, then people must be an integral part of the solution. Before the motivation to protect, must come the instinct to care, which is driven by knowledge of the existence and benefits provided to humanity by the natural world. The following chapter of this report details the actions taken by the conservation community in Kent to create effective engagement in the county, and the successes of the last 10 years.

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Blue Tit nesting © Patrick Jennings

PUBLIC HEALTH

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INTRODUCTION

MAYA BUTLER, NATURAL ENGLAND

It could be argued that public health and nature are two sides of the same coin, and the COVID-19 pandemic made this clearer than ever before. Even pre-COVID-19, the NHS model was unsustainable. The NHS Long Term Plan highlighted that GPs were being inundated with patient visits that could be better dealt with within the wider community. People are living longer and tend to be suffering from more than one ailment. Pressure on primary care network time and resource acted as a catalyst for the change.

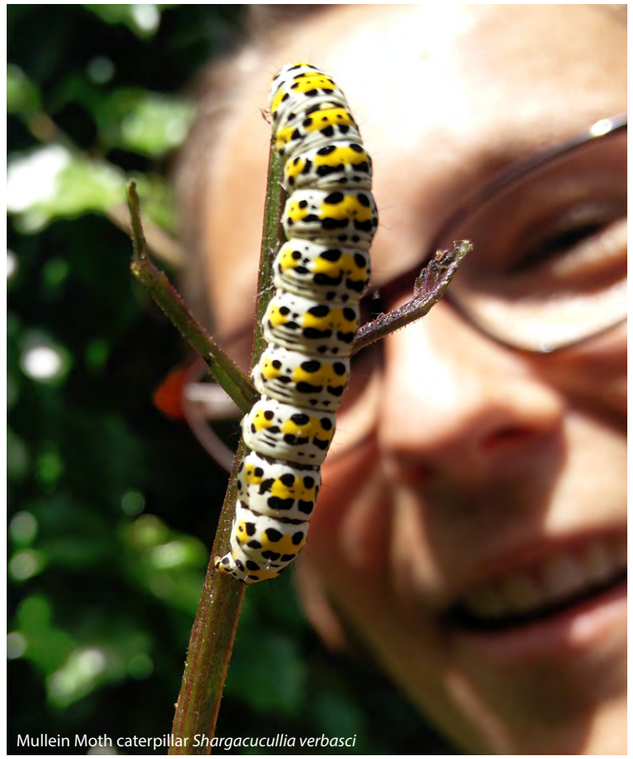
The idea of social prescribing and social link workers was born. These individuals would be recruited to act as a broker between the GP and the VCSE sector; although it is important to note that some link workers are directly employed by the latter. Through personalised care plans, the link worker would work closely with the referred patient to understand what their needs and desires are, what their interests are, and how they think the community might be able to provide specific tasks/activities as part of an alternative therapy plan.

Nature is often chosen as an option for alternative therapy, whether that be through forest bathing, therapeutic horticulture, or volunteering for a conservation body; the benefits associated with being in the outdoors and increasing one's wellbeing is extensive and well documented. Topically, the pandemic has highlighted the importance of nature connectedness and its direct link to health and wellbeing.

Natural England's People and Nature Survey (Natural England, 2020) – published during the second lockdown – showed that 41% of participants said nature was more important than ever with 61% of adults visiting a green and natural space in the last 14 days (April-June 2020). The top three reasons for visits to green spaces were related to physical and mental health.

However, we know that people's ability and opportunity to connect with nature is not equal and is often shrouded by and determined based on the health inequalities of a place. The People and Nature Survey showed that the people who were less likely to visit a green space tended to fall under one or several of the following groupings: minority ethnic groups, older people, people with long term illness, people without children, and those living in highly deprived areas. In fact, 71% of children from ethnic minority backgrounds spend less time outside than 57% of children who identify as 'white British'. Nature is a global connector and Natural England's MENE data also provides hope for the future. It shows that the number of visits to urban greenspaces have doubled in the last 10 years, providing some evidence to show that there is a real appetite for people to engage with their wider environment.

This section of the State of Nature in Kent report looks at how planning and policy has started to come into line with the areas described above. Policies such as the EIA and BNG will hold the key to providing natural areas that can offer these health benefits. This is covered here along with areas such as green social prescribing. These approaches need to be at the core of our post COVID recovery as we 'build back better' by putting natural solutions at the centre of our thinking.



Mullein Moth caterpillar *Shargacucullia verbasci*

ACCESSIBILITY TO GREEN SPACES AND NATURE IN KENT

ISABEL SHAW, NORTH WEST KENT COUNTRYSIDE PARTNERSHIP

The importance of a connection with nature

It is increasingly accepted that access to nature is important for human wellbeing – a link which has started to be researched, evidenced and acknowledged through policy during the latter half of the past decade. A 2016 study by the IEEP on the health and social benefits of nature and biodiversity protection was, at the time, the most wide-ranging probe yet into the dynamics of health, nature and wellbeing; it showed the link between access to nature and health benefits, such as lower incidence of obesity and depression. Since then, both nature conservation and health sectors have endorsed the importance of nature connection, and the 25-year environment plan has formalised it in policy (Chapter3: Connecting people with the environment to improve health and wellbeing). Research is ongoing into the most effective kinds of nature connection, with a Nature Connection Indicator Working Group (Natural England, the RSPB, National Trust, Historic England, the Wildlife Trusts and others), developing a national indicator for connection to nature. Detailed evidence is fast emerging, which will allow a more nuanced approach on the ground.

Public rights of ways and the countryside code

Kent's Public Rights of Way network, in common with the wider network, has come under increased pressure during the past decade, particularly during the Coronavirus pandemic, highlighting its vital role in providing access to green space.

Underfunded rural parishes have struggled to deal with issues, such as litter, which have resulted from the increase in visitor numbers to the countryside – many of whom are not always aware of the rules relating to access and parking. To help address this, in April 2021, an updated Countryside Code was launched by Natural England and Natural Resources Wales, reflecting the changing needs of the Countryside and PROW network.

It has also become apparent that the countryside is not fully accessible to all. Research in 2019 by the CPRE, which looked at the barriers to accessing nature, highlighted factors such as transport access as well as a feeling of being unwelcome in the countryside by ethnic minorities.

Some of the barriers to accessing green space were picked up in the 2016 KNP study 'A needs assessment relating to the provision of natural greenspace in areas with low levels of physical activity'. This not only examined the semi natural greenspace near populations, but also the ability of people to access that green space via public rights of way.

The study found that, in general, accessibility was no worse in areas of higher levels of deprivation, and that more deprived populations often had more access to green space, but they were not always using it. Although quality of green space wasn't the focus of the study, it would seem that issues such as anti-social behaviour or perceived anti-social behaviour were among the barriers to this accessible green space not being used.
Overall, the study did show that unfortunately, big sections of the Kent population do not have good access to semi-natural green space. It concluded that two-thirds (66%) of the Kent population do not have a green space of at least 2 ha (about two full sized football pitches) within 300 m (five minutes' walk) of home. This was the least well met of all the accessibility standards, which included ones arrived at nationally by Natural England and locally by Dover District Council. It also showed that over a quarter of the Kent population (28%) do not have access to a green space of at least 20 ha (18.5 football pitches) within 2 km (approximately 30 minutes walking) of home.

Restricted Access
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Green spaces for urban communities

Urban greening has become a tool for fighting climate change in the past decade, and since 2020, the Coronavirus pandemic has highlighted both our basic need to access green space, and the inequalities that exist in doing so. Public Health England's 2020 review, 'Improving Access to Greenspace' recommends that local green (and blue) space should be considered critical assets for maintaining and supporting health and wellbeing in local communities. A 2020 study by Friends of the Earth mapped the availability of green space for people living in communities across England. The study revealed a strong correlation between green space deprivation and ethnicity, with almost 40% of people of BAME backgrounds living in England's most green space-deprived neighbourhoods, compared to 14% of white people.

Across Kent (and nationally), local community projects are working to bridge these gaps in access, with local groups and partnerships delivering inspirational green space projects across the county. Organisations such as the Kent Countryside Partnerships and KWT are working in partnership with local mental health charities, social prescribing agencies and community groups to connect those most in need with their local parks and green spaces.

Green social prescribing

The Loneliness Strategy 2018, was one of the first policy documents to show that one in five people were visiting their GPs because they were lonely. GP time and resource was limited, and many were realising that a vast majority of their patients were visiting them for socio-economic issues that couldn't be solved through medical means. Their argument was that there needed to be a broker who could take those patients that needed alternative support and connect them with support from the wider community. Social prescribing was the mechanism by which people could be helped to take active steps to seek out support and engage with their communities. It didn't take long to see the results – 28% fewer GP consultations and 24% fewer attendances at A&E. Despite the Covid 19 pandemic, social prescribing link workers have been able to come into post at the numbers first envisaged in the Long-Term Plan, with 1,500 currently in post nationally and the hope of having 4,000/4,500 by 2023/2024.
GSP enables GPs, nurses and other primary care professionals to refer people to a range of local, non-clinical services to support their health and wellbeing in a nature-based setting. Social Prescribing is fast being recognised as a valuable part of primary care, and in the 2019 Long Term Plan, NHS England committed to building the infrastructure for social prescribing in primary care. The Long Term Plan put personalised care at its core, ensuring that 'people will get control over their own health and more personalised care when they need it, at a time that suited them'. It broke society into three broad categories: the generalised population; the particular population (those who had a mental and/or physical need); and the specific population (those that had very specific complex needs). The categories were never to be seen as set in stone, and the idea was that, as people went through their therapy, they could move between the categories.

There is emerging evidence that social prescribing can lead to a range of positive health and wellbeing outcomes for people, such as improved quality of life and emotional wellbeing. Social prescribing schemes may also lead to a reduction in the use of NHS services, including GP attendance. The very nature of social prescribing is that it should be seen as a prevention tool, thereby saving the NHS money. This will only be achieved if GPs and the wider PCN network understand what social prescribing can offer, manage patient expectations, and ensure that referrals are done sensitively and appropriately.

With GSP projects growing in number, their recipients have the potential to achieve significant benefits for biodiversity. Projects such as Ecology Island – a partnership project run in a central Dartford greenspace by North West Kent Countryside Partnership and North Kent Mind – focus on outcomes for both wellbeing and biodiversity. Recipients attend the group as part of their recovery from mental health issues and spend sessions improving an urban greenspace for wildlife. In feedback, the recipients said that knowing they are making 'a positive difference for local wildlife' gives them a sense of pride and self-worth. These outcomes directly feed into the five ways of wellbeing, in particular on the themes of 'to give' and 'to learn'. The site itself has come into good ecological management and has experienced a drop in antisocial behaviour.

In July 2020, the Environment Secretary announced a cross-government project aimed at preventing and tackling mental ill health through green social prescribing. Several pilot sites have been funded to test how to embed green social prescribing into communities across England. Meanwhile, in Kent and Medway, a Green Social Prescribing Partnership has emerged and is actively working to champion, support and increase GSP in Kent and Medway.
The partnership is made up of representatives from the health, green, local government and academic sectors. Finally, Kent County Council is utilising a data driven approach to improve population health. The Kent Integrated Dataset is evolving a tool known as

KeRNEL, which will expand the breadth, depth and use of integrated data across the NHS and wider partner organisations to support effective approaches to population management. This is important as current tools and indicators are not necessarily 'sharp' enough to undertake granular measurements of health and care inequalities. The Kent and Medway SHcAB act on behalf of the relevant integrated care system to provide oversight, set up, and manage single process/operating models for linked dataset development and access data for population health benefit.

Establishing long-term funding for GSP projects is a challenge, but as more evidence to support its impact emerges it is hoped that funding opportunities will increase. The NASP has recently announced a new academic pillar where they will be working with leading academic institutions like Exeter University to evaluate the importance of GSP. Their Ideas Hub also enables voluntary, community and the faith sector to share on the ground GSP experiences, including successes and barriers. This is imperative as the majority of social prescribing activities are third party funded and, therefore, not sustainable. A cross-sector partnership approach is vital, and with outcomes for health, biodiversity, as well as local economy and climate change, GSP is well worth investing in.

Green prescribing
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PLANNING AND CHANGES IN GOVERNMENT POLICIES

RUFUS HOWARD, INSTITUTE OF ENVIRONMENTAL MANAGEMENT AND ASSESSMENT

The role of planning and the built environment is integral to individual and community health by shaping the homes we live in, the buildings we work within, the public realm, transport modes, open space and green space that connects the various aspects of the built and natural environment. Planning is also much wider than just residential and commercial developments in towns and cities. The planning regime covers major infrastructure such as rail, road, quarrying, flood defences, airports, pipelines, ports, reservoirs and renewable energy – all of which will have repercussions for human health and wellbeing.

In terms of land use and the natural environment, as the population has grown over time, development space in the south east has become increasingly contested with competing interests seeking to promote different land uses in and around communities. To ensure human health is considered in the planning balance when considering new development proposals, there are a number of key policy and legal instruments. For plans and policies that set the parameters for future development, there is a legal requirement to undertake what is known as a SEA. For individual projects, which are likely to result in significant environmental effects (including on human health and populations), an EIA is a legal requirement. Both SEA and EIA are designed to identify potentially significant impacts on the full environment, including air, water, land, heritage, landscape, ecology, human health and communities, and then seek to mitigate these to avoid, reduce or minimise any negative effects.

Historically, there has been some criticism of the assessment of health within EIA and SEA, with poor engagement in the planning process from health organisations and poor quality of health assessment by many planners and impact assessment professionals. In particular, EIAs have typically focused on the biophysical aspects of health, such as air quality, noise and contamination. However, in recent years, good practice has expanded the scope of the assessment of health in planning to better consider wellbeing, mental health and the social determinants of health. Furthermore, there has been an increased focus on health assessment more generally, and some plans and policies that do not require SEA or EIA may now undertake a standalone HIA.

The current UK government is proposing radical reforms of the existing planning system. In August 2020, the MHCLG released its White Paper *Planning for the Future*. The White Paper promised to modernise the planning system, transform the way communities are shaped, and speed up house building. In the Prime Minister's words, the planning system, "…is beginning to crumble and the time has come to do what too many have for too long lacked the courage to do – tear it down and start again". Meanwhile the HCLG Committee of the House of Commons launched an inquiry into the White Paper in October 2020 and published their first report in June 2021. The HCLG Committee report is critical of many aspects of the proposed reforms, including questioning the scientific justification behind the stated 300,000 annual house building target.

Many professional organisations, such as the RTPI and the Institute for IEMA, have responded to the proposed planning reforms and have been lobbying to ensure that any proposed reforms are aligned to the urgent need to address the climate and biodiversity crises and help to deliver the Governments commitments to the United Nations Sustainable Development Goals. Ultimately, the consensus amongst planning and sustainability professionals is that the reforms should look to strengthen, rather than sacrifice, existing environmental and social protections to create a more sustainable, healthy, equitable and prosperous built environment.

The concepts of net environmental gain, BNG and net zero all represent a shift from simply mitigating negative effects of developments towards all developments making a positive contribution to the environment and society. In respect to health, there are clear synergistic opportunities through the planning system to promote biodiversity recovery and net gain, which also have significant benefits to human health through better design of planning policies and projects to promote these positive outcomes.

HOW CAN BIODIVERSITY NET GAIN ENHANCE PEOPLE'S WELLBEING?

JULIA BAKER, BALFOUR BEATTY

Links between Biodiversity Net Gain and wellbeing

BNG is development that leaves the natural environment in a better state than before. It could transform how we finance, design, build and operate development, with the UK's Good Practice Principles providing an approach for developers to generate long-term, measurable, and meaningful net benefits for biodiversity (CIEEM, CIRIA, IEMA (2016) Biodiversity Net Gain Good Practice Principles for Development, UK). But while we are making progress towards this goal – focused on the conservation of biodiversity for its own sake – it is important to remain mindful of the connection between biodiversity and people's wellbeing.

BNG can benefit people's wellbeing directly; for example, when communities enjoy high-quality natural surroundings, either by BNG being achieved within the development footprint, or when a biodiversity offset increases people's access to, or views of, nature. Indirectly, BNG has a wider societal benefit of enhancing the natural environment for everyone, and people can benefit from simply knowing there has been a net gain of biodiversity from a development. But poorly designed BNG can be detrimental to people's wellbeing, for example, by restricting access to nature within a development site, without adequate alternative provision.

International principles give guidance on how to assess the social impacts of NNL and BNG in depth (Bull *et al.*, 2018). These 'People Principles' set an outcome for NNL/BNG projects to achieve what is firmly rooted within wellbeing; which is as follows: "People perceive the components of their wellbeing affected by biodiversity losses and gains to be at least as good as a result of the development project and associated biodiversity NNL/NG activities, than if the development had not been implemented."

Wellbeing is a positive physical, social, and mental state. It involves objective and subjective elements, including financial stability, education, basic necessities, and feelings of happiness and life satisfaction.

The international 'People Principles' for BNG focus on wellbeing associated with biodiversity. Their application involves measuring change to people's wellbeing that is caused by losses and gains in biodiversity from a development and its BNG activities, and then making sure that this change is positive through an inclusive approach to planning BNG activities to support the wellbeing of affected people.

In contrast, the UK's BNG Good Practice Principles involve sharing the benefits fairly among stakeholders and achieving an overall gain in the services that ecosystems provide (Biodiversity Net Gain: Good Practice Principles for Development. | CIEEM). However, implementation of these social aspects of BNG has been limited to-date, and the principles do not explicitly state that BNG should avoid or mitigate detrimental impacts on people's wellbeing. Neither do they explicitly link BNG to the various dimensions of wellbeing that BNG may affect. Without this clarity, a single-minded focus on the pursuit of BNG could have unintentional consequences for people. This risk has already been highlighted for the UK. For example, Taherzadeh and Howley (2018) gathered stakeholder views on biodiversity offsetting within England. Social issues including social justice and equity were as important to stakeholders as biodiversity issues. Furthermore, Bateman and Zonneveld (2018) (*No net loss of what, for whom?: stakeholder perspectives to Biodiversity Offsetting in England* | SpringerLink) show how locating BNG measures close to the development site could lead to overall social gain, while leaving the poorest members of UK's society worse off.

COVID-19 restrictions not only highlighted the significance of accessible local green spaces to people's wellbeing, but also the inequalities within society in terms of who has access to green space and who does not. As the UK emerges from COVID-19 restrictions, the importance of considering the social impacts of BNG is even more apparent; this is because of likely policy changes that explicitly link BNG to people's access to nature, but with no safeguards to protect people's wellbeing. For example, proposed amendments to England's National Planning Policy Framework (Ministry of Housing, draft text for consultation (2021)), include that: "…opportunities to improve biodiversity in and around other developments should be pursued as an integral part of the design especially where this can secure measurable net gains for biodiversity and enhance public access to nature."

Enhancing public access to nature does not presuppose that people actually use it, nor does it account for the various values that different groups attribute to nature and how this influences their wellbeing. Also, enhancing overall access does not mean access is equitable, nor does it consider people's access to nature before the development – and its BNG measures – were instituted. Making explicit the principle of 'do no harm' (Box 1) with regards to people's wellbeing could be a safeguard against these concerns; although it must happen in ways that achieve net gains in biodiversity.

BOX 1
The principle of 'do no harm'

Broadly speaking, 'do no harm' requires implementers of development projects to avoid or mitigate the negative social impacts of their activities. More recently, some areas of international sustainable development have adopted the principle of 'do good', which requires developers to contribute proactively towards improving people's lives and wellbeing.

Scoping study

How could wellbeing assessments, as part of BNG approaches, work in practice? What are the risks of doing so, and what are the opportunities? To help answer these questions, and with funding from the Esmée Fairbairn Trust, CIEEM, in collaboration with Balfour Beatty, the University of Oxford, and Wild Business Ltd, undertook a scoping study to determine whether, and, if so, how, wellbeing should be incorporated more directly into UK industry's BNG Good Practice Principles. The scoping study commenced during autumn 2020 and was completed in spring 2021, and involved desk-based reviews and consultations. The main findings included:

- During the consultations, there was widespread agreement that BNG projects should be designed and implemented in ways that 'do no harm' with regards to people's wellbeing. However, there were differences in opinion in how this should be achieved. Some thought that wellbeing considerations should be separate from BNG practice because they lessen ambitions to enhance biodiversity; whereas others believed that BNG practice must consider wellbeing in order to successfully achieve net gains in biodiversity. While these differences existed, making explicit the 'do no harm' principle for BNG approaches was a place of common ground.
- Closely related was the question about success: how can practitioners know what the indicators of success for wellbeing are (including 'no harm') and when it has been accomplished?
- Policy requirements to consider and address how development affects people's wellbeing already exist across the UK. However, the requirements are inconsistent, unclear, and not linked with BNG. This limits policy implementation so that wellbeing is a material consideration when planning development. This also limits the integration of wellbeing and BNG planning policy requirements.
- Assessing impacts on people's wellbeing from BNG requires expertise in social impact assessments. It is not the responsibility or role of ecologists, although it requires close collaboration between social and BNG experts as part of a multi-disciplinary, proportionate approach to impact assessments. In turn, this requires improving existing social assessments to capture both the objective and subjective elements of people's wellbeing in connection to BNG, and to demonstrate how BNG can be designed and implemented to support wellbeing.

The study made a series of recommendations that included greater rigour in implementing the social aspects of BNG; strengthening existing planning policies on wellbeing and better integrating these policy requirements with those for BNG; supporting calls to boost capacity within local authorities especially given forthcoming policy changes; and, incorporating the subjective elements of wellbeing into existing social impact assessments of developments.

All the study findings and recommendations are documented in the following reports displayed in Table 1, which are available on the project webpage: Biodiversity Net Gain and People's Wellbeing | CIEEM

Table 1 Study findings and recommendation documents produced from undertaking a scoping study to determine if, and how, wellbeing should be incorporated more directly into the UK industry's good practice approach to BNG

Document title	Document contents
Defining and assessing human wellbeing: what the science says	A literature review of how wellbeing is defined and assessed within the academic literature
How do governments define wellbeing?	A literature review of how wellbeing is defined by international and UK governments and key organisations
Accounting for wellbeing within planning applications	A desk-based review of whether planning authorities in England require consideration of a development's impacts on people's wellbeing as part of a planning application
Biodiversity Net Gain and Wellbeing: consultation responses	A report on responses to this study's consultations on whether, and, if so, how, wellbeing should be incorporated more directly into UK industry's BNG Good Practice Principles
Biodiversity Net Gain and Wellbeing: core messages and recommendations	A summary of the core messages from all the evidence gathered by this scoping study, together with the recommendations

Biodiversity Net Gain will be mandatory under the Environment Act. KNP has taken the lead for Biodiversity Net Gain in Kent and is working to develop a coordinated and consistent approach throughout the county. This is being delivered by a task and finish group that comprises planners, statutory agencies, NGOs, private companies, consultants, and landowners.

Conclusion

Throughout this section, we have seen how nature and public health can, and should, be intertwined. It has highlighted the importance of the assessment of health in the planning system and the links between the positive benefits of human health and environmental net gain. Furthermore, it has highlighted the importance of access to nature and the benefits of green social prescribing.

Using tools like green social prescribing and data analytics will inevitably help to evaluate the impacts nature connectedness can have on people's health and wellbeing. Unfortunately, green social prescribing is often funded through third party providers and there is a real struggle to demonstrate its worth within the mainly economics-based resource allocations processes used for public funding. Recommendations of ensuring the long-term suitability of GSP could include mechanisms to facilitate co-ordination of supply and demand, therefore ensuring that new offers are not duplicating existing provision, but are instead enhancing advocacy through relevant networks, enhancing the capacity of local co-ordinating bodies, and developing the skills for providers such as accreditation schemes and professional development.

In terms of planning and the built environment, there needs to be a greater focus on the impact assessment of health, wellbeing and populations when considering plans and proposals for development. There also needs to be greater engagement with health bodies and health professionals regarding the planning process to ensure these stakeholders are contributing to the planning debate. Ideally, they need to join their voices with conservation and environmental bodies in calling for BNG and sustainable development that promotes a low carbon, ecologically beneficial and healthy built environment.

In conclusion, we have seen natural links between promoting the health agenda through work on BNG, and with a new Planning Bill forthcoming – along with the Environment Bill due to receive royal assent later on in the year – there is real potential to enhance biodiversity while supporting public health through mechanisms such as nature recovery networks.

KNP will be at the centre of work on both BNG and the Local Nature Recovery Strategy. The Kent Biodiversity Strategy has targets for "connecting people with the natural environment". Ensuring closer working between the planning and health sectors will be key to the future success of this work, for the benefit of both public health and biodiversity in the county.

Introduction | Headlines | Drivers | Conservation | Kent's Species | Landscape-scale | Case Studies | Conclusion
Agri management | Climate change | Hydrological change | Urbanisation | Invasives | Pollution | Habitat management | Marine | Wildlife recording | Licensing | Engagement | Public health

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